Inch Cape Offshore Wind Farm

New Energy for Scotland

Offshore Environmental Statement:
VOLUME 2D
Appendix 12A: Benthic Ecology Baseline Development Area

REPSOL edp renewables

Inch Cape Offshore Limited

Appendix 12A: Benthic Ecology Baseline Development Area

AMEC Environment & Infrastructure UK Limited

August 2012

Inch Cape Offshore Limited

Appendix 12A: Benthic Ecology Baseline Development Area

AMEC Environment & Infrastructure UK Limited

August 2012

Report for

Andy Precious, Development Manager
The Natural Power Consultants Ltd
The Green House
Forest Estate
Dalry
Castle Douglass

Main Contributors

Stuart McCallum
Sarah Read

Issued by

…………………………………………………………
…
Stuart McCallum

Approved by

…………………………………………………………
…
Angus Bloomfield

AMEC Environment & Infrastructure UK Limited

Northumbria House, Regent Centre, Gosforth,
Newcastle upon Tyne NE3 3PX, United Kingdom
Tel +44 (0) 191 272 6100
Fax +44 (0) 191 272 6592

Doc Reg No. 29059 gr066

w:\gwm\data\project\29059 inch cape oswf\g030 general\benthic sediments\for issue\appendix 12a\appendix 12a.docx

Certificate No. FS 13881

Certificate No. EMS 69090

Executive Summary

Purpose of this Report

This report has been produced for the purpose of characterising the benthic and epibenthic ecology conditions at the Development Area of the Inch Cape Offshore Wind Farm. A number of survey methods have been used to inform this assessment, namely DDV, benthic grabs and epibenthic trawls, undertaken between 19 March and 25 May 2012.

Overall, the Development Area is characterised by circalittoral sands and gravels in which a number of polychaete and bivalve species persist. The majority of the sedimentary habitat across the Development Areais classified as the circalittoral mixed sediment biotope '*Mysella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment (SS.SMx.CMx.MysThyMx)', with a total ofeight other biotopes identified as present across the entire survey area (i.e. an area encompassing the Development Area, an area of one tidal excursion from the Development Area, as well as discreet reference sites outside of this):

- SS.SSa - Sublittoral sands and muddy sands;
- SS.SCS.CCS - Circalittoral coarse sediment;
- SS.SCS.CCS.PomB - *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles;
- SS.SCS.CCS.MedLumVen - *Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel;
- SS.SCS.OCS - Offshore circalittoral coarse sediment;
- SS.SMx.CMx - Circalittoral mixed sediment;
- SS.SMx.CMx.OphMx - *Ophiothrix fragilis* brittlestar beds on sublittoral mixed sediment; and
- CR.HCR.Xfa - Mixed faunal turf communities.

A number of habitats and species of conservation importance are described at the Development Area, predominantly the: circalittoral and offshore coarse sediment habitats, listed under the UK Post 2010 Biodiversity Framework (2012)[1]. In addition, dense brittlestar beds, recognised as nationally important marine habitats, were recorded in two locations. The Icelandic cyprine, *A. islandica*, included on The Convention for the Protection of the Marine Environment of the North-East Atlantic's (The OSPAR Convention)list of threatened and/or declining species, was recorded at moderate abundances across the Development Area.

Comparisons with previous data sets indicate that the Development Area has been relatively stable in its sedimentary composition for up to 10 years with little change observed in the infaunal component for 10-20 years.

[1] Formerly UK Biodiversity Action Plan (BAP)

Contents

List of Tables

List of Figures

List of Annexs

Abbreviations

BAP - Biodiversity Action Plan

BGS - British Geological Survey

CPUE - Catch Per Unit Effort (number per hour)

Cefas - Centre for Environment, Fisheries and Aquaculture Science

CSEMP - Clean Seas Environmental Monitoring Programme

DATRAS - Database Trawl Survey

DECC - Department of Energy and Climate Change

FSA - Food Standards Agency

IBTS - International Bottom Trawl Survey

ICES - International Council for the Exploration of the Sea

JNCC - Joint Nature Conservation Committee

MESH - Mapping European Seabed Habitats

MNCR - Marine Nature Conservation Review

MMO - Marine Management Organisation

OSPAR - The OSPAR Convention is the current legal instrument guiding international cooperation on the protection of the marine environment of the North-East Atlantic

PEL - Probable Effect Levels

RAMSAR - The Convention on Wetlands of International Importance

SAC - Special Area of Conservation

SEA - Strategic Environmental Assessment

SNH - Scottish Natural Heritage

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

TEL - Threshold Effect Levels

UKOOA - United Kingdom Offshore Operators Association

12A.1 Introduction

12A.1.1 The Development Area

Inch Cape Offshore Limited (ICOL) are developing a Wind Farm and associated Offshore Transmission Works (OfTW). Definitions for the Wind Farm, OfTW, Development Area and Offshore Export Cable Corridor are as follows:

- Offshore Wind Farm/Wind Farm: Includes WTGs, inter-array cables, meteorological masts and other associated and ancillary elements and works (such as metocean buoys). This includes all permanent and temporary works required.
- Offshore Transmission Works (OfTW): The Offshore Export Cable and Offshore Substation Platforms (OSPs). This includes all permanent and temporary works required.
- Development Area: The area which includes WTGs, inter-array cables, OSPs and initial part of the Offshore Export Cable and any other associated works (see Chapter 7 Figure 7.1).
- Offshore Export Cable Corridor/Export Cable Corridor: The area within which the Offshore Export Cables will be laid outside of the Development Area and up to Mean High Water Springs (see Chapter 7, Figure 7.1).

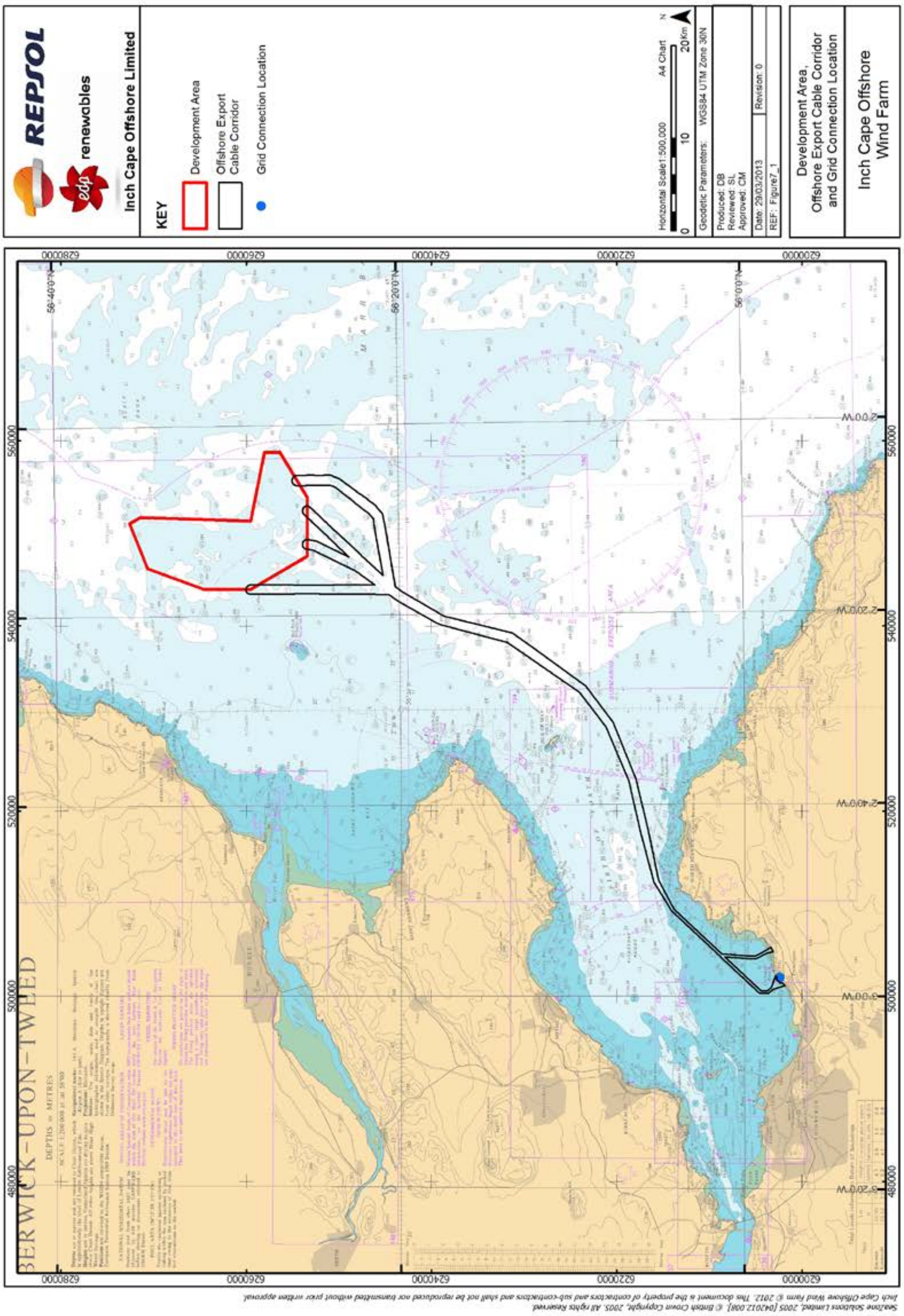
The Development Area and Offshore Export Cable Corridor and Regional Study Area can be seen in Figure 12A.1.

12A.1.2 Aims of this Study

The Environmental Impact Assessment (EIA) process for an offshore wind farm requires a full understanding of the marine ecology of the area which may be affected. This requires a full review of existing benthic survey data as well as benthic and epibenthic surveys of the Development Area and adjacent areas.A separate study was commissioned for the Offshore Export Cable Corridor (see Appendix 12C Benthic Ecology Baseline Offshore Export Cable Corridor). Following the analysis of the geophysical survey data, the Inch Cape Development Area was subsequently surveyed through the use of benthic grab sampling, epibenthic beam trawl surveys and a DDV survey.

The primary aim of this study is to inform the EIA through characterisation and mapping of the marine communities in the vicinity of the Development Area, and to identify the location of any sensitive features present (e.g. Annex 1 features of the Habitats Directive, or Priority Marine Features). The benthic environment will be characterised using standard marine ecological techniques i.e. acoustic surveys and interpretation with subsequent ground truthing through the use of benthic grabs, DDV and epibenthic beam trawls. This study will support the impact assessment which is summarised in the ES Chapter 12: Benthic Ecology.

Figure 12A.1 Inch Cape Development Area



12A.1.3 Desk Study

12A.1.3.1 Local Designations

A number of sites, designated for nature conservation in proximity of the Development Area. These sites are detailed in *Chapter 9: Designated Nature Conservation Sites*. None of these sites are intercepted by the Development Area:

- SACs detailed in Chapter 9 which cite Annex I habitats as their qualifying conservation interests, including the Isle of May, Firth of Tay and Eden Estuary, the Moray Firth and the River Tay. The Isle of May Special Area of Conservation (SAC) is designated in relation to sub-tidal benthic features, with rocky reefs surrounding the island.
- JNCC and SNH have identified one potential nature conservation Marine Protected Area in the vicinity of the Development Area, the Firth of Forth Banks Complex. *Arctica islandica* has been identified as a PMF in this location.
- The Firth of Forth Site of Special Scientific Interest covers large areas of the Firth of Forth (including the Offshore Export Cable landfall options, at Cockenzie and Seton Sands) with the marine Notified Natural Features of mudflats and saltmarsh within its boundary. None of these Notified Natural Features are present at the landfall options for the Offshore Export Cable Corridor.

Potential impacts relating to these Sites are discussed in Chapter 12.

12A.1.3.2 Benthic Ecology

The benthic ecology of the area surrounding the Inch Cape Devlopment Area has historically been studied to varying degrees. The Firth of Tay, situated between the sandy peninsulas of Buddon Ness on the north side, and Tentsmuir on the south, is extended seawards by the Gay and Abertay sandbanks and is relatively well studied in comparison to the offshore environment. The Firth of Forth, to the south of the site, has also received attention within the literature, particularly concerning the effects of sewage on the benthic ecology. Typically, the offshore environment has been studied to a lesser degree, with the main body of information focused around the Bell Rock disposal site and the long term benthic monitoring records of Clean Seas Environmental Monitoring Programme (CSEMP) and the United Kingdom Offshore Operators Association (UKOOA), as well as specific studies for the Mapping European Seabed Habitats (MESH) project.

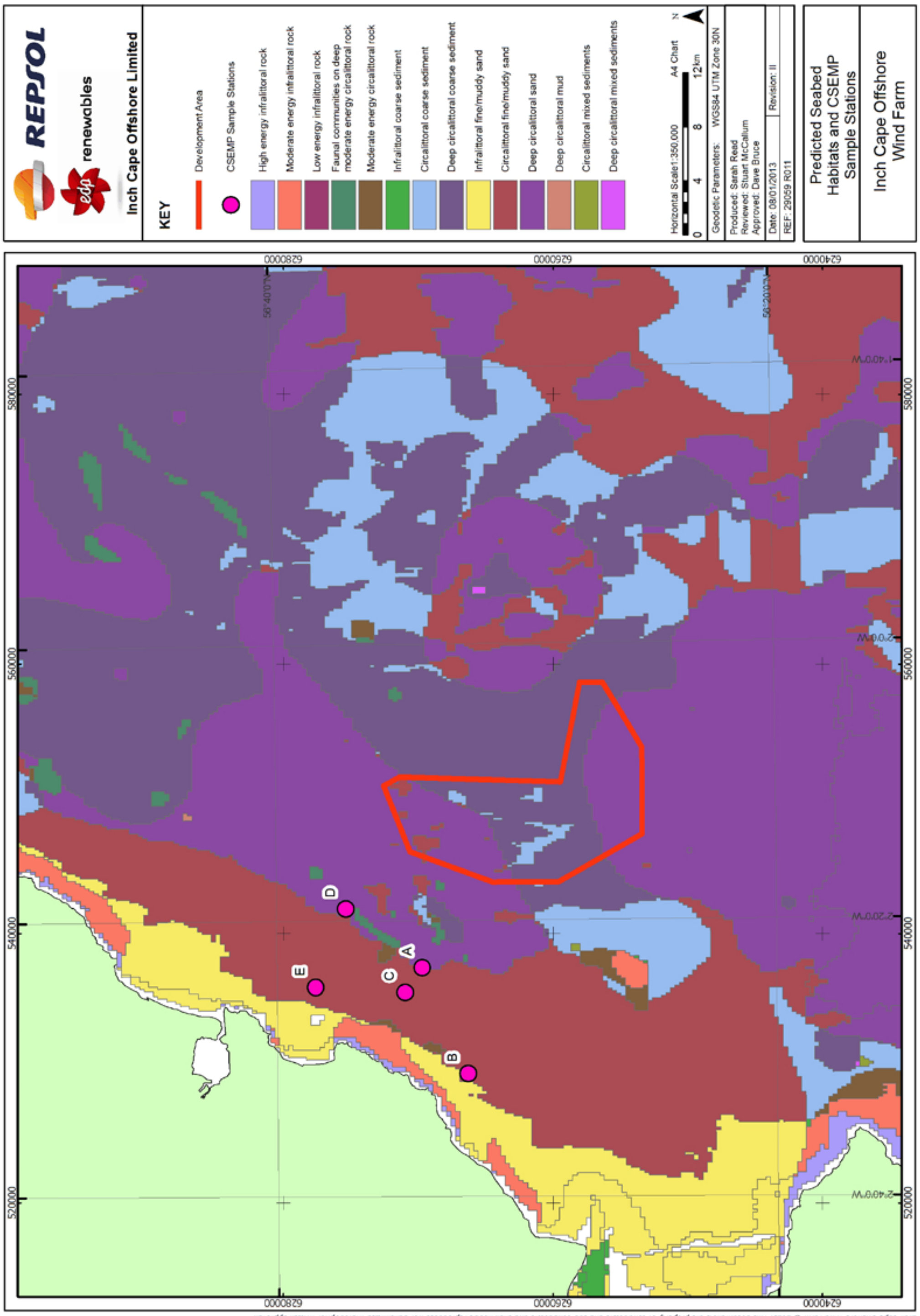
For a broad overview of the benthic habitats in the Development Area, a number of scientific papers describe the benthic and epibenthic community composition over large areas of the North Sea. Kunitzer *et al.* (1992) describe the differences between the benthic fauna of the deeper northern half of the North Sea and the shallower southern half. Relevant to the Development Area, this paper highlights *Sphaerosyllis bulbosa* below 100 m depth at sampling stations along the Scottish coast, and *Thyasira* sp. in areas deeper than 100 m on muddy fine sand. Other wide ranging surveys, including Basford & Eleftheriou, 1988; Eleftheriou & Basford, 1989; Basford *et al.*, 1989, & 1990; as well as Dyer *et al.*, 1982, 1983; Jennings *et al.*, 1999 and Zulhke, 2001, have been undertaken and are reviewed in the 2004 Strategic Environmental Assessment (SEA) for region 5 (which includes the Development Area). Within the SEA review, the benthic communities south of latitude 57° 30' N (Peterhead) are described which includes the propsed Development Area and surrounding area. For example studies by Dyer *et al*. (1983) indicated a small increase in both diversity and faunal abundance as the stations extend offshore with the most common organisms at the deepest station (80–100 m) being dead man's fingers (*Alcyonium digitatum*) and hornwrack (*Flustra foliacea*). The hermit crab (*Suberites domuncula*) and sea anemone (*Actinostola callossa*) were the most common organisms in the nearest inshore station (60–80 m depth). Monitoring at Bell Rock, disposal ground from 1979 to 1998, due to the disposal of wet solids from a treatment facility at Seafield, provides long term benthic data near the Development Area. Amongst the dominant species recorded at Bell Rock were the polychaetes *Galathowenia oculata*, *Spiophanes bombyx*, *Pholoe inornata* and *Lumbrineris* sp., and the bivalves *Nucula tenuis*, *Mysella bidentata* and *Abra* sp. Only occasionally opportunistic species were encountered, usually the secondary opportunist *Chaetozone setosa*, with some records of *Capitella* sp. (SEA 5, 2004). The common species and findings from a number of studies, cited in SEA 5, 2004 are summarised in **Table 12A. 1**.

Table 12A.1 Key Benthic Communities in the North Sea (SEA Region 5)

Survey	Reference	Summary
Epifauna		
Epibenthic trawls and photography surveys in the SEA 5 region	Dyer *et al*. 1982	The echinoids, *Echinus acutus* , *Asterias rubens*, the cnidarian, *Alcyonium digitatum*, and the polyzoan, *Flustra foliacea*, were commonly trawled within this sub-division of SEA 5 and to a lesser degree also occurred at the photographic station. The most common organisms at the deepest station (80–100 m) were *Alcyonium digitatum* and *Flustra foliacea*. The hermit crab, *Suberites domuncula*, and the cnidarian, *Actinostola callossa*, were the most common organisms in the nearest inshore station (60–80 m depth).
Epibenthic trawls in the SEA 5 region	Basford *et al*., 1989, 1990	The numbers of species trawled was generally low. The northern half of the area had fewer than 10 species per trawl and the southern half had 10–20. Densities of less than 200 individuals per trawl were recorded throughout the area. Statistical analysis grouped the majority of the stations together based on the presence of Porifera, Tunicates, *Spirontocaris lilljeborgi* and the hermit crab *Pagurus bernhardus*.
Epibenthic trawls in the SEA 5 region	Jennings *et al.,* 1999	Results showed a mean diversity of 25 species per trawl. The authors divide the epifauna into two categories: free-living and attached. The stations within this sub-division of SEA 5 were represented by two faunal communities; the first being characterised by *Flustra foliacea, Hydrallmania falcata, Lafoea dumosa, Subarites fictus, Ciona intestinalis* and *Alcyonidium diaphanum*; and the other by *Hydractinia echinata, Subarites fictus, Flustra foliacea, Alcyonidium diaphanum, Alyconium digitatum* and *Epizoanthus papillosus*. A single free-living group was characterised by *Asterias rubens, Crangon allmanni, Pagurus bernhardus, Hyas coarctatus, Astropecten irregularis* and *Anapagurus laevis.*
Infauna		
Grab surveys in the SEA 5 region	Stephen, 1922	The inshore sub-division of SEA 5 was considered to be from a community characterised by the presence of *Ophiura affinis* and *Echinocyamus pusillus*. There was large-scale geographic similarity in the offshore fauna and it was less abundant than the inshore fauna. A sub-community off the north-east coast of Aberdeenshire was noted where large numbers of broken *Sabellaria* tubes, probably originating from the masses growing near Rattray Head, formed a community characterised by the molluscs *Astarte compressa, Cardium fasciatum, Venus ovata* and *Leda minuta,* and the polychaetes *Glycera lapidum* and *Ophelia limacina*. Further south, in the shallower sandy sediments off the Forfarshire and Kincardineshire coast and St Andrews Bay, a variety of the *Echinocardium cordatum* – *Tellina fabula* community existed where *Nucula nucleus* occurred locally in very large numbers, with *Tellina fabula* and *Venus gallina* being less common. This sub-community was more diverse (particularly with polychaetes) than the *Amphiura filiformis – A. chiajii* community found further offshore.
Grab surveys of St Andrews and Aberdeen Bays	McIntyre, 1958	Fauna was dominated by lamellibranchs and polychaetes with *Abra alba, Tellina fabula, Nucula turgida* and *Ensis* sp. At both locations, in addition the polychaetes *Lanice conchilega, Sigalion mathildae, Notomastus latericeus* and *Nephtys* sp. were also abundant. Aberdeen Bay had a quantitatively richer fauna than St Andrews. The poorer offshore fauna was dominated by *Abra alba* at St Andrews and by *Nucula turgida* in Aberdeen Bay.
Grab surveys in the SEA 5 region	Kunitzer *et al*., 1992	The north eastern group was characterised by the presence of the polychaetes *Minuspio cirrifera, Aricidea catherinae, Exogone hebes, E. verugera, Spiophanes bombyx, Polycirrus* sp., *Ophelia borealis* and the bivalve *Thyasira* sp.. The offshore group had a large faunal diversity, but no species was particularly characteristic.
Data review	Heip *et al.,* 1992	The North Sea in general showed an increased diversity and reduction of biomass to the north, with a more localised increase in biomass in the finer sediment stations in the southern North Sea.

More recently predictive habitat mapping, based on British Geological Survey (BGS) derived sediment type, allows an overview of the likely habitats surrounding the Development Area. **Figure 12A.2** shows the UK sea bed habitat maps and shows the main Development Area as deep circalittoral sand and deep circalittoral coarse sediment. There are also areas of circalittoral coarse sediment and circalittoral fine sand or muddy sand. This predictive information can be used alongside survey data such as that collected by Envision Mapping in 2003 for the MESH sea bed mapping project.

Figure 12A.2 Predicted Seabed Habitats and CSEMP Sample Stations



Temporal

In additional to the regional overview provided in the SEA 5 report, on a finer scale there are a number of studies that highlight the temporal variability of benthic habitats across the Development Area which are described below:

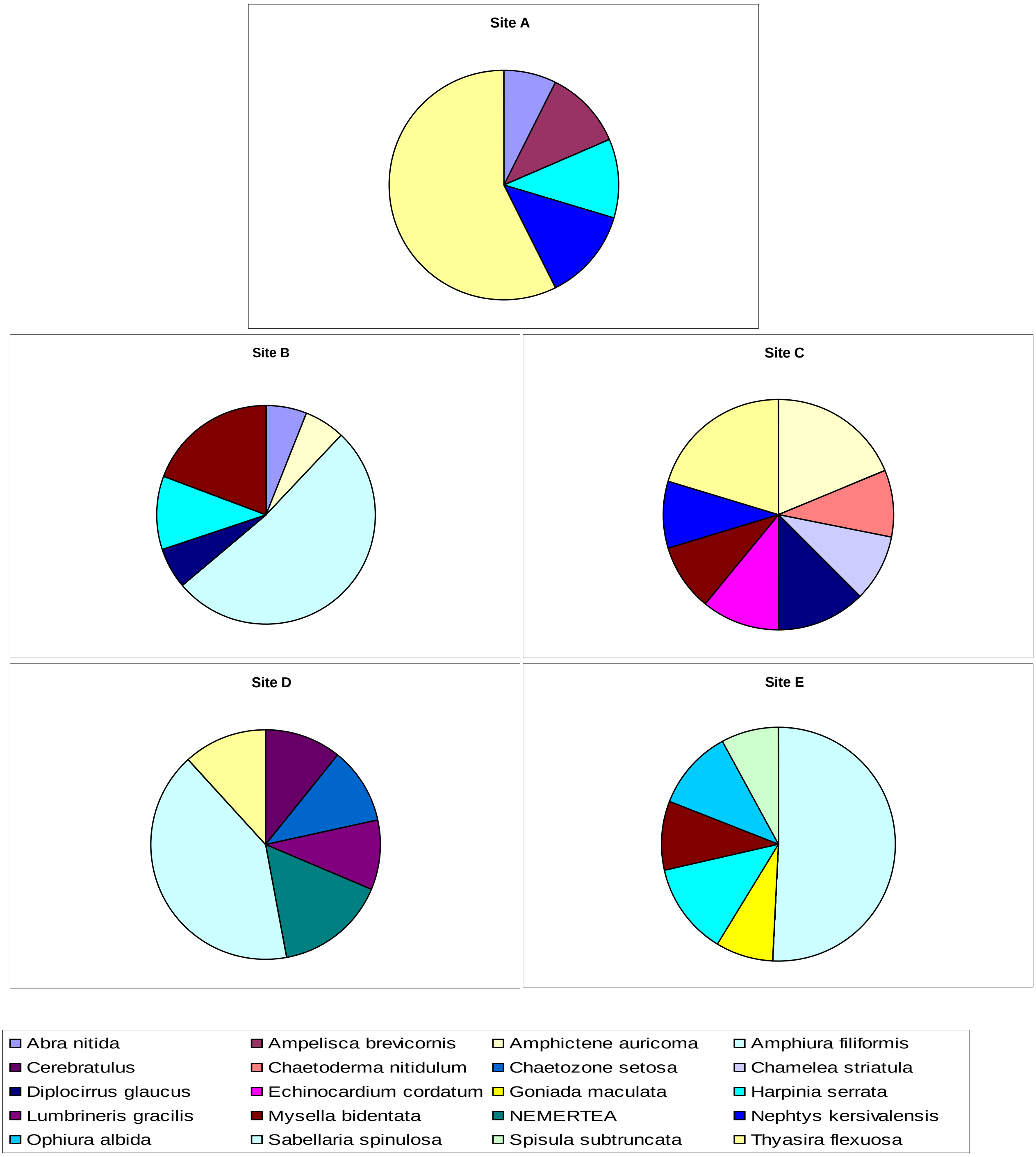
- The sublittoral sediments and fauna near Bell Rock, 18 km south east of Arbroath, have been studied in relation to sewage sludge dumping over a long time period and results show that sediments consist of fine to medium grained sand, supporting more than 300 species (Bennet and McLeod, 1998). As wastewater sludge was disposed for 20 years at Bell Rock and St. Abbs (South of the Firth of Forth) disposal grounds, the associated monitoring of sublittoral sediments and fauna give a temporal data set at both St. Abbs and Bell Rock (partially within the Development Area);

- Jones *et al*. (1994) summarised the benthic fauna at St Abbs Head in 1992 which was shown to have large numbers of the heart urchin *Echinocardium cordatum*; and a similar event occurred in 1987. This was a natural event, and was not accompanied by any reduction in species diversity or abundance. There was no equivalent settlement of *E. cordatum* at the Bell Rock site where the total numbers of taxa recorded was 332, similar to previous years. At both sites the application of an Infaunal Trophic Index gave values representative of a normal, healthy community, showing no evidence of sludge related effects on the benthos, although surveys show a physical imprint of sludge particulates;

- Following the report in 1994, the Seventh Report of the Group Co-ordinating Sea Disposal Monitoring (Jones *et al*., 1997) highlights the benthic results at Bell Rock and St. Abbs head disposal grounds in 1993 and 1994. As common with sewage-sludge disposal sites, significant accumulations of tomato pips (and other fruit seeds) occurred in the vicinity. Sediments where shown to support a high diversity of species; 308 at St. Abbs Head, and 352 at Bell Rock. Data from both locations were analysed to detect the effects of the sludge disposal and no statistical differences between impacted and not impacted sites were seen. Despite this, the presence of the polychaete worm *Capitella* sp., a commonly cited indicator of organic enrichment (Pearson and Rosenberg, 1978), at central stations at St Abbs Head and, in lower numbers, at Bell Rock suggested a mild effect of sludge disposal. However similar studies in 1994 showed there was no evidence of appreciable change in the structure of benthic communities between 1993 and 1994 which might be attributable to sewage-sludge disposal. This is reiterated by Bennett *et al*., 1998, who considered that the sediments and benthic macrofauna in the vicinity of Bell Rock did not appear to have been adversely affected by the dumping of sewage sludge; and

- In addition to the information available at the Bell Rock disposal site, studies of other less impacted areas are available. The CSEMP monitoring stations, due to the long timeframe over which sampling has been undertaken, can provide a picture of benthic communities over time in discreet areas. This historical data set includes a number of benthic sample points around the Development Area. Figure 12A.2 shows the 2010 CSEMP benthic sampling stations, and Figure 12A.3 displays the most abundant species found at these CSEMP monitoring stations. Although there are some common species, the spatial variability is highlighted. Sites B and E, the furthest inshore, show the most similarity; being dominated by Amphiura filiformis.

Figure 12A.3 CSEMP (2010) Benthic Data showing the Most Common Species

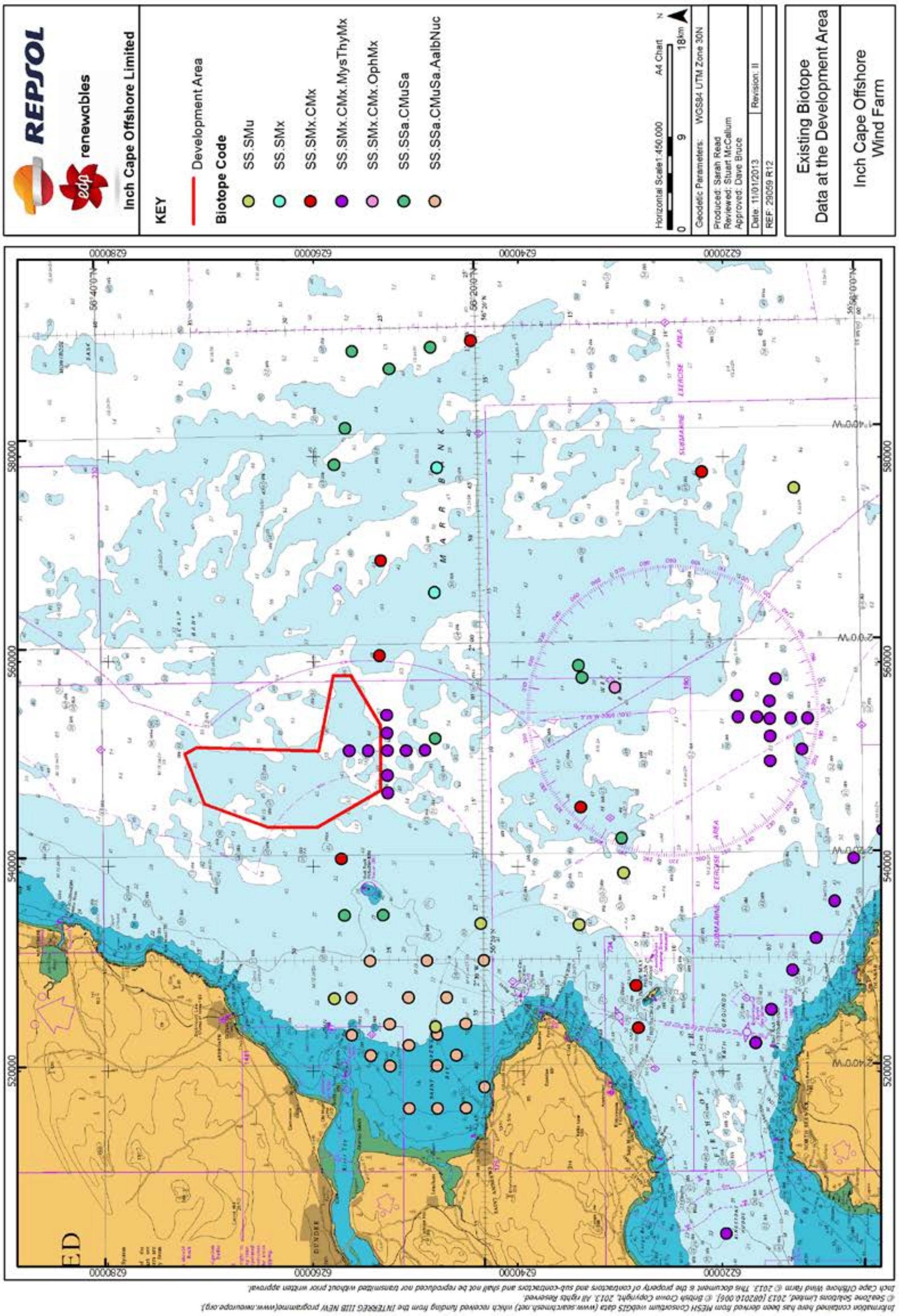


Spatial

In addition to the CSEMP long term monitoring programs, benthic samples have been collected and analysed across a number of sites, within the Development Area and the surrounding area, for focused survey programs. The MESH project provides benthic data near the Development Area and surrounding area, with data recorded predominantly in 2003 by Envision. **Figure 12A.4** displays the EUNIS habitat classifications around the Development Area identified in the most recent surveys. The offshore Bell Rock disposal ground, within the southern section of the Development Area, is classed as the EUNIS habitat A5.443 – *Mysella bidentata* and *Thyasira* sp. in circalittoral muddy mixed sediment, with areas of circalittoral muddy sand. The Tay entrance is identified as A5.625 – *Mytilus edulis* beds on sublittoral sediment, and A5.352 – *Thyasira* sp. and *Nuculoma tenuis* in circalittoral sandy mud. At the mouth of the Tay is a cluster of points identified as A5.625 – *Mytilus edulis* beds on sublittoral sediment.

Further offshore from the Development Area, data exists from the marine benthic dataset commissioned by UKOOA. This comprises data from surveys designed to document and analyse data collected from offshore environmental surveys carried out on the behalf of UKOOA. Although the site closest to the Development Area is around 200 km offshore, results do give an indication of the species found in the wider area. Data from 1992 to 1993 highlights the presence of around 250 species from a wide rage of taxon including molluscs, annelids, echinoderms and crustacea. This is consistent with typical sedimentary habitats in dynamic environments. Closer to the Development Area, OSPAR monitoring sites in the Firth of Forth, and one to the northwest of Montrose, show records of seapens and burrowing megafauna.

Figure 12A.4 Existing Biotope Data in Proximity to the Development Area



12A.2 Methods

12A.2.1 Introduction to Survey Methods

The survey methods presented below have been designed based on the requirements laid out in the scoping document and after analysis of the acoustic data and our preliminary desktop study. The survey methods were approved prior to use through consultation with Marine Scotland, after the submission of a detailed Survey Monitoring Plan, which covered all survey work on the Development Area, including Natural Fish and Shellfish and contaminated sediment studies (reported separately in Appendix 13A Natural Fish and Shellfish Survey Report and Appendix 12B Contaminated Sediments Baseline respectively).

The survey area for the benthic baseline encompasses the Development Area, an area extending for one tidal excursion outside of the Development Area, as well as discreet reference stations outside of these areas.

12A.2.2 Geophysical Data

Geophysical data (multibeam bathymetry and sidescan data) collected in the Inch Cape Development Area, as well as meteorological and oceanographic (metocean) data, was analysed by Envision Mapping Ltd (Envision) in order to create broad-scale habitat maps that allowed the development of a stratified sampling design (Appendix 12D Biotope Mapping). From these habitat maps sample locations were selected, based on a systematic analysis of the available data so that the samples would be representative of the full range of habitats across the study area. Data on seabed sediments were collated from various sources and, together with direct interpretation of the sidescan mosaic, provided some evidence for sediment types across the study area.

Two approaches to the seabed analysis undertaken by Envision were used: (1) unsupervised statistical classification of the primary variables; and (2) directed segmentation of the variables re-classed into a small number of biologically relevant classes. Both processes resulted in a very similar distribution of potentially different ground types. However, the output from the segmentation process was more easily interpreted and, therefore, this was used for sampling station selection. The ground types were classified by three variables: backscatter strength, slope, and depth; which gave a total of 18 ground types (**Figure 12A.5**). Further analysis of the area's geology identified areas of shallow sediment overlaying rockhead (potential rock outcrop areas - **Figure 12A.6)** which when combined with the ground type data gave a total of 22 habitat classes (**Table 12A.2**).

Figure 12A.5 Geophysical Classes

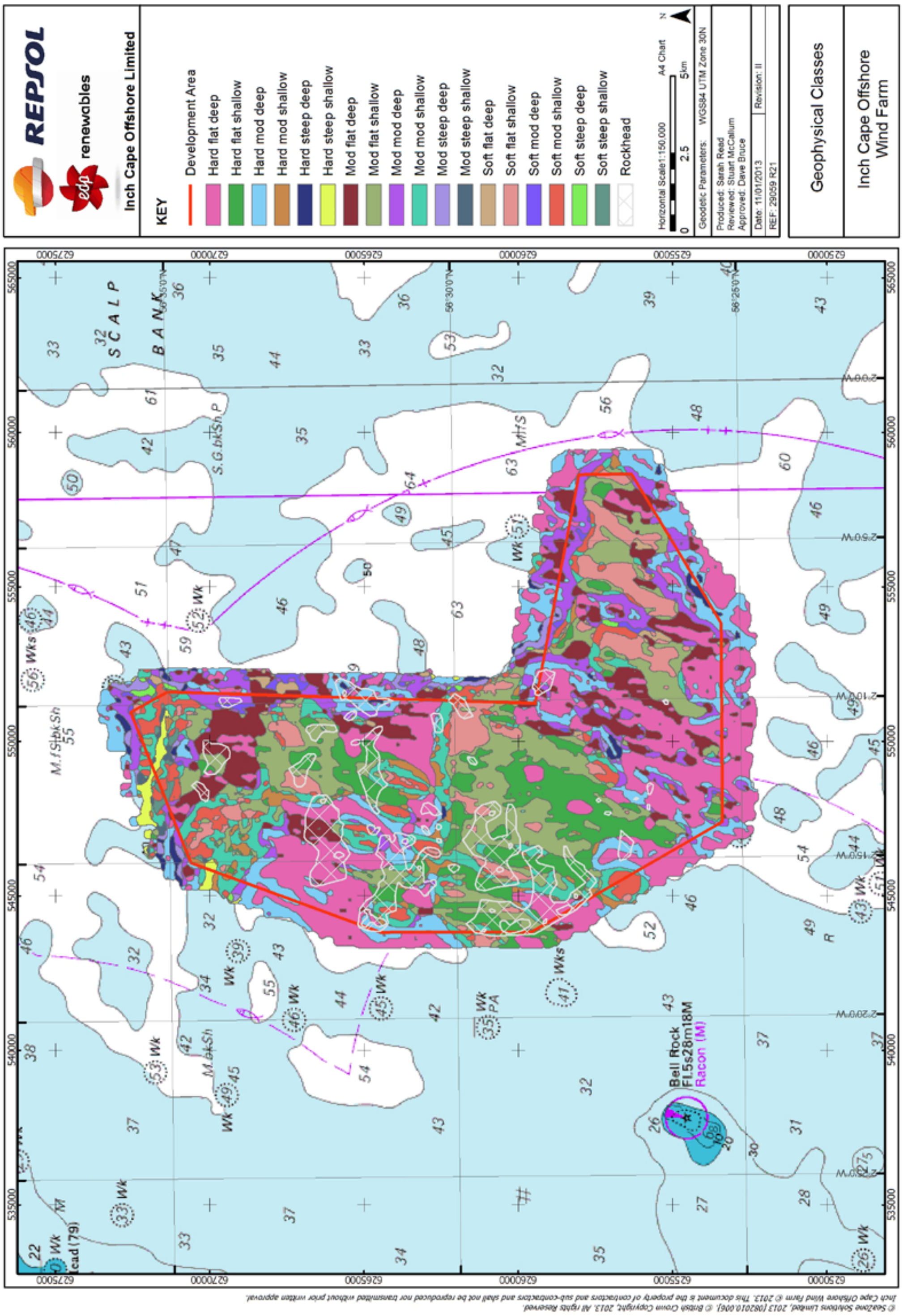


Figure 12A.6 Geophysical Classes and Proposed Samping Stations

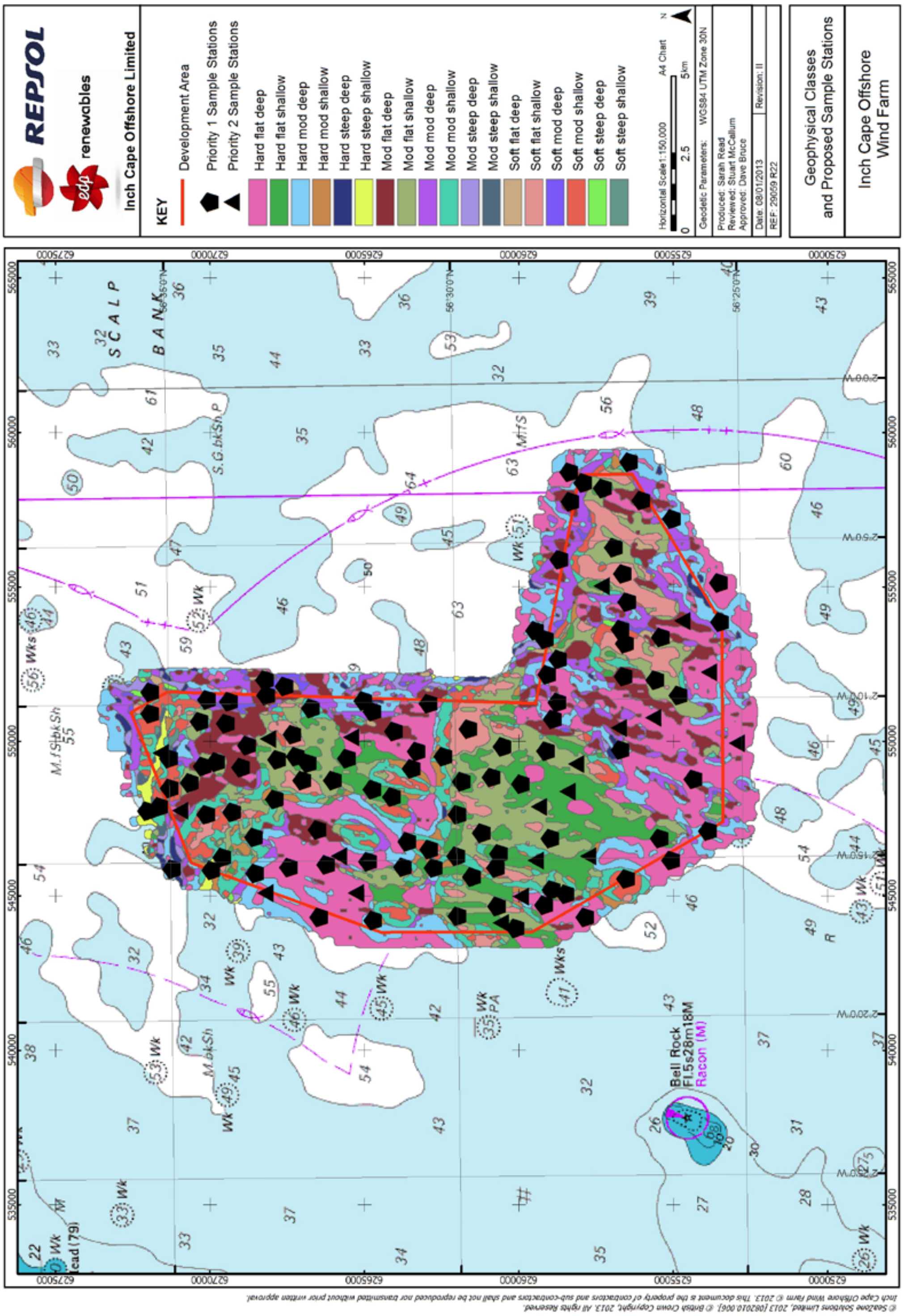


Table 12A.2 Habitat Classes Identified through Acoustic Analysis

Backscatter strength	Slope	Depth	Rockhead
Strong	Flat	Deep	
Strong	Flat	Deep	Rockhead
Strong	Flat	Shallow	
Strong	Flat	Shallow	Rockhead
Strong	Mod	Deep	
Mod	Flat	Deep	
Mod	Flat	Shallow	
Mod	Flat	Shallow	Rockhead
Mod	Mod	Deep	
Mod	Mod	Shallow	
Mod	Mod	Shallow	Rockhead
Weak	Flat	Shallow	
Weak	Flat	Shallow	Rockhead
Weak	Mod	Shallow	
Weak	Mod	Shallow	Rockhead
Strong	Mod	Shallow	
Mod	Steep	Deep	
Strong	Steep		
Weak	Flat	Deep	
Weak	Steep	Shallow	
Mod	Flat	Deep	
Weak	Steep	Deep	

During the survey campaign the geophysical data was ground truthed by comparing the particle size analysis (PSA) and video data (see section 12A.2.3 for survey methodology) from each station to the habitat classes identified during the geophysical analysis. PSA and video data were used in combination to produce a sediment classification for each sampling station using the Wentworth scale. These sediment classes were grouped according to the original geophysical classes allowing an interpretation to be made of the sediment type represented by each class. Using both PSA and video meant that features such as cobbles and boulders were not under-represented, as would have been the case had PSA data been used in isolation.

12A.2.3 Benthic Grab and Drop-Down Video Survey Design

The following section details the proposed survey methodology which was based on the analysis of geophysical survey data. The actual survey details, which were amended based on conditions encountered during the survey, are found in 12A.3.

At each sampling station a combination of drop-down video (DDV) and benthic grab sampling were proposed to be undertaken, with the DDV deployed prior to the grab sampler. This method allows identification of any potential sensitive Annex I habitats (e.g. biogenic reefs) or Priority Marine Features (PMFs), therefore avoiding any damage by the grab sampling. This method also allows an assessment as to the likely success of grabbing in a particular location, for example if the sampling station consists of hard substrate or boulders the sampling of that area using the grab can be scoped out. In addition, the DDV data aids biotope identification and provides additional data for the epibenthic study. The DDV data was also used to identify habitats in place of grab survey data in areas unsuitable for grab deployment, e.g. those with rocks or boulders.

A systematic approach to the selection of benthic sampling stations proposed, with 95 primary stations initially selected within the Development Area that would provide adequate samples for representivity based on the geophysical data interpretation (**Figure 12A.6**). Additional secondary stations were also selected to be held in reserve in case some primary stations could not be sampled (e.g. due to obstructions). Each sampling station visited was proposed to be sampled consistently with DDV and grab methodologies ensuring that the final interpretation of the data produced a robust and comprehensive characterisation of the benthos.

The sampling strategy represented a random stratified approach with a minimum of three stations within each habitat type, except for discrete features where only a single sample was proposed. This allowed accurate and robust ground truthing of the habitat maps produced from the geophysical data. Single sampling was carried out at each sampling station, as recommended by the current guidance for benthic studies (Ware and Kenny, 2011) which states *'Characterisation is best achieved through a combination of acoustic mapping of seabed features followed by targeted (stratified) single sample station ground truthing'*. **Table 12A.3** shows the number of stations assigned to each habitat class for ground truthing. The position of all initially proposed sampling stations is provided in **Annex 12A.1**.

Table 12A.3 Number of Sampling Stations in each Habitat Class

Ground type	Number of stations	Area (km^2)	Area (%)
Mod, flat, deep	9	19.1	9.4
Mod, flat, shallow	8	24.5	12.1
Mod, flat, shallow, rockhead	3	4.2	2.1
Mod, Mod, deep	3	16.1	8
Mod, mod, shallow	3	12.5	6.2
Mod, mod, shallow, rockhead	1	2.1	1

Ground type	Number of stations	Area (km^2)	Area (%)
Mod, steep, deep	1*	2.2	1.1
Strong, flat shallow	11	15.5	7.7
Strong, flat shallow, rockhead	5	3.5	1.7
Strong, flat, deep	16	41.4	20.4
Strong, flat, deep, rockhead	2	3.9	1.9
Strong, mod, deep	6	23.9	11.8
Strong, mod, shallow	3	3.9	1.9
Strong, steep	4	1.9	0.9
Weak, flat, deep	3	1.5	0.7
Weak, flat, shallow	5	12.4	6.1
Weak, mod, shallow	3	7.7	3.8
Others	9	8.4	4.1

* Three stations originally placed within this classification. However, as it is a single feature with low coverage only one was placed

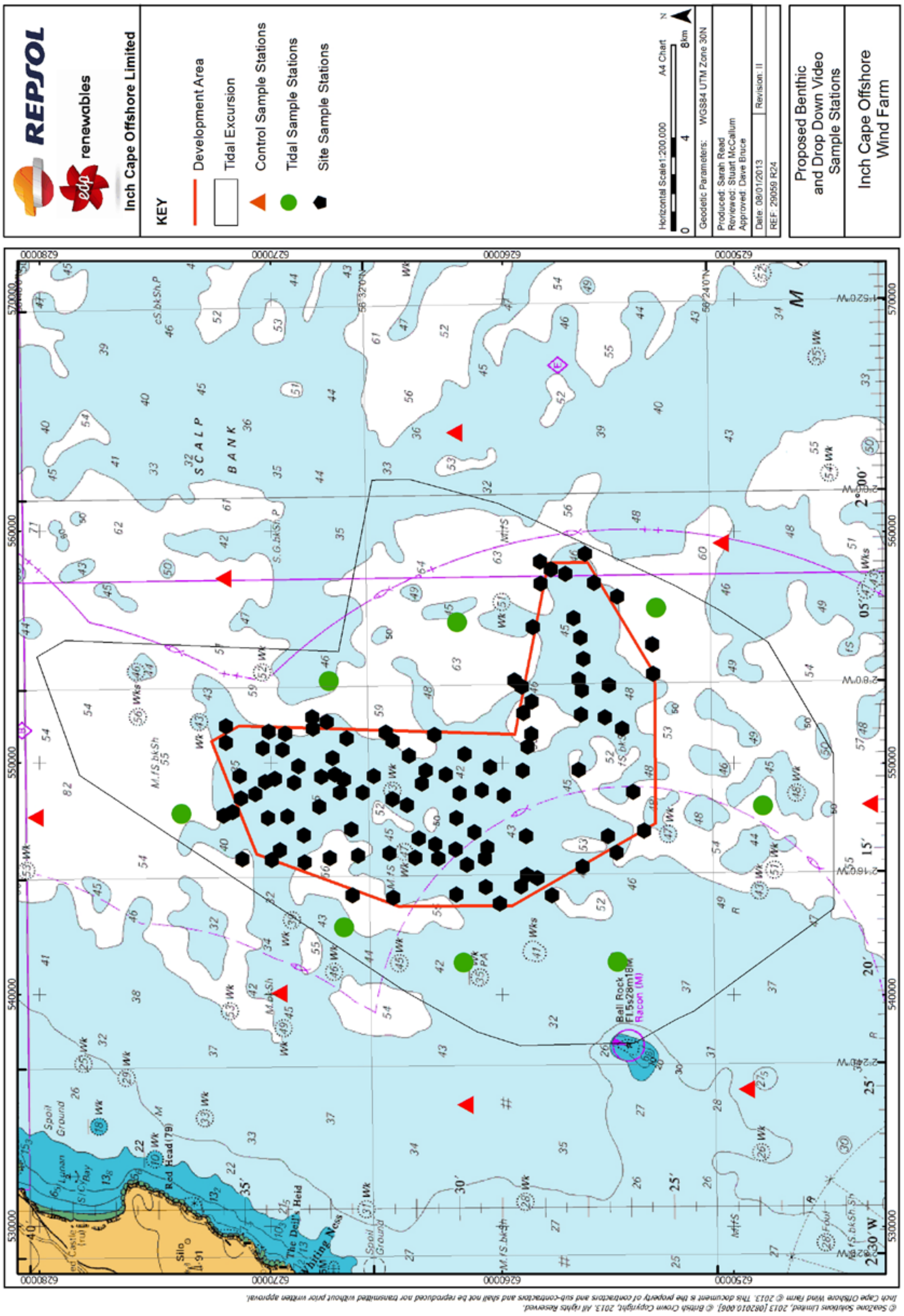
Further to the characterisation of the Development Area, the scoping report recommended systematic sampling over the extent of a single tidal excursion and wave affected region, as well as in discrete reference stations. As no acoustic mapping information is available for this wider area, a further 16 sampling stations were proposed for sample by DDV and benthic grab in triplicate, distributed in a systematic (radiating) grid covering the area of one tidal excursion and discreet reference stations outside of this (**Figure 12A.7**). The numbers of sampling stations proposed per treatment area is shown in **Table 12A.4** and **Figure 12A.8**, with the coordinates listed in **Annex12A.1**.

Table 12A.4 Proposed Benthic Grab/Drop-Down Video Sampling Stations

Treatment area	No. of sampling stations	Single/Triplicate sampling	Total no. of samples
Within the Development Area*	95	Single	95
Within 1 tidal excursion	8	Triplicate	24
Reference (beyond 1 tidal excursion)	8	Triplicate	24
Total	**111**		**143**

* see **Table 12A.2** for break down by habitat type. Some stations are actually located outside the Development Area boundary, however these stations were within the area covered by the geophysical survey, and represented impotant sampling stations for the ground truthing of this data.

Figure 12A.7 Proposed Benthic and Drop-Down Video Samping Stations



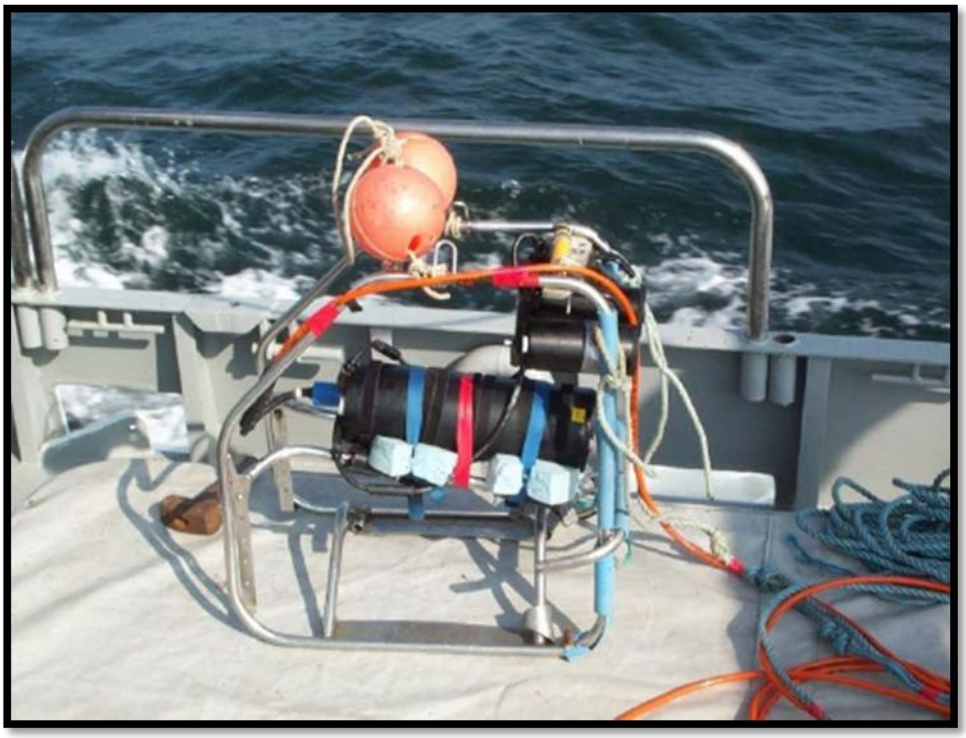
12A.2.3.1 Drop-Down Video Survey

The DDV survey work took place during the period 20-25 March 2012 on the vessel SB Seaguard (**Figure 12A.8**) based out of Montrose Harbour.

Figure 12A.8 SB Seaguard

The DDV work was undertaken by specialist underwater video and mapping consultants and followed procedural guidance 3-5 of the JNCC marine monitoring handbook. This produced data suitable for identification of Annex 1 habitats, biotope and habitat mapping. For the work a high-definition (HD) video camera (SONY-HDR-HC9E) was mounted within an underwater housing attached to a drop-down frame incorporating underwater lights and adjustable buoyancy and weights (**Figure 12A.9**). The system is tethered to and powered from the surface via an umbilical connected to a surface unit. This unit enables the operator to control the camera functions, enables a live image to be viewed whilst the camera is deployed and allows for footage to be recorded onto MiniDigital Video (DV) tape at the surface. In order to collect the best quality footage HD recordings were also made within the camera on the seabed. The system was lowered to the seafloor with the vessel drifting or gently towing the camera for one to five minutes. The location of each drop was mapped using Global Positioning System (GPS) and backed up with the vessel's on board positioning system, whilst depth was recorded using the vessel's sounder. Salinity, water temperature, turbidity and local weather conditions were also noted for each survey location.

Figure 12A.9 HD Camera within Frame and Housing



12A.2.3.2 Benthic Grab Survey

The benthic grab survey took place on board both the SB Seaguard and the research vessel the Arie Dirk (**Figure 12A.10**) operating out of Montrose Harbour between the 20 March 2012 and 2 May 2012. In order to minimise damage to sensitive Annex I habitats (i.e. reefs) the grab was only deployed if the DDV revealed that there were no sensitive habitats present. A standard (0.1 m^2) day grab was used.

After the DDV camera had been deployed at each sampling station a decision was taken based on the presence or absence of sensitive or unsuitable habitats as to whether the grab should be deployed. At each sampling station the time and location (coordinates) of the grab's deployment was recorded, as well as depth, water temperature, salinity, turbidity and prevailing weather conditions.

After the grab was recovered a visual assessment of sediment was made and a sub-sample taken for PSA and Total Organic Carbon (TOC) analysis. The sediment was then sieved through a 1 mm mesh sieve and the invertebrates retained were preserved in five per cent buffered formaldehyde.

Figure 12A.10 The Arie Dirk

12A.2.4 Epibenthic Beam Trawl Survey Design

The epibenthic beam trawl took place on board the FV Harvester (**Figure 12A.11**) operating out of Guordon Harbour between the 21 and the 24 May 2012. 24 sampling stations were sampled using a two meter scientific beam trawl (**Figure 12A.12)**. The mesh size of the main body of the net was five milimeters, with a five milimeter mesh cod-end. Tow duration at each station was 10 minutes, and with a tow speed of approximately 2-2.5 knots this equates to an approximate distance of between 500-700 m per tow. Starting and finishing times (when the trawl hits and leaves the seabed) and positions were recorded by GPS (Garmin GPS Map78s with external antennae) and backed up using the vessel's own on board positioning system. Depth, water temperature, salinity, turbidity, tidal state, prevailing weather conditions and sea state were noted at each sampling station.

Sampling was originally proposed at 24 sampling stations, with two replicates at each sampling station within the Development Area, and three replicates at sampling stations outwith the Development Area. These included sampling tows within the Development Area to cover the 22 habitat types within the Development Area, plus the area within one tidal excursion of the Development, and the reference areas (outwith one tidal excursion). These epibenthic sampling stations covered the seabed where some of the benthic grab sampling stations were located in order to provide information on the epibenthos present and therefore assist with biotope identification. Prior to the survey taking place, special dispensation for the use of undersized mesh was obtained from Marine Scotland.

Figure 12A.11 FV Harvester

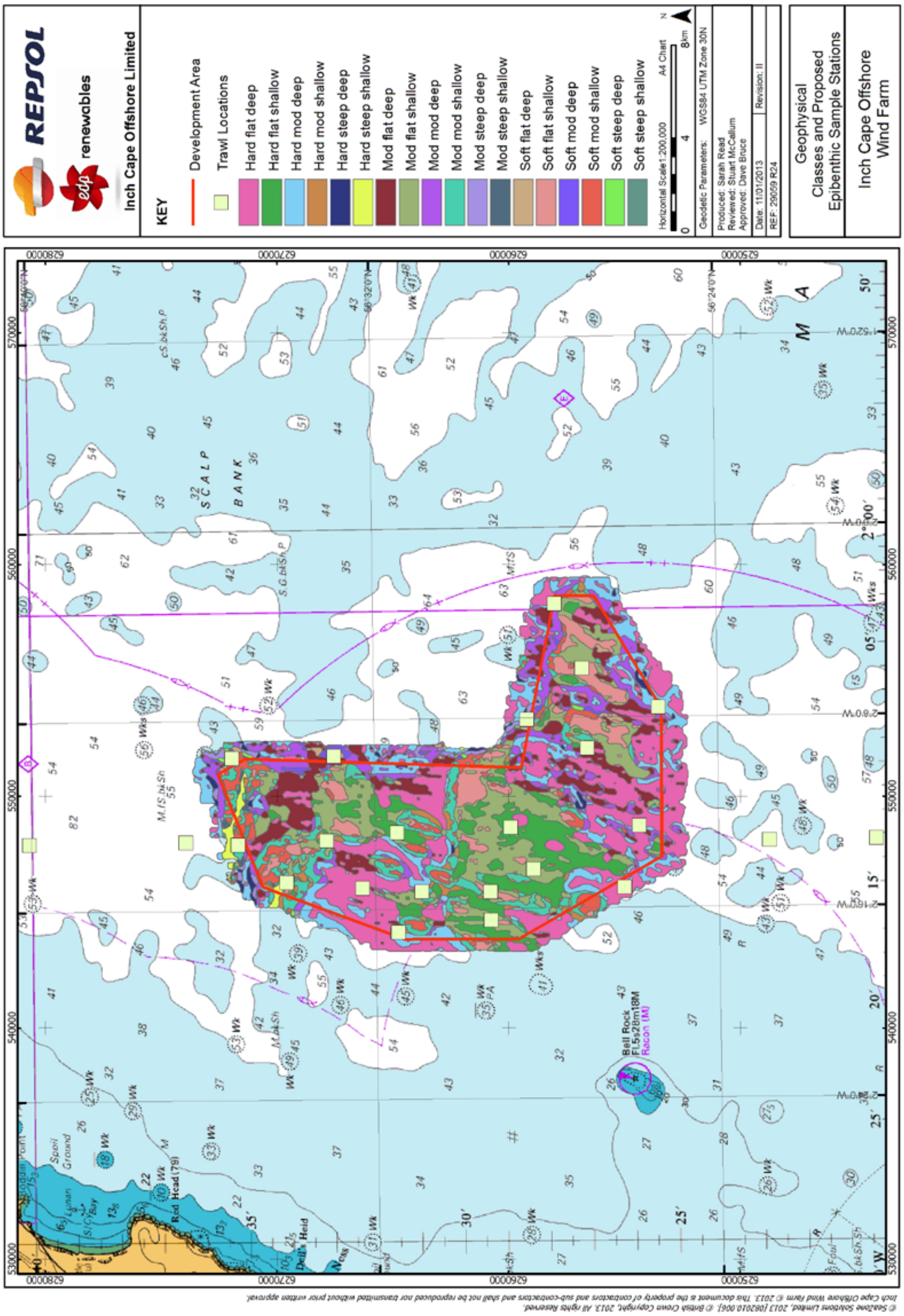
Figure 12A.12 2 m Scientific Beam Trawl

The evidence from the DDV survey carried out prior to the epibenthic beam trawl survey was used to finalise sampling station positions and ensure that no sampling occurred where sensitive habitats were present (e.g. biogenic reef, brittlestar beds, etc), and to eliminate areas which represented a high chance of gear loss or damage. This review resulted in two of the proposed epibenthic trawl locations being relocated due to unsuitable ground conditions and the presence of dense brittlestar beds within two relatively small habitat classes (weak, mod, shallow, and weak, mod, shallow, rockhead). The final positions of the epibenthic trawl locations are shown in **Figure 12A.13** with their coordinates listed in **Annex12A.1**.

After each tow the catch was separated into species and the numbers of each species recorded. The length (total length) of fish species (including electro-sensitive species) and commercially important invertebrates was recorded. Species were measured using the methods set out in European Commission (EC) Regulation 850/98 for the conservation of Fisheries resources through Technical Measures for the Protection of Juveniles of Marine Organisms.

Due to the diversity and abundance of species present within the epibenthic tows, full records of the catch were not always possible on board. As such, where in-situ sorting and identification was not possible, scientific samples were retained and frozen until they could be processed in AMEC's laboratory.

Figure 12A.13 Proposed Epibenthic Sample Stations



12A.2.5 Data Analysis

12A.2.5.1 Video Analysis

Video tracks and photographic stills were reviewed and analysed by experienced marine ecologists at Envision. Video data was used to assign epibenthic biotopes to habitats and to denote species present at each sampling station. The video clips that had been recorded on the digital tapes for each of the sampling stations were transferred to an external hard drive as (a) a form of back-up and (b) for analysis using video processing software. During analysis, each video clip was observed several times: firstly to get an overview of the sample station; secondly to obtain substrate data; thirdly to obtain species data and fourthly, to take frame grabs to illustrate particular features. Initially, a brief written description of each of the camera drops was given. Substrate and species data obtained from the video clips were then entered into an Excel™ spreadsheet based on a 'Data Entry Spreadsheet' produced by the JNCC for biotope analysis. The abundances of any species identified through the video analysis were defined using the SACFOR scale[2].

12A.2.5.2 Infaunal Identification

Taxonomic identification of the infauna retained from the grab samples was undertaken by our specialist subcontractor Identichaete. All fauna in the samples was identified to species level, where possible, with all extracted material stored in 70 per cent industrial methylated spirits (IMS).

12A.2.5.3 Epibenthic Fauna Identification

Epibenthic samples retained for processing were frozen and returned to AMEC's laboratory. Samples were sorted to species level where possible and all individuals of all species were counted. All fish, and invertebrates of commercial importance, were measured in accordance with the methods set out in EC Regulation 850/98 for the Conservation of Fisheries Resources through Technical Measures for the Protection of Juveniles of Marine Organisms.

12A.2.5.4 Particle Size and Total Organic Carbon Analysis

The United Kingdom Accreditation Service (UKAS) accredited National Laboratory Services (NLS) undertook PSA and TOC analysis on the sediment samples collected. The PSA analysis was undertaken using laser diffraction, which involves a low power visible laser transmitter producing a parallel, monochromatic beam of light which illuminates the particles by use of an appropriate sample cell. The incident light is diffracted by the particles illuminated to give a stationary diffraction pattern regardless of particle movement. By integrating over a suitable period a representative bulk sample of the particles contributes to the final measured diffraction pattern. For TOC analysis, organic carbon is oxidised to carbon dioxide in the dichromate method with a parallel reduction of hexavalent chromium (Cr6+) to trivalent chromium (Cr3+) and an accompanying colour change from orange to

[2] The SACFOR scale provides a unified system for recording the abundance of marine benthic flora and fauna in biological surveys. Definitions: Superbundant (S), Abundant (A), Common (C), Frequent (F), Occassional (O), Rare (R). http://jncc.defra.gov.uk/page-2684

green. The intensity of the colour change, measured by spectrophotometer, is proportional to the trivalent chromium concentration which is related to the organic matter content in the soil or sludge. This colour change is compared to calibration curves to obtain the TOC concentrations of the samples.

12A.2.5.5 Statistical Analysis

Statistical analyses were undertaken on the data generated from the benthic, video, and epibenthic survey work using PRIMER 6 (Plymouth Routines in Multivariate Ecological Research; Clarke and Gorley, 2006).

Physical data was normalised prior to examination with Principal Component Analysis (PCA). This allows an understanding to be gained on the variation present in the habitats physical parameters; i.e. per cent sand, per cent gravel, per cent mud, mean particle size, sorting coefficient, and depth, as well as the interactions between these parameters.

Biological data was standardised to remove multiple taxonomic levels that could potentially cause duplication of faunal records, as inclusion of multiple records can obscure true variation in community data, and square root transformed. A number of diversity indices (as described below) were calculated to provide a metric of diversity and species richness present at each station:

- Species richness (S) - the number of species present in an ecosystem, with no indication of relative abundances.
- Number of individuals (N) - total number of individuals counted.
- Margalef's index (d) - a measure of the number of species present for a given number of individuals - the higher the index, the greater the diversity.
- Pielou's evenness (J') - shows how equally the individuals in a population are distributed. J' = 0 – 1. The less variation in the samples, the higher J' is.
- Shannon-Wiener index ($H'log_e$) - measures the uncertainty of being able to predict the identity of the next species withdrawn from a sample. H' is generally found to be in the range 1.2 – 7.0. The higher the index the greater the diversity.
- Simpson's index (1-λ) – a measure of the probability that when choosing two individuals from a sample that they will be of different species. D = 0 (minimum diversity) – 1.0 (maximum diversity).

To determine the faunal groupings for the biotope assessment, samples that naturally group together were identified using multivariate statistics. Bray-Curtis similarity matrices were produced for both benthic and epibenthic data and the similarity scores graphically illustrated using Cluster Analysis and Multidimensional scaling (MDS) plots. SIMPROF routines were initially used to identify the sampling stations to be grouped together based on their similarity, with the groups further described using SIMPER (similarity percentage) analysis and ANOSIM (analysis of similarity). The SIMPROF determination resulted in 22 statistically dissimilar groups, although when compared at a biological level it was found that many of these groups represented the same biotope, albeit with a slight alteration of community composition. The process was therefore re-run in an iterative manner to manually determine the most relevant split of data (using cluster analysis) resulting in the creation of biologically dissimilar groups. The first stage in this process was to examine where the groups produced by the SIMPROF analysis began to differ in terms of their biotopes, and relate this to the cluster analysis, prompting a split in the faunal data at a similarity level of 30 per cent. These groups were then examined in terms of their faunal composition, with the resulting biological communities tested using ANOSIM to determine their relative similarity, and SIMPER to establish the taxa driving their grouping.

In order to look for relationships between physical and biological traits, the physical data was examined in relation to the biotope groupings through the BIOENV routine in PRIMER using Spearman’s Rank Correlation and a Euclidian Distance similarity matrix.

12A.2.5.6 Biotope Assessment

The assessment of the infaunal and epifaunal biotopes present across the Inch Cape Development Area was done using the video, benthic infauna, and epibenthic trawl data.

Allocation of biotopes from the video data was done using the ‘Marine Habitat Classification v. 04.05’ (Connor *et al.*, 2004) with frame grabs taken from the video to illustrate the different biotopes present. Where biota could not be identified to species (e.g. because they would need to be collected and closely examined to be certain, such as for some of the sponges, or where only a glimpse of them was available on the video) then they were assigned to a higher taxonomic category within which they are definitely contained. It was not possible to be certain about the precise identity of some of the encrusting fauna (e.g. Bryozoa) because of their small size.

For the classification of biotopes from the infaunal data, the species making up the top 90 per cent of each of the groups identified through the cluster analysis were entered into the biological comparative tables which returns all possible biotope matches, giving a percentage occurrence (when over 20 per cent) for a given species in all core records of a biotope. Infaunal samples that were too dissimilar to be combined into other groups were removed at this point as they are unlikely to be representative of distinct biotopes. The PSA data was then incorporated into the assessment in order to determine the most appropriate biotope for the faunal and sedimentary data.

The epibenthic trawl data was assessed alongside the video and infaunal data using the same biological comparative tables to determine whether it complimented the infaunal biotopes identified, or led to the classification of separate epibenthic biotopes.

12A.2.6 Habitat Mapping

The PSA and video data was used to validate the geophysical analysis and determine the habitat types present across the Development Area. Habitat types at the sampling stations within the tidal excursion and reference areas were also classified, although without geophysical data to determine the extent of such habitats only point source interpretation was applied at these sampling stations.

The biotopes and sedimentary environment data determined for each sampling station were then imported into GIS and mapped, allowing a detailed interpretation of the physical conditions and benthic communities present in and around the location of the Development Area.

12A.3 Results

12A.3.1 Drop-Down Video Survey

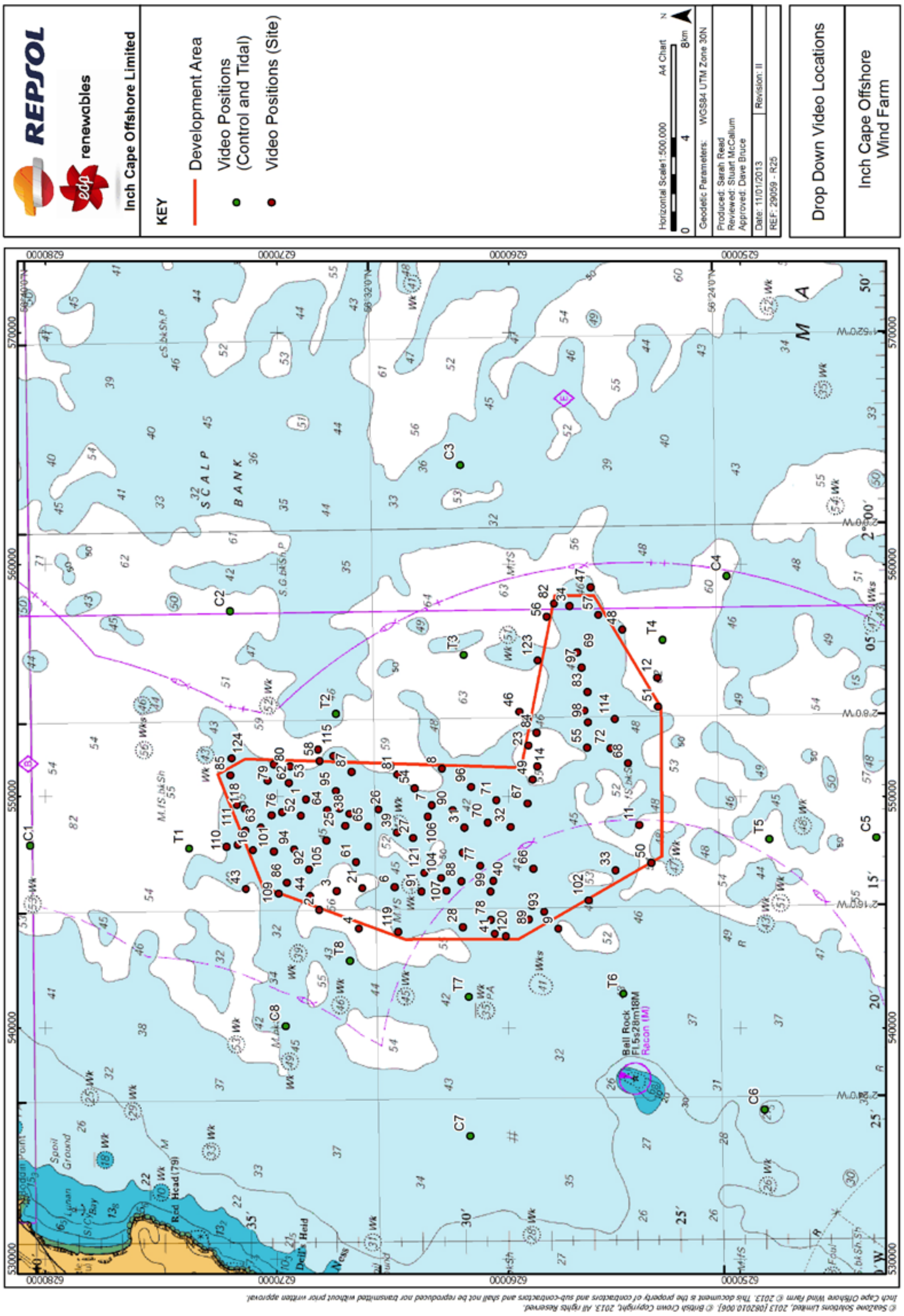
A total of 124 video drops were taken across the Development Area and surrounding area at 124 sampling stations (8 control stations, 8 stations within the tidal excursion, 108 Development Stations). The positions of all video drops are listed in **Annex 12A.2**, and shown on **Figure 12A.14**

As described in the background information section above (Section 12A1.3), the benthic ecology of the area surrounding the Development Area has been studied to varying degrees. The Firth of Tay, situated between the sandy peninsulas of Buddon Ness on the north side, and Tentsmuir on the south, is extended seawards by the Gay and Abertay sandbanks and is relatively well studied in comparison to the offshore environment. The Firth of Forth, to the south of the Development Area, has also received attention within the literature, particularly concerning the effects of sewage on the benthic ecology. The Marine Nature Conservation Review (MNCR) of East Scotland provides much benthic information on the coastal and estuarine environments in proximity to Development Area. Typically, the offshore environment has been studied to a lesser degree, with the main body of information focused around Bell Rock disposal site and the long term benthic monitoring records of Clean Seas Environmental Monitoring Programme (CSEMP) and the United Kingdom Offshore Operators Association (UKOOA), as well as specific studies for the Mapping European Seabed Habitats (MESH) project.

Preliminary observations of the DDV data indicated that the habitat and biota present in the survey area at the Development Area are typical of North Sea sedimentary communities described in the desk study section above. Although a wide range of sediment types were found to be present within the survey area as a whole – including coarse sand, shell and stone gravel, pebble, and cobble – the dominant substrate type recorded was rippled sand with shell gravel. No areas of bedrock or biogenic reef features were recorded.

The key species present in the survey area were found to be: *Alcyonium digitatum*, *Pomatoceros triqueter*, *Munida rugosa*, *Flustra foliacea*, and *Asterias rubens*. The brittlestar *Ophiothrix fragilis* occurred in high densities, but only at two stations. All species identified at each sampling station are shown in **Annex 12A.3**.

Figure 12A.14 Drop-Down Video Locations



12A.3.2 Benthic Grab Survey

A total of 113 grabs were taken across the Development Area and surrounding area at 87 sampling stations (6 control stations, 7 tidal excursion stations, and 74 Development Area stations). The positions of all benthic grab samples taken are shown on **Figure 12A.15** with positions and survey information detailed in **Annex 12A.4**.

12A.3.2.1 Physical Data

The PSA data collected across the survey area indicates that the sediment at the Development Area and surrounding area is moderately sorted (average sorting coefficient 1.08) and is dominated by medium to fine sands with areas of gravel (**Figure 12A.16**). The survey notes also indicate that a high proportion of shell debris was found in many samples. This backs up the results of the DDV survey which stated the dominant sediment type observed was of rippled sands with shell gravel. TOC was generally low at all sampling stations (<0.4 per cent) and was only found to be above one per cent at a single sampling station (number 1) located toward the north of the Development Area. The full PSA data is included in **Annex 12A.5**, with the PSA components (per cent gravel, per cent sand, per cent mud, and sorting coefficient) mapped across the Development Area in **Figure 12A.17**.

12A.3.2.2 Faunal Data

A total of 336 taxa were recorded in the faunal analysis of the benthic samples, the 10 most abundant (across all sampling stations) are shown in **Table 12A.5** below.

Table 12A.5 10 Most Abundant Species Recorded from the Benthic Samples

Species	Faunal group	Total number caught	Number of stations where present
Sabellaria spinulosa	Polychaeta	1139	21
Amphiura filiformis	Echinodermata	917	78
Galathowenia oculata	Polychaeta	828	102
Lumbrineris gracilis	Polychaeta	581	93
Astrorhiza limicola	Foraminifera	400	86
Owenia fusiformis	Polychaeta	370	99
Chamelea striatula	Mollusca	337	79
Diplocirrus glaucus	Polychaeta	271	82
Nemertea indet.	Polychaeta	266	89
Spiophanes bombyx	Polychaeta	262	87

Figure 12A.15 Benthic Grab Locations

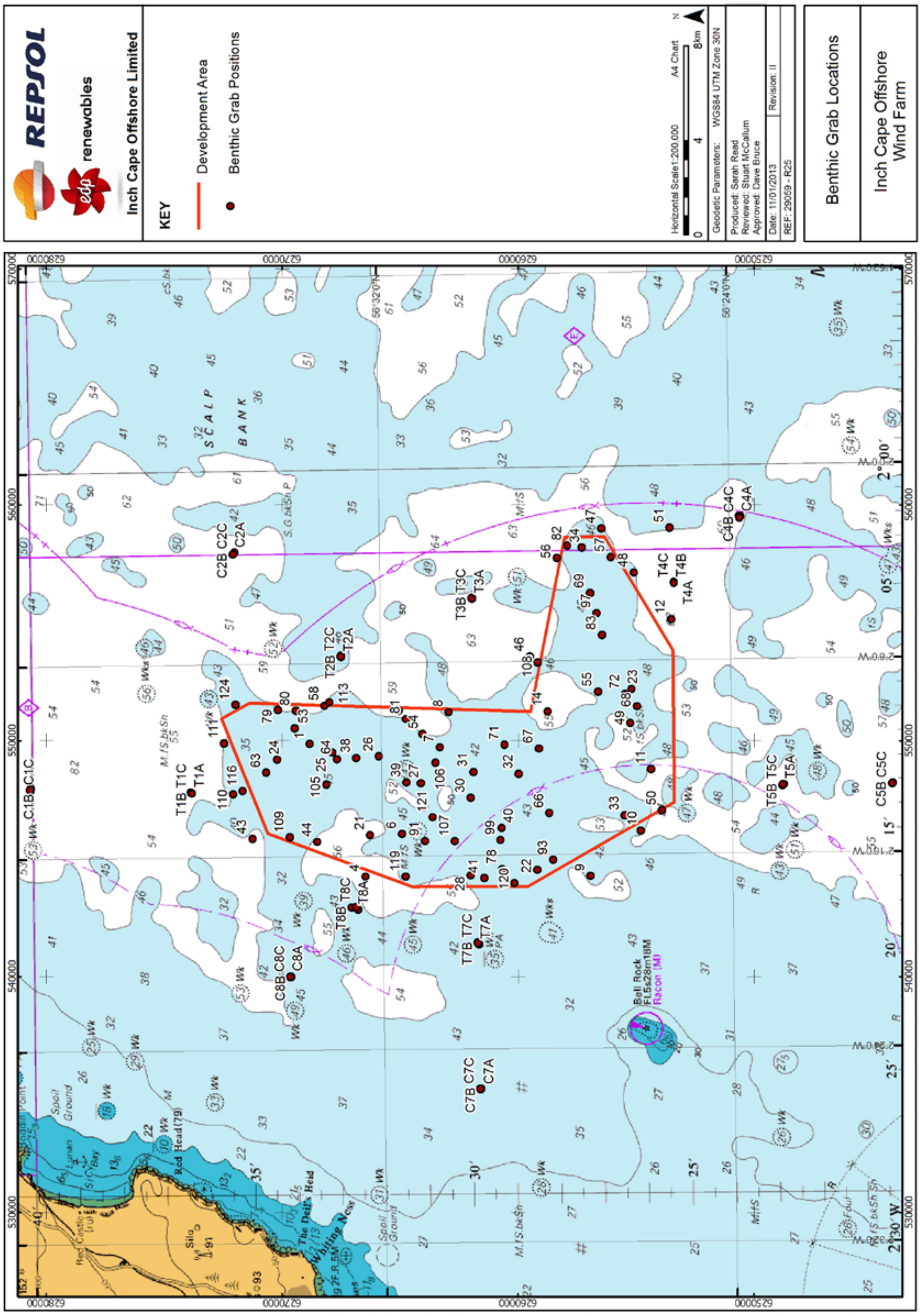


Figure 12A.16 Particle Size Analysis

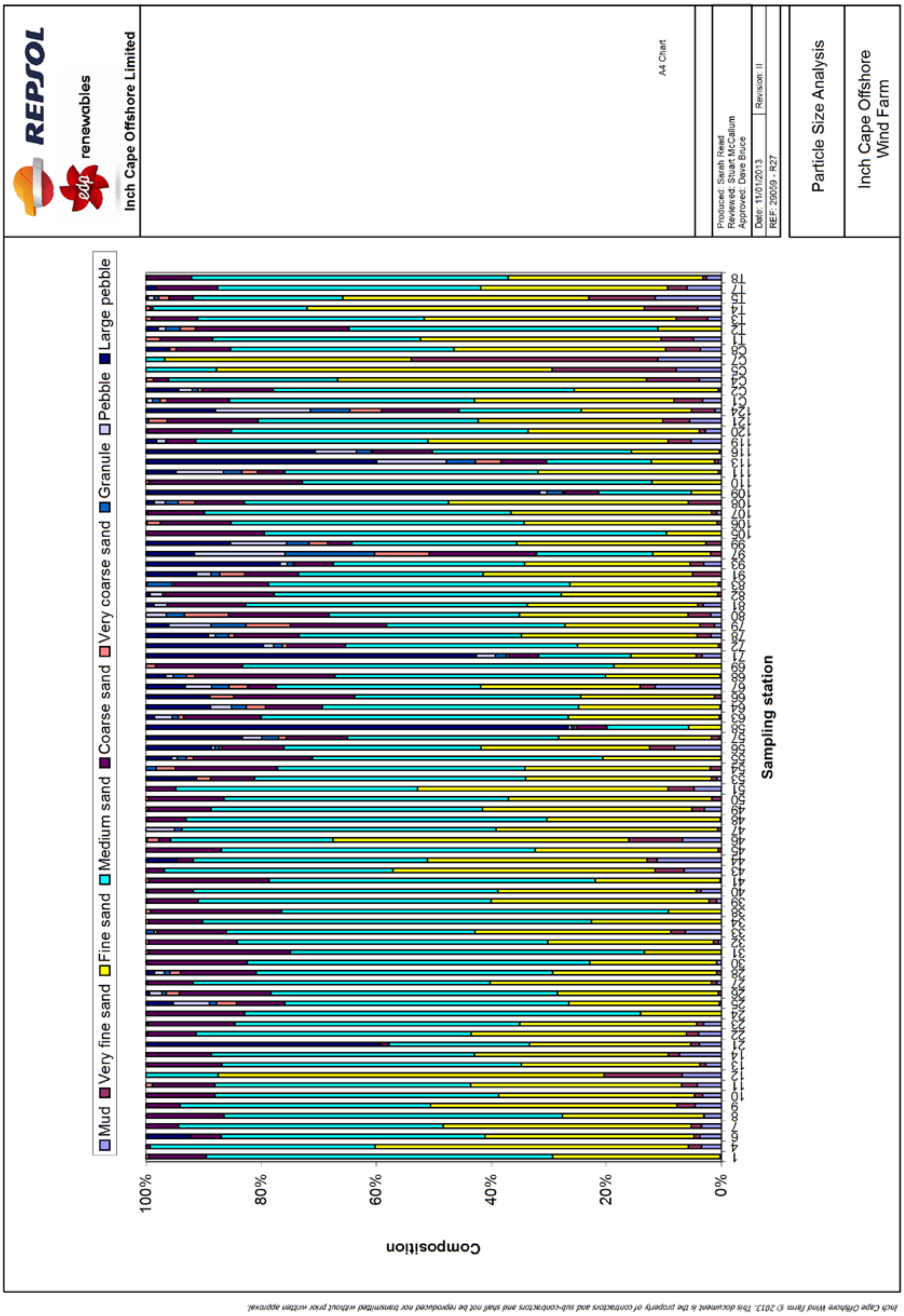
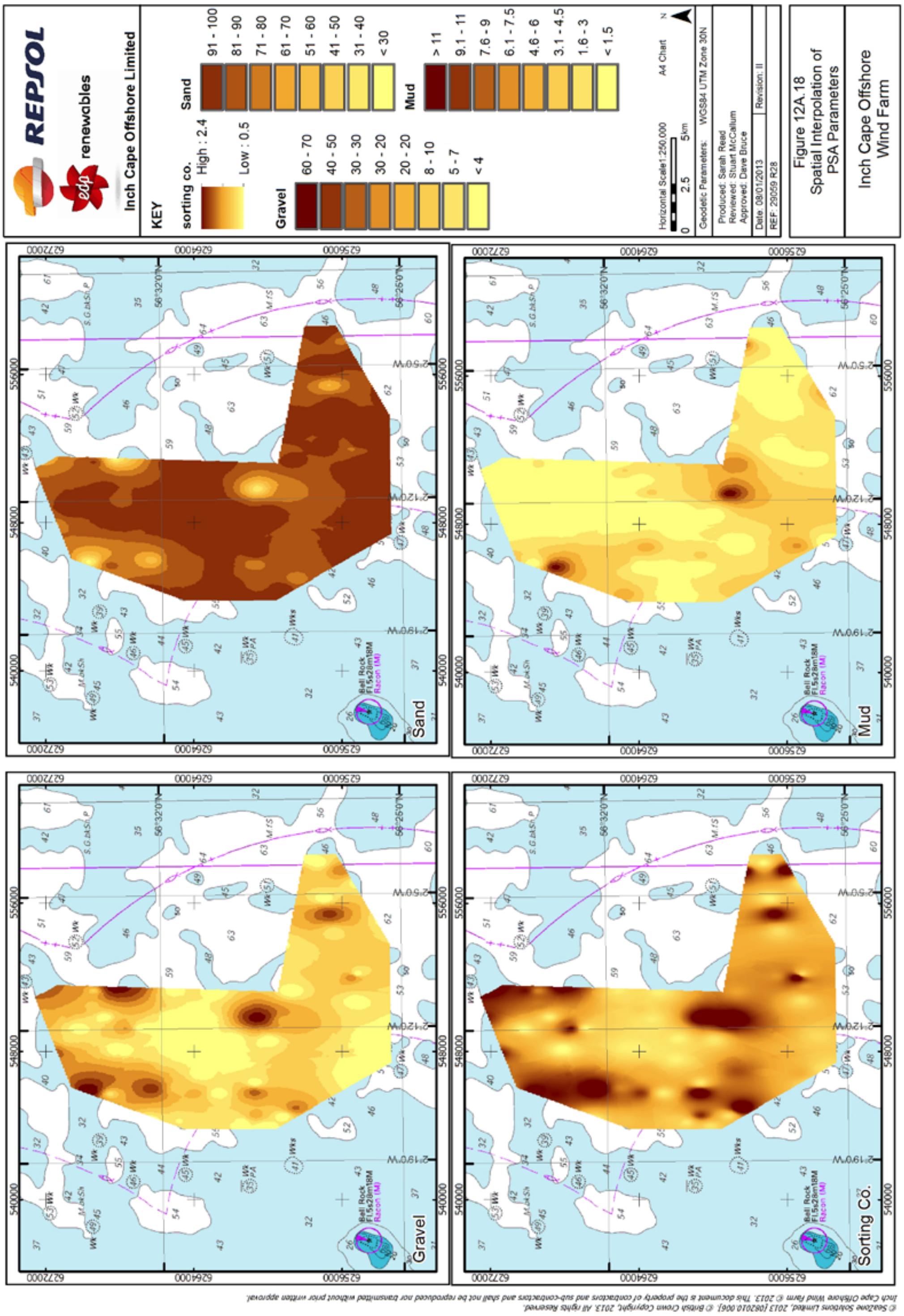


Figure 12A.17 Spatial Interpolation of PSA Parameters



12A.3.3 Epibenthic Beam Trawl Survey

52 epibenthic beam trawls were undertaken across the Development Area and surrounding area over 24 stations (see **Figure 12A.18** and **Annex 12A.6**), including 20 stations within the Development Area, 2 within the tidal excursion, and 2 control stations. 2566 individuals from 71 species were recorded, including 47 invertebrate species; dominated by the pink shrimp (*Pandalus montagui*), comb jellies (*Pleurobrachia pileus*) and the common brittlestar (*Ophiothrix fragilis*); and 24 fish species; dominated by dab (*Limanda limanda*), pogge (*Agonus cataphractus*), and long rough dab (*Hippoglossoides platessoides*). The ten most abundant non-colonial species caught during the trawls are shown below in **Table 12A.6**.

Table 12A.6 Most Abundant Non-colonial Species Recorded during Epibenthic Trawl Surveys

Common Name	Latin Name	Total number caught	Number of stations where present
Pink shrimp	*Pandalus montagui*	493	22
Comb jelly	*Pleurobrachia pileus*	393	11
Common brittle star	*Ophiothrix fragilis*	262	19
Common starfish	*Asterius rubens*	191	20
Dab	*Limanda limanda*	186	23
Grey shrimp	*Crangon allmanni*	110	16
Moon jellyfish	*Aurelia aurita*	69	10
Squat lobster	*Munida rugosa*	57	16
Pogge	*Agonus cataphractus*	57	19
Long rough dab	*Hippoglossoides platessoides*	50	10

In addition to the above species, the colonial bryozoan, hornwrack (*Flustra folicacea*), and the soft coral, dead man's fingers (*Alcyonium digitatum*), were also present at a high number of sampling stations (each species was present at 19 of the 24 stations), often in great abundances (**Figure 12A.19**). Furthermore, individuals of the Ross worm (*Sabellaria spinulosa*) were found at eight sampling stations, although all colonies were small (< 50 individuals) and none represented reef formations.

Figure 12A.18 Epibenthic Trawl Locations

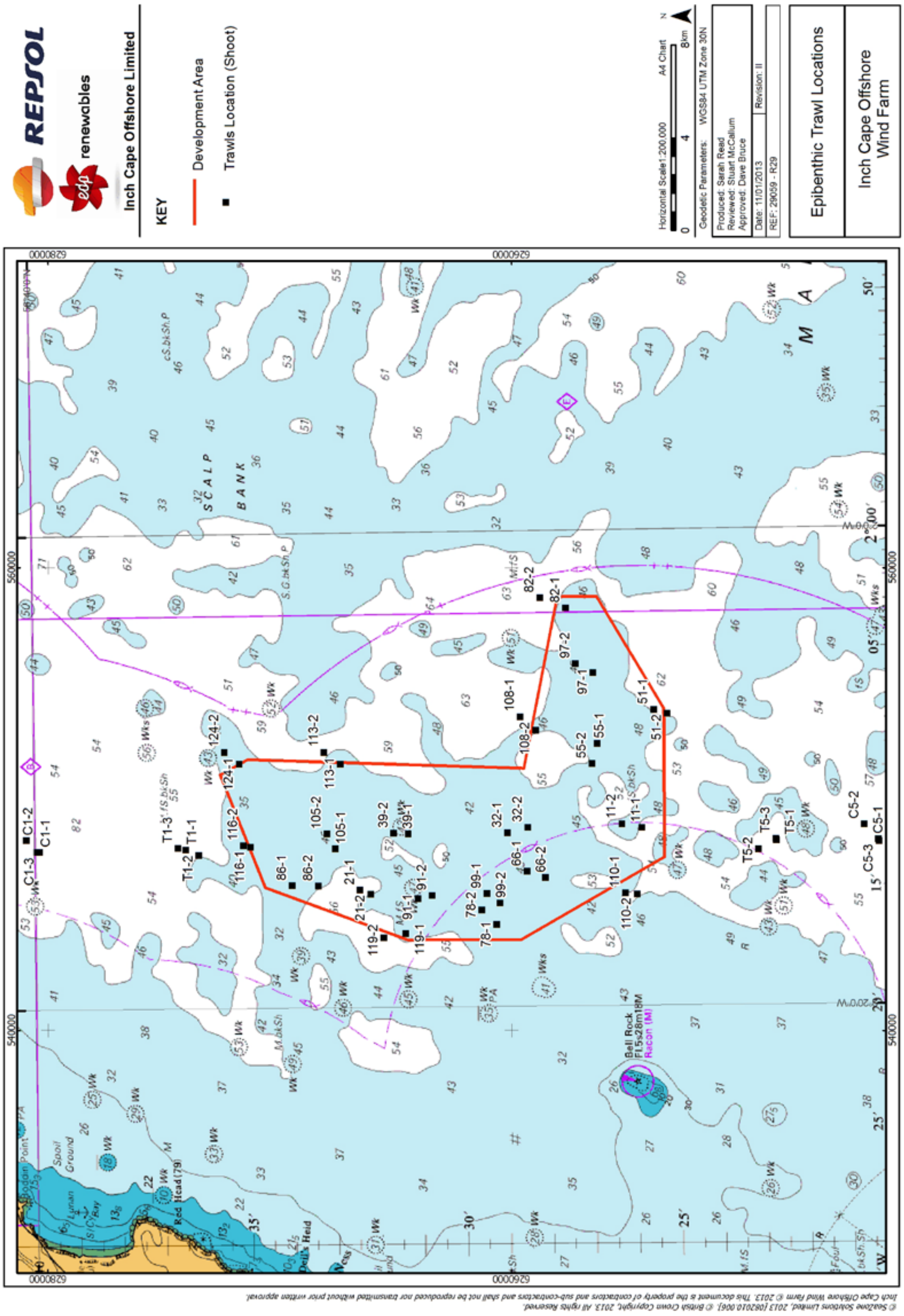
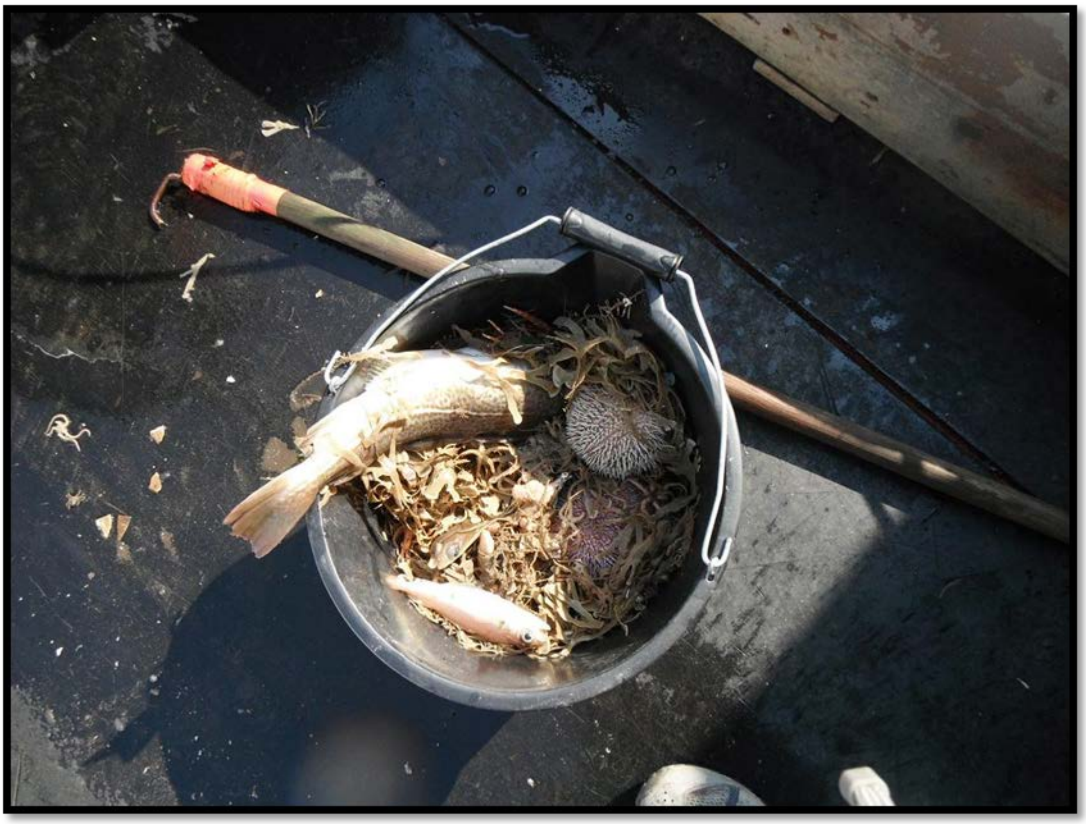


Figure 12A.19 Typical Catch from Epibenthic Survey including Large Amounts of Hornwrack



The sampling tows in which the greatest diversity of species was recorded were at stations 113, 99, and 116 where 25, 24, and 23 species were recorded respectively. The sampling stations with the greatest number of individuals caught within them were stations 124, 99, and 113 where 185, 124 and 147 individuals were caught respectively.

12A.4 Data Analysis

12A.4.1 Physical Data

Interpretation of the interaction and variation within the physical parameters across the survey area was investigated using PCA and factor analysis; with per cent sand, per cent gravel, per cent mud, mean particle size, sorting coefficient, and depth as factors. TOC was almost uniformly low at all sampling stations (< 0.4), and so was not taken forward in any further analyses. The factor analysis indicates that almost all variation (99.9 per cent) within the dataset is explained on the first four principal component (PC) axes, with the majority (82.4 per cent) described over the first two (table of Eigenvalues can be found in **Annex 12A.7**). Further examination of each variable's contribution to the axes indicates that PC1 is generated by the interaction of the percentage of gravel and mean particle size, contrasting against the percentage of sand, with PC2 generated primarily by the percentage of mud in each sample (**Figure 12A.20** and **Table 12A.7**). The appearance of depth and sorting coefficient contributing to two primary axes in **Figure 12A.20** is a consequence of the flattening of the multiple component axes into two dimensions; depth is represented on PC3 and sorting coefficient on PC4 (**Table 12A.7**), each driving a lower percentage of the variation in the data.

Figure 12A.20 PCA graph. Vectors Indicate Contribution of Parameters to Variation within the Dataset

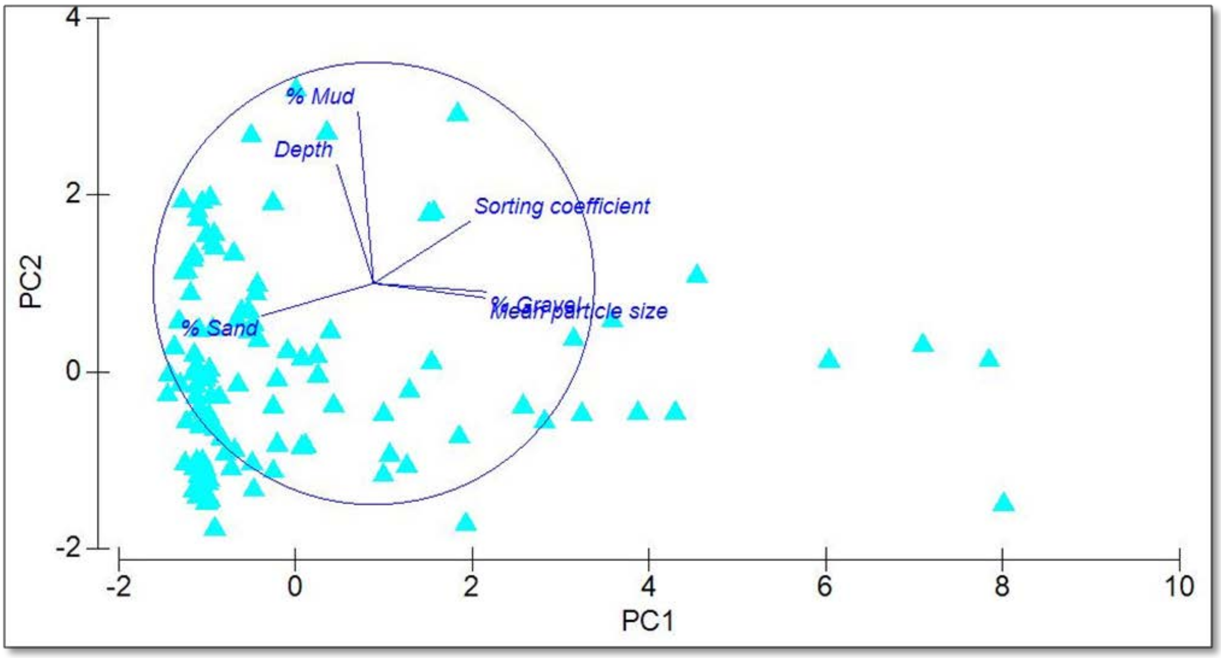


Table 12A.7 Eigenvectors (coefficients in the linear combinations of variables making up PCs)

Variable	PC1	PC2	PC3	PC4
% Gravel	**-0.511**	0.038	-0.135	-0.221
Mean Particle Size (mm)	**-0.507**	0.066	-0.143	-0.271
% Sand	**0.507**	0.146	0.012	0.274
% Mud	0.07	**-0.777**	0.518	-0.295
Depth	0.167	-0.539	**-0.826**	0.009
Sorting Coefficient	-0.438	-0.281	0.105	**0.846**

12A.4.2 Biological Data

12A.4.2.1 Infaunal Data

Cluster analysis using a SIMPROF routine described 22 statistically dissimilar groups from the 113 faunal samples. However, when examined at a scale appropriate for determining biotopes, many of these groups proved to be very similar. As a result a more iterative, manual process was employed to determine more biologically significant classes at a biotope level.

Examination of the Cluster analysis identified four groups with similarity scores greater than 30 per cent (**Figure 12A.21**). The taxa making up these four groups were examined and it was determined that groups three and four represented the same biological community. The three biological groups identified were: 1) a polychaete and bivalve community with burrowing echinoderms; 2) a polychaete dominated community; and 3) a polychaete and bivalve community. Analysis of Similarity (ANOSIM) between the three groups shows there exists a significant difference between the community compositions of the groups (R=0.767, p=0.1 per cent) (**Table 12A.8**). This separation is shown graphically via the MDS plot in **Figure 12A.22**.

Table 12A.8 ANOSIM Results for Infaunal Groups

Groups	R statistic	Significance level (%)
Global	**0.767**	**0.1**
1 & 3	0.718	0.1
1 & 2	0.786	0.1
2 & 3	0.894	0.1

Figure 12A.21 Benthic Cluster Analysis

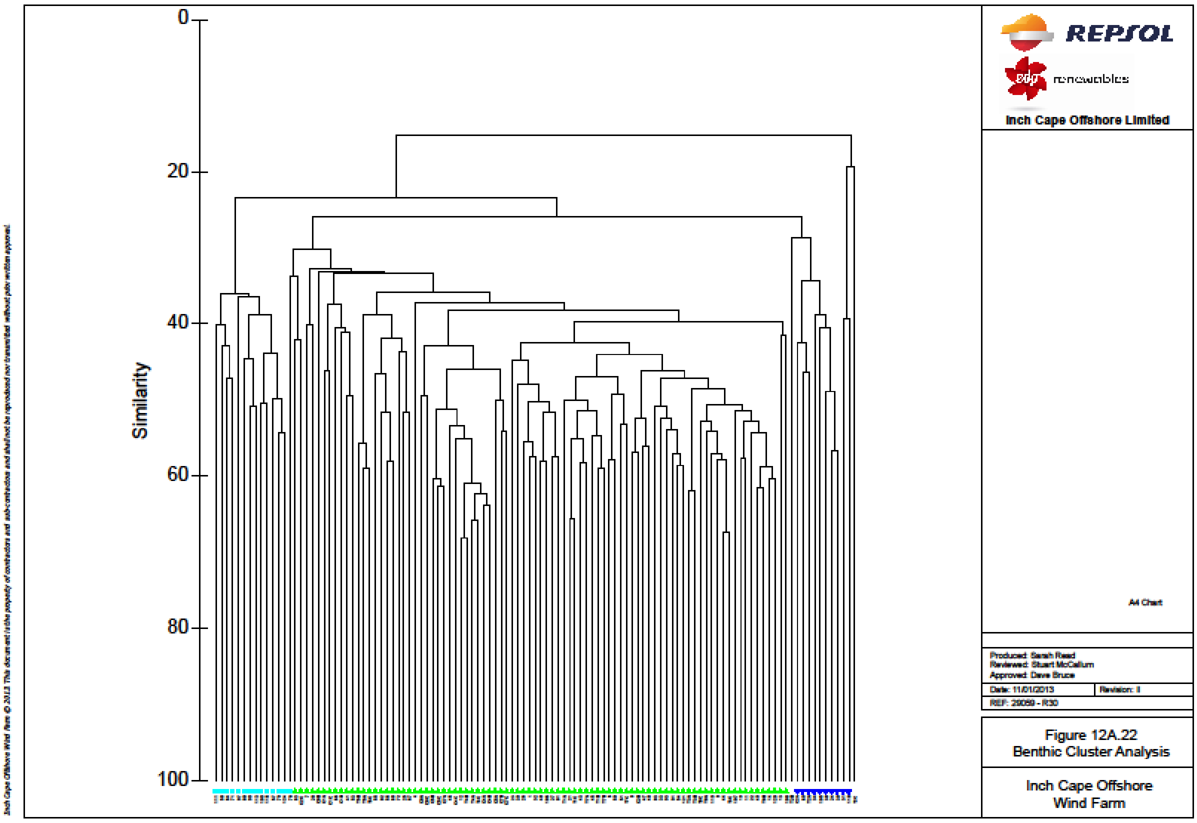
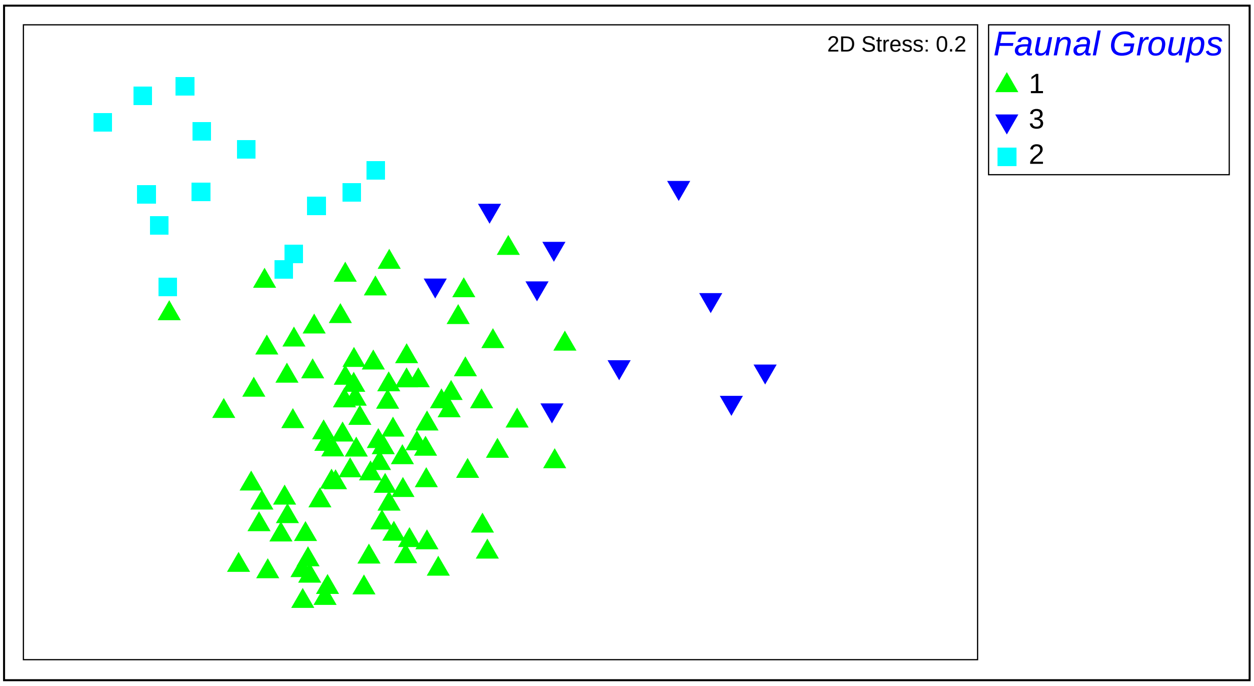


Figure 12A.22 MDS Plot of Faunal Groups



Diversity indices were also calculated for each grab sample using the DIVERSE test in Primer V6, summaries of which are shown below for each of the faunal groups (**Table 12A.9**). Univariate statistical tests using analsyis of variance (ANOVA) on the diversity indices (**Table 12A.10**) show there to be significant differences between at least two of the groups over all diversity indices. For the majority, the difference is seen between both groups one and two and group three which, from examination of the index means, appears to be the most separate over the first four indices (N, S, d, and H'(log_e)). Simpson's index (1- **λ**) showed a significant difference only between groups one and two, despite the identical index means between all groups, indicating a high level of diversity. Peilou's evenness was significantly different between all community groups, although again the mean value of this index across all groups was very similar, and indicated a low amount of variation existed between the samples. A spatial representation of the results of the DIVERSE test is shown in **Figure 12A.23**.

Table 12A.9 Mean Diversity Index Values for each Faunal Group Identified through Cluster Analysis

Diversity Index	**Biological group**		
	1	**2**	**3**
N	52.06	57.12	35.66
S	35.89	38.21	26.5
d	8.81	9.23	7.09
H'(log_e)	3.45	3.47	3.13
1- **λ**	0.98	0.98	0.98
J'	0.97	0.96	0.98

Table 12A.10 Probability Scores <0.05 from One Way ANOVA Tests on each Diversity Index at a Community Level

Combination	**S**	**N**	**d**	**H'(log_e)**	**1- λ**	**J'**
All	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001
Groups 1 & 2					<0.001	<0.001
Groups 1 & 3	<0.005	<0.005	<0.01	<0.005		<0.05
Groups 2 & 3	<0.005	<0.01	<0.005	<0.05		<0.05

12A.4.2.2 Epibenthic Data

Diversity statistics were calculated for the epibenthic data and these show a wide variation in values (**Table 12A.11**). The diversity and richness of each tow are shown on **Figure 12A.24**.

Table 12A.11 Summary Diversity Data for Epibenthic Trawls

	S	N	d	J'	H'(log_e)	1- λ '
Minimum	1	1	0.629692	0.817248	0	0.574731408
Maximum	20	38.36948	5.293871	1	2.836086	1
Mean	8.134615	13.1002	2.882396	0.958224	1.814139	0.923149851

Figure 12A.23 Spatial Interpolation of Diversity Indices

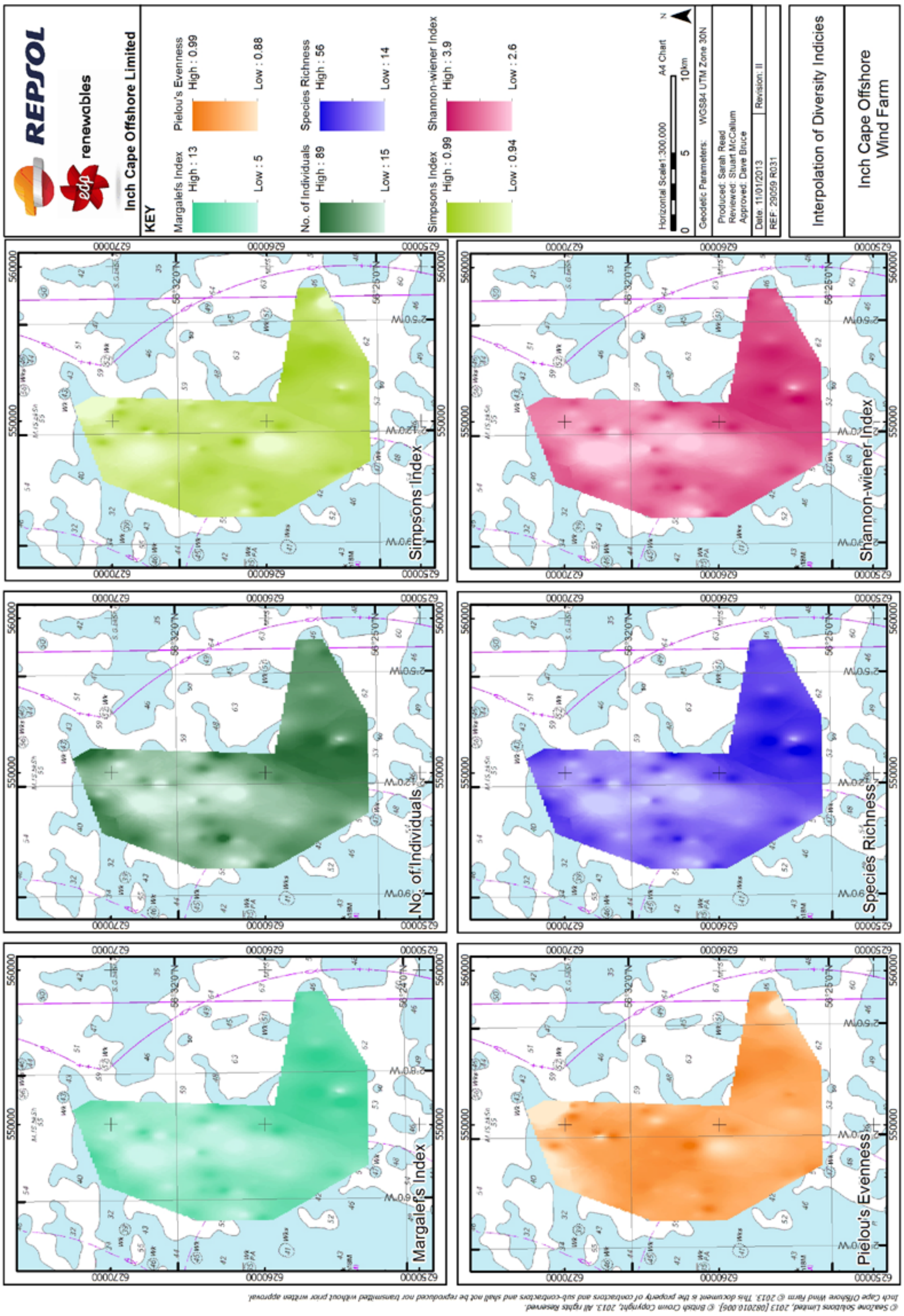
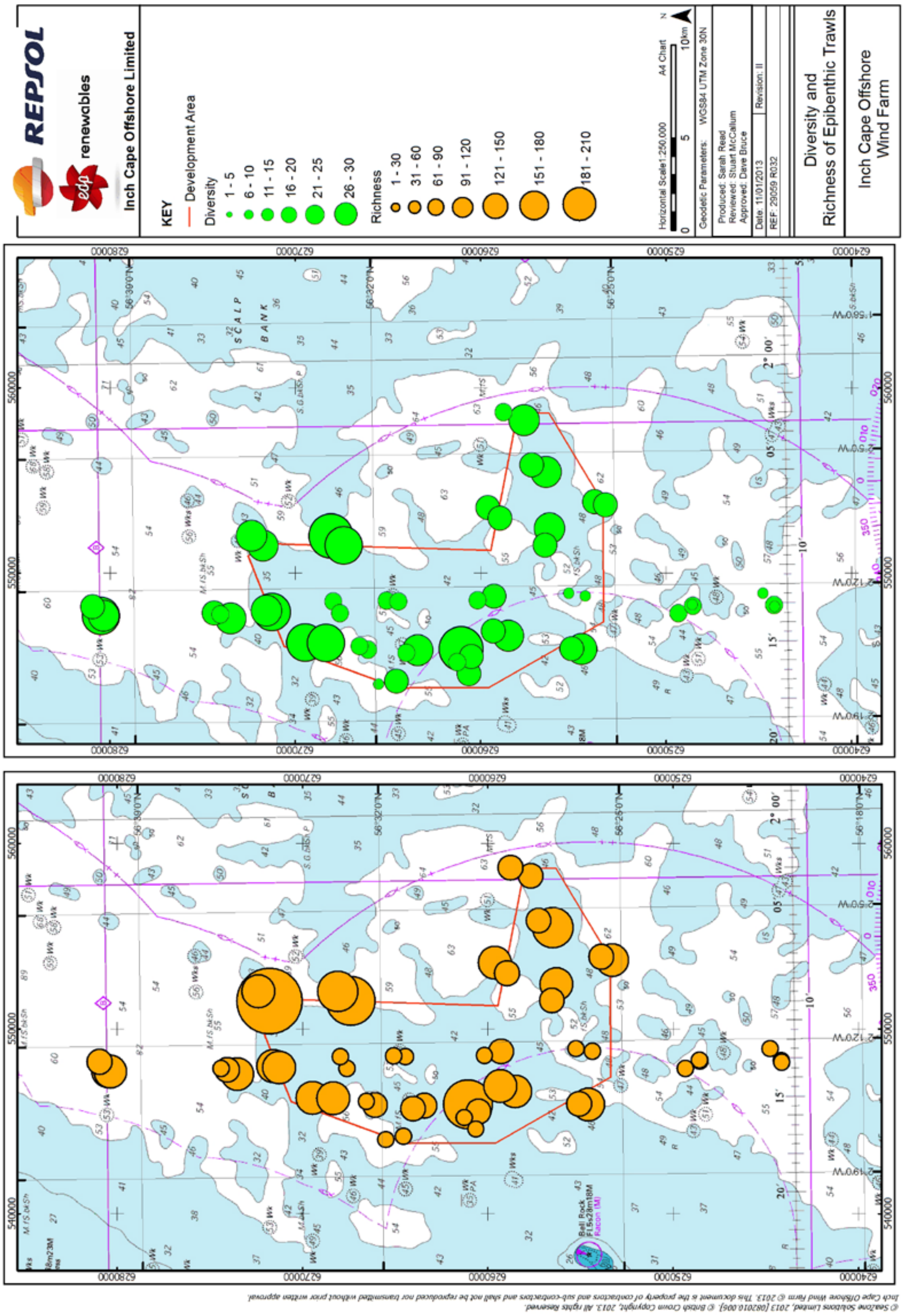


Figure 12A.24 Diversity and Richness of Epibenthic Trawls



12A.4.3 Physical-Biological Interactions

The physical and biological data sets recorded for the benthic grab survey allow some comparisons to be drawn between the two. The relationship between individual physical factors and the biological variation present has been examined graphically using MDS plots of the faunal data overlaid with a representation of the magnitude of each physical parameter (**Figure 12A.25**).

A visual comparison of the physical parameters determined in each of the biological groups indicates a degree of separation between the three communities, particularly in terms of the per cent gravel, the per cent mud, and the mean particle size. However, due to the unbalanced nature of the groups and differences in variance of several orders of magnitude, despite heavy transformation, univariate testing of this separation was not appropriate. A summary of the physical parameters for each group are detailed below in **Table 12A.12** and these clearly show a degree of separation over all parameters between the groups. The three biological communities can now be further described, using physical information from the PSA data, as follows:

1. a polychaete and bivalve community with burrowing echinoderms in circalittoral mixed sediments;
2. a polychaete dominated community in circalittoral sandy gravels; and
3. a polychaete and bivalve community in medium to coarse circalittoral sands.

Table 12A.12 Summary Statistics of Physical Parameters for each Biological Group

Group (records)	Mean	Standard Error	Standard deviation	Variance	Range	Minimum	Maximum
% Sand							
1 (87)	92.89874	0.773004	7.210104	51.98559	44.72	55.39	100.00
2 (14)	62.87429	5.9766	22.36239	500.0765	65.85	25.61	91.46
3 (10)	98.911	0.674048	2.131528	4.54341	6.38	93.65	100.00
% Mud							
1 (87)	3.733333	0.382723	3.569801	12.74348	13.8	0	13.8
2 (14)	0.767143	0.275704	1.031589	1.064176	3.41	0	3.41
3 (10)	0.087	0.087	0.275118	0.07569	0.87	0	0.87
% Gravel							
1 (87)	3.25977	0.697137	6.502459	42.28198	40.82	0	40.82
2 (14)	35.89071	6.028388	22.55616	508.7805	67.69	6.64	74.33
3 (10)	0.997	0.699625	2.21241	4.894757	6.45	0	6.45
Sorting co.							
1 (87)	0.997241	0.048379	0.451246	0.203623	1.89	0.5	2.39
2 (14)	1.970714	0.072274	0.270426	0.07313	1	1.28	2.28

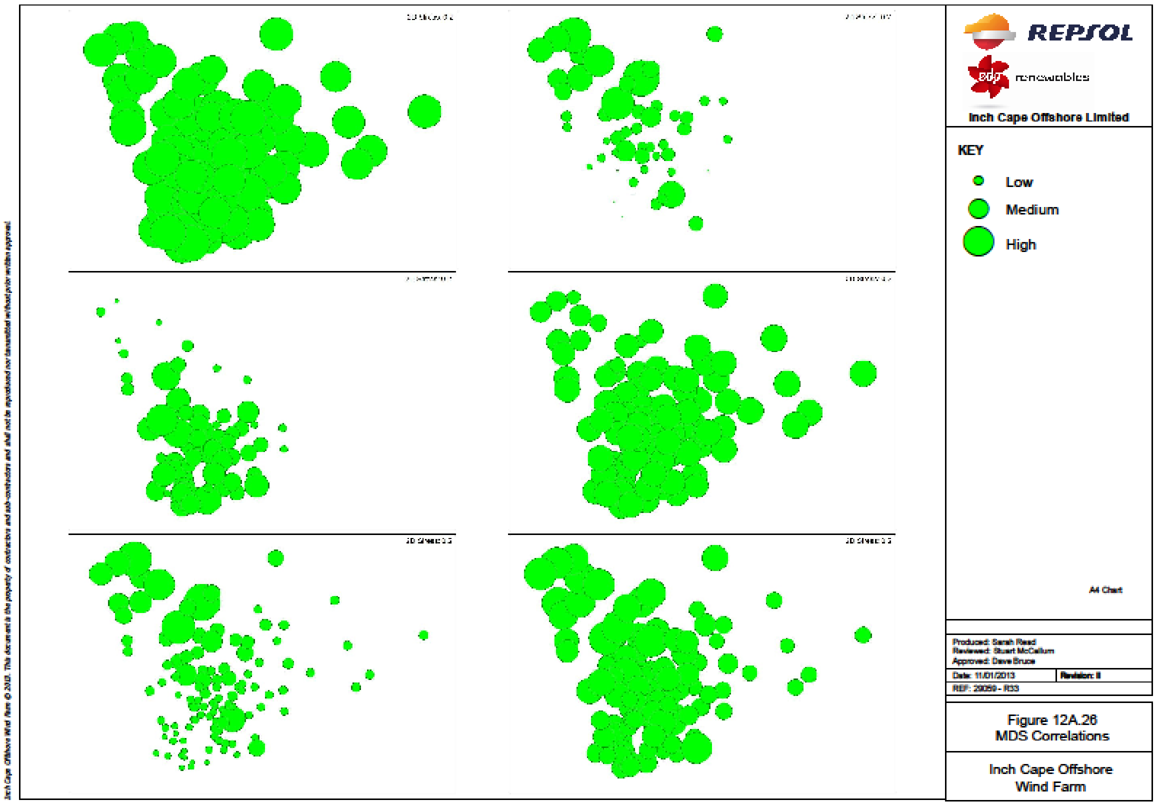
Group (records)	Mean	Standard Error	Standard deviation	Variance	Range	Minimum	Maximum
3 (10)	0.618	0.064907	0.205253	0.042129	0.72	0.46	1.18
Mean particle size							
1 (87)	0.531448	0.057433	0.535695	0.286969	3.336	0.124	3.46
2 (14)	3.053643	0.521355	1.950731	3.80535	5.949	0.671	6.62
3 (10)	0.4477	0.043659	0.138062	0.019061	0.474	0.35	0.824

The BIOENV routine in PRIMER allows correlations between the biological and physical data to be determined. The same parameters as used in the examination of the physical data (per cent sand, per cent gravel, per cent mud, mean particle size, sorting coefficient and depth) were compared to the biological data in order to determine if any correlations between the data sets could be determined. The global permutation test indicated that the correlations produced were significant (*P*<1 per cent) and the BIOENV test identified the greatest correlation between the physical and biological data sets was achieved through the combination of percentage gravel and mean particle size – the two factors most closely linked in the generation of the Principal Component vectors (**Table 12A.13**).

Table 12A.13 BIOENV Analysis Summary

Number of variables	BIOENV variables combination	Correlation (P_w)
2	% gravel, mean particle size	0.407
1	mean particle size	0.403
3	% sand, % gravel, mean particle size	0.376
2	% sand, mean particle size	0.37
2	% sand, % gravel	0.366
3	% gravel, mean particle size, sorting coefficient	0.359
4	% sand, % gravel, mean particle size, sorting coefficient	0.356
2	% gravel, sorting coefficient	0.351
2	mean particle size, sorting coefficient	0.35
3	% sand, mean particle size, sorting coefficient	0.349

Figure 12A.25 MDS Correllations



Physical parameters show poor correlation with both diversity and species richness (**Table 12A.14).** Amongst these, the strongest correlation occurs between the two biological metrics and the sorting coefficient of the sediments, indicating an increase in diversity and richness with reductions in the level of sorting within the sediments. Positive correlations (though slight) also exist with the percentage gravel, and with the mean particle size. Percentage sand has an inverse relationship to that of the percentage gravel, and shows a slight negative correlation with both richness and diversity. Percentage mud and depth appear to have almost no relationship with the diversity and richness encountered at each sampling station. The relationships described above are illustrated graphically in **Figure 12A.26**.

Table 12A.14 Correlation Values between Species Diversity and Richness from Infaunal Samples

Parameter	Diversity	Richness
Depth	0.075010926	0.047534124
Mean particle size (mm)	0.160845754	0.097328175
% mud	-0.008814419	0.091524111
% sand	-0.205656515	-0.153651785
% gravel	0.203057999	0.129981608
Sorting coefficient	0.251394381	0.260050044

Figure 12A.26 Scatterplots of Correlations between Diversity or Richness and Various Physical Factors

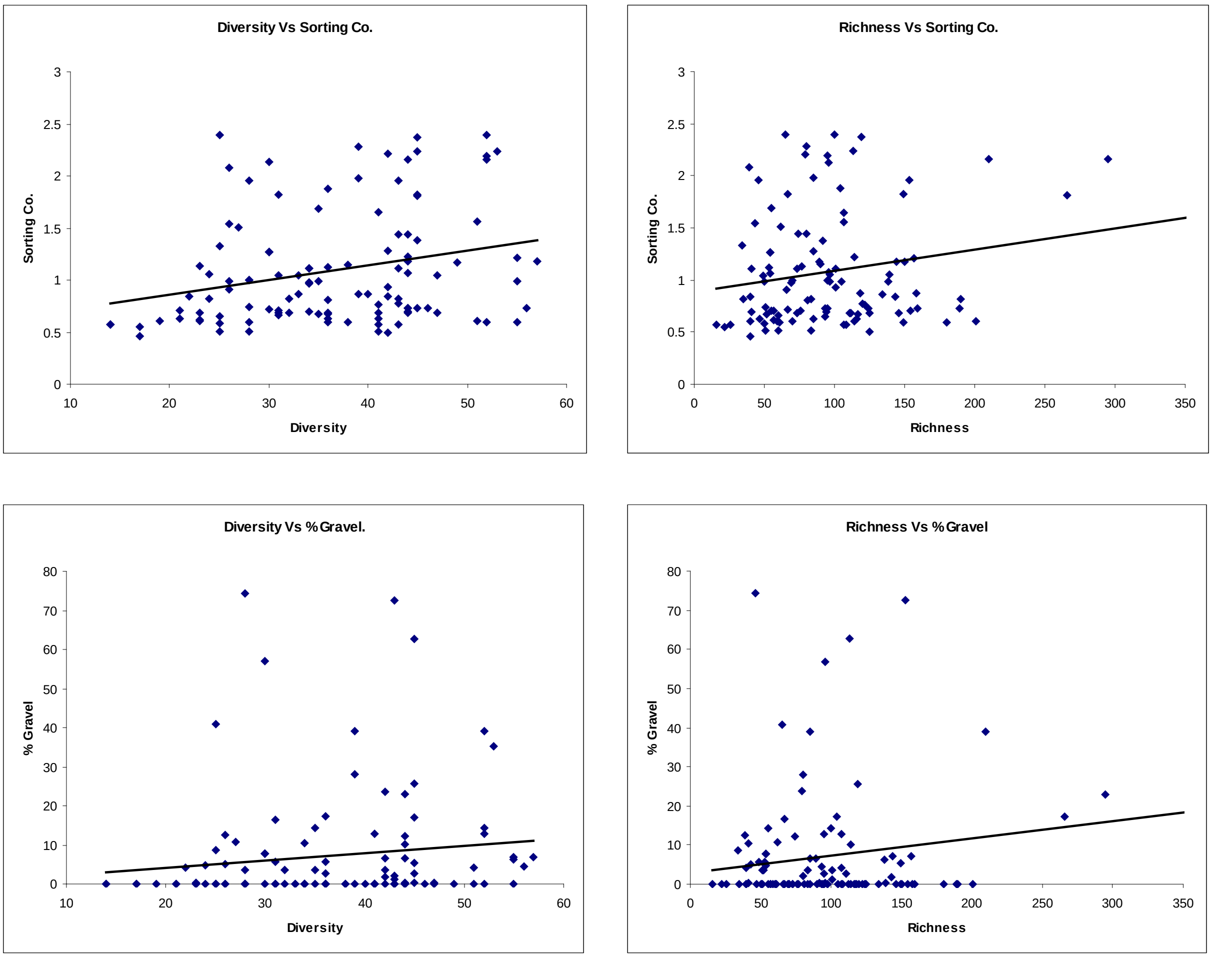
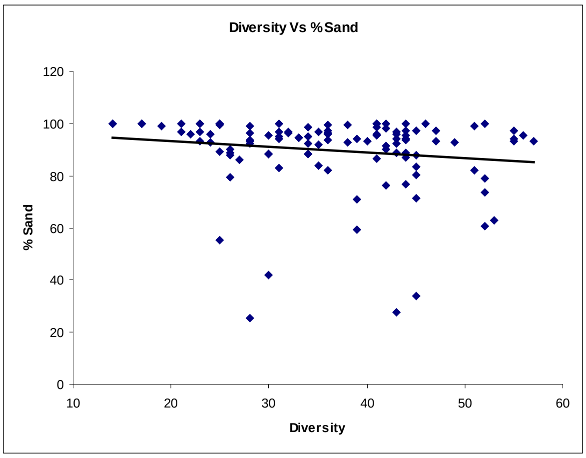
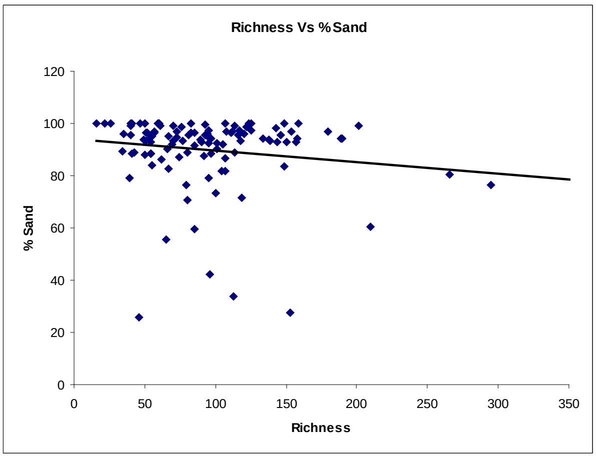
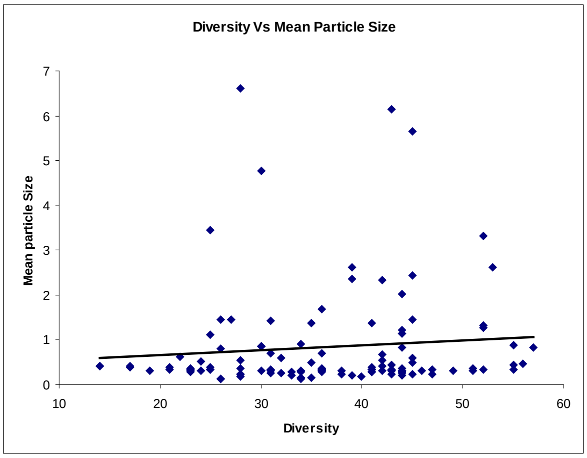
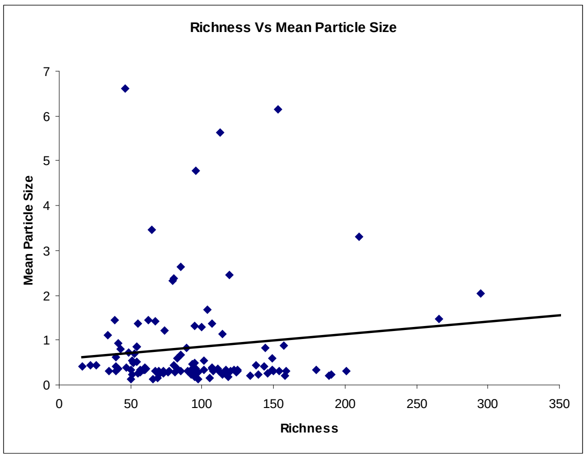


Figure 12A.26 cont. Scatterplots of Correlations between Diversity or Richness and Physical Factors









12A.5 Biotope Classification

12A.5.1 Video Survey Classification

Seven different biotopes were recorded in the survey area (**Table 12A.15**); the most common being sublittoral sands and muddy sands (SS.SSa), found at 88 sampling stations. Four sampling stations had two biotopes recorded within them (**Table 12A.16**). Biotopes identified during the DDV survey are mapped on **Figure 12A.27,** and described fully within **Annex12A.8**.

Table 12A.15 Biotopes Identified from Drop-Down Video Analysis

Biotope Code and Name	Number of records	
SS.SSa Sublittoral sands and muddy sands	88	 Station T4
SS.SMx.CMx Circalittoral mixed sediment	21	 Station 99

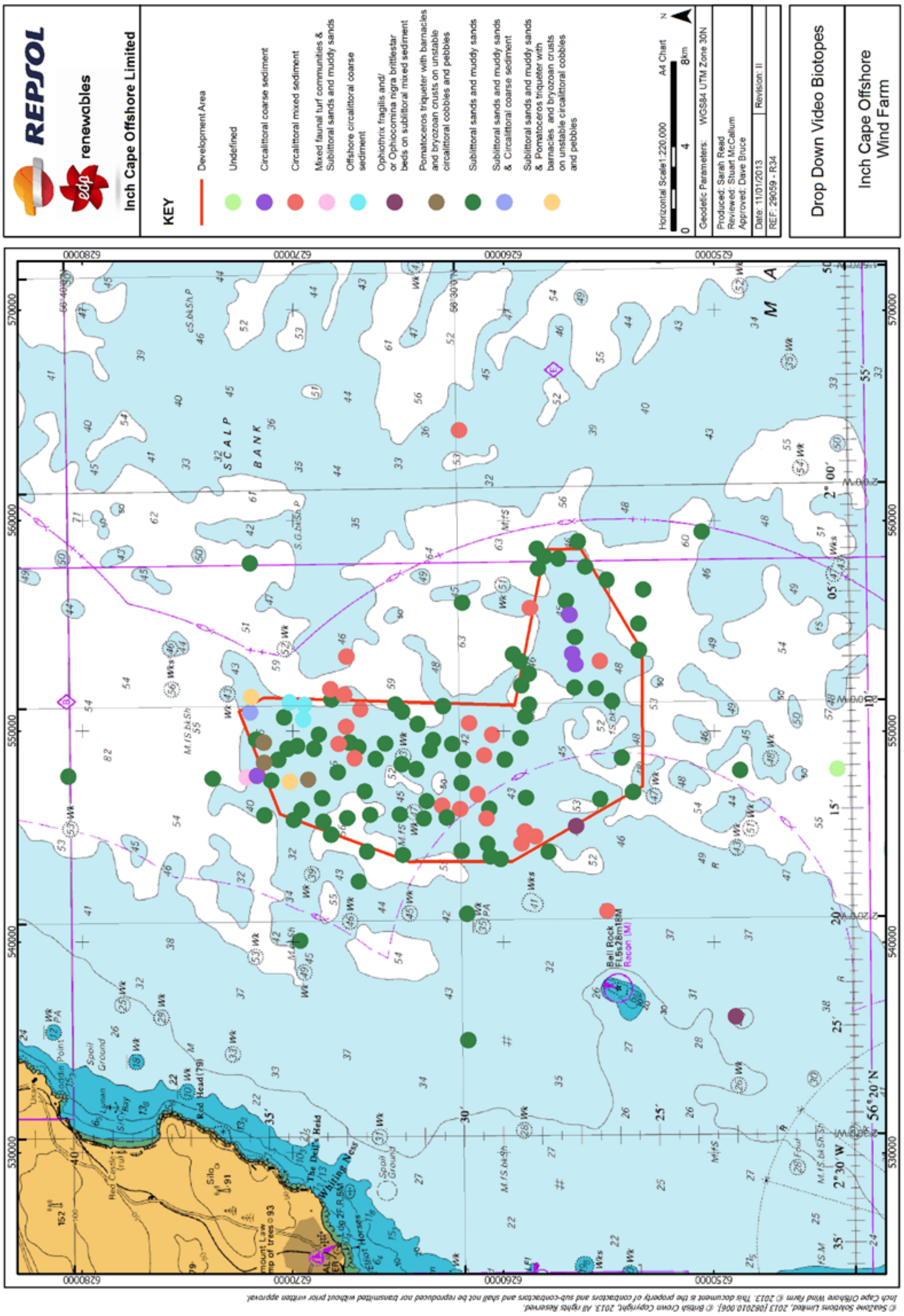
Biotope Code and Name	Number of records	
SS.SCS.CCS Circalittoral coarse sediment	5	 Station 97
SS.SCS.CCS.PomB *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	5	 Station 118
SS.SCS.OCS Offshore circalittoral coarse sediment	3	 Station 80

Biotope Code and Name	Number of records	
SS.SMx.CMx.OphMx *Ophiothrix fragilis* brittlestar beds on sublittoral mixed sediment	2	 Station 102
CR.HCR.Xfa Mixed Faunal turf communities	1	 Station 110

Table 12A.16 Sampling Stations with Multiple Biotopes Recorded during Drop-Down Video Survey

Sampling Station	Biotope Code	Biotope Name
85	SS.SSa	Sublittoral sands and muddy sands
	SS.SCS.CCS	Circalittoral coarse sediments
101	SS.SSa	Sublittoral sands and muddy sands
	SS.SCS.CCS.PomB	*Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles
110	SS.SSa	Sublittoral sands and muddy sands
	CR.HCR.Xfa	Mixed Faunal turf communities
124	SS.SSa	Sublittoral sands and muddy sands
	SS.SCS.CCS.PomB	*Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles

Figure 12A.27 Drop-Down Video Biotopes



12A.5.2 Grab Sample Classification

The infaunal biotopes determined for each of the communities identified through the cluster analysis are provided in **Table 12A.17** and shown on **Figure 12A.28**, with full biotope descriptions provided in **Annex 12A.8**. SIMPER outputs of the taxa driving the groupings are provided in **Annex 12A.7**.

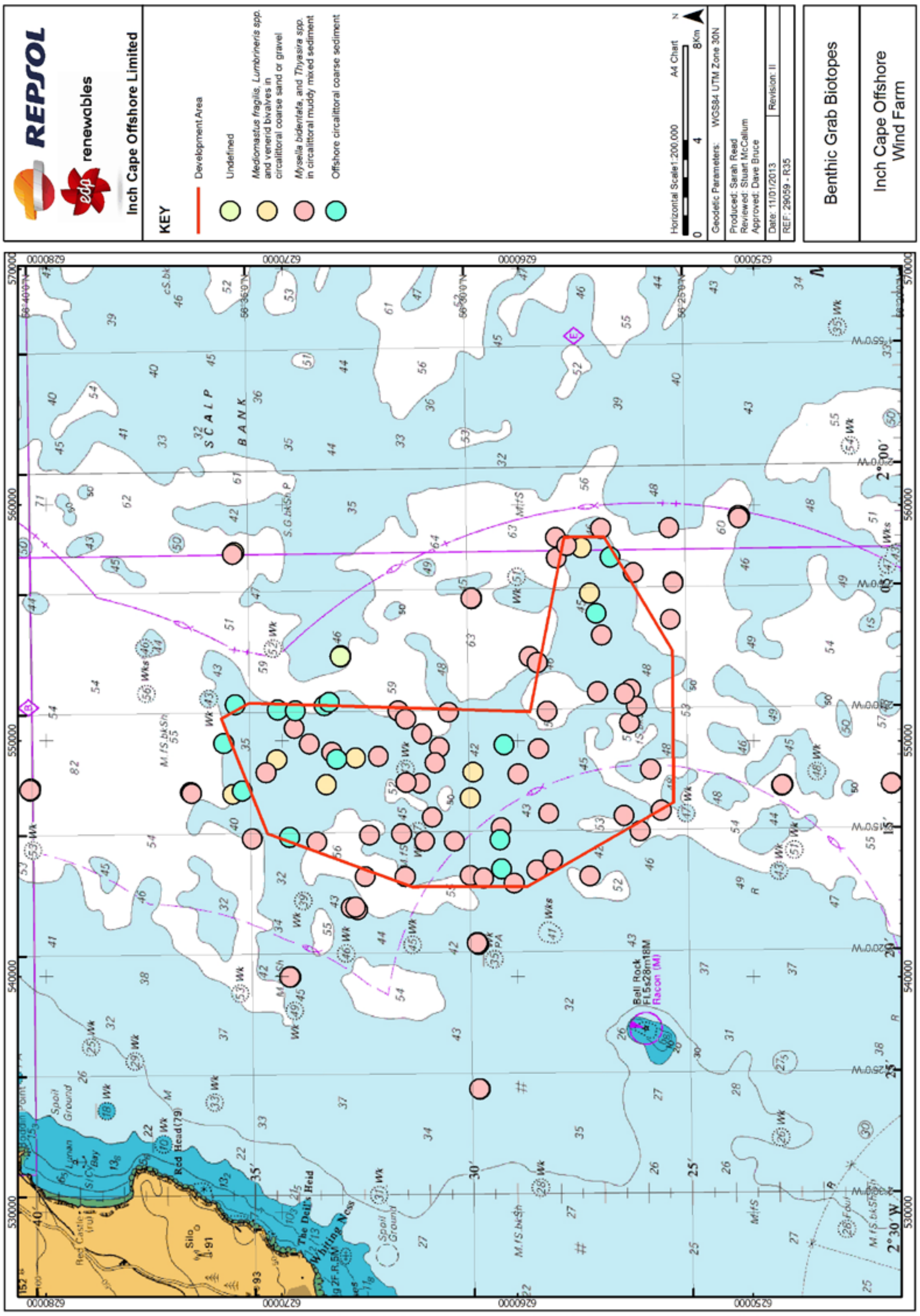
Table 12A.17 Infaunal Biotopes Determined at the Inch Cape Offshore Wind Farm

Community	Biotope code	Biotope name
Polychaete and bivalve community with burrowing echinoderms	SS.SMx.CMx.MysThyMx	*Mysella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment
Polychaete dominated community	SS.SCS.OCS	Offshore circalittoral coarse sediment
Polychaete and bivalve community	SS.SCS.CCS.MedLumVen	*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel

12A.5.3 Epibenthic Classification

The epibenthic data was examined (at each station and as a whole) to determine whether the data complemented the biotope groups described during the benthic and video biotope analysis, or whether other epibiotic overlays were apparent. The species encountered are characteristic of circalittoral gravelly sands and mixed sediments and as such confirm the biotopes described above.

Figure 12A.28 Benthic Grab Biotopes



12A.6 Comparison with Previous Data

Maps of the predicted seabed type produced by JNCC (**Figure 12A.2**) show the majority of the seabed in the area around the Development Area to be circalittoral and deep circalittoral sand and coarse sediments, with small patches of rocky substrate at the northern end of the Development Area. The physical habitat map produced from the ground truthed geophysical data in this study, shows that although the actual distribution of habitats are more complex than this, they are nonetheless made up of circalittoral sands and gravels as predicted, with small areas of hard substrate at the northern end of the Development Area.

Comparable previous benthic sampling stations are limited to the southern end of the Development Area, and are mainly composed of those situated within the Bell Rock disposal ground, sampled and analysed by CEFAS under their programme for the monitoring of disposal grounds around the UK. These sampling stations, along with others sampled as part of the MESH programme situated slightly away from the Development Area, allow some comparison with the species and communities identified by this study; also, as the data from these stations is relatively old (1997-2003) it also allows a measure of temporal change to be discussed.

Within the Bell Rock disposal ground the habitat was identified as SS.SMx.CMx.MysThyMx, matching that identified over the majority of the Development Area, including in the southern areas where the sampling stations for the disposal ground were positioned. These disposal ground habitats were described in 2003 and so it is clear that very little temporal change has occurred in the last 10 years in this area of the Development Area. Further afield, sampling stations surveyed as part of the MESH programme indicate that the sediments immediately inshore and offshore of the Development Area were typical of circalittoral mixed sediments (SS.SMx.CMx), again matching the data recorded during this survey. These MESH stations were sampled in 1997 and therefore show longer term stability of the sediments surrounding the Development Area.

In terms of the temporal changes in species composition, records from Bell Rock again allow some comparison – the MESH sampling used DDV surveys and as such provides no infaunal comparison. As described in the desk study, the species diversity recorded from the Bell Rock samples taken in 1994 listed 352 species. 336 taxa have been described during this study indicating little change in the overall diversity since 1994. Dominant species within the Bell Rock sediments were the polychaetes *Galathowenia oculata, Spiophanes bombyx, Pholoe inornata* and *Lumbrineris* sp., and the bivalves *Nucula tenuis*, *Mysella bidentata* and *Abra* sp. These species were all found in the faunal group defined as MysThyMx, within this study, and were responsible for driving much of the similarity within that group, indicating that they featured prominently in the majority of samples. Opportunistic species were encountered in the samples from the spoil ground in 2003, specifically the secondary opportunist *Chaetozone setosa*, with some records of *Capitella* sp. (SEA 5, 2004). No individuals of *Capitella* sp. were recorded during this survey, and only a few individuals of *C. setosa* were found - two at station 91, in the central area of the Development Area, with all other records present at control stations 4, 5, 7, and 8. These control stations are located either side of the Bell Rock spoil ground (4 and 5), as well as inshore of the Development Area (7 and 8) towards the currently open Montrose and Arbroath spoil grounds. *A. islandica* was also recorded at the Bell Rock sampling stations in densities similar to those encountered during this study, i.e. 1000-3000 per 100m^2 (Forth River Purification Board, 1991).

As with the habitats, this comparison with older datasets (10-20 years old) indicates little change in the faunal community, except for a reduction in opportunistic species such as *Capitella* sp. at the Bell Rock disposal ground, indicating a general improvement from the impacted state of this disposal ground.

12A.7 Conclusion

Overall, the Development Area is characterised by circalittoral sands and gravels in which a number of polychaete and bivalve species persist. The majority of the sedimentary habitat across the Development Area is classified as the circalittoral mixed sediment biotope '*Mysella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment (SS.SMx.CMx.MysThyMx)', with a total of 8 other biotopes identified as present across the entire survey area.

Comparisons with previous data sets indicate that the Development Area and surrounding area has been relatively stable in its sedimentary composition for up to 10 years with little change observed in the infaunal component for 10-20 years.

Further interpretation of the benthic survey data, and its application in the ground truthing of the geophysical survey data have been undertaken by Envision Mapping Ltd. Details of this process, and the subsequent habitat maps produced, are provided in Appendix 12D: Biotope Mapping.

12A.8 References

Basford DJ, Eleftheriou A & Raffaelli D (1989). The epifauna of the northern North Sea (56-61°N). Journal of the Marine Biological Association of the United Kingdom 69: 387-407.

Basford DJ, Eleftheriou A & Raffaelli D (1990). The infauna and epifauna of the northern North Sea. Netherlands Journal of Sea Research 25: 165–173.

Basford DJ, Moore DC & Eleftheriou A (1996). Variations in benthos in the north-western North Sea in relation to the inflow of Atlantic water, 1980–1984. ICES Journal of Marine Science 53: 957-963.

Bennett, T.L. & McLeod, C.R. 1998. East Scotland (Duncansby Head to Dunbar) (MNCR Sector 4). In: Marine

Blondel, P. and Murton, B.J. (1997). Handbook of seafloor sonar imagery, 314pp. Chichester (Wiley).

Clarke, K. R. & Gorley, R. N. 2006. Plymouth Routines In Multivariate Ecological Research (PRIMER) v6. PRIMER-E: Plymouth

Collier, J.S. and Brown, C.J. (2005). Correlation of sidescan backscatter with grain size distribution of surficial seabed sediments. Marine Geology 214, 431-449.

DEFRA (2008) Regional Environmental Assessment: A Framework for the Marine Minerals Sector http://jncc.defra.gov.uk/pdf/rea%20framework%20guidelines_final.pdf

Dyer MF, Fry WG, Fry PD & Cranmer GJ (1982). A series of North Sea benthos surveys with trawl and headline camera. Journal of the Marine Biological Association of the United Kingdom 62: 297–313.

Dyer MF, Fry WG, Fry PD & Cranmer GJ, (1983). Benthic regions within the North Sea. Journal of the Marine Biological Association of the United Kingdom 63: 683–693.

Eleftheriou A & Basford DJ (1989). The macrobenthic infauna of the offshore northern North Sea. Journal of the Marine Biological Association of the United Kingdom 69: 123–143.

Freitas, R., Rodrigues, A.M. and Quintino, V. (2003). Benthic biotopes remote sensing using acoustics. Journal of Experimental Marine Biology and Ecology 285-286, 339-353

Goff, J.A., Olson, H.C. and Duncan, C.S. (2000). Correlation of side-scan backscatter intensity with grain-size distribution of shelf sediments, New Jersey margin. Geo-Marine Letters, 20, 43-49

Jennings S, Lancaster J, Woolmer A & Cotter J (1999). Distribution, diversity and abundance of epibenthic fauna in the North Sea. Journal of the Marine Biological Association of the United Kingdom 79: 385–399.

Jones, J., Rowlatt, S. M., Rees, H.L., Portmann, J. E. 1994. Sixth Report of the Group Co-ordinating Sea Disposal Monitoring Joint Nature Conservation Committee. (Coasts and seas of the United Kingdom. MNCR series.) AQUATIC ENVIRONMENT MONITORING REPORT Number 43. Aquat. Environ. Monit. Rep., MAFF Direct. Fish. Res., Lowestoft, (43): 45pp

Jones, J., Rowlatt, S. M., Rees, H.L., Portmann, J. E. 1997. Seventh Report of the Group Co-ordinating Sea Disposal Monitoring Joint Nature Conservation Committee. (Coasts and seas of the United Kingdom. MNCR series.) AQUATIC ENVIRONMENT MONITORING REPORT Number 50. Sci. Ser., Aquat. Environ. Monit. Rep., CEFAS, Lowestoft, (50): 44pp

Kunitzer, A., Basford, D., Craeymeersch, J. A., Dores, J., Duineveld, G.C.A., Eleftheriou, A., Heip, C., Herman, P., Kingston, P., Niermann, U., Rachor, H., Rumohr, H., and Wilde, P.A.J. 1992. The benthic infauna of the North Sea: species distribution and assemblages. ICES J. mar. Sci. 49:127 – 143.

Marine Assessment and Review Group (MARG) UK Clean Seas Environment Monitoring Programme (2010) Clean Seas Environment Monitoring Programme (CSEMP) Green Book, Cefas. Online: http://www.cefas.defra.gov.uk/publications/scientific-series/green-book.aspx

Pearson, T. H. And Rosenberg, R. 1978. Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. Oceanogr. Mar. Biol. Ann. Rev., 16, 229-311.

Strategic Environmental Assessment (SEA) 5. 2004. Online: http://www.offshoresea.org.uk/site/scripts/consultation_download_info.php?downloadID=61

Ware, S.J. and Kenny, A.J. (2011). Guidelines for the conduct of Benthic studies at Marine Aggregate Extraction Sites (2nd Addition). Marine Aggregate Levy sustainability fund, 80pp.

Zülhke R (2001). Monitoring biodiversity of epibenthos and demersal fish in the North Sea and the Skagerrak. Monitoring Report 2001 to the CEC. EC Project No. 98/021, 31pp.

Annex 12A.1 Proposed Sampling Stations

Table 12A.1.1 Location of Ground Truthing Sampling Stations

ID	Lat	Long	Priority	Ground type
1	56.56328370	-2.20037005	1	Mod, flat, deep
2	56.56758870	-2.17721505	2	Mod, flat, deep
3	56.51860770	-2.18230805	1	Mod, flat, deep
4	56.45159170	-2.15501005	1	Mod, flat, deep
5	56.46652670	-2.06268005	2	Mod, flat, deep
6	56.44584170	-2.06262205	1	Mod, flat, deep
7	56.55571970	-2.16248605	1	Mod, flat, deep
8	56.54121870	-2.23367605	1	Mod, flat, deep
9	56.46988070	-2.09318505	1	Mod, flat, deep
10	56.57521770	-2.17589305	1	Mod, flat, shallow
11	56.57829370	-2.20812905	1	Mod, flat, shallow
12	56.55275470	-2.19655705	1	Mod, flat, shallow
13	56.53659970	-2.20784505	1	Mod, flat, shallow
14	56.47346070	-2.23963705	1	Mod, flat, shallow
15	56.47444670	-2.19361805	2	Mod, flat, shallow
16	56.43574670	-2.16512605	2	Mod, flat, shallow
17	56.45397670	-2.08713805	2	Mod, flat, shallow
18	56.49044670	-2.20708505	2	Mod, flat, shallow
19	56.48716170	-2.19104105	2	Mod, flat, shallow
20	56.44237670	-2.15693405	2	Mod, flat, shallow
21	56.57058670	-2.19733505	1	Mod, flat, shallow, rockhead
22	56.49349570	-2.23636105	1	Mod, flat, shallow, rockhead
23	56.48927070	-2.27499105	1	Mod, flat, shallow, rockhead
24	56.57291270	-2.16441705	1	Mod, Mod, deep
25	56.56655970	-2.16571305	2	Mod, Mod, deep
26	56.52490870	-2.17181605	1	Mod, Mod, deep
27	56.46263470	-2.05300405	2	Mod, Mod, deep
28	56.45036670	-2.11596205	1	Mod, Mod, deep
29	56.47061970	-2.14538205	2	Mod, Mod, deep
30	56.58951070	-2.17154305	2	Mod, mod, shallow
31	56.56898670	-2.24752005	1	Mod, mod, shallow
32	56.54271270	-2.16968605	2	Mod, mod, shallow
33	56.50089170	-2.24830105	1	Mod, mod, shallow

ID	Lat	Long	Priority	Ground type
34	56.55969670	-2.23733805	1	Mod, mod, shallow
35	56.46918970	-2.26905905	2	Mod, mod, shallow
36	56.47330870	-2.26667405	2	Mod, mod, shallow, rockhead
37	56.50438270	-2.19585805	2	Mod, mod, shallow, rockhead
38	56.51651470	-2.25374605	1	Mod, mod, shallow, rockhead
39	56.47437470	-2.13495405	1	Mod, steep, deep
40	56.52526970	-2.28179905	1	Rockhead
41	56.48392870	-2.28660805	2	Rockhead
42	56.51515870	-2.24054105	2	Rockhead
43	56.57441970	-2.19956505	1	Strong, flat shallow
44	56.54733570	-2.19494705	1	Strong, flat shallow
45	56.53239370	-2.19641905	1	Strong, flat shallow
46	56.51946770	-2.21683505	1	Strong, flat shallow
47	56.50075570	-2.27995505	1	Strong, flat shallow
48	56.49650170	-2.25932205	1	Strong, flat shallow
49	56.50043470	-2.22644005	1	Strong, flat shallow
50	56.49904970	-2.20919705	1	Strong, flat shallow
51	56.48187970	-2.21070705	2	Strong, flat shallow
52	56.44163870	-2.24027305	2	Strong, flat shallow
53	56.45692470	-2.05601905	1	Strong, flat shallow
54	56.54386270	-2.19847005	1	Strong, flat shallow, rockhead
55	56.52517470	-2.21268505	1	Strong, flat shallow, rockhead
56	56.48846870	-2.24739305	1	Strong, flat shallow, rockhead
57	56.56142070	-2.18882205	1	Strong, flat, deep
58	56.54965870	-2.25337005	1	Strong, flat, deep
59	56.54101870	-2.27985805	2	Strong, flat, deep
60	56.52664970	-2.25075005	2	Strong, flat, deep
61	56.51208170	-2.19293205	1	Strong, flat, deep
62	56.50853870	-2.16793105	1	Strong, flat, deep
63	56.46359170	-2.28132505	1	Strong, flat, deep
64	56.43839070	-2.25140105	1	Strong, flat, deep
65	56.43170470	-2.20929805	1	Strong, flat, deep
66	56.42357470	-2.10633605	1	Strong, flat, deep
67	56.46675170	-2.04728505	1	Strong, flat, deep
68	56.47099870	-2.16815205	2	Strong, flat, deep
69	56.53877970	-2.25215305	1	Strong, flat, deep, rockhead
70	56.47558470	-2.27468405	1	Strong, flat, deep, rockhead
71	56.47386370	-2.15336205	2	Strong, flat, deep, rockhead

ID	Lat	Long	Priority	Ground type
72	56.58366870	-2.25357905	1	Strong, mod, deep
73	56.55949770	-2.25636605	2	Strong, mod, deep
74	56.52741270	-2.16598905	2	Strong, mod, deep
75	56.47719970	-2.13029405	2	Strong, mod, deep
76	56.44918270	-2.04241805	1	Strong, mod, deep
77	56.43700370	-2.07260505	1	Strong, mod, deep
78	56.47243270	-2.17698605	1	Strong, mod, deep
79	56.42761670	-2.23653105	1	Strong, mod, deep
80	56.42338870	-2.12691805	1	Strong, mod, deep
81	56.55352470	-2.21728605	1	Strong, mod, shallow
82	56.51364970	-2.20198505	1	Strong, mod, shallow
83	56.50760570	-2.25450605	1	Strong, mod, shallow
84	56.57221770	-2.25437405	1	Strong, steep
85	56.59079470	-2.22286805	1	Strong, steep
86	56.45280870	-2.19349205	1	Strong, steep
87	56.55027170	-2.15800205	1	Weak, flat, deep
88	56.44063170	-2.13456905	1	Weak, flat, deep
89	56.55597970	-2.15440905	1	Weak, flat, deep
90	56.56598470	-2.22394605	1	Weak, flat, shallow
91	56.54821270	-2.18339405	1	Weak, flat, shallow
92	56.49696570	-2.18162105	1	Weak, flat, shallow
93	56.45153470	-2.10099005	1	Weak, flat, shallow
94	56.45115870	-2.13778605	1	Weak, flat, shallow
95	56.48946670	-2.25486205	1	Weak, flat, shallow, rockhead
96	56.54551170	-2.20765905	1	Weak, flat, shallow, rockhead
97	56.57362770	-2.22494605	1	Weak, mod, shallow
98	56.45163170	-2.26134705	1	Weak, mod, shallow
99	56.45238170	-2.13027705	1	Weak, mod, shallow
100	56.50882170	-2.24469905	1	Weak, mod, shallow, rockhead
101	56.58947070	-2.16009405	1	Weak, steep, deep
102	56.58728570	-2.22062705	1	Weak, steep, shallow
103	56.58403470	-2.21089105	1	Weak, steep, shallow
104	56.58425770	-2.19531905	1	Weak, steep, shallow
105	56.45304770	-2.18199705	1	Mod, flat, deep
106	56.43421070	-2.12610205	1	Mod, flat, deep
107	56.55523470	-2.18555405	1	Mod, flat, shallow
108	56.46557870	-2.20070505	1	Mod, flat, shallow
109	56.47654670	-2.22289905	1	Mod, flat, shallow

ID	Lat	Long	Priority	Ground type
110	56.53493270	-2.24762605	1	Rockhead
111	56.46822170	-2.21501705	2	Strong, flat shallow
112	56.46238570	-2.24906205	1	Strong, flat shallow
113	56.45762670	-2.10715905	1	Strong, flat shallow
114	56.48804570	-2.28365605	1	Strong, flat shallow, rockhead
115	56.47767270	-2.25106605	1	Strong, flat shallow, rockhead
116	56.55649470	-2.26670905	1	Strong, flat, deep
117	56.53012670	-2.26721905	1	Strong, flat, deep
118	56.44299370	-2.17669705	1	Strong, flat, deep
119	56.58091070	-2.22272905	1	Strong, flat, deep
120	56.42660870	-2.15324505	1	Strong, flat, deep
121	56.41873570	-2.19064605	1	Strong, flat, deep
122	56.53096370	-2.18519705	2	Strong, flat, deep
123	56.48212470	-2.26996305	1	Strong, flat, deep
124	56.58646770	-2.19238905	1	Strong, steep

Table 12A.1.2 Location of Sampling Stations within 1 Tidal Ellipse

ID	Lat	Long	Priority	Ground type
T1	56.60657700	-2.22145000	1	Tidal ellipse
T2	56.54883800	-2.12929200	1	Tidal ellipse
T3	56.49880600	-2.08915100	1	Tidal ellipse
T4	56.42143500	-2.08075700	1	Tidal ellipse
T5	56.38095200	-2.22013900	1	Tidal ellipse
T6	56.43793300	-2.32845400	1	Tidal ellipse
T7	56.49775600	-2.32779500	1	Tidal ellipse
T8	56.54398600	-2.30229900	1	Tidal ellipse

Table 12A.1.3 Location of Control Sampling Stations outside 1 Tidal Ellipse

ID	Lat	Long	Priority	Ground type
C1	56.66314200	-2.22296200	1	Control
C2	56.58920500	-2.05636800	1	Control
C3	56.49883100	-1.95630500	1	Control
C4	56.39609700	-2.03615000	1	Control
C5	56.33933700	-2.21990000	1	Control
C6	56.38824500	-2.41828700	1	Control
C7	56.49745200	-2.42771800	1	Control
C8	56.56922400	-2.34843600	1	Control

Table 12A.1.4 Location of Epibenthic Sampling Stations

ID	Lat Start	Long Start	Lat End	Long End
11	56.431278	-2.209373	56.430942	-2.20937
21	56.538932	-2.251592	56.539407	-2.251355
32	56.481253	-2.209825	56.480927	-2.209457
39	56.525297	-2.212698	56.525263	-2.2129
51	56.423507	-2.126857	56.423953	-2.126825
55	56.451143	-2.155058	56.451128	-2.1555
66	56.472548	-2.239345	56.47215	-2.239387
78	56.489112	-2.274685	56.489253	-2.274535
82	56.463282	-2.053703	56.46364	-2.053435
86	56.568205	-2.24716	56.567895	-2.247123
91	56.516037	-2.254492	56.51638	-2.25485
97	56.452935	-2.099002	56.453333	-2.09878
99	56.48923	-2.255095	56.489438	-2.254968
105	56.552658	-2.218058	56.552457	-2.218337
108	56.474458	-2.13432	56.474802	-2.133908
110	56.437267	-2.252338	56.436915	-2.252497
113	56.549655	-2.158508	56.549285	-2.158843
116	56.587097	-2.220335	56.58771	-2.220262
119	56.525298	-2.282622	56.525532	-2.282965
124	56.589153	-2.159347	56.589295	-2.158987
C1	56.667637	-2.219312	56.668017	-2.218887
C5	56.339325	-2.21988	56.339478	-2.219528
T1	56.605975	-2.222335	56.605743	-2.222672
T5	56.380902	-2.220295	56.383945	-2.409632

Annex 12A.2 Drop-Down Video Positions

Table 12A.2.1 Drop-Down Video Survey Positions

ID	LAT IN	LONG IN	LAT OUT	LONG OUT	DATE	TIME	DEPTH
1	56.560458	-002.188775	56.560023	-002.188943	22/03/2012	13:23:15	52
2	56.555713	-002.266602	56.555358	-002.266820	22/03/2012	12:34:47	62
3	56.548902	-002.253578	56.548762	-002.253963	22/03/2012	15:49:47	55
4	56.540503	-002.279893	56.540498	-002.280033	22/03/2012	16:08:21	60
6	56.526462	-002.251285	56.526657	-002.251598	23/03/2012	09:48:26	49
7	56.511697	-002.194138	56.511383	-002.194752	23/03/2012	12:10:02	52
8	56.507525	-002.168278	56.507403	-002.168475	23/03/2012	11:58:38	51
9	56.463065	-002.281360	56.462552	-002.281443	24/03/2012	14:00:07	55
11	56.431278	-002.209373	56.430942	-002.209370	24/03/2012	15:25:43	55
12	56.423622	-002.106420	56.424133	-002.106482	25/03/2012	09:23:11	68
13	56.466453	-002.047670	56.466865	-002.047118	25/03/2012	08:10:34	59
14	56.470608	-002.167623	56.471033	-002.167318	25/03/2012	07:05:49	60
16	56.581172	-002.224010	56.581848	-002.223662	22/03/2012	07:31:49	50
21	56.538932	-002.251592	56.539407	-002.251355	23/03/2012	06:20:03	50
22	56.474558	-002.274720	56.474137	-002.274685	24/03/2012	13:42:01	53
23	56.473917	-002.152837	56.474287	-002.152103	25/03/2012	07:14:13	60
24	56.573870	-002.199722	56.573662	-002.200075	22/03/2012	10:33:46	53
25	56.547500	-002.195433	56.547917	-002.195433	23/03/2012	07:10:34	43
26	56.532292	-002.196400	56.532520	-002.196422	23/03/2012	08:50:55	48
27	56.519057	-002.216827	56.518970	-002.216908	23/03/2012	11:04:38	48
28	56.500178	-002.279900	56.500098	-002.279992	23/03/2012	13:19:23	47
30	56.499920	-002.227625	56.499877	-002.227663	24/03/2012	11:27:45	46
31	56.499090	-002.209918	56.499095	-002.210242	24/03/2012	11:38:01	48
32	56.481253	-002.209825	56.480927	-002.209457	24/03/2012	12:37:22	50
33	56.440633	-002.241187	56.440245	-002.241258	24/03/2012	14:56:34	51
34	56.457252	-002.055818	56.457557	-002.055407	25/03/2012	08:28:06	53
38	56.543667	-002.199200	56.544233	-002.199227	23/03/2012	07:21:54	45
39	56.525297	-002.212698	56.525263	-002.212900	23/03/2012	11:14:12	49
40	56.488088	-002.247522	56.488190	-002.247577	24/03/2012	10:52:12	48
41	56.487772	-002.284490	56.488367	-002.284590	24/03/2012	08:22:39	47
43	56.584090	-002.251298	56.584628	-002.250587	22/03/2012	07:20:58	60
44	56.559140	-002.256610	56.558777	-002.256728	22/03/2012	12:44:46	60
45	56.527717	-002.166417	56.528208	-002.166512	23/03/2012	08:28:45	55

ID	LAT IN	LONG IN	LAT OUT	LONG OUT	DATE	TIME	DEPTH
1	56.560458	-002.188775	56.560023	-002.188943	22/03/2012	13:23:15	52
2	56.555713	-002.266602	56.555358	-002.266820	22/03/2012	12:34:47	62
46	56.477338	-002.129098	56.477562	-002.128697	25/03/2012	07:36:35	68
47	56.448965	-002.042703	56.449412	-002.042248	25/03/2012	08:38:02	56
48	56.436917	-002.072560	56.437202	-002.072197	25/03/2012	08:58:48	56
49	56.472462	-002.176787	56.472772	-002.176370	25/03/2012	06:56:58	57
50	56.426822	-002.236122	56.426282	-002.236107	24/03/2012	15:10:23	57
51	56.423507	-002.126857	56.423953	-002.126825	25/03/2012	09:33:29	60
52	56.562558	-002.200145	56.562282	-002.200245	22/03/2012	13:13:20	51
53	56.567098	-002.177235	56.567052	-002.177333	22/03/2012	09:31:11	52
54	56.518207	-002.182072	56.518102	-002.182072	23/03/2012	11:45:40	51
55	56.451143	-002.155058	56.451128	-002.155500	24/03/2012	16:33:05	52
56	56.466155	-002.062872	56.466155	-002.062872	25/03/2012	08:02:26	57
57	56.446033	-002.061955	56.446598	-002.061512	25/03/2012	08:47:42	54
58	56.555003	-002.162105	56.554690	-002.162105	22/03/2012	13:36:40	54
61	56.541183	-002.233373	56.541693	-002.233188	23/03/2012	06:31:37	49
62	56.575252	-002.175462	56.575455	-002.175270	22/03/2012	09:40:18	48
63	56.577977	-002.208200	56.577768	-002.208185	22/03/2012	10:41:45	52
64	56.552198	-002.196460	56.552012	-002.196607	22/03/2012	14:33:47	50
65	56.536370	-002.208375	56.536605	-002.208702	23/03/2012	09:33:24	45
66	56.472548	-002.239345	56.472150	-002.239387	24/03/2012	12:52:52	
67	56.474572	-002.193553	56.474925	-002.193523	25/03/2012	06:44:53	52
68	56.435275	-002.165952	56.435073	-002.166082	24/03/2012	15:45:39	50
69	56.454447	-002.088105	56.455105	-002.088080	25/03/2012	09:49:51	52
70	56.490047	-002.206552	56.489925	-002.206603	24/03/2012	12:25:28	47
71	56.486485	-002.190900	56.486198	-002.190882	24/03/2012	12:12:45	49
72	56.442028	-002.155742	56.441895	-002.155522	24/03/2012	15:54:25	50
76	56.569817	-002.197767	56.569782	-002.197760	22/03/2012	10:27:52	52
77	56.493095	-002.236703	56.493255	-002.236877	24/03/2012	11:02:49	49
78	56.489112	-002.274685	56.489253	-002.274535	24/03/2012	10:36:39	47
79	56.572787	-002.164235	56.572933	-002.163728	22/03/2012	09:13:06	53-55
80	56.566467	-002.165687	56.566750	-002.165483	22/03/2012	09:21:29	55
81	56.524860	-002.172018	56.525257	-002.172067	23/03/2012	08:37:17	50
82	56.463282	-002.053703	56.463640	-002.053435	25/03/2012	08:19:28	56
83	56.450747	-002.115900	56.451202	-002.115825	25/03/2012	10:15:34	57
84	56.470657	-002.144118	56.470900	-002.143545	25/03/2012	07:23:07	55
85	56.589682	-002.171233	56.590065	-002.170930	22/03/2012	08:48:52	45
86	56.568205	-002.247160	56.567895	-002.247123	22/03/2012	11:10:57	42

ID	LAT IN	LONG IN	LAT OUT	LONG OUT	DATE	TIME	DEPTH
1	56.560458	-002.188775	56.560023	-002.188943	22/03/2012	13:23:15	52
2	56.555713	-002.266602	56.555358	-002.266820	22/03/2012	12:34:47	62
87	56.542688	-002.170032	56.543262	-002.169963	23/03/2012	08:13:17	45
88	56.500583	-002.247728	56.500785	-002.247552	24/03/2012	11:14:10	50
89	56.473100	-002.265298	56.472662	-002.265068	24/03/2012	13:29:44	50
90	56.503648	-002.197500	56.503512	-002.197783	24/03/2012	11:48:49	48
91	56.516037	-002.254492	56.516380	-002.254850	23/03/2012	10:16:31	45
92	56.559465	-002.238212	56.559193	-002.238718	22/03/2012	12:57:36	50
93	56.468527	-002.269390	56.468527	-002.269390	24/03/2012	13:50:32	50
94	56.565227	-002.223710	56.564875	-002.223632	22/03/2012	10:58:39	47
95	56.548890	-002.183120	56.549475	-002.183032	23/03/2012	08:00:39	44
96	56.496307	-002.181417	56.496385	-002.181425	24/03/2012	12:00:50	47
97	56.452935	-002.099002	56.453333	-002.098780	25/03/2012	10:06:11	53
98	56.450772	-002.137163	56.451015	-002.136778	25/03/2012	10:33:01	50
99	56.489230	-002.255095	56.489438	-002.254968	24/03/2012	10:46:16	45
100	56.545417	-002.207783	56.546037	-002.207683	23/03/2012	07:09:10	43
101	56.573105	-002.225182	56.573090	-002.225195	22/03/2012	10:52:10	46
102	56.451238	-002.261738	56.450853	-002.261658	24/03/2012	14:11:19	45
103	56.452040	-002.128843	56.452553	-002.128710	25/03/2012	10:24:51	53
104	56.508297	-002.245065	56.507982	-002.245888	23/03/2012	12:32:03	45
105	56.552658	-002.218058	56.552457	-002.218337	22/03/2012	15:36:05	53
106	56.513173	-002.202045	56.513048	-002.202382	23/03/2012	12:18:29	
107	56.506412	-002.254225	56.506218	-002.254505	23/03/2012	12:42:44	49
108	56.474458	-002.134320	56.474802	-002.133908	25/03/2012	07:30:37	57
109	56.571542	-002.254655	56.571357	-002.254932	22/03/2012	11:57:04	40
110	56.591510	-002.221532	56.592008	-002.220723	20/03/2012	17:47:31	50
110	56.437267	-002.252338	56.436915	-002.252497	24/03/2012	14:21:48	50
111	56.587232	-002.192272	56.587855	-002.192077	22/03/2012	08:05:50	35
113	56.549655	-002.158508	56.549285	-002.158843	22/03/2012	14:10:45	52
114	56.440193	-002.135093	56.440118	-002.135303	24/03/2012	16:21:30	52
115	56.555455	-002.154152	56.555202	-002.154337	22/03/2012	13:44:27	55
116	56.587097	-002.220335	56.587710	-002.220262	22/03/2012	07:38:50	45
117	56.584027	-002.210145	56.584373	-002.209667	22/03/2012	07:49:19	40
118	56.584163	-002.194717	56.584578	-002.194085	22/03/2012	07:59:53	41
119	56.525298	-002.282622	56.525532	-002.282965	23/03/2012	10:00:34	49
120	56.483493	-002.286607	56.483718	-002.286452	24/03/2012	08:13:46	48
121	56.514815	-002.241240	56.514815	-002.241240	23/03/2012	10:53:20	50
123	56.469827	-002.093293	56.470232	-002.093070	25/03/2012	07:52:12	56

ID	LAT IN	LONG IN	LAT OUT	LONG OUT	DATE	TIME	DEPTH
1	56.560458	-002.188775	56.560023	-002.188943	22/03/2012	13:23:15	52
2	56.555713	-002.266602	56.555358	-002.266820	22/03/2012	12:34:47	62
124	56.589153	-002.159347	56.589295	-002.158987	22/03/2012	08:58:34	55
C1	56.667637	-002.219312	56.668017	-002.218887	20/03/2012	16:53:27	58
C2	56.589020	-002.056115	56.588778	-002.056287	25/03/2012	14:27:01	65
C3	56.498965	-001.955633	56.498810	-001.955202	25/03/2012	13:26:09	46
C4	56.396128	-002.036038	56.396053	-002.035623	25/03/2012	12:53:27	60
C5	56.339325	-002.219880	56.339478	-002.219528	25/03/2012	12:04:17	59
C6	56.383812	-002.409447	56.383812	-002.409447	25/03/2012	11:33:01	30
C6	56.382845	-002.410662	56.382845	-002.410662	25/03/2012	11:25:24	
C7	56.498075	-002.426283	56.498330	-002.426230	24/03/2012	07:35:29	40
C8	56.569327	-002.348015	56.569738	-002.347683	24/03/2012	07:01:39	50
T1	56.605975	-002.222335	56.605743	-002.222672	25/03/2012	14:59:07	70
T2	56.548405	-002.129225	56.548002	-002.129152	22/03/2012	13:57:15	51
T3	56.498652	-002.088655	56.498608	-002.088675	25/03/2012	13:56:56	50
T4	56.421325	-002.080207	56.421638	-002.079832	25/03/2012	09:10:50	63
T5	56.380902	-002.220295	56.383945	-002.409632	25/03/2012	12:23:46	59
T6	56.438148	-002.327295	56.438213	-002.327088	25/03/2012	11:05:44	47
T7	56.498115	-002.328637	56.499003	-002.328385	24/03/2012	07:57:29	44
T8	56.544123	-002.302758	56.544308	-002.302822	22/03/2012	16:21:55	53

Annex 12A.3 Video Faunal Data

Table12A.3.1 Species List (SACFOR Scale) from Drop-Down Video Survey

	1	2	3	4	6	7	8	9	11	12	13	14	16	21	22	23	24	25	26	27
Abietinaria abietina																				
Aequipecten opercularis																				
Alcyonium digitatum										R	F	O		O	O	O				
Anthozoan																				
Aspitrigla cuculus																				
Asterias rubens	R	R	O		O	O		O							R	O			O	O
Bright orange sponge																				
Bryozoa																				
Buccinum undatum																				
Callionymus lyra										R						R				
Echinocardium cordatum										O										
Echinus esculentus																				
Fish																				
Fish - Blenny?																				
Flatfish			R																	
Flustra foliacea					O	O	O			O	O	O	O	O	O	O			O	
Halichondria panicea																				
Haliclona oculata																				
Hydroida																				
Liocarcinus depurator																				
Luidia sarsi																				
Macropodia																				
Munida rugosa													R							
Mysids									C											
Nemertesia																				
Nemertesia antennina																				
Nemertesia ramosa																				
Ophiocomina nigra																				
Ophiothrix fragilis																				
Orange Porifera																				
Pagurus																				
Pagurus bernhardus												R				R				
Pholis gunnellus																				
Pomatoschistus minutus																				
Porifera																				
Sagartia																				
Sertularia																				
Solaster endeca											R									
Thuiaria thuja																				

Urticina eques	R

	28	30	31	32	33	34	38	39	40	41	43	44	45	46	47	48	49	50	51	52	53
Abietinaria abietina																					
Aequipecten opercularis																					
Alcyonium digitatum				R	O				O	R				O			O	O	R	O	
Anthozoan																					
Aspitrigla cuculus																					
Asterias rubens			O	R	R					O	R		O	O							
Bright orange sponge																					
Bryozoa																					
Buccinum undatum																					
Callionymus lyra							R														
Echinocardium cordatum																					
Echinus esculentus																					
Fish																		R			
Fish - Blenny?																					
Flatfish				R																	
Flustra foliacea	O			R	O	O		R		R			O	O	O		O	O		O	F
Halichondria panicea																					
Haliclona oculata																					
Hydroida																					
Liocarcinus depurator																					
Luidia sarsi																					
Macropodia																					
Munida rugosa																					
Mysids																					
Nemertesia																					
Nemertesia antennina																					
Nemertesia ramosa																					
Ophiocomina nigra																					
Ophiothrix fragilis																					
Orange Porifera																					
Pagurus																					
Pagurus bernhardus																					
Pholis gunnellus																					
Pomatoschistus minutus																					
Porifera																					
Sagartia																					
Sertularia																					
Solaster endeca																					
Thuiaria thuja																					
Urticina eques																					

	54	55	56	57	58	61	62	63	64	65	66	67	68	69	70	71	72	76	77	78
Abietinaria abietina										O										
Aequipecten opercularis						R														
Alcyonium digitatum	O	O	F			O	O			O	R	O	O		F		F	F		O
Anthozoan																				
Aspitrigla cuculus																				
Asterias rubens						R			R	O		R								
Bright orange sponge																				
Bryozoa																			O	
Buccinum undatum			R									R								
Callionymus lyra																				
Echinocardium cordatum																				
Echinus esculentus																				
Fish																				
Fish - Blenny?																				
Flatfish																				
Flustra foliacea	O	O	O		O	O	F		O	O	O	O	O		O	O	O	C	O	
Halichondria panicea																				
Haliclona oculata																				
Hydroida										O										
Liocarcinus depurator																				
Luidia sarsi																				
Macropodia																				
Munida rugosa						R				R										
Mysids																				
Nemertesia		O																		
Nemertesia antennina																				
Nemertesia ramosa												R								
Ophiocomina nigra																				
Ophiothrix fragilis																				
Orange Porifera																				
Pagurus																				
Pagurus bernhardus			R																	
Pholis gunnellus																				
Pomatoschistus minutus																				
Porifera																				
Sagartia																				
Sertularia																				
Solaster endeca																				
Thuiaria thuja																				
Urticina eques												R								

	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
Abietinaria abietina																			
Aequipecten opercularis																			
Alcyonium digitatum		O	O	O		O	O		O	O	F	O	O	O	O		O		O
Anthozoan																	R		
Aspitrigla cuculus																			
Asterias rubens			O									O	O						
Bright orange sponge																	O		
Bryozoa																			
Buccinum undatum																			
Callionymus lyra			R		R														
Echinocardium cordatum																			
Echinus esculentus														O					
Fish																			
Fish - Blenny?																			
Flatfish																			
Flustra foliacea	C	C		O		O	F		F	O	O	O	O	O			F	F	
Halichondria panicea																	O		
Haliclona oculata							O												
Hydroida									O							F			
Liocarcinus depurator																			
Luidia sarsi								R											
Macropodia																			
Munida rugosa		R									R			R					
Mysids																			
Nemertesia																			
Nemertesia antennina							O				O								
Nemertesia ramosa																			
Ophiocomina nigra																			
Ophiothrix fragilis																			
Orange Porifera									O	O									
Pagurus																			
Pagurus bernhardus					R					R									
Pholis gunnellus																			
Pomatoschistus minutus																			
Porifera																F			
Sagartia																			
Sertularia																			
Solaster endeca																			
Thuiaria thuja																			
Urticina eques											R								

	98	99	100	101	102	103	104	105	106	107	108	109	110	110
Abietinaria abietina														
Aequipecten opercularis						R								
Alcyonium digitatum	F	O	O	F		O	C			O	R			
Anthozoan														
Aspitrigla cuculus														
Asterias rubens			O		O		O			O				
Bright orange sponge														
Bryozoa				C										
Buccinum undatum														
Callionymus lyra														
Echinocardium cordatum														
Echinus esculentus														
Fish														
Fish - Blenny?														
Flatfish														
Flustra foliacea	F	O	C	C	O	R	C	O			O		O	
Halichondria panicea														
Haliclona oculata														
Hydroida		O		F									O	
Liocarcinus depurator		R												
Luidia sarsi														
Macropodia														
Munida rugosa	R		F			R	F							
Mysids														
Nemertesia														
Nemertesia antennina		R					O							
Nemertesia ramosa							O							
Ophiocomina nigra														
Ophiothrix fragilis					A									
Orange Porifera			O				O							
Pagurus														
Pagurus bernhardus														R
Pholis gunnellus														
Pomatoschistus minutus										R				
Porifera														
Sagartia			R											
Sertularia														
Solaster endeca														
Thuiaria thuja														
Urticina eques														

	111	113	114	115	116	117	118	119	120	121	123	124
Abietinaria abietina												
Aequipecten opercularis												
Alcyonium digitatum		O	O			F				O	O	
Anthozoan												
Aspitrigla cuculus												
Asterias rubens		R				O		O	O	O		O
Bright orange sponge												
Bryozoa						C						
Buccinum undatum												
Callionymus lyra												
Echinocardium cordatum												
Echinus esculentus												
Fish												
Fish - Blenny?												
Flatfish												
Flustra foliacea		O	O	O		C		O		O	O	C
Halichondria panicea												
Haliclona oculata												
Hydroida												
Liocarcinus depurator												
Luidia sarsi												
Macropodia												
Munida rugosa					O							
Mysids												
Nemertesia												
Nemertesia antennina												
Nemertesia ramosa												
Ophiocomina nigra												
Ophiothrix fragilis												
Orange Porifera												
Pagurus						O						
Pagurus bernhardus												
Pholis gunnellus												
Pomatoschistus minutus												
Porifera												
Sagartia				R								
Sertularia												
Solaster endeca												
Thuiaria thuja												
Urticina eques										R		

	C1	C2	C3	C4	C5	C6	C7	C8
Abietinaria abietina								
Aequipecten opercularis								
Alcyonium digitatum			3			4		
Anthozoan								
Aspitrigla cuculus								
Asterias rubens				1		3		2
Bright orange sponge								
Bryozoa								
Buccinum undatum								
Callionymus lyra								
Echinocardium cordatum								
Echinus esculentus								
Fish								
Fish - Blenny?							1	
Flatfish								
Flustra foliacea		2	2					
Halichondria panicea								
Haliclona oculata								
Hydroida								
Liocarcinus depurator								
Luidia sarsi								
Macropodia								
Munida rugosa								
Mysids								
Nemertesia								
Nemertesia antennina			1					
Nemertesia ramosa								
Ophiocomina nigra						2		
Ophiothrix fragilis						5		
Orange Porifera								
Pagurus								
Pagurus bernhardus								
Pholis gunnellus			1					
Pomatoschistus minutus								
Porifera								
Sagartia			2					
Sertularia			2					
Solaster endeca								
Thuiaria thuja								
Urticina eques								

	T1	T1	T2	T3	T4	T5	T6	T7	T8
Abietinaria abietina									
Aequipecten opercularis									
Alcyonium digitatum						2	4		
Anthozoan									
Aspitrigla cuculus					1				
Asterias rubens						1	1		
Bright orange sponge									
Bryozoa									
Buccinum undatum									
Callionymus lyra									
Echinocardium cordatum					2				
Echinus esculentus									
Fish									
Fish - Blenny?									
Flatfish									
Flustra foliacea							2		
Halichondria panicea									
Haliclona oculata									
Hydroida									
Liocarcinus depurator									
Luidia sarsi									
Macropodia									
Munida rugosa							2		
Mysids									
Nemertesia									
Nemertesia antennina									
Nemertesia ramosa									
Ophiocomina nigra									
Ophiothrix fragilis						1			
Orange Porifera									
Pagurus									
Pagurus bernhardus									
Pholis gunnellus									
Pomatoschistus minutus									
Porifera									
Sagartia									
Sertularia									
Solaster endeca									
Thuiaria thuja							2		
Urticina eques							1		

Annex 12A.4
Benthic Grab Sampling Positions

Table 12A.4.1 Benthic Grab Physical Data

Station	Class	Lat	Long	Date	Time	Depth	Salinity	Water temp	Secchi	Weather	Visual assessment	Conspicuous fauna
1	Strong, flat, deep	56.5611	-2.1888833	17/04/2012	15:40:00	54	35	8	3	2m swell, fine, light NE wind	fine sand	tube casts
4	Strong, flat, deep	56.540433 3	-2.2805667	28/04/2012	09:00:00	60	35	8	3	1.5m swell, wind 12mph, chop	fine sand	annelids
6	Strong, flat, deep	56.526333 3	-2.2514333	28/04/2012	15:38:00	54	35	8	3	1m swell light NE wind	sand	
7	Strong, flat, deep	56.511618 3	-2.1919233	17/04/2012	14:12:00	55	35	8	5	2m swell, fine, light NE wind	fine sand with some shell	annelids, bivalves, sand casts
8	Strong, flat, deep	56.508016 7	-2.1678167	02/05/2012	08:10:00	55	35	8	5	wind 15mph NE, 1.5m swell	sand	annelids, tube worms
9	Strong, flat, deep	56.454766 7	-2.2817667	28/04/2012	12:19:00	53	35	8	5	1.5m swell, wind 12mph, chop	sand	annelids
10	Strong, flat, deep	56.435413 3	-2.2510833	24/03/2012	14:00:00	50	35	7	5	Calm, 1m swell	clean sands	Seapen, brittlestars
11	Strong, flat, deep	56.4312	-2.20875	01/05/2012	11:45:00	59	35	8	5	3/4 NE, 1m swell	sand	annelids, tube worms
12	Strong, flat, deep	56.422966 7	-2.1058	02/05/2012	11:40:00	67	35	8	4	wind 15mph NE, 1.5m swell	fine muddy sand	brittle star, heart urchin, annelids

Station	Class	Lat	Long	Date	Time	Depth	Salinity	Water temp	Secchi	Weather	Visual assessment	Conspicuous fauna
13	Strong, flat, deep	56.4663167	-2.0484667	02/05/2012	15:52:00	58	35	8	4	wind 15mph NE, 1.5m swell	coarse sand and shell	annelids
14	Strong, flat, deep	56.4703167	-2.1681167	01/05/2012	12:40:00	58	35	8	4	3/4 NE, 1m swell	sand	brittlestar, annelids
21	Strong, flat, deep, rockhead	56.5384667	-2.2520667	28/04/2012	16:01:00	56	35	8	6	1m swell light NE wind	sand and shell	annelids
22	Strong, flat, deep, rockhead	56.4750167	-2.27715	28/04/2012	12:04:00	52	35	8	3	1.5m swell, wind 12mph, chop	muddy sand	annelids, tube worms
23	Strong, flat, deep, rockhead	56.4382833	-2.1534833	01/05/2012	12:45:00	59	35	8	3	3/4 NE, 1m swell	sand and shell	britlestars
24	Strong, flat shallow	56.5736167	-2.1991167	17/04/2012	08:52:00	63	35	8	3	2m swell, fine, light NE wind	fine sand with shell	annelids
25	Strong, flat shallow	56.5526633	-2.1948233	23/03/2012	08:00:00	48	35	7	6	Calm, 1m swell	coarse sand with shell	
26	Strong, flat shallow	56.5347967	-2.19781	23/03/2012	09:00:00	50	35	7	6	Calm, 1m swell	sand with shell	Sabellaria on shell, Echinocardium cordatum
27	Strong, flat shallow	56.5190167	-2.2166667	17/04/2012	15:15:00	52	35	8	5	2m swell, fine, light NE wind	fine sand	razor shell, soft worm casts
28	Strong, flat shallow	56.50035	-2.2805833	28/04/2012	10:46:00	53	35	8	3	1.5m swell, wind 12mph, chop	sand	astrerias x 1, sand star
30	Strong, flat shallow	56.5000167	-2.2271	28/04/2012	15:52:00	50	35	8	5	1m swell light NE wind	shelly sand	annelids
31	Strong, flat shallow	56.4989167	-2.20925	28/04/2012	15:03:00	47	35	8	5	1m swell light NE wind	fine sand with shell	5cm heart urchin x1

Station	Class	Lat	Long	Date	Time	Depth	Salinity	Water temp	Secchi	Weather	Visual assessment	Conspicuous fauna
32	Strong, flat shallow	56.48165	-2.2109667	28/04/2012	14:25:00	52	35	8	4	1m swell light NE wind	sand	
33	Strong, flat shallow	56.441416 7	-2.2404333	01/05/2012	11:05:00	54	35	8	4	3/4 NE, 1m swell	sand	brittlestar, heart urchin, annelids
34	Strong, flat shallow	56.456616 7	-2.0558833	02/05/2012	15:40:00	51	35	8	5	wind 15mph NE, 1.5m swell	coarse sand and shell	annelids
38	Strong, flat shallow, rockhead	56.543466 7	-2.1986667	17/04/2012	19:07:00	51	35	8	4	2m swell, fine, light NE wind	sand with some shell	annelids
39	Strong, flat shallow, rockhead	56.52445	-2.2160333	23/03/2012	11:30:00	50	35	7	6	Calm, 1m swell	sand with some shell	
40	Strong, flat shallow, rockhead	56.488366 7	-2.2480667	28/04/2012	14:11:00	51	35	8	3	1m swell light NE wind	sand	annelids
41	Strong, flat shallow, rockhead	56.495298 3	-2.28251	24/03/2012	08:00:00	50	35	7	4	Calm, 1m swell	sand with shell	
43	Strong, mod, deep	56.583316 7	-2.2537667	17/04/2012	16:29:00	66	35	8	4	2m swell, fine, light NE wind	muddy sand	brittle stars, annelids
44	Strong, mod, deep	56.558616 7	-2.2564	28/04/2012	08:45:00	59	35	8	3	1.5m swell, wind 12mph, chop	muddy sand w fine silt layer	brittle stars
45	Strong, mod, deep	56.527216 7	-2.1666833	17/04/2012	13:34:00	53	35	8	4	2m swell, fine, light NE wind	fine sand, few shells	annelids
46	Strong, mod, deep	56.476866 7	-2.13035	01/05/2012	14:45:00	66	35	8	3	3/4 NE 1.5m swell	muddy shelly sand	many brittlestars and annelids
47	Strong, mod, deep	56.449	-2.0429167	02/05/2012	15:35:00	51	35	8	5	wind 15mph NE, 1.5m swell	coarse sand and shell	shrimp

Station	Class	Lat	Long	Date	Time	Depth	Salinity	Water temp	Secchi	Weather	Visual assessment	Conspicuous fauna
48	Strong, mod, deep	56.4368667	-2.0733333	02/05/2012	15:11:00	55	35	8	5	wind 15mph NE, 1.5m swell	sand and shell	annelids, tube worms
49	Strong, mod, deep	56.43885	-2.17685	01/05/2012	12:20:00	57	35	8	4	3/4 NE, 1m swell	sand	
50	Strong, mod, deep	56.4272667	-2.2371	01/05/2012	10:55:00	59	35	8	4	3/4 NE, 1m swell	fine sand	isopods, bivalves
51	Strong, mod, deep	56.42305	-2.0430333	02/05/2012	10:50:00	53	35	8	3	wind 15mph NE, 1.5m swell	sand with shell	
53	Mod, flat, deep	56.5668333	-2.1778333	17/04/2012	09:25:00	55	35	8	2	2m swell, fine, light NE wind	sand w some shell	
54	Mod, flat, deep	56.5181667	-2.1826833	17/04/2012	14:59:00	56	35	8	5	2m swell, fine, light NE wind	gravelly sand	
55	Mod, flat, deep	56.4511333	-2.1551333	02/05/2012	09:15:00	53	35	8	3	wind 15mph NE, 1.5m swell	shelly sand	
56	Mod, flat, deep	56.4661333	-2.0627667	02/05/2012	16:10:00	55	35	8	5	wind 15mph NE, 1.5m swell	gravelly sand	annelids
57	Mod, flat, deep	56.4455833	-2.0627333	02/05/2012	15:29:00	51	35	8	5	wind 15mph NE, 1.5m swell	coarse sand and shell	Sabellaria
58	Mod, flat, deep	56.5552333	-2.16245	17/04/2012	10:20:00	57	35	8	3	2m swell, fine, light NE wind	coarse sand with shell	
63	Mod, flat, shallow	56.5777333	-2.2082	17/04/2012	08:44:00	54	35	8	3	2m swell, fine, light NE wind	sand/shell	annelids
64	Mod, flat, shallow	56.5509083	-2.1993417	22/03/2012	15:24:00	50	35	7	6	Calm, no swell	coarse sand with shell	
66	Mod, flat, shallow	56.4701917	-2.238295	24/03/2012	09:00:00	50	35	7	4	Calm, 1m swell	sand with shell and some clay	Hermit crab

Station	Class	Lat	Long	Date	Time	Depth	Salinity	Water temp	Secchi	Weather	Visual assessment	Conspicuous fauna
67	Mod, flat, shallow	56.4739167	-2.1936167	01/05/2012	12:15:00	57	35	8	4	3/4 NE, 1m swell	sand and shell	starfish, bivalves
68	Mod, flat, shallow	56.4363167	-2.1653333	02/05/2012	09:45:00	53	35	8	3	wind 15mph NE, 1.5m swell	sand	squat lobster, brittlestar
69	Mod, flat, shallow	56.4537	-2.0872833	02/05/2012	16:25:00	50	35	8	5	wind 15mph NE, 1.5m swell	coarse sand	shrimp, sand eels (14,16,15,15,15,11,11,14,14,14)
71	Mod, flat, shallow	56.48685	-2.1908167	28/04/2012	14:51:00	49.3	35	8	4	1m swell light NE wind	gravelly sand	sponge, heart urchin, annelids
72	Mod, flat, shallow	56.4407617	-2.1568017	24/03/2012	15:00:00	50	35	7	4	Calm, 1m swell	sand with shell	
78	Mod, flat, shallow, rockhead	56.4883167	-2.2763667	28/04/2012	11:43:00	52	35	8	3	1.5m swell, wind 12mph, chop	muddy sand	
79	Mod, Mod, deep	56.5731333	-2.1651167	17/04/2012	09:45:00	56	35	8	3	2m swell, fine, light NE wind	muddy sand/shell	sabellaria, annelids, b.star, pea crab, crustacea
80	Mod, Mod, deep	56.5663333	-2.1657667	17/04/2012	09:53:00	59	35	8	3	2m swell, fine, light NE wind	fin/muddy sand with some shell	tube worms, annelids, shrimp, crab
81	Mod, Mod, deep	56.5244167	-2.1722667	17/04/2012	13:42:00	55	35	8	4	2m swell, fine, light NE wind	large shell fragments	annelids, isopods, copepods
82	Mod, Mod, deep	56.46205	-2.0542667	02/05/2012	15:46:00	53	35	8	5	wind 15mph NE, 1.5m swell	coarse sand and shell	annelids

Station	Class	Lat	Long	Date	Time	Depth	Salinity	Water temp	Secchi	Weather	Visual assessment	Conspicuous fauna
83	Mod, Mod, deep	56.449333 3	-2.11625	02/05/2012	17:00:00	55	35	8	5	wind 15mph NE, 1.5m swell	coarse sand	
91	Mod, mod, shallow, rockhead	56.517651 7	-2.25641	23/03/2012	10:30:00	48	35	7	6	Calm, 1m swell	sand with shell	Sabellaria, brittlestars, polychaetes
93	Mod, mod, shallow	56.46885	-2.2704333	28/04/2012	12:37:00	51	35	8	3	1.5m swell, wind 12mph, chop	sand and mud.	
97	Weak, flat, shallow	56.451316 7	-2.1009333	02/05/2012	16:35:00	51	35	8	5	wind 15mph NE, 1.5m swell	gravel	annelids
99	Weak, flat, shallow, rockhead	56.488783 3	-2.2563833	28/04/2012	13:45:00	50	35	8	5	1m swell light NE wind	muddy sand	
105	Strong, mod, shallow	56.554938 3	-2.216985	22/03/2012	16:50:00	52	35	7	6	Calm, no swell	clean sands - few shells	
106	Strong, mod, shallow	56.513333 3	-2.2026167	17/04/2012	14:19:00	52	35	8	5	2m swell, fine, light NE wind	shelly sand	annelids
107	Strong, mod, shallow	56.506293 3	-2.2567333	23/03/2012	13:00:00	50	35	7	6	Calm, 1m swell	sand/shell	Brittlestars, polychaetes
108	Mod, steep, deep	56.473866 7	-2.1345833	01/05/2012	12:50:00	58	35	8	3	3/4 NE, 1m swell	gravelly sand	brittlestar
109	Strong, steep	56.569096 7	-2.2531083	22/03/2012	12:15:00	40	35	7	6	Calm, no swell	coarse/stony sand	Pomatoceros/ DMF
110	Strong, steep	56.590533 3	-2.2227133	17/04/2012	08:41:00	50	35	8	4	2m swell, fine, light NE wind	sandy gravel w shell	bivalves
111	Strong, steep	56.593755	-2.1876467	22/03/2012	08:34:00	40	35	7	6	Calm, no swell	Sand/gravel	Sabellaria

Station	Class	Lat	Long	Date	Time	Depth	Salinity	Water temp	Secchi	Weather	Visual assessment	Conspicuous fauna
113	Weak, flat, deep	56.553456 7	-2.15986	22/03/2012	17:30:00	55	35	7	6	Calm, no swell	gravelly/shell y	Sabellaria, Pomatocerou s, hydroids
116	Weak, steep, shallow	56.58685	-2.2206833	17/04/2012	08:10:00	50	35	8	4	2m swell, fine, light NE wind	gravelly sandy mud	starfish, whelk, DMF. 50%sample
119	Rockhead	56.525166 7	-2.2808167	28/04/2012	10:20:00	54	35	8	3	1.5m swell, wind 12mph, chop	sandy mud	brittle stars, annelids, tube worms
120	Rockhead	56.483616 7	-2.2861667	28/04/2012	11:53:00	52	35	8	3	1.5m swell, wind 12mph, chop	muddy sand	brittle star
121	Rockhead	56.514566 7	-2.2401833	28/04/2012	15:27:00	55	35	8	6	1m swell light NE wind	shelly sand	annelids
124	Weak, steep, deep	56.589266 7	-2.1610833	02/05/2012	07:25:00	58	35	8	3	wind 15mph NE, 1.5m swell	gravel	crab
C1A	Control	56.667716 7	-2.2189667	17/04/2012	05:50:00	63	35	8	3	2m swell, fine, light NE wind	muddy sand and shell	bivalves, no anoxic layer
C1B	Control	56.667533 3	-2.2174333	17/04/2012	06:46:00	66	35	8	2	2m swell, fine, light NE wind	muddy sand and shell	brittle stars and tube worms
C1C	Control	56.667866 7	-2.2185667	17/04/2012	06:53:00	64	35	8	2	2m swell, fine, light NE wind	muddy sand and shell	bivalves, annelids, and nematodes
C2A	Control	56.588883 3	-2.0562167	01/05/2012	16:06:00	61	35	8	3	3/4 NE 1.5m swell	coarse sand	
C2B	Control	56.589516 7	-2.05725	01/05/2012	16:10:00	61	35	8	3	3/4 NE 1.5m swell	coarse sand	
C2C	Control	56.5895	-2.0571	01/05/2012	16:14:00	61	35	8	3	3/4 NE 1.5m swell	coarse sand	annelids, razor shell

Station	Class	Lat	Long	Date	Time	Depth	Salinity	Water temp	Secchi	Weather	Visual assessment	Conspicuous fauna
C4A	Control	56.3959667	-2.0358167	02/05/2012	12:35:00	62	35	8	4	wind 15mph NE, 1.5m swell	shelly fine sand	annelids, brittlestar
C4B	Control	56.3965167	-2.0350333	02/05/2012	14:45:00	55	35	8	4	wind 15mph NE, 1.5m swell	shelly fine sand	annelids, brittlestars, calcified tube worms
C4C	Control	56.3964	-2.0368333	02/05/2012	14:58:00	54	35	8	4	wind 15mph NE, 1.5m swell	shelly fine sand	annelids, brittlestar
C5A	Control	56.3393333	-2.2196833	01/05/2012	07:30:00	59	35	8	3	3/4 NE, 1m swell	muddy sand	annelids
C5B	Control	56.3394833	-2.2202833	01/05/2012	07:35:00	59	35	8	3	3/4 NE, 1m swell	muddy sand	annelids
C5C	Control	56.3394167	-2.2199333	01/05/2012	07:40:00	59	35	8	3	3/4 NE, 1m swell	muddy sand	annelids, tube worms
C7A	Control	56.49735	-2.2612833	01/05/2012	06:40:00	44	35	8	2	3/4 NE, 1m swell	muddy sand, gold fecks	heart urchin, brittlestars
C7B	Control	56.4971333	-2.261	01/05/2012	06:45:00	44	35	8	2	3/4 NE, 1m swell	muddy sand, gold fecks	annelidsa and brittlestars
C7C	Control	56.4975333	-2.2610167	01/05/2012	06:50:00	44	35	8	2	3/4 NE, 1m swell	muddy sand, gold fecks	brittlestars
C8A	Control	56.5693	-2.3487667	28/04/2012	17:13:00	55	35	8	6	1m swell light NE wind	muddy sand	heart urchin
C8B	Control	56.56915	-2.3495333	28/04/2012	17:16:00	55	35	8	6	1m swell light NE wind	muddy sand	asterius x1, heart urchin, brittle star.
C8C	Control	56.5695	-2.3494667	28/04/2012	17:20:00	56	35	8	6	1m swell light NE wind	muddy sand	brittle stars
T1A	Tidal	56.60665	-2.2215333	17/04/2012	07:31:00	66	35	8	2	2m swell, fine, light NE wind	sand/shell	annalids

Station	Class	Lat	Long	Date	Time	Depth	Salinity	Water temp	Secchi	Weather	Visual assessment	Conspicuous fauna
T1B	Tidal	56.60615	-2.2216333	17/04/2012	07:36:00	66	35	8	4	2m swell, fine, light NE wind	sand/shell	tubve worms/annelids
T1C	Tidal	56.6062	-2.2220167	17/04/2012	07:43:00	67	35	8	4	2m swell, fine, light NE wind	fine sand	annelids
T2A	Tidal	56.5488	-2.12895	17/04/2012	12:53:00	55	35	8	3	2m swell, fine, light NE wind	coarse sand and shell with gravel	lesser sandeel 15cm
T2B	Tidal	56.5488	-2.1278833	17/04/2012	13:03:00	55	35	8	3	2m swell, fine, light NE wind	coarse sand and shell with gravel	razor shell, 50% sample
T2C	Tidal	56.5490333	-2.1287167	17/04/2012	13:16:00	55	35	8	3	2m swell, fine, light NE wind	coarse sand with shell	
T3A	Tidal	56.4986167	-2.0901167	01/05/2012	14:50:00	63	35	8	3	3/4 NE 1.5m swell	sand and shell	
T3B	Tidal	56.49875	-2.08955	01/05/2012	14:55:00	63	35	8	3	3/4 NE 1.5m swell	sand and shell	razor shell
T3C	Tidal	56.4987667	-2.0896	01/05/2012	15:00:00	63	35	8	3	3/4 NE 1.5m swell	sand and shell	bivalves, brittlestars, annelids
T4A	Tidal	56.4216333	-2.0802833	02/05/2012	12:25:00	63	35	8	4	wind 15mph NE, 1.5m swell	fine sand	fan worm, heart urchin, brittlestar
T4B	Tidal	56.4215833	-2.0804833	02/05/2012	12:20:00	63	35	8	4	wind 15mph NE, 1.5m swell	fine sand	annelids, brittlestar
T4C	Tidal	56.42165	-2.0807667	02/05/2012	12:22:00	63	35	8	4	wind 15mph NE, 1.5m swell	fine sand	heart urchin, brittlestar
T5A	Tidal	56.3808	-2.2201	01/05/2012	08:00:00	59	35	8	4	3/4 NE, 1m swell	muddy sand and shell	annelids

Station	Class	Lat	Long	Date	Time	Depth	Salinity	Water temp	Secchi	Weather	Visual assessment	Conspicuous fauna
T5B	Tidal	56.3812333	-2.2208667	01/05/2012	08:05:00	59	35	8	4	3/4 NE, 1m swell	muddy sand and shell	bivalves, annelids
T5C	Tidal	56.38115	-2.2203	01/05/2012	08:10:00	59	35	8	4	3/4 NE, 1m swell	muddy sand and shell	
T7A	Tidal	56.4974333	-2.3280333	01/05/2012	07:15:00	50	35	8	2	3/4 NE, 1m swell	sand	brittlestar, annelids
T7B	Tidal	56.4978833	-2.3268167	01/05/2012	07:20:00	50	35	8	2	3/4 NE, 1m swell	sand	brittlestar, annelids
T7C	Tidal	56.4978333	-2.3272667	01/05/2012	07:25:00	50	35	8	2	3/4 NE, 1m swell	sand	brittlestar, annelids, heart urchin
T8A	Tidal	56.5433333	-2.3034833	28/04/2012	09:24:00	53	35	8	3	1.5m swell, wind 12mph, chop	sand	heart urchin, brittlestar
T8B	Tidal	56.5457833	-2.3019833	28/04/2012	09:35:00	53	35	8	3	1.5m swell, wind 12mph, chop	sand	brittlestars
T8C	Tidal	56.5441667	-2.3018333	28/04/2012	09:40:00	52	35	8	3	1.5m swell, wind 12mph, chop	sand	tube worms

Annex 12A.5 PSA Data

Table 12A.5.1 PSA Data

Analyte	Units	41	72	66	10	26	91	39	113	109	105	64	107	111	25
Grain Size Fraction : <3.9 microns	%	0	0	0	0.19	0	0	0	0	0	0	0	0.01	0	0
Grain Size Fraction : 3.9 - 7.79 microns	%	0	0	0	0.85	0	0	0	0	0	0	0	0.53	0	0
Grain Size Fraction : 7.8 - 15.59 microns	%	0	0	0	0.75	0	0	0	0.01	0	0	0	0.34	0	0
Grain Size Fraction : 15.6 - 31.99 microns	%	0	0	0	0.97	0	0	0.22	0.45	0	0	0	0	0	0
Grain Size Fraction : < 20 microns	%	0	0	0	2.01	0	0	0	0.15	0	0	0	0.88	0	0
Grain Size Fraction : 32 - 62.9 microns	%	0	0	0	0.56	0	0	0.63	0.08	0	0	0	0	0	0
Grain Size Fraction : < 63 microns	%	0	0	0	3.31	0	0	0.85	0.54	0	0	0	0.88	0	0
Grain Size Fraction : 63 to 125 microns	%	0.24	0.53	1.15	1.4	0.64	4.99	1.32	0.68	0	0	0.24	0.9	0.49	0.39
Grain Size Fraction : 125 to 249 microns	%	21.8	24.5	22.6	34.1	27.8	36.2	37.9	10.9	5.24	9.57	24.4	34.8	31.2	25.9
Grain Size Fraction : 250 to 499 microns	%	56.6	40.4	38	49.3	49.7	31.9	50.9	18.2	16.1	69.9	44.2	53.3	43.7	48.9
Grain Size Fraction : 500 to 999 microns	%	21	10.2	20.3	11.9	15.9	9.33	8.95	7.86	5.92	20.5	9.82	9.94	4.74	8.36
Grain Size Fraction : 1000 to 1999 microns	%	0.47	0.77	4.05	0.07	2.26	4.26	0.1	4.41	0.3	0	3.26	0.21	2.65	3.4
Grain Size Fraction : 2000 to 3999 microns	%	0	1.49	0	0	0.7	1.53	0	5.05	2.82	0	2.56	0	3.11	1.2
Grain Size : 4000 to 7999 microns	%	0	1.8	0	0	2.2	2.46	0	12	1.2	0	3.62	0	8.2	6.21
Grain Size Fraction : > 8000 microns	%	0	20.4	10.7	0	0.58	8.73	0	39.9	68.4	0	11.1	0	5.2	4.71
Grain Size : 8000 to 15999 microns	%	0	1.11	0.52	0	0.58	8.73	0	39.9	0	0	11.1	0	5.2	4.71
Grain Size Fraction : 16000 - 31999 microns	%	0	0	5.74	0	0	0	0	0	0	0	0	0	0	0
Grain Size Fraction : 32000 - 62999 microns	%	0	19.3	4.4	0	0	0	0	0	68.4	0	0	0	0	0
Grain Size Fraction : > 63000 microns	%	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Analyte	Units	41	72	66	10	26	91	39	113	109	105	64	107	111	25
Grain Size Inclusive Kurtosis	mm	0.507	0.616	0.319	0.497	0.426	0.31	0.49	0.697	0.551	0.514	0.291	0.48	0.23	0.207
Grain Size Inclusive Mean	mm	0.351	0.865	0.467	0.287	0.339	0.39	0.277	2.35	3.2	0.382	0.646	0.287	0.555	0.426
Inclusive Graphic Skewness :- {SKI}	Unitless	0.01	0.64	0.4	-0.01	0.16	0.54	0.03	-0.63	-0.94	0.01	0.64	0.02	0.64	0.51
Kurtosis	Unitless	1.48	0.64	5.3	1.58	37.2	4.23	3.37	-1.78	-1.45	0.55	4.16	3.6	9.67	9.56
Particle Diameter : Mean	mm	0.387	2.33	1.44	0.316	0.588	1.37	0.309	4.77	6.15	0.401	1.69	0.32	1.42	1.22
Particle Diameter : Median	mm	0.351	0.373	0.4	0.286	0.333	0.287	0.278	4.8	8.69	0.38	0.352	0.289	0.316	0.344
Sorting Coefficient	Unitless	0.63	2.21	1.51	0.68	0.82	1.65	0.61	2.13	1.96	0.46	1.88	0.61	1.82	1.44
Carbon, Organic : Dry Wt as C	%	<0.4	<0.4	<0.4	<0.4	0.449	<0.4	<0.4	0.767	0.414	<0.4	0.546	0.549	0.584	<0.4

Analyte	Units	C1a	C1b	C1c	T1a	T1b	T1c	T2a	T2b	T2c	110	116	63	24	53
Grain Size Fraction : <3.9 microns	%	0	0.65	0.08	0.32	0.67	0.7	0	0	0	0	0	0	0	0.07
Grain Size Fraction : 3.9 - 7.79 microns	%	0	1.5	0.49	1.01	1.39	1.51	0	0	0	0	0.12	0	0	0.51
Grain Size Fraction : 7.8 - 15.59 microns	%	0	1.77	0.5	0.94	1.23	1.44	0	0	0	0	0.14	0	0	0.23
Grain Size Fraction : 15.6 - 31.99 microns	%	0.67	1.7	0.4	1.4	1.45	1.65	0	0	0	0	0	0	0	0
Grain Size Fraction : < 20 microns	%	0.03	4.48	1.25	2.66	3.72	4.17	0	0	0	0	0.26	0	0	0.81
Grain Size Fraction : 32 - 62.9 microns	%	0.25	1.22	0.8	0.28	0.36	0.31	0	0	0	0	0	0	0	0
Grain Size Fraction : < 63 microns	%	0.91	6.84	2.28	3.95	5.11	5.6	0	0	0	0	0.26	0	0	0.81
Grain Size Fraction : 63 to 125 microns	%	1.93	3.64	9.36	5.01	6.17	5.85	0	0	0	0	0.1	0.41	0.01	0.94
Grain Size Fraction : 125 to 249 microns	%	34.9	29.7	39.2	43.1	38.6	43.7	15.6	12.6	5.08	12.1	15.3	26.1	14.1	31.9
Grain Size Fraction : 250 to 499 microns	%	49.1	44.5	34.1	36.6	35.5	36.2	54.7	53.4	52.7	60.7	34.6	53.1	68.7	46.6
Grain Size Fraction : 500 to 999 microns	%	8.76	15.2	8.43	8.28	11.5	7.56	25.2	15.7	39	26.7	10.3	13.4	17.1	7.55
Grain Size Fraction : 1000 to 1999 microns	%	1.76	0.12	1.87	3.04	3.06	1.11	1.1	3.48	3.23	0.45	0.33	0.98	0	2.41
Grain Size Fraction : 2000 to 3999 microns	%	2.61	0	1.44	0	0	0	3.52	4.34	0	0	2.56	1	0	0
Grain Size : 4000 to 7999 microns	%	0	0	2.99	0	0	0	0	3.9	0	0	7.13	3.07	0	0.28
Grain Size Fraction : > 8000 microns	%	0	0	0.27	0	0	0	0	6.13	0	0	29.4	1.46	0	8.4
Grain Size : 8000 to 15999 microns	%	0	0	0.27	0	0	0	0	6.13	0	0	18.8	1.46	0	8.4
Grain Size Fraction : 16000 - 31999 microns	%	0	0	0	0	0	0	0	0	0	0	10.6	0	0	0
Grain Size Fraction : 32000 - 62999 microns	%	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grain Size Fraction : > 63000 microns	%	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grain Size Inclusive Kurtosis	mm	0.518	0.297	0.346	0.432	0.334	0.285	0.493	0.195	0.511	0.457	0.712	0.241	0.451	0.198
Grain Size Inclusive Mean	mm	0.293	0.281	0.259	0.25	0.257	0.237	0.395	0.551	0.47	0.398	1.07	0.339	0.366	0.334
Inclusive Graphic Skewness :- {SKI}	Unitless	0.02	-0.28	0.19	0.11	-0.08	-0.18	0.09	0.59	0.05	-0.03	0.51	0.29	-0.13	0.41
Kurtosis	Unitless	22.7	0.77	28.4	10.6	7.9	11	19.8	6.31	1.83	1.06	-1.03	23.3	0.32	9.12

Analyte	Units	C1a	C1b	C1c	T1a	T1b	T1c	T2a	T2b	T2c	110	116	63	24	53
Particle Diameter : Mean	mm	0.371	0.318	0.516	0.307	0.319	0.275	0.494	1.34	0.507	0.427	3.31	0.711	0.384	1.12
Particle Diameter : Median	mm	0.292	0.289	0.247	0.243	0.25	0.234	0.388	0.405	0.461	0.399	0.545	0.335	0.372	0.312
Sorting Coefficient	Unitless	0.68	1.13	1.06	0.82	1.11	1.05	0.67	1.46	0.56	0.57	2.16	1.04	0.51	1.33
Carbon, Organic : Dry Wt as C	%	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.82	<0.4	<0.4	<0.4

Analyte	Units	79	80	58	45	81	54	7	106	27	38	1	43	48
Grain Size Fraction : <3.9 microns	%	0	0.08	0	0	0.22	0	0.19	0	0	0	0	0.83	0
Grain Size Fraction : 3.9 - 7.79 microns	%	0.02	0.56	0	0	0.99	0	0.9	0	0.5	0	0	1.8	0
Grain Size Fraction : 7.8 - 15.59 microns	%	0.41	0.4	0	0	0.71	0	0.61	0	0.29	0	0	1.67	0
Grain Size Fraction : 15.6 - 31.99 microns	%	0.15	0.09	0	0	0.81	0	0.96	0	0	0	0	1.65	0
Grain Size Fraction : < 20 microns	%	0.56	1.1	0	0	2.13	0	1.92	0	0.79	0	0	4.81	0
Grain Size Fraction : 32 - 62.9 microns	%	0.64	0.78	0	0	0.45	0	0.78	0	0	0	0	0.55	0
Grain Size Fraction : < 63 microns	%	1.22	1.91	0	0	3.17	0	3.44	0	0.79	0	0	6.48	0
Grain Size Fraction : 63 to 125 microns	%	2.5	3.96	0.03	0.61	0.93	1.96	1.85	0.72	0.97	0.01	0.26	5.07	0.19
Grain Size Fraction : 125 to 249 microns	%	23.2	29.3	5.67	31.8	29.7	32.2	43.1	33.6	38.5	9.26	29.1	45.6	30.2
Grain Size Fraction : 250 to 499 microns	%	30.6	33.1	14.2	54.6	48.9	42.9	46	50.9	51.7	67.1	60.2	39.7	62.7
Grain Size Fraction : 500 to 999 microns	%	16.6	17.4	5.29	13	13.6	17.8	5.64	12.3	8.01	22.8	9.99	3.18	6.88
Grain Size Fraction : 1000 to 1999 microns	%	7.57	7.7	0.42	0.03	0	3.35	0	2.29	0.13	0.74	0.43	0	0.03
Grain Size Fraction : 2000 to 3999 microns	%	6.02	3.15	0.44	0	0.03	1.71	0	0.19	0	0	0	0	0
Grain Size : 4000 to 7999 microns	%	7.24	3.49	0.59	0	2.32	0	0	0	0	0	0	0	0
Grain Size Fraction : > 8000 microns	%	3.88	0	73.3	0	1.33	0	0	0	0	0	0	0	0
Grain Size : 8000 to 15999 microns	%	3.88	0	2.06	0	1.33	0	0	0	0	0	0	0	0
Grain Size Fraction : 16000 - 31999 microns	%	0	0	11	0	0	0	0	0	0	0	0	0	0
Grain Size Fraction : 32000 - 62999 microns	%	0	0	60.3	0	0	0	0	0	0	0	0	0	0
Grain Size Fraction : > 63000 microns	%	0	0	0	0	0	0	0	0	0	0	0	0	0
Grain Size Inclusive Kurtosis	mm	0.46	0.435	0.611	0.518	0.49	0.497	0.486	0.454	0.49	0.429	0.444	0.248	0.493
Grain Size Inclusive Mean	mm	0.59	0.371	3.23	0.308	0.31	0.328	0.253	0.304	0.275	0.401	0.306	0.227	0.295
Inclusive Graphic Skewness :- {SKI}	Unitless	0.44	0.27	-0.95	0.03	0.02	0.14	-0.02	0.13	0.03	0.18	0.06	-0.3	-0.04
Kurtosis	Unitless	4.66	0.27	-1.17	1.31	44	16.7	2.07	15.4	3.53	1.59	4.44	0.83	3.82

Analyte	Units	79	80	58	45	81	54	7	106	27	38	1	43	48
Particle Diameter : Mean	mm	1.46	0.671	6.62	0.335	0.541	0.421	0.275	0.359	0.307	0.427	0.341	0.244	0.319
Particle Diameter : Median	mm	0.413	0.331	8.87	0.305	0.31	0.316	0.254	0.298	0.278	0.38	0.306	0.23	0.3
Sorting Coefficient	Unitless	1.81	1.28	1.96	0.61	0.74	0.84	0.62	0.69	0.6	0.55	0.58	1	0.5
Carbon, Organic : Dry Wt as C	%	0.77	0.47	0.67	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	2.91	<0.4	<0.4

Analyte	Units	30	99	119	93	22	71	40	31	32	C8A	C8B	C8C	121
Grain Size Fraction : <3.9 microns	%	0	0	0.66	0.28	0.33	0.28	0.2	0	0	0	0.71	0	0.49
Grain Size Fraction : 3.9 - 7.79 microns	%	0.39	0	1.46	0.87	1.04	0.74	0.93	0	0	0	1.62	0	1.37
Grain Size Fraction : 7.8 - 15.59 microns	%	0.48	0	1.27	0.77	0.88	0.93	0.74	0	0	0	1.95	0	1.57
Grain Size Fraction : 15.6 - 31.99 microns	%	0	0	0.92	0.88	0.97	0.83	1.08	0	0.11	0.15	1.79	0.48	0.93
Grain Size Fraction : < 20 microns	%	0.87	0	3.73	2.16	2.53	2.23	2.14	0	0.11	0	4.88	0	3.85
Grain Size Fraction : 32 - 62.9 microns	%	0	0	0.95	0.35	0.78	0.64	0.67	0	0.57	1.13	2.31	0.93	1.22
Grain Size Fraction : < 63 microns	%	0.87	0	5.26	3.15	3.99	3.41	3.62	0	0.57	1.28	8.35	1.41	5.57
Grain Size Fraction : 63 to 125 microns	%	0.02	2.67	3.96	2.24	2.13	0.99	0.78	0.02	0.85	6.84	7.02	4.3	4.61
Grain Size Fraction : 125 to 249 microns	%	22	32.5	41.3	28.9	37.4	11.4	34.5	13.4	28.8	43.4	28.8	38	32.1
Grain Size Fraction : 250 to 499 microns	%	59.5	28.2	39.9	33.2	47.8	16	52.9	61.5	53.9	41.2	32.3	43	38.2
Grain Size Fraction : 500 to 999 microns	%	17.5	4.28	5.11	6.7	8.52	5.2	8.01	24.7	15.4	7.04	10.1	11.2	15.8
Grain Size Fraction : 1000 to 1999 microns	%	0.06	3.12	0	0.32	0.2	0.41	0.18	0.4	0.39	0.18	1.03	2.1	3.3
Grain Size Fraction : 2000 to 3999 microns	%	0	3.85	0.12	1.02	0	1.86	0	0	0	0	0.22	0	0.35
Grain Size : 4000 to 7999 microns	%	0	9.6	1.51	1.21	0	3.36	0	0	0	0	0.27	0	0
Grain Size Fraction : > 8000 microns	%	0	14.5	1.82	23.3	0	57.4	0	0	0	0	11.9	0	0
Grain Size : 8000 to 15999 microns	%	0	14.5	1.82	2.09	0	8.7	0	0	0	0	0.97	0	0
Grain Size Fraction : 16000 - 31999 microns	%	0	0	0	21.2	0	48.7	0	0	0	0	10.9	0	0
Grain Size Fraction : 32000 - 62999 microns	%	0	0	0	0	0	0	0	0	0	0	0	0	0
Grain Size Fraction : > 63000 microns	%	0	0	0	0	0	0	0	0	0	0	0	0	0
Grain Size Inclusive Kurtosis	mm	0.503	0.669	0.31	0.629	0.451	0.693	0.47	0.454	0.514	0.463	0.187	0.483	0.387
Grain Size Inclusive Mean	mm	0.339	0.768	0.25	0.801	0.266	2.71	0.277	0.387	0.316	0.247	0.33	0.275	0.289
Inclusive Graphic Skewness :- {SKI}	Unitless	-0.01	0.66	-0.06	0.6	-0.05	-0.92	-0.04	-0.06	-0.01	-0.01	0.2	0.07	-0.08
Kurtosis	Unitless	1.02	5.29	41.6	0.19	3.35	-1.65	3.46	1.33	2.27	4.66	4.53	10.3	10.4

Analyte	Units	30	99	119	93	22	71	40	31	32	C8A	C8B	C8C	121
Particle Diameter : Mean	mm	0.368	2.37	0.537	2.45	0.296	5.64	0.305	0.416	0.35	0.278	1.44	0.326	0.361
Particle Diameter : Median	mm	0.341	0.319	0.248	0.332	0.269	8.25	0.282	0.391	0.318	0.245	0.278	0.271	0.283
Sorting Coefficient	Unitless	0.59	2.28	0.93	2.37	0.69	2.24	0.63	0.57	0.65	0.7	2.08	0.76	1.07
Carbon, Organic : Dry Wt as C	%	<0.4	0.63	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.42

Analyte	Units	T7A	T7B	T7C	C7A	C7B	C7C	9	120	78	28	44	T8A	T8B	T8C	4
Grain Size Fraction : <3.9 microns	%	0.39	0.47	0.66	1.43	1.11	1.71	0.38	0.15	0.05	0	1.29	0.38	0.17	0	0.2
Grain Size Fraction : 3.9 - 7.79 microns	%	1.1	1.37	1.69	1.96	1.51	1.89	1.19	0.72	0.49	0	2.71	1.2	0.8	0	0.88
Grain Size Fraction : 7.8 - 15.59 microns	%	1.22	1.6	2.03	2.75	2.27	2.81	1.06	0.62	0.35	0	3.03	0.98	0.67	0	0.62
Grain Size Fraction : 15.6 - 31.99 microns	%	1.27	1.54	1.47	1.54	1.22	1.69	1.41	0.8	0.68	0	2.79	1.23	0.78	0	1.34
Grain Size Fraction : < 20 microns	%	3.09	3.93	4.98	7.11	3.5	7.47	2.99	1.7	1.03	0	7.94	2.89	1.78	0	1.98
Grain Size Fraction : 32 - 62.9 microns	%	0.74	1.01	1.43	3.8	3.73	3.78	0.55	0.57	0.28	0	1.32	0.75	0.84	0	0.44
Grain Size Fraction : < 63 microns	%	4.73	6.01	7.28	11.5	9.84	11.9	4.59	2.85	1.86	0	11.2	4.55	3.26	0	3.48
Grain Size Fraction : 63 to 125 microns	%	2.19	4.19	3.8	42.8	43.1	42.7	3.15	1.01	2.33	0.89	1.73	0.86	0.5	0.6	2.31
Grain Size Fraction : 125 to 249 microns	%	33.2	32.2	32	42.6	43.6	42.4	42.8	29.8	30.6	28.4	38.2	34.9	33.6	33.1	54.4
Grain Size Fraction : 250 to 499 microns	%	50.3	42.4	44.5	3.1	3.52	3	43.5	51.6	38.7	51.5	40.7	53.2	56	55.8	39.1
Grain Size Fraction : 500 to 999 microns	%	9.62	10.1	12.4	0	0	0	5.88	14.7	11.3	13.1	2.84	6.51	6.66	10.4	0.69
Grain Size Fraction : 1000 to 1999 microns	%	0	0	0	0	0	0	0.03	0.13	1	1.83	0	0	0	0.08	0
Grain Size Fraction : 2000 to 3999 microns	%	0	0	0	0	0	0	0	0	2.33	0.97	0	0	0	0	0
Grain Size : 4000 to 7999 microns	%	0	0	0	0	0	0	0	0	1.21	1.7	0	0	0	0	0
Grain Size Fraction : > 8000 microns	%	0	5.16	0	0	0	0	0	0	10.8	1.45	5.36	0	0	0	0
Grain Size : 8000 to 15999 microns	%	0	0	0	0	0	0	0	0	0.55	1.45	0	0	0	0	0
Grain Size Fraction : 16000 - 31999 microns	%	0	5.16	0	0	0	0	0	0	0	0	5.36	0	0	0	0
Grain Size Fraction : 32000 - 62999 microns	%	0	0	0	0	0	0	0	0	10.2	0	0	0	0	0	0
Grain Size Fraction : > 63000 microns	%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grain Size Inclusive Kurtosis	mm	0.46	0.151	0.274	0.253	0.281	0.25	0.473	0.507	0.259	0.379	0.061	0.463	0.493	0.473	0.49
Grain Size Inclusive Mean	mm	0.277	0.277	0.27	0.117	0.119	0.116	0.248	0.306	0.441	0.328	0.241	0.272	0.283	0.295	0.227
Inclusive Graphic Skewness :- {SKI}	Unitless	-0.12	0.12	-0.3	-0.31	-0.28	-0.32	-0.05	-0.04	0.52	0.18	-0.02	-0.1	-0.05	0.04	-0.05
Kurtosis	Unitless	0.58	15.3	0.57	0.41	0.57	0.36	1.98	1.31	6.06	30.3	30.3	2.57	0.77	2.87	0.96

Analyte	Units	T7A	T7B	T7C	C7A	C7B	C7C	9	120	78	28	44	T8A	T8B	T8C	4
Particle Diameter : Mean	mm	0.301	0.794	0.301	0.124	0.127	0.124	0.27	0.336	1.37	0.615	0.585	0.295	0.3	0.327	0.237
Particle Diameter : Median	mm	0.282	0.279	0.276	0.119	0.121	0.119	0.248	0.308	0.318	0.326	0.246	0.277	0.284	0.296	0.228
Sorting Coefficient	Unitless	0.72	1.54	1.15	0.98	0.91	0.99	0.68	0.68	1.69	0.84	1.82	0.63	0.57	0.59	0.51
Carbon, Organic : Dry Wt as C	%	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

Analyte	Units	6	21	124	8	11	55	33	67	T5A	T5B	30	99	119	93	22
Grain Size Fraction : <3.9 microns	%	0.28	0.33	0	0.08	0.37	0	0.82	1.73	1.51	1.05	0	0	0.66	0.28	0.33
Grain Size Fraction : 3.9 - 7.79 microns	%	0.98	0.99	0	0.84	1.09	0	1.74	2.74	2.81	2.12	0.39	0	1.46	0.87	1.04
Grain Size Fraction : 7.8 - 15.59 microns	%	0.87	0.98	0.15	0.79	0.98	0	1.61	3.19	3.76	2.66	0.48	0	1.27	0.77	0.88
Grain Size Fraction : 15.6 - 31.99 microns	%	1.05	1.13	0.44	0.58	0.9	0	1.24	2.41	2.26	1.53	0	0	0.92	0.88	0.97
Grain Size Fraction : < 20 microns	%	2.38	2.62	0.3	1.84	2.74	0	4.62	8.62	9.15	6.57	0.87	0	3.73	2.16	2.53
Grain Size Fraction : 32 - 62.9 microns	%	0.56	0.42	0.57	0.73	0.82	0	0.93	1.44	1.78	1.36	0	0	0.95	0.35	0.78
Grain Size Fraction : < 63 microns	%	3.74	3.84	1.16	3.01	4.16	0	6.34	11.5	12.1	8.72	0.87	0	5.26	3.15	3.99
Grain Size Fraction : 63 to 125 microns	%	1.11	1.53	4.04	0.13	2.76	0.14	2.47	2.57	12	10.1	0.02	2.67	3.96	2.24	2.13
Grain Size Fraction : 125 to 249 microns	%	36.3	28	19	24.5	36.7	20.5	34.1	27.5	41.7	41.6	22	32.5	41.3	28.9	37.4
Grain Size Fraction : 250 to 499 microns	%	45.8	24.4	21.1	58.9	44.4	50.5	43.1	35.3	28.1	27.5	59.5	28.2	39.9	33.2	47.8
Grain Size Fraction : 500 to 999 microns	%	5.26	1.46	13.4	13.5	10.9	20.7	12.1	4.88	4.49	6.51	17.5	4.28	5.11	6.7	8.52
Grain Size Fraction : 1000 to 1999 microns	%	0	0	5.46	0.01	1.06	1.21	0.53	3.24	1.45	3.06	0.06	3.12	0	0.32	0.2
Grain Size Fraction : 2000 to 3999 microns	%	0.03	0.17	6.85	0	0	1.66	1.33	3.01	0.16	0	0	3.85	0.12	1.02	0
Grain Size : 4000 to 7999 microns	%	0.12	0.25	16.4	0	0	0.88	0	4.52	0	1.25	0	9.6	1.51	1.21	0
Grain Size Fraction : > 8000 microns	%	7.6	40.4	11.9	0	0	4.45	0	6.73	0	0.97	0	14.5	1.82	23.3	0
Grain Size : 8000 to 15999 microns	%	0.65	0	11.9	0	0	1.78	0	6.73	0	0.97	0	14.5	1.82	2.09	0
Grain Size Fraction : 16000 - 31999 microns	%	0	0	0	0	0	2.67	0	0	0	0	0	0	0	21.2	0
Grain Size Fraction : 32000 - 62999 microns	%	6.95	40.4	0	0	0	0	0	0	0	0	0	0	0	0	0
Grain Size Fraction : > 63000 microns	%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grain Size Inclusive Kurtosis	mm	0.15	0.712	0.66	0.497	0.467	0.213	0.279	0.123	0.243	0.218	0.503	0.669	0.31	0.629	0.451
Grain Size Inclusive Mean	mm	0.279	0.835	0.946	0.319	0.274	0.384	0.277	0.403	0.187	0.218	0.339	0.768	0.25	0.801	0.266
Inclusive Graphic Skewness :- {SKI}	Unitless	0.33	0.58	0.32	-0.03	-0.04	0.34	-0.22	0.2	-0.31	-0.11	-0.01	0.66	-0.06	0.6	-0.05

Analyte	Units	6	21	124	8	11	55	33	67	T5A	T5B	30	99	119	93	22
Kurtosis	Unitless	15.1	-1.34	-0.22	0.95	8.34	17.7	32.9	5.2	25.2	46	1.02	5.29	41.6	0.19	3.35
Particle Diameter : Mean	mm	0.857	3.46	2.62	0.341	0.311	0.873	0.338	1.28	0.238	0.451	0.368	2.37	0.537	2.45	0.296
Particle Diameter : Median	mm	0.276	0.349	0.604	0.32	0.272	0.373	0.276	0.289	0.196	0.213	0.341	0.319	0.248	0.332	0.269
Sorting Coefficient	Unitless	1.27	2.39	2.24	0.59	0.77	1.21	1.11	2.39	1.38	1.44	0.59	2.28	0.93	2.37	0.69
Carbon, Organic : Dry Wt as C	%	<0.4	0.42	0.53	<0.4	<0.4	<0.4	<0.4	0.69	0.41	0.52	<0.4	0.63	<0.4	<0.4	<0.4

Analyte	Units	T5C	C5A	C5B	C5C	T3A	T3B	T3C	C2A	C2B	C2C
Grain Size Fraction : <3.9 microns	%	2.15	1.22	1.19	1.36	0.2	0.31	0	0	0	0.05
Grain Size Fraction : 3.9 - 7.79 microns	%	3.23	2.07	2.03	2.25	0.79	1.05	0	0	0	0.53
Grain Size Fraction : 7.8 - 15.59 microns	%	4.25	2.27	2.16	2.34	0.61	1.18	0	0	0	0.47
Grain Size Fraction : 15.6 - 31.99 microns	%	2.46	2.28	2.16	2.27	1.34	0.47	0	0	0	0
Grain Size Fraction : < 20 microns	%	10.9	6.57	6.34	6.97	1.95	2.82	0	0	0	1.05
Grain Size Fraction : 32 - 62.9 microns	%	1.75	0.03	0.04	0.03	0.2	1.15	0	0	0	0
Grain Size Fraction : < 63 microns	%	13.8	7.87	7.56	8.25	3.14	4.17	0	0	0	1.05
Grain Size Fraction : 63 to 125 microns	%	12.4	21.7	20.6	22.5	6.01	6.2	4.05	0.09	0.27	0.35
Grain Size Fraction : 125 to 249 microns	%	45	59.3	56.6	59	47.7	44.5	39.2	23.8	23.9	27.2
Grain Size Fraction : 250 to 499 microns	%	22.4	11.2	15.2	10.3	37.4	37	43.7	54.3	51.5	50.6
Grain Size Fraction : 500 to 999 microns	%	1.37	0	0.01	0	5.04	6.84	12.3	15.1	11.6	10.4
Grain Size Fraction : 1000 to 1999 microns	%	0.78	0	0	0	0.69	1.22	0.82	0.36	1.66	0
Grain Size Fraction : 2000 to 3999 microns	%	2.27	0	0	0	0	0.03	0	1	1.32	0.87
Grain Size : 4000 to 7999 microns	%	1.91	0	0	0	0	0	0	0.85	3.84	2.09
Grain Size Fraction : > 8000 microns	%	0.06	0	0	0	0	0	0	4.6	5.05	7.44
Grain Size : 8000 to 15999 microns	%	0.06	0	0	0	0	0	0	1.63	5.05	0
Grain Size Fraction : 16000 - 31999 microns	%	0	0	0	0	0	0	0	0	0	7.44
Grain Size Fraction : 32000 - 62999 microns	%	0	0	0	0	0	0	0	2.97	0	0
Grain Size Fraction : > 63000 microns	%	0	0	0	0	0	0	0	0	0	0
Grain Size Inclusive Kurtosis	mm	0.168	0.206	0.228	0.196	0.486	0.401	0.511	0.178	0.189	0.243
Grain Size Inclusive Mean	mm	0.172	0.154	0.159	0.152	0.232	0.24	0.277	0.351	0.358	0.337
Inclusive Graphic Skewness :- {SKI}	Unitless	-0.22	-0.33	-0.32	-0.34	0.02	-0.01	0.07	0.34	0.35	0.31
Kurtosis	Unitless	34.3	0.55	0.54	0.52	17.5	14.3	4.57	19.4	8.27	13.9

Analyte	Units	T5C	C5A	C5B	C5C	T3A	T3B	T3C	C2A	C2B	C2C
Particle Diameter : Mean	mm	0.352	0.161	0.17	0.158	0.263	0.279	0.319	0.824	1.13	0.918
Particle Diameter : Median	mm	0.183	0.157	0.162	0.154	0.231	0.235	0.273	0.345	0.349	0.329
Sorting Coefficient	Unitless	1.56	0.97	1	0.99	0.68	0.81	0.73	1.18	1.22	1.11
Carbon, Organic : Dry Wt as C	%	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

Analyte	Units	46	23	108	49	14	50	97	83	51	68	69	12
Grain Size Fraction : <3.9 microns	%	0.9	0.19	0	0.18	0.95	0	0	0	0.57	0	0	1.01
Grain Size Fraction : 3.9 - 7.79 microns	%	1.79	0.84	0	0.8	1.95	0	0	0	1.3	0	0	1.83
Grain Size Fraction : 7.8 - 15.59 microns	%	1.9	0.72	0	0.61	1.98	0	0	0	1.11	0	0	1.69
Grain Size Fraction : 15.6 - 31.99 microns	%	1.09	0.8	0	0.74	1.52	0	0	0	1.46	0	0	2.29
Grain Size Fraction : < 20 microns	%	5.1	1.98	0	1.78	5.45	0	0	0	2.83	0	0	5.36
Grain Size Fraction : 32 - 62.9 microns	%	1.11	0.57	0	0.7	0.94	0	0	0	0.39	0	0	0.05
Grain Size Fraction : < 63 microns	%	6.8	3.12	0	3.03	7.35	0	0	0	4.84	0	0	6.87
Grain Size Fraction : 63 to 125 microns	%	9.34	1.23	5.75	2.12	1.93	1.65	1.89	0.49	4.52	0.26	0	13.6
Grain Size Fraction : 125 to 249 microns	%	51.5	30.7	41.3	36.4	33.7	35.4	9.9	25.9	43.5	19.9	18.7	67.1
Grain Size Fraction : 250 to 499 microns	%	28.2	49.5	35.2	47.2	45.7	49.4	19.9	52.4	42	47.1	64.6	12.5
Grain Size Fraction : 500 to 999 microns	%	2.08	15.2	8.46	11	11.3	13.2	18.4	16.5	5.17	24.3	15.1	0
Grain Size Fraction : 1000 to 1999 microns	%	2.04	0.25	2.88	0.31	0.07	0.35	9.33	0.33	0	1.47	1.59	0
Grain Size Fraction : 2000 to 3999 microns	%	0.16	0	2.25	0	0	0	15.3	4.38	0	2.29	0	0
Grain Size : 4000 to 7999 microns	%	0	0	1.87	0	0	0	15.5	0.14	0	1.26	0	0
Grain Size Fraction : > 8000 microns	%	0	0	1.41	0	0	0	8.27	0	0	3.46	0	0
Grain Size : 8000 to 15999 microns	%	0	0	1.41	0	0	0	8.27	0	0	1.08	0	0
Grain Size Fraction : 16000 - 31999 microns	%	0	0	0	0	0	0	0	0	0	2.38	0	0
Grain Size Fraction : 32000 - 62999 microns	%	0	0	0	0	0	0	0	0	0	0	0	0
Grain Size Fraction : > 63000 microns	%	0	0	0	0	0	0	0	0	0	0	0	0
Grain Size Inclusive Kurtosis	mm	0.218	0.507	0.293	0.507	0.237	0.514	0.607	0.47	0.463	0.261	0.438	0.193
Grain Size Inclusive Mean	mm	0.202	0.304	0.285	0.279	0.272	0.295	1.26	0.342	0.24	0.398	0.346	0.167
Inclusive Graphic Skewness :- {SKI}	Unitless	-0.26	-0.03	0.36	-0.01	-0.3	0.06	0.16	0.09	-0.09	0.31	0.16	-0.34
Kurtosis	Unitless	26.5	1.5	22.8	3.06	1.1	2.74	0.33	22.6	1.03	20.4	3.67	0.62

Analyte	**Units**	**46**	**23**	**108**	**49**	**14**	**50**	**97**	**83**	**51**	**68**	**69**	**12**
Particle Diameter : Mean	mm	0.245	0.336	0.699	0.31	0.299	0.331	2.63	0.461	0.261	0.826	0.386	0.172
Particle Diameter : Median	mm	0.205	0.304	0.26	0.278	0.275	0.292	0.993	0.338	0.242	0.389	0.337	0.17
Sorting Coefficient	Unitless	1.05	0.71	1.12	0.7	1.17	0.66	1.98	0.73	0.71	1.18	0.57	0.87
Carbon, Organic : Dry Wt as C	%	<0.4	<0.4	0.45	<0.4	<0.4	<0.4	0.52	<0.4	<0.4	<0.4	<0.4	<0.4

Analyte	Units	C4A	C4B	C4C	T4A	T4B	T4C	56	47	82	13	34	57
Grain Size Fraction : <3.9 microns	%	0.6	0.72	0	0.75	0.74	0.14	1.12	0	0	0.14	0	0
Grain Size Fraction : 3.9 - 7.79 microns	%	1.41	1.39	0	1.54	1.48	0.52	2.09	0	0	0.67	0	0.21
Grain Size Fraction : 7.8 - 15.59 microns	%	1.67	1.52	0	1.37	1.29	0.12	2.26	0	0	0.55	0	0.16
Grain Size Fraction : 15.6 - 31.99 microns	%	0.66	0.96	0	2.04	1.94	0	1.97	0	0	0.77	0	0
Grain Size Fraction : < 20 microns	%	4.08	4.07	0	4.3	4.11	0.77	6.16	0	0	1.55	0	0.37
Grain Size Fraction : 32 - 62.9 microns	%	1.48	1.11	0	0.19	0.2	0	0.72	0	0	0.58	0	0
Grain Size Fraction : < 63 microns	%	5.83	5.71	0	5.89	5.66	0.77	8.15	0	0	2.72	0	0.38
Grain Size Fraction : 63 to 125 microns	%	8.25	10.2	9.27	8.97	8.55	10.4	4.33	0.68	0.66	1.06	0	1.36
Grain Size Fraction : 125 to 249 microns	%	56.9	54	50.1	59.8	58.9	57.3	29.3	38.6	27.2	31	22.6	26.6
Grain Size Fraction : 250 to 499 microns	%	28.3	27.2	32.7	25.2	26.6	28.5	34.2	54.6	49.9	52	67.7	36.7
Grain Size Fraction : 500 to 999 microns	%	0.72	1.3	5.81	0.13	0.3	1.08	10.8	0.11	19	13.2	9.37	10.6
Grain Size Fraction : 1000 to 1999 microns	%	0	1.48	2.16	0	0	2.02	0.39	0	0.42	0	0.36	1.38
Grain Size Fraction : 2000 to 3999 microns	%	0	0.13	0	0	0	0	0.79	1.17	0	0	0	2.94
Grain Size : 4000 to 7999 microns	%	0	0	0	0	0	0	0.53	4.97	2.1	0	0	3.34
Grain Size Fraction : > 8000 microns	%	0	0	0	0	0	0	11.4	0	0.71	0	0	16.7
Grain Size : 8000 to 15999 microns	%	0	0	0	0	0	0	0	0	0.71	0	0	3.74
Grain Size Fraction : 16000 - 31999 microns	%	0	0	0	0	0	0	11.4	0	0	0	0	0
Grain Size Fraction : 32000 - 62999 microns	%	0	0	0	0	0	0	0	0	0	0	0	13
Grain Size Fraction : > 63000 microns	%	0	0	0	0	0	0	0	0	0	0	0	0

Analyte	Units	C4A	C4B	C4C	T4A	T4B	T4C	56	47	82	13	34	57
Grain Size Inclusive Kurtosis	mm	0.337	0.323	0.473	0.245	0.253	0.5	0.148	0.168	0.507	0.511	0.444	0.529
Grain Size Inclusive Mean	mm	0.202	0.199	0.228	0.191	0.195	0.206	0.371	0.275	0.339	0.299	0.319	0.774
Inclusive Graphic Skewness :- {SKI}	Unitless	-0.18	-0.19	0.14	-0.29	-0.28	0.05	0.21	0.29	0.06	-0.04	0.07	0.61
Kurtosis	Unitless	0.93	36	16.1	0.68	0.77	28.7	5.45	37.4	63.6	1	4.88	1.63
Particle Diameter : Mean	mm	0.211	0.232	0.279	0.201	0.205	0.243	1.31	0.45	0.5	0.328	0.35	2.03
Particle Diameter : Median	mm	0.201	0.201	0.222	0.193	0.196	0.204	0.289	0.278	0.336	0.302	0.319	0.364
Sorting Coefficient	Unitless	0.73	0.82	0.73	0.87	0.86	0.6	2.19	0.99	0.73	0.67	0.51	2.16
Carbon, Organic : Dry Wt as C	%	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.49	<0.4	<0.4	<0.4	<0.4	<0.4

Annex 12A.6
Epibenthic Physical Data

Table 12A.7.1 Epibenthic Physical Data

Station	Date	Time shoot	Time haul	Lat shoot	Long shoot	Lat haul	Long haul	Depth shoot	Depth haul	Conditions
11-1	21/05/2012	18:39	18:49	N56.431383	W002.209050	N56.438400	W002.209483	54.72	52.56	Calm
11-2	21/05/2012	18:56	19:06	N56.439233	W002.206417	N56.433467	W002.207017	54	54.36	Calm
21-1	22/05/2012	09:00	09:10	N56.541000	W002.250700	N56.535067	W002.252217	52.74	53.46	Calm
21-2	22/05/2012	09:17	09:27	N56.536817	W002.253850	N56.543550	W002.250633	52.74	53.46	Calm
32-1	22/05/2012	12:19	12:29	N56.483583	W002.211700	N56.477667	W002.205133	50.04	51.84	Calm
32-2	22/05/2012	12:41	12:51	N56.475600	W002.208000	N56.480700	W002.212950	51.48	51.12	Calm
39-1	22/05/2012	13:22	13:32	N56.522067	W002.211867	N56.520983	W002.191500	51.12	51.48	Calm
39-2	22/05/2012	13:44	13:54	N56.527667	W002.211133	N56.517833	W002.211217	51.3	50.04	Calm
51-1	23/05/2012	08:57	09:07	N56.426367	W002.126433	N56.419600	W002.126617	54.18	58.68	Calm
51-2	23/05/2012	09:13	09:23	N56.421100	W002.129317	N56.427783	W002.128017	55.44	51.12	Calm
55-1	23/05/2012	08:04	08:14	N56.448417	W002.149783	N56.447967	W002.162100	50.76	51.12	Calm
55-2	23/05/2012	08:20	08:30	N56.450500	W002.163900	N56.450950	W002.150633	52.38	50.76	Calm
66-1	22/05/2012	11:35	11:45	N56.476133	W002.238783	N56.468950	W002.240283	46.26	47.88	Calm
66-2	22/05/2012	11:52	12:02	N56.468983	W002.243317	N56.475800	W002.240567	47.88	46.98	Calm
78-1	21/05/2012	20:44	20:54	N56.488133	W002.276000	N56.494233	W002.269583	49.14	49.14	Calm
78-2	21/05/2012	21:04	21:14	N56.493833	W002.265733	N56.487900	W002.272133	49.32	48.78	Calm
82-1	23/05/2012	10:34	10:44	N56.459983	W002.054517	N56.467617	W002.050850	56.52	56.52	Calm
82-2	23/05/2012	10:51	11:01	N56.469900	W002.047167	N56.451433	W002.051483	56.52	54	Calm

Station	Date	Time shoot	Time haul	Lat shoot	Long shoot	Lat haul	Long haul	Depth shoot	Depth haul	Conditions
86-1	24/05/2012	07:04	07:14	N56.567300	W002.247217	N56.560650	W002.247150	50.94	49.32	Calm
86-2	24/05/2012	07:24	07:34	N56.557117	W002.247633	N56.563550	W002.245567	51.66	48.96	Calm
91-1	22/05/2012	09:52	10:02	N56.518517	W002.257217	N56.512483	W002.250900	47.88	48.78	Calm
91-2	22/05/2012	10:08	10:18	N56.513000	W002.255067	N56.518367	W002.260990	46.62	48.24	Calm
97-1	23/05/2012	09:52	10:02	N56.449683	W002.100283	N56.457367	W002.096283	49.14	44.64	Calm
97-2	23/05/2012	10:00	10:10	N56.456467	W002.093667	N56.450250	W002.097933	47.16	48.78	Calm
99-1	22/05/2012	10:43	10:53	N56.491817	W002.254167	N56.485383	W002.256517	46.62	46.62	Calm
99-2	22/05/2012	11:05	11:15	N56.486833	W002.260833	N56.493500	W002.254817	45.72	46.44	Calm
105-1	22/05/2012	14:22	14:32	N56.550417	W002.221650	N56.555733	W002.213233	52.56	50.76	Calm
105-2	22/05/2012	14:40	14:50	N56.553617	W002.211133	N56.548383	W002.222417	49.5	53.28	Calm
108-1	23/05/2012	07:11	07:21	N56.478150	W002.130467	N56.471850	W002.136850	64.98	51.48	Calm
108-2	23/05/2012	07:28	07:38	N56.472233	W002.139900	N56.478733	W002.129883	47.52	64.8	Calm
110-1	21/05/2012	19:48	19:58	N56.438150	W002.254733	N56.431717	W002.252067	52.38	53.28	Calm
110-2	21/05/2012	20:05	20:15	N56.433567	W002.255750	N56.440517	W002.254833	50.4	52.56	Calm
113-1	23/05/2012	12:06	12:16	N56.548133	W002.162133	N56.553383	W002.157033	51.48	52.92	Calm
113-2	23/05/2012	12:23	12:33	N56.554350	W002.153733	N56.548017	W002.159500	52.2	51.84	Calm
116-1	24/05/2012	07:55	08:05	N56.583317	W002.219833	N56.589583	W002.219200	53.64	49.5	Calm
116-2	24/05/2012	08:13	08:23	N56.586067	W002.218850	N56.579817	W002.219417	49.5	52.02	Calm
119-1	21/05/2012	21:37	21:47	N56.523383	W002.281633	N56.529850	W002.287733	50.04	55.26	Calm
119-2	21/05/2012	21:53	22:03	N56.531950	W002.284417	N56.526300	W002.279983	55.44	51.84	Calm
124-1	23/05/2012	13:03	13:13	N56.587333	W002.161533	N56.593900	W002.156267	59.4	419.4	Calm
124-2	23/05/2012	13:20	13:30	N56.592950	W002.152900	N56.587000	W002.160083	54.36	51.84	Calm
C1-1	23/05/2012	14:38	14:48	N56.666150	W002.221817	N56.671850	W002.216000	63.72	61.92	Calm

Station	Date	Time shoot	Time haul	Lat shoot	Long shoot	Lat haul	Long haul	Depth shoot	Depth haul	Conditions
C1-2	23/05/2012	14:54	15:04	N56.670183	W002.213417	N56.663400	W002.223150	64.08	67.32	Calm
C1-3	23/05/2012	15:13	15:23	N56.665033	W002.221900	N56.670700	W002.217090	62.64	62.82	Calm
C5-1	21/05/2012	16:14	16:24	N56.339833	W002.218833	N56.345500	W002.211667	57.6	57.6	Calm
C5-2	21/05/2012	16:33	16:43	N56.345167	W002.208333	N56.339500	W002.216500	57.6	57.6	Calm
C5-3	21/05/2012	16:50	17:00	N56.339500	W002.220333	N56.345567	W002.214617	57.6	57.6	Calm
T1-1	24/05/2012	08:44	08:54	N56.608333	W002.221383	N56.602150	W002.222717	65.52	56.34	Calm
T1-2	24/05/2012	09:00	09:10	N56.603383	W002.225367	N56.610300	W002.222867	58.86	63.36	Calm
T1-3	24/05/2012	09:17	09:27	N56.611400	W002.220233	N56.605050	W002.221433	62.28	60.84	Calm
T5-1	21/05/2012	17:25	17:35	N56.379250	W002.218783	N56.384050	W002.225867	56.52	54.9	Calm
T5-2	21/05/2012	17:43	17:53	N56.386283	W002.225017	N56.380833	W002.233000	55.26	56.52	Calm
T5-3	21/05/2012	17:59	18:09	N56.379500	W002.217667	N56.384283	W002.224033	56.34	54.9	Calm

Annex 12A.7 Statistical Outputs

Table 12A.9.1 Eigenvalues and Per Cent Variation Described Across Principal Component Axis

Principal Component Axis	Eigenvalues	% variation	Cumulative variation (%)
1	3.71	61.8	61.8
2	1.24	20.6	82.4
3	0.788	13.1	95.6
4	0.256	4.3	99.9
5	8.54E-03	0.1	100

Table 12A.9.2 SIMPER outputs for faunal groups

Group 1

Average similarity: 39.10

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Galathowenia oculata	2.53	3.39	1.65	8.67	8.67
Amphiura filiformis	2.61	2.96	1.25	7.57	16.24
Chamelea striatula	1.71	2.33	1.39	5.97	22.21
Owenia fusiformis	1.66	2.33	1.45	5.96	28.16
Lumbrineris gracilis	1.89	2.29	1.34	5.84	34.01
Astrorhiza limicola	1.65	1.95	1.04	4.98	38.99
Spiophanes bombyx	1.41	1.74	1.36	4.45	43.44
Diplocirrus glaucus	1.42	1.72	1.21	4.39	47.83
Abra prismatica	1.32	1.63	1.15	4.17	52
Nemertea indet.	1.35	1.61	1.28	4.12	56.12
Thracia phaseolina	1.15	1.16	0.92	2.96	59.08
Pholoe baltica	1.01	1.07	0.95	2.73	61.8
Antalis entalis	0.91	1.03	0.85	2.62	64.43
Edwardsia claparedii	1.06	1.02	0.86	2.61	67.04
Dosinia lupinus	0.95	0.89	0.76	2.28	69.32
Nephtys Sp.	0.82	0.79	0.74	2.03	71.35
Echinocyamus pusillus	0.83	0.74	0.7	1.89	73.24
Anobothrus gracilis	0.78	0.65	0.61	1.65	74.89
Mysella bidentata	0.95	0.62	0.53	1.58	76.47
Scoloplos armiger	0.66	0.57	0.59	1.45	77.91
Harpinia antennaria	0.69	0.47	0.5	1.2	79.11
Minuspio cirrifera	0.63	0.43	0.49	1.11	80.22
Eugyra arenosa	0.53	0.37	0.44	0.94	81.15
Echinocardium sp.	0.54	0.36	0.47	0.93	82.09
Chaetozone christiei	0.51	0.35	0.45	0.89	82.98
Glycinde nordmanni	0.48	0.34	0.43	0.87	83.84
Arctica islandica	0.5	0.33	0.4	0.84	84.68
Paradoneis lyra	0.56	0.32	0.42	0.81	85.5
Nuculoma tenuis	0.49	0.31	0.4	0.79	86.29
Phoronis muelleri	0.48	0.3	0.39	0.76	87.05
Corymorpha nutans	0.69	0.29	0.35	0.75	87.8
Phaxas pellucidus	0.47	0.28	0.41	0.72	88.52
Nucula nitidosa	0.44	0.26	0.36	0.67	89.19
Ophiura albida	0.42	0.25	0.38	0.64	89.84
Gari fervensis	0.38	0.21	0.32	0.55	90.38

Group 2
Average similarity: 37.56

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sabellaria spinulosa	6.98	6.14	1.37	16.34	16.34
Lumbrineris gracilis	2.8	3.48	1.83	9.27	25.61
Astrorhiza limicola	1.56	2.05	1.93	5.47	31.07
Nemertea indet.	1.43	1.9	1.43	5.07	36.14
Galathowenia oculata	1.31	1.78	1.37	4.74	40.88
Eumida sp.	1.6	1.69	1.48	4.49	45.37
Prionospio banyulensis	1.43	1.57	1.47	4.17	49.55
Owenia fusiformis	1.1	1.4	1.12	3.72	53.26
Minuspio cirrifera	1.13	1.22	1.15	3.24	56.5
Diplocirrus glaucus	1.01	1.16	1.15	3.09	59.59
Ophiura albida	1.05	1.1	0.93	2.94	62.53
Glycera Sp.	1.11	1.1	0.9	2.92	65.44
Anobothrus gracilis	1.01	1.04	0.9	2.77	68.21
Ampharete Sp.	0.94	0.73	0.75	1.94	70.15
Glycinde nordmanni	0.7	0.69	0.79	1.85	72
Hydroides norvegica	0.88	0.53	0.51	1.42	73.41
Pholoe baltica	0.94	0.51	0.51	1.36	74.77
Pholoe inornata	0.73	0.5	0.54	1.32	76.09
Mediomastus fragilis	0.6	0.46	0.53	1.22	77.32
Polycirrus Sp.	0.61	0.43	0.54	1.14	78.46
Serpula vermicularis	0.74	0.4	0.42	1.06	79.52
Spiophanes bombyx	0.56	0.37	0.41	0.98	80.49
Leptochitona asellus	0.73	0.33	0.42	0.87	81.37
Notomastus latericeus	0.64	0.32	0.43	0.84	82.21
Exogone naidina	0.57	0.28	0.44	0.75	82.96
Amphipholis squamata	0.61	0.28	0.43	0.75	83.71
Sphaerosyllis taylori	0.53	0.26	0.44	0.68	84.4
Edwardsia claparedii	0.47	0.26	0.34	0.68	85.08
Hiatella arctica	0.51	0.25	0.44	0.67	85.76
Spiophanes kroyeri	0.51	0.25	0.44	0.66	86.42
Gnathia oxyuraea	0.57	0.24	0.33	0.64	87.06
Diastylis laevis	0.47	0.23	0.34	0.62	87.68
Tharyx killariensis	0.41	0.23	0.34	0.61	88.29
Trichobranchus glacialis	0.49	0.23	0.34	0.6	88.89
Ampelisca tenuicornis	0.39	0.21	0.35	0.56	89.45
Ophiothrix fragilis	0.36	0.18	0.34	0.49	89.94
Laonice bahusiensis	0.36	0.18	0.34	0.48	90.42

Group 3

Average similarity: 34.31

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Owenia fusiformis	1.8	4.6	2.43	13.4	13.4
Moerella pygmaea	1.43	3.2	1.45	9.32	22.72
Dosinia lupinus	1.35	2.4	1.1	7	29.71
Abra prismatica	1.39	2.29	1.17	6.67	36.39
Galathowenia oculata	1.52	1.79	0.89	5.21	41.6
Crenella decussata	1.39	1.74	0.63	5.08	46.68
Goodalia triangularis	1.18	1.73	0.84	5.04	51.72
Pseudomystides limbata	1	1.48	0.88	4.32	56.04
Ophelia borealis	1.06	1.46	0.84	4.26	60.3
Nothria britannica	0.97	1.35	0.88	3.93	64.23
Eugyra arenosa	0.89	1.3	0.86	3.78	68.01
Astrorhiza limicola	0.75	1.13	0.65	3.28	71.29
Chaetozone christiei	0.68	1.09	0.64	3.16	74.45
Clymenura johnstoni	0.68	1.03	0.68	3.01	77.47
Spiophanes bombyx	0.8	0.85	0.67	2.49	79.96
Lumbrineris gracilis	0.58	0.74	0.49	2.17	82.12
Arctica islandica	0.57	0.62	0.51	1.8	83.92
Lepidepecreum longicorne	0.5	0.56	0.51	1.64	85.57
Nephtys Sp.	0.58	0.51	0.37	1.49	87.06
Nemertea indet.	0.74	0.49	0.52	1.44	88.5
Glycera Sp.	0.54	0.35	0.38	1.01	89.51
Polycirrus Sp.	0.44	0.28	0.38	0.83	90.34

Annex 12A.8 Biotope Descriptions

SS.SSa - Sublittoral sands and muddy sands

Clean medium to fine sands or non-cohesive slightly muddy sands on open coasts, offshore or in estuaries and marine inlets. Such habitats are often subject to a degree of wave action or tidal currents which restrict the silt and clay content to less than 15 per cent. This habitat is characterised by a range of taxa including polychaetes, bivalve molluscs and amphipod crustacea.

SS.SCS.CCS - Circalittoral coarse sediment

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. Certain species of sea cucumber (e.g. *Neopentadactyla*) may also be prevalent in these areas along with the lancelet *Branchiostoma lanceolatum*.

SS.SCS.CCS.PomB - *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles

This biotope is characterised by a few ubiquitous robust and/or fast growing ephemeral species which are able to colonise pebbles and unstable cobbles and slates which are regularly moved by wave and tidal action. The main cover organisms tend to be restricted to calcareous tube worms such as *Pomatoceros triqueter (*or *P. lamarcki),* small barnacles including *Balanus crenatus* and *Balanus balanus*, and a few bryozoan and coralline algal crusts. Scour action from the mobile substratum prevents colonisation by more delicate species. Occasionally in tide-swept conditions tufts of hydroids such as *Sertularia argentea* and *Hydrallmania falcata* are present. This biotope often grades into SMX.FluHyd which is characterised by large amounts of the above hydroids on stones also covered in *Pomatoceros* and barnacles. The main difference here is that SMX.FluHyd, seems to develop on more stable, consolidated cobbles and pebbles or larger stones set in sediment in moderate tides. These stones may be disturbed in the winter and therefore long-lived and fragile species are not found.

SS.SCS.CCS.MedLumVen - *Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel

Circalittoral gravels, coarse to medium sands, and shell gravels, sometimes with a small amount of silt and generally in relatively deep water (generally over 15-20 m), may be characterised by polychaetes such as *Mediomastus fragilis*, *Lumbrineris* spp., *Glycera lapidum* with the pea urchin *Echinocyamus pusillus*. Other taxa may include Nemertea spp., *Protodorvillea kefersteini, Owenia fusiformis, Spiophanes bombyx* and *Amphipholis squamata* along with amphipods such as *Ampelisca spinipes*. This biotope may also be characterised by the presence of conspicuous venerid bivalves, particularly *Timoclea ovata*. Other robust bivalve species such as *Moerella* spp., *Glycymeris glycymeris* and *Astarte sulcata* may also be found in this biotope. *Spatangus purpureus* may be present especially where the interstices of the gravel are filled by finer particles, in which case, *Gari tellinella* may also be prevalent (Glemarec 1973). Venerid bivalves are often under-sampled in benthic grab surveys and as such may not be conspicuous in many infaunal datasets. Such communities in gravelly sediments may be relatively species-rich and they may also contain epifauna such as *Hydroides norvegicus* and *Pomatoceros lamarcki*. In sand wave areas this biotope may also contain elements of the FfabMag biotope, particularly *Magelona* species. This biotope has previously been described as the 'Deep *Venus* Community' and the 'Boreal Off-Shore Gravel Association' by other workers (Ford 1923; Jones 1950) and may also be part of the Venus community described by Thorson (1957) and in the infralittoral etage described by Glemarec (1973). SCS.MedLumVen may be quite variable over time and in fact may be closer to a biotope complex in which a number of biotopes or sub-biotopes may yet be defined. For example, Ford (1923) describes a 'Series A' and a 'Series B' characterised by *Echinocardium cordatum-Chamelea gallina* and *Spatangus purpurea-Clausinella fasciata*. Furthermore, mosaics of cobble and lag gravel often contain ridges of coarse gravelly sand and these localised patches are also characterised by robust veneriid and similar bivalves including *Arcopagia crassa*, *Laevicardium crassum* and others including *Glycymeris glycymeris* (E.I.S. Rees pers. comm.. 2002). This high porosity fine gravel or coarse sand may be a separate biotope.

SS.SCS.OCS - Offshore circalittoral coarse sediment

Offshore (deep) circalittoral habitats with coarse sands and gravel or shell. This habitat may cover large areas of the offshore continental shelf although there is relatively little quantitative data available. Such habitats are quite diverse compared to shallower versions of this habitat and generally characterised by robust infaunal polychaete and bivalve species. Animal communities in this habitat are closely related to offshore mixed sediments and in some areas settlement of *Modiolus modiolus* larvae may occur and consequently these habitats may occasionally have large numbers of juvenile *M. Modiolus*. In areas where the mussels reach maturity their byssus threads bind the sediment together, increasing stability and allowing an increased deposition of silt leading to the development of the biotope SBR.ModMx.

SS.SMx.CMx - Circalittoral mixed sediment

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 mud, sand or gravel. Due to the variable nature of the seabed a variety of communities can develop which are often very diverse. A wide range of infaunal polychaetes, bivalves, echinoderms and burrowing anemones such as Cerianthus lloydii are often present in such habitat and the presence of hard substrata (shells and stones) on the surface enables epifaunal species to become established, particularly hydroids such as *Nemertesia* spp and *Hydrallmania falcata*. The combination of epifauna and infauna can lead to species rich communities. Coarser mixed sediment communities may show a strong resemblance, in terms of infauna, to biotopes within the SCS complex. However, infaunal data for this biotope complex is limited to that described under the biotope MysThyMx, and so are not representative of the infaunal component of this biotope complex.

SS.SMx.CMx.OphMx - *Ophiothrix fragilis* brittlestar beds on sublittoral mixed sediment

Circalittoral sediment dominated by brittlestars (hundreds or thousands m^{-2}) forming dense beds, living epifaunally on boulder, gravel or sedimentary substrata. *Ophiothrix fragilis* and *Ophiocomina nigra* are the main bed-forming species, with rare examples formed by *Ophiopholis aculeate*. Brittlestar beds vary in size, with the largest extending over hundreds of square metres of sea floor and containing millions of individuals. They usually have a patchy internal structure, with localised concentrations of higher animal density. *Ophiothrix fragilis* or *Ophiocomina nigra* may dominate separately or there may be mixed populations of the two species. *Ophiothrix* beds may consist of large adults and tiny, newly-settled juveniles, with animals of intermediate size living in nearby rock habitats or among sessile epifauna. Unlike brittlestar beds on rock, the sediment based beds may contain a rich associated epifauna (Warner, 1971; Allain, 1974; Davoult & Gounin, 1995). Large suspension feeders such as the octocoral *Alcyonium digitatum*, the anemone *Metridium senile* and the hydroid *Nemertesia antennina* are present mainly on rock outcrops or boulders protruding above the brittlestar-covered substratum. The large anemone *Urticina feline* may be quite common. This species lives half-buried in the substratum but is not smothered by the brittlestars, usually being surrounded by a 'halo' of clear space (Brun, 1969; Warner, 1971). Large mobile animals commonly found on Ophiothrix beds include the starfish *Asterias rubens*, *Crossaster papposus* and *Luidia ciliaris*, the urchins *Echinus esculentus* and *Psammechinus miliaris*, edible crabs *Cancer pagurus*, swimming crabs *Necora puber*, *Liocarcinus* spp., and hermit crabs *Pagurus bernhardus*. The underlying sediments also contain a diverse infauna including the bivalve *Abra alba*. Warner (1971) found that numbers and biomass of sediment dwelling animals were not significantly reduced under dense brittlestar patches.

SS.SMx.CMx.MysThyMx - *Mysella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment

In moderately exposed or sheltered, circalittoral muddy sands and gravels a community characterised by the bivalves *Thyasira* spp. (often *Thyasira flexuosa*), *Mysella bidentata* and *Prionospio fallax* may develop. Infaunal polychaetes such as *Lumbrineris gracilis*, *Chaetozone setosa* and *Scoloplos armiger* are also common in this community whilst amphipods such as *Ampelisca* spp. and the cumacean *Eudorella truncatula* may also be found in some areas. The brittlestar *Amphiura filiformis* may also be abundant at some sites. Conspicuous epifauna may include encrusting bryozoans *Escharella* spp. particularly *Escharella immersa* and, in shallower waters, maerl (*Phymatolithon calcareum*), although at very low abundances and not forming maerl beds.

CR.HCR.Xfa - Mixed faunal turf communities

This biotope complex occurs on wave-exposed circalittoral bedrock and boulders, subject to tidal streams ranging from strong to moderately strong. This complex is characterised by its diverse range of hydroids (*Halecium halecinum*, *Nemertesia antennina* and *Nemertesia ramosa*), bryozoans (*Alcyonidium diaphanum*, *Flustra foliacea*, *Bugula flabellata* and *Bugula plumosa*) and sponges (*Scypha ciliata*, *Pachymatisma johnstonia*, *Cliona celeta*, *Raspailia ramosa*, *Esperiopsis fucorum*, *Hemimycale columella* and *Dysidea fragilis*) forming an often dense, mixed faunal turf. Other species found within this complex are *Alcyonium digitatum*, *Urticina felina*, *Sagartia elegans*, *Actinothoe sphyrodeta*, *Caryophyllia smithii*, *Pomatoceros triqueter*, *Balanus crenatus*, *Cancer pagurus*, *Necora puber*, *Asterias rubens*, *Echinus esculentus* and *Clavelina lepadiformis*. Nine biotopes have been identified within this complex: ByErSp, FluCoAs, FluHocu, CvirCri, SwiLgAs, Mol, SubCriTf, SpNemAdia and SpAnVt