Outer Dowsing Offshore Wind

Preliminary Environmental Information Report

Volume 2, Appendix 9.2: Benthic Ecology Technical Report (ECC)

Date: June 2023

Outer Dowsing Document No: 6.2.9.2
Internal Reference: PP1-ODOW-DEV-CS-REP-0047

Rev: V1.0

OUTER DOWSING
OFFSHORE WIND

Benthic Ecology ECC Area Results Report (Vol. 2)

UK4855H-824-RR-02

GEOxyz Document Number: UK4855H-824-RR-02

Revision: 1.1

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Prepared by:	LP	Report Writer	29-11-2022	
Reviewed by:	LB	Report Manager	30-11-2022	
Approved by:	PC	Survey Manager	30-11-2022	
Owner:	**Survey Department**			

REVISION HISTORY

A record of revisions and amendments to this document is given below:

Rev.	Date	Reason for amendments	Section changes from previous version
1.0	30-11-2022	Issued for Client Review	N/A
1.1	04-05-2023	Comments Addressed	Various

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Document No.	UK4855H-824-RR-02				Rev	1.1
Uncontrolled Copy	☐		Controlled Copy	☒	Date	04-05-2023

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DEFINITIONS AND ABBREVIATIONS

Where abbreviation used in this document are not included in this list, it may be assumed that they are either equipment brand names or company names.

Table 1: Abbreviations Used in this Document

Acronym	Description	Acronym	Description
ANZECC	Australian and New Zealand Environment and Conservative Council	MBT	Monobutyltin
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand	MCZ	Marine Conservation Zone
BAC	Background Assessment Concentration	MCZ	Marine Conservation Zones
BC	Background Concentration	MESH	Mapping European Seabed Habitats
BDC	Biodiversity Committee	MMO	Marine Management Organisation
BGS	British Geological Survey	MNCR	Marine Nature Conservation Review
BSL	Benthic Solutions Limited	MP	Megapixel
cAL 1 and 2	CEFAS Action levels 1 and 2	MPA	Marine Protected Area
CBD	Conservation of Biological Diversity	N/S	No Sample
CCME	Canadian Council of Ministers of the Environment	NMBAQC	National Marine Biological Analytical Quality Control
Cefas	Centre for Environment, Fisheries and Aquaculture.	NMCAQC	National Chemistry Analytical Quality Control
CEMP	Coordinated Environmental Monitoring Programme	NMEAQC	National Marine Ecotoxicological Analytical Quality Control Group
CLUSTER	hierarchical agglomerative clustering	NMMP	UK National Marine Monitoring Programme
CV	coefficient of variation	OCP	Organochlorine pesticides
DBT	Dibutyltin	OGA	Oil and Gas Authority
DDT	Dichlorodiphenyltrichloroethane	OGUK	Oil and Gas United kingdom
EAC	environmental assessment criteria	OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
EBS	Environmental Baseline Survey	OWF	Outer Dowsing Offshore Windfarm
EC	European Commission	PAH	Polycyclic Aromatic Hydrocarbon
ECC	Export Cable corridor	PC	Physio-chemistry
ED50	European Datum 1950	PCB	Polychlorinated Biphenyls
EIA	Environmental Impact Assessment	PCBs	Polychlorinated biphenyls
EMODnet	European Marine Observation and Data Network	PEL	Probable effect Level
EOL	End of Line	PEP	Project Execution Plan
EPA	Environmental Protection Agency	PSD	Particle Size Distribution
ERL	Effects Range Low	SAC	Special Area of Conservation
ERM	Effects Range Median	SACFOR	MNCR cover/density scales
EU	European Union	SAP	Species Action Plan

Acronym	Description	Acronym	Description
EUBS	European Union Biodiversity Strategy	SAPs	Species Action Plans
EUNIS	European University Information Systems organisation	SBP	Sub-bottom Profiler
F1	Fauna grab sample 1	SBP	sub-bottom profiler
FOCI	Features of Conservation Interest	SCI	Site of Community Importance
GC-MS	Gas Chromatography Mass Spectrometry	SCI	Sites of Community Importance
GEOxyz	GEOxyz Offshore UK Limited	SD	Standard Deviation
GIG	Macquarie's Green Investment Group	SIC	Single Ion Current
GIS	Geographic Information System	SNS	Southern North Sea
GIS	Geographic Information System	SOL	Start of Line
GT R4 Limited	50/50 joint venture between TotalEnergies and Macquarie's Green Investment Group (GIG)	SPA	Special Protection Areas
GW	Gigawatt	SQGV	Sediment Quality Guideline value
HAP	Habitat Action Plan	SS.SCS.CCS / A5.14 / MC32	Circalittoral Coarse Sediment
HAS	Habitat Assessment Survey	SS.SBR.PoR.SspiMx / A5.611 / MC2211	*Sabellaria spinulosa* on Stable Circalittoral Mixed Sediment
HAS	Habitat Assessment Spreadsheet	SS.SMx.CMx / A5.44 / MC42	Circalittoral Mixed Sediment
HC	Hydrocarbons	SS.SSa.CMuSa / A5.26 / MC52	Circalittoral Muddy Sand
HD	High Definition	SS.SSa.IMuSa / A5.24 / MB5	Infralittoral Muddy Sand
HF	High Frequency	SSS	Side Scan Sonar
HG	Hamon Grab Sampler	TBT	tributyltin
HG	Hamon Grab	TEL	Threshold Effect level
HM	Heavy Metals	TOC	Total Organic Carbon
HR	High Resolution (seismic)	UHR	Ultra-High Resolution (seismic)
HSG	Herring Spawning Ground	UK	United Kingdom
INNS	Invasive Non-native Species	UKOOA	United Kingdom Offshore Operators Association
JNCC	Joint Nature Conservation Committee	UK BAP	United Kingdom Biodiversity Action Plan
LAT	Lowest Astronomical Tide	UKCS	United Kingdom Continental Shelf
LED	Light-emitting Diode	UTC	Universal Time Coordinated
LOD	Limit of Detection	UTM 31	Universal Transverse Mercator – Zone 31
MAG	Magnetometer	WGS84	World geodetic system 1984
MBES	Multi Beam Echo Sounder		

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1 EXECUTIVE SUMMARY

A habitat assessment and environmental baseline and survey was carried out by GEOxyz, in association with Benthic Solutions Limited (BSL), for GT R4 Limited within the Outer Dowsing Export Cable Corridor (ECC) in the southern North Sea. Survey operations were carried out aboard the *Geo Ocean III* between the 17th and 26th of July 2022. This report details the habitat and environmental survey operations conducted as part of the environmental phase 5 ECC scope.

Environmental sampling at the ECC site involved the acquisition of physico-chemical and macrofauna samples using a Hamon grab for particle size analysis (PSA) and total organic carbon (TOC) and a Shipek grab for contaminant analysis at 59 and 30 stations, respectively, along with underwater footage and still photographs from 33 stations using a MOD4 camera system. Seven >500m epibenthic trawls were also carried out across the ECC site. eDNA water samples were successfully subsampled at five water sample stations with an additional station, successfully subsampled for organic carbon and suspended solids. Sampling and camera locations were pre-selected by GoBe Consultants prior to mobilisation, with modifications to the scope based on infield observations from Benthic Solutions Limited.

The water depth across the ECC survey area ranged between 1.17m to 32.91m LAT with the water depth undulating due to the presence of megaripples, sandwaves and sandbanks. Sandbanks were also a common feature along the ECC route and were predominantly found within the funnel area, located to the south of the Offshore Wind Farm (OWF) survey area. The seabed sediments were generally dominated by either sands or gravel. Some stations at shallower water depths had a higher proportion of sand; however, this was not a consistent pattern throughout the survey area. Similarly, the proportion of gravel in the form of pebbles and gravel matrixes interspersed with sand was fairly variable across the survey area. TOC was relatively low across the survey area and indicated an organically-deprived environment, with lower TOC concentrations recorded on the crests of sandbanks, which was unsurprising given the dominance of sand and gravel with minimal fines.

The total polycyclic aromatic hydrocarbons (PAH) were generally low across the survey area with an elevated ∑16PAH and ∑22PAH recorded at one station. Polychlorinated biphenyls (PCBs) and organotins were recorded at relatively low concentrations, which in conjunction with the low PAHs suggests a natural distribution of aromatic hydrocarbons across the site. The concentration of DDT was elevated above the Cefas action level 1 at eight stations, indicating the material at these stations would have to be further investigated before disposal. However, DDT was below the ERL and TEL reference values so it is unlikely the concentrations of DDT would have impacted the macrobenthic community.

Trace metals showed no particular spatial pattern with most elevated above United Kingdom offshore operators association (UKOOA) thresholds but within background conditions reported in nearby surveys. All metals with the exception of arsenic and nickel were below their respective sediment quality guideline value (SQGV) and were deemed to be 'low risk' within the ECC survey area. Arsenic and nickel exceeded their SQGVs at several stations but at levels which would be considered acceptable as the concentrations recorded were below the background levels determined from previous surveys conducted by BSL for different operators close to the ECC survey area.

Benthic macrofaunal species richness and faunal abundance was variable across the survey area and reflected the sand and gravel dominated sediments present, with a total of 6,352 individuals recorded. Review of the macrofauna dataset using multivariate statistics revealed four significantly different macrofaunal cluster groupings at a Bray-Curtis similarity slice of 15, with differences in macrofaunal assemblages attributed to the exclusion of certain taxa and the underlying 'mapping European seabed habitat' (MESH) sediment classifications.

Epibenthic trawl species richness and faunal abundance reflected the sand and gravel dominated sediments throughout the survey area, with 49,484 individuals recorded across 92 species. Arthropods were represented by 31 species and accounted for 93.6% of the total individuals due to the high abundance of the shrimp *Pandalus montagui*. Review of the trawl macrofaunal dataset using multivariate statistics identified three significantly different macrofaunal groupings within the survey area, which were differentiated based on the epifaunal differences between sand and coarse gravelly sediments. The grab macrofaunal and epifaunal trawl datasets were considered to represent natural background infaunal and epifaunal conditions for this region of the southern North Sea.

The seabed across the ECC survey area was assigned six JNCC/EUNIS habitat types with several habitats present across all extents of the ECC survey area: "Circalittoral coarse sediment" (SS.SCS.CCS/MC32) and "Circalittoral mixed sediment" (SS.SMx.CMx/MC42). Of these two habitat types, variations existed within both with SS.SCS.CCS separated into two variants; "Circalittoral coarse sediment" (sand with shell, pebbles and cobbles) and "Circalittoral coarse sediment" (sand with shell gravel), due to differing degrees of coarseness. The level 5 habitat '*Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand' (SS.SCS.CCS.Pkef/MC3213) was likely to occur in areas of coarse sediment. The SS.SMx.CMx habitat type also showed variation with mixed sediment present throughout the route but the presence of *Sabellaria spinulosa* on stable circalittoral mixed sediment (SS.SBR.PoR.SspiMx/MC2211) was observed in Blocks 7, 8, 9 and 15. The level 5 habitat '*F. foliacea* and *H. falcata* on tide-swept circalittoral mixed sediment' (SS.SMx.CMx.FluHyd/MC4214) was likely to occur within areas delimited as 'Circalittoral mixed sediment'. Areas of "Infralittoral muddy sand" (SS.SSa.IMuSa/MB5) were present in the FA and within Block 12 coinciding with sandbanks. Smaller areas of "Circalittoral muddy sand" (SS.SSa.CMuSa/MC52) were identified along the ECC route predominantly in Blocks 5, 7, 8, 9 and 17 closer to the coastline. The closest resembling level 5 biotope to this habitat was '*Ophiura ophiura* on circalittoral muddy sand' (SS.SSa.CMuSa.Ooph/MC521), which presented in an impoverished form.

The presence of cobbles and boulders indicated the potential for Annex I stony reef to occur in areas of intermediate habitats of 'Atlantic circalittoral mixed sediment' and 'Atlantic circalittoral coarse sediment'; however, all camera transects were classified as 'Not a Reef' according to the Irving (2009) criteria as the percentage cover of cobbles and boulders was <10%. Station ECC_VID_37 had epifauna present at sufficient densities to be considered 'possible reef with sand veneer' or 'reef with sand veneer' but lacked the mean reef species count to be confidently assigned as an area of Annex I stony reef. The presence of *S. spinulosa* aggregations in Blocks 7, 8,9 and 15 indicated conformance to the SS.SBR.PoR.SspiMx '*S. spinulosa* on stable circalittoral mixed sediment' biotope. However, the *S. spinulosa* aggregations were too patchy to be classified as Annex I reef.

The ECC survey area crosses six sandbanks ('Additional Bank 93', 'Additional Bank 97', 'Additional Bank 96', 'Additional Bank 8' 'Inner Dowsing North' and 'Race Bank and North Ridge'). The 'Inner Dowsing North' and 'Race Bank and North Ridge' both form part of the 'Inner Dowsing, Race Bank and North Ridge' Special Areas of Conservation (SAC). The higher proportions of sand dominated sediment in Blocks 12, 13 and the FA, in conjunction with shallow water depths of <15m are consistent with the expected presence of Annex I sandbank habitat within the ECC site.

Sandeels were occasionally observed on the video footage with 44% of stations in the ECC survey area classified as 'Prime' or 'Suitable' sandeel habitats. Areas of 'Circalittoral coarse sediment' and 'Circalittoral mixed sediment' were the most optimal for herring spawning grounds, ranging from 'Suitable' to 'Prime'. Whereas areas of 'Atlantic infralittoral muddy sand', 'Circalittoral muddy sand' and '*Sabellaria spinulosa* on Stable Circalittoral Mixed Sediment' were all unsuitable for herring spawning ground.

A. islandica siphons were observed at four stations, via video footage and still photographs; however, no adult or juvenile specimens were recovered in the trawl or grab datasets.

2 INTRODUCTION

2.1 PROJECT OVERVIEW

An environmental baseline survey (EBS) and habitat assessment survey (HAS) was carried out by GEOxyz in association with Benthic Solutions Limited (BSL) for GT R4 Limited within the Outer Dowsing Wind Farm (OWF) development area and along the Export Cable Corridor (ECC) and including the Funnel Area (FA) located in the southern North Sea (SNS) (Figure 1). Survey operations were carried out aboard the *Geo Ocean III* between 17th and 26th July 2022.

A geophysical survey across the ECC survey area was performed by GEOxyz using a vessel-mounted multibeam echosounder (MBES), side scan sonar (SSS), sub-bottom profiler (SBP), magnetometry (MAG) and ultra-high resolution (UHR). Environmental seabed sampling and video assessments were carried out across the ECC survey area to provide a regional understanding of the different habitats encountered. Data was acquired through sampling of the seabed using a Hamon grab (HG) at 55 stations and a Shipek grab at 30 stations. Seabed video footage was acquired using the BSL MOD4.2 and MOD4.4 camera systems mounted within a BSL freshwater lens drop down frame equipped with a separate strobe, LED lamps and high definition (HD) camera (Appendix C).

This report is focused on the phase 5 habitat investigation and environmental survey operations conducted within the ECC survey area located across UK Quadrants 47 and 48 which encompasses UKCS Blocks 48/17a, 48/13b. The phase 1 environmental survey operations conducted within the OWF area are reported separately (UK4855H-824-RR-01).

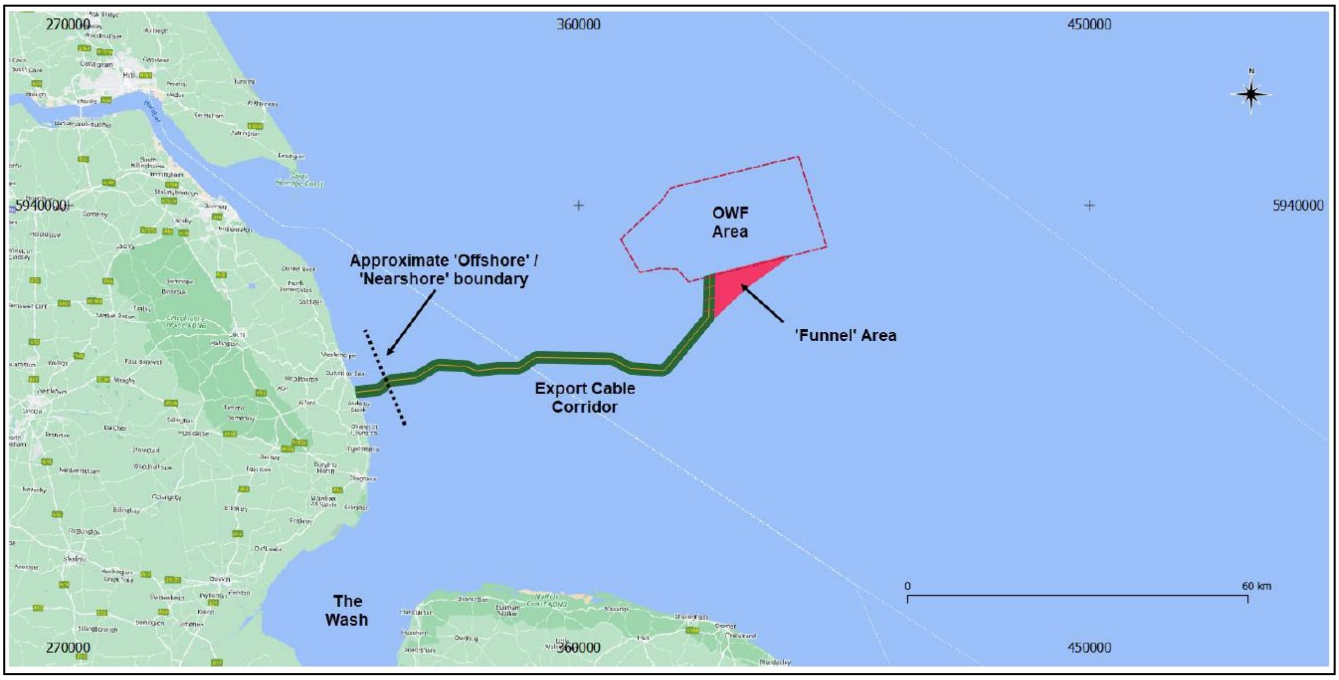


Figure 1: Project Location Overview

2.2 SCOPE OF WORK

The survey included characterisation of the benthos and investigation of the sediment physico-chemistry (PC) to provide an understanding of the local benthic environment and ecology in the ECC and Funnel Area. This will be used to support the EIA baseline characterisation process, to underpin any future consent application for the development of the Outer Dowsing Offshore Wind project.

The main objectives of the environmental baseline survey and habitat investigation were to:

- Acquire characterising data of sediment PC and biology at all stations in the ECC and Funnel area;
- Provide high resolution still images and corresponding video at specific stations to ground truth and characterise benthic habitat;
- Identify the occurrence and distribution of any habitats or species of conservation interest, including Annex I habitats, Annex II species and Annex V species of the EC Habitats Directive, species listed under Schedule 5 of the Wildlife and Countryside Act, designated features of the MPA network, species and habitats listed in the OSPAR List of Threatened and/or Declining Species and Habitats, and the UK Post-2010 Biodiversity Framework (formerly the UK Biodiversity Action Plan Priority Habitat descriptions);
- Determine the presence of any invasive non-native species (INNS) in the ECC and FA;
- Characterise the benthic subtidal environment in the ECC and FA and assign habitat types to biotope level according to the JNCC/EUNIS habitat classification system;
- Characterise the sediment particle size and levels of contaminants in the seabed sediments;
- Collect observational data about marine mammal and seabird occurrence in the ECC and FA during Phase 5 survey operations;
- Collect Niskin water samples across the ECC, FA and OWF to sub-sample surface and bottom water depths for fish eDNA to aid characterisation of potential pelagic and benthic species;
- Collect Niskin water samples 100m from the seabed frame marker buoy from three water depths (surface, middle and bottom) across two tidal cycles (ebb and flow) to verify buoy calibration.

2.3 REPORTING STRUCTURE

The following reports will be provided by BSL, relating to the habitat assessment and environmental baseline surveys conducted during phase 5 environmental operations across the ECC survey area:

- UK4855H-824-FR-05: Phase 5 Benthic Ecology Survey Field Report
- **UK4855H-824-RR-02: Phase 5 Benthic Ecology ECC Area Results Report (Vol 2) (This Report)**

The following reports have been provided by GT R4 Limited relating to the geophysical surveys conducted across the ECC survey area:

- UK4855H-824-BR-01a: Block 01a Geophysical Survey Summary Report (KP 77.624 to KP 74.682)
- UK4855H-824-BR-03: Block 01b Geophysical Survey Summary Report (KP 74.651 to KP 71.880)
- UK4855H-824-BR-04: Block 2 Geophysical Survey Summary Report (KP 71.880 to KP 69.098)
- UK4855H-824-BR-05: Block 3 Geophysical Survey Summary Report (KP 69.098 to KP 64.892)
- UK4855H-824-BR-06: Block 4 Geophysical Survey Summary Report (KP 64.892 to KP 60.661)
- UK4855H-824-BR-07: Block 5 Geophysical Survey Summary Report (KP 60.661 to KP 55.658)
- UK4855H-824-BR-08: Block 6 Geophysical Survey Summary Report (KP 55.658 to KP 53.003)
- UK4855H-824-BR-09: Block 7 Geophysical Survey Summary Report (KP 53.003 to KP 45.739)

- UK4855H-824-BR-10: Block 8 Geophysical Survey Summary Report (KP 45.739 to KP 42.410)
- UK4855H-824-BR-11: Block 9 Geophysical Survey Summary Report (KP 42.410 to KP 28.919)
- UK4855H-824-BR-12: Block 10 Geophysical Survey Summary Report (KP 28.919 to KP 25.273)
- UK4855H-824-BR-13: Block 11 Geophysical Survey Summary Report (KP 25.273 to KP 19.926)
- UK4855H-824-BR-14: Block 12 Geophysical Survey Summary Report (KP 19.926 to KP 7.256)
- UK4855H-824-BR-15: Block 13 Geophysical Survey Summary Report (KP 7.256 to KP 0)
- UK4855H-824-BR-17: Block 14 Geophysical Survey Summary Report (KP 58.533 to KP 54.685)
- UK4855H-824-BR-18: Block 15 Geophysical Survey Summary Report (KP 67.109 to KP 61.533)
- UK4855H-824-BR-19: Block 16 Geophysical Survey Summary Report (KP 70.039 to KP 67.109)
- UK4855H-824-BR-20: Block 17 Geophysical Survey Summary Report (KP 61.533 to KP 58.533)

2.4 GEODETIC PARAMETERS

2.4.1 Horizontal Reference

The horizontal datum will be referenced to the WGS84 Datum, UTM 31N projection. The datum and projection parameters used are provided below in Table 2 and Table 3.

Table 2: Datum Parameters

Coordinate Reference System: World Geodetic System 1984 / UTM Zone 31 North	
Datum	World Geodetic System 1984
Prime Meridian	Greenwich
Ellipsoid/Spheroid	World Geodetic System 1984
Semi Major Axis (a)	6378137.000m
Semi Minor Axis	6356911.946m
Inverse flattening (1/f)	298.25
Projection	UTM Zone 31 North (EPSG Code: 23031)
Coordinate Operation Method	Universal Transverse Mercator
Latitude at Origin	00° 00’ 00” N
Longitude at Origin/Central Meridian	003° 00’ 00” E
False Easting	500000
False Northing	0m
Scale Factor at Central Meridian	0.9996

Table 3: Projection Parameters

Coordinate Transformation	
Coordinate Transformation	ED50 to WGS84 (18)
Transformation Version	UKOOS-CO
Transformation Variant	18
EPSG Code	1311
Source CRS	ED50
Target CRS	WGS84
X-axis translation (m)	+89.5m
Y-axis translation (m)	+93.8m
Z-axis translation (m)	+123.1m
X-axis rotation (arc-second)	0.0”
Y-axis rotation (arc-second)	0.0”
Z-axis rotation (arc-second)	–0.156”
Scale difference (ppm)	+1.2ppm

2.4.2 Vertical Reference

The vertical datum for the project was Lowest Astronomical Tide (LAT). Height data was acquired in relation to the ellipsoid and translated to the project vertical datum (LAT) as defined by the United Kingdom Office Vertical Offshore Reference Frame geoid model at the project location. LAT is 2.45m below Mean Sea Level (MSL) within the survey area.

2.5 BACKGROUND INFORMATION

2.5.1 Background Information on the ECC Survey Area

The offshore wind leasing round 4 in England was launched in 2018 by the Crown Estate with the aim of identifying 7 GW of new offshore wind projects in UK waters. The round 4 tender process concluded in February 2021 with six new offshore wind projects selected in England and Wales. The Outer Dowsing Offshore Wind Farm (OWF) project, a 50/50 joint venture between TotalEnergies and Macquarie’s Green Investment Group (GIG), is predicted to be commissioned in 2027 and is estimated to provide 1.5GW of energy annually (GT R4 Limited, 2022).

The ECC (including the FA) survey area, located approximately 34km Southeast of the Humber Estuary, is approximately 75km in length (not including the FA) and is situated across 2 UK Quadrants (47 and 48) and intercepts 5 existing pipelines (Viking AR to Theddlethorpe 28in Gas Line, Loggs PP to Theddlethorpe 36in Gas Line, Loggs PP to Theddlethorpe 4in Meoh Line, Galahad to Lancelot Tee 12in Gas Export and the Shearwater to Bacton (Seal) 34in Gas Line). Table 4 displays the historical wells located within 3km of the ECC survey boundary. Wells located further from the site were considered to be outside the potential effect range for contamination from these sources.

Table 4: Historical Well Information

DECC Well Origin Wellbore Name	Well Origin Spud Date	Spud Completion Date	Original Well Intent	Current Status	Water Depth (m)
48/12b- 6	01/12/1988	20/02/1989	Exploration	Abandoned Phase 3	23.2
48/12c- 10	15/11/1997	31/01/1998	Appraisal	Abandoned Phase 3	21.3
48/12c- 10Z	19/12/1997	31/01/1998	Appraisal	Abandoned Phase 3	21.3
48/13b- 3	09/03/1982	12/05/1982	Exploration	Abandoned Phase 3	25.3
48/16b-2	07/11/2002	13/12/2002	Exploration	Abandoned Phase 3	27.1
48/16b-3	07/12/2008	01/01/2009	Appraisal	Abandoned Phase 3	28.0
48/16b-3Z	01/01/2009	21/01/2009	Appraisal	Abandoned Phase 3	28.0
48/17a-10	14/03/1990	07/05/1990	Appraisal	Abandoned Phase 3	21.9
48/17b-3	05/07/1986	07/10/1986	Appraisal	Abandoned Phase 2	18.3
48/17-1	20/06/1969	21/07/1969	Exploration	Abandoned Phase 3	22.3
48/17b-5	31/03/1988	02/04/1993	Development	Abandoned Phase 3	17.7
48/17b-G1	31/03/1988	25/05/1988	Exploration	Abandoned Phase 3	26.8
48/17b-G2	29/12/1992	08/03/1993	Development	Abandoned Phase 3	17.7
48/17a-E1	07/03/1991	25/04/1991	Appraisal	Abandoned Phase 1	22.9
48/17a-E2	13/12/1992	18/06/1994	Development	Completed (Operating)	26.2
48/17a-E3	05/03/1993	08/06/1994	Development	Completed (Operating)	22.9
48/17a-E4	30/04/1993	22/06/1994	Development	Completed (Operating)	26.2
48/17a-E5	29/06/1993	02/07/1994	Development	Completed (Shut In)	22.9
48/17a-E6	28/08/1997	06/11/1997	Development	Completed (Operating)	26.2
48/17a-E1Z	07/03/1991	14/06/1994	Development	Completed (Operating)	22.9
48/17b- 7	19/09/1988	05/11/1988	Exploration	Abandoned Phase 3	19.8
48/17b- 7Z	05/11/1988	23/01/1989	Exploration	Abandoned Phase 3	19.8
48/17a- 8	08/01/1989	01/03/1989	Exploration	Abandoned Phase 3	21.3

2.5.2 Existing Information Relating to the ECC Survey Area

Existing information considered as part of this assessment includes the geophysical survey result reports for each block along the ECC route (Doc refs: UK4885H-824-01a to UK4885H-824-20). These report provides details of seabed elevation, seabed features, shallow geology and identifies potential hazards present within the survey area utilising MBES, SSS, SBP, MAG and UHR data.

To aid in regional comparisons between the chemical and macrofaunal parameters the current report utilises previous surveys carried out by BSL in 2019 and 2020:

- Southern North Sea survey, environmental habitat and baseline survey, (BSL SNS, 2019; BSL SNS 2020a; BSL SNS 2020b)

The three regional BSL surveys showed similar sediment characteristics and water depths along with similar sampling methodology (two macrofauna and one PC per station) to those used during the current ECC survey. The mean, standard deviation (SD) and coefficient of variance (CV) from the previous BSL surveys are provided within their respective tables.

2.5.3 Reference Sources

Sediment quality guidelines for the protection of benthic macrofauna estimate the thresholds of specific compound concentrations in sediments above which can result in adverse effects to sediment-dwelling organisms. The sediment quality guidelines cited in this report in regards to each parameter are tabulated in Table 5 and described in sections a to g below.

Table 5: Sediment Quality Reference Values

SQGVs/Parameters	PSA	TOC	PAH	HM	Organotin	PCB	Organochlorine	Macrofauna
UKOOA 50th 95th Percentiles			X	X				X
OSPAR BC and BAC			X					
OSPAR ERL and ERM			X	X		X	X	
CEFAS Action Levels 1 and 2				X	X	X	X	
CCME TEL and PEL			X	X		X	X	
AZNECC/ARMCANZ SQGV			X	X				

a UKOAA 50th and 95th Percentiles for Background North Sea Sediments

In 2001, the United Kingdom Offshore Operators Association (herein known as UKOOA) published sediment quality guidelines for the UK North Sea (UKOOA, 2001). Using a database of survey data collected between 1975-95, the report sets out 'background' levels for a variety of parameters (e.g. organic carbon, hydrocarbon, and metals content) in sediments over 5km from an existing oil and gas platform. For the current EBS the 50th and 95th percentile levels for uncontaminated background sediments are presented where available, using a combination of levels for the entire North Sea, specific North Sea sectors or specific sediment types, as appropriate to best inform the interpretation.

b OSPAR Background Concentrations and Background Assessment Concentrations

To monitor progress towards 'background conditions' in the marine environment, OSPAR developed a range of background concentrations (BCs) and background assessment concentrations (BACs) for use as reference levels throughout the OSPAR marine area. BCs are concentrations of contaminants derived from analysis of core samples to reflect pre-industrial, pristine, background levels for the OSPAR area (Webster *et al.*, 2009). BACs have been statistically derived from BCs and represent the level above which concentrations can be considered to be significantly higher than the relevant BC, with concentrations said to be near background if they are below their corresponding BAC (OSPAR, 2008). In the current report, reference to BCs and BACs has been made after normalisation of metals and PAHs using the method described in detail in the corresponding results sections and Appendix F.

c OSPAR Effect Range Low and Effect Range Median Levels

In order to assign a level of context for toxicity, an approach used by Long *et al.*, (1995) to characterise contamination in sediments will be used in this report. 'Effect range low' (ERL) levels were defined as concentration of metals at which adverse effects were reported in 10% of the data reviewed, whilst 'effect range median' (ERM) levels were defined as the concentrations at which 50% of studies reported harmful effects. The ERLs and ERMs have been used to evaluate the ecological significance of heavy and trace metal concentrations within the survey area.

d CEFAS Action Levels 1 and 2

The UK is a signatory of both the London Protocol and OSPAR Convention for the protection of the marine environment of the Northeast Atlantic, which addresses the prevention of marine pollution from disposal at sea. The Marine and Coastal Access Act (2009) transposes the requirements of these conventions into English law. The Marine Management Organisation (MMO), in conjunction with the guidelines set out by OSPAR, established two action levels to enable consideration of potential adverse environmental effects from sea disposal activities (MMO, 2015). The two action levels are listed below:

- Below Action Level 1: Contaminants are generally considered to be of no concern and are unlikely to influence the licensing condition.
- Between Action Levels 1 and 2: Contaminants are generally further investigated against background concentrations.
- Above Action Level 2: Contaminants are generally considered unsuitable for disposal at sea.

e CCME Threshold Effect Level and Probable Effect Level

The Canadian sediment quality guidelines were developed by the Canadian Council of Ministers of the Environment as broadly protective tools to protect aquatic life for an indefinite period of exposure to chemicals associated with sediments. The CCME have derived two reference values for aquatic sediments: a threshold effect level (TEL) and a probable effect level (PEL). The TEL and PEL reference values are described below:

- Below TEL: the lowest range of concentrations, within which adverse effects are rarely observed.
- Between TEL and PEL: possible effects range, within which adverse effects are occasionally observed.
- Above PEL: probable effects range, within which adverse biological effects are frequently observed.

f AZNECC and ARMCANZ SQGV and SQGV High

In order to characterise contamination in sediments, when OSPAR normalisation was inappropriate, sediment quality guidelines (SQGs) adopted by the Australian and New Zealand Environment and Conservative Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) will be used in this report (Simpson *et al.*, 2013). The application of SQGs involves a tiered, decision-tree approach. Following this framework, the total concentrations of contaminants are compared to SQG values. For metals, the sediment quality guideline values' (SQGVs) and SQG-High values are largely unchanged and remain based on the effects range low (ERL) and effects range median (ERM) values. For organics, threshold effects level (TEL) and probable effects level (PEL) values are now used. If the contaminant concentrations exceed the SQGVs, further investigations are initiated to determine whether there is indeed an environmental risk associated with the exceedance by assessing the contaminant bioavailability.

g EMODnet Predicted Habitat 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, 2022). The broad-scale seabed habitat map is a predictive delineation of habitats within all European seas to the EUNIS classification system (EMODnet, 2022). 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 in confidently assigning biotopes within a given survey area (Figure 2).

2.5.4 Legislative Background

a UK Post 2010 Biodiversity Framework

The 'UK Post-2010 Biodiversity Framework' was published in July 2012 to succeed the UK BAP 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. All of the 1,150 species, 391 Species Action Plans (SAPs) and 45 Habitat Action Plans (HAPs) included in the UKBAP were incorporated into the framework Key UK BAP 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,
- *Sabellaria spinulosa* Reefs,
- Seamount Communities.
- *Ammodytes marinus* Spawning and Nesting grounds

b 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 own 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 UK Post-2010 Biodiversity Framework, with the "Mud Habitats in Deep Water" listed as "Seapens & Burrowing Megafauna Communities".

c 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:

- Sub-tidal reefs (e.g. biogenic reefs formed by *Sabellaria spinulosa*, *Modiolus* and rocky reefs formed from iceberg scour or moraine deposits);
- Sandbanks which are slightly covered by sea water all the time;
- 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 UKs 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 UKs 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 1 January 2021 (GOV.UK, 2022).

Main changes to the regulation include:

- The creation of a national site network within the UK territory comprising the protected sites already designated under the Nature Directives, and any further sites designated under these regulations;
- The establishment of management objectives for the national site network (the 'network objectives');
- A duty for appropriate authorities to manage and where necessary adapt the national site network as a whole to achieve the network objectives;
- An amended process for the designation of Special Areas of Conservation (SACs);
- Arrangements for reporting on the implementation of the regulations, given that the UK no longer provides reports to the European Commission;
- Arrangements replacing the European Commission's functions with regard to the imperative reasons of overriding public interest test where a plan or project affects a priority habitat or species, and;
- Arrangements for amending the schedules to the Regulations and the annexes to the Nature Directives that apply to the UK.

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).

d 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.

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 exist for chemical monitoring (NMCAQC) and ecotoxicological monitoring (NMEAQC) (Davies *et al.*, 2001).

2.5.5 Habitat Investigation

a 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 *et al.* (2015) to provide improved classification of deep-sea habitats. The resultant combined JNCC (2015) classification system is analogous with the European Nature Information Service Habitat Classification (EUNIS, 2019), which has compiled habitat information from across Europe into a single database. The two classification systems are both based around 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 interpreted from the side scan sonar (SSS) and bathymetric data acquired during the current survey. Global Mapper V20 GIS software was used to review the SSS mosaic (Geotiff) and multibeam bathymetry data (Geotiff and xyz) and to delineate areas of different seabed habitats. In addition, 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 ECC survey area. As illustrated in Figure 2, the ECC route passes through several predicted EUNIS habitats: ‘Atlantic Circalittoral Sand’ (A5.25/MC52), Atlantic Circalittoral Coarse Sand’ (A5.26/MC32), ‘Atlantic Infralittoral Sand’ (A5.23/MB5), ‘Atlantic Offshore Circalittoral Coarse Sediment’ (A5.24/MD32), ‘Atlantic Offshore Circalittoral Biogenic Habitat’ (A5.15/MC2), ‘Atlantic Circalittoral Mixed Sediment’ (A5.44/MC42), ‘Worm Reefs in the Atlantic Circalittoral Zone’ (A5.61/MC221), Sabellaria on Stable Atlantic Circalittoral Mixed Sediment’ (A5.611/MC2211) and ‘Atlantic Circalittoral Infralittoral Coarse Sediment’ (A5.13/MB32).

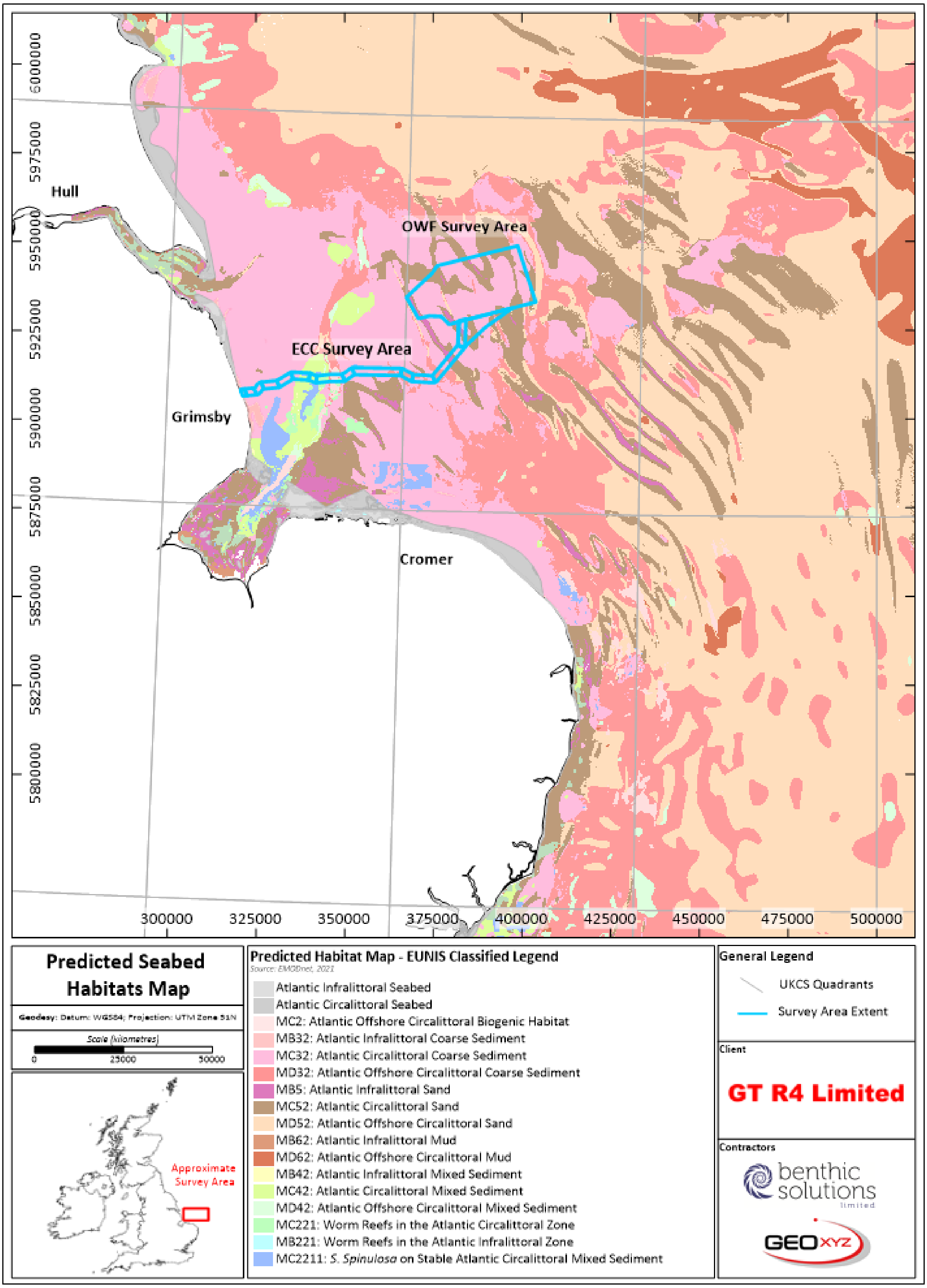


Figure 2: EMODnet Predicted Seabed Habitats Map in Relation to the Survey Area

b Expected Habitat Sensitivities

The ECC survey area is situated within the large Southern North Sea Special Area of Conservation (SAC), which stretches from the central North Sea (north of Dogger Bank) to the straits of Dover in the south. A mix of habitats which are afforded Annex I protection, such as sandbanks and gravel beds, are present within the SAC but are designated as individual SACs and Marine Conservation Zones (MCZs), of which, part of the ECC survey area (Blocks 6 to 9) is situated within the Inner Dowsing, Race Bank and North Ridge SAC (Figure 3). The Inner Dowsing, Race Bank and North Ridge SAC is designated for the presence of sandbanks and areas of *Sabellaria spinulosa* biogenic reefs. Other MCZs and SACs found near to the ECC survey area and the primary features for which they were designated are summarised below in Table 6.

Table 6: Key Aspects of Nearby Protected Areas

SAC/ MCZ	Designated Site	Site Area	Closest distance and bearing from the survey area	Key Aspects
SAC	Inner Dowsing, Race Bank and North Ridge	845km^2	17km southeast	Sandbanks bordering channels, linear relict banks, sinusoidal banks with distinctive 'comb-like' subsidiary banks and areas of *Sabellaria spinulosa* biogenic reefs.
	The Wash and North Norfolk Coast	1,072km^2	49km southeast	Sublittoral sandbanks, *Sabellaria spinulosa* biogenic reefs, intertidal mudflats, large shallow inlets and bays, salt meadows, Mediterranean and thermo-Atlantic halophilous scrubs and *Salicornia* and other annuals colonising mud and sand.
	Haisborough, Hammond and Winterton	1,468km^2	57km south	Sandbanks formed via headland associated geological processes and occasional areas of *Sabellaria spinulosa*.
	North Norfolk Sandbanks and Saturn Reef	3,603km^2	5.8km west	Offshore linear ridge and tidal sandbanks with extensive sand waves and areas of *Sabellaria spinulosa* biogenic reefs.
	Dogger Bank	12,331km^2	78km northwest	Sublittoral sandbanks formed by glacial and submergence through sea-level rise.
	Southern North Sea	36,951km^2	Passes through western extent of the survey area	Important area for Annex II harbour porpoise (*Phocoena phocoena*).
	Runswick Bay	68km^2	154km northwest	Protects subtidal coarse and mixed sediments which support the ocean quahog (*Arctica islandica*)

SAC/ MCZ	Designated Site	Site Area	Closest distance and bearing from the survey area	Key Aspects
MCZ	Orford Inshore	72 km²	157km south	Orford Inshore MCZ is dominated by subtidal mixed sediments which act as an important nursery and spawning grounds for many fish species, including dover sole, lemon sole and sandeels.
	Markham's Triangle	200km²	72km east	Protects subtidal mud, sand, coarse and mixed sediments which supports varied faunal assemblages of polychaetes, molluscs, echinoderms and commercially important flatfish such as sole and plaice.
	Holderness Offshore	309km²	16km northwest	North Sea glacial tunnel valleys (inner Silver Pit), and the presence of *Arctica islandica*.
	Holderness Inshore	309km²	50km northwest	Deep water circalittoral rocks supporting sponge aggregations and commercially significant crustaceans (*Cancer pagurus* and *Necora puber*).
	Cromer Shoal Chalk Beds	321km²	50km southwest	Presence of peat and clay exposures and subtidal chalk providing nursery areas for crustaceans, fish and the small spotted catshark.

c Sensitive Habitat and Species Assessment

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

- Ross worm (*S. spinulosa*) reef (EC Habitats Directive Annex I, Habitat FOCI, OSPAR Threatened and/or declining Habitat, UKBAP Priority Habitat);
- Stony reef (EC Habitats Directive Annex I, UKBAP Priority Habitat);
- Sandbanks which are slightly covered by sea water all the time (EC Habitats Directive Annex I, Habitat FOCI);
- The Ocean Quahog, *Arctica islandica* (Species FOCI, OSPAR Threatened and/or declining species), and;.
- Lesser sandeels (*Ammodytes marinus*) (Species FOCI, UKBAP Priority Species, SPI England and Wales, PMF species Scotland).

Parts of the ECC survey area overlap areas designated as herring spawning ground (HSG) and nursery ground areas as well as sandeel spawning and nursery ground areas. As such, there was potential for sediment suitable for herring and sandeel spawning to occur within the survey area.

d Legislative Species Protection Assessment

The epifauna taxa recorded from review of the underwater video footage and infauna taxa identified by taxonomic analysis were inputted into a database developed by BSL staff which identified any species that are afforded protection under several legislative conventions/directives implemented in the UK, including the UK Post-2010 Biodiversity Framework and the Species of Principal Importance England.

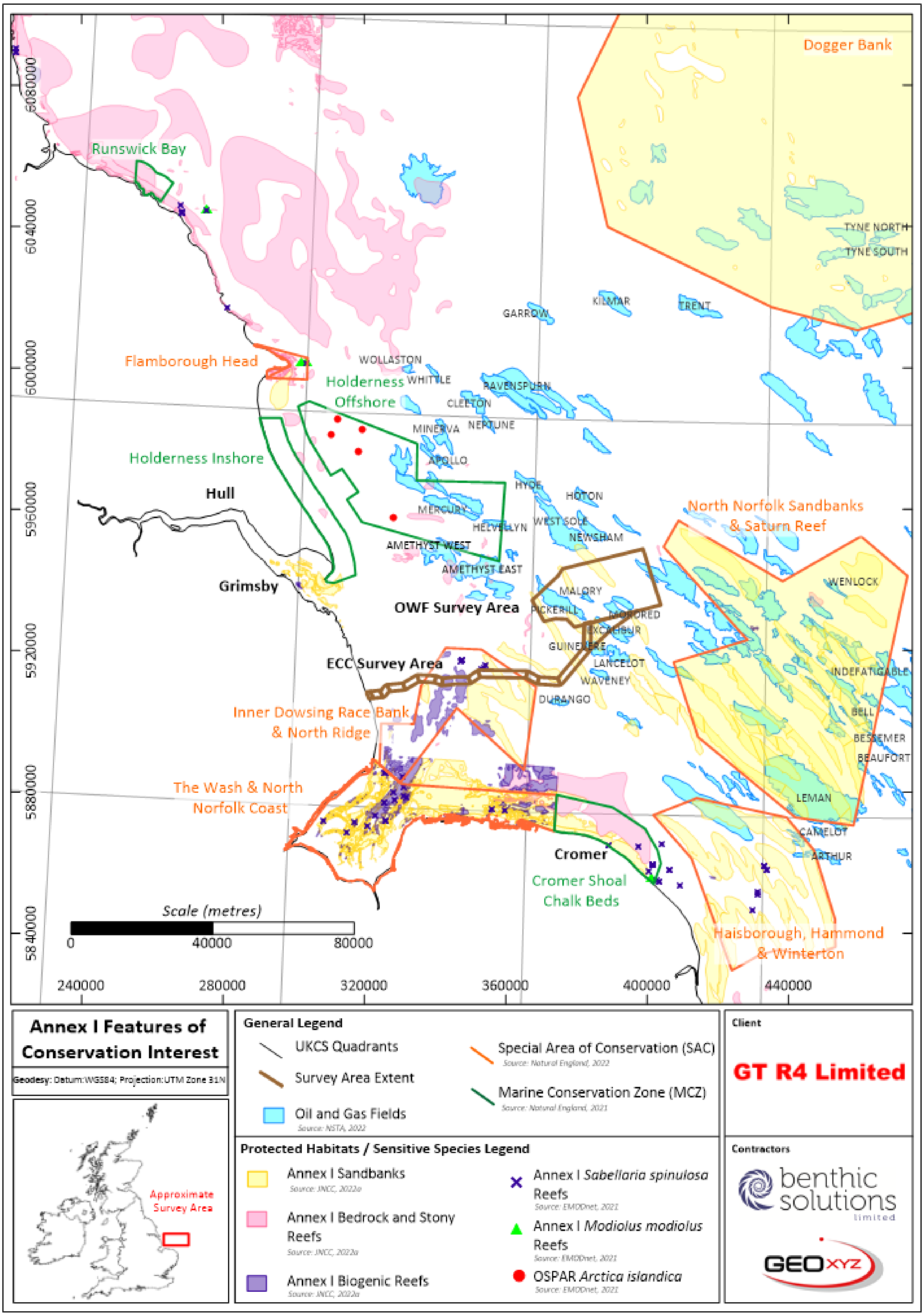


Figure 3: Location of Features of Conservation Interest in Relation to the Survey Area

3 FIELD SURVEY AND ANALYTICAL METHODS

3.1 GEOPHYSICAL DATA

Analogue geophysical data acquired by GEOxyz during the survey were used for site selection. Site selection using geophysical data can ensure specific locations are selected for the camera transects to investigate any habitats and boundaries across the survey area, with particular attention being paid to the investigation of potential Annex I habitats protected under the EC Habitats Directive.

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

- Bathymetry reduced and processed offshore to provide a digital terrain model (0.25m x 0.25m bin size) where major bathymetric features and minor bathymetric changes could be identified and highlighted. This included the identification of seabed morphology within the survey area (e.g., megaripples, sand waves, canyons and sandbanks), seabed infrastructure and debris (e.g. anthropogenic debris, existing cables and pipelines).
- SSS with data run at both high (600kHz) and low (300kHz) frequencies at a 75m range per channel both acquiring data perpendicular to the towfish. Data was processed using Chesapeake SonarWiz and were digitally rendered onto a seabed mosaic of 0.15m pixel size of the area using the HF 600kHz data for review. Changes in sediment type and hardness, along with features observed through low level relief and discrete objects could be delineated

3.2 ENVIRONMENTAL GROUND-TRUTHING AND SAMPLING

The environmental sampling strategy was outlined by the client in the project execution plan (Doc Ref UK4855H-824-PEP-01-1.5) and GoBe Consultants selected stations based on the acquired geophysical data during the survey. All amendments to the environmental data acquisition were agreed prior to sampling in accordance with the JNCC marine monitoring handbook, relevant procedural guidelines and SSS/MBES data review (Bullimore and Hiscock, 2001; Davies *et al.*, 2001; Hitchin *et al.*, 2015; Holt and Sanderson, 2001; Munro, 2001; OGUK, 2019).

Grab sampling was undertaken at a total of 59 stations with seabed video acquisition carried out at 33 stations based on GoBe Consultants intelligent sampling (Table 7, Table 9 and Figure 4). Intelligent sampling covered areas of interest highlighted by the geophysical data such as changes in SSS reflectivity or changes in bathymetry to provide an ecological baseline of the ECC survey area, as per the JNCC marine monitoring handbook (Davies *et al.*, 2001). Contaminant analysis was sampled using the Shipek grab sampler while benthic macrofauna and physico-chemical samples were acquired using the min-Hamon grab sampler. Two grab stations with the suffix were offset (>25m) from the proposed position due to hard underlying sediments. The Shipek grab deployment at station ECC_23 was offset 280m south due to the presence of fishing gear and was subsequently given the “a” suffix. Station FA_04 was offset by 20m after mooring rope was caught accidentally. Seven trawl transects were selected across the ECC survey area to characterise the epibenthic species that are commonly under-represented during grab surveys.

All 59 benthic stations underwent the following sampling/sub-sampling:

- 59 x 0.1m^2 macro-invertebrate samples processed over a 5mm and a 1000µm aperture sieve in the field and 1000µm in the lab;

- 59 x 0.1m^2 physico-chemical samples, subsampled for particle size distribution (PSD) and total organic carbon (TOC) at a single surface depth of 0-2cm.

Additionally, 30 benthic stations underwent the following sampling/sub-sampling:

- 30 x 0.05m^2 Contaminant samples, subsampled for trace metals (HM), organotins, polyaromatic hydrocarbons (PAH), polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs).
- 3 x 0.05m^2 50ml eDNA samples, subsampled from four corners of a surface depth of 0-2cm.

Seven collocated beam trawl transects underwent the following sampling/sub-sampling:

- 7 x ~500m trawl samples for macroinvertebrates processed over a 5mm mesh in the field and 5mm in the lab.

Physico-chemical samples were retrieved from each Hamon grab and Shipek contaminant sampling stations across the ECC survey area, except ECC_29 where no grab sampling took place due to the presence of *Sabellaria spinulosa*. However, four stations did not meet the minimum sample retention (40%) to be processed for macrofaunal analysis, as the hard underlying sediment at these stations restricted sample penetration (Table 7). Samples for eDNA analysis were collected from three stations (ECC_18, ECC_34 and ECC_49) using the Shipek grab. No eDNA was sampled from ECC_08 as the cobbles at this station resulted in low sediment retention (<40%) and sample washout, which were inadequate for eDNA subsampling. eDNA water samples were successfully subsampled at all five water sample stations and corresponding water depths (surface and bottom), with an additional station, SF_WS_01, successfully subsampled for TOC/TSS at three water depths (surface, middle and bottom) during two tidal cycles (ebb and flow) (Table 8). Sediment and water eDNA results and interpretation from the ECC and OWF survey areas will be presented and discussed in the subsequent benthic ecology eDNA results report.

All seven beam trawl samples were successfully collected one first attempt, with any trawls offset by >50m recorded with an “a” suffix due to the presence of fishing gear, i.e. ECC_T3 (Table 10). Camera transects of approximately 50m in length were collocated with 30 grab locations to acquire video and stills data to facilitate a habitat assessment (Table 9). Survey operations were carried out using a MOD4.2 and 4.4 camera system mounted within a BSL freshwater lens adapted camera sled frame equipped with a separate strobe, LED lamps and HD video. Additional camera transects were added to the scope (ECC_64, ECC_65 and ECC_66) due to the presence of *Sabellaria spinulosa* within Block 9 of the ECC survey route. The survey field operations are detailed in Appendix C, with the grab sampling logs and deck observations provided in Appendix F, camera transect logs in Appendix G, and trawl sampling logs in Appendix H.

Table 7: Summary of Grab Station Sample Acquisition

Geodetics: WGS84, UTM31N, CM 3°E									
Station	Easting (m)	Northing (m)	Rationale	Depth (m)	PC*	F1*	Contaminant (Primary**)	Contaminant (Spare)**	eDNA **
FA_01	368 325	5 933 910	Funnel; in megaripples	17.70	Y	Y	-	-	-
FA_02	370 677	5 931 587	Funnel; in megaripples; sandbank	23.91	Y	Y	Y	Y (500mL)	-
FA_03	370 789	5 928 857	Funnel; adjacent to boulders; DDV cross boundary	19.34	Y	Y	-	-	-
FA_04	371 114	5 934 756	Funnel; no defined features	21.04	Y	Y	Y	Y (500mL)	-
FA_05	372 032	5 937 085	Funnel; on sandbank	14.59	Y	Y	-	-	-
ECC_06	373 189	5 929 297	Block 13; no defined features	23.46	Y	Y	Y	NS	-
ECC_07	373 062	5 931 766	Block 13; on sandbank	10.64	Y	Y	-	-	-
ECC_08	399 171	5 942 280	Block 13; adjacent boulders; trawl; fish eDNA	18.44	Y	Y*	Y	Y (150mL)	NS
ECC_09	392 180	5 940 380	Block 12; adjacent boulders; megaripples	19.90	Y	Y	-	-	-
ECC_10	374 491	5 934 097	Block 12; megaripples; sandbank slope	18.97	Y	Y	Y	Y (500mL)	-
ECC_11	374 806	5 932 218	Block 12; on sandbank	9.69	Y	Y	-	-	-
ECC_12	375 073	5 939 863	Block 12; no defined features	22.36	Y	Y	Y	NS	-
ECC_13	375 788	5 937 614	Block 12; sandbank	25.60	Y	Y	-	-	-
ECC_14	375 564	5 930 201	Block 11; megaripples	21.95	Y	Y	Y	Y (500mL)	-
ECC_15	376 342	5 942 246	Block 11; no defined features	22.59	Y	Y	-	-	-
ECC_16	376 475	5 934 626	Block 10; edge megaripples; sandbank	27.89	Y	Y	Y	Y (500mL)	-
ECC_17	376 766	5 939 971	Block 10; adjacent debris	23.08	Y	Y	-	-	-
ECC_18	377 425	5 936 529	Block 9; no defined features; trawl	20.82	Y	Y	Y	NS	-
ECC_19	377 956	5 933 911	Block 9; megaripples; in SAC	23.92	Y	Y	-	-	-
ECC_20	378 434	5 938 542	Block 9; no defined features; in SAC	21.99	Y	Y	Y	Y (150mL)	-
ECC_21	378 588	5 928 938	Block 9; no defined features; in SAC	20.54	Y	Y	-	-	-
ECC_22	378 963	5 940 391	Block 9; adjacent megaripples; in SAC	19.96	Y	Y*	Y	Y (150mL)	-
ECC_23A	379 012	5 943 303	Block 9; megaripples; sandbank slope; in SAC	21.27	Y	Y	-	-	-
ECC_24	379 489	5 932 718	Block 9; on sandbank; in SAC	16.14	Y	Y	Y	Y (300mL)	-
ECC_25	379 700	5 935 604	Block 9; on sandbank; trawl; in SAC	13.78	Y	Y	-	-	-
ECC_26	392 596	5 937 978	Block 9; megaripples; sandbank slope; in SAC	17.80	Y	Y	Y	Y (500mL)	-
ECC_27	381 289	5 938 700	Block 9; megaripples; in SAC	18.05	Y	Y	-	-	-
ECC_28	381 893	5 931 030	Block 9; unknown feature; in SAC	17.00	Y	Y*	Y	NS	-
ECC_29	382 190	5 942 983	Block 9; no defined features; in SAC	17.58	Y	Y*	-	-	-
ECC_30	382 215	5 936 874	Block 8; adjacent boulders; in SAC	17.23	Y	Y*	Y	NS	-
ECC_31	382 454	5 928 327	Block 8; megaripples; in SAC	14.38	Y	Y	-	-	-
ECC_32	382 669	5 933 674	Block 8; adjacent boulders; in SAC	13.76	Y	Y	Y	Y (300mL)	-
ECC_33	382 666	5 940 287	Block 8; megaripples; in SAC	28.36	Y	Y	-	-	-
ECC_34	383 061	5 931 425	Block 7; no features; trawl; fish eDNA; in SAC	16.61	Y	Y	Y	Y (350mL)	Y
ECC_35	383 118	5 935 025	Block 8; no defined features; in SAC	29.39	Y	Y	-	-	-
ECC_36	384 016	5 933 223	Block 7; adjacent boulders; in SAC	28.34	Y	Y	Y	Y (500mL)	-

Geodetics: WGS84, UTM31N, CM 3°E									
Station	Easting (m)	Northing (m)	Rationale	Depth (m)	PC*	F1*	Contaminant (Primary**)	Contaminant (Spare)**	eDNA **
ECC_37	384 463	5 936 267	Block 7; adjacent boulders; in SAC	26.16	Y	Y	-	-	-
ECC_38	384 543	5 934 491	Block 7; megaripples; in SAC	22.66	Y	Y	Y	Y (500mL)	-
ECC_39	384 808	5 940 130	Block 7; no defined features; in SAC	21.55	Y	Y	-	-	-
ECC_40	384 835	5 928 514	Block 7; adjacent boulders; in SAC	19.10	Y	Y	Y	NS	-
ECC_41	384 915	5 931 423	Block 6; no defined features; in SAC	16.18	Y	Y	-	-	-
ECC_42	384 942	5 943 991	Block 5; adjacent sand crest; in SAC	11.40	Y	Y	-	-	-
ECC_43	384 966	5 938 223	Block 5; megaripples; spoil ground	11.51	Y	Y	Y	Y (500mL)	-
ECC_44	385 577	5 940 949	Block 4; adjacent boulders; spoil ground	12.19	Y	Y	-	-	-
ECC_45	385 841	5 929 678	Block 4; unlisted feature; spoil ground	14.29	Y	Y	Y	Y (500mL)	-
ECC_46	386 508	5 928 375	Block 3; megaripples	14.23	Y	Y	-	-	-
ECC_47	386 555	5 935 791	Block 3; adjacent debris	12.56	Y	Y	Y	NS	-
ECC_48	387 377	5 939 388	Block 3; unknown feature	11.28	Y	Y	-	-	-
ECC_49	387 851	5 930 602	Block 2; unknown feature; trawl; fish eDNA	19.36	Y	Y	Y	Y (500mL)	Y
ECC_50	387 946	5 942 699	Block 6; no defined features; in SAC	9.95	Y	Y	Y	Y (500mL)	-
ECC_51	388 515	5 933 803	Block 2; no defined features	19.01	Y	Y	Y	NS	-
FA_52	389 066	5 930 894	Funnel; on sandbank	12.86	Y	Y	-	-	-
ECC_53	389 147	5 944 654	Block 15; megaripples	17.30	Y	Y	-	-	-
ECC_54	389 704	5 935 683	Block 14; adjacent megaripples; in SAC	10.05	Y	Y	Y	Y (500mL)	-
ECC_55	390 497	5 939 123	Block 17; megaripples; in SAC; trawl	16.92	Y	Y	-	-	-
ECC_56	390 747	5 941 518	Block 14; Sandwaves crest; in SAC	13.97	Y	Y	-	-	-
ECC_57	390 624	5 932 907	Block 15; unknown feature; in SAC	12.94	Y	Y	Y	Y (150mL)	-
ECC_58	392 721	5 945 816	Block 15; megaripples	12.15	Y	Y	Y	Y (500mL)	-
ECC_59	393 190	5 942 430	Block 15; unknown feature	10.13	Y	Y	-	-	-
ECC_60	393 246	5 931 743	Block 16; no defined features	17.70	Y	Y	Y	Y (500mL)	-

**HG = Hamon grab utilised*
***SG = Shipek grab utilised*
NS = No sampled retained
Y= F1 sample lower than 40%*

Table 8: Summary of Water Station Sample Acquisition

Geodetics: WGS84 UTM31N 3°E					
Station	Depth	Easting (m)	Northing (m)	TOC/TSS	eDNA
SF_WS_01 (Ebb Tide)	Surface (2m)	395 072	5 942 905	Y	-
	Middle (11m)	395 074	5 942 903	Y	-
	Bottom (22m)	395 074	5 942 903	Y	-
SF_WS_01 (Flood Tide)	Surface (2m)	395 075	5 942 905	Y	-
	Middle (12m)	395 074	5 942 904	Y	-
	Bottom (24m)	395 074	5 942 904	Y	-
OWF_WS_01	Surface (2m)	397 270	5 941 082	-	Y
	Bottom (22m)	397 268	5 941 082	-	Y
OWF_WS_02	Surface (2m)	377 958	5 933 906	-	Y
	Bottom (36m)	377 958	5 933 907	-	Y
ECC_WS_03	Surface (2m)	383 694	5 920 832		Y
	Bottom (16m)	383 696	5 920 832		Y
ECC_WS_04	Surface (2m)	348 159	5 912 120	-	Y
	Bottom (28m)	348 157	5 912 123	-	Y
ECC_WS_05	Surface (2m)	329 596	5 905 401	-	Y
	Bottom (9m)	329 598	5 905 403	-	Y
SF_WS_01 was sampled during the flow and ebb tide to aid calibration of the seabed frame marker buoy					

Table 9: Summary of Environmental Camera Transect Acquisition

Geodetics: WGS84, UTM31N, CM 3°E					
Transect	Type	Easting (m)	Northing (m)	HD Video footage (mm:ss)	No. Stills
FA_VID_03	SOL	388 843	5 928 119	06:03	12
	EOL	388 863	5 928 067		
ECC_VID_06	SOL	383 310	5 926 455	06:01	13
	EOL	383 289	5 926 505		
ECC_VID_08	SOL	383 670	5 920 813	06:53	44
	EOL	383 706	5 920 866		
ECC_VID_11	SOL	379 817	5 916 678	06:43	15
	EOL	379 787	5 916 631		
ECC_VID_12	SOL	378 013	5 914 138	06:01	12
	EOL	378 035	5 914 088		
ECC_VID_15	SOL	370 525	5 910 991	09:05	20
	EOL	370 505	5 911 043		
ECC_VID_17	SOL	366 932	5 912 583	06:18	12
	EOL	366 912	5 912 635		
ECC_VID_18	SOL	364 088	5 913 202	06:29	34
	EOL	364 146	5 913 201		
ECC_VID_21	SOL	361 572	5 913 455	06:19	48
	EOL	361 550	5 913 509		
ECC_VID_25	SOL	357 036	5 913 634	12:33	37
	EOL	357 095	5 913 627		
ECC_VID_28	SOL	354 119	5 912 546	06:49	40
	EOL	354 141	5 912 486		
ECC_VID_29*	SOL	352 950	5 914 067	00:45	-
	EOL	352 952	5 914 063		

Geodetics: WGS84, UTM31N, CM 3°E					
Transect	Type	Easting (m)	Northing (m)	HD Video footage (mm:ss)	No. Stills
ECC_VID_30	SOL	351 815	5 913 893	06:17	31
	EOL	351 793	5 913 946		
ECC_VID_31	SOL	351 880	5 913 031	06:18	36
	EOL	351 858	5 913 084		
ECC_VID_33	SOL	350 429	5 910 937	06:18	14
	EOL	350 448	5 910 885		
ECC_VID_34	SOL	348 184	5 912 125	06:48	42
	EOL	348 130	5 912 100		
ECC_VID_35	SOL	349 910	5 912 393	06:10	17
	EOL	349 891	5 912 444		
ECC_VID_37	SOL	346 068	5 912 025	06:01	46
	EOL	346 012	5 912 021		
ECC_VID_38	SOL	345 680	5 911 832	06:23	31
	EOL	345 691	5 911 888		
ECC_VID_42**	SOL	338 364	5 912 001	04:02	14
	EOL	338 308	5 911 969		
ECC_VID_43	SOL	335 507	5 911 310	03:50	14
	EOL	335526	5 911 255		
ECC_VID_48**	SOL	330 863	5 906 501	04:38	0
	EOL	330 840	5 906 556		
ECC_VID_49	SOL	329 614	5 905 418	03:14	17
	EOL	329 587	5 905 374		
ECC_VID_55	SOL	336 777	5 906 841	05:49	15
	EOL	336 826	5 906 864		
ECC_VID_56	SOL	340 232	5 909 220	04:56	18
	EOL	340 189	5 909 189		
ECC_VID_57	SOL	335 385	5 906 148	06:32	53
	EOL	335 404	5 906 092		
ECC_VID_59	SOL	331 368	5 904 303	06:46	39
	EOL	331 347	5 904 358		
ECC_VID_61	SOL	349 254	5 911 094	06:00	18
	EOL	349 275	5 911 044		
ECC_VID_62	SOL	346 142	5 911 433	08:29	44
	EOL	346 161	5 911 378		
ECC_VID_63	SOL	382 499	5 921 033	07:01	33
	EOL	382 477	5 921 093		
ECC_VID_64***	SOL	355 655	5 913 618	43:45	101
	EOL	355 275	5 913 629		
ECC_VID_65***	SOL	352 582	5 913 244	27:11	29
	EOL	352 836	5 913 240		
ECC_VID_66***	SOL	353 049	5 912 512	34:42	66
	EOL	353 271	5 912 277		
ECC_VID_29a	SOL	352 949	5 914 069	07:10	0
	EOL	352 971	5 914 012		

Geodetics: WGS84, UTM31N, CM 3°E					
Transect	Type	Easting (m)	Northing (m)	HD Video footage (mm:ss)	No. Stills
ECC_VID_29b	SOL	352 949	5 914 069	06:54	47
	EOL	352 972	5 914 012		
ECC_VID_48a	SOL	330 861	5 906 483	02:49	10
	EOL	388 843	5 928 119		
ECC_VID_48b	SOL	388 863	5 928 067	08:35	56
	EOL	383 310	5 926 455		
ECC_VID_42a	SOL	383 289	5 926 505	05:48	14
	EOL	383 670	5 920 813		

SOL = Start of line; EOL = End of line
** ECC_VID_29(a,b) was re-attempted due to VNC connection dropout and SD/HD recording corruption*
***ECC_VID_48(a,b) and ECC_VID_42(a) and were re-attempted due to poor visibility*
**** Three additional camera transects were selected by BSL personnel during environmental sampling to investigate the Sabellaria spinulosa 'reefiness' observed at camera station ECC_VID_29*

Table 10: Summary of Epibenthic Trawl Acquisition

Geodetics: WGS84, UTM31N, CM 3°E							
Station	Depth Range (m)	SOL		EOL		Length (m)	Duration (hh:mm)
		Easting (m)	Northing (m)	Easting (m)	Northing (m)		
ECC_T1	10.5 – 12.5	329 444	5 905 179	329 803	5 905 714	644.89	00:20:59
ECC_T2	9.0 - 11.5	336 609	5 906 764	337 185	5 907 049	642.99	00:21:47
ECC_T3	28.8 - 31.6	348 156	5 912 127	347 364	5 911 534	989.58	00:19:49
ECC_T4	13.4 - 15.1	357 740	5 913 534	356 992	5 913 627	753.85	00:25:13
ECC_T5	21.3 - 22.6	363 880	5 913 217	364 541	5 913 194	661.74	00:23:00
ECC_T6	9.1 - 10.0	379 668	5 916 464	380 039	5 917 021	668.94	00:22:25
ECC_T7	17.9 – 19.7	383 810	5 920 989	383 407	5 920 470	657.88	00:22:03
ECC_T1	10.5 – 12.5	329 444	5 905 179	329 803	5 905 715	644.89	00:20:59

SOL = Start of line; EOL = End of line

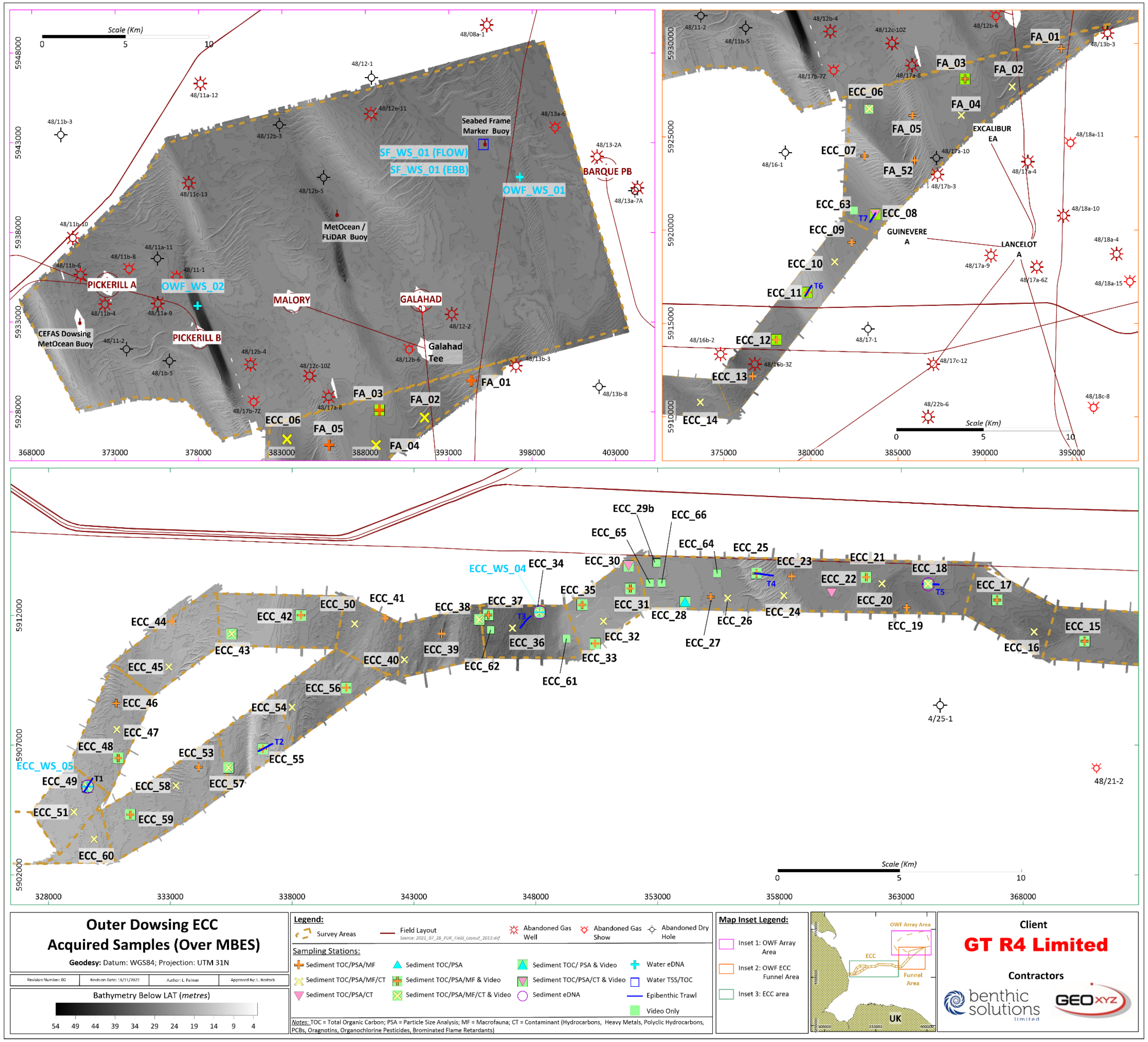


Figure 4: MBES Data and Environmental Sampling Strategy for the Survey Area

3.3 SEDIMENT SAMPLE ANALYSES

The recovered benthic samples were correctly stored prior to demobilisation and transportation of the material to the analytical laboratories. Correct storage involved the freezing of all physico chemical samples on recovery and transportation back to the BSL warehouse to be forwarded to a laboratory, remaining frozen at all times. The material acquired during the survey was analysed at the following laboratories:

- BSL: Particle size Analysis
- BSL: Macro-invertebrate Analysis
- Socotec: Sediment Chemistry

The analytical methods used for the current survey are summarised below in Table 11 with further detail provided in Appendix D.

Table 11: Summary of Analytical Methods

Determinant*	Detection Limits*	Accreditation	Laboratory Technique
Particle Size Distribution	N/A	NMBAQ**	Dry sieving and laser diffraction (Malvern Mastersizer) to whole and half phi intervals, respectively.
Total Organic Carbon	0.02%	ISO 17025 & UKAS/MMO	Documented in-house method with carbonate removal and sulphurous acid/combustion at 1600°C/NDIR, WSLM59.
Trace Metals	Various	ISO 17025, UKAS/MMO	Hydrofluoric/Boric acid extraction followed by ICPMS or ICPOES.
Organotins	0.001mg.kg^{-1}	ISO 17025, UKAS/MMO	Documented in-house method using solvent extraction and derivatisation followed by GC-MS analysis.
Polychlorinated Biphenyls (PCBs)	0.00008µg.kg^{-1}	ISO 17025, UKAS/MMO	Documented in-house method using solvent extraction and clean up followed by GC-MS-MS analysis.
Organochlorine Pesticides (OCP)	0.001mg.kg^{-1}	ISO 17025, UKAS/MMO	Documented in-house method using solvent extraction and clean up followed by GC-MS-MS analysis.
Polycyclic Aromatic Hydrocarbons (PAH)***	1µg.kg^{-1}	ISO 17025 & UKAS/MMO for EPA 16 and DTI Parent PAHs	Documented in-house method using DTI specification involving solvent extraction and clean up followed by GC-MS.
Benthic Macrofauna	n/a	NMBAQC**	Biological identification of 1000µm fractions with univariate and multivariate analyses. 1 of 1 replicate processed.

Socotec, the laboratory, who undertook the contaminant, trace metal, PAH and TOC analysis are MMO accredited (https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans)
**Detection limit is the lowest quantity of a substance that can be distinguished from the absence of that substance (a blank value) with a stated confidence level.*
***NMBAQC is not strictly an accreditation but provides external quality assurance for particle size and macrofaunal analysis*
****EPA list of 16 potentially hazardous compounds and six DTI parent and alkylated PAHs*

3.4 DROP DOWN VIDEO ASSESSMENT

The habitat assessment was based on the review of high-resolution still images and video data collected across 33 transects. Review of video footage and still photographs was undertaken multiple times, as per JNCC/NMBAQC/MESH guidelines (Coggan *et al.*, 2007; Turner *et al.*, 2016).

An initial review of the video footage was undertaken at high speed (max 3x speed) to assess video quality based on the Centre for Environment, Fisheries and Aquaculture's (CEFAS) processing protocol (Hitchin *et al.*, 2015). The CEFAS processing protocol subdivided video and stills quality into four groups (good, satisfactory, poor and not visible) based on:

- Good = No reduced visibility. Broadscale habitat can be assessed. Classification to JNCC/EUNIS level three and four can be confidently undertaken and level five, based on corresponding epifauna, is possible.
- Satisfactory = Some reduced visibility but seabed area can be assessed and identification of the majority of fauna is unaffected. Classification to JNCC/EUNIS level three and four habitats can be confidently undertaken.
- Poor = Broadscale habitat may be assessed but identification of epifauna may be restricted. Classification to JNCC/EUNIS level three habitats can be confidently undertaken.
- Not visible = broadscale habitat cannot be assessed, preventing assessment of seabed character and identification of epifauna.

BSL used the above guidance and assessed 10-second intervals of video footage to calculate the percentage occurrence of each quality category per habitat section and each individual underwater still (Appendix G). Based on the quality review, the majority of stills and video footage acquired were classified as 'good' quality and enabled the classification of each transect to level four and five JNCC/EUNIS habitats.

The second review of the video was undertaken to identify and log the start and end positions of varying sediment types/characteristics. Sediment types were to be classified using the MESH modified Folk triangle sediment classification (Long, 2006), as this is most appropriate to habitat/biotope mapping. Additional details were added where necessary to capture ecologically relevant variation within a single Folk sediment type for example, descriptions of seabed bedforms, coarse substratum (e.g. pebble, cobble, boulder) and shell/shingle content. Furthermore, as noted in the JNCC Marine Monitoring Handbook (Davies *et al.*, 2001), the lower size limit for a biotope is typically considered to be $5m^2$, below which data is not normally distinguished from the surrounding larger biotope. Therefore, sparse or scattered features, such as boulders on sediment plains, were only counted as separate biotopes if their total cumulative area exceeded $5m^2$, although their presence was noted. The presence and positioning of any anthropogenic debris was also noted.

The third review of the video was undertaken to identify and assess the presence/absence and abundance of organisms visible on the video footage. The current study assessed the presence/absence, SACFOR scale and counts/percentage cover of visible organisms in accordance with the JNCC/NMBAQC guidelines (Turner *et al.*, 2016). The physical and biological characteristics of each transect were then used to assign level four JNCC and EUNIS habitat classifications, which were mapped via the differences/similarities in SSS/MBES signatures across the video tracks and wider survey area.

The semi-quantitative SACFOR scale can be used to transform abundance data, determined by size class and percentage cover, into seven categories: super-abundant (S), abundant (A), common (C), frequent (F), occasional (O), rare (R) and less than rare (L) (Table 12). The application of the SACFOR scale involved counting the number of individual species within 15 seconds of video footage based on either 5-minute intervals, or sediment changes, depending on which occurred first. The number of individuals per 15-second interval were converted to abundance (m^2) data using a laser scale of 10cm to assess the field of view (Coggan *et al.*, 2007). SACFOR scale abundances were also calculated per individual image, with both stills and video SACFOR scales averaged per transect to calculate the typical abundance and percentage frequency of occurrence in line with the JNCC methodology to habitat assessment (JNCC, 2020).

Video assessment of potential habitats is limited to characterising the epifaunal species present; however, level JNCC/EUNIS five biotopes and a majority of level four JNCC/EUNIS habitats require an infauna assessment. The infaunal assessment, obtained from Hamon Grab samples, was performed (see Section 4.8.1) in accordance with the methodology described by Parry (2019) and Jenkins *et al.* (2015). Therefore, the holistic approach of epifauna and infauna assessment grab enabled the assignment of corresponding level five JNCC/EUNIS biotope classifications.

Table 12: SACFOR Abundance Scale

Cover (%)	Crust/ Meadow	Massive/Turf	<1cm	1-3cm	3-15cm	>15cm	Density	
>80%	S		S				>1/0.001m^2 (1x1 cm)	>10,000/m^2
40-79%	A	S	A	S			1-9/0.001m^2	1000-9999/m^2
20-39%	C	A	C	A	S		1-9 / 0.01m^2 (10 x 10 cm)	100-999/m^2
10-19%	F	C	F	C	A	S	1-9 / 0.1m^2	10-99/m^2
5-9%	O	F	O	F	C	A	1-9/m^2	
1-5% or density	R	O	R	O	F	C	1-9 / 10m^2 (3.16 x 3.16m)	
<1% or density	L	R	L	R	O	F	1-9 / 100m^2 (10 x 10m)	
		L		L	R	O	1-9 / 1000m^2 (31.6 x 31.6m)	
					L	R	<1/1000m^2	
						L	<1/10,000m^2	

Key						
S	A	C	F	O	R	L
Super-abundant	Abundant	Common	Frequent	Occasional	Rare	Less than Rare

The SACFOR typical abundance and the percentage frequency of occurrence for each transect based on the video and stills review is provided below in Table 13 and Table 14 and indicates that the predominantly coarse sediment stations had a greater abundance of epifaunal species when compared to the stations dominated by sand. The SACFOR analysis also revealed that the stills SACFOR review observed a greater overall occurrence of species when compared to the video review, respectively. This was unsurprising given more stills were taken and analysed than 15 second intervals of video footage. Therefore, stills SACFOR review was more likely to capture the variability in conspicuous epifauna across the OWF survey area due to the increased sampling effort.

Table 13: SACFOR Scale Abundance and Frequency of Occurrence Based on Video Analysis

	Lanice Conchilega	*Sabellaria spinulosa*	Serpulidae	Caridea	Anomura	*Pagurus* sp.	*Ebalia* sp.	*Cancer pagurus*	*Hyas* sp.	Brachyura	*Necora puber*	Cirripedia	*Alcyonidium diaphanum*		*Flustra foliacea*		*Vesicularia spinosa*		Cheilostomatida	ACTINOPTERYGII
Size Class	3 - 15cm	%	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	%	3 - 15cm	>15cm	3 - 15cm	>15cm	3 - 15cm	>15cm	%	3 - 15cm
SACFOR Scale*																				
ECC_VID_03										F		L	C	A	O					
ECC_VID_06						F						L	C	S	F		C		L	
ECC_VID_08						F							C	C			C			
ECC_VID_11																				
ECC_VID_12	F		L	F		F				F		L			C	C	F			
ECC_VID_17			L								F	L			C		C			
ECC_VID_18	F									F		L			F	C	C			
ECC_VID_21	F		L							F		L	C	C	C		C		L	
ECC_VID_28	F			F						F		L	C		F				L	
ECC_VID_29B	C	R		C	F	F						L	F	C	C	C	C	C	L	
ECC_VID_30												L	C	C	C	A	C			
ECC_VID_31												L			F	C				
ECC_VID_33															F		F	C		
ECC_VID_34		O		F				C		F					F		C	C		
ECC_VID_35		R		F					F	F			C		C	C	C	C		
ECC_VID_37		R		C					F	F		L			C		C			F
ECC_VID_38															F		F			
ECC_VID_42A									F						C	A	A			
ECC_VID_43		R														A	C	C		
ECC_VID_48A		R							O						F	C	F			
ECC_VID_49		L				F														
ECC_VID_55																				
ECC_VID_56		L			F				F						F	A	C	A		
ECC_VID_57		R								O					O	F	F			
ECC_VID_59		R														C	F			
ECC_VID_61				F						F		L			C	A	C			
ECC_VID_62		O		C											C	A	C		O	
ECC_VID_63						F						L	C	A			C			
ECC_VID_64	O	L		F	O				O	R			F	A	O	F	F			
ECC_VID_65		L		O		O				O			O		F	F	F			
ECC_VID_66		L		O		O	R	F	R	O			R	O	F	F	O			

	Pholis gunnelus	Pleuronectiformes	ASCIDIACEA	HYDROZOA	*Nemertesia* sp.	Actinaria	*Metridium* sp.	*Dahlia* sp.	*Asterias rubens*		*Henricia* sp.	Crossaster papposus		OPHIUROIDEA	Janolus cristatus	Nudibranchia		*Calliostoma zizyphinum*	*Crepidula fornicata*	PORIFERA
Size Class	3 - 15cm	3 - 15cm	3 - 15cm	%	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	eggs	3 - 15cm	3 - 15cm	%
SACFOR Scale*																				
ECC_VID_03									F											
ECC_VID_06					R			F						C		F		F		L
ECC_VID_08				L																
ECC_VID_11																				
ECC_VID_12			C	L				F					C		F		F	F	C	L
ECC_VID_17			C	R		F		F				F							F	L
ECC_VID_18			F	R		C		F											C	
ECC_VID_21				R		C				C		F								
ECC_VID_28		F		R		F		F										F	C	L
ECC_VID_29B				R	R			F						F			F			
ECC_VID_30								F												
ECC_VID_31								F												
ECC_VID_33																				
ECC_VID_34				R		F								F				F		L
ECC_VID_35				R	R	F		F						F						
ECC_VID_37				R	L			F						F						L
ECC_VID_38				L																
ECC_VID_42A					R	F	F	F		C										
ECC_VID_43					O		F	F												
ECC_VID_48A				L				F		F										
ECC_VID_49				R				F						C						
ECC_VID_55																				
ECC_VID_56				R				F	F		F									
ECC_VID_57						F		O						F						
ECC_VID_59						F		F						F						
ECC_VID_61				R		F						F		F						
ECC_VID_62				R	L	F		F										F		
ECC_VID_63				L				F												
ECC_VID_64				L	L	O		O					O	R				O		
ECC_VID_65				L				O	O	F			F					O		
ECC_VID_66				L	L	O		O		F		R	F							

Percentage Frequency of Occurrence (%)**

ECC_VID_03										100		50	100	100	50														100											
ECC_VID_06						50						100	100	100	50		100		50						50			50						100		50		50		50
ECC_VID_08						50							100	50			50							100																
ECC_VID_11																																								
ECC_VID_12	50		50	50		50				100		100			100	50	50						50	100				50					50		50		50	50	50	50
ECC_VID_15				50								50	50		100		100		50		50	50	50	100	100	100		100			50	50	50							50
ECC_VID_17			50								50	100			100		100						100	100		100		100				50							50	50
ECC_VID_18	50									50		100			50	100	50						50	100		100		50											50	
ECC_VID_21	50		50							100		100	50	50	100		100		50					100		100				50		50								
ECC_VID_28	50			50						50		100	100		100				50			50		100		100		100										50	50	50
ECC_VID_29B	100	100		100	100	100						50	50	100	100	100	100	100	50					50	100			50						50			50			
ECC_VID_30												50	100	50	100	50	100											100												
ECC_VID_31												50			100	50												50												
ECC_VID_33															50		50	50																						
ECC_VID_34		100		50				50		50					50		100	50						50		100								50				50		50
ECC_VID_35		100		50					100	50			100		100	50	50	50						50	100	100		50						100						
ECC_VID_37		100		100					50	100		50			100		100			50				100	50			50						50						100
ECC_VID_38															50		50							50																
ECC_VID_42A									50						50	50	50								50	50	50	50		50										
ECC_VID_43		100														100	100	100							100		100	100												
ECC_VID_48A		67							33						33	33	33							33				33		33										
ECC_VID_49		100				100																		100				100						100						
ECC_VID_55																																								
ECC_VID_56		100			50				50						50	50	100	100						100				50	50		50									
ECC_VID_57		100								50					50	50	100									100		50						50						
ECC_VID_59		100														50	50									100		50						50						
ECC_VID_61				50						50		100			100	100	50							50		50						50		100						
ECC_VID_62		100		100											100	100	100		100					100	50	100		50										50		
ECC_VID_63						50						50	50	50			100							50				50												
ECC_VID_64	29	71		57	29				29	14			86	100	29	29	86							86	43	43		14					14	14				14		
ECC_VID_65		100		33		17				33			17		100	17	33							100				33	17	17			17					17		
ECC_VID_66		100		71		29	14	29	14	43			14	14	100	29	14							86	14	29		43		14		14	43							

**To aid clarity 0% frequency of occurrence values have been excluded from the table.

Superabundant = (S) | Abundant = (A) | Common = (C) | Frequent = (F) | Occasional = (O) | Rare = (R) | Less than Rare = (L)

Table 14: SACFOR Scale Abundance and Frequency of Occurrence Based on Stills Analysis

	Sabella pavonina	Lanice conchilega	Sabellaria spinulosa	Serpulidae	Caridea	Anomura	Pagurus sp.	Ebalia sp.	Brachyura	Cancer pagurus	Hyas sp.	Liocarcinus sp.	Necora puber	Cirripedia	BRYOZOA	Alcyonidium diaphanum		Flustra foliacea		Vesicularia spinosa		Cheilostomatida	ASCIDIACEA	ACTINOPTERYGII	Agonus cataphractus	Clavelina lepadiformis	Callionymus lyra	Cyclopteridae	Pholis gunnellus	Gobiidae	Echiichthys vipera	Pleuronectiformes
Size Class	8-15cm	8-15cm	%	%	8-15cm	8-15cm	8-15cm	8-15cm	8-15cm	>15cm	8-15cm	8-15cm	8-15cm	%	8-15cm	8-15cm	>15cm	8-15cm	>15cm	8-15cm	>15cm	%	8-15cm	8-15cm	8-15cm	8-15cm	8-15cm	8-15cm	8-15 cm	8-15cm	8-15cm	8-15cm
SACFOR Scale																																
ECC_VID_03			L	O								F	F	R		A											F					
ECC_VID_06									F					R		A		C		C		R										
ECC_VID_08		F												R		C				C	A	L										
ECC_VID_11																F																
ECC_VID_12		C		R	C	C	F					F		C		C		C		A			A				F					
ECC_VID_15	F	A	R	O	C	C			O		O	F		F		C	C	A		A			A			A	O					
ECC_VID_17		C		O	F									F				C	C	C		L	A									
ECC_VID_18		A		R	F	F	F	O				O		F		C		C		A		O	C				O					
ECC_VID_21		A	R	R	O	F	F	O	F	F	O	O	F	R		A		C		A		O	C									
ECC_VID_28		C	L	R	C	F	O		O					R		A	F	C		A		R	F	F		O						O
ECC_VID_29b		C	F	L	C	F	F				O	F		L		C		C		A		L								O		
ECC_VID_30		F	L	L	O									R		C	C	C		C												
ECC_VID_31														L		O		F		C												
ECC_VID_33																F																
ECC_VID_34		F	A	R	C	F	O		F		F	O		L				F		C		L				F						
ECC_VID_35		F	F		F			F	F		F	F		L		C		C		A		R	F		F	C						
ECC_VID_37	O	C	O	R	C	C			F		O	F	F	O		O		C		A		L	O	O	O		O	O		O		
ECC_VID_38		F		L	O	O						O	O	L				C		C												
ECC_VID_42				L	F				F		F							F		A			F								F	
ECC_VID_43														L				C		C												
ECC_VID_48														L				C		C												
ECC_VID_49			O				F					F								A												
ECC_VID_55																																
ECC_VID_56		F		L	F						F					F		A		A			F									
ECC_VID_57			F		O	O	F	O	F		O					F		C		A			O									
ECC_VID_59			O	L	O		F								F			F		A												
ECC_VID_61		F		L	C	F					F	O		R		C		A		A		R	O		F		F					
ECC_VID_62		F	F	L	C	C		O	F		F	F	O					C		A			F	O		F	O					
ECC_VID_63		F	L				O									C	A	F		C	C											
ECC_VID_64		A	R		C	F	O	O	O	F	O	O				C	A	F		A				O					O			
ECC_VID_65		C	F		C	F						F	O			C		C		A												
ECC_VID_66		C	C		C	F	F	O	O		F	F				F	C	C		A			F				O					

	CNIDARIA	ANTHOZOA	Alcyonium digitatum		Hydrozoa	Plumulariidae	Tubularia sp.	Sertulariidae		Halecidae	Actiniaria	Metridium sp.	Actinothoe sphyrodeta	Dahlia sp.	Asteroidea	Asterias rubens		Henricia sp.	Crossaster papposus		OPHIUROIDEA	Gastropoda	Buccinum undatum	Trivia arctica	Aequipecten opercularis	[illegible]	Sepiola atlantica	Nudibranchia		[illegible]	Calliostoma zizyphinum	[illegible]	[illegible]	PORIFERA
Size Class	8-15cm	8-15cm	8-15cm	>15cm	8-15cm	8-15cm	8-15cm	8-15cm	>15cm	8-15cm	8-15cm	8-15cm	8-15cm	8-15cm	8-15cm	8-15cm	>15cm	8-15cm	8-15cm	>15cm	8-15cm	8-15cm	8-15cm	8-15cm	8-15cm	8-15cm	8-15cm	8-15cm	eggs	8-15cm	8-15cm	8-15cm	8-15cm	%
SACFOR Scale																																		
ECC_VID_03			F													F			F												F			R
ECC_VID_06					C						F										C										F			
ECC_VID_08					F																							F						
ECC_VID_11																																		
ECC_VID_12			C		C	C		F			C			F					F				F					F	F			S		R
ECC_VID_15			F			A	F	A			C			C					F				F								F	A		R
ECC_VID_17					F	F	F	A			F			F															F			A		
ECC_VID_18			F		C	C		A			C		F	F					F				F					F	C	F	F	A		L
ECC_VID_21	O				F	C	F	C			C		F	F		O			F		O	O	F							F	O	F		
ECC_VID_28						C		C			F					O			F			O						F		O	O	A	O	L
ECC_VID_29b					C	A	O	C			F		O	F							F							O		O	O			L
ECC_VID_30						F	F	F			O			F		F				F			O											
ECC_VID_31						C		F			O			O																				
ECC_VID_33																																		
ECC_VID_34					F	F		F			F		O	F			F				F		O				O	F			F		O	
ECC_VID_35					C	A	F	C	C		C		F							C	F		F											L
ECC_VID_37						A	F	C			C		O	O	O	O			F		F				O			O	O	O	F	O		L
ECC_VID_38																														O				
ECC_VID_42								C					F	F		F			F															
ECC_VID_43														O																				
ECC_VID_48														O																				
ECC_VID_49					C	C		C													C		F							F				
ECC_VID_55																																		
ECC_VID_56						C	F							F							F		F											
ECC_VID_57					C	C		C			F		F	F		O					C	O	O							O	F			
ECC_VID_59					C	F		F			C		F	F		O					F		O								O			
ECC_VID_61					F	A		C		C	F		F			O			F		C							O			F			L
ECC_VID_62		F			F	C	F	C		F	C			F			F	O	F		F			O		O				F	F	C		
ECC_VID_63			O			O	O	F				O		F							O								F	O				
ECC_VID_64						C		C		O				F					O		F	F							O		O		O	
ECC_VID_65					O	C				O	O			O		F			O		F										F			L
ECC_VID_66					F	C		F		F	F					F		O	F	F	F									O	F	F	O	L

	Sabella pavonina	Lanice conchilega	Sabellaria spinulosa	Serpulidae	Caridea	Anomura	Pagurus sp.	Ebalia sp.	Brachyura	Cancer pagurus	Hyas sp.	Liocarcinus sp.	Necora puber	Cirripedia	BRYOZOA	Alcyonidium diaphanum		Flustra foliacea		Vesicularia spinosa		Cheilostomatida	ASCIDIACEA	ACTINOPTERYGII	Agonus cataphractus	Clavelina lepadiformis	Callionymus lyra	Cyclopteridae	Pholis gunnellus	Gobiidae	Echiichthys vipera	Pleuronectiformes
Percentage Frequency of Occurrence (%)*																																
ECC_VID_03			83	75								17	8	42		92											8					
ECC_VID_06									8					46		100		23		31		15										
ECC_VID_08		15												46		54				15	15	8										
ECC_VID_11																13																
ECC_VID_12		25		33	67	33	17					8		92		33		58		100			100				17					
ECC_VID_15	10	85	30	100	55	50			5		5	20		100		75	5	95		90			100			80	5					
ECC_VID_17		50		58	8									92				75	8	92		8	100									
ECC_VID_18		79		79	12	6	6	3				3		100		65		50		97		65	91				3					
ECC_VID_21		96	29	98	2	4	6	2	10	2	2	4	6	94		85		63		88		94	38									
ECC_VID_28		50	8	88	58	20	3		3					88		83	3	58		88		88	5	10		3						3
ECC_VID_29b		57	89	2	55	15	6				2	4		28		53		53		83		4								2		
ECC_VID_30		13	6	6	3									52		45	3	48		90												
ECC_VID_31														19		3		11		31												
ECC_VID_33																7																
ECC_VID_34		19	90	21	60	17	2		7		7	2		19				17		62		2				17						
ECC_VID_35		12	100		18			6	12		18	12		6		59		71		76		24	6		6	12						
ECC_VID_37	4	39	83	48	85	72			15		4	7	7	67		2		78		100		7	4	2	2		2	2		2		
ECC_VID_38		5		3	3	3						3	3	6				13		16												
ECC_VID_42				7	7				7		7							21		64			7								7	
ECC_VID_43														4				8		8												
ECC_VID_48														4				7		7												
ECC_VID_49			71				18					6								88												
ECC_VID_55																																
ECC_VID_56		18		6	6						18					6		88		88			6									
ECC_VID_57			70		2	2	30	4	6		4					4		15		70			2									
ECC_VID_59			30	3	3		8								3			20		55												
ECC_VID_61		17		6	50	17					17	6		94		61		94		100		17	6		6		11					
ECC_VID_62		5	98	5	84	75		5	9		9	11	2					91		100			14	2		2	2					
ECC_VID_63		3	3				3									21	12	3		42	12											
ECC_VID_64		64	62		35	9	3	2	1	1	4	4				41	65	14		67				1					3			
ECC_VID_65		48	86		34	3						7	3			31		76		76												
ECC_VID_66		44	95		50	5	8	2	3		8	8				18	5	80		79			5				2					

	CNIDARIA	ANTHOZOA	Alcyonium digitatum		Hydrozoa	Plumulariidae	Tubularia sp.	Sertulariidae		Halecidae	Actiniaria	Metridium sp.	Actinothoe sphyrodeta	Dahlia sp.	Asteroidea	Asterias rubens		Henricia sp.	Crossaster papposus		OPHIUROIDEA	Gastropoda	Buccinum undatum	Trivia arctica	Aequipecten opercularis	[illegible]	Sepiola atlantica	Nudibranchia		[illegible]	Calliostoma zizyphinum	[illegible]	[illegible]	PORIFERA
Percentage Frequency of Occurrence (%)*																																		
ECC_VID_03			8													42			8													17		
ECC_VID_06					38						31										54											8		
ECC_VID_08					15																							8						8
ECC_VID_11																																		
ECC_VID_12			33		8	50		17			58			8					8				17					17	8				100	
ECC_VID_15			5			75	10	90			65			35					15				10									15	95	5
ECC_VID_17					8	8	8	50			8			17															8	8			83	8
ECC_VID_18			3		41	24		88			85		12	9					9				6					9	15		6	9	100	
ECC_VID_21	2				4	19	2	35			85		6	8		2			8		2	4	4							2	8	2	13	
ECC_VID_28						8		18			18					3			20			3						15		3	3	3	55	
ECC_VID_29b					15	49	2	19			13		2	9							9							2		2	2	2		2
ECC_VID_30						3	3	10			3			13		6				3			3											
ECC_VID_31						22		8			3			6																				
ECC_VID_33																																		
ECC_VID_34					2	14		10			12		5	7			5				26		5				2	7				10		5
ECC_VID_35					18	76	6	47	6		65		12							6	29		12											
ECC_VID_37						76	7	35			43		2	2	2	2			15		13				2			4	4		2	11	2	
ECC_VID_38																															3			
ECC_VID_42								14					7	21		7			7															
ECC_VID_43														4																				
ECC_VID_48														4																				
ECC_VID_49					12	18		24													94		12								53			
ECC_VID_55																																		
ECC_VID_56						12	6							6							6		6											
ECC_VID_57					19	38		19			26		2	8		2					34	2	4								4	6		2
ECC_VID_59					15	3		3			43		5	8		3					28		3									3		
ECC_VID_61					6	72		50		17	39		6			6			28		44							6				11		
ECC_VID_62		2			5	27	7	30		7	45			7			2	5	11		16			2		2					7	9	30	
ECC_VID_63			3			3	3	3				3		6							3								3		3			
ECC_VID_64						11		55		2				6					1		5	3							2		3			1
ECC_VID_65					3	17				3	3			3		7			3		7											10		
ECC_VID_66					3	23		14		5	18					3		2	6	3	6										5	18	5	

**To aid clarity 0% frequency of occurrence values have been excluded from the table.

Superabundant = (S) | Abundant = (A) | Common = (C) | Frequent = (F) | Occasional = (O) | Rare = (R) | Less than Rare = (L)

4 ENVIRONMENTAL BASELINE SURVEY RESULTS AND DISCUSSION

4.1 BATHYMETRY AND SEABED FEATURES

The following text was adapted from the environmental fieldwork report for the ECC survey area (UK4855H-824-FR-01) and GEOxyz Geophysical Survey Reports (ENV21-21042-GTR4-02_Rev.01) to describe the bathymetry across the ECC survey area. Bathymetric and backscatter data was acquired using a R2Sonic 2024 multibeam echo sounder and have been reduced to LAT.

The water depth along the ECC ranged between 1.17m to 32.91m LAT with the water depth undulating due to the presence of megaripples, sandwaves and sandbanks (Figure 5 and Figure 6). The seabed morphology resulted in variable seabed slopes, with a maximum seabed slope of 76° attributed to a sandbank located within block 17. Megaripples and sandwaves were ubiquitous features observed across the ECC survey area but their orientations were variable, with the western end of the route bedforms (Blocks 2, 4, 5, 15 and 16) generally orientated north to south. While, at the eastern end of the route (Blocks 13 and 9) the megaripples and sandwaves were generally orientated northwest to southeast, indicating a change in predominant current direction as the water depth decreased to the east of the ECC route. Sandbanks were also a common feature along the ECC route and were predominantly found within the funnel area, located to the south of the OWF survey area.

Side scan sonar (SSS) data were acquired at a 75m range per channel using a 2x Edgetech 4205 simultaneous, dual frequency (300/600kHz) and mosaiced to a 0.15m pixel size. Based on SSS reflectivity and background reference material, seabed sediments were interpreted to vary between mixed sediment, coarse sediment and sand along the ECC route, which were defined as 'Muddy SAND', 'Medium SAND', 'Silty Sandy GRAVEL, 'Coarse Gravelly SAND', 'Silty Gravelly SAND', 'Silty Clayey SAND', 'Clayey Gravelly SILT', 'SAND', 'SILT' and' Coarse SAND' by GEOxyz (Figure 5). Megaripples and sandwaves present on the bathymetry data were also visible on the SSS record due to the steep slopes.

The number of seabed contacts interpreted from the analogue dataset were limited as detailed target picking had not yet been undertaken at the time of the geophysical report submission; however, areas of boulder aggregations were identified on the SSS dataset, so it is likely that numerous boulders, cobbles and pebbles are present along the route. The majority of the survey area was characterised by high and moderate reflectivity areas, with isolated patches of low reflective sediments, indicating areas of variable coarse and fine sediments along with variable densities of shell fragments, pebbles, cobbles and boulders across the ECC survey area. It should be noted that BSL modified the 15 sediment classifications originally supplied by the GEOxyz Geophysical Report by grouping similar sediment types to give a more general indication of seabed sediment variation as an aid to habitat mapping, which are discussed below and charted on Figure 5 and Figure 6.

Moderate reflectivity sediments along the ECC route were characterised by the GEOxyz geophysical reports as 'Clayey Gravelly SILT', 'Silty Gravelly SAND', 'Coarse SAND' and 'Silty Clayey SAND' (Figure 5 and Figure 6). Whereas the lighter reflective sediments interspersed between the areas of moderate reflective sediments, indicated finer, sand dominated sediments, which were characterised as 'Muddy SAND' by the GEOxyz geophysical report (Figure 5 and Figure 6). Areas of moderate reflective sediment with mottled and striated patches of lighter reflective sediment were characterised by the GEOxyz geophysical report as 'Coarse Gravelly SAND', Medium SAND' and 'Silty Sandy GRAVEL' (Figure 5 and Figure 6). Additionally, predominantly lighter reflective sediment with linear bands of moderate reflective sediment were characterised as by the GEOxyz Geophysical Report as 'SILT' and 'SAND' formed intermediate sediment types between patches of predominantly moderate sediment to the east of the ECC route. There was no unique SSS/MBES features which would be associated to biogenic reefs formed by *Sabellaria spinulosa*.

At the time of the submission, comprehensive anomaly and target picking had not yet been undertaken. Preliminary findings revealed nine shipwrecks along with several other linear debris. The largest shipwreck observed was UKHO 8635, which had a LxWxH of 85.9m, 41.6m and 3.3m, respectively, while the largest linear debris item measured 125m in length. Seabed infrastructure was minimal along the ECC route and was limited to linear magnetic anomalies associated with the presence of the Viking AR to Theddlethorpe Gas and Loggs PP to Theddlethorpe MEOH Gas pipelines.

4.2 SHALLOW GEOLOGY

The following text was adapted from the geophysical survey reports provided by GEOxyz (ENV21-21042-GTR4-02_Rev.01) for the ECC route, focussing on those layers lying close to the seabed surface which may have influenced surface sediment composition. Interpretation of the shallow geology is based upon sub-bottom profiler (SBP). Lithological descriptions are based on seismic character and regional background information.

The dominant surface sediments along the ECC are comprised of gravelly sand and sand which form the upper and lower Holocene sediments. The upper Holocene Sands are well layered and show high reflectivity, while the lower Holocene Sands are highly undulating and form channel like structures of varying size with distinct stages of sedimentation. In some instances these Holocene channels are incised by later Holocene erosional surfaces and form widespread braided channel systems. The thickness of the surface Holocene Sands is heavily influenced by the surface morphology of these lower channel systems along with the hydrodynamically driven superficial bedforms. Blocks 2 and 13 had the thickest Holocene Sand layers of 18m due to the influence of sandbank features, while the megarippled and sandwave influenced Holocene Sands along the wider ECC route form a thin veneer of 1m to 5m. Below the Holocene Sands are the shallow Pleistocene sediments comprised of the late Weichselian Boulders Bank Formation. The Weichselian Bank Formation is considered highly chaotic with no clear internal structure with sediments expected to comprise of glacial till, which can, in places, be seen incised by the Holocene channel system. The erosion and subsequent thinning of the Pleistocene sediments, most notably within Blocks 6 and 7, forced the late cretaceous chalk layer closer to the surface.

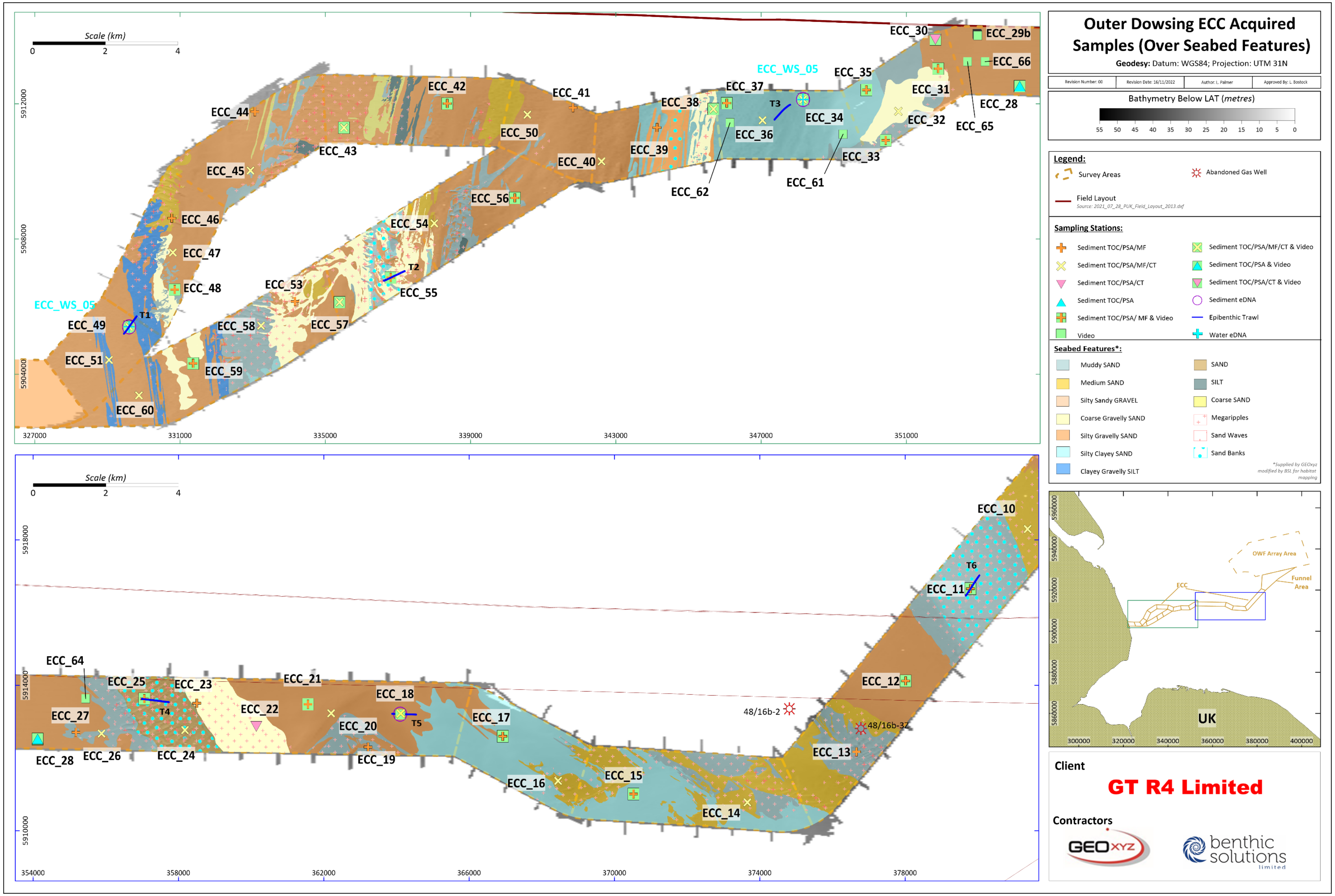


Figure 5: Seabed Features of the ECC Supplied by GEOxyz

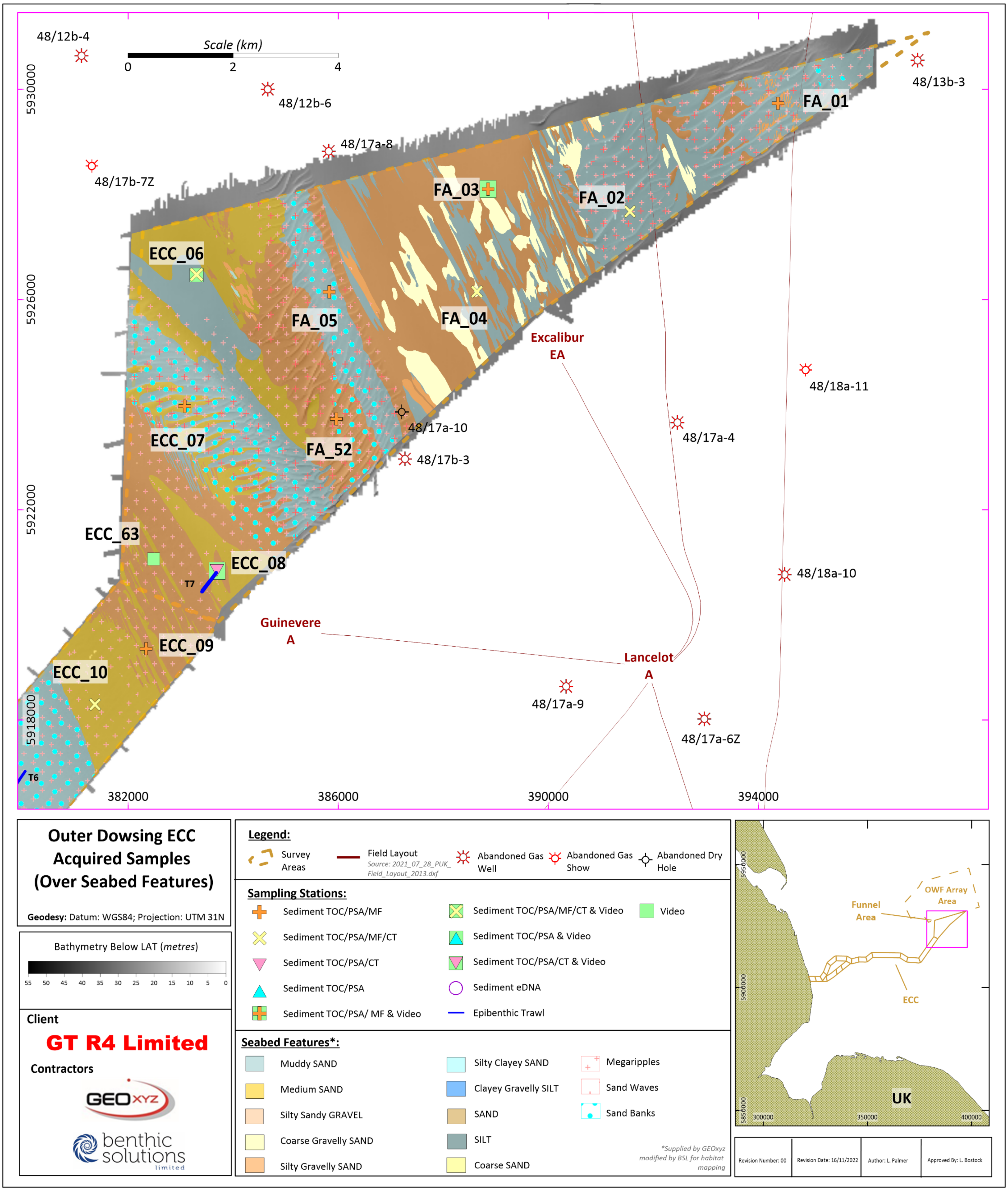


Figure 6: Seabed Features of the FA Supplied by GEOxyz

4.3 PARTICLE SIZE DISTRIBUTIONS

The particle size interpretation of sediments from the environmental baseline survey conducted across the ECC survey area was based on observations made from the acoustic data and seabed photography, and from the analytical results acquired from the surface sediments at 59 stations (Table 15). Material for particle size analysis was recovered from the surface 5cm of the grab samples and was analysed by BSL upon return of the samples to Norfolk, UK. Please refer to Appendix D for the laboratory methods employed. Individual particle size distribution plots are presented in Appendix E.

4.3.1 General Description

The results of particle size analyses indicated a variable sediment type across the ECC survey area where the seabed sediments showed a general sand dominance (mean 70.76%±18.54SD) with a lower proportion of gravel (mean 22.8%±15.30SD) and minimal proportion of fines (mean 6.42%±7.25SD; Table 15 and Figure 7). The variable distribution of fines, sand and gravel across the survey area was represented by the relatively high coefficients of variation (112.9%, 26.2% and 67.2% respectively), which was expected given the large extent of the survey area but is considered to reflect the ambient seabed sediments of the southern North Sea (Table 15).

Proportions of sand were variable across the ECC survey area, ranging between 41.67% at ECC_59 to 99.94% at FA_05 (Figure 8). Sand content showed a seemingly random spatial pattern not correlated to water depth ($\rho(80)=-0.116$, $p>0.05$). Some stations at shallower water depths had a higher proportion of sand; however, this was not a consistent pattern throughout the survey area.

Similarly to sand, gravel was fairly variable across the survey area ranging from <0.1% at ECC_58 (0.02%) and FA_05 (0.06%), to 55.77% at ECC_53 (Figure 9). The spatial distribution of gravel demonstrated the inverse relationship to the proportion of sand due to the relatively minimal proportion of fines, and was corroborated by a significant Spearman's correlation between the proportions of gravel and sand ($\rho(80)=-0.915$, $p<0.001$). Comparable to the proportion of sand, no significant correlation was found between the proportion of gravel and the depth ($p>0.05$). A significant Spearman's correlation between the sorting coefficient and depth ($\rho(80)=-0.318$, $p<0.01$) indicated the presence of more mixed sediments further offshore .

The proportion of fines within the survey area was generally low with the seabed sediment at most stations containing <10% fines while the survey maximum of 26.00% was recorded at station ECC_41 (Figure 10).

The Folk (1954) and Wentworth (1922) classifications for each station are listed in Table 15. The Wentworth classification assigns a single sediment class based on the mean particle size and is appropriate for well-sorted modal sediments, dominated by a narrow range of sediment particle sizes. The Folk classification provides a more representative description for poorly sorted sediments, encompassing a range of particle sizes as it takes into account the relative proportions of mud (<63µm), sand (63µm-2mm) and gravel (>2mm) fractions (Figure 8 to Figure 10). For the purposes of this study, we have used the modified Folk classification produced by the British Geological Survey (Long, 2006).

The samples collected in the survey area represented eight Folk classifications with most (62.75% of the total) assigned to sand dominant classifications such as 'Sand', 'Slightly Gravelly Sand', 'Gravelly Sand' 'Gravelly Muddy Sand' and 'Slightly Gravelly Muddy Sand', while the remaining stations (35.6% of the total) were assigned gravel dominant classifications such as 'Gravel', 'Sandy Gravel' or 'Muddy Sandy Gravel' (Table 15). There was no clear pattern between the Folk sediment classifications for each sampling station and the mapped seabed features interpretation (Section 4.1), which was attributed to the highly variable nature of the seabed within the ECC survey area. The Wentworth classification scale identified six different sediment classifications ranging from 'Fine Sand' to 'Pebble'. The variable sediment within the samples was reflected in the sorting coefficient (Table 15), with the majority of stations (79.7%) classified as "Very poorly sorted" or 'Poorly sorted' and the minority of stations (20.3%) classified as "Moderately sorted", 'Moderately well sorted' or 'Well sorted' (mean 2.12%±0.97SD).

Previous BSL SNS surveys, close to the OWF survey area at the offshore end of the ECC survey area, showed more consistent sediment compositions than the current ECC survey (Table 15). The previous SNS surveys had a mean particle size range of 0.68mm to 1.62mm when compared to 0.68mm during the current survey. Similarly to the OWF survey, differences in mean particle sizes were due to the variable gravel and sand proportions, with the previous SNS surveys recording an overall sand dominance (ranging between 57.51% to 84.07%), with lower gravel proportions of 15.79% to 38.35% in comparison to 70.80% sand and 22.80% gravel recorded during the current survey (Table 15). However, the proportion of fines recorded from the previous studies were minimal (ranging between 0.15% to 4.15%) when compared to 6.42% for the current ECC survey (Table 15).

Table 15: Summary of Surface Particle Characteristics

Station	Depth (m)	Distance to Nearest Well (km)	Mean Sediment Size		Wentworth Classification	Sorting Coefficient	Sorting Classification	Fines (%)	Sands (%)	Gravel (%)	Modified Folk Scale
			(mm)	(Phi)							
FA_01	17.70	2.78	0.44	1.19	Medium Sand	0.87	Moderately Sorted	0.00	99.42	0.59	Sand
FA_02	23.91	2.92	0.35	1.50	Medium Sand	0.72	Moderately Sorted	0.98	97.11	1.91	Slightly Gravelly Sand
FA_03	19.34	3.12	0.76	0.38	Coarse Sand	2.74	Very Poorly Sorted	6.92	59.82	33.27	Muddy Sandy Gravel
FA_04	21.04	1.67	1.04	-0.11	Very Coarse Sand	2.28	Very Poorly Sorted	4.62	63.11	32.27	Sandy Gravel
FA_05	14.59	2.68	0.28	1.84	Medium Sand	0.44	Well Sorted	0.00	99.94	0.06	Sand
ECC_06	23.46	2.88	0.92	0.10	Coarse Sand	2.67	Very Poorly Sorted	1.71	62.60	35.69	Sandy Gravel
ECC_07	10.64	4.13	0.41	1.28	Medium Sand	0.88	Moderately Sorted	0.00	99.89	0.11	Sand
ECC_08	18.44	1.85	1.35	2.33	Very Coarse Sand	2.74	Very Poorly Sorted	6.14	48.25	45.61	Muddy Sandy Gravel
ECC_09	19.90	2.86	0.65	0.59	Coarse Sand	1.72	Poorly Sorted	0.07	81.07	18.86	Gravelly Sand
ECC_10	18.97	2.48	0.24	2.06	Fine Sand	0.50	Moderately Well Sorted	0.00	98.78	1.23	Slightly Gravelly Sand
ECC_11	9.69	0.81	0.23	2.12	Fine Sand	0.52	Moderately Well Sorted	0.00	95.05	4.95	Slightly Gravelly Sand
ECC_12	22.36	0.54	0.73	0.45	Coarse Sand	2.83	Very Poorly Sorted	6.53	66.81	26.67	Gravelly Sand
ECC_13	25.60	0.65	0.32	1.66	Medium Sand	0.49	Well Sorted	0.00	99.62	0.38	Sand
ECC_14	21.95	2.82	0.57	0.80	Coarse Sand	1.46	Poorly Sorted	1.80	84.29	13.91	Gravelly Sand
ECC_15	22.59	2.79	0.68	0.54	Coarse Sand	2.97	Very Poorly Sorted	8.98	67.11	23.91	Gravelly Muddy Sand
ECC_16	27.89	2.48	0.57	0.77	Coarse Sand	1.61	Poorly Sorted	2.50	81.28	16.23	Gravelly Sand
ECC_17	23.08	1.29	0.60	0.69	Coarse Sand	2.76	Very Poorly Sorted	8.57	63.98	27.45	Gravelly Muddy Sand
ECC_18	20.82	0.76	1.05	-0.11	Very Coarse Sand	3.07	Very Poorly Sorted	9.24	48.91	41.85	Muddy Sandy Gravel
ECC_19	23.92	1.69	0.58	0.76	Coarse Sand	1.67	Poorly Sorted	0.52	77.86	21.62	Gravelly Sand
ECC_20	21.99	0.78	0.66	0.58	Coarse Sand	2.53	Very Poorly Sorted	4.83	66.80	28.38	Gravelly Sand
ECC_21	20.54	0.56	0.70	0.50	Coarse Sand	2.72	Very Poorly Sorted	5.04	70.64	24.32	Gravelly Sand
ECC_22	19.96	1.20	0.78	0.36	Coarse Sand	2.33	Very Poorly Sorted	0.60	68.98	30.42	Sandy Gravel
ECC_23	21.27	0.61	0.67	0.57	Coarse Sand	2.02	Very Poorly Sorted	0.00	68.69	31.31	Sandy Gravel
ECC_24	16.14	1.36	0.25	1.98	Medium Sand	0.56	Moderately Well Sorted	0.00	98.88	1.12	Slightly Gravelly Sand
ECC_25	13.78	0.54	0.38	1.39	Medium Sand	0.88	Moderately Sorted	0.00	96.30	3.70	Slightly Gravelly Sand
ECC_26	17.80	1.52	0.50	0.99	Coarse Sand	1.21	Poorly Sorted	0.00	89.37	10.63	Gravelly Sand

Station	Depth (m)	Distance to Nearest Well (km)	Mean Sediment Size		Wentworth Classification	Sorting Coefficient	Sorting Classification	Fines (%)	Sands (%)	Gravel (%)	Modified Folk Scale
			(mm)	(Phi)							
ECC_27	18.05	1.52	0.63	0.65	Coarse Sand	1.73	Poorly Sorted	1.59	80.55	17.86	Gravelly Sand
ECC_28	17.00	1.74	0.93	0.08	Coarse Sand	2.89	Very Poorly Sorted	5.37	54.21	40.43	Sandy Gravel
ECC_29	No sample acquired (<40%)										
ECC_30	17.58	0.42	1.14	-0.19	Very Coarse Sand	2.60	Very Poorly Sorted	0.20	66.26	33.54	Sandy Gravel
ECC_31	17.23	1.28	0.37	1.45	Medium Sand	0.99	Moderately Sorted	0.24	94.87	4.89	Slightly Gravelly Sand
ECC_32	14.38	2.59	0.97	0.04	Coarse Sand	2.40	Very Poorly Sorted	0.00	56.21	43.79	Sandy Gravel
ECC_33	13.76	3.46	0.26	1.95	Medium Sand	0.55	Moderately Well Sorted	0.00	99.24	0.76	Sand
ECC_34	28.36	2.34	0.17	2.52	Fine Sand	1.53	Poorly Sorted	14.97	81.06	3.97	Slightly Gravelly Muddy Sand
ECC_35	16.61	1.99	0.75	0.42	Coarse Sand	2.60	Very Poorly Sorted	3.72	69.04	27.24	Gravelly Sand
ECC_36	29.39	2.98	0.28	1.84	Medium Sand	2.80	Very Poorly Sorted	17.44	67.18	15.39	Gravelly Muddy Sand
ECC_37	28.34	2.49	1.26	-0.33	Very Coarse Sand	3.18	Very Poorly Sorted	10.47	45.89	43.65	Gravel
ECC_38	26.16	2.68	0.87	0.20	Coarse Sand	1.07	Poorly Sorted	0.14	85.84	14.01	Gravelly Sand
ECC_39	22.66	3.30	0.77	0.38	Coarse Sand	3.72	Very Poorly Sorted	15.26	49.84	34.90	Muddy Sandy Gravel
ECC_40	21.55	4.36	0.65	0.63	Coarse Sand	3.27	Very Poorly Sorted	14.43	51.58	34.00	Muddy Sandy Gravel
ECC_41	19.10	2.78	0.16	2.66	Fine Sand	2.77	Very Poorly Sorted	26.00	60.67	13.34	Gravelly Muddy Sand
ECC_42	16.18	2.77	0.62	0.68	Coarse Sand	3.19	Very Poorly Sorted	16.00	50.43	33.57	Muddy Sandy Gravel
ECC_43	11.40	3.59	1.22	-0.29	Very Coarse Sand	1.91	Poorly Sorted	0.33	56.27	43.40	Sandy Gravel
ECC_44	11.51	3.20	0.90	0.15	Coarse Sand	3.12	Very Poorly Sorted	12.80	49.94	37.27	Muddy Sandy Gravel
ECC_45	12.19	4.95	0.41	1.30	Medium Sand	2.85	Very Poorly Sorted	15.40	59.96	24.64	Gravelly Muddy Sand
ECC_46	14.29	0.00	0.70	0.52	Coarse Sand	1.55	Poorly Sorted	3.89	74.90	21.22	Gravelly Sand
ECC_47	14.23	0.00	0.33	1.62	Medium Sand	3.30	Very Poorly Sorted	22.95	53.48	23.57	Gravelly Muddy Sand
ECC_48	12.56	0.00	0.37	1.45	Medium Sand	3.33	Very Poorly Sorted	21.38	52.44	26.18	Gravelly Muddy Sand
ECC_49	11.28	0.00	0.35	1.51	Medium Sand	3.09	Very Poorly Sorted	19.04	61.54	19.42	Gravelly Muddy Sand
ECC_50	19.36	3.02	0.35	1.53	Medium Sand	2.76	Very Poorly Sorted	14.25	69.16	16.59	Gravelly Muddy Sand
ECC_51	9.95	0.00	1.66	-0.73	Very Coarse Sand	2.96	Very Poorly Sorted	8.02	45.08	46.90	Muddy Sandy Gravel
FA_52	19.01	1.25	0.65	0.63	Coarse Sand	1.28	Poorly Sorted	0.00	90.84	9.16	Gravelly Sand
ECC_53	12.86	0.00	2.06	-1.04	Granule	1.97	Poorly Sorted	0.67	43.56	55.77	Sandy Gravel

Station	Depth (m)	Distance to Nearest Well (km)	Mean Sediment Size		Wentworth Classification	Sorting Coefficient	Sorting Classification	Fines (%)	Sands (%)	Gravel (%)	Modified Folk Scale
			(mm)	(Phi)							
ECC_54	17.30	0.00	0.90	0.15	Coarse Sand	1.88	Poorly Sorted	4.26	69.07	26.67	Gravelly Sand
ECC_55	10.05	0.00	0.50	0.99	Coarse Sand	0.76	Moderately Sorted	0.00	97.92	2.08	Slightly Gravelly Sand
ECC_56	16.92	0.00	1.92	-0.94	Very Coarse Sand	2.69	Very Poorly Sorted	3.84	51.07	45.09	Sandy Gravel
ECC_57	13.97	0.00	0.62	0.70	Coarse Sand	2.86	Very Poorly Sorted	11.02	57.76	31.22	Muddy Sandy Gravel
ECC_58	12.94	0.00	0.30	1.74	Medium Sand	1.08	Poorly Sorted	9.23	90.75	0.02	Sand
ECC_59	12.15	0.00	0.92	0.12	Coarse Sand	3.35	Very Poorly Sorted	15.22	41.67	43.12	Muddy Sandy Gravel
ECC_60	10.13	0.00	0.54	0.89	Coarse Sand	3.74	Very Poorly Sorted	21.69	42.08	36.23	Muddy Sandy Gravel
Mean			**0.68**	**0.82**	**Coarse Sand**	**2.12**	**Very Poorly Sorted**	**6.42**	**70.76**	**22.82**	**Gravelly Sand**
SD			**0.40**	**0.84**	-	**0.97**	-	**7.25**	**18.54**	**15.32**	-
CV (%)			**58.8**	**102.42**	-	**45.9**	-	**112.9**	**26.2**	**67.2**	-
Minimum			**0.16**	**-1.04**	-	**0.44**	-	**0.00**	**41.67**	**0.02**	-
Maximum			**2.06**	**2.66**	-	**3.74**	-	**26.00**	**99.94**	**77**	-
Regional Examples											
BSL SNS, 2019	**Mean**		**1.02**	**0.08**	**Very Coarse Sand**	**2.64**	**Very Poorly Sorted**	**4.15**	**57.51**	**38.35**	**Sandy Gravel**
	SD		**0.49**	**0.61**	-	**0.15**	-	**2.51**	**7.49**	**9.18**	-
	CV (%)		**47.9**	**695.2**	-	**5.6**	-	**60.6**	**13.0**	**23.9**	-
BSL SNS, 2020a	**Mean**		**1.62**	**-0.31**	**Very Coarse Sand**	**2.20**	**Very Poorly Sorted**	**3.40**	**61.25**	**35.35**	**Sandy Gravel**
	SD		**1.35**	**1.14**	-	**0.86**	-	**2.65**	**22.67**	**21.68**	
	CV (%)		**83.1**	**-367.1**	-	**39.3**	-	**78.2**	**37.0**	**61.3**	
BSL SNS, 2020b	**Mean**		**0.68**	**0.63**	**Coarse Sand**	**1.35**	**Poorly Sorted**	**0.15**	**84.07**	**15.79**	**Gravelly Sand**
	SD		**0.23**	**0.55**	-	**0.41**	-	**0.20**	**10.86**	**10.72**	-
	CV (%)		**34.0**	**87.2**	-	**30.4**	-	**135.9**	**12.9**	**67.9**	-

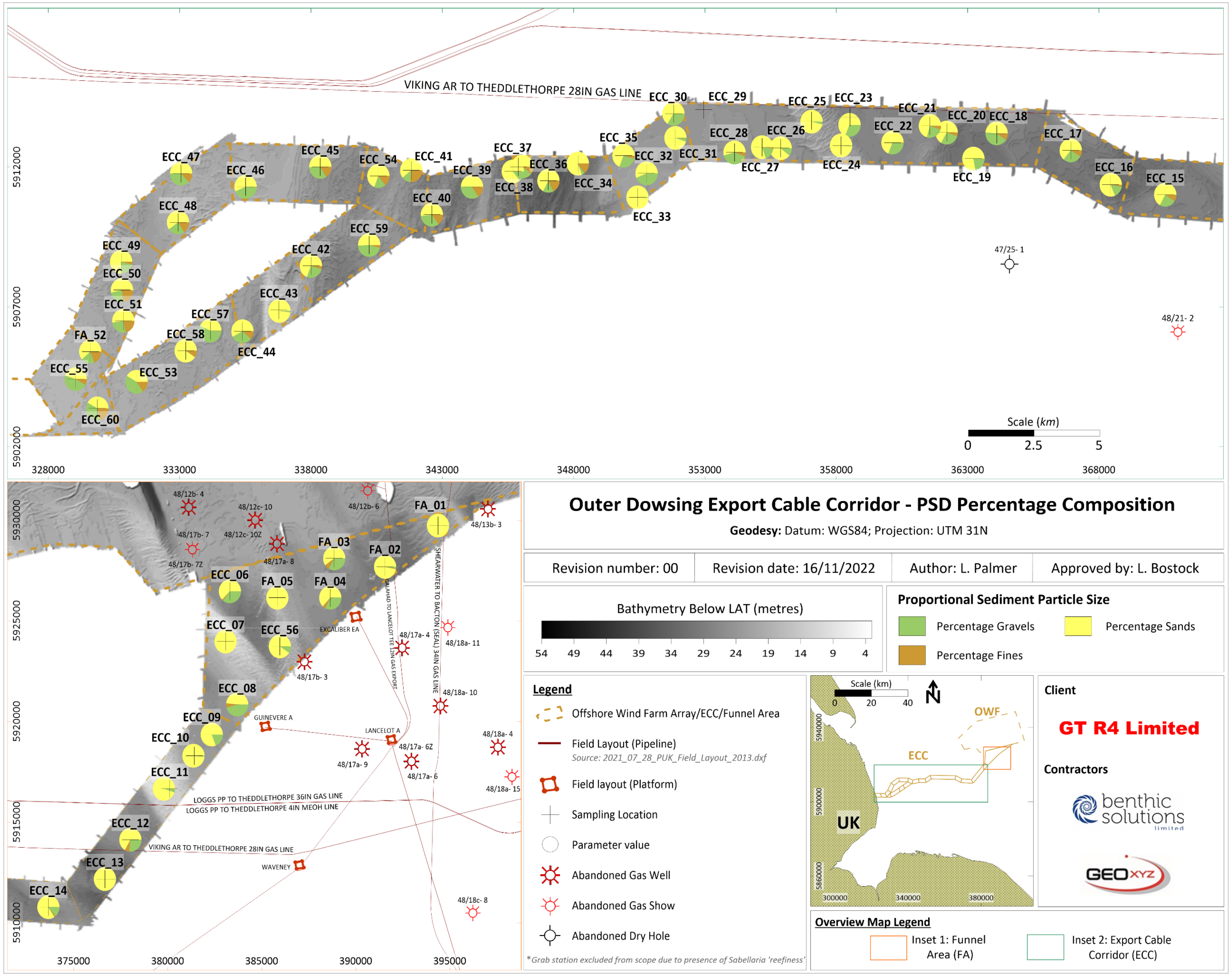


Figure 7: Proportional Sediment Particle Size

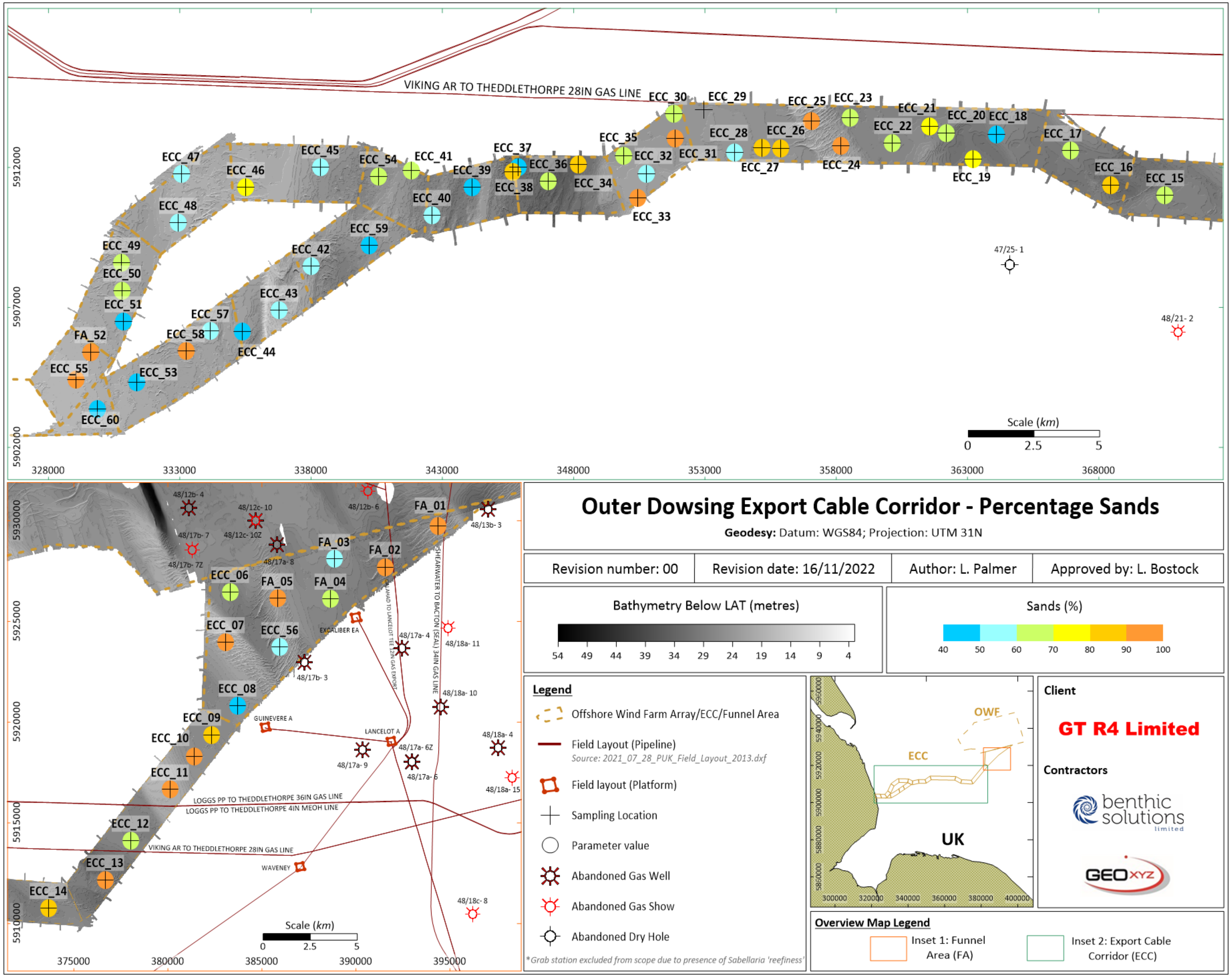


Figure 8: Percentage of Sands

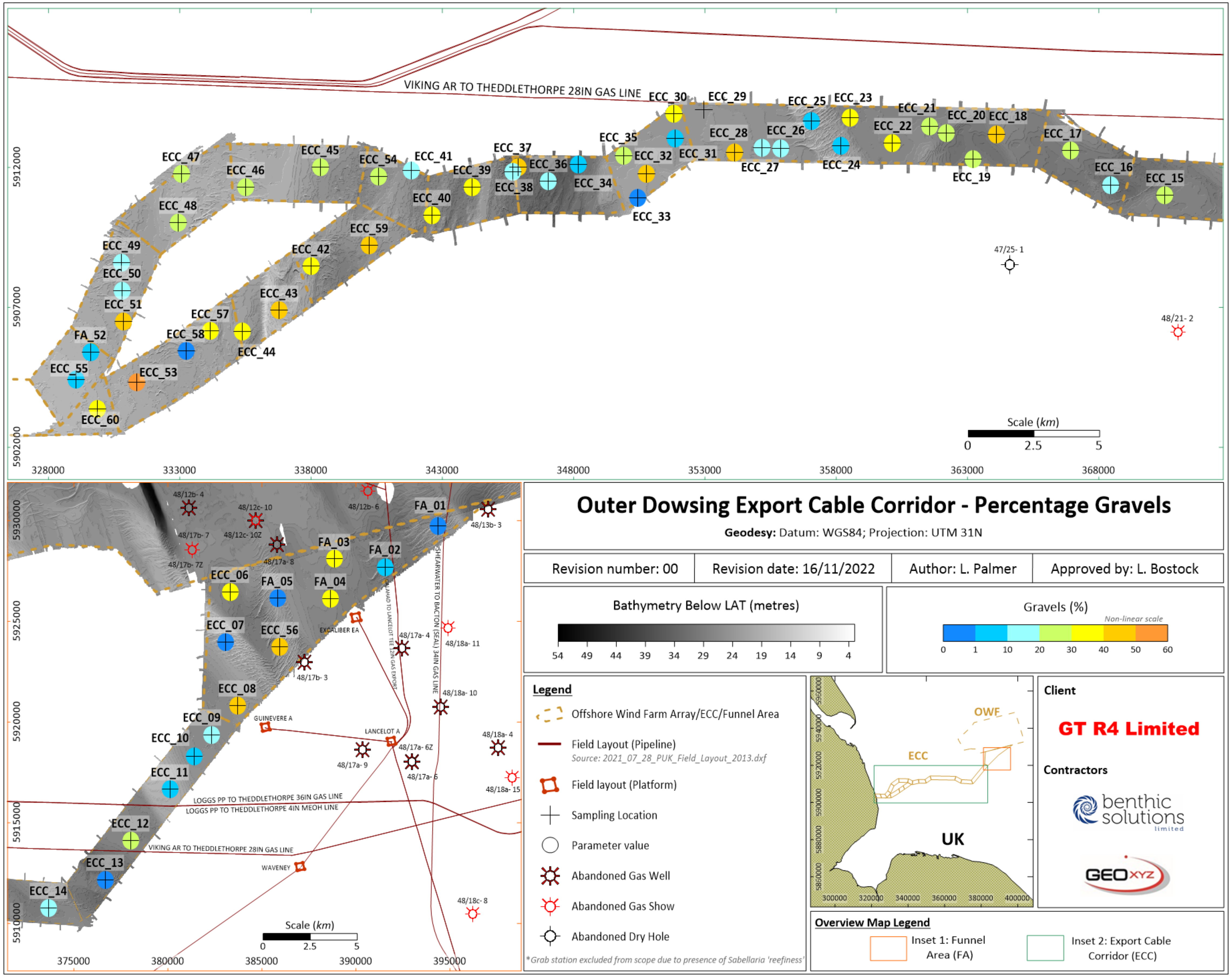


Figure 9: Percentage of Gravel

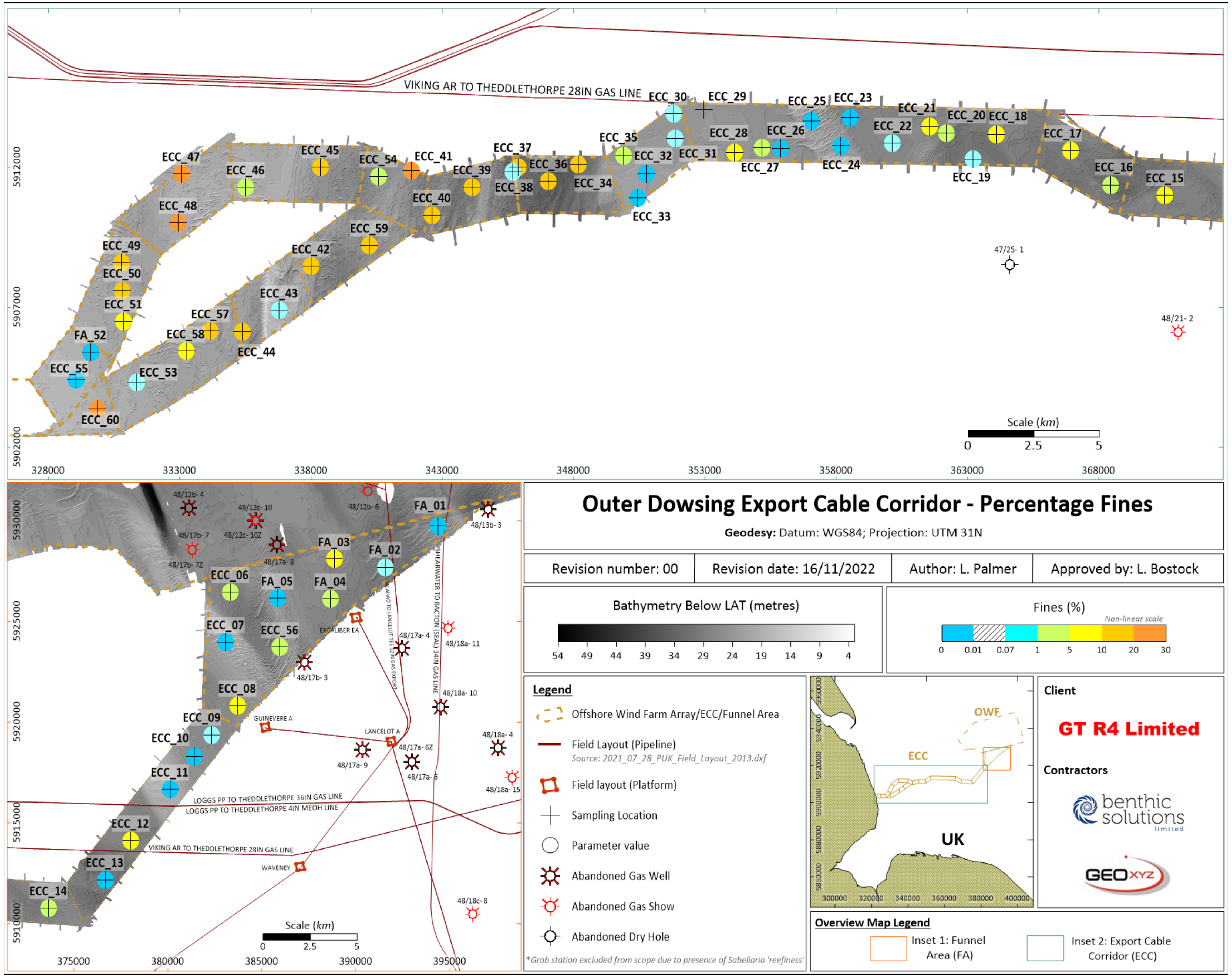


Figure 10: Percentage of Fines

4.3.2 Multivariate Analyses

The particle size distribution of sediments across the survey area were subjected to further detailed investigation by multivariate analysis using the Plymouth Routines in Multivariate Ecological Research software (PRIMER 7.0.17; Clarke *et al.*, 2014) to elucidate any spatial trends within the data.

A similarity dendrogram was generated by hierarchical agglomerative clustering (CLUSTER) using particle size data (phi) to illustrate similarities/differences between stations using the Euclidean distance dissimilarity measure. The dendrogram produced by cluster analysis is shown in Figure 11, with red lines denoting statistically similar stations and black lines revealing significant differences. Similarity profiling analysis (SIMPROF); indicates the presence of 14 significantly different (p<0.05) clusters; however this was thought to have over-differentiated the dataset. In order to provide a more relevant interpretation to the current survey dataset, a slice was overlain of the SIMPROF clusters at a Euclidean Distance of 36 in order to group the stations at a higher level (Figure 11). The slice splits the dataset into five significantly different (p<0.05) cluster groups, as follows:

- Cluster *'a'*: The differentiation of the first cluster, represented by 34 stations, was not immediately apparent from review of the descriptive statistics (Table 15), although these stations tended to have more broad sediment compositions, with the majority having sediments classed as very poorly sorted. Review of the particle size distribution plots for each station revealed cluster *'b'* had a higher proportion of granules (phi -1), when compared to clusters *a, c, d* and *e,* and pebbles (phi -3), when compared to clusters *c, d* and *e*. The stations within this cluster were typically classified as the Folk descriptions 'Muddy Sandy Gravel', 'Gravelly Muddy Sand', 'Sandy Gravel' and 'Gravelly Sand'.
- Cluster *'b'*: Similarly to cluster *'a'*, the differentiation of the second cluster, represented by 14 stations, was not immediately apparent from review of the descriptive statistics (Table 15). Review of the PSD plots for each station revealed cluster *'b'* had higher and more variable proportions of coarse sand and very coarse sand (phi 1 to 0) when compared to the other clusters. The stations within this cluster were predominately classified as the Folk descriptions 'Gravelly Sand' and 'Slightly Gravelly Sand'.
- Cluster '*c*': Similarly to cluster *'a'* and *'b'*, the differentiation of the third cluster, represented by six stations, was not immediately apparent from review of the descriptive statistics (Table 15). Review of the particle size distribution plots for each station revealed cluster *'c'* had a higher proportion of fine sand (phi 3) when compared to the other clusters. The stations in this cluster, were classified as 'Slightly Gravelly Sand' and 'Sand'.
- Cluster *'d'*: The fourth cluster was represented by four stations which recorded some of the highest proportions of sand (90.75% to 99.94%) (Table 15). Review of the particle size distribution plots for each station revealed cluster *'d'* had a higher proportion of medium sand (phi 2) when compared to the other clusters. The stations in this cluster were all classified as 'Sand' using the Folk classification.
- Cluster *'e'*: The last cluster included a single station (ECC_37), was immediately apparent from review of the descriptive statistics as the station within cluster *'e'* showed distinctively different sediment characteristics, specifically highest percentage of gravels, compared to those stations within the clusters *'a'*, *'b'*, *'c'*, and *'d'* (Table 15). Review of the PSD plots for this station confirmed cluster *'e'* had a much higher proportion of pebbles (phi -3) than any other clusters, as surmised from the descriptive statistics. The station within this cluster was classified as 'Gravel' according to the Folk classification system.

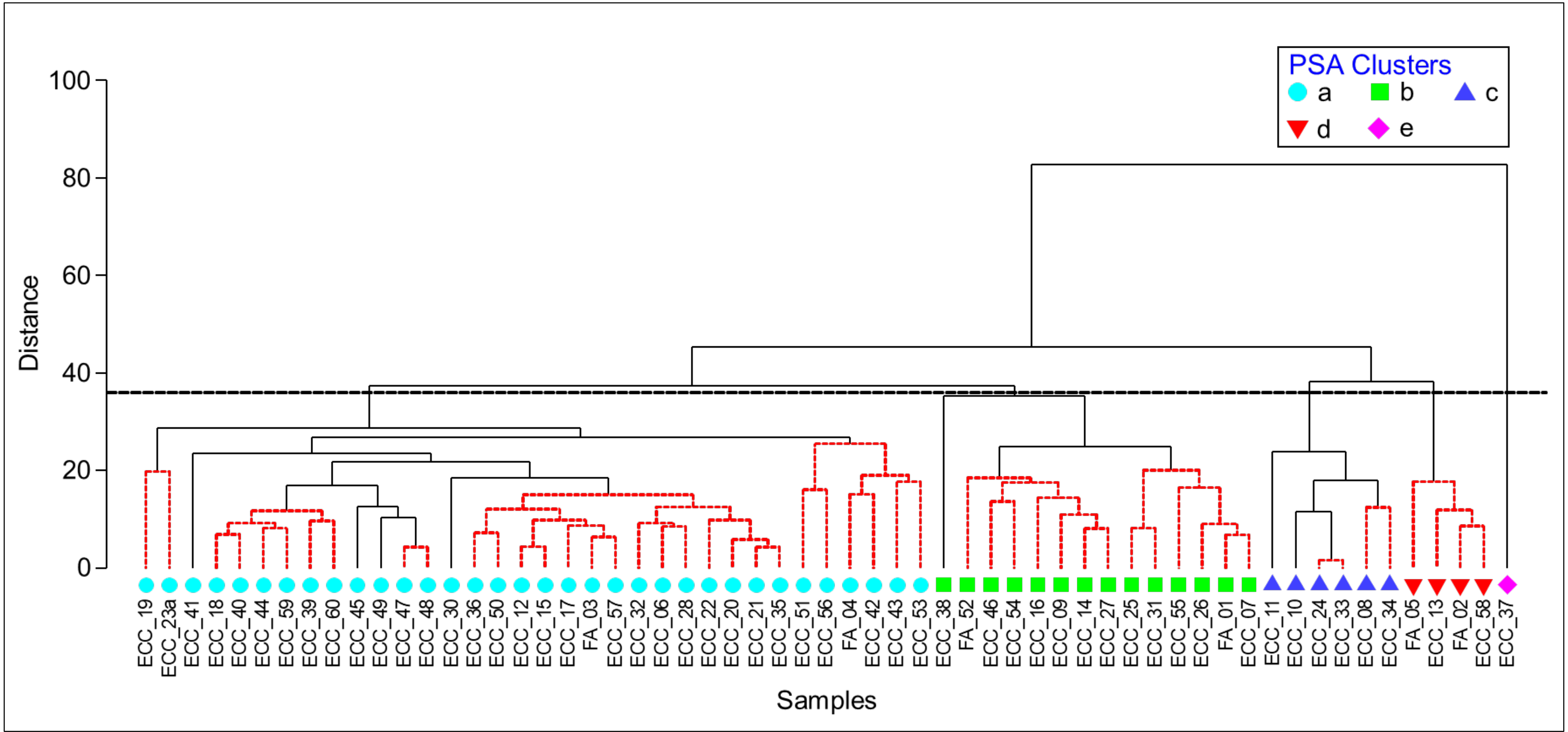


Figure 11: Particle Size Analysis - Similarity Dendrogram

A principal component analysis (PCA) was carried out on the proportional whole phi sieve fraction data for each survey station (Figure 12). The resultant PCA plot shows the distribution of each station along axes formed by the two principal components (PC1 and PC2) which together describe the largest proportion of overall variability in the particle size fraction dataset. The direction of change for each sediment phi fraction is shown by eigenvectors. Overall, the plot illustrated the subtle variability in sediment composition driving the differentiation of the clusters. The differentiation was attributed to the variable proportions of the pebble, coarse sand, medium sand and fine sand fractions within the samples, as evidenced by the length of the eigenvectors labelled with phi fraction -3, 1, 2 and 3 (Figure 12). Cluster *'e'* separated from the other four clusters due to the greater influence of the pebble fraction (phi -3) at this station. Cluster *'b'* also had a high proportion of the pebble fraction, although not as high as cluster *'e'*. The spread of clusters *'b', 'c'* and *'d'* across the eigenvectors reflects the inter-cluster variation in sand composition at these stations. Cluster 'b' showing higher coarse sand content (phi 1), while cluster *'c'* showed higher proportion fine sand (phi 3) and cluster *'d'* showed higher medium sand (phi 2).

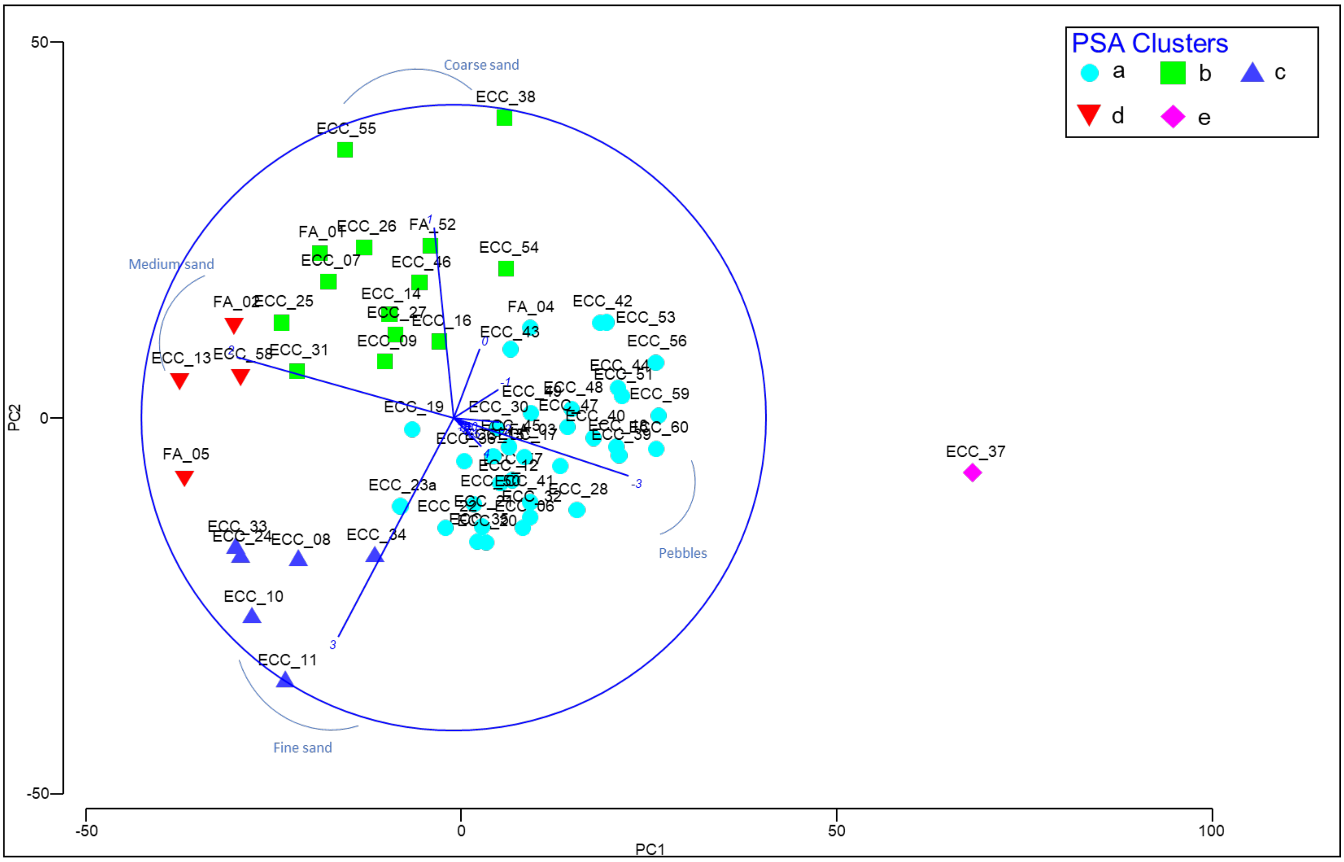


Figure 12: Particle Size Analysis - Principal Components Analysis

A comparison of the full particle size distribution dataset using Wentworth (1922) size categories split into the five clusters described above is shown in Figure 13 along with example seabed and grab sample photographs. The plot illustrates the heterogeneity of the seabed sampled, with all five clusters showing variable peaks across the range of phi fractions. Cluster *'a'* had a bimodal distribution with peaks in the pebble (phi -3) and medium to fine sand fractions (phi 2 and 3). The peak sediment classes at stations within cluster *'b'* were seen for the medium to fine sand fractions (phi 1 to 2), whereas cluster *'c'* showed peak levels for the medium to fine sand fractions (phi 2 and 3). Clusters *'d'* and *'e'* both showed a general unimodal distribution, however, the sediment at stations within cluster *'d'* peaked for the medium sand fraction (phi 2) whereas, sediment at the station within cluster *'e'* peaked for the pebble fraction (phi -3). The geographical distribution of clusters is displayed over MBES in Figure 14.

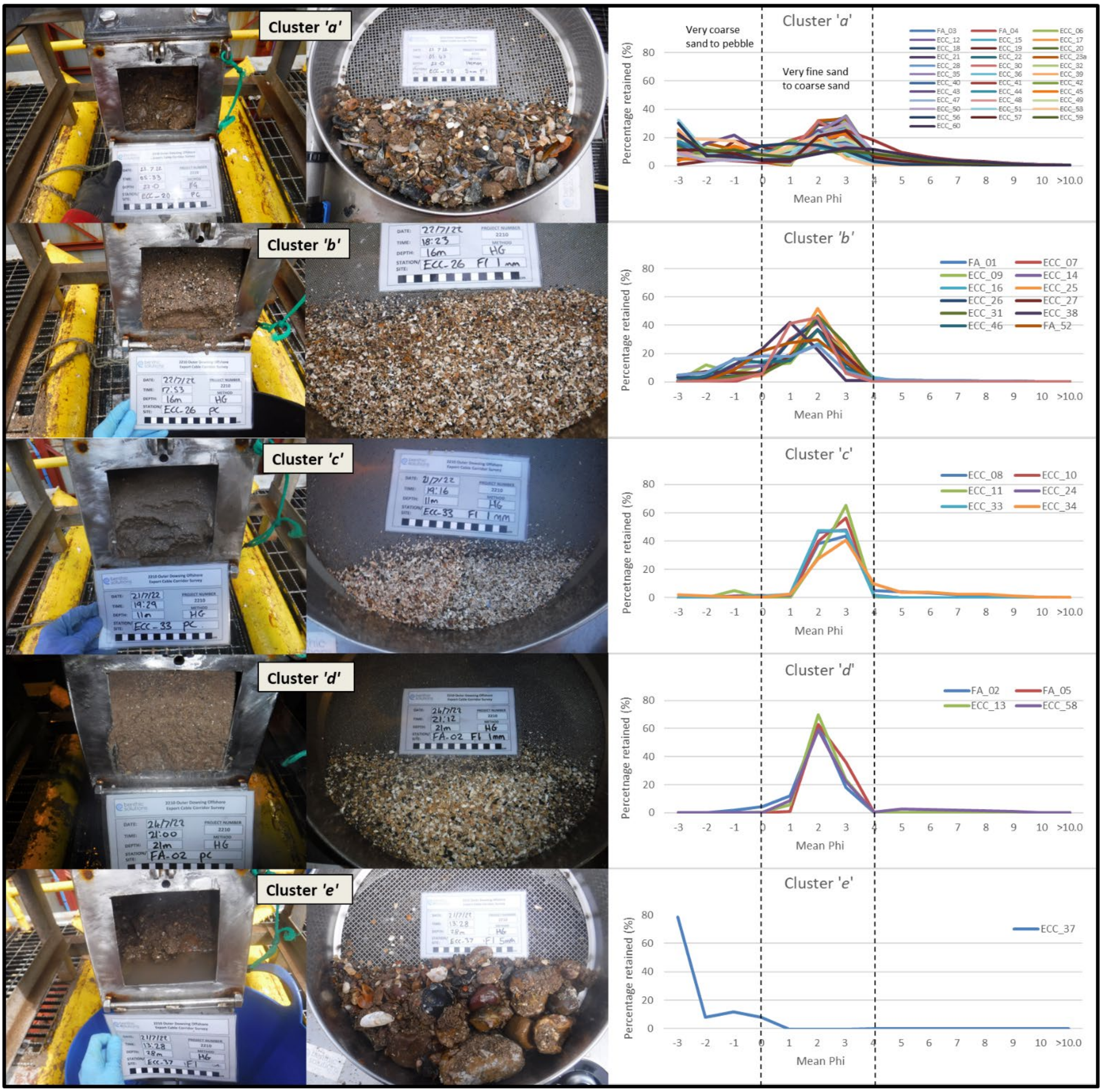


Figure 13: Particle Size Distribution for the Different Clusters *'a'*, *'b'*, *'c'*, *'d'* and *'e'*

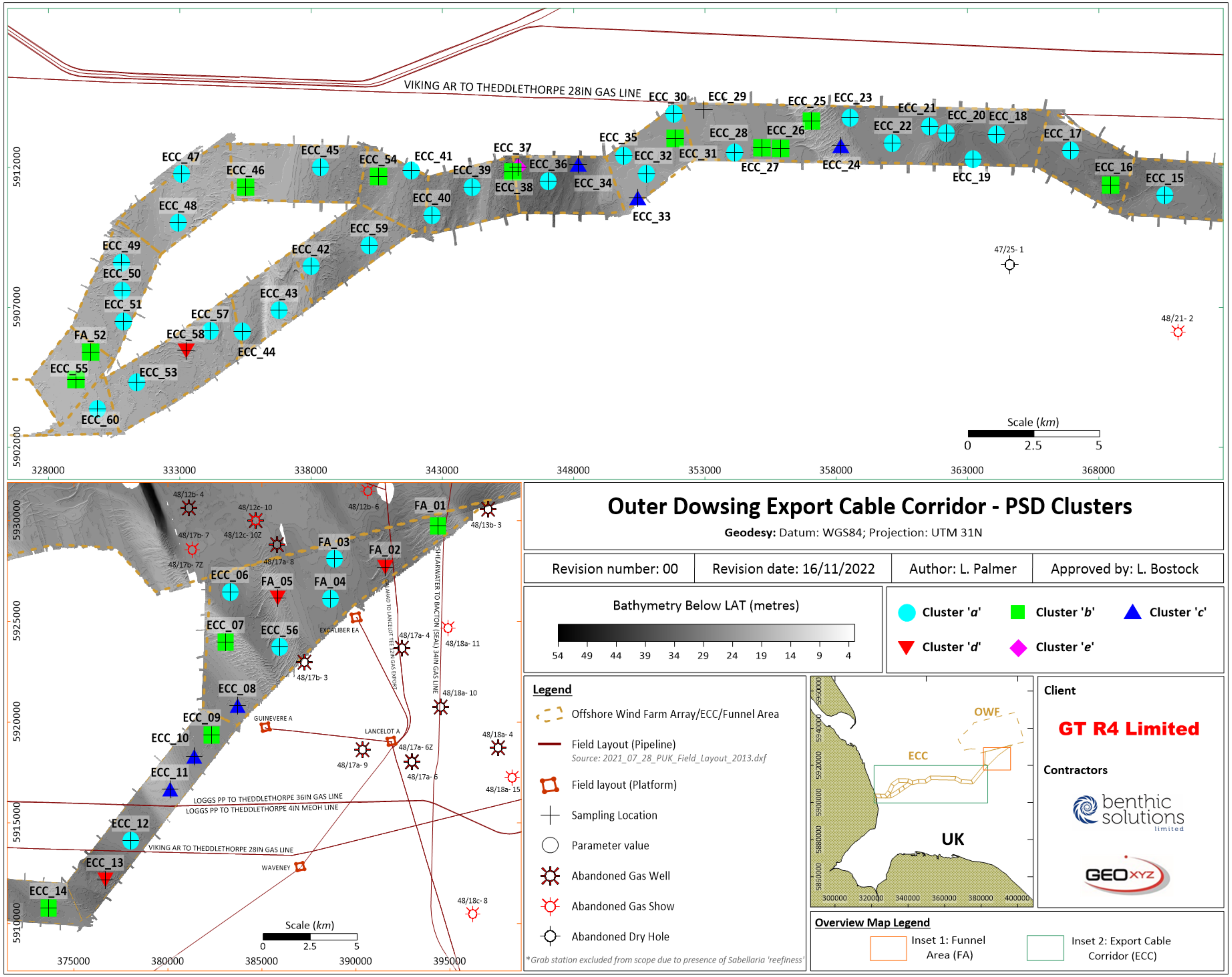


Figure 14: Multivariate PSD Cluster Distribution over MBES

4.4 TOTAL ORGANIC CARBON CONTENT

Sediments were analysed for total organic carbon (TOC) and the results of which are presented in (Table 16), with the spatial variation in TOC illustrated in (Figure 13). TOC represents the proportion of biological material and organic detritus within substrates. The method is less susceptible to the interference sometimes recorded using crude combustion techniques, such as analysing total organic matter by loss on ignition (LOI).

TOC was generally low across the ECC survey area and ranged between 0.05% at stations FA_05, ECC_08 to 0.91% ECC_60 (mean 0.40%±0.30SD), reflecting an organically-deprived environment. However, there is an outlying percentage of TOC at station ECC_19 (1.95%). There was a significant negative Spearman's correlations between TOC and distance from existing well locations ($\varrho(59)=-0.316$, $p<0.5$), which could indicate low-level organic enrichment, however station ECC_19 was located 1.69km from the nearest well so drilling impact is unlikely. Elevated TOC may also reflect increases in both physical factors (i.e. fines) and common co-varying environmental factors through greater sorption on increased sediment surface areas (Thompson and Lowe, 2004). This general pattern was supported by significant positive Spearman's correlations between TOC and fines proportion ($\varrho(59)=0.629$, $p<0.001$), and a significant negative correlation between TOC and sand proportion ($\varrho(59)=-0.459$, $p<0.001$). There was no significant Spearman's correlation between distance to the nearest well and TOC, indicating that anthropogenic factors were not likely to be affecting the distribution of TOC across the ECC survey area.

Terrestrially derived carbon from runoff and fluvial systems, combined with primary production from sources such as phytoplankton blooms, contribute to the TOC levels recorded in sediments. This accounts for the higher percentage TOC found at ECC_60 (0.91%). While both allochthonous and autochthonous sources will be present throughout the ECC survey area, the general lack of fine sediment and therefore, reduced surface area for adsorption, meant that overall TOC levels were low. This may in turn affect the richness and abundance of deposit-feeding organisms within the sediment.

There were notable densities of the tube-building polychaete *Sabellaria spinulosa* throughout much of the ECC survey area. Some stations with higher TOC (ECC_60, ECC_59 and ECC_49) were mapped within or near areas of biogenic habitat, as well as having *S. spinulosa* observed in video footage of the site. This is a pattern that has been noted on a number of previous surveys undertaken by BSL, with higher TOC in areas such as this thought to reflect the increased flux of suspended particulate organic matter to the seabed sediments through the filter-feeding of *Sabellaria* worm, with organic matter potentially also more likely to become entrained within *Sabellaria* aggregation structures.

Previous BSL surveys carried out close to the OWF and ECC survey area had a slightly lower range in TOC of 0.10% to 0.33% when compared to 0.40% for the current ECC survey, which is expected due to the ECC survey area's proximity to shore. The coefficient of variance (CV) was greater for the current ECC survey (74%) when compared to the range of CVs for the previous surveys (15.8% to 33.6%), which was unsurprising given the large area of the ECC site and the variability in sediment composition recorded.

Table 16: Total Organic Carbon Content

Station	Depth (m)	Distance to Nearest Well (km)	Total Organic Carbon (% M/M)
FA_01	18	2.78	0.08
FA_02	24	2.92	0.17
FA_03	19	3.12	0.22
FA_04	21	1.67	0.43
FA_05	15	2.68	0.05
ECC_06	23	2.88	0.17
ECC_07	11	4.13	0.09
ECC_08	18	1.85	0.05
ECC_09	20	2.86	0.22
ECC_10	19	2.48	0.09
ECC_11	10	0.81	0.07
ECC_12	22	0.54	0.26
ECC_13	26	0.65	0.21
ECC_14	22	2.82	0.25
ECC_15	23	2.79	0.27
ECC_16	28	2.48	0.32
ECC_17	23	1.29	0.55
ECC_18	21	0.76	0.33
ECC_19	24	1.69	1.95
ECC_20	22	0.78	0.53
ECC_21	21	0.56	0.52
ECC_22	20	1.20	0.19
ECC_23	21	0.61	0.18
ECC_24	16	1.36	0.57
ECC_25	14	0.54	0.12
ECC_26	18	1.52	0.17
ECC_27	18	1.52	0.20
ECC_28	17	1.74	0.33
ECC_30	18	0.42	0.19
ECC_31	17	1.28	0.24
ECC_32	14	2.59	0.16
ECC_33	14	3.46	0.11
ECC_34	28	2.34	0.40
ECC_35	17	1.99	0.23
ECC_36	29	2.98	0.50
ECC_37	28	2.49	0.34
ECC_38	26	2.68	0.39
ECC_39	23	3.30	0.49
ECC_40	22	4.36	0.66
ECC_41	19	2.78	0.59
ECC_42	16	2.77	0.69
ECC_43	11	3.59	0.31
ECC_44	12	3.20	0.58
ECC_45	12	4.95	0.55
ECC_46	14	0.00	0.80
ECC_47	14	0.00	0.66
ECC_48	13	0.00	0.61

Station	Depth (m)	Distance to Nearest Well (km)	Total Organic Carbon (% M/M)
ECC_49	11	0.00	0.81
ECC_50	19	3.02	0.53
ECC_51	10	0.00	0.63
FA_52	19	1.25	0.61
ECC_53	13	0.00	0.49
ECC_54	17	0.00	0.30
ECC_55	10	0.00	0.59
ECC_56	17	0.00	0.35
ECC_57	14	0.00	0.40
ECC_58	13	0.00	0.35
ECC_59	12	0.00	0.75
ECC_60	10	0.00	0.91
Mean			**0.40**
SD			**0.30**
CV (%)			**75.0**
Minimum			**0.05**
Maximum			**1.95**
Regional Examples			
BSL SNS, 2019	**Mean**		**0.20**
	SD		**0.05**
	CV (%)		**26.3**
BSL SNS, 2020a	**Mean**		**0.33**
	SD		**0.11**
	CV (%)		**33.6**
BSL SNS, 2020b	**Mean**		**0.10**
	SD		**0.02**
	CV (%)		**15.8**

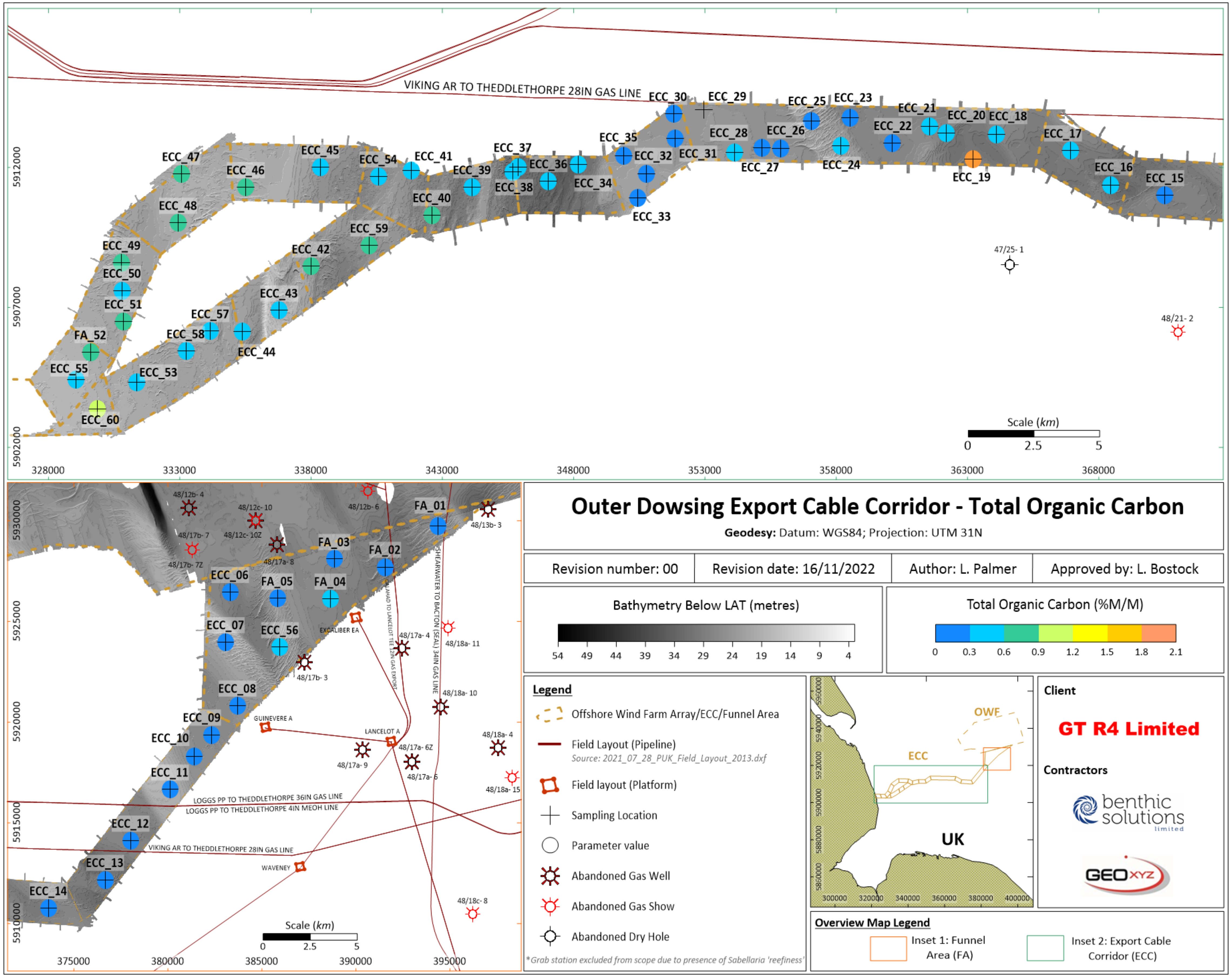


Figure 15: Total Organic Carbon

4.5 SEDIMENT HYDROCARBONS

Results for hydrocarbon analyses are summarised and tabulated as total polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), organotins (DBT, TBT and MBT) and organochlorides (Dieldrin and DDT) in Table 17, Table 20, Table 21 and Table 22.

4.5.1 Non-normalised Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAH) were analysed at each station using gas chromatography-mass spectrometry (GC-MS). Results of the single ion current (SIC) analyses are summarised in Table 17.

PAHs and their alkyl derivatives have been recorded in a wide range of marine sediments (Laflamme and Hites, 1978) with the majority of compounds produced from what is thought to be pyrolytic sources. These include the combustion of organic material such as forest fires (Youngblood and Blumer, 1975), the burning of fossil fuels and, in the case of offshore oil fields, flare stacks. The resulting PAHs, rich in the heavier weight 4-6 ring aromatics, are normally transported to the sediments via atmospheric fallout or river runoff. Another PAH source is petroleum hydrocarbon, often associated with localised drilling activities. These are rich in the lighter, more volatile 2 and 3 ring PAHs (naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene and anthracene)

The sum of the EPA's 16 PAH (∑16PAH) concentrations (2-6 compounds) were variable across the ECC survey area ranging from 7.73µg.kg^{-1} at station ECC_10 to 803µg.kg^{-1} at station ECC_60 which was over two times the UKOOA 95th percentile threshold value of 366µg.kg^{-1} (Figure 16). The elevated ∑16PAH concentration at station ECC_60 reflected higher concentrations of each individual PAH; however, only naphthalene and acenaphthylene exceeded their TELs (34.6 µg.kg^{-1} and 6.7µg.kg^{-1} respectively) and fluorene exceeded its ERL (19µg.kg^{-1}) threshold. The elevated ∑16PAH at station ECC_60 could be attributed to the proximity of the station to the coast (approximately 8km), which will receive increased input from terrestrial sources. This is supported in Figure 14 where stations of similar distance from the coast also saw higher levels of PAHs (ECC_49 and ECC_50) when compared to those further offshore (FA_02 and ECC_06). However, station ECC_51 sampled within similar distance to the coast had a lower ∑16PAH of 25.88µg.kg^{-1}, indicating that this relationship is not uniform and likely subject to variation according to local environmental conditions and sources of pollution. The elevated levels of ∑16PAH at ECC_60 is consistent with the results for TOC, with station ECC_60 showing the second highest levels of both parameters, however this was not supported by a significant Spearman's correlation.

Similarly to ∑16PAH, the sum of 22 PAH (∑22PAH) concentrations (2-6 compounds) were also variable across the ECC survey area ranging from 16.3µg.kg^{-1} (LOD) at station ECC_10, to 1555µg.kg^{-1} at station ECC_60, which was not elevated above the CCME TEL threshold (1,684µg.kg^{-1}) regardless of the elevated concentrations of C1-naphthalenes, C2-naphthalenes and C1-phenanthrene (Table 17 and Figure 17). The similar distributions of ∑16PAH and ∑22PAH were not corroborated by a significant Spearman's correlation between the two parameters.

The MMO have considered whether the use of low (2-3 ring PAHs) and high (4-6 ring PAHs) molecular weight PAHs, in conjunction with ERL and ERM reference values, can provide suitable benchmarks for PAH interpretation (MMO, 2015). Similarly to the ∑16PAH and ∑22PAH distributions, elevated low and high molecular weight PAHs of 234µg.kg^{-1} and 568µg.kg^{-1}, respectively, were recorded at station ECC_60 when compared to the other stations; however, both low and high molecular weight PAHs were below their respective ERL, ERM and TEL reference levels. As previously discussed, the concentrations of low and high molecular weight PAHs could be attributed to the proximity of station ECC_60 to the shore, however there is no Spearman's correlation to confirm this relationship. Therefore, the general lower abundance of low molecular weight PAHs compared to the high molecular weight PAHs could indicate a mixed and petrogenic influenced upper background limit of PAH distribution across the ECC survey area. However, caution must be applied when comparing and interpreting low and high-molecular-weight PAHs as low molecular weight PAHs are more susceptible to microbial degradation (Douglas *et al.*, 1996).

All the maximum PAH concentrations recorded during the current survey were higher than the PAH content observed in previous surveys carried out by BSL in the SNS. Regardless of the elevated PAH concentrations recorded at just one station, ECC_60, individual PAH concentrations exceeded the ranges recorded from the previous BSL SNS surveys. Although all individual PAHs were elevated when compared to the regional comparisons, the ∑16PAH and ∑22PAH levels were within the range recorded during previous SNS surveys (Table 17), excluding ∑16PAH for ECC_49 and ECC_60. Therefore, it is likely that the PAH levels recorded across the OWF survey area likely reflect background levels for this region of the SNS.

Table 17: Summary of Non-normalised PAH Concentrations (µg.kg-1 or ppb)

Station	Depth	Distance to Nearest Well (km)	Naphthalene	C1 Naphthalenes	C2 Naphthalenes	C3 Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	C1-phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluoranthene (	Benzo[k]fluoranthene	Benzo[e]pyrene	Benzo[a]pyrene	Perylene	Indeno[123,cd]pyrene	Dibenzo[a,h]anthracene	Benzo[ghi]perylene	Total PAHs (Σ16)	Total PAHs (Σ22)	Total 2-3 ring PAH *	Total 4-6 ring PAH *
FA_02	24	2.92	<1	1.27	1.58	1.72	<1	<1	<1	<1	1.62	<1	1.59	1.69	<1	1.40	1.65	<1	1.61	1.08	<1	1.09	<1	2.10	10.6	18.4	0.00	10.6
FA_04	21	1.67	1.42	4.50	14.1	22.3	<1	<1	<1	18.8	29.5	<1	9.15	10.3	3.46	7.71	6.10	1.76	7.02	3.91	1.42	2.56	1.04	8.11	74.3	153	20.2	54.1
ECC_06	23	2.88	1.66	2.52	3.80	3.06	<1	<1	<1	2.12	2.99	<1	1.43	1.67	<1	1.25	1.43	<1	1.38	1.02	<1	1.13	<1	1.88	13.6	27.3	3.78	9.81
ECC_08	18	1.85	1.12	2.38	2.52	2.38	<1	<1	<1	1.44	2.25	<1	1.31	1.29	<1	1.16	1.12	<1	1.38	<1	<1	<1	<1	2.00	9.44	20.4	2.56	6.88
ECC_10	19	2.48	<1	1.83	2.11	1.68	<1	<1	<1	1.04	1.94	<1	1.47	1.44	<1	1.12	1.12	<1	1.05	<1	<1	<1	<1	1.54	7.73	16.3	1.04	6.69
ECC_14	22	2.82	1.58	6.23	7.57	7.36	<1	<1	<1	5.15	7.86	<1	4.21	4.46	1.94	3.64	3.46	1.29	3.51	2.17	1.04	1.93	<1	4.49	34.3	67.9	6.73	27.6
ECC_16	28	2.48	1.54	5.81	5.82	5.73	<1	<1	<1	4.22	5.69	<1	2.64	3.22	1.41	2.40	2.22	<1	2.31	1.43	1.28	1.29	<1	2.74	23.1	49.8	5.76	17.4
ECC_18	21	0.76	7.69	24.1	23.8	22.2	<1	1.09	1.99	12.90	17.1	1.66	8.83	8.35	4.45	6.77	7.61	2.91	7.19	5.65	2.10	5.87	1.35	9.05	86.2	183	25.3	60.8
ECC_20	22	0.78	5.32	18.1	18.4	17.8	<1	<1	1.32	10.70	13.9	<1	6.92	6.92	3.62	5.39	6.39	1.88	5.40	4.51	1.36	4.02	1.13	7.08	65.2	140	17.3	47.9
ECC_22	20	1.20	2.29	6.29	8.49	13.7	<1	<1	<1	8.10	14.5	1.28	5.81	6.04	2.81	4.76	4.33	1.45	4.40	3.57	<1	2.85	<1	5.62	48.9	96.3	11.7	37.2
ECC_24	16	1.36	<1	2.10	1.83	2.52	<1	<1	<1	1.91	4.16	<1	2.63	4.50	1.58	2.48	2.14	1.36	2.13	2.12	<1	1.24	<1	3.36	23.3	36.1	1.91	21.4
ECC_26	18	1.52	<1	1.65	1.39	1.51	<1	<1	<1	1.30	3.55	<1	3.10	3.41	1.49	3.07	2.87	1.21	3.08	1.98	<1	1.53	<1	4.04	24.0	35.2	1.30	22.7
ECC_30	18	0.42	1.16	3.48	3.10	3.36	<1	<1	<1	2.43	3.61	<1	2.50	2.67	1.11	1.96	1.81	1.17	2.16	1.39	<1	1.24	<1	2.60	20.0	35.8	3.59	16.5
ECC_32	14	2.59	1.87	5.26	6.13	7.39	<1	<1	<1	6.16	11.4	<1	5.86	5.20	2.70	4.12	3.34	1.26	3.19	2.23	<1	1.61	<1	3.74	38.1	71.5	8.03	30.1
ECC_34	28	2.34	13.2	50.2	59.7	60.0	1.13	2.09	3.64	40.6	50.4	3.50	20.3	18.3	9.52	15.8	11.8	5.68	13.1	10.2	2.95	7.94	2.05	16.3	182	418	64.2	118
ECC_36	29	2.98	32.7	85.5	63.0	56.5	1.27	2.32	4.01	32.0	38.3	2.87	19.1	18.4	9.40	13.2	12.4	6.52	11.2	10.6	2.51	7.75	1.99	13.2	188	445	75.2	113
ECC_38	26	2.68	2.22	6.49	9.81	18.3	<1	<1	<1	9.82	18.1	1.53	6.16	7.72	3.27	4.39	2.96	1.22	3.16	2.98	<1	1.76	<1	4.20	48.2	104	13.6	34.7
ECC_40	22	4.36	14.7	43.4	39.9	34.2	1.25	2.01	3.70	23.4	27.8	2.76	22.7	21.1	11.7	15.3	13.8	6.79	13.5	13.3	3.81	10.7	2.20	16.0	181	344	47.8	134
ECC_43	11	3.59	2.99	9.47	9.06	10.3	<1	<1	<1	7.45	12.6	<1	5.50	6.27	2.43	4.23	3.28	1.76	4.04	2.90	<1	1.78	<1	4.77	43.4	88.8	10.4	32.9
ECC_45	12	4.95	2.49	8.01	6.44	5.55	<1	<1	<1	4.70	6.26	<1	3.39	3.80	1.25	2.74	2.57	1.12	3.01	1.70	<1	1.19	<1	3.93	28.9	58.2	7.19	21.7
ECC_47	14	0.00	28.5	86.7	73.8	66.8	2.36	3.90	7.77	45.5	54.7	6.77	36.5	34.7	17.6	26.0	25.2	10.4	24.6	21.5	6.71	18.1	4.06	28.9	318	631	94.8	223
ECC_49	11	0.00	52.3	163	138	123	3.44	6.86	12.1	93.4	114	10.6	68.8	65.5	32.9	48.7	45.4	18.6	42.8	38.9	12.0	32.0	7.02	50.4	587	1180	179	408
ECC_50	19	3.02	18.4	64.5	59.3	63.0	1.29	2.43	4.35	41.6	57.3	3.57	24.9	25.1	12.3	18.3	15.9	6.34	15.8	13.70	3.11	9.06	2.55	20.5	220	483	71.6	149
ECC_51	10	0.00	1.10	3.30	2.63	2.86	<1	<1	<1	2.59	3.76	<1	4.04	4.25	1.21	2.85	2.80	1.13	2.76	1.47	<1	1.42	<1	3.02	25.9	41.2	3.69	22.2
ECC_54	17	0.00	1.73	5.38	4.94	4.93	<1	<1	<1	3.45	4.79	<1	2.60	3.05	1.13	2.44	2.06	1.10	2.81	1.55	<1	1.29	<1	3.31	23.7	46.6	5.18	18.5
ECC_57	14	0.00	11.7	36.6	31.9	31.8	<1	1.68	3.02	21.3	27.2	1.70	14.4	14.5	6.24	10.5	7.99	3.67	9.46	8.01	2.57	6.01	1.68	11.9	124	264	39.4	84.9
ECC_58	13	0.00	5.10	13.0	12.6	13.2	<1	<1	<1	20.6	20.3	<1	13.0	14.9	5.71	11.0	7.25	3.09	8.71	5.40	1.45	3.73	1.11	9.29	100	169	25.7	74.5
ECC_60	10	0.00	68.2	201	180	156	5.34	10.00	19.10	119	138	12.8	94.6	88.9	43.8	66.0	61.9	29.7	59.6	54.9	17.7	45.7	10.0	72.6	803	1555	234	568
Mean			**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
SD			**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
CV (%)			**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
Minimum			**<1**	**1.27**	**1.39**	**1.51**	**<1**	**<1**	**<1**	**<1**	**1.62**	**<1**	**1.31**	**1.29**	**<1**	**1.12**	**1.12**	**<1**	**1.05**	**<1**	**<1**	**<1**	**<1**	**1.54**	**7.73**	**16.34**	**0.00**	**6.69**
Maximum			**68.2**	**201**	**180**	**156**	**5.34**	**10.0**	**19.1**	**119**	**138**	**12.8**	**94.6**	**88.9**	**43.8**	**66.0**	**61.9**	**29.7**	**59.6**	**54.9**	**17.7**	**45.7**	**10.0**	**72.6**	**803**	**1555**	**234**	**408**
Regional Examples																												
BSL SNS, 2019**	**Minimum**		**<1**	**3.08**	**3.18**	**3.40**	**<1**	**<1**	**<1**	**1.79**	**2.54**	**<1**	**1.47**	**1.28**	**<1**	**1.10**	**1.21**	**<1**	**1.10**	**<1**	**<1**	**<1**	**<1**	**1.43**	**8.27**	**21.8**	**1.79**	**6.48**
	Maximum		**6.27**	**30.2**	**32.7**	**39.8**	**<1**	**2.15**	**3.85**	**16.5**	**25.1**	**1.58**	**8.54**	**9.37**	**3.96**	**6.93**	**5.67**	**1.83**	**6.96**	**4.91**	**4.34**	**3.62**	**<1**	**11.4**	**86.6**	**226**	**30.4**	**56.2**
BSL SNS, 2020a**	**Minimum**		**1.42**	**5.41**	**5.02**	**7.13**	**<1**	**<1**	**<1**	**3.59**	**7.10**	**<1**	**3.92**	**4.30**	**1.66**	**2.95**	**2.64**	**1.09**	**3.34**	**1.84**	**<1**	**1.46**	**<1**	**3.79**	**29.5**	**59.0**	**5.00**	**24.5**
	Maximum		**10.2**	**39.6**	**38.3**	**55.7**	**<1**	**1.94**	**2.62**	**28.4**	**40.9**	**2.22**	**17.8**	**20.3**	**6.77**	**13.3**	**10.1**	**4.34**	**13.8**	**7.21**	**3.63**	**5.18**	**1.57**	**15.8**	**148**	**339**	**45.1**	**102**
BSL SNS, 2020b**	**Minimum**		**<1**	**<1**	**1.37**	**1.68**	**<1**	**<1**	**<1**	**1.53**	**1.50**	**<1**	**1.13**	**1.03**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**4.91**	**10.6**	**1.53**	**2.16**
	Maximum		**3.22**	**5.67**	**4.21**	**3.82**	**<1**	**<1**	**<1**	**3.16**	**4.21**	**<1**	**2.23**	**2.41**	**<1**	**1.56**	**1.50**	**<1**	**1.47**	**<1**	**<1**	**<1**	**<1**	**1.76**	**12.7**	**29.2**	**6.38**	**9.23**
Reference Levels																												
TEL (CCME, 2001)			34.6	-	-	-	5.9	6.7	21.2	86.7	-	46.9	113	153	74.8	108	-	-	-	88.8	-	-	6.22	-	-	1,684	312	655
Cefas cAL1 (MMO, 2015)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	-	-
UKOOA 95th Percentile SNS			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	366	-	-	-
OSPAR ERL (OSPAR, 2012)			160	155	150	-	44	16	19	240	170	85	600	665	261	384	-	240	-	430	-	240	63	85	-	4,022	552	1,700
PEL (CCME, 2001)			391	-	-	-	128	88.9	144	544	-	245	1494	1398	693	846	-	-	-	763	-	-	135		-	16,770	1,442	6,676
OSPAR ERM (OSPAR, 2012)			2,100	-	-	-	640	500	540	1,500	-	1,100	5,100	2,600	1,600	2,800	-	-	-	1,600	-	-	260	2,800	-	44,792	3,160	9,600

NC = Not calculated due to incomplete dataset
**Low molecular weight (2-3 ring) PAHs and high molecular weight (4-6 ring) PAHs calculated from the EPA 16 PAHs*
***Minimum and maximum data for regional examples shown instead of means due to 'NC' values*

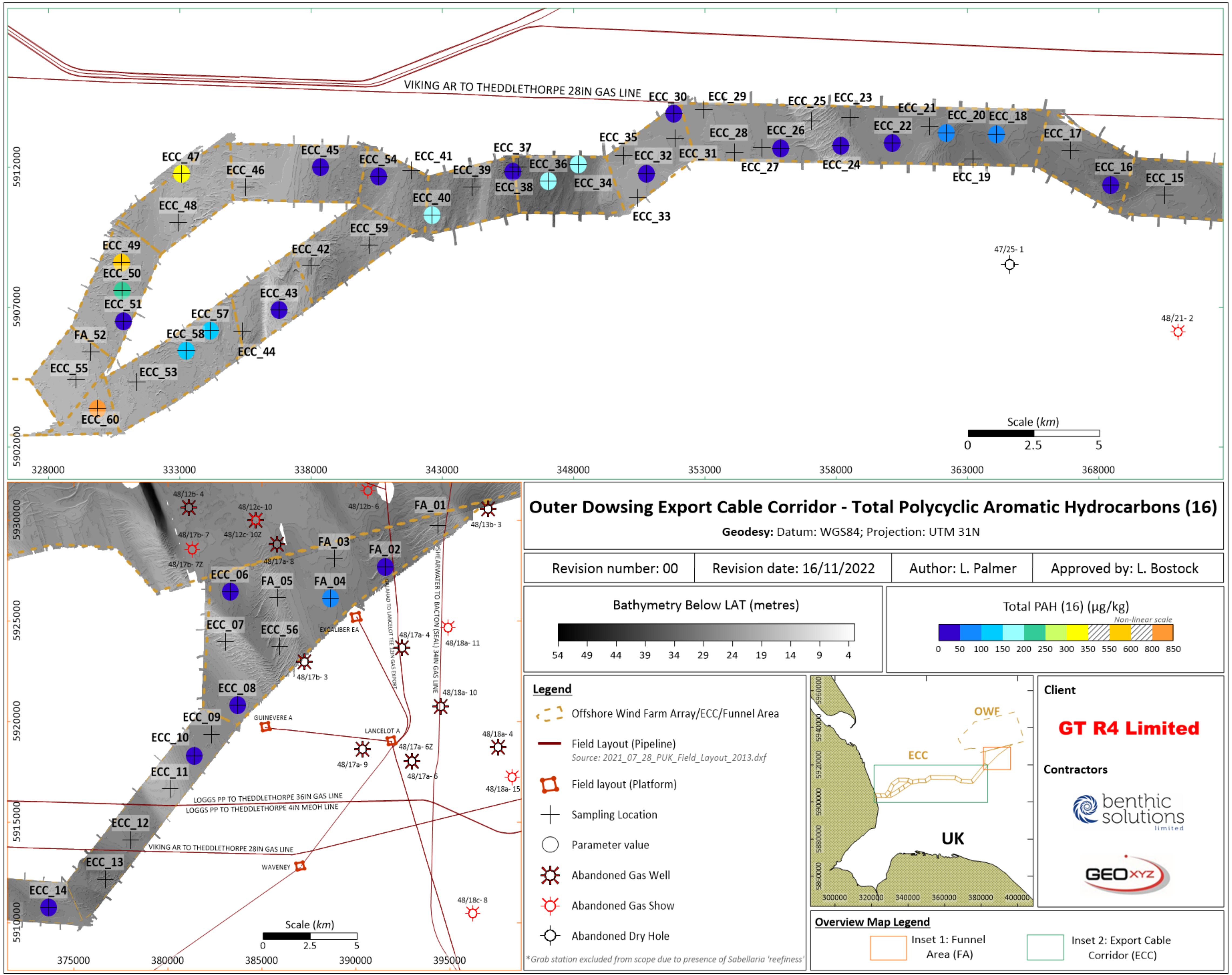


Figure 16: Total Polycyclic Aromatic Hydrocarbons (∑16PAH)

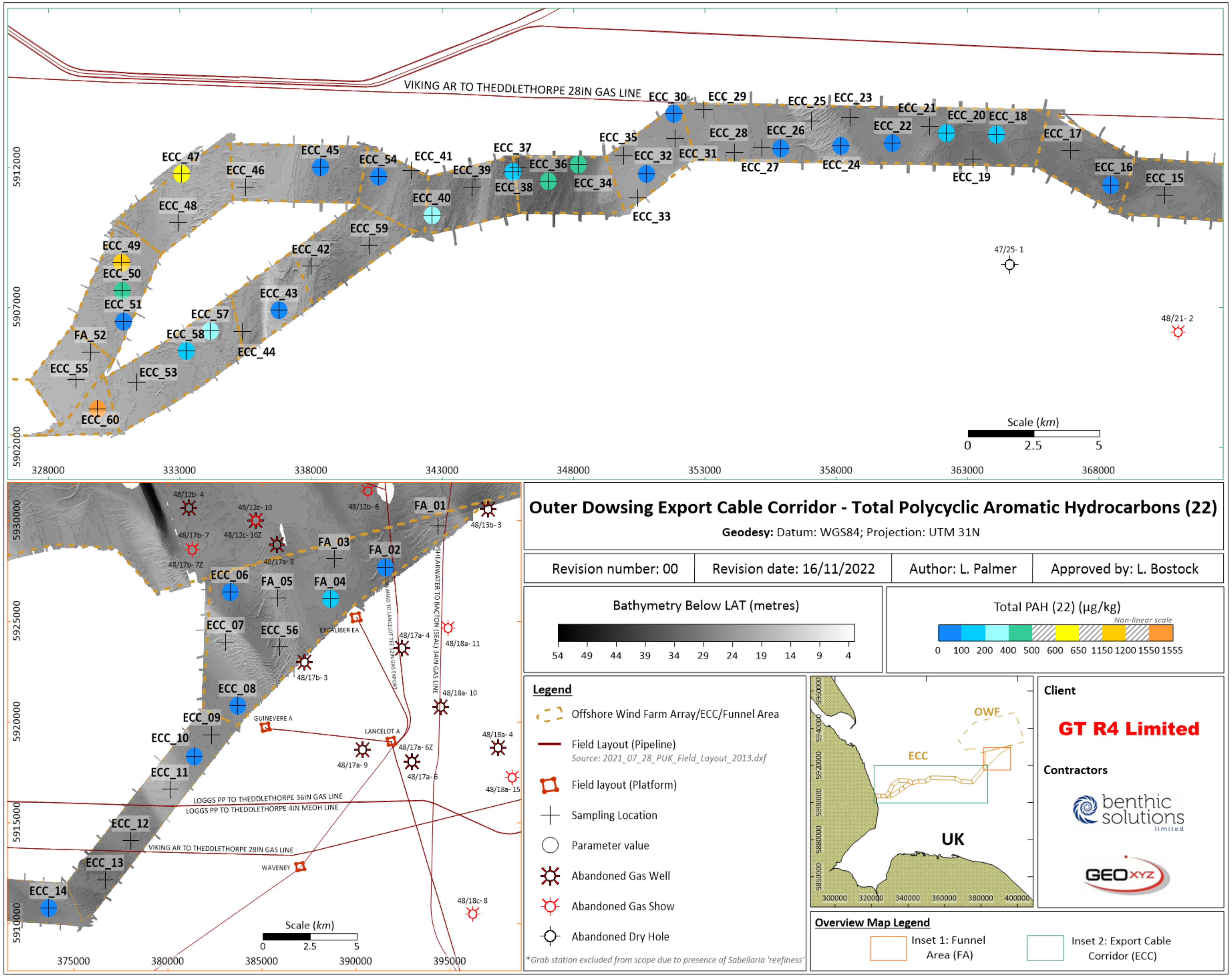


Figure 17: Total Polycyclic Aromatic Hydrocarbons (∑22PAH)

Further information on the source(s) of PAH in the sediment may be obtained from a study of their alkyl homologue distributions (i.e. the degree of methyl, ethyl, substitution of the parent compounds). Pyrolytically derived PAHs are predominantly unalkylated, whereas PAHs derived from petrogenic sources are formed at relatively low temperatures (<150°C) and contain mainly alkylated species. The proportion of 2-6 ring PAH comprising unalkylated parent compounds also reflects whether the source is petrogenic or pyrolytic. However, due to the absence of specific PAHs the alkylated/ unalkylated species could not be calculated and plotted.

An alternative approach to characterising PAH source(s) of PAH in sediments may be obtained from a study of their isomeric ratios (i.e. the same molecular formula but different arrangement of atoms). Two isomeric ratios were used to assess the potential pyrolytic and petrogenic sources of PAHs within the ECC survey area: (1) phenanthrene/anthracene compared with fluoranthene/pyrene and (2) benzo[a]anthracene/ (benzo[a]anthracene + chrysene) compared with fluoranthene/(fluoranthene + pyrene). Isomeric ratios can, to a certain extent, distinguish the pyrolytic and petrogenic sources of PAHs as phenanthrene and fluoranthene are more thermally stable than their anthracene and pyrene isomers (Vane *et al.*, 2014). However, due to the presence of <1 (LOD) concentrations of PAHs the isomeric ratios could not determine the likely source of the PAH across the ECC survey area. Furthermore, the isomeric method alone cannot provide a definitive source due to the degree of uncertainty (Vane *et al.*, 2014).

For further investigation into the possible source(s) of PAH, a principal component analysis (PCA) was performed on the correlation matrix of log-transformed individual 22PAH concentrations. The resultant PCA plot shows the distribution of each station along axes formed by the two principal components (PC1 and PC2) which together describe the largest proportion of overall variability in the PAH concentration dataset. The direction of influence of each individual PAH concentration is shown by the eigenvectors and hence can indicate the potential source(s) of PAH within the ECC survey area. Overall, the PCA plot illustrated a mixed source of (i.e. pyrolytic and petrogenic) PAHs within the survey area, with the differences in PAH concentrations across the stations potentially attributed to variability in natural distribution instead of a dominance of one PAH over another (Figure 18). The mixed source of PAHs was unsurprising given the oil and gas exploration surrounding the ECC survey area and proximity to the coast of the UK and the Humber Estuary.

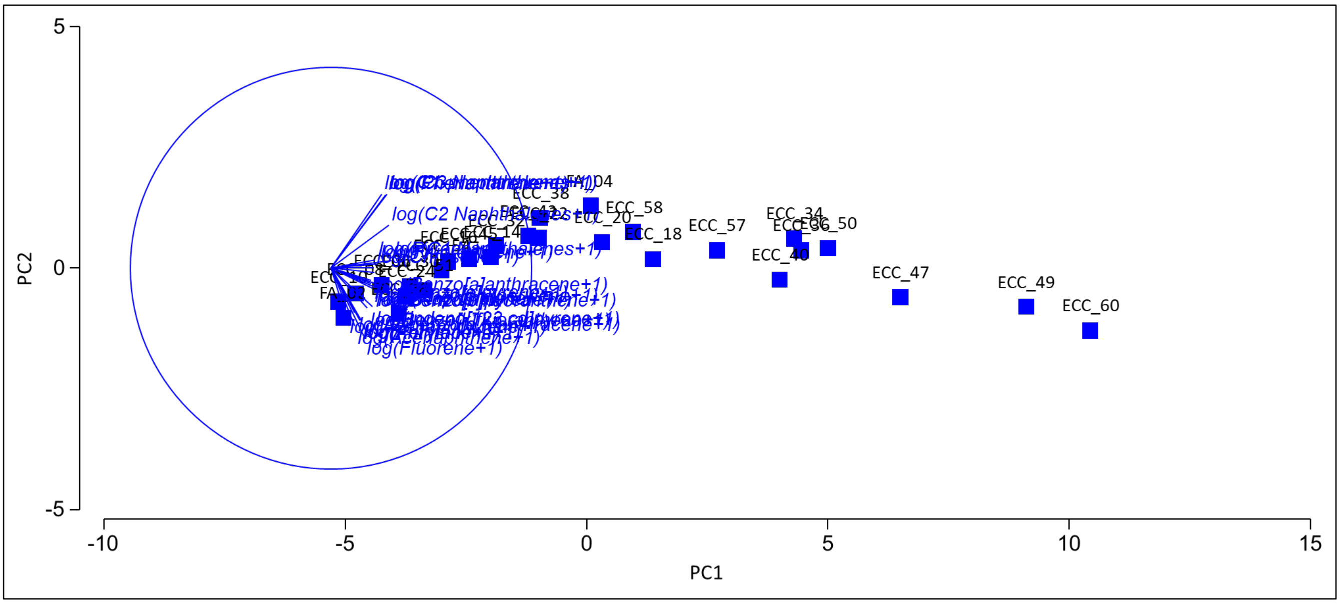


Figure 18: Polycyclic Aromatic Hydrocarbons Principal Component Analysis Source Assignment

4.5.2 Normalised Polycyclic Aromatic Hydrocarbons

a ANZECC and ARMCANZ Sediment Guidelines

Normalised PAH concentrations were calculated to allow comparison to the ANZECC and ARMCANZ SQGVs and OSPAR (2014) background concentrations. The ANZECC and ARMCANZ framework (see Section 2.5.3 and Appendix D) aims to assess contaminated sediment against a set of sediment quality guideline values (SQGV) to establish the level of risk to the biological community, with concentrations below their respective SQGVs indicative of 'low risk' to marine life (Simpson *et al.*, 2013). Whereas, the BCs are concentrations of contaminants derived from analysis of core samples to reflect pre-industrial background levels for the OSPAR area. BACs have been statistically derived from BCs and represent the level above which concentrations can be considered significantly higher than the relevant BC (OSPAR, 2008). Contaminants tend to show a much higher affinity to fine particulate matter (OSPAR, 2009b) due to the increased adsorption capacity of organic matter and clay minerals. In sites where there is variability in grain size between stations, effects due to point sources of contamination will at least partly be obscured by grain size differences.

All PAH concentrations have been normalised to 1% total organic carbon content of the sediment at each station in line with guidance set by the ANZECC and ARMCANZ framework are displayed in Table 18, along with OSPAR BCs and BACs, and OSPAR effect range low (ERL) and effect range median (ERM) thresholds. ERLs are defined as the lowest concentration producing adverse effects in 10% of studies, whilst ERMs are the levels at which harmful effects are expected in 50% of studies.

Normalised PAHs were incalculable at most stations due to concentrations being below the limit of detection (<1µg.kg^{-1}). Of the 22 PAHs analysed during this study, eight PAHs (out of a possible 10 with BCs and BACs) were elevated above their respective BACs at one or more stations, with all eight elevated PAHs recorded at station ECC_60 (Table 18). At station ECC_60, the concentration of phenanthrene (131µg.kg^{-1}) was four times greater than its respective BAC of 32µg.kg^{-1} but did not exceed its ERL of 240µg.kg^{-1}. The presence of PAHs significantly elevated above their respective BCs and ERLs is not surprising given the proximity of the survey area to oil and gas exploration activities. However, the ANZECC and ARMCANZ framework state that, while it is recognised the toxicities of individual PAHs differ significantly, it considers individual PAHs unlikely to be dominant when compared to the total PAH concentration. In light of this, the concentration of Σ22PAH was below the SQGV at every station and indicates that the total PAH concentrations observed across the ECC survey area were likely to be 'low risk' with negligible effects to marine life based on the ANZECC and ARMCANZ framework. Therefore, the PAH concentrations and distribution across the ECC survey area are likely to reflect ambient background conditions of diffuse loading for this region of the SNS. However, it should be noted that the current study used Σ22PAH while the ANZECC and ARMCANZ SQGVs were based on Σ18PAH, which could potentially limit the conclusions drawn from direct comparisons.

Table 18: Normalised ANZECC and ARMCANZ Total Polycyclic Aromatic Hydrocarbons (µg.kg⁻¹ or ppb)

Station	Depth	Distance to Nearest Well (km)	Naphthalene	C1 Naphthalenes	C2 Naphthalenes	C3 Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	C1-phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Benzo[e]pyrene	Benzo[a]pyrene	Perylene	Indeno[123,cd]pyrene	Dibenzo[a,h]anthracene	Benzo[ghi]perylene	Total PAHs (Σ16)	Total PAHs (Σ22)	Total 2-3 ring PAH *	Total 4-6 ring PAH *
FA_02	24	2.92	NC	7.5	9.3	10.1	NC	NC	NC	NC	9.5	NC	9.4	9.9	NC	8.2	9.7	NC	9.5	6.4	NC	6.4	NC	12.4	62.4	108	0.0	62.4
FA_04	21	1.67	3.3	10.5	32.8	51.9	NC	NC	NC	43.7	68.6	NC	21.3	24.0	8.0	17.9	14.2	4.1	16.3	9.1	3.3	6.0	2.4	18.9	173	353	47.0	126
ECC_06	23	2.88	9.8	14.8	22.4	18.0	NC	NC	NC	12.5	17.6	NC	8.4	9.8	NC	7.4	8.4	NC	8.1	6.0	NC	6.6	NC	11.1	79.9	151	22.2	57.7
ECC_08	18	1.85	22.4	47.6	50.4	47.6	NC	NC	NC	28.8	45.0	NC	26.2	25.8	NC	23.2	22.4	NC	27.6	NC	NC	NC	NC	40.0	189	385	51.2	138
ECC_10	19	2.48	NC	20.3	23.4	18.7	NC	NC	NC	11.6	21.6	NC	16.3	16.0	NC	12.4	12.4	NC	11.7	NC	NC	NC	NC	17.1	85.9	182	11.6	74.3
ECC_14	22	2.82	6.3	24.9	30.3	29.4	NC	NC	NC	20.6	31.4	NC	16.8	17.8	7.8	14.6	13.8	5.2	14.0	8.7	4.2	7.7	NC	18.0	137	265	26.9	110
ECC_16	28	2.48	4.8	18.2	18.2	17.9	NC	NC	NC	13.2	17.8	NC	8.3	10.1	4.4	7.5	6.9	NC	7.2	4.5	4.0	4.0	NC	8.6	72.2	151	18.0	54.2
ECC_18	21	0.76	23.3	73.0	72.1	67.3	NC	3.3	6.0	39.1	51.8	5.0	26.8	25.3	13.5	20.5	23.1	8.8	21.8	17.1	6.4	17.8	4.1	27.4	261	530	76.8	184
ECC_20	22	0.78	10.0	34.2	34.7	33.6	NC	NC	2.5	20.2	26.2	NC	13.1	13.1	6.8	10.2	12.1	3.5	10.2	8.5	2.6	7.6	2.1	13.4	123	254	32.7	90.3
ECC_22	20	1.20	12.1	33.1	44.7	72.1	NC	NC	NC	42.6	76.3	6.7	30.6	31.8	14.8	25.1	22.8	7.6	23.2	18.8	NC	15.0	NC	29.6	257	495	61.4	196
ECC_24	16	1.36	NC	3.7	3.2	4.4	NC	NC	NC	3.4	7.3	NC	4.6	7.9	2.8	4.4	3.8	2.4	3.7	3.7	NC	2.2	NC	5.9	40.9	63.3	3.4	37.6
ECC_26	18	1.52	NC	9.7	8.2	8.9	NC	NC	NC	7.6	20.9	NC	18.2	20.1	8.8	18.1	16.9	7.1	18.1	11.6	NC	9.0	NC	23.8	141	207	7.6	134
ECC_30	18	0.42	6.1	18.3	16.3	17.7	NC	NC	NC	12.8	19.0	NC	13.2	14.1	5.8	10.3	9.5	6.2	11.4	7.3	NC	6.5	NC	13.7	106	182	18.9	86.6
ECC_32	14	2.59	11.7	32.9	38.3	46.2	NC	NC	NC	38.5	71.3	NC	36.6	32.5	16.9	25.8	20.9	7.9	19.9	13.9	NC	10.1	NC	23.4	238	435	50.2	188
ECC_34	28	2.34	33.0	126	149	150	2.8	5.2	9.1	102	126	8.8	50.8	45.8	23.8	39.5	29.5	14.2	32.8	25.5	7.4	19.9	5.1	40.8	455	1013	160	295
ECC_36	29	2.98	65.4	171	126	113	2.5	4.6	8.0	64.0	76.6	5.7	38.2	36.8	18.8	26.4	24.8	13.0	22.4	21.2	5.0	15.5	4.0	26.4	376	824	150	225
ECC_38	26	2.68	5.7	16.6	25.2	46.9	NC	NC	NC	25.2	46.4	3.9	15.8	19.8	8.4	11.3	7.6	3.1	8.1	7.6	NC	4.5	NC	10.8	124	261	34.8	88.9
ECC_40	22	4.36	22.3	65.8	60.5	51.8	1.9	3.0	5.6	35.5	42.1	4.2	34.4	32.0	17.7	23.2	20.9	10.3	20.5	20.2	5.8	16.2	3.3	24.2	275	499	72.5	202
ECC_43	11	3.59	9.6	30.5	29.2	33.2	NC	NC	NC	24.0	40.6	NC	17.7	20.2	7.8	13.6	10.6	5.7	13.0	9.4	NC	5.7	NC	15.4	140	277	33.7	106
ECC_45	12	4.95	4.5	14.6	11.7	10.1	NC	NC	NC	8.5	11.4	NC	6.2	6.9	2.3	5.0	4.7	2.0	5.5	3.1	NC	2.2	NC	7.1	52.5	101	13.1	39.4
ECC_47	14	0.00	43.2	131	112	101	3.6	5.9	11.8	68.9	82.9	10.3	55.3	52.6	26.7	39.4	38.2	15.8	37.3	32.6	10.2	27.4	6.2	43.8	482	913	144	338
ECC_49	11	0.00	64.6	201	170	152	4.2	8.5	14.9	115	141	13.1	84.9	80.9	40.6	60.1	56.0	23.0	52.8	48.0	14.8	39.5	8.7	62.2	725	1392	221	504
ECC_50	19	3.02	34.7	122	112	119	2.4	4.6	8.2	78.5	108	6.7	47.0	47.4	23.2	34.5	30.0	12.0	29.8	25.8	5.9	17.1	4.8	38.7	416	877	135	281
ECC_51	10	0.00	1.7	5.2	4.2	4.5	NC	NC	NC	4.1	6.0	NC	6.4	6.7	1.9	4.5	4.4	1.8	4.4	2.3	NC	2.3	NC	4.8	41.1	63.6	5.9	35.2
ECC_54	17	0.00	5.8	17.9	16.5	16.4	NC	NC	NC	11.5	16.0	NC	8.7	10.2	3.8	8.1	6.9	3.7	9.4	5.2	NC	4.3	NC	11.0	79.0	149	17.3	61.8
ECC_57	14	0.00	29.3	91.5	79.8	79.5	NC	4.2	7.6	53.3	68.0	4.3	36.0	36.3	15.6	26.3	20.0	9.2	23.7	20.0	6.4	15.0	4.2	29.8	311	630	98.5	212
ECC_58	13	0.00	14.6	37.1	36.0	37.7	NC	NC	NC	58.9	58.0	NC	37.1	42.6	16.3	31.4	20.7	8.8	24.9	15.4	4.1	10.7	3.2	26.5	286	470	73.4	213
ECC_60	10	0.00	74.9	221	198	171	5.9	11.0	21.0	131	152	14.1	104	97.7	48.1	72.5	68.0	32.6	65.5	60.3	19.5	50.2	11.0	79.8	882	1634	258	624
Mean			**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
SD			**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
CV (%)			**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
Minimum			**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**
Maximum			**74.9**	**221**	**198**	**171**	**5.9**	**11.0**	**21.0**	**131**	**152**	**14.1**	**104**	**97.7**	**48.1**	**72.5**	**68.0**	**32.6**	**65.5**	**60.3**	**19.5**	**50.2**	**11.0**	**79.8**	**882**	**1634**	**258**	**624**
Reference Values																												
BC (OSPAR, 2008)			5	-	-	-	-	-	-	17	-	3	20	13	9	11	-	-	-	15	-	50	-	45	-	-	-	-
BAC (OSPAR, 2008)			8	-	-	-	-	-	-	32	-	5	39	24	16	20	-	-	-	30	-	103	-	80	-	-	-	-
UKOOA 95th Percentile SNS			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	366	-	-	-
OSPAR ERL (OSPAR, 2012)			160	155	150		44	16	19	240	170	85	600	665	261	384	-	240	-	430	-	240	63	85	-	4,022	552	1,700
SQGV (Simpson *et al.*, 2013)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		10,000	-	-
OSPAR ERM (OSPAR, 2012)			2,100				640	500	540	1,500		1,100	5,100	2,600	1,600	2,800	-	-	-	1,600	-	-	260	2,800	-	44,792	3,160	9,600
SQGV High (Simpson *et al.*, 2013)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				50,000	-	-

NC = Not calculated due to incomplete dataset

**Low molecular weight (2-3 ring) PAHs and high molecular weight (4-6 ring) PAHs calculated from the EPA 16 PAHs* *b OSPAR Coordinated Environmental Guidelines*

Normalised PAH concentrations were calculated to allow comparison to OSPAR (2014) background concentrations (BCs) and background assessment concentrations (BACs). BCs are concentrations of contaminants derived from the analysis of core samples to reflect pre-industrial background levels for the OSPAR area. BACs have been statistically derived from BCs and represent the level above which concentrations can be considered significantly higher than the relevant BC (OSPAR, 2008). Contaminants tend to show a much higher affinity to fine particulate matter (OSPAR, 2009b) due to the increased adsorption capacity of organic matter and clay minerals. In sites where there is variability in grain size between stations, effects due to point sources of contamination will at least partly be obscured by grain size differences.

All total PAH concentrations (based on the 11 PAH components outlined in OSPAR, 2014) have been normalised to the 2.5% total organic carbon content of the sediment at each station. Total PAH concentrations normalised to 2.5% TOC content are displayed in Table 19, along with OSPAR BCs and BACs, and OSPAR effect range low (ERL) and effect range median (ERM) thresholds. ERLs are defined as the lowest concentration producing adverse effects in 10% of studies, whilst ERMs are the levels at which harmful effects are expected in 50% of studies.

Normalised PAHs were incalculable at most stations due to concentrations being below the limit of detection (<1µg.kg^{-1}). Similarly to the ANZECC and ARMCANZ normalisation, ten out of 22 PAHs had a concentration elevated above their respective BAC concentrations, with all ten elevated PAHs recorded at station ECC_60 (Table 19). At station ECC_60, phenanthrene (327µg.kg^{-1}) was 10 times greater than its respective BAC of 32µg.kg^{-1} and 1.5 times greater than its ERL of 240µg.kg^{-1}. Additionally, station ECC_60 had eight PAHs recorded above their respective ERLs (Table 18). Whereas multiple stations, including ECC_24 and ECC_26 had no PAHs above their ERLs. As previously discussed in the ANZECC and ARMCANZ normalisation section, the elevated PAHs significantly above their BCs and ERLs is not surprising given the close proximity of the survey area to gas exploration activities. However, the total concentration of PAHs may provide a more suitable approach to investigating impacts to marine life. Σ22PAH concentration (4,272µg.kg^{-1}) was elevated above its respective ERL of 4,022µg.kg^{-1} but was below the OSPAR ERM of 44,792µg.kg^{-1}. Therefore, the PAH concentrations and distribution across the ECC survey area were likely to reflect background ambient conditions of diffuse PAH loading for this region of the SNS.

In addition, Brils *et al.* (2002) states that weathered sediments are significantly less toxic than freshly-spiked sediments and the toxicity to marine life was attributed to oil constituents rather than the co-occurring PAHs. Therefore, GC traces and TPH analysis could be conducted during environmental baseline surveys to form a more holistic approach when linking historic oil and gas exploration to marine life toxicity and background conditions.

Table 19: Normalised OSPAR Total Polycyclic Aromatic Hydrocarbons (µg.kg^{-1} or ppb)

Station	Depth	Distance to Nearest Well (km)	Naphthalene	C1 Naphthalenes	C2 Naphthalenes	C3 Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	C1-phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluoranthene	Benzo[k]fluoranthene (	Benzo[e]pyrene	Benzo[a]pyrene	Perylene	Indeno[123,cd]pyrene	Dibenzo[a,h]anthracene	Benzo[ghi]perylene	Total PAHs (Σ16)	Total PAHs (Σ22)	Total 2-3 ring PAH *	Total 4-6 ring PAH *
FA_02	24	2.92	-	18.7	23.2	25.3	-	-	-	-	23.8	-	23.4	24.9	-	20.6	24.3	-	23.7	15.9	-	16.0	-	30.9	156	271	0.0	156
FA_04	21	1.67	8.3	26.2	82.0	130	-	-	-	109	172	-	53.2	59.9	20.1	44.8	35.5	10.2	40.8	22.7	8.3	14.9	6.0	47.2	432	891	118	315
ECC_06	23	2.88	24.4	37.1	55.9	45.0	-	-	-	31.2	44.0	-	21.0	24.6	-	18.4	21.0	-	20.3	15.0	-	16.6	-	27.6	200	402	55.6	144
ECC_08	18	1.85	56.0	119	126	119	-	-	-	72.0	113	-	65.5	64.5	-	58.0	56.0	-	69.0	-	-	-	-	100	472	1018	128	344
ECC_10	19	2.48	-	50.8	58.6	46.7	-	-	-	28.9	53.9	-	40.8	40.0	-	31.1	31.1	-	29.2	-	-	-	-	42.8	215	454	618	186
ECC_14	22	2.82	15.8	62.3	75.7	73.6	-	-	-	51.5	78.6	-	42.1	44.6	19.4	36.4	34.6	12.9	35.1	21.7	10.4	19.3	-	44.9	343	679	944	276
ECC_16	28	2.48	12.0	45.4	45.5	44.8	-	-	-	33.0	44.5	-	20.6	25.2	11.0	18.8	17.3	-	18.0	11.2	10.0	10.1	-	21.4	181	389	45.0	136
ECC_18	21	0.76	58.3	183	180	168	-	8.3	15.1	97.7	130	12.6	66.9	63.3	33.7	51.3	57.7	22.0	54.5	42.8	15.9	44.5	10.2	68.6	653	1384	192	461
ECC_20	22	0.78	25.1	85.4	86.8	84.0	-	-	6.2	50.5	65.6	-	32.6	32.6	17.1	25.4	30.1	8.9	25.5	21.3	6.4	19.0	5.3	33.4	308	661	81.8	226
ECC_22	20	1.20	30.1	82.8	112	180	-	-	-	107	191	16.8	76.4	79.5	37.0	62.6	57.0	19.1	57.9	47.0	-	37.5	-	73.9	644	1267	154	490
ECC_24	16	1.36	-	9.2	8.0	11.1	-	-	-	8.4	18.2	-	11.5	19.7	6.9	10.9	9.4	6.0	9.3	9.3	-	5.4	-	14.7	102	158	8.4	93.9
ECC_26	18	1.52	-	24.3	20.4	22.2	-	-	-	19.1	52.2	-	45.6	50.1	21.9	45.1	42.2	17.8	45.3	29.1	-	22.5	-	59.4	353	517	19.1	334
ECC_30	18	0.42	15.3	45.8	40.8	44.2	-	-	-	32.0	47.5	-	32.9	35.1	14.6	25.8	23.8	15.4	28.4	18.3	-	16.3	-	34.2	264	470	47.2	216
ECC_32	14	2.59	29.2	82.2	95.8	116	-	-	-	96.3	178	-	91.6	81.3	42.2	64.4	52.2	19.7	49.8	34.8	-	25.2	-	58.4	595	1117	126	470
ECC_34	28	2.34	82.5	314	373	375	7.1	13.1	22.8	254	315	21.9	127	114	59.5	98.8	73.8	35.5	81.9	63.8	18.4	49.6	12.8	102	1138	2615	401	737
ECC_36	29	2.98	164	428	315	283	6.4	11.6	20.1	160	192	14.4	95.5	92.0	47.0	66.0	62.0	32.6	56.0	53.0	12.6	38.8	10.0	66.0	939	2224	376	563
ECC_38	26	2.68	14.2	41.6	62.9	117	-	-	-	62.9	116	9.8	39.5	49.5	21.0	28.1	19.0	7.8	20.3	19.1	-	11.3	-	26.9	309	667	87.0	222
ECC_40	22	4.36	55.7	164	151	130	4.7	7.6	14.0	88.6	105	10.5	86.0	79.9	44.3	58.0	52.3	25.7	51.1	50.4	14.4	40.5	8.3	60.6	687	1303	181	506
ECC_43	11	3.59	24.1	76.4	73.1	83.1	-	-	-	60.1	102	-	44.4	50.6	19.6	34.1	26.5	14.2	32.6	23.4	-	14.4	-	38.5	350	716	84.2	266
ECC_45	12	4.95	11.3	36.4	29.3	25.2	-	-	-	21.4	28.5	-	15.4	17.3	5.7	12.5	11.7	5.1	13.7	7.7	-	5.4	-	17.9	131	264	32.7	98.6
ECC_47	14	0.00	108	328	280	253	8.9	14.8	29.4	172	207	25.6	138	131	66.7	98.5	95.5	39.4	93.2	81.4	25.4	68.6	15.4	110	1204	2390	359	845
ECC_49	11	0.00	161	503	426	380	10.6	21.2	37.3	288	352	32.7	212	202	101.5	150	140	57.4	132	120.1	37.0	98.8	21.7	156	1812	3641	552	1260
ECC_50	19	3.02	86.8	304	280	297	6.1	11.5	20.5	196	270	16.8	118	118	58.0	86.3	75.0	29.9	74.5	64.6	14.7	42.7	12.0	96.7	1039	2280	338	701
ECC_51	10	0.00	4.4	13.1	10.4	11.3	-	-	-	10.3	14.9	-	16.0	16.9	4.8	11.3	11.1	4.5	11.0	5.8	-	5.6	-	12.0	103	164	14.6	88.1
ECC_54	17	0.00	14.4	44.8	41.2	41.1	-	-	-	28.8	39.9	-	21.7	25.4	9.4	20.3	17.2	9.2	23.4	12.9	-	10.8	-	27.6	198	388	43.2	154
ECC_57	14	0.00	73.1	229	199	199	-	10.5	18.9	133	170	10.6	90.0	90.6	39.0	65.6	49.9	22.9	59.1	50.1	16.1	37.6	10.5	74.4	777	1649	246	531
ECC_58	13	0.00	36.4	92.9	90.0	94.3	-	-	-	147	145	-	92.9	106	40.8	78.6	51.8	22.1	62.2	38.6	10.4	26.6	7.9	66.4	716	1210	184	532
ECC_60	10	0.00	187	552	495	429	14.7	27.5	52.5	327	379	35.2	260	244	120	181	170	81.6	164	151	48.6	126	27.5	200	2205	4272	644	1561
Mean			**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
SD			**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
CV (%)			**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
Minimum			**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**
Maximum			**206**	**1,027**	**1,431**	**1,650**	**19.7**	**39.2**	**46.9**	**1,019**	**1,258**	**51.5**	**232**	**297**	**158**	**158**	**111**	**55.8**	**142**	**146**	**36.7**	**46.5**	**12.6**	**152**	**2,603**	**8,090**	**1,234**	**1,369**
Reference Values																												
BC (OSPAR, 2008)			5	-	-	-	-	-	-	17	-	3	20	13	9	11	-	-	-	15	-	50	-	45	-	-	-	-
BAC (OSPAR, 2008)			8	-	-	-	-	-	-	32	-	5	39	24	16	20	-	-	-	30	-	103	-	80	-	-	-	-
UKOOA 95th Percentile SNS			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	366	-	-	-
OSPAR ERL (OSPAR, 2012)			160	155	150	-	44	16	19	240	170	85	600	665	261	384	-	240	-	430	-	240	63	85	-	4,022	552	1,700
OSPAR ERM (OSPAR, 2012)			2,100	-	-	-	640	500	540	1,500	-	1,100	5,100	2,600	1,600	2,800	-	-	-	1,600	-	-	260	2,800	-	44,792	3,160	9,600

'-' environmentally inadmissible due to the contaminant being below the LOD
NC = Not calculated due to incomplete dataset
**Low molecular weight (2-3 ring) PAHs and high molecular weight (4-6 ring) PAHs calculated from the EPA 16 PAHs*

4.5.3 Sediment Endocrine Disrupters

a Polychlorinated Biphenyls

Samples were analysed for PCBs from 28 stations sampled across the ECC survey area using the Shipek grab sampler. These compounds are considered a major environmental concern due to their high lipophilicity and resistance to metabolic degradation and are used on oil and gas platforms in electrical plants and transformer oils. PCBs are non-ionic (hydrophobic) organic chemicals that have low solubility and as such concentrations in water and sediments are generally low (Cefas, 2001). Of the 25 PCBs analysed only five (PCB28, PCB66, PCB110, PCB118, PCB153) had concentrations above the LoD of <0.08µg.kg^{-1}, ranging between 0.08µg.kg^{-1} and 0.12µg.kg^{-1}, with a peak value of 0.12µg.kg^{-1} recorded for PCB110 at station ECC_60 (Table 20). All individual PCBs were below their respective EAC reference values, where applicable, indicating concentrations of individual PCBs across the survey area were representative of background concentrations. Due to the low concentrations of individual PCBs across the survey area, one station, ECC_60, had a calculable ICES 7 PCB congener of 0.29µg.kg^{-1} and calculable 25 PCB congeners of 0.50µg.kg^{-1} (Table 20). All PCBs (individual and sum 7 and 25) were below their respective cAL 1, cAL 2, EAC, TEL and PEL thresholds at every station evidencing little to no PCB contamination across the site.

Table 20: Summary of Sediment Polychlorinated Biphenyls Analysis (ug.kg-1 or ppb)

Station	Depth (m)	Distance to Nearest Well (km)	PCB 18	PCB 28	PCB 31	PCB 44	PCB 47	PCB 49	PCB 52	PCB 66	PCB 101	PCB 105	PCB 110	PCB 118	PCB 128	PCB 138	PCB 141	PCB 149	PCB 151	PCB 153	PCB 156	PCB 158	PCB 170	PCB 180	PCB 183	PCB 187	PCB 194	Total ICES 7 PCB	Total of 25 Congeners
FA_02	24	2.92	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
FA_04	21	1.67	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_06	23	2.88	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_08	18	1.85	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_10	19	2.48	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_14	22	2.82	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_16	28	2.48	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_18	21	0.76	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_20	22	0.78	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_22	20	1.20	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_24	16	1.36	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_26	18	1.52	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_30	18	0.42	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_32	14	2.59	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_34	28	2.34	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_36	29	2.98	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_38	26	2.68	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_40	22	4.36	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_43	11	3.59	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_45	12	4.95	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_47	14	0.00	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_49	11	0.00	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_50	19	3.02	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_51	10	0.00	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_54	17	0.00	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_57	14	0.00	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_58	13	0.00	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
ECC_60	10	0.00	<0.08	0.10	<0.08	<0.08	<0.08	<0.08	<0.08	0.09	<0.08	<0.08	0.12	0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.11	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.29	0.50
Mean			**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
SD			**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
CV (%)			**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
Minimum			**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**
Maximum			**<0.08**	**0.10**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**0.09**	**<0.08**	**<0.08**	**0.12**	**0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**0.11**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**<0.08**	**0.29**	**0.50**
Reference Values																													
Cefas cAL1 (MMO, 2015)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.00	
ERL (OSPAR, 2012)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.50	-
TEL (CCME, 2001)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21.60
EAC (OSPAR, 2012)			-	1.70	-	-	-	-	2.70	-	3	-	-	0.60	-	7.90	-	-	-	40.00	-	-	-	12.00	-	-	-	67.90	
Cefas cAL2 (MMO, 2015)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	140.00	
PEL (CCME, 2001)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	189.00

NC = Not calculated due to incomplete dataset

b Organotin

Organotin compounds, principally tributyltin (TBT), have historically been used in marine antifouling products, but their use is now prohibited due to the disruption of the reproductive capabilities of a number of gastropod species (Iguchi *et al.*, 2007). Organotin compounds are relatively persistent and may still be present in offshore cuttings piles from their use in the 1980s. No formal environmental assessment criteria (EAC) thresholds for TBT in sediment have been set through CEMP (OSPAR, 2008), however, limits have been proposed via various OSPAR programmes and meetings, with 0.01µg.kg^{-1} suggested as a provisional EAC for TBT (OSPAR, 2009). No organotin compounds (Dibutyltin, TBT and MBT) were recorded above their respective LoD of <1ug.kg^{-1} (Table 21). The lack of organotin presence across the ECC survey area was unsurprising given the lack of platform infrastructure surrounding the grab locations, as grab samples were taken >500m from any platform infrastructure. However, it is worth noting the LOD of the method used is higher than the EAC thresholds set by OSPAR, including the highest upper EAC level of 0.15µg.kg^{-1} issued in 2004.

Table 21: Summary of Sediment Organotin Analysis (µg.kg^{-1} or ppb)

Station	Depth (m)	Distance to Nearest Well (km)	Dibutyltin (DBT)	Tributyltin (TBT)	Monobutyltin (MBT)
FA_02	24	2.92	<1	<1	<1
FA_04	21	1.67	<1	<1	<1
ECC_06	23	2.88	<1	<1	<1
ECC_08	18	1.85	<1	<1	<1
ECC_10	19	2.48	<1	<1	<1
ECC_14	22	2.82	<1	<1	<1
ECC_16	28	2.48	<1	<1	<1
ECC_18	21	0.76	<1	<1	<1
ECC_20	22	0.78	<1	<1	<1
ECC_22	20	1.20	<1	<1	<1
ECC_24	16	1.36	<1	<1	<1
ECC_26	18	1.52	<1	<1	<1
ECC_30	18	0.42	<1	<1	<1
ECC_32	14	2.59	<1	<1	<1
ECC_34	28	2.34	<1	<1	<1
ECC_36	29	2.98	<1	<1	<1
ECC_38	26	2.68	<1	<1	<1
ECC_40	22	4.36	<1	<1	<1
ECC_43	11	3.59	<1	<1	<1
ECC_45	12	4.95	<1	<1	<1
ECC_47	14	0.00	<1	<1	<1
ECC_49	11	0.00	<1	<1	<1
ECC_50	19	3.02	<1	<1	<1
ECC_51	10	0.00	<1	<1	<1
ECC_54	17	0.00	<1	<1	<1
ECC_57	14	0.00	<1	<1	<1
ECC_58	13	0.00	<1	<1	<1
ECC_60	10	0.00	<1	<1	<1
Mean			**NC**	**NC**	**NC**
SD			**NC**	**NC**	**NC**
CV (%)			**NC**	**NC**	**NC**
Minimum			**<1**	**<1**	**<1**
Maximum			**<1**	**<1**	**<1**
Reference Levels					
Cefas cAL1 (MMO, 2015)			100	100	100
Cefas cAL2 (MMO, 2015)			1000	1000	1000

c Organochlorine Pesticides

Organochlorine pesticides (OCPs) are synthetic pesticides used globally for the control of biological vectors. OCPs are considered persistent organic pollutants due to their high toxicity, degradation resistance, fat solubility and bioaccumulation. Many OCPs are semi-volatile and can be transported over long distances via atmospheric currents in a gaseous state before wet or dry deposition occurs in the oceans. These compounds are transported from the surface waters to the bottom sediments as OCPs are denser than water and can adsorb onto fine particles. Humans and biota can be affected by the toxic effects caused by OCPs, which involve reproductivity damage, endocrine disruption and immune suppression (Girones *et al.*, 2020). Two OCPs were analysed during the current survey, dieldrin and DDT, of which eight stations, ECC_34, 36, 40, 43, 45, 47, 49, 60, had a DDT concentration recorded above the LoD (see Table 22). The DDT concentrations at these stations were above the Cefas action level 1 value of 0.1µg.kg^{-1}, indicating the material at these stations would have to be further investigated before disposal. However, DDT was below the ERL and TEL reference values so it is unlikely the concentrations of DDT would have impacted the macrobenthic community. Furthermore, the UK Cefas action level 1 concentration for DDT were the lowest and strictest for any OSPAR country (MMO, 2015). It is also worth noting the LOD of the method used is equal to the thresholds set by the UK.

Table 22: Summary of Sediment Organochlorine Analysis (µg.kg^{-1} or ppb)

Station	Depth (m)	Distance to Nearest Well (km)	Dieldrin	DDT*
FA_02	24	2.92	<0.1	<0.1
FA_04	21	1.67	<0.1	<0.1
ECC_06	23	2.88	<0.1	<0.1
ECC_08	18	1.85	<0.1	<0.1
ECC_10	19	2.48	<0.1	<0.1
ECC_14	22	2.82	<0.1	<0.1
ECC_16	28	2.48	<0.1	<0.1
ECC_18	21	0.76	<0.1	<0.1
ECC_20	22	0.78	<0.1	<0.1
ECC_22	20	1.20	<0.1	<0.1
ECC_24	16	1.36	<0.1	<0.1
ECC_26	18	1.52	<0.1	<0.1
ECC_30	18	0.42	<0.1	<0.1
ECC_32	14	2.59	<0.1	<0.1
ECC_34	28	2.34	<0.1	0.2
ECC_36	29	2.98	<0.1	0.2
ECC_38	26	2.68	<0.1	<0.1
ECC_40	22	4.36	<0.1	0.3
ECC_43	11	3.59	<0.1	0.5
ECC_45	12	4.95	<0.1	0.4
ECC_47	14	0.00	<0.1	0.7
ECC_49	11	0.00	<0.1	<0.1
ECC_50	19	3.02	<0.1	<0.1
ECC_51	10	0.00	<0.1	<0.1
ECC_54	17	0.00	<0.1	<0.1
ECC_57	14	0.00	<0.1	<0.1
ECC_58	13	0.00	<0.1	<0.1
ECC_60	10	0.00	0.1	0.4
Mean			**NC**	**NC**
SD			**NC**	**NC**
CV (%)			**NC**	**NC**
Minimum			<0.1	<0.1
Maximum			0.1	0.7
Reference Levels				
Cefas cAL1 (MMO, 2015)			0.5	0.1
TEL (CCME, 2001)			0.72	1.19
ERL (OSPAR, 2012)			2	1
PEL (CCME, 2001)			4.3	4.77
ERM (OSPAR, 2012)			8	7

** DDT = p,p'-Dichlorodiphenyltrichloroethane*

4.6 TRACE METALS

4.6.1 Non-normalised Trace Metals

Results for trace metals analysis are given in Table 23 and Figure 19 to Figure 22. All of the metals analysed (arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni) and zinc (Zn)), underwent an aqua-regia acid digestion and extraction for partial sediment metals.

The question of bioavailability of metals to marine organisms is a complex one, as sediment granulometry and the interface between water and sediment all affect the bioavailability and subsequent toxicity. Therefore, even if a metal is found in higher concentrations it does not necessarily follow that this will have a detrimental effect on the environment, if present in an insoluble state. Historically, several extraction techniques have been applied to metal analysis, with the most common applying to an HF/perchloric extraction for total metals, and a weaker nitric or aqua regia extraction. The latter techniques have shown close correlation to metal burdens in the tissues of benthic organisms (Luoma and Davies, 1983; Bryan and Langston, 1992). However, the way bioavailability is reflected by the extent to which a particular metal digests is not well understood, and research is ongoing.

Metals occur naturally in the marine environment and are widely distributed in both dissolved and sedimentary forms. Some are essential to marine life while others may be toxic to numerous organisms (Paez Osuna and Ruiz-Fernandez, 1995). Rivers, coastal discharges, and the atmosphere are the principal modes of entry for most metals into the marine environment (Schaule and Patterson, 1983), with anthropogenic inputs occurring primarily as components of industrial and municipal wastes. Historically, several metals are found in elevated concentrations where drilling fluids or produced waters have been discharged by oil and gas installations. These include intentional additives (such as metal-based salts and organo-metallic compounds in the fluids) as well as impurities within the drilling mud systems such as clays (e.g. bentonites; a gelling and viscosifying agent) and metal lignosulphates (a viscosity controller; Bordin *et al.*, 1992). Metals most characteristic of offshore contamination of marine sediments from oil and gas exploration are barium (Ba), chromium (Cr), lead (Pb) and zinc (Zn; Neff, 2005), although these may vary greatly dependent upon the constituents in drilling fluids used.

Trace metal contaminants in the marine environment tend to form associations with the non-residual phases of mineral matter, such as iron and manganese oxides and hydroxides, metal sulphides, organics, and carbonates. Metals associated with these non-residual phases are prone to various environmental interactions and transformations (physical, chemical and biological), potentially increasing their biological availability (Tessier *et al.*, 1979). Residual trace metals are defined as those which are part of the silicate matrix of the sediment and that are located mainly in the lattice structures of the component minerals. Non-residual trace metals are not part of the silicate matrix and have been incorporated into the sediment from aqueous solution by processes such as adsorption and organic complexes and may include trace metals originating from sources of pollution. Therefore, in monitoring trace metal contamination of the marine environment, it is important to distinguish these more mobile metals from the residual metals held tightly in the sediment lattice (Chester and Voutsinou, 1981), which are of comparatively little environmental significance.

Metals are generally not harmful to organisms at concentrations normally found in marine sediments and some, like zinc, may be essential for normal metabolism although can become toxic above a critical threshold. In order to assign a level of context for toxicity, an approach used by Long, *et al.* (1995) to characterise contamination in sediments will be used here. These researchers reviewed field and laboratory studies and identified nine metals that were observed to have ecological or biological effects on organisms. They defined 'effect range low' (ERL) values as the lowest concentration of a metal that produced adverse effects in 10% of the data reviewed, whilst 'effect range median' (ERM) values designate the level at which half of the studies reported harmful effects. Consequently, metal concentrations recorded below the ERL and TEL value are not expected to elicit adverse effects, while levels above the ERM and PEL value are likely to be toxic to some marine life.

Of particular relevance to the offshore wind farm industry within close proximity to offshore oil and gas exploration are metals associated with drilling related discharges. Trace metals such as either from impurities or additives can accumulate in marine sediments surrounding oil and gas exploration activities (NRC, 1983; McLeese *et al.*, 1987). Zinc and mercury were above their respective UKOOA 95th percentile thresholds of 35.8mg.kg^{-1} and 0.05mg.kg^{-1} at nine and eight stations, respectively, although they did not exceed any other thresholds (Table 23). Nickel was above its respective Cefas action level 1 of 20.0mg.kg^{-1} at four stations, also exceeding the UKOOA 95th percentile, NOAA ERL and the SQGV thresholds (Table 23). Furthermore, copper was elevated above the CCME TEL reference value of 18.7mg.kg^{-1} at station ECC_22 with a concentration of 27.9mg.kg^{-1} recorded (Table 23), also exceeding the UKOOA 95th percentile threshold. The elevated values could indicate a potential residual trace of historical drilling activities within the ECC area as all metals, excluding mercury, had a significant positive relationship to either ∑16PAH or ∑22PAH and could indicate a similar diffuse source of metals (Appendix K; p>0.05). However, a majority of the metals were below their respective UKOOA 95th percentiles and no significant relationship was observed between the nearest well and any metal concentration (Appendix K; p>0.05). Furthermore, all metals, apart from chromium, cadmium and mercury, had a significant positive Spearman's correlation with the proportion of sand along with a significant negative relationship, excluding arsenic and nickel, with the proportion of gravel (Appendix K).

A series of significant correlations between metal concentrations and sediment proportions indicate that sediment variability was likely influencing the distribution of metals across the ECC survey area. For example, aluminosilicates present in gravels are associated with several trace metals (Zn, Cr, Ni, Co and Cu) and the erosion of aluminosilicates can lead to the accumulation of trace metals in the overlaying surface sediments (Musafa *et al.*, 1996).

Arsenic was elevated above the NOAA ERL at 8.2mg.kg^{-1} at the majority of stations (18 out of a possible 28), with a further seven stations, ECC_06, 26, 30, 43, 45, 49 and 60, elevated above the Cefas action level 1 of 20mg.kg^{-1} (Table 23). One station in the survey area, ECC_51, had very high concentrations of arsenic, exceeding all thresholds detailed in Table 23, including Cefas action level 1 of 20mg.kg^{-1} and Cefas action level 2 of 50 mg.kg^{-1}. Elevated arsenic concentrations is unsurprising given previous studies that have found high levels of arsenic within the southern North Sea, potentially due to the influence of historic industrial discharge from the Humber Estuary (Whalley *et al.*, 1999). The levels of arsenic seen at ECC_51 seem to be influenced by proximity to the Humber Estuary and riverine input, rather than proximity to infrastructure, as there was no significant Spearman's correlation between distance from infrastructure and any heavy metal. Furthermore, it can be speculated, given the intensity of drilling activity, that arsenic rich shale has been brought and distributed across the surface sediments of the ECC survey area potentially resulting in elevated surface arsenic concentrations (Whalley *et al.*, 1999). Therefore, the concentrations of arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc are likely to represent the upper limit of natural background levels for this region of the SNS.

The previous SNS surveys carried out by BSL within close proximity to the ECC survey area utilised the same 'aqua-regia' digest on the trace metals analysed enabling a direct comparison between results. All metals analysed were lower (Cd) or comparable (As, Cr, Cu, Pb, Hg, Ni and Zinc) in the current ECC survey when compared to the regional SNS surveys (Table 23). For example, the mean arsenic concentration (18.5mg.kg^{-1}) for the current survey was well within the range of the mean concentrations (11.4mg.kg^{-1} to 25.8mg.kg^{-1}) calculated from the previous BSL

SNS surveys. Therefore, further indicating the potential for metal concentrations across the ECC survey area to be representative of natural background conditions for this region of the SNS.

Table 23: Total Trace Metal Concentrations (mg.kg^{-1} or ppm)

Station	Depth (m)	Distance from nearest well (km)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Zinc (Zn)
FA_02	23.91	2.916	12.2	0.05	6.7	5.6	3.9	0.02	5.9	18.6
FA_04	21.04	1.67	15.8	0.07	14.2	7.7	6.2	0.02	18.8	32.5
ECC_06	23.46	2.878	30.0	0.05	9.2	7.0	5.4	0.03	9.5	34.9
ECC_08	18.44	1.853	15.8	0.06	12.1	8.6	6.0	0.02	15.3	32.3
ECC_10	18.97	2.479	6.2	<0.04	4.2	4.6	3.4	0.02	3.2	12.9
ECC_14	21.95	2.822	9.8	0.05	4.7	5.6	9.3	0.02	5.5	23.0
ECC_16	27.89	2.479	10.5	0.06	4.3	5.1	7.2	0.05	5.2	19.3
ECC_18	20.82	0.757	19.2	0.09	12.0	11.1	8.4	0.04	13.4	27.9
ECC_20	21.99	0.784	12.3	0.06	9.6	6.4	6.6	0.03	9.4	25.2
ECC_22	19.96	1.204	13.0	<0.04	9.9	27.9	3.9	0.02	9.1	30.1
ECC_24	16.14	1.361	13.2	<0.04	5.7	4.9	3.8	0.02	5.6	32.5
ECC_26	17.8	1.522	21.3	0.05	7.0	6.4	9.1	0.05	9.1	34.4
ECC_30	17.58	0.421	36.9	0.06	12.0	8.2	9.1	0.03	14.3	42.1
ECC_32	14.38	2.588	12.8	0.08	6.6	6.3	5.9	0.05	23.8	38.0
ECC_34	28.36	2.341	8.1	<0.04	7.9	8.0	7.6	0.04	6.7	22.9
ECC_36	29.39	2.977	9.6	0.05	11.1	8.2	9.1	0.04	9.2	34.6
ECC_38	26.16	2.68	16.4	0.06	5.7	5.5	12.0	0.04	8.1	32.3
ECC_40	21.55	4.355	19.6	<0.04	12.6	8.3	10.2	0.04	15.0	38.3
ECC_43	11.4	3.585	22.9	0.25	16.2	10.4	8.6	0.08	19.8	46.3
ECC_45	12.19	4.951	24.0	0.11	21.1	13.5	9.1	0.04	22.8	53.9
ECC_47	14.23	0	17.8	<0.04	13.6	9.6	12.1	0.07	13.8	43.1
ECC_49	11.28	0	22.0	0.05	17.3	13.0	16.2	0.06	23.0	45.1
ECC_50	19.36	3.021	16.2	<0.04	10.5	8.3	10.6	0.04	10.2	30.6
ECC_51	9.95	0	72.0	0.09	55.7	10.2	9.5	0.12	40.4	57.5
ECC_54	17.3	0	13.7	<0.04	8.7	6.3	5.4	0.03	8.7	23.5
ECC_57	13.97	0	14.3	0.04	11.4	8.9	9.0	0.03	11.4	32.9
ECC_58	12.94	0	12.7	<0.04	10.0	8.1	11.3	0.03	9.3	33.5
ECC_60	10.13	0	20.3	0.05	16.9	11.6	15.2	0.04	18.0	46.7
Mean			**18.5**	**0.07**	**12.0**	**8.8**	**8.4**	**0.04**	**13.0**	**33.7**
SD			**12.4**	**0.05**	**9.5**	**4.4**	**3.2**	**0.02**	**7.9**	**10.5**
CV (%)			**67.0%**	**64.1%**	**79.3%**	**50.6%**	**38.6%**	**54.9%**	**60.5%**	**31.1%**
Maximum			**72**	**0.25**	**55.7**	**27.9**	**16.2**	**0.12**	**40.4**	**57.5**
Minimum			**6.2**	**0.04**	**4.2**	**4.6**	**3.4**	**0.02**	**3.2**	**12.9**
Regional Examples										
BSL SNS, 2019		**Mean**	**11.4**	**0.15**	**10.8**	**8.05**	**5.83**	**0.02**	**9.82**	**33.9**
		SD	**4.62**	**0.07**	**5.23**	**3.18**	**1.56**	**0.00**	**4.72**	**12.5**
		CV (%)	**40.7**	**48.9**	**48.5**	**39.5**	**26.7**	**20.3**	**48.1**	**36.9**
BSL SNS, 2020a		**Mean**	**15.0**	**0.14**	**47.9**	**8.09**	**11.0**	**0.03**	**12.9**	**38.5**
		SD	**3.44**	**0.04**	**7.66**	**2.62**	**2.18**	**0.01**	**4.98**	**16.2**
		CV (%)	**23.0**	**30.2**	**16.0**	**32.4**	**19.9**	**30.2**	**38.7**	**42.0**
BSL SNS, 2020b		**Mean**	**25.8**	**0.10**	**10.6**	**5.76**	**7.58**	**0.02**	**11.1**	**37.6**
		SD	**7.54**	**0.05**	**3.79**	**1.79**	**3.65**	**0.01**	**4.22**	**17.8**
		CV (%)	**29.3**	**45.3**	**35.8**	**31.0**	**48.1**	**47.1**	**38.1**	**47.3**
Reference levels										
UKOOA (2001) 50th Percentile SNS			-	0.03	6.5	2.0	6.0	0.02	4.0	12.2
UKOOA (2001) 95th Percentile SNS			-	0.72	44.8	13.9	21.0	0.05	21.5	35.8
TEL (CCME, 2001)			7.2	0.70	52.3	18.7	30.2	0.13	-	124
Cefas cAL1 (MMO, 2015)			20.0	0.40	40.0	40.0	50.0	0.30	20.0	130
NOAA ERL (Buchman, 2008)			8.2	1.20	81.0	34.0	46.7	0.15	20.9	150
SQGV (Simpson *et al.*, 2013)			20.0	1.50	80.0	65.0	50.0	0.15	21.0	200
PEL (CCME, 2001)			41.6	4.20	160	108	112	0.70	-	271
SQGV High (Simpson *et al.*, 2013)			70.0	10.00	370	270	220	1.00	52.0	410
NOAA ERM (Buchman, 2008)			70.0	9.60	370	270	218	0.71	51.6	410
Cefas cAL2 (MMO, 2015)			50.0	2.00	400	400	500	3.00	200	800

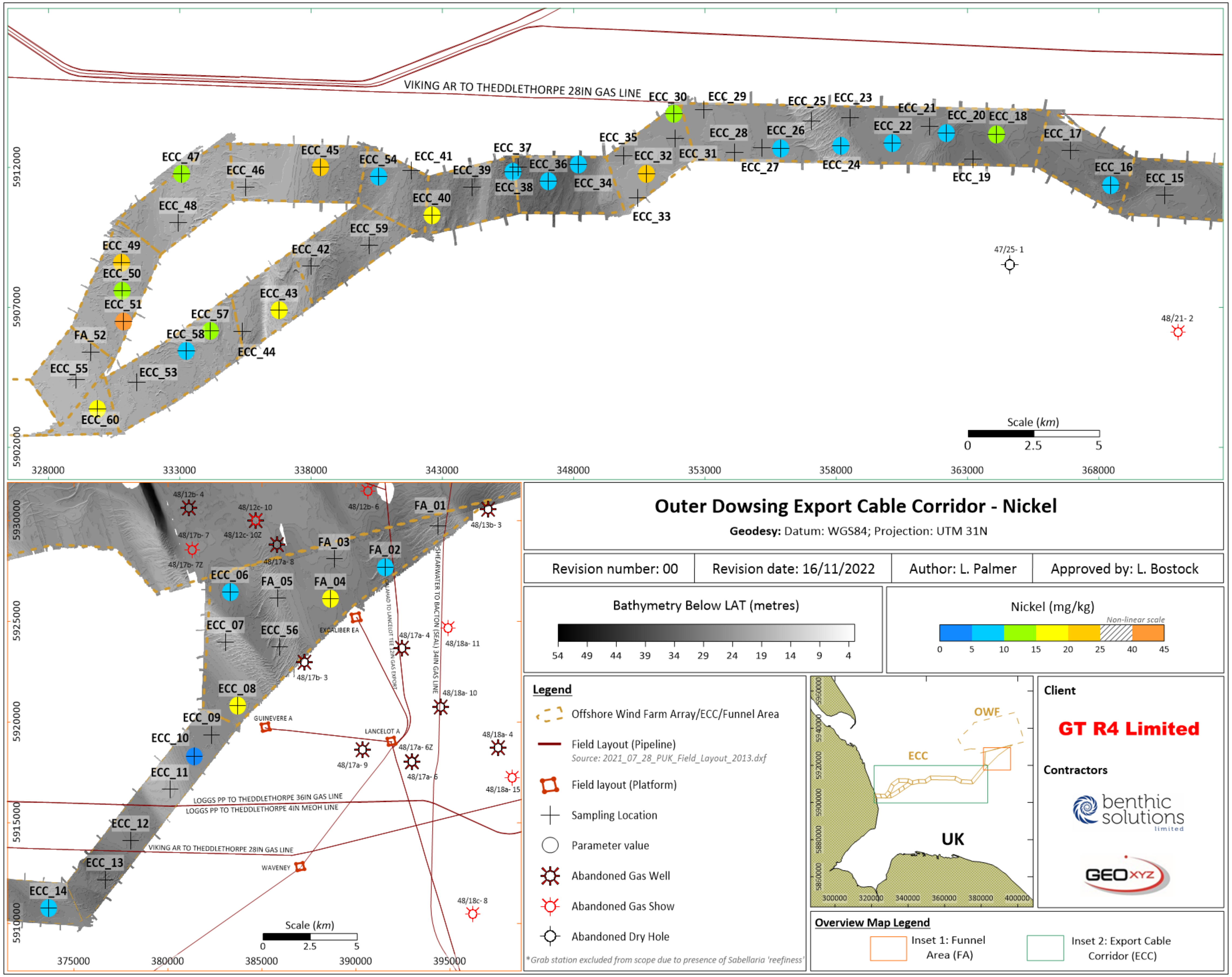


Figure 19: Concentration of Nickel

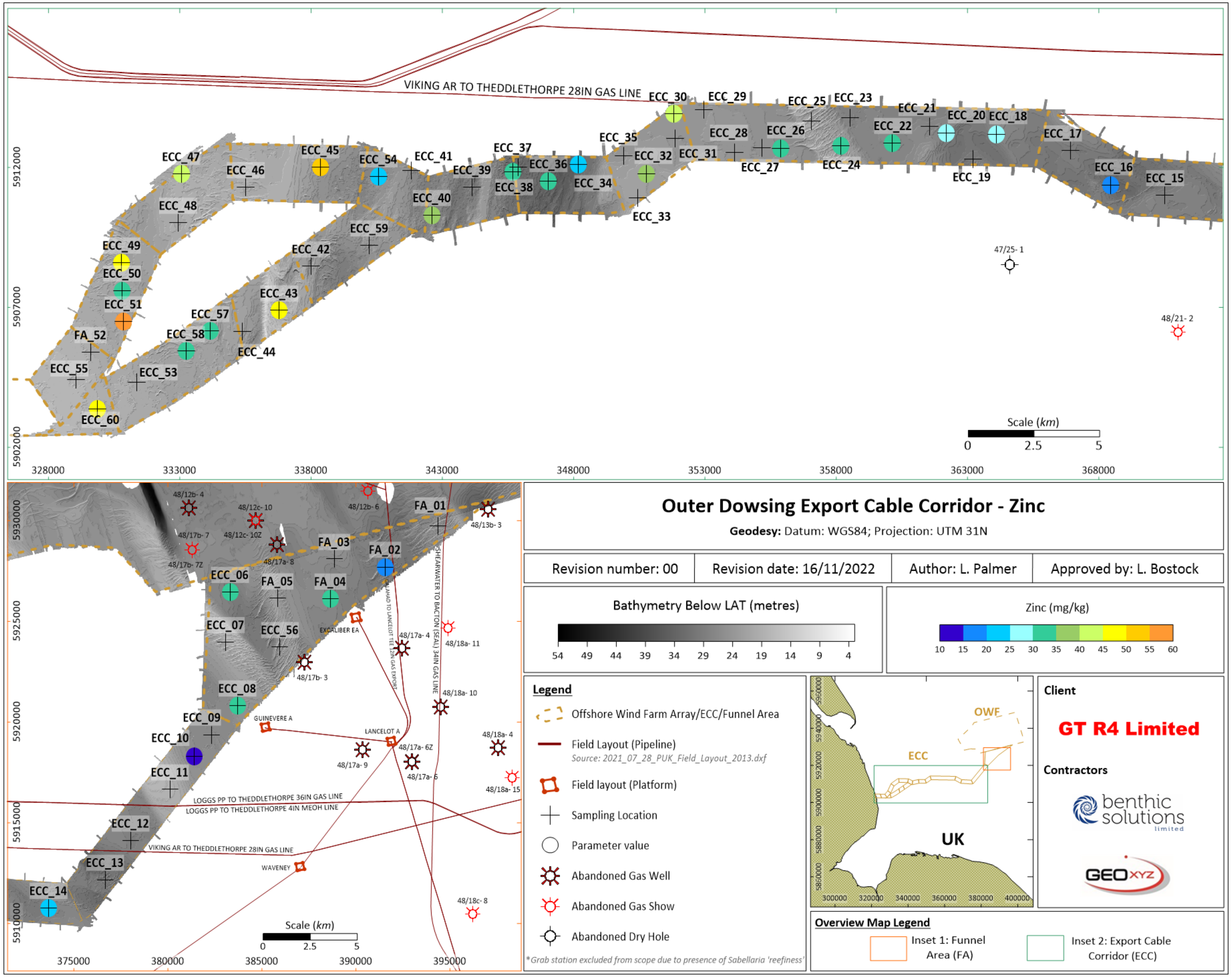


Figure 20: Concentration of Zinc

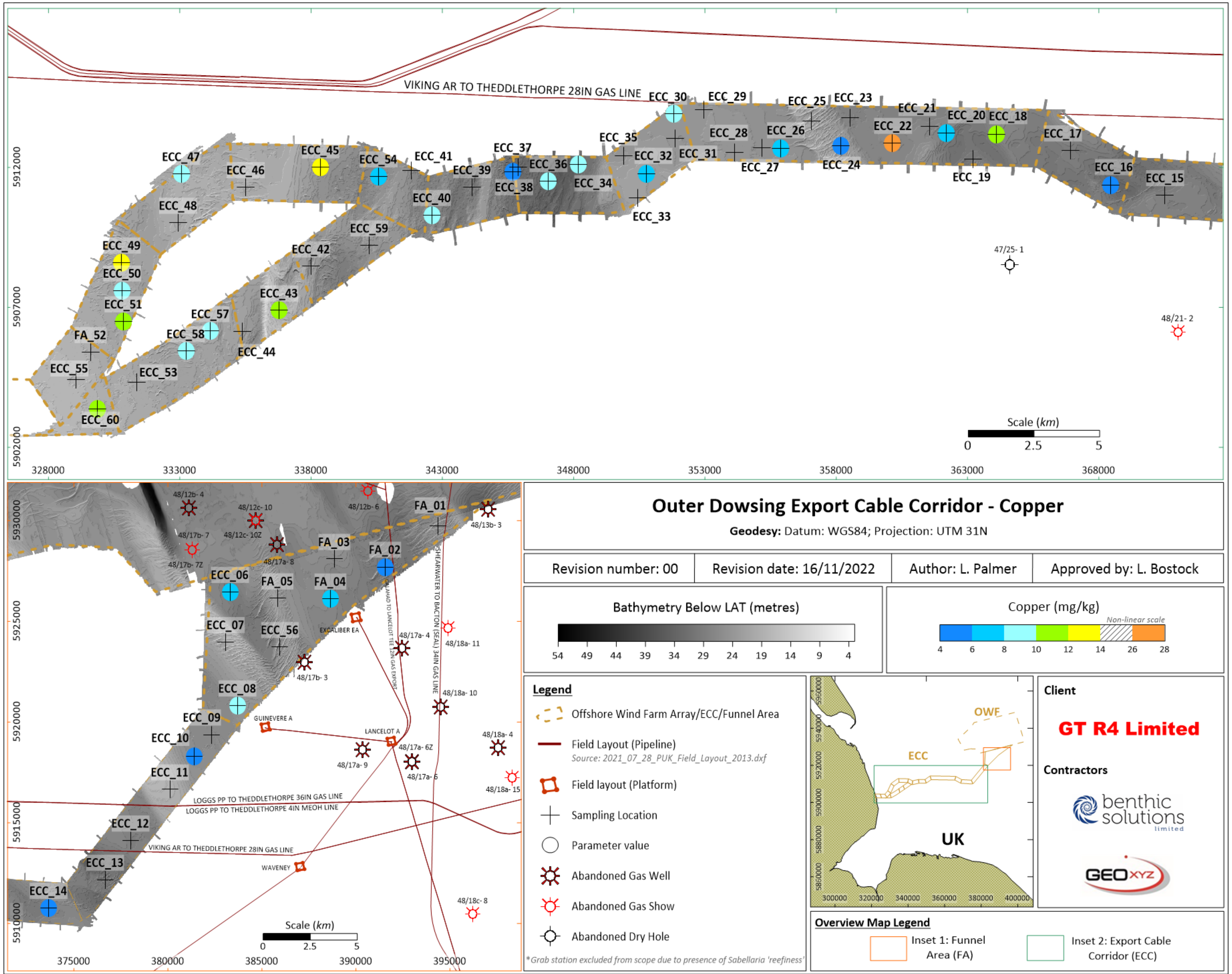


Figure 21: Concentration of Copper

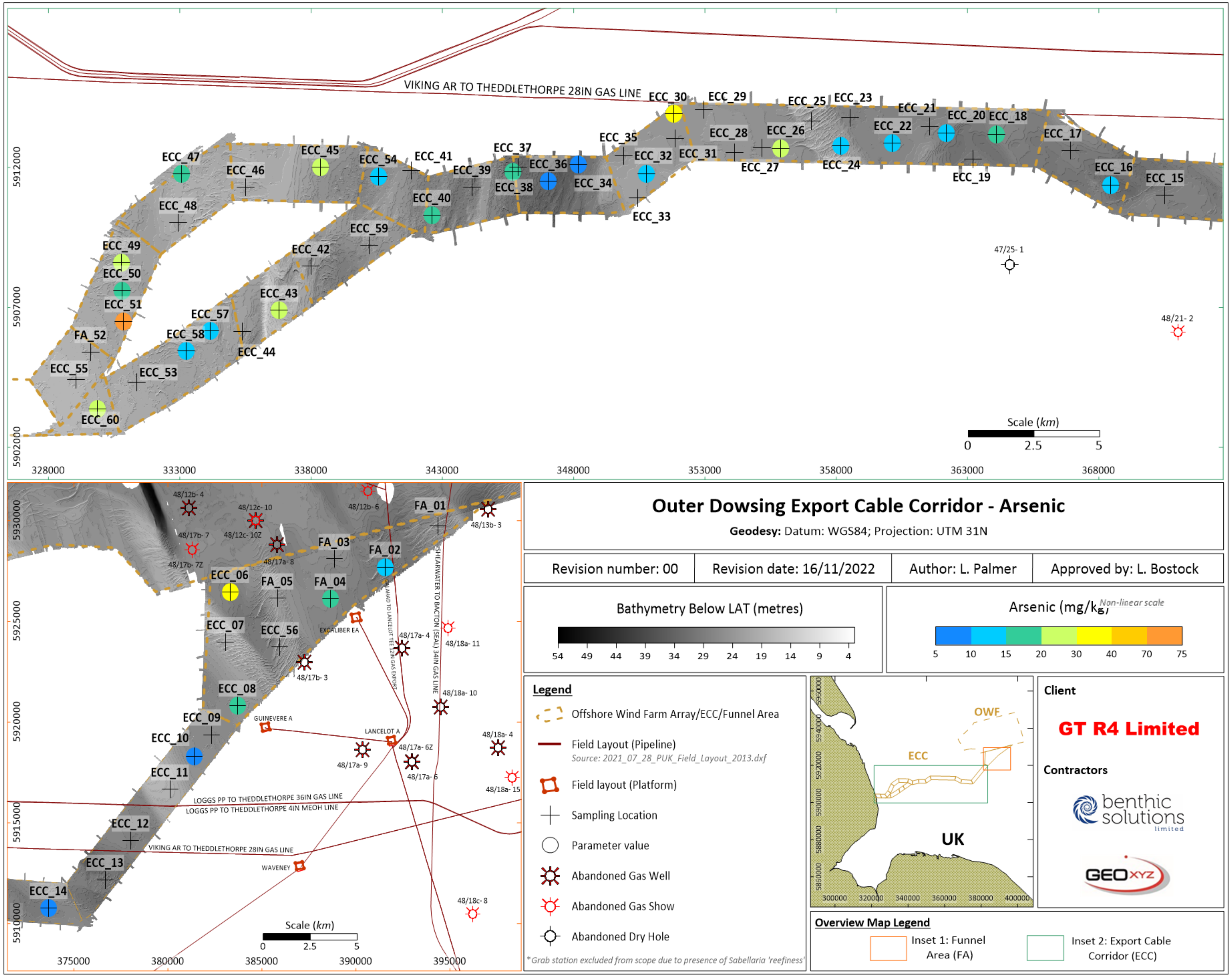


Figure 22: Concentration of Arsenic

4.6.2 Normalised Heavy Metals

a ANZECC and ARMCANZ Sediment Guidelines

As previously stated, the bulk properties of the sediment and the distribution of coarse grained material are closely related to the distribution of heavy metal concentrations across the ECC survey area (Musafa *et al.*, 1996). The ANZECC and ARMCANZ framework (see Section 2.5.3 and Appendix D) aims to assess contaminated sediment against a set of sediment quality guideline values (SQGV) to establish the level of risk to the biological community (Simpson *et al.*, 2013).

The framework dictates that all analysed metals are first assessed against the SQGVs following a total particular metal digestion, with results below their respective SQGVs deemed to constitute 'low risk', indicating the contaminant poses negligible risk of adverse biological effects (Simpson *et al.*, 2013). As shown in Table 23, all metals, with the exception of arsenic and nickel, were below their respective SQGVs and are deemed to be 'low risk' within the ECC survey area. Arsenic and nickel exceeded their SQGVs of 20mg.kg^{-1} and 21mg.kg^{-1} at eight and four stations, respectively, and as per the ANZECC and ARMCANZ framework, these levels are acceptable if the concentrations recorded are below the background levels determined from previous surveys close to the ECC survey area. Three previous SNS surveys conducted by BSL close to the ECC survey area had average arsenic concentrations of between 11.3mg.kg^{-1} and 25.8mg.kg^{-1} along with average nickel concentrations of between 9.8mg.kg^{-1} and 12.8mg.kg^{-1}. Arsenic concentrations at station ECC_51 surpassed the SQGV High threshold of 70 mg.kg^{-1}, which was much higher than those in previous BSL surveys in the area and the OWF survey, and nickel concentrations at ECC_51 were significantly higher than other stations. With the exception of this station, concentrations of arsenic and nickel were likely to reflect the upper limit of background concentrations for this region of the SNS. Furthermore, based on the ANZECC and ARMCANZ framework, the mean concentrations of arsenic and nickel were below their respective SQGVs, indicating that arsenic and nickel concentrations across the ECC survey area are deemed 'low risk' with 'negligible' effects to wildlife. However, it is worth noting that comparisons to SQGVs were limited due to partial strong acid extraction rather than a total metal extraction, which likely resulted in lower concentrations of extracted metals during the current study. However, it should be noted that Santoro *et al.* (2017) state differences in metal extraction metals can result in a 10% difference, which given the metal concentrations across the ECC survey area would result in concentrations well below their respective SQGV-high thresholds.

b OSPAR Coordinated Environmental Guidelines

Normalisation to a normaliser metal such as aluminium or lithium can be carried out in an attempt to standardise metal concentrations by filtering out the effect that variable clay and aluminosilicates will have on metal concentrations. Normalisation to lithium attempts to standardise metals data by filtering out the effect that variable clay content will have on metal concentrations and is considered a superior cofactor to aluminium for the normalisation of metal data from sediments derived mainly from the glacial erosion of crystalline rocks, such as those found in the southern North Sea. Glacially derived sediments tend to be enriched with T-O-T phyllosilicates which can amplify results if an aluminium normalisation is undertaken (Loring 1990; Herut and Sandler, 2006).

Normalisation for the full range of metals in line with the current Coordinated Environmental Monitoring Programme (CEMP) normalisation procedure, involving the use of pivot values, was not possible due to the absence of lithium analysis (OSPAR, 2008). However, due to the minimal proportion and variation of fines a lithium based normalisation may not have been entirely beneficial across the ECC survey area.

4.7 WATER CHEMISTRY

4.7.1 Total Organic Carbon and Total Suspended Solids

Water chemistry analysis was undertaken at one station at different levels in the water column (top, middle and bottom) and during the ebb and flow phases of the tide. total organic carbon (TOC) and total suspended solids (TSS) analyses was carried out on all samples (Figure 4).

Table 24: Total Organic Carbon and Total Suspended Solids from Seawater Samples

Sample	TOC (mg/l)	TSS (mg/l)
SF_WS_01 (FLOW)_TOP	1.27	9.0
SF_WS_01 (FLOW)_MID	0.79	<5
SF_WS_01 (FLOW)_BOT	0.99	<5
SF_WS_01 (EBB)_TOP	1.19	<5
SF_WS_01 (EBB)_MID	1.00	7.0
SF_WS_01 (EBB)_BOT	1.10	32.0

TOC was fairly consistent across the samples (0.79 to 1.27mg/l). Higher levels of TSS were found at the bottom of the water column during the ebb phase. This could be attributed to stronger bottom currents resuspending seabed sediments into the water column.

4.7.2 Water eDNA

Water eDNA analysis was also carried out on these samples. These results will be discussed in a separate eDNA report.

4.8 FAUNAL ANALYSIS

4.8.1 Grab Macrofaunal Analysis

Macrofaunal analysis was carried out on 59 single grab samples obtained from 59 stations across the ECC survey area. One station, ECC_29, was not sampled due to the presence of a potential *Sabellaria spinulosa* reef. The sediments were relatively variable across the survey area with 62.75% of the stations assigned to sand dominant classifications such as "Sand", "Slightly Gravelly Sand", "Gravelly Sand" "Gravelly Muddy Sand" and "Slightly Gravelly Muddy Sand", while the remaining stations (37.25% of the total) were assigned gravel dominant classifications such as "Gravel", "Sandy Gravel" or "Muddy Sandy Gravel". Macrofaunal samples were processed in the field and the lab over a 1mm mesh sieve.

For this assessment epifaunal species have been separated into two categories: solitary epifauna and colonial epifauna. Solitary epifauna includes specimens that, although epifaunal in nature, are recorded in low counts. As such, solitary epifauna are often considered to be less ecologically important components of the marine benthos; for this survey they consisted of solitary Cnidaria, Annelida, Arthropoda, Mollusca and Chordata individuals. Colonial epifauna are inclusive of encrusting epifauna which are generally recorded in high counts or as presence/absence. For this survey they include colonial Porifera, Cnidaria, Bryozoa, Entoprocta and Chordata. Within these analyses colonial epifauna have been omitted as they are often not possible to enumerate and therefore only assessed on a presence/absence basis; however, due to the importance of colonial epifauna at stations containing coarse sediments, the richness of this component of the macrobenthos is discussed separately in Section 4.8.1c.

Subsequent macrofaunal taxonomy of all recovered fauna identified a total of 6,352 individuals (infauna and solitary epifauna) from the 59 samples analysed. Faunal data for each sample are listed in Appendix I, whilst univariate analyses are summarised in Table 25. Of the 366 taxa recorded, 65 were colonial epifauna, 14 were solitary epifauna and 287 were infaunal. The infaunal taxa consisted of 130 annelid species accounting for 21% of the total individuals. The arthropods were represented by 89 species (17.7% of the total individuals), the molluscs by 51 species (9% of the total individuals), echinoderms by 9 species (1.8% of the total individuals), Chordata (inc. Hemichordata) by 3 species (<0.1% of the total individuals) and other phyla (Cnidaria, Nematoda, Nemertea, Platyhelminthes and Phoronida) by 5 species (2.2% of the total individuals). Solitary epifauna was represented by a single Cnidaria (Actiniaria sp.), a single Porifera (*Sycon ciliatum*), five Chordata (*Ascidiella scabra*, *Molgula* sp., *Dendrodoa grossularia*, *Polycarpa* sp., Styelidae sp.), four Annelida (*Sabellaria spinulosa*, *Hydroides norvegica*, *Spirobranchus lamarcki* and *S. triqueter*), two Arthropoda (*Balanus crenatus* and *Verruca stroemia*) and a single Mollusca (*Crepidula fornicata*). Four specimens of the lesser sandeel, *Ammodytes marinus*, were identified at station ECC_52 (fewer specimens also found at ECC_01, 05, 07 and 11). This species is a priority species under the UK Post 2010 Biodiversity Framework as it is considered an important food source for many commercial fish, seals and seabirds. Furthermore, the invasive non-native slipper limpet, *C. fornicata*, was identified frequently throughout the ECC survey area, most notably at ECC_18 (130 individuals) and ECC_60 (101 individuals). Slipper limpets can form dense aggregations, which can compete for space and smother native benthic fauna.

The fluctuation in accumulation of taxa with each new sample and hence heterogeneity across the survey area was demonstrated by a species accumulation curve as shown in Figure 23. The species accumulation curve as sampled in this figure demonstrates the variable but incremental increase in recorded species as additional samples were acquired. The sharp increase in species at sample two (ECC_02) was due to sampling an area of *Sabellaria spinulosa,* where a large number of individuals were counted. This suggests that the population was diverse with a relatively high species richness being recorded in every new sample. This analysis estimated the maximum species accumulation (Chao-1 curve) for the survey area to be 364 species, compared to the actual 301 infaunal species recorded during the survey. The number of species recorded exceeds the representative portion of the population (i.e. 67% or 244 species) meaning no additional replicates would be required. The current survey discovered 301 infaunal species with over two-thirds (83%) of the population represented.

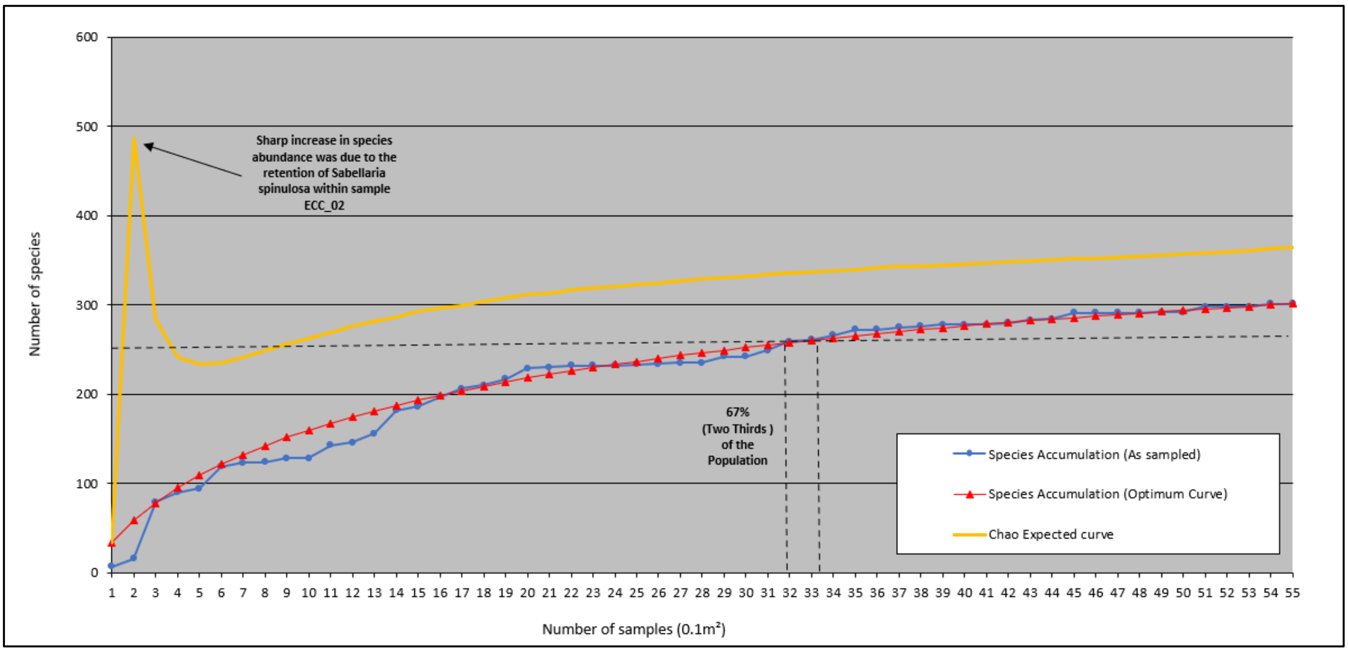


Figure 23: Species Accumulation Curve of ECC Survey Area

With the exception of species that have been intentionally grouped into higher taxonomic levels (e.g. Nematoda, Nemertea, Platyhelminthes etc.), the majority of adult specimens were identified to genus level or lower (~96%). A total of 25 juvenile taxa (including eggs) were recorded during the current survey area, of which Chordata (414 individuals), Mollusca (166 individuals), Arthropoda (35 individuals) and Echinodermata (ten individuals) were the most abundant. It was not possible to ascribe these specimens to a particular species at this stage in their lifecycle, and as such have been usually grouped to order level. Juveniles are often excluded from community analyses due to their high mortality prior to reaching maturity and difficulties in distinguishing species of the same genus. Consequently, they tend to induce a recruitment spike at certain times of the year due to rapid settlement and colonisation but are essentially an ephemeral part of the population masking the underlying trends within the mature adults. Similarly to juveniles, nine damaged specimens could not be ascribed to a particular species and could potentially add processing bias to the macrofaunal dataset. These specimens have, therefore, been excluded from univariate and multivariate analyses but have been listed separately in Appendix I.

Nematoda have been included in macrofauna analysis, as they can often serve as indicators of organic enrichment. However, as Nematoda vary in size, the estimates of its abundance may not be entirely accurate, with some likely to have passed through the 1mm sieve during macrofauna sample processing.

a Primary and Univariate Parameters

The primary and univariate parameters for all stations are listed in Table 25 and graphically represented in Figure 24 and Figure 25.

The number of individuals per 0.1m^2 was highly variable across the ECC survey area (Table 25), ranging between 7 per 0.1m^2 at station ECC_45 to 1554 per 0.1m^2 at station ECC_36 (Figure 25). The variation is also evidenced by a relatively high coefficient of variation (124.06%). The number of species per 0.1m^2 sample was also variable, ranging from 5 species per 0.1m^2 at station ECC_25 to 81 per 0.1m^2 at station ECC_37 (Figure 24).

The variation in the number of individuals and species was unsurprising given the variability in sediment composition observed across the ECC survey area, which was corroborated by significant negative Spearman's correlations between the number of species and individuals to the proportion of sand along with a significant positive correlation to the proportion of gravel (Appendix K; $p<0.05$). The number of individuals and species also positively correlated with TOC, indicating organic enrichment, however, number of individuals and species did not correlate with ∑16PAH and ∑22PAH (Appendix K; $p>0.05$). However, as previously discussed, the TOC across the survey area were generally low and would have less of an impact on the macrofaunal community, so these parameters are likely to be autocorrelated to other factors such as sediment composition (Appendix K), as indicated by stronger Spearman's correlations between these parameters.

The highest number of species and third highest number of individuals recorded at station ECC_37 could be attributed to the presence of *Sabellaria spinulosa*, as *S. spinulosa* aggregations can act as refuges for marine species and hence create localised hotspots of biodiversity (see Section 4.9.2b).

Table 25 displays the UKOOA predicted macrofauna parameters for three environments. Due to the abundance of both sand and gravel in the survey area, both sediment types are provided in the table, as well as the expected values for the general SNS area. When comparing the abundance of individuals and species to UKOOA background levels for the SNS, the current survey had an average lower than expected species abundance (33.0±24.7SD species) and a similarly low individual abundance with 266.3±330.3SD individuals compared to a predicted 37 species and 334 individuals. Abundance of species were also lower than those given by UKOOA for gravel and sand substrata, abundance of individuals was only lower than those given by UKOOA for sand. However, only four samples were included in the creation of gravel community predictions, as opposed to >200 for the creation of the sand habitat background macrofauna levels, highlighting the uncertainty in the values provided for gravel communities.

Margalef's Index, a measure of species richness, was highest at station ECC_15 (12.23) and lowest at station ECC_25 (1.36; Table 25). The denuded community at ECC_25 may relate to the dominance of medium and coarse sand sampled from sandwaves, which are naturally characterised by impoverished faunal communities (JNCC, 2020), although the macrofaunal community at this station would still be considered to be species-poor in comparison to other stations with similar sediment type (PSA cluster '*b*'). In contrast, ECC_15 had a higher species richness due to the inclusion of cobbles and pebbles at this station, which provided additional attachment for the colonisation and establishment of solitary epifauna, contributing to an increased species diversity.

Simpson's Diversity Index was highly variable within the survey area, ranging from a minimum of 0.480 at station ECC_23a to a maximum of 0.972 at station ECC_26, with an average of 0.812±0.128SD indicating a variable but fairly diverse macrofaunal community (Table 25 and Figure 26). Pielou's Equitability differed from the Simpson's Index, with station ECC_57 having the lowest evenness at 0.383, compared to a maximum of 0.987 at station ECC_55 (Table 25). The Shannon-Wiener Diversity index showed the lowest diversity of 1.51 recorded at station ECC_25 compared to the highest recorded diversity of 4.73 at station ECC_56. The impoverished macrofaunal community at ECC_25 could be related to the coarse sand encountered at this station, supported by a significant negative correlation between percent sands and Shannon-Wiener Diversity (Appendix K; $p<0.05$), which could have limited the establishment of burrowing macrofaunal assemblages (Appendix F).

The macrofauna data obtained from three previous BSL surveys carried out in the SNS between 2019 and 2020 revealed similar univariate parameters to the current ECC survey. The previous surveys sampled two macrofaunal replicates per station, while the current survey required one sample per station. To account for this difference, the two replicates were averaged to enable for comparison between the previous and current ECC survey (Table 25). Species richness across the ECC survey area was comparable the values of the previous surveys, ranging from 8 to 29 species per $0.1m^2$ however, species abundance across the ECC survey area was much higher than previous studies (22 to 157 individuals per $0.1m^2$). The disparity between the current survey area and previous studies may be related to the high numbers of *Sabellaria spinulosa* throughout the survey area, as previously discussed. The previous surveys also had species richness and individual abundance below the respective UKOOA values for the SNS, apart from BSL SNS 2020a which showed abundances slightly above the UKOOA 50^{th} percentile for SNS gravel habitat. Therefore, the macrofaunal assemblages within the ECC can be considered to reflect the ambient background conditions for this region of the SNS.

Table 25: Univariate Faunal Parameters (0.1m²)

Sample	Distance to Nearest Well (km)	Depth (m)	Number of Species (S)	Number of Individuals (N)	Richness (Margalef)	Evenness (Pielou's Evenness)	Simpson's Diversity (1-Lambda')	Shannon-Weiner Diversity
FA_01	2.78	18	7	16	2.16	0.927	0.867	2.60
FA_02	2.92	24	13	34	3.40	0.806	0.818	2.98
FA_03	3.12	19	67	481	10.69	0.583	0.745	3.54
FA_04	1.67	21	33	124	6.64	0.799	0.899	4.03
FA_05	2.68	15	10	35	2.53	0.879	0.871	2.92
ECC_06	2.88	23	54	327	9.15	0.726	0.863	4.18
ECC_07	4.13	11	9	13	3.12	0.955	0.936	3.03
ECC_08	No MF sample acquired (<40% retention)							
ECC_09	2.86	20	11	43	2.66	0.615	0.602	2.13
ECC_10	2.48	19	14	90	2.89	0.470	0.487	1.79
ECC_11	0.81	10	6	17	1.77	0.771	0.721	1.99
ECC_12	0.54	22	51	493	8.06	0.621	0.825	3.53
ECC_13	0.65	26	11	27	3.03	0.878	0.875	3.04
ECC_14	2.82	22	21	44	5.29	0.893	0.923	3.92
ECC_15	2.79	23	80	640	12.23	0.687	0.883	4.34
ECC_16	2.48	28	32	128	6.39	0.913	0.953	4.57
ECC_17	1.29	23	61	453	9.81	0.733	0.908	4.35
ECC_18	0.76	21	59	483	9.39	0.714	0.887	4.20
ECC_19	1.69	24	17	35	4.50	0.896	0.924	3.66
ECC_20	0.78	22	69	406	11.32	0.668	0.847	4.08
ECC_21	0.56	21	79	614	12.15	0.686	0.877	4.32
ECC_22	No MF sample acquired (<40% retention)							
ECC_23a	0.61	21	16	109	3.20	0.449	0.480	1.80
ECC_24	1.36	16	15	32	4.04	0.896	0.915	3.50
ECC_25	0.54	14	5	19	1.36	0.648	0.532	1.51
ECC_26	1.52	18	8	9	3.19	0.983	0.972	2.95
ECC_27	1.52	18	13	21	3.94	0.946	0.943	3.50
ECC_28	No MF sample acquired (<40% retention)							
ECC_29	Station excluded from scope due to presence of *Sabellaria* 'reefiness' presence							
ECC_30	No MF sample acquired (<40% retention)							
ECC_31	1.28	17	9	16	2.89	0.915	0.892	2.90
ECC_32	2.59	14	15	23	4.47	0.949	0.953	3.71
ECC_33	3.46	14	8	12	2.82	0.931	0.909	2.79
ECC_34	2.34	28	58	388	9.56	0.657	0.831	3.85
ECC_35	1.99	17	38	185	7.09	0.629	0.724	3.30
ECC_36	2.98	29	62	1554	8.30	0.434	0.655	2.58
ECC_37	2.49	28	81	1089	11.44	0.541	0.763	3.43
ECC_38	2.68	26	13	30	3.53	0.862	0.871	3.19
ECC_39	3.30	23	69	616	10.59	0.571	0.778	3.49
ECC_40	4.36	22	70	569	10.88	0.688	0.874	4.22
ECC_41	2.78	19	42	330	7.07	0.621	0.736	3.35
ECC_42	2.77	16	69	523	10.86	0.631	0.832	3.86
ECC_43	3.59	11	11	22	3.24	0.879	0.887	3.04
ECC_44	3.20	12	48	192	8.94	0.791	0.920	4.42
ECC_45	4.95	12	6	7	2.57	0.976	0.952	2.52

Sample	Distance to Nearest Well (km)	Depth (m)	Number of Species (S)	Number of Individuals (N)	Richness (Margalef)	Evenness (Pielou's Evenness)	Simpson's Diversity (1-Lambda')	Shannon-Weiner Diversity
ECC_46	0.00	14	7	16	2.16	0.809	0.775	2.27
ECC_47	0.00	14	23	110	4.68	0.813	0.891	3.68
ECC_48	0.00	13	46	370	7.61	0.601	0.724	3.32
ECC_49	0.00	11	36	869	5.17	0.469	0.571	2.42
ECC_50	3.02	19	66	444	10.66	0.633	0.819	3.82
ECC_51	0.00	10	19	66	4.30	0.660	0.711	2.80
FA_52	1.25	19	12	38	3.02	0.817	0.822	2.93
ECC_53	0.00	13	8	16	2.53	0.893	0.867	2.68
ECC_54	0.00	17	39	220	7.05	0.753	0.896	3.98
ECC_55	0.00	10	6	11	2.09	0.987	0.909	2.55
ECC_56	0.00	17	56	241	10.03	0.814	0.931	4.73
ECC_57	0.00	14	51	1105	7.14	0.383	0.521	2.17
ECC_58	0.00	13	6	12	2.01	0.822	0.758	2.13
ECC_59	0.00	12	37	322	6.23	0.512	0.623	2.67
ECC_60	0.00	10	39	556	6.01	0.557	0.737	2.95
Mean			**33.0**	**266.3**	**5.96**	**0.741**	**0.812**	**3.24**
SD			**24.7**	**330.3**	**3.32**	**0.162**	**0.128**	**0.79**
CV (%)			**75.0**	**124.0**	**55.7**	**21.8**	**15.7**	**24.4**
Minimum			**5**	**7**	**1.36**	**0.383**	**0.480**	**1.51**
Maximum			**81**	**1554**	**12.23**	**0.987**	**0.972**	**4.73**
Regional Comparisons								
BSL SNS, 2019		**Mean**	**18**	**74**	**4.37**	**0.823**	**0.856**	**3.25**
		SD	**12**	**105**	**1.66**	**0.157**	**0.155**	**0.680**
		CV (%)	**66.3**	**141.5**	**38.0**	**19.0**	**18.1**	**20.9**
BSL SNS, 2020a		**Mean**	**29**	**157**	**5.68**	**0.763**	**0.824**	**3.27**
		SD	**22**	**188**	**3.03**	**0.170**	**0.154**	**0.84**
		CV (%)	**75.2**	**119.7**	**53.3**	**22.2**	**18.7**	**25.7**
BSL SNS 2020b		**Mean**	**8**	**22**	**2.37**	**0.817**	**0.768**	**2.26**
		SD	**4**	**16**	**0.88**	**0.128**	**0.118**	**0.66**
		CV (%)	**49.5**	**69.9**	**37.3**	**15.7**	**15.4**	**29.3**
Reference levels								
UKOOA (2001) Background Gravel			34	116	-	0.830	0.910	4.20
UKOOA (2001) Background -Sand			65.	451	-	0.760	0.880	4.44
UKOOA (2001) SNS Mean			37	334	-	0.690	0.810	3.45

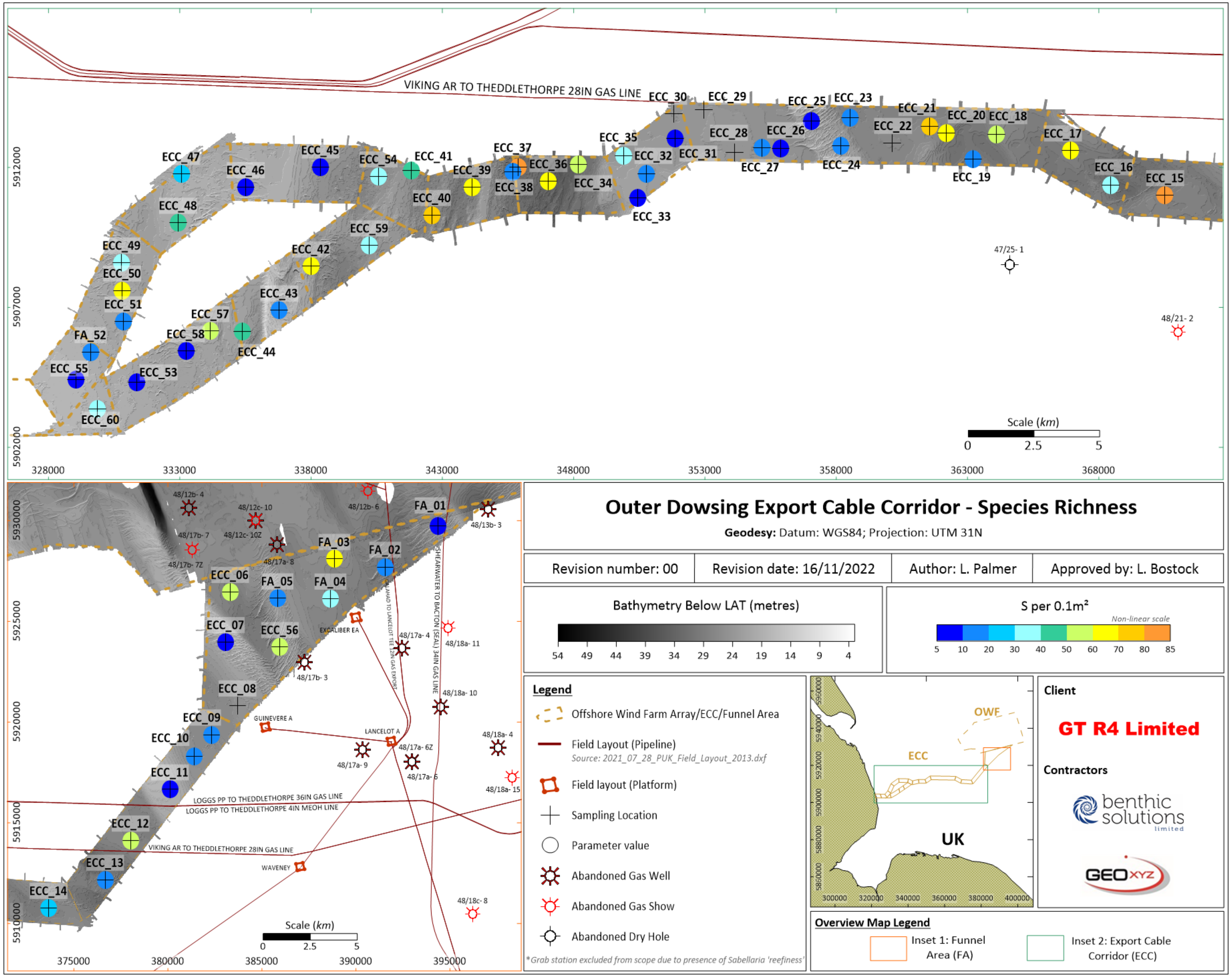


Figure 24: Macrofauna Species Richness (0.1m²)

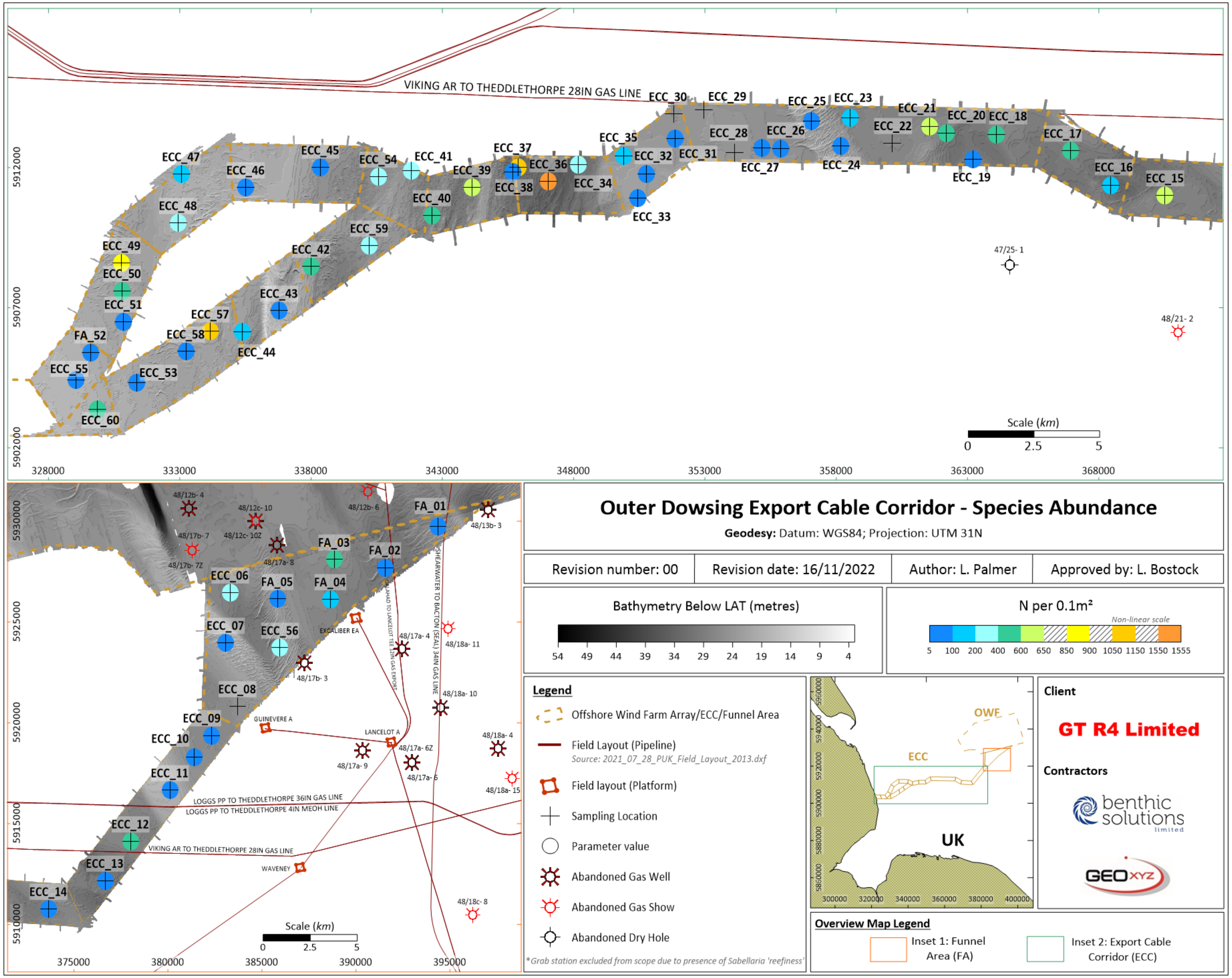


Figure 25: Macrofauna Faunal Abundance (0.1m²)

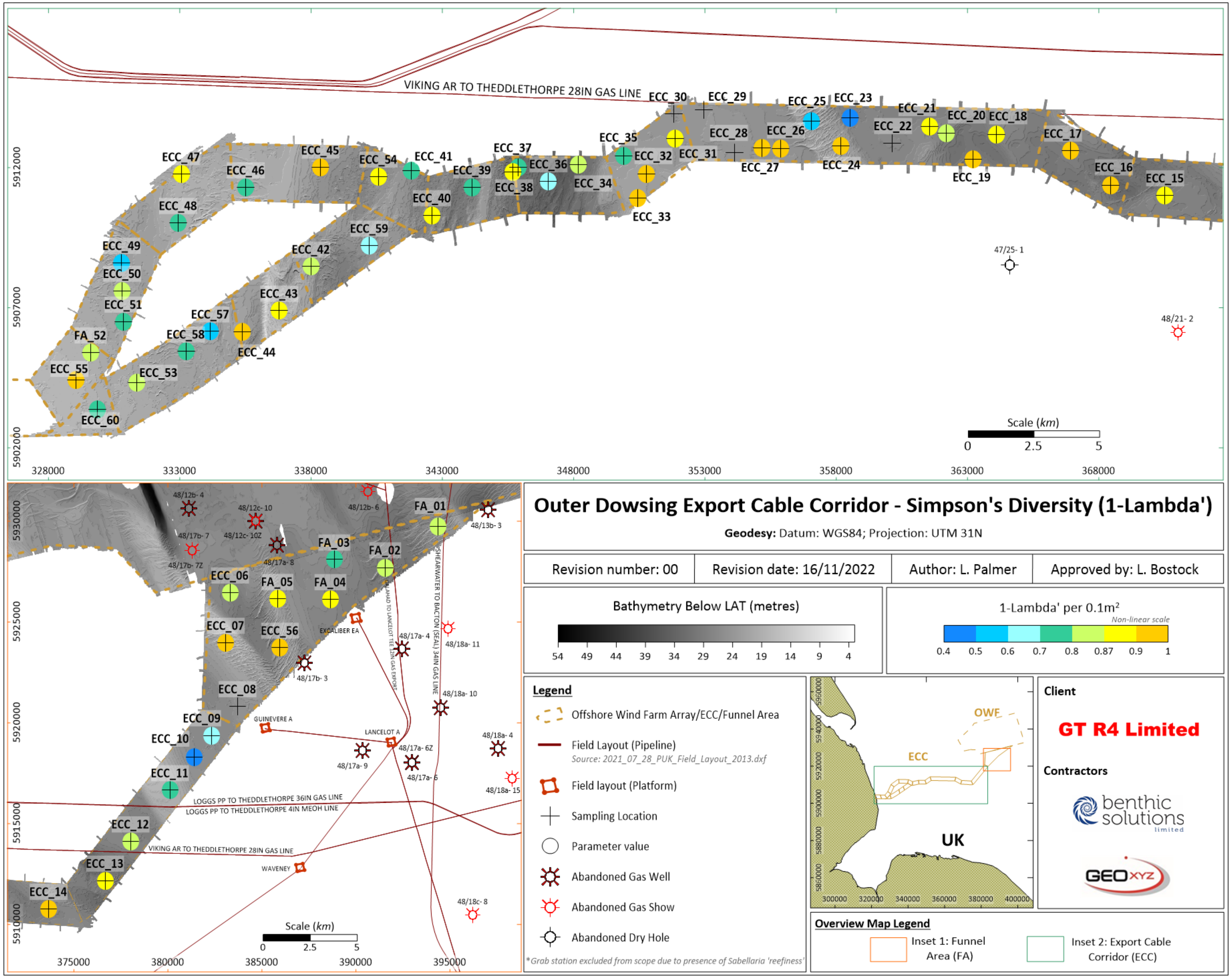


Figure 26: Macrofauna Simpsons Diversity (1-Lambda') per 0.1m²

b Multivariate Analysis

To provide a more thorough examination of the macrofaunal community, multivariate analysis was performed upon the replicate and station data using Plymouth Routines in Multivariate Ecological Research software (PRIMER 7.0.17; Clarke, K.R. *et al.*, 2014) to illustrate data trends. Unlike univariate or derived diversity indices, multivariate analyses preserve the identity of the different species by assigning a similarity or dissimilarity between the samples based on differences in the abundances of constituent species. All data were squared-root transformed prior to analysis to down-weight the influence of any overriding species dominance between sample similarities/dissimilarities.

Hierarchical Agglomerative Clustering – Group Average Method

A similarity dendrogram was created using hierarchical agglomerative clustering (CLUSTER) and is presented for all stations in Figure 27. SIMPROF analysis highlighted the presence of multiple significantly different ($p<0.05$) clusters which were differentiated by black branches, a slice was put in at 15 to simplify the data and show wider patterns in the dataset. This slice resulted in four different structural groups, which are interpreted below in Table 26. The dendrogram revealed little intra-cluster variability as the stations differentiated at a similar similarity level within each cluster group, indicating that the clusters had a high degree of similar macrofaunal assemblages. Overlaying the MESH sediment classification across the cluster groupings indicated that stations within cluster *'a'* predominantly comprised fine sand dominated sediments when compared to stations within clusters *'b', 'c'* and *'d'* which comprised coarser sediments (Figure 28). Cluster *'b'* comprised entirely of coarse sediment stations. However, coarse sediments were found throughout all macrofauna clusters, indicating that this sediment type had little impact on differentiation of the clusters. Stations within clusters *'c'* and *'d'* had similar MESH sediment classifications (mixed and coarse sediments) (Figure 28).

Table 26: Summary of SIMPROF Station Groupings

SIMPROF Group	Similarity (%)	Stations	Interpretation
'a'	26.16	01, 02, 05, 07, 09, 10, 11, 13, 23, 24, 25, 26, 32, 33, 43, 52, 53, 55, 58	The first cluster of stations primarily comprised stations with fine sandy sediments with several stations (53, 52, 09, 23, 32 and 26) conforming to a coarser sediment habitat classification and one station (43) classified as mixed sediment. The stations within the cluster had intermediate levels of abundances of individuals but low species richness when compared to the other clusters with *Ophelia borealis* accounting for 38.8% of the total number of individuals. This cluster could be considered to represent the finer sediment species poor macrofaunal assemblages.
'b'	20.64	14, 16, 19, 27, 31, 38	The second cluster contained six coarse sediment stations that were the most species rich but had relatively low abundances compared to other stations. These stations were dominated by *Ophelia borealis, Travisia forbesii* and *Glycera lapidum* which together accounted for 30.9% of the total number of individuals. This cluster can be considered to represent the variable coarse sediment macrofaunal assemblages across the ECC survey area.
'c'	35.33	03, 04, 06, 12, 15, 17, 18, 20, 21, 34, 35, 36, 37, 39, 40, 41, 42, 44, 47, 48, 49, 50, 51, 54, 56, 57, 59, 60	The third cluster of stations had intermediate levels of species diversity but the highest individual abundance. *Sabellaria spinulosa, Pisidia longicornis* and *Abra alba* had the highest abundances and accounted for 29.1% of the total number of individuals. This cluster can be considered to represent the variable mixed and coarse sediment macrofaunal assemblages across the ECC survey area.
'd'	37.36	45, 46	The sixth cluster contained two stations (45 and 46), one mixed and one coarse sediment classification, which were characterised by relatively low abundances of species and individuals compared to other stations, with *Eunereis longissima*, *Chaetozone zetlandica* and *Abra alba* accounting for 100% of the total number of individuals.

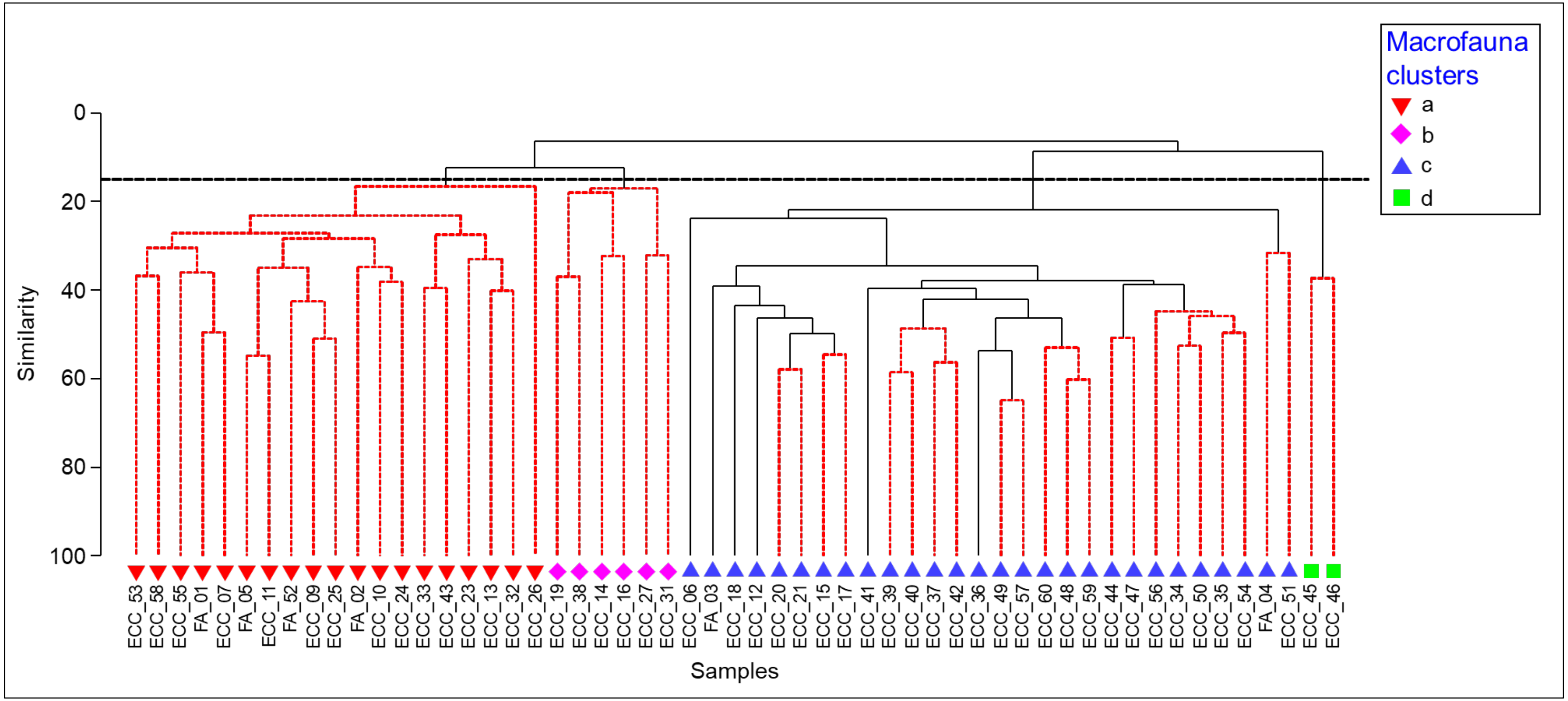


Figure 27: Dendrogram of Macrofaunal Stations (0.1m²)

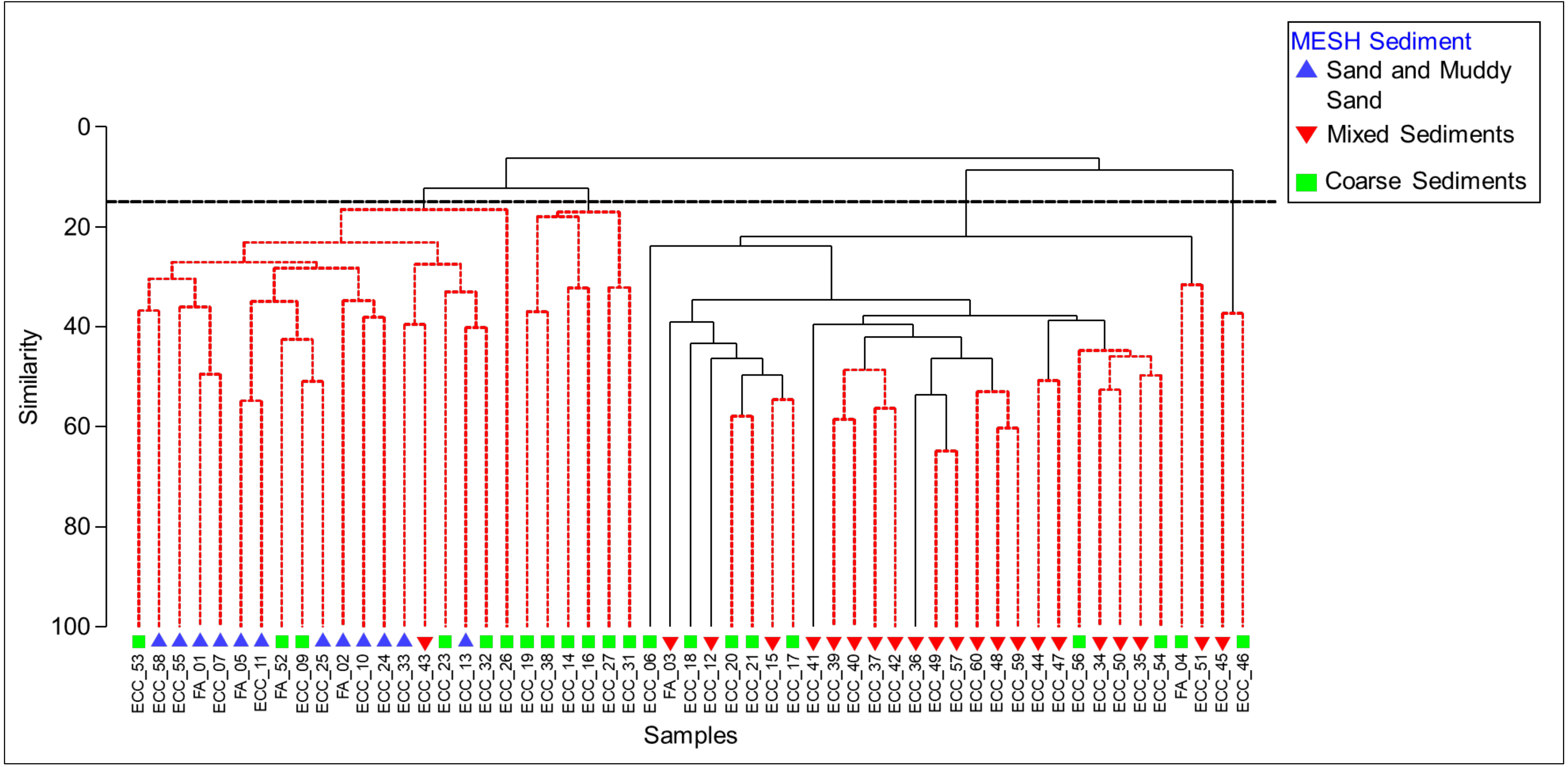


Figure 28: Dendrogram of MESH Sediment Macrofaunal Stations (0.1m²)

Non-metric Multi-dimensional Scaling (nMDS) Ordination

Similarities in the macrofaunal communities recorded across the ECC survey area are presented in Figure 30 as a 2-dimensional non-metric multi-dimensional scaling (nMDS) ordination. The nMDS plot revealed four different SIMPROF groupings with a moderate stress value of 0.15 (Figure 30). The plotted stations were fairly consistent to the clusters identified in the dendrogram (Figure 27), with cluster *'b'* grouping more tightly together, representing a higher proportion of mixed sediment dominated macrofaunal assemblages. Whereas the other clusters were more loosely grouped potentially due to variability in the coarse and fine sand fractions resulting in more variable macrofaunal communities.

The nMDS plot, overlain with the MESH sediment classifications, revealed cluster *'b'* macrofaunal assemblage were more likely to be influenced by differences in sediment composition due to the clear separation of cluster '*b*' stations according to sediment type (coarse). Clusters *'a'*, *'c'* and *'d'* showed less clear differentiation by sediment type, with more overlaps in sediment compositions, and hence were more likely to be differentiated based on macrofaunal assemblages. The geographical distribution of multivariate clusters is shown in Figure 31 and further corroborates the spatial variability in the macrofaunal communities which were not solely attributed to sediment composition or by extension the geophysical sediment delineations. For example, stations ECC_52 and ECC_56 were sampled at similar depths and had similar sediment types, but different macrofaunal communities. The macrofaunal communities present within each cluster grouping will be further explored in the sections discussed below.

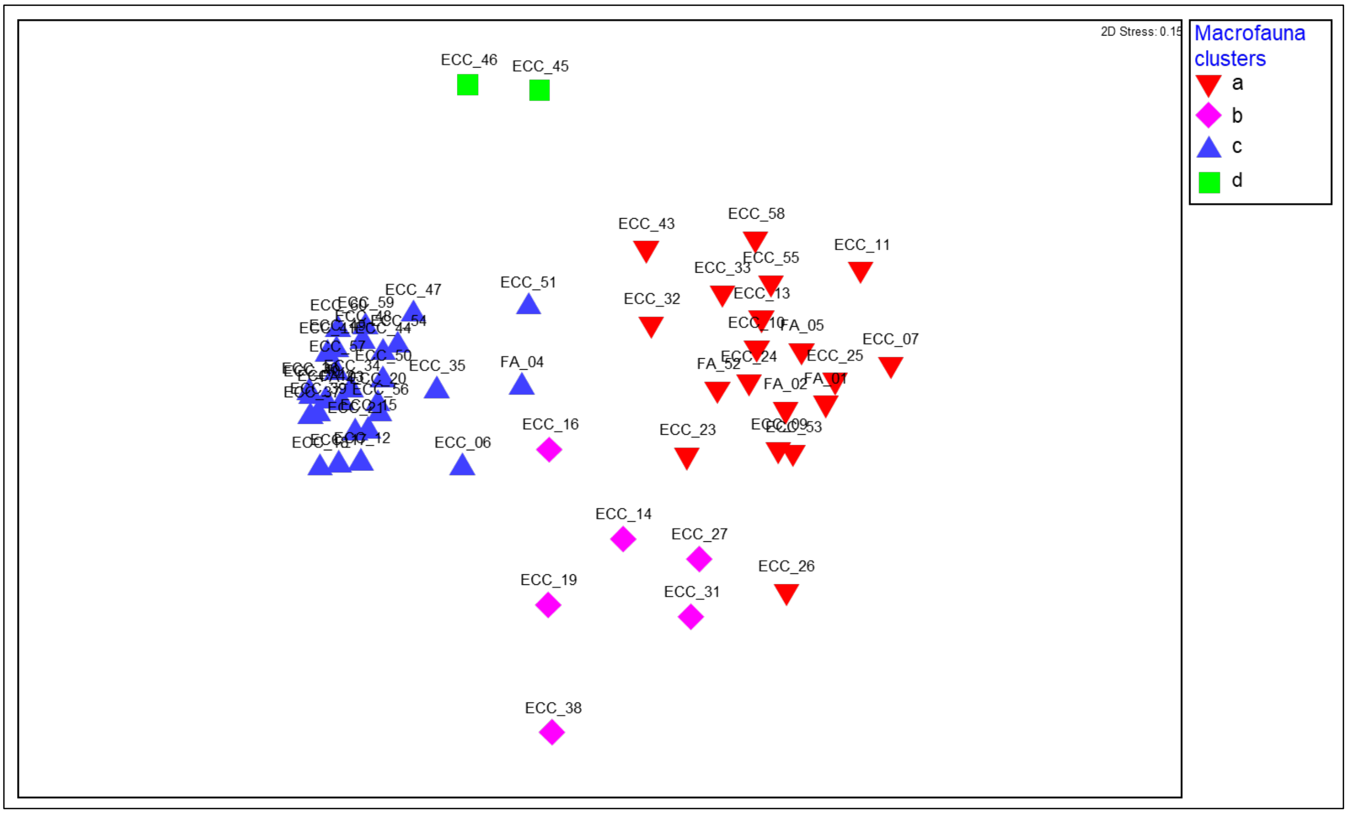


Figure 29: nMDS Ordination Plot of Macrofaunal Stations (0.1m²)

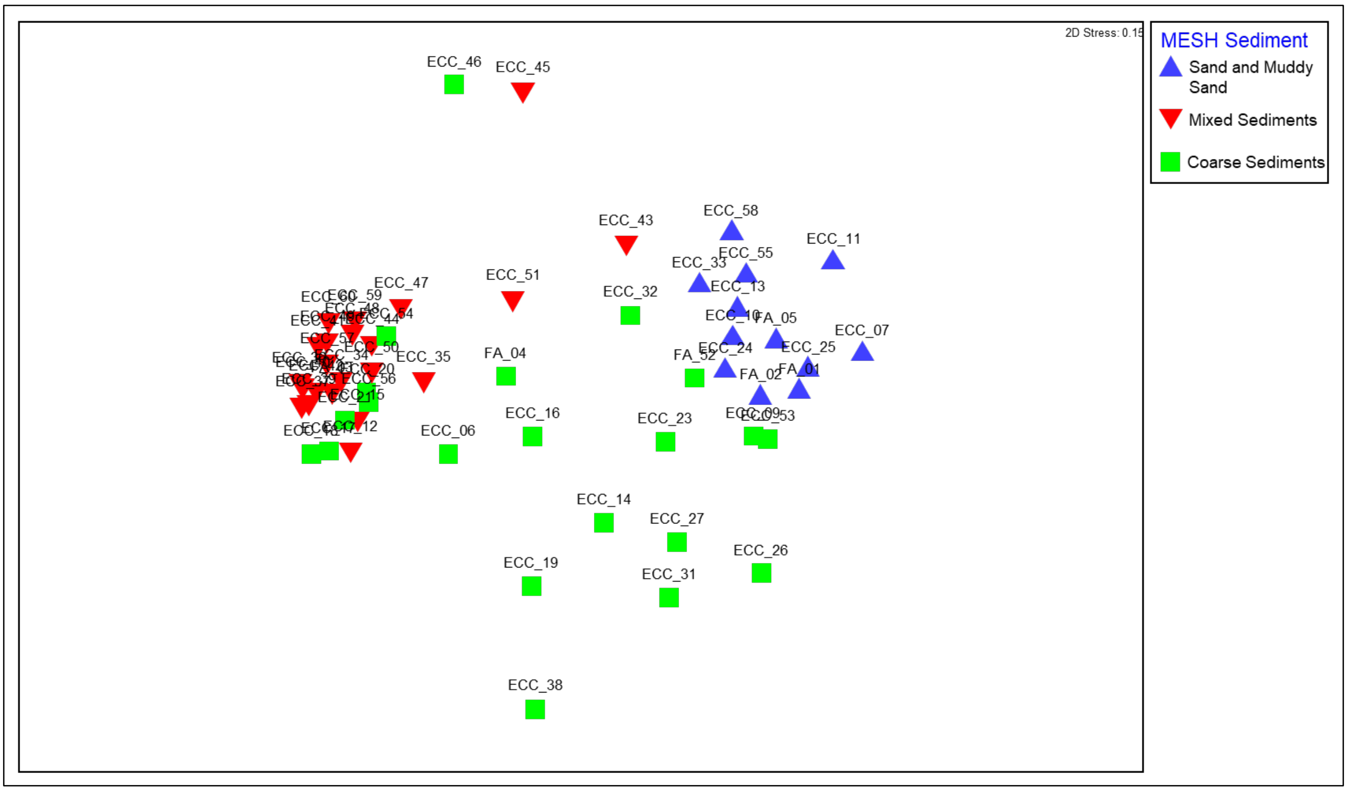


Figure 30: nMDS Ordination Plot of MESH Sediment Macrofaunal Stations (0.1m²)

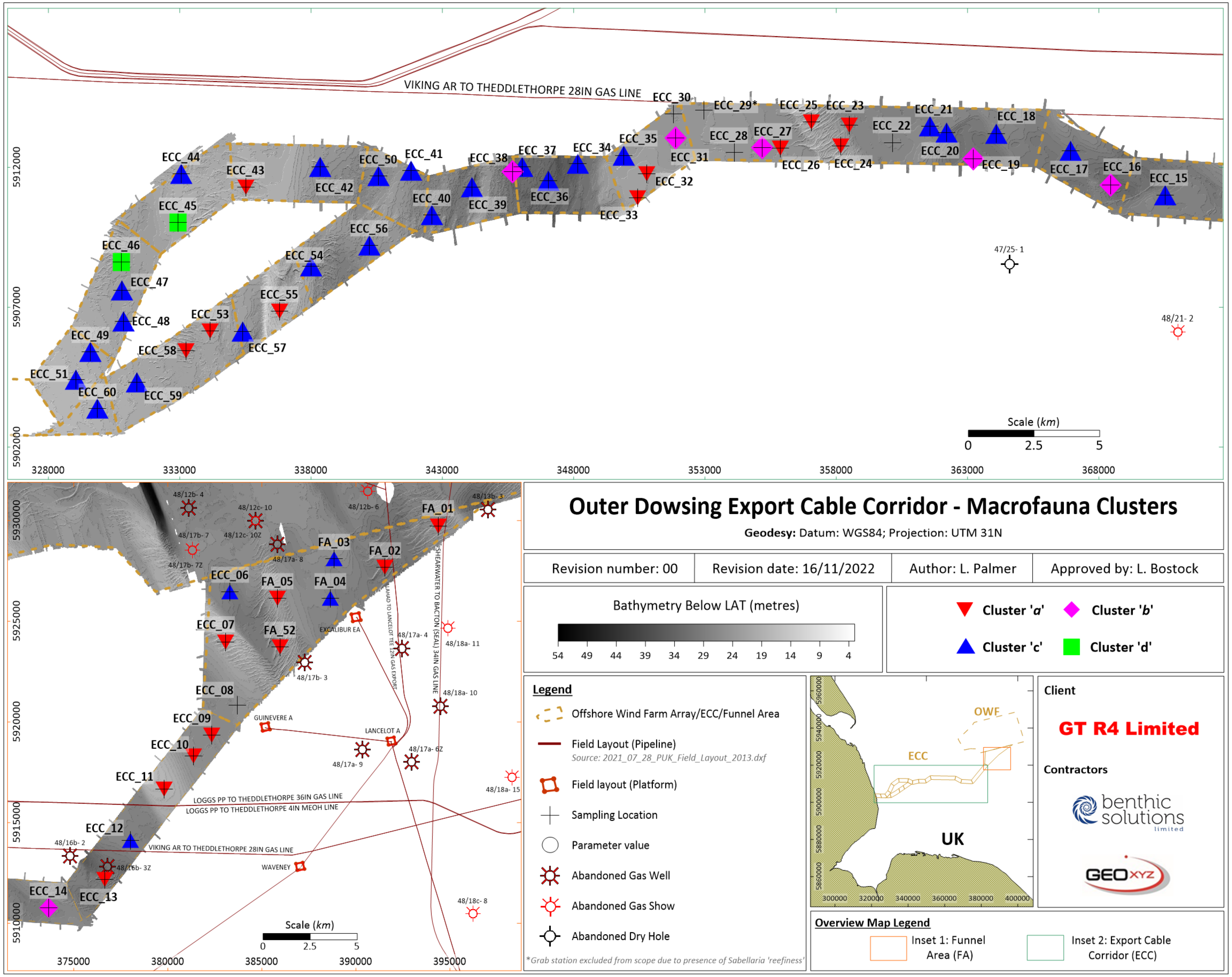


Figure 31: Macrofauna SIMPROF Groupings

Correlation with Environmental Variables

To assess whether the observed differences in community composition were a result of any relationships between the biological community and environmental parameters, such as sediment composition or the concentrations of metals or hydrocarbons, a series of RELATE tests (correlation tests) were performed.

A RELATE test between the macrofaunal and PSA phi fractions and PSA proportions (i.e. sands, fines and gravel) similarity matrices indicated a significant relationship with sample statistics of ϱ=0.344 *p*<0.001 and ϱ=0.5 *p*<0.001, respectively. To visualise this relationship a PCA was carried out on the PSA phi data overlain with clusters identified from the macrofauna dataset (Figure 32). The PCA plot highlighted that cluster *'a'* and cluster *'b'* were primarily influenced by the phi fractions 1 to 3 (fine to coarse sand), whereas cluster *'c'* was more heavily influenced by the phi fractions 0 to -3, and cluster *'d'* displayed more intermediate sediment composition.

The PCA plot further indicates that the influence of the PSA data on the macrofaunal dataset was not the only environmental driver of the dissimilarity between all the macrofaunal clusters. For example, coarser sediment stations, ECC_43, ECC_53 and ECC_32, influenced by phi fractions 0 to -3 were grouped within the primarily sand dominated macrofaunal cluster *'a'*. The stations in cluster *'a'* overlapped those of clusters '*b*' and '*d*', indicating that differences in faunal communities were not solely driven by differences in sediment type. Additionally, stations ECC_45 and 46, within the macrofaunal cluster *'d'* had different phi fractions to each other but similar phi fraction distributions to the other stations within cluster *'c'* and cluster *'a'* and *'b'*, respectively.

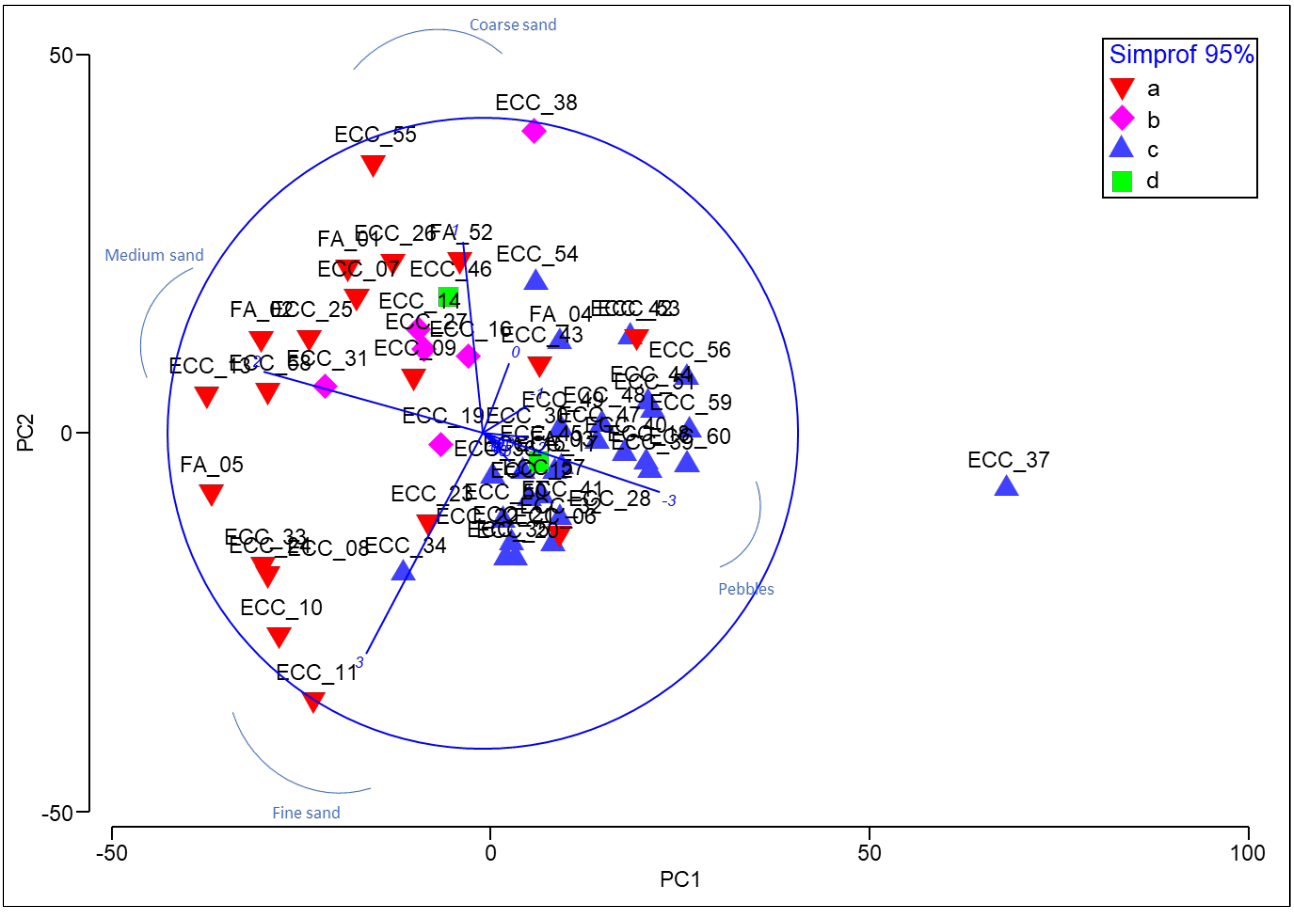


Figure 32: Principal Component Analysis of Phi PSA with Macrofaunal Clusters

Further RELATE tests were carried out between the macrofaunal dataset and separate subsets of PAH, TOC, and trace metal concentrations to further investigate any potential relationships between the benthic macrofauna and physico-chemical characteristics. These found a significant relationship between the macrofauna community data and TOC (ρ=0.23 p<0.001) but no significant relationship between trace metals or PAH. This correlation could indicate that TOC influenced the macrofaunal community variation observed within the survey area. However, the fact TOC showed only minor variation across the ECC survey area, suggests that this variable was unlikely to be significantly influencing the macrofaunal community differentiation observed. Therefore, it is unlikely that any point source contamination has significantly altered the macrofaunal community present within the ECC survey area. For example, station ECC_19 had the highest TOC concentrations but had a similar macrofauna community to the other stations with cluster *'b'*.

Inter-cluster Variation in Community Composition

To investigate the differing macrofaunal communities described by the identified multivariate clusters, the range in primary and derived univariate diversity indices for stations grouped within each cluster were calculated and are summarised in Table 27.

Stations within cluster *'c'* had some of the highest and the greatest range for numbers of species and individuals across the ECC survey area (19 to 81 species and 66 to 1554 individuals), while also representing stations with the highest Margalef's index (max 12.23) and Shannon-Wiener Diversity index (max 4.73). In contrast, cluster *'d'* had the lowest range of number of species and individuals (6 to 7 species and 7 to 16 individuals) and relatively low richness and diversities. Cluster *'a'* had the widest range of Pielou's Evenness and Simpsons Diversity index but had a relatively low number of species and number of individuals. Although each cluster had subtle differences between their respective univariate parameters, overlaps between the clusters was evident and indicates that more in depth review of the macrofaunal dataset is required to adequately describe the differentiation between the macrofaunal clusters.

Table 27: Overview of Univariate Parameters per SIMPROF Cluster

SIMPROF Cluster	Number of species (S)		Number of individuals (N)		Richness (Margalef)		Evenness (Pielou's Evenness)		Simpsons Diversity (1-Lambda')		Shannon Wiener Diversity	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
a	5	16	9	109	1.36	4.47	0.449	0.987	0.480	0.972	1.51	3.71
b	9	32	16	128	2.89	6.39	0.862	0.946	0.871	0.953	2.90	4.57
c	19	81	66	1554	4.30	12.23	0.383	0.814	0.521	0.931	2.17	4.73
d	6	7	7	16	2.16	2.57	0.809	0.976	0.775	0.952	2.27	2.52

Differences in the macrofaunal communities at a phyla level were explored by plotting the average percentage contribution of major phyla to the overall number of individuals and number of species within each cluster (Figure 33 and Figure 34). The results showed that half of the clusters were dominated by annelids, which is expected for habitats composed of sand with variable gravel and mud contents. There was a notable difference in the abundances of solitary epifauna, particularly for cluster *'c'* where these species accounted for a large proportion of the overall species abundance, due to the presence of *Sabellaria spinulosa*, and clusters *'b'* and *'d'* where solitary epifauna were in a very small proportion or completely absent. Additionally, other species were the dominant phyla in cluster *'d'* and had a much greater proportion in this cluster compared to cluster *'a'*, *'b'* and *'c'* due to the number of individuals of Nematoda in this cluster compared to the number of individuals for any other phyla. Cluster *'c'* was also lacking a significant proportion of annelids and crustacea. A maximum of 14 solitary epifauna taxa were recorded in cluster *'c'*, which was a major contributor to the community due to the 4,848 *S. spinulosa* individuals present. Discounting solitary epifauna, molluscs and echinoderms appeared to be the least abundant of all phyla, with the exception of cluster *'d'* where molluscs were more abundant than the annelids.

In terms of the contribution of phyla to the numbers of species, the clusters were fairly similar, suggesting that the differing abundances of phyla were more important for the separation of clusters (Figure 34). Cluster *'d'* was devoid of any solitary epifauna and Echinodermata, as discussed above. Clusters *'a', 'b'* and *'c'* were characterised by similar compositions of phyla, with Annelida accounting for the greatest proportion of the overall species richness, followed by colonial epifauna. Crustacea and Mollusca also represented a large portion of overall species richness and these groups.

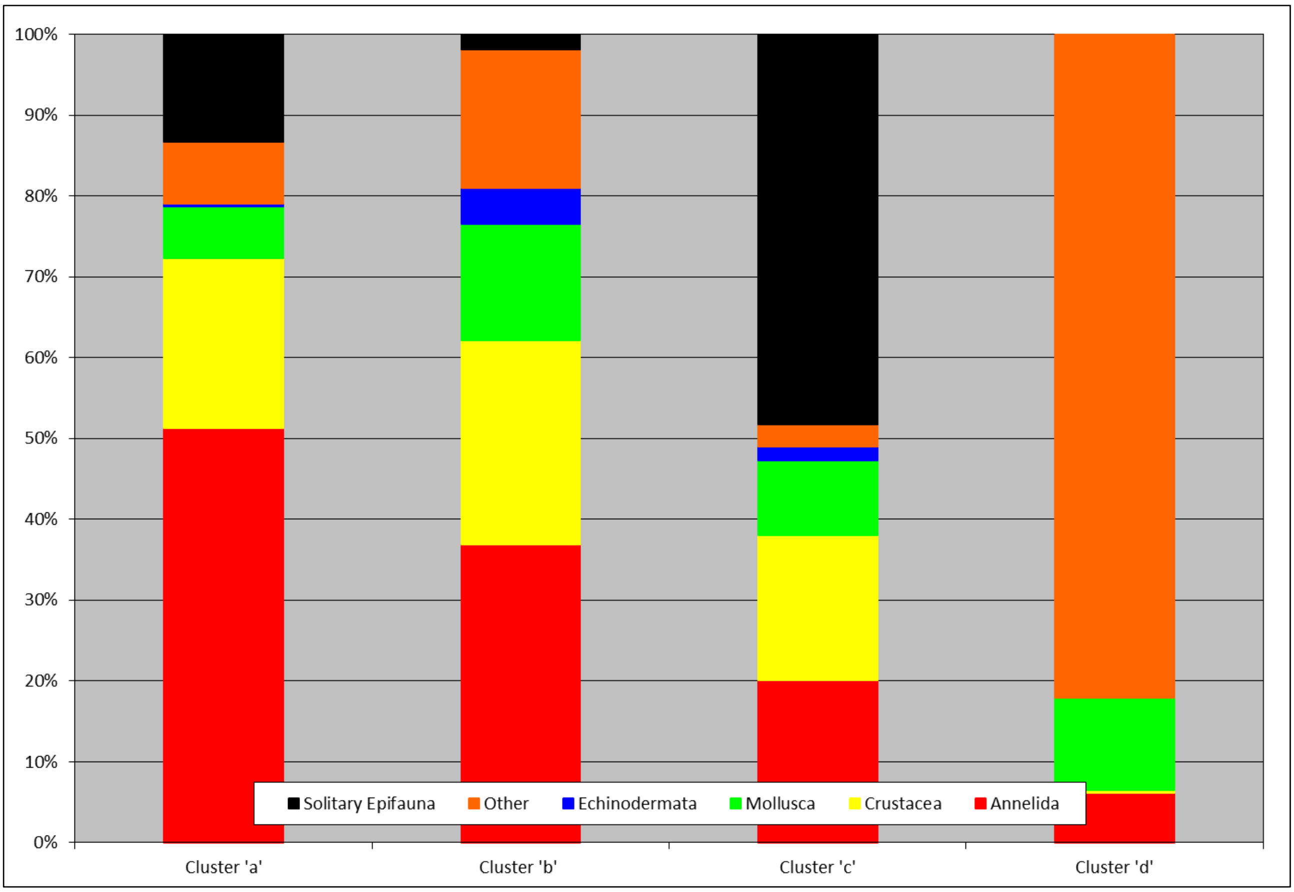


Figure 33: Average Contribution of Each Phyla to Total Faunal Abundance for Each Cluster

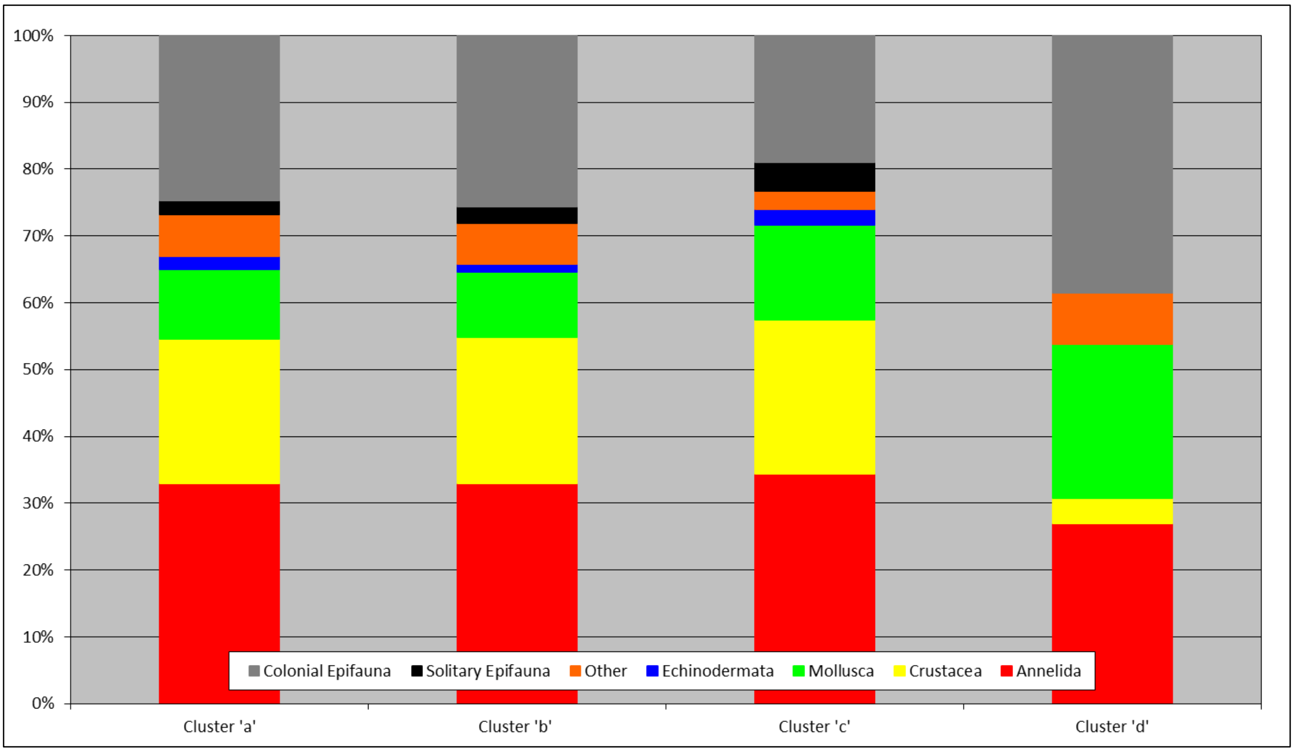


Figure 34: Average Contribution of Each Phyla to Total Number of Species for Each Cluster

Table 28 provides further information on the ecological parameters driving the separation of macrofaunal clusters across the ECC survey area. The contribution of different feeding groups was calculated using the Infaunal Trophic Index, developed by Codling and Ashley (1992). This revealed the dominance of suspension feeders (ITI 1) across the ECC survey area (Figure 35), with the exception of cluster *'d'* where surface detritus feeders (ITI 2) were the most dominant feeding guild and ITI 1 feeders were the least prominent. All clusters included representatives of all four trophic feeding guilds. Overall the ITI scores for each cluster reflected a changed and normal seabed. Clusters *'b'* and *'c'* had a predominantly 'normal' seabed due to the wide range of species recorded, influenced by the bristleworm *Ophelia borealis* (cluster *'b'*), an ITI 3 surface deposit feeder commonly found to inhabit sand dominated sediments, and the high numbers of *Sabellaria spinulosa* (cluster *'c'*).

The AZTI Marine Biotic Index (AMBI) is based on the proportion of disturbance-sensitive taxa, which are categorised into five ecological groups, depending on their dominance along a gradient of organic enrichment, and provides insights into the ecological quality status of soft-bottom marine benthic communities (WFD-UKTAG, 2014). The AMBI BC operates between 0 and 6, with lower numbers corresponding to higher or good ecological status (WFD-UKTAG, 2014). Just under half of the stations (49.1%) sampled scored <1, indicative of 'high' ecological status, while a similar proportion of stations (45.5%) scored between 1 and 2, indicative of 'good' ecological status and the remaining 5.5% of stations scored between 2 and 3, indicating 'moderate' ecological status. A "high" ecological status indicates the level of diversity and abundance of invertebrate taxa is within the range normally associated with undisturbed conditions, where species richness and diversity are high and all the disturbance-sensitive taxa associated with undisturbed conditions are present (WFD-UKTAG, 2014). Stations that were deemed to have "good" ecological status have slightly reduced species richness and diversity where most of the sensitive taxa of the type-specific communities are present (WFD-UKTAG, 2014). Whereas a "moderate" ecological status indicates a moderately reduced species richness and diversity where many of the sensitive taxa the type-specific communities are absent (WFD-UKTAG, 2014). The majority of stations with a "high" and "good"

AMBI ecological status indicates that the majority of the survey area is considered to be within background levels for species diversity and abundance, with a minority of stations classed as "moderate", indicative of slight pollution disturbance. For the ECC survey dataset, 'moderate' ecological status was assigned to the two stations grouped within cluster '*d*'. However, this result was likely due to cluster '*d*' stations being characterised by relatively low abundances of species and individuals compared to other stations and does not necessarily indicate any anthropogenic disturbance at these locations. The ecological status and hence degree of disturbance from anthropogenic pollution was unlikely to have differentiated the clusters, due to the overlaps in AMBI score between the cluster groups; therefore, it is likely the differentiation can be attributed to differences in community structure not accounted for during the AMBI and ITI analysis.

A comparison of the infaunal versus epifaunal richness within each cluster is provided in Table 28. The ECC survey area macrofaunal community, across all clusters, was dominated by infaunal taxa, with the exception of two stations grouped within cluster '*a*' (ECC_33 and ECC_55) that recorded 47.1% and 46.2% infauna, respectively. Clusters *'a'* and *'b'* had the highest maximum infaunal richness at 100%. Epifauna were a variable component of the benthic community, most likely reflecting the variable coarse sediment content, as evidenced by a low infauna/epifauna ratio of 0 for stations from clusters '*a*', '*c*' and '*d*'.

Table 28: Overview of Faunal Assemblage Parameters per SIMPROF Cluster

SIMPROF Cluster	ITI 1 Contribution (%)		ITI 2 Contribution (%)		ITI 3 Contribution (%)		ITI 4 Contribution (%)		ITI Score		AMBI BC Score		Ecological Status*		Infauna Richness (%)		Epifauna Richness (%)		Infauna / Epifauna Ratio	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
a	0	83.3	0	52.4	0	73.5	3	68.4	10.5	87	0.40	2.08	H	M	46.2	100	0	53.8	0	13.0
b	11.4	63.6	14.3	40	5.8	44.8	0	45.7	30.5	90	0.80	1.68	H	G	52.9	91.3	8.7	47.1	1.1	10.5
c	13.6	88.5	5.3	30.3	4.1	67.0	0	34.1	47.9	94.0	0.29	1.79	H	G	60.3	89.4	10.6	39.7	0	12.0
d	6.3	14.3	37.5	42.9	12.5	42.9	0.0	43.8	35.4	57.1	3.00	3.00	G	M	100	100	0	0	0	0

** M = Moderate, G = Good and H = High*

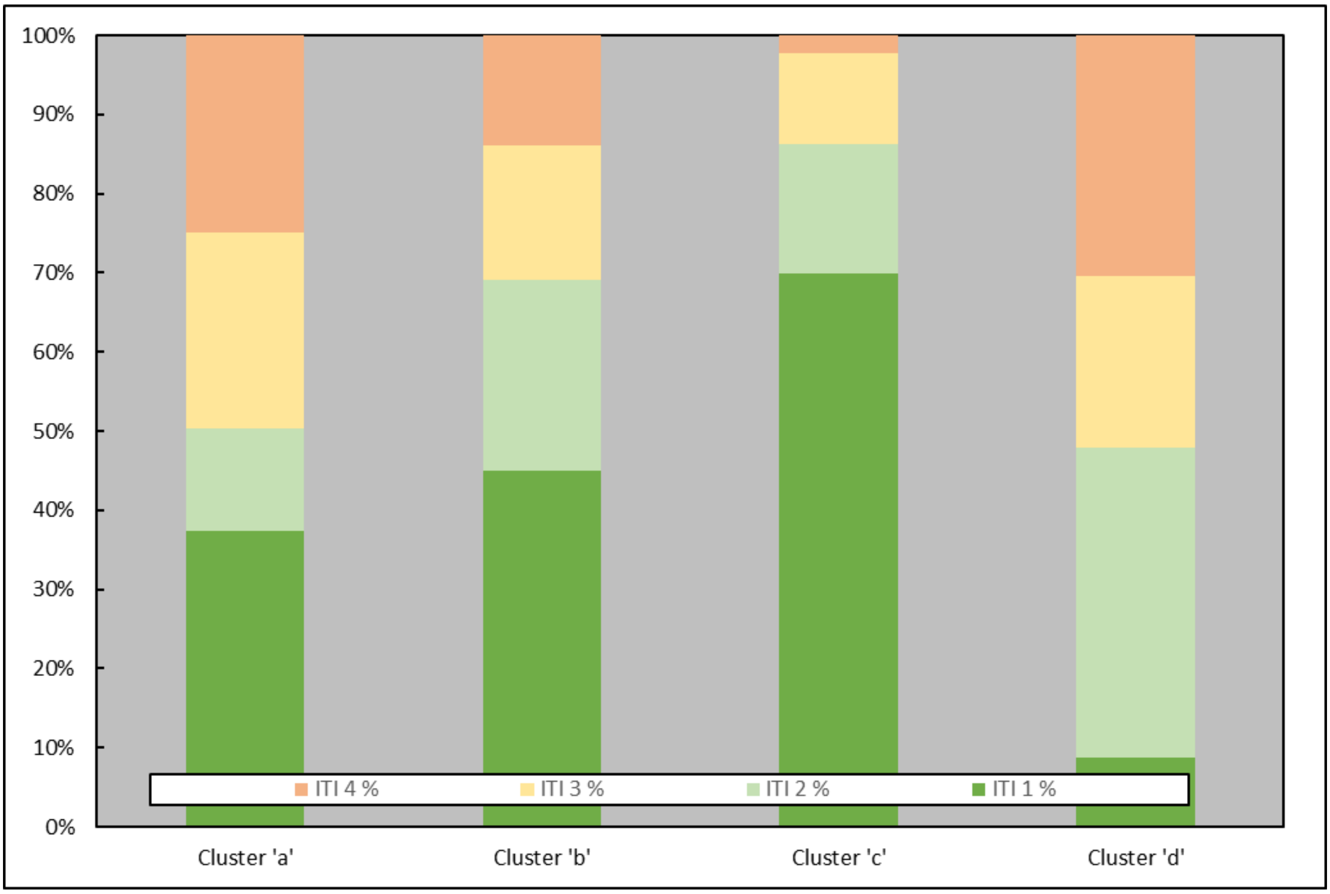


Figure 35: ITI Feeding Groups 1-4 Percentage Contribution per MF Cluster

To determine the species driving the differences between the five SIMPROF clusters identified from the macrofauna data, Table 29 presents the top ten species in each cluster together with their percentage contribution to the overall similarity within the cluster. Whereas Table 30 shows the top five species responsible for differences between clusters.

Table 29 highlights the similarities in the species assemblages represented by clusters *'a'*, *'b'*, *'c'* and *'d'*. Two clusters were characterised by the bristle worm *O. borealis*, with this species being the top characterising species for clusters *'a'* and *'b*. The ross worm, *Sabellaria spinulosa*, was the top characterising species for cluster *'c'*, showed a high average abundance of 173.14 per 0.1m^2 and contributing 18.28% to within cluster similarities. The absence of *O. borealis* and the presence of multiple characterising species that do not occur in any other group differentiated cluster *'c'* from the other six clusters. Variation was still apparent between the remaining clusters with only five characterising taxa shared between a maximum of two cluster groups, including *O. borealis*, *Abra alba,* Nemertea, *Polycirrus* and *Amphipholis squamata*.

Cluster *'b'* and *'c'* showed the least dissimilarity, sharing five (four each) of the same top 10 characterising species with other clusters (*O. borealis, Nemertea, Amphipholis squamata, Polycirrus* and *Abra alba*), however, the abundances of the shared species varied between the clusters. The variation between species abundances and contribution, along with the majority of characterising species differing for each cluster, explains the separation of the four clusters.

Review of the taxa most responsible for differentiating the four clusters (Table 30) included one dominating taxon (*Alba alba*), previously highlighted as characteristic for two out of four clusters, again suggesting that some differentiation was due to variability in the abundance of consistently dominant taxa, which could potentially be attributed to sediment composition as *A. alba* preferentially inhabits clean sands. Table 30 also showed *Sabellaria spinulosa* was the second most responsible taxa for differentiating the four clusters, separating cluster *'c'* from the other clusters.

As previously mentioned, cluster *'c'* separated from the other stations on the dendrogram (Figure 27) and nMDS (Figure 30), indicating variation in the stations macrofauna assemblage. This separation was deemed to be a result of the variable coarse and mixed sediment at these stations. On closer review, the stations forming cluster *'c'* were characterised by the dominance of the ross worm *S. spinulosa and* mollusc *Abra alba*. Therefore, the natural variation in taxa and underlying sediment composition across the ECC survey area are both likely to be influencing the differentiation of the macrofaunal clusters.

Table 29: Top 10 Species Abundances for Clusters *'a'*, *'b'*, *'c'*, *'d'* and *'e'*

Top 10 Species	Cluster *'a'*			Cluster *'b'*			Cluster *'c'*			Cluster *'d'*		
	Species	Av. Abundance	Contribution (%)	Species	Av. Abundance	Contribution (%)	Species	Av. Abundance	Contribution (%)	Species	Av. Abundance	Contribution (%)
1	*Ophelia borealis*	*6.37*	38.79	*Ophelia borealis*	2.17	15.33	*Sabellaria spinulosa*	173.14	18.28	*Eunereis longissima*	1.5	33.33
2	*Nephtys cirrosa*	1.58	15.94	*Glycera lapidum*	1	8.28	*Abra alba*	22.68	6.9	*Chaetozone zetlandica*	1	33.33
3	*Bathyporeia elegans*	4.63	7.31	*Protodorvillea kefersteini*	1.17	7.36	*Lumbrineris cingulata*	44.46	4.87	*Abra alba*	2.5	33.33
4	*Scoloplos armiger*		5.03	*Travisia forbesii*	1.67	7.32	*Pisidia longicornis*	15.79	3.92	-	-	-
5	*Glycera oxycephala*		3.90	*Lysilla nivea*	2.5	5.44	Nemertea	6.32	3.85	-	-	-
6				Nemertea	0.67	4.78	*Lanice conchilega*	13.68	3.66	-	-	-
7				*Leptocheirus hirsutimanus*	2.33	4.6	*Ampelisca spinipes*	5.04	3.06	-	-	-
8	-	-	-	*Amphipholis squamata*	0.67	4.53	*Polycirrus*	-	2.74	-	-	-
9	-	-	-	Polycirrus	0.67	3.6	Actiniaria	-	2.74	-	-	-
10	-	-	-	*Notomastus*	1.5	3.59	*Amphipholis squamata*	-	2.49	-	-	-

* = Less than two samples within the cluster
Dark blue shading = shared taxa across 4 clusters Light blue shading = sharded taxa across 3 clusters Orange shading = shared taxa across 2 clusters

Table 30: Dissimilarity Percentages (SIMPER) for Macrofauna Dataset

	Cluster *a*		Cluster *b*		Cluster *c*	
Cluster *d*	**Average dissimilarity 94.56%**		**Average dissimilarity 94.59%**		**Average dissimilarity 91.26%**	
	Ophelia borealis	9.73	*Abra alba*	5.07	*Sabellaria spinulosa*	9.62
	Abra alba	6.76	*Notomastus*	4.39	*Pisidia longicornis*	3.15
	Notomastus	5.86	*Ophelia borealis*	4.00	*Ampelisca spinipes*	2.4
	Eunereis longissima	5.6	*Eunereis longissima*	3.51	*Lanice conchilega*	2.38
	Nephtys cirrosa	4.85	*Chaetozone zetlandica*	3.38	*Abra alba*	2.3
Cluster *a*			**Average dissimilarity 87.69%**		**Average dissimilarity 94.60%**	
			Ophelia borealis	3.79	*Sabellaria spinulosa*	9.04
			Bathyporeia elegans	2.82	*Abra alba*	3.18
			Nephtys cirrosa	2.78	*Pisidia longicornis*	2.99
			Amphipholis squamata	2.62	*Lanice conchilega*	2.30
			Protodorvillea kefersteini	2.38	*Ampelisca spinipes*	2.23
Cluster *b*					**Average dissimilarity 90.28%**	
					Sabellaria spinulosa	8.28
					Abra alba	2.99
					Pisidia longicornis	2.73
					Lanice conchilega	2.29
					Ampelisca spinipes	1.93
Cluster *c*						

c Epifaunal and Other Biological Groups

All macrofaunal replicates obtained within the ECC survey area recorded the presence of colonial epifauna that were not statistically assessed within the infauna data analysis, as they were tabulated on a presence/absence basis. Due to the presence/absence scale to which epifaunal species were identified, for the purpose of this chart and to highlight the epifaunal richness; where epifaunal species were recorded as present this was given the numerical value of “1” to represent the colony. The distribution of epifaunal assemblages across the survey area is represented in Figure 36 and highlights the variation in infaunal and epifaunal richness. Analysis of the infaunal and epifaunal communities indicated that the infauna was dominant, with epifauna making up a very small, but important part of the community. While allowing the data to be presented, the actual abundance of epifaunal species cannot be determined. Infaunal and epifaunal species are listed separately in Appendix I.

Across the stations, 98 taxa were considered to be epifaunal which belonged to the phyla Porifera, Cnidaria, Annelida, Arthropoda, Mollusca, Entoprocta, Bryozoa and Chordata, most of which were Bryozoa. Bryozoa showed the highest number of species and were represented by 35 taxa with *Bicellariella ciliata* and *Conopeum reticulum* being the most prevalent recorded at 53% of stations. Cnidaria were represented by 22 taxa with *Sertularia* being the most prevalent at 44% of stations. Mollusca was represented by 13 taxa with the clam Myidae being the most prevalent appearing at 35% of stations. Arthropoda were represented by 11 taxa with Paguridae being the most prevalent appearing at 20% of stations. Annelida was represented by eight taxa with Polynoidae and Serpulidae occurring at 20% of stations. Porifera and Chordata were represented by three taxa each, with *Cliona* and *Perophora listeri* being the most prevalent. Entoprocta was represented by a two taxa and included 14 recordings of *Pedicellina* sp. at multiple stations.

Cluster *‘c’* had the highest richness of epifaunal taxa (95 taxa), this is expected due to the high gravel content compared to other clusters (13.34% to 46.90%) at all but one station (ECC_34, gravel content 3.97%), the observation of pebbles and/or cobbles at these stations and the presence of *S. spinulosa* which can provide further attachment points. Grab sampling often fails to recover coarse material, especially larger pebbles and cobbles colonised by epifauna; therefore, it is important to not only assess epifauna through physical samples but also to analyse video footage.

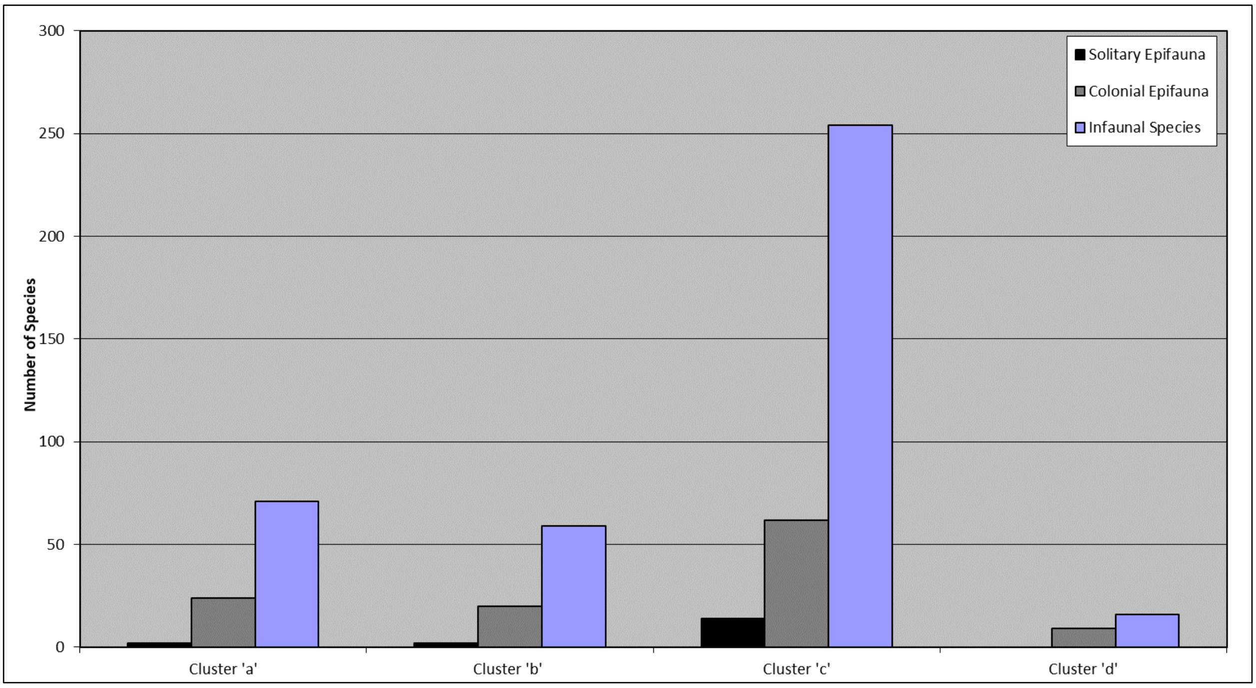


Figure 36: Epifaunal Versus Infaunal Richness

d Biomass

Biomass allows another viewpoint into the community structure of the benthos, providing additional information about changes to potential organic enrichment, pollution and natural variability within a habitat. The biomass (blotted wet weight) of the macrofauna for the ECC survey area is displayed by phylum in Table 31 and by taxa in Appendix I. This includes data for both infauna, epifauna and other biological groups.

The total biomass for the ECC survey area was estimated to be 4,735g/m^2, with the majority comprising Mollusca which accounted for 2740.05g/m^2 (57.86%) of the total biomass, however this group had a relatively small contribution to the number of individuals and species (12.03% and 16.21%, respectively). The next major contributor to total biomass was Polychaeta which accounted for 816.56g/m^2 (17.124%), which was unsurprising as Polychaeta accounted for 50.98% of the total number of individuals recorded (Table 31).

Cnidaria was the third highest contributor to overall biomass, accounting for 659.88g/m^2 (13.93%) of total biomass but relatively little to the total species and total individuals (5.99% of the total species and 1.85% of the individuals, respectively). Annelida, Crustacea and Chordata represented relatively small proportions of the total biomass, with 142.7723g/m^2 (3.0150%), 187.6880g/m^2(3.9635%) and 108.3130g/m^2(2.2873%), respectively. Despite Crustacea contributing to only 3.9635% of the total biomass, it represented 23.94% of the macrofaunal species found in the ECC survey area. Similarly, species categorised as 'other minor phyla' (Animalia eggs, Porifera, Foraminifera, Nematoda, Nemertea, Platyhelminthes, Phoronida, Bryozoa and Hemichordata) made up 0.42% of the proportional biomass contribution but was relatively species rich (contained 10.97% of the total number of species found). The groups contributing the lowest biomass in the ECC survey area were Echinodermata (58.81g/m^2, 1.242%) and Arthropoda (1.269g/m^2, 0.0268%) and Oligochaeta (0.008g/m^2, 0.0002%). The low biomass of Arthropoda, Oligochaeta and Annelida were unsurprising given the subdivisions of these groups (i.e. Polychaeta and Crustacea) so only represent those species that could not be taxonomically ranked any lower.

Table 31: Blotted Wet Weight Biomass (0.0001g) of Major Groups Within the ECC Survey Area

Station	Depth (m)	Distance to Nearest Well (km)	Other minor phyla	Cnidaria	Annelida	Polychaeta	Oligochaeta	Arthropoda	Crustacea	Mollusca	Echinodermata	Chordata	**Total**
FA_01	2.78	18	0.0001	-	-	0.0876	-	-	0.0025	-	-	0.6776	**0.7678**
FA_02	2.92	24	-	-	-	0.7740	-	-	0.0033	0.0431	0.0001	-	**0.8205**
FA_03	3.12	19	0.0035	0.0437	0.0023	5.7755	-	0.0026	0.1615	5.9414	0.1076	-	**12.0381**
FA_04	1.67	21	0.0001	-	0.0001	0.7019	0.0002	-	0.0154	5.1100	0.9229	-	**6.7506**
FA_05	2.68	15	-	-	-	0.6477	-	-	0.0341	-	-	3.1631	**3.8449**
ECC_06	2.88	23	0.0349	-	-	2.5197	-	0.0101	0.1126	0.2495	0.6272	-	**3.5540**
ECC_07	4.13	11	-	-	-	0.0961	-	-	0.0033	-	-	2.8945	**2.9939**
ECC_09	2.86	20	-	-	-	0.2700	-	-	0.0091	0.0984	-	-	**0.3775**
ECC_10	2.48	19	0.0001	-	-	0.3026	-	-	0.0684	1.3460	0.0049	-	**1.7220**
ECC_11	0.81	10	-	-	-	0.0864	-	-	0.0112	-	-	0.9152	**1.0128**
ECC_12	0.54	22	0.0678	15.2051	-	2.8132	-	0.0045	0.2069	16.0442	0.0233	-	**34.3650**
ECC_13	0.65	26	-	0.1047	-	0.1689	-	-	0.0163	0.4081	-	-	**0.6980**
ECC_14	2.82	22	0.0010	-	-	0.1347	-	-	0.0794	0.0472	-	0.1458	**0.4081**
ECC_15	2.79	23	0.1802	0.9265	0.0025	4.0990	-	0.0028	0.3825	0.7469	0.0434	-	**6.3838**
ECC_16	2.48	28	-	-	-	1.2531	-	-	0.1679	20.6032	0.0071	-	**22.0313**
ECC_17	1.29	23	0.0570	1.0401	-	0.6503	0.0001	0.0090	0.2543	0.5744	0.0974	-	**2.6826**
ECC_18	0.76	21	0.0104	0.1805	-	1.1426	-	0.0008	-	151.2859	0.0003	-	**152.6205**
ECC_19	1.69	24	0.0061	-	-	0.1300	-	-	0.0079	0.0401	0.0002	-	**0.1843**
ECC_20	0.78	22	0.0017	0.0016	0.0068	2.7833	-	0.0036	0.5117	2.5153	0.0297	-	**5.8537**
ECC_21	0.56	21	0.0219	0.9602	0.0009	1.9635	0.0001	0.0001	0.0946	0.3561	0.0100	-	**3.4074**
ECC_23	0.61	21	0.0001	-	-	0.1315	-	-	0.0901	2.4211	-	-	**2.6428**
ECC_24	1.36	16	-	-	-	0.0980	-	-	0.0072	0.0209	-	-	**0.1261**
ECC_25	0.54	14	-	-	-	0.1190	-	-	0.0052	0.9560	-	-	**1.0802**
ECC_26	1.52	18	0.0001	-	-	0.0390	-	-	0.0005	0.0014	0.0001	-	**0.0411**
ECC_27	1.52	18	-	-	-	0.0792	-	-	0.0121	9.9991	-	-	**10.0904**
ECC_31	1.28	17	0.0001	-	-	0.0638	-	-	0.0044	-	-	-	**0.0683**
ECC_32	2.59	14	0.0034	-	-	0.0947	-	0.0001	-	0.0078	-	-	**0.1060**
ECC_33	3.46	14	-	-	-	0.2241	-	-	0.0228	0.0070	0.1034	-	**0.3573**
ECC_34	2.34	28	0.0453	-	0.0185	1.9471	-	0.0006	0.5066	4.7796	0.0802	-	**7.3779**

Station	Depth (m)	Distance to Nearest Well (km)	Other minor phyla	Cnidaria	Annelida	Polychaeta	Oligochaeta	Arthropoda	Crustacea	Mollusca	Echinodermata	Chordata	**Total**
ECC_35	1.99	17	0.0002	0.0008	-	2.2741	0.0001	0.0001	0.0493	1.2274	0.0007	-	**3.5527**
ECC_36	2.98	29	0.1594	0.1195	0.0165	11.4266	-	-	3.2122	2.7220	0.1152	-	**17.7714**
ECC_37	2.49	28	0.0061	1.8102	0.0079	3.1203	-	0.0281	0.0660	7.4743	0.0160	-	**12.5289**
ECC_38	2.68	26	-	-	-	1.0659	-	-	0.0146	0.0414	0.0039	-	**1.1258**
ECC_39	3.30	23	0.0105	1.8399	0.0571	1.9793	-	0.0043	3.0810	1.7426	0.0671	-	**8.7818**
ECC_40	4.36	22	0.0292	0.5284	0.0179	2.9805	-	0.0056	0.5293	2.7943	2.7611	-	**9.6463**
ECC_41	2.78	19	0.0239	0.1721	0.0244	0.7404	-	0.0014	0.1148	3.9241	0.0072	-	**5.0083**
ECC_42	2.77	16	0.0165	18.5314	0.0082	0.8096	-	0.0182	2.1383	0.9807	0.0030	-	**22.5059**
ECC_43	3.59	11	-	-	-	0.0201	-	0.0002	0.0661	0.4572	-	-	**0.5436**
ECC_44	3.20	12	0.0016	3.9712	-	0.7209	-	0.0129	0.3889	1.4598	0.0952	-	**6.6505**
ECC_45	4.95	12	-	-	-	0.5681	-	-	-	0.0001	-	-	**0.5682**
ECC_46	0.00	14	0.0001	-	-	0.2578	-	-	0.0001	0.1675	-	-	**0.4255**
ECC_47	0.00	14	0.3485	0.6748	-	0.6387	-	-	0.0467	0.9896	-	-	**2.6983**
ECC_48	0.00	13	0.5001	12.0710	3.0149	1.0716	0.0003	-	0.5656	2.2235	0.3488	-	**19.7958**
ECC_49	0.00	11	0.0129	0.6980	3.2148	7.7256	-	-	0.5087	6.5085	0.2531	-	**18.9216**
ECC_50	3.02	19	0.0236	-	0.0132	2.5825	-	0.0047	0.6015	0.6134	0.0071	-	**3.8460**
ECC_51	0.00	10	0.0008	0.0433	0.0076	0.3974	-	-	-	0.3902	-	-	**0.8393**
FA_52	1.25	19	0.0211	-	-	0.2530	-	-	0.0073	0.0009	-	3.0351	**3.3174**
ECC_53	0.00	13	-	-	-	0.1647	-	-	0.0001	0.0094	-	-	**0.1742**
ECC_54	0.00	17	0.0003	0.6450	-	0.2882	-	0.0016	0.2555	0.8446	-	-	**2.0352**
ECC_55	0.00	10	-	-	-	0.1177	-	-	0.0169	-	-	-	**0.1346**
ECC_56	0.00	17	0.0250	0.1237	-	1.5572	-	0.0117	0.3490	2.6997	0.1014	-	**4.8677**
ECC_57	0.00	14	0.3386	1.8318	0.0322	5.7258	-	0.0005	3.3654	1.6468	0.0374	-	**12.9785**
ECC_58	0.00	13	-	-	-	0.6828	-	-	-	-	-	-	**0.6828**
ECC_59	0.00	12	0.0228	2.9514	4.4432	3.4160	-	-	0.4014	0.3729	0.0061	-	**11.6138**
ECC_60	0.00	10	0.0332	1.5129	3.3882	1.8748	-	0.0034	0.1983	11.1116	-	-	**18.1224**
Total Biomass (g) by group			**2.0082**	**65.9878**	**14.2772**	**81.6561**	**0.0008**	**0.1269**	**18.7688**	**274.0052**	**5.8811**	**10.8313**	**473.5434**
Proportional Contribution (%)			**0.4241**	**13.9349**	**3.0150**	**17.2436**	**0.0002**	**0.0268**	**3.9635**	**57.8627**	**1.2419**	**2.2873**	**-**
Biomass (g/m^2) by group			**20.0820**	**659.8780**	**142.7723**	**816.5610**	**0.0080**	**1.2690**	**187.6880**	**2740.0520**	**58.8110**	**108.3130**	**4735.4343**

4.8.2 Epibenthic Trawl Analysis

Beam trawling can capture species that are less likely to be represented by standard grab sampling and can offer supplementary macrofauna data for subsequent habitat characterisation and analysis. The beam trawl sampling undertaken across the survey area revealed a diverse fish and epifaunal assemblage. In total, 110 different species were recovered across the survey area, of which 99 were adults.

For the following epibenthic trawl assessment, the sampling effort was standardised to 500m for each trawl. Species that were recorded in their tens or hundreds are represented in the following analysis by the numerical equivalent of '10' or '100', respectively. This was necessary for small species that were present in extremely high abundances or aggregations, where counting individuals would be unfeasible in the field; For example, barnacle species *Balanus crenatus* and *Sabellaria spinulosa*.

Species that could not be enumerated and therefore only assessed on a presence/absence basis have been omitted from abundance analysis. This includes colonial fauna such as Cnidaria and Bryozoa, mixed Hydrozoa and Bryozoa assemblages and species where individuals are difficult to differentiate between, such as Porifera. However, due to the importance of these groups to the epibenthic community, these groups have been investigated in more detail in the Biomass analysis in Section 4.8.20.

A total of 11 juvenile specimens, including eggs, were also excluded from analysis due to their high mortality prior to reaching maturity. Consequently, they tend to induce a recruitment spike at certain times of the year due to rapid settlement and colonisation but are essentially an ephemeral part of the population masking the underlying trends within the mature adults. The European squid *Loligo vulgaris* was also excluded, as well as Clupeidae and Gadiformes, from analysis as it is not epibenthic, and likely entered the trawl during deployment and recovery.

Subsequent analysis of the epibenthic trawl samples identified a total of 49,484 individuals across 92 species from the seven trawl samples obtained in the ECC survey area. Faunal data for each sample are listed in Appendix I, whilst univariate analyses are summarised in Table 32 by trawl.

The epibenthic taxa consisted of Arthropods, represented by 31 species (93.6% of the total individuals). Chordata accounted for 21 species (2.9% of the total individuals) all of which were fish. This was followed by Molluscs with 17 species (0.56% of the total individuals), Annelids with 13 species (2.3% of the total individuals) and six Echinoderm species, which accounted for 0.54% of the total individuals. Solitary Cnidaria consisted of Actiniaria, identified down to two groups (Scyphozoa and Actiniaria) representing 0.05% of the total individuals.

Five fish species recovered in trawl analysis are UKBAP Priority Species and Species of Principal Importance in England (SPIe) and are species of commercial value; Raitt's sandeel, *Ammodytes marinus*, whiting, *Merlangius merlangus*, ling, *Molva*, plaice, *Pleuronectes platessa* and sole, *Solea solea*. Furthermore, *Ammodytes marinus* is a priority species under the UK Post 2010 Biodiversity Framework as it is considered an important food source for many commercial fish, seals and seabirds (see Section 4.9.2d). One other species of sandeel was also recovered from the ECC survey area, *Hyperoplus lanceolatus*. Other species that are commercially valuable that were recovered from trawl stations in the survey area included dab, *Limanda limanda*, lemon sole, *Microstomus kitt*, brown crab, *Cancer pagurus* and the common mussel, *Mytilus edulis*. Fish lengths were recorded on site and are presented in Appendix J.

The reef building ross worm, *S. spinulosa*, was recovered in samples from ECC_T1 to T4 and its presence is discussed further in Section 4.9.2b. Three specimens of the invasive non-native slipper limpet, *Crepidula fornicata*, were identified at each station, ECC_T1, T2 and T3 and 50 individuals were identified at station ECC_T5. Slipper limpets can form dense aggregations, which can compete for space and smother native benthic fauna (see Section 4.9.1g).

The consistent accumulation of taxa with each trawl was demonstrated by a species accumulation curve as shown in Figure 37. The minimum curve in this figure demonstrates the incremental increase in recorded species as additional samples were acquired. This suggests that the population was diverse with a relatively high species richness being recorded in every new sample. This analysis estimated the maximum species accumulation (Chao-1 curve) for the survey area to be 114 species, compared to the actual 92 species recorded during the survey. The number of species recorded matches the representative portion of the population (i.e. 67% or 76 species) meaning no additional trawls were required to adequately sample the epibenthic fauna.

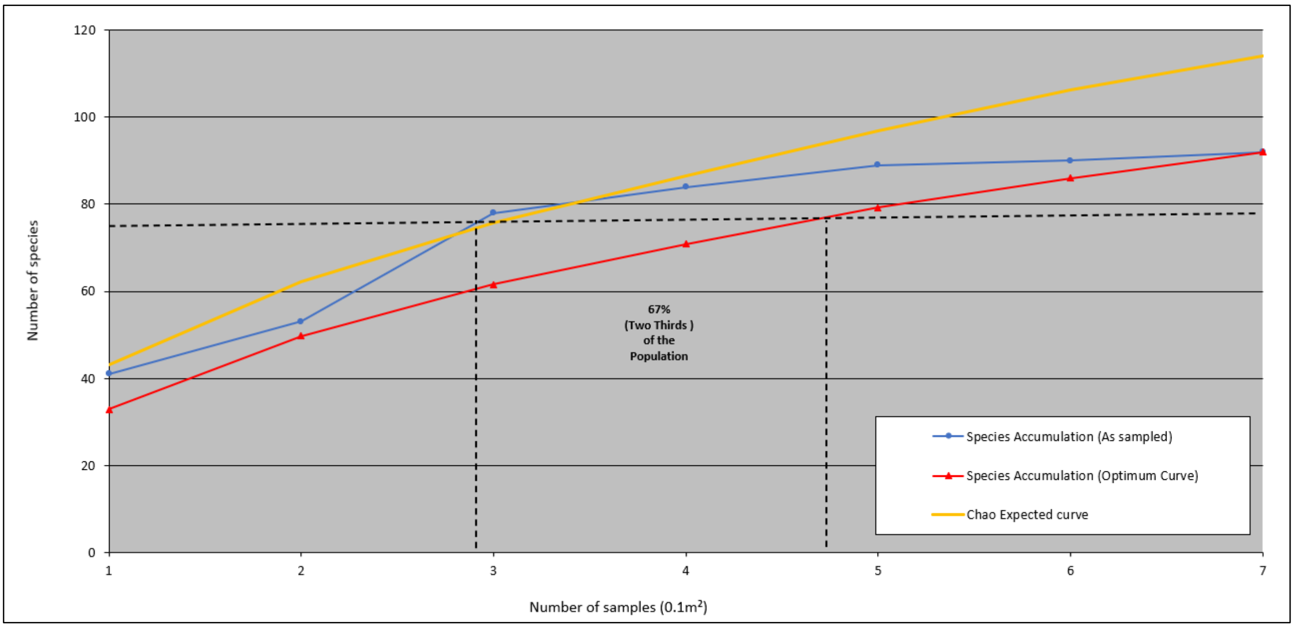


Figure 37: Species Accumulation Curve of ECC Epibenthic Trawls

a Primary and Univariate Parameters

The primary and univariate parameters for all trawls are listed in Table 32. The highest species numbers were identified in areas of mixed sediment consisting of between 16.59% to 43.65% gravel (Table 15). For example, a maximum of 52 species were recovered from ECC_T3 (coarse sediment), and a minimum of 14 were recovered from ECC_T6 (sand). The number of individuals per 500m were considerably more variable, evidenced by a relatively high coefficient of variation (201.8%; Table 32) across the ECC survey area, ranging between 399 per 500m at station ECC_T4 to 39,101 per 500m at station ECC_T3 (Table 32). The higher number of individuals and species at ECC_T3 is attributed to the relatively high abundance of the shrimp *Pandalus montagui*.

Margalef's Index is a measure of species richness. The maximum Margalef's index was identified at station ECC_T1 (5.17), while the minimum was identified at station ECC_T6 (1.93) (Table 32). Stations with sand proportions of >90% had the lowest species richness, while areas of mixed and coarse sediments, cobbles and pebbles had the highest.

The Simpson's diversity varied from a maximum of 0.89 at station ECC_T4 and ECC_T7 to a minimum of 0.1 at station ECC_T3, with overall variability of 52.52% (Table 32). Whereas, the Shannon-Wiener Diversity index was more variable (CV 54.51%), with a maximum recorded at trawl ECC_T7 (3.74) and the minimum at trawl ECC_T3 (0.46). This is due to the difference in the way that the Simpsons and Shannon-Wiener diversity indices are calculated; the Shannon-Wiener diversity index gives more weight to species found in low abundances, while the Simpsons Diversity index gives more weight to abundant species. As such, rare species have less influence over the Simpson's diversity value. For instance, many species were only represented by a few individuals, with only a few highly abundant species (For example, the shrimp *Pandalus montagui*). Therefore, the diversity indices revealed trawls with coarse and mixed sediments had higher diversity than those sand-dominated trawls.

Pielou's Equitability displayed a similar pattern to Simpson's Diversity, with coarse and mixed sediment areas, having a more evenly represented epibenthic community, with a maximum of 0.89 at ECC_T7 and a minimum of 0.10 at ECC_T3 (Table 32). Therefore, sand dominated sites had a more uneven community due to a small number of representative species when compared to the coarser sediments. Furthermore, the higher diversity found in areas of coarse and mixed sediment can be attributed both to the availability of attachment sites for colonial species, and greater availability and heterogeneity in interstitial space providing refuge sites for a greater range of species.

Table 32: Univariate Faunal Parameters per Epibenthic Trawl (Standardised to 500m)

Station	Depth Range (m)	Distance to Nearest Well (km)	Number of Species (S)	Number of Individuals (N)	Richness (Margalef)	Evenness (Pielou's Evenness)	Shannon-Wiener Diversity	Simpsons Diversity (1-Lambda')
ECC_T1	10 – 13	0	41	2307	5.17	0.49	2.60	0.73
ECC_T2	9 - 12	0	31	619	4.67	0.53	2.60	0.72
ECC_T3	28 - 32	0	52	39101	4.82	0.08	0.46	0.10
ECC_T4	13 - 16	0	31	399	5.01	0.75	3.72	0.89
ECC_T5	21 - 23	4.69	33	5973	3.68	0.20	0.99	0.22
ECC_T6	9 - 10	3.98	14	838	1.93	0.53	2.02	0.64
ECC_T7	17– 20	1.85	27	247	4.72	0.79	3.74	0.89
Mean			**32.71**	**7069.14**	**4.28**	**0.48**	**2.30**	**0.60**
SD			**11.76**	**14267.58**	**1.14**	**0.26**	**1.26**	**0.31**
CV (%)			**35.94**	**201.83**	**26.66**	**54.70**	**54.51**	**52.52**

b Multivariate Analysis

To provide a more thorough examination of the macrofaunal community, multivariate analysis was performed upon the epibenthic trawl data using PRIMER software (PRIMER 7.0.17; Clarke, K.R. *et al.*, 2014) to illustrate data trends. All data was fourth-root transformed prior to analysis to down-weight the influence of any overriding species dominance between sample similarities/dissimilarities. The shrimp, *Pandalus montagui*, had extremely high numbers of individuals, therefore, a fourth root transform was necessary to highlight other patterns within the dataset.

Hierarchical Agglomerative Clustering – Group Average Method

A similarity dendrogram was created using hierarchical agglomerative clustering (CLUSTER) and is presented for all trawls in Figure 38. SIMPROF analysis highlighted the presence of three significantly different (p<0.05) clusters which were differentiated by black branches and the different structural groups are interpreted below in Table 33. The dendrogram revealed cluster 'a' and 'b' had little intra-cluster variability as the stations differentiated at a similar similarity level within each cluster group, indicating that the clusters had a high degree of similar epifaunal assemblages present. However, stations within cluster 'c' separated at a slightly lower similarity level, indicating more intra-cluster variability.

Table 33: Summary of SIMPROF Trawl Groupings (500m)

SIMPROF Group	Similarity (%)	Stations	Interpretation
'a'	58.96%	ECC_T3, ECC_T5	The first cluster of stations were comprised of coarse, gravelly sediments between 21m to 32m of depth. These stations were moderately species rich (ECC_T3 had the highest number of species) with low diversity values, and were defined by the presence of cobbles, pebbles and high numbers of the shrimp, *Pandalus montagui*. This cluster can be considered to represent a variable gravel sediment epibenthic assemblage.
'b'	54.10%	ECC_T1, ECC_T2	Stations in this cluster were characterised by very poorly sorted sediments composed of coarse sand, between 9 to 13m in depth. These stations had the moderate levels of diversity. This cluster could be considered to represent the coarse sand dominated, average epibenthic assemblages.
'c'	48.72%	ECC_T4, ECC_T6, ECC_T7	These stations were characterised by higher sand composition with minimal proportions of gravel. High numbers of Chordates, especially *Echiichthys vipera,* which characterised the epibenthic fauna at these stations when compared to other clusters. This cluster can be considered to represent sandier sediment epibenthic assemblages with high species diversity.

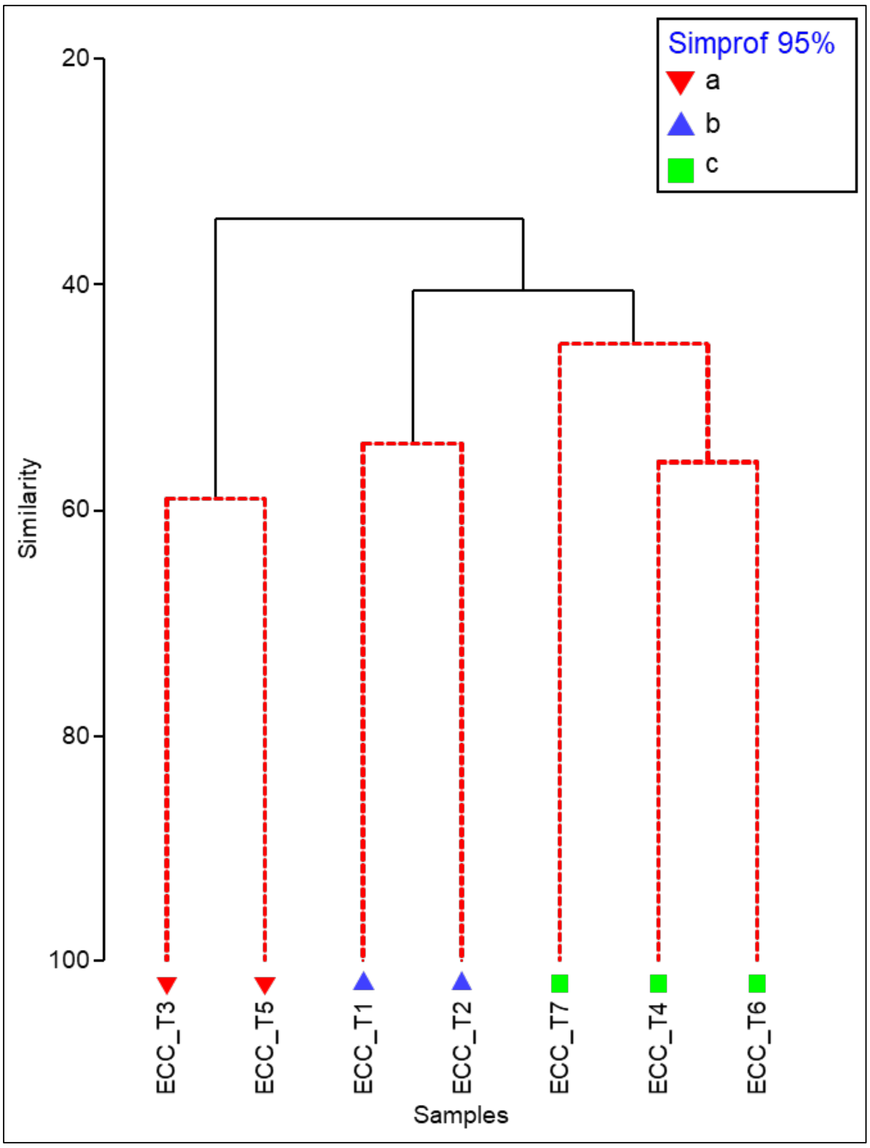


Figure 38: Dendrogram of epibenthic trawls (500m)

Non-metric Multi-dimensional Scaling (nMDS) Ordination

Similarities in the epifaunal communities recorded across the ECC survey area are presented in Figure 39 by trawls, as a 2D nMDS plot. The nMDS plot revealed three different SIMPROF groupings with a low stress value of 0.02 (Figure 39). The low stress value indicates that the complexity of the epibenthic trawl data has been adequately captured by the 2D nMDS. The plotted stations were consistent with the clusters identified in the dendrogram (Figure 38) and further indicate the inter-cluster variability as all stations within each cluster grouped tightly together with no overlap.

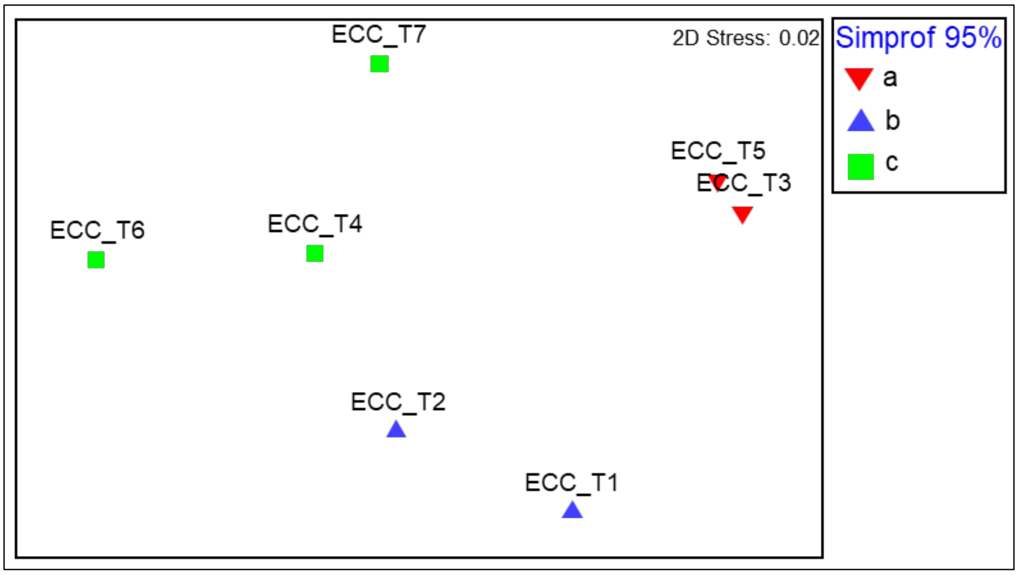


Figure 39: nMDS Ordination Plot of trawls (500m)

Inter-cluster Variation in Community Composition

To investigate the differing macrofaunal communities described by the identified multivariate clusters, the range in univariate diversity indices for the trawl clusters are summarised in Table 34. Stations within cluster *'b'* and *'c'* had the highest overall species richness, diversity and evenness, while cluster *'a'* displayed much lower overall values. Number of individuals displays greater variability and some overlap between clusters. This is as a result of a few species in cluster *'a'* being present in very high abundances. Overlaps in diversity indices indicate the subtle difference in epifaunal community structure between the clusters; therefore, further review of the epifaunal dataset is required to describe the differences between each cluster.

Table 34: Overview of Univariate Parameters per SIMPROF Cluster

SIMPROF Cluster	Number of species (S)		Number of individuals (N)		Richness (Margalef)		Evenness (Pielou's Evenness)		Simpsons Diversity (1-Lambda')		Shannon Wiener Diversity	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
a	33	52	5973	39101	3.68	4.82	0.08	0.20	0.46	0.99	0.10	0.22
b	31	41	619	2307	4.67	5.17	0.49	0.53	2.60	2.60	0.72	0.73
c	14	31	247	838	1.93	5.01	0.53	0.79	2.02	3.74	0.64	0.89

Differences in the macrofaunal communities at a phyla level was explored by plotting the average percentage contribution of the major phyla to the overall number of individuals and number of species within each station, which have been ordered by cluster for visual clarity, and by cluster (Figure 39 and Figure 40).

There was a notable difference in the abundance of Arthropoda (Crustacea), particularly for cluster *'a'* where Arthropoda accounted for a large proportion of the overall species abundance compared to the other clusters. The dominance of Arthropoda to the overall abundance of phyla for trawls within cluster *'a'* was due to the high abundance of the pink shrimp (*Pandalus montagui*), which could be attributed to the moderate proportion of sand at these trawl stations (gravel dominated). Mollusca were more prevalent within cluster *'c'*, most notably the nudibranch, *Acanthodoris pilosa*. The greater abundance of Mollusca within cluster *'c'* was potentially attributed to the sand dominated sediment at these trawl locations when compared to the mixed sediment within cluster *'a'* and the coarse dominated sediments of cluster *'b'*. Arthropoda abundance was not consistent across the cluster groups. High abundance of Arthropoda in cluster *'a'* could be attributed to the high percentage of gravel as a more suitable habitat at these sites. Echinodermata were more significant in cluster *'b'*, notably the predatory common starfish, *Asterias rubens,* and the common sunstar, *Crosstaster papposus,* when compared to the other clusters. The higher abundance of echinoderms in cluster *'b'*, especially *A. rubens,* could be attributed to the presence of *S. spinulosa* at these trawl locations, as *A. rubens* predates *S. spinulosa*. Cnidaria, that are included in the 'Other' category for Figure 38 and 39, were the least abundant phyla represented by the epifaunal trawl. Annelida and Platyhelminthes were also underrepresented by the epibenthic trawl dataset however, there was a significant abundance of *Sabellaria spinulosa* at cluster *'b'*, most likely because of the coarse sediment found at these stations. Epifaunal trawls retained epifauna greater or equal to 5cm in length and skimmed across the superficial surface layer of the sediment; therefore, the trawls are likely, by design, to underrepresent infaunal assemblages.

In terms of the contribution of phyla to the numbers of species, the clusters were fairly similar, suggesting that the differing abundances of phyla were more important for the separation of clusters. All clusters were characterised by similar compositions of phyla, with Arthropoda accounting for the greatest proportion of the overall species richness within all clusters. The species richness of Arthropoda was less dominant than the species abundance due to the high abundance of the pink shrimp (*P. montagui)* within the whole sample set. Cnidaria, Echinodermata and Mollusca had the lowest species richness of any phyla recorded, which was surprising given the typical representation of these phyla within epibenthic trawl datasets.

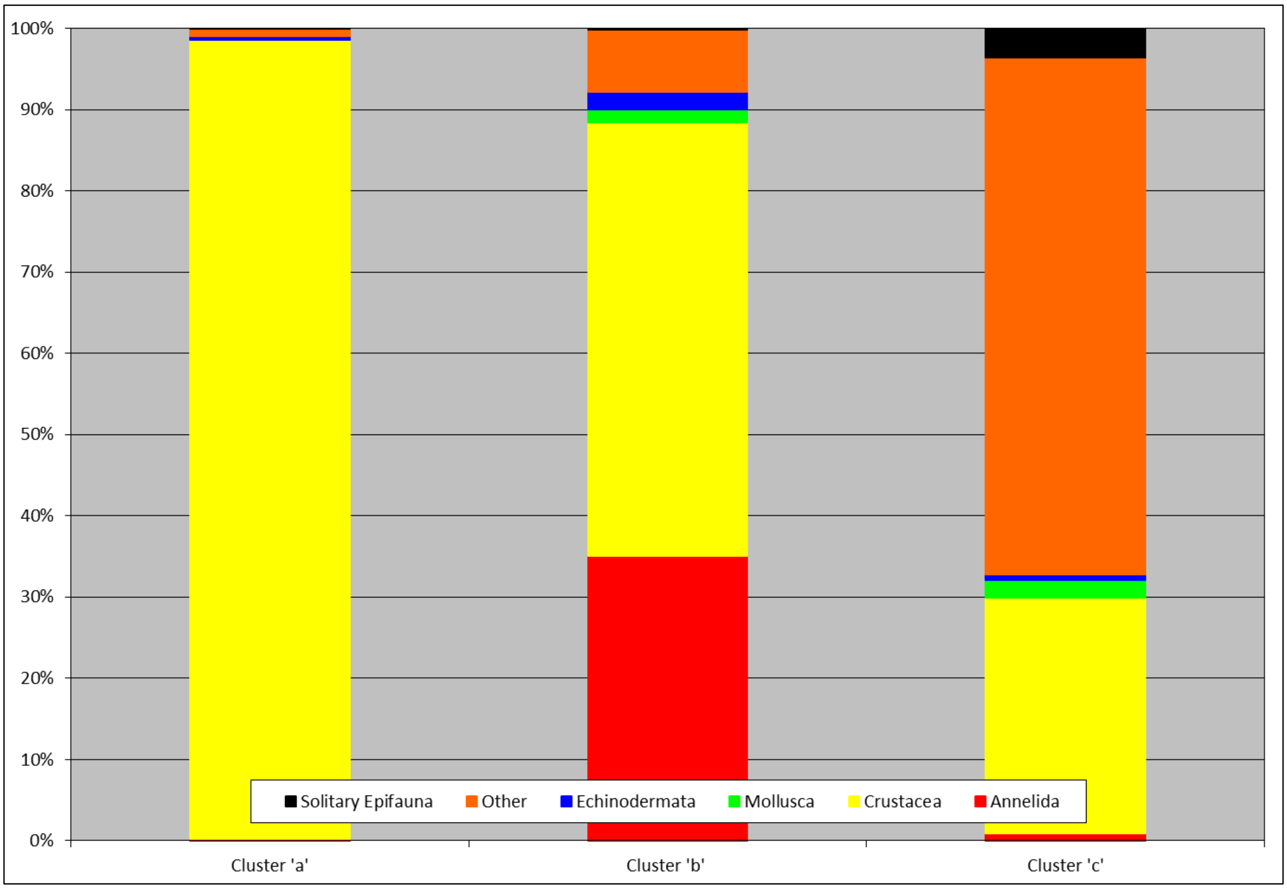


Figure 40 Average Contribution of Each Phyla to Total Epifaunal Abundance for Each Cluster

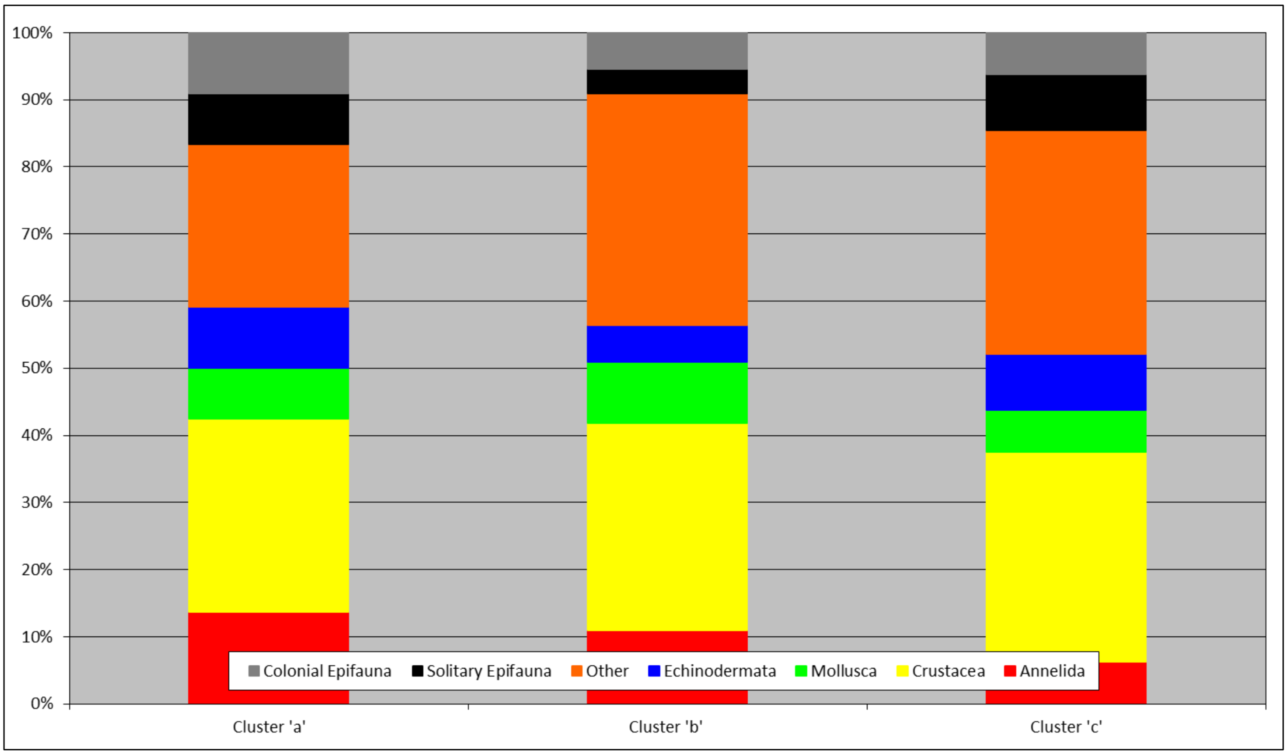


Figure 41 Average Contribution of Each Phyla to Total Number of Species for Each Cluster

To determine the species driving the differences between the three SIMPROF clusters identified from the epifauna data, Table 21 presents the top ten species in each cluster together with their percentage contribution to the overall similarity within the cluster. Whereas Table 22 shows the top five species responsible for differences between clusters.

Table 21 highlights the similarities in the species assemblages represented by clusters *'a'*, *'b'* and *'c'*. Clusters *'b'* and *'c'* were characterised by the brown shrimp (*Crangon crangon*) and the shrimp (*Philocheras trispinosus*) within the top three characterising species. Cluster *'a'* had no shared species with either cluster *'b'* or *'c'*, therefore this can be inferred as the reason for stations in this cluster to be separated from the others. Despite the similarities in epifauna between clusters *'b'* and *'c'*, the top characterising species for these clusters were different. For example, *Limanda limanda* was the most abundant species within cluster *'c'* (246 individuals) when compared to *C. crangon* (895 individuals) for cluster *'b'* and cluster *'c'* (204 individuals).

Further review of the taxa most responsible for differentiating the three clusters (Table 22) included all three dominating taxa (*P. montagui, S. spinulosa* and *C. crangon*), previously highlighted as characteristic for all three clusters, again suggesting that some differentiation was due to variability in the abundance of consistently dominant taxa. The differences in species between the clusters are likely attributed to differences in sediment composition. Clusters *'a'* was differentiated from cluster 'b' and *'c'* based on the higher abundance of *P. montagui* (42,378 individuals) within cluster *'a'* compared to for cluster *'b'* (88 individuals) and cluster *'c'* (17 individuals), as well as the absence of *C. crangon* which was presence in both cluster *'b'* and *'c'* . In addition, the differentiation of cluster *'b'* and *'c'* could be attributed to abundances of *S. spinulosa* in cluster *'b'* (1010 individuals) and cluster *'c'* (10 individuals). However, this disparity would be due to the different sediment types present at these stations, as cluster 'c' had a sandier sediment, with less hard substrate for *S. spinulosa* to attach to. Therefore, these stations were most likely differentiated due to sediment types.

Table 35: Top 10 Species Abundances for Trawl Clusters 'a', 'b' and 'c'

Top 10 Species	Cluster *'a'*			Cluster *'b'*			Cluster *'c'*		
	Species	Av. Abundance	Contribution (%)	Species	Av. Abundance	Contribution (%)	Species	Av. Abundance	Contribution (%)
1	*Pandalus montagui*	21,189	17.32	*Crangon crangon*	447.5	12.54	*Limanda limanda*	82	13.91
2	*Liocarcinus depurator*	279.5	7.26	*Philocheras trispinosus*	201.5	11.09	*Crangon crangon*	68	13
3	-	-	-	*Pomatoschistus pictus*	68.5	8.71	*Philocheras trispinosus*	37	8.31
4	-	-	-	*Ophiura albida*	12.5	5.61	*Echiichthys vipera*	170.67	9.46
5	-	-	-	*Sabellaria spinulosa*	505	5.48	*Sepiola atlantica*	10.67	9.52
6	-	-	-	*Macropodia linaresi*	30.5	5.48	*Pleuronectes platessa*	23.67	8.78
7	-	-	-	*Pagurus bernhardus*	10.5	5.34	*Liocarcinus holsatus*	10	8.55
8	-	-	-	*Solea solea*	18	5.18	*Lacuna crassior*	8.67	2.58
9	-	-	-	-	-	-	*Callionymus lyra*	8	2.4
10	-	-	-	-	-	-	-	-	-

Light blue shading = sharded taxa across 3 clusters   Orange shading = shared taxa across 2 clusters

Table 36: Dissimilarity Percentages (SIMPER) for Epifaunal Trawl Dataset

	Cluster *a*		Cluster *b*	
Cluster c	**Average dissimilarity 69.24%**		**Average dissimilarity 59.47%**	
	Pandalus montagui	8.54	*Sabellaria spinulosa*	3.02
	Liocarcinus depurator	3.05	*Limanda limanda*	2.42
	Echiichthys vipera	2.46	*Echiichthys vipera*	2.15
	Crossaster papposus	1.84	*Pomatoschistus pictus*	2.04
	Pandalina brevirostris	1.82	*Solea solea*	2.02
Cluster a			**Average dissimilarity 60.63%**	
			Pandalus montagui	6.3
			Crangon crangon	2.58
			Sabellaria spinulosa	1.99
			Philocheras trispinosus	1.96
			Necora puber	1.75

a Biomass

The biomass (blotted wet weight) of the epifaunal trawl data from the ECC survey area is displayed by phylum in Table 37, and by taxa in Appendix I. The total biomass for the epibenthic trawls conducted in the ECC survey area was 108,793 g/500m. Bryozoa comprised 44,289g/500m, which was the largest proportional biomass of any group (40.7% of total biomass). Surprisingly, Bryozoa comprised of just two species; *Alcyonidium diaphanum* and *Flustra foliacea*. The next major contributor to total biomass was Arthropoda, which accounted for 30,676 (28.2%), made up of 36 species including *P. montagui* and *Liocarcinus depurator.* The group 'Hydrozoa and Bryozoa assemblages' contained mixed Bryozoa and Cnidaria that could not be identified to a lower taxonomic level in the field. This group comprised 17,931g/500m (16.5% total biomass).

Chordata accounted for 7,884g/500m (7.2%), the majority of this was from flatfish (Pleuronectiformes) such as *Solea solea*, and bony fish (Actinopterygii) such as *E. vipera.* Echinodermata followed, accounting for 6,599g/500m (6.1%). Mollusca only made up 975g/500m (0.9%) of the total biomass but was the third most species rich group (19.1%).

Cnidaria only made up 252g/500m (0.2%) of the total biomass but was not species rich (3.6%). Similarly, Porifera contributed to 156g/500m (0.1%) of total biomass in the ECC survey area, however, was not species rich (0.9% of species). Annelida represented the smallest proportion of the total epibenthic trawl biomass in the ECC survey area, making up only 30g/500m, (0.03%) but was relatively species rich (12.7%). This can be attributed to the relatively small body sizes of most of the Annelid species, therefore were not retained in the 5mm mesh of the trawl net.

Table 37:Blotted Wet Weight Biomass (g/500m) of Major Groups Within the ECC Survey Area

Station	Depth (m)	Distance to Nearest Well (km)	Cnidaria	Porifera	Annelida	Arthropoda	Mollusca	Bryozoa	Echinodermata	Chordata	Hydrozoa and Bryozoa assemblages	Other	Total
ECC_T1	10 -11	3.06	0	0	0	142	9	1,772	0	1,188	381	0	**3,492**
ECC_T2	16 - 17	0.75	0	0	0	383	19	812	246	1,357	37	4	**2,857**
ECC_T3	40 - 43	1.43	59	45	32	638	98	2,193	597	1,777	145	0	**5,583**
ECC_T4	18 - 20	2.17	4	84	213	438	1,392	24,687	563	752	2,043	12	**30,190**
ECC_T5	20 - 21	1.67	21052	2,270	2	5,111	65	18,458	6608	2,132	255	0	**55,954**
ECC_T6	20 - 21	1.06	16,820	968	4	2,098	53	9,893	2250	950	249	0	**33,283**
ECC_T7	21 -22	3.29	74	0	0	234	19	3,254	63	786	89	3	**4,521**
Total Biomass (g/500m) by group			**60616**	**5,647**	**256**	**11,091**	**1,757**	**68,820**	**15280**	**11,361**	**4,504**	**19**	**179,351**
Proportional Contribution (%)			**34**	**3**	**0**	**6**	**1**	**38**	**9**	**6**	**3**	**0**	**-**

4.9 ENVIRONMENTAL HABITATS

Video and still photographic ground-truthing from the 33 transects across the ECC survey area confirmed the presence of a heterogeneous environment, consisting of coarse sediment with shell debris, mixed sediment, muddy sands and the presence of *Sabellaria* across the survey area.

Habitats were identified using a combination of field observations, a detailed review of video footage, still images, infaunal macrofauna and epibenthic trawl datasets in accordance with the guidelines outlined by Parry (2019). SSS data showed areas of mottled reflectivity sediment across the majority of the survey, with an increased presence in Block 7, 9 15 and 17, indicating areas dominated by mixed sediments with patches of *Sabellaria spinulosa*. Coarser sediment areas composed of sand, shell gravel, pebbles and cobbles, was present across most Blocks along the ECC survey area but most prevalent in the funnel area (FA). Sand dominated sediment related to the presence of seabed features such as sand waves and megaripples occurring across Blocks 3, 5, 7, 9, 12, 13 and the FA. In Block 12, 13 and the FA, lower reflectivity SSS data indicated areas of muddy sand which coincided with the presence of sandbanks.

Based on the ground-truthing data obtained from the ECC survey area a total of six JNCC/EUNIS habitats were assigned (Table 38). Several habitats were present across all extents of the ECC survey area: “Circalittoral coarse sediment” (SS.SCS.CCS/MC32) and “Circalittoral mixed sediment” (SS.SMx.CMx/MC42). Of these two habitat types, variations existed within both with SS.SCS.CCS separated into two variants; “Circalittoral coarse sediment” (sand with shell, pebbles and cobbles) and “Circalittoral coarse sediment” (sand with shell gravel), due to differing degrees of coarseness. The SS.SMx.CMx habitat type also showed variation with mixed sediment present throughout the route but the presence of *Sabellaria spinulosa* on stable circalittoral mixed sediment (SS.SBR.PoR.SspiMx/MC2211) was isolated to areas within Blocks 7, 8, 9 and 15. Areas of “Infralittoral muddy sand” (SS.SSa.IMuSa/MB5) were present in the FA and within Block 12 coinciding with sand banks. Smaller areas of “Circalittoral muddy sand” (SS.SSa.CMuSa/MC52) were identified along the ECC route predominantly in Blocks 5, 7, 8, 9 and 17 closer to the coastline.

It is important to note that habitat classifications will differ from the seabed features identified for the geophysical aspect, as they are required for different purposes and use different sediment classification nomenclature. As such, the current survey re-defined some of the boundaries based on the added information gathered from trawl, video and grab analysis. The ‘Infralittoral muddy sand’ habitats generally relate to the geophysical classification of ‘Muddy SAND’ or ‘SILT’ overlying sandbank features. Whereas ‘Circalittoral muddy sand’ habitats relate more strongly to ‘Silty Gravelly SAND’ overlying sandbank features. The ‘Circalittoral coarse sediment’ habitats generally relate to a mix of sand based sediment types including ‘Muddy SAND’, ‘Medium SAND’, ‘Coarse gravelly SAND’ and ‘Coarse SAND’. The habitat classification of ‘Circalittoral mixed sediment’ generally relates to the classifications: ‘Silty Gravelly SAND’, ‘Silty Sandy GRAVEL’, Silty Gravelly SAND’, ‘Silty Clayey SAND’ and ‘Clayey Gravelly SILT’ (Figure 5).

Table 38: Summarised Habitat Classification

BGS Modified Folk Classification of Particle Size Analysis	JNCC Classification	2012 EUNIS Classification	2019 EUNIS Classification
Sand, Slightly Gravelly Sand	SS.SSa.IMuSa Infralittoral Muddy Sand	A5.24 Infralittoral muddy sand	MB5 Infralittoral sand
Slightly Gravelly Sand, Sand	SS.SSa.CMuSa Circalittoral Muddy sand	A5.26 Circalittoral muddy sand	MC52 Atlantic circalittoral sand
Muddy Sandy Gravel, Gravelly Muddy Sand,	SS.SMx.CMx Circalittoral Mixed Sediment	A5.44 Circalittoral mixed sediments	MC42 Atlantic circalittoral mixed sediment
Muddy Sandy Gravel, Gravelly Muddy Sand, Slightly Gravelly Muddy Sand, Gravel	SS.SBR.PoR.SsipMx *Sabellaria spinulosa* on Stable Circalittoral Mixed Sediment	A5.611 *Sabellaria spinulosa* on stable circalittoral mixed sediment	MC2211 *Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment
Sandy Gravel, Gravelly Sand, Gravel	SS.SCS.CCS Circalittoral Coarse Sediment	A5.14 Circalittoral coarse sediment	MC32 Atlantic circalittoral coarse sediment

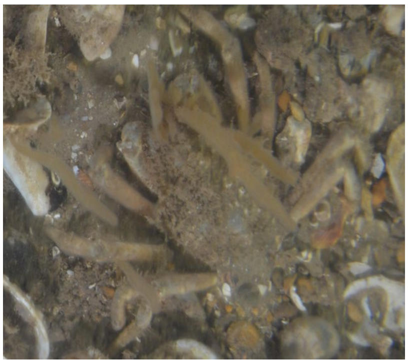
Conspicuous fauna within the ECC survey area showed relatively high diversity and density, with a total of 98 epifaunal species recorded reflecting the broad range of habitats identified. Mobile Arthropoda such as shrimp (Caridea), brown crab (*Cancer pagurus*), spider crab (*Hyas* sp.), velvet swimming crab (*Necora puber*), harbour crab (*Liocarcinus* sp.) and unidentifiable crabs (Bachyura sp.) were generally restricted to areas of coarse and mixed sediment. Other mobile fauna included a limited variety of Echinodermata, including the common starfish (*Asterias rubens*) observed at the majority of mixed sediment stations and brittle stars (Opiuroidea sp.) which were observed at similar sites, as well as those containing *S. spinulosa* aggregations. Chordata species included, flatfish (Pleuronectiformes sp.), dragonet (*Callionymus lyra*), pogge (*Agonus cataphractus*) and unidentified fish (Actinopterygii sp.). The presence of sandeels (*Ammodytes* sp.) in macrofaunal grab samples warranted further investigation due to the potential for sandeel spawning and nursery grounds to occur within the survey area (discussed further in Section4.9.2d).

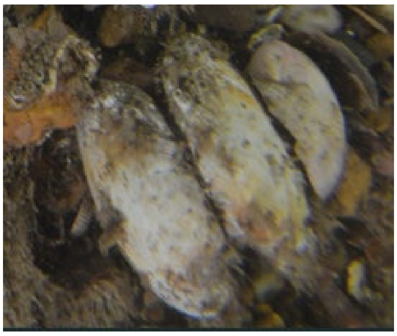
Anthozoa were also present within the survey area, including the dahlia anemone (*Urticina felina*) and unidentified anemones (Actiniaria sp. and Ceriantharia sp.) were also observed along multiple transects. Mobile Mollusca were rarely observed and limited to the common whelk (*Buccinum undatum*). Other sessile fauna such as barnacles (Cirripedia sp.), Serpulidae, encrusting sponge (Porifera), antenna hydroid (*Nemertesia* sp.), Sertulariidae, hornwrack (*Flustra foliacea*), the Bryozoa (*Vesicularia spinosa*), *Cheilostomatida*, sea chervil (*Alcyonidium diaphanum*), sand mason worm (*Lanice conchilega*) and hydrozoan/bryozoan turf were sporadically distributed across the survey area based on hard substrate availability. The invasive non-native slipper limpet (*Crepidula fornicata*) and the Annex 1 habitat forming ross worm (*Sabellaria spinulosa*) were also observed within the ECC survey area and will be further discussed in Sections 4.9g and 4.9.2b.

Habitats comprised of mixed and coarse sediments supported higher diversities and abundance of conspicuous fauna when compared to the sand dominated habitats. The sediment heterogeneity resulted in greater hard surface availability and lead to increased colonisation by a range of epibenthic species. The higher diversity and abundance of epifaunal species was especially apparent at station ECC_37 which had aggregations of ross worm (*S. spinulosa*) and recorded the highest diversity of epifaunal species, with a total of 81 out of 98 species observed. However, Chordata species were more commonly observed across areas of sand dominated sediments as

(Ammodytes sp.*)*, flatfish (Pleuronectiformes sp.), dragonet (*C. Lyra*), and pogge (*A. cataphractus*) appeared to be more reliant on sand burial as a refuge rather than the presence of hard substrates.

Example images of conspicuous fauna within the ECC survey area are presented below in Figure 42, while example seabed images for each transect are provided in Appendix P.

Examples of Conspicuous Fauna		
 Ross worm (*Sabellaria spinulosa)*	 Tube worm (Serpulidae)	 Shrimp (Caridea)
 Hermit crab (*Pagurus* sp.)	 Sponge (Porifera)	 Spider crab (*Hyas* sp.)
 Harbour crab (*Liocarcinus* sp.)	 Barnacles (Cirripedia)	 Sea Chervil (*Alcyonidium diaphanum)*

Examples of Conspicuous Fauna		
 Hornwrack (*Flustra foliacea*)	 Bryozoa (*Vesicularia spinosa*)	 Bryozoa (Cheilostomatida)
 Pogge (*Agonus cataphractus*)	 Swimming crab (Necora puber)	 Brittle star (Ophiuroidea)
 Flatfish (Pleuronectiformes)	 Slipper limpet (*Crepidula fornicata*)	 Common Sunstar (*Crosstaster papposus*)
 Hydrozoa (*Nemertesia* sp.)	 Painted Top-Shell (*Calliostoma zizyphinum*)	 Hydrozoa (Sertulariidae)

Examples of Conspicuous Fauna		
 Hydrozoa (Haleciidae)	 Anemone (*Dahlia* sp.)	 Common starfish (*Asterias rubens*)
 Butterfish (*Pholis gunnelis*)	 Squat lobster (Galatheoidea)	 Sand mason (*Lanice conchilega*)

Figure 42: Species Examples from Seabed Photographs

4.9.1 Habitat Classification

a Infralittoral Muddy Sand (SS.SSa.IMuSa / MB5)

Habitats dominated by homogeneous fine sand with minimal shell fragments were associated with the presence of sandbanks (<15m LAT) in the FA and within Block 12 and 13 along the ECC route. Given the elevation, the infralittoral fine sand dominated habitats were influenced by megaripples and sand waves. Described by the JNCC as "*Non-cohesive muddy sand (with 5% to 20% silt/clay) in the infralittoral zone, extending from the extreme lower shore down to more stable circalittoral zone at about 15-20 m. The habitat supports a variety of animal-dominated communities, particularly, bivalves and the urchin Echinocardium cordatum*".

Due to the homogeneous sand with negligible hard substrate, conspicuous fauna was limited to frequent observations of the Bryozoa, *Alcyonidium diaphanum*, which was likely attached to sub-surface shells. Chordata was limited to the presence of sandeels (Ammodytidae sp.) which were also commonly recovered within the seabed grab sampling (Appendix F). The presence of fine to medium sand, low abundance and diversity of observed epifauna is consistent with the level four EUNIS habitat classification MB5 describing 'Infralittoral sand', corresponding with the JNCC classification SS.SSa.IMuSa, 'Infralittoral muddy sand', which is within the expected depth range (0 – 20m) for this biotope. The presence of sandeels within the grab samples and occasionally on the video transects warranted further investigation into this habitat type's suitability for sandeel spawning and nursery grounds (see Section 4.9.2d).

Four level five biotopes exist within the 'Infralittoral muddy sand' habitat; however, none of the level five biotope defining species, such as, *Echinocardium cordatum*, *Ensis, Fabulina fabula, Arenicola marina or Spisula subtruncata* were present at the stations sampled within the MB5 habitat type (ECC_05, ECC_07, ECC_11 and FA_52). This suggests that the most suitable JNCC level 5 biotope to describe the area is 'Infralittoral mobile clean sand with sparse fauna' (SS.SSa.IFiSa.IMoSa) but should be cautiously applied due to the different overarching sediment category this biotope falls under (Infralittoral fine sand).

The SACFOR scale results based on the video and stills analysis further evidenced the impoverished environment with species observed during video and stills analysis of ECC_11 limited to the sea chervil, *Alcyonidium diaphanum*, classifying as 'frequent' (Table 39 and Table 40). The limited epifauna is to be expected from 'Infralittoral muddy sand', as fauna present in this biotope is robust and often infaunal, giving the sand a 'clean' and impoverished appearance.

Therefore, based on no level 5 characterising species present within the infauna dataset and an impoverished epifauna community the muddy sand sediment associated to sandbank features were classified as the overarching 'Infralittoral muddy sand' habitat. Example images are given in Figure 43 and the expected extent of the habitat 'Infralittoral fine sand' (EUNIS: 'Infralittoral sand', MB5) is mapped in Figure 48 and Figure 49. For the purposes of habitat mapping to a level 5 detail, the biotope SS.SSa.IFiSa.IMoSa is displayed in Figure 50 and Figure 51.

Table 39: SACFOR Scale from Video Analysis of SS.SSa.IMuSa Habitat

	Lanice Conchilega	*Sabellaria spinulosa*	Serpulidae	Caridea	Anomura	*Pagurus* sp.	*Ebalia* sp.	*Cancer pagurus*	*Hyas* sp.	Brachyura	*Necora puber*	Cirripedia	*Alcyonidium diaphanum*		*Flustra folicea*		*Vesicularia spinosa*		Cheilostomatida	ACTINOPTERYGII	*Pholis gunnelus*	Pleuronectiformes	ASCIDIACEA	HYDROZOA	Nemertesia sp.	Actinaria	*Metridium* sp.	*Dahlia* sp.	*Asterias rubens*		*Henricia* sp.	Crossaster papposus		Ophiuroidea	Janolus cristatus	Nudibranchia		*Calliostoma zizyphinum*	*Crepidula fornicata*	Porifera
Size Class	3 - 15cm	%	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	%	3 - 15cm	>15cm	3 - 15cm	>15cm	3 - 15cm	>15cm	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	%	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	eggs	3 - 15cm	3 - 15cm	%
SACFOR Scale*																																								
ECC_VID_11																																								
Percentage Frequency of Occurrence (%)**																																								
ECC_VID_11																																								

*To aid clarity 0% frequency of occurrence values have been excluded from the table.

Superabundant = (S) | Abundant = (A) | Common = (C) | Frequent = (F) | Occasional = (O) | Rare = (R) | Less than Rare = (L)

Table 40: SACFOR Scale from Stills Analysis SS.SSa.IMuSa Habitat

	Sabella pavonina	*Lanice Conchilega*	*Sabellaria spinulosa*	Serpulidae	Caridea	Anomura	*Pagurus* sp.	*Ebalia* sp.	Brachyura	*Cancer pagurus*	*Hyas* sp.	*Liocarcinus* sp.	*Necora puber*	Cirripedia	BRYOZOA	*Alcyonidium diaphanum*		*Flustra foliacea*		*Vesicularia spinosa*		Cheilostomatida	ASCIDIACEA	ACTINOPTERYGII	*Agonus cataphractus*	*Clavelina lepadiformis*	*Callionymus lyra*	Cyclopteridae	*Pholis gunnelus*	Gobiidae	*Echiichthys vipera*	Pleuronectiformes	CNIDARIA	ANTHOZOA	*Alcyonium digitatum*		Hydrozoa	Plumulariidae	*Tubularia* sp.	Sertulariidae		Haleciidae	Actiniaria	*Metridium* sp.	*Actinothoe sphyrodeta*	*Dahlia* sp.	Asteroidea	*Asterias rubens*		*Henricia* sp.	*Crossaster papposus*		OPHIUROIDEA	Gastropoda	*Buccinum undatum*	*Trivia arctica*	*Aequipecten opercularis*	*Janolus cristatus*	*Sepiola atlantica*	Nudibranchia		*Steromphala* sp.	*Calliostoma zizyphinum*	*Crepidula fornicata*	*Ensis* sp.	PORIFERA
Size Class	3 - 15cm	3 - 15cm	%	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	%	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	>15cm	3 - 15cm	>15cm	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3-15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	eggs	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	%
SACFOR Scale																																																																		
ECC_VID_11																F																																																		
Percentage Frequency of Occurrence (%)*																																																																		
ECC_VID_11																13																																																

**To aid clarity 0% frequency of occurrence values have been excluded from the table.

Superabundant = (S) Abundant = (A) Common = (C) Frequent = (F) Occasional = (O) Rare = (R) Less than Rare = (L)

Figure 43 Example Images of Atlantic Infralittoral Muddy Sand Habitats

b Circalittoral Muddy Sand (SS.SSa.CMuSa / MC52)

Similarly to the infralittoral fine sand habitats, the deeper (>15m) habitats, partly associated with sandbanks and sand waves in Blocks 4, 5, 7, 8 and 17, were dominated by rippled fine to coarse sands and silty sands with little shell fragments. Described by the JNCC as "*Circalittoral non-cohesive muddy sands with the silt content of the substratum typically ranging from 5% to 20%. This habitat is generally found in water depths of over 15-20m and supports animal-dominated communities characterised by a wide variety of polychaetes, bivalves and echinoderms. These circalittoral habitats tend to be more stable than their infralittoral counterparts and as such support a richer infaunal community*".

Due to the homogeneous sand with negligible hard substrate, fauna observed on the seabed photographs and video were limited to sporadic sightings of an unidentified fish (Actinopterygii), common starfish (*Asterias rubens),* brittlestars (Ophiuroidea sp.), sun starfish (*Crossaster papposus*), hermit crabs (*Pagurus* sp.) and shrimp (Caridea). Sub-surface availability of hard substrate resulted in the colonisation of sessile epifauna such as *A. diaphanum, Flustra foliacea, Vesicularia spinosa* and sand mason worms (*Lanice conchilega*).

The presence of fine to coarse sand, moderate abundance and diversity observed epifauna is consistent with the level four EUNIS habitat classification MC52 describing 'Atlantic circalittoral sand', corresponding with the JNCC classification SS.SSa.CMuSa which is within the expected depth range (10 – 50m) for this biotope.

Three level five biotopes exist within the 'Circalittoral muddy sand'; but only one had somewhat of a similarity to the survey area: SS.SSa.CMuSa.Ooph '*Ophiura ophiura* on circalittoral muddy sand' habitat. The presence of Ophiuroidea, *Pagurus*, *Caridea* and starfish could support the assignment of this level five biotope. Similarly, the SACFOR review of the stills revealed the presence of 'frequent' abundances of Ophiuroidea with a 5% frequency of occurrence. However, the epibenthic trawls undertaken in the circalittoral muddy sand habitat (ECC_T2 and ECC_T4) did not reveal these fauna to be any more abundant than in other transects sampled in different habitats, for example a higher abundance of Ophiuroidea was present in the ECC_T1 trawl undertaken in a circalittoral mixed sediment type. Despite this, the 'Circalittoral muddy sand' environment could be considered to reflect the level five biotope SS.SSa.CMuSa.Ooph, albeit an impoverished version of it and the extent of this habitat type has been mapped to both a level 4 and level 5 category.

Example images are given in Figure 44 and the expected extent of the habitat 'Circalittoral muddy sand' (EUNIS: 'Atlantic circalittoral sand', MC52) is mapped in Figure 48. The level 5 habitat map is displayed in Figure 50.

Table 41: SACFOR Scale from Video Analysis of SS.SSa.CMuSa Habitat

	Lanice Conchilega	*Sabellaria spinulosa*	Serpulidae	Caridea	Anomura	*Pagurus* sp.	*Ebalia* sp.	*Cancer pagurus*	*Hyas* sp.	Brachyura	*Necora puber*	Cirripedia	*Alcyonidium diaphanum*		*Flustra foliacea*		*Vesicularia spinosa*		Cheilostomatida	ACTINOPTERYGII	*Pholis gunnelus*	Pleuronectiformes	ASCIDIACEA	HYDROZOA	*Nemertesia* sp.	Actinaria	*Metridium* sp.	*Dahlia* sp.	*Asterias rubens*		*Henricia* sp.	*Crossaster papposus*		OPHIUROIDEA	Janolus cristatus	Nudibranchia		*Calliostoma zizyphinum*	*Crepidula fornicata*	PORIFERA
Size Class	3 - 15cm	%	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	%	3 - 15cm	>15cm	3 - 15cm	>15cm	3 - 15cm	>15cm	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	%	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	eggs	3 - 15cm	3 - 15cm	%
SACFOR Scale*																																								
ECC_VID_33															F		F	C																						
ECC_VID_55																																								
ECC_VID_64 (1)										F			C	A			C	C																						
Percentage Frequency of Occurrence (%)**																																								
ECC_VID_33															50		50	50																						
ECC_VID_55																																								
ECC_VID_64 (1)										50			50	100			50	50																						

**To aid clarity 0% frequency of occurrence values have been excluded from the table.

Superabundant = (S) | Abundant = (A) | Common = (C) | Frequent = (F) | Occasional = (O) | Rare = (R) | Less than Rare = (L)

Table 42: SACFOR Scale From Stills Analysis of SS.SSa.CMuSa Habitat

	Sabella pavonina	*Lanice Conchilega*	*Sabellaria spinulosa*	Serpulidae	Caridea	Anomura	*Pagurus* sp.	*Ebalia* sp.	Brachyura	*Cancer pagurus*	*Hyas* sp.	*Liocarcinus* sp.	*Necora puber*	Cirripedia	BRYOZOA	*Alcyonidium diaphanum*		*Flustra foliacea*		Vesicularia spinosa		Cheilostomatida
Size Class	3 - 15cm	3 - 15cm	%	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	%	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	>15cm	3 - 15cm	>15cm	%
SACFOR Scale																						
ECC_VID_33																F						
ECC_VID_55																						
ECC_VID_64		A	R		C	F	O	O	O	F	O	O				C	A	F		A		
Percentage Frequency of Occurrence (%)*																						
ECC_VID_33																7						
ECC_VID_55																						
ECC_VID_64		64	62		35	9	3	2	1	1	4	4				41	65	14		67		

	ASCIDIACEA	ACTINOPTERYGII	*Agonus cataphractus*	*Clavelina lepadiformis*	*Callionymus lyra*	Cyclopteridae	*Pholis gunnelus*	Gobiidae	*Echichthys vipera*	Pleuronectiformes	CNIDARIA	ANTHOZOA	*Alcyonium digitatum*		Hydrozoa	Plumulariidae	*Tubularia* sp.	Sertulariidae		Halecidae	Actinaria	*Metridium* sp.
Size Class	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3-15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm
SACFOR Scale																						
ECC_VID_33																						
ECC_VID_55																						
ECC_VID_64		O					O									C		C		O		
Percentage Frequency of Occurrence (%)*																						
ECC_VID_33																						
ECC_VID_55																						
ECC_VID_64		1					3									11		55		2		

	Actinothoe sphyrodeta	*Dahlia* sp.	Asteroidea	*Asterias rubens*		*Henricia* sp.	*Crossaster papposus*		OPHIUROIDEA	Gastropoda	*Buccinum undatum*	*Trivia arctica*	*Aequipecten opercularis*	*Janolus cristatus*	*Sepiola atlantica*	Nudibranchia		*Sterompha* sp.	*Calliostoma zizyphinum*	*Crepidula fornicata*	*Ensis* sp.	PORIFERA
Size Class	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	eggs	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	%
SACFOR Scale																						
ECC_VID_33																						
ECC_VID_55																						
ECC_VID_64		F					O		F	F							O		O		O	
Percentage Frequency of Occurrence (%)*																						
ECC_VID_33																						
ECC_VID_55																						
ECC_VID_64		6					1		5	3							2			3		1

**To aid clarity 0% frequency of occurrence values have been excluded from the table.

Superabundant = (S) | Abundant = (A) | Common = (C) | Frequent = (F) | Occasional = (O) | Rare = (R) | Less than Rare = (L)

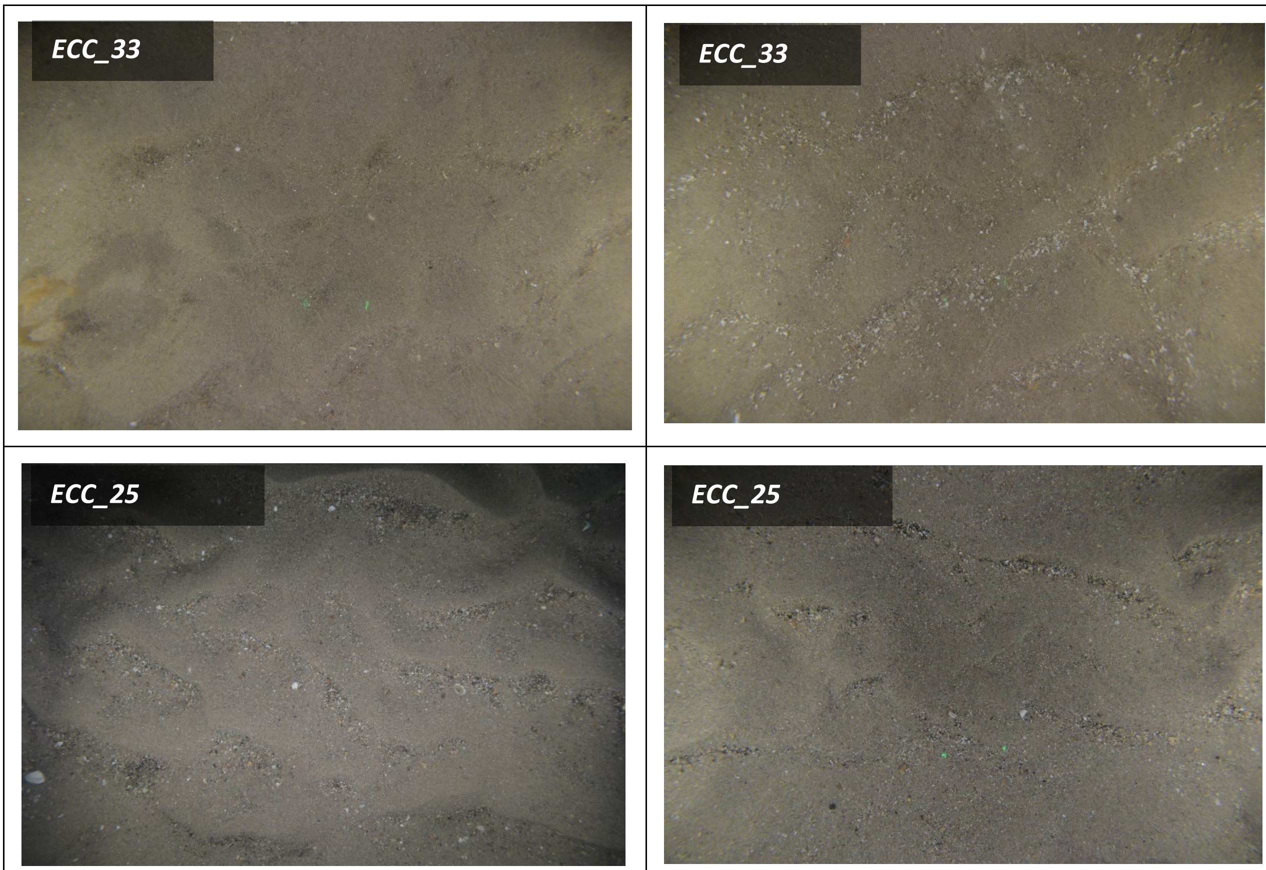


Figure 44: Example Images of Atlantic Circalittoral Muddy Sand Habitats

c Circalittoral Coarse Sediments (SS.SCS.CCS / MC32)

Habitats comprised of variable densities of cobbles, pebbles and shell fragments overlaying sand at water depths greater than 15m were predominantly observed in the FA and intermittently in Blocks 3 to 12 and 14, 15 and 17. The coarse sediment was mobile forming sand waves that were orientated northeast to west-southwest. Relatively smaller patches of shell gravel, pebbles and cobbles were also interspersed between the mixed sediment and sand matrices across the entire ECC and FA. Described by the JNCC as "*Tide-swept circalittoral coarse sands, gravel and shingle generally in depths of over 15-20 m. This habitat may be found in tidal channels of marine inlets, along exposed coasts and offshore. This habitat, as with shallower coarse sediments, may be characterised by robust infaunal polychaetes, mobile crustacea and bivalves".*

Fauna observed on the seabed photographs and video were similar to the assemblages observed in the muddy sand dominated habitats but were of slightly higher diversity and abundance given the greater availability of hard substrate for colonisation. Echinoderms were limited to the common starfish (*A. rubens*). Mobile Arthropoda were also observed and included spider crabs (*Hyas* sp.), unidentifiable crabs (Bachyura sp.), hermit crabs (*Pagurus* sp.), and swimming crabs (*Necora puber* and *Liocarcinus* sp.). Mobile Chordata was restricted to occasional sightings of the butterfish (*Pholis gunnellus*).

Sessile organisms were largely limited to the sporadic cobbles and pebbles found throughout the coarse habitats and included hydroids (*Vesicularia spinosa,* Sertulariidae, *Nemertesia* sp.), sea chervil (*A. diaphanum*), hornwrack (*F. foliacea*), dahlia anemone (*U. felina*), porifera and barnacles (Cirripedia sp.). The presence of these species is relatively consistent with the level four EUNIS habitat classification MC32 describing 'Circalittoral coarse sediment', corresponding with the JNCC classification SS.SCS.CCS which is within the expected depth range (10-50m) for this biotope. The observation of cobble and pebbles on the underwater video transects warranted further investigation into the possible presence of Annex I geogenic stony reef habitats (discussed further in Sections 4.9.2a).

Five level five biotopes exist within the 'Circalittoral coarse sediment' habitat; but only one had a similarity to the survey area: SS.SCS.CCS.Pkef '*Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand'. The presence of *P. kefersteini,* Nemertea, *Chaetozone zetlandica, Exogone verugera* and *Glycera lapidum* could support the assignment of the level five biotope. However, the impoverished species abundances across all the coarse sediment stations limits the confident assignment of any level five biotope.

The SACFOR review of the stills and video revealed the presence of 'abundant' abundance of *Lanice conchilega*, *A. diaphanum* and *V. spinosa* but none are considered relative important to the SS.SCS.CCS.Pkef biotope. However, the SS.SCS.CCS.Pkef could not be determined through video, stills and trawl data review due to the infaunal characterising species, which are not accurately assessed by these survey methods (Table 43 and Table 44). Therefore, given the uncertainty, the overarching habitat classification was kept at 'Circalittoral coarse sediment'.

Example images are given in Figure 45 and the expected extent of the habitat 'Circalittoral coarse sediment' (EUNIS: 'Atlantic circalittoral coarse sediment', MC32) is mapped in Figure 48 and Figure 49. For the purposes of habitat mapping to a JNCC level 5 classification, the most likely biotope (SS.SCS.CCS.Pkef) is displayed in Figure 50 and Figure 51.

Table 43: SACFOR Scale from Video Analysis of SS.SCS.CCS Habitat

	Lanice Conchilega	*Sabellaria spinulosa*	Serpulidae	Caridea	Anomura	*Pagurus* sp.	*Ebalia* sp.	*Cancer pagurus*	*Hyas* sp.	Brachyura	*Necora puber*	Cirripedia	*Alcyonidium diaphanum*		*Flustra foliacea*		*Vesicularia spinosa*		Cheilostomatida	Actinopterygii	*Pholis gunnellus*	Pleuronectiformes	Ascidiacea	Hydrozoa	*Nemertesia* sp.	Actinaria	*Metridium* sp.	*Dahlia* sp.	*Asterias rubens*		*Henricia* sp.	*Crossaster papposus*		Ophiuroidea	*Ianolus cristatus*	Nudibranchia		*Calliostoma zizyphinum*	*Crepidula fornicata*	Porifera
Size Class	3 - 15cm	%	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	%	3 - 15cm	>15cm	3 - 15cm	>15cm	3 - 15cm	>15cm	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	%	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	eggs	3 - 15cm	3 - 15cm	%
SACFOR Scale*																																								
ECC_VID_06						F						L	C	S	F		C		L						R			F						C		F		F		L
ECC_VID_08						F							C	C			C							L																
ECC_VID_17			L								F	L			C		C						C	R		F		F				F							F	L
ECC_VID_18	F									F		L			F	C	C						F	R		C		F											C	
ECC_VID_21	F		L							F		L	C	C	C		C		L					R		C				C		F								
ECC_VID_28	F			F						F		L	C		F				L			F		R		F		F										F	C	L
ECC_VID_37		R		C					F	F		L			C		C			F				R	L			F						F						L
ECC_VID_38															F		F							L																
ECC_VID_56		L			F				F						F	A	C	A						R				F	F		F									
ECC_VID_62		O		C											C	A	C		O					R	L	F		F										F		
ECC_VID_63						F						L	C	A			C							L				F												
Percentage Frequency of Occurrence (%)**																																								
ECC_VID_06						50						100	100	100	50		100		50						50			50						100		50		50		50
ECC_VID_08						50							100	50			50							100																
ECC_VID_17			50								50	100			100		100						100	100		100		100				50							50	50
ECC_VID_18	50									50		100			50	100	50						50	100		100		50											50	
ECC_VID_21	50		50							100		100	50	50	100		100		50					100		100				50		50								
ECC_VID_28	50			50						50		100	100		100				50			50		100		100		100										50	50	50
ECC_VID_37		100		100					50	100		50			100		100			50				100	50			50						50						100
ECC_VID_38															50		50							50																
ECC_VID_56		100			50				50						50	50	100	100						100				50	50		50									
ECC_VID_62		100		100											100	100	100		100					100	50	100		50										50		
ECC_VID_63						50						50	50	50			100							50				50												

**To aid clarity 0% frequency of occurrence values have been excluded from the table.

Superabundant = (S) | Abundant = (A) | Common = (C) | Frequent = (F) | Occasional = (O) | Rare = (R) | Less than Rare = (L)

Table 44: SACFOR Scale from Stills Analysis of SS.SCS.CCS Habitat

	Sabella pavonina	Lanice Conchilega	Sabellaria spinulosa	Serpulidae	Caridea	Anomura	Pagurus sp.	Ebalia sp.	Brachyura	Cancer pagurus	Hyas sp.	Liocarcinus sp.	Necora puber	Cirripedia	BRYOZOA	Alcyonidium diaphanum		Flustra foliacea		Vesicularia spinosa		Cheilostomatida
Size Class	3 -15cm	3 -15cm	%	%	3 -15cm	3 -15cm	3 -15cm	3 -15cm	3 -15cm	>15cm	3 -15cm	3 -15cm	3 -15cm	%	3 -15cm	3 -15cm	>15cm	3 -15cm	>15cm	3 -15cm	>15cm	%
SACFOR Scale																						
ECC_VID_06									F					R		A		C		C		R
ECC_VID_08		F												R		C				C	A	L
ECC_VID_17		C		O	F									F				C	C	C		L
ECC_VID_18		A		R	F	F	F	O				O		F		C		C		A		O
ECC_VID_21		A	R	R	O	F	F	O	F	F	O	O	F	R		A		C		A		O
ECC_VID_28		C	L	R	C	F	O		O					R		A	F	C		A		R
ECC_VID_37	O	C	O	R	C	C			F		O	F	F	O		O		C		A		L
ECC_VID_38		F		L	O	O						O	O	L				C		C		
ECC_VID_56		F		L	F						F					F		A		A		
ECC_VID_62		F	F	L	C	C		O	F		F	F	O					C		A		
ECC_VID_63		F	L				O									C	A	F		C	C	
Percentage Frequency of Occurrence (%)*																						
ECC_VID_06									8					46		100		23		31		15
ECC_VID_08		15												46		54				15	15	8
ECC_VID_17		50		58	8									92				25	8	92		8
ECC_VID_18		79		79	12	6	9	3				3		100		65		50		97		91
ECC_VID_21		96	29	98	2	4	6	2	10	2	2	4	6	94		85		63		88		94
ECC_VID_28		50	8	88	58	20	3		3					88		83	3	58		88		88
ECC_VID_37	4	39	83	48	85	72			15		4	7	7	67		2		78		100		7
ECC_VID_38		3		3	3	3						3	3	6				13		16		
ECC_VID_56		18		6	6						18					6		88		88		
ECC_VID_62		5	98	5	84	75		5	9		9	11	2					91		100		
ECC_VID_63		3	3				3									21	12	3		42	12	

	ASCIDIACEA	ACTINOPTERYGII	Agonus cataphractus	Clavelina lepadiformis	Callionymus lyra	Cyclopteridae	Pholis gunnelus	Gobiidae	Echiichthys vipera	Pleuronectiformes	CNIDARIA	ANTHOZOA	Alcyonium digitatum		Hydrozoa	Plumulariidae	Tubularia sp.	Sertulariidae		Haleciidae	Actinaria	Metridium sp.	Actinothoe sphyrodeta
Size Class	3 -15cm	3 -15cm	3 -15cm	3 -15cm	3 -15cm	3 -15cm	3-15cm	3 -15cm	3 -15cm	3 -15cm	3 -15cm	3 -15cm	3 -15cm	>15cm	3 -15cm	3 -15cm	3 -15cm	3 -15cm	>15cm	3 -15cm	3 -15cm	3 -15cm	3 -15cm
SACFOR Scale																							
ECC_VID_06															C						F		
ECC_VID_08															F								
ECC_VID_17	A														F	F	F	A			F		
ECC_VID_18	C				O								F		C	C		A			C		F
ECC_VID_21	C										O				F	C	F	C			C		F
ECC_VID_28	F	F		O						O						C		C			F		
ECC_VID_37	O	O	O		O	O		O								A	F	C			C		O
ECC_VID_38																							
ECC_VID_56	F															C	F						
ECC_VID_62	F	O		F	O							F			F	C	F	C		F	C		
ECC_VID_63													O			O	O	F				O	
Percentage Frequency of Occurrence (%)*																							
ECC_VID_06															38						31		
ECC_VID_08															15								
ECC_VID_17	100														8	8	8	50			8		
ECC_VID_18	91				3								3		41	24		88			85		12
ECC_VID_21	38										2				4	19	2	35			85		6
ECC_VID_28	5	10		3						3						8		18			18		
ECC_VID_37	4	2	2		2	2		2								76	7	35			43		2
ECC_VID_38																							
ECC_VID_56	6															12	6						
ECC_VID_62	14	2		2	2							2			5	27	7	30		7	45		
ECC_VID_63													3			3	3	3				3	

	Dahlia sp.	Asteroidea	Asterias rubens		Henricia sp.	Crossaster papposus		OPHIUROIDEA	Gastropoda	Buccinum undatum	Trivia arctica	Aequipecten opercularis	Janolus cristatus	Sepiola atlantica	Nudibranchia		Steromphala sp.	Calliostoma zizyphinum	Crepidula fornicata	Ensis sp.	PORIFERA
Size Class	3 -15cm	3 -15cm	3 -15cm	>15cm	3 -15cm	3 -15cm	>15cm	3 -15cm	3 -15cm	3 -15cm	3 -15cm	3 -15cm	3 -15cm	3 -15cm	3 -15cm	eggs	3 -15cm	3 -15cm	3 -15cm	3 -15cm	%
SACFOR Scale																					
ECC_VID_06								C										F			
ECC_VID_08															F						
ECC_VID_17	F															F			A		
ECC_VID_18	F					F				F					F	C	F	F	A		L
ECC_VID_21	F		O			F		O	O	F							F	O	F		
ECC_VID_28			O			F			O						F		O	O	A	O	L
ECC_VID_37	O	O	O			F		F				O			O	O	O	F	O		L
ECC_VID_38																	O				
ECC_VID_56	F							F		F											
ECC_VID_62	F			F	O	F		F			O		O				F	F	C		
ECC_VID_63	F							O								F	O				
Percentage Frequency of Occurrence (%)*																					
ECC_VID_06								54											8		
ECC_VID_08															8						8
ECC_VID_17	17															8	8			83	8
ECC_VID_18	9					9				9					9	15		6	9	100	
ECC_VID_21	8		2			8		2	4	4							2	8	2	13	
ECC_VID_28			3			20			3						15		3	3	3	55	
ECC_VID_37	2	2	2			15		13				2			4	4		2	11	2	
ECC_VID_38																		3			
ECC_VID_56	6							6		6											
ECC_VID_62	7			2	5	11		16			2		2					7	9	30	
ECC_VID_63	6							3								3		3			

**To aid clarity 0% frequency of occurrence values have been excluded from the table.

Superabundant = (S) Abundant = (A) Common = (C) Frequent = (F) Occasional = (O) Rare = (R) Less than Rare = (L)

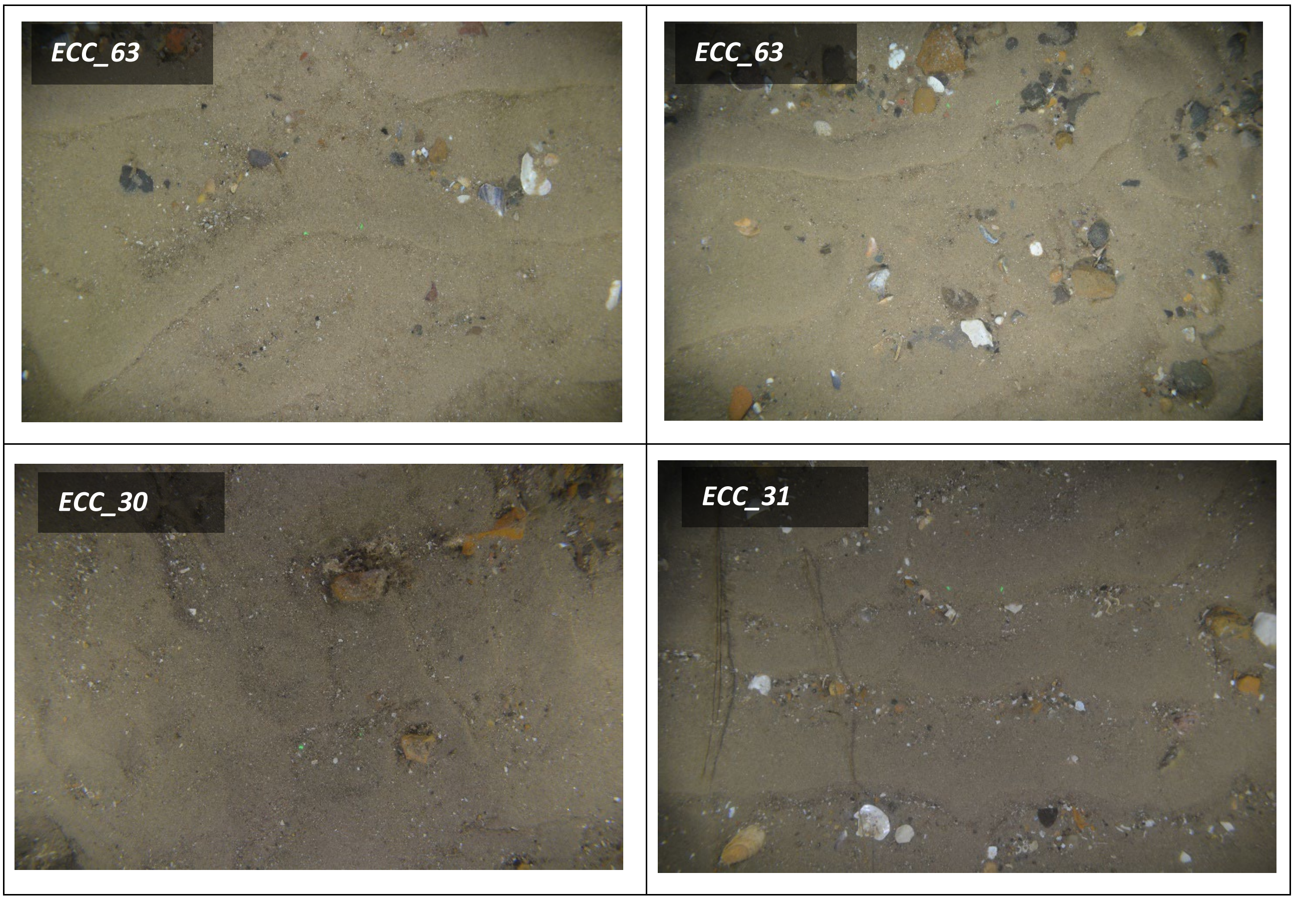


Figure 45: Example Images of Circalittoral Coarse Sediment Habitats

d Circalittoral Mixed Sediments (SS.SMx.CMx / MC42)

This habitat was widespread across the ECC route but occurred less frequently in the FA. The sediment was less mobile than the coarse sediment or sand dominated habitats, with a general absence of megaripples and sandwaves. Similarly to the circalittoral coarse sediments, circalittoral mixed sediments were comprised of variable abundances of cobbles, pebbles and shell gravel overlaying coarse sediments with variable proportions of clay/silt. Circalittoral mixed sediments are described by the JNCC as "*Mixed (heterogeneous) sediment habitats in the circalittoral zone (generally below 15-20 m) including well mixed muddy gravelly sands or very poorly sorted mosaics of shell, cobbles and pebbles embedded in or lying upon the mud, sand or gravel".*

Similarly, to the overarching coarse sediment, fauna observed on the seabed photographs and video included a variety of mobile fauna, including several echinoderms such as common starfish (*A. rubens*), sun starfish (*Crossaster popposus*) and brittle stars (Ophiuroidea sp.). Molluscs were limited to Queen scallops (*Aequipecten opercularis*) and the common whelk (*Buccinum undatum*). Mobile Arthropoda were also observed such as hermit crabs (*Pagurus* sp.), brown crab (*C. pagurus*), spider crab (*Hyas* sp.), velvet swimming crab (*N. puber*), harbour crabs (*Liocarcinus* sp.), and unidentified crabs (Brachyura sp.). Mobile Chordata were occasionally observed including butterfish (*Pholis gunnellus*), and pogge (*Agonus cataphractus*). Sessile organisms which settled onto the boulders, cobbles and pebbles included antenna hydroid (*Nemertesia* sp.), hydrozoan/bryozoan turf, unidentified anemones (Actinaria sp.), dead man's fingers (*A. digitatum*), dahlia anemone (*U. felina*), barnacles (Cirripedia sp.), Serpulidae tubes, hornwrack (*F. foliacea*), Porifera, *V. spinosa*, Haleciidae, sea chervil (*A. diaphanum*), sertulariidae, sand mason worm (*L. conchilega*), ross worm (*S. spinulosa*) and slipper limpet

(*Crepidula fornicata*). The relatively high species diversity of 33 out of a total of 43 epifaunal species observed was unsurprising given the range of sediment types encompassed in the intermediate coarse and mixed sediment habitat, ranging from variable proportions of fines to matrices of cobbles and pebbles overlaying variable densities of shell gravel.

The presence of these faunal assemblages indicates conformance towards the level four EUNIS habitat classification MC42 describing 'Circalittoral mixed sediment', corresponding with the JNCC classification SS.SMx.CMx, which is within the depth range of (15-20m) for this biotope. The abundance of faunal covered boulders, cobbles, pebbles across the ECC survey area and the presence of *S. spinulosa* aggregations warrants further investigation as potential Annex I geogenic stony and biogenic reef habitats (discussed further in Section 4.9.2a and b).

The mixed sediment habitats showed strong conformity to the level five biotope SS.SMx.CMx.FluHyd '*F. foliacea* and *H. falcata* on tide-swept circalittoral mixed sediment' with 11 characterising species such as hornwrack (*F. foliacea*), hydroids, common starfish (*A. rubens*), dahlia anemone (*U. felina*), hermit crab (*Pagurus* sp.), sea chervil (*A. diaphanum*), dead man's fingers (*A. digitatum*), *S. triqueter*, *V. spinosa* and *Balanus crenatus* present.

SACFOR abundances of characterising species were either in keeping or more abundant than their expected JNCC SACFOR abundances and frequency of occurrence for the aforementioned biotopes, with 'abundant' to 'occasional' abundances of *F. foliacea*, *Pagurus* sp., *A. diaphanum*, *Nemertesia*, *A. digitatum*, *U. felina* and *A. rubens*, indicating a conformance to the SS.SMx.CMx.FluHyd biotopes (Table 45 and Table 46). Additionally, the epibenthic trawls, ECC_T2 and ECC_T5 at stations ECC_49 and ECC_18, respectively, recorded a presence of *A. diaphanum*, *F. foliacea*, *A. rubens*, *P. bernhardus*, and Actinaria, which could have contained *U. feline* and further supports an assignment to the level 5 biotope. One station (FA_03), however showed closer conformity to '*Sabellaria spinulosa* on Stable Circalittoral Mixed Sediment' (SS.SBR.PoR.SsipiMx) upon review of infaunal data due to relatively high abundances of *S. spinulosa*. However, the classification of this level 5 biotope around FA_03 should be done so cautiously due to the caveat of video evidence of *S. spinulosa* at this location limited to small sections of thin crusts.

Example images are given in Figure 46 and the expected extent of the habitat 'Circalittoral mixed sediment' (EUNIS: 'Atlantic circalittoral mixed sediment', MC42) is mapped in Figure 48 and Figure 49 as 'SS.SCS.CCS' with patches of 'SS.SMx.CMx'. The extent of the habitat mapped to the level 5 SS.SMx.CMx.FluHyd biotope classification is displayed in Figure 50. For the purposes of mapping at a level 5 classification, cautiously, the SS.SBR.PoR.SsipiMx biotope surrounding FA_03 displayed in Figure 51 based on infaunal findings.

Table 45: SACFOR Scale from Video Analysis of SS.SMx.CMx Habitat

	Lanice Conchilega	*Sabellaria spinulosa*	Serpulidae	Caridea	Anomura	*Pagurus* sp.	*Ebalia* sp.	*Cancer pagurus*	*Hyas* sp.	Brachyura	*Necora puber*	Cirripedia	*Alcyonidium diaphanum*		*Flustra foliacea*		*Vesicularia spinosa*		Cheilostomatida	ACTINOPTERYGII
Size Class	3 -15cm	%	%	3 -15cm	3 -15cm	3 -15cm	3 -15cm	>15cm	3 -15cm	3 -15cm	3 -15cm	%	3 -15cm	>15cm	3 -15cm	>15cm	3 -15cm	>15cm	%	3 -15cm
SACFOR Scale*																				
ECC_VID_03										F		L	C	A	O					
ECC_VID_12	F		L	F		F				F		L			C	C	F			
ECC_VID_30												L	C	C	C	A	C			
ECC_VID_31												L			F	C				
ECC_VID_42A									F						C	A	A			
ECC_VID_43		R														A	C	C		
ECC_VID_48A		R							O						F	C	F			
ECC_VID_49		L				F														
ECC_VID_61				F						F		L			C	A	C			
Percentage Frequency of Occurrence (%)**																				
ECC_VID_03										100		50	100	100	50					
ECC_VID_12	50		50	50		50				100		100			100	50	50			
ECC_VID_15				50								50	50		100		100		50	
ECC_VID_30												50	100	50	100	50	100			
ECC_VID_31												50			100	50				
ECC_VID_42A									50						50	50	50			
ECC_VID_43		100														100	100	100		
ECC_VID_48A		67							33						33	33	33			
ECC_VID_49		100				100														
ECC_VID_61				50						50		100			100	100	50			

	Pholis gunnelus	Pleuronectiformes	ASCIDIACEA	HYDROZOA	*Nemertesia* sp.	Actinaria	*Metridium* sp.	*Dahlia* sp.	*Asterias rubens*		*Henricia* sp.	*Crossaster papposus*		OPHIUROIDEA	*Jandus cristatus*	Nudibranchia		*Calliostoma zizyphinum*	*Crepidula fornicata*	PORIFERA
Size Class	3 -15cm	3 -15cm	3 -15cm	%	%	3 -15cm	3 -15cm	3 -15cm	3 -15cm	>15cm	3 -15cm	3 -15cm	>15cm	3 -15cm	3 -15cm	3 -15cm	eggs	3 -15cm	3 -15cm	%
SACFOR Scale*																				
ECC_VID_03									F											
ECC_VID_12			C	L				F					C		F		F	F	C	L
ECC_VID_30								F												
ECC_VID_31								F												
ECC_VID_42A					R	F	F	F		C										
ECC_VID_43					O		F	F												
ECC_VID_48A				L				F		F										
ECC_VID_49				R				F						C						
ECC_VID_61				R		F						F		F						
Percentage Frequency of Occurrence (%)**																				
ECC_VID_03									100											
ECC_VID_12			50	100				50					50		50		50	50	50	50
ECC_VID_15	50	50	50	100	100	100		100			50	50	50							50
ECC_VID_30								100												
ECC_VID_31								50												
ECC_VID_42A					50	50	50	50		50										
ECC_VID_43					100		100	100												
ECC_VID_48A				33				33		33										
ECC_VID_49				100				100						100						
ECC_VID_61				50		50						50		100						

**To aid clarity 0% frequency of occurrence values have been excluded from the table.

Superabundant = (S) Abundant = (A) Common = (C) Frequent = (F) Occasional = (O) Rare = (R) Less than Rare = (L)

Table 46: SACFOR Scale from Video Analysis of SS.SMx.CMx Habitat

	Sabella pavonina	Lanice conchilega	Sabellaria spinulosa	Serpulidae	Caridea	Anomura	Pagurus sp.	Ebalia sp.	Brachyura	Cancer pagurus	Hyas sp.	Liocarcinus sp.	Necora puber	Cirripedia	BRYOZOA	Alcyonidium diaphanum		Flustra foliacea		Vesicularia spinosa		Cheilostomatida	ASCIDIACEA	ACTINOPTERYGII	Agonus cataphractus	Clavelina lepadiformis	Callionymus lyra	Cyclopteridae	Pholis gunnellus	Gobiidae	Echiichthys vipera	Pleuronectiformes
Size Class	3 - 15cm	3 - 15cm	%	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	%	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	>15cm	3 - 15cm	>15cm	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3-15cm	3 - 15cm	3 - 15cm	3 - 15cm
SACFOR Scale																																
ECC_VID_03			L	O								F	F	R		A											F					
ECC_VID_12		C		R	C	C	F					F		C		C		C		A			A				F					
ECC_VID_15	F	A	R	O	C	C			O		O	F		F		C	C	A		A			A			A	O					
ECC_VID_30		F	L	L	O									R		C	C	C		C												
ECC_VID_31														L		O		F		C												
ECC_VID_33																F																
ECC_VID_42				L	F				F		F							F		A			F								F	
ECC_VID_43														L				C		C												
ECC_VID_48														L				C		C												
ECC_VID_49			O				F					F								A												
ECC_VID_61		F		L	C	F					F	O		R		C		A		A		R	O		F		F					
Percentage Frequency of Occurrence (%)*																																
ECC_VID_03			83	75								17	8	42		92											8					
ECC_VID_12		25		33	67	33	17					8		92		33		58		100			100				17					
ECC_VID_15	10	85	30	100	55	50			5		5	20		100		75	5	95		90			100			80	5					
ECC_VID_30		13	6	6	3									52		45	3	48		39												
ECC_VID_31														19		3		11		31												
ECC_VID_33																7																
ECC_VID_42				7	7				7		7							21		64			7								7	
ECC_VID_43														4				8		8												
ECC_VID_48														4				7		7												
ECC_VID_49			71				18					6								88												
ECC_VID_61		17		6	50	17					17	6		94		61		94		100		17	6		6		11					

	CNIDARIA	ANTHOZOA	Alcyonium digitatum		Hydrozoa	Plumulariidae	Tubularia sp.	Sertulariidae		Halecidae	Actinaria	Metridium sp.	Actinothoe sphyrodeta	Dahlia sp.	Asteroidea	Asterias rubens		Henricia sp.	Crossaster papposus		OPHIUROIDEA	Gastropoda	Buccinum undatum	Trivia arctica	Aequipecten opercularis	Janolus cristatus	Sepiola atlantica	Nudibranchia		Steromphala sp.	Calliostoma zizyphinum	Crepidula fornicata	Ensis sp.	PORIFERA
Size Class	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	eggs	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	%
SACFOR Scale																																		
ECC_VID_03			F													F			F												F			R
ECC_VID_12			C		C	C		F			C			F					F				F					F	F			S		R
ECC_VID_15			F			A	F	A			C			C					F				F								F	A		R
ECC_VID_30						F	F	F			O			F		F				F			O											
ECC_VID_31						C		F			O			O																				
ECC_VID_33																																		
ECC_VID_42								C					F	F		F			F															
ECC_VID_43														O																				
ECC_VID_48														O																				
ECC_VID_49					C	C		C													C		F							F				
ECC_VID_61					F	A		C		C	F		F			O			F		C							O			F			L
Percentage Frequency of Occurrence (%)*																																		
ECC_VID_03			8													42			8													17		
ECC_VID_12			33		8	50		17			58			8					8				17					17	8				100	
ECC_VID_15			5			75	10	90			65			35					15				10									15	95	5
ECC_VID_30						3	3	10			3			13		6				3			3											
ECC_VID_31						22		8			3			6																				
ECC_VID_33																																		
ECC_VID_42								14					7	21		7			7															
ECC_VID_43														4																				
ECC_VID_48														4																				
ECC_VID_49					12	18		24													94		12								53			
ECC_VID_61					6	72		50		17	39		6			6			28		44							6				11		

**To aid clarity 0% frequency of occurrence values have been excluded from the table.

Superabundant = (S) Abundant = (A) Common = (C) Frequent = (F) Occasional = (O) Rare = (R) Less than Rare = (L)

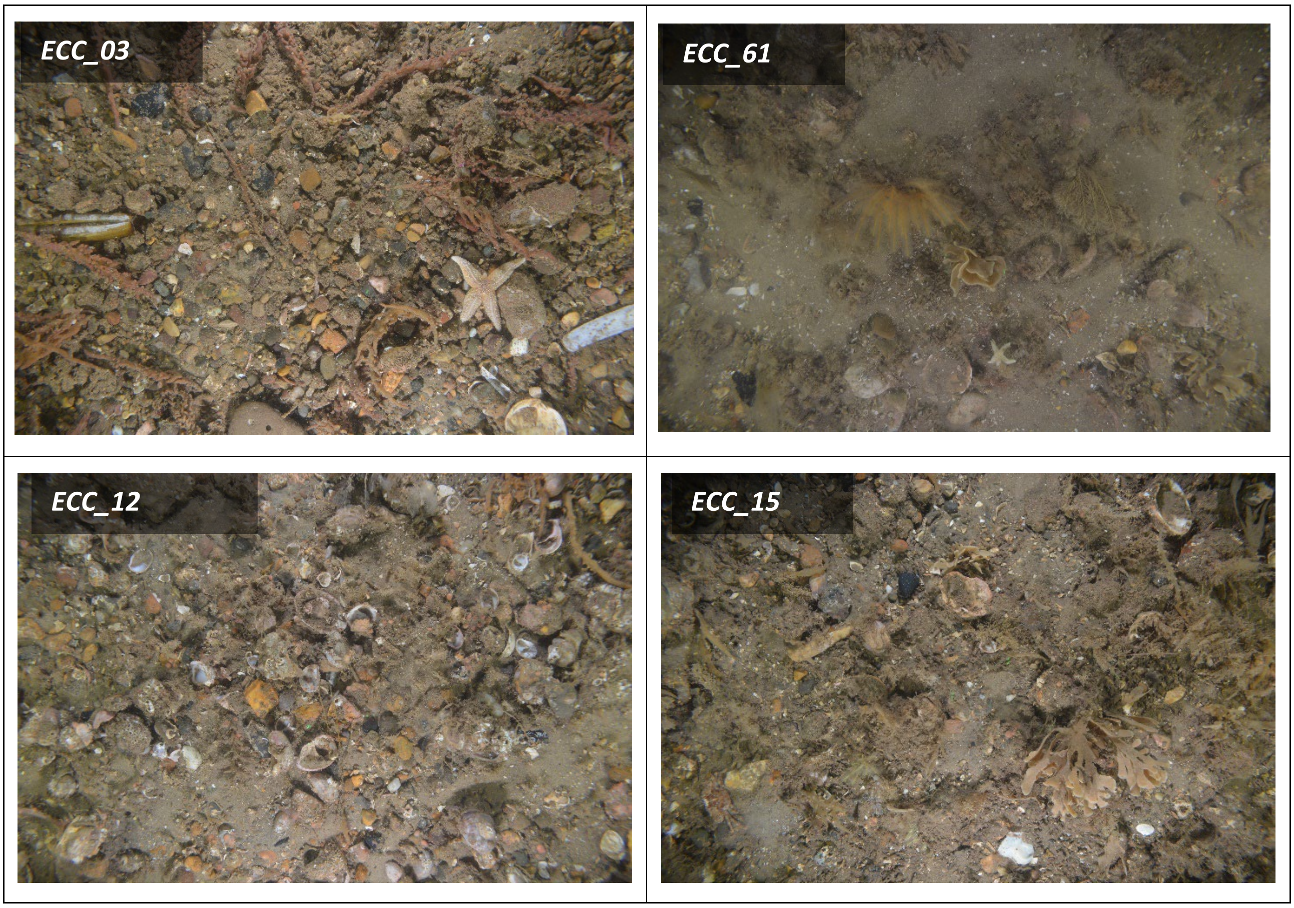


Figure 46: Example Images of Circalittoral Mixed Sediment Habitats

e *Sabellaria spinulosa on Stable Circalittoral Mixed Sediment (SS.SBR.PoR.SsipiMx / MC2211)*

Patches of broken and degraded *S. spinulosa* crusts as well as small clumps of live reef were most observed in Blocks 7, 9 and 15 of the ECC route (stations ECC_28, 29b, 34, 37, 35, 57, 59, 62, 64, 65 and 66) amongst mixed sediment. Described by JNCC as "*The tube-building polychaete Sabellaria spinulosa at high abundances on mixed sediment. This species typically forms loose agglomerations of tubes forming a low lying matrix of sand, gravel, mud and tubes on the seabed*".

This form of *S. spinulosa* habitat had a similar epifaunal diversity and abundance as that previously described for 'Circalittoral mixed sediment' due to *S. spinulosa* stabilising the underlying sediment which increased the availability of sessile epifaunal attachment. For example, such species included the common starfish (*Asterias rubens*),brittle star (Ophiuroidea sp.). Mobile Arthropoda were also observed such as brown crab (*Cancer* Pagurus), swimming crabs (*Liocarcinus* sp. and *Necora puber*), spider crabs (*Hyas* sp.) and hermit crabs (*Pagurus* sp.). Sessile organisms which settled onto the *S. spinulosa* aggregations, boulders, cobbles and pebbles were as diverse as the mobile fauna and included unidentified anemones (Actinaria sp.), antenna hydroid (*Nemertesia* sp.), hornwrack (*Flustra foliacea*), hydrozoan/bryozoan turf, sea squirt (Ascidiacea sp.), sea chervil (*Alcyonidium diaphanum*), Serpulidae tubes.

The abundance of faunal covered boulders, cobbles, pebbles across the ECC survey area and the presence of *S. spinulosa* aggregations warrants further investigation as potential Annex I geogenic stony and biogenic reef habitats (discussed further in Section 4.9.2a and b).

Of the 37 characterising species, 35 were identified by the macrofaunal analysis in low to moderate abundances, further supporting the assignment of the *S. spinulosa* on stable circalittoral mixed sediment biotope. SACFOR abundances of characterising species were either in keeping or more abundant than their expected JNCC SACFOR abundances and frequency of occurrence for the aforementioned biotopes, with 'abundant' to 'occasional' abundances of *S. spinulosa, .A. diaphanum, F. foliacea*, *Pagurus* sp., *Nemertesia* and *A. rubens*, indicating a strong conformance to the SS.SBR.PoR.SsipiMx biotope (Table 47 and Table 48).

Example images are given in Figure 47 and the expected extent of the habitat '*Sabellaria spinulosa* on Stable Circalittoral Mixed Sediment' (EUNIS: '*Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment' (MC2211) is mapped in Figure 48 and Figure 51.

Table 47: SACFOR Scale from Video Analysis of SS.SBR.PoR.SsipiMx Habitat

	Lanice Conchilega	*Sabellaria spinulosa*	Serpulidae	Caridea	Anomura	*Pagurus* sp.	*Ebalia* sp.	*Cancer pagurus*	*Hyas* sp.	Brachyura	*Necora puber*	Cirripedia	*Alcyonidium diaphanum*		*Flustra foliacea*		*Vesicularia spinosa*		Cheilostomatida
Size Class	3 - 15cm	%	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	%	3 - 15cm	>15cm	3 - 15cm	>15cm	3 - 15cm	>15cm	%
SACFOR Scale*																			
ECC_VID_29B	C	R		C	F	F						L	F	C	C	C	C	C	L
ECC_VID_34		O		F				C		F					F		C	C	
ECC_VID_35		R		F					F	F			C		C	C	C	C	
ECC_VID_57		R								O					O	F	F		
ECC_VID_59		R														C	F		
ECC_VID_64 (2)	O	L		F	O				O	R			F	A	O	F	F		
ECC_VID_65		L		O		O				O			O		F	F	F		
ECC_VID_66		L		O		O	R	F	R	O			R	O	F	F	O		
Percentage Frequency of Occurrence (%)**																			
ECC_VID_29B	100	100		100	100	100						50	50	100	100	100	100	100	50
ECC_VID_34		100		50				50		50					50		100	50	
ECC_VID_35		100		50					100	50			100		100	50	50	50	
ECC_VID_57		100								50					50	50	100		
ECC_VID_59		100														50	50		
ECC_VID_64 (2)	29	71		57	29				29	14			86	100	29	29	86		
ECC_VID_65		100		33		17				33			17		100	17	33		
ECC_VID_66		100		71		29	14	29	14	43			14	14	100	29	14		

	ACTINOPTERYGII	*Pholis gunnelus*	Pleuronectiformes	ASCIDIACEA	HYDROZOA	*Nemertesia* sp.	Actiniaria	*Metridium* sp.	*Dahlia* sp.	*Asterias rubens*		*Henricia* sp.	*Crossaster papposus*		OPHIUROIDEA	*Janolus cristatus*	Nudibranchia		*Calliostoma zizyphinum*	*Crepidula fornicata*	PORIFERA
Size Class	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	%	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	eggs	3 - 15cm	3 - 15cm	%
SACFOR Scale*																					
ECC_VID_29B					R	R			F						F			F			
ECC_VID_34					R		F								F				F		L
ECC_VID_35					R	R	F		F						F						
ECC_VID_57							F		O						F						
ECC_VID_59							F		F						F						
ECC_VID_64 (2)					L	L	O		O					O	R				O		
ECC_VID_65					L				O	O	F			F					O		
ECC_VID_66					L	L	O		O		F		R	F							
Percentage Frequency of Occurrence (%)**																					
ECC_VID_29B					50	100			50						50			50			
ECC_VID_34					50		100								50				50		50
ECC_VID_35					50	100	100		50						100						
ECC_VID_57							100		50						50						
ECC_VID_59							100		50						50						
ECC_VID_64 (2)					86	43	43		14					14	14				14		
ECC_VID_65					100				33	17	17			17					17		
ECC_VID_66					86	14	29		43		14		14	43							

**To aid clarity 0% frequency of occurrence values have been excluded from the table.

Superabundant = (S) Abundant = (A) Common = (C) Frequent = (F) Occasional = (O) Rare = (R) Less than Rare = (L)

Table 48: SACFOR Scale from Stills Analysis of SS.SBR.PoR.SsipiMx Habitat

	Sabella pavonina	*Lanice Conchilega*	*Sabellaria spinulosa*	Serpulidae	Caridea	Anomura	*Pagurus* sp.	*Ebalia* sp.	Brachyura	*Cancer pagurus*	*Hyas* sp.	*Liocarcinus* sp.	*Necora puber*	Cirripedia	BRYOZOA	*Alcyonidium diaphanum*		*Flustra foliacea*		*Vesicularia spinosa*		Cheilostomatida	ASCIDIACEA
Size Class	3 - 15cm	3 - 15cm	%	%	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	%	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	>15cm	3 - 15cm	>15cm	%	3 - 15cm
SACFOR Scale																							
ECC_VID_29b		C	F	L	C	F	F				O	F		L		C		C		A		L	
ECC_VID_34		F	A	R	C	F	O		F		F	O		L				F		C		L	
ECC_VID_35		F	F		F			F	F		F	F		L		C		C		A		R	F
ECC_VID_57			F		O	O	F	O	F		O					F		C		A			O
ECC_VID_59			O	L	O		F								F			F		A			
ECC_VID_64		A	R		C	F	O	O	O	F	O	O				C	A	F		A			
ECC_VID_65		C	F		C	F						F	O			C		C		A			
ECC_VID_66		C	C		C	F	F	O	O		F	F				F	C	C		A			F
Percentage Frequency of Occurrence (%)*																							
ECC_VID_29b		57	89	2	55	15	6				2	4		28		53		53		83		4	
ECC_VID_34		19	90	21	60	17	2		7		7	2		19				17		62		2	
ECC_VID_35		12	100		18			6	12		18	12		6		59		71		76		24	6
ECC_VID_57			70		2	2	30	4	6		4					4		15		70			2
ECC_VID_59			30	3	3		8								3			20		55			
ECC_VID_64		64	62		35	9	3	2	1	1	4	4				41	65	14		67			
ECC_VID_65		48	86		34	3						7	3			31		76		76			
ECC_VID_66		44	95		50	5	8	2	3		8	8				18	5	80		79			5

	ACTINOPTERYGII	*Agonus cataphractus*	*Clavelina lepadiformis*	*Callionymus lyra*	Cyclopteridae	*Pholis gunnelus*	Gobiidae	*Echiichthys vipera*	Pleuronectiformes	CNIDARIA	ANTHOZOA	*Alcyonium digitatum*		Hydrozoa	Plumulariidae	*Tubularia* sp.	Sertulariidae		Haleciidae	Actiniaria	*Metridium* sp.
Size Class	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3-15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm
SACFOR Scale																					
ECC_VID_29b							O							C	A	O	C			F	
ECC_VID_34			F											F	F		F			F	
ECC_VID_35		F	C											C	A	F	C	C		C	
ECC_VID_57														C	C		C			F	
ECC_VID_59														C	F		F			C	
ECC_VID_64	O					O									C		C		O		
ECC_VID_65														O	C				O	O	
ECC_VID_66				O										F	C		F		F	F	
Percentage Frequency of Occurrence (%)*																					
ECC_VID_29b							2							15	49	2	19			13	
ECC_VID_34			17											2	14		10			12	
ECC_VID_35		6	12											18	76	6	47	6		65	
ECC_VID_57														19	38		19			26	
ECC_VID_59														15	3		3			43	
ECC_VID_64	1					3									11		55		2		
ECC_VID_65														3	17				3	3	
ECC_VID_66				2										3	23		14		5	18	

	Actinothoe sphyrodeta	*Dahlia* sp.	Asteroidea	*Asterias rubens*		*Henricia* sp.	*Crossaster papposus*		OPHIUROIDEA	Gastropoda	*Buccinum undatum*	*Trivia arctica*	*Aequipecten opercularis*	*Janolus cristatus*	*Sepiola atlantica*	Nudibranchia		*Sterompha* sp.	*Calliostoma zizyphinum*	*Crepidula fornicata*	*Ensis* sp.	PORIFERA
Size Class	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	>15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	eggs	3 - 15cm	3 - 15cm	3 - 15cm	3 - 15cm	%
SACFOR Scale																						
ECC_VID_29b	O	F							F							O		O	O			L
ECC_VID_34	O	F			F				F		O				O	F			F		O	
ECC_VID_35	F							C	F		F											L
ECC_VID_57	F	F		O					C	O	O							O	F			
ECC_VID_59	F	F		O					F		O								O			
ECC_VID_64		F					O		F	F							O		O		O	
ECC_VID_65		O		F			O		F										F			L
ECC_VID_66				F		O	F	F	F									O	F	F	O	L
Percentage Frequency of Occurrence (%)*																						
ECC_VID_29b	2	9							9							2		2	2	2		2
ECC_VID_34	5	7			5				26		5				2	7				10		5
ECC_VID_35	12							6	29		12											
ECC_VID_57	2	8		2					34	2	4								4	6		2
ECC_VID_59	5	8		3					28		3									3		
ECC_VID_64		6					1		5	3							2			3		1
ECC_VID_65		3		7			3		7											10		
ECC_VID_66				3		2	6	3	6										5	18	5	

**To aid clarity 0% frequency of occurrence values have been excluded from the table.

Superabundant = (S) | Abundant = (A) | Common = (C) | Frequent = (F) | Occasional = (O) | Rare = (R) | Less than Rare = (L)

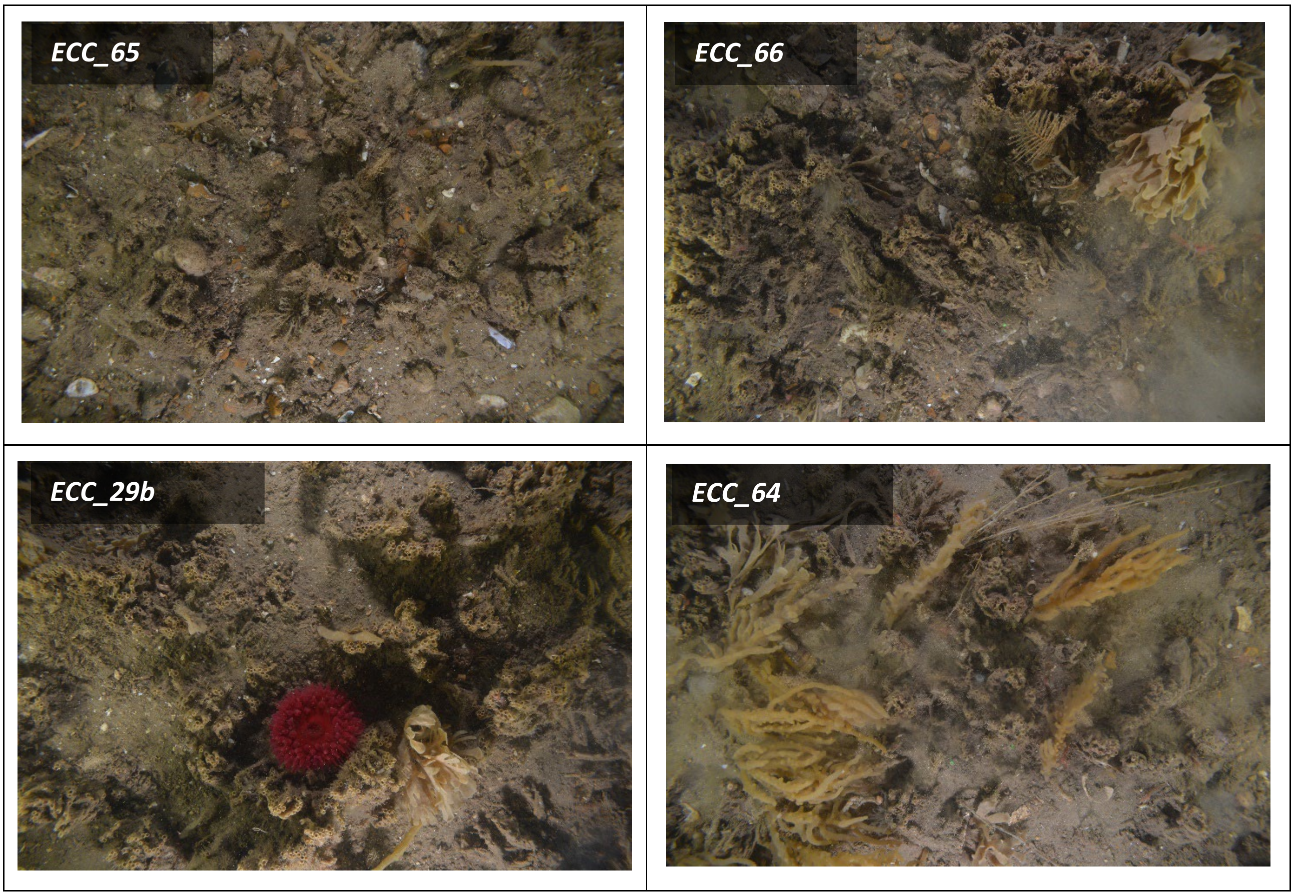


Figure 47 Example Images of *Sabellaria spinulosa* on Stable Circalittoral Mixed Sediment Habitats

f Anthropogenic habitats (No corresponding JNCC/EUNIS code)

During the environmental sampling operations, no anthropogenic habitat was identified. The geophysical inspection of the ECC survey also revealed a low abundance of anthropogenic debris, with seven suspected wrecks, associated scattered debris and fish traps identified in four blocks.

Not all anthropogenically derived debris have deleterious effects on the underlying benthic communities, as the introduction of additional hard substrates into the marine environment can increase epifaunal biodiversity by providing hard attachment in an otherwise homogeneous soft sediment environment (Leewis *et al.*, 2000; Hiscock *et al.*, 2010).

g Non-native Invasive Species

Non-native marine species are of particular concern when they become invasive and thus are detrimental to native species. Invasive species have the potential to displace native species, modify habitats, cause the loss of native genotypes, alter community structure, affect ecosystem processes, disrupt the provision of ecosystem services, negatively impact human health and cause substantial economic losses (Cinar *et al.*, 2014).

The macrofauna data revealed a high number of individuals of a single non-native species, slipper limpet (*Crepidula fornicata)*, at station ECC_18 and ECC_60, as well as lower abundances at 16 other stations in the ECC survey area. Underwater video data also revealed the presence of *C. fornicata* at stations ECC_12, 15, 17, 21 and 28, whilst relic shells were also recorded at ECC_59 and ECC_66. The slipper limpet was unintentionally introduced to the UK with imports of the eastern oyster *Crassostrea virginica* and the Pacific oyster *Crassostrea gigas* in the 1800s (Preston *et al.*, 2020). The depletion of oyster habitat due to overfishing exacerbated the spread and abundance of *C. fornicata* over the years*,* making this species a well-established invasive species and a major concern across Europe (Blanchard *et al.*, 1997).

C. fornicata has already caused serious ecological and economic impacts across Europe. It has been known to be detrimental to habitat suitability for juvenile fish (Le Pape *et al.*, 2004), as the limpet impacts the survival and shell growth of other commercially important bivalves such as the blue mussel *Mytilus edulis* (Thieltges *et al.*, 2005) and modify habitats by converting predominantly sandy substrata into anoxic mud dominated substrata through the production of mucoidal pseudofaeces (Streftaris *et al.*, 2006). The reduction of suitable substrata means habitats become unsuitable for other species, including oysters that prefer less muddy waters (Barnes *et al.*, 1973). The European oyster (*Ostrea edulis*) is negatively impacted due to the lack of suitable substrate for larval settlement (Blanchard *et al.*, 1997), impeding recruitment and potential restoration efforts on the seabed (Preston *et al.*, 2020). Sea users who find slipper limpets are advised to report to the Marine Biological Association.

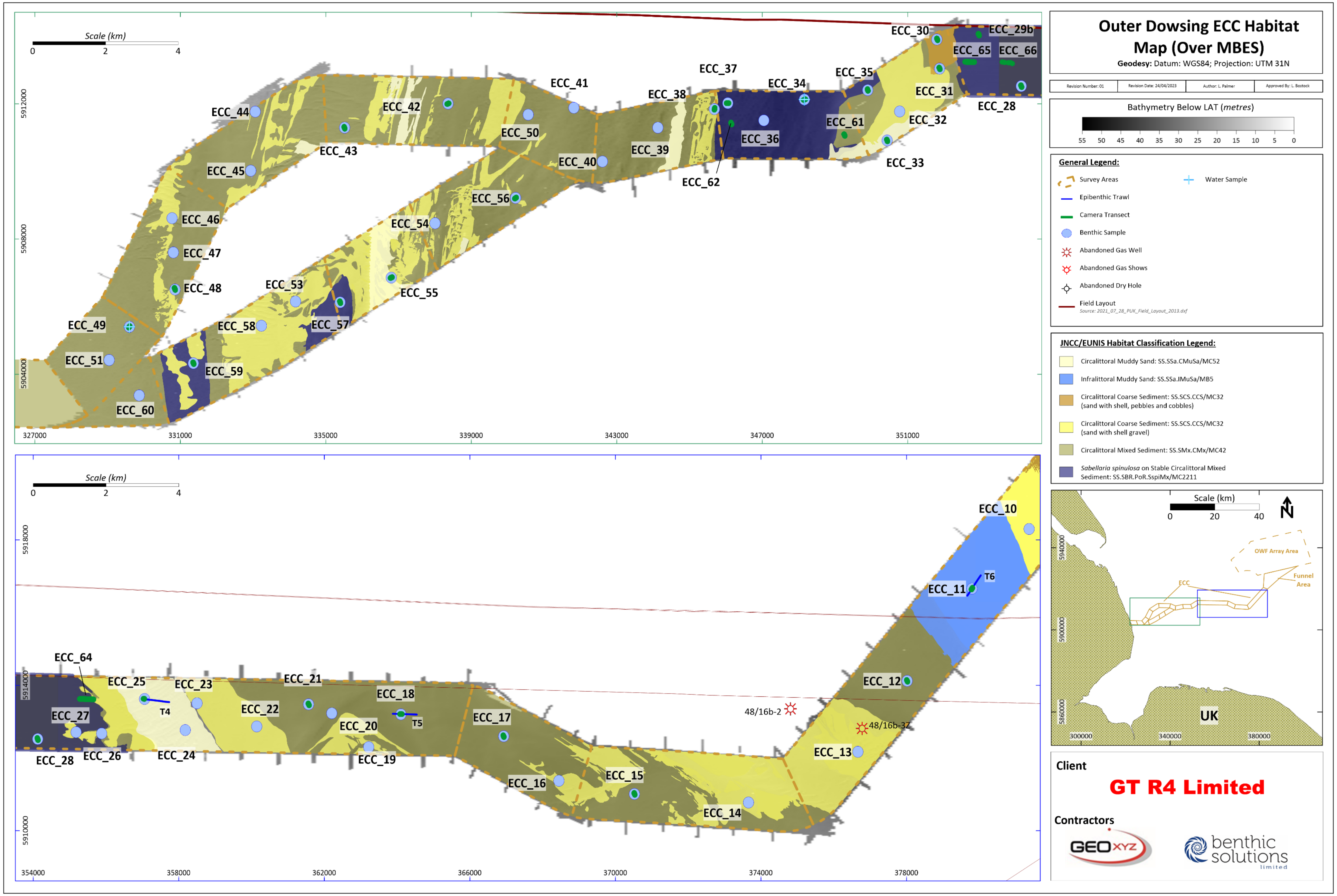


Figure 48: Habitat Distribution (to JNCC level 4) over MBES Data for the ECC Survey Area

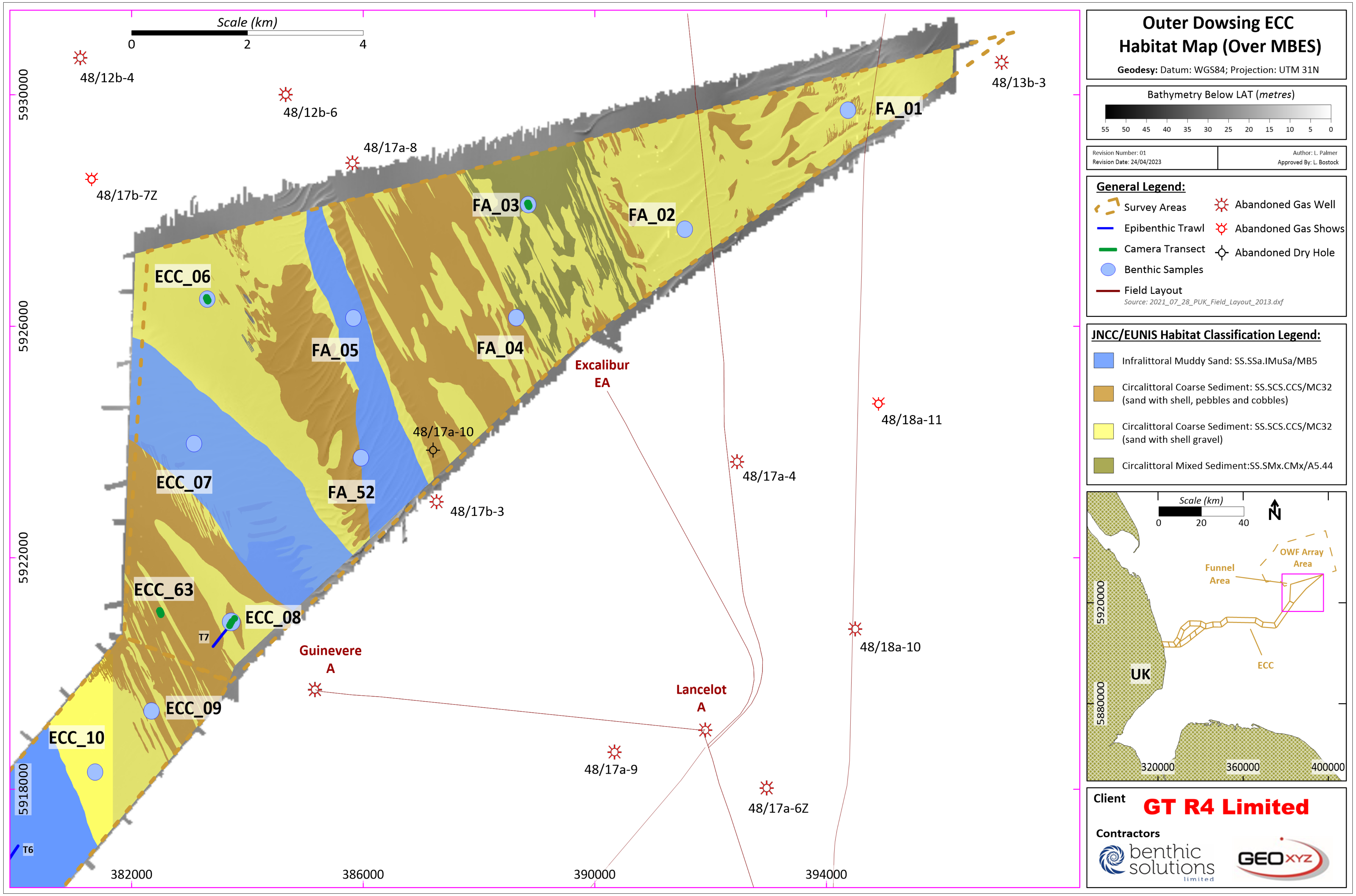


Figure 49: Habitat Distribution (to JNCC Level 4) over MBES Data for the FA Survey Area

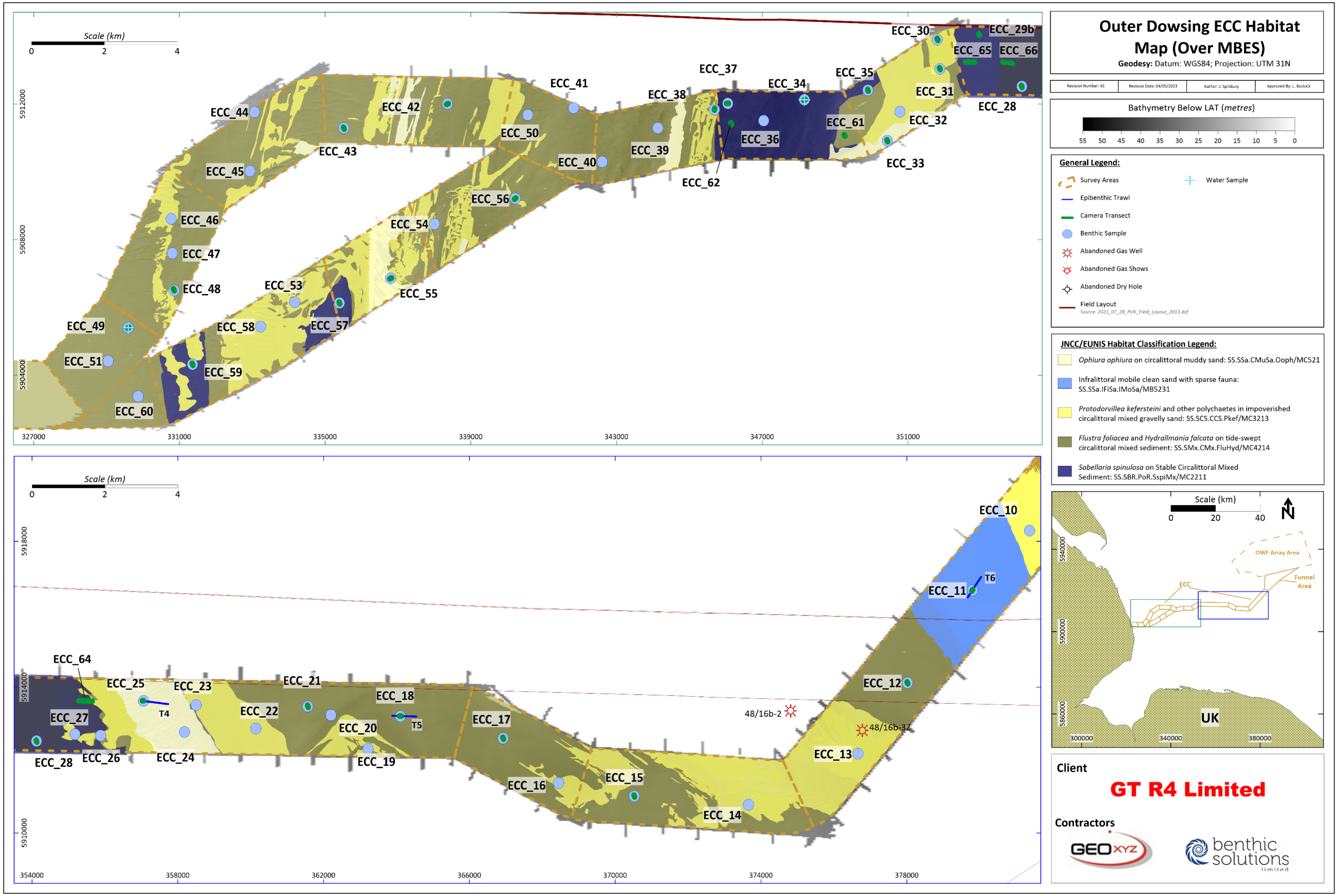


Figure 50: Habitat Distribution (to JNCC Level 5) over MBES Data for the ECC Survey Area

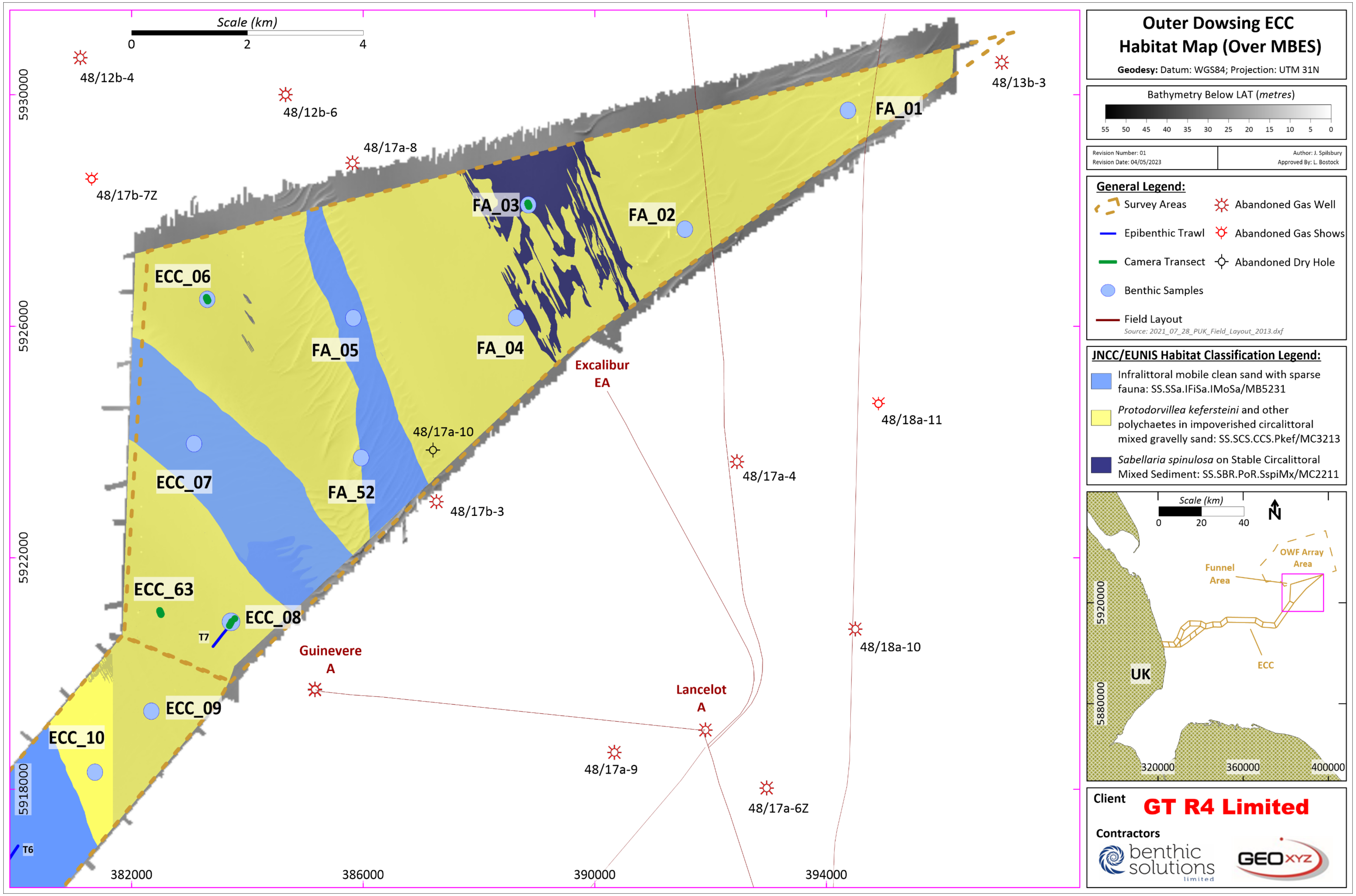


Figure 51: Habitat Distribution (to JNCC Level 5) over MBES Data for the FA Survey Area

4.9.2 Potential Sensitive Habitats and Species

As previously discussed, there are a number of potentially sensitive habitats and species which are known to occur in the wider region (North Sea), including:

- Stony reefs formed from boulders and cobbles;
- Biogenic reefs formed from *Sabellaria spinulosa*;
- Ocean quahog (*Arctica islandica*);
- Lesser sandeel (*Ammodytes marinus*) spawning and nursery grounds;
- Herring spawning and nursery grounds;
- Sandbanks which are slightly covered by sea water all the time.

These habitats and species are listed by one or more International Conventions, European Directives or UK Legislation (including devolved UK administrations).

a Annex I Stony Reef

Cobbles and rare boulders were recorded along four transects (ECC_VID_18, 21, 37 and 48a) within the ECC survey area. Matrices of gravelly sand, sandy gravel and muddy sandy gravel with cobbles and boulders were observed across the ECC, with these areas classed as 'Circalittoral mixed sediment' and 'Circalittoral coarse sediment'. These transects were investigated further to assess whether any areas have the potential to be classified as EC Habitats Directive Annex I stony reef.

The seabed camera ground-truthing data were assessed for potential stony reefs using the criteria proposed by Irving (2009). This breaks down the assessment criteria measures of 'quality' or 'reefiness' as outlined in Table 49. This is based on a minimum cobble size of 64mm being present and indicating relief above the natural seabed where >10% of the matrix are cobble related and a minimum area of around 25m^2 is recorded. The stony reef assessment was based on acquired underwater stills taken every 10 seconds along the camera transect. When this produced underwater stills that were out of focus due to environmental conditions (boat movement, seabed slope, turbidity etc) then additional screengrabs were taken in the office (from the HD video footage) as close to the 10-second interval as possible, but which may have varied by a few seconds to enable a clear enough focus on the screengrab. Each still and screengrab was assessed for changes in density, height and cover of cobbles and boulders. Each section of the transects where cobbles or boulders were detected was then analysed and categorised according to its composition, elevation and extent.

Table 49: Summary of Resemblance to a Stony Reef as Summarised in Irving (2009)

Measure of 'Reefiness'	Not a Reef	Low[(c)]	Medium	High
Composition[(a)]	<10%	10-40%	40-95%	>95%
Elevation[(b)]	Flat seabed	<64mm	64mm-5m	>5m
Extent (m^2)	<25m^2	>25m^2	>25m^2	>25m^2
Biota	Dominated by infauna			>80% of species are epifauna

(a) *Diameter of cobbles / boulders being greater than 64mm. Percentage cover relates to a minimum area of 25m². This 'composition' characteristic also includes 'patchiness'.*

(b) *Minimum height (64mm) relates to minimum size of constituent cobbles. This characteristic could also include 'distinctness' from the surrounding seabed.*

(c) *When determining if the seabed is considered as Annex I stony reef, a 'low' scored in any category, would require a strong justification for this area to be considered as contributing to the Marine Natura site network of qualifying reefs in terms of the EC Habitats Directive.*

The Irving (2009) stony reef protocol was split into separate assessments of reef 'structure' and 'overall reefiness' using a method developed by BSL staff (Table 50 and Table 51). This provided a reef structure value that could then be assessed against extent, where applicable, to provide a measure of overall reefiness, as illustrated in Table 51. As separate thresholds for 'Low', 'Medium' and 'High' stony reef extent were not given in Irving (2009), the overall reefiness is determined by reef structure provided that the extent of the stony reef covers a minimum of 25m^2. Reefiness parameters are colour coded to aid visual assessment of the data.

Table 50: Stony Reef Structure Matrix (after Irving, 2009)

Reef Structure Matrix			Elevation			
			Flat	<64mm	64mm-5m	>5m
			Not a Reef	Low	Medium	High
Composition	<10%	Not a reef	Not a Reef	Not a Reef	Not a Reef	Not a Reef
	10-40%	Low	Not a Reef	Low	Low	Low
	40-95%	Medium	Not a Reef	Low	Medium	Medium
	>95%	High	Not a Reef	Low	Medium	High

Table 51: Overall Stony Reefiness Matrix (Structure vs Extent)

Overall Reefiness Matrix			Reef Structure (incl. Composition and Elevation)			
			Not a Reef	Low	Medium	High
Extent (m^2)	<25	Not a Reef	Not a Reef	Not a Reef	Not a Reef	Not a Reef
	>25	Low - High	Not a Reef	Low	Medium	High

The stills taken during the survey and additional screengrabs from the video footage analysed for stony reef assessment indicated the intermittent distribution of cobbles and boulders across the camera transects (a complete log of the assessment per still is provided in Appendix N). Out of the 151 images from transects reviewed for stony reef, 97 (64.2%) showed evidence of potential stony reefs due to the presence of cobbles (Table 52). Of the images showing potential stony reef, 44 (29.1%) were classed as 'Not a Reef' and 10 (6.6%) as 'Low Reef' in terms of stony reef composition or percentage cover (Table 52). In terms of elevation, all stills were classed as 'Medium Reef' as areas of cobbles were between 64mm and 5m in height. There were also flat areas of coarse rippled shelly sand between the intermittent aggregations of cobbles across the survey area. When both composition and elevation were taken into account, by examining reef structure, 44 images (29.1%) were classed as 'Not a Reef', 10 (6.6%) as 'Low Reef' and no 'Medium Reef' or 'High Reef' was indicated (Table 52). The low overall reef structure levels are consistent with the review of video footage, with transects within the 'Circalittoral mixed sediment' and 'Circalittoral coarse sediment' characterised by patches of mixed gravelly sand, sand gravel and muddy sandy gravel with varying densities of cobbles and rare boulders.

Table 52: Summary of Stony Reef Image Analysis

'Reefiness' of Video Screengrabs	No Stony Reef		Not a Reef		Low		Medium		High	
	No.	%	No.	%	No.	%	No.	%	No.	%
Composition (% cover)	9	64.2	44	29.1	10	6.6	0	0	0	0
Elevation			0		0		53	35.1	0	0
Reef Structure			44	29.1	10	6.6	0	0	0	0

The results of the reefiness assessment on the four transects, with a notable presence of cobbles and boulders, showed evidence of isolated patches of stony reef habitat as per the Irving 2009 criteria. Three transects were classified as 'Not a Reef' in terms of the composition of cobbles/boulders as the percentage cover was less than 10% (Table 53). Whereas the remaining two transects had instances of cobble compositions classed as 'Low Reef' (Table 53). All instances of 'Low Reef' reflect the variability in cobble density within the 'Circalittoral mixed sediment' habitats. No estimation of reef extent could be made for areas which could not be delineated as they lacked any distinct side scan sonar signatures and could not be distinguished from the surrounding non-reef seabed. Therefore, no additional areas across the wider survey area could be mapped as potential 'Low Reef' and the mappable extent of the 'Low Reef' was limited to the reef structure overlain across the camera navigation track (Figure 52 and Figure 53). A precautionary approach was applied to areas of 'Low Reef' structure by assuming that these areas covered >25m^2 extent. As per the Irving (2009) guidance, areas of seabed classified as 'Not a Reef', based on reef structure (composition vs elevation), are still 'Not a Reef' regardless of whether the extent was <25m^2 or >25m^2 (Table 53). Therefore, a measure of overall reefiness was determined by combining the reef structure level with a reefiness level based on a conservative assumed extent of >25m^2 for each area of 'Low Reef' structure.

The majority of points of 'Low Reef' structure along the transects were within wider areas of 'Not a Reef' and as such the average of the reef structure for each segment of sediment change was calculated and used with the assumed extent of 25m^2 to calculate a measure of overall reefiness (Figure 52, Figure 53 and Table 53). Areas of potential 'Low Reef', based on an assumed 25m^2 extent, were identified along a single transect (ECC_37). The single point of 'Low Reef' structure identified at ECC_21 was considered unlikely to cover an area of 25m^2 as cobbles were only present for a three second section of video footage.

Areas of 'Not a Reef' were classified as circalittoral coarse or mixed sediments, comprising mosaics of gravel, pebbles, occasional cobbles and variable densities of shell debris, while areas of 'Low Reef' were comprised of similar sediments but cobbles were more frequently observed. The 'Low Reef' identified at station ECC_37 has been classified on a precautionary basis as 'potential low reef' and showed some resemblance to the biotope ''SS.SMx.CMx.FluHyd - *Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment". Although the area of 'Low Reef' had an average elevation of <64mm, the cobbles may still ecologically function as an associated reef community (Table 54; Golding *et al.*, 2020). Therefore, the area of 'Low Reef' at station ECC_37 could potentially show some resemblance to Annex I stony reefs.

Table 53: Summary of Stony Reef Assessment (after Irving, 2009)

Geodetics: WGS84, UTM 31N, CM 3°E								
Station	Easting (m)	Northing (m)	Sediment Type	Stony Reefiness (After Irving 2009)				
				Mean Composition (% Cover of Cobbles/ Boulders)	Mean Elevation (of Cobbles/ Boulders in mm)	Mean Reefiness (Structure)	>25m^2	Overall Mean Reefiness (Structure vs Extent)
ECC_VID_18	364 079	5 913 208	Mixed/coarse sediment with frequent shells, shell fragments, pebbles and cobbles	1.34	27.23	Not a Reef	>25m^2*	Not a Reef
	364 136	5 913 207						
ECC_VID_21	361 581	5 913 451	Mixed/coarse sediment with frequent shells, shell fragments, pebbles and cobbles	8.33	666.67	Not a Reef	>25m^2*	Not a Reef
	361 559	5 913 504						
ECC_VID_37	346 075	5 912 022	Mixed sediment composed of mud, pebbles, shells and shell fragments as well as relic *Sabellaria*	4.74	43.29	Not a Reef	>25m^2*	Not a Reef
	346 020	5 912 013						
ECC_VID_48A	330 866	5 906 475	Mixed sediment, possible boulders or areas of coarser sand	0.17	10.67	Not a Reef	>25m^2*	Not a Reef
	330 839	5 906 555						

Notes:
*>25m^2 was precautionarily applied as the boundary off the feature observed on the camera data could not be distinguished from the SSS/MBES data
**<25m^2 was applied as the sediment change was only observed for a few seconds and is not likely to represent an area >25m^2

One of the key principles to be considered for an area when assessing its 'resemblance' to Annex I stony reef is stability; areas of consolidated and patchy hard substrate may not fulfil the composition requirements of Annex I stony reef criteria by Irving (i.e. not having the required percentage of cobbles and boulders, as seen along the proposed CA route), but stability allows a diverse and 'reef-like' epifaunal community to develop (Golding *et al.,* 2020). Therefore, the transects where an initial Annex I stony reef assessment was conducted were further investigated to establish whether hard substrate areas still corresponded to reef-like structures based on the epifauna present. This involved the assignment of 'reef biotopes', the identification of key species and the richness of 'reef species' according to the criteria outlined in Golding *et al.,* 2020 (Table 54).

Table 54: Biota Criteria for Defining 'Low Resemblance' Stony Reef (Golding et al., 2020)

Reef	Stage 1	Stage 2	Stage 3
	Reef Biotopes	Key Reef Species Count	Reef Species Count
Reef	Reef biotope	≥3	>20
Possible reef	Possible reef biotope	>1 and <3	>5 and <20
Not reef	Non-reef biotope	0	<5

The results of the further stony reef assessment indicated that stations in areas of mixed sediment comprised 'Possible Reef' biotopes due to the presence of the level five biotope 'SS.SMx.CMx.FluHyd - *Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment'. Characterising species such as hornwrack (*Flustra foliacea),* dahlia anemone *(Urticina felina),* sea chervil *(Alcyonium diaphanum)* hydroids (*Nemertesia* sp.), tube worms (Serpulidae), barnacles (Cirripedia), hermit crabs (*Pagurus* sp.) and common sea star (*Asterias rubens)* were present. Transect ECC_37 was a 'Possible Reef biotope' due to the sediment composition of <10% of bedrock, boulder or cobble larger than 64mm and conspicuous reef associated epifauna. This area was considered unstable due to the substrate present (i.e. areas of mixed or coarse sediment which contained no 'reef biotopes'), meaning they could not be classified as Annex I stony reef. However, by reviewing the epifauna they could be considered a 'possible reef with sand veneer' or 'reef with sand veneer' (Golding *et al.,* 2020). Furthermore, the transect supported <5 'reef species', which would indicate that the transect is 'not a reef'– highlighting the need for further refinement of the Golding *et al.* (2020) criteria (Table 55). Therefore, in the absence of strong justification due to the low composition (7.4%), elevation (43mm), an assumed threshold extent of 25m^2 and threshold biota of a single key reef associated species the ECC_37 transect was deemed not to represent Annex I stony reef along with the other transects carried out throughout the survey area.

Table 55: Reef Structure Assessment (Golding et al., 2020)

Reef	Stage 1	Stage 2		Stage 3		Reefiness Value
	Reef Biotopes	Mean Key Reef Species Count	Key Reef Species Category	Mean Reef Species Count	Reef Species Category	
ECC_VID_37	Not a Reef Biotope	1	>1 and <3	2	<5	Possible Reef

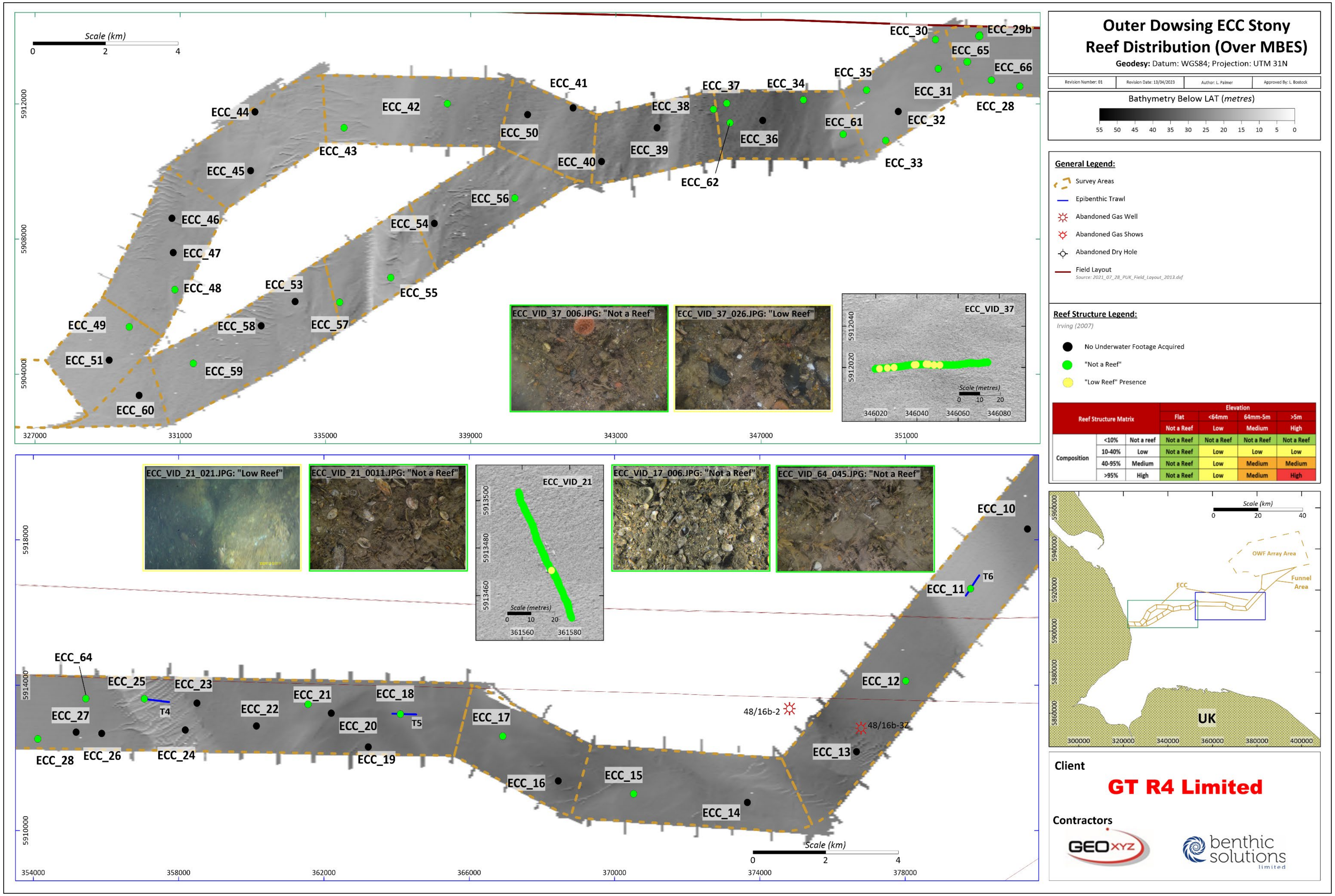
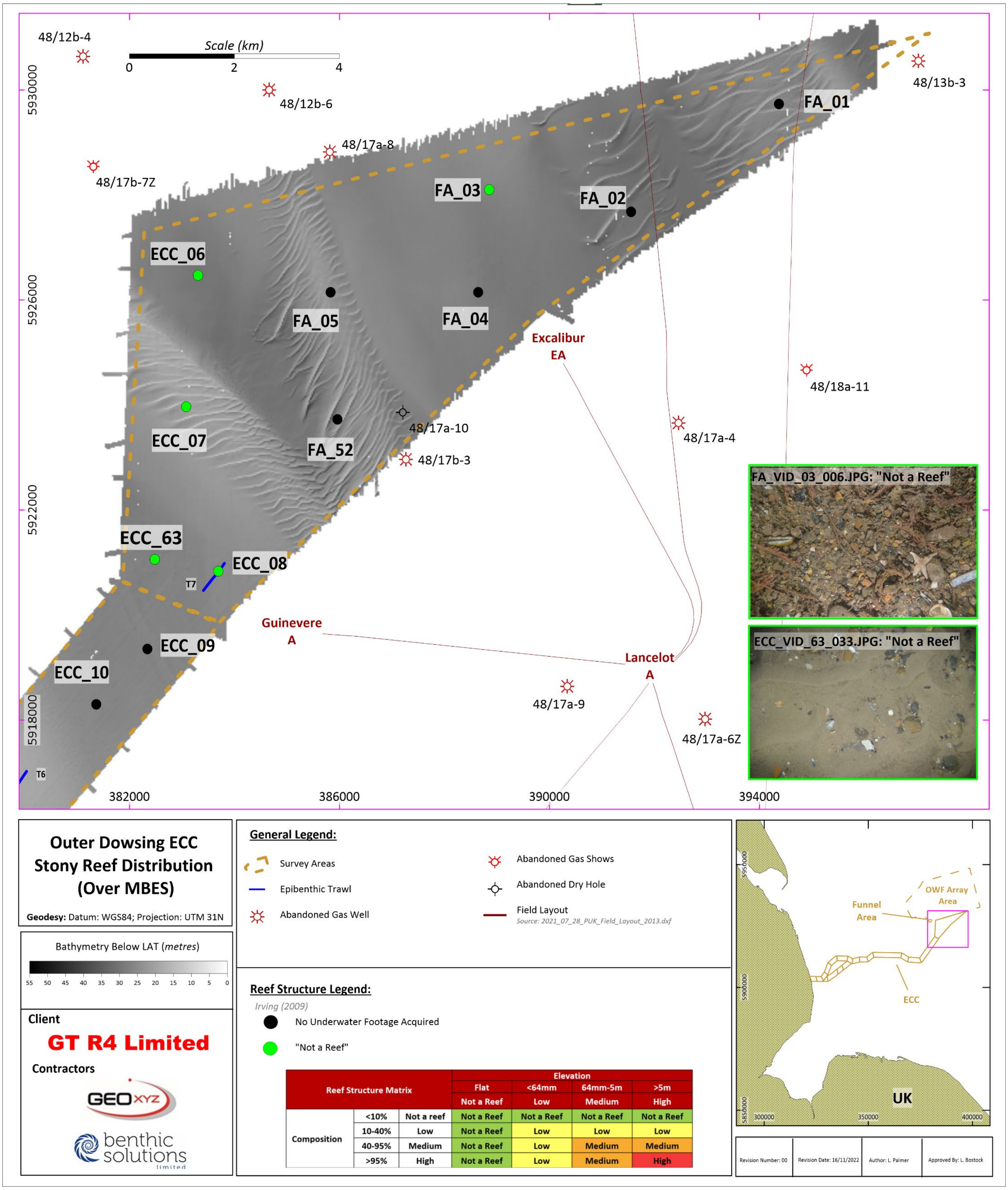


Figure 52: Stony Reef Habitat Assessment for the ECC Survey Area



Reef Structure Matrix			Elevation: Flat	Elevation: <64mm	Elevation: 64mm-5m	Elevation: >5m
			Not a Reef	Low	Medium	High
Composition	<10%	Not a reef	Not a Reef	Not a Reef	Not a Reef	Not a Reef
	10-40%	Low	Not a Reef	Low	Low	Low
	40-95%	Medium	Not a Reef	Low	Medium	Medium
	>95%	High	Not a Reef	Low	Medium	High

Figure 53: Stony Reef Habitat Assessment for the FA Survey Area

b Biogenic Reef Formed by *Sabellaria spinulosa*

Sabellaria spinulosa was present at several stations along the ECC route but predominantly occurred within Blocks 7, 9 and 15 (stations: ECC_VID_29b, 34, 35, 57, 59, 64, 65 and 66) but was typically limited to encrusting hard substrates such as cobbles and pebbles. *S. 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 stabilise the surrounding seabed (Gibb *et al.* 2014). As their tubes are built of sand, a high suspended sediment content is essential for the growth of reef like structures and the tidally swept sandy sediments across the survey area could provide adequate habitat conditions.

An assessment of 'reefiness' as described by Gubbay (2007) and presented in Table 56 was performed to describe the habitat, focussing on transects where *S. spinulosa* was recorded during a review of video footage and still photographs (Jenkins *et al.*, 2018). Changes in the coverage and density of *S. spinulosa* tubes were noted during the videos in order to accurately estimate the area covered by *S. spinulosa.* However, this was limited as the texture differences on the SSS/MBES could not determine if the changes in density or coverage were part of a larger 'reef' feature or isolated aggregations.

Table 56: *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 it was further separated into reef 'structure' and overall 'reefiness' (Table 57 and Table 58). The advantage of this method is that the reef 'structure' value, derived from the patchiness (i.e. percent cover) and tube elevation reefiness, can be assessed against the extent to produce a measure of overall reefiness, as illustrated in Table 57 and Table 58. This method was initially devised by BSL staff and later approved by the JNCC in 2010 (see Jenkins *et al* (2015) for an example application by JNCC and CEFAS).

To avoid potential bias of manual still photographs towards areas of greater environmental interest and to more accurately quantify the reefiness of heterogeneous patches of *S. spinulosa,* screengrabs were taken approximately every 10 seconds along the camera transects (Appendix O). Each screengrab was assessed for *Sabellaria* patchiness and tube elevation, which were then combined to assess reef structure. The average reef structure is then usually assessed for each delineated patch of *S. spinulosa*; however, due to the patchiness in *S. spinulosa* coverage and the absence of texture differences on the SSS/MBES, the transect as a whole was averaged to assess potential 'reefiness' (Table 58).

Table 57: *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 58: *Sabellaria* Reef Structure vs Area Matrix (After Gubbay, 2007)

Reef Structure vs Area		Area (m²)			
		<25	25 – 10,000	10,000 – 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 10 second interval screen grabs and HD video indicated a variable distribution of *S. spinulosa* encrusted over cobbles and pebbles across the eight transect. For example, out of the 751 images taken along the transect and reviewed for *S. spinulosa* 'reefiness', 505 (67.1%) showed evidence of *S. spinulosa* aggregations. Of the images showing *S. spinulosa*, 121 (16.1%) were classed as 'Not Reef', 115 (15.3%) as 'Low Reef', 102 (13.6%) as 'Medium Reef' and 167 (22.2%) as 'High Reef' in terms of *S. spinulosa* patchiness or percent cover. For tube elevation, 313 (41.7%) classed as 'Not Reef', 167 (22.2%) as 'Low Reef', 129 (17.2%) as 'Medium Reef' and none were 'High Reef'. When both patchiness and elevation were considered, by examining reef structure, even fewer images showed noteworthy reefiness, with 338 (45.0%) classed as 'Not a Reef', 146 (19.4%) as 'Low Reef' and just 21 (2.8%) as 'Medium Reef' and no instances of 'High Reef'. This equates to a total of 167 images (22.1%) showing appreciable reefiness of 'Low Reef' or 'Medium Reef (Table 59). The low overall reef structure levels are consistent with the review of video footage, with many areas seen to be characterised by low coverage of *Sabellaria* encrusting cobbles and pebbles.

Table 59: Summary of *Sabellaria* Reefiness Image Analysis Results (After Gubbay, 2007)

'Reefiness' of Video Screengrabs	No *Sabellaria*		Not a Reef		Low		Medium		High	
	No.	%	No.	%	No.	%	No.	%	No.	%
Patchiness (% Cover)	246	32.8	121	16.1	115	15.3	102	13.6	167	22.2
Elevation (Tube Height, cm)			313	41.7	167	22.2	129	17.2	0	0
Reef Structure			338	45.0	146	19.4	21	2.8	0	0

As previously discussed, the lack of unique SSS/MBES features associated with the *S. spinulosa* aggregations made it impossible to delineate the extent of the *Sabellaria* habitat within the ECC survey area. As such, the reef structure matrix of each 10-second still image was overlain across the camera track and indicates the variability in *Sabellaria* coverage and elevation across the eight transect (Figure 54 and Figure 55). The spatial variability in individual 'reefiness', with a maximum coverage of 90.88% and elevation of 1.57cm, indicates '*S. spinulosa* on stable circalittoral mixed sediment' (SS.SBR.PoR.SspiMx./MC2211) habitat occurs within Blocks 7, 8, 9 and 15 of the ECC survey area. A conservative approach revealed an average tube elevation of <2cm and percentage cover of ranging between 4.47% and 90.88% across the eight transects, indicating that the *Sabellaria* aggregations were not reef forming, even when an area of >25m^2 was assumed.

Although the *S. spinulosa* aggregations along the transects were not classified as reef forming, a notable difference in the species diversity between aggregations of *S. spinulosa* and cobbles/pebbles were observed, with 35 epifaunal species observed within areas of *Sabellaria*, while only 11 epifaunal species were observed in areas of 'Circalittoral coarse sediment' or 'Circalittoral mixed sediment' habitats. The finding of increased biodiversity surrounding fragmented *S. spinulosa* aggregations, such as those observed along the eight transects within the survey area, was corroborated by Van der Reijden *et al.*, (2021) that found even patchy biogenic 'reefs' may promote density and local biodiversity of mobile, epibenthic species, due to increased habitat heterogeneity. This indicates that patchy biogenic reefs that occur in dynamic environments may also have high ecological value and that their conservation status should be considered to ensure their protection (Van der Reijden *et al.*, 2021).

Table 60: Conservative Summary of *Sabellaria* Reef Assessed from Video, Stills and SSS Data

Geodetics: WGS84, UTM 31N, CM 3°E							
Station	Easting (m)	Northing (m)	Sediment Type	*Sabellaria* Reefiness (After Gubbay 2007)			
				Patchiness (Average % cover)	Elevation (Average tube height in cm)	Area (m^2)	Reef Structure
ECC_VID_29b	352 942	5 914 077	Mixed sediment composed of frequent shells, shell fragments, pebbles and cobbles with encrusting *Sabellaria*	13.69	1.23	>25m²*	Not a Reef
	352 965	591 4021					
ECC_VID_34	348 186	5 912 137	Mixed sediment composed of mud, pebbles, shells and shell fragments as well as frequent Sabellaria	90.88	0.60	>25m²	Not a Reef
	348 133	5 912 113					
ECC_VID_35	349 909	5 912 388	Mixed sediment composed of frequent shells, shell fragments, pebbles and cobbles with encrusting *Sabellaria*	9.5	0.94	>25m²	Not a Reef
	349 891	5 912 435					
ECC_VID_57	335 384	5 906 157	Mixed sediment composed of pebbles and shingle with mud and sand with encrusting *Sabellaria*	11.66	1.12	>25m²	Not a Reef
	335 403	5 906 103					
ECC_VID_59	331 370	5 904 298	Mixed sediment composed of pebbles and shingle with mud and sand with encrusting *Sabellaria*	4.47	0.17	>25m²	Not a Reef
	331 350	5 904 351					
ECC_VID_64	355 647	5 913 613	Sand with frequent shell fragments	0	0	>25m²	Not a Reef
	355 576	5 913 616					
	355 576	5 913 616	Mixed sediment composed of mud, pebbles, shells and shell fragments as well as frequent *Sabellaria*	17.02	1.46	>25m²	Not a Reef
	355 278	5 913 625					
ECC_VID_65	352 578	5 913 242	Fine sand and mixed sediment composed of gravelly muddy sand and frequent shells, pebbles and cobbles and encrusting *Sabellaria*	10.65	1.06	>25m²	Not a Reef
	352 830	5 913 237					
ECC_VID_66	353 044	5 912 517	Mixed sediment composed of gravelly muddy sand and frequent shells, pebbles and encrusting *Sabellaria*	24.23	1.57	>25m²	Not a Reef
	353 264	5 912 281					

Notes:
*>25m² was precautionarily applied as the boundary off the feature observed on the camera data could not be distinguished from the SSS/MBES data

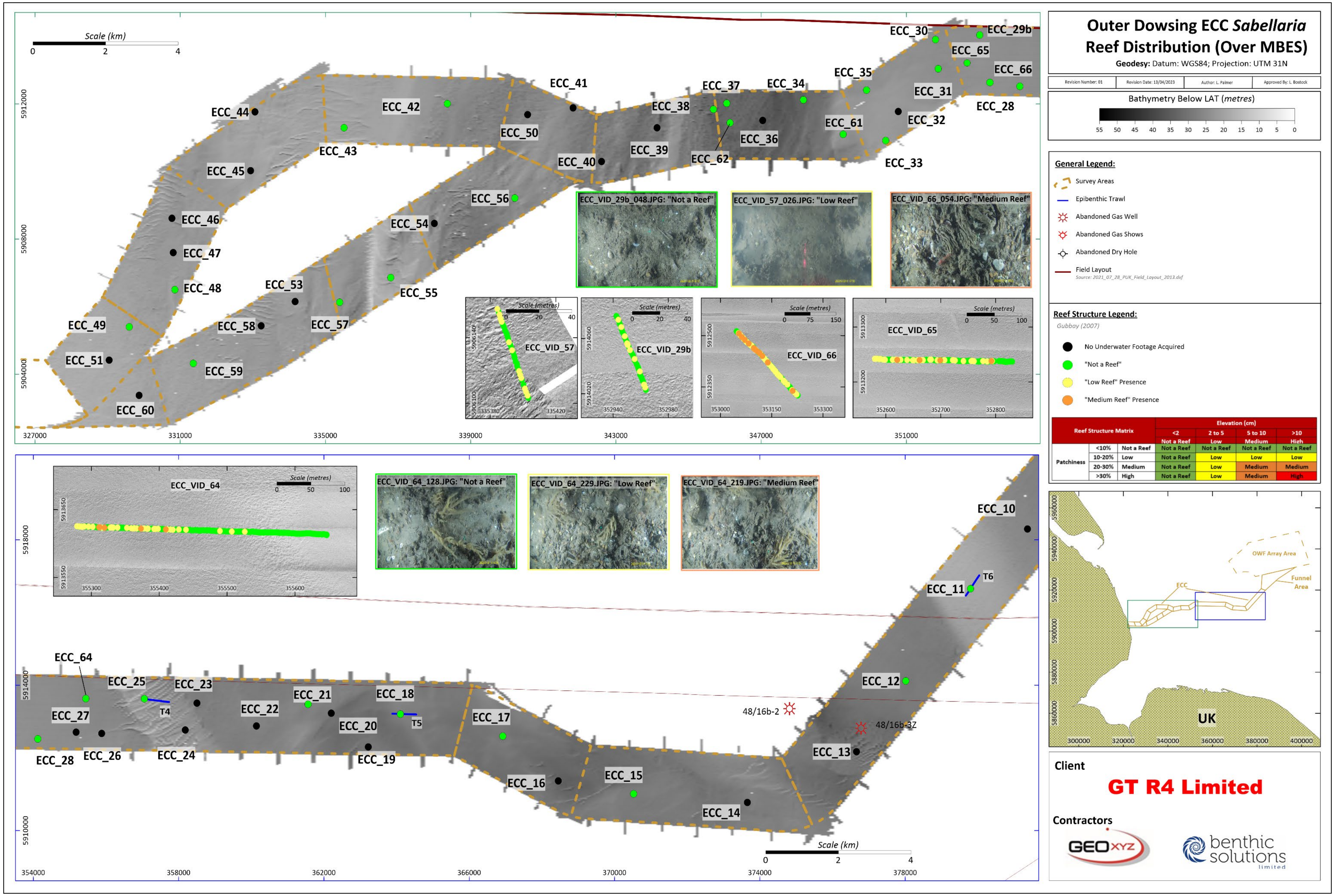
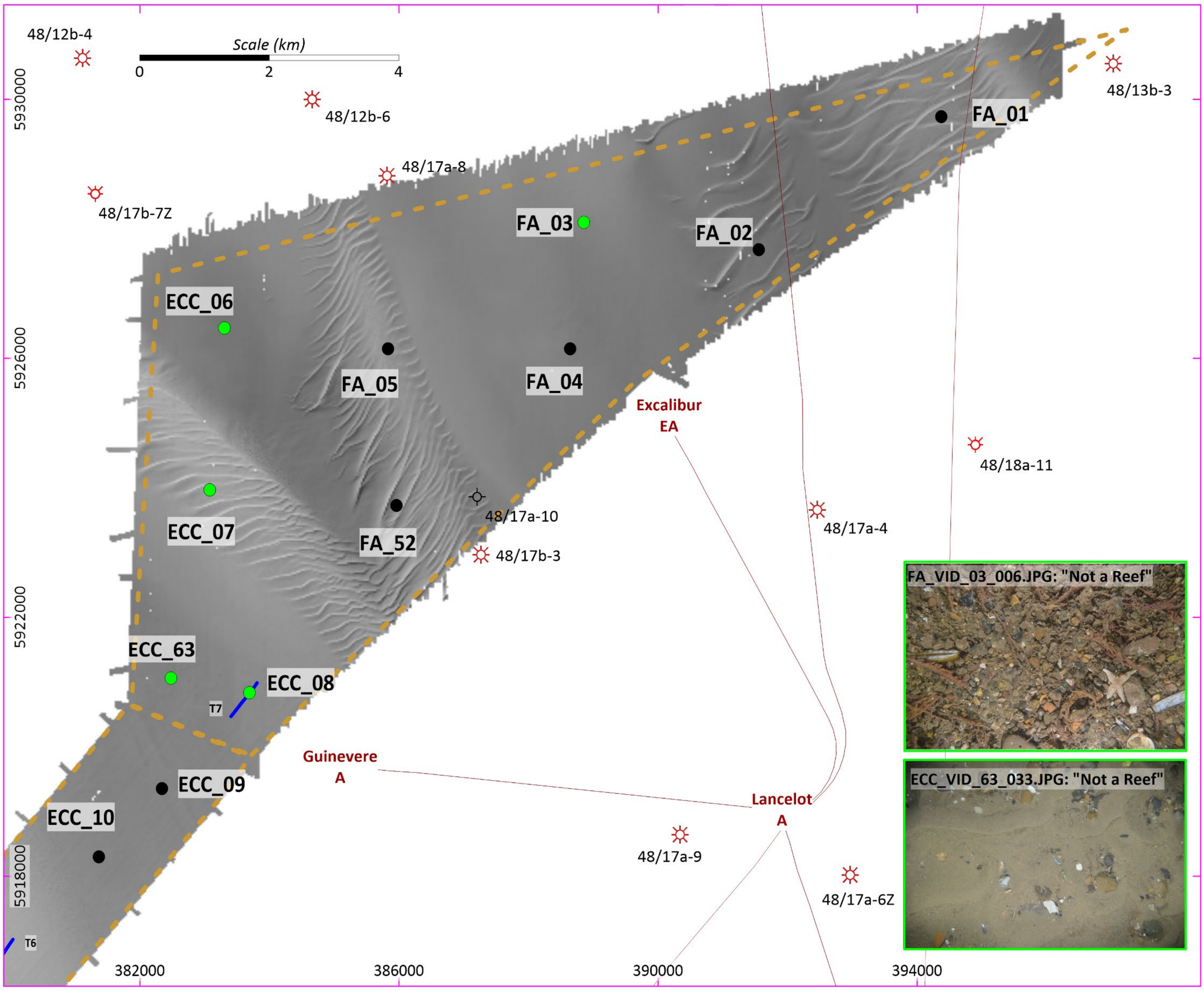


Figure 54: *Sabellaria spinulosa* reef habitat assessment for the ECC survey area



Outer Dowsing ECC
***Sabellaria* Reef Distribution (Over MBES)**

Geodesy: Datum: WGS84; Projection: UTM 31N

Bathymetry Below LAT (*metres*)

55 50 45 40 35 30 25 20 15 10 5 0

Client

GT R4 Limited

Contractors

GEOXYZ

benthic solutions limited

General Legend:

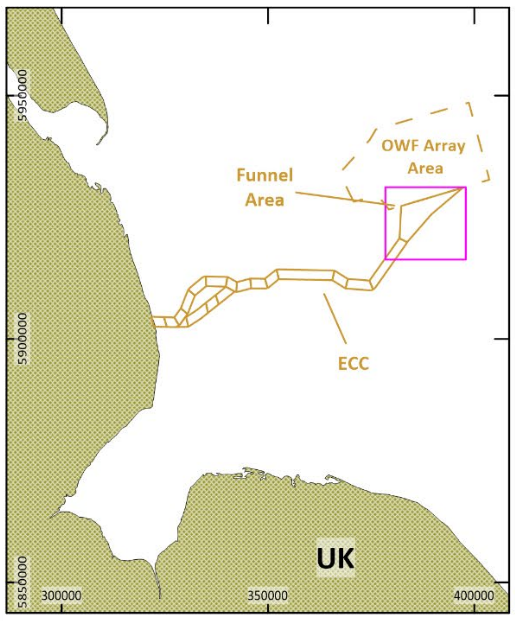
- Survey Areas
- Epibenthic Trawl
- Abandoned Gas Well
- Abandoned Gas Shows
- Abandoned Dry Hole
- Field Layout
  Source: 2021_07_28_PUK_Field_Layout_2013.dxf

Reef Structure Legend:

Gubbay (2009)

- No Underwater Footage Acquired
- "Not a Reef"

Reef Structure Matrix		Elevation (cm) <2 Not a Reef	2 to 5 Low	5 to 10 Medium	>10 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



Revision Number: 00	Revision Date: 16/11/2022	Author: L. Palmer	Approved By: L. Bostock

Figure 55: *Sabellaria spinulosa* reef habitat assessment for the FA survey area

c Ocean Quahog (Arctica islandica)

The ocean quahog (*Arctica islandica*) bivalve species are afforded protected status under the OSPAR Commission due to their inclusion in the OSPAR list of threatened and/or declining species in the Greater North Sea area as a priority species (OSPAR, 2008; 2009a). This species is also listed as an MCZ 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 been reduced their populations can take a long time to recover.

Live *A. islandica* can be identified by their siphons and these were observed at four stations (ECC_18, ECC_21, ECC_28, ECC_29b), via video footage and still photographs; however, no adult or juvenile specimens were recovered in the trawl or grab datasets. The observation of *A. islandica* at these stations was surprising as the coarse sediment types and *S. spinulosa* aggregations are not preferred sediment types for burrowing infauna, as well as relatively shallow depths compared to previously recorded limits of *A. islandica* (Witbaard & Bergman, 2003).

d Sandeel Spawning and Nursery Grounds

Sandeels are small, thin eel-like fish that form large shoals and live most of their life buried in the seabed. They are considered an important component of marine food webs providing food for marine predators such as seabirds, mammals, and other fish (Furness, 1990; 2002). Of the five species of sandeels occurring in the North Sea, the lesser sandeel (*A. marinus*) is the most abundant and comprises over 90% of sandeel fishery catches (Fisheries Management Guidance, 2014). Sandbanks and other sandy areas are known to be important habitats for sandeel, which prefer habitats in water depths between 30m and 70m but are known to occur at depths of 15 m and 120 m (Holland *et al.,* 2005). These small fish burrow into the sediment, sand and use interstitial water to ventilate their gills (Holland *et al.,* 2005). They do not create a permanent opening when burrowed. Fine sediment has the potential to clog their gills and therefore, sandeel have a very specific habitat requirement, resulting in an often highly patchy distribution (Holland *et al.,* 2005; Jensen *et al.,* 2011). Sandeel spawning and nursery grounds have been delineated by Cefas for UK waters; The ECC survey area is located in a low intensity spawning and nursery ground area (Figure 57). Small scale variations in sediment type across the ECC and FA survey area result in a heterogenous mosaic of habitat suitability, ranging from ‘Unsuitable’ to ‘Prime’ spawning and nursing grounds for the species (Ellis *et al.,* 2012; Figure 57).

Preferred sandeel habitat is a substrate which contains a high percentage of medium to coarse sand (particle size of 0.25 mm to 2 mm), with a mud content of less than 10% (particles <63 µm) (Wright *et al.,* 1998; Holland *et al.,* 2005). Sediments with a gravel component are also considered to be suitable for sandeel habitat. The inclusion of gravel means that using Folk classifications (Folk, 1954) to assess sandeel habitat can overstate the suitability of the habitat for sandeels. To determine areas of potentially available habitat for sandeel grounds, the PSA results for the grab stations were compared to the parameters specified by Latto *et al.* (2013), as shown in Table 61.

Table 61: Sandeel Ground Assessment Categories Specified by Latto et al. (2013)

Folk Categories	Habitat Preference
Sand	Preferred
Gravelly Sand	Preferred
Slightly Gravelly Sand	Preferred
Sandy Gravel	Marginal
Other	Unsuitable

Results from the analysis of PSA and assigned Folk scale data, using the Latto *et al.* (2013) method are outlined in Table 62. Variations in the particle size composition of sediments across the survey area produced highly variable suitability ratings across habitats assigned the same biotope type, for example stations within the 'Circalittoral mixed sediment' habitat had contrasting preferences with ECC_54 classed as 'Prime', while ECC_41 was 'Unsuitable'. 'Preferred' sediments for sandeel grounds were identified at 27 stations across the ECC survey area, with 10 stations considered 'Marginal' for sandeel grounds. The remaining 22 stations were classed as 'Unsuitable' for sandeel habitat. These stations were either too coarse or showed bimodal sediment distributions, containing both very fine and coarse material. As a result, these stations were assigned the Folk classifications of 'Gravelly Muddy Sand', 'Muddy Sandy Gravel' or 'Slightly Gravelly Muddy Sand' (Table 62).

Table 62: Sandeel Ground Assessment Results using Latto et al. (2013)

Station	Depth (m)	Modified Folk Scale	Habitat Preference
FA_01	17.7	Sand	Preferred
FA_02	23.9	Slightly Gravelly Sand	Preferred
FA_03	19.3	Muddy Sandy Gravel	Unsuitable
FA_04	21.0	Sandy Gravel	Marginal
FA_05	14.6	Sand	Preferred
ECC_06	23.5	Sandy Gravel	Marginal
ECC_07	10.6	Sand	Preferred
ECC_08	18.4	Muddy Sandy Gravel	Unsuitable
ECC_09	19.9	Gravelly Sand	Preferred
ECC_10	19.0	Slightly Gravelly Sand	Preferred
ECC_11	9.7	Slightly Gravelly Sand	Preferred
ECC_12	22.4	Gravelly Sand	Preferred
ECC_13	25.6	Sand	Preferred
ECC_14	22.0	Gravelly Sand	Preferred
ECC_15	22.6	Gravelly Muddy Sand	Unsuitable
ECC_16	27.9	Gravelly Sand	Preferred
ECC_17	23.1	Gravelly Muddy Sand	Unsuitable
ECC_18	20.8	Muddy Sandy Gravel	Unsuitable
ECC_19	23.9	Gravelly Sand	Preferred
ECC_20	22.0	Gravelly Sand	Preferred
ECC_21	20.5	Gravelly Sand	Preferred
ECC_22	20.0	Sandy Gravel	Marginal
ECC_23A	21.3	Sandy Gravel	Marginal
ECC_24	16.1	Slightly Gravelly Sand	Preferred
ECC_25	13.8	Slightly Gravelly Sand	Preferred

Station	Depth (m)	Modified Folk Scale	Habitat Preference
ECC_26	17.8	Gravelly Sand	Preferred
ECC_27	18.1	Gravelly Sand	Preferred
ECC_28	17.0	Sandy Gravel	Marginal
ECC_30	17.6	Sandy Gravel	Marginal
ECC_31	17.2	Slightly Gravelly Sand	Preferred
ECC_32	14.4	Sandy Gravel	Marginal
ECC_33	13.8	Sand	Preferred
ECC_34	28.4	Slightly Gravelly Muddy Sand	Unsuitable
ECC_35	16.6	Gravelly Sand	Preferred
ECC_36	29.4	Gravelly Muddy Sand	Unsuitable
ECC_37	28.3	Muddy Sandy Gravel	Unsuitable
ECC_38	26.2	Gravelly Sand	Preferred
ECC_39	22.7	Muddy Sandy Gravel	Unsuitable
ECC_40	21.6	Muddy Sandy Gravel	Unsuitable
ECC_41	19.1	Gravelly Muddy Sand	Unsuitable
ECC_42	16.2	Muddy Sandy Gravel	Unsuitable
ECC_43	11.4	Sandy Gravel	Marginal
ECC_44	11.5	Muddy Sandy Gravel	Unsuitable
ECC_45	12.2	Gravelly Muddy Sand	Unsuitable
ECC_46	14.3	Gravelly Sand	Preferred
ECC_47	14.2	Gravelly Muddy Sand	Unsuitable
ECC_48	12.6	Gravelly Muddy Sand	Unsuitable
ECC_49	11.3	Gravelly Muddy Sand	Unsuitable
ECC_50	19.4	Gravelly Muddy Sand	Unsuitable
ECC_51	10.0	Muddy Sandy Gravel	Unsuitable
FA_52	19.0	Gravelly Sand	Preferred
ECC_53	12.9	Sandy Gravel	Marginal
ECC_54	17.3	Gravelly Sand	Preferred
ECC_55	10.1	Slightly Gravelly Sand	Preferred
ECC_56	16.9	Sandy Gravel	Marginal
ECC_57	14.0	Muddy Sandy Gravel	Unsuitable
ECC_58	12.9	Sand	Preferred
ECC_59	12.2	Muddy Sandy Gravel	Unsuitable
ECC_60	10.1	Muddy Sandy Gravel	Unsuitable

More specific definitions of sandeel preferred grounds using sediment particle size were provided by Greenstreet *et al.* (2010). This method utilises the percentage composition of the sediment by weight, which is split into two distinct fractions; silt and fine sand (particles >0.25mm), and medium to coarse sand (particles 0.25-2.0mm). The coarse >2mm fraction, which can often overstate sandeel habitat suitability, is not considered by this method. The sediment fraction data are then used to assess sandeel sediment preference for each station from Figure 56.

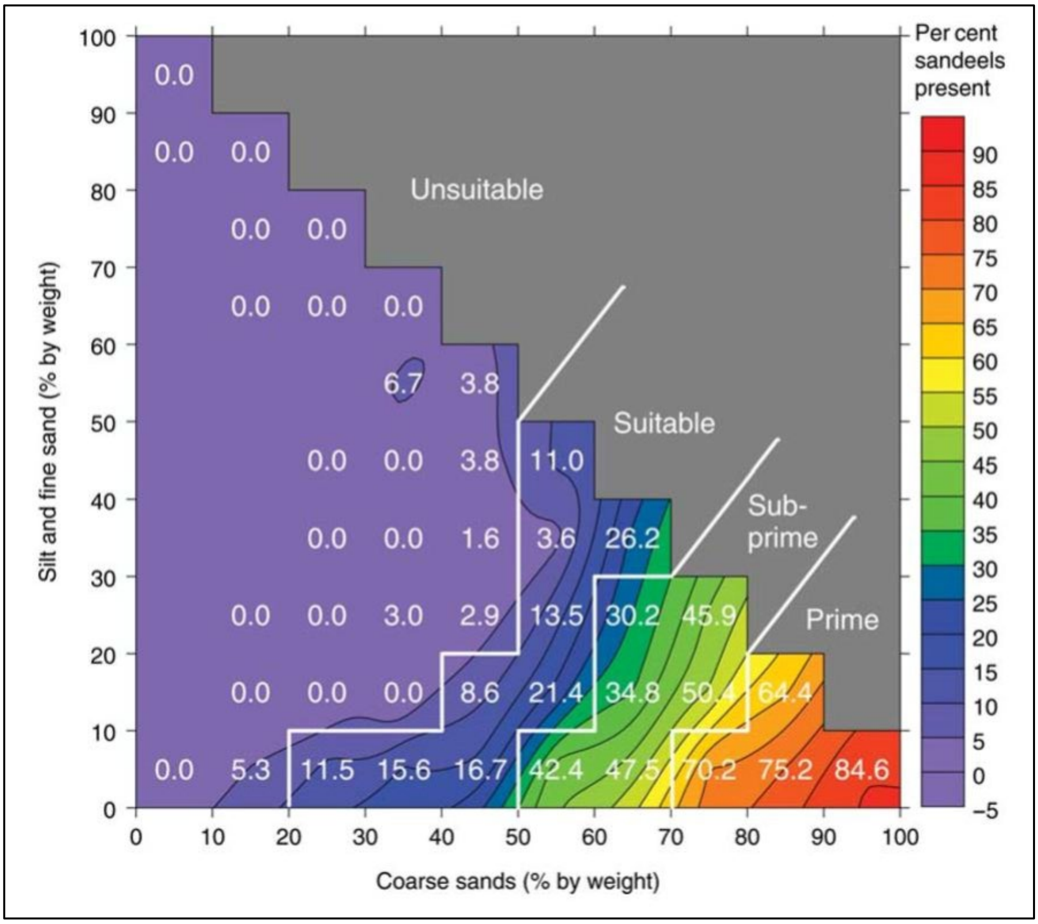


Figure 56: Sandeel Sediment Preference Categories as per Greenstreet *et al.* (2010) (Silt and Fine Sand refer to Particle Sizes >0.25mm, whilst Medium to Coarse Sand refer to Particle Sizes 0.25 to 2.0mm)

The results using the method outlined in Greenstreet *et al.* (2010) indicated less favourable habitat for sandeel grounds across the survey area than the Latto *et al.,* (2013) method. The suitability of some stations was downgraded under the Greenstreet *et al* (2010), while others were upgraded. Overall, the majority of stations (59.3%) did not have an appropriate sediment type to be utilised by sandeels as spawning and nursery ground.

A total of 14 stations in the ECC survey area were classified as 'Prime' sandeel habitat according to Greenstreet *et al*. (2010), of which 12 stations were classed as 'Preferred' habitat under Latto *et al*, 2013 and 2 were considered 'Marginal'. A further two stations were classed as 'Sub-Prime' (Greenstreet *et al*., 2010), all of which were previously 'Preferred' (Latto *et al*., 2013). 'Suitable' habitat was determined to be present at 8 stations (Greenstreet *et al*., 2010), of which 3 stations (ECC_37, ECC_42 and ECC_51) that were previously considered 'Unsuitable' under Latto *et al.,* (2013). These stations generally had a higher proportion of medium and coarse sands and lower proportion of fines when compared to the other 'Unsuitable' stations. As coarse sediments over 2mm are not considered in this method, nine stations previously considered 'Preferred' and seven considered 'Marginal' habitat are classed as 'Unsuitable'. 19 stations classed as 'Unsuitable' areas of 'Gravelly Muddy Sand', 'Muddy Sandy Gravel' or 'Slightly Gravelly Muddy Sand' have remained so, with a total of 35 stations considered 'Unsuitable' for sandeel spawning and nursing (Table 63). Therefore, similarly to the Latto *et al*. (2013) method, the Greenstreet *et al*. (2010) method revealed no overall mapped habitat preference due to the variability in sediment composition within habitat delineations.

Sandeels were also present within the grab macrofauna and epibenthic trawl datasets. Furthermore, the ECC site partially falls within sandeels spawning and nursery grounds; however, it should be noted that even optimal habitats may not be occupied by sandeels if populations are below the area's carrying capacity (Holland *et al.,* 2005).

Table 63: Sandeel Ground Assessment Results using Greenstreet et al. (2010)

Station	Water Depth (m)	Silt and Fine Sands (% by weight)	Medium to Coarse Sands (% by weight)	Habitat Preference
FA_01	17.7	17.8	90.3	Prime
FA_02	23.9	20.3	84.0	Prime
FA_03	19.3	56.2	49.1	Unsuitable
FA_04	21.0	30.9	79.6	Unsuitable
FA_05	14.6	36.1	64.2	Suitable
ECC_06	23.5	59.7	45.1	Unsuitable
ECC_07	10.6	22.7	83.1	Prime
ECC_08	18.4	61.5	45.1	Unsuitable
ECC_09	19.9	30.8	80.9	Prime
ECC_10	19.0	59.0	42.6	Unsuitable
ECC_11	9.7	69.5	30.5	Unsuitable
ECC_12	22.4	57.3	46.7	Unsuitable
ECC_13	25.6	23.9	76.4	Sub-Prime
ECC_14	22.0	27.2	84.2	Prime
ECC_15	22.6	54.3	49.5	Unsuitable
ECC_16	27.9	37.2	77.4	Unsuitable
ECC_17	23.1	61.2	45.9	Unsuitable
ECC_18	20.8	62.5	44.2	Unsuitable
ECC_19	23.9	46.2	67.3	Suitable
ECC_20	22.0	66.3	37.8	Unsuitable
ECC_21	20.5	62.9	43.3	Unsuitable
ECC_22	20.0	53.6	50.0	Unsuitable
ECC_23A	21.3	51.3	51.3	Unsuitable
ECC_24	16.1	50.8	50.4	Unsuitable
ECC_25	13.8	23.2	81.1	Prime
ECC_26	17.8	15.1	90.4	Prime
ECC_27	18.1	27.3	79.2	Sub-Prime
ECC_28	17.0	64.4	39.9	Unsuitable
ECC_30	17.6	35.1	68.9	Suitable
ECC_31	17.2	30.5	75.0	Unsuitable
ECC_32	14.4	55.0	48.6	Unsuitable
ECC_33	13.8	49.1	52.1	Suitable
ECC_34	28.4	68.5	32.1	Unsuitable
ECC_35	16.6	61.9	42.2	Unsuitable
ECC_36	29.4	63.4	38.8	Unsuitable
ECC_37	28.3	48.6	59.3	Suitable
ECC_38	26.2	3.0	120.1	Prime
ECC_39	22.7	66.5	37.9	Unsuitable

Station	Water Depth (m)	Silt and Fine Sands (% by weight)	Medium to Coarse Sands (% by weight)	Habitat Preference
ECC_40	21.6	66.6	40.3	Unsuitable
ECC_41	19.1	82.1	20.0	Unsuitable
ECC_42	16.2	49.2	57.3	Suitable
ECC_43	11.4	28.3	80.5	Prime
ECC_44	11.5	57.8	52.6	Unsuitable
ECC_45	12.2	66.8	41.3	Unsuitable
ECC_46	14.3	21.6	91.9	Prime
ECC_47	14.2	72.9	37.1	Unsuitable
ECC_48	12.6	67.4	41.0	Unsuitable
ECC_49	11.3	63.4	42.8	Unsuitable
ECC_50	19.4	68.2	35.4	Unsuitable
ECC_51	10.0	36.7	67.8	Suitable
FA_52	19.0	20.2	101.5	Prime
ECC_53	12.9	14.8	92.1	Prime
ECC_54	17.3	23.1	95.4	Prime
ECC_55	10.1	6.5	99.0	Prime
ECC_56	16.9	37.7	76.4	Unsuitable
ECC_57	14.0	63.7	39.9	Unsuitable
ECC_58	12.9	32.0	68.2	Suitable
ECC_59	12.2	68.7	39.1	Unsuitable
ECC_60	10.1	77.6	26.9	Unsuitable

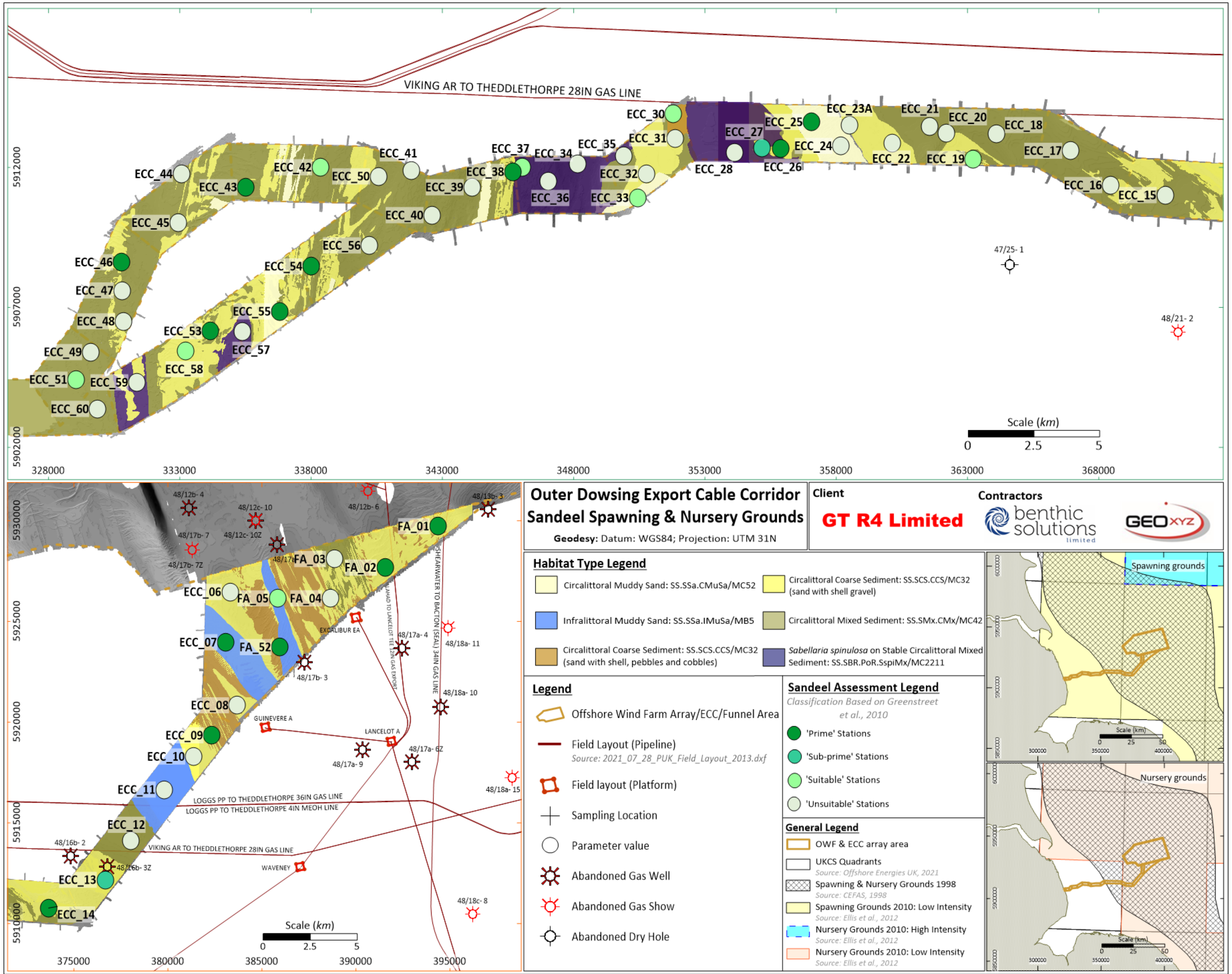


Figure 57: Sandeel Spawning and Nursing Grounds

e Herring Spawning and Nursery Grounds

Herring spawning grounds (HSGs) and nursery grounds have been delineated by Cefas for UK waters. The ECC survey area lies within an area of low intensity nursery ground, and within the adjacent high intensity nursery ground (Figure 58, Ellis *et al*, 2012). Spawning occurs during August to October and suitable HSGs include sediments that are well oxygenated, allowing their sticky eggs to gestate for around three weeks before they hatch (Rogers & Stocks, 2001). Such sediments are limited to unimodal, unmixed very coarse sands and gravels with a low proportion of fines (Ellis *et al.,* 2012). Overexploitation and poor recruitment led to a decline in the North Sea herring spawning stock in the 1970s, forcing closure of the fishery in 1977. Due to the unique sedimentary requirement for HSGs and the stock's vulnerability to overfishing (Rogers & Stocks, 2001), HSGs may be subject to protection if found. To determine whether any potential habitat for herring spawning exists within the ECC survey area, the PSA results from the grab sampling stations were assigned to the categories specified by Reach *et al.* (2013), as shown in Table 64.

Table 64: Herring Spawning Ground Assessment Categories Specified by Reach et al. (2013)

Percent Contribution of Mud & Gravel	Habitat Sediment Preference	Habitat Sediment Classification
<5% mud, >50% gravel	Prime	Preferred
<5% mud, >25% gravel	Sub-prime	Preferred
<5% mud, >10% gravel	Suitable	Marginal
>5% mud <10% gravel	Unsuitable	Unsuitable

Results from particle size distribution of the survey area indicated that 20 stations sampled across the ECC and FA showed HSG habitat sediment preference ranging from 'Suitable' to 'Prime'. A single station showed the highest 'Prime-Preferred' sediment for HSG, indicating a high likelihood of herring spawning at this sample location (Table 65). The remaining 39 stations within the survey area were classed as 'Unsuitable' or 'No Preference' for both habitat sediment preference and classification due to the presence of >5% fines and <10% gravel. Areas of seabed habitat assigned as MB5 (Atlantic infralittoral muddy sand), MC52 (Circalittoral muddy sand) and MC2211 (*Sabellaria spinulosa* on Stable Circalittoral Mixed Sediment) were all unsuitable for herring spawning ground (Table 65 and Figure 58).

Table 65: Herring Spawning Ground Assessment Results using Reach et al. (2013)

Station	Water Depth (m)	Fines (%)	Sands (%)	Gravel (%)	Modified Folk Scale	Habitat Sediment Preference	Habitat Sediment Classification
FA_01	17.7	0.00	99.42	0.59	Sand	No Preference	No Preference
FA_02	23.9	0.98	97.11	1.91	Slightly Gravelly Sand	No Preference	No Preference
FA_03	19.3	6.92	59.82	33.27	Muddy Sandy Gravel	No Preference	No Preference
FA_04	21.0	4.62	63.11	32.27	Sandy Gravel	Sub-prime	Preferred
FA_05	14.6	0.00	99.94	0.06	Sand	No Preference	No Preference
ECC_06	23.5	1.71	62.60	35.69	Sandy Gravel	Sub-prime	Preferred
ECC_07	10.6	0.00	99.89	0.11	Sand	No Preference	No Preference
ECC_08	18.4	6.14	48.25	45.61	Muddy Sandy Gravel	No Preference	No Preference
ECC_09	19.9	0.07	81.07	18.86	Gravelly Sand	Suitable	Marginal
ECC_10	19.0	0.00	98.78	1.23	Slightly Gravelly Sand	No Preference	No Preference
ECC_11	9.7	0.00	95.05	4.95	Slightly Gravelly Sand	No Preference	No Preference

Station	Water Depth (m)	Fines (%)	Sands (%)	Gravel (%)	Modified Folk Scale	Habitat Sediment Preference	Habitat Sediment Classification
ECC_12	22.4	6.53	66.81	26.67	Gravelly Sand	No Preference	No Preference
ECC_13	25.6	0.00	99.62	0.38	Sand	No Preference	No Preference
ECC_14	22.0	1.80	84.29	13.91	Gravelly Sand	Suitable	Marginal
ECC_15	22.6	8.98	67.11	23.91	Gravelly Muddy Sand	No Preference	No Preference
ECC_16	27.9	2.50	81.28	16.23	Gravelly Sand	Suitable	Marginal
ECC_17	23.1	8.57	63.98	27.45	Gravelly Muddy Sand	No Preference	No Preference
ECC_18	20.8	9.24	48.91	41.85	Muddy Sandy Gravel	No Preference	No Preference
ECC_19	23.9	0.52	77.86	21.62	Gravelly Sand	Suitable	Marginal
ECC_20	22.0	4.83	66.80	28.38	Gravelly Sand	Sub-prime	Preferred
ECC_21	20.5	5.04	70.64	24.32	Gravelly Sand	No Preference	No Preference
ECC_22	20.0	0.60	68.98	30.42	Sandy Gravel	Sub-prime	Preferred
ECC_23A	21.3	0.00	68.69	31.31	Sandy Gravel	Sub-prime	Preferred
ECC_24	16.1	0.00	98.88	1.12	Slightly Gravelly Sand	No Preference	No Preference
ECC_25	13.8	0.00	96.30	3.70	Slightly Gravelly Sand	No Preference	No Preference
ECC_26	17.8	0.00	89.37	10.63	Gravelly Sand	Suitable	Marginal
ECC_27	18.1	1.59	80.55	17.86	Gravelly Sand	Suitable	Marginal
ECC_28	17.0	5.37	54.21	40.43	Sandy Gravel	No Preference	No Preference
ECC_30	17.6	0.20	66.26	33.54	Sandy Gravel	Sub-prime	Preferred
ECC_31	17.2	0.24	94.87	4.89	Slightly Gravelly Sand	No Preference	No Preference
ECC_32	14.4	0.00	56.21	43.79	Sandy Gravel	Sub-prime	Preferred
ECC_33	13.8	0.00	99.24	0.76	Sand	No Preference	No Preference
ECC_34	28.4	14.97	81.06	3.97	Slightly Gravelly Muddy Sand	Unsuitable	Unsuitable
ECC_35	16.6	3.72	69.04	27.24	Gravelly Sand	Sub-prime	Preferred
ECC_36	29.4	17.44	67.18	15.39	Gravelly Muddy Sand	No Preference	No Preference
ECC_37	28.3	10.47	45.89	43.65	Muddy Sandy Gravel	No Preference	No Preference
ECC_38	26.2	0.14	85.84	14.01	Gravelly Sand	Suitable	Marginal
ECC_39	22.7	15.26	49.84	34.90	Muddy Sandy Gravel	No Preference	No Preference
ECC_40	21.6	14.43	51.58	34.00	Muddy Sandy Gravel	No Preference	No Preference
ECC_41	19.1	26.00	60.67	13.34	Gravelly Muddy Sand	No Preference	No Preference
ECC_42	16.2	16.00	50.43	33.57	Muddy Sandy Gravel	No Preference	No Preference
ECC_43	11.4	0.33	56.27	43.40	Sandy Gravel	Sub-prime	Preferred
ECC_44	11.5	12.80	49.94	37.27	Muddy Sandy Gravel	No Preference	No Preference
ECC_45	12.2	15.40	59.96	24.64	Gravelly Muddy Sand	No Preference	No Preference
ECC_46	14.3	3.89	74.90	21.22	Gravelly Sand	Suitable	Marginal
ECC_47	14.2	22.95	53.48	23.57	Gravelly Muddy Sand	No Preference	No Preference
ECC_48	12.6	21.38	52.44	26.18	Gravelly Muddy Sand	No Preference	No Preference
ECC_49	11.3	19.04	61.54	19.42	Gravelly Muddy Sand	No Preference	No Preference
ECC_50	19.4	14.25	69.16	16.59	Gravelly Muddy Sand	No Preference	No Preference
ECC_51	10.0	8.02	45.08	46.90	Muddy Sandy Gravel	No Preference	No Preference

Station	Water Depth (m)	Fines (%)	Sands (%)	Gravel (%)	Modified Folk Scale	Habitat Sediment Preference	Habitat Sediment Classification
FA_52	19.0	0.00	90.84	9.16	Gravelly Sand	No Preference	No Preference
ECC_53	12.9	0.67	43.56	55.77	Sandy Gravel	Prime	Preferred
ECC_54	17.3	4.26	69.07	26.67	Gravelly Sand	Sub-prime	Preferred
ECC_55	10.1	0.00	97.92	2.08	Slightly Gravelly Sand	No Preference	No Preference
ECC_56	16.9	3.84	51.07	45.09	Sandy Gravel	Sub-prime	Preferred
ECC_57	14.0	11.02	57.76	31.22	Muddy Sandy Gravel	No Preference	No Preference
ECC_58	12.9	9.23	90.75	0.02	Sand	Unsuitable	Unsuitable
ECC_59	12.2	15.22	41.67	43.12	Muddy Sandy Gravel	No Preference	No Preference
ECC_60	10.1	21.69	42.08	36.23	Muddy Sandy Gravel	No Preference	No Preference

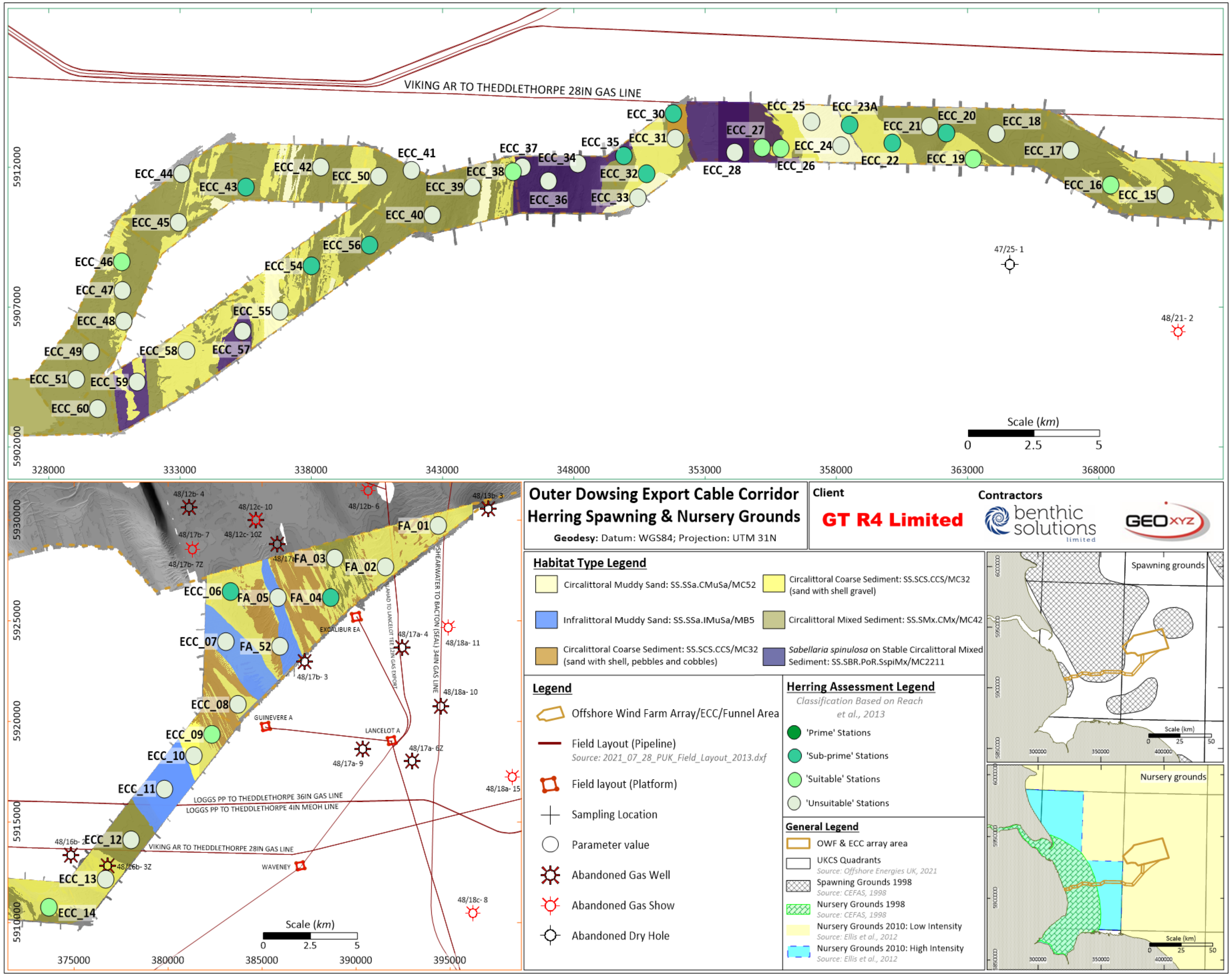


Figure 58: Herring Spawning and Nursing Grounds

f Sandbanks which are Slightly Covered by Seawater all the Time

The Annex I habitat 'sandbanks which are slightly covered by seawater all the time' comprises sandy sediments that typically occur at depths of less than 20m below LAT. The diversity and types of community associated with this habitat are determined primarily by sediment type, together with a variety of other physical, chemical, and hydrographic factors. This habitat type is further split into a range of sub-types, including eelgrass '*Zostera marina*' beds and maerl beds, which are both particularly distinctive and of high conservation value because of the diversity of species they may support and their general scarcity in UK waters.

The ECC site boundary crosses six sandbank areas which have been delineated by the JNCC (2020); 'Additional Bank 93', 'Additional Bank 97', 'Additional Bank 96', 'Additional Bank 8' 'Inner Dowsing North' and 'Race Bank and North Ridge' (Figure 3). The 'Inner Dowsing North' and 'Race Bank and North Ridge' both form part of the 'Inner Dowsing, Race Bank and North Ridge' Special Areas of Conservation (SAC). The higher proportions of sand dominated sediment in Blocks 12, 13 and the FA, in conjunction with shallow water depths of <15m are consistent with the expected presence of Annex I sandbank habitat within the ECC site.

5 CONCLUSION

The water depth across the ECC survey area ranged between 1.17m to 32.91m LAT with the water depth undulating due to the presence of megaripples, sandwaves and sandbanks. Megaripples and sandwaves were ubiquitous features observed across the ECC survey area but their orientations were variable, with the western end of the route bedforms (Blocks 2, 4, 5, 15 and 16) generally orientated north to south. While, at the eastern end of the route (Blocks 13 and 9) the megaripples and sandwaves were generally orientated northwest to southeast, indicating a change in predominant current direction as the water depth decreased to the east of the ECC route. Sandbanks were also a common feature along the ECC route and were predominantly found within the funnel area, located to the south of the OWF survey area.

The results of the particle size analysis indicated a variable sediment type present across the ECC survey area. The seabed sediments were generally dominated by either sands or gravel. Some stations with shallower depths did show higher have more sand content, however, this was not a consistent pattern throughout the survey area. Similarly the proportion of gravel, in the form of pebbles and gravel matrices, interspersed with sand was variable across the survey area. The samples collected in the survey area represented eight Folk classifications with most assigned to sand dominant classifications such as 'Sand', 'Slightly Gravelly Sand', 'Gravelly Sand' 'Gravelly Muddy Sand' and 'Slightly Gravelly Muddy Sand', while the remaining stations were assigned gravel dominant classifications such as 'Gravel', 'Sandy Gravel' or 'Muddy Sandy Gravel'.

Total organic carbon was relatively low across the survey area and indicated an organically-deprived environment, with lower TOC concentrations recorded on the crests of sandbanks, which was unsurprising given the dominance of sand and gravel with minimal fines. There were notable densities of the tube-building polychaete *Sabellaria spinulosa* throughout much of the ECC survey area. Some stations with higher TOC (ECC_60, ECC_59 and ECC_49) were mapped within or near areas of biogenic habitat, as well as having *S. spinulosa* observed in video footage of the site. This is a pattern that has been noted on a number of previous surveys undertaken by BSL, with higher TOC in areas such as this thought to reflect the increased flux of suspended particulate organic matter to the seabed sediments through the filter-feeding of *Sabellaria* worm, with organic matter potentially also more likely to become entrained within *Sabellaria* aggregation structures.

The total polycyclic aromatic hydrocarbons (PAH) were generally low across the survey area with an elevated ∑16PAH and ∑22PAH recorded at station ECC_60. The elevated ∑16PAH concentration at station OWF_60 reflected higher concentrations of each individual PAH; however, only naphthalene and acenaphthylene exceeded their TELs and fluorene exceeded its ERL threshold. The elevated ∑16PAH at station ECC_60 could be attributed to the proximity of the station to the coast (approximately 8km), which will receive increased input from terrestrial sources. However, station ECC_51 sampled within similar distance to the coast had a significantly lower ∑16PAH, indicating that this relationship is not uniform and likely subject to variation according to local environmental conditions and sources of pollution. The source of the PAHs across the survey area was determined to be from a mixed source of pyrolytic and petrogenic sources given the equal loading of 22 PAHs across the survey area, which was unsurprising given the oil and gas exploration surrounding the ECC survey area and proximity to the coast of the UK and the Humber Estuary. Polychlorinated biphenyls (PCBs) and organotins were recorded at relatively low concentrations, which in conjunction with the low PAHs suggests a natural distribution of aromatic hydrocarbons across the site. The concentration of DDT was elevated above the Cefas action level 1 at eight stations, indicating the material at these stations would have to be further investigated before disposal. However, DDT was below the ERL and TEL reference values so it is unlikely the concentrations of DDT would have impacted the macrobenthic community.

Concentrations of all analysed trace metals were generally elevated above UKOOA thresholds but within background conditions reported in nearby surveys, indicating the site is reflective of ambient conditions for this region of the SNS. One station in the survey area, ECC_51, had very high concentrations of arsenic, exceeding all thresholds, including Cefas action level 1 and 2. However, elevated arsenic concentrations is unsurprising given previous studies that have found high levels of arsenic within the SNS, potentially due to the influence of historic industrial discharge from the Humber Estuary. All metals with the exception of arsenic and nickel were below their respective sediment quality guideline value (SQGV) and were deemed to be 'low risk' within the ECC survey area. Arsenic and nickel exceeded their SQGVs at eight and four stations respectively, at levels which reflect the upper limit of background concentrations for this region of the SNS.

Benthic macrofaunal species richness and faunal abundance was variable across the survey area and reflected the sand and gravel dominated sediments across the survey area. A total of 6,352 individuals were recorded, of which 130 annelid species represented 21% of the total number of individuals. Simpson's diversity indices for the macrofauna showed variation across the survey area, where results ranged from 0.480 to 0.972 and indicated a variable community structure. Further analysis using multivariate statistics revealed four significantly different macrofaunal cluster groupings at a Bray-Curtis similarity slice of 15 within the survey area, with differences in macrofaunal assemblages attributed to the exclusion of certain taxa and the underlying MESH sediment classifications. As such, the variation in the macrofaunal community composition was significantly correlated to the sediment particle size, with all other correlations to physico-chemical parameters attributed to autocorrelation to sedimentary parameters due to the relatively low concentrations of trace metals, PAH and TOC.

Epibenthic trawl species richness and faunal abundance reflected the sand and gravel dominated sediments throughout the survey area. A total of 49,484 individuals were recorded across 92 species, of which 21 species of Chordata represented 2.9% of the total number of individuals. Arthropods were represented by 31 species and accounted for 93.6% of the total individuals due to the high abundance of the shrimp *Pandalus montagui* at ECC_T3. Further analysis using multivariate statistics identified three significantly different macrofaunal groupings within the survey area, which were differentiated based on the epifaunal differences between sand and coarse gravelly sediments. The grab macrofaunal and epifaunal trawl datasets were considered to represent natural background infaunal and epifaunal conditions for this region of the southern North Sea.

The seabed across the ECC survey area was assigned six JNCC/EUNIS habitat types with several habitats present across all extents of the ECC survey area: "Circalittoral coarse sediment" (SS.SCS.CCS/MC32) and "Circalittoral mixed sediment" (SS.SMx.CMx/MC42). Of these two habitat types, variations existed within both with SS.SCS.CCS separated into two variants: "Circalittoral coarse sediment" (sand with shell, pebbles and cobbles) and "Circalittoral coarse sediment" (sand with shell gravel), due to differing degrees of coarseness. The level 5 habitat '*Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand' (SS.SCS.CCS.Pkef/MC3213) was likely to occur in areas of coarse sediment. The SS.SMx.CMx habitat type also showed variation with mixed sediment present throughout the route but the presence of *Sabellaria spinulosa* on stable circalittoral mixed sediment (SS.SBR.PoR.SspiMx/MC2211) isolated to areas within Blocks 7, 8, 9 and 15. The level 5 habitat '*F. foliacea* and *H. falcata* on tide-swept circalittoral mixed sediment' (SS.SMx.CMx.FluHyd/MC4214) was likely to occur within areas delimited as 'Circalittoral mixed sediment'. Areas of "Infralittoral muddy sand" (SS.SSa.IMuSa/MB5) were present in the FA and within Block 12 coinciding with sandbanks. Smaller areas of "Circalittoral muddy sand" (SS.SSa.CMuSa/MC52) was identified along the ECC route predominantly in Blocks 5, 7, 8, 9 and 17 closer to the coastline. The closest resembling level 5 biotope to this habitat was ‘*Ophiura ophiura* on circalittoral muddy sand’ (SS.SSa.CMuSa.Ooph/MC521), which presented in an impoverished form.

The associated fauna evident from video footage and still photographs comprised a high diversity and density of epifauna. The finer sand dominated sediments had an impoverished epifaunal community when compared to visual inspections of the coarse and mixed sediment habitats. This is due to the greater abundance of hard substrate in the form of cobbles and pebbles present across the coarser sediment habitats, which enables the development of complex epifaunal communities.

A number of potential sensitive habitats and species are known to occur in the wider southern North Sea including, geogenic stony reefs (EC Habitats Directive Annex I habitat), biogenic reef (EC Habitats Directive Annex I, Habitat FOCI, OSPAR Threatened and/or Declining Habitat, UKBAP Priority Habitat), lesser sandeel (*Ammodytes marinus*) (Species FOCI, UKBAP Priority Species), herring spawning grounds, shallow sandbanks (EC Habitats Directive Annex I) and ocean quahog (*A. islandica*) (Species FOCI, OSPAR Threatened and/or Declining Species).

The presence of cobbles and boulders indicated the potential for Annex I stony reef to occur in areas of intermediate habitats of ‘Atlantic circalittoral mixed sediment’ and ‘Atlantic circalittoral coarse sediment’; however, all camera transects were classified as ‘Not a Reef’ according to the Irving (2009) criteria as the percentage cover of cobbles and boulders was <10%. Station ECC_VID_37 had epifauna present at sufficient densities to be considered ‘possible reef with sand veneer’ or ‘reef with sand veneer’ according to Golding *et al.* (2020) criteria; however, the lack of mean reef species restricted the confident assignment of Annex I stony reef.

The presence of *S. spinulosa* aggregations at stations ECC_VID_29b, 34, 35, 57, 59, 64, 65 and 66 indicated conformance to the SS.SBR.PoR.SspiMx ‘*S. spinulosa* on stable circalittoral mixed sediment’ biotope. The presence of *S. spinulosa* aggregations could indicate a presence of Annex I *S. spinulosa* reef; however, according to Gubbay (2007), the *S. spinulosa* aggregations observed along the eight transects were unlikely to represent ‘reef’. Although, these aggregations of *S. spinulosa* were not reef forming, areas of *S. spinulosa* aggregations had higher epifaunal species diversity when compared to areas where *S. spinulosa* was absent, indicating that even fragmented *Sabellaria* aggregations can have ecological benefits.

Sandeels (Species FOCI, PMF species Scotland, UKBAP Priority Species) were occasionally observed on the video footage with 44% of stations in the ECC survey area classified as ‘Prime’ or ‘Suitable’ sandeel habitats according to Greenstreet (2010). Sandeels were also present within the grab macrofauna and epibenthic trawl datasets and the survey area falls within a spawning and nursery ground for sandeels. It should also be noted that even optimal habitats may not be occupied by sandeels when populations are below the area’s carrying capacity.

Areas of ‘Circalittoral coarse sediment’ and ‘Circalittoral mixed sediment’ were the most optimal for herring spawning grounds, ranging from ‘Suitable’ to ‘Prime’. Whereas areas of ‘Atlantic infralittoral muddy sand’, ‘Circalittoral muddy sand’ and ‘*Sabellaria spinulosa* on Stable Circalittoral Mixed Sediment’ were all unsuitable for herring spawning ground.

The ECC survey area crosses six sandbanks (‘Additional Bank 93’, ‘Additional Bank 97’, ‘Additional Bank 96’, ‘Additional Bank 8’ ‘Inner Dowsing North’ and ‘Race Bank and North Ridge’). The ‘Inner Dowsing North’ and ‘Race Bank and North Ridge’ both form part of the ‘Inner Dowsing, Race Bank and North Ridge’ Special Areas of Conservation (SAC). The higher proportions of sand dominated sediment in Blocks 12, 13 and the FA, in conjunction with shallow water depths of <15m are consistent with the expected presence of Annex I sandbank habitat within the ECC site.

A. islandica siphons were observed at four stations (ECC_18, ECC_21, ECC_28, ECC_29b), via video footage and still photographs; however, no adult or juvenile specimens were recovered in the trawl or grab datasets.

Non-native marine species are of particular concern when they become invasive thus detrimental to native species. However, invasive species within the ECC survey area were limited to observations of slipper limpets (*C. fornicata),* which have been present in the UK since the late 1800s.

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7 APPENDIX

APPENDIX A – GEO OCEAN III

GEO OCEAN III

Offshore Survey & Support Vessel

GEOXYZ OFFSHORE

SUPPORT ACTIVITIES / VESSEL CAPABILITIES

The GEO OCEAN III is a multi-disciplined DP II offshore survey vessel. With her specifically selected equipment and capabilities for the North Sea survey and light construction support activities, she is the ideal candidate for our Oil & Gas and Renewables clients.

The vessel is equipped with 56 berths, Offshore crane, Survey and ROV systems. Equipment can be rapidly deployed using the large Stern A-Frame, crane or through the 6 x6 m moonpool via the dedicated A-frame and 30t AHC winch. All together making the Geo Ocean III a dynamic platform for subsea operations.

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GEO OCEAN III

Offshore Survey & Support Vessel

TECHNICAL SPECIFICATION

General

Name	Geo Ocean III
Flag	Luxembourg
Port Registry	Luxembourg
Call Sign	LXGP
IMO Number	9285586
Classification	LLOYDS - HULL – MACH
Vessel Type	Survey Vessel SV
Special Service:	Fire fighting ship / Fire fighting 1 Waterspray / Oil Recovery / Stand by rescue
Unrestricted navigation	AUT-UMS - ALM - DYNAPOS-AM/AT-R; SDS

Dimensions and Construction

Builder	De Hoop
Built	2004
LOA	77,30 m
Width Moulded	18 m
Depth Moulded	7,40 m
Draft min. / max.	3,80 m/6,10 m
Gross Tonnage	3,722
Moonpool	6 m x 6m

Accommodation

Total Berths	56 persons
Total Cabins	32
Single cabins	8 x 1 person
Double cabins	24 x 2 persons
Offices	1 x Dedicated Online 1 x Dedicated Offline / Conference room 1 x Client Office 1 x OCM Office 1 x 3rd Party Office
Hospital	1 x Hospital
Other Facilities	Galley, Large Mess room, 2 x day room, Gymnasium, Dirty Mess

Capacities & delivery Rates

Main Deck area:	670 m²
Hangar Deck:	290 m²
Mezzanine Deck Area:	268 m²
Max Deck Loading	Main Deck 5t/m² Mezzanine Deck 2t/m²
Max Deck Load	1,300 t @ 1m above deck
Fuel oil (capacity - transfer):	1,105m³ - 100m³/h @ 8bars
Drill or Water ballast (capacity - transfer):	1,350m³ - 40m³/h @ 4.5bars
Antiheeling (capacity - transfer):	250m³ - 2 x 500m³/h
Fresh water (capacity - transfer):	495 m3 - 40 m³/h @ 4.5bars
Oil recovery:	324 m³
Foam:	24 m³

Safety Equipment

Fi-Fi:	Class 1
Pumps:	2 x 1,200m³/h
Monitors:	2 x 1,200m³/h
Fast Rescue Craft:	1 x Seabear 23 MKII
Rescue capacity:	150 persons in tropical area

MACHINERY & PERFORMANCE

Propulsion - Machinery

Main propulsion:	2 x 1,800 kW FP Azimuth thrusters
Main Engines:	4 x 1360kW Caterpillar
Tunnel thrusters:	1 x Insert manufacturer 780 kW
Fwd Azimuth	1 x Rolls Royce 600kW retractable

SPEED & CONSUMPTION (Information only)

Service Speed	10 kts
Max Speed	12 kts

Fuel consumption

Stand-by in port:	2t/day
Survey Speed:	7t/day
DPII:	6t/day

Deck Equipment and Cranes

Main Crane:	SMST telescopic 40t @ 9m - 6t @ 23.5m
Winch Capacity:	40t / 40t - 200m
Deck Crane	4.5t @9m Man-riding
Stern A- Frame :	54t @ 8m outreach
Max launching Dims	8m clearance up / 10m wide opening
Offshore capacity:	54t @ 8m outreach
Winch Capacity	30t / 30t - 1,500m - AHC
Moonpool A-Frame	30t
Winch Capacity	30t / 30t - 1,500m - AHC
Tuggers:	1 x 10t & 1 x 30t
Capstans:	2 x 5t
Deck Service Air Supply:	66 m³/h @ 8 bars
Deck Power Supply:	3 x 265 kW - 480 VAC /60Hz

Navigation and Dynamic Positioning

DP System:	GE DP21 + IJS
Type:	DP 2
Reference 1:	DGPS 1 Fugro Seastar 9205
Reference 2:	DGPS 2 Fugro Seastar 9205
Reference 3:	G4 and XP2 corrections USBL
Reference 4:	Kongsberg Fan Beam
Primary Heading/motion/INS	POSMV 320 Ocean Master
Secondary Heading/motion/INS	POSMV 320 Ocean master
Subsea Positioning	Sonardyne Ranger 2 c/w 6G HPT 5000

Survey Suite and Offline software

Survey Suite	QINSY EIVA
Offline Software	QINSy, NaviSuite, Beamworks, Oasis Montaj (UXO marine), Visual works, Autodesk, Arc GIS,
Video Distribution	4k ultra high definition
Audio comms	Canford clear comms

Survey Sensors

MBES	Hull Mounted (Optional Dual head) R2Sonic 2024 UHR
Single Beam	XXXXXXX
Sound Velocity Sensor	Valeport Swift
Sidescan Sonar	Edgetech 2200
Sub Bottom Profiler	Silas, Depending on requirements

Subsea Equipment

WROV	1 x 150HP WROV
IROV	Mezzanine deck configured for rapid mobilisation 1 x Seaeye Cougar
Vibrocorer	3/6m electric/hydraulic systems as required
CPT	Optional 1.5 – 20t systems (Neptune or Manta type as required)

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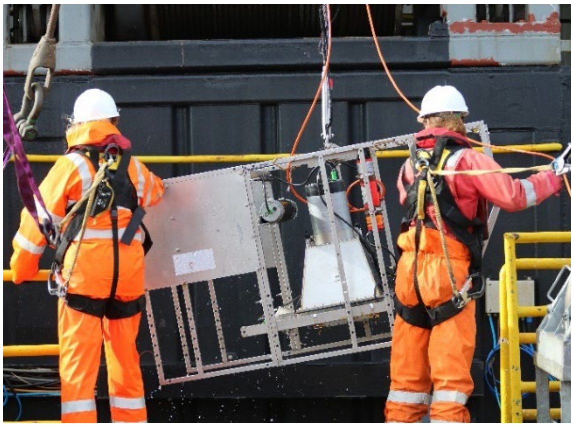
APPENDIX B – SAMPLING EQUIPMENT

Item	Comments
	For detailed assessment of ecologically sensitive habitats. The camera system was housed within a freshwater lens (FWL) adapted sled, which allows this system to take high resolution images and video in areas of poor visibility water clarity. During phase 1, the FWL frame was setup for both the BSL MOD 4.2 and 4.4 camera systems. Two additional camera sleds were retained onboard as backups.
	The Mini-Hamon Grab was the primary sampler used at every station throughout Phase 1 for all MF/PSA/TOC sampling. It is a single shovel sampler designed for operations in mixed, diamicton sands and gravel sediments and acquires a 1 x 0.1m^2 sample from a single deployment.
	The Shipek Grab was utilised at 30 sampling stations to acquire samples for contaminant analysis, with a further 15 sub-sampled for eDNA. When the grab touches the bottom, inertia from a self-contained weight releases a catch and helical springs rotate the inner half cylinder by 180°. After turning, the scoop remains closed by the residual torque of the scoop spring. Because the rotation of the bucket is under tension, its shear strength is far greater than the sediment strength, thus cutting cleanly, particularly in soft clays, muds, silts & sands.

Item	Comments
	The Day Grab was retained onboard as a backup to the Mini-Hamon and was not used in the course of Phase 1 environmental sampling operations. It is normally used to acquire undisturbed samples from muddy or sandy seabed sediment, collecting 1 x 0.1m^2 sample from a single deployment.
	The *Wilson* Auto-siever was loaded with a sieve stack of 5mm and 1mm sieves and utilises seawater to remove excess sediment whilst retaining macrofauna for formaldehyde preservation.
	A robust commercial Jennings-type 2m beam trawl was used in Phase 1 to acquire Macro Faunal samples from a minimum of 500m long trawl transects Comprised of a heavy-duty steel beam, outer commercial mesh, and internal 7.5mm scientific mesh and is configured with a 5mm mesh liner in the cod-end to retain smaller organisms.

APPENDIX C – FIELD OPERATIONS AND SURVEY METHODS

Seabed Photography and Video

Seabed video footage was acquired at 32 locations across the ECC site to provide ground-truthing of sediments indicated in the acoustic data. The 32 camera transects were carried out using MOD4.4 and MOD4.2 camera systems mounted within a BSL freshwater lens drop down frame equipped with a separate strobe, and LED lamps.

Once at the seabed, the camera was moved along the length of the transect at a speed of 0.3 knots. Still photographs were captured remotely using a surface control unit via a soft towed umbilical to the camera system. The stills were uploaded in real-time and saved to the camera and a laptop via specialist software. Live video footage, overlaid with the date, time, position and site details were viewed in real-time. The live video stream was used to assist with targeting of the stills camera. HD footage was saved internally by the video camera; data was downloaded at the end of each day of camera operations and backed-up onto a hard drive

Grab Sampling

A 0.1m^2 mini Hamon grab was used for macrofaunal and physico-chemistry sampling at all sample locations due to coarse sediments encountered across the ECC area. Three consecutive 'no sample' deployments were agreed to be the maximum number of attempts at any location before moving on. Samples above the predetermined minimum of 40% retention were obtained at 55 sampling stations. Coarse material at the remaining five stations prevented adequate grab penetration (10-35% retention) and therefore were rejected as an acceptable sample after discussion with GT R4/GoBe.

A 0.1m^2 Shipek grab used to collect contaminant samples. Three consecutive 'no samples' per grab type was agreed to be the maximum at each location before moving on. At 18 stations, at least one primary contaminant sample (500ml) was obtained, and at 10 stations less than 500ml samples were taken for secondary sub-sampling contaminant analysis. Sufficient sediment samples could not be retained at two stations (ECC_12 and ECC_28), due to coarse underlying sediment.

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 upon recovery and were flagged if they did not meet the following requirements:

- Water above sample is 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 (ca. 40% of the sampler's capacity);
- No hagfish (*Myxine glutinosa*) and/or other mucus coagulants were found in the sample;
- No obvious contamination from equipment or the vessel;
- 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, smell (including the presence of H_2S), obvious fauna, evidence of bioturbation and evidence of anthropogenic debris. One successful 0.1m^2 sample was required per station to acquire enough material for macrofauna and sub-sampling of physico-chemistry from the remaining sample, achieved through two deployments of the Hamon Grab. The macrofaunal samples were processed on-board over a 5mm and a 1mm aperture mesh by BSL scientists using a *Wilson* Auto-siever.

Sample Processing

Field processing was conducted on board after they had been subjected to the afore mentioned quality control and proclaimed acceptable. Sub-sampling of physico-chemical parameters was undertaken from the grab samples with the following material retrieved from the surface sediments (0-2cm) for later analysis:

1. Heavy & trace metals and total organic carbon & matter (stored in doubled lined Ziplock plastic bag);
2. Particle size distribution (PSA) and stored sample (stored in doubled lined Ziplock plastic bag).

Sub-sampling of contaminants from the Shipek grab was undertaken by BSL scientists from the grab samples for later analysis. Sediment samples were collected using stainless steel implements and stored in a pre-washed foil capped glass jar.

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 (IMS). All biological samples were double labelled with internal tags.

Benthic Trawls

A 2-metre Jennings style beam trawl was to be deployed along 7 trawl routes across the ECC survey area. Samples were required to be a minimum of 5 litres with smaller trawl catches classed as a ‘no samples and repeated at a 50m offset. Three consecutive ‘no samples’ was agreed to be the maximum number of attempts at any location before moving on. Where preliminary review of co-located camera transects indicated that an area supported sparse epifauna, the trawl length was extended beyond the minimum 500m length to increase the chance of acquiring satisfactory trawl samples.

Samples were extracted from the trawl, photographed with their respective identification label and, if necessary, sieved over a 5mm mesh. Biological organisms were separated into trays by general groups (e.g. crustaceans, echinoderms, mollusc, sponges and others). Sub-sampling was conducted for two of the trawls (ECC_T3 and ECC_T5) due to large numbers of shrimp species present. Individuals were counted and identified to species where possible, those that were unable to be identified in the field were fixed and returned to the onshore laboratory for analysis. One example for each taxa was fixed and kept as a reference collection.

Before fixing, conspicuous specimens were photographed and all specimens were biomassed by taxa. The lengths of fish specimens were also measured and recorded. Larger reference specimens including all fish were stored in bags in the freezer, smaller specimens were fixed in formalin and stored in plastic bags or pots, grouped by trawl into larger buckets.

APPENDIX D – DATA PRESENTATION, LABORATORY AND STATISTICAL ANALYSES

PARTICLE SIZE DISTRIBUTION

The samples recovered from each site were analysed by BSL who participate in the North East Atlantic Marine Biological Analytical Quality Control Scheme (NMBAQC) for PSA analysis.

The sample was homogenised and split into a small sub-sample for laser diffraction and the remaining material was sieved through stainless steel sieves with mesh apertures of 8000µm, 4000µm, 2000µm and 1000µm. In most cases almost the entire sample would pass through the sieve stack, but any material retained on the sieve, such as small shells, shell fragments and stones were removed, and the weight was recorded.

The smaller sub-sample was wet screened through a 1000µm sieve and determined using a Malvern Mastersizer 2000 particle sizer according to Standard Operating Procedures (SOP). The results obtained by a laser sizer have been previously validated by comparison with independent assessment by wet sieving (Hart, 1996). The range of sieve sizes, together with their Wentworth classifications, is given in Table A. For additional quality control, all datasets were run through the Mastersizer in triplicate and the variations in sediment distributions assessed to be within the 95% percentile.

The separate assessments of the fractions above and below 1000µm were combined using a computer programme. This followed a manual input of the sieve results for fractions 16mm-8mm, 8mm-4mm, 4mm-2mm and 2mm-1mm fractions and the electronic data captured by the Mastersizer below 1000µm.

This method defines the particle size distributions in terms of Phi mean, median, fraction percentages (i.e., coarse sediments, sands and fines), sorting (mixture of sediment sizes) and skewness (weighting of sediment fractions above and below the mean sediment size; Folk 1954).

Formulae and classifications for particle calculations made are given below:

- **Graphic Mean (M)** - a very valuable measure of average particle size in Phi units (Folk and Ward, 1957).

$$M = \frac{\phi 16 + \phi 50 + \phi 84}{3}$$

Where *M = The graphic mean particle size in Phi*
ø = the Phi size of the 16th, 50th and 84th percentile of the sample

Table II.I - Phi and Sieve Apertures with Wentworth Classifications

Microns (µm)		Phi (ϕ)		Sediment Description	
Aperture	Sediment Retained	Aperture	Sediment Retained		
4000	≥ 4000	-2	-2 < -1	Pebble	Gravel
2000	2000 < 4000	-1	-1 < -0.5	Granule	
1400	1400 < 2000	-0.5	-0.5 < 0	Very Coarse Sand	Sands
1000	1000 < 1400	0	0 < 0.5		
710	710 < 1000	0.5	0.5 < 1	Coarse Sand	
500	500 < 710	1	1 < 1.5		
355	355 < 500	1.5	1.5 < 2	Medium Sand	
250	250 < 355	2	2 < 2.5		
180	180 < 250	2.5	2.5 < 3	Fine Sand	
125	125 < 180	3	3 < 3.5		
90	90 < 125	3.5	3.5 < 4	Very Fine Sand	
63	63 < 90	4	4 < 4.5		
44	44 < 63	4.5	4.5 < 5	Coarse Silt	Fines (Silts)
31.5	31.5 < 44	5	5 < 5.5		
22	22 < 31.5	5.5	5.5 < 6	Medium Silt	
15.6	15.6 < 22	6	6 < 6.5		
11	11 < 15.6	6.5	6.5 < 7	Fine Silt	
7.8	7.8 < 11	7	7 < 7.5		
5.5	5.5 < 7.8	7.5	7.5 < 8	Very Fine Silt	
3.9	3.9 < 5.5	8	8 < 9		
2	2 < 3.9	9	9 <10	Clay	Fines (Clays)
1	1 < 2	10	≥ 10		

- **Sorting (D)** – the inclusive graphic standard deviation of the sample is a measure of the degree of sorting (Table B).

$$D = \frac{\phi 84 + \phi 16}{4} + \frac{\phi 95 + \phi 5}{6.6}$$

where *D = the inclusive graphic standard deviation*
ø = the Phi size of the 84^{th}, 16^{th}, 95^{th} and 5^{th} percentile of the sample

Table II.II - Sorting Classifications

Sorting Coefficient (Graphical Standard Deviation)	Sorting Classifications
0 < 0.35	Very well sorted
0.35 < 0.50	Well sorted
0.50 < 0.71	Moderately well sorted
0.71 < 1	Moderately sorted
1 < 2	Poorly sorted
2 < 4	Very poorly sorted
4 +	Extremely poorly sorted

- **Skewness (S)** – the degree of asymmetry of a frequency or cumulative curve (Table C).

$$S = \frac{\o84 + \o16 - (\o50)}{2(\o84 - \o16)} + \frac{\o95 + \o5 - 2(\o50)}{2(\o95 - \o5)}$$

where *S = the skewness of the sample*
ø = the Phi size of the 84th, 16th, 50th, 95th and 5th percentile of the sample

Table II.III - Skewness Classifications

Skewness Coefficient	Mathematical Skewness	Graphical Skewness
+1 > +0.30	Strongly positive	Strongly coarse skewed
+0.30 > +0.10	Positive	Coarse skewed
+0.10 > -0.10	Near symmetrical	Symmetrical
-0.10 > -0.30	Negative	Fine skewed
-0.30 > -1	Strongly negative	Strongly fine skewed

- **Graphic Kurtosis (K) –** The degree of peakedness or departure from the 'normal' frequency or cumulative curve (Table D).

$$K = \frac{\o95 - \o5}{2.44(\o75 - \o25)}$$

Where *K = Kurtosis*
ø = the Phi size of the 95th, 5th, 75th and 25th percentile of the sample

Table II.IV - Kurtosis Classifications

Kurtosis Coefficient	Kurtosis Classification	Graphical meaning
0.41 < 0.67	Very Platykurtic	Flat-peaked; the ends are better sorted than the centre
0.67 < 0.90	Platykurtic	
0.90 < 1.10	Mesokurtic	Normal; bell shaped curve
1.11 < 1.50	Leptokurtic	Curves are excessively peaked; the centre is better sorted than the ends.
1.50 < 3	Very Leptokurtic	
3 +	Extremely Leptokurtic	

LABORATORY ANALYSIS

The samples recovered from each site were analysed by SOCOTEC. SOCOTEC is accredited by the Marine Management Organisation and UKAS to test for the following in marine sediments;

- Total Organic Carbon (TOC)
- Petroleum Hydrocarbon (THC) (MMO accreditation)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Trace/Heavy Metals
- Organotins
- Polychlorinated Biphenyls (PCBs)
- Organochlorine Pesticides (OCPs)

TOTAL ORGANIC CARBON CONCENTRATIONS

Total Organic Carbon in Sediment

A portion of air-dried and ground sample is mixed with concentrated sulphurous acid. This is warmed to 40°C for an extended period of time. The resultant mixture is then heated to dryness at 100°C.The dried residue is analysed for carbon content using an Eltra induction furnace fitted with an NDIR cell. The total quantity of carbon liberated is calculated and reported as a percentage of the original mass of sample.

HYDROCARBON CONCENTRATIONS (TOTAL HYDROCARBON CONCENTRATIONS AND ALIPHATICS)

General Precautions

High purity solvents were used throughout the analyses. Solvent purity was assessed by evaporating an appropriate volume to 1ml and analysing the concentrate by GC for general hydrocarbons, target n-alkanes and aromatics. All glassware and extraction sundries were cleaned prior to use by thorough rinsing with hydrocarbon-free deionised water followed by two rinses with dichloromethane. All glassware was heated in a high temperature oven at 450°C for 6 hours.

Total Hydrocarbon Content (THC) in Marine Sediment

Anhydrous Sodium Sulphate, Sodium Chloride and DCM are added to a portion of the As Received sample and is vigorously agitated. The sample is placed in an ultrasonic bath and then centrifuged. The extract is then analysed by UV Fluorescence Screening and quantified by comparing the results against a Forties Oil calibration curve.

Polycyclic Aromatic Hydrocarbons in Marine Sediment

Methanol and DCM are added to a portion of the As Received sample and mixed on a magnetic stirring plate. The solvent extract is then water partitioned and concentrated to a low volume. A double clean-up stage is employed to remove contaminants that may interfere with the analysis. The extract is analysed by GC-MS and quantified by comparing the results against a calibration curve for each of the target analytes.

HEAVY AND TRACE METAL CONCENTRATIONS

Metals in Sediment by ICP- MS

A portion of air-dried and ground sample is digested with Aqua Regia. Once cooled the extract is filtered and pre-diluted before being analysed. Analysis is performed by ICP-MS and quantified by comparing the results against a calibration curve for each of the target analytes

Analytical Methodology

Inductively Coupled-Plasma Optical Emission Spectrometry

The instrument is calibrated using dilutions of the 1ml (=10mg) spectroscopic solutions. The final calibration solutions are matrix matched with the relevant acids. The calibration line consists of five standards.

Inductively Coupled Plasma- Mass Spectrometry

The instrument is calibrated using dilutions of the 1ml (=10mg) spectroscopic solutions. The calibration line consists of seven standards.

The analytes are scaled against internal standards to take account of changes in plasma conditions as a result of matrix differences for standards and samples. The internal standards have a similar mass and ionisation properties to the target metals.

CONTAMINANT CONCENTRATIONS

Organotins in Marine Sediment

A portion of the As Received sample is digested with hydrochloric acid and methanol before being extracted into toluene. The extract is then derivatized using sodium tetraethylborate (STEB) before concentration and a copper/silica clean-up is performed. The extract is analysed by GC-MS and quantified by comparing the results against a calibration curve for each of the target analytes.

Poly Chlorinated Biphenyls (PCBs) in Marine Sediment

A portion of air-dried and sieved sample is spiked with 13C labelled internal standards, ultrasonically solvent extracted and concentrated under nitrogen. A clean-up stage is employed to remove contaminants that may interfere with the analysis. The sample extract is analysed by Gas Chromatography coupled to a triple quadrupole mass spectrometer (GC-MS-MS). Quantification is performed by comparison with a solution containing each of the targeted compounds, normalised to the 13C labelled internal standards.

Organochlorine Pesticides (OCPs) in Marine Sediment

A portion of air-dried and sieved sample is spiked with 13C labelled internal standards, ultrasonically solvent extracted and concentrated under nitrogen. A clean-up stage is employed to remove contaminants that may interfere with the analysis. The sample extract is analysed by Gas Chromatography coupled to a triple quadrupole mass spectrometer (GC-MS-MS). Quantification is performed by comparison with a solution containing each of the targeted compounds, normalised to the 13C labelled internal standards.

MACRO-INVERTEBRATE ANALYSIS

Methodology

All macrofaunal determination was carried out inhouse by the BSL specialist taxonomist team. The BSL specialist taxonomist team are comprised of three senior individuals who possess a wealth of experience in macrofaunal identification in temperate deep-water environments.

Benthic sediment samples were thoroughly washed with freshwater on a 500µm sieve to remove traces of formalin, placed in gridded, white trays and then hand sorted by eye followed by binocular microscope, to remove all fauna. Sorted organisms were preserved in 70% IMS and 5% glycerol. Where possible, all organisms were identified to species level according to appropriate keys for the region. Colonial and encrusting organisms were recorded by presence alone and, where colonies could be identified as a single example, these were also recorded, although these datasets have not been considered in the overall statistical analysis of the material. The presence of anthropogenic components was also recorded where relevant.

All taxa were distinguished to species level and identified to at least family level where possible, and many of the species that could not be fully identified were separated putatively. Nomenclature for species names were allocated either when identity was confirmed, allocated as “cf.” when apparently identifying to a known species but confirmation was not possible (for example, incomplete specimens or descriptions), or allocated as “aff.”

when close to but distinct from a described species. The terms "indet." refers to being unable to identify to a lower taxon and "juv" as a juvenile to that species, genus or family.

Quality Assurance

BSL is committed to total quality control from the start of a project to its completion. All samples taken or received by the company were given a unique identification number. All analytical methods were carried out according to recognised standards for marine analyses. All taxonomic staff are fully qualified to post-doctorate level. Documentation is maintained that indicates the stage of analysis that each sample has reached. A full reference collection of all specimens has been retained for further clarification of putative species groups where/if required. BSL is a participant in the NMBAQC quality assurance scheme.

Digital datasets are kept for all sites in the form of excel spreadsheets (by sample and by station) on BSL's archive computer. This system is duplicated onto a second archive drive in case of electronic failure. These datasets will be stored in this way for a minimum of 3 years or transferred to storage disk (data CD or DVD).

Biological Data Standardisation and Analyses

In accordance with OSPAR Commission (2004) guidelines, all species falling into juvenile, colonial, planktonic of meiofaunal taxa are excluded from the full analyses within the dataset. This helps to reduce the variability of data undertaken during different periods within the year, or where minor changes may occur or where some groups may only be included in a non-quantitative fashion, such as presence/absence. Certain taxa, such as the Nematoda, normally associated with meiofauna, were included where individuals greater than 10mm were recorded. The following primary and univariate parameters were calculated for all data by stations and sample (Table II.VI).

Table II.VI - Primary and Univariate Parameter Calculations

Variable	Parameter	Formula	Description
Total Species	S	Number of species recorded	Species richness
Total Individuals	N	Number of individuals recorded	Sample abundance
Shannon-Wiener Index	H(s)	$H(s) = -\sum_{i=1}^{s} (Pi)(\log_2 Pi)$ where s = number of species & Pi = proportion of total sample belonging to *i*th species.	Diversity: using both richness and equitability, recorded in log 2.
Simpsons Diversity	1-Lambda	$Lambda = \sum \left(\frac{ni(ni-1)}{N(N-1)} \right)$ where ni = number of individuals in the *i*th species & N = total number of individuals	Evenness, related to dominance of most common species (Simpson, 1949)
Pielou's Equitability	J	$J = \frac{H(s)}{(\log S)}$ where s = number of species & H(s) = Shannon-Wiener diversity index.	Evenness or distribution between species (Pielou, 1969)
Margalef's Richness	D_{Mg}	$D_{Mg} = \frac{(S-1)}{(\log N)}$ where s = number of species & N = number of individuals.	Richness derived from number of species and total number of individuals (Clifford and Stevenson, 1975)

In addition to univariate methods of analysis, data for both sample replicates and stations were analysed using multivariate techniques. These serve to reduce complex species-site data to a form that is visually interpretable. A multivariate analysis was based on transformed data (square root) to detect any improved relationships when effects of dominance were reduced. The basis for multivariate analyses was based upon the software PRIMER (Plymouth Routines in Multivariate Ecological Research).

Similarity Matrices and Hierarchical Agglomerative Clustering (CLUSTER)

A similarity matrix is used to compare every individual sample replicate and/or stations with each other. The coefficient used in this process is based upon Bray Curtis (Bray and Curtis, 1957), considered to be the most suitable for community data. These are subsequently assigned into groups of replicates and/or stations according to their level of similarity and clustered together based upon a Group Average Method into a dendrogram of similarity.

Non-metric Multidimensional Scaling (nMDS)

nMDS is currently widely used in the analysis of spatial and temporal change in benthic communities (e.g. Warwick and Clarke, 1991). The recorded observations from data were exposed to computation of triangular matrices of similarities between all pairs of samples. The similarity of every pair of sites was computed using the Bray-Curtis index on transformed data. Clustering was undertaken by a hierarchical agglomerative method using group average sorting, and the results are presented as a dendrogram and as a two-dimensional ordination plot. The degree of distortion involved in producing an ordination gives an indication of the adequacy of the nMDS representation and is recorded as a stress value as outlined in Table II.VII.

Table II.VII - Inference from nMDS Stress Values

nMDS Stress	Adequacy of Representation for Two-Dimensional Plot
≤0.05	Excellent representation with no prospect of misinterpretation.
>0.05 to 0.1	Good ordination with no real prospect of a misleading interpretation.
>0.1 to 0.2	Potentially useful 2-d plot, though for values at the upper end of this range too much reliance should not be placed on plot detail; superimposition of clusters should be undertaken to verify conclusions.
>0.2 to 0.3	Ordination should be treated with scepticism. Clusters may be superimposed to verify conclusions, but ordinations with stress values >2.5 should be discarded. A 3-d ordination may be more appropriate.
>0.3	Ordination is unreliable with points close to being arbitrarily placed in the 2-d plot. A 3-d ordination should be examined.

Similarity Percentages Analysis (SIMPER)

The nMDS clustering program is used to analyse differences between sites. SIMPER enables those species responsible for differences to be identified by examining the contribution of individual species to the similarity measure.

Bioaccumulation Curve

Bioaccumulation Curve Estimates are undertaken using Chao-1 (S*1). This is a formula that estimates how many additional species would be needed to sample all of the asymptotic species richness of a region, based on the samples acquired. It calculates this by comparing the number of species that occur in one sample with those that occur in two samples where;

$$S^*_1 = S_{obs} + (a^2/2b)$$

S_{obs} is the number of species observed
a is the number of species observed just once
b is the number of species observed just twice

Relationship Testing (RELATE)

A non-parametric Mantel test that looks at the relationship between 2 matrices (often biotic and environmental). This shows the degree of seriation, an alternative to cluster analysis, which looks for a sequential pattern in community change. The test computes Spearman's rank correlation coefficient (ρ) between the corresponding elements of each pair of matrices to produce a correlation statistic present between the two datasets, the significance of the correlation determined by a permutation procedure (Clarke and Gorley, 2006).

Analysis of Similarity (ANOSIM)

Non-parametric, multivariate test often used in community ecology that calculates Bray-Curtis coefficient (for biological data) or Euclidean distance (for environmental data) based on permutations of ranked data. It produces an R value which is an effect level on a scale of 0-1; R=1 where all differences between sites are greater than any differences within site, R=0 when there is no separation between groups. P value (<5%) is the likelihood of arriving at that R value by chance, this significance value is determined by a permutation procedure (Clarke and Gorley, 2006).

Similarity Profile (SIMPROF)

Analyses data for significant clusters that show evidence of a multivariate pattern in data that are a priori unstructured, i.e. single samples from each site, this differs from the ANOSIM tests which permutes data based on a grouping factor such as 'site' or 'year'. The test works by comparing samples which have been ranked and ordered by resemblance against an expected profile which is obtained by permuting random species (variables) across the set of samples, a mean of 1000 permutations is taken to produce an expected result for null structure with rare and common species displaying the same pattern. If the actual data deviates outside the 95% limits of the expected profile, then there is evidence for significant structure and vice versa. The 'significant structure' is well represented on a dendrogram which will also show the clusters containing that lack significant differentiation (null structure; Clarke and Gorley, 2006).

NORMALISATION

Normalisation is a procedure used here to correct concentrations for the influence of the natural variability in sediment composition (i.e. grain size, organic matter and mineralogy). Natural and anthropogenic contaminants tend to show a much higher affinity to fine particulate matter compared to coarse (OSPAR, 2009) due to the increased adsorption capacity of organic matter and clay minerals. In sites where there is variability in grain size between stations, effects of sources of contamination will at least partly be obscured by grain size differences.

Normalisation can be performed through linear regression or by simple contaminant/normaliser ratios.

Linear regression normalisation takes into account the possible presence of contaminants and co-factors. The binding capacity of the sediments can be related to the content of fines (primary co-factor) in the sediments. The level of fines can be represented by the contents of major elements of the clay fraction such as aluminium (secondary co-factor). Figure II.I represents the general model for normalisation of the contaminants.

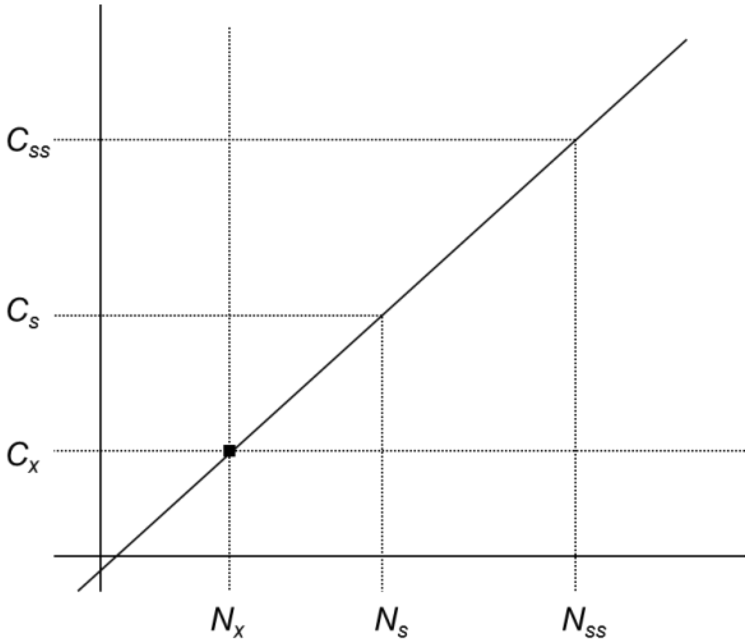


Figure II.I - Relation between the contaminant C and the cofactor N

Cx and Nx represent the contaminant and the co-factor contents, respectively, in pure sand. The regression line will always originate from this point and pivot depending on the sampled contaminant concentrations (Cs and Ns). These 'pivot values' are derived from statistical analysis of contaminant concentrations in pure sand.

The linear relationship between the pivot point and the sampled concentrations allows determination of the contaminant content for any preselected co-factor content (Nss) by interpolation and extrapolation. When comparing to the OSPAR BCs and BACs the secondary cofactors for normalisation are 50ppm of Li for metals and 2.5% TOC when normalising organics. The slope of the regression line (PL) can be represented by Equation 1, which can then be re-arranged to give the contaminant content Css that is normalised to Nss in Equation 2.

$$PL = \frac{dC}{dN} = \frac{C_s - C_x}{N_s - N_x} = \frac{C_{ss} - C_x}{N_{ss} - N_x}$$

Equation 1: Slope of the regression line expressed in terms of N_{ss}

$$C_{ss} = (C_s - C_x)\frac{N_{ss} - N_x}{N_s - N_x} + C_x$$

Equation 2: Rewritten equation giving the contaminant content C_{ss} normalised to N_{ss}

Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC / ARMCANZ)

The ANZECC and ARMCANZ framework is a tiered, decision-tree approach to assess contaminated sediments against a set of sediment quality guideline values (SQGV) to establish the level of risk on the biological community (Simpsons *et al.,* 2013; Figure II.I). The SQGVs are tabulated in Table II.IX. If the contaminant concentrations exceed the SQGVs, further investigation is recommended to determine whether there is indeed an environment risk associated with the exceedance.

Table II.IX Sediment Quality Guideline Values (Simpson et al., 2013)

Contaminant	SQGV	SQGV-High
Antimony (mg.kg^{-1})	2.0	25.0
Cadmium (mg.kg^{-1})	1.5	10.0
Chromium (mg.kg^{-1})	80.0	370.0
Copper (mg.kg^{-1})	65.0	270.0
Lead (mg.kg^{-1})	50.0	220.0
Mercury (mg.kg^{-1})	0.15	1.00
Nickel (mg.kg^{-1})	21.0	52.0
Silver (mg.kg^{-1})	1.0	4.0
Zinc (mg.kg^{-1})	200.0	410.0
Arsenic (mg.kg^{-1})	20.0	70.0
Tributyltin (µg.kg^{-1})	9.0	70.0
Total PAHs (µg.kg^{-1})	10,000	50,000
Total DDT (µg.kg^{-1})	1.2	5.0
Total PCBs (µg.kg^{-1})	34.0	280.0
Total Petroleum Hydrocarbons (TPHs) (mg.kg^{-1})	280.0	550.0

For metals, if the SQGV is exceeded by the results of the total metals analysis, the metals should be compared to background concentrations in reference sediments of comparable grain size from appropriate sites (Figure II.I part a). Exceedance of the SQGV is acceptable if it is below the background concentration. Note that for most anthropogenic organic contaminants, the background concentrations should be zero, but for metals it is possible for background concentrations to significantly exceed trigger values. If the SQGV is exceeded, and above the background concentration, the next step in the case of metal contaminants is to look at a dilute acid extractable metal concentration (AEM, by 30 min 1 M HCl extraction) which provides a useful measure of the potentially bioavailable metals (Figure II.I part a). Non-available forms of metals in sediments might include mineralised metals that require strong acid dissolution, as achieved by total particulate metal (TPM) measurements (also referred to as total recoverable metals). For many assessments, AEM measurements may be a useful starting point in the decision tree, rather than TPM determinations. However, for some metal phases that are sparing soluble in 1 M HCl (e.g. sulphide phases of Ag, Cu, Hg) and metals associated with organic polymers that may degrade over time (e.g. antifouling paints, tyre rubber), the measurement of TPM allows the potential future transformation of these metals into more bioavailable forms to be adequately considered.). In some jurisdictions, TPM measurements are deemed necessary for comparison with historical data trends. The contaminants whose concentrations exceed SQGVs following consideration of contaminant bioavailability are termed contaminants of potential concern (COPCs). The contaminants whose concentrations exceed SQGVs following consideration of contaminant bioavailability are termed contaminants of potential concern (COPCs). If the SQGV is still exceeded, the third step involves the more explicit consideration of the bioavailable contaminant fraction (Figure II.I part a).

For metals that form insoluble sulphides, amorphous iron sulphide (FeS) measured as so-called acid-volatile sulphides (AVS), is an important metal-binding phase that reduces metal bioavailability. Measurements of metal concentrations in the pore waters and elutriates also provides valuable information on metal bioavailability.

Many organic contaminants are hydrophobic and bind strongly to the organic carbon in sediments. To account for the preferential partitioning of these contaminants to organic matter, organic contaminants and their SQGVs are normalised to the total organic carbon (TOC) concentration of the sediment (i.e. normalised to 1% TOC) ((Figure II.I part b). This normalisation should only be applied for TOC concentrations between 0.2 and 10% (Simpson *et al.*, 2013).

Trawl Sample Processing

Trawl sample analysis is carried out in accordance with the Recommended operating guidelines (ROG) for MESH trawls and dredges. Upon collection, samples are sieved over a 5mm mesh then sorted into species where possible. A reference collection and any fauna unable to be identified in the field are preserved in 4% buffered formaldehyde solution and transferred to the laboratory. Identification of the reference collection is checked and all other fauna identified to the lowest possible taxonomical level, enumerated and preserved in 70% Industrial Methylated Spirit (IMS).

APPENDIX E – PARTICLE SIZE DISTRIBUTION

FA_01-ECC_31 (rev1).pdf

ECC_32-ECC_60 (rev1).pdf

APPENDIX F – SAMPLE LOG SHEETS

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
1	ECC_39	HG	21	18:06	18/7/22	95	F1	2 x 5L		Too coarse for redox	10 yr 3/2	Soft, muddy gravelly sand with pebbles and shell fragments	Whelk, *Ebalia, Pisidia longicornis, Polyplacophora, Actinaria, Sabellaria* debris
2	ECC_39	HG	21	18:19	18/7/22	70	PC	3 x Ziplock Bag			10 yr 3/2	Soft, muddy gravelly sand with pebbles and shell fragments	-
3	ECC_40	HG	21	19:08	18/7/22	95	PC	3 x Ziplock Bag			10 yr 3/2	Soft, muddy gravelly sand with pebbles and shell fragments	-
4	ECC_40	HG	21	19:26	18/7/22	85	F1	1 x 5L 1 x 3L		Too coarse for redox	10 yr 3/2	Soft, muddy gravelly sand with pebbles and shell fragments	*Sabellaria* debris and hydroids/bryozoans
5	ECC_40	Shipek	21	20:01	18/7/22	5	NS	-	Insufficient sample for retention		10 yr 3/2	Soft, muddy gravelly sand with pebbles and shell fragments	-
6	ECC_40	Shipek	21	20:17	18/7/22	40	Contam 1	1L Glass Jar (500ml)			10 yr 3/2	Soft, muddy gravelly sand with pebbles and shell fragments	-
7	ECC_40	Shipek	21	20:32	18/7/22	-	-	-	Grab made contact with seabed, but did not trigger - max attempts reached with no contam 2 sample collected		-	-	-
8	ECC_41	HG	19	21:15	18/7/22	95	PC	3 x Ziplock Bag			10 yr 3/2	Soft, muddy gravelly sand with pebbles and shell fragments	-
9	ECC_41	HG	19	21:32	18/7/22	95	F1	1 x 5L, 1 x 3L		Too coarse for redox	10 yr 3/2	Soft, muddy gravelly sand with pebbles and shell fragments	Species poor, *Sabellaria* debris
10	ECC_50	HG	20	22:12	18/7/22	80	PC	3 x Ziplock Bag			10 yr 3/2	Soft, muddy gravelly sand with pebbles and shell fragments	-
11	ECC_50	HG	20	22:36	18/7/22	70	F1	1 x 5L		Too coarse for redox	10 yr 3/2	Soft, muddy gravelly sand with pebbles and shell fragments	Polychaetes

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
12	ECC_50	Shipek	19	23:41	18/7/22	20	NS	-			2.5y 4/2	Soft sandy mud	-
13	ECC_50	Shipek	19	23:53	18/7/22	30	Contam 2	1L Glass Jar (500ml)			2.5y 4/2	Soft sandy mud	-
14	ECC_50	Shipek	19	00:08	19/7/22	30	Contam 1	1L Glass Jar (500ml)			2.5y 4/2	Soft sandy mud	-
15	ECC_42	HG	14	01:51	19/7/22	10	NS	-	Cobble in jaw		2.5y 4/2	-	-
16	ECC_42	HG	14	02:05	19/7/22	80	PC	3 x Ziplock Bag			2.5y 4/2	Soft sandy gravel	-
17	ECC_42	HG	14	02:21	19/7/22	10	NS	-	Cobble in jaw		2.5y 4/2		-
18	ECC_42	HG	14	02:27	19/7/22	80	F1	1 x 5L		Too coarse for redox	2.5y 4/2		*Flustra, Actiniaria*
19	ECC_43	HG	11	04:15	19/7/22	80	PC	3 x Ziplock Bag			10 yr 3/2	Soft muddy sandy gravel	-
20	ECC_43	HG	11	04:33	19/7/22	80	F1	1 x 5L 1 x 3L		Too coarse for redox	10 yr 3/2	Soft muddy sandy gravel	No visible fauna
21	ECC_43	Shipek	11	05:39	19/7/22	50	Contam 1	1L Glass Jar (500ml)			10 yr 3/2	Soft muddy sandy gravel	-
22	ECC_43	Shipek	11	05:54	19/7/22	50	Contam 2	1L Glass Jar (500ml)			10 yr 3/2	Soft muddy sandy gravel	-
23	ECC_44	HG	11	06:27	19/7/22	60	PC	3 x Ziplock Bag			10 yr 2/2	Soft muddy sand with pebbles	-
24	ECC_44	HG	11	06:39	19/7/22	60	F1	1 x 5L		Too coarse for redox	10 yr 2/2	Soft muddy sand with pebbles	Brachyura

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
25	ECC_45	HG	13	07:20	19/7/22	70	PC	3 x Ziplock Bag			10 yr 2/2	Soft muddy sandy gravel	-
26	ECC_45	HG	13	07:34	19/7/22	70	F1	1 x 5L		209.5mV @ 18.9˚c	10 yr 2/2	Soft muddy sandy gravel	*Sabellaria* debris, Nephtyidae
27	ECC_45	Shipek	13	08:01	19/7/23	70	Contam 1	1L Glass Jar (500ml)			Mixed	Soft muddy sandy gravel	Ophiuroidea
28	ECC_45	Shipek	13	08:01	19/7/24	70	Contam 2	1L Glass Jar (500ml)			Mixed	Soft muddy sandy gravel	Ophiuroidea
29	ECC_46	HG	16	08:46	19/7/22	100	PC	3 x Ziplock Bag			Mixed	Soft muddy sandy gravel	Worm tubes
30	ECC_46	HG	16	08:57	19/7/22	100	F1	1 x 5L		Too coarse for redox	Mixed	Soft muddy sandy gravel	Crab
31	ECC_47	HG	16	09:20	19/7/22	50	PC	3 x Ziplock Bag			2.5y 3/2	Soft slightly gravelly mud	-
32	ECC_47	HG	16	09:38	19/7/22	70	F1	1 x 5L 1 x 3L		Too coarse for redox	2.5y 3/2	Soft slightly gravelly mud	*Sabellaria* fragments
33	ECC_47	Shipek	16	10:10	19/7/22	20	NS	-			2.5y 3/2	Soft slightly gravelly mud	-
34	ECC_47	HG	16	10:12	19/7/22	25	Contam 1	1L Glass Jar (500ml)			2.5y 3/2	Soft slightly gravelly mud	-
35	ECC_47	HG	16	10:31	19/7/22	10	NS	-			2.5y 3/2	Soft slightly gravelly mud	-
36	ECC_48	HG	16	13:48	19/7/22	60	F1	1 x 5L		Too coarse for redox	2.5y 3/2	Soft gravelly muddy sand	Ophiuroidea, Actiniaria, Sipuncula, *Crangon crangon*

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
37	ECC_48	HG	16	13:57	19/7/22	95	PC	3 x Ziplock Bag			2.5y 3/2	Soft gravelly muddy sand	Polychaeta
38	ECC_51	HG	13	14:44	19/7/22	70	F1	1 x 5L 1 x 3L		Too coarse for redox	10yr 3/2	Soft gravelly muddy sand	Mytilidae
39	ECC_51	HG	13	14:53	19/7/22	45	PC	3 x Ziplock Bag			10yr 3/2	Soft gravelly muddy sand	*Sabellaria* debris and hydrozoan
40	ECC_51	Shipek	13	15:17	19/7/22	10	NS	-			10yr 3/2	Soft gravelly muddy sand	-
41	ECC_51	Shipek	13	15:27	19/7/22	0	NS	-			10yr 3/2	Soft gravelly muddy sand	-
42	ECC_51	Shipek	13	15:33	19/7/22	25	Contam 1	1L Glass Jar (200ml)			10yr 3/2	Soft gravelly muddy sand	-
43	ECC_60	Shipek	11	16:11	19/7/22	35	Contam 1	1L Glass Jar (500ml)			10yr 3/2	Soft gravelly muddy sand	-
44	ECC_60	Shipek	11	16:24	19/7/22	50	Contam 2	1L Glass Jar (500ml)			10yr 3/2	Soft gravelly muddy sand	-
45	ECC_60	HG	13	16:34	19/7/22	80	PC	3 x Ziplock Bag			10yr 3/2	Soft gravelly muddy sand	*Crepidula fornicata*
46	ECC_60	HG	13	16:51	19/7/22	70	F1	1 x 5L		Too coarse for redox	10yr 3/2	Soft gravelly muddy sand	*Crepidula fornicata*, acorn worm, *Abra alba*, Amphipoda
47	ECC_WS_05 (ECC_49)	5L Niskin	2	21:18	19/7/22	5L	eDNA Water	1 x 0.45um filter	Surface sample, 4L filtered		-	-	-
48	ECC_WS_05 (ECC_49)	5L Niskin	10	21:55	19/7/22	NS	-	-	no trigger, two messenger weights used		-	-	-
49	ECC_WS_05 (ECC_49)	5L Niskin	10	22:14	19/7/22	5L	eDNA Water	1 x 0.45um filter	Bottom sample, 3L filtered		-	-	-

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
50	ECC_49	Shipek	12	22:53	19/7/22	10	eDNA Sediment	50ml falcon tube	Sample retention too low for contam samples, so eDNA taken		10yr 3/2	Soft muddy gravelly sand	-
51	ECC_57	HG	14	01:28	20/7/22	NS	-	-			-	-	-
52	ECC_57	HG	14	01:40	20/7/22	80	PC	3 x Ziplock Bag			10yr 3/2	Soft gravelly sandy mud	-
53	ECC_57	HG	14	01:53	20/7/22	80	F1	1 x 5L 1 x 1L		Too coarse for redox	10yr 3/2	Soft gravelly sandy mud	Crab
54	ECC_57	Shipek	14	02:09	20/7/22	10	NS	-			10yr 3/2	Soft gravelly sandy mud	-
55	ECC_57	Shipek	14	02:22	20/7/22	20	Contam 2	1L Glass Jar (150ml)			10yr 3/2	Soft gravelly sandy mud	-
56	ECC_57	Shipek	12	02:36	20/7/22	20	Contam 1	1L Glass Jar (350ml)			10yr 2/2	Soft sandy mud	-
57	ECC_53	HG	11	03:05	20/7/22	100	PC	3 x Ziplock Bag			10yr 2/2	Soft sandy mud	-
58	ECC_53	HG	11	03:17	20/7/22	100	F1	1 x 5L 1 x 1L		225mV @ 18.2°c	10yr 2/2	Soft sandy mud	No visible fauna
59	ECC_58	HG	11	03:45	20/7/22	100	PC	3 x Ziplock Bag			10YR 4/3	Firm coarse sand	-
60	ECC_58	HG	11	04:03	20/7/22	100	F1	1 x 1L		Too coarse for redox	10YR 4/3	Firm coarse sand	Polychaeta
61	ECC_58	Shipek	11	04:34	20/7/22	40	Contam 1	1L Glass Jar (500ml)			10YR 4/3	Firm coarse sand	-

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
62	ECC_58	Shipek	11	04:49	20/7/22	50	Contam 2	1L Glass Jar (500ml)			10YR 4/3	Firm coarse sand	-
63	ECC_59	HG	11	05:46	20/7/22	NS	-	-			10yr 2/2	Soft gravelly mud	-
64	ECC_59	HG	11	05:55	20/7/22	40	PC	3 x Ziplock Bag			10yr 2/2	Soft gravelly mud	-
65	ECC_59	HG	11	06:05	20/7/22	50	F1	1 x 5L 1 x 1L		Too coarse for redox	10yr 2/2	Soft gravelly mud	*Sabellaria* debris, acorn worm, Brachyura
66	ECC_49	HG	10	06:48	20/7/22	70	PC	3 x Ziplock Bag			10yr 2/2	Soft gravelly mud	-
67	ECC_49	Shipek	10	07:22	20/7/22	30	Contam 1	1L Glass Jar (100ml)			10yr 2/2	Soft gravelly mud	-
68	ECC_49	Shipek	10	07:36	20/7/22	30	Contam 2	1L Glass Jar (500ml)			10yr 2/2	Soft gravelly mud	-
69	ECC_56	HG	15	13:52	20/7/22	80	F1	2 x 5L		Too coarse for redox	10YR 3/2	Soft gravelly muddy sand	*Flustra,* Amphipoda
70	ECC_56	HG	15	14:05	20/7/22	70	PC	3 x Ziplock Bag			10YR 3/2	Soft gravelly muddy sand	-
71	ECC_54	HG	16	14:52	20/7/22	80	PC	3 x Ziplock Bag			10yr 3/2	firm gravelly sand	-
72	ECC_54	HG	16	15:10	20/7/22	90	F1	1 x 5L		Too coarse for redox	10yr 3/2	firm gravelly sand	*Bryozoa, Flustra,* Amphipoda
73	ECC_54	Shipek	16	15:27	20/7/22	30	Contam 1	1L Glass Jar (500ml)			10yr 3/2	firm gravelly sand	-
74	ECC_54	Shipek	16	15:42	20/7/22	40	Contam 2	1L Glass Jar (500ml)			10yr 3/2	firm gravelly sand	-

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
75	ECC_55	HG	9	16:18	20/7/22	80	PC	3 x Ziplock Bag			10yr 3/2	firm gravelly sand	-
76	ECC_55	HG	9	16:30	20/7/22	80	F1	1 x 3L		Too coarse for redox	10yr 3/2	firm gravelly sand	polychaete, species poor
77	Edna Blank	-	-	-	21/7/22	-	eDNA Blank	-	2 litres processed		-	-	-
78	ECC_34	5L Niskin	2m	04:33	21/7/22	5L	eDNA Water	1 x 0.45um filter	Surface sample, 4.2L filtered		-	-	-
79	ECC_34	5L Niskin	28	05:07	21/7/22	5L	eDNA Water	1 x 0.45um filter	Bottom sample, 4.2L filtered		-	-	-
80	ECC_34	HG	28	06:24	21/7/22	100	PC	3 x Ziplock Bag			2.5Y 4/3	Soft muddy sand with relic *Sabellaria*	-
81	ECC_34	HG	28	06:38	21/7/22	100	F1	1 x 5L 1 x 3L			2.5Y 4/3	Soft muddy sand with relic *Sabellaria*	Top shell, Crab
82	ECC_34	Shipek	28	06:56	21/7/22	10	NS	-			2.5Y 4/3	Soft muddy sand with relic *Sabellaria*	-
83	ECC_34	Shipek	28	07:06	21/7/22	30	Contam 1	1L Glass Jar (350ml)			2.5Y 4/3	Soft muddy sand with relic *Sabellaria*	-
84	ECC_34	Shipek	28	07:19	21/7/22	40	Contam 2	1L Glass Jar (350ml)			2.5Y 4/3	Soft muddy sand with relic *Sabellaria*	-
85	ECC_38	HG	27	11:58	21/7/22	100	PC	3 x Ziplock Bag		210mV @ 18.9˚C	Mixed	Firm shelly gravel	
86	ECC_38	HG	27	12:21	21/7/22	100	F1	2 x 5L			Mixed	Firm shelly gravel	No visible fauna

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
87	ECC_38	Shipek	27	12:37	21/7/22	100	Contam 1 Contam 2	2 x 1L Glass Jar (500ml)			Mixed	Firm shelly gravel	
88	ECC_37	HG	28	12:57	21/7/22	20	NS	-			-	-	-
89	ECC_37	HG	28	13:05	21/7/22	10	NS	-			-	-	-
90	ECC_37	HG	28	13:16	21/7/22	40	PC	3 x Ziplock Bag			10yr 3/2	Firm gravelly muddy sand	-
91	ECC_37	HG	28	13:28	21/7/22	40	F1	1 x 5L			10yr 3/2	Firm gravelly muddy sand	*Nemertesia*, slipper limpet, Brachyura, *Sabellaria* fragments
92	ECC_36	HG	29	13:49	21/7/22	70	PC	3 x Ziplock Bag			10yr 3/2	Firm gravelly muddy sand	-
93	ECC_36	HG	29	14:04	21/7/22	100	F1	2 x 5L			10yr 3/2	Firm gravelly muddy sand	Brachyura, *Sabellaria*, brittle stars
94	ECC_36	Shipek	29	14:32	21/7/22	20	NS	-			10yr 3/2	Firm gravelly muddy sand	-
95	ECC_36	Shipek	29	14:44	21/7/22	20	Contam 1	1L Glass Jar (500ml)			10yr 3/2	Firm gravelly muddy sand	-
96	ECC_36	Shipek	29	14:57	21/7/22	100	Contam 2	1L Glass Jar (500ml)			10yr 3/2	Firm gravelly muddy sand	-
97	ECC_33	HG	11	19:16	21/7/22	80	F1	1 x 1L		148.9mV @ 16.8˚c	10yr 4/3	Firm fine sand	*Ophelia*, brittle star, Brachyura, Annelida
98	ECC_33	HG	11	19:29	21/7/22	80	PC	3 x Ziplock Bag			10yr 4/3	Firm fine sand	-
99	ECC_32	HG	12	20:23	21/7/22	30	NS	-			-	-	-

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
100	ECC_32	HG	12	20:33	21/7/22	40	PC	3 x Ziplock Bag			10yr 4/3	Firm coarse sand with pebbles	-
101	ECC_32	HG	12	20:55	21/7/22	40	F1	1 x 5L		Too coarse for redox	10yr 4/3	Firm coarse sand with pebbles	No visible fauna
102	ECC_32	Shipek	12	21:20	21/7/22	30	Contam 1	1L Glass Jar (500ml)			10yr 4/3	Firm coarse sand with pebbles	-
103	ECC_32	Shipek	12	21:33	22/7/22	20	Contam 2	1L Glass Jar (300ml)			10yr 4/3	Firm coarse sand with pebbles	-
104	ECC_35	HG	17	00:10	22/7/22	50	PC	3 x Ziplock Bag			10yr 4/3	Soft muddy sand	-
105	ECC_35	HG	17	00:22	22/7/22	40	F1	1 x 5L			2.5y 4/2	Soft muddy sand	*Nepthys*
106	ECC_31	HG	18	01:28	22/7/22	5	NS	-	Cobbles caught in jaw - washout		-	-	-
107	ECC_31	HG	18	01:38	22/7/22	70	PC	3 x Ziplock Bag			2.5y 4/2	Soft muddy sand	-
108	ECC_31	HG	18	01:44	22/7/22	30	NS	-			2.5y 4/2	Soft muddy sand	-
109	ECC_31	HG	18	01:53	22/7/22	80	F1	1 x 5L		112.4mV @ 16.6˚c	2.5y 4/2	Soft muddy sand	Species poor, Annelida
110	ECC_30	HG	18	03:02	22/7/22	10	NS	-			-	-	-
111	ECC_30	HG	18	03:08	22/7/22	10	NS	-			-	-	-

Geodetics: WGS84 UTM31N 3°E														
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
112	ECC_30	HG	18	03:18	22/7/22	10	NS	-			-	-	-
113	ECC_30	HG	18	03:29	22/7/22	20	NS	-			-	-	-
114	ECC_30	HG	18	03:41	22/7/22	0	NS	-			-	-	-
115	ECC_30	HG	18	03:50	22/7/22	40	PC	3 x Ziplock Bag			10yr 4/3	Firm coarse sand with pebbles	-
116	ECC_30	Shipek	16	04:08	22/7/22	10	NS	-			-	-	-
117	ECC_30	Shipek	16	04:15	22/7/22	10	Contam 1	1L Glass Jar (150ml)			-	-	-
118	ECC_30	Shipek	16	04:24	22/7/22	10	NS	-	less than 100ml		-	-	-
119	ECC_28	HG	15	08:20	22/7/22	60	PC	3 x Ziplock Bag			-	-	squat lobster on surface
120	ECC_28	HG	15	08:31	22/7/22	30	NS	-			-	-	-
121	ECC_28	HG	15	08:40	22/7/22	30	NS	-			-	-	-
122	ECC_28	HG	15	08:47	22/7/22	10	NS	-			-	-	-
123	ECC_28	Shipek	15	09:04	22/7/22	10	NS	-			-	-	-
124	ECC_28	Shipek	15	09:11	22/7/22	10	NS	-			-	-	-

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
125	ECC_28	HG	20	09:19	22/7/22	0	NS	-	Grab did not trigger		-	-	-
126	ECC_23a	HG	20	13:49	22/7/22	50	PC	3 x Ziplock Bag	moved 280m south to avoid fishing gear		10yr 4/3	Firm coarse sand with pebbles	-
127	ECC_23a	HG	20	14:01	22/7/22	60	F1	1 x 5L		Too coarse for redox	10yr 4/3	Firm coarse sand with pebbles	Bryozoa, species poor
128	ECC_25	HG	13	14:38	22/7/22	80	PC	3 x Ziplock Bag			10yr 4/3	Soft fine sand	-
129	ECC_25	HG	13	14:50	22/7/22	80	F1	1 x 3L		178.2mV @ 16.4˚c	10yr 4/3	Soft fine sand	*Ophelia*, species poor
130	ECC_26	Shipek	16	15:51	22/7/22	100	Contam 1 Contam 2	2 x 1L Glass Jar (500ml)			10yr 4/3	Soft fine sand	-
131	ECC_26	HG	16	17:53	22/7/22	100	PC	3 x Ziplock Bag			10yr 4/3	Soft fine sand	-
132	ECC_26	HG	16	18:18	22/7/22	30	NS	-	-	-	-	-	-
133	ECC_26	HG	16	18:26	22/7/22	50	F1	1 x 3L		184.4mV @ 16.5˚c	10YR 4/3	Soft fine sand	No visible fauna
134	ECC_27	HG	16	18:53	22/7/22	80	PC	3 x Ziplock Bag			10YR 4/3	Firm coarse sand	-
135	ECC_27	HG	16	19:12	22/7/22	70	F1	1 x 5L		148.6mV @ 16.4˚c	10YR 4/3	Firm coarse sand	No visible fauna
136	ECC_24	HG	16.2	00:28	23/07/22	90	PC	3 x Ziplock Bag	Organic smell	134.4mV @ 16.8˚c	2.5Y 3/4	Soft medium sand	-

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
137	ECC_24	HG	16.2	00:50	23/07/22	90	F1	1 x 3L	Organic smell		2.5Y 3/4	Soft medium sand	Bivalves, worms
138	ECC_24	HG	15.9	01:04	23/07/22	10	NS	-	Not enough recovered		-	-	-
139	ECC_24	Shipek	15.9	01:26	23/07/22	40	Contam 1	1L Glass Jar (600ml)			2.5Y 3/4	Soft medium sand	Crest of sand wave trough
140	ECC_24	Shipek	15.9	01:46	23/07/22	30	Contam 2	1L Glass Jar (300ml)	Slightly finer sand than contaminant 1		2.5Y 3/4	Soft medium sand	Crest of sand wave trough
141	ECC_22	HG	20	01:59	23/07/22	20	NS	-	Low retention		-	Soft fine sand	-
142	ECC_22	Shipek	20	02:07	23/07/22	20	Contam 1	1L Glass Jar (150ml)			2.5Y 3/4	Soft fine sand	-
143	ECC_22	Shipek	20	02:19	23/07/22	20	Contam 2	1L Glass Jar (150ml)			2.5Y 3/4	Soft fine sand	-
144	ECC_22	HG	20	02:37	23/07/22	20	NS	-			-	Soft fine sand with pebbles	-
145	ECC_22	HG	20	02:44	23/07/22	20	NS	-	cobble in jaws		-	-	-
146	ECC_22	HG	20	02:53	23/07/22	10	NS	-	cobble in jaws		-	-	-
147	ECC_22	HG	20	03:02	23/07/22	40	PC	3 x Ziplock Bags		0.9mV @ 16.7°C	2.5Y 3/4	Soft muddy sand with pebbles and shell fragments	-
148	ECC_21	HG	22	04:17	23/07/22	70	PC	3 x Ziplock Bag		Too coarse for redox	2.5Y 5/2	Soft muddy gravel	-
149	ECC_21	HG	22	04:32	23/07/22	40	F1	1 x 5L			2.5Y 5/2	Soft muddy gravel	Crab, Ophiuroidea

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
150	ECC_20	HG	22	05:33	23/07/22	50	PC	3 x Ziplock Bag		Too coarse for redox	2.5Y 5/2	Soft gravelly muddy sand	Crabs, shells
151	ECC_20	HG	22	05:43	23/07/22	50	F1	1 x 5L			2.5Y 5/2	Soft gravelly muddy sand	*Sabellaria fragments*
152	ECC_20	Shipek	22	05:57	23/07/22	<10	NS	-			-	-	-
153	ECC_20	Shipek	22	06:05	23/07/22	20	Contam 2	1L Glass Jar (150ml)			10yr 4/2	Soft muddy sand with shells	-
154	ECC_20	Shipek	22	06:15	23/07/22	30	Contam 1	1L Glass Jar (300ml)			10yr 4/2	Soft muddy sand with shells	-
155	ECC_19	HG	21.3	06:46	23/07/22	40	PC	3 x Ziplock Bag			10yr 4/2	Soft shelly gravel	No visible fauna
156	ECC_19	HG	21.3	07:01	23/07/22	40	F1	2 x 5L 1 x 3L			10yr 4/2	Soft muddy gravelly sand	-
157	ECC_18	HG	19.3	10:38	23/07/22	40	PC	3 x Ziplock Bag			10yr 4/3	Soft muddy gravelly sand	
158	ECC_18	HG	19.3	10:54	23/07/22	20	NS	-	Rock lodged in jaws		10yr 4/4	Soft muddy gravelly sand	
159	ECC_18	HG	19.4	11:02	23/07/22	70	F1	1 x 5L 1 x 3L			10yr 4/5	Soft muddy gravelly sand	Slipper limpet, *Flustra*, barnacles
160	ECC_18	Shipek	19	5	23/07/22	5	eDNA	50ml falcon tube			10yr 4/5	Soft muddy gravelly sand	-
161	ECC_18	Shipek	19	5	23/07/22	5	N/S	-	Only pebbles, <50ml		-	-	-

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
162	ECC_18	Shipek	19	5	23/07/2022	5	N/S	1L Glass Jar (<50ml)	Little sediment sampled		-	-	-
163	ECC_17	HG	22	13:56	23/07/2022	60	PC	3 x Ziplock Bag			10yr 4/2	Soft muddy Gravelly Sand with shell	-
164	ECC_17	HG	22	14:13	23/07/2022	60	F1	1 x 5L			10yr 4/2	Soft muddy Gravelly Sand with shell	Slipper limpet, Brachyura, anemone
165	ECC_16	HG	27	14:45	23/07/2022	60	PC	3 x Ziplock Bag			Mixed	Firm gravelly sand with shell	-
166	ECC_16	HG	27	15:05	23/07/2022	70	F1	1 x 5L		152.2mV @ 16.6˚C	Mixed	Firm gravelly sand with shell	No visible fauna
167	ECC_16	Shipek	27	15:22	23/07/2022	80	Contam 1 & 2	2 x 1L Glass Jars (500ml)			Mixed	Firm gravelly sand with shell	-
168	ECC_15	HG	27	16:39	23/07/2022	80	PC	3 x Ziplock Bag			Mixed	Firm gravelly sand with shell	-
169	ECC_15	HG	20	16:50	23/07/2022	10	N/S	-			-	-	-
170	ECC_15	HG	20	17:34	23/07/2022	10	N/S	-		Too coarse for redox	-	-	-
171	ECC_15	HG	20	17:41	23/07/2022	40	F1	1 x 5L			10yr 4/3	Soft gravelly muddy sand with shell	Sea chervil, bivalves, polychaetes, *Sabellaria*
172	ECC_14	HG	20	18:30	23/07/2022	40	PC	3 x Ziplock Bag			Mixed	Firm coarse sandy shell	-
173	ECC_14	HG	20	18:43	23/07/2022	60	F1	1 x 5L 1 x 3L			Mixed	Firm coarse sandy shell	Polychaete, amphipod
174	ECC_14	Shipek	20	19:04	23/07/2022	50	Contam 1	1L Glass Jar (500ml)			Mixed	-	-

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
175	ECC_14	Shipek	20	19:15	23/07/2022	50	Contam 2	1L Glass Jar (500ml)			Mixed	-	-
176	ECC_13	HG	22	20:14	23/07/2022	70	PC	3 x Ziplock Bag			10yr 4/2	Soft fine sand	-
177	ECC_13	HG	22	20:27	23/07/2022	70	F1	1 x 1L		165.2mV @ 16.1˚C	10yr 4/3	Soft fine sand	Polychaetes, species poor
178	ECC_12	HG	20	21:32	23/07/2022	90	PC	3 x Ziplock Bag			10yr 3/2	Soft coarse sand	*Sabellaria* tubes
179	ECC_12	HG	20	21:47	23/07/2022	90	F1	1 x 5L			10yr 3/2	Soft coarse sand	Brachyura, *Sabellaria*, *Dahlia*, polychaetes
180	ECC_12	Shipek	20	22:03	23/07/2022	10	N/S	-	<50ml		10yr 3/2	Mostly shell	-
181	ECC_12	Shipek	20	22:10	23/07/2022	5	N/S	-	<50ml		10yr 3/2	Mostly shell	-
182	ECC_12	Shipek	20	22:15	23/07/2022	5	N/S	-	<50ml		10yr 3/2	Mostly pebbles	-
183	ECC_10	HG	19	00:03	24/07/2022	80	PC	3 x Ziplock Bag	Organic smell		10yr 3/2	Soft fine sand	-
184	ECC_10	HG	19	00:18	24/07/2022	50	F1	1 x 3L		240mV @ 16.2˚C	-	Soft fine sand with gravel	Polychaetes
185	ECC_10	Shipek	19	00:32	24/07/2022	50	Contam 2	1L Glass Jar (500ml)			-	Layer of compact clay	-
186	ECC_10	Shipek	19	00:46	24/07/2022	50	Contam 1	1L Glass Jar (500ml)			-	Layer of compact clay	-

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
187	ECC_09	HG	18.6	01:17	24/07/2022	10	N/S	-			10yr 5/3	Soft shelly sand	-
188	ECC_09	HG	18.6	01:24	24/07/2022	60	PC	3 x Ziplock Bag			10yr 5/4	Soft shelly sand	-
189	ECC_09	HG	18.6	01:36	24/07/2022	90	F1	1 x 3L			10yr 5/3	Soft shelly fine sand with pebbles	Sea chervil
190	ECC_WS_03 (ECC_08)	5L Niskin	18.6	04:10	24/07/2022	5L	eDNA Water	1 x 0.45um filter	Surface sample, 4.5L filtered		-	-	-
191	ECC_WS_03 (ECC_08)	5L Niskin	18.9	04:30	24/07/2022	5L	eDNA Water	1 x 0.45um filter	Bottom sample, 4.5L filtered		-	-	-
192	Edna Blank	-	-	-	24/07/2022	-	Edna Blank	-	2 litres processed		-	-	-
193	ECC_08	Shipek	18.9	05:48	24/07/2022	30	Contam 2	1L Glass Jar (150ml)	No eDNA sediment		10yr 5/3	-	-
194	ECC_08	Shipek	18.9	06:00	24/07/2022	<10	N/S	-	No eDNA sediment		10yr 5/3	-	-
195	ECC_08	Shipek	18.9	06:05	24/07/2022	30	Contam 1	1L Glass Jar (150ml)	No eDNA sediment		10yr 5/3	-	-
196	ECC_08	HG	18.9	06:24	24/07/2022	-	N/S	-		Insufficient penetration for redox measurement	10yr 5/3	Soft shelly sand	-
197	ECC_08	HG	18.9	06:33	24/07/2022	-	N/S	-	Cobble in jaw		10yr 5/3	Soft shelly sand	-
198	ECC_08	HG	18.9	06:46	24/07/2022	-	N/S	-	Cobble in jaw		10yr 5/3	-	Bryozoa
199	ECC_08	HG	18.9	06:52	24/07/2022	-	N/S	-			10yr 5/3	*Sabellaria surface*, clay layer	-

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
200	ECC_08	HG	18.9	07:06	24/07/2022	10	N/S	1 x Ziplock bag	Rock lodged in jaws		2.5y 3/2	-	Sub-sampled for Spare 1
201	ECC_08	HG	18.9	07:12	24/07/2022	10	N/S	2 x Ziplock bag	Rock lodged in jaws		2.5y 3/2	-	Sub-sampled for Spare 2
202	FA_52	HG	16.1	09:57	24/07/2022	100	PC	3 x Ziplock Bag		182.1mV @ 15.9°C	10yr 5/3	Soft muddy sand with shell fragments	-
203	FA_52	HG	16.1	10:10	24/07/2022	100	F1	1 x 3L			-	-	Species poor, polychaetes
204	ECC_11	HG	8	12:02	24/07/2022	60	F1	1 x 1L		26.7mV @ 16.5°C	10yr 4/3	Soft fine sand	Sand eel, polychaetes
205	ECC_11	HG	8	12:09	24/07/2022	80	PC	3 x Ziplock Bag			10yr 4/3	Soft fine sand	-
206	ECC_07	HG	10	14:26	24/07/2022	60	PC	3 x Ziplock Bag			2.5y 4/2	Soft coarse sand	-
207	ECC_07	HG	10	14:34	24/07/2022	60	F1	1 x 1L		52.1mV @ 16.1°C	2.5y 4/2	Soft coarse sand	Polychaetes, sandeel
208	ECC_06	Shipek	22	15:45	24/07/2022	10	N/S	-			-	-	-
209	ECC_06	Shipek	22	15:51	24/07/2022	15	Contam 1	1L Glass Jar (350ml)			-	-	-
210	ECC_06	Shipek	22	15:59	24/07/2022	0	N/S	-	No trigger		-	-	-
211	ECC_06	HG	22	16:08	24/07/2022	70	F1	1 x 1L 1 x 3L		Too coarse for redox	2.5y 4/2	Soft gravelly muddy sand with pebbles and shell fragments	sea chervil, Actinaria, brittle star

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
212	ECC_06	HG	22	16:16	24/07/2022	40	PC	3 x Ziplock Bag	black anoxic layer		2.5y 4/2	Soft gravelly muddy sand with pebbles and shell fragments	-
213	FA_05	HG	14	16:47	24/07/2022	60	F1	1 x 3L		Redox 2.1mV @ 14.0˚C	10yr 4/2	Soft fine sand	Polychaetes and sandeels
214	FA_05	HG	14	16:54	24/07/2022	90	PC	3 x Ziplock Bag			10yr 4/2	Soft fine sand	-
215	FA_04	HG	20	17:43	24/07/2022	0	N/S	-	caught mooring rope - moving 20m		-	-	-
216	FA_04	HG	20	18:07	24/07/2022	40	F1	1 x 5L		Too coarse for redox	2.5y 4/2	Soft coarse sand with gravel	Polychaetes, sea chervil
217	FA_04	HG	20	18:13	24/07/2022	60	PC	3 x Ziplock Bag	black anoxic layer		2.5y 4/2	Soft coarse sand with gravel	-
218	FA_04	Shipek	20	18:27	24/07/2022	30	Contam 1	1L Glass Jar (500ml)			2.5y 4/2	Soft coarse sand with gravel	-
219	FA_04	Shipek	20	18:35	24/07/2022	10	N/S	-			2.5y 4/2	Soft coarse sand with gravel	-
220	FA_04	Shipek	20	18:41	24/07/2022	20	Contam 2	1L Glass Jar (500ml)			2.5y 4/2	Soft coarse sand with gravel	-
221	FA_03	Shipek	20	20:04	24/07/2022	60	PC	3 x Ziplock Bag	black anoxic layer		10yr 3/2	Soft gravelly muddy sand with pebbles and shell fragments	-
222	FA_03	HG	20	20:16	24/07/2022	80	F1	5L		-118.7mV @ 16.1°C	10yr 3/2	Soft gravelly muddy sand with pebbles and shell fragments	polychaetes, barnacles
223	FA_02	HG	21	21:00	24/07/2022	80	PC	3 x Ziplock Bag			10yr 4/5	Soft fine sand	-
224	FA_02	HG	21	21:12	24/07/2022	90	F1	3L		-25.6mV @ 16.1°c	10yr 4/5	Soft fine sand	polychaetes

Geodetics: WGS84 UTM31N 3°E													
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
225	FA_02	Shipek	21	21:35	24/07/2022	30	Contam 1	1L Glass Jar (500ml)			10yr 4/5	Soft fine sand	-
226	FA_02	Shipek	21	21:48	24/07/2022	20	Contam 2	1L Glass Jar (500ml)			10yr 4/5	Soft fine sand	-
227	FA_01	HG	15	22:28	24/07/2022	80	PC	3 x Ziplock Bag			10yr 4/3	Soft fine sand	-
228	FA_01	HG	15	22:36	24/07/2022	80	F1	1L		62.3mV @ 16.1°C	10yr 4/3	Soft fine sand	polychaetes and sandeels
229	OWF_WS_02 surface (FLOW)	5L Niskin	2	01:22	25/07/2022	5L	eDNA	1 x 0.45um filter	4.5L filtered for eDNA		-	-	-
230	OWF_WS_02 bottom (FLOW)	5L Niskin	36	01:48	25/07/2022	5L	eDNA	1 x 0.45um filter	3.4L filtered for eDNA			-	-
231	SF_WS_01 surface (FLOW)	5L Niskin	2	07:43	25/07/2022	5L	TOC/TSS and spare	2 x 1L plastic bottles			-	-	-
232	SF_WS_01 middle (EBB)	5L Niskin	12	07:53	25/07/2022	5L	TOC/TSS and spare	2 x 1L plastic bottles			-	-	-
233	OWF_WS_01 bottom (EBB)	5L Niskin	24	08:01	25/07/2022	5L	TOC/TSS and spare	2 x 1L plastic bottles			-	-	-
234	OWF_WS_01 surface	5L Niskin	2	08:52	25/07/2022	5L	eDNA	1 x 0.45um filter	3.1L filtered for eDNA		-	-	-
235	OWF_WS_01 bottom	5L Niskin	22	09:47	25/07/2022	5L	eDNA	1 x 0.45um filter	4.3L filtered for eDNA		-	-	-
236	SF_WS_01 surface (EBB)	5L Niskin	2	12:57	25/07/2022	5L	TOC/TSS and spare	2 x 1L plastic bottles			-	-	-

Geodetics: WGS84 UTM31N 3°E														
Cast#	Station	Sampler Used	Water Depth (m)	Time (UTC; hh:mm)	Date	Volume Recovered (%)	Sample Name	Container Type and Quantity	Comments	Sediment Description			Conspicuous Fauna/Comments
										Redox	Colour	Sediment Description/Stratification	
237	SF_WS_01 middle (EBB)	5L Niskin	13	13:19	25/07/2022	5L	TOC/TSS and spare	2 x 1L plastic bottles			-	-	-
238	SF_WS_01 bottom (EBB)	5L Niskin	24	13:29	25/07/2022	0	NS	-			-	-	-
239	SF_WS_01 bottom (EBB)	5L Niskin	24	13:33	25/07/2022	0	NS	-			-	-	-
240	SF_WS_01 bottom (EBB)	5L Niskin	24	13:40	25/07/2022	5L	TOC/TSS and spare	2 x 1L plastic bottles			-	-	-

APPENDIX G – CAMERA TRANSECT LOG SHEET

Appendix - Camera Transect Log (HAS).x

APPENDIX H – EPIBENTHIC TRAWL LOGS

Epibenthic Trawl Deck Log Observations

Cast#	Station	Sampler Used	Water Depth (m)	Time	Length of Trawl (m)	Date	Volume Recovered (L)	Comments	Conspicuous Fauna
1	ECC_T1	Beam Trawl	10.5 - 12.5	09:08 - 09:52	637	20/07/2022	25	Time in: 09:08; On seabed: 09:16; SOL: 09:22; EOL: 09:41; Time out: 09:52	*Dover sole, sunstars.*
2	ECC_T2	Beam Trawl	9 - 11.5	09:02 - 09:40	636	21/07/2022	12	Time in: 09:02; On seabed: 09:08; SOL: 09:11; EOL: 09:33; Time out: 09:40	-
3	ECC_T3	Beam Trawl	28 - 31.6	15:35 - 16:21	931	21/07/2022	145	Time in: 15:35; On seabed: 15:45; SOL: 15:49; EOL: 16:08; Time out: 16:21	Pink shrimp, crabs
4	ECC_T4	Beam Trawl	15.1 - 13.4	12:26 - 13:08	748	22/07/2022	7	Time in: 12:26; On seabed: 12:29; SOL: 12:33; EOL: 12:58; Time out: 13:08	Weever fish
5	ECC_T5	Beam Trawl	22.6 - 21.3	09:20 - 10:03	687	23/07/2022	50	Time in: 09:20; On seabed: 09:23; SOL: 09:29; EOL: 09:52; Time out: 10:03	Many small pink shrimp
6	ECC_T7	Beam Trawl	9.1 - 10	08:07 - 08:52		24/07/2022	80	Time in: 08:07; On seabed: 08:12; SOL: 08:20; EOL: 08:42; Time out: 08:52	*Alcyonidium diaphanum*
7	ECC_T6	Beam Trawl	17.9 - 19.7	12:38 - 13:14	670	24/07/2022	12	Time in: 12:38; On seabed: 12:41; SOL: 12:47; EOL: 13:09; Time out: 13:14	Weever fish

Epibenthic Trawl Field Weight Logs

Geodetics: WGS84 UTM31N 3°E								
Station Name	**ECC_T1**	Processed?	Y		Time (UTC; hh:mm)	Fix #	Easting (m)	Northing (m)
Fix Name		Ref sp. Kept?	Y	Shoot	15:36	1	368 472.2	5 933 352.6
Distance		Photographed?	Y	Lock	15:43	3	368 460.1	5 933 585.0
Vessel Speed		Sieve Mesh Size	5mm	Haul	16:10	4	368 150.2	5 934 336.2
Trawl Length (m)	812.59	Sample Volume	40L					
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth (m)	9.8 – 10.4
Notes								
Storage Equipment Weights	Bag = 7g 1L bucket = 35g 3L bucket = 90g 5L bucket = 140g 10L bucket = 300g							

Bulk Trawl Data						
Taxon	Kept (Y/N)	Count	Weight (g)*	Sub Vol.	Raised Count	Raised Weight
Alcyonidium diaphanum	N	P	13700 (6x5L)			
Flustra foliacea	N	P	960 (5L)			
Hydrozoa	N	P	920 (10L)			
Gastropoda #E	N	P	/			
Ascidiacea	Y	5	50 (1L)			
Sepiola atlantica	N	7	50 (1L)			
Pisidia longicornis	N	4	50 (1L)			
Crangon crangon	N	138	260 (3L)			
Shrimp #1	N	2	40(1L)			
Liocarcinus holsatus	N	1	60 (1L)			
Munida	Y	3	40 (1L)			
Echiichthys vipera	N	414	1000 (5L)			
Agonus cataphractus	N	1	50 (1L)			
Pomatoschistus pictus	N	2	40 (1L)			
Hyperoplus lanceolatus	N	1	140 (3L)			
Sandeel #1	Y	44	240 (3L)			
Pleuronectes platessa	N	9	200 (3L)			
Microstomus kitt	N	1	120 (3L)			
Sandeel #2	Y	5	50 (1L)			
Limanda limanda	Y	10	650 (5L)			
Flatfish #J	Y	6	50 (3L)			
Macropodia ?	Y	5	40 (1L)			
Inachus	Y	2	40 (1L0			
Arnoglossus Laterna ?	Y	5	300 (3L)			

** Taxon weights include the weight of containers, i.e. buckets or bags, used to weigh the organisms.*

Geodetics: WGS84 UTM31N 3°E								
Station Name	**ECC_T2_A**	Processed?	Y		Time (UTC; hh:mm)	Fix #	Easting (m)	Northing (m)
Fix Name		Ref sp. Kept?	Y	Shoot	17:21	1	376 724.5	5 940 437.8
Distance		Photographed?	Y	Lock	17:27	3	376 725.2	5 940 395.8
Vessel Speed		Sieve Mesh Size	5mm	Haul	17:49	4	376 705.9	5 939 724.6
Trawl Length (m)	671.45	Sample Volume	5.5L					
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth (m)	13.8 - 15.8
Notes	Plastic litter present.							
Storage Equipment Weights	Bag = 7g 1L bucket = 35g 3L bucket = 90g 5L bucket = 140g 10L bucket = 300g							

Bulk Trawl Data						
Taxon	Kept (Y/N)	Count	Weight (g)*	Sub Vol.	Raised Count	Raised Weight
Alcyonidium diaphanum	N	P	1200 (3L)			
Flustra foliacea	N	P	300 (5L)			
Hydrozoa	N	P	140 (3L)			
Sepiola atlantica	N	7	60 (1L)			
Pleurobranchia pileus	N	2	40 (1L)			
Macropodia	Y	1	40 (1L)			
Asterias rubens	N	7	420 (3L)			
Balanus crenatus	N	4	/			
Liocarcinus depurator	N	3	180 (3L)			
Liocarcinus holsatus	N	6	200 (3L)			
Crangon crangon	N	202	400 (3L)			
Echiichthys vipera	N	305	1100 (3L)			
Pholis gunnellus	N	1	120 (3L)			
Merlangius merlangus	Y	1	260 (3L)			
Sandeel #J	Y	35	100 (1L)			
Pomatoschistus pictus	N	4	20 (1L)			
Solea solea	N	4	60 (1L)			
Platichthys flesus	N	13	200 (3L)			
Limanda limanda	N	9	440 (3L)			
Pleuronectes platessa	N	4	200 (3L)			
Microstomus kitt	N	3	120 (120)			
Flatfish #J	Y	37	100 (1L)			

** Taxon weights include the weight of containers, i.e. buckets or bags, used to weigh the organisms.*

Geodetics: WGS84 UTM31N 3°E								
Station Name	**ECC_T3**	Processed?	Y		Time (UTC; hh:mm)	Fix #	Easting (m)	Northing (m)
Fix Name		Ref sp. Kept?	Y	Shoot	07:14	1	377 899.0	5 934 181.8
Distance		Photographed?	Y	Lock	07:18	3	377 917.3	5 934 078.0
Vessel Speed		Sieve Mesh Size	5mm	Haul	07:38	4	378 073.7	5 933 371.8
Trawl Length (m)	723.33	Sample Volume	320L					
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth (m)	38-40
Notes	Bag + Label (B+L) = 2g							
Storage Equipment Weights	Bag = 7g 1L bucket = 35g 3L bucket = 90g 5L bucket = 140g 10L bucket = 300g							

Bulk Trawl Data						
Taxon	Kept (Y/N)	Count	Weight (g)*	Sub Vol.	Raised Count	Raised Weight
Alcyonidium diaphanum	N	P	2900 (5L)			
Flustra foliacea	N	P	500 (3L)			
Hydrozoa	N	P	300 (3L)			
Gastropoda #E	N	p	60 (1L)			
Bryozoa (Dead?)	Y	P	/			
Alcyonidium parasiticum	N	P	20 (1L)			
Porifera	Y	P	100 (1L)			
Serpulidae	N	7	/			
Ophelia	Y	2	7 (Bag)			
Nephtyidae	Y	13	80 (1L)			
Actiniaria	N	5	120 (1L)			
Sepiola atlantica	N	8	60 (1L)			
Ensis	Y®	7	130 (2x1L)			
Nudibranchia	N	1	8 (Bag)			
Clausinella fasciata	Y	1	9 (Bag)			
Abra prismatica	Y	2	3 (B+L)			
Moerella donacina	Y	2	4 (B+L)			
Mactridae	Y	57	140 (1L)			
Sipuncula ?	Y	2	3 (B+L)			
Holothuroidea	Y	1	2 (B+L)			
Echinocyamus pusillus	N	3	2 (B+L)			
Asterias rubens	N	19	1000 (5L)			
Ophiura	Y	1	2 (B+L)			
Inachus	Y	1	3 (B+L)			
Ebalia	Y	3	4 (B+L)			
Liocarcinus depurator	Y	31	500 (5L)			
Balanus crenatus	N	Hundreds	/			
Crepidula fornicata	Y	3	3 (B+L)			
Crangon crangon	N	85	300 (5L)			
Liocarcinus holsatus	Y	14	260 (5L)			
Liocarcinus #J	Y	27	60 (1L)			
Shrimp #1	N	9	60 (1L)			
Pagurus bernhardus	Y	25	320 (3L)			
Branchiostoma lanceolata	Y	4	50 (1L)			
Callionymus lyra	Y	7	300 (5L)			
Eutrigla gurnardus	Y	1	120 (3L)			

Geodetics: WGS84 UTM31N 3°E								
Station Name	**ECC_T3**	Processed?	Y		Time (UTC; hh:mm)	Fix #	Easting (m)	Northing (m)
Fix Name		Ref sp. Kept?	Y	Shoot	07:14	1	377 899.0	5 934 181.8
Distance		Photographed?	Y	Lock	07:18	3	377 917.3	5 934 078.0
Vessel Speed		Sieve Mesh Size	5mm	Haul	07:38	4	378 073.7	5 933 371.8
Trawl Length (m)	723.33	Sample Volume	320L					
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth (m)	38-40
Notes	Bag + Label (B+L) = 2g							
Storage Equipment Weights	Bag = 7g 1L bucket = 35g 3L bucket = 90g 5L bucket = 140g 10L bucket = 300g							

Bulk Trawl Data						
Taxon	Kept (Y/N)	Count	Weight (g)*	Sub Vol.	Raised Count	Raised Weight
Agonus cataphractus	Y	36	280(3L)			
Hyperoplus lanceolatus	Y	13	600 (5L)			.0
Sandeel #1	Y	1	120 (3L)			
Pomatoschistus pictus	Y	2	40 (1L)			
Pleuronectes platessa	N	1	180 (3L)			
Microstomus kitt	N	1	140 (3L)			
Solea solea	N	11	500 (3L)			
Limanda	Y	2	160 (3L)			
Limanda limanda ?	Y	13	780 (5L)			
Platichthys flesus	Y	4	300 (3L)			

** Taxon weights include the weight of containers, i.e. buckets or bags, used to weigh the organisms.*

Geodetics: WGS84 UTM31N 3°E								
Station Name	**ECC_T4**	Processed?	Y		Time (UTC; hh:mm)	Fix #	Easting (m)	Northing (m)
Fix Name		Ref sp. Kept?	Y	Shoot	12:42	1	384 558.1	5 935 982.1
Distance		Photographed?	Y	Lock	12:46	3	384 544.8	5 936 017.4
Vessel Speed		Sieve Mesh Size	5mm	Haul	13:09	4	384 349.2	5 936 607.4
Trawl Length (m)	621.57	Sample Volume	100L					
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth (m)	16.9-17.5
Notes								
Storage Equipment Weights	Bag = 7g 1L bucket = 35g 3L bucket = 90g 5L bucket = 140g 10L bucket = 300g							

Bulk Trawl Data						
Taxon	Kept (Y/N)	Count	Weight (g)*	Sub Vol.	Raised Count	Raised Weight
Alcyonidium diaphanum	N	P	30200 (12x5L)			
Flustra foliacea	N	P	2420 (2x5L)			
Hydrozoa	N	P	2820 (2x5L)			
Alcyonidium parasiticum	N	P	120 (3L)			
Gastropoda #E	N	P	/			
Animalia #E	N	P	/			
Ascidiacea #J	N	1	40 (1L)			
Porifera	N	P	140 (1L)			
Fucus?	Y	P	50 (1L)			
Edwardsiidae?	Y	1	40 (1L)			
Platyhelminthes	N	1	50 (1L)			
Sepiola atlantica	N	4	50 (1L)			
Ensis	Y	117	740 (2x3L)			
Mactridae	Y	222	800 (3L)			
Arcopagia crassa	Y	16	440 (3L)			
Clausinella fasciata	Y	9	50 (1L)			
Venus	Y	1	70 (1L)			
Dosinia	Y	2	50 (1L)			
Tellinidae	Y	12	50 (1L)			
Astartidae?	Y	1	40 (1L)			
Euspira nitida	Y	4	40 (1L)			
Naticidae	Y	1	40 (1L)			
Asterias rubens	N	22	840 (5L)			
Macropodia	Y	3	50 (1L)			
Inachus?	Y	2	40 (1L)			
Liocarcinus depurator	N	5	120 (3L)			
Liocarcinus holsatus	N	5	140 (3L)			
Idotea	Y	2	40 (1L)			
Pagurus bernhardus	Y	17	280 (3L)			
Balanus crenatus	N	Tens	/			
Crangon crangon	N	39	60 (1L)			
Shrimp #3	Y	8	40 (1L)			
Nephtyidae	Y	83	300 (1L)			

Geodetics: WGS84 UTM31N 3°E								
Station Name	**ECC_T4**	Processed?	Y		Time (UTC; hh:mm)	Fix #	Easting (m)	Northing (m)
Fix Name		Ref sp. Kept?	Y	Shoot	12:42	1	384 558.1	5 935 982.1
Distance		Photographed?	Y	Lock	12:46	3	384 544.8	5 936 017.4
Vessel Speed		Sieve Mesh Size	5mm	Haul	13:09	4	384 349.2	5 936 607.4
Trawl Length (m)	621.57	Sample Volume	100L					
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth (m)	16.9-17.5
Notes								
Storage Equipment Weights	Bag = 7g 1L bucket = 35g 3L bucket = 90g 5L bucket = 140g 10L bucket = 300g							

Bulk Trawl Data						
Taxon	Kept (Y/N)	Count	Weight (g)*	Sub Vol.	Raised Count	Raised Weight
Branchiostoma lanceolata	N	3	40 (1L)			
Agonus cataphractus	N	2	160 (3L)			
Callionymuys lyra	N	10	200 (3L)			
Hyperoplus lanceolatus	Y	2	220 (3L)			
Sandeel #1	Y	8	180 (3L)			
Pomatoschistus pictus	N	7	50 (L)			
Pleuronectes platessa	Y	16	400 (3L)			
Limanda limanda	Y	2	200 (3L)			

** Taxon weights include the weight of containers, i.e. buckets or bags, used to weigh the organisms.*

Geodetics: WGS84 UTM31N 3°E								
Station Name	ECC_T5	Processed?	Y		Time (UTC; hh:mm)	Fix #	Easting (m)	Northing (m)
Fix Name		Ref sp. Kept?	Y	Shoot	07:29	1	387 965.0	5 942 333.5
Distance		Photographed?	Y	Lock	07:33	3	387 954.3	5 942 500.6
Vessel Speed		Sieve Mesh Size	5mm	Haul	07:47	4	387 930.7	5 943 008.9
Trawl Length (m)	508.85	Sample Volume	100L					
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth (m)	18.6-19.2
Notes	Plastic litter present.							
Storage Equipment Weights	Bag = 7g 1L bucket = 35g 3L bucket = 90g 5L bucket = 140g 10L bucket = 300g							
Bulk Trawl Data								
Taxon			Kept (Y/N)	Count	Weight (g)*	Sub Vol.	Raised Count	Raised Weight
Alcyonidium diaphanum			N	P	18800 (7x5L)			
Alcyonium digitatum			N	P	22400 (7x5L)			
Alcyonidium parasiticum			N	P	12 (Bag)			
Porifera			N	P	2400 (3L)			
Flustra foliacea			N	P	1100 (5L)			
Hydrozoa			N	P	400 (5L)			
Animalia #E			N	P	/			
Asterias rubens			N	190	7000 (2x5L)			
Ascidiacea			Y	13	140 (1L)			
Nudibranchia			N	28	60 (1L)			
Sepiola atlantica			N	4	40 (1L)			
Hiatella arctica			Y	8	40 (1L)			
Mytilus edulis			Y	1	40 (1L)			
Venerupis corrugata			Y	4	40 (1L)			
Rhizorus acuminatus			N	2	40 (1L)			
Gastropoda			Y	1	40 (1L)			
Mytilidae #J			N	2	40 (1L)			
Ophiothrix fragilis			Y	2	40 (1L)			
Bryozoa			Y	P	/			
Mytilidae			Y	1	3 (B+L)			
Sabellaria spinulosa			Y	Hundreds	/			
Scale worm			Y	3	3 (B+L)			
Balanus crenatus			N	Tens	/			
Macropodia			Y	5	80 (2x1L)			
Hyas			Y	8	55 (2x1L)			
Pisidia longicornis			N	4	40 (1L)			
Actiniaria			N	2	40 (1L)			
Munida			Y	1	3 (B+L)			
Necora puber			N	16	3200 (5L)			
Liocarcinus depurator			N	8	220 (3L)			
Liocarcinus #J			N	1	40 (1L)			
Cancer pagurus			N	8	1900 (2x5L + 1x3L)			

Geodetics: WGS84 UTM31N 3°E								
Station Name	**ECC_T5**	Processed?	Y		Time (UTC; hh:mm)	Fix #	Easting (m)	Northing (m)
Fix Name		Ref sp. Kept?	Y	Shoot	07:29	1	387 965.0	5 942 333.5
Distance		Photographed?	Y	Lock	07:33	3	387 954.3	5 942 500.6
Vessel Speed		Sieve Mesh Size	5mm	Haul	07:47	4	387 930.7	5 943 008.9
Trawl Length (m)	508.85	Sample Volume	100L					
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth (m)	18.6-19.2
Notes	Plastic litter present.							
Storage Equipment Weights	Bag = 7g 1L bucket = 35g 3L bucket = 90g 5L bucket = 140g 10L bucket = 300g							

Bulk Trawl Data						
Taxon	Kept (Y/N)	Count	Weight (g)*	Sub Vol.	Raised Count	Raised Weight
Crangon crangon	N	87	180 (3L)			
Crepidula fornicata	N	1	40 (1L)			
Pagurus bernhardus	Y	1	40 (1L)			
Shrimp #1	N	172	340 (3L)			
Sandeel #1	Y	1	40 (1L)			
Pholis gunnellus	N	4	85 (1L)			
Merlangius merlangus	N	1	80 (1L)			
Fish #1	Y	1	140 (1L)			
Agonus cataphractus	N	6	180 (3L)			
Myoxocephalus scorpius	N	24	700 (3L)			
Pomatoschistus pictus	N	2	45 (1L)			
Pleuronectes platessa	Y	29	1100 (3L)			
Microstomus kitt	N	1	180 (3L)			
Limanda limanda	Y	1	140 (3L)			

** Taxon weights include the weight of containers, i.e. buckets or bags, used to weigh the organisms.*

Geodetics: WGS84 UTM31N 3°E								
Station Name	**ECC_T6_A**	Processed?	Y		Time (UTC; hh:mm)	Fix #	Easting (m)	Northing (m)
Fix Name		Ref sp. Kept?	Y	Shoot	18:44	1	390 563.2	5 933 272.7
Distance		Photographed?	Y	Lock	18:46	3	390 589.3	5 933 290.0
Vessel Speed		Sieve Mesh Size	5mm	Haul	19:10	4	390 800.0	5 932 619.8
Trawl Length (m)	702.59	Sample Volume	80L					
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth (m)	19.4-19.1
Notes	First attempt was a no sample (4L catch), moved 50m East and moved the shackles attaching the chain to the beam down to the middle hole. One large *Cancer pagurus* and 3 boulders.							
Storage Equipment Weights	Bag = 7g 1L bucket = 35g 3L bucket = 90g 5L bucket = 140g 10L bucket = 300g							

Bulk Trawl Data						
Taxon	Kept (Y/N)	Count	Weight (g)*	Sub Vol.	Raised Count	Raised Weight
Flustra foliacea	N	P	1530 (5L)			
Alcyonidium diaphanum	N	P	13200 (5x5L)			
Alcyonium digitatum	N	P	24,500 (6x5L + 1x3L)			
Hydrozoa (Sertulariidae present)	N	P	440 (3L)			
Alcyonidium (?)	Y	P	220 (3L)			
Porifera	Y	P	1410 (2x3L)			
Alcyonidium parasiticum	N	P	18 (bag)			
Animalia #E	N	P	On Hydrozoa			
Ascidiacea	Y	6	37 (Bag)			
Actiniaria	Y	10	100 (1L)			
Sepiola atlantica	N	4	40 (1L)			
Nudibranchia	Y	6	100 (1L)			
Hiatella arctica	Y	4	13 (Bag)			
Polititapes rhomboides	Y	1	9 (Bag)			
Rhizorus Acuminatus (?)	Y	1	10 (Bag)			
Sabellaria spinulosa	Y	Tens	/			
Scaleworm	Y	1	12 (Bag)			
Asterias rubens	N	114	3300 (5L)			
Microstomus kitt	Y	1	60 (1L)			
Cancer pagurus	Y	2	480 (3L)			
Hyas areneus	N	1	140 (3L)			
Liocarcinus holsatus	Y	6	240 (3L)			
Necora puber	Y	29	2300 (2x5L)			
Liocarcinus (?)	Y	1	10 (Bag)			
Inachus (?)	Y	2	50 (1x1L + 1xBag)			
Crab #1	Y	1	11 (Bag)			
Macropodia	Y	5	40 (1L)			
Crangon crangon	N	97	140 (1L)			
Shrimp #1	Y	134	300 (3L)			
Shrimp #2	Y	1	10 (Bag)			
Pleuronectes platessa	N	9	375 (3L)			

<table>
<tr><th colspan="9">Geodetics: WGS84 UTM31N 3°E</th></tr>
<tr><td>Station Name</td><td>ECC_T6_A</td><td>Processed?</td><td>Y</td><td></td><td>Time (UTC; hh:mm)</td><td>Fix #</td><td>Easting (m)</td><td>Northing (m)</td></tr>
<tr><td>Fix Name</td><td></td><td>Ref sp. Kept?</td><td>Y</td><td>Shoot</td><td>18:44</td><td>1</td><td>390 563.2</td><td>5 933 272.7</td></tr>
<tr><td>Distance</td><td></td><td>Photographed?</td><td>Y</td><td>Lock</td><td>18:46</td><td>3</td><td>390 589.3</td><td>5 933 290.0</td></tr>
<tr><td>Vessel Speed</td><td></td><td>Sieve Mesh Size</td><td>5mm</td><td>Haul</td><td>19:10</td><td>4</td><td>390 800.0</td><td>5 932 619.8</td></tr>
<tr><td>Trawl Length (m)</td><td>702.59</td><td>Sample Volume</td><td>80L</td><td colspan="5"></td></tr>
<tr><td>Log method</td><td>Distance</td><td>Log frequency</td><td>1 Second</td><td>Sampling Device</td><td colspan="2">2m Beam Trawl</td><td>Water Depth (m)</td><td>19.4-19.1</td></tr>
<tr><td>Notes</td><td colspan="8">First attempt was a no sample (4L catch), moved 50m East and moved the shackles attaching the chain to the beam down to the middle hole. One large Cancer pagurus and 3 boulders.</td></tr>
<tr><td>Storage Equipment Weights</td><td colspan="8">Bag = 7g
1L bucket = 35g
3L bucket = 90g
5L bucket = 140g
10L bucket = 300g</td></tr>
<tr><th colspan="9">Bulk Trawl Data</th></tr>
<tr><th colspan="3">Taxon</th><th>Kept (Y/N)</th><th>Count</th><th>Weight (g)*</th><th>Sub Vol.</th><th>Raised Count</th><th>Raised Weight</th></tr>
<tr><td colspan="3">Solea solea</td><td>N</td><td>1</td><td>200 (3L)</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Pomatoschistus pictus</td><td>Y</td><td>5</td><td>50 (1L)</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Pholis gunnellus</td><td>Y</td><td>7</td><td>150 (1L)</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Callionymus lyra</td><td>Y</td><td>2</td><td>100 (1L)</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Molva molva</td><td>Y</td><td>1</td><td>50 (1L)</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Agonus cataphractus</td><td>Y</td><td>1</td><td>60 (1L)</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Taurulus bubalis</td><td>Y</td><td>16</td><td>400 (3L)</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Limanda limanda</td><td>Y</td><td>10</td><td>430 (3L)</td><td></td><td></td><td></td></tr>
</table>

** Taxon weights include the weight of containers, i.e. buckets or bags, used to weigh the organisms.*

Geodetics: WGS84 UTM31N 3°E								
Station Name	**ECC_T7**	Processed?	Y		Time (UTC; hh:mm)	Fix #	Easting (m)	Northing (m)
Fix Name		Ref sp. Kept?	Y	Shoot	11:49	1	397 234.8	5 940 639.5
Distance		Photographed?	Y	Lock	11:51	3	397 296.7	5 940 733.0
Vessel Speed		Sieve Mesh Size	5mm	Haul	12:10	4	397 189.9	5 941 402.2
Trawl Length (m)	677.67	Sample Volume	15L					
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl	Water Depth (m)	22.2	
Notes	Practice attempt before this one was 1.5km from SOL. Some plastic litter.							
Storage Equipment Weights	Bag = 7g 1L bucket = 35g 3L bucket = 90g 5L bucket = 140g 10L bucket = 300g							

Bulk Trawl Data						
Taxon	Kept (Y/N)	Count	Weight (g)*	Sub Vol.	Raised Count	Raised Weight
Flustra foliacea	Y	P	420 (3L)			
Alcyonidium diaphanum	Y	P	4200 (5L)			
Alcyonidium parasiticum	Y	P	110 (3L)			
Alcyonium digitatum	Y	P	190 (3L)			
Sertulariidae	Y	P	140 (3L)			
Hydrozoa	Y	P	160 (3L)			
Ascidiacea	Y	1	16 (Bag)			
Ophiocten affinis	Y	1	7 (Bag)			
Asterias rubens	Y	3	120 (1L)			
Mactridae	Y	1	8 (Bag)			
Pleurobrachia pileus	Y	4	11 (Bag)			
Sepiola atlantica	Y	8	60 (1L)			
Pisidia longicornis	Y	2	8 (Bag)			
Macropodia	Y	1	7 (Bag)			
Liocarcinus holsatus	Y	3	55 (1L)			
Hyas areneus	Y	1	130 (3L)			
Hyas coarctatus	Y	1	200 (3L)			
Crangon crangon	Y	70	210 (3L)			
Shrimp #1	Y	3	60 (1L)			
Agonus cataphractus	Y	1	50 (3L)			
Echiichthys vipera	Y	109	720 (3L)			
Pleuronectes platessa	Y	4	280 (3L)			
Solea solea	Y	2	120 (3L)			
Arnoglossus laterna	Y	4	180 (3L)			
Platichthys plesus	Y	3	160 (3L)			
Microstomus kitt	Y	6	120 (3L)			
Callionymus lyra	Y	1	8 (Bag)			
Serpulidae	Y	Tens	On *Hyas coarctatus*			
Animalia #E	y	P	On Hydrozoa			

** Taxon weights include the weight of containers, i.e. buckets or bags, used to weigh the organisms.*

Geodetics: WGS84 UTM31N 3°E								
Station Name	**ECC_T7**	Processed?	Y		Time (UTC; hh:mm)	Fix #	Easting (m)	Northing (m)
Fix Name		Ref sp. Kept?	Y	Shoot	11:49	1	397 234.8	5 940 639.5
Distance		Photographed?	Y	Lock	11:51	3	397 296.7	5 940 733.0
Vessel Speed		Sieve Mesh Size	5mm	Haul	12:10	4	397 189.9	5 941 402.2
Trawl Length (m)	677.67	Sample Volume	15L					
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl	Water Depth (m)	22.2	
Notes								
Storage Equipment Weights								

Fish Length Data				
Taxon	Kept (Y/N)	Length (cm)	Count	
Agonus cataphractus	Y	10	1	
Echiichthys vipera	Y	10	10	
Echiichthys vipera	N	12	11	
Echiichthys vipera	N	13.5	1	
Echiichthys vipera	N	9	12	
Echiichthys vipera	N	13	2	
Echiichthys vipera	N	12.5	6	
Echiichthys vipera	N	11	3	
Echiichthys vipera	N	10.5	1	
Echiichthys vipera	N	2.5	2	
Echiichthys vipera	N	9.5	8	
Echiichthys vipera	N	11.5	1	
Echiichthys vipera	N	8	3	
Echiichthys vipera	N	7	5	
Echiichthys vipera	N	6	10	
Echiichthys vipera	N	3	11	
Echiichthys vipera	N	4	25	
Echiichthys vipera	N	6.5	1	
Echiichthys vipera	N	3.5	5	
Echiichthys vipera	N	5	1	
Echiichthys vipera	N	4.5	1	
Pleuronectes platessa	Y	19.5	1	
Pleuronectes platessa	Y	20	1	
Pleuronectes platessa	Y	11	1	
Pleuronectes platessa	Y	9	1	
Solea solea	Y	9.5	1	
Solea solea	Y	9	1	
Arnoglossus laterna	Y	14	1	
Arnoglossus laterna	Y	13.5	1	
Arnoglossus laterna	Y	13	1	
Arnoglossus laterna	Y	6.5	1	
Arnoglossus laterna	Y	5	1	
Platichthys plesus	Y	19	1	
Platichthys plesus	Y	7.5	1	
Platichthys plesus	Y	8	1	
Microstomus kitt	Y	7	1	
Microstomus kitt	Y	6	1	
Microstomus kitt	Y	4	1	

Geodetics: WGS84 UTM31N 3°E								
Station Name	**ECC_T7**	Processed?	Y		Time (UTC; hh:mm)	Fix #	Easting (m)	Northing (m)
Fix Name		Ref sp. Kept?	Y	Shoot	11:49	1	397 234.8	5 940 639.5
Distance		Photographed?	Y	Lock	11:51	3	397 296.7	5 940 733.0
Vessel Speed		Sieve Mesh Size	5mm	Haul	12:10	4	397 189.9	5 941 402.2
Trawl Length (m)	677.67	Sample Volume	15L					
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth (m)	22.2
Notes								
Storage Equipment Weights								

Fish Length Data				
Taxon	Kept (Y/N)	Length (cm)	Count	
Microstomus kitt	Y	8	1	
Callionymus lyra	Y	3	1	

Geodetics: WGS84 UTM31N 3°E								
Station Name	**ECC_T9**	Processed?	Y		Time (UTC; hh:mm)	Fix #	Easting (m)	Northing (m)
Fix Name		Ref sp. Kept?	Y	Shoot	07:40	1	401 226.2	5 936 615.8
Distance		Photographed?	Y	Lock	07:44	3	401 256.1	5 936 524.9
Vessel Speed		Sieve Mesh Size	5mm	Haul	08:00	4	401 451.7	5 936 045.6
Trawl Length (m)	517.64	Sample Volume	140L					
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth (m)	22.4-22.2
Notes								
Storage Equipment Weights	Bag = 7g 1L bucket = 35g 3L bucket = 90g 5L bucket = 140g 10L bucket = 300g							

Bulk Trawl Data						
Taxon	Kept (Y/N)	Count	Weight (g)*	Sub Vol.	Raised Count	Raised Weight
Alcyonidium diaphanum	N	P	6500 (3x5L)			
Alcyonium digitatum	N	P	24300 (7x5L)			
Flustra foliacea	N	P	2200 (10L)			
Hydrozoa	N	P	1600 (10L)			
Alcyonidium parasiticum	N	P	80 (1L)			
Porifera	N	P	2500 (5L)			
Asterias rubens	N	365	5400 (2x5L)			
Ascidiacea	Y	27	200 (1L)			
Actiniaria	N	32	120 (1L)			
Sepiola atlantica	N	6	60 (1L)			
Nudibranchia	N	17	100 (2x1L)			
Rhizorus acuminatus	N	6	40 (1L)			
Pectinidae	Y®	1	60 (1L)			
Nephtyidae	Y	1	40 (1L)			
Actinopterygii #E	N	P	/			
Animalia #E	N	P	/			
Sabellaria spinulosa	Y	Tens	/			
Hiatella arctica	N	11	50 (1L)			
Abra alba	Y®	2	40 (1L)			
Ebalia	Y	1	3 (B+L)			
Polititapes rhomboides	Y	1	3 (B+L)			
Pycnogonum littorale	Y	2	3 (B+L)			
Pisidia longicornis	N	36	80 (2x1L)			
Balanus balanus	N	Tens	/			
Balanus crenatus	N	Tens	/			
Bryozoa	Y	P	/			
Psammechinus miliaris	Y®	1	4 (B+L)			
Ophiocten affinis	N	1	2 (B+L)			
Ophiothrix fragilis	N	10	40 (1L)			
Pagurus bernhardus	N	1	25 (1L)			
Necora puber	N	7	500 (5L)			
Cancer pagurus	N	9	1160 (x3L + 1x5L)			

Geodetics: WGS84 UTM31N 3°E								
Station Name	**ECC_T9**	Processed?	Y		Time (UTC; hh:mm)	Fix #	Easting (m)	Northing (m)
Fix Name		Ref sp. Kept?	Y	Shoot	07:40	1	401 226.2	5 936 615.8
Distance		Photographed?	Y	Lock	07:44	3	401 256.1	5 936 524.9
Vessel Speed		Sieve Mesh Size	5mm	Haul	08:00	4	401 451.7	5 936 045.6
Trawl Length (m)	517.64	Sample Volume	140L					
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth (m)	22.4-22.2
Notes								
Storage Equipment Weights	Bag = 7g 1L bucket = 35g 3L bucket = 90g 5L bucket = 140g 10L bucket = 300g							

Bulk Trawl Data						
Taxon	Kept (Y/N)	Count	Weight (g)*	Sub Vol.	Raised Count	Raised Weight
Hyas areneus	Y	4	240 (1L)			
Macropodia	Y	16	1200 (3L)			
Inachus	Y	4	50 (1L)			
Liocarcinus holsatus	N	10	240 (3L)			
Liocarcinus depurator	N	7	100 (1L)			
Liocarcinus #J	N	4	40 (1L)			
Munida	Y	44	60m (1L)			
Crangon crangon	N	116	248 (3L)			
Polynoidae	Y	1	2 (B+L)			
Shrimp #1	N	223	230 (3L)			
Shrimp #2	Y	1	50 (1L)			
Pholis gunnellus	N	1	60 (1L)			
Pomatoschistus pictus	N	4	50 (1L)			
Callionymus lyra	N	14	220 (1L)			
Myoxocephalus scorpius	N	12	340 (1L)			
Agonus cataphractus	N	4	100 (1L)			
Solea solea	N	5	90 (1L)			
Microstomus kitt	N	1	160 (3L)			
Pleuronectes platessa	N	8	500 (5L)			
Limanda limanda	Y	30	1400 (5L)			

** Taxon weights include the weight of containers, i.e. buckets or bags, used to weigh the organisms.*

APPENDIX I – MACROFAUNAL SPECIES LIST

Benthic Macrofauna Infauna Matrix

Benthic
Macrofauna Infauna

Benthic Macrofauna Epifauna Matrix

Benthic
Macrofauna Epifaur

Benthic Macrofauna Biomass Matrix

Benthic
Macrofauna Biomas:

Epibenthic Trawl Matrix

Epibenthic Trawl
Matrix.pdf

Epibenthic Trawl Biomass Matrix

Epibenthic Trawl
Biomass Matrix.pdf

APPENDIX J – FISH MEASUREMENT DATA

Towed Gear Log sheet								Sheet # 1 of 1
Job No:	2210		Vessel:	Geo Ocean 3		Client:	GT R4	
Date:	20/07/2022		Project:	Outer Dowsing ECC		Operators:	BSL	
Station Name	ECC_T1	Processed?	Y		Time	Fix #	Easting	Northing
Fix Name		Ref sp. Kept?	Y	Shoot	09:08	1	329361.44	5905116.07
Distance		Photographed?	Y	Lock	09:22	3	329456.71	5905197.21
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	09:41	4	329803.2	5905714.55
Trawl Length (m)	637	Sample Volume	25L	Geodesy	Datum: WGS84/Projection: UTM 31N			
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth	10.5 - 12.5
Notes								

Fish Length Data				
Taxon	Kept (Y/N)	Length (cm)	Count	Comments
Merlangius merlangus	N	205	1	
Callionymus lyra	N	180	1	
Myoxocephalius scorpius	N	150	1	
Myoxocephalius scorpius	N	180	1	
Myoxocephalius scorpius	N	125	1	
Agonus cataphractus	N	70	1	
Sprattus sprattus	N	70	1	
Solea solea	N	300	1	
Solea solea	N	190	3	
Solea solea	N	140	4	
Solea solea	N	105	1	
Solea solea	N	175	1	
Solea solea	N	200	2	
Solea solea	N	210	1	
Solea solea	N	135	4	
Solea solea	N	145	2	
Solea solea	N	130	3	
Solea solea	N	45	2	
Solea solea	N	180	1	
Solea solea	N	220	1	
Solea solea	N	40	3	
Solea solea	N	125	1	
Solea solea	N	235	1	
Limanda limanda	N	190	1	

Towed Gear Log sheet							Sheet # 1 of 1	
Job No:	2210		Vessel:	Geo Ocean 3		Client:	GT R4	
Date:	20/07/2022		Project:	Outer Dowsing ECC		Operators:	BSL	
Station Name	ECC_T1	Processed?	Y		Time	Fix #	Easting	Northing
Fix Name		Ref sp. Kept?	Y	Shoot	09:08	1	329361.44	5905116.07
Distance		Photographed?	Y	Lock	09:22	3	329456.71	5905197.21
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	09:41	4	329803.2	5905714.55
Trawl Length (m)	637	Sample Volume	25L	Geodesy	Datum: WGS84/Projection: UTM 31N			
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth	10.5 - 12.5
Notes								

Fish Length Data

Taxon	Kept (Y/N)	Length (cm)	Count	Comments		
Limanda limanda	N	175	1			
Limanda limanda	N	205	1			
Limanda limanda	N	200	1			
Liparis liparis	Y	30	2			
Gadiformes #J	Y	65	1			
Gadiformes #J	Y	45	1			
Gadiformes #J	Y	50	1			
Pomatoschistus pictus	Y	45	4			
Pomatoschistus pictus	Y	40	12			
Pomatoschistus pictus	Y	25	10			
Pomatoschistus pictus	Y	35	14			
Pomatoschistus pictus	Y	30	26			
Pomatoschistus pictus	Y	20	9			

Towed Gear Log sheet								Sheet # 1 of 1	
Job No:	2210		Vessel:	Geo Ocean 3		Client:		GT R4	
Date:	21/07/2022		Project:	Outer Dowsing ECC		Operators:		BSL	
Station Name	ECC_T2	Processed?	Y		Time	Fix #	Easting	Northing	
Fix Name		Ref sp. Kept?	Y	Shoot	09:02	11	336600.07	5906759.52	
Distance		Photographed?	Y	Lock	09:11	3	336613.63	5906764.5	
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	09:33	4	337185.23	590949.53	
Trawl Length (m)	642.99	Sample Volume	12L	Geodesy	Datum: WGS84/Projection: UTM 31N				
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth	9- 11.5m	
Notes									

Taxon	Kept (Y/N)	Length (cm)	Count	Comments		
Pleuronectes platessa	N	135	1			
Pleuronectes platessa	N	140	1			
Solea solea	N	260	1			
Solea solea	N	190	1			
Solea solea	N	175	1			
Solea solea	N	160	1			
Solea solea	N	195	1			
Solea solea	N	20	1			
Solea solea	N	15	2			
Agonus cataphractus	N	25	1			
Agonus cataphractus	N	35	1			
Eutrigla gurnardus	Y	40	1			
Eutrigla gurnardus	Y	50	1			
Liparis liparis	Y	20	1			
Gadiformes #J	Y	40	2			
Gadiformes #J	Y	45	3			
Pomatoschistus pictus	N	55	1			
Pomatoschistus pictus	N	25	7			
Pomatoschistus pictus	N	40	15			
Pomatoschistus pictus	N	35	15			
Pomatoschistus pictus	N	30	23			
Pomatoschistus pictus	N	45	1			
Pomatoschistus pictus	N	20	1			
Hyperoplus lanceolatus	N	220	1			

Towed Gear Log sheet							Sheet # 1 of 1	
Job No:	2210		Vessel:	Geo Ocean 3		Client:	GT R4	
Date:	21/07/2022		Project:	Outer Dowsing ECC		Operators:	BSL	
Station Name	ECC_T2	Processed?	Y		Time	Fix #	Easting	Northing
Fix Name		Ref sp. Kept?	Y	Shoot	09:02	11	336600.07	5906759.52
Distance		Photographed?	Y	Lock	09:11	3	336613.63	5906764.5
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	09:33	4	337185.23	590949.53
Trawl Length (m)	642.99	Sample Volume	12L	Geodesy	Datum: WGS84/Projection: UTM 31N			
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth	9- 11.5m
Notes								

Fish Length Data						
Taxon	Kept (Y/N)	Length (cm)	Count	Comments		
Hyperoplus lanceolatus	N	190	1			
Echichthys vipera	N	105	1			
Echichthys vipera	N	85	3			
Echichthys vipera	N	100	1			
Echichthys vipera	N	80	3			
Echichthys vipera	N	90	1			
Echichthys vipera	N	55	1			

Towed Gear Log sheet							Sheet # 1 of 1	
Job No:	2210		Vessel:	Geo Ocean 3		Client:	GT R4	
Date:	21/07/2022		Project:	Outer Dowsing ECC		Operators:	BSL	
Station Name	ECC_T3	Processed?	Y		Time	Fix #	Easting	Northing
Fix Name		Ref sp. Kept?	Y	Shoot	15:35	1	348293.22	5912182.12
Distance		Photographed?	Y	Lock	15:49	3	347800.04	5911973.48
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	16:08	4	34367.95	5911532.6
Trawl Length (m)		Sample Volume	145L	Geodesy	Datum: WGS84/Projection: UTM 31N			
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth	28 - 31.6m
Notes	Taxon weights include the weight of containers, i.e. buckets or bags, used to weigh the organisms. SB = Small Bag (1g), MB = Medium Bag (5g), 1L bucket (35g), 3L bucket (90g), 5L bucket (140g) and 10L bucket (300g) Due to fishing gear, the vessel made a 90° turn and trawled south, extending the line to approximately 900m							

Fish Length Data

Taxon	Kept (Y/N)	Length (cm)	Count	Comments		
Pholis gunnellus	N	145	2			
Pholis gunnellus	N	150	1			
Pholis gunnellus	N	140	5			
Pholis gunnellus	N	90	1			
Pholis gunnellus	N	125	3			
Pholis gunnellus	N	100	1			
Pholis gunnellus	N	185	1			
Pholis gunnellus	N	135	1			
Pholis gunnellus	N	120	2			
Solea solea	N	200	1			
Solea solea	N	195	1			
Limanda limanda	N	160	1			
Microstomus kitt	Y	125	1			
Microstomus kitt	Y	120	1			
Callionymus lyra	N	200	1			
Callionymus lyra	N	170	3			
Callionymus lyra	N	165	1			
Callionymus lyra	N	155	3			
Callionymus lyra	N	225	1			
Callionymus lyra	N	125	3			
Callionymus lyra	N	145	1			
Callionymus lyra	N	130	3			
Callionymus lyra	N	160	1			
Callionymus lyra	N	135	3			

Towed Gear Log sheet							Sheet # 1 of 1	
Job No:	2210		Vessel:	Geo Ocean 3		Client:	GT R4	
Date:	21/07/2022		Project:	Outer Dowsing ECC		Operators:	BSL	
Station Name	ECC_T3	Processed?	Y		Time	Fix #	Easting	Northing
Fix Name		Ref sp. Kept?	Y	Shoot	15:35	1	348293.22	5912182.12
Distance		Photographed?	Y	Lock	15:49	3	347800.04	5911973.48
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	16:08	4	34367.95	5911532.6
Trawl Length (m)		Sample Volume	145L	Geodesy	Datum: WGS84/Projection: UTM 31N			
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth	28 - 31.6m
Notes	Taxon weights include the weight of containers, i.e. buckets or bags, used to weigh the organisms. SB = Small Bag (1g), MB = Medium Bag (5g), 1L bucket (35g), 3L bucket (90g), 5L bucket (140g) and 10L bucket (300g) Due to fishing gear, the vessel made a 90° turn and trawled south, extending the line to approximately 900m							

Fish Length Data

Taxon	Kept (Y/N)	Length (cm)	Count	Comments		
Callionymus lyra	N	115	1			
Callionymus lyra	N	110	1			
Callionymus lyra	N	180	4			
Agonus cataphractus	N	90	16			
Agonus cataphractus	N	135	1			
Agonus cataphractus	N	95	4			
Agonus cataphractus	N	115	2			
Agonus cataphractus	N	110	3			
Agonus cataphractus	N	80	8			
Agonus cataphractus	N	100	4			
Agonus cataphractus	N	130	1			
Agonus cataphractus	N	105	1			
Agonus cataphractus	N	85	4			
Agonus cataphractus	N	75	3			
Agonus cataphractus	N	125	2			
Agonus cataphractus	N	70	3			
Taurulus bubalis	N	110	1			
Molva molva	N	110	2			
Molva molva	N	60	1			
Gadiformes #J	Y	70	1			
Pomatoschistus pictus	N	>50	12			
Liparis liparis	Y	>50	41			
Liparis liparis	Y	50 - 100	35			

Towed Gear Log sheet							Sheet # 1 of 1	
Job No:	2210		Vessel:	Geo Ocean 3		Client:	GT R4	
Date:	22/07/2022		Project:	Outer Dowsing ECC		Operators:	BSL	
Station Name	ECC_T4	Processed?	Y		Time	Fix #	Easting	Northing
Fix Name		Ref sp. Kept?	Y	Shoot	12:26	1	357758.21	5913543.07
Distance		Photographed?	Y	Lock	12:33	3	357735.25	5913537.54
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	12:58	4	356991.79	5913626.7
Trawl Length (m)	748	Sample Volume	7L	Geodesy	Datum: WGS84/Projection: UTM 31N			
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth	15.1 - 13.4
	ECC_T4		Y					
Notes								

Taxon	Kept (Y/N)	Length (cm)	Count	Comments		
Hyperoplus lanceolatus	N	240	1			
Ammodytes marinus	N	185	1			
Ammodytes marinus	N	145	1			
Limanda limanda	N	230	1			
Limanda limanda	N	215	1			
Limanda limanda	N	205	1			
Limanda limanda	N	200	1			
Limanda limanda	N	185	1			
Limanda limanda	N	100	4			
Limanda limanda	N	95	1			
Limanda limanda	N	120	1			
Limanda limanda	Y	30	<50			
Pleuronectes platessa	N	95	1			
Pleuronectes platessa	N	120	1			
Pleuronectes platessa	N	100	1			
Pleuronectes platessa	N	110	4			
Pleuronectes platessa	N	115	1			
Pleuronectes platessa	Y	<50	3			
Buglossidium luteum	N	20	1			
Agonus cataphractus	N	40	1			
Agonus cataphractus	N	35	1			
Callionymus lyra	N	30	4			
Callionymus lyra	N	40	1			
Callionymus lyra	N	35	1			

Towed Gear Log sheet							Sheet # 1 of 1	
Job No:	2210		Vessel:	Geo Ocean 3		Client:	GT R4	
Date:	22/07/2022		Project:	Outer Dowsing ECC		Operators:	BSL	
Station Name	ECC_T4	Processed?	Y		Time	Fix #	Easting	Northing
Fix Name		Ref sp. Kept?	Y	Shoot	12:26	1	357758.21	5913543.07
Distance		Photographed?	Y	Lock	12:33	3	357735.25	5913537.54
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	12:58	4	356991.79	5913626.7
Trawl Length (m)	748	Sample Volume	7L	Geodesy	Datum: WGS84/Projection: UTM 31N			
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth	15.1 - 13.4
	ECC_T4		Y					
Notes								

Fish Length Data

Taxon	Kept (Y/N)	Length (cm)	Count	Comments		
Eutrigla gurnardus	N	45	1			
Pomatoschistus pictus	N	40	9			
Pomatoschistus pictus	N	50	1			
Pomatoschistus pictus	N	45	2			
Pomatoschistus pictus	N	35	1			
Echichthys vipera	N	60	12			
Echichthys vipera	N	95	2			
Echichthys vipera	N	55	11			
Echichthys vipera	N	50	7			
Echichthys vipera	N	40	2			
Echichthys vipera	N	65	2			
Echichthys vipera	N	45	1			
Echichthys vipera	N	130	1			
Echichthys vipera	N	100	1			

Towed Gear Log sheet							Sheet # 1 of 1	
Job No:	2210		Vessel:	Geo Ocean 3		Client:	GT R4	
Date:	23/07/2022		Project:	Outer Dowsing ECC		Operators:	BSL	
Station Name	ECC_T5	Processed?	Y		Time	Fix #	Easting	Northing
Fix Name		Ref sp. Kept?	Y	Shoot	09:20	1	363866.87	5913213.37
Distance		Photographed?	Y	Lock	09:29	3	363882.99	5913216.87
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	09:52	4	364540.98	5913194.36
Trawl Length (m)	687	Sample Volume	50L	Geodesy	Datum: WGS84/Projection: UTM 31N			
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth	22.6 - 21.3
Notes								

Fish Length Data				
Taxon	Kept (Y/N)	Length (cm)	Count	Comments
Agonus cataphractus	N	110	5	
Agonus cataphractus	N	100	2	
Agonus cataphractus	N	120	7	
Agonus cataphractus	N	130	2	
Agonus cataphractus	N	115	4	
Agonus cataphractus	N	125	1	
Agonus cataphractus	N	135	1	
Agonus cataphractus	N	140	1	
Agonus cataphractus	N	95	4	
Agonus cataphractus	N	90	2	
Agonus cataphractus	N	85	4	
Callionymus lyra	N	200	2	
Callionymus lyra	N	165	1	
Callionymus lyra	N	195	1	
Callionymus lyra	N	150	1	
Callionymus lyra	N	175	1	
Callionymus lyra	N	120	2	
Callionymus lyra	N	125	1	
Callionymus lyra	N	155	1	
Callionymus lyra	N	115	4	
Callionymus lyra	N	140	1	
Callionymus lyra	N	100	1	
Callionymus lyra	N	135	1	
Myoxocephalus scorpius	N	100	2	
Myoxocephalus scorpius	N	95	1	
Myoxocephalus scorpius	N	80	1	

Towed Gear Log sheet								Sheet # 1 of 1
Job No:	2210	Vessel:	Geo Ocean 3		Client:	GT R4		
Date:	23/07/2022	Project:	Outer Dowsing ECC		Operators:	BSL		
Station Name	ECC_T5	Processed?	Y		Time	Fix #	Easting	Northing
Fix Name		Ref sp. Kept?	Y	Shoot	09:20	1	363866.87	5913213.37
Distance		Photographed?	Y	Lock	09:29	3	363882.99	5913216.87
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	09:52	4	364540.98	5913194.36
Trawl Length (m)	687	Sample Volume	50L	Geodesy	Datum: WGS84/Projection: UTM 31N			
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth	22.6 - 21.3
Notes								

Fish Length Data

Taxon	Kept (Y/N)	Length (cm)	Count	Comments
Taurulus bubalis	N	80	2	
Taurulus bubalis	N	85	1	
Taurulus bubalis	N	50	2	
Pholis gunnellus	N	160	3	
Pholis gunnellus	N	170	2	
Pholis gunnellus	N	140	3	
Pholis gunnellus	N	150	4	
Pholis gunnellus	N	180	2	
Pholis gunnellus	N	175	1	
Pholis gunnellus	N	95	3	
Pholis gunnellus	N	90	4	
Pholis gunnellus	N	155	1	
Pholis gunnellus	N	100	4	
Pholis gunnellus	N	130	2	
Pholis gunnellus	N	105	2	
Pholis gunnellus	N	80	2	
Pholis gunnellus	N	145	2	
Pholis gunnellus	N	85	1	
Limanda limanda	N	185	1	
Limanda limanda	N	165	1	
Microstomus kitt	N	130	2	
Microstomus kitt	N	135	1	
Microstomus kitt	N	115	1	
Microstomus kitt	N	80	1	
Microstomus kitt	N	35	1	
Liparis liparis	Y	60	2	
Liparis liparis	Y	35	3	

Towed Gear Log sheet							Sheet # 1 of 1	
Job No:	2210		Vessel:	Geo Ocean 3		Client:	GT R4	
Date:	23/07/2022		Project:	Outer Dowsing ECC		Operators:	BSL	
Station Name	ECC_T5	Processed?	Y		Time	Fix #	Easting	Northing
Fix Name		Ref sp. Kept?	Y	Shoot	09:20	1	363866.87	5913213.37
Distance		Photographed?	Y	Lock	09:29	3	363882.99	5913216.87
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	09:52	4	364540.98	5913194.36
Trawl Length (m)	687	Sample Volume	50L	Geodesy	Datum: WGS84/Projection: UTM 31N			
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth	22.6 - 21.3
Notes								

Fish Length Data						
Taxon	Kept (Y/N)	Length (cm)	Count	Comments		
Liparis liparis	Y	40	5			
Liparis liparis	Y	50	1			
Liparis liparis	Y	55	1			
Liparis liparis	Y	45	1			
Liparis liparis	Y	30	2			
Pomatoschistus pictus	Y	<50	19			
Pomatoschistus pictus	Y	50 - 100	3			

Towed Gear Log sheet							Sheet # 1 of 1	
Job No:	2210		Vessel:	Geo Ocean 3		Client:	GT R4	
Date:	24/07/2022		Project:	Outer Dowsing ECC		Operators:	BSL	
Station Name	ECC_T6	Processed?	Y		Time	Fix #	Easting	Northing
Fix Name		Ref sp. Kept?	Y	Shoot	12:38	1	379661.39	5916457.33
Distance		Photographed?	Y	Lock	12:47	3	379669.3	5916466
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	13:09	4	380039.2	5917020.81
Trawl Length (m)	670	Sample Volume	12L	Geodesy	Datum: WGS84/Projection: UTM 31N			
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth	
Notes								

Fish Length Data				
Taxon	Kept (Y/N)	Length (cm)	Count	Comments
Hyperoplus lanceolatus	N	210	1	
Ammodytes marinus	N	105	3	
Ammodytes marinus	N	115	1	
Ammodytes marinus	N	125	1	
Agonus cataphractus	N	30	1	
Agonus cataphractus	N	25	1	
Echichthys vipera	N	0-50	380	
Echichthys vipera	N	50-100	63	
Echichthys vipera	N	100-150	24	
Echichthys vipera	N	150-200	2	
Pleuronectes platessa	N	205	1	
Pleuronectes platessa	N	105	4	
Pleuronectes platessa	N	110	3	
Pleuronectes platessa	N	165	1	
Pleuronectes platessa	N	95	1	
Pleuronectes platessa	Y	<50	44	
Limanda limanda	N	70	1	
Limanda limanda	N	170	1	
Limanda limanda	N	85	2	
Limanda limanda	N	90	3	
Limanda limanda	N	100	3	
Limanda limanda	N	150	1	
Limanda limanda	N	115	1	
Limanda limanda	N	60	1	
Limanda limanda	N	95	3	
Limanda limanda	N	120	1	

Towed Gear Log sheet								Sheet # 1 of 1	
Job No:	2210		Vessel:	Geo Ocean 3		Client:	GT R4		
Date:	24/07/2022		Project:	Outer Dowsing ECC		Operators:	BSL		
Station Name	ECC_T6	Processed?	Y		Time	Fix #	Easting	Northing	
Fix Name		Ref sp. Kept?	Y	Shoot	12:38	1	379661.39	5916457.33	
Distance		Photographed?	Y	Lock	12:47	3	379669.3	5916466	
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	13:09	4	380039.2	5917020.81	
Trawl Length (m)	670	Sample Volume	12L	Geodesy	Datum: WGS84/Projection: UTM 31N				
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth		
Notes									

Fish Length Data

Taxon	Kept (Y/N)	Length (cm)	Count	Comments		
Limanda limanda	N	105	1			
Limanda limanda	Y	<50	129			
Flatfish #J	Y	<50	1			

Towed Gear Log sheet								Sheet # 1 of 1	
Job No:	2210		Vessel:	Geo Ocean 3		Client:		GT R4	
Date:	24/07/2022		Project:	Outer Dowsing ECC		Operators:		BSL	
Station Name	ECC_T7	Processed?	Y		Time	Fix #		Easting	Northing
Fix Name		Ref sp. Kept?	Y	Shoot	08:07	1		383818.01	5920992.59
Distance		Photographed?	Y	Lock	08:20	3		383807.2	5920987.5
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	08:42	4		383406.58	5920469.68
Trawl Length (m)		Sample Volume	80L	Geodesy	Datum: WGS84/Projection: UTM 31N				
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth	17.9 - 19.7	
Notes									

Fish Length Data

Taxon	Kept (Y/N)	Length (cm)	Count	Comments		
Hyperoplus lanceolatus	N	415	1			
Callionymus lyra	N	200	1			
Callionymus lyra	N	105	1			
Callionymus lyra	N	125	3			
Callionymus lyra	N	95	1			
Callionymus lyra	N	120	2			
Callionymus lyra	N	155	1			
Callionymus lyra	N	110	2			
Callionymus lyra	N	170	1			
Callionymus lyra	N	115	1			
Callionymus lyra	N	30	3			
Callionymus lyra	N	35	1			
Callionymus lyra	N	40	1			
Agonus cataphractus	N	100	2			
Agonus cataphractus	N	90	3			
Agonus cataphractus	N	115	1			
Agonus cataphractus	N	110	1			
Agonus cataphractus	N	80	2			
Agonus cataphractus	N	40	2			
Agonus cataphractus	N	30	1			
Taurulus bubalius	N	110	1			
Taurulus bubalius	N	40	2			
Taurulus bubalius	N	30	1			
Taurulus bubalius	N	25	1			
Pholis gunnellus	N	140	2			
Pholis gunnellus	N	125	1			
Pholis gunnellus	N	130	1			

Towed Gear Log sheet							Sheet # 1 of 1	
Job No:	2210		Vessel:	Geo Ocean 3		Client:	GT R4	
Date:	24/07/2022		Project:	Outer Dowsing ECC		Operators:	BSL	
Station Name	ECC_T7	Processed?	Y		Time	Fix #	Easting	Northing
Fix Name		Ref sp. Kept?	Y	Shoot	08:07	1	383818.01	5920992.59
Distance		Photographed?	Y	Lock	08:20	3	383807.2	5920987.5
Vessel Speed	1 knot over ground	Sieve Mesh Size	5mm	Haul	08:42	4	383406.58	5920469.68
Trawl Length (m)		Sample Volume	80L	Geodesy	Datum: WGS84/Projection: UTM 31N			
Log method	Distance	Log frequency	1 Second	Sampling Device	2m Beam Trawl		Water Depth	17.9 - 19.7
Notes								

Fish Length Data

Taxon	Kept (Y/N)	Length (cm)	Count	Comments		
Echichthys vipera	N	70	2			
Echichthys vipera	N	60	1			
Echichthys vipera	N	125	1			
Eutrigla gurnardus	N	30	1			
Eutrigla gurnardus	N	45	1			
Pomatoschistus pictus	N	45	1			
Liparis liparis	N	45	1			
Liparis liparis	N	55	1			
Liparis liparis	N	40	1			
Pleuronectes platessa	N	120	1			
Pleuronectes platessa	N	150	1			
Pleuronectes platessa	N	145	2			
Pleuronectes platessa	N	140	1			
Pleuronectes platessa	N	125	1			
Limanda limanda	N	160	1			
Limanda limanda	N	110	3			
Limanda limanda	N	170	1			
Limanda limanda	N	90	1			
Limanda limanda	N	80	1			
Limanda limanda	N	50	1			
Limanda limanda	Y	<50	50			

APPENDIX K – SPEARMAN'S CORRELATIONS

Hamon Grab Spearman's Correlation (PSA and TOC)

Spearman's Correlation Coefficient (Two-tailed)	
Number of Data Points	59
p=0.05, 95% Significant	0.257
p=0.01, 99% Significant	0.334
p=0.001, 99.9% Significant	0.421

	Distance from infrastructure (km)	Water Depth (m)	Mean (mm)	Sorting	Skewness	Kurtosis	% Fines	% Sands	% Gravel	Total Organic Carbon (% dwt)
Distance from infrastructure (km)		0.364	-0.111	-0.095	-0.077	0.035	-0.081	0.166	-0.130	-0.316
Water Depth (m)			0.042	-0.023	-0.318	-0.056	0.067	0.116	-0.055	-0.119
Mean (mm)				0.402	-0.153	0.108	0.103	-0.620	0.838	0.027
Sorting					0.059	-0.105	0.843	-0.891	0.728	0.550
Skewness						-0.092	0.221	-0.177	-0.027	0.224
Kurtosis							-0.133	0.039	0.055	-0.247
% Fines								-0.708	0.442	0.629
% Sands									-0.915	-0.459
% Gravel										0.257
Total Organic Carbon (% dwt)										

Shipek Grab Spearman's Correlation (Contaminants)

Spearman's Correlation Coefficient (Two-tailed)	
Number of Data Points	28
p=0.05, 95% Significant	0.375
p=0.01, 99% Significant	0.483
p=0.001, 99.9% Significant	0.598

	Distance from infrastructure (km)	Water Depth (m)	Mean (mm)	Sorting	Skewness	Kurtosis	% Fines	% Sands	% Gravel	Total Organic Carbon (% dwt)	Arsenic (mg.kg-1)	Chromium (mg.kg-1)	Copper (mg.kg-1)	Lead (mg.kg-1)	Nickel (mg.kg-1)	Zinc (mg.kg-1)	Cadmium (mg.kg-1)	Mercury (mg.kg-1)	Total 16 PAH (µg.Kg-1)	Total 22 PAH (µg.Kg-1)	Low moleculaweight PAH (µg.Kg-1)	High molecular weight PAH (µg.Kg-1)
Distance from infrastructure (km)		1.000	0.517	-0.048	-0.238	-0.169	-0.003	-0.226	0.196	-0.090	-0.257	-0.130	-0.242	-0.237	-0.227	-0.146	-0.149	0.202	-0.106	-0.234	-0.219	-0.196
Water Depth (m)			0.517	-0.048	-0.238	-0.169	-0.003	-0.226	0.196	-0.090	-0.257	-0.130	-0.242	-0.237	-0.227	-0.146	-0.149	0.202	-0.106	-0.234	-0.219	-0.196
Mean (mm)				-0.134	-0.348	-0.278	-0.172	-0.137	0.424	-0.320	-0.295	-0.536	-0.567	-0.507	-0.317	-0.614	-0.668	-0.285	-0.355	-0.136	-0.091	-0.070
Sorting					0.235	-0.219	0.236	-0.230	-0.560	0.830	-0.269	0.493	0.305	0.214	-0.111	0.496	0.227	0.621	0.092	-0.292	-0.271	-0.245
Skewness						0.025	-0.156	0.743	-0.868	0.647	0.552	0.537	0.784	0.768	0.506	0.719	0.622	0.065	0.420	0.558	0.567	0.598
Kurtosis							-0.191	0.335	-0.110	-0.108	0.280	-0.034	0.267	0.186	0.193	0.095	0.096	0.402	0.242	0.142	0.149	0.143
% Fines								-0.307	0.071	0.121	-0.389	0.147	-0.086	-0.011	-0.108	0.064	0.127	0.313	0.038	-0.274	-0.313	-0.271
% Sands									-0.503	0.142	0.692	0.136	0.650	0.628	0.594	0.378	0.316	-0.136	0.268	0.724	0.741	0.772
% Gravel										-0.893	-0.317	-0.567	-0.773	-0.711	-0.317	-0.838	-0.630	-0.416	-0.415	-0.327	-0.339	-0.379
Total Organic Carbon (% dwt)											0.017	0.565	0.590	0.530	0.033	0.760	0.488	0.535	0.270	0.032	0.049	0.091
Arsenic (mg.kg-1)												0.262	0.551	0.414	0.627	0.350	0.463	0.059	0.365	0.713	0.716	0.677
Chromium (mg.kg-1)													0.669	0.555	0.402	0.682	0.771	0.294	0.452	0.047	0.015	0.025
Copper (mg.kg-1)														0.862	0.482	0.848	0.748	0.347	0.371	0.450	0.426	0.449
Lead (mg.kg-1)															0.425	0.689	0.609	0.271	0.334	0.519	0.494	0.517
Nickel (mg.kg-1)																0.381	0.530	-0.151	0.544	0.675	0.662	0.648
Zinc (mg.kg-1)																	0.803	0.527	0.469	0.320	0.299	0.326
Cadmium (mg.kg-1)																		0.247	0.573	0.313	0.269	0.287
Mercury (mg.kg-1)																			0.325	-0.143	-0.110	-0.123
Total 16 PAH (µg.Kg-1)																				0.359	0.348	0.331
Total 22 PAH (µg.Kg-1)																					0.988	0.970
Low moleculaweight PAH (µg.Kg-1)																						0.989
High molecular weight PAH (µg.Kg-1)																						

Spearman's Correlation (Macrofauna & Diversity indices)

Spearman's Correlation Coefficient (Two-tailed)	
Number of Data Points	55
p=0.05, 95% Significant	0.266
p=0.01, 99% Significant	0.346
p=0.001, 99.9% Significant	0.435

	Distance from infrastructure (km)	Water Depth (m)	Mean (mm)	Sorting	Skewness	Kurtosis	% Fines	% Sands	% Gravel	Total Organic Carbon (% dwt)	Arsenic (mg.kg-1)	Chromium (mg.kg-1)	Copper (mg.kg-1)	Lead (mg.kg-1)	Nickel (mg.kg-1)	Zinc (mg.kg-1)	Cadmium	Mercury	Total 16 PAH (µg.Kg-1)	Total 22 PAH (µg.Kg-1)	Low molecularweight PAH (µg.Kg-1	High molecular weight PAH (µg.Kg	Number of Species (S) (per 0.1m²)	Number of Individuals (N) (per 0.1	Margalef Richness (d) (per 0.1m²)	Pielou's evenness (J') (per 0.1m²)	Simpson's Diversity (1-Lambda') (	Shannon-Wiener Diversity (H'(log
Distance from infrastructure (km)		0.361	-0.094	-0.101	-0.120	0.071	-0.095	0.173	-0.131	-0.340	0.014	-0.012	-0.007	-0.015	0.001	0.007	0.094	0.000	-0.017	-0.014	-0.037	-0.018	0.117	-0.007	0.162	0.150	0.243	0.218
Water Depth (m)			0.053	-0.020	-0.331	-0.067	0.070	0.110	-0.048	-0.128	-0.002	-0.009	-0.005	0.030	-0.016	-0.025	0.047	0.013	0.056	0.065	0.035	0.056	0.473	0.386	0.462	-0.158	0.066	0.440
Mean (mm)				0.416	-0.152	0.031	0.112	-0.606	0.817	0.115	0.002	-0.037	-0.056	-0.093	0.000	-0.036	0.173	-0.035	-0.104	-0.103	-0.081	-0.105	0.309	0.207	0.340	-0.081	0.108	0.354
Sorting					0.059	-0.125	0.847	-0.904	0.755	0.598	0.145	0.181	0.185	0.145	0.172	0.161	0.127	0.135	0.161	0.161	0.195	0.157	0.706	0.725	0.691	-0.564	-0.196	0.348
Skewness						0.000	0.199	-0.164	-0.031	0.226	0.059	0.098	0.106	0.090	0.062	0.075	-0.040	0.092	0.090	0.089	0.096	0.089	-0.078	-0.046	-0.099	0.018	-0.037	-0.104
Kurtosis							-0.120	0.057	0.005	-0.215	0.086	0.054	0.055	0.059	0.082	0.091	0.038	0.093	0.032	0.024	0.070	0.029	-0.105	-0.188	-0.095	0.043	-0.041	-0.115
% Fines								-0.721	0.469	0.633	0.233	0.304	0.313	0.292	0.261	0.254	0.172	0.233	0.312	0.315	0.323	0.306	0.650	0.681	0.640	-0.531	-0.218	0.324
% Sands									-0.919	-0.540	-0.184	-0.207	-0.206	-0.150	-0.215	-0.194	-0.222	-0.173	-0.165	-0.164	-0.195	-0.162	-0.578	-0.565	-0.571	0.457	0.150	-0.317
% Gravel										0.362	0.142	0.139	0.129	0.063	0.166	0.135	0.243	0.118	0.077	0.078	0.109	0.075	0.533	0.474	0.540	-0.350	-0.045	0.377
Total Organic Carbon (% dwt)											0.149	0.194	0.186	0.191	0.165	0.173	0.068	0.144	0.195	0.195	0.221	0.195	0.340	0.362	0.324	-0.239	-0.072	0.177
Arsenic (mg.kg-1)												0.984	0.981	0.969	0.985	0.989	0.971	0.972	0.955	0.952	0.930	0.955	0.065	0.085	0.091	0.025	0.096	0.100
Chromium (mg.kg-1)													0.996	0.974	0.992	0.988	0.970	0.967	0.977	0.975	0.951	0.976	0.096	0.136	0.110	-0.037	0.041	0.075
Copper (mg.kg-1)														0.979	0.989	0.986	0.968	0.970	0.982	0.980	0.958	0.980	0.097	0.142	0.111	-0.039	0.040	0.070
Lead (mg.kg-1)															0.969	0.976	0.958	0.970	0.986	0.984	0.964	0.987	0.082	0.122	0.095	-0.017	0.047	0.073
Nickel (mg.kg-1)																0.991	0.980	0.974	0.972	0.969	0.948	0.971	0.085	0.113	0.104	-0.004	0.073	0.092
Zinc (mg.kg-1)																	0.970	0.977	0.968	0.965	0.947	0.967	0.060	0.092	0.078	0.010	0.075	0.063
Cadmium																		0.971	0.956	0.956	0.924	0.955	0.023	0.042	0.069	0.090	0.162	0.111
Mercury																			0.959	0.958	0.938	0.959	0.067	0.090	0.089	0.029	0.101	0.102
Total 16 PAH (µg.Kg-1)																				0.999	0.980	1.000	0.136	0.179	0.144	-0.062	0.030	0.099
Total 22 PAH (µg.Kg-1)																					0.981	0.999	0.142	0.186	0.149	-0.062	0.035	0.110
Low moleculaweight PAH (µg.Kg-1)																						0.978	0.157	0.201	0.160	-0.071	0.043	0.114
High molecular weight PAH (µg.Kg-1)																							0.135	0.177	0.144	-0.058	0.032	0.103
Number of Species (S) (per 0.1m²)																								0.932	0.981	-0.607	-0.124	0.676
Number of Individuals (N) (per																									0.868	-0.780	-0.360	0.448
Margalef Richness (d) (per 0.1m²)																										-0.491	0.012	0.759
Pielou's evenness (J') (per 0.1m²)																											0.824	0.098
Simpson's Diversity (1-Lambda') (per																												0.551
Shannon-Wiener Diversity (H'(log2))																												

APPENDIX L – CONVERSION OF EUNIS CLASSIFICATIONS

2012 EUNIS Code	2012 EUNIS Name	2019 EUNIS Code	2019 EUNIS Name	Variation
A5.61	Sublittoral polychaete worm reefs on sediment	**MB221**	Worm reefs in the Atlantic infralittoral zone	Narrower
A5.13	Infralittoral Coarse Sediment	**MB3**	Infralittoral coarse sediment	Equal
A5.13; **A5.1;** **A5.5;** **A5**	Infralittoral coarse sediment; Sublittoral coarse sediment; Sublittoral macrophyte-dominated sediment; Sublittoral sediment	**MB32**	Atlantic infralittoral coarse sediment	Wider
A5.13	Infralittoral Coarse Sediment	**MB323**	Faunal communities in full salinity Atlantic infralittoral coarse sediment	Narrower
A5.131	Sparse fauna on highly mobile sublittoral shingle (cobbles and pebbles)	**MB3231**	Sparse fauna on highly mobile Atlantic infralittoral shingle (cobbles and pebbles)	Equal
A5.135	Glycera lapidum in impoverished infralittoral mobile gravel and sand	**MB3235**	*Glycera lapidum* in impoverished Atlantic infralittoral mobile gravel and sand	Equal
A5.43	Infralittoral Mixed Sediments	**MB4**	Infralittoral Mixed Sediments	Equal
A5.4; **A5.43;** **A5.41;** **A5.5;** **A5**	Sublittoral mixed sediment; Infralittoral mixed sediments; Sublittoral mixed sediment in low or reduced salinity; Sublittoral macrophyte-dominated sediment; Sublittoral sediment	**MB42**	Atlantic infralittoral mixed sediment	Wider
A5.23	Infralittoral Fine Sand	**MB5**	Infralittoral Sand	Wider
A5.23	Infralittoral Fine Sand	**MB52**	Atlantic Infralittoral Sand	Overlap
A5.23	Infralittoral Fine Sand	**MB523**	Faunal Communities of Full Salinity Atlantic Infralittoral Sand	Equal
A5.231	Infralittoral mobile clean sand with sparse fauna	**MB5231**	Sparse fauna in Atlantic infralittoral mobile clean sand	Equal
A5.233	*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand	**MB5233**	*Nephtys cirrosa* and *Bathyporeia* spp. in Atlantic infralittoral sand	Equal
A5.33; **A5.34;** **A5.3;** **A5.5;** **A5**	Infralittoral sandy mud; Infralittoral fine mud; Sublittoral mud; Sublittoral macrophyte-dominated sediment; Sublittoral sediment	**MB62**	Atlantic infralittoral mud	Wider
A5.6	Sublittoral biogenic reefs	**MC2**	Circalittoral biogenic habitat	Wider
A5.61	Sublittoral polychaete worm reefs on sediment	**MC221**	Worm reefs in the Atlantic circalittoral zone	Narrower
A5.611	*Sabellaria spinulosa* on stable circalittoral mixed sediment	**MC2211**	*Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment	Equal
A5	Sublittoral Sediments	**MC3**	Circalittoral Coarse Sediment	Overlap
A5.14; **A5.1;** **A5**	Circalittoral coarse sediment; Sublittoral coarse sediment; Sublittoral sediment	**MC32**	Atlantic circalittoral coarse sediment	Wider

2012 EUNIS Code	2012 EUNIS Name	2019 EUNIS Code	2019 EUNIS Name	Variation
A5.14	Circalittoral coarse sediment	**MC321**	Faunal communities of Atlantic circalittoral coarse sediment	Narrower
A5.141	*Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	**MC3211**	*Pomatoceros triqueter* with barnacles and bryozoan crusts on Atlantic circalittoral unstable cobbles and pebbles	Equal
A5.142	*Mediomastus fragilis, Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel	**MC3212**	*Mediomastus fragilis, Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel	Equal
A5.143	Protodorvillea kefersteini and other polychaetes in impoverished circalittoral mixed gravelly sand	**MC3213**	Protodorvillea kefersteini and other polychaetes in impoverished Atlantic circalittoral mixed gravelly sand	Equal
A5.44	Circalittoral Mixed Sediments	**MC42**	Atlantic Circalittoral Mixed Sediment	Narrower
A5.44	Circalittoral Mixed Sediments	**MC421**	Faunal communities of Atlantic circalittoral mixed sediment or coarse sediment depending on PSA	Narrower
A5.25	Circalittoral Fine Sand	**MC512**	Faunal Communities of Atlantic Circalittoral Sand	Overlap with A5.26
A5.25; A5.26; A5.2; A5	Circalittoral fine sand; Circalittoral muddy sand; Sublittoral sand; Sublittoral sediment	**MC52**	Atlantic circalittoral sand	Wider
A5.25	Circalittoral Fine Sand	**MC521**	Faunal communities of Atlantic circalittoral sand	Overlap with A5.26
A5.251	*Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	**MC5211**	*Echinocyamus pusillus*, *Ophelia borealis and Abra prismatica* in circalittoral fine sand	Equal
A5.252	*Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand	**MC5212**	*Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand	Equal
A5.15; A5.1; A5	Deep circalittoral coarse sediment; Sublittoral coarse sediment; Sublittoral sediment	**MD32**	Atlantic offshore circalittoral coarse sediment	Wider
A5.45; A5; A5.4	Deep circalittoral mixed sediments; Sublittoral sediment; Sublittoral mixed sediment	**MD42**	Atlantic offshore circalittoral mixed sediment	Wider
A5.27; A5.2; A5	Deep circalittoral sand; Sublittoral sand; Sublittoral sediment	**MD52**	Atlantic offshore circalittoral sand	Wider
A5.37; A5; A5.3	Deep circalittoral mud; Sublittoral sediment; Sublittoral mud	**MD62**	Atlantic offshore circalittoral mud	Wider

APPENDIX M – SACFOR ABUNDANCE

Stills Data

Appendix - SACFOR
Abundance_SACFOF

Video Data

Appendix - SACFOR
Abundance_SACFOF

APPENDIX N – STONY REEF ASSESSMENT

Transect Name	Picture	Picture No.*	Date	Time	Easting (m)	Northing (m)	Composition (% Cover)	Elevation (Average Boulder And Cobble Height In Mm)	Reefiness Value
ECC_VID_18	ECC_VID_18_000038	00038	23/07/2022	07:50:33	364078.92	5913207.7			-
	ECC_VID_18_000043	00043	23/07/2022	07:51:26	364080.32	5913207.8	0	0	-
	ECC_VID_18_000044	00044	23/07/2022	07:51:36	364081.21	5913207.7	3	64	Not a Reef
	ECC_VID_18_000045	00045	23/07/2022	07:51:47	364082.24	5913207.7	2	64	Not a Reef
	ECC_VID_18_000046	00046	23/07/2022	07:51:54	364083.56	5913208	3	64	Not a Reef
	ECC_VID_18_000047	00047	23/07/2022	07:52:05	364084.6	5913207.9	1	64	Not a Reef
	ECC_VID_18_000048	00048	23/07/2022	07:52:15	364085.91	5913208	2	64	Not a Reef
	ECC_VID_18_000049	00049	23/07/2022	07:52:25	364087.61	5913207.8	8	64	Not a Reef
	ECC_VID_18_000050	00050	23/07/2022	07:52:35	364088.99	5913207.8	0	0	-
	ECC_VID_18_000051	00051	23/07/2022	07:52:44	364090.6	5913207.7	2	64	Not a Reef
	ECC_VID_18_000052	00052	23/07/2022	07:52:55	364091.95	5913207.6	0	0	-
	ECC_VID_18_000053	00053	23/07/2022	07:53:05	364093.56	5913207.5	1	64	Not a Reef
	ECC_VID_18_000054	00054	23/07/2022	07:53:15	364095.32	5913207.4	2	64	Not a Reef
	ECC_VID_18_000055	00055	23/07/2022	07:53:25	364096.25	5913207.7	0	0	-
	ECC_VID_18_000056	00056	23/07/2022	07:53:35	364098.19	5913207.7	0	0	-
	ECC_VID_18_000057	00057	23/07/2022	07:53:45	364099.36	5913207.7	0	0	-
	ECC_VID_18_000058	00058	23/07/2022	07:53:58	364101.31	5913207.5	4	64	Not a Reef
	ECC_VID_18_000059	00059	23/07/2022	07:54:08	364101.49	5913207.3	4	64	Not a Reef
	ECC_VID_18_000060	00060	23/07/2022	07:54:20	364102.73	5913207.5	0	0	-
	ECC_VID_18_000061	00061	23/07/2022	07:54:29	364104.72	5913207.6	2	64	Not a Reef
	ECC_VID_18_000062	00062	23/07/2022	07:54:41	364106.5	5913207.2	2	64	Not a Reef
	ECC_VID_18_000063	00063	23/07/2022	07:54:51	364107.98	5913207.3	0	0	-
	ECC_VID_18_000064	00064	23/07/2022	07:54:00	364109.67	5913207.2	0	0	-
	ECC_VID_18_000065	00065	23/07/2022	07:55:09	364112.31	5913207	0	0	-
	ECC_VID_18_000066	00066	23/07/2022	07:55:20	364113.76	5913206.9	4	64	Not a Reef
	ECC_VID_18_000067	00067	23/07/2022	07:55:30	364115.38	5913207.2	0	0	-
	ECC_VID_18_000068	00068	23/07/2022	07:55:40	364117.21	5913206.9	0	0	-
	ECC_VID_18_000069	00069	23/07/2022	07:55:49	364118.55	5913206.8	2	64	Not a Reef

Transect Name	Picture	Picture No.*	Date	Time	Easting (m)	Northing (m)	Composition (% Cover)	Elevation (Average Boulder And Cobble Height In Mm)	Reefiness Value
	ECC_VID_18_000070	00070	23/07/2022	07:56:00	364120.14	5913207	0	0	-
	ECC_VID_18_000071	00071	23/07/2022	07:56:09	364121.69	5913206.9	0	0	-
	ECC_VID_18_000072	00072	23/07/2022	07:56:21	364122.66	5913207	0	0	-
	ECC_VID_18_000073	00073	23/07/2022	07:56:32	364123.95	5913206.8	7	64	Not a Reef
	ECC_VID_18_000074	00074	23/07/2022	07:56:40	364125.43	5913206.6	0	0	-
	ECC_VID_18_000075	00075	23/07/2022	07:56:50	364127.05	5913206.2	0	0	-
	ECC_VID_18_000076	00076	23/07/2022	07:56:58	364128.29	5913206.4	0	0	-
	ECC_VID_18_000077	00077	23/07/2022	07:57:10	364131.02	5913206.7	0	0	-
	ECC_VID_18_000078	00078	23/07/2022	07:57:20	364132.61	5913206.8	0	0	-
	ECC_VID_18_000079	00079	23/07/2022	07:57:30	364133.75	5913206.9	2	64	Not a Reef
	ECC_VID_18_000080	00080	23/07/2022	07:57:42	364134.89	5913206.9	0	0	-
	ECC_VID_18_000081	00081	23/07/2022	07:57:51	364135.48	5913206.7	0	0	-
ECC_VID_21	ECC_VID_21_00001	00001	23/07/2022	03:53:58	361580.89	5913450.6	0	0	-
	ECC_VID_21_00021	00021	23/07/2022	03:57:08	361572.34	5913470.6	25	1500	Low Reef
	ECC_VID_21_00042	00042	23/07/2022	04:00:52	361558.72	5913502.7	0	0	-
ECC_VID_37	ECC_VID_37_00001	00001	21/07/2022	01:52:36	346074.49	5912022.4	0	0	-
	ECC_VID_37_00002	00002	21/07/2022	01:52:47	345693.64	5911880.2	1	64	Not a Reef
	ECC_VID_37_00003	00003	21/07/2022	01:52:57	346073.56	5912022.5	0	0	-
	ECC_VID_37_00004	00004	21/07/2022	01:53:07	346072.73	5912022.6	0		-
	ECC_VID_37_00005	00005	21/07/2022	01:53:19	346070.14	5912021.9	-	-	-
	ECC_VID_37_00006	00006	21/07/2022	01:53:27	346069.21	5912021.9	0	0	-
	ECC_VID_37_00007	00007	21/07/2022	01:53:43	346066.82	5912022	0	0	-
	ECC_VID_37_00008	00008	21/07/2022	01:53:47	346064.24	5912021.9	0	0	-
	ECC_VID_37_00009	00009	21/07/2022	01:53:57	346063.65	5912021.9	-	-	-
	ECC_VID_37_00010	00010	21/07/2022	01:54:05	346063.11	5912021.7	0	0	-
	ECC_VID_37_00011	00011	21/07/2022	01:54:18	346061.01	5912021.5	0	0	-
	ECC_VID_37_00013	00013	21/07/2022	01:54:25	346059.09	5912021.2	0	0	-
	ECC_VID_37_00014	00014	21/07/2022	01:54:34	346058.02	5912021.2	2	64	Not a Reef
	ECC_VID_37_00016	00016	21/07/2022	01:54:45	346055.93	5912021.2	0	0	-
	ECC_VID_37_00017	00017	21/07/2022	01:54:55	346054.43	5912021.3	0	0	-
	ECC_VID_37_00018	00018	21/07/2022	01:55:05	346052.71	5912021.1	2	64	Not a Reef

Transect Name	Picture	Picture No.*	Date	Time	Easting (m)	Northing (m)	Composition (% Cover)	Elevation (Average Boulder And Cobble Height In Mm)	Reefiness Value
	ECC_VID_37_00019	00019	21/07/2022	01:55:16	346051.18	5912021.2	10	64	Low Reef
	ECC_VID_37_00020	00020	21/07/2022	01:55:29	346048.32	5912021.2	14	64	Low Reef
	ECC_VID_37_00021	00021	21/07/2022	01:55:35	346047.05	5912021.4	5	64	Not a Reef
	ECC_VID_37_00022	00022	21/07/2022	01:55:45	346045.66	5912021.5	11	64	Low Reef
	ECC_VID_37_00023	00023	21/07/2022	01:55:55	346044.4	5912021.7	14	64	Low Reef
	ECC_VID_37_00024	00024	21/07/2022	01:56:07	346042.93	5912021.4	4	64	Not a Reef
	ECC_VID_37_00025	00025	21/07/2022	01:56:18	346041.86	5912021.3	3	64	Not a Reef
	ECC_VID_37_00026	00026	21/07/2022	01:56:28	346039.66	5912021.3	10	64	Low Reef
	ECC_VID_37_00027	00027	21/07/2022	01:56:39	346038.69	5912021.3	12	64	Low Reef
	ECC_VID_37_00028	00028	21/07/2022	01:56:46	346037.33	5912021.4	2	64	Not a Reef
	ECC_VID_37_00029	00029	21/07/2022	01:56:56	346035.45	5912020.9	3	64	Not a Reef
	ECC_VID_37_00030	00030	21/07/2022	01:57:05	346034.36	5912020.8	-	-	-
	ECC_VID_37_00031	00031	21/07/2022	01:57:15	346032.15	5912020.4	6	64	Not a Reef
	ECC_VID_37_00032	00032	21/07/2022	01:57:26	346030.24	5912020.2	7	64	Not a Reef
	ECC_VID_37_00033	00033	21/07/2022	01:57:37	346028.87	5912020	13	64	Low Reef
	ECC_VID_37_00034	00034	21/07/2022	01:57:46	346028.44	5912020.1	5	64	Not a Reef
	ECC_VID_37_00035	00035	21/07/2022	01:57:57	346025.63	5912019.8	18	64	Low Reef
	ECC_VID_37_00036	00036	21/07/2022	01:58:05	346025.14	5912019.8	4	64	Not a Reef
	ECC_VID_37_00037	00037	21/07/2022	01:58:13	346023.74	5912019.7	5	64	Not a Reef
	ECC_VID_37_00038	00038	21/07/2022	01:58:24	346021.84	5912019.4	10	64	Low Reef
	ECC_VID_37_00039	00039	21/07/2022	01:58:33	346020.2	5912019.3	0	0	-
	ECC_VID_37_00040	00040	21/07/2022	01:58:45	346019.61	5912019.2	5	64	Not a Reef
ECC_VID_48A	ECC_VID_48A_00001	00001	20/07/2022	10:39:03	330860.23	5906491.8	0	0	-
	ECC_VID_48A_00002	00002	20/07/2022	10:39:13	No Nav	No Nav	0	0	-
	ECC_VID_48A_00003	00003	20/07/2022	10:39:22	No Nav	No Nav	1	64	Not a Reef
	ECC_VID_48A_00004	00004	20/07/2022	10:39:32	No Nav	No Nav	0	0	-
	ECC_VID_48A_00005	00005	20/07/2022	10:39:42	No Nav	No Nav	0	0	-
	ECC_VID_48A_00006	00006	20/07/2022	10:39:51	No Nav	No Nav	0	0	-
	ECC_VID_48A_00007	00007	20/07/2022	10:40:02	No Nav	No Nav	0	0	-
	ECC_VID_48A_00008	00008	20/07/2022	10:40:10	No Nav	No Nav	0	0	-
	ECC_VID_48A_00009	00009	20/07/2022	10:40:22	No Nav	No Nav	0	0	-

Transect Name	Picture	Picture No.*	Date	Time	Easting (m)	Northing (m)	Composition (% Cover)	Elevation (Average Boulder And Cobble Height In Mm)	Reefiness Value
	ECC_VID_48A_00010	00010	20/07/2022	10:40:30	No Nav	No Nav	0	0	-
	ECC_VID_48A_00011	00011	20/07/2022	10:40:40	No Nav	No Nav	0	0	-
	ECC_VID_48A_00012	00012	20/07/2022	10:40:49	No Nav	No Nav	0	0	-
	ECC_VID_48A_00013	00013	20/07/2022	10:40:59	No Nav	No Nav	-	-	-
	ECC_VID_48A_00014	00014	20/07/2022	10:41:10	No Nav	No Nav	1	64	Not a Reef
	ECC_VID_48A_00015	00015	20/07/2022	10:41:20	No Nav	No Nav	-	-	-
	ECC_VID_48A_00016	00016	20/07/2022	10:41:30	No Nav	No Nav	-	-	-
	ECC_VID_48A_00017	00017	20/07/2022	10:41:40	No Nav	No Nav	1	64	Not a Reef
	ECC_VID_48A_00018	00018	20/07/2022	10:45:11	No Nav	No Nav	-	-	-
	ECC_VID_48A_00019	00019	20/07/2022	10:50:07	330860.19	5906491.8	0	0	-
	ECC_VID_48A_00021	00021	20/07/2022	10:51:14	330859.97	5906492.8	-	-	-
	ECC_VID_48A_00022	00022	20/07/2022	10:51:26	330859.9	5906493.1	0	0	-
	ECC_VID_48A_00023	00023	20/07/2022	10:51:34	330859.61	5906494	1	64	Not a Reef
	ECC_VID_48A_00024	00024	20/07/2022	10:51:48	330858.81	5906495.6	0	0	-
	ECC_VID_48A_00025	00025	20/07/2022	10:52:05	330857.97	5906498	0	0	-
	ECC_VID_48A_00026	00026	20/07/2022	10:52:14	330857.38	5906499.5	1	64	Not a Reef
	ECC_VID_48A_00027	00027	20/07/2022	10:52:21	330857.21	5906500.2	0	0	-
	ECC_VID_48A_00028	00028	20/07/2022	10:52:32	330856.63	5906502.1	1	64	Not a Reef
	ECC_VID_48A_00029	00029	20/07/2022	10:52:44	330855.97	5906503.8	0	0	-
	ECC_VID_48A_00030	00030	20/07/2022	10:52:55	330855.4	5906505.5	0	0	-
	ECC_VID_48A_00031	00031	20/07/2022	10:53:07	330855.05	5906506.6	0	0	-
	ECC_VID_48A_00032	00032	20/07/2022	10:53:13	330854.58	5906507.6	0	0	-
	ECC_VID_48A_00033	00033	20/07/2022	10:53:27	330853.79	5906510	0	0	-
	ECC_VID_48A_00034	00034	20/07/2022	10:53:35	330853.56	5906510.4	0	0	-
	ECC_VID_48A_00035	00035	20/07/2022	10:53:47	330853.12	5906512	0	0	-
	ECC_VID_48A_00036	00036	20/07/2022	10:53:57	330852.47	5906513.8	0	0	-
	ECC_VID_48A_00038	00038	20/07/2022	10:54:07	330851.91	5906515.5	0	0	-
	ECC_VID_48A_00039	00039	20/07/2022	10:54:14	330851.57	5906516.5	0	0	-
	ECC_VID_48A_00040	00040	20/07/2022	10:54:25	330851	5906518.3	0	0	-
	ECC_VID_48A_00041	00041	20/07/2022	10:54:36	330850.57	5906519.8	0	0	-
	ECC_VID_48A_00042	00042	20/07/2022	10:54:46	330850.03	5906521	0	0	-

Transect Name	Picture	Picture No.*	Date	Time	Easting (m)	Northing (m)	Composition (% Cover)	Elevation (Average Boulder And Cobble Height In Mm)	Reefiness Value
	ECC_VID_48A_00043	00043	20/07/2022	10:54:56	330849.61	5906522.6	0	0	-
	ECC_VID_48A_00044	00044	20/07/2022	10:55:05	330849.13	5906523.6	0	0	-
	ECC_VID_48A_00045	00045	20/07/2022	10:55:20	330848.51	5906525.5	0	0	-
	ECC_VID_48A_00046	00046	20/07/2022	10:55:31	330847.82	5906527.4	1	64	Not a Reef
	ECC_VID_48A_00047	00047	20/07/2022	10:55:39	330847.37	5906528.9	0	0	-
	ECC_VID_48A_00048	00048	20/07/2022	10:55:49	330847.08	5906530	-	-	-
	ECC_VID_48A_00049	00049	20/07/2022	10:56:01	330846.47	5906531.9	0	0	-
	ECC_VID_48A_00050	00050	20/07/2022	10:56:09	330845.99	5906533.1	0	0	-
	ECC_VID_48A_00051	00051	20/07/2022	10:56:21	330845.43	5906534.8	1	64	Not a Reef
	ECC_VID_48A_00053	00053	20/07/2022	10:56:33	330844.73	5906536.6	1	64	Not a Reef
	ECC_VID_48A_00054	00054	20/07/2022	10:56:43	330844.35	5906537.8	-	-	-
	ECC_VID_48A_00055	00055	20/07/2022	10:56:51	330844.35	5906537.9	0	0	-
	ECC_VID_48A_00056	00056	20/07/2022	10:57:12	330843.09	5906541.7	-	-	-
	ECC_VID_48A_00057	00057	20/07/2022	10:57:26	330842.44	5906543.5	0	0	-
	ECC_VID_48A_00058	00058	20/07/2022	10:57:35	330841.68	5906545.2	0	0	-
	ECC_VID_48A_00060	00060	20/07/2022	10:57:48	330840.85	5906548.1	0	0	-
	ECC_VID_48A_00061	00061	20/07/2022	10:58:02	330840.22	5906549.6	0	0	-
	ECC_VID_48A_00062	00062	20/07/2022	10:58:17	330839.41	5906552.3	0	0	-
	ECC_VID_48A_00063	00063	20/07/2022	10:58:27	330838.94	5906553.4	0	0	-
	ECC_VID_48A_00064	00064	20/07/2022	10:58:37	330838.56	5906554.6	0	0	-

**Additional screenshots were captured from the HD video approximately every 10 seconds if the underwater stills captured in the field underrepresented the spatial variability in cobbles and boulders*

APPENDIX O – SABELLARIA REEF ASSESSMENT

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
ECC_VID_29b	ECC_VID_29b-00001	0001	22/07/2022	06:43:31	352942.17	5914077.06	7	1.5	Not a Reef
	ECC_VID_29b-00002	0002	22/07/2022	06:43:41	No nav	No nav	5	1	Not a Reef
	ECC_VID_29b-00003	0003	22/07/2022	06:43:50	No nav	No nav	7	1	Not a Reef
	ECC_VID_29b-00004	0004	22/07/2022	06:44:01	No nav	No nav	2	0.5	Not a Reef
	ECC_VID_29b-00005	0005	22/07/2022	06:44:09	No nav	No nav	2	1.9	Not a Reef
	ECC_VID_29b-00006	0006	22/07/2022	06:45:26	No nav	No nav	7	1	Not a Reef
	ECC_VID_29b-00007	0007	22/07/2022	06:45:42	No nav	No nav	8	1	Not a Reef
	ECC_VID_29b-00008	0008	22/07/2022	06:45:56	352942.35	5914076.34	9	2	Not a Reef
	ECC_VID_29b-00009	0009	22/07/2022	06:46:06	352943.14	5914074.79	0	0	-
	ECC_VID_29b-00010	0010	22/07/2022	06:46:16	352943.66	5914073.85	13	2	Low Reef
	ECC_VID_29b-00011	0011	22/07/2022	06:46:24	352944.29	5914072.24	3	0.5	Not a Reef
	ECC_VID_29b-00012	0012	22/07/2022	06:46:36	352944.76	5914070.79	10	1	Not a Reef
	ECC_VID_29b-00013	0013	22/07/2022	06:46:45	352945.46	5914069.23	8	1.5	Not a Reef
	ECC_VID_29b-00014	0014	22/07/2022	06:46:55	352945.93	5914068.35	24	2	Low Reef
	ECC_VID_29b-00015	0015	22/07/2022	06:47:06	352946.06	5914067.12	7	0.5	Not a Reef
	ECC_VID_29b-00016	0016	22/07/2022	06:47:15	352946.69	5914065.72	19	1.5	Not a Reef
	ECC_VID_29b-00017	0017	22/07/2022	06:47:25	352946.85	5914064.77	25	1	Not a Reef
	ECC_VID_29b-00018	0018	22/07/2022	06:47:36	352947.87	5914062.92	17	0.5	Not a Reef
	ECC_VID_29b-00019	0019	22/07/2022	06:47:47	352948.43	5914061.65	21	2	Low Reef
	ECC_VID_29b-00020	0020	22/07/2022	06:47:56	352948.59	5914060.56	14	1.5	Not a Reef
	ECC_VID_29b-00021	0021	22/07/2022	06:48:08	352949.35	5914058.75	6	0.5	Not a Reef
	ECC_VID_29b-00022	0022	22/07/2022	06:48:17	352949.95	5914057.45	14	1.5	Not a Reef
	ECC_VID_29b-00023	0023	22/07/2022	06:48:26	352950.11	5914056.58	13	2	Low Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_29b-00024	0024	22/07/2022	06:48:35	352950.71	5914055.4	17	2	Low Reef
	ECC_VID_29b-00025	0025	22/07/2022	06:48:45	352951.31	5914054.03	8	0.5	Not a Reef
	ECC_VID_29b-00026	0026	22/07/2022	06:48:54	352952.44	5914051.5	41	2	Low Reef
	ECC_VID_29b-00027	0027	22/07/2022	06:49:05	352953.23	5914050.15	19	1	Not a Reef
	ECC_VID_29b-00028	0028	22/07/2022	06:49:15	352954.22	5914048.21	16	1	Not a Reef
	ECC_VID_29b-00029	0029	22/07/2022	06:49:30	352954.81	5914046.74	6	1	Not a Reef
	ECC_VID_29b-00030	0030	22/07/2022	06:49:39	352955.6	5914045.14	30	2	Low Reef
	ECC_VID_29b-00031	0031	22/07/2022	06:49:52	352955.85	5914043.91	13	0.7	Not a Reef
	ECC_VID_29b-00032	0032	22/07/2022	06:49:50	352955.68	5914044.61	0	0	-
	ECC_VID_29b-00033	0033	22/07/2022	06:50:10	352957.09	5914041.44	49	1.9	Not a Reef
	ECC_VID_29b-00034	0034	22/07/2022	06:50:23	352957.96	5914039.59	17	1	Not a Reef
	ECC_VID_29b-00035	0035	22/07/2022	06:50:31	352958.34	5914038.88	13	0.5	Not a Reef
	ECC_VID_29b-00036	0036	22/07/2022	06:50:42	352958.46	5914037.82	12	1	Not a Reef
	ECC_VID_29b-00037	0037	22/07/2022	06:50:51	352959.11	5914036.6	23	1.7	Not a Reef
	ECC_VID_29b-00038	0038	22/07/2022	06:50:59	352959.38	5914036.14	34	2	Low Reef
	ECC_VID_29b-00039	0039	22/07/2022	06:51:10	352959.59	5914034.11	12	1	Not a Reef
	ECC_VID_29b-00040	0040	22/07/2022	06:51:20	352960.31	5914032.25	9	0.3	Not a Reef
	ECC_VID_29b-00041	0041	22/07/2022	06:51:31	352960.75	5914031.52	4	0.5	Not a Reef
	ECC_VID_29b-00042	0042	22/07/2022	06:51:41	352961.32	5914029.81	8	1.5	Not a Reef
	ECC_VID_29b-00043	0043	22/07/2022	06:51:50	352961.94	5914028.65	7	1	Not a Reef
	ECC_VID_29b-00044	0044	22/07/2022	06:52:01	352962.49	5914027.01	20	4	Low Reef
	ECC_VID_29b-00045	0045	22/07/2022	06:52:10	352962.82	5914025.22	14	0.5	Not a Reef
	ECC_VID_29b-00046	0046	22/07/2022	06:52:20	352963.25	5914024.46	28	3	Low Reef
	ECC_VID_29b-00047	0047	22/07/2022	06:52:32	352963.79	5914022.73	9	1	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_29b-00048	0048	22/07/2022	06:53:16	352964.61	5914021.23	16	0.5	Not a Reef
	ECC_VID_29b-00049	0049	22/07/2022	06:53:26	No nav	No nav	5	1	Not a Reef
ECC_VID_34	ECC_VID_34-00010	1	21/07/2022	03:43:48	348183.98	5912135.91	90	0.5	Not a Reef
	ECC_VID_34-00011	2	21/07/2022	03:44:00	348183.06	5912135.84	90	0.5	Not a Reef
	ECC_VID_34-00012	3	21/07/2022	03:44:13	348181.85	5912135.27	98	0.5	Not a Reef
	ECC_VID_34-00013	4	21/07/2022	03:44:20	348180.85	5912134.95	95	0.5	Not a Reef
	ECC_VID_34-00014	5	21/07/2022	03:44:30	348179.96	5912134.65	93	0.5	Not a Reef
	ECC_VID_34-00015	6	21/07/2022	03:44:42	348178.78	5912134.26	96	0.5	Not a Reef
	ECC_VID_34-00016	7	21/07/2022	03:44:50	348177.7	5912133.79	98	0.5	Not a Reef
	ECC_VID_34-00017	8	21/07/2022	03:45:00	348176.06	5912133.6	98	0.7	Not a Reef
	ECC_VID_34-00018	9	21/07/2022	03:45:13	348174.35	5912132.82	93	0.5	Not a Reef
	ECC_VID_34-00019	10	21/07/2022	03:45:18	348173.38	5912132.05	85	0.5	Not a Reef
	ECC_VID_34-00020	11	21/07/2022	03:45:30	348171.67	5912131.45	97	0.5	Not a Reef
	ECC_VID_34-00021	12	21/07/2022	03:45:42	348170.02	5912130.87	88	0.5	Not a Reef
	ECC_VID_34-00001	13	21/07/2022	03:45:55	348168.04	5912130.2	98	1	Not a Reef
	ECC_VID_34-00023	14	21/07/2022	03:46:00	348167.23	5912129.29	96	0.9	Not a Reef
	ECC_VID_34-00024	15	21/07/2022	03:46:10	348165.66	5912128.4	98	0.5	Not a Reef
	ECC_VID_34-00002	16	21/07/2022	03:46:26	348163.56	5912127.49	94	0.5	Not a Reef
	ECC_VID_34-00026	17	21/07/2022	03:46:30	348163.2	5912127.16	96	0.5	Not a Reef
	ECC_VID_34-00027	18	21/07/2022	03:46:41	348161.74	5912126.46	98	0.5	Not a Reef
	ECC_VID_34-00028	19	21/07/2022	03:46:52	348160.84	5912126.42	80	0.5	Not a Reef
	ECC_VID_34-00029	20	21/07/2022	03:47:01	348159.08	5912125.47	98	0.8	Not a Reef
	ECC_VID_34-00030	21	21/07/2022	03:47:10	348158.51	5912125.38	98	0.5	Not a Reef
	ECC_VID_34-00031	22	21/07/2022	03:47:20	348156.67	5912124.88	97	0.7	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_34-00032	23	21/07/2022	03:47:30	348155.1	5912123.9	99	0.5	Not a Reef
	ECC_VID_34-00033	24	21/07/2022	03:47:40	348153.76	5912123.21	84	0.5	Not a Reef
	ECC_VID_34-00034	25	21/07/2022	03:47:50	348152.68	5912122.53	97	0.5	Not a Reef
	ECC_VID_34-00035	26	21/07/2022	03:48:01	348150.86	5912122.03	96	0.3	Not a Reef
	ECC_VID_34-00003	27	21/07/2022	03:48:16	348148.68	5912120.77	95	0.5	Not a Reef
	ECC_VID_34-00037	28	21/07/2022	03:48:20	348148	5912120.2	93	0.5	Not a Reef
	ECC_VID_34-00038	29	21/07/2022	03:48:32	348147.07	5912119.94	95	0.5	Not a Reef
	ECC_VID_34-00039	30	21/07/2022	03:48:41	348145.3	5912118.93	92	0.3	Not a Reef
	ECC_VID_34-00040	31	21/07/2022	03:48:52	348144.63	5912118.7	97	0.5	Not a Reef
	ECC_VID_34-00041	32	21/07/2022	03:49:01	348142.66	5912117.77	97	0.5	Not a Reef
	ECC_VID_34-00042	33	21/07/2022	03:49:12	348141.68	5912117.21	98	0.5	Not a Reef
	ECC_VID_34-00043	34	21/07/2022	03:49:22	348140.51	5912116.54	36	0.7	Not a Reef
	ECC_VID_34-00004	35	21/07/2022	03:49:28	348139.85	5912116.31	36	0.7	Not a Reef
	ECC_VID_34-00045	36	21/07/2022	03:49:41	348137.82	5912115.3	73	1	Not a Reef
	ECC_VID_34-00046	37	21/07/2022	03:49:50	348136.56	5912114.54	95	0.5	Not a Reef
	ECC_VID_34-00047	38	21/07/2022	03:50:03	348134.86	5912113.51	96	0.5	Not a Reef
	ECC_VID_34-00048	39	21/07/2022	03:50:13	348133.52	5912113.17	91	1.5	Not a Reef
	ECC_VID_34-00049	40	21/07/2022	03:50:21	348132.86	5912112.95	91	1.5	Not a Reef
ECC_VID_35	ECC_VID_35-00002	2	21/07/2022	22:28:30	349907.61	5912388.98	12	1	Not a Reef
	ECC_VID_35-00003	3	21/07/2022	22:28:40	349907.42	5912389.39	13	1.5	Not a Reef
	ECC_VID_35-00005	5	21/07/2022	22:28:54	349906.55	5912391.74	7	1	Not a Reef
	ECC_VID_35-00006	6	21/07/2022	22:29:01	349906.05	5912393	12	1	Not a Reef
	ECC_VID_35-00007	7	21/07/2022	22:29:09	349905.55	5912394.27	6	0.7	Not a Reef
	ECC_VID_35-00009	9	21/07/2022	22:29:20	349904.94	5912395.37	12	0.5	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_35-00010	10	21/07/2022	22:29:32	349904.2	5912397.1	9	1	Not a Reef
	ECC_VID_35-00012	12	21/07/2022	22:29:48	349903.51	5912398.92	8	1	Not a Reef
	ECC_VID_35-00014	14	21/07/2022	22:30:11	349902.29	5912402.14	9	0.5	Not a Reef
	ECC_VID_35-00001	15	21/07/2022	22:30:23	349901.62	5912403.42	8	1	Not a Reef
	ECC_VID_35-00016	16	21/07/2022	22:30:33	349901.24	5912405.16	8	1	Not a Reef
	ECC_VID_35-00018	18	21/07/2022	22:30:50	349900.67	5912407.02	5	0.5	Not a Reef
	ECC_VID_35-00019	19	21/07/2022	22:31:00	349899.92	5912408.21	2	0.2	Not a Reef
	ECC_VID_35-00020	20	21/07/2022	22:31:09	349899.58	5912409.02	20	2	Low Reef
	ECC_VID_35-00021	21	21/07/2022	22:31:20	349899.28	5912411.12	9	1	Not a Reef
	ECC_VID_35-00023	23	21/07/2022	22:31:33	349898.58	5912412.75	9	0.5	Not a Reef
	ECC_VID_35-00024	24	21/07/2022	22:31:41	349898.1	5912413.81	6	1	Not a Reef
	ECC_VID_35-00004	25	21/07/2022	22:31:55	349897.33	5912416.04	4	0.5	Not a Reef
	ECC_VID_35-00008	26	21/07/2022	22:32:10	349896.52	5912418.24	14	1	Not a Reef
	ECC_VID_35-00022	27	21/07/2022	22:32:15	349896.44	5912418.55	6	1	Not a Reef
	ECC_VID_35-00029	29	21/07/2022	22:32:31	349895.75	5912420.74	2	0.5	Not a Reef
	ECC_VID_35-00030	30	21/07/2022	22:32:44	349895.1	5912422.68	12	1.5	Not a Reef
	ECC_VID_35-00039	31	21/07/2022	22:32:52	349894.69	5912423.73	3	1	Not a Reef
	ECC_VID_35-00032	32	21/07/2022	22:33:07	349894.01	5912425.78	12	0.9	Not a Reef
	ECC_VID_35-00033	33	21/07/2022	22:33:14	349893.72	5912426.41	1	0.5	Not a Reef
	ECC_VID_35-00034	34	21/07/2022	22:33:25	349893.38	5912428.23	22	2	Low Reef
	ECC_VID_35-00040	35	21/07/2022	22:33:41	349892.2	5912430.62	22	1.5	Not a Reef
	ECC_VID_35-00036	36	21/07/2022	22:33:46	349891.98	5912431.28	0	0	-
	ECC_VID_35-00037	37	21/07/2022	22:33:55	349891.72	5912432.89	8	1	Not a Reef
	ECC_VID_35-00038	38	21/07/2022	22:34:06	349890.96	5912434.49	24	1.5	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
ECC_VID_57	ECC_VID_57-00026	1	20/07/2022	01:07:50	335384.31	5906157.48	22	4	Low Reef
	ECC_VID_57-00027	2	20/07/2022	01:07:57	335385.09	5906155.69	0	0	-
	ECC_VID_57-00028	3	20/07/2022	01:08:09	335385.73	5906154.11	32	2	Low Reef
	ECC_VID_57-00029	4	20/07/2022	01:08:20	335386.22	5906151.73	31	2	Low Reef
	ECC_VID_57-00030	5	20/07/2022	01:08:30	335386.77	5906150.44	0	0	-
	ECC_VID_57-00031	6	20/07/2022	01:08:39	335387.06	5906149.64	40	2	Low Reef
	ECC_VID_57-00032	7	20/07/2022	01:08:47	335387.61	5906148.55	2	2	Not a Reef
	ECC_VID_57-00033	8	20/07/2022	01:08:59	335388.37	5906146.64	0	0	-
	ECC_VID_57-00034	9	20/07/2022	01:09:10	335389	5906145.06	0	0	-
	ECC_VID_57-00035	10	20/07/2022	01:09:20	335389.75	5906142.99	2	0.5	Not a Reef
	ECC_VID_57-00036	11	20/07/2022	01:09:30	335390.29	5906141.76	25	1.5	Not a Reef
	ECC_VID_57-00037	12	20/07/2022	01:09:42	335390.72	5906140.25	0	0	-
	ECC_VID_57-00038	13	20/07/2022	01:09:53	335391.16	5906138.68	1	0.5	Not a Reef
	ECC_VID_57-00039	14	20/07/2022	01:10:04	335391.74	5906137.05	10	2	Low Reef
	ECC_VID_57-00040	15	20/07/2022	01:10:15	335392.55	5906135	0	0	-
	ECC_VID_57-00041	16	20/07/2022	01:10:26	335392.97	5906133.73	0	0	-
	ECC_VID_57-00042	17	20/07/2022	01:10:36	335393.56	5906132.17	22	2	Low Reef
	ECC_VID_57-00043	18	20/07/2022	01:10:48	335393.98	5906130.81	15	1	Not a Reef
	ECC_VID_57-00044	19	20/07/2022	01:11:00	335394.68	5906128.68	2	0.5	Not a Reef
	ECC_VID_57-00045	20	20/07/2022	01:11:10	335394.94	5906127.67	14		Not a Reef
	ECC_VID_57-00046	21	20/07/2022	01:11:20	335395.49	5906125.47	9	1	Not a Reef
	ECC_VID_57-00047	22	20/07/2022	01:11:30	335396.2	5906124.38	0	0	-
	ECC_VID_57-00048	23	20/07/2022	01:11:40	335396.48	5906122.98	0	0	-
	ECC_VID_57-00001	24	20/07/2022	01:11:55	335397.18	5906120.66	2	1	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_57-00050	25	20/07/2022	01:12:04	335397.62	5906119.67	36	3	Low Reef
	ECC_VID_57-00051	26	20/07/2022	01:12:15	335398.14	5906117.73	5	0.5	Not a Reef
	ECC_VID_57-00052	27	20/07/2022	01:12:24	335398.21	5906117.47	15	2	Low Reef
	ECC_VID_57-00053	28	20/07/2022	01:12:34	335398.88	5906115.58	22	2	Low Reef
	ECC_VID_57-00054	29	20/07/2022	01:12:42	335399.26	5906114.38	0	0	-
	ECC_VID_57-00056	31	20/07/2022	01:13:03	335400.35	5906111.29	3	1.5	Not a Reef
	ECC_VID_57-00057	32	20/07/2022	01:13:16	335401.1	5906109.1	32	2	Low Reef
	ECC_VID_57-00003	33	20/07/2022	01:13:30	335401.82	5906107.17	20	2	Low Reef
	ECC_VID_57-00059	34	20/07/2022	01:13:42	335402.42	5906105.81	0	0	-
	ECC_VID_57-00060	35	20/07/2022	01:13:51	335402.76	5906104.81	38	2	Low Reef
	ECC_VID_57-00004	37	20/07/2022	01:14:19	335403.24	5906103.38	8	1	Not a Reef
ECC_VID_59	ECC_VID_59-00037	1	19/07/2022	23:52:08	331370.04	5904298.05	42	1.5	Not a Reef
	ECC_VID_59-00002	2	19/07/2022	23:52:15	331369.9	5904298.45	0	0	-
	ECC_VID_59-00003	3	19/07/2022	23:52:25	331369.73	5904299.18	0	0	-
	ECC_VID_59-00004	4	19/07/2022	23:52:34	331369.43	5904300.66	25	1	Not a Reef
	ECC_VID_59-00005	5	19/07/2022	23:52:45	331368.89	5904301.93	0	0	-
	ECC_VID_59-00006	6	19/07/2022	23:52:55	331368.71	5904302.46	0	0	-
	ECC_VID_59-00007	7	19/07/2022	23:53:05	331368.19	5904303.67	0	0	-
	ECC_VID_59-00008	8	19/07/2022	23:53:19	331367.62	5904305	24	1	Not a Reef
	ECC_VID_59-00009	9	19/07/2022	23:53:25	331367.42	5904305.5	0	0	-
	ECC_VID_59-00010	10	19/07/2022	23:53:35	331367.09	5904306.53	0	0	-
	ECC_VID_59-00011	11	19/07/2022	23:53:45	331366.62	5904309.07	0	0	-
	ECC_VID_59-00012	12	19/07/2022	23:54:02	331365.25	5904311.94	30	1.5	Not a Reef
	ECC_VID_59-00013	13	19/07/2022	23:54:14	No nav	No nav	28	1	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_59-00014	14	19/07/2022	23:54:15	No nav	No nav	0	0	-
	ECC_VID_59-00015	15	19/07/2022	23:54:25	331364.33	5904315.08	0	0	-
	ECC_VID_59-00016	16	19/07/2022	23:54:35	331363.88	5904316.13	0	0	-
	ECC_VID_59-00017	17	19/07/2022	23:54:45	331363.21	5904317.34	0	0	-
	ECC_VID_59-00018	18	19/07/2022	23:54:55	331362.76	5904319.25	0	0	-
	ECC_VID_59-00019	19	19/07/2022	23:55:05	331362.15	5904320.96	0	0	-
	ECC_VID_59-00020	20	19/07/2022	23:55:15	331361.72	5904322.15	0	0	-
	ECC_VID_59-00021	21	19/07/2022	23:55:25	331361.19	5904323.37	0	0	-
	ECC_VID_59-00022	22	19/07/2022	23:55:35	331360.39	5904324.97	0	0	-
	ECC_VID_59-00023	23	19/07/2022	23:56:11	331358.23	5904330.15	12		Not a Reef
	ECC_VID_59-00024	24	19/07/2022	23:55:55	331359.37	5904327.59	0	0	-
	ECC_VID_59-00025	25	19/07/2022	23:56:05	331358.42	5904329.84	0	0	-
	ECC_VID_59-00026	26	19/07/2022	23:56:15	331358.07	5904330.77	0	0	-
	ECC_VID_59-00027	27	19/07/2022	23:56:25	331357.66	5904331.55	0	0	-
	ECC_VID_59-00028	28	19/07/2022	23:56:35	331356.99	5904333.18	0	0	-
	ECC_VID_59-00029	29	19/07/2022	23:56:45	331356.33	5904334.61	0	0	-
	ECC_VID_59-00030	30	19/07/2022	23:56:55	331355.73	5904335.71	0	0	-
	ECC_VID_59-00031	31	19/07/2022	23:57:05	331355.13	5904337.28	0	0	-
	ECC_VID_59-00032	32	19/07/2022	23:57:15	331354.36	5904338.92	0	0	-
	ECC_VID_59-00033	33	19/07/2022	23:57:25	331353.67	5904340.73	0	0	-
	ECC_VID_59-00034	34	19/07/2022	23:57:35	331353.23	5904341.73	0	0	-
	ECC_VID_59-00035	35	19/07/2022	23:57:45	331352.77	5904343.28	0	0	-
	ECC_VID_59-00036	36	19/07/2022	23:57:55	331352.02	5904344.97	0	0	-
ECC_VID_64	ECC_VID_64-00001	1	22/07/2022	15:34:41	355646.68	5913612.7	0	0	-

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_64-00002	2	22/07/2022	15:34:50	355646.63	5913613	0	0	-
	ECC_VID_64-00003	3	22/07/2022	15:35:00	355646.64	5913613.15	0	0	-
	ECC_VID_64-00004	4	22/07/2022	15:35:10	355646.47	5913613.05	0	0	-
	ECC_VID_64-00005	5	22/07/2022	15:35:20	355645.99	5913613.22	0	0	-
	ECC_VID_64-00006	6	22/07/2022	15:35:30	355645.1	5913613.41	0	0	-
	ECC_VID_64-00007	7	22/07/2022	15:35:41	355643.56	5913613.58	0	0	-
	ECC_VID_64-00008	8	22/07/2022	15:35:50	355642.45	5913613.88	0	0	-
	ECC_VID_64-00009	9	22/07/2022	15:35:59	355641.42	5913613.87	0	0	-
	ECC_VID_64-00010	10	22/07/2022	15:36:12	355639.8	5913613.38	0	0	-
	ECC_VID_64-00011	11	22/07/2022	15:36:30	355637.12	5913613.85	0	0	-
	ECC_VID_64-00012	12	22/07/2022	15:36:40	355635.27	5913613.82	0	0	-
	ECC_VID_64-00013	13	22/07/2022	15:36:50	355634.02	5913613.88	0	0	-
	ECC_VID_64-00014	14	22/07/2022	15:37:00	355632.37	5913614.05	0	0	-
	ECC_VID_64-00015	15	22/07/2022	15:37:10	355630.92	5913613.88	0	0	-
	ECC_VID_64-00016	16	22/07/2022	15:37:20	355630.27	5913614.14	0	0	-
	ECC_VID_64-00017	17	22/07/2022	15:37:31	355628.45	5913614.47	0	0	-
	ECC_VID_64-00018	18	22/07/2022	15:37:40	355626.99	5913614.51	0	0	-
	ECC_VID_64-00019	19	22/07/2022	15:37:49	355625.58	5913614.5	0	0	-
	ECC_VID_64-00020	20	22/07/2022	15:38:00	355624.29	5913614.73	0	0	-
	ECC_VID_64-00021	21	22/07/2022	15:38:10	355623.24	5913615	0	0	-
	ECC_VID_64-00022	22	22/07/2022	15:38:20	355621.62	5913614.99	0	0	-
	ECC_VID_64-00023	23	22/07/2022	15:38:30	355619.89	5913614.91	0	0	-
	ECC_VID_64-00024	24	22/07/2022	15:38:40	355618.39	5913615.02	0	0	-
	ECC_VID_64-00025	25	22/07/2022	15:38:52	355616.98	5913615.29	0	0	-

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_64-00026	26	22/07/2022	15:39:00	355615.37	5913615.15	0	0	-
	ECC_VID_64-00027	27	22/07/2022	15:39:10	355613.68	5913614.85	0	0	-
	ECC_VID_64-00028	28	22/07/2022	15:39:20	355612.2	5913614.79	0	0	-
	ECC_VID_64-00029	29	22/07/2022	15:39:31	355610.41	5913614.76	0	0	-
	ECC_VID_64-00117	30	22/07/2022	15:39:43	355608.61	5913614.6	0	0	-
	ECC_VID_64-00031	31	22/07/2022	15:39:51	355607.49	5913614.62	0	0	-
	ECC_VID_64-00032	32	22/07/2022	15:40:01	355605.81	5913614.66	0	0	-
	ECC_VID_64-00033	33	22/07/2022	15:40:10	355604.55	5913614.52	0	0	-
	ECC_VID_64-00034	34	22/07/2022	15:40:21	355602.69	5913614.7	0	0	-
	ECC_VID_64-00035	35	22/07/2022	15:40:31	355601.23	5913614.93	0	0	-
	ECC_VID_64-00036	36	22/07/2022	15:40:39	355600.54	5913614.83	0	0	-
	ECC_VID_64-00037	37	22/07/2022	15:40:50	355599.46	5913614.98	0	0	-
	ECC_VID_64-00038	38	22/07/2022	15:40:58	355597.79	5913615.15	0	0	-
	ECC_VID_64-00039	39	22/07/2022	15:41:11	355595.67	5913615.11	0	0	-
	ECC_VID_64-00040	40	22/07/2022	15:41:19	355594.45	5913615.36	0	0	-
	ECC_VID_64-00041	41	22/07/2022	15:41:34	355591.99	5913615.58	0	0	-
	ECC_VID_64-00042	42	22/07/2022	15:41:42	355590.63	5913615.58	0	0	-
	ECC_VID_64-00043	43	22/07/2022	15:41:53	355589.59	5913615.84	0	0	-
	ECC_VID_64-00044	44	22/07/2022	15:42:03	355587.81	5913615.82	0	0	-
	ECC_VID_64-00045	45	22/07/2022	15:42:13	355586.2	5913615.85	0	0	-
	ECC_VID_64-00046	46	22/07/2022	15:42:24	355584.4	5913615.78	0	0	-
	ECC_VID_64-00047	47	22/07/2022	15:42:34	355583.07	5913615.84	0	0	-
	ECC_VID_64-00048	48	22/07/2022	15:42:41	355581.59	5913615.97	0	0	-
	ECC_VID_64-00049	49	22/07/2022	15:42:54	355579.62	5913616.06	0	0	-

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_64-00050	50	22/07/2022	15:43:02	355578.63	5913615.86	0	0	-
	ECC_VID_64-00051	51	22/07/2022	15:43:12	355577	5913615.97	0	0	-
	ECC_VID_64-00052	52	22/07/2022	15:43:20	355576.13	5913616	0	0	-
	ECC_VID_64-00053	53	22/07/2022	15:43:31	355574.69	5913616.1	0	0	-
	ECC_VID_64-00054	54	22/07/2022	15:43:41	355573.04	5913616.3	0	0	-
	ECC_VID_64-00055	55	22/07/2022	15:43:51	355571.53	5913616.51	0	0	-
	ECC_VID_64-00056	56	22/07/2022	15:43:59	355570.47	5913616.43	0.5	0.2	Not a Reef
	ECC_VID_64-00057	57	22/07/2022	15:44:10	355568.59	5913616.34	0	0	-
	ECC_VID_64-00144	58	22/07/2022	15:44:24	355566.54	5913616.35	0	0	-
	ECC_VID_64-00195	59	22/07/2022	15:44:33	355565.16	5913616.27	1	1	Not a Reef
	ECC_VID_64-00060	60	22/07/2022	15:44:41	355564.08	5913616.25	4	2	Not a Reef
	ECC_VID_64-00196	61	22/07/2022	15:44:49	355562.44	5913616.19	4	2	Not a Reef
	ECC_VID_64-00203	62	22/07/2022	15:45:03	355560.41	5913616.33	8	2	Not a Reef
	ECC_VID_64-00063	63	22/07/2022	15:45:10	355559.12	5913616.57	2	3	Not a Reef
	ECC_VID_64-00064	64	22/07/2022	15:45:20	355557.47	5913616.44	4	1	Not a Reef
	ECC_VID_64-00065	65	22/07/2022	15:45:31	355556.02	5913616.31	1	1	Not a Reef
	ECC_VID_64-00066	66	22/07/2022	15:45:40	355554.15	5913616.24	8	1	Not a Reef
	ECC_VID_64-00241	67	22/07/2022	15:45:54	355552	5913616.39	2	2	Not a Reef
	ECC_VID_64-00068	68	22/07/2022	15:46:01	355550.78	5913616.27	0	0	-
	ECC_VID_64-00069	69	22/07/2022	15:46:10	355549.49	5913616.09	1	0.5	Not a Reef
	ECC_VID_64-00070	70	22/07/2022	15:46:21	355547.93	5913616.67	0	0	-
	ECC_VID_64-00071	71	22/07/2022	15:46:29	355546.7	5913616.62	0	0	-
	ECC_VID_64-00242	72	22/07/2022	15:46:38	355545.15	5913616.62	0	0	-
	ECC_VID_64-00243	73	22/07/2022	15:46:48	355543.42	5913617.01	2	1	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_64-00074	74	22/07/2022	15:47:01	355541.29	5913617.05	0	0	-
	ECC_VID_64-00075	75	22/07/2022	15:47:11	355539.74	5913617.25	0	0	-
	ECC_VID_64-00076	76	22/07/2022	15:47:20	355538.37	5913617.4	0	0	-
	ECC_VID_64-00244	77	22/07/2022	15:47:25	355537.6	5913617.42	1	1	Not a Reef
	ECC_VID_64-00245	78	22/07/2022	15:47:35	355536.26	5913617.34	2	1	Not a Reef
	ECC_VID_64-00079	79	22/07/2022	15:47:49	355534.48	5913617.2	4	0.5	Not a Reef
	ECC_VID_64-00246	80	22/07/2022	15:48:04	355532.24	5913617.27	11	1	Not a Reef
	ECC_VID_64-00081	81	22/07/2022	15:48:12	355530.79	5913617.32	0	0	-
	ECC_VID_64-00247	82	22/07/2022	15:48:23	355528.92	5913617.37	0	0	-
	ECC_VID_64-00083	83	22/07/2022	15:48:31	355527.83	5913617.45	7	1	Not a Reef
	ECC_VID_64-00084	84	22/07/2022	15:48:42	355526.05	5913617.58	17	2	Low Reef
	ECC_VID_64-00085	85	22/07/2022	15:48:52	355524.15	5913617.74	1	0.5	Not a Reef
	ECC_VID_64-00086	86	22/07/2022	15:49:00	355523	5913617.71	6	1	Not a Reef
	ECC_VID_64-00248	87	22/07/2022	15:49:08	355521.9	5913617.62	5	2	Not a Reef
	ECC_VID_64-00088	88	22/07/2022	15:49:19	355520.17	5913617.49	5	2	Not a Reef
	ECC_VID_64-00089	89	22/07/2022	15:49:28	355519.06	5913617.62	8	5	Not a Reef
	ECC_VID_64-00090	90	22/07/2022	15:49:42	355516.42	5913617.6	7	2	Not a Reef
	ECC_VID_64-00249	91	22/07/2022	15:49:52	355514.73	5913617.56	5	0.5	Not a Reef
	ECC_VID_64-00092	92	22/07/2022	15:49:59	355513.22	5913617.7	2	1	Not a Reef
	ECC_VID_64-00093	93	22/07/2022	15:50:10	355511.65	5913617.78	6	1	Not a Reef
	ECC_VID_64-00094	94	22/07/2022	15:50:20	355510.04	5913617.77	3	0.5	Not a Reef
	ECC_VID_64-00250	95	22/07/2022	15:50:34	355506.98	5913617.78	10	2	Low Reef
	ECC_VID_64-00251	96	22/07/2022	15:50:45	355505.4	5913617.81	4	1	Not a Reef
	ECC_VID_64-00097	97	22/07/2022	15:50:53	355504.19	5913617.88	4	1	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_64-00252	98	22/07/2022	15:51:02	355502.8	5913618.07	5	1.5	Not a Reef
	ECC_VID_64-00253	99	22/07/2022	15:51:10	355501.58	5913617.89	6	0.5	Not a Reef
	ECC_VID_64-00254	100	22/07/2022	15:51:19	355500.35	5913617.94	11	1.5	Not a Reef
	ECC_VID_64-00101	101	22/07/2022	15:51:33	355498.09	5913617.97	14	1	Not a Reef
	ECC_VID_64-00102	102	22/07/2022	15:51:45	355496.16	5913618.18	4	3	Not a Reef
	ECC_VID_64-00255	103	22/07/2022	15:51:54	355494.88	5913618.46	11	1.5	Not a Reef
	ECC_VID_64-00104	104	22/07/2022	15:52:09	355492.49	5913618.29	8	1	Not a Reef
	ECC_VID_64-00105	105	22/07/2022	15:52:19	355490.79	5913618.51	28	1	Not a Reef
	ECC_VID_64-00256	106	22/07/2022	15:52:28	355489.55	5913618.49	30	2	Low Reef
	ECC_VID_64-00107	107	22/07/2022	15:52:39	355487.83	5913618.69	7	1.5	Not a Reef
	ECC_VID_64-00257	108	22/07/2022	15:52:48	355486.72	5913618.81	9	1	Not a Reef
	ECC_VID_64-00109	109	22/07/2022	15:53:02	355484.19	5913618.74	5	1	Not a Reef
	ECC_VID_64-00110	110	22/07/2022	15:53:11	355482.89	5913618.64	8	2	Not a Reef
	ECC_VID_64-00258	111	22/07/2022	15:53:18	355481.8	5913618.74	8	2	Not a Reef
	ECC_VID_64-00112	112	22/07/2022	15:53:33	355479.07	5913619.08	0	0	-
	ECC_VID_64-00113	113	22/07/2022	15:53:41	355477.78	5913619.06	11	1	Not a Reef
	ECC_VID_64-00114	114	22/07/2022	15:53:53	355475.95	5913619	0	0	-
	ECC_VID_64-00115	115	22/07/2022	15:54:00	355475.26	5913619.3	9	1	Not a Reef
	ECC_VID_64-00116	116	22/07/2022	15:54:22	355472.5	5913619.64	10	1	Not a Reef
	ECC_VID_64-00118	118	22/07/2022	15:54:30	355471.08	5913619.52	20	1	Not a Reef
	ECC_VID_64-00119	119	22/07/2022	15:54:31	355471.21	5913619.41	10	1.5	Not a Reef
	ECC_VID_64-00120	120	22/07/2022	15:54:40	355469.79	5913619.48	15	0.5	Not a Reef
	ECC_VID_64-00121	121	22/07/2022	15:54:51	355467.99	5913619.67	7	2	Not a Reef
	ECC_VID_64-00122	122	22/07/2022	15:54:59	355466.68	5913619.46	3	0.5	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_64-00123	123	22/07/2022	15:55:11	355465.13	5913619.47	16	1	Not a Reef
	ECC_VID_64-00259	124	22/07/2022	15:55:22	355462.99	5913619.55	8	1.5	Not a Reef
	ECC_VID_64-00125	125	22/07/2022	15:55:31	355461.66	5913619.3	25	1.5	Not a Reef
	ECC_VID_64-00126	126	22/07/2022	15:55:39	355460.4	5913619.25	17	1	Not a Reef
	ECC_VID_64-00127	127	22/07/2022	15:55:48	355459.17	5913618.97	21	1.5	Not a Reef
	ECC_VID_64-00127a	127a	22/07/2022	15:56:00	355457.28	5913619.48	23	1	Not a Reef
	ECC_VID_64-00128	128	22/07/2022	15:56:09	355456.08	5913619.55	2	1	Not a Reef
	ECC_VID_64-00129	129	22/07/2022	15:56:22	355453.97	5913619.94	4	1	Not a Reef
	ECC_VID_64-00130	130	22/07/2022	15:56:31	355452.63	5913619.77	9	1	Not a Reef
	ECC_VID_64-00131	131	22/07/2022	15:56:44	355450.28	5913619.7	7	1.5	Not a Reef
	ECC_VID_64-00132	132	22/07/2022	15:56:53	355449.02	5913619.68	12	1.5	Not a Reef
	ECC_VID_64-00133	133	22/07/2022	15:57:00	355448.51	5913619.38	4	1	Not a Reef
	ECC_VID_64-00260	134	22/07/2022	15:57:09	355447.42	5913619.55	45	0.5	Not a Reef
	ECC_VID_64-00135	135	22/07/2022	15:57:20	355445.22	5913620.1	5	1	Not a Reef
	ECC_VID_64-00136	136	22/07/2022	15:57:28	355443.97	5913620.05	9	1	Not a Reef
	ECC_VID_64-00137	137	22/07/2022	15:57:38	355442.37	5913620.11	13	1.5	Not a Reef
	ECC_VID_64-00261	138	22/07/2022	15:57:53	355439.51	5913620.43	35	3	Low Reef
	ECC_VID_64-00139	139	22/07/2022	15:58:01	355438.68	5913620.24	4	1.7	Not a Reef
	ECC_VID_64-00140	140	22/07/2022	15:58:10	355437.21	5913620.09	9	0.5	Not a Reef
	ECC_VID_64-00141	141	22/07/2022	15:58:23	355435.38	5913620.29	8	0.3	Not a Reef
	ECC_VID_64-00142	142	22/07/2022	15:58:31	355434.6	5913620.32	17	1	Not a Reef
	ECC_VID_64-00143	143	22/07/2022	15:58:39	355433.5	5913620.25	8	0.3	Not a Reef
	ECC_VID_64-00145	145	22/07/2022	15:58:47	355432.03	5913620.35	0	0	-
	ECC_VID_64-00146	146	22/07/2022	15:58:56	355430.45	5913620.25	11	0.3	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_64-00147	147	22/07/2022	15:59:06	355428.84	5913620.55	36	4	Low Reef
	ECC_VID_64-00148	148	22/07/2022	15:59:22	355425.65	5913620.75	2	0.5	Not a Reef
	ECC_VID_64-00149	149	22/07/2022	15:59:28	355424.66	5913620.69	11	1	Not a Reef
	ECC_VID_64-00150	150	22/07/2022	15:59:41	355422.64	5913620.46			
	ECC_VID_64-00151	151	22/07/2022	15:59:50	355421.16	5913620.4	20	1	Not a Reef
	ECC_VID_64-00152	152	22/07/2022	15:59:57	355419.97	5913620.43	24	2	Low Reef
	ECC_VID_64-00153	153	22/07/2022	16:00:07	355418.35	5913620.59	15	1.8	Not a Reef
	ECC_VID_64-00154	154	22/07/2022	16:00:20	355416.69	5913620.6	12	2	Low Reef
	ECC_VID_64-00155	155	22/07/2022	16:00:33	355414.44	5913620.71	12	1.5	Not a Reef
	ECC_VID_64-00155a	155a	22/07/2022	16:00:43	355413.23	5913620.72	8	1	Not a Reef
	ECC_VID_64-00156	156	22/07/2022	16:00:50	355411.96	5913620.98	17	5	Low Reef
	ECC_VID_64-00157	157	22/07/2022	16:01:05	355409.72	5913621.1	24	7	Medium Reef
	ECC_VID_64-00158	158	22/07/2022	16:01:15	355408.1	5913621.13	29	1	Not a Reef
	ECC_VID_64-00159	159	22/07/2022	16:01:28	355405.68	5913621.35	55	0.5	Not a Reef
	ECC_VID_64-00160	160	22/07/2022	16:01:35	355404.7	5913621.49	14	0.5	Not a Reef
	ECC_VID_64-00161	161	22/07/2022	16:01:45	355403.28	5913621.57	6	1	Not a Reef
	ECC_VID_64-00162	162	22/07/2022	16:01:56	355401.49	5913621.74	6	1.5	Not a Reef
	ECC_VID_64-00163	163	22/07/2022	16:02:06	355399.62	5913621.85	24	1	Not a Reef
	ECC_VID_64-00164	164	22/07/2022	16:02:15	355398.2	5913622	11	2	Low Reef
	ECC_VID_64-00165	165	22/07/2022	16:02:24	355396.88	5913621.78	8	1	Not a Reef
	ECC_VID_64-00166	166	22/07/2022	16:02:33	355395.7	5913621.69	10	0.5	Not a Reef
	ECC_VID_64-00167	167	22/07/2022	16:02:41	355394.43	5913621.53	22	2	Low Reef
	ECC_VID_64-00168	168	22/07/2022	16:02:54	355392.3	5913621.59	13	2	Low Reef
	ECC_VID_64-00169	169	22/07/2022	16:03:03	355390.97	5913621.63	2	1	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_64-00170	170	22/07/2022	16:03:15	355389.25	5913621.89	5	1	Not a Reef
	ECC_VID_64-00171	171	22/07/2022	16:03:29	355386.86	5913621.83	15	1.5	Not a Reef
	ECC_VID_64-00172	172	22/07/2022	16:03:38	355385.58	5913621.85	10	1	Not a Reef
	ECC_VID_64-00173	173	22/07/2022	16:03:51	355383.6	5913621.96	17	2	Low Reef
	ECC_VID_64-00174	174	22/07/2022	16:04:00	355382.27	5913621.83	15	2	Low Reef
	ECC_VID_64-00175	175	22/07/2022	16:04:08	355381.09	5913621.98	17	1	Not a Reef
	ECC_VID_64-00176	176	22/07/2022	16:04:22	355378.66	5913622.21	7	1	Not a Reef
	ECC_VID_64-00177	177	22/07/2022	16:04:32	355377.53	5913622.19	37	2	Low Reef
	ECC_VID_64-00178	178	22/07/2022	16:04:40	355376.31	5913622.19	25	1	Not a Reef
	ECC_VID_64-00179	179	22/07/2022	16:04:53	355374.04	5913622.19	25	4	Low Reef
	ECC_VID_64-00180	180	22/07/2022	16:05:01	355372.95	5913622.1	32	7	Medium Reef
	ECC_VID_64-00181	181	22/07/2022	16:05:14	355370.75	5913621.92	5	2	Not a Reef
	ECC_VID_64-00182	182	22/07/2022	16:05:23	355369.56	5913622.06	17	1.5	Not a Reef
	ECC_VID_64-00183	183	22/07/2022	16:05:33	355368.11	5913622.3	29	0.5	Not a Reef
	ECC_VID_64-00184	184	22/07/2022	16:05:42	355366.5	5913622.21	47	2	Low Reef
	ECC_VID_64-00185	185	22/07/2022	16:05:52	355364.63	5913622.47	32	1.5	Not a Reef
	ECC_VID_64-00186	186	22/07/2022	16:06:00	355363.62	5913622.48	43	2	Low Reef
	ECC_VID_64-00187	187	22/07/2022	16:06:13	355361.36	5913622.4	28	2	Low Reef
	ECC_VID_64-00188	188	22/07/2022	16:06:21	355360.22	5913622.41	30	1.5	Not a Reef
	ECC_VID_64-00189	189	22/07/2022	16:06:30	355358.9	5913622.54	36	2	Low Reef
	ECC_VID_64-00190	190	22/07/2022	16:06:44	355356.67	5913622.73	25	1	Not a Reef
	ECC_VID_64-00191	191	22/07/2022	16:06:56	355354.53	5913622.94	10	0.5	Not a Reef
	ECC_VID_64-00192	192	22/07/2022	16:07:09	355352.49	5913622.95	14	2	Low Reef
	ECC_VID_64-00193	193	22/07/2022	16:07:17	355351.4	5913622.94	20	0.5	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_64-00194	194	22/07/2022	16:07:28	355349.7	5913623.07	38	1	Not a Reef
	ECC_VID_64-00197	197	22/07/2022	16:07:35	355348.65	5913623.13	31	1	Not a Reef
	ECC_VID_64-00198	198	22/07/2022	16:07:46	355347.25	5913623.51	50	1	Not a Reef
	ECC_VID_64-00199	199	22/07/2022	16:07:59	355344.92	5913623.25	21	1	Not a Reef
	ECC_VID_64-00200	200	22/07/2022	16:08:07	355344.1	5913623.19	55	1	Not a Reef
	ECC_VID_64-00201	201	22/07/2022	16:08:18	355342.11	5913623.58	54	1	Not a Reef
	ECC_VID_64-00202	202	22/07/2022	16:08:29	355340.13	5913623.53	23	1.5	Not a Reef
	ECC_VID_64-00204	204	22/07/2022	16:08:38	355338.53	5913623.63	33	4	Low Reef
	ECC_VID_64-00205	205	22/07/2022	16:08:50	355335.62	5913623.68	46	1.5	Not a Reef
	ECC_VID_64-00206	206	22/07/2022	16:08:59	355334.34	5913623.62	64	1	Not a Reef
	ECC_VID_64-00207	207	22/07/2022	16:09:14	355332.05	5913623.65	34	3	Low Reef
	ECC_VID_64-00208	208	22/07/2022	16:09:23	355330.6	5913623.71	39	3	Low Reef
	ECC_VID_64-00209	209	22/07/2022	16:09:34	355329.61	5913623.93	48	2	Low Reef
	ECC_VID_64-00210	210	22/07/2022	16:09:44	355328.37	5913623.86	20	2	Low Reef
	ECC_VID_64-00211	211	22/07/2022	16:09:58	355325.71	5913623.89	28	1.5	Not a Reef
	ECC_VID_64-00212	212	22/07/2022	16:10:10	355323.63	5913623.83	28	1.5	Not a Reef
	ECC_VID_64-00213	213	22/07/2022	16:10:19	355322.15	5913623.66	27	1	Not a Reef
	ECC_VID_64-00214	214	22/07/2022	16:10:31	355320.28	5913623.49	41	1.5	Not a Reef
	ECC_VID_64-00215	215	22/07/2022	16:10:39	355319.48	5913623.4	55	5	Medium Reef
	ECC_VID_64-00216	216	22/07/2022	16:10:51	355317.18	5913623.27	32	1	Not a Reef
	ECC_VID_64-00217	217	22/07/2022	16:11:00	355315.89	5913623.37	38	2	Low Reef
	ECC_VID_64-00218	218	22/07/2022	16:11:08	355315.04	5913623.44	62	1	Not a Reef
	ECC_VID_64-00219	219	22/07/2022	16:11:23	355312.41	5913624.05	45	5	Medium Reef
	ECC_VID_64-00220	220	22/07/2022	16:11:31	355311.27	5913624.11	45	8	Medium Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_64-00221	221	22/07/2022	16:11:44	355309.15	5913624.13	0	0	-
	ECC_VID_64-00222	222	22/07/2022	16:11:53	355308.53	5913624.23	15	1.5	Not a Reef
	ECC_VID_64-00223	223	22/07/2022	16:12:06	355306.52	5913624.42	16	1	Not a Reef
	ECC_VID_64-00224	224	22/07/2022	16:12:15	355305.28	5913624.58	13	0.5	Not a Reef
	ECC_VID_64-00225	225	22/07/2022	16:12:26	355303.39	5913624.58	26	1	Not a Reef
	ECC_VID_64-00226	226	22/07/2022	16:12:36	355302.11	5913624.71	18	4	Low Reef
	ECC_VID_64-00227	227	22/07/2022	16:12:45	355300.01	5913624.8	22	0.5	Not a Reef
	ECC_VID_64-00228	228	22/07/2022	16:12:55	355298.27	5913624.86	18	1	Not a Reef
	ECC_VID_64-00229	229	22/07/2022	16:13:08	355295.75	5913624.92	30	2	Low Reef
	ECC_VID_64-00230	230	22/07/2022	16:13:19	355294.48	5913624.98	31	1.5	Not a Reef
	ECC_VID_64-00231	231	22/07/2022	16:13:33	355292	5913624.92	26	1.5	Not a Reef
	ECC_VID_64-00232	232	22/07/2022	16:13:47	355289.66	5913625.29	63	3	Low Reef
	ECC_VID_64-00233	233	22/07/2022	15:13:55	355657.53	5913613.46	0	0	-
	ECC_VID_64-00234	234	22/07/2022	16:14:04	355286.85	5913624.89	24	3	Low Reef
	ECC_VID_64-00235	235	22/07/2022	16:14:17	355284.62	5913625.29	40	2	Low Reef
	ECC_VID_64-00236	236	22/07/2022	16:14:26	355283.06	5913625.15	53	1	Not a Reef
	ECC_VID_64-00237	237	22/07/2022	16:14:35	355281.39	5913625.16	30	1	Not a Reef
	ECC_VID_64-00238	238	22/07/2022	16:14:44	355280.6	5913625.12	6	1	Not a Reef
	ECC_VID_64-00239	239	22/07/2022	16:14:54	355279.04	5913625.51	72	3	Low Reef
	ECC_VID_64-00240	240	22/07/2022	16:14:31	355282.19	5913625.28	19	3	Low Reef
ECC_VID_65	ECC_VID_65-00079	1	22/07/2022	22:17:39	352580.04	5913242.23	10	3	Low Reef
	ECC_VID_65-00004	4	22/07/2022	22:17:55	352582.4	5913242.39	16	2	Low Reef
	ECC_VID_65-00005	5	22/07/2022	22:18:06	352584.05	5913242.3	25	3	Low Reef
	ECC_VID_65-00107	6	22/07/2022	22:18:19	352585.99	5913242.11	6	4	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_65-00131	7	22/07/2022	22:18:25	352586.74	5913242.17	0	0	-
	ECC_VID_65-00008	8	22/07/2022	22:18:35	352588.59	5913241.86	19	4	Low Reef
	ECC_VID_65-00009	9	22/07/2022	22:18:45	352590.5	5913241.62	12	3	Low Reef
	ECC_VID_65-00143	10	22/07/2022	22:18:59	352592.2	5913241.26	9	3	Not a Reef
	ECC_VID_65-00011	11	22/07/2022	22:19:06	352593.31	5913241.3	6	3	Not a Reef
	ECC_VID_65-00169	12	22/07/2022	22:19:17	352595.37	5913241.04	18	3	Low Reef
	ECC_VID_65-00013	13	22/07/2022	22:19:25	352595.89	5913240.61	10	2	Low Reef
	ECC_VID_65-00170	14	22/07/2022	22:19:41	352598.61	5913240.35	15	2	Low Reef
	ECC_VID_65-00016	16	22/07/2022	22:19:55	352601.02	5913240.58	0	0	-
	ECC_VID_65-00171	17	22/07/2022	22:20:03	352602.24	5913240.68	3	1	Not a Reef
	ECC_VID_65-00172	18	22/07/2022	22:20:12	352603.52	5913240.73	6	1	Not a Reef
	ECC_VID_65-00173	19	22/07/2022	22:20:20	352604.71	5913240.53	6	0.5	Not a Reef
	ECC_VID_65-00174	20	22/07/2022	22:20:32	352606.5	5913240.51	4	0.5	Not a Reef
	ECC_VID_65-00175	21	22/07/2022	22:20:40	352607.72	5913240.6	11	1	Not a Reef
	ECC_VID_65-00022	22	22/07/2022	22:20:55	352610.12	5913240.54	3	1	Not a Reef
	ECC_VID_65-00176	23	22/07/2022	22:21:07	352612.22	5913240.46	29	2	Low Reef
	ECC_VID_65-00177	24	22/07/2022	22:21:15	352613.37	5913240.5	10	1	Not a Reef
	ECC_VID_65-00025	25	22/07/2022	22:21:24	352614.7	5913240.52	14	0.5	Not a Reef
	ECC_VID_65-00026	26	22/07/2022	22:21:33	352615.6	5913240.82	22	1	Not a Reef
	ECC_VID_65-00027	27	22/07/2022	22:21:46	352617.73	5913240.64	21	2	Low Reef
	ECC_VID_65-00028	28	22/07/2022	22:21:54	352619.08	5913240.61	11	2	Low Reef
	ECC_VID_65-00029	29	22/07/2022	22:22:07	352621.17	5913240.35	24	5	Medium Reef
	ECC_VID_65-00030	30	22/07/2022	22:22:15	352622.27	5913239.93	0	0	-
	ECC_VID_65-00031	31	22/07/2022	22:22:25	352624.11	5913240.16	18	3	Low Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_65-00032	32	22/07/2022	22:22:35	352625.66	5913240.2	0	0	-
	ECC_VID_65-00033	33	22/07/2022	22:22:43	352627	5913240.36	18	3	Low Reef
	ECC_VID_65-00178	34	22/07/2022	22:22:50	352628.35	5913240.34	23	1	Not a Reef
	ECC_VID_65-00179	35	22/07/2022	22:23:03	352630.32	5913240.19	15	1.5	Not a Reef
	ECC_VID_65-00180	36	22/07/2022	22:23:11	352631.33	5913240.33	14	1.5	Not a Reef
	ECC_VID_65-00038	38	22/07/2022	22:23:35	352635.32	5913240.31	0	0	-
	ECC_VID_65-00039	39	22/07/2022	22:23:45	352637.02	5913240.22	0	0	-
	ECC_VID_65-00040	40	22/07/2022	22:23:55	352638.59	5913240.13	0	0	-
	ECC_VID_65-00041	41	22/07/2022	22:23:54	352638.47	5913240.2	19	2	Low Reef
	ECC_VID_65-00042	42	22/07/2022	22:24:15	352641.74	5913240.31	0	0	-
	ECC_VID_65-00181	43	22/07/2022	22:24:20	352642.45	5913240.05	15	0.5	Not a Reef
	ECC_VID_65-00037	37	22/07/2022	22:24:36	352645.13	5913240.04	9	1	Not a Reef
	ECC_VID_65-00045	45	22/07/2022	22:24:43	352646.29	5913239.81	2	1	Not a Reef
	ECC_VID_65-00046	46	22/07/2022	22:24:57	352648.48	5913239.88	8	2	Not a Reef
	ECC_VID_65-00182	47	22/07/2022	22:25:04	352649.07	5913239.47	26	3	Low Reef
	ECC_VID_65-00183	48	22/07/2022	22:25:14	352650.83	5913239.56	35	4	Low Reef
	ECC_VID_65-00184	49	22/07/2022	22:25:30	352653.36	5913239.46	26	1	Not a Reef
	ECC_VID_65-00185	50	22/07/2022	22:25:39	352654.44	5913239.53	16	1.5	Not a Reef
	ECC_VID_65-00051	51	22/07/2022	22:25:45	352655.53	5913239.61	0	0	-
	ECC_VID_65-00052	52	22/07/2022	22:25:58	352657.65	5913239.69	16	2	Low Reef
	ECC_VID_65-00053	53	22/07/2022	22:26:05	352658.4	5913239.36	19	3	Low Reef
	ECC_VID_65-00054	54	22/07/2022	22:26:15	352659.94	5913239.28	0	0	-
	ECC_VID_65-00055	55	22/07/2022	22:26:25	352662.06	5913239.73	26	5	Medium Reef
	ECC_VID_65-00186	56	22/07/2022	22:26:36	352662.7	5913239.84	20	3	Low Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_65-00187	57	22/07/2022	22:26:50	352665.04	5913239.87	40	2	Low Reef
	ECC_VID_65-00058	58	22/07/2022	22:26:55	352665.69	5913239.77	0	0	-
	ECC_VID_65-00059	59	22/07/2022	22:27:07	352667.78	5913239.66	17	2	Low Reef
	ECC_VID_65-00060	60	22/07/2022	22:27:15	352668.89	5913239.83	0	0	-
	ECC_VID_65-00061	61	22/07/2022	22:27:25	352670.72	5913240.03	0	0	-
	ECC_VID_65-00062	62	22/07/2022	22:27:35	352672.37	5913240.28	0	0	-
	ECC_VID_65-00063	63	22/07/2022	22:27:45	352673.77	5913240.33	0	0	-
	ECC_VID_65-00064	64	22/07/2022	22:27:55	352675.39	5913240.17	0	0	-
	ECC_VID_65-00188	65	22/07/2022	22:28:02	352676.56	5913240.12	7	2	Not a Reef
	ECC_VID_65-00189	66	22/07/2022	22:28:10	352677.82	5913240.35	40	1.5	Not a Reef
	ECC_VID_65-00067	67	22/07/2022	22:28:25	352680.38	5913240.73	0	0	-
	ECC_VID_65-00190	68	22/07/2022	22:28:27	352680.53	5913240.76	23	4	Low Reef
	ECC_VID_65-00191	69	22/07/2022	22:28:39	352682.78	5913240.86	36	2	Low Reef
	ECC_VID_65-00070	70	22/07/2022	22:28:55	352684.9	5913240.32	0	0	-
	ECC_VID_65-00192	71	22/07/2022	22:29:02	352686.26	5913240.28	11	1	Not a Reef
	ECC_VID_65-00072	72	22/07/2022	22:29:15	352688.3	5913239.87	0	0	-
	ECC_VID_65-00073	73	22/07/2022	22:29:25	352690.12	5913239.42	0	0	-
	ECC_VID_65-00193	74	22/07/2022	22:29:34	352691.42	5913239.24	12	1	Not a Reef
	ECC_VID_65-00075	75	22/07/2022	22:29:45	352693.17	5913239.36	0	0	-
	ECC_VID_65-00194	76	22/07/2022	22:29:52	352693.89	5913239.54	29	2	Low Reef
	ECC_VID_65-00195	77	22/07/2022	22:30:02	352695.42	5913239.58	10	1.5	Not a Reef
	ECC_VID_65-00078	78	22/07/2022	22:30:15	352697.6	5913239.57	0	0	-
	ECC_VID_65-00196	79	22/07/2022	22:30:24	352699.12	5913239.52	23	5	Medium Reef
	ECC_VID_65-00197	80	22/07/2022	22:30:32	352700.21	5913239.61	22	1	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_65-00198	81	22/07/2022	22:30:49	352702.91	5913239.51	9	0.5	Not a Reef
	ECC_VID_65-00082	82	22/07/2022	22:30:55	352703.9	5913239.59	0	0	-
	ECC_VID_65-00199	83	22/07/2022	22:31:05	352705.63	5913239.82	21	2	Low Reef
	ECC_VID_65-00085	85	22/07/2022	22:31:14	352706.92	5913239.67	23	2	Low Reef
	ECC_VID_65-00086	86	22/07/2022	22:31:35	352710.23	5913239.69	0	0	-
	ECC_VID_65-00087	87	22/07/2022	22:31:45	352711.55	5913239.85	0	0	-
	ECC_VID_65-00201	88	22/07/2022	22:31:57	352713.47	5913239.49	15	1	Not a Reef
	ECC_VID_65-00202	89	22/07/2022	22:32:05	352714.13	5913239.41	12	1.5	Not a Reef
	ECC_VID_65-00203	90	22/07/2022	22:32:12	352715.06	5913239.32	14	1.5	Not a Reef
	ECC_VID_65-00091	91	22/07/2022	22:32:25	352717.93	5913239.66	0	0	-
	ECC_VID_65-00204	92	22/07/2022	22:32:28	352718.51	5913239.61	19	1	Not a Reef
	ECC_VID_65-00205	93	22/07/2022	22:32:35	352719.5	5913239.78	17	1.5	Not a Reef
	ECC_VID_65-00206	94	22/07/2022	22:32:48	352721.74	5913239.87	14	4	Low Reef
	ECC_VID_65-00095	95	22/07/2022	22:32:56	352722.91	5913239.83	24	2	Low Reef
	ECC_VID_65-00096	96	22/07/2022	22:33:05	352724.35	5913239.57	47	3	Low Reef
	ECC_VID_65-00097	97	22/07/2022	22:33:14	352725.42	5913239.39	10	1	Not a Reef
	ECC_VID_65-00098	98	22/07/2022	22:33:25	352725.89	5913239.27	23	2	Low Reef
	ECC_VID_65-00207	99	22/07/2022	22:33:36	352728.16	5913238.89	21	1.5	Not a Reef
	ECC_VID_65-00100	100	22/07/2022	22:33:55	352731.57	5913238.91	0	0	-
	ECC_VID_65-00101	101	22/07/2022	22:34:05	352733.05	5913238.34	0	0	-
	ECC_VID_65-00102	102	22/07/2022	22:34:15	352734.61	5913238.27	0	0	-
	ECC_VID_65-00103	103	22/07/2022	22:34:25	352736.11	5913238.15	0	0	-
	ECC_VID_65-00104	104	22/07/2022	22:34:35	352737.67	5913238.18	0	0	-
	ECC_VID_65-00105	105	22/07/2022	22:34:45	352739.39	5913238.44	0	0	-

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_65-00106	106	22/07/2022	22:34:55	352740.87	5913238.18	0	0	-
	ECC_VID_65-00208	107	22/07/2022	22:34:01	352732.42	5913238.52	22	1	Not a Reef
	ECC_VID_65-00108	108	22/07/2022	22:34:58	352741.24	5913238.14	38	2	Low Reef
	ECC_VID_65-00109	109	22/07/2022	22:35:25	352746.1	5913238.18	0	0	-
	ECC_VID_65-00110	110	22/07/2022	22:35:35	352747.69	5913238.44	0	0	-
	ECC_VID_65-00111	111	22/07/2022	22:35:45	352749.12	5913238.59	0	0	-
	ECC_VID_65-00112	112	22/07/2022	22:35:55	352750.61	5913238.73	0	0	-
	ECC_VID_65-00113	113	22/07/2022	22:36:05	352752.24	5913238.55	0	0	-
	ECC_VID_65-00114	114	22/07/2022	22:36:15	352753.77	5913238.74	0	0	-
	ECC_VID_65-00115	115	22/07/2022	22:36:25	352755.61	5913238.17	0	0	-
	ECC_VID_65-00116	116	22/07/2022	22:36:35	352757	5913238.31	0	0	-
	ECC_VID_65-00209	117	22/07/2022	22:36:26	352755.77	5913238.21	35	3	Low Reef
	ECC_VID_65-00118	118	22/07/2022	22:36:55	352759.63	5913238.24	0	0	-
	ECC_VID_65-00119	119	22/07/2022	22:36:45	352758.59	5913238.34	52	2	Low Reef
	ECC_VID_65-00210	120	22/07/2022	22:36:54	352759.44	5913238.09	20	1	Not a Reef
	ECC_VID_65-00211	121	22/07/2022	22:37:02	352760.63	5913237.75	36	4	Low Reef
	ECC_VID_65-00122	122	22/07/2022	22:37:35	352766.31	5913237.5	0	0	-
	ECC_VID_65-00123	123	22/07/2022	22:37:45	352767.82	5913237.22	0	0	-
	ECC_VID_65-00124	124	22/07/2022	22:37:55	352769.61	5913237.21	0	0	-
	ECC_VID_65-00125	125	22/07/2022	22:38:05	352770.98	5913237.53	0	0	-
	ECC_VID_65-00126	126	22/07/2022	22:38:15	352772.58	5913238.04	0	0	-
	ECC_VID_65-00127	127	22/07/2022	22:38:25	352774.25	5913238.34	0	0	-
	ECC_VID_65-00128	128	22/07/2022	22:38:35	352775.79	5913238.22	0	0	-
	ECC_VID_65-00129	129	22/07/2022	22:38:45	352777.18	5913238.31	0	0	-

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_65-00130	130	22/07/2022	22:38:36	352775.96	5913238.38	43	1	Not a Reef
	ECC_VID_65-00132	132	22/07/2022	22:38:43	352776.78	5913238.14	50	3	Low Reef
	ECC_VID_65-00133	133	22/07/2022	22:39:25	352783.01	5913237.26	0	0	-
	ECC_VID_65-00134	134	22/07/2022	22:39:35	352784.68	5913237.44	0	0	-
	ECC_VID_65-00135	135	22/07/2022	22:39:45	352785.36	5913237.53	0	0	-
	ECC_VID_65-00136	136	22/07/2022	22:39:55	352787.17	5913237.46	0	0	-
	ECC_VID_65-00137	137	22/07/2022	22:39:35	No nav	No nav	44	3	Low Reef
	ECC_VID_65-00139	139	22/07/2022	22:39:43	352785.07	5913237.14	29		Not a Reef
	ECC_VID_65-00140	140	22/07/2022	22:40:35	352794.05	5913237.67	0	0	-
	ECC_VID_65-00141	141	22/07/2022	22:40:45	352795.73	5913237.92	0	0	-
	ECC_VID_65-00142	142	22/07/2022	22:40:55	352797.62	5913237.76	0	0	-
	ECC_VID_65-00212	143	22/07/2022	22:40:20	352792.13	5913238.08	32	5	Medium Reef
	ECC_VID_65-00144	144	22/07/2022	22:40:28	352793.35	5913238.04	40	2	Low Reef
	ECC_VID_65-00145	145	22/07/2022	22:40:35	No nav	No nav	58	1.5	Not a Reef
	ECC_VID_65-00146	146	22/07/2022	23:40:35	352829.93	5913237.19	0	0	-
	ECC_VID_65-00147	147	22/07/2022	22:41:45	352806.07	5913238.15	0	0	-
	ECC_VID_65-00148	148	22/07/2022	22:41:55	352807.74	5913238.22	0	0	-
	ECC_VID_65-00149	149	22/07/2022	22:42:05	352809.3	5913237.93	0	0	-
	ECC_VID_65-00150	150	22/07/2022	22:42:15	352810.73	5913237.96	0	0	-
	ECC_VID_65-00151	151	22/07/2022	22:42:25	352812.18	5913237.9	0	0	-
	ECC_VID_65-00152	152	22/07/2022	22:42:35	352813.57	5913237.72	0	0	-
	ECC_VID_65-00153	153	22/07/2022	22:42:45	352815.24	5913237.61	0	0	-
	ECC_VID_65-00154	154	22/07/2022	22:42:55	352816.58	5913236.79	0	0	-
	ECC_VID_65-00155	155	22/07/2022	22:43:05	352817.92	5913236.49	0	0	-

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_65-00156	156	22/07/2022	22:43:15	352819.66	5913236.53	0	0	-
	ECC_VID_65-00157	157	22/07/2022	22:43:25	352821.17	5913236.9	0	0	-
	ECC_VID_65-00158	158	22/07/2022	22:42:50	352815.94	5913237.15	42	1.5	Not a Reef
	ECC_VID_65-00159	159	22/07/2022	22:43:45	352824.48	5913237.22	0	0	-
	ECC_VID_65-00160	160	22/07/2022	22:43:55	352825.95	5913237.24	0	0	-
	ECC_VID_65-00161	161	22/07/2022	22:44:05	352827.73	5913237.32	0	0	-
	ECC_VID_65-00162	162	22/07/2022	22:44:15	352829.23	5913237.35	0	0	-
	ECC_VID_65-00163	163	22/07/2022	22:44:25	No nav	No nav	0	0	-
	ECC_VID_65-00164	164	22/07/2022	22:44:35	No nav	No nav	0	0	-
	ECC_VID_65-00165	165	22/07/2022	22:44:45	No nav	No nav	0	0	-
	ECC_VID_65-00166	166	22/07/2022	22:44:55	No nav	No nav	0	0	-
	ECC_VID_65-00167	167	22/07/2022	22:45:05	No nav	No nav	0	0	-
	ECC_VID_65-00168	168	22/07/2022	22:45:05	No nav	No nav	0	0	-
ECC_VID_66	ECC_VID_66-00007	7	22/07/2022	21:01:14	353047.21	5912513.01	36	1	Not a Reef
	ECC_VID_66-00201	8	22/07/2022	21:01:25	353047.74	5912512.4	27	0.5	Not a Reef
	ECC_VID_66-00009	9	22/07/2022	21:01:37	353049.64	5912510.88	40	1	Not a Reef
	ECC_VID_66-00010	10	22/07/2022	21:01:44	353050.44	5912510.41	0	0	-
	ECC_VID_66-00011	11	22/07/2022	21:01:55	353051.52	5912509.37	36	1	Not a Reef
	ECC_VID_66-00012	12	22/07/2022	21:02:08	353052.48	5912508.24	17	0.5	Not a Reef
	ECC_VID_66-00013	13	22/07/2022	21:02:16	353053.17	5912507.46	30	4	Low Reef
	ECC_VID_66-00014	14	22/07/2022	21:02:25	353054.35	5912506.44	67	5	Medium Reef
	ECC_VID_66-00015	15	22/07/2022	21:02:34	353054.71	5912505.75	0	0	-
	ECC_VID_66-00202	16	22/07/2022	21:02:51	353056.63	5912503.32	31	2	Low Reef
	ECC_VID_66-00017	17	22/07/2022	21:02:59	353057.28	5912502.49	44	4	Low Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_66-00203	18	22/07/2022	21:03:07	353057.99	5912501.77	24	3	Low Reef
	ECC_VID_66-00019	19	22/07/2022	21:03:24	353059.84	5912499.35	30	3	Low Reef
	ECC_VID_66-00204	20	22/07/2022	21:03:35	353061.12	5912498.12	40	4	Low Reef
	ECC_VID_66-00205	21	22/07/2022	21:03:45	353061.96	5912496.87	23	1	Not a Reef
	ECC_VID_66-00206	22	22/07/2022	21:03:54	353063.02	5912495.68	24	5	Medium Reef
	ECC_VID_66-00023	23	22/07/2022	21:04:04	353064.11	5912494.9	0	0	-
	ECC_VID_66-00207	24	22/07/2022	21:04:12	353065.16	5912493.88	39	3	Low Reef
	ECC_VID_66-00025	25	22/07/2022	21:04:20	353066.18	5912493.19	28	1.5	Not a Reef
	ECC_VID_66-00026	26	22/07/2022	21:04:31	353067.13	5912492.03	35	1	Not a Reef
	ECC_VID_66-00027	27	22/07/2022	21:04:39	353067.35	5912491.55	40	4	Low Reef
	ECC_VID_66-00208	28	22/07/2022	21:04:52	353068.66	5912489.86	30	2	Low Reef
	ECC_VID_66-00209	29	22/07/2022	21:05:00	353069.77	5912488.91	44	3	Low Reef
	ECC_VID_66-00030	30	22/07/2022	21:05:11	353071.33	5912487.54	47	5	Medium Reef
	ECC_VID_66-00031	31	22/07/2022	21:05:24	353072.38	5912486.33	0	0	-
	ECC_VID_66-00032	32	22/07/2022	21:05:34	353073.6	5912485.21	11	1	Not a Reef
	ECC_VID_66-00033	33	22/07/2022	21:05:41	353074.35	5912484.33	11	1	Not a Reef
	ECC_VID_66-00034	34	22/07/2022	21:05:49	353075.06	5912483.37	45	2	Low Reef
	ECC_VID_66-00210	35	22/07/2022	21:06:05	353076.81	5912481.6	22	1.5	Not a Reef
	ECC_VID_66-00036	36	22/07/2022	21:06:13	353077.35	5912481.29	57	3	Low Reef
	ECC_VID_66-00037	37	22/07/2022	21:06:21	353078.46	5912480.23	43	2	Low Reef
	ECC_VID_66-00038	38	22/07/2022	21:06:34	353080.23	5912478.87	0	0	-
	ECC_VID_66-00039	39	22/07/2022	21:06:42	353081.32	5912477.93	27	2	Low Reef
	ECC_VID_66-00041	40	22/07/2022	21:06:53	353082.67	5912476.99	60	5	Medium Reef
	ECC_VID_66-00042	41	22/07/2022	21:07:04	353083.93	5912476.11	0	0	-

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_66-00211	42	22/07/2022	21:07:17	353085.47	5912474.47	32	3	Low Reef
	ECC_VID_66-00044	43	22/07/2022	21:07:24	353086.36	5912474.01	0	0	-
	ECC_VID_66-00045	44	22/07/2022	21:07:36	353087.87	5912472.86	34	2	Low Reef
	ECC_VID_66-00046	45	22/07/2022	21:07:44	353088.24	5912472.57	0	0	-
	ECC_VID_66-00047	46	22/07/2022	21:07:55	353090.01	5912471.32	24	1.5	Not a Reef
	ECC_VID_66-00048	47	22/07/2022	21:08:05	353090.49	5912471.17	50	3	Low Reef
	ECC_VID_66-00049	48	22/07/2022	21:08:18	353092.02	5912469.41	25	2	Low Reef
	ECC_VID_66-00050	49	22/07/2022	21:08:31	353094.67	5912467.66	30	1.5	Not a Reef
	ECC_VID_66-00212	50	22/07/2022	21:08:39	353094.97	5912466.93	28	0.5	Not a Reef
	ECC_VID_66-00052	51	22/07/2022	21:08:49	353096.44	5912465.69	28	1	Not a Reef
	ECC_VID_66-00053	52	22/07/2022	21:08:54	353096.83	5912465.05	0	0	-
	ECC_VID_66-00054	53	22/07/2022	21:09:03	353097.26	5912463.97	59	5	Medium Reef
	ECC_VID_66-00055	54	22/07/2022	21:09:14	353098.51	5912462.71	0	0	-
	ECC_VID_66-00056	55	22/07/2022	21:09:21	353099.47	5912461.22	46	2	Low Reef
	ECC_VID_66-00057	56	22/07/2022	21:09:30	353099.98	5912460.97	38	2	Low Reef
	ECC_VID_66-00213	57	22/07/2022	21:09:37	353100.85	5912459.97	61	6	Medium Reef
	ECC_VID_66-00059	58	22/07/2022	21:09:53	353103.65	5912458.07	55	4	Low Reef
	ECC_VID_66-00060	59	22/07/2022	21:10:00	353104.18	5912457.81	55	3	Low Reef
	ECC_VID_66-00214	60	22/07/2022	21:10:09	353104.89	5912457	0	0	-
	ECC_VID_66-00062	61	22/07/2022	21:10:20	353106.15	5912455.85	59	3	Low Reef
	ECC_VID_66-00215	62	22/07/2022	21:10:33	353107.73	5912454.11	64	5	Medium Reef
	ECC_VID_66-00064	63	22/07/2022	21:10:44	353109.2	5912453.42	0	0	-
	ECC_VID_66-00065	64	22/07/2022	21:10:54	353110.66	5912451.9	0	0	-
	ECC_VID_66-00066	65	22/07/2022	21:11:04	353112.21	5912451.25	0	0	-

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_66-00067	66	22/07/2022	21:11:11	353112.75	5912450.59	33	0.5	Not a Reef
	ECC_VID_66-00091	67	22/07/2022	21:11:23	353114.12	5912449.85	53	9	Medium Reef
	ECC_VID_66-00069	68	22/07/2022	21:11:31	353114.56	5912449.47	70	7	Medium Reef
	ECC_VID_66-00176	69	22/07/2022	21:11:45	353115.47	5912448.32	36	3	Low Reef
	ECC_VID_66-00071	70	22/07/2022	21:11:52	353116.34	5912447.22	54	3	Low Reef
	ECC_VID_66-00072	71	22/07/2022	21:12:04	353117.87	5912445.88	0	0	-
	ECC_VID_66-00073	72	22/07/2022	21:12:14	353119	5912444.22	0	0	-
	ECC_VID_66-00074	73	22/07/2022	21:12:24	353120.44	5912442.77	0	0	-
	ECC_VID_66-00075	74	22/07/2022	21:12:32	353121.26	5912441.64	20	1.5	Not a Reef
	ECC_VID_66-00076	75	22/07/2022	21:12:41	353122.26	5912440.83	48	5	Medium Reef
	ECC_VID_66-00077	76	22/07/2022	21:12:49	353122.74	5912439.76	41	2	Low Reef
	ECC_VID_66-00078	77	22/07/2022	21:13:04	353124.71	5912437.97	0	0	-
	ECC_VID_66-00079	78	22/07/2022	21:13:14	353125.75	5912436.57	0	0	-
	ECC_VID_66-00080	79	22/07/2022	21:13:24	353126.63	5912435.54	0	0	-
	ECC_VID_66-00081	80	22/07/2022	21:13:27	353126.87	5912435.11	35	2	Low Reef
	ECC_VID_66-00082	81	22/07/2022	21:13:43	353128.27	5912433.79	33	2	Low Reef
	ECC_VID_66-00083	82	22/07/2022	21:13:54	353129.25	5912432.65	0	0	-
	ECC_VID_66-00177	83	22/07/2022	21:14:04	353130.37	5912431.26	12	1.5	Not a Reef
	ECC_VID_66-00085	84	22/07/2022	21:14:11	353131.22	5912430.31	14	1	Not a Reef
	ECC_VID_66-00086	85	22/07/2022	21:14:21	353132.04	5912429.3	14	1	Not a Reef
	ECC_VID_66-00087	86	22/07/2022	21:14:29	353132.34	5912428.65	32	3	Low Reef
	ECC_VID_66-00088	87	22/07/2022	21:14:43	353133.99	5912427.02	12	1	Not a Reef
	ECC_VID_66-00089	88	22/07/2022	21:14:52	353135.43	5912425.82	55	4	Low Reef
	ECC_VID_66-00090	89	22/07/2022	21:15:04	353136.94	5912424.14	0	0	-

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_66-00092	90	22/07/2022	21:15:17	353138.18	5912422.31	35	2	Low Reef
	ECC_VID_66-00093	91	22/07/2022	21:15:25	353138.52	5912421.4	32	5	Medium Reef
	ECC_VID_66-00094	92	22/07/2022	21:15:34	353139.28	5912420.71	0	0	-
	ECC_VID_66-00178	93	22/07/2022	21:15:41	353140.19	5912419.76	54	4	Low Reef
	ECC_VID_66-00179	94	22/07/2022	21:16:03	353142.42	5912416.73	44	3	Low Reef
	ECC_VID_66-00097	95	22/07/2022	21:16:09	353142.89	5912416.05	18	1	Not a Reef
	ECC_VID_66-00098	96	22/07/2022	21:16:18	353143.64	5912415.17	16	1	Not a Reef
	ECC_VID_66-00180	97	22/07/2022	21:16:24	353144.2	5912414.49	21	1	Not a Reef
	ECC_VID_66-00100	98	22/07/2022	21:16:34	353145.59	5912413.3	0	0	-
	ECC_VID_66-00181	99	22/07/2022	21:16:44	353146.64	5912412.01	27	0.5	Not a Reef
	ECC_VID_66-00102	100	22/07/2022	21:16:59	353148.1	5912410.69	29	2	Low Reef
	ECC_VID_66-00103	101	22/07/2022	21:17:04	353148.4	5912410.16	0	0	-
	ECC_VID_66-00104	102	22/07/2022	21:17:14	353150.04	5912408.59	0	0	-
	ECC_VID_66-00182	103	22/07/2022	21:17:22	353150.98	5912407.3	15	1.5	Not a Reef
	ECC_VID_66-00183	104	22/07/2022	21:17:34	353151.31	5912406.48	53	1	Not a Reef
	ECC_VID_66-00184	105	22/07/2022	21:17:42	353152.39	5912405.41	53	3	Low Reef
	ECC_VID_66-00108	106	22/07/2022	21:17:59	353154.22	5912403.37	40	2	Low Reef
	ECC_VID_66-00185	107	22/07/2022	21:18:08	353155.01	5912402.16	20	1	Not a Reef
	ECC_VID_66-00110	108	22/07/2022	21:18:18	353156.43	5912400.72	31	2	Low Reef
	ECC_VID_66-00111	109	22/07/2022	21:18:24	353156.97	5912400.22	0	0	-
	ECC_VID_66-00112	110	22/07/2022	21:18:38	353158.66	5912398.17	18	2	Low Reef
	ECC_VID_66-00113	111	22/07/2022	21:18:48	353159.87	5912397.03	59	4	Low Reef
	ECC_VID_66-00186	112	22/07/2022	21:18:55	353160.4	5912395.97	20	2	Low Reef
	ECC_VID_66-00187	113	22/07/2022	21:19:03	353161.06	5912395.11	40	2	Low Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_66-00115	114	22/07/2022	21:19:11	353161.63	5912394.28	42	4	Low Reef
	ECC_VID_66-00116	115	22/07/2022	21:19:21	353162.36	5912393.02	17	1	Not a Reef
	ECC_VID_66-00117	116	22/07/2022	21:19:29	353162.96	5912392.1	31	0.5	Not a Reef
	ECC_VID_66-00118	117	22/07/2022	21:19:40	353164.44	5912390.49	15	1	Not a Reef
	ECC_VID_66-00119	118	22/07/2022	21:19:47	353164.96	5912389.53	35	1	Not a Reef
	ECC_VID_66-00120	119	22/07/2022	21:19:56	353166.13	5912388.1	45	3	Low Reef
	ECC_VID_66-00121	120	22/07/2022	21:20:04	353166.92	5912387.29	23	1.5	Not a Reef
	ECC_VID_66-00188	121	22/07/2022	21:20:12	353167.67	5912386.26	14	0.5	Not a Reef
	ECC_VID_66-00189	122	22/07/2022	21:20:22	353169.06	5912385.04	28	2	Low Reef
	ECC_VID_66-00190	123	22/07/2022	21:20:38	353171.2	5912383.25	27	1	Not a Reef
	ECC_VID_66-00191	124	22/07/2022	21:20:46	353171.57	5912382.59	26	2	Low Reef
	ECC_VID_66-00126	125	22/07/2022	21:21:04	353173.85	5912380.65	0	0	-
	ECC_VID_66-00127	126	22/07/2022	21:21:14	353174.98	5912379.6	0	0	-
	ECC_VID_66-00128	127	22/07/2022	21:21:15	353175.1	5912379.53	30	1.5	Not a Reef
	ECC_VID_66-00129	128	22/07/2022	21:21:24	353175.56	5912378.91	33	2	Low Reef
	ECC_VID_66-00130	129	22/07/2022	21:21:34	353176.35	5912377.5	31	0.5	Not a Reef
	ECC_VID_66-00131	130	22/07/2022	21:21:54	353178.7	5912375.02	0	0	-
	ECC_VID_66-00132	131	22/07/2022	21:22:04	353180.31	5912373.63	0	0	-
	ECC_VID_66-00192	132	22/07/2022	21:22:11	353180.86	5912372.95	24	1	Not a Reef
	ECC_VID_66-00193	133	22/07/2022	21:22:21	353181.56	5912371.76	44	1	Not a Reef
	ECC_VID_66-00135	134	22/07/2022	21:22:28	353182.19	5912371.08	40	1.5	Not a Reef
	ECC_VID_66-00136	135	22/07/2022	21:22:46	353184.2	5912368.56	20	2	Low Reef
	ECC_VID_66-00137	136	22/07/2022	21:22:54	353184.63	5912368.3	0	0	-
	ECC_VID_66-00138	137	22/07/2022	21:23:04	353185.95	5912366.5	0	0	-

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_66-00139	138	22/07/2022	21:23:14	353187.29	5912365.37	0	0	-
	ECC_VID_66-00140	139	22/07/2022	21:23:20	353188.28	5912364.38	0	0	-
	ECC_VID_66-00141	140	22/07/2022	21:23:23	353188.66	5912364.06	58	3	Low Reef
	ECC_VID_66-00194	141	22/07/2022	21:23:30	353189.2	5912363.14	19	1.5	Not a Reef
	ECC_VID_66-00143	142	22/07/2022	21:23:54	353192.11	5912360.5	0	0	-
	ECC_VID_66-00144	143	22/07/2022	21:24:04	353193.33	5912359.48	0	0	-
	ECC_VID_66-00145	144	22/07/2022	21:24:14	353194.69	5912358.5	0	0	-
	ECC_VID_66-00146	145	22/07/2022	21:24:24	353195.64	5912357.29	0	0	-
	ECC_VID_66-00147	146	22/07/2022	21:24:27	353195.98	5912356.81	58	2	Low Reef
	ECC_VID_66-00148	147	22/07/2022	21:24:44	353197.5	5912354.98	0	0	-
	ECC_VID_66-00195	148	22/07/2022	21:24:49	353198.23	5912354.09	25	1.5	Not a Reef
	ECC_VID_66-00150	149	22/07/2022	21:24:58	353199.36	5912353.08	16	1	Not a Reef
	ECC_VID_66-00151	150	22/07/2022	21:25:14	353201.26	5912351.22	0	0	-
	ECC_VID_66-00152	151	22/07/2022	21:25:24	353202.3	5912349.8	0	0	-
	ECC_VID_66-00196	152	22/07/2022	21:25:36	353203.73	5912348.8	37	1	Not a Reef
	ECC_VID_66-00155	153	22/07/2022	21:25:47	353204.57	5912347.48	36	1	Not a Reef
	ECC_VID_66-00156	154	22/07/2022	21:26:04	353205.66	5912345.38	0	0	-
	ECC_VID_66-00157	155	22/07/2022	21:26:14	353207	5912343.94	0	0	-
	ECC_VID_66-00158	156	22/07/2022	21:26:24	353207.76	5912342.58	0	0	-
	ECC_VID_66-00159	157	22/07/2022	21:26:34	353208.8	5912341.4	0	0	-
	ECC_VID_66-00160	158	22/07/2022	21:26:39	353209.33	5912340.72	40	4	Low Reef
	ECC_VID_66-00161	159	22/07/2022	21:26:49	353210.4	5912339.71	39	3	Low Reef
	ECC_VID_66-00162	160	22/07/2022	21:26:58	353210.84	5912338.97	64	5	Medium Reef
	ECC_VID_66-00197	161	22/07/2022	21:27:07	353212.48	5912338.14	44	1.5	Not a Reef

Transect Name	Picture	Picture no.*	Date	Time (UTC)	Easting (m)	Northing (m)	Composition (% cover)	Elevation (Average tube height in cm)	Reefiness value
	ECC_VID_66-00164	162	22/07/2022	21:27:24	353214.45	5912336.52	0	0	-
	ECC_VID_66-00165	163	22/07/2022	21:27:34	353215.43	5912335.43	0	0	-
	ECC_VID_66-00166	164	22/07/2022	21:27:44	353216.89	5912334.44	0	0	-
	ECC_VID_66-00167	165	22/07/2022	21:27:47	353217.12	5912333.97	59	1.5	Not a Reef
	ECC_VID_66-00198	166	22/07/2022	21:27:55	353217.71	5912333.36	46	2	Low Reef
	ECC_VID_66-00199	167	22/07/2022	21:28:14	353220.15	5912330.9	36	1	Not a Reef
	ECC_VID_66-00170	168	22/07/2022	21:28:24	353221.17	5912329.8	0	0	-
	ECC_VID_66-00171	169	22/07/2022	21:28:34	353222.57	5912328.56	0	0	-
	ECC_VID_66-00172	170	22/07/2022	21:28:39	353223.03	5912327.84	38	2	Low Reef
	ECC_VID_66-00173	171	22/07/2022	21:28:54	353224.72	5912326.4	0	0	-
	ECC_VID_66-00174	172	22/07/2022	21:29:04	353225.84	5912325.28	0	0	-

**Additional screenshots were captured from the HD video approximately every 10 seconds if the underwater stills captured in the field underrepresented the spatial variability in Sabellaria spinulosa*

APPENDIX P – SAMPLE AND SEABED PHOTOGRAPHS

2210 ECC Photopages.pdf

APPENDIX Q – SERVICE WARRANTY

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