Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Annex 5-2: Benthic Characterisation Report

June, 2018, Revision A

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Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Annex 5-2: Benthic Characterisation Report

June, 2018

Drafted By:	Fugro
Approved By:	Helen Jameson
Date of Approval	June 2018
Revision	A

Fugro Group

Environmental Investigation Report
Thanet Extension Offshore Wind Farm
Benthic Characterisation Report
UK Continental Shelf, North Sea

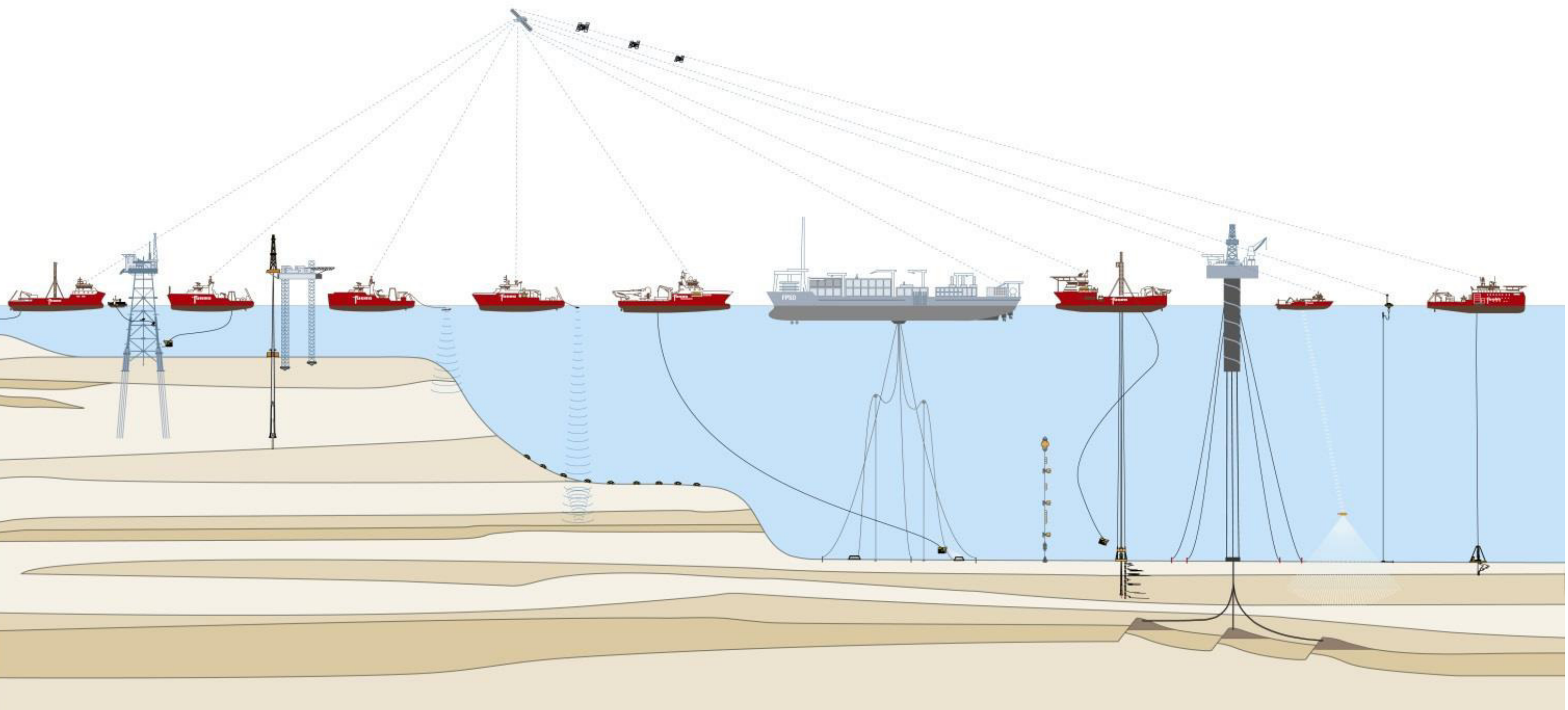
Fugro Document No.: 160975.2 (02)

Fugro (FSBV) Report No.: GE051-R3

07 April 2017

Report 3 of 3

Vattenfall Wind Power Ltd



Environmental Investigation Report
Thanet Extension Offshore Wind Farm
Benthic Characterisation Report
UK Continental Shelf, North Sea

30 October to 10 November 2016
Fugro Project No.: 160975.2 (02)

Report 3 of 3

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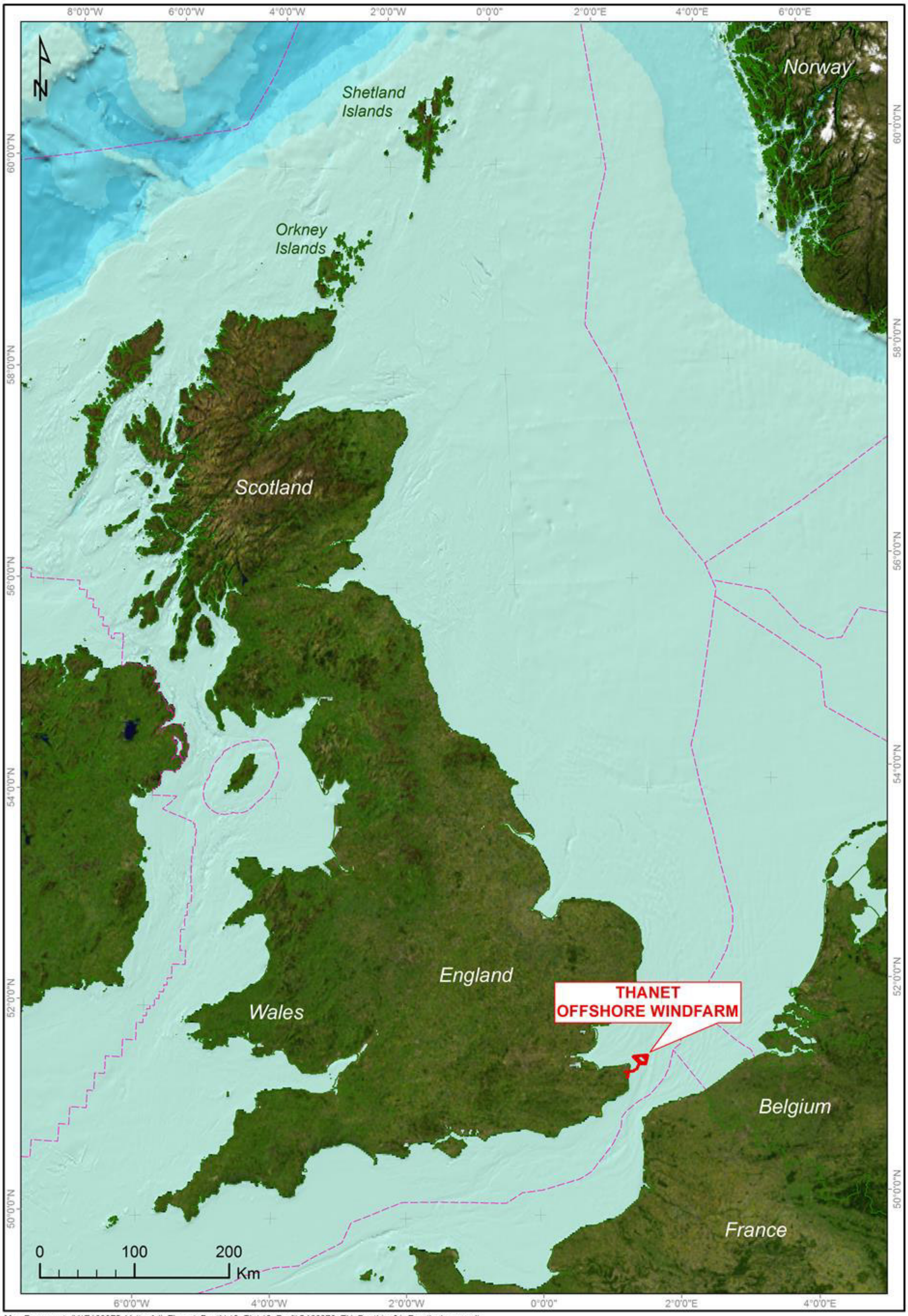
REPORT AMENDMENT SHEET

Issue No.	Report section	Page No.	Table No.	Figure No.	Description
02	All	All			And headers updated and consistent
02	1.3	2		Figure 1.1	Title updated to Thanet Extension
02	5.2.1	34			Updated cross-reference to Section 4.6.2
02	5.4.2	59	Table 5.11		Italicisation of non-genus and non-species names removed
02	5.4.3	62			Cross-references for Table 5.12 and Figure 5.25 updated to correct formatting problem.
02	5.4.4	69			Page 69, Paragraph 5, Line 1 wording changed to "*The two subgroups within group A differed due to the coarseness…*"
02	5.5.2	74	Table 5.15		All genus and species names italicised
02	5.5.2	75			Duplication of 'within group' deleted
02	6.1	81			All genus and species names in Paragraph 2 italicised
02	6.2.4	84			'*N. cirrosa*' italicised in Paragraph 2
02	6.2.5	86/87	Table 6.1		All genus and species names italicised

KEYPLAN



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EXECUTIVE SUMMARY

Fugro was commissioned to undertake the geophysical and benthic ecology characterisation surveys within and around the proposed Thanet Extension Offshore Wind Farm development area. The environmental survey was required to assess the benthic communities and potential Annex I habitats using drop down video and grab samples of fauna, PSD and contaminants. The geophysical and subsequent grab sampling survey, required to inform the Environmental Impact Assessment (EIA) for Thanet Extension, was undertaken in autumn 2016.

Analysis of the video footage was limited to qualitative assessment due to poor underwater visibility at the time of the survey. Where visible, results showed the presence of two major habitats within the Thanet offshore windfarm survey area, one featuring predominantly sandy sediments, characteristic of the offshore stations, and one featuring highly heterogeneous seabed sediment, comprising a mix of coarse sand and gravel, including pebbles, cobbles and boulders, and characteristic of the inshore stations.

The epibiotic communities reflected the sediment complexity, with the offshore sandier sediments hosting lower faunal diversity represented mainly, echinoderms, crustaceans and molluscs, with sessile epifauna being absent or scarce and represented mainly by low-lying bryozoans.

Stations featuring coarser sediments generally comprised more epibenthic community which included a variety of sessile epifauna.

Of the two stations assessed in relation to *Sabellaria spinulosa* reefs, only one, WF28, showed low resemblance to reef structures, whereas station WF46 showed no resemblance and was therefore classified as not reef.

Subtidal chalk was recorded at station WF36, in the form of flat bedrock overlain by sand.

Results of the grab samples analysis showed a mixed range of sediment types from moderately well sorted sands to very poorly sorted muddy sandy gravel.

In general, the seabed sediments across the survey area were highly heterogeneous, however, an overall pattern of sediment distribution was identified, with coarser sediments characterising sites to the south-west of the proposed wind farm area extension and parts of the cable route.

No pattern of spatial distribution between organic content and particle sediment size was identified, with the results of the correlation analysis showing only a moderate correlation with percentage of mud.

Results of the biological analyses indicated the presence of moderately rich and diverse invertebrate benthic communities, the occurrence and distribution of which was broadly associated with the sediment type. Two major communities were identified, which differed based on the seabed sediment characteristics: one featuring highly heterogeneous sediment and hosting relatively high faunal diversity and abundance including epibiotic organisms; the other featuring sandier sediment and hosting low taxa and abundance represented predominantly by infaunal organisms.

The habitats and associated epibenthic communities recorded by the video footage, and following analysis of the grab samples, were classified to biotopes where possible and/or to habitat/biotope complex, in line with the JNCC and the EUNIS classification systems. These were subsequently assessed in terms of ecological and conservation importance, drawing from current marine nature legislation.

No species of conservation importance were recorded. The slipper limpet *Crepidula fornicata* was the only non-native species found.

DOCUMENT ARRANGEMENT

REPORT 1: GEOPHYSICAL INVESTIGATION REPORT

VOLUME 1: OPERATIONS & CALIBRATIONS

VOLUME 2: GEOPHYSICAL SITE SURVEY

VOLUME 3: GEOPHYSICAL ROUTE SURVEY

REPORT 2: GEOTECHNICAL INVESTIGATION REPORT

REPORT 3: ENVIRONMENTAL INVESTIGATION REPORT

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ANNEXES

TABLES IN THE MAIN TEXT

FIGURES IN THE MAIN TEXT

ABBREVIATIONS

AFDW	Ash-Free Dry Weight
Al	Aluminium
AL	Action Level
As	Arsenic
BAP	Biodiversity Action Plan
BSH	Broad Scale Habitat
CCME	Canadian Council of Ministers of the Environment
Cd	Cadmium
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
Cr	Chromium
CR	Cable Route
Cu	Copper
DDV	Drop Down Video
DVD	Digital Versatile Disk
DEFRA	Department for Environment Food & Rural Affairs
dGPS	differential Geo Positioning System
EcoQOs	Ecological Quality Objectives
EC	European Community
EMODnet	European Marine Observation Data network
EIA	Environmental Impact Assessment
ENG	Ecological Network Guidance
ERL	Effects Range - Low
ERM	Effects Range - Medium
EUNIS	European Nature Information System
FOCI	Feature of Conservation Interest
GC – MS	Gas Chromatography - Mass Spectrometry
HC	Hydrocarbons
HDD	Hard Disk Drive
Hg	Mercury
HM	Heavy Metals
HPI	Habitat of Priority Importance
HOCI	Habitat of Conservation Importance
IDA	Industrial Denatured Alcohol
ISQGs	Interim Sediment Quality Guidelines
JNCC	Joint Nature Conservation Committee
LSE	Likely Significant Effect
MCZ	Marine Conservation Zone
MDS	Multi-Dimensional Scaling
MNCR	Marine Nature Conservation Review
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
N	Number of Individuals
NEKEMS	North-east Kent European Marine Site

Ni	Nickel
NMBAQC	National Marine Biological Analytical Quality Control
OSPAR	Oslo/Paris Conventions
P	Present
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PCA	Principal Component Analysis
PCB	Poly-Chlorinated Biphenyls
PEL	Probable Effects Levels
PSD	Particle Size Determination
PSD	Particle Size Distribution
QC	Quality Control
rMCZ	Recommended Marine Conservation Zone
S	Number of Taxa
SAC	Special Area of Conservation
SCI	Site of Community Importance
SIMPER	Similarity Percentage
SIMPROF	Similarity Profile
Sn	Tin
SPA	Special Protected Area
TBT	Tributyltin
TEL	Threshold Effects Levels
TEOWF	Thanet Extension Offshore Wind Farm
TOWF	Thanet Offshore Wind Farm
TOM	Total Organic Matter
UKAS	United Kingdom Accreditation Service
USEPA	United State Environmental Protection Agency
Z	Zinc

1. INTRODUCTION

1.1 Study Background

The Thanet Offshore Wind Farm (TOWF) is one of fifteen Round 2 projects, announced by the Crown Estate in January 2004, and the world's third largest offshore wind farm with a maximum output of 300 mega-watts (MW). The project covers an area of 35 km^2 with 500 m between turbines and 800 m between the rows. The submarine cables run from an offshore substation within the wind farm connecting to an existing onshore substation in Richborough, Kent. Thanet OWF project was acquired by Vattenfall in November 2008 and was officially opened in September 2010.

In June 2010, the Crown Estate announced that Thanet OWF could be extended to produce an additional 147 MW. The Thanet extension offshore wind farm (TEOWF) is to be developed within an area of approximately 80 km^2 surrounding the existing TOWF. The location of the site is shown in Figure 1.1.

1.2 Aims of the Study

As part of the Environmental Impact Assessment (EIA) required for the consent application for permission to develop the TEOWF, geophysical and benthic ecology characterisation surveys of the proposed extension area are required, in order to provide information on the existing environment at the proposed site and surrounding areas, with particular emphasis on features of conservation importance.

Fugro was commissioned to undertake the geophysical and benthic ecology characterisation surveys within and around the proposed TEOWF development area.

This report focusses on the benthic ecology survey, the aims of which were fulfilled through acquisition of seabed sediment samples by means of grab sampling and through acquisition of seabed video footage by means of drop-down video camera. Seabed sediment samples were subsequently analysed with respect to physico-chemical and biological characteristics. Underwater video footage allowed investigating the different habitat types present within the survey area and identifying habitats of potential conservation importance.

The habitats and associated biological communities were subsequently classified in terms of biotopes, in line with current Marine Habitat Classification for Britain and Ireland (Connor et al., 2004) and the corresponding European Nature Information System (EUNIS) classification. A biotope is defined as the combination of an abiotic habitat and its associated community of species which can be defined at a variety of scales (with related corresponding degrees of similarity) and is a regularly occurring association, hence its inclusion within the classification system (Connor et al., 2004). Once identified, the biotopes can be assessed in relation to their ecological and conservation importance, drawing upon current guidelines.

1.3 Regional Context

The Thanet OWF is located 11 km off Foreness Point on the coast of Thanet district in Kent, UK, within the southern North Sea.

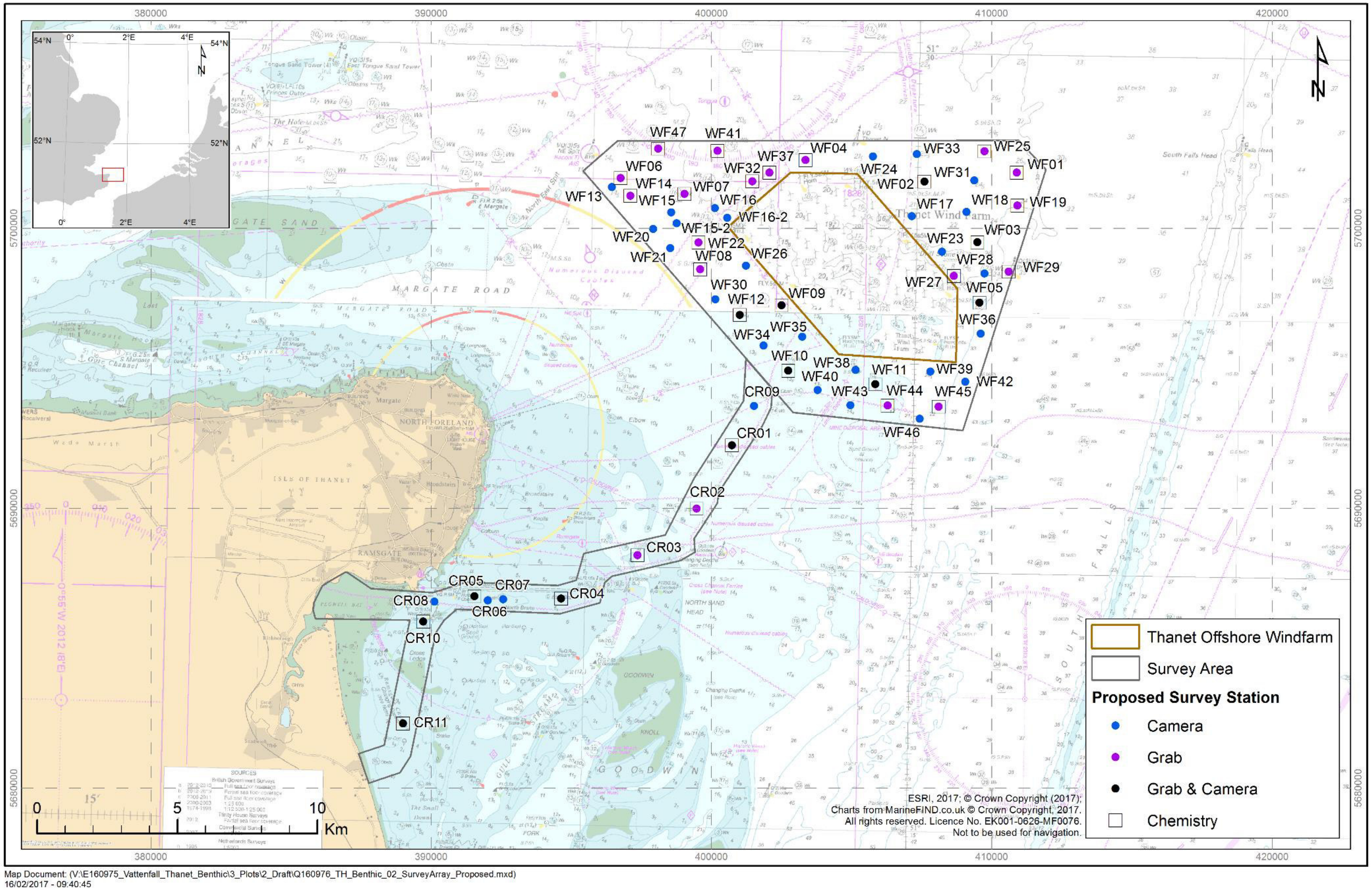

Figure 1.1 Thanet Extension Offshore Windfarm Survey Area

1.3.1 Benthic environment

The seabed habitats known to occur within the study area, based on the European Marine Observation Data network (EMODnet) online data, are illustrated in Figure 1.2 and Figure 1.3.

Softer sedimentary habitats (sandy muds, muddy sands and fine sands) occur primarily in the north and the east section of the windfarm area, whereas infralittoral and circalittoral mixed sediments are present to the west of the windfarm area, together with patches of *Sabellaria spinulosa* reefs. Mixed reef habitats of biogenic and/or geogenic nature (*S. spinulosa* and/or chalk reefs) are reported to occur in the south west of the windfarm area and along the cable route, particularly the nearshore section (Figure 1.4).

Coarser sediments and potential reef habitats are likely to occur in much of the remaining area, primarily in the central and southern parts of the survey area and along sections of the cable route, and to a lesser extent within the north-western part of the survey area. There is little likelihood of Annex 1 sandbank features occurring in the survey area based on the most recent JNCC data and the lack of sandy features raised from the surrounding seabed identified throughout the existing wind farm survey programme (CMACS, 2016).

1.4 Nature Conservation

The study area is located offshore north-east Kent coast, which supports a diverse range of flora and fauna including protected habitats and species. Some of these habitats and species are located within designated conservation areas. These areas can be designated at a national or international level to protect habitats and species of particular importance.

Although the development area is not located within any designated sites, there are six internationally designated sites between the coastline and the windfarm, with a section of the cable route partially overlapping designated areas (Figure 1.5).

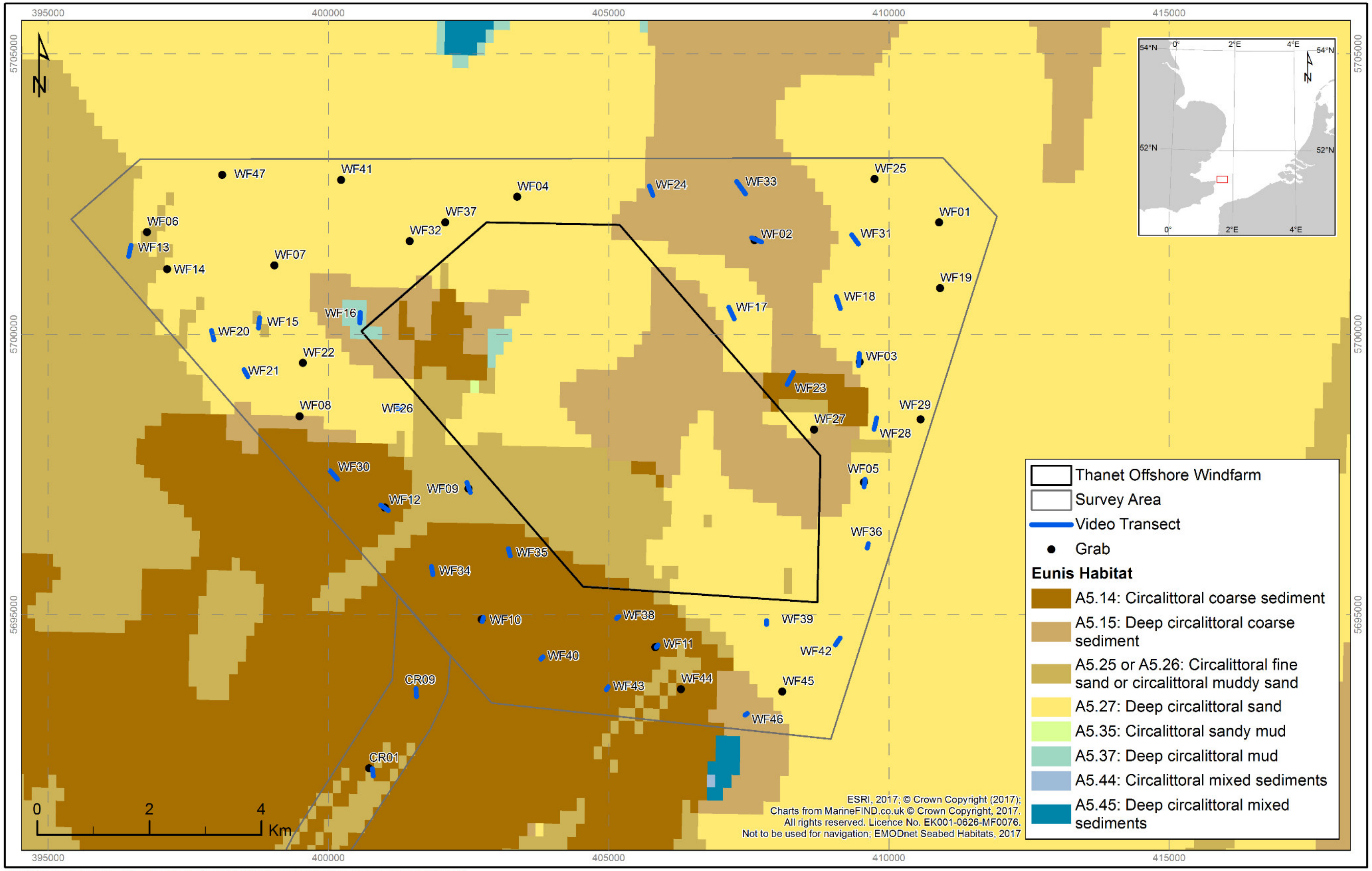

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Figure 1.2: Anticipated EUNIS seabed habitats within and around the Thanet Extension OWF area

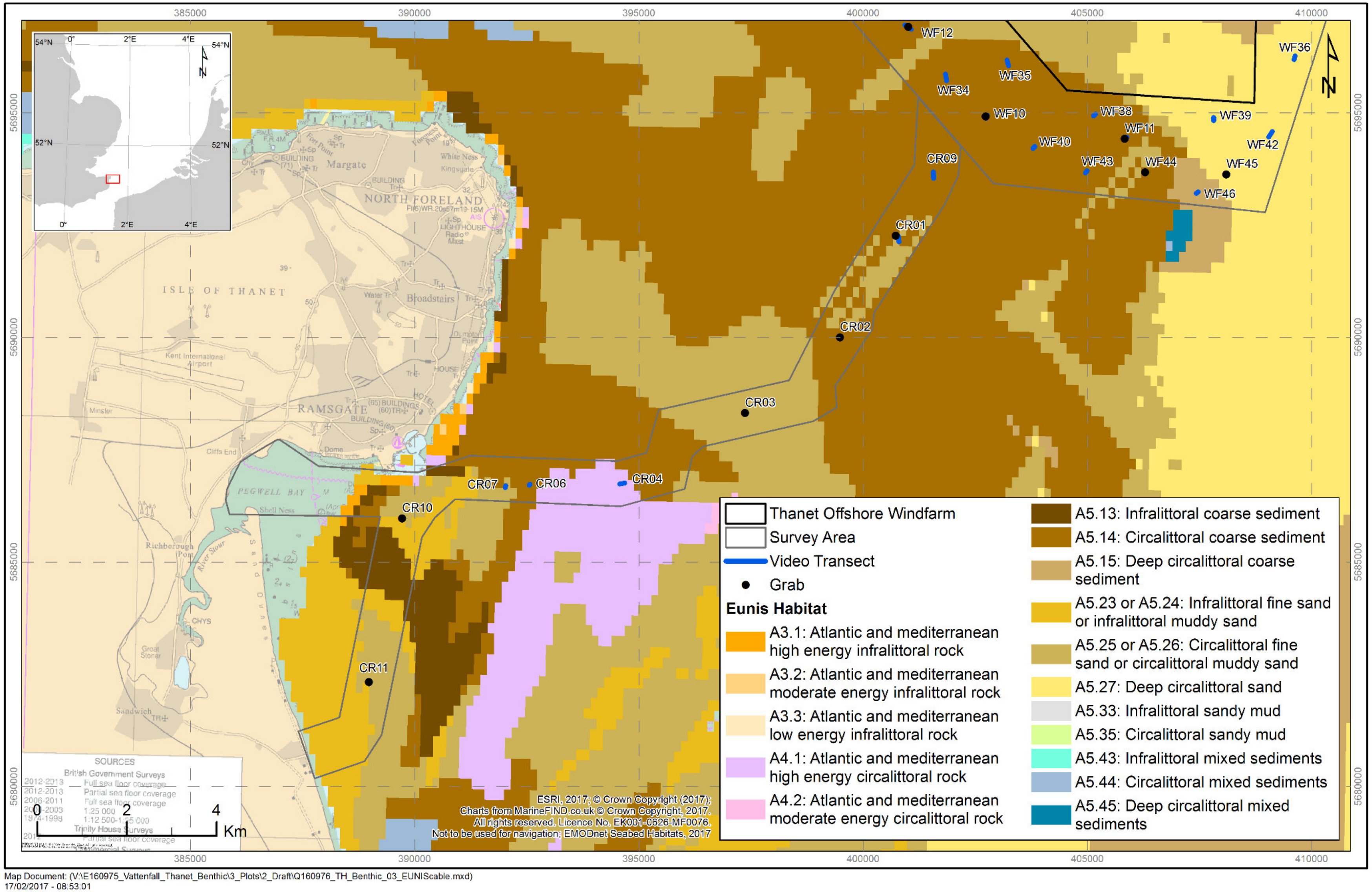

Figure 1.3: Anticipated EUNIS seabed habitats within and around the Thanet Extension OWF cable route area

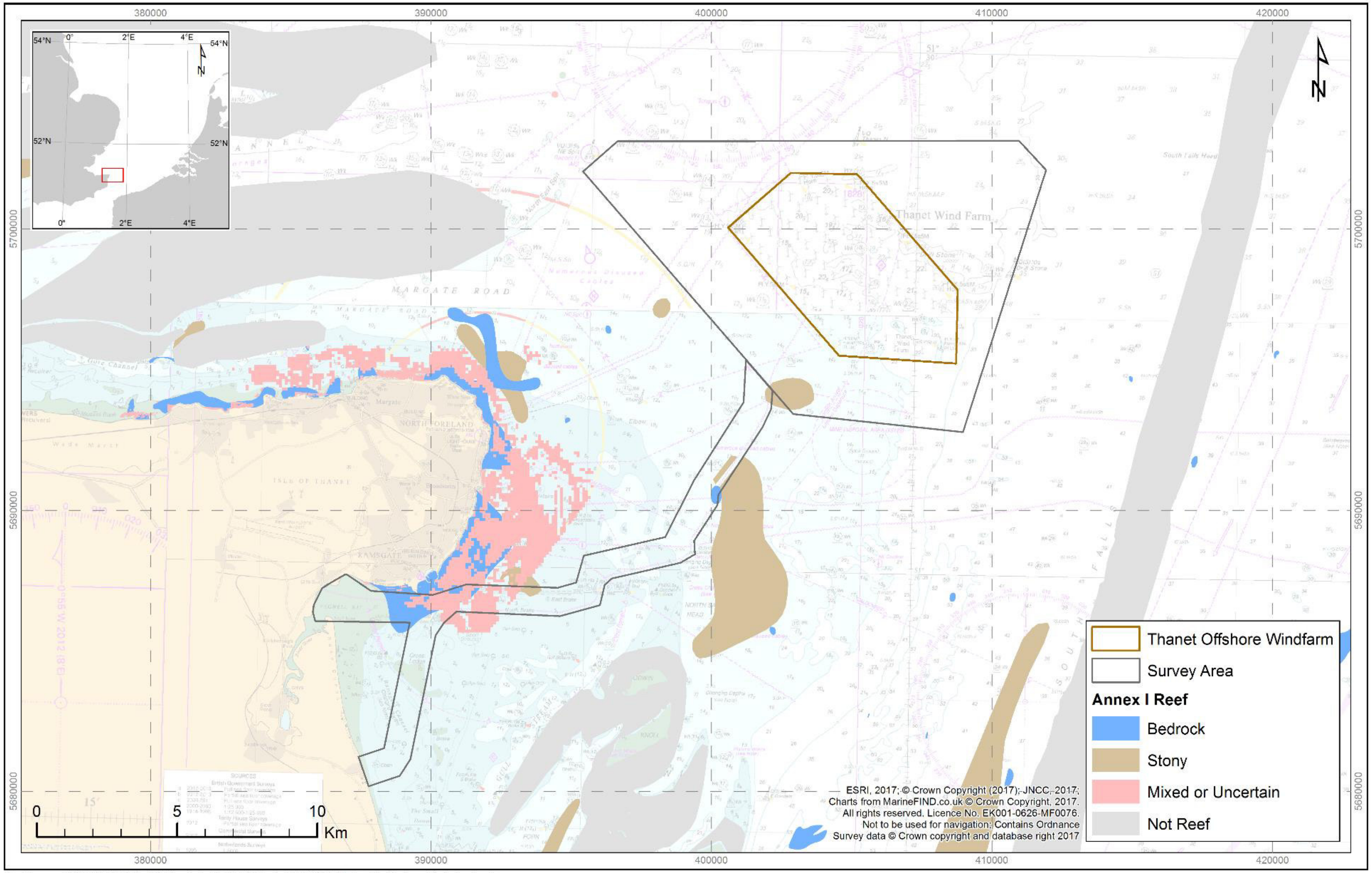

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Figure 1.4: Potential distribution of Annex I rocky reef off the north-east Kent coast from recent JNCC GIS data

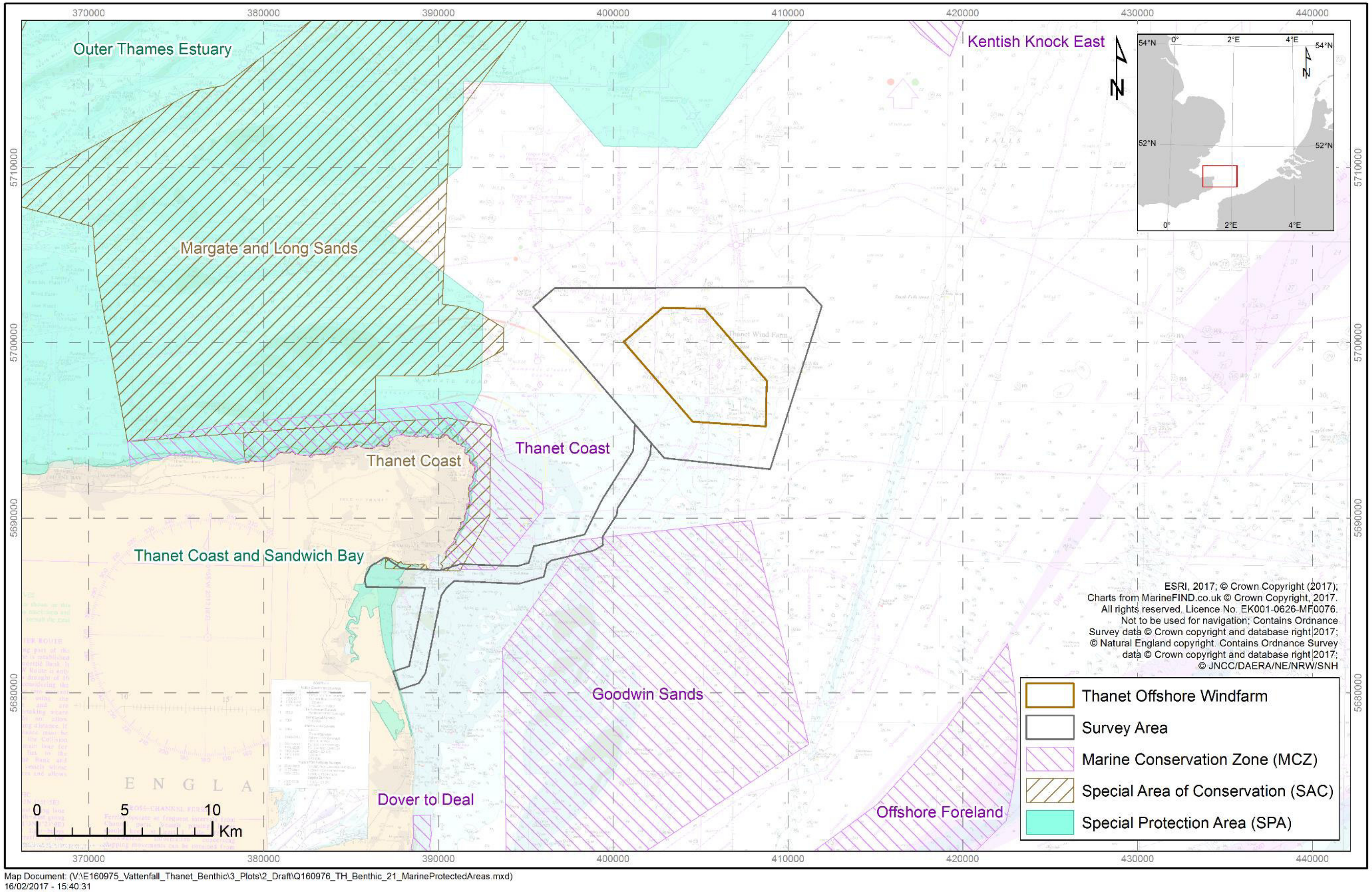


Figure 1.5: Survey area in relation to marine protected area

1.4.1 Protected Areas

The North East Kent European Marine Site (NEKEMS) was designated in 1995. The site covers an area of 22.69 km^2 of coastline and intertidal area stretching from Herne Bay to Deal with a small separate area at Swalecliff (Roberts and Jones, 2013). It also extends out to sea for up to 2 km around Thanet and includes the following nature conservation designations, some of which overlap:

- Thanet Coast Special Area of Conservation (SAC);
- Thanet Coast and Sandwich Bay Special Protection Area (SPA);
- Sandwich Bay SAC.

In 2013, the Thanet Coast was also designated a Marine Conservation Zone (MCZ), as part of progress toward a network of marine protected areas, and the designations are now collectively known as north-east Kent Marine Protected Area (NEKMPA) (Thanet District Council, 2015), the boundary of which stretches from the east of Herne Bay, around Thanet, to the northern Wall of Ramsgate harbour, covering an area of approximately 64 km^2 (Natural England, 2013) (Figure 1.5).

The Margate and Long Sands SAC, which overlaps the Outer Thames SPA, is located to the north-west of the development area, whereas the Goodwin Sands recommended MCZ, lies to the south (Figure 1.5).

Details of the designations, including type and features of interest are summarised in Table 1.1

Table 1.1: Nature Conservation Designations within Study Area

Site and Status	Qualifying Features	Distance from Development Area
Thanet Coast SAC	Annex I Habitats: ■ Reefs ■ Submerged or partially submerged sea caves	8 km to the south-west of proposed extension; overlapped by nearshore section of cable route
Thanet Coast MCZ	■ Moderate energy infralittoral rock ■ Moderate energy circalittoral rock Subtidal coarse sediment ■ Subtidal sand ■ Subtidal mixed sediments ■ Blue Mussel Beds Mytilus edulis bed ■ Peat and clay exposures ■ Ross worm reefs *Sabellaria spinulosa* ■ Subtidal chalk ■ Stalked jellyfish *Lucernariopsis cruxmelitensis*	6 km to the south-west of proposed extension; overlapped by nearshore section of cable route
Thanet Coast and Sandwich Bay SPA	International species: ■ Wintering turnstone (*Arenaria interpres*) National species: ■ Little tern Sterna albifrons ■ Golden plover *Pluvialis apricaria* ■ Ringed plover *Charadrois hiaticula* ■ Grey plover *Pluvialis squatarola* ■ Sanderling *Calidris alba* ■ Lapland bunting *Calcarius lapponicus*	16 km to the south-west of proposed extension; overlapped by nearshore and landfall section of cable route
Sandwich Bay SAC	Annex I Habitats: ■ Embyronic shifting dunes ■ Shifting dunes along the shoreline with Ammophilia arenaria (‘white dunes’)	16 km to the south-west of proposed extension; overlapped by nearshore and landfall section of cable route

Site and Status	Qualifying Features	Distance from Development Area
	■ Fixed coastal dunes with herbaceous vegetation ('grey dunes') ■ Dunes with Salix repens ssp.argentea (Salicon arenariae) Annex II Habitats ■ Humid dune slacks	
Outer Thames SAC	Annex I species: Red throated diver *Gavia stellata*	3 km to the west of the proposed extension
Margate and Long Sands SAC	Annex I Habitats: Sandbanks which are slightly covered by sea water all the time	3 km to the west of the proposed extension
Goodwin Sands rMCZ	■ Moderate energy infralittoral rock ■ Moderate energy circalittoral rock ■ Subtidal coarse sediment ■ Subtidal sand ■ Blue mussel *Mytilus edulis* beds ■ Ross worm *Sabellaria spinulosa* reef	3 km to the south of the proposed extension; overlapped by central section of cable route

1.4.1.1 Thanet Coast SAC

The site has been selected on account of the unusual communities that are found on its coastal chalk, which is the longest and continuous stretch of chalk coast in the UK, representing 20 % of this resource at national level, and 12 % at European level. Chalk cliffs comprise many caves, stack and arch formations. Partially submerged caves vary considerably in their physical characteristics and associated algal communities present, supporting very specialised algal and lichen species such as *Pseudendoclonium submarinum* and species of *Lyngbya* (Natural England 2014a).

1.4.1.2 Thanet Coast and Sandwich Bay SPA

Thanet Coast and Sandwich Bay SPA consists of a long stretch of rocky shore, adjoining areas of estuary, sand dune, maritime grassland, saltmarsh and grazing marsh (JNCC, 2005). In addition to the nationally and internationally important bird assemblages, large number of migratory passerine birds pass through the site during the spring and autumn migration period, as reported by the Sandwich Bay Bird Observatory since 1952 (Natural England 2014b). The site also supports outstanding communities of terrestrial and marine plants species, a significant number of rare invertebrate species, and is of considerable geological importance (JNCC, 2005).

1.4.1.3 Thanet Coast Marine Conservation Zone (MCZ)

The Thanet Coast MCZ partially overlaps with the existing SAC, building upon this designation, to protect features that are not already protected (Natural England, 2013a). This MCZ contains the best examples of a variety of features found within the south-east region, including an area of subtidal chalk that extends seawards from the chalk reefs, cliffs and caves already afforded protection by the Thanet Coast SAC. This is the only designated MCZ to protect one species of stalked jellyfish, namely *Lucernariopsis cruxmelitensis* (Table 1.1) (Natural England, 2016).

The Thanet Coast MCZ includes an unusual composition of blue mussel (*Mytilus edulis*) beds and ross worm (*S. spinulosa*) reefs that have formed a complex intertidal biogenic reef. Living reefs such as these play an important role within the ecosystem as they stabilise otherwise mobile sediment. The small habitat niches they provide can support a range of species which live on or within the sediment pockets. Reefs also play an important role in protecting the coastlines, by reducing the energy of incoming waves and improving water quality through water filtration processes (Natural England, 2016).

1.4.1.4 Goodwin Sands rMCZ

The Goodwin Sands rMCZ is being considered for inclusion in a network of Marine Protected Areas (MPAs) in UK waters, designed to meet conservation objectives under the Marine and Coastal Access Act 2009. The Goodwin Sands rMCZ is located just north of the English Channel, approximately 5 km east offshore from the Kent coast (DEFRA, 2015). The Goodwin Sands rMCZ was included in the proposed network because of its contribution to Ecological Network Guidance (ENG) criteria to broadscale habitats (BSH) and protected habitats (Table 1.1)

1.4.1.5 Outer Thames Estuary Special Protection Areas (SPA)

The site is designated for the protection of rare, vulnerable and migratory birds, particularly the Annex II species *Gavia stellata*. This species is associated with inshore waters of less than 20 m depth. As an opportunistic feeder, the diet of this species is formed by a variety of fish species. The sandbanks of the Outer Thames Estuary, functioning as nursery for fish species, are likely to support the diet of *G. stellata* (Natural England, 2013b).

1.4.1.6 Margate and Long Sands SAC

Margate and Long Sands starts to the north of the Thanet coast and proceeds in a north-easterly direction to the outer reaches of the Thames Estuary. The site contains a number of Annex I Sandbanks slightly covered by seawater at all times, the largest of which is Long Sands itself. The sandbanks are composed of well-sorted sandy sediments, with muddier and more gravelly sediments in the troughs between banks, and the upper crests of some of the larger banks dry out at low tide. By their very nature the banks are dynamic and there have been significant movements of the edges over time. The fauna of the bank crests is characteristic of mobile sand environments hosting few species represented mainly by selected polychaete worms and crustacean amphipods. Within the troughs and on the bank slopes, a higher diversity of benthic fauna is found including mobile epifauna and fish species (JNCC, 2017).

1.4.2 Habitats of Nature Conservation Interest

1.4.2.1 Blue Mussel (*Mytilus edulis)* Beds

Blue mussel beds in the Thanet Coast MCZ are found within the intertidal zone between Reculver and Minnis bay, on the north Kent coastline. Along this section of the coast there are unbroken stretches of intertidal chalk reef, which provide a good location for the Blue mussel larvae to settle. Old mussel beds in the chalk reefs also provide an ideal settlement location for larval stages of mussels as well as other species with planktonic larval stages (Natural England, 2014b).

1.4.2.2 Peat and Clay Exposures

Although peat and clay exposures are both noted as being a habitat feature for the Thanet Coast MCZ, it is only clay exposures that occur throughout the entire MCZ. Primarily located in the intertidal zone, and often covered by a thin layer of sand, this feature is very common along the northern Kent coast. This habitat type is generally scarce in the UK, but large expanses are found around the south-east, particularly the Kent and Essex coastline. This feature is characterised by piddock burrows and algal mats that colonise the clay exposures (Natural England, 2016).

1.4.2.3 Ross Worm (*Sabellaria spinulosa*) Reefs

Ross worm reefs provide a habitat for organisms in usually inaccessible areas of seabed. The *Sabellaria spinulosa* reefs within the Thanet Coast MCZ are of particular importance because they are found in close association with the Blue mussel beds. This is not only special because they have created a habitat composition that is very unique to the Thanet coastline, but also because it is rare to find *Sabellaria* reefs on intertidal rock and unrecorded anywhere else in the UK (Natural England, 2016).

1.4.2.4 Subtidal Chalk

The subtidal chalk around the Thanet coastline is typically quite soft and easily bored by animals, such as the piddocks, which constitutes a habitat considered scarce in Britain (Jones et al., 2005). In deeper waters, subtidal chalk is a very important habitat as reefs and sea caves are formed (Natural England, 2016). The subtidal chalk reefs within the site are comparatively impoverished, owing to the harsh environmental conditions in the extreme southern area of the North Sea, but they are an unusual feature because of the scarcity of hard substrates in the area. Infralittoral kelp forests are characteristically absent, owing to the high turbidity of the water, and species present include chalk-boring algae, which may extend above high water mark into the splash zone in wave-exposed areas (Natural England, 2014b).

1.4.2.5 Sandbank Habitat

There seems little likelihood of Annex 1 sandbank features in the survey area based on the most recent JNCC data (Figure 1.4) and the lack of sandy features raised from the surrounding seabed identified throughout the existing wind farm survey programme (CMACS, 2016).

1.4.3 Species of Nature Conservation Interest

1.4.3.1 Stalked Jellyfish (*Lucernariopsis cruxmelitensis*)

Identified in only one location in the Thanet Coast MCZ, off the coast of Margate, this species, also known as the St Johns jellyfish, is small, reaching less than 1 cm in height, and, unlike other species of stalked jellyfish it is rarely attached to sea grasses (Natural England, 2013a) but instead is typically found in shallow or low tidal regions closely associated with species of kelp and green algae (Natural England, 2016). This type of jellyfish is unusual in that its stinging tentacles face upwards, and they attach to the substrate in the polyp position, instead of the medusa position like most other free-floating jellies (Natural England, 2016).

1.4.4 Non Indigenous Species

Non-native species may become invasive and displace native organisms by preying on them or out-competing them for resources such as food, space or both. In some cases, this has lead to the loss of indigenous species from certain areas. Non-native species may also be carriers of pathogens (e.g. bacteria, viruses, protozoa and fungi) which cause disease or illness to its host.

The Thanet Coast is particularly at risk from non-native species, and in this regard, it is worth noting that the carpet sea squirt *Didemnum vexilum* is being monitored across the site intertidal area with a focus near Reculver. Other non-native species that have been identified and are being monitored are the seaweed *Sargassum muticum*, abundant around the north-east Kent coast, between Palm Bay and Margate, as well as the Pacific Oyster and slipper limpets, which are found throughout the site (Natural England, 2016).

2. METHODOLOGIES

2.1 Survey Design

A total of 58 environmental stations were proposed within the TEOWF development area, of which 47 were within the proposed wind farm area (WF) and 11 along the cable route (CR), with the following strategy:

- Thirty-one grab samples to be analysed for macrofauna and particle size distribution (PSD), of which:
  - Twenty-four samples within the TEOWF area;
  - Four samples along the TEOWF export cable route outside of the 5 m depth contour;
  - Three samples from within the 5 m depth contour;
- Thirty-one grab samples to be acquired for sediment chemistry, of which:
  - Twenty-four samples within the TEOWF area;
  - Seven samples along the TEOWF export cable route;
- Thirty-nine drop-down video stations in order to characterised the seabed, of which:
  - Thirty stations within the TEOWF area;
  - Nine along the TEOWF export cable route.

The survey array is displayed in Figure 2.1, with details of the proposed sampling locations presented in Table 2.1.

The locations of environmental sampling stations for sediment grabs were pre-selected, but micro sited, as required, based on infrastructure and features identified from geophysical data, as detailed below:

- CR10 and CR11 - new sites for proposed southern cable corridor (shallow);
- WF08 - relocated 122 m north-west to avoid an underwater obstruction;
- WF15 and WF16 – micro-sited to assess features that were not represented;
- CR05 - relocated 50 m south-east of proposed location, due to a navigation buoy.

Seabed video footage was acquired at each sampling station prior to grab deployment, to check for the potential presence of features of conservation importance, for example *Sabellaria* reefs, in which case grab sampling would be restricted.

For the purposes of this characterisation survey, single replicate samples were taken at each survey site to provide information on the substrates and benthic infaunal communities present, in line with the guidelines outlined in the Zonal Characterisation Survey Method (Marine Ecological Surveys, 2011) and Ware and Kenny, (2011).

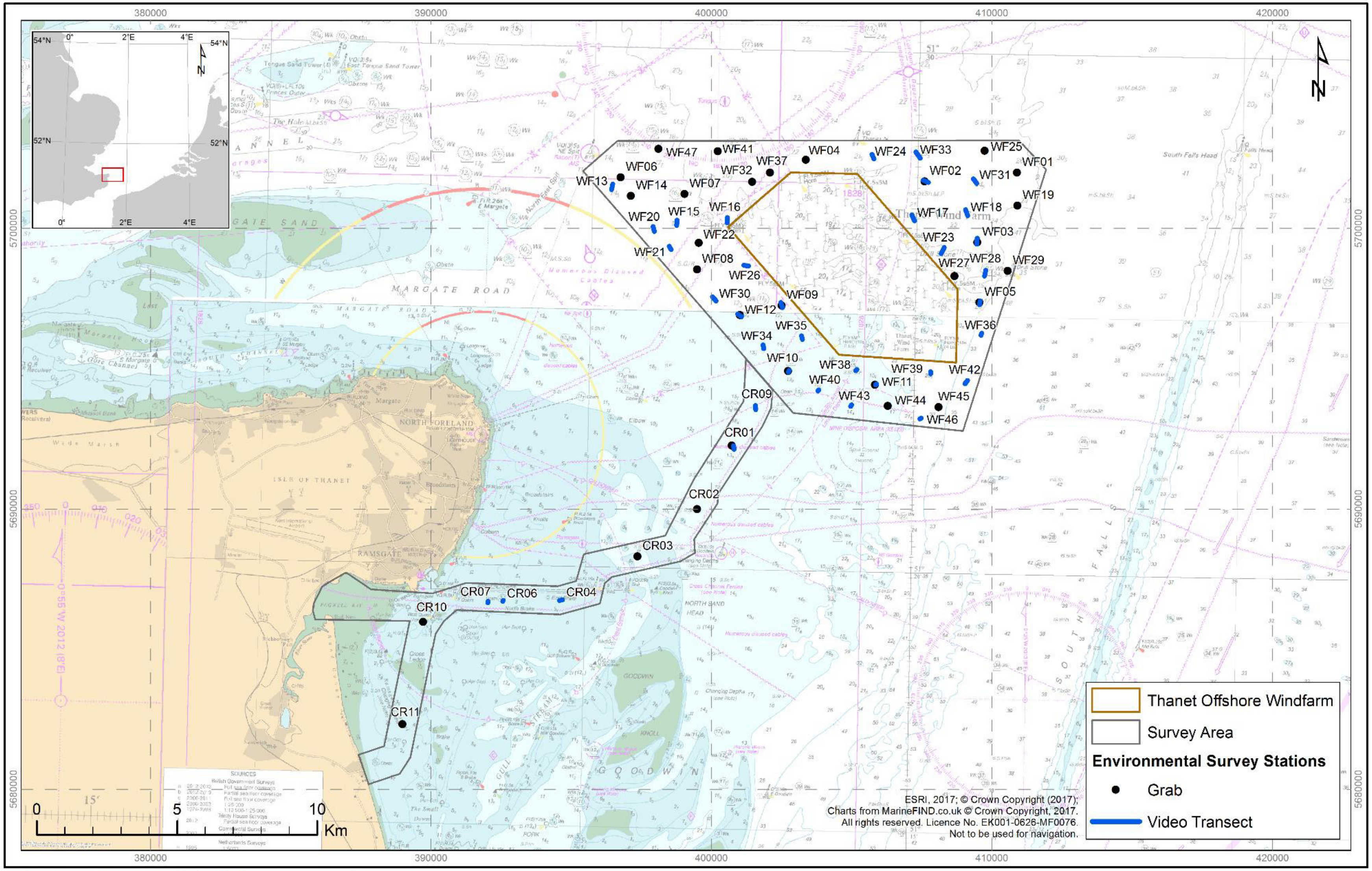


Figure 2.1: Survey array, Thanet Extension offshore wind farm

Table 2.1: Proposed Environmental Stations

Site	Coordinates ETRS 89UTM 31N		Sample Acquisition
	Easting [m]	Northing [m]	
CR01	400 731	5 692 258	PC, FA, DD
CR02	399 475	5 689 998	PC, FA,
CR03	397 362	5 688 325	PC, FA,
CR04	394 643	5 686 781	PC, FA, DD
CR05	391 544	5 686 862	PC, FA, DD
CR06	392 573	5 686 754	DD
CR07	392 023	5 686 712	DD
CR08	390 118	5 686 669	DD
CR09	401 523	5 693 650	DD
CR10	389 716	5 685 957	PC, FA, DD
CR11	388 996	5 682 318	PC, FA, DD
WF01	410 896	5 701 995	PC, FA
WF02	407 599	5 701 673	PC, FA, DD
WF03	409 487	5 699 500	PC, FA, DD
WF04	403 358	5 702 438	PC, FA
WF05	409 569	5 697 347	PC, FA, DD
WF06	396 764	5 701 796	PC, FA
WF07	399 042	5 701 231	PC, FA
WF08	399 597	5 698 534	PC, FA
WF09	402 504	5 697 247	PC, FA, DD
WF10	402 744	5 694 913	PC, FA, DD
WF11	405 846	5 694 429	PC, FA, DD
WF12	401 014	5 696 904	PC, FA, DD
WF13	396 451	5 701 478	DD
WF14	397 113	5 701 164	PC, FA
WF15	398 568	5 700 569	DD
WF15 (micro-sited)	398 758	5 700 183	DD
WF16	400 122	5 700 718	DD
WF16 (micro sited)	400 567	5 700 375	DD
WF17	407 150	5 700 436	DD
WF18	409 101	5 700 585	DD
WF19	410 921	5 700 817	PC, FA
WF20	397 923	5 699 973	DD
WF21	398 535	5 699 295	DD
WF22	399 543	5 699 494	PC, FA
WF23	408 225	5 699 163	DD
WF24	405 761	5 702 570	DD
WF25	409 746	5 702 752	PC, FA
WF26	401 230	5 698 667	DD
WF27	408 655	5 698 303	PC, FA
WF28	409 747	5 698 386	DD
WF29	410 606	5 698 452	PC, FA
WF30	400 139	5 697 460	DD
WF31	409 383	5 701 710	DD
WF32	401 462	5 701 677	PC, FA

Site	Coordinates ETRS 89UTM 31N		Sample Acquisition
	Easting [m]	Northing [m]	
WF33	407 332	5 702 652	DD
WF34	401 862	5 695 809	DD
WF35	403 238	5 696 126	DD
WF36	409 609	5 696 232	DD
WF37	402 074	5 701 991	PC, FA
WF38	405 143	5 694 941	DD
WF39	407 810	5 694 878	DD
WF40	403 788	5 694 221	DD
WF41	400 221	5 702 768	PC, FA
WF42	409 056	5 694 518	DD
WF43	404 961	5 693 674	DD
WF44	406 286	5 693 671	PC, FA
WF45	408 106	5 693 629	PC, FA
WF46	407 432	5 693 203	DD
WF47	398 105	5 702 851	PC, FA

2.2 Sampling Survey

The characterisation survey was conducted on board the MV Victor Hensen between 11 November and 14 November 2016; and onboard the Norfolk Swift between 1 December and 5 December 2016.

2.2.1 Seabed Video Footage and Photographic Stills Images

Seabed video footage was acquired by means of a Kongsberg OE-208 camera system mounted on a drop-down video (DDV) or low visibility frame, depending on the level of underwater turbidity. The frame was equipped with an adjustable weight system, and was connected to the surface by a subsea telemetry cable system. The bespoke topside control unit, comprised a hard disc drive (HDD), and incorporated a digital versatile disc (DVD) recorder for use as the primary video recording system, with differential global positioning system (dGPS) overlay. A mini-DV player was used for simultaneous backup. The camera was towed approximately 0.5 m above the seabed at approximately 0.7 knots. At each environmental site a short (up to 5 minutes) seabed video footage was acquired together with still images (five or more). Positions for the video survey were logged throughout each drop at each static image location, and overlaid on the video footage to ensure accurate geo-referencing. Field logs were kept throughout the video survey and are presented in Annex C.2.

2.2.2 Macrofauna Grab Sampling

Sediment samples for macrofauna and particle size analysis were acquired by means of a 0.1 m^2 mini-Hamon grab at stations outside of the 5 m contour, whereas a 0.1 m^2 Day grab was used to acquire samples within the 5 m contour. Sediment samples for chemistry analysis were acquired by means of a 0.1 m^2 Day grab.

The positions of all benthic sample stations were recorded by means of dGPS with a nominal accuracy of 2 m. The actual position of each sample was recorded each time the grab landed on the seabed as indicated by the winch wire slackening. The grab was not deployed in areas where sensitive habitats or hazardous obstructions were identified, in which case the sampling station was micro-sited at the time of the survey.

Upon retrieval, samples were checked for adequate sample volume, those of 5 litres and above considered to be acceptable. Samples with a lower volume than this were generally rejected and sampling re-attempted up to three times. Where samples of low volume were continuously obtained, best judgment was used as whether to accept or reject these samples, with all details recorded in the field log (Annex C.3). A photographic log of each samples was also kept (Annexes C.5 and C.6).

Once a sample was accepted, it was photographed and a qualitative assessment of the sediment type, together with presence of conspicuous fauna, was undertaken and documented in the field log. A subsample of 500 g for particle size distribution (PSD) analysis was taken at this stage and placed in a plastic bag. The remaining sediment was gently washed over a 1 mm sieve with retained material transferred into a pre-labeled container and preserved with 8 % formalin solution. The sample containers were then sealed, hazard labelled and stored securely on deck.

2.2.3 Contaminants Grab Sampling

Subsamples for chemistry analysis were taken from the surface of the day grab sample while still in the grab. Samples for hydrocarbon content analysis were collected using a metal scoop, whereas a plastic scoop was used to subsample for heavy metal content analysis, both to a nominal depth of 2 cm. The samples were then stored in glass jars (hydrocarbons) and polythene bags (heavy metals) at -20 ºC. Plastic scoops were pre-washed in saltwater and metal scoops were cleaned using acetone, prior and between each subsampling.

3. SAMPLE ANALYSIS

3.1 Laboratory Analysis

3.1.1 Sediment Particle Size Distribution (PSD)

Particle size analysis was undertaken in accordance with Fugro's in house methods based on BS1377: 1990 Parts 1-2 and NMBAQC best practice guidance. Fugro are UKAS accredited for dry sieve analysis. Laser Diffraction is not UKAS accredited.

Representative material > 1 mm was split from the bulk subsample and oven dried at 105 ± 5 °C to constant weight before sieving through a series of sieves with apertures corresponding to 1 Phi intervals between 64000 µm and 1 mm as described by the Wentworth scale. The weight of the sediment fraction retained on each mesh was measured and recorded.

Where required, representative material < 1 mm was removed from the bulk subsample for laser analysis; a minimum of three triplicate analyses (mixed samples) or one triplicate analyses (sands) were analysed using the laser sizer at 1 Phi intervals between < 1 mm to < 3.9 µm. Laser diffraction was carried out using a Malvern Mastersizer 2000 using a Hydro 2000G dispersion unit.

3.1.2 Sediment Chemistry

The total organic matter (TOM) samples were analysed in Fugro's sediment laboratory, whereas chemical analyses were sub-contracted to an experienced United Kingdom Accreditation Service (UKAS) accredited chemistry laboratory. Summaries of the methodologies used are detailed in Table 3.1 to Table 3.6.

Table 3.1: Sediment Chemistry Analysis – Total Organic Matter

Total Organic Matter	
Method Description	Loss on ignition at 500 °C
Minimum Reporting Value (mg/kg)	0.5 %
UKAS Accreditation	Y

Table 3.2: Sediment Chemistry Analysis – Total Hydrocarbons

Determination of Hydrocarbons in Marine Sediment Samples by Fluorescence Spectroscopy	
Method Description	Extraction in methanol under alkaline conditions then extracted with pentane and analysed on a fluorescence spectrophotometer. This method is NOT specific for petroleum hydrocarbons, being sensitive to all aromatics, particularly those with multiple fused rings (PAH).
QC	In-house QC scheme and samples are run with certified NIST reference oil AR2071 – North Sea crude oil.

Table 3.3: Sediment Chemistry Analysis – Polycyclic Aromatic Hydrocarbons (PAHs)

Determination of Poly-nuclear Aromatic Hydrocarbons in Marine Sediment by GC-MS/MS	
Method Description	Solvent extraction using dichloromethane followed by clean up, followed by analysis by GC-MS/MS.
QC	In-house QC: Precision: - Better than 15 % RSD Bias: - Better than 20 % Bias Error Target: - Better than 50 % Total Error External QC: - Quasimeme

Table 3.4: Sediment Chemistry Analysis – Trace Metals

Determination of Metals by ICP-MS in Marine Sediment	
Method Description	Aqua Regia (< 2 mm fraction) or HF (< 63 µm fraction) digest followed by analysis using Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES). (**Note:** Mercury (Hg) analysed using Cold Vapour Atomic Fluorescence Spectroscopy).
Analytes	Copper (Cu), Cadmium (Cd), Lead (Pb), Chromium (Cr), Nickel (Ni), Manganese (Mn), Zinc (Zn), Arsenic (As), Lithium (Li), Vanadium (V) and Tin (Sn). (**Note:** Tin not analysed using the Aqua Regia digest)
QC	In-house QC: Precision: - Better than 20 % RSD Bias: - Better than 20 % Bias Error Target: - Better than 60 % Total Error Performance testing to WRc NS30 External QC: - Quasimeme

Table 3.5: Sediment Chemistry Analysis – Organotins

Method Summary for the Determination of Organotin Compounds by GCMS		
Method Description	Aqueous extraction with derivatisation, GC-MS	
Analytes	**Compound**	**CAS Number**
	Dibutyltin	683-18-1
	Tributyltin	1461-22-9
	Tetrabutyltin	1461-25-2
	Diphenyltin	1135-99-5
	Triphenyltin	639-58-7
	Tetraphenyltin	595-90-4
	Dioctyltin	3542-36-7
QC	In-house QC: Precision: - Better than 25 % RSD Bias: - Better than 25 % Bias Error Target: - Better than 75 % Total Error Performance testing to WRc NS30 External QC: - Contest, SETOC, Quasimeme	

Table 3.6: Sediment Chemistry Analysis – Polychlorinated Biphenyls (PCB)

Determination of Polychlorinated Biphenyls in Marine Sediment by GC-MS/MS		
Method Description	Solvent extraction using dichloromethane followed by clean up, followed by analysis by GC-MS/MS	
Analytes	**Compound**	**CAS Number**
	PCB 28	7012-37-5
	PCB 52	35693-99-3
	PCB 101	37680-73-2
	PCB 118	31508-00-6
	PCB 153	35065-27-1
	PCB 138	35065-28-2
	PCB 180	35065-29-3
QC	In-house QC: Precision: - Better than 15 % RSD Bias: - Better than 20 % Bias Error Target: - Better than 50 % Total Error Performance testing to WRc NS30 External QC: - Quasimeme	

3.1.3 Grab Macrofauna Abundance

Grab samples were returned to Fugro's benthic laboratory for analysis. The laboratory is a full participant in the National Marine Biological Analytical Quality Control (NMBAQC) scheme. Fugro's in-house procedures for benthic macro-invertebrate analyses are in line with procedures recommended by the NMBAQC scheme (Worsfold et al., 2010) and BSI 16665:2013. Fugro is UKAS accredited for macrofaunal analysis.

Macrofaunal grab samples were sieved over a 1 mm mesh to remove all fine sediment and fixative. Fauna were sorted from the sieved sample under a dissecting microscope and subsequently identified to the lowest possible taxonomic level and enumerated. Colonial, encrusting epifaunal species were identified to species level, where possible, and allocated a P (present) value.

All biological faunal material retained were stored in 70 % industrial denatured alcohol (IDA). A reference collection was prepared with a minimum of one individual of all species identified retained.

Fugro undertook quality control (QC) checks on a representative number of whole samples, as well as the entire reference collection in compliance with internal analytical QC criteria.

3.1.4 Grab Macrofauna Biomass

Biomass analysis was undertaken on the infauna from grab samples, following identification and enumeration. The infauna from each sample was sorted into groups, including: Polychaeta, Oligochaeta, Crustacea, Mollusca, Echinodermata, Cnidaria (burrowing species only) and "Other Taxa", and biomass undertaken using the wet blot method. Subsequently, the appropriate standard corrections were applied to these data to provide equivalent dry weight biomass (as outlined in Eleftheriou and Basford, 1989):

- Annelida 15.5 %
- Crustacea 22.5 %
- Mollusca 8.5 %
- Echinodermata 8.0 %
- Cnidaria 15.5 %
- Others 15.5%

4. DATA ANALYSIS

Data analyses were undertaken using Microsoft Excel 2010 and the statistical package PRIMER v6 (Clarke and Gorley, 2006; Clarke and Warwick, 2001). Laboratory result values below the analytical detection/reporting limit were treated as being equal to half of that of the analytical/reporting limit for data analysis purposes only (Croghan, 2003).

4.1 Particle Size Distribution Data Analysis

Sediment particle size distribution statistics, summarised in Table 4.1, for each sample were calculated from the raw data using Gradistat V8 (Blott, 2010).

Table 4.1: Sediment Particle Size Distribution Statistics

Distributional Statistic Measure	Description
Phi scale	A logarithmic scale which allows grain size data to be expressed in units of equal value for the purpose of graphical plotting and statistical calculations. The scale is based on the following relationship: $phi = -log_2 d$ where *d* is the grain size diameter in mm.
Median or D_{50}	Measure of central tendency. Defined as the value where half of the sample particle size grain reside above this point and half below it.
Mode	Peak of the frequency distribution. The mode represents the particle size (or size range) most commonly found in the distribution.
Sorting	A measure of the range of grain size present and the magnitude of the spread or scatter of these around the mean
Percentiles (D_{10}, D_{50}, D_{90})	Defined as the maximum particle diameter below which 10 %, 50 % or 90 % of the sample particle grain size occurs, respectively. Monitoring the percentiles allows assessing changes in the main particle size, as well as changes at the extremes of the distribution.
Skewness	A degree of symmetry – skewness reflects sorting in the tails of a grain size data set. Data set that have a tail of excess fines particles are said to positively skewed or fine skewed; data sets with a tail of excess coarse particles are negatively skewed or coarse skewed.
Kurtosis	The degree of sharpness or peakedness in a grain size frequency distribution curve.

Data for the percentage composition retained within each sieve size classes were assessed by means of multivariate analysis employing the hierarchical agglomerative clustering analysis, using the Euclidean distance measure as recommended by Clarke and Gorley (2006) (further details on this analysis in section 4.3.3). Data were square root transformed to reduce the degree of skewness and bring the data set close to multivariate normality, which allowed best performance of the analysis (Clarke and Gorley, 2006).

The Principal Component Analysis (PCA) was undertaken on the main sediment fractions data set in order to identify spatial patterns and relationships between variables. The PCA is a method of identifying multidimensional patterns in data sets; once these multidimensional patterns have been found the data are compressed by reducing the number of dimensions without loss of information. The results of a PCA are graphically represented by the principal component axes, which are linear combination of the values for each variable, and represent the perpendicular distance, in a multidimensional space, along which the variance is maximised. The degree to which a two-dimensional PCA succeed in representing the full multidimensional information is seen in the percentage of the total variance expressed by the first two principal components. In general, a picture which accounts for as much as 70 % to 75 % of the original variation is likely to describe the overall structure rather well (Clarke and Warwick, 2001).

4.2 Correlations

Correlation analysis between environmental variables was undertaken using the Spearman's correlation coefficient. This correlation analysis, based on ranks, allows characterising of the strength of relationships among a set of variables, without making assumption of linearity between variables (Hauke and Kossowski, 2011; Clarke, 2014).

4.3 Macrofauna Data Analysis

The macrofaunal data set was imported into Primer v6 and analysed by means of univariate and multivariate analyses.

4.3.1 Data Rationalisation before the Analysis

Prior to analysis being undertaken, the faunal data set was subjected to a degree of rationalisation, specifically, a number of species and/or higher taxa of indeterminate identity, and therefore already possibly identified, were removed from the data set or merged with higher taxa to avoid spurious enhancement of the species list. Juvenile species were also removed, as they represent an ephemeral stage of macrofauna community and therefore not representative of prevailing benthic conditions. Further details in section 5.4.1.

4.3.2 Univariate Analysis

Univariate analyses are used to extract features of communities which are not the function of specific taxa; i.e. these methods are species independent. They are not sensitive to spatio-temporal variations in species composition, so that assemblages with no species in common can theoretically have equal diversities. Univariate analyses included the primary variables: number of taxa (S) and abundance (N), together with the Margalef's index of Richness (d), Pielou's index of Evenness *(J)*, Shannon-Wiener index of Diversity ($H'Log_2$) and the Simpson's index of Dominance (λ).

Margalef's index of richness incorporates the total number of individuals and is a measure of the number of species present for a given number of individuals. Unlike the total number of species, this index is less dependent from sample size.

Pielou's expresses how evenly distributed the individuals are among the different species. In general, the higher the evenness, the more balanced the sample is, as it indicates that the individuals are evenly distributed between the species recorded.

The Shannon-Wiener index of diversity incorporates richness and evenness, as it expresses the number of species within a sample and the distribution of abundance across these species.

The Simpson's index has a number of forms, λ representing the probability that any two individuals from the sample, chosen at random, are from the same species. As such the index is a dominance index in the sense that its largest value corresponds to assemblages the total abundance of which is dominated by one or very few of the species present.

Assessment of benthic faunal diversity, calculated using Shannon-Wiener Index, ($H'Log_2$) followed the threshold values outlined in Dauvin et al. (2012), whereby values of Shannon-Wiener Index greater than four indicate high diversity; values between three and four indicate good diversity; values between three and two indicate moderate diversity; values between one and two indicate poor diversity; and valued less than one indicate bad diversity (Dauvin et al., 2012).

4.3.3 Multivariate Analysis

In the initial stage, multivariate analysis may involve transformation of data, particularly when the fauna data set is numerically dominated by a few species which may mask the underlying community composition. Transformation reduces the influence of these more dominant species allowing the whole faunal assemblages to be assessed. The data set in the current study was square root transformed (further details in section 5.4.4).

The transformed data were then analysed employing the hierarchical agglomerative clustering analysis, where samples are grouped on the basis of nearest neighbour sorting of a matrix of sample similarities, using the Bray-Curtis similarity measure, the results of which are displayed in a dendrogram. The Multi-Dimensional Scaling (MDS) or ordination analysis was undertaken in conjunction with the cluster analysis. The MDS analysis uses the same similarity matrix as that of the cluster analysis to produce a multidimensional ordination of samples. This attempts to construct a map of the samples, in which the more similar two samples are, the closer they appear on the map. The extent to which these relations can be adequately represented in a two-dimensional map is expressed as the stress coefficient statistic, low values (< 0.1) indicating a good ordination with no real prospect of misleading interpretation. The combination of clustering and ordination analysis allows checking the adequacy and mutual consistency of both representations (Clarke and Warwick, 2001).

The Similarity Profile (SIMPROF) test was run in conjunction with the cluster analysis in order to identify station groupings that are significantly different in statistical terms. Results are displayed by colour convention, with samples connected by red lines indicating a difference which is not statistically significant. It is noteworthy however, that samples which may be considered statistically different, based on the SIMPROF output, may host similar faunal communities which differ e.g. in terms of abundance rather than species composition. In such case, the samples may be interpreted as being not significantly different, from an ecological point of view. The SIMPROF output was therefore always considered in terms of statistical and ecological significance, in line with Clarke et al. (2008), who indicate that creating coarser groupings is entirely appropriate, provided that the resulting clusters are always supersets of the SIMPROF groups.

The Similarity Percentage Analysis (SIMPER) was undertaken following the clustering analysis, in order to gauge the faunal distinctiveness of each of the identified group of samples. SIMPER provides a ranked list of taxa which contributes most to the similarity/dissimilarity within/between groups of samples.

Relationships between macrofauna from grab samples and sediment particle size variables were tested employing the BIOENV analysis in PRIMER v6. This statistical procedure works by superimposing the abiotic groups derived by the Euclidean distance matrix onto the biotic groups derived from the Bray-Curtis similarity matrix. The two similarity matrices are then correlated, in order to find the strength of the association between the two sets of variables. If the patterns derived by the two matrices are similar, then they correlate, with a value of the correlation coefficient rho approaching 1 indicating good correlation, and a value of rho approaching 0 indicating poor correlation.

4.4 Seabed Video Footage and Photographic Stills Analysis

Video footage and still images collected at each site were analysed to assess the seabed habitat type and epibenthic communities. The analysis was carried out by reviewing the video footage from each site describing the sediment type and conspicuous species recorded along transect. The digital still images were used to assist identification of species and improve habitat descriptions. The video footage provided a more complete and detailed description of the communities observed, including the less frequently occurring species likely to be under represented from static image analysis alone. Species abundance was estimated, where underwater visibility allowed, using the industry standard SACFOR abundance scale (JNCC, 2015a) shown in Table 4.2, which uses the average species size to classify the population.

Table 4.2: Marine Nature Conservation Review (MNCR) SACFOR* Abundance Scale

Growth Form			Size of Individuals/Colonies				Density
% Cover	Crust/Meadow	Massive/Turf	< 1 cm	1 - 3 cm	3 - 15 cm	> 15 cm	
> 80%	S		S				> 1/0.001 m^2
40 – 79 %	A	S	A	S			1 - 9/0.001 m^2
20 – 39 %	C	A	C	A	S		1 - 9/0.01 m^2
10 – 19 %	F	C	F	C	A	S	1 - 9/0.1 m^2
5 – 9 %	O	F	O	F	C	A	1 - 9/1 m^2
1 – 5 % or density	R	O	R	O	F	C	1 - 9/10 m^2
< 1 % or density	R	R		R	O	F	1 - 9/100 m^2
					R	O	1 - 9/1000 m^2
						R	< 1/1000 m^2

Notes:
S = Superabundant
A = Abundant
C = Common
F = Frequent
O = Occasional
R = Rare

4.5 Biotope Classification

Biotope classification followed that outlined by EUNIS (EEA, 2016) and JNCC (Connor et al., 2004). The latter has actively contributed to the development of the marine sections of the EUNIS classification (JNCC, 2015b), and was adhered to with respect to the biotopes description. Biotope classification was carried out by experienced ecologists following revision of results from the video footage, the sediment particle size analysis and the macrofauna identification and biomass.

4.6 Habitats and Species of Nature Conservation Interest

4.6.1 *Sabellaria* Reef Assessment

Video footages and still images from each site were reviewed, noting the type of *S. spinulosa* aggregation present, following the categories outlined below:

- Absent;
- Moribund loose tubes;
- Crusts;
- Clumps (nodules of reef < 10 cm in diameter);
- Potential reef.

Assessment of potential reef structure followed the standard methodology for classification of reef structure and population density (Gubbay, 2007). Guidelines for the assessment of *S. spinulosa* reef, as outlined in Hendrick and Foster-Smith (2006) and Limpenny et al. (2010), were also adhered to. A summary of the assessment criteria are presented in Table 4.3. The simplest definition of *S. spinulosa* reef in the context of the Habitats Directive is currently considered to be an area of *S. spinulosa* which is elevated from the seabed and has a large spatial extent (two of the characteristics presented by Hendrick and Foster-Smith, 2006). Colonies may be patchy within an area defined as reef and show a range of elevations.

Table 4.3: Criteria for the Assessment of *Sabellia spinulosa* Reefs (from Gubbay, 2007)

Measure of 'Reefiness'	NOT A REEF	LOW	MEDIUM	HIGH
Elevation (cm) (average tube height)	< 2	2 - 5	5 – 10	> 10
Patchiness (% cover)	< 10	10 - 20	20 - 30	> 30
Consolidation♦	< 5	5 on Limpenny et al. (2010) scale*. Stones joined by tubes that overlap	Upright *Sabellaria* including concretion of substrata	Intertwined matrix of upright *Sabellaria* tubes
Density (maximum/m^2)	< 500	500 - 1700	1700 - 3500	> 3500

Notes:
* = *S. spinulosa* reef scale (Limpenny et al., 2010) where:
1. Discreet tubes only; none connected (<1 cm thick)
2. Some connection between tubes but not overlapping (accretions < 1 cm thick)
3. Some tubes on top of each other in three dimensions (accretions 1-2 cm thick)
4. Many tubes overlapping but no incorporation or joining of stones (accretions 1-2 cm thick)
5. Stones joined by tubes; most tubes overlapping or connected (accretions >2 cm thick). (If 5, state maximum thickness)

4.6.2 Chalk Reef Assessment

Assessment of potential chalk reefs followed the guidelines for classification of geogenic reef outlined in Irving (2009) and Limpenny et al. (2010), whereby the following key parameters of reefiness are proposed:

- Physical composition – > 10 % of the seabed substratum should be composed of particles greater than 64 mm across, i.e. cobbles and boulders. The remaining supporting 'matrix' could be of smaller sized material;
- Biological cover – greater the dominance of epifaunal species indicating greater likelihood of an area of habitat being categorised as stony reef;
- Elevation – revert to Habitats Directive's Interpretation Manual to include areas that 'arise from the seafloor' (i.e. are topographically distinct from the surrounding sea floor);
- Extent – minimum area which could be considered as stony reef is 25 m^2;
- Quality – including its structure and function i.e. as a refuge or shelter for mobile fauna such as crustaceans and fish.

Table 4.4 summarises the main characterising features of geogenic reef. Using these criteria, data were compared for assessment of the presence of no, low, medium and high resemblance to a geogenic reef.

Table 4.4: Measure of Geogenic Reefiness

Measure of 'Reefiness'	NOT A REEF	LOW	MEDIUM	HIGH
Composition diameter of cobbles/ boulders being greater than 64 mm. Percentage cover relates to a minimum area of 25 m^2 (%) This 'composition' characteristic also includes 'patchiness'.	< 10	10 - 40 Matrix supported	40 - 95	> 95 Clast supported
Elevation Minimum height (64 mm) relates to minimum size of constituent cobbles. This characteristic could also include 'distinctness' from the surrounding seabed. **Note:** that two units (mm and m) are used here.	Flat seabed	<64 mm	64 mm – 5 m	> 5 m
Extent (m^2)	< 25	> 25		
Biota	Dominated by infaunal species			> 80 % of species present composed of epifaunal species

4.7 Quality Standards

Standards and/or guidelines which are used to define marine sediment quality standards at national and international level were used in the current study in order to contextualise the results generated from the study. Quality standards are interpretative tools used to determine if contaminants are present at concentrations which could potentially impair the designated uses of the marine environment.

Results of chemistry concentrations were compared to the Clean Seas Environment Monitoring Programme (CSEMP) guideline levels (CSEMP, 2012a and b). This is the mechanism through which the UK delivers its monitoring commitments as signatories to the OSPAR Convention. Two assessment criteria have been used to assess contaminant (PAH and metals) concentrations in sediment under CSEMP. These are the Effects Range Low (ERL) and Effects Range Medium (ERM) criteria. Effects Range values were originally developed by the United States Environmental Protection Agency (US-EPA) as sediment quality guidelines to predict adverse biological effects on organisms. Concentrations below the ERL rarely cause adverse effects in marine organisms; concentrations above the ERM, however, will often cause adverse effects in some marine organisms (OSPAR, 2009a).

Contaminant levels from seabed sediment samples were also compared with Canadian Sediment Guidelines for the Protection of Aquatic Life (PLA, 2015a) and CEFAS Guideline Action Levels for the Disposal of Dredged Material (PLA, 2015b).

The Canadian Sediment Guidelines were developed by the Canadian Council of Ministers of the Environment (CCME) as broadly protective tools to support the functioning of healthy aquatic ecosystems. They are based on field research programmes that have demonstrated associations between chemicals and biological effects by establishing cause and effect relationships in particular organisms. The guidelines consist of threshold effects levels (TELs) and probable effects levels (PELs). Together they are used to identify three ranges of chemical concentrations with regard to biological effects; specifically, values below the TEL indicate the minimal effect range within which adverse effects rarely occur; values between the TEL and PEL indicate the possible effect range within which adverse effects occasionally occur; values above the PEL indicate the probable effect range within which adverse effects frequently occur. The TELs have been adopted as the Interim Marine Sediment Quality Guidelines (ISQGs).

CEFAS Guidelines are not statutory contaminant concentrations for dredged material, but are used as part of a weight of evidence approach to decision making on the disposal of dredged material at sea. The CEFAS guidelines are used in conjunction with other assessment methods to make management decisions regarding the fate of dredged material. As such, they are not “pass/fail” criteria, but triggers for further assessment. In general, dredged material contaminant levels below action level 1 are of no concern; dredged material with contaminant levels above action level 2 is generally considered unsuitable for sea disposal. Dredged material with contaminant levels between action levels 1 and 2 require further investigation prior to a decision being made.

Amongst the organotins, concentrations of Tributyltin (TBT) in the sediments are used by OSPAR to assess adverse effects on biota. The potential effect on benthic fauna is therefore assessed against

TBT concentrations reported by the chemistry analysis. As TBT is the most toxic organotin compound to marine fauna, this considers the worst case scenario against which conservative judgment can be made. The assessment is based on a six class (A to F) assessment scheme for TBT-specific biological effects in dogwhelks and other gastropods. The classes are described by a coloured scale (Table 4.5) which indicates if the Ecological Quality Objectives (EcoQOs) are met, providing an indication of the effects that concentration levels of TBT tin may have on the reproductive capability of sensitive key species (OSPAR, 2009b).

Table 4.5: Assessment Classes for TBT (from OSPAR, 2009b)

Assessment Class	TBT Sediment (µg TBT/kg dw)
A	n.d.
B	< 2
C	2 - <50
D	50-<200
E	200 -500
F	>500

5. RESULTS

5.1 Field Operations

Details of grab samples acquisition are presented in Table 5.1.

Sediment sampling for chemistry analysis was successfully acquired at 22 of the 31 proposed stations. Sampling at the remaining 9 stations failed due to presence of stones which prevented closure of the grab. These included: CR01, CR02, CR05, CR11, WF09, WF10, WF11, WF44 and WF45.

Of the 31 stations proposed for macrofauna and sediment PSD analysis, 26 were successfully sampled for macrofauna and 28 for sediment PSD analysis, as detailed below:

- CR02 and WF10 - samples for sediment PSD only, due to low sample volume;
- CR04 - no sample due to pebbles and stones in the grab jaws;
- CR05 - no sample; surface scrape only, due to presence of cobbles;
- CR11 - no sample for PSD analysis; low volume faunal sample.

Seabed video images were successfully acquired at all of the proposed 39 stations. Very poor visibility was encountered at 6 stations, to include: CR05, CR06, CR07, CR08, CR10 and CR11.

Details of seabed video footage are presented in Table 5.2.

Table 5.1: Grab Sampling Stations

Station	Depth [m]	Coordinates ETRS 89UTM 31N		Sample Acquisition
		Easting [m]	Northing [m]	
CR01	16	400 728	5 692 261	PSD, FA, DD
CR02	13	399 487	5 689 998	PSD, FA
CR03	12	397 368	5 688 312	PSD, FA, HM, HC
CR10	8	389 721	5 685 970	PSD, FA, HM, HC, DD
CR11	13	388 984	5 682 323	FA, DD
WF01	35	410 896	5 701 992	PSD, FA, HM, HC
WF02	33	407 605	5 701 677	PSD, FA, HM, HC, DD
WF03	31	409 479	5 699 504	PSD, FA, HM, HC, DD
WF04	27	403 369	5 702 450	PSD, FA, HM, HC
WF05	33	409 553	5 697 364	PSD, FA, HM, HC, DD
WF06	19	396 766	5 701 820	PSD, FA, HM, HC
WF07	21	399 039	5 701 228	PSD, FA, HM, HC
WF08	24	399 488	5 698 540	PSD, FA, HM, HC
WF09	21	402 502	5 697 248	PSD, FA, DD
WF10	22	402 736	5 694 915	PSD, FA, DD
WF11	21	405 846	5 694 429	PSD, FA, DD
WF12	20	401 011	5 696 911	PSD, FA, HM, HC, DD
WF14	21	397 125	5 701 160	PSD, FA, HM, HC
WF19	40	410 914	5 700 819	PSD, FA, HM, HC
WF22	21	399 548	5 699 486	PSD, FA, HM, HC
WF25	29	409 744	5 702 768	PSD, FA, HM, HC

Station	Depth [m]	Coordinates ETRS 89UTM 31N		Sample Acquisition
		Easting [m]	Northing [m]	
WF27	21	408 666	5 698 303	PSD, FA, HM, HC
WF29	40	410 568	5 698 486	PSD, FA, HM, HC
WF32	25	401 454	5 701 661	PSD, FA, HM, HC
WF37	25	402 088	5 701 994	PSD, FA, HM, HC
WF41	24	400 227	5 702 752	PSD, FA, HM, HC
WF44	22	406 291	5 693 671	PSD, FA,
WF45	27	408 101	5 693 627	PSD, FA,
WF47	23	398 108	5 702 838	PSD, FA, HM, HC

Notes:
PSD = particle size distribution
FA = faunal sample replicate A
HM = heavy metals
HC = hydrocarbons

Table 5.2: Seabed Video Footage

Station	ETRS 1989 UTM Zone 31N			
	Start of Line		End of Line	
	Easting [m]	Northing [m]	Easting [m]	Northing [m]
CR01	400 783	5 692 253	400 801	5 692 128
CR04	394 684	5 686 756	394 577	5 686 738
CR05	391 576	5 686 782	391 616	5 686 830
CR06	392 571	5 686 733	392 553	5 686 712
CR07	392 018	5 686 658	392 032	5 686 698
CR08	390 118	5 686 667	390 110	5 686 684
CR09	401 564	5 693 683	401 573	5 693 540
CR10	389 727	5 685 962	389 718	5 685 958
CR11	388 995	5 682 291	389 015	5 682 341
WF02	407 549	5 701 724	407 725	5 701 645
WF03	409 459	5 699 440	409 471	5 699 657
WF05	409 555	5 697 282	409 574	5 697 415
WF09	402 532	5 697 181	402 468	5 697 360
WF10	402 765	5 694 948	402 743	5 694 877
WF11	405 882	5 694 457	405 846	5 694 421
WF12	401 067	5 696 857	400 931	5 696 955
WF13	396 476	5 701 587	396 437	5 701 393
WF15	398 772	5 700 295	398 753	5 700 112
WF16	400 568	5 700 390	400 558	5 700 201
WF17	407 143	5 700 483	407 239	5 700 273
WF18	409 061	5 700 675	409 133	5 700 463
WF20	397 913	5 700 067	397 954	5 699 904
WF21	398 495	5 699 369	398 561	5 699 246
WF23	408 183	5 699 105	408 295	5 699 322
WF24	405 726	5 702 645	405 788	5 702 481
WF26	401 146	5 698 693	401 317	5 698 661
WF28	409 732	5 698 308	409 779	5 698 511
WF30	400 161	5 697 417	400 029	5 697 566

Station	ETRS 1989 UTM Zone 31N			
	Start of Line		End of Line	
	Easting [m]	Northing [m]	Easting [m]	Northing [m]
WF31	409 335	5 701 772	409 453	5 701 609
WF33	407 284	5 702 728	407 436	5 702 507
WF34	401 863	5 695 716	401 839	5 695 858
WF35	403 243	5 696 051	403 209	5 696 177
WF36	409 610	5 696 189	409 633	5 696 266
WF38	405 180	5 694 973	405 139	5 694 934
WF39	407 814	5 694 894	407 816	5 694 825
WF40	403 828	5 694 248	403 787	5 694 210
WF42	409 042	5 694 461	409 126	5 694 586
WF43	404 993	5 693 712	404 959	5 693 664
WF46	407 472	5 693 238	407 431	5 693 208

5.2 Seabed Video Footage and Photographic Stills Analysis

Underwater visibility was very poor at the time of the survey, consequently, only a general, qualitative description of the seabed sediment could be made. At station CR10, lack of underwater visibility prevented any assessment of the seabed physical and biological features. A summary of the video footage assessment is presented in this section together with selected representative images (Figure 5.1). Details of the assessment are presented in Annex F.1.

The seabed sediments at stations along the cable route comprised predominantly of sand, with shell fragments, pebbles and cobbles (CR01, CR04, CR05, CR07, CR09); pebbles and cobbles only characterised station CR06, whereas muddy sand characterised stations CR11 and CR08, the latter also comprising pieces of clay. Epibiota at these station comprised of starfish (*Asterias rubens* and unidentifiable species of the Asteroidea class), sea anemones (species of the Actiniaria order, and *Urticina felina*), soft corals (*Alcyionium digitatum*), polychaetes (*Spirobranchus*), turfs of unidentifiable hydrozoans and/or bryozoans, hermit crabs (Paguridae), mussels (*Mytilus edulis*), sponges (Porifera), the brittlestar *Ophiotrix fargilis* and the erect bryozoan *Flustra foliacea*.

Stations within the proposed extension wind farm site comprised predominantly of sand with shell fragments and less often shells; at selected stations (WF10, WF11, WF12, WF26, WF28, WF34, WF35, WF40, WF42 and WF43), pebbles and cobbles were observed in addition to sand and shells, whereas station WF36 comprised of sand overlaying chalk. Pieces of chalk were also observed at stations WF34 and WF35.

Stations featuring sand and shells fragments comprised little epibiota, characterised by species of Asteroidea, Ophiuroidea, Actiniaria, *Spirobranchus*, Paguridae and *Calliostoma*). Stations featuring pebbles and cobbles comprised more epibiotic taxa, which included additional species such as: *Alcyonium digitatum*, the sea urchin *Psammechinus miliaris*, *U. felina*, Porifera, crustacean decapods (*Brachyura*), and fish. Hydrozoan and/or bryozoan turfs were recorded across the survey area. The ross worm *S. spinulosa* was recorded at six stations, four of which (WF02, WF23, WF28 and WF46) were characterised by sandy sediments.

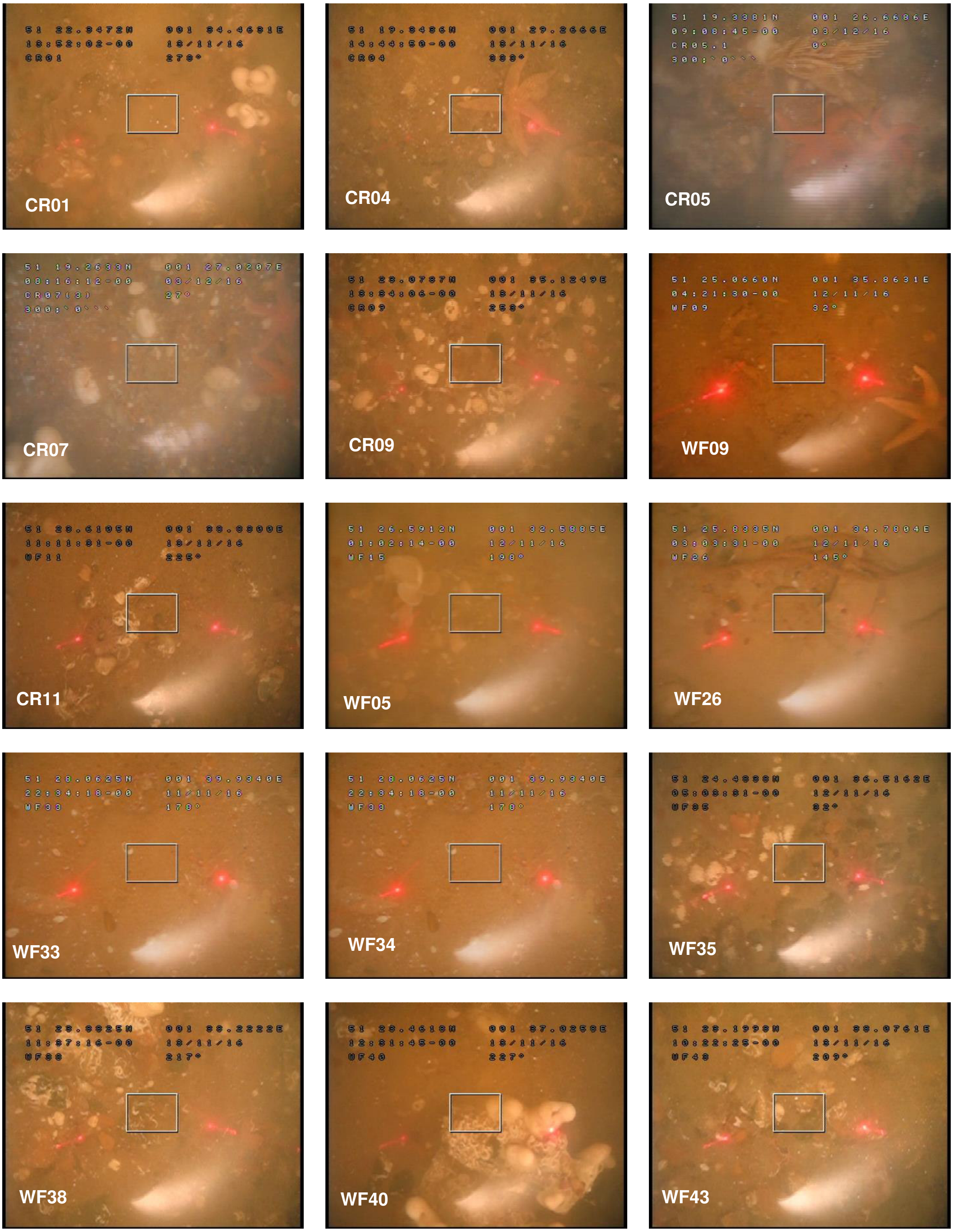


Figure 5.1: Representative images from seabed video footage

5.2.1 *Sabellaria* and Chalk Reef Assessment

Of the 39 stations assessed by video footage, two, namely WF28 and WF46, were further assessed for potential *S. spinulosa* reef presence, whereas station WF36 was assessed for potential chalk reef, in line with the methods detailed in section 4.6.2 of this report. Details of the full assessment are presented in Annex F.2.

Station WF28 comprised of sand with patches of pebbles and shells. *S. spinulosa* was observed at this station both in small clumps and large clumps of upright intertwined tubes, some of which were embedded in the sand, whilst others appeared to be moribund. The elevation of the tubes from the sediment varied along the transect, ranging between less than 2 cm and more than 5 cm, with an average height estimated in the range of 3 cm, and a patchiness of 12 % along the transect. The overall assessment of potential *S. spinulosa* reef at station WF28 was LOW (Table 5.3).

Station WF46 comprised of sand with shell fragments. *S. spiunulosa* was observed at this station in small clumps, mostly embedded in the sand, with moribund tubes also present. The elevation of the tubes from the seabed was less than 2 cm, with a patchiness of 7 % along the transect. The overall assessment of potential *S. spinulosa* reef at station WF46 was NOT REEF (Table 5.3).

Station WF36 comprised of sand overlaying chalk. The seabed showed low relief throughout the transect and, where visible, the chalk appeared bored with holes, the nature of which could not be further assessed due to poor visibility. No visible epibiota other than star fish (Asteroidea) were observed. The flat seabed and lack of distinctness from the surrounding seabed, resulted in an overall assessment of NOT REEF (Table 5.4).

Table 5.3: Potential *Sabellaria* Reef Assessment

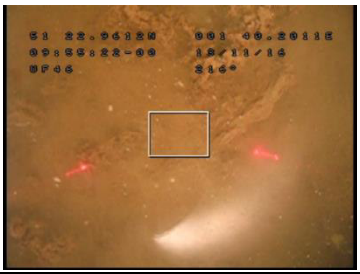
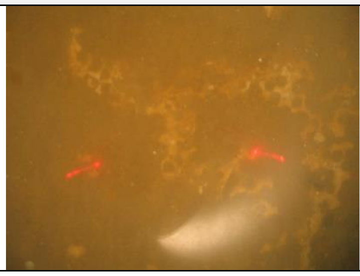
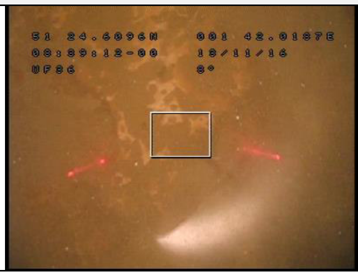
Station	Assessment Criteria		Representative Image	
WF28	Elevation:	LOW		
	Patchiness:	LOW		
	Consolidation	LOW/MED		
	Overall Assessment	LOW REEF		
WF46	Elevation	NOT REEF		
	Patchiness	NOT REEF		
	Consolidation	NOT REEF		
	Overall Assessment	NOT REEF		

Table 5.4: Chalk Reef Assessment

Station	Seabed Description	Overall Assessment	Representative Image
WF36	Low relief seabed of sand overlaying chalk. No fauna visible other than star fish	NOT REFF	 

5.3 Sediment Particle Size Distribution (PSD)

Sediments across the survey area comprised a mix of Folk (1954) classes, including: gravel (7 %), gravelly muddy sand (4 %), muddy sandy gravel (7 %), sandy gravel (15 %), slightly gravelly muddy sand (41 %) and slightly gravelly sand (26 %) (Figure 5.2).

Results of the particle size distribution analysis are summarised in Table 5.5 and Table 5.6, and graphically represented in Figure 5.3 and Figure 5.4. Full results are presented in Annex D.

Samples' sorting coefficient ranged from moderately well sorted (11 % of samples) to very poorly sorted (48 % of samples), with the remaining samples being moderately sorted (7 %) and poorly sorted (33 %).

The majority of samples were very fine skewed (67 %), with the remaining being coarse skewed (15 %), fine skewed (7 %), symmetrical (7 %) and very coarse skewed (4 %) (Table 5.5).

Levels of gravel were between 0.3 % (WF06) and 87.4 % (WF10), with an average of 20.2 % across the survey area. High percentages of gravel were also recorded at site CR02 (87 %) and station WF11 (74.6 %).

Sand levels were between 11.7 % (WF10) and 99.5 % (CR10), average 70.8 % across survey area. High percentages of sand were also recorded at stations CR03 (98.9 %), WF05 (96.8 %), WF25 (95.4 %) and WF29 (97.7 %).

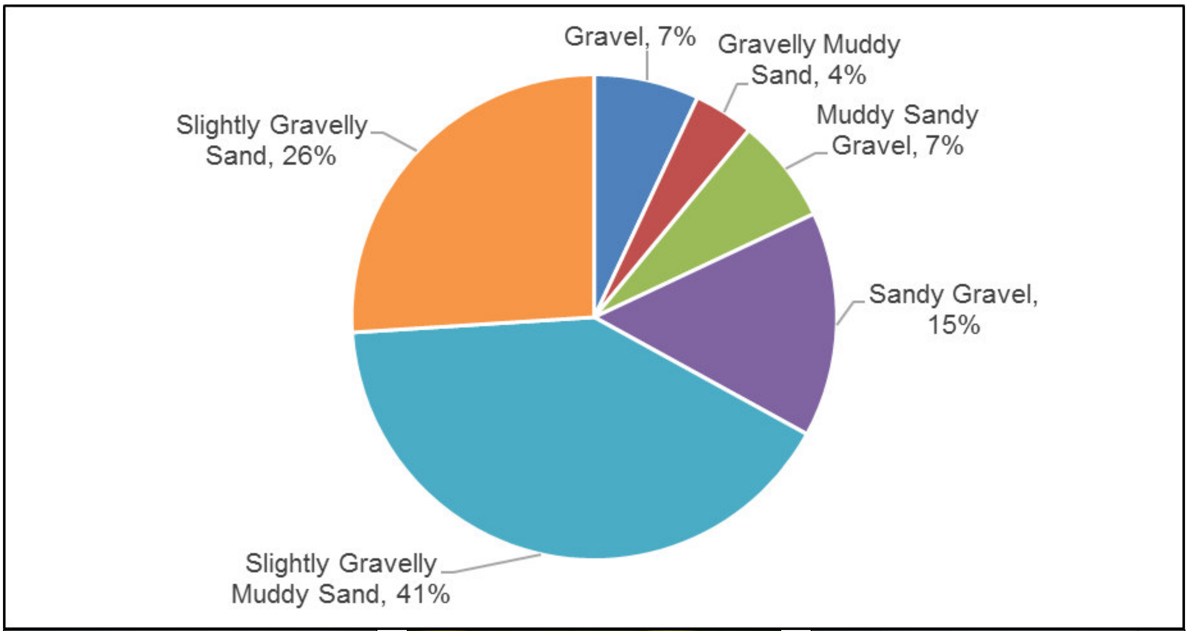
Mud levels, where present, were generally low, with values of between 0.8 % (CR02) and 24 % (WF47), averaging 11 % across the survey area. Relatively high percentages of mud were also recorded at station WF27 (23.9 %), whereas samples from stations CR03, CR10, WF01, WF25 and WF29 showed no mud content.

In general, the seabed sediments across the survey area were highly heterogeneous, however, an overall pattern of sediment distribution could be identified with coarser sediments characterising stations to the south-west of the proposed wind farm extension area and parts of the cable route, whereas sandier sediments characterised the most offshore stations (Figure 5.3).

Investigation of sediment particle size modal distribution showed that of the 27 samples analysed, 21 (78 %) exhibited unimodal distribution, 5 (19 %) showed bimodal distribution and 1 (4 %) showed trimodal distribution. The majority of samples (56 %) peaked in the medium sand region (1.5 phi), 22 % peaked in the fine sand region (2.5 phi) and 15 % peaked in the coarse gravel region (-5.48 phi), with the remaining 2 samples (4 %) peaking in the very coarse (-6.24 phi) and medium gravel (-4.49 phi) regions. Additional peaks were recorded in the very fine sand region (3.5 phi) for samples with multimodal distribution (Table 5.6). Information from the in-situ sample description showed that patches of anoxic sediment were recorded in 14 samples (Table 5.5).

Organic content, in the form of total organic matter (TOM), was between 0.52 % (CR03) and 1.51 % (WF03), with an average of 1.05 % across the survey area. A broad pattern of spatial distribution between organic content and particle sediment size was identified, with the results of the correlation analysis showing moderate correlation (rho = 0.577) between percentage of mud and TOM.

The distribution of sediments across the survey was not correlated with depth, the highest value of correlation coefficient (rho = 0.319) being recorded with sand.




Gravel (CR02)


Gravelly Muddy Sand (WF07)


Muddy Sandy Gravel (WF09)


Sandy Gravel (WF01)


Slightly Gravelly Muddy Sand (WF41)


Slightly Gravelly Sand (CR03)

Figure 5.2: Sediment classes (Folk, 1954) across survey area

Table 5.5: Seabed Sediment Classification and Description

Station	Sediment Classification		Sorting	Skewness	In-situ Sediment Description
	Folk (1954)	Wentworth			
CR01	Sandy Gravel	Pebble	Very Poorly Sorted	Very Fine Skewed	Cobbles, pebbles, gravelly muddy Sand
CR02	Gravel	Pebble	Very Poorly Sorted	Very Fine Skewed	Cobbles, pebbles, gravelly sand
CR03	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Symmetrical	Fine sand; very little shell fragments
CR10	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Coarse skewed	Sand with few shell fragments
WF01	Sandy Gravel	Very Coarse Sand	Very Poorly Sorted	Very Coarse Skewed	Fine sand; pebbles
WF02	Slightly	Medium	Poorly Sorted	Very Fine	Fine sand; clay and shell

Station	Sediment Classification		Sorting	Skewness	In-situ Sediment Description
	Gravelly Muddy Sand	Sand		Skewed	fragments; patches of anoxic sediment
WF03	Slightly Gravelly Muddy Sand	Fine Sand	Very Poorly Sorted	Very Fine Skewed	Muddy sand; few pebbles; black mud nodules; patches of anoxic sediment
WF04	Slightly Gravelly Muddy Sand	Fine Sand	Very Poorly Sorted	Very Fine Skewed	Fine sand overlaying clayey silt
WF05	Slightly Gravelly Sand	Medium Sand	Moderately Sorted	Symmetrical	Fine to medium sand over clay
WF06	Slightly Gravelly Muddy Sand	Fine Sand	Poorly Sorted	Very Fine Skewed	Silt with shell fragments
WF07	Gravelly Muddy Sand	Fine Sand	Very Poorly Sorted	Fine Skewed	Fine sand overlaying clayey silt
WF08	Slightly Gravelly Muddy Sand	Fine Sand	Poorly Sorted	Very Fine Skewed	Fine sand overlaying silt; patches of anoxic sediment
WF09	Muddy Sandy Gravel	Pebble	Very Poorly Sorted	Very Fine Skewed	Cobbles, pebbles and muddy gravelly sand
WF10	Gravel	Pebble	Poorly Sorted	Very Fine Skewed	Cobbles, pebbles and muddy gravelly sand
WF11	Sandy Gravel	Pebble	Very Poorly Sorted	Very Fine Skewed	Pebbles and gravelly muddy sand; patches of anoxic sediment 1 cm
WF12	Sandy Gravel	Pebble	Very Poorly Sorted	Very Fine Skewed	Large cobbles and muddy gravelly sand
WF14	Slightly Gravelly Muddy Sand	Very Fine Sand	Poorly Sorted	Very Fine Skewed	Fine sand overlaying clayey silt
WF19	Slightly Gravelly Sand	Medium Sand	Poorly Sorted	Fine Skewed	Muddy sand with some shell fragments; patches of anoxic sediment
WF22	Muddy Sandy Gravel	Coarse Sand	Very Poorly Sorted	Coarse Skewed	Silt with gravel, pebbles and cobbles; patches of anoxic sediment
WF25	Slightly Gravelly Sand	Medium Sand	Moderately Sorted	Coarse Skewed	Fine sand and shell fragments
WF27	Slightly Gravelly Muddy Sand	Fine Sand	Very Poorly Sorted	Very Fine Skewed	Fine/medium sand over grey/black stiff sandy mud
WF29	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Coarse Skewed	Slightly muddy fine to medium sand; some pebbles and 1 cobble; patches of anoxic sediment
WF32	Slightly Gravelly Muddy Sand	Fine Sand	Poorly Sorted	Very Fine Skewed	Fine sand overlaying clayey silt; patches of anoxic sediment
WF37	Slightly Gravelly Muddy Sand	Fine Sand	Poorly Sorted	Very Fine Skewed	Fine sand overlaying clayey silt; patches of anoxic sediment
WF41	Slightly Gravelly Muddy Sand	Very Fine Sand	Very Poorly Sorted	Very Fine Skewed	Fine sand overlaying clayey silt; patches of anoxic sediment
WF45	Slightly Gravelly Sand	Medium Sand	Poorly Sorted	Very Fine Skewed	Slightly muddy fine to medium sand; some pebbles present; patches of anoxic sediment
WF47	Slightly Gravelly Muddy Sand	Very Fine Sand	Very Poorly Sorted	Very Fine Skewed	Silt clay with shell fragments; patches of anoxic sediment

Table 5.6: Particle Size Distribution and Organic Content

Station	Depth [m]	Median [µm]	Mode 1	Mode 2	Mode 3	Fractional Composition			TOM [%]
			Phi	Phi	Phi	Gravel [%]	Sand [%]	Mud [%]	
CR01	16	-6.1	-5.48	-3.50	1.5	73.5	24.7	1.8	1.11
CR02	13	0.3	-6.24	-	-	87.0	12.2	0.8	1.15
CR03	12	2.9	1.50	-	-	1.1	98.9	0.0	0.52
CR10	8	2.9	1.50	-	-	0.5	99.5	0.0	0.81
WF01	35	-6.1	1.50	-3.5	-	30.4	69.6	0.0	0.66
WF02	33	0.3	1.50	-	-	4.6	81.0	14.4	1.24
WF03	31	2.9	1.50	-	-	2.9	78.8	18.3	1.51
WF04	27	2.9	1.50	-	-	0.5	81.6	17.9	1.34
WF05	33	-6.1	1.50	-	-	0.9	96.8	2.3	0.83
WF06	19	0.3	1.50	-	-	0.3	87.5	12.1	1.14
WF07	21	2.9	2.50	-	-	7.2	78.3	14.5	1.29
WF08	24	2.9	1.50	-	-	1.0	85.3	13.6	1.25
WF09	21	-6.1	-5.48	1.50	-	59.2	34.6	6.2	1.43
WF10	22	0.3	-5.48	-	-	87.4	11.7	0.9	1.15
WF11	21	2.9	-5.48	1.5	-	74.6	23.6	1.8	1.15
WF12	20	2.9	-4.49	1.5	-	65.9	31.8	2.3	1.19
WF14	21	-6.1	2.50	-	-	1.3	79.6	19.1	1.30
WF19	40	0.3	1.50	-	-	3.5	88.9	7.5	0.79
WF22	21	2.9	2.50	-3.50	-	30.8	60.5	8.7	1.34
WF25	29	2.9	1.50	-	-	4.6	95.4	0.0	0.69
WF27	21	-6.1	1.50	-	-	1.3	74.9	23.9	1.01
WF29	40	0.3	1.50	-	-	2.3	97.7	0.0	0.60
WF32	25	2.9	2.50	-	-	0.4	87.8	11.8	0.94
WF37	25	2.9	1.50	-	-	0.4	85.3	14.3	0.97
WF41	24	-6.1	2.50	-	-	1.2	80.3	18.5	1.11
WF45	27	0.3	1.50	-	-	1.7	90.5	7.8	0.67
WF47	23	2.9	2.50	-	-	0.9	75.1	24.0	1.22
Summary Statistics									
Min	8	-6.1	-6.24	-3.50	NA	0.3	11.7	0.0	0.52
Mean	24	0.3	0.18	-1.00	NA	20.2	70.8	9.0	1.05
Max	40	2.9	2.50	1.50	NA	87.4	99.5	24.0	1.51
SD	8	2.9	3.10	2.74	NA	31.0	27.8	8.0	0.27

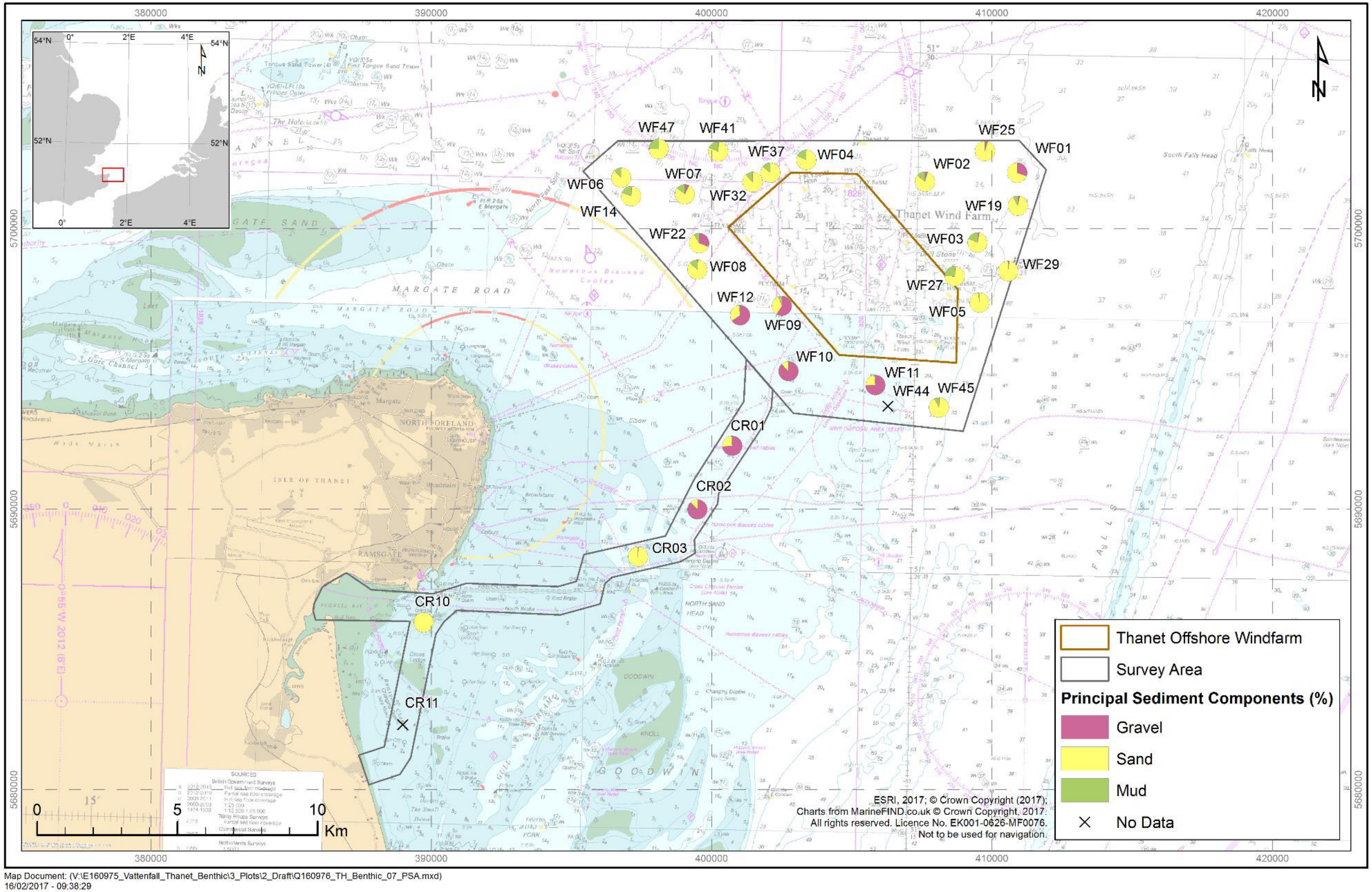


Figure 5.3: Spatial distribution of sediment particle size

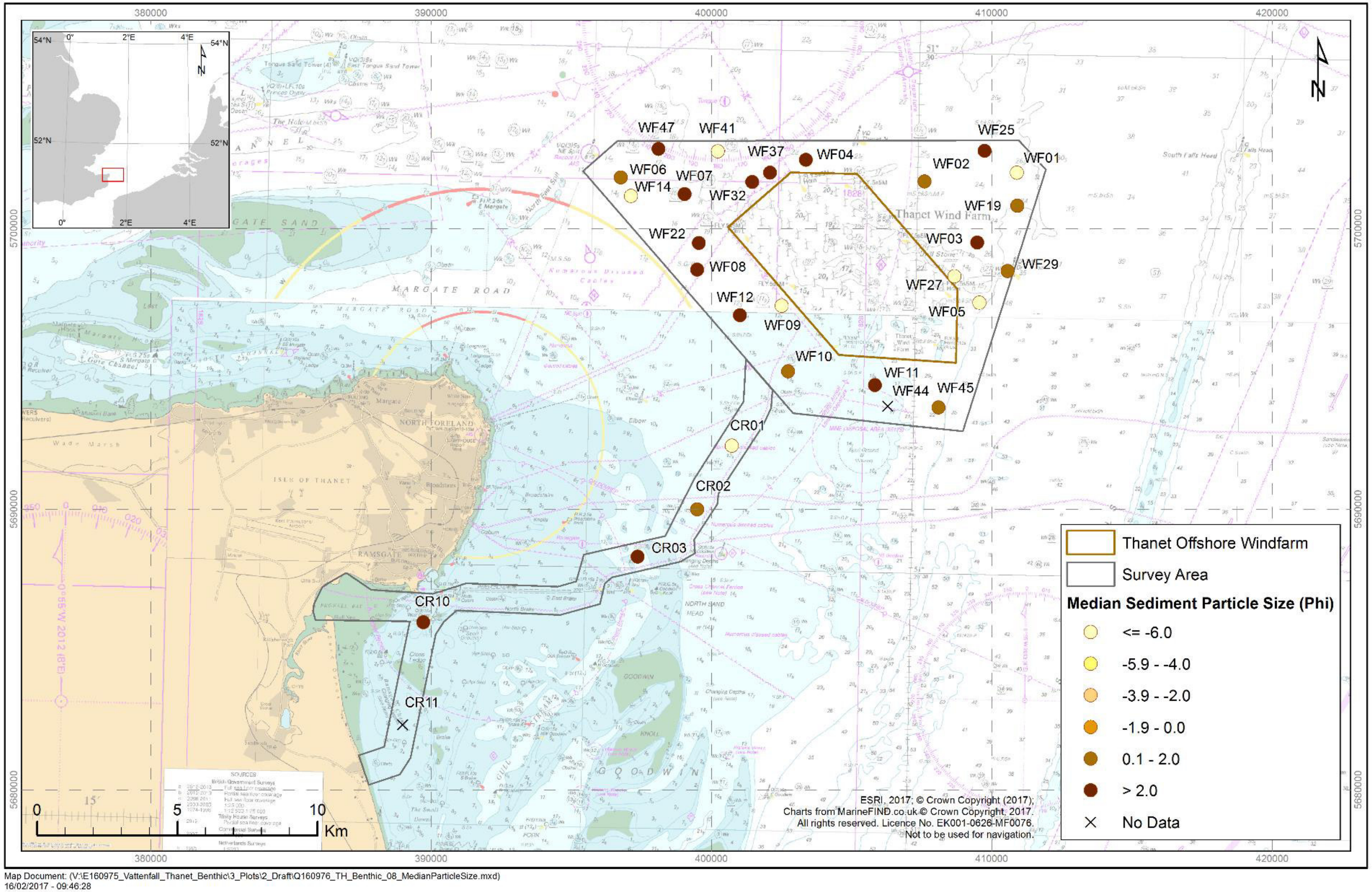
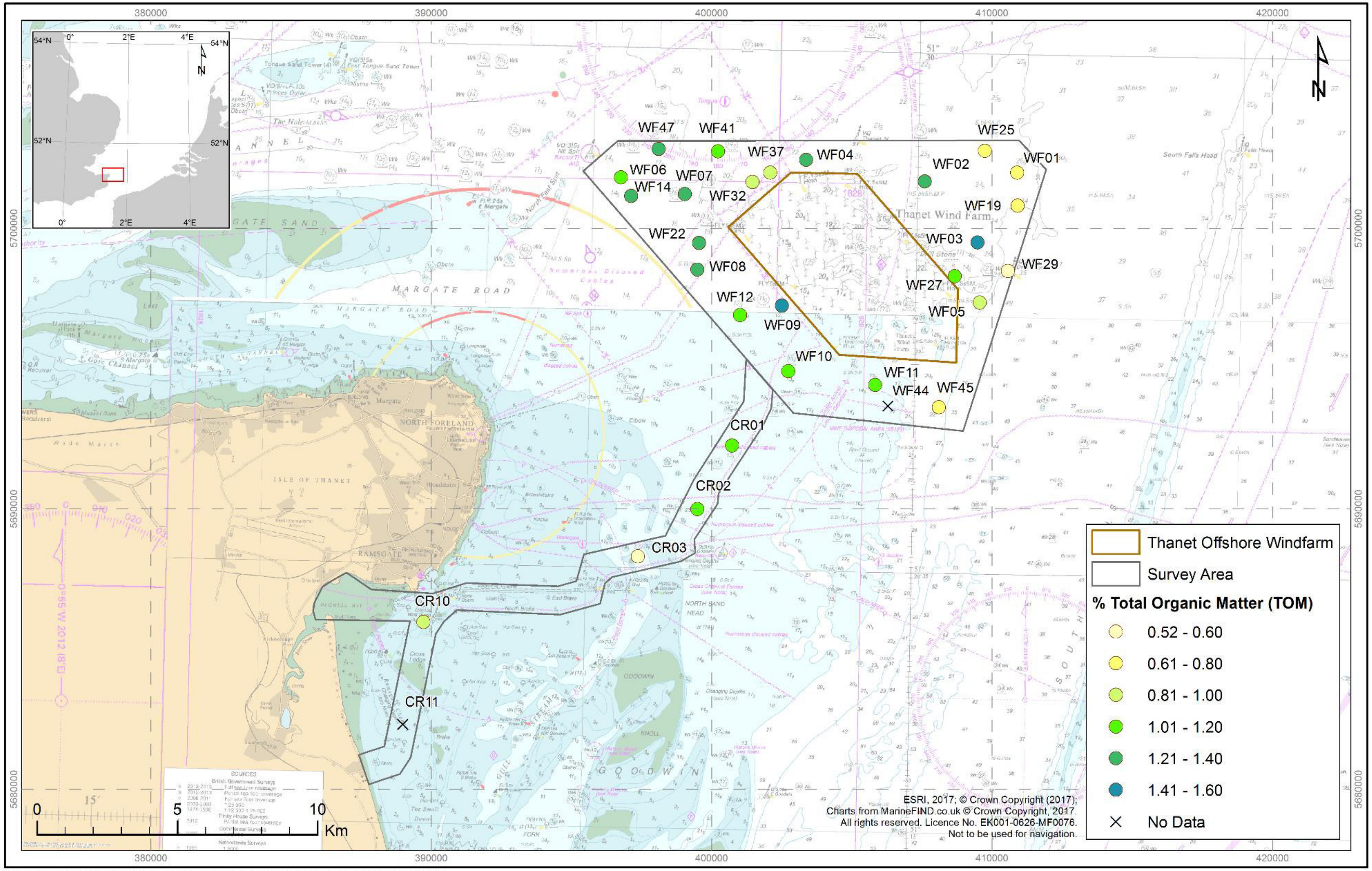


Figure 5.4: Spatial distribution of median (d_{50}) sediment particle size



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16/02/2017 - 09:49:35

Figure 5.5: Spatial distribution of total organic matter (TOM)

5.3.1 Multivariate Analysis

Multivariate analysis was undertaken on the sediment particle size data set in order to identify spatial patterns of distribution in the sediment composition. Analysis included hierarchical agglomerative clustering employing the Euclidean distance resemblance matrix and the principal component analysis (PCA). Data were square root transformed prior to analysis being undertaken.

5.3.1.1 Hierarchical Agglomerative Clustering Analysis

Results of the hierarchical agglomerative clustering analysis identified four groups of samples and a single sample which was different enough to remain separate (Figure 5.6 and Figure 5.7). The characteristics of each group are summarised in Table 5.7 and graphically displayed in Figure 5.8.

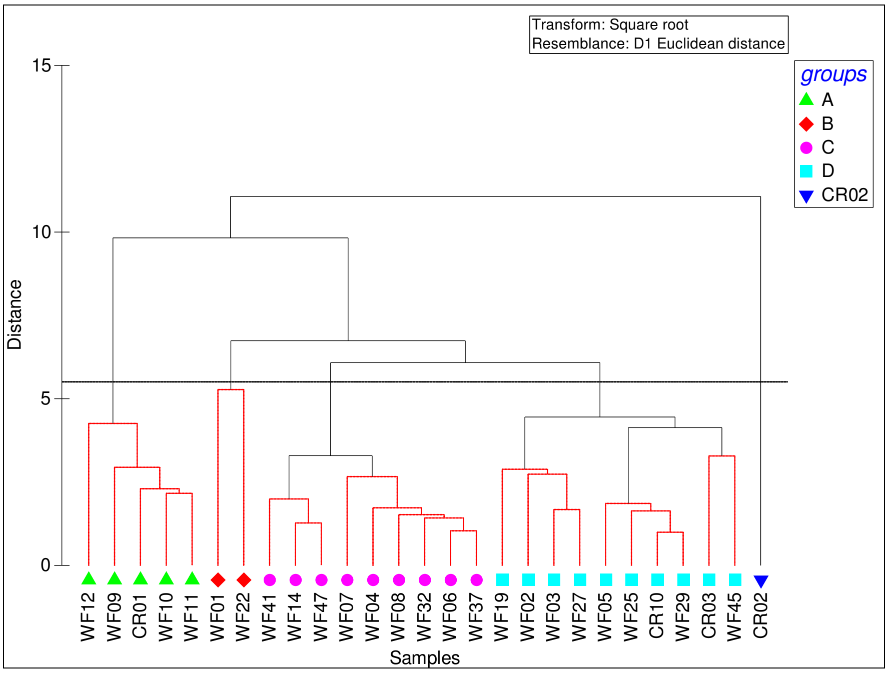


Figure 5.6: Dendrogram of Euclidean distance of sediment particle size

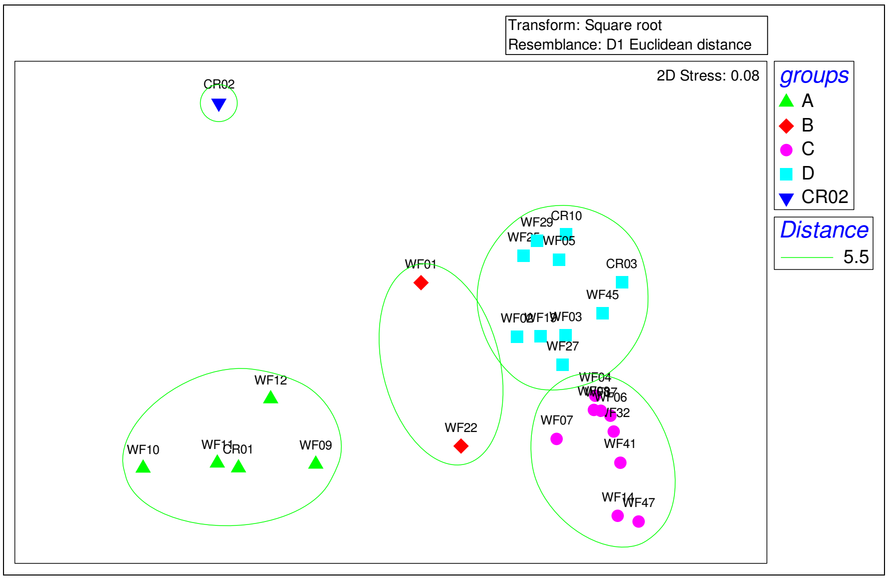
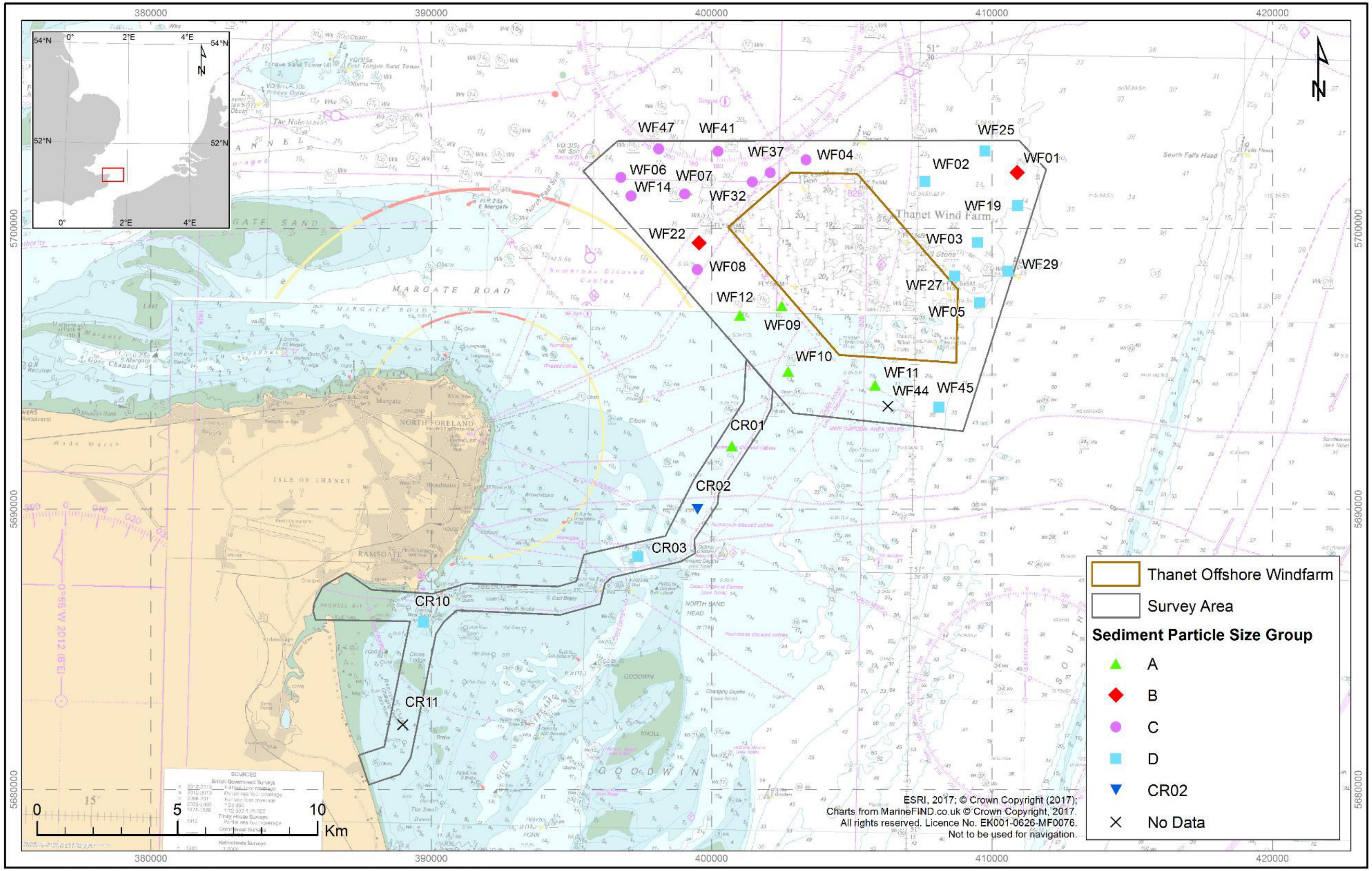


Figure 5.7: MDS of Euclidean distance of sediment particle size



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16/02/2017 - 09:50:05

Figure 5.8: Sediment groups identified by the multivariate analysis

Group A comprised five samples, to include: one from stations within the most offshore section of the cable route and four from stations within the southern section of the proposed windfarm extension. It was characterised by sandy gravel, poorly sorted, in mean water depth of 20 m, featuring a mean median sediment particle of -4.71 phi (coarse gravel) (Table 5.7). Group A showed a bimodal distribution, with a major peak in the coarse gravel region (-5 phi) and a second minor peak in the fine sand region (2 phi) (Figure 5.9). The coarse gravel sediment particle was primarily responsible for the separation of this group of samples (Figure 5.10).

Group B comprised two samples from stations within the north east area of the proposed windfarm extension. It was characterised by gravelly sand, very poorly sorted, in mean water depth of 28 m and with mean median particle size of 1.28 phi (medium sand) (Table 5.7). It showed a bimodal distribution with a major peak in the fine sand region (2 phi) and minor peak in the medium (-4 phi) to fine (-3 phi) gravel region (Figure 5.9), the latter being primarily responsible for the separation of this group of samples (Figure 5.8).

Group C comprised eight samples from stations within the proposed wind farm extension. It was characterised by muddy sand, poorly sorted, in mean water depth of 23 m and a mean median particle size of 2.36 phi (fine sand) (Table 5.7). It showed unimodal distribution with a peak in the very fine sand region (3 phi) (Figure 5.9), which was primarily responsible for the separation of this group of samples (Figure 5.10).

Group D comprised nine samples, to include: two from stations within the cable corridor and seven within the proposed windfarm extension. It was characterised by muddy sand, poorly sorted, in mean water depth of 27 m and with a mean median particle size of 1.45 phi (medium sand) (Table 5.7). It showed unimodal distribution with a peak in the fine sand region (2 phi) (Figure 5.9), which was primarily responsible for the separation of this group of samples (Figure 5.10).

Finally, the single sample was from station CR02 along the cable route. It featured sandy gravel, very poorly sorted, in 13 m water depth, with median particle size of -6.08 (very coarse gravel) (Table 5.7). It showed unimodal distribution peaking in the very coarse gravel (-6 phi) (Figure 5.9) which caused this sample to be separate from the other groups (Figure 5.10).

Table 5.7: Groups of Sediment Samples Identified by the Multivariate Analysis

Group	Station	Depth [m]	Median [phi]	Main Sediment Fraction [%]			Description
				Gravel	Sand	Mud	
A ▲	CR01; WF (09,10,11,12)	20 ± 2	-4.71 ± 0.5	72 ± 11	25 ± 9	3 ± 2	Sandy Gravel, very poorly sorted
B ◆	WF (01,22)	28 ± 10	1.28 ± 0.3	31 ± 0	65 ± 6	4 ± 6	Gravelly sand, very poorly sorted
C ●	WF (04, 06, 07, 14, 32, 37, 41, 47)	23 ± 2	2.36 ± 0.3	1 ± 2	82 ± 4	16 ± 4	Muddy Sand, poorly sorted
D ■	CR (03, 10) WF (02, 03, 05, 19, 25, 27, 29, 45)	27 ± 11	1.45 ± 0.2	2 ± 2	90 ± 9	7 ± 9	Muddy Sand, poorly sorted
CR02 ▼	CR02	13	-6.08	87	12	1	Sandy Gravel, very poorly sorted

Sediment PSD of Multivariate Groups | **Representative Photo**

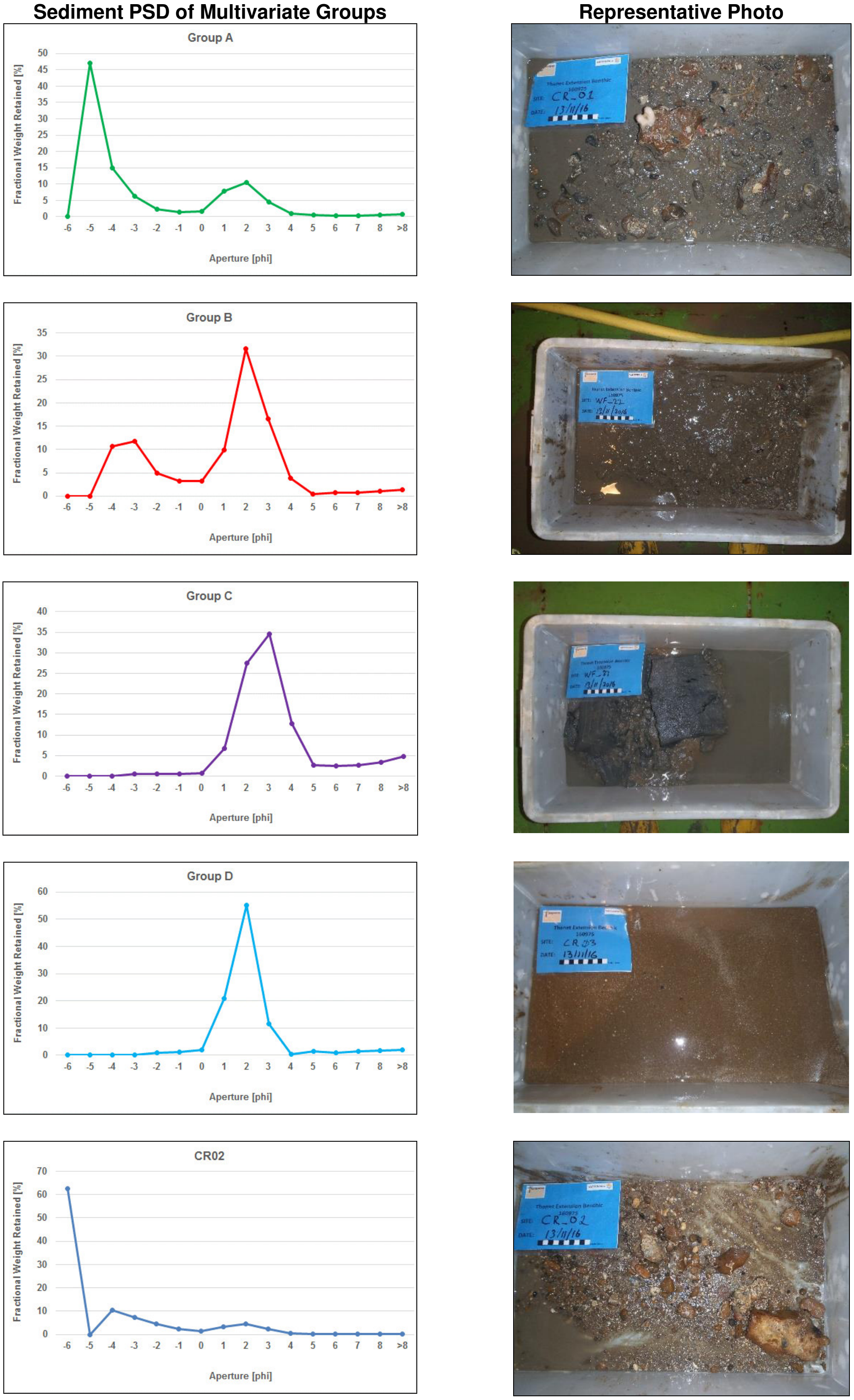


Figure 5.9: Average particle size distribution within multivariate groups of samples

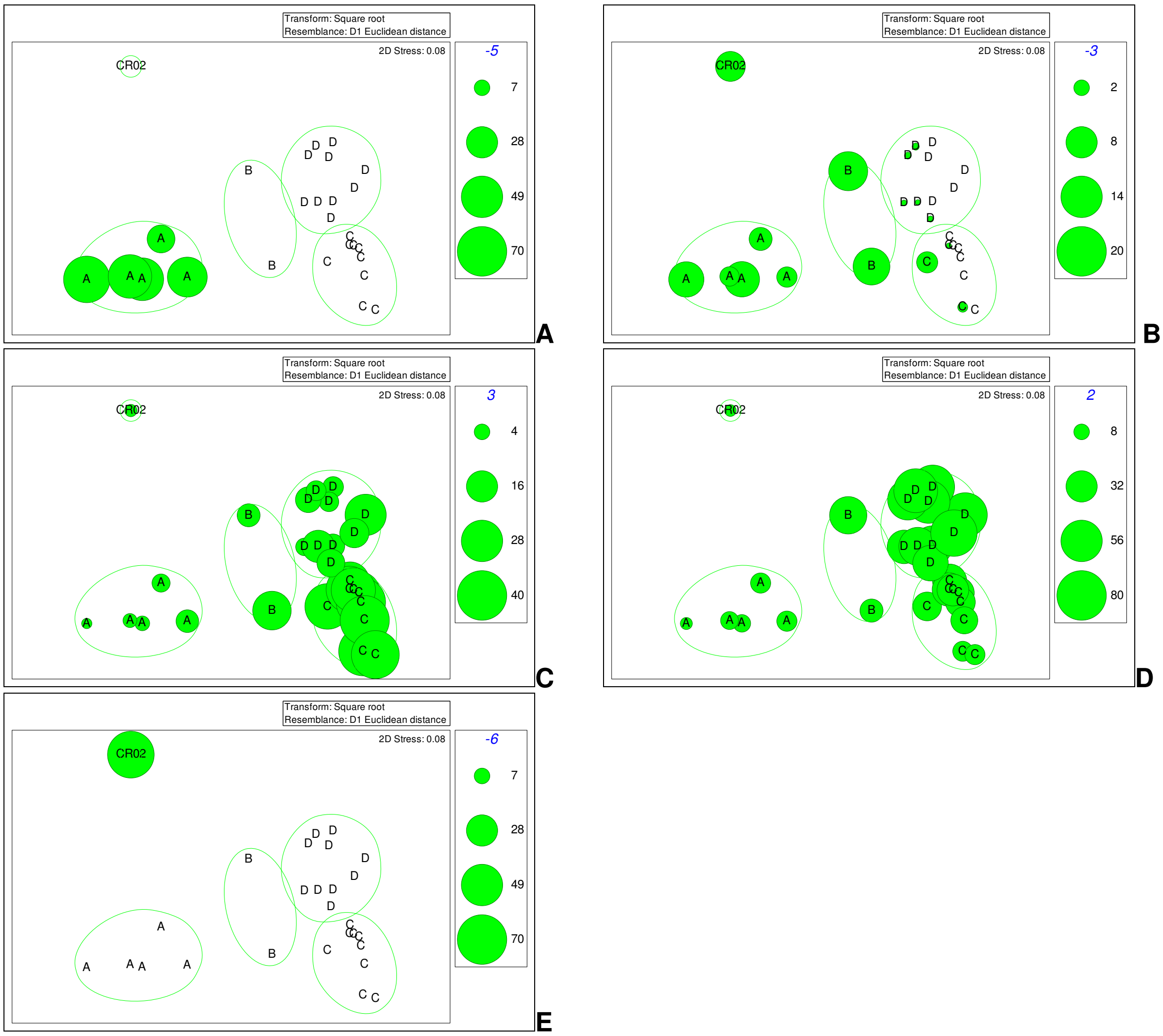


Figure 5.10: MDS of Euclidean distance. Data with superimposed circles proportional in diameter to the percentage of: coarse gravel (-5 phi) (A); fine gravel (-3 phi) (B); very fine sand (3 phi) (C); fine sand (2 phi); and very coarse gravel (-6 phi) (E)

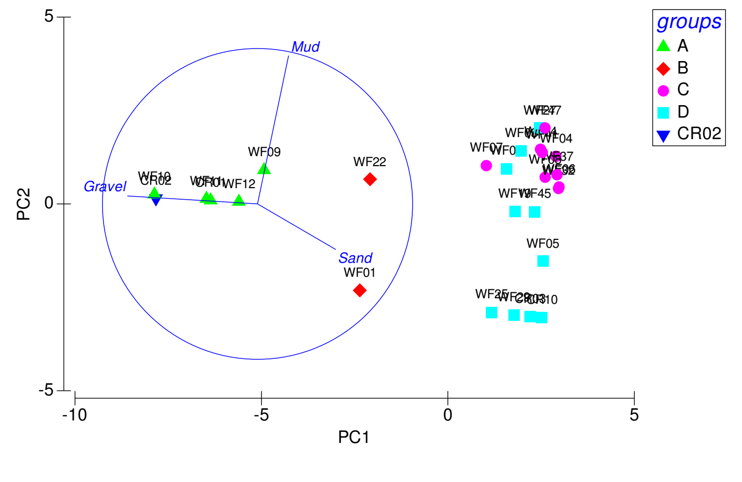
5.3.1.2 Principal Component Analysis

The Principal Component Analysis (PCA) was undertaken on the major sediment fractions (gravel, sand and mud), in order to identify the variables primarily responsible for the variation in particle size distribution across the survey area.

Results are illustrated in Figure 5.11. The first two components accounted for 99 % of the variation, with the greatest variation along PC1 (84.5 %) being explained by the percentage of gravel; percentage of mud was responsible for the greatest variation along PC2, the contribution of which was 14.4 %, whereas sand accounted for the greatest variation along PC3, the contribution of which was just 1.1 %. Variations in gravel and, to a less extent, mud content were therefore the two variables responsible for the variation in sediment composition across the survey area.

This is illustrated in Figure 5.11, which shows results of the PCA with superimposed groups identified by the clustering analysis (see section 5.3.1.1) and location of sampling stations in relation to the wind farm area (WF) and the cable corridor (CR).

A broad pattern of sediment distribution could be identified within the survey area, with the most offshore stations being characterised by finer sediment particles than those nearshore. The sediment sorting coefficient reflected the heterogeneity of the sediment, with the predominantly sandy sediments being moderately well, to moderately sorted, and the coarser mixed sediments being poorly, to very poorly, sorted (Figure 5.12).

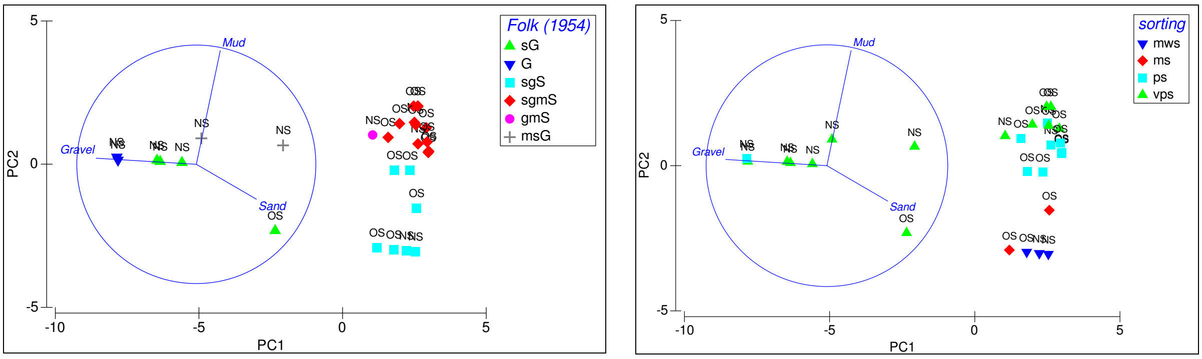


PC	% Variation
1	84.5
2	14.1
3	1.1

Coefficients in the linear combinations of variables making up PC's

Variable	PC1	PC2	PC3
% Gravel	-0.840	0.051	0.540
% Sand	0.504	-0.294	0.812
% Mud	0.200	0.955	0.221

Figure 5.11: Two-dimensional representation of the PCA of sediment composition



NS = nearshore; OS = offshore; vps=very poorly sorted; ps=poorly sorted; ms=moderately sorted; mws = moderately well sorted; mS = muddy Sand; sgmS = slightly gravelly muddy Sand; sgS = slightly gravelly Sand; gmS = gravelly muddy Sand; gS = gravelly Sand; sgS = slightly gravelly Sand; sM=sandy Mud; sG = sandy Gravel; msG = muddy sandy Gravel; G= Gravel

Figure 5.12: Two-dimensional representation of the PCA of sediment composition: data with superimposed sediment classification (Folk, 1954) and sorting

5.4 Macrofauna from Grab Samples

The invertebrate fauna from the grab samples included infauna and epifauna, the latter comprising sessile solitary and colonial organisms. Sessile solitary epifauna were identified to the lowest taxonomic level and enumerated; sessile colonial epifauna were equally identified to the lowest taxonomic level and recorded as present/absent only. For analytical purposes, the infauna and the sessile solitary epifauna were combined and assessed together as enumerated fauna in terms of species diversity, abundance and distribution, whereas the colonial epifauna were assessed separately, providing information on species diversity and distribution. Full species lists of fauna and epifauna from the grab samples are presented in Annexes D.3 and D.5.

5.4.1 Enumerated Fauna

Following the rationalisation process (detailed in section 4.3.1), the enumerated benthic fauna from grab samples comprised a total of 170 taxa, represented by 2807 individuals. These included three taxa of solitary epifauna comprising 283 individuals. The removed taxa comprised juveniles (13 taxa and 410 individuals), taxa of indeterminate identity (5 taxa and 6 individuals), 2 damaged taxa each comprising 1 individual and 3 species aggregated to their respective higher taxa.

Of the juveniles, echinoderms of the Ophiuroidea class were numerically dominant (359 individuals), followed by bivalve molluscs of *Nucula* and *Abra* genera (37individuals).

Sample from station CR11 was of low volume (< 5 litres), however, taxonomic analysis showed this sample to comprise 36 species and 147 individuals, compared to an average of 27 species and 104 individuals across the survey area, and was therefore considered to be representative of the macrofauna at this station, and included in the analysis.

5.4.1.1 Phyletic Composition

The phyletic composition of the enumerated benthic fauna is summarised in Table 5.8 and graphically represented in Figure 5.13. Values refer to total number of taxa and abundance across the survey area.

Annelida were dominant in terms of taxa composition, accounting for 46 % of the infaunal diversity, followed by Crustracea (22 %) and Mollusca (20 %), whereas Echinodermata and other taxa comprised 5 % and 7 %, respectively, of the infaunal diversity.

Annelida were also dominant in terms of abundance (53 %), followed by the Mollusca (21 %) and other taxa (13 %). Crustacea comprised 6 % of the infaunal abundance and Echinodermata 7 %.

Table 5.8: Phyletic Composition of Enumerated Fauna from Grab Samples

Taxonomic Group	Number of Taxa	Abundance (Number of Individuals)
Annelida (Polychaete (bristle worms) and Oligochaetes	77	1498
Crustacea (shrimps, prawn, crabs)	38	165
Mollusca (bivalves, chitons)	35	595
Echinodermata (sea urchins, brittlestars, starfish)	8	187
Other Taxa (flatworms, peanut worms, sea spiders etc.)	12	362
TOTAL	**170**	**2807**
Total Infaunal	**167**	**2524**
Total Solitary Epifauna	**3**	**283**

Notes:
'Other Taxa' included Actiniaria, Platyheminthes, Nemertea, Chaetognata, Pycnogonida, Sipuncula, Enteropneusta, Tunicata, Barnacles
Values refer to total number of taxa and abundance across the survey area.

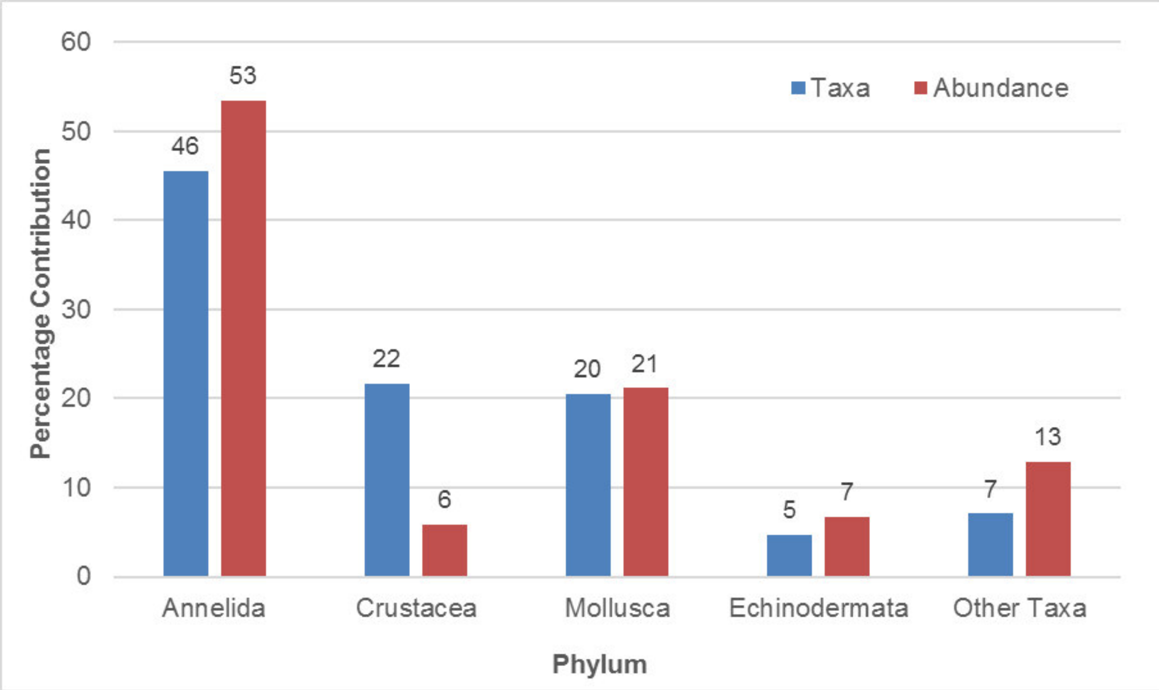


Figure 5.13: Phyletic composition of enumerated fauna from grab samples

Amongst the annelids, *Sabellaria spinulosa* was numerically dominant (298 individuals), together with *Euclymene oerstedii* (231 individuals). The latter was also the most frequently occurring, being recorded in 48 % of samples, whereas *S. spinulosa* occurred in 33 % of samples. *Spiophanes bombyx*, with 136 individuals, *Lagis koreni* with 97 and *Owenia borealis* with 96, featured within the top 5 most abundant annelids. These species showed frequency of occurrence of between 37 % (*L. koreni*) and 41 % (*S. bombyx* and *O. borealis*). *Pholoe baltica* with 38 individuals, *Ampharete lindstroemi* with 25 individuals, and *Lumbrineris cingulata* with 61 individuals, were amongst the top 5 most frequently occurring annelids, being recorded in up to 48 % of samples.

Crustaceans were dominated by amphipods, including *Urothoe brevicornis* (53 individuals) *Ampelisca diadema* (17 individuals), *Unicola crenatipalma* (10 individuals) and *Leucothoe incisa* (8 individuals). The long-clawed porcelain crab *Pisidia longicornis*, with 13 individuals, featured also amongst the top 5 most abundant crustaceans. The occurrence of these species was restricted across the survey area, with frequency of occurrence of up to 22 % of samples.

Of the molluscs, the bivalve *Kurtiella bidentata* (236 individuals) was by far the most abundant, alone comprising 40 % of mollusc abundance. This species was also the most frequently occurring, being recorded in 48 % of samples. *Nucula nitidosa* (111 individuals), *Tellymia ferruginosa* (79 individuals), *Fabulina fabula* (34 individuals) and *Abra alba* (22 individuals), were within the top 5 most abundant molluscs and were recorded in up to 30 % of samples.

Echinoderms were mainly represented by brittlestars, including *Ophiura albida* (79 individuals), *Amphipolis squamata* (57 individuals) and *O. ophiura* (10 individuals) and by the sea urchin *Echinocardium cordatum* (34 individuals). Of these species, *O. albida* was the most frequently occurring (48 % of samples).

Within the other taxa, sea anemones of the Actiniaria order were by far the most abundant with 278 individuals (77 % of other taxa abundance), across 22 % of samples. Nemertean worms (41 individuals) were the most frequently occurring being recorded in 37 % of samples.

A list of the top ten most abundant and most frequently occurring taxa across the survey area is presented in Table 5.9.

Table 5.9: Top Ten Most Abundant and Frequently Occurring Species of Enumerated Fauna from Grab Samples

Most Abundant Taxa			Most Frequently Occurring Taxa		
Taxon	**Abundance**	**Frequency [% Samples]**	**Taxon**	**Frequency [% Samples]**	**Abundance**
Sabellaria spinulosa	298	33	*Pholoe baltica*	48	38
ACTINIARIA	278	22	*Euclymene oerstedii*	48	231
Kurtiella bidentata	236	48	*Kurtiella bidentata*	48	236
Euclymene oerstedii	231	48	*Ophiura albida*	48	79
Spiophanes bombyx	136	41	*Ampharete lindstroemi*	44	25
Nucula nitidosa	111	30	*Lumbrineris cingulata*	41	61
Lagis koreni	97	37	*Spiophanes bombyx*	41	136
Owenia borealis	96	41	*Owenia borealis*	41	96
Tellimya ferruginosa	79	22	NEMERTEA	37	41
Ophiura albida	79	48	*Glycera*	37	29

5.4.1.2 Univariate Analysis

Univariate analysis was undertaken with a view to assessing faunal richness and diversity, together with evenness and dominance, the latter highlighting areas of numerically dominant taxa.

Results of the univariate analysis are presented in Table 5.10 and graphically represented in Figure 5.14 to Figure 5.18.

The total number of species ranged from 3 (CR03 and WF01) to 52 (WF09) with an average of 21 across the survey area. A broad pattern of species distribution was observed, with samples from offshore stations generally showing lower mean number of species compared to samples from nearshore stations.

Faunal abundances were between 3 individuals (CR03) and 651 individuals (WF09), with an average of 104 individuals across survey area. In general, stations with high number of species also showed high abundances, this pattern being mirrored in the mean values of richness.

Values of diversity were on average moderate ($H'\ log_2 = 2.96$), with 22 % of samples showing high diversity ($H'\ log_2 > 4$); 37 % of samples showing good diversity ($3 \leq H'\ log_2 \leq 4$); 15 % of samples showing moderate diversity ($2 \leq H' log_2 \leq 3$); 19 % showing poor diversity ($1 \leq H'\ log_2 \leq 2$) and 7 % showing bad diversity ($0 \leq H'\ log_2 \leq 1$). Mean diversity values in samples from offshore stations were generally lower than those in samples from nearshore stations.

Values of evenness were between 0.37 (WF05) and 1 (WF01) with an average of 0.37 across the survey area. The low evenness value in sample WF05 was associated with a numerical dominance of the amphipod *Urothoe brevicornis*, which comprised 87 % of the faunal abundance at this station. This was further confirmed by the value of high dominance (0.77) at this station. Conversely, the high value of evenness in sample WF08 was due to the presence of eight species each comprising one individual.

Values of dominance were on average low (0.24), with the lowest (0.04) recorded at stations WF11 and WF12. These stations were characterised by relatively low abundances per number of taxa.

Table 5.10: Univariate Indices of Enumerated Fauna from Grab Samples

Station	Number of Species (*S*)	Number of Individuals (*N*)	Margalef's Index (d)	Pielou's Index (J)	Shannon-Wiener Index (H' log^2)	Simpson's Index (λ)
CR01	36	78	8.0	0.92	4.77	0.05
CR03	3	3	1.8	1.00	1.58	0.33
CR10	6	14	1.9	0.93	2.41	0.20
CR11	37	149	7.2	0.78	4.07	0.12
WF01	3	9	0.9	0.62	0.99	0.63
WF02	6	25	1.6	0.60	1.54	0.49
WF03	4	15	1.1	0.78	1.56	0.39
WF04	27	224	4.8	0.71	3.40	0.16
WF05	4	24	0.9	0.37	0.74	0.77
WF06	21	112	4.2	0.74	3.24	0.19
WF07	42	176	7.9	0.79	4.28	0.10
WF08	8	8	3.4	1.00	3.00	0.13
WF09	52	651	7.9	0.55	3.13	0.24
WF11	46	81	10.2	0.93	5.15	0.04
WF12	37	69	8.3	0.94	4.88	0.04
WF14	36	178	6.8	0.74	3.84	0.14
WF19	4	9	1.4	0.92	1.84	0.31
WF22	33	140	6.5	0.76	3.86	0.14
WF25	5	7	2.1	0.92	2.13	0.27
WF27	4	8	1.4	0.88	1.75	0.34
WF29	5	19	1.4	0.87	2.02	0.29
WF32	18	76	3.9	0.77	3.20	0.18
WF37	24	254	4.2	0.74	3.41	0.13
WF41	26	105	5.4	0.86	4.04	0.08
WF44	44	196	8.1	0.70	3.83	0.20
WF45	4	4	2.2	1.00	2.00	0.25
WF47	28	175	5.2	0.68	3.26	0.19
Summary Statistics						
Min	**3**	**3**	**0.9**	**0.37**	**0.74**	**0.04**
Mean	**21**	**104**	**4.4**	**0.80**	**2.96**	**0.24**
Max	**52**	**651**	**10.2**	**1.00**	**5.15**	**0.77**
SD	**16**	**134**	**2.9**	**0.15**	**1.23**	**0.17**

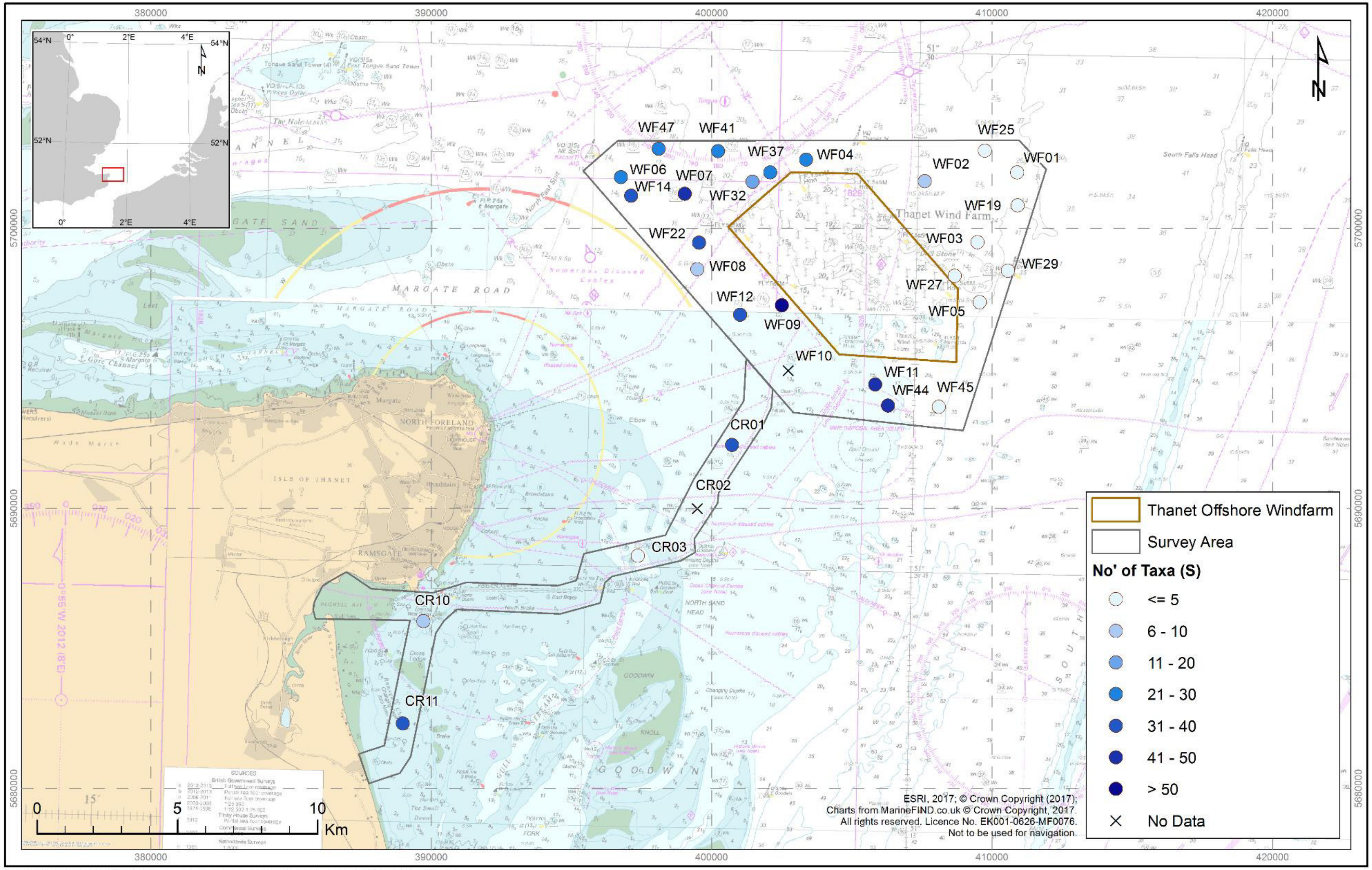


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Figure 5.14: Spatial variations of the number of taxa from grab samples

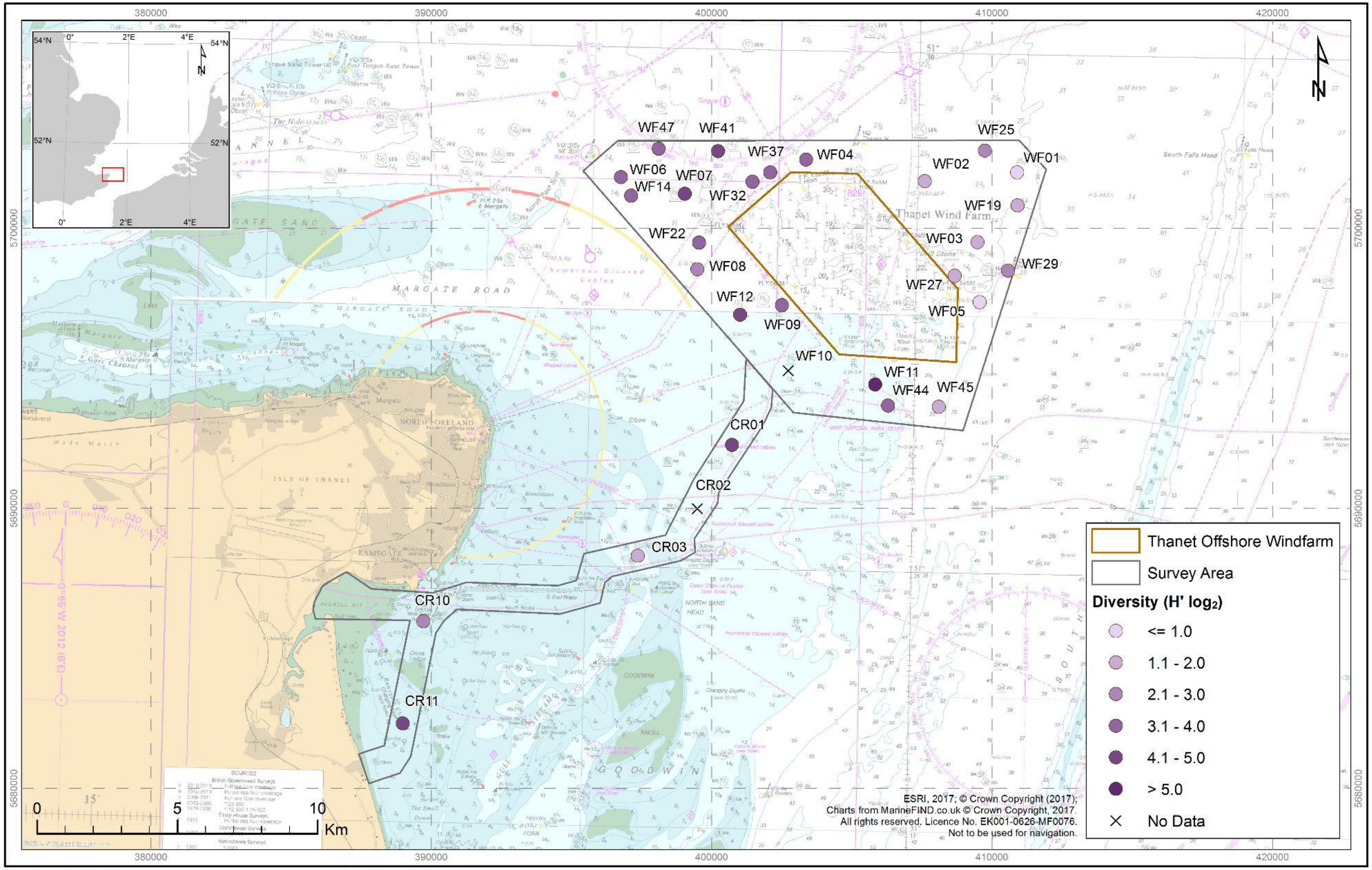

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Figure 5.15: Spatial variations of the number of individual from grab samples

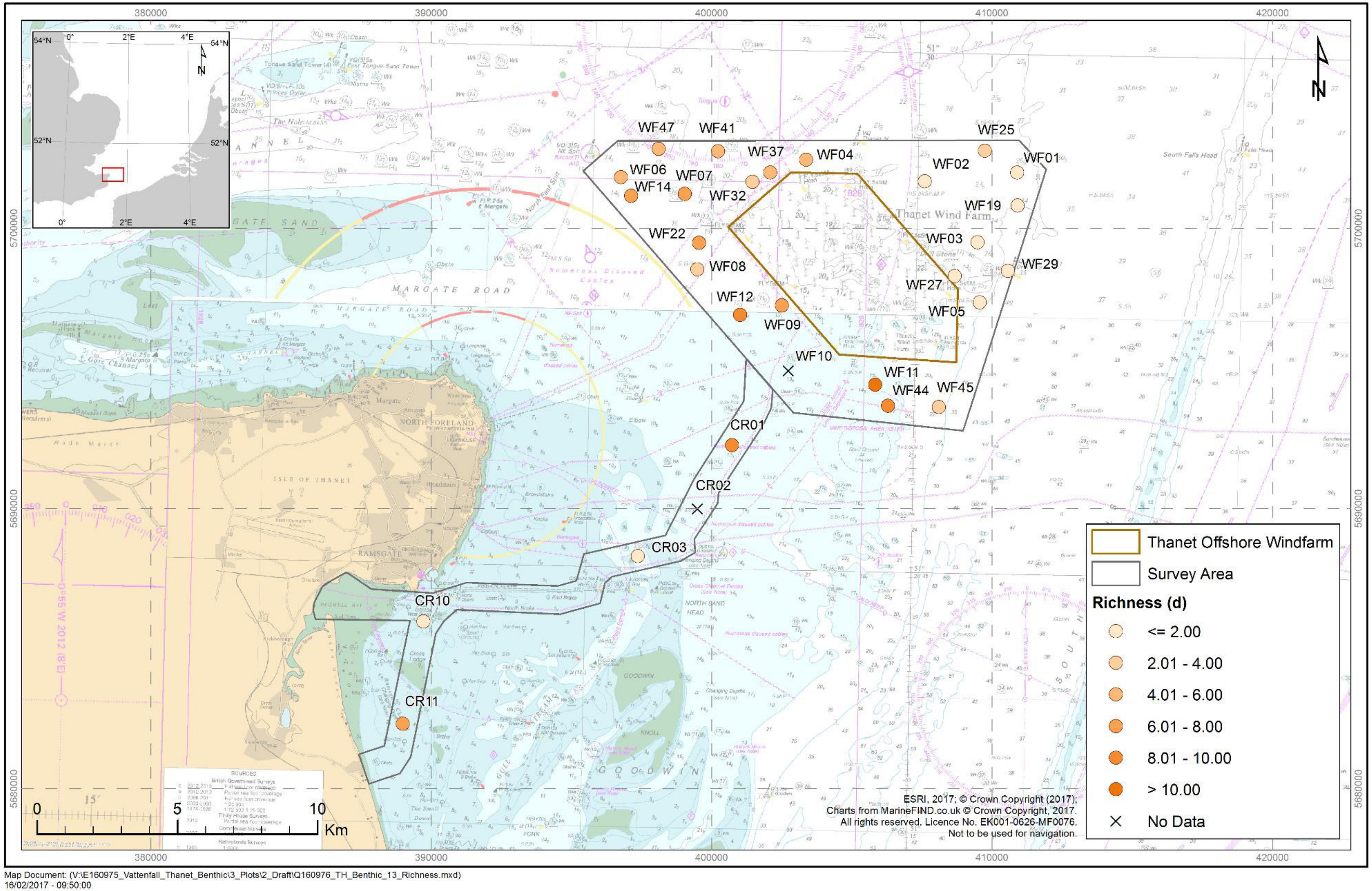

Figure 5.16: Spatial variations of faunal richness (d) from grab samples

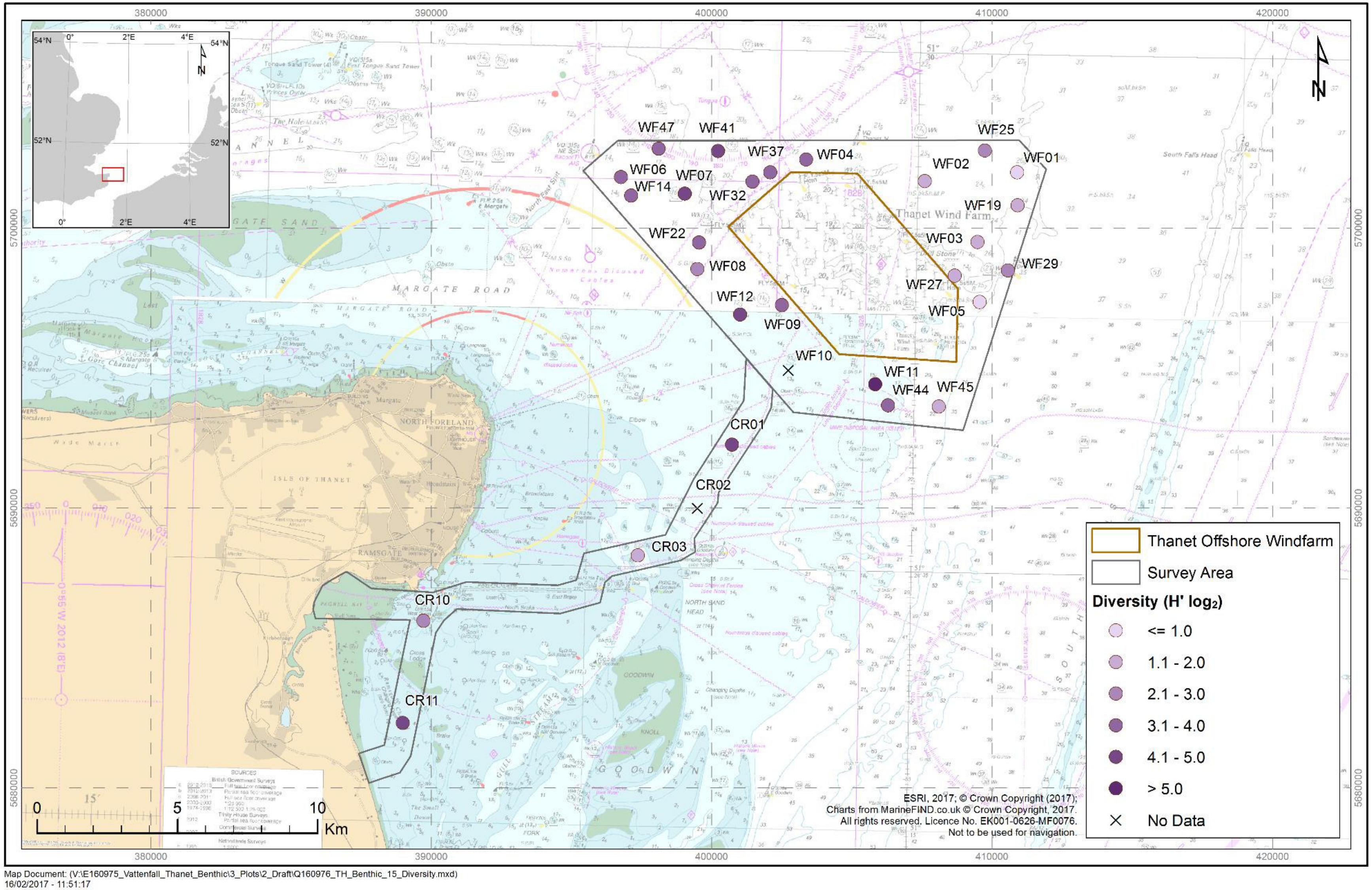

Figure 5.17: Spatial variations of faunal diversity (H'log_2) from grab samples

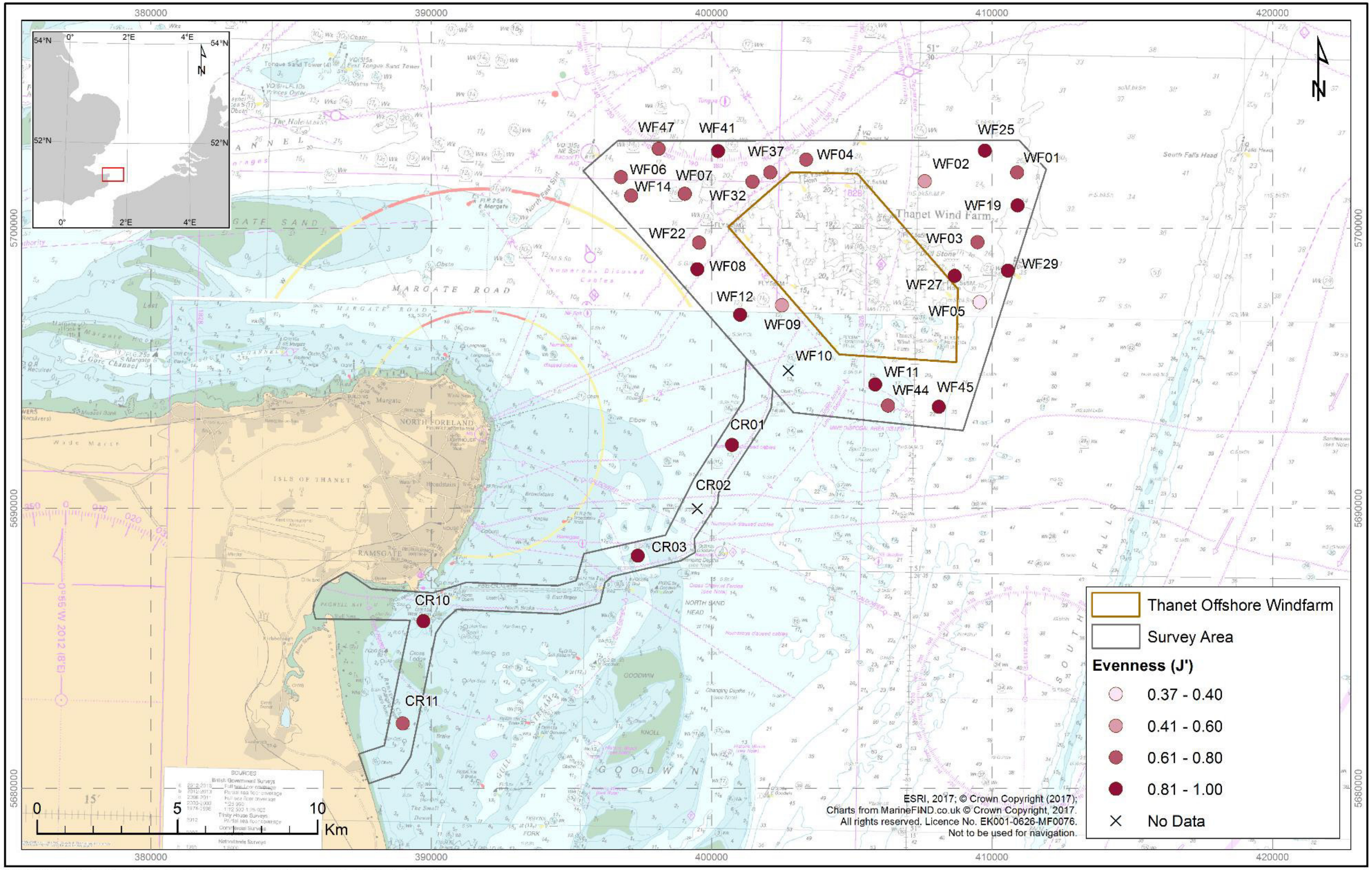

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Figure 5.18: Spatial variations of faunal evenness (J') from grab samples

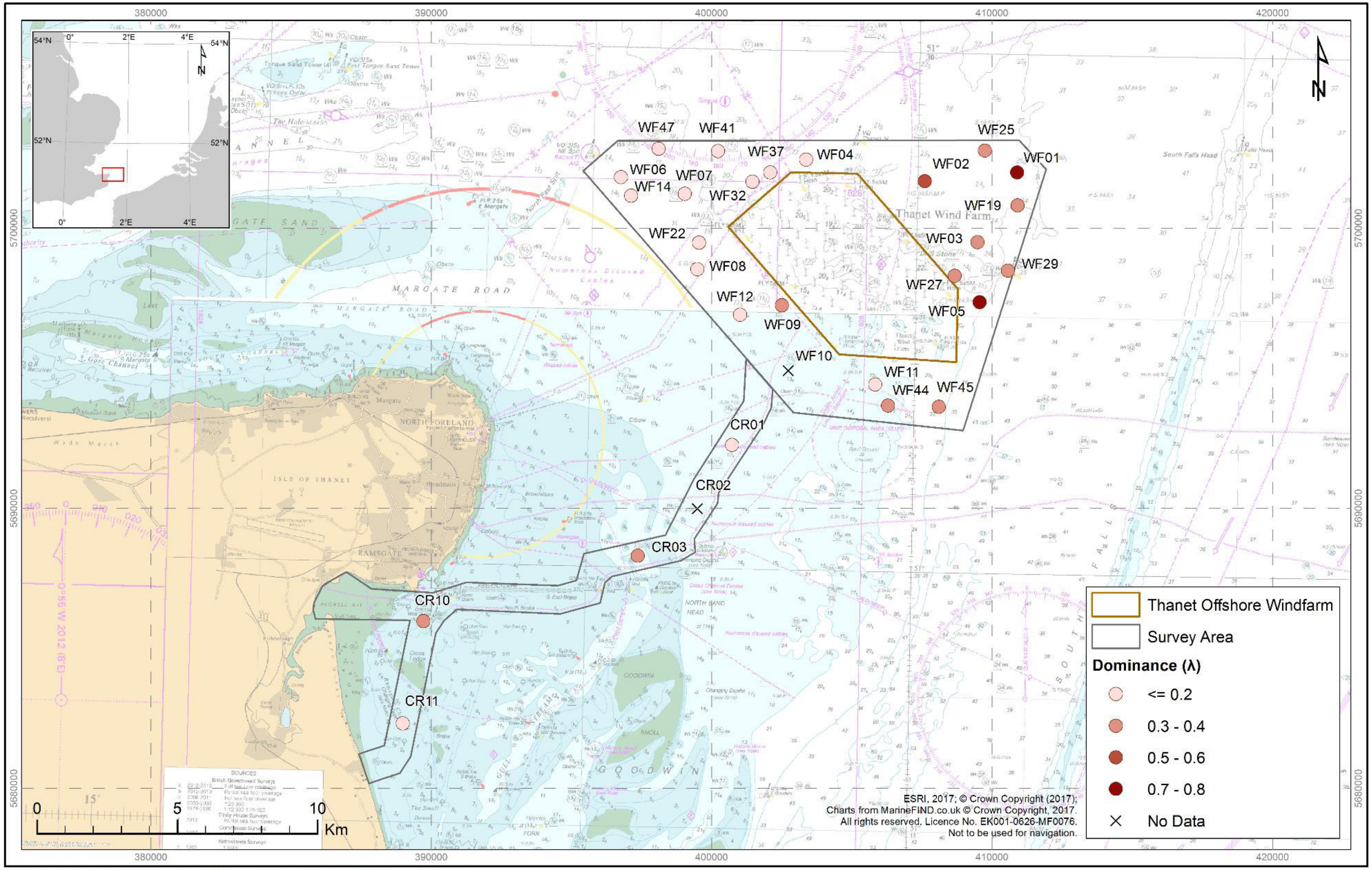

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Figure 5.19: Spatial variations of faunal dominance (λ) from grab samples

5.4.2 Sessile Colonial Epifauna from Grab Samples

A total of 24 taxa of colonial epibiota were recorded across the survey area. These included 11 taxa of Bryozoa, 3 taxa of Porifera, 7 taxa of Cnidaria, 1 taxon each of Entoprocta and Folliculinidae. In addition, coralline algae were recorded at station CR11.

The phyletic composition of the colonial epifauna from the grab samples is summarised in Table 5.11 and graphically represented in Figure 5.20.

Bryozoans were dominant in terms of diversity across the survey area, followed by the cnidarians; other taxa and poriferans comprised, each, three taxa. Bryozoans were also the most frequently occurring together with other taxa, whereas poriferans and cnidarians showed a much restricted distribution (Figure 5.21).

Of the bryozoans, species of the superfamily Membraniporoidea were recorded in 63 % of samples, *Aspidelectra melodonta* in 59 % of samples, *Conopeum reticulum* in 44 % of samples, and *Electra monostachys* in 41 % of samples. Of the other taxa Folliculinidae were recorded in 44 % of samples.

The highest number of epifaunal taxa was recorded from stations CR11 and WF44 (11 taxa); conversely, the sample from station CR03 did not comprise epifauna, and the remaining stations showed epifaunal taxa numbers of between 1 (WF19 and WF32) and 9 (WF12)

Table 5.11: Phyletic Composition of Colonial Epifauna from Grab Samples

Phyletic Group	Total No of Taxa	Most Frequently Occurring Taxa	% of Samples
Porifera (sea sponges)	3	*Cliona* (agg.) PORIFERA Microcionidae	7 4 4
Cnidaria (sea anemones)	7	Tubulariidae Bougainvilliidae *Hydrallmania falcata* *Sertularella 'gaudichaudi'* *Sertularia* *Clytia* *Alcyonium digitatum*	4 7 4 4 15 4 7
Entorpocta (goblet worms)	1	*Barentsia*	4
Bryozoa (sea mats)	11	*Alcyonidium* *Amathia lendigera* Membraniporoidea *Conopeum reticulum* *Electra monostachys* *Electra pilosa* *Aspidelectra melolontha* *Bicellariella ciliata* *Scrupocellaria scruposa* *Escharella immersa* *Schizomavella*	15 4 63 44 41 7 59 4 4 19 22
Other taxa (ciliates, algae)	2	Folliculinidae Corallinaceae	44 4
Total	**24**		

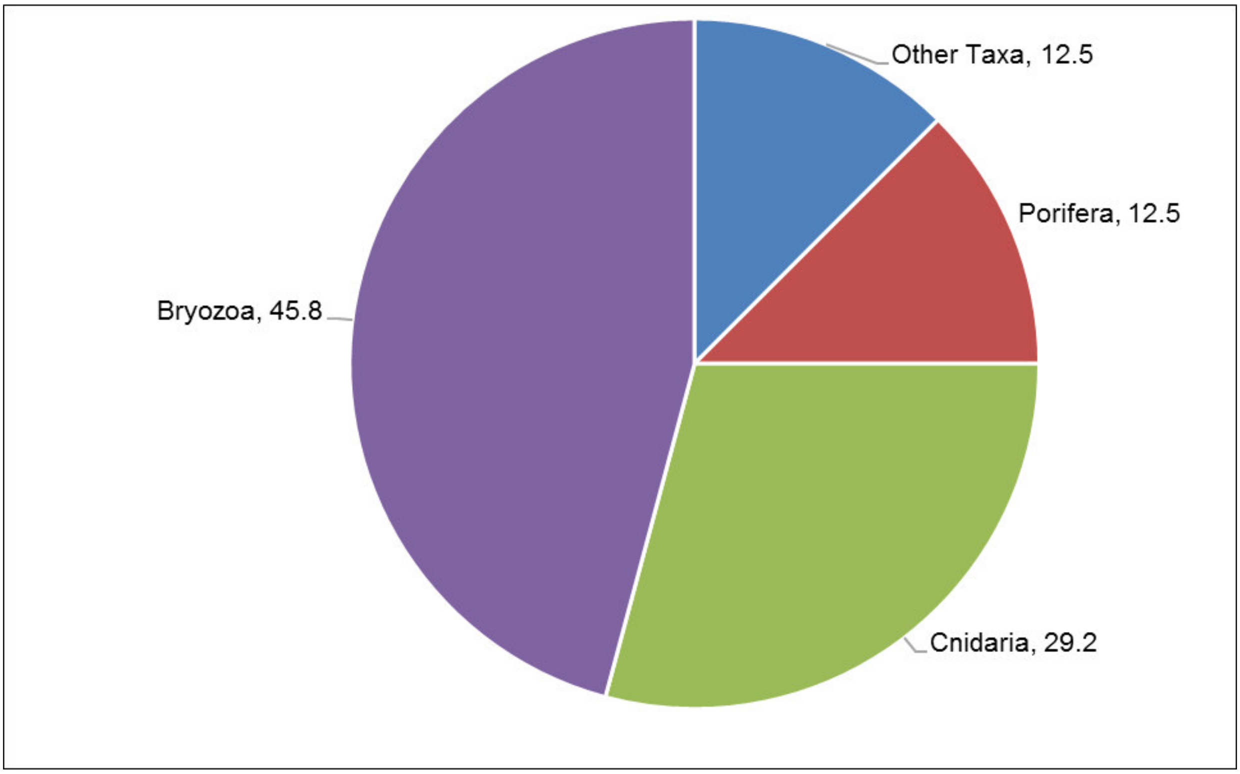

Figure 5.20: Phyletic composition of sessile colonial epifauna from grab samples

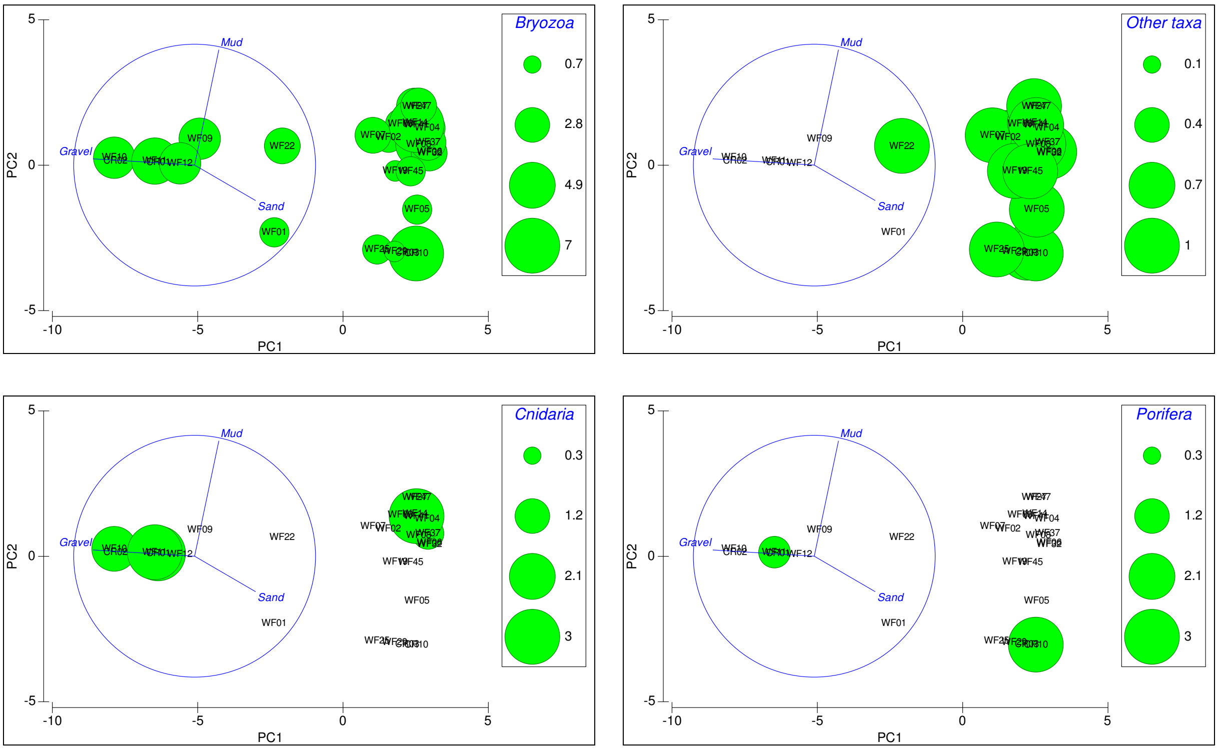

Figure 5.21: Two-dimensional representation of the PCA of sediment composition: data with superimposed circles proportional in diameter to number of Bryozoa, Other taxa, Cnidaria and Porifera

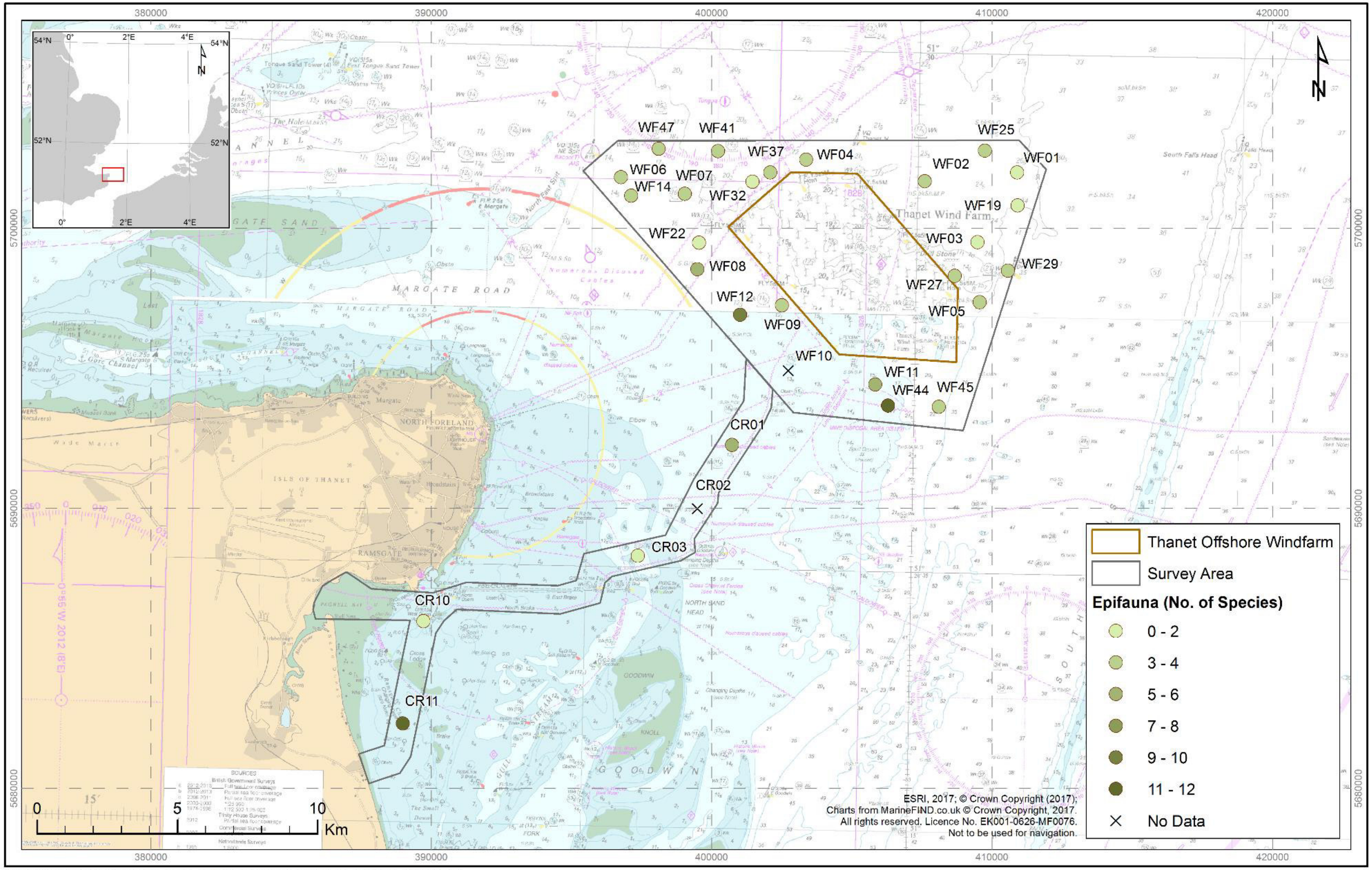

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Figure 5.22: Spatial distribution of epifauna from grab samples

5.4.3 Biomass

Biomass was undertaken on the infaunal organisms from grab samples; solitary epifauna was not biomassed.

Results are presented in Table 5.12 and illustrated in Figure 5.25, the latter showing the spatial distribution of infaunal biomass (expressed as ash free dry weight (AFDW) g.0.1m^{-2}) across the survey area.

Infaunal biomass ranged from 0.01 AFDW g.0.1 m^{-2} (WF01) to 12.35 AFDW g.0.1m2 (WF32), with an average of 1.61 AFDW g.0.1m^{2} across the survey area. The high value of biomass at station WF32 was associated with echinoderms, which included 14 individuals of the sea urchin *Echinocardium cordatum*, 4 individuals of the brittlestars *Ophiura albida* and 1 individual of *O. ophiura*, representing together 23 % of the faunal abundance at this station.

High biomass was also recorded at station WF41, where it was associated with echinoderms and molluscs. The former included 6 individuals of *E. cordatum* and 9 brittlestars represented by *O. albida* and *Acrocnida brachiate*. Mollusca included 32 bivalves, represented by *Nucula nitidosa*, *Tellimya ferruginosa*, *Kurtiella bidentata*, *Acanthocardia echinata* and *Corbula gibba* and 2 gastropods of the genus *Euspira*.

The third highest infaunal biomass was recorded at station CR11, where polychetes dominated, together with molluscs and to a lesser extent, crustaceans. Analysis of the species list from this station showed that annelids were dominated by the peacock worm *Sabella pavonina*, which comprised 46 % of the annelids abundance at this station; molluscs comprised 22 bivalves (*Nucula nucleus*, *K. bidentata*, *Laevicardium crissum*, *Asbjornsenia pygmaea*, *Abra alba*) and 6 gastropods (*Gibbula cineraria*, *Crepidula fornicata* and *Buccinum undatum*). Of the crustaceans, the crabs *Pisidia longicornis*, *Atelecyclus rotundatus* and *Liocarcinus navigator*, contributed most to the infaunal biomass at this station (Table 5.12).

Overall, the infaunal biomass was dominated by the echinoderms, followed by the annelids and molluscs, with crustaceans and other taxa being much lower by comparison (Figure 5.23).

In general, echinoderms and molluscs biomass was higher at stations featuring finer sediments, whereas annelids favoured coarser mixed sediments (Figure 5.24).

Table 5.12: Infaunal Biomass [AFDW g.0.1 m^{-2}] from Grab Samples

Station	Taxa					Total
	Polychaeta	Crustacea	Mollusca	Echinodermata	Other Taxa	
CR01	1.421	0.014	0.005	0.209	0.004	**1.65**
CR03	0.057	0.000	0.000	0.003	0.000	**0.06**
CR10	0.041	0.000	0.002	0.000	0.000	**0.04**
CR11	2.643	0.726	2.054	0.000	0.014	**5.44**
WF01	0.001	0.012	0.000	0.000	0.000	**0.01**
WF02	0.010	0.012	0.000	0.000	0.000	**0.02**
WF03	0.026	0.001	0.000	0.000	0.000	**0.03**

Station	Taxa					Total
	Polychaeta	Crustacea	Mollusca	Echinodermata	Other Taxa	
WF04	0.547	0.000	0.179	0.222	0.017	**0.97**
WF05	0.016	0.024	0.000	0.000	0.000	**0.04**
WF06	0.319	0.000	0.170	0.029	0.005	**0.52**
WF07	0.490	0.047	0.801	0.004	0.009	**1.35**
WF08	0.003	0.000	0.000	0.005	0.000	**0.01**
WF09	0.576	0.019	0.004	0.250	0.131	**0.98**
WF11	0.027	0.002	0.016	0.050	0.007	**0.10**
WF12	0.262	0.012	0.000	0.003	0.005	**0.28**
WF14	0.427	0.211	0.470	0.136	0.000	**1.24**
WF19	0.033	0.000	0.000	0.000	0.000	**0.03**
WF22	0.198	0.000	0.033	0.054	0.042	**0.33**
WF25	0.307	0.000	0.000	0.000	0.000	**0.31**
WF27	0.117	0.000	0.003	0.000	0.000	**0.12**
WF29	0.034	0.010	0.000	0.000	0.000	**0.04**
WF32	0.045	0.002	0.318	11.970	0.013	**12.35**
WF37	0.975	0.001	0.134	3.598	0.000	**4.71**
WF41	0.136	0.002	3.791	4.035	0.001	**7.96**
WF44	0.105	0.034	0.010	0.039	0.003	**0.19**
WF45	0.005	0.000	0.000	0.000	0.000	**0.01**
WF47	0.567	0.000	0.242	3.965	0.011	**4.79**
Mean	**0.348**	**0.042**	**0.305**	**0.910**	**0.010**	**1.61**

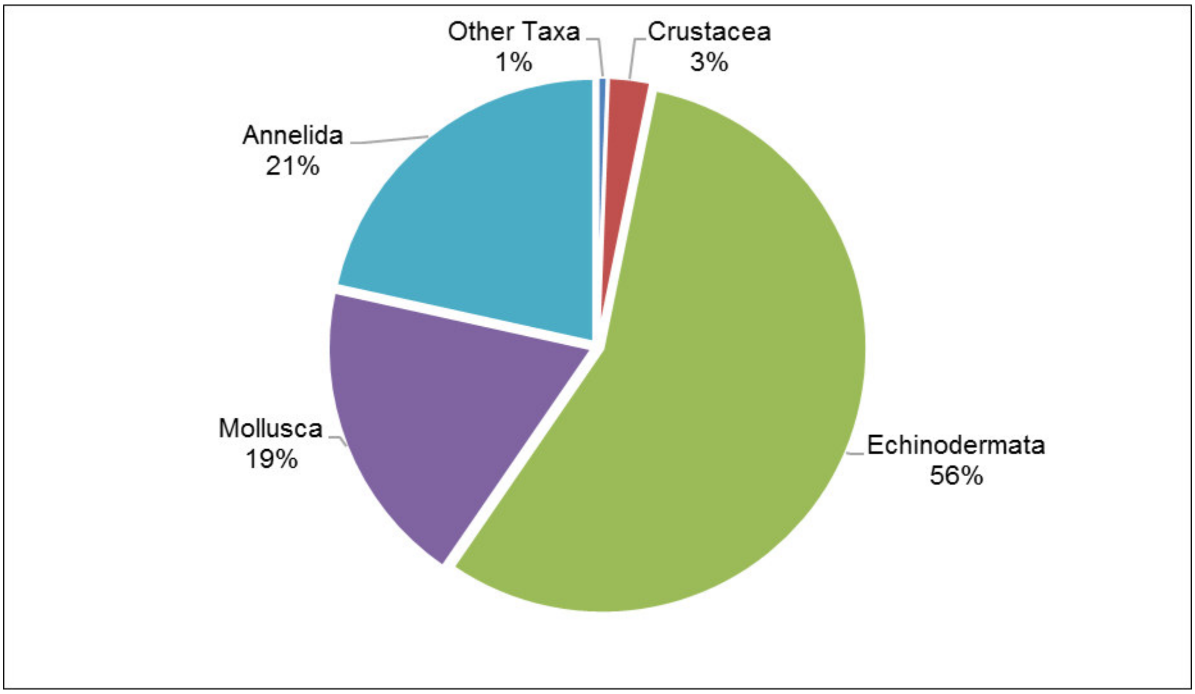

Figure 5.23: Percentage contribution of major taxa to infaunal biomass from grab samples

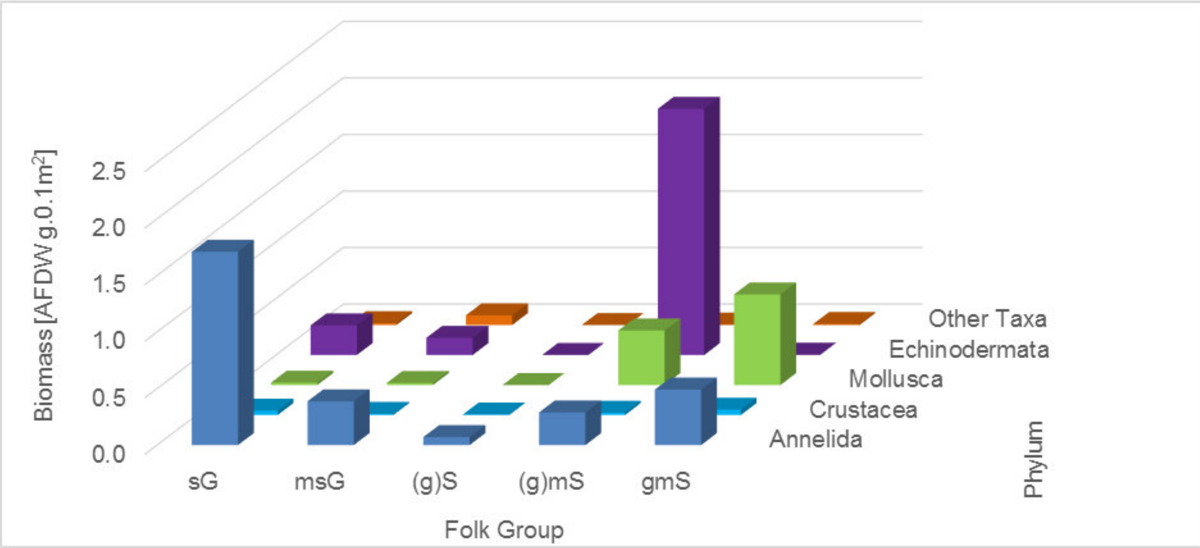

Figure 5.24: Relationships between sediment type and infaunal biomass from grab samples

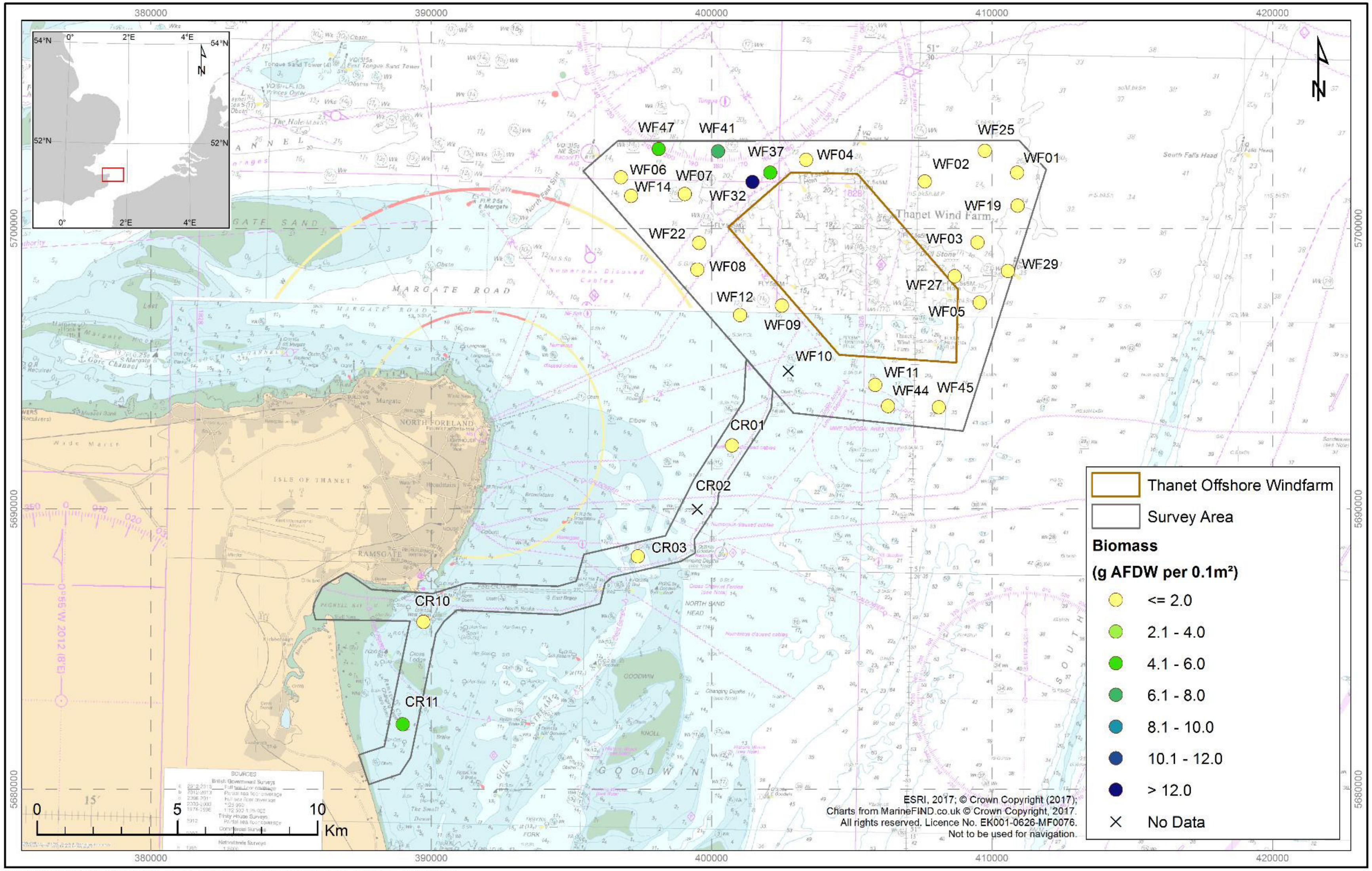

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Figure 5.25: Spatial distribution of infaunal biomass (AFDW g.0.1m^{-2})

5.4.4 Multivariate Analysis

Multivariate analysis was undertaken on the enumerated faunal data set, which was transformed prior to analysis. A square root transformation provided the best assessment of the enumerated faunal community down weighting the numerically dominant species (> 100 individuals) which represented 4 % of the fauna, giving the right weight to the abundant taxa (> 10 individuals), which comprised 23 % of the fauna and the underlying community (< 10 individuals), which represented 73 % of the fauna.

Community structure of the enumerated fauna within the survey area was assessed, employing the hierarchical clustering analysis, the results of which are shown in Figure 5.26 and Figure 5.27. It is worth noting that, although some stations are displayed as being statistically different, based on the output of the SIMPROF test, differences between these stations were not considered to be of ecological significance based on the analysis of the individual sample's faunal composition, the details of which are discussed further in this section. Two main groups of samples were identified, the characteristics of which are summarised in Table 5.13. In addition, two subgroups were identified within group A, namely A1 and A2, as shown in Figure 5.26 and Figure 5.27, and dealt with later in this section.

The spatial distribution of the multivariate groups is illustrated in Figure 5.28.

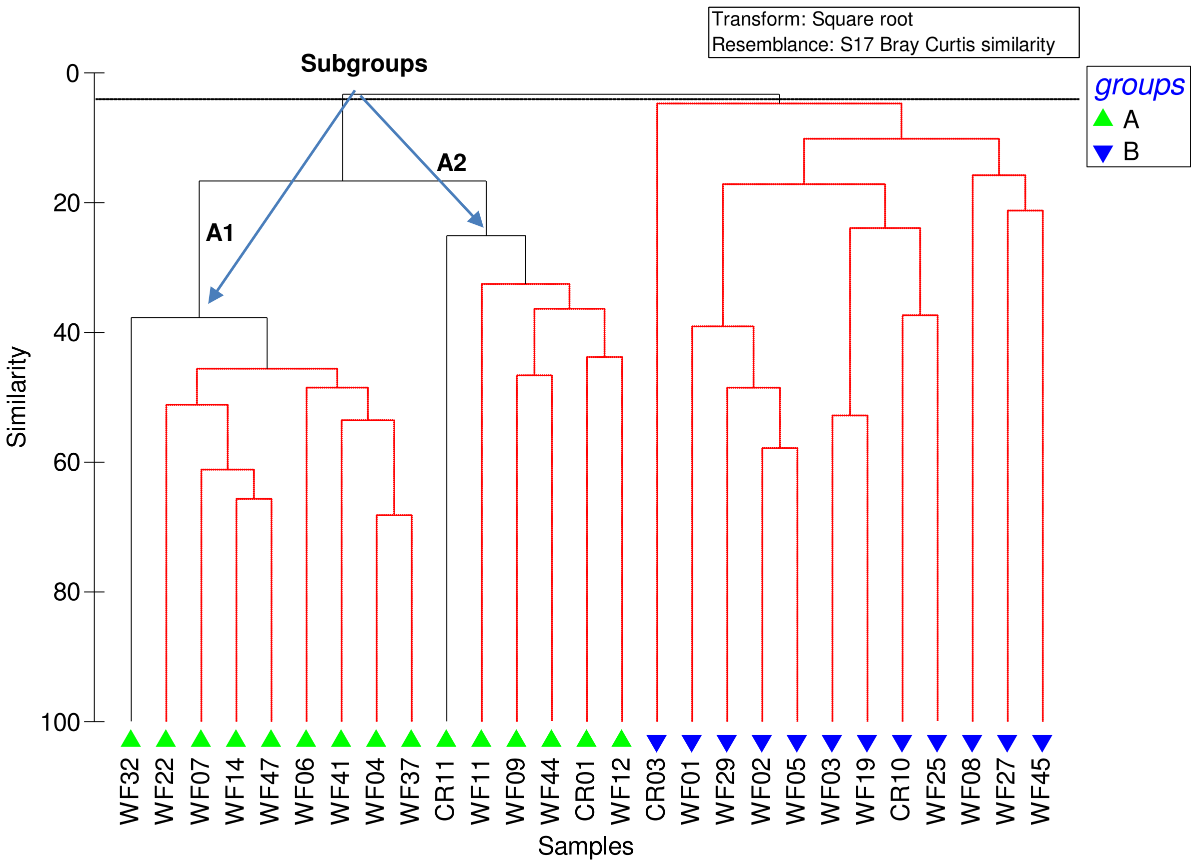

Figure 5.26: Dendrogram of Bray-Curtis similarity index of enumerated fauna from grab samples

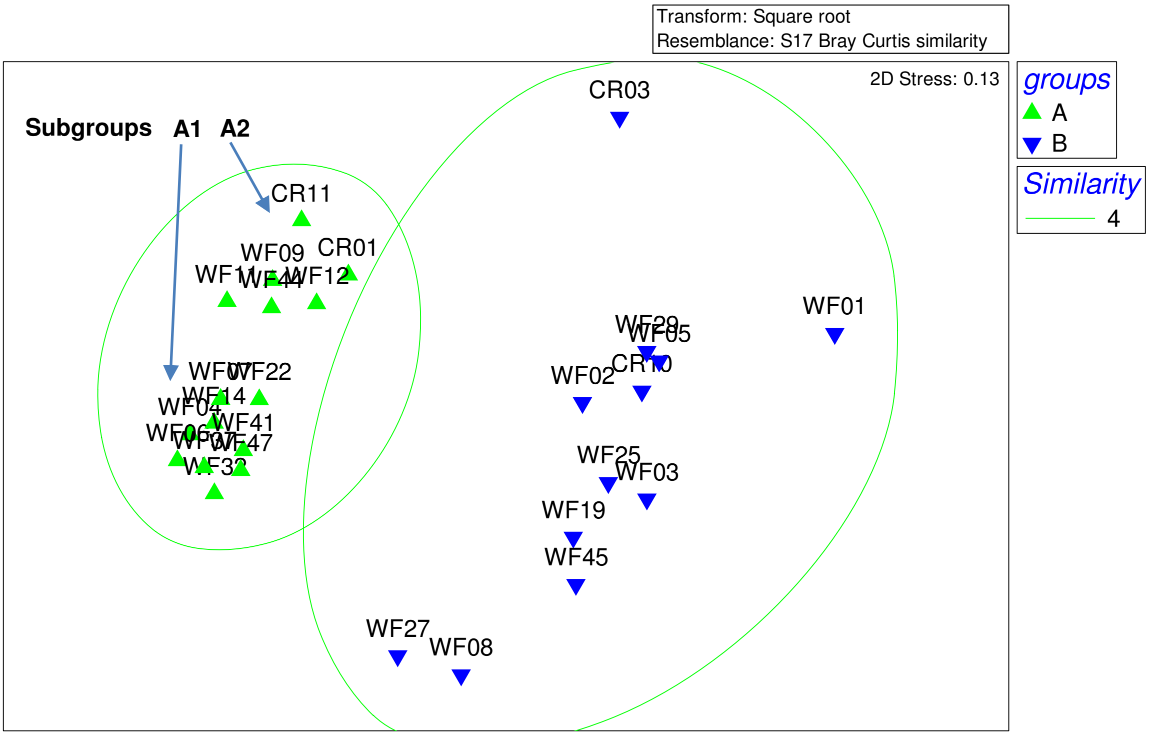

Figure 5.27: MDS plot of Bray-Curtis similarity index of enumerated fauna from grab samples

Table 5.13: Summary Attributes of the Faunal Group Derived from Multivariate Analysis of Enumerated Fauna from Grab samples

Group	Samples	Characterizing Features	Species	Mean Abundance	Occurrence [% Samples]
A ▲ Average similarity: 29.4 %	CR (01, 11) ; WF (04, 06, 07, 09, 11, 12, 14, 22, 32, 37, 41, 44, 47)	S: 34 ± 10 N: 177 ± 143 Depth [m]: 22 Gravel: 23% Sand: 65% Mud: 12% D_{50} [µm]: 7373	*Ophiura albida* *Pholoe baltica* *Ampharete lindstroemi* *Kurtiella bidentata* *Spiophanes bombyx* *Owenia borealis* *Lumbrineris cingulata* *Lagis koreni* *Euclymene oerstedii* *Nucula nitidosa*	5.3 2.5 1.7 15.6 9.1 6.4 4.1 6.5 15.1 7.4	87 87 80 73 73 73 73 67 60 53
B ▼ Average similarity: 16.4 %	CR (03, 10) ; WF (01, 02, 03, 05, 08, 19, 25, 27, 29, 45)	S: 5 ± 1 N: 12 ± 7 Depth [m]: 28 Gravel: 5% Sand: 88% Mud: 7% D_{50} [µm]: 366	*Nephtys cirrosa* *Urothoe brevicornis* *Ophelia borealis* *Euclymene oerstedii* *Spio goniocephala* *Magelona johnstoni* *Nephtys hombergii*	1.8 4.4 0.6 0.3 0.3 0.9 0.3	67 33 33 33 25 17 17

D_{50}: median sediment particle size
S = number of species
N = number of individuals
Abundance refers to untransformed data and is expressed as mean value within the multivariate group; frequency refers to the % of samples within the multivariate group. Cut off for contribution to percentage: 90 %

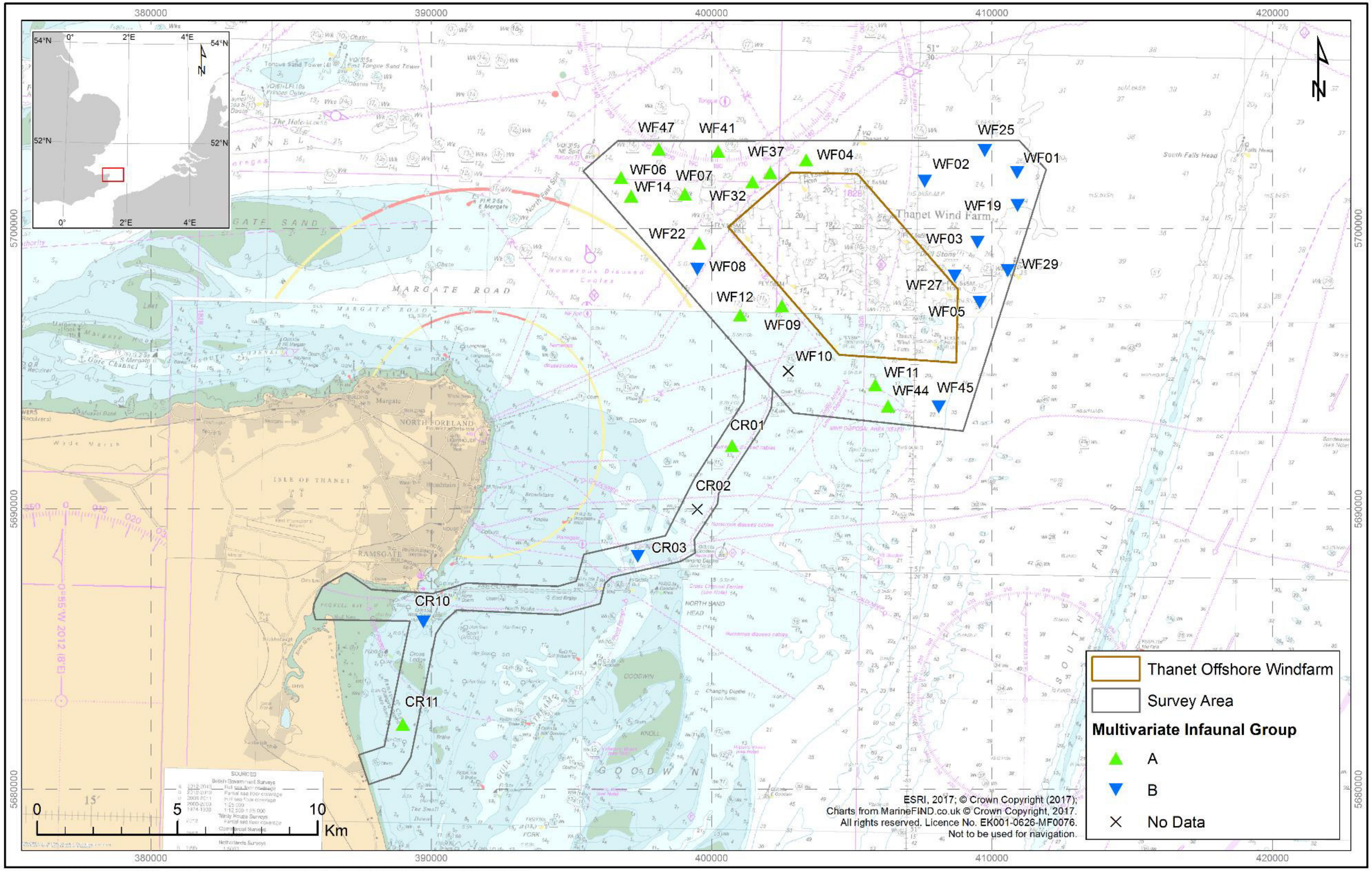

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Figure 5.28: Faunal Groups identified by the multivariate analysis of grab samples

Group A comprised 15 samples, of which 2 were from stations within the cable route and 13 from stations within the wind farm area. It was characterised by highly heterogeneous sediment, comprising sand and a conspicuous percentage of gravel and mud, which resulted in the sediment being very poorly sorted. The median sediment particle size was between 133 µm (very fine sand) and 33237 µm (very coarse gravel) with a mean of 7373 µm (fine gravel). The group comprised 34 species and 177 individuals (mean values), of which the brittle star *Ophiura albida* and polychaete worms, such as *Pholoe baltica* and *Ampharete lindstroemi*, were the most frequently occurring species (Figure 5.29).

Group B comprised 12 samples, of which 2 were from stations within the cable route and 10 from stations within the wind farm area. This group showed a very low average similarity, indeed, some of the samples within this group had no taxa in common. However, all samples within this group showed low numbers of taxa (between 3 and 8) and low faunal abundance (between 3 and 25 individuals), which resulted in them being statistically not different, based on the output of the SIMPROF test. The group was characterised by less heterogeneous seabed sediment than that of group A, and comprised mostly of sand with small mean percentages of gravel and mud. The median sediment particle size was between 229 µm (fine sand) and 469 µm (medium sand), with an average of 366 µm. The group comprised 5 taxa and 12 individuals (mean values), of which the polychaete *Nephtys cirrosa* was the most frequently occurring species, whereas the amphipod *Urothoe brevicornis* was the most abundant, albeit less frequently occurring (Figure 5.29).

Average biomass within group A was 2.86 AFDW g.0.1m^2 compared to 0.06 AFDW g.0.1m^2 of group B (Figure 5.30) and represented mainly by echinoderms (57 %), annelids (20 %) and molluscs (19 %), with crustaceans and other taxa together comprising just over 3 % of the faunal abundance in this group.

The epifaunal component from grab samples within group A was represented primarily by bryozoans, specifically *Conopeum reticulum*, species of the Membraniporoidea superfamily, and *Aspidelectra melolontha*, which showed frequency of occurrence of between 53 % and 73 % of samples. All of the epifaunal taxa recorded, were present in this group, with total number of taxa per sample of between 1 and 11, with an average of 5. The epifaunal component from grab samples within group B comprised Folliculinide and bryozoans, with the total number of taxa per sample ranging from 1 to 6, with an average of 3 (Figure 5.30).

The two subgroups within group A differed due to the coarseness of the sediment and associated fauna. Thus, subgroup A1 showed a smaller median sediment particle size compared to that of subgroup A2 (Figure 5.31). Fauna responsible for the separation of these subgroups included: the polychaetes *Euclymene oerstedii* and *Spiophanes bombyx*, and the bivalves *Kurtiella bidentata* and *Nucula nitidosa* in subgroup A1; the ross worm *S. spinulosa* and sea anemones of the Actiniaria order in subgroup A2 (Figure 5.32).

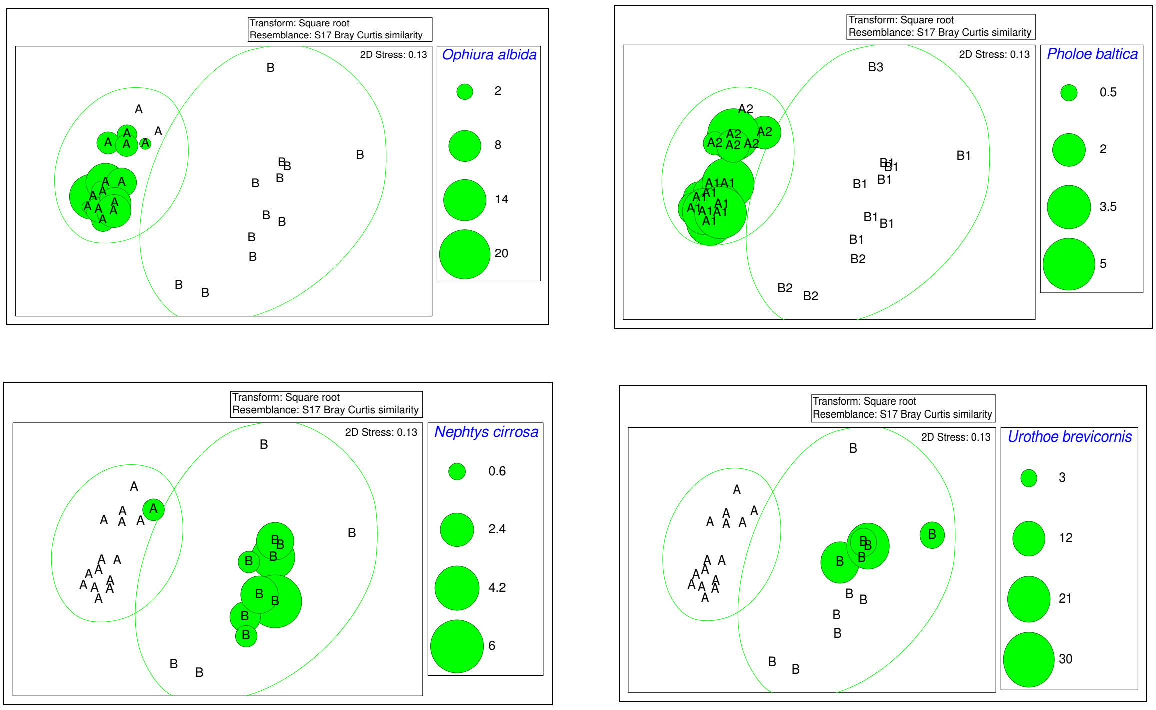


Figure 5.29: MDS plot of Bray-Curtis similarity matrix of enumerated fauna from grab samples: data with superimposed circles proportional in diameter to values of abundance of *Ophiura albida* and *Pholoe baltica* in group A; *Nephtys cirrosa* and *Urothoe brevicornis* in group B

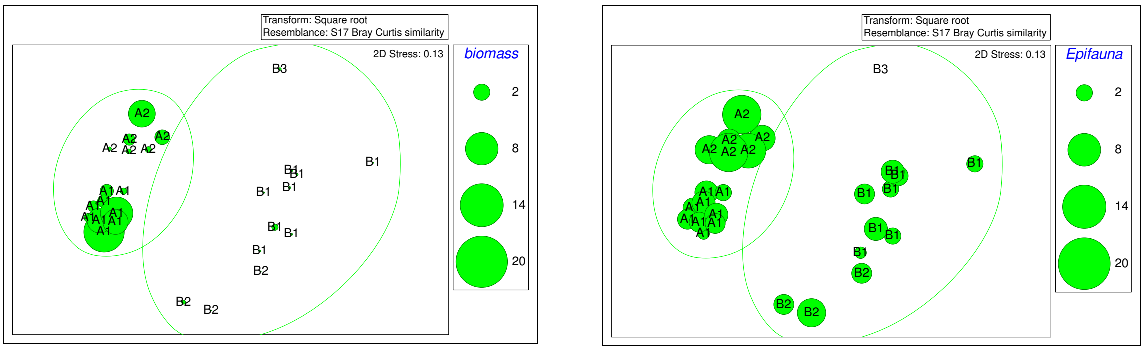


Figure 5.30: MDS plot of Bray-Curtis similarity matrix of enumerated fauna from grab samples: data with superimposed circles proportional in diameter to values of biomass and epifauna

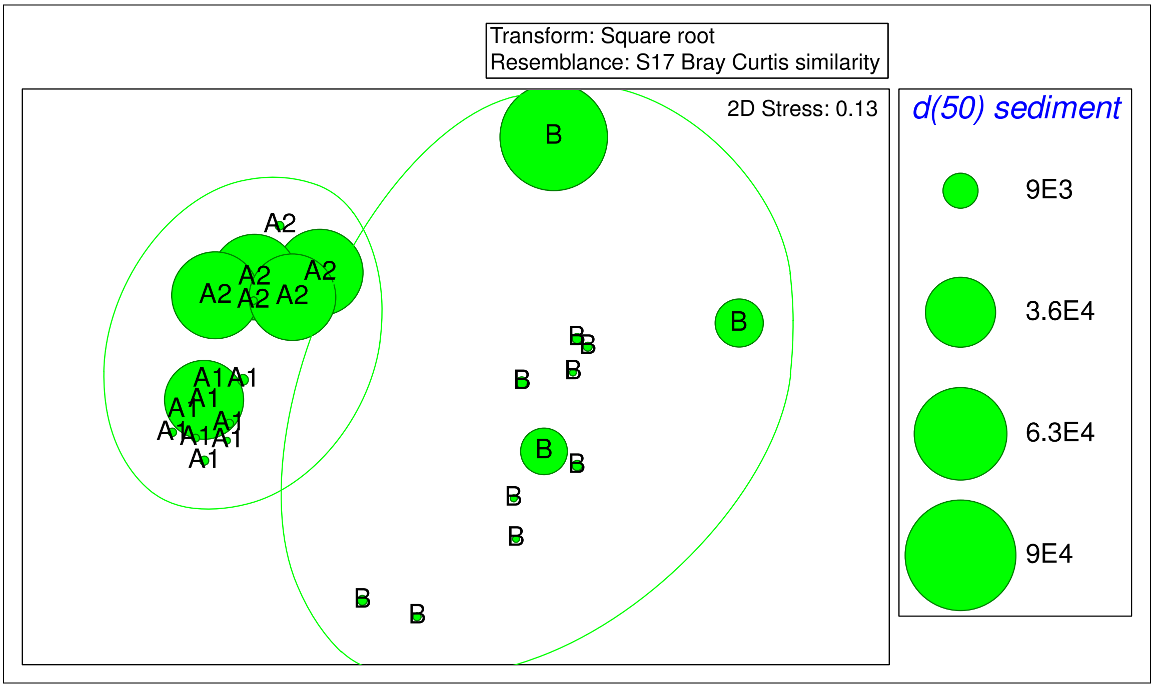


Figure 5.31: MDS plot of Bray-Curtis similarity matrix of enumerated fauna from grab samples: data with superimposed circles proportional in diameter the median sediment particle size

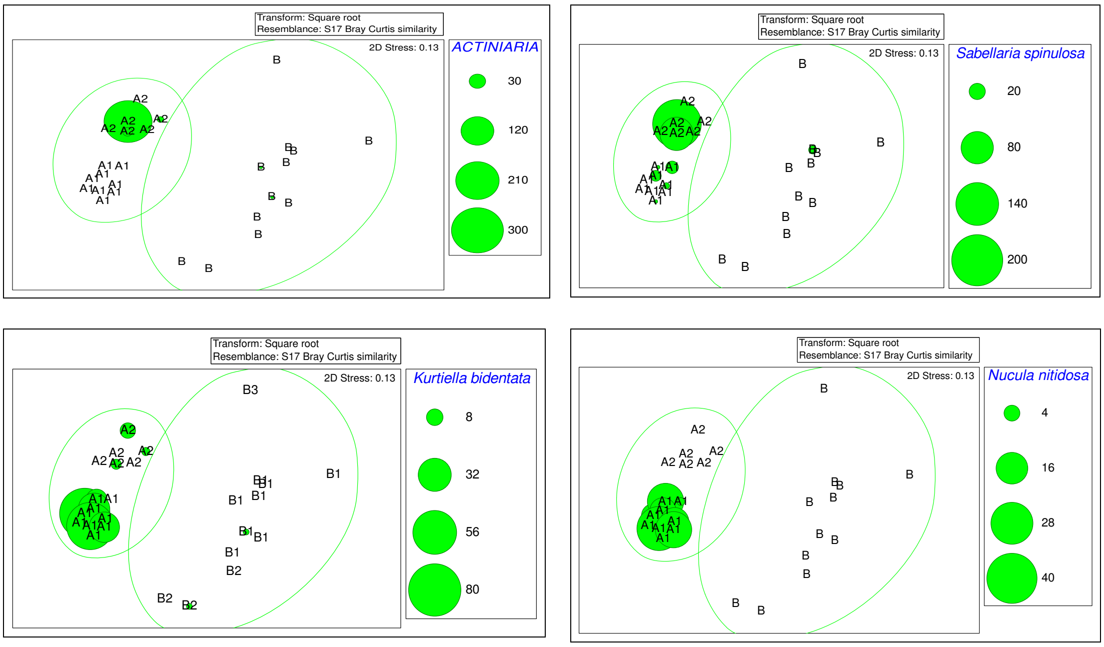


Figure 5.32: MDS plot of Bray-Curtis similarity matrix of enumerated fauna from grab samples: data with superimposed circles proportional in diameter

5.4.5 Relationship between Physical and Biological Variables

Relationships between sediment type and faunal communities were assessed by means of the BEST analysis from the Primer suite, in order to identify which of the sediment particle size best explained the observed patterns of enumerated faunal distribution across the survey area.

Results showed a moderate correlation between finer sediments and pattern of macrofaunal distribution, with the combination of: fine sand (2 phi), very coarse silt (4 phi), fine silt (7 phi and clay (>8 phi), returning the highest value of rho: 5.99, significance level 1 %.

Correlation between the sediment particle size and the observed pattern of infaunal biomass distribution was weak, with the combination of: fine gravel (-3 phi), medium sand (1 phi) and very coarse silt (4 phi), returning the highest correlation coefficient (rho = 0.463, significance level 1 %).

The broad association of faunal communities and sediment type is graphically illustrated in Figure 5.33 which shows the distribution of infaunal richness and biomass across the different sediment types within the survey area. It can be seen that the homogeneous sandier sediments showed lower richness than the coarser more heterogeneous sediments. The high biomass in finer sediments was associated with the presence of large organisms, such as echinoderms and molluscs (presented in section 5.4.3).

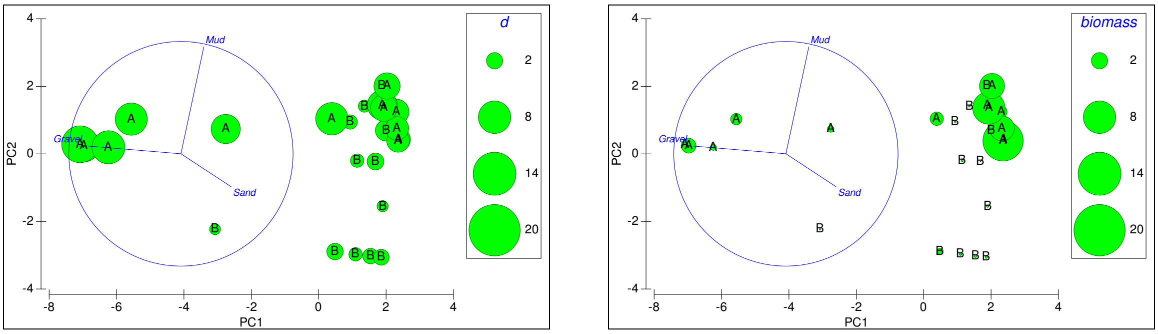


Figure 5.33: Two-dimensional representation of the PCA of sediment composition: data with superimposed circles proportional in diameter to values of faunal richness (Margalef's index g) and biomass

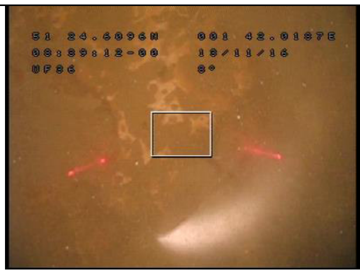
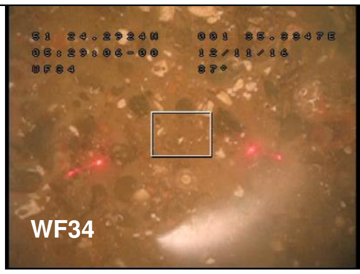
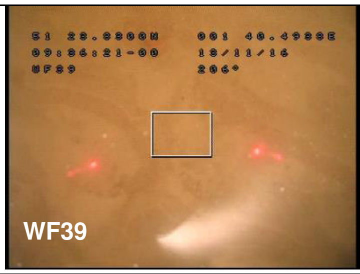
5.5 Biotope Classification

Biotope classification, in line with the current Marine Habitat Classification of Britain and Ireland, and corresponding EUNIS classification, was undertaken based on the results of the video footage and grab samples analysis, with a view to provide a comprehensive habitat assessment. The video footage provides an overview of the seabed over a wider area, and can identify rarer features such as isolated boulders or cobbles. By comparison, grab sampling provides detailed information of the sediment composition and associated fauna at a single point source. The combination of the video footage and the sediment sampling by remote-operated grab allows making in-situ observations of the habitats sampled and putting data generated by the overall sampling exercise into a wider local context.

5.5.1 Seabed Video Footage

The qualitative assessment of the seabed video footage allowed only broad habitats to be assigned, due to low underwater visibility at the time of the survey. Four broad habitat complexes were identified by the analysis of the video footage, the characteristic of which are summarised in Table 5.14.

Table 5.14: Biotopes from Seabed Video Footage

Biotope Code and Name		Representative Image	Stations
JNCC	**EUNIS**		
SS.SCS Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	**A5.1** Sublittoral coarse sediment		CR06
CR.MCR.SfR Soft rock communities	**A4.23** Communities on soft circalittoral rock		WF36
SS.SMX.CMx Circalittoral mixed sediment	**A5.44** Circalittoral mixed sediment		CR (01, 04, 05, 07, 09) WF (10, 11, 12, 28, 34, 35, 38, 40, 43)
SS.SSA Sublittoral sands and muddy sands	**A5.2** Sublittoral sands		CR (08, 11) WF (02, 03, 05, 09, 13, 15, 16, 17, 18, 20, 21, 23, 24, 26, 30, 31, 33, 39, 42, 46)

SS.SCS (A5.1) was observed at station CR06. This habitat features coarse sediments including coarse sand, gravel, pebbles, shingle and cobbles, which are often unstable due to tidal currents and/or wave action. This habitat is generally found on the open coast or in tide-swept channels of marine inlets. It typically has a low silt content and is characterised by a robust fauna, which in the current study included star fish (*A. rubens*) and sea anemones (Actiniaria).

CR.MCR.SfR (A4.23) was observed at station WF36, featuring chalk overlain by sand. This biotope complex occurs on moderately wave-exposed, circalittoral soft bedrock subject to moderately strong tidal streams, in highly turbid water conditions. In the current study, epibiota recorded in this habitat was represented by star fish (Asteroidea).

SS.SMX.CMx (A5.44) was observed at 14 stations, to include five within the cable route and nine within the proposed wind farm extension. This habitat occurs in the circalittoral zone and features mixed sediment of sand, mud and gravel, often with shells, cobbles and pebbles embedded in or lying upon the sediment matrix. The variable nature of the seabed is reflected in the variety of communities which are found and include: polychaetes, bivalves, echinoderms and burrowing anemones all of which were recorded within this habitat in the current study.

SS.SSA (A5.2) was observed at 22 stations, to include 2 within the cable route and 20 within the proposed wind farm extension. This habitat features medium to fine sands, clean or non-cohesive slightly muddy sands on open coasts and offshore, where there is a degree of wave action or tidal currents which restrict the silt and clay content, generally to less than 15 %. This habitat is characterised by a range of taxa including polychaetes, bivalve molluscs and amphipod crustacean. In the current study, epibiota comprising of crustaceans, gastropods and echinoderms characterised stations featuring this habitat.

5.5.2 Grab Samples

Four infaunal biotopes were identified by the analysis of the grab samples the characteristic of which are summarised in Table 5.15. Biotope classification of the infaunal communities was based upon the faunal groups identified by the multivariate analysis.

Table 5.15: Biotopes from Grab Samples Analysis

Biotope Code and Name		Representative Image	Stations
JNCC	**EUNIS**		
SS.SMX.CMx.MysThyMx *Mysella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment	**A5.443** [*Mysella bidentata*] and [*Thyasira* spp.] in circalittoral muddy mixed sediment		CR (01, 11) ; WF (04, 06, 07, 09, 11, 12, 14, 22, 32, 37, 41, 44, 47)
SS.SBR.PoR.SspiMx *Sabellaria spinulosa* on stable circalittoral mixed sediment	**A5.611** [*Sabellaria spinulosa*] on stable circalittoral mixed sediment		
SS.SSA.IMuSa.FfabMag *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	**A5.242** *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand		CR (03, 10) ; WF (01, 02, 03, 05, 08, 19, 25, 27, 29, 45)
SS.SSA.IFiSa.NcirBat *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand	**A5.233** *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand		

SS.SMX.CMx.MysThyMx (A5.443) features muddy sands and gravels in moderately exposed or sheltered, circalittoral habitats. Characterising species include bivalves such as *Thyasira flexuosa* and *Mysella* (now *Kurtiella*) *bidentata*. Infaunal polychaetes include (but are not limited to) *Lumbrineris gracilis*, *Chaetozone setosa* and *Scoloplos armiger*, whilst amphipods of the *Ampelisca* genus may also be present. Epibiota include brittestars and bryozoans.

SS.SBR.PoR.SspiMx (A5.611) features mixed sediment, characterised by high abundance of the tube-building polychaete *S. spinulosa* which can forms loose agglomerations of tubes forming a low lying matrix of sand, gravel, mud and tubes on the seabed. The infauna comprises typical sublittoral polychaete including species of *Pholoe*, *Harmothoe*, and *Mediomastus fragilis*, together with the bivalve *Abra alba* and tube building amphipods of the *Ampelisca* genus, in addition to calcareous tubeworms, hermit crabs and burrowing anemones.

In the current study, SS.SMX.CMx.MysThyMx (A5.443) occurred in combination with SS.SBR.PoR.SspiMx (A5.611) in group A, with elements of the former prevailing in subgroup A1, and elements of the latter prevailing in subgroup A2.

Seabed video footage, obtained at five of the stations within group A (CR01, CR11, WF09, WF11, WF12), showed a sediment comprising gravelly sand with shell fragments and less often pebbles and cobbles. Epibiota included echinoderms (Asteroidea, *Asteria rubens*, *Psammechimus miliaris*) sea anemones (Actiniaria, *Urticina felina*), polychaete (*Spirobranchus*) and soft corals (*Alcyonium digitatum*).

SS.SSA.IMuSa.FfabMag (A5.242) features fine, compacted sand and slightly muddy sand, with communities dominated by venerid bivalves. The biotope may be characterised by a prevalence of *Fabulina fabula* and species of *Magelona*. Other taxa, including the amphipod *Bathyporeia* spp. and polychaetes such as *Chaetozone setosa*, *Spiophanes bombyx* and *Nephtys* spp. are also commonly recorded. The community is stable in its species composition, although numbers of *Magelona* and *F. fabulina* tend to fluctuate.

SS.SSA.IFiSa.NcirBat (A5.233) features well-sorted medium to fine sand characterised by *Nephtys cirrosa* and amphipods such as *Bathyporeia* occurring in the shallow sublittoral to at least 30 m depth. This biotope occurs in sediments subject to physical disturbance, as a result of wave action and occasionally strong tidal streams. The polychaete *M. mirabilis* may be frequent in this biotope in more sheltered, less tide swept areas. The faunal diversity of this biotope is considerably reduced compared to less disturbed biotopes (e.g. FfabMag) and for the most part consists of the more actively-swimming amphipods. Spionid polychaetes may also be present.

In the current study SS.SSA.IMuSa.FfabMag (A5.242) occurred in combination with SS.SSA.IFiSa.NcirBat (A5.233) within the multivariate group B, which featured predominantly sandy sediments with low species richness and abundance. This group was dominated by *N. cirrosa* and the crustacean amphipod *Urothoe brevicornis*. The polychaetes *Ophelia borealis*, *Spio goniopcephala*, *N. hombergii* and *M. johnstoni* were also present in this group, albeit at lower abundances and frequency of occurrence. Amphipods of the *Bathyporeia* genus also occurred in single samples within this group. Sediment coarseness and heterogeneity, particularly mud content, determined the prevalence of each biotope, with elements of SS.SSA.IMuSa.FfabMag (A5.242) being dominant at stations with more compacted muddy sand sediments; elements of SS.SSA.IFiSa.NcirBat (A5.233) being dominant in sandier more mobile sediments.

Seabed video footage, obtained at three of the stations within group B (WF02, WF03 and WF05), showed a sediment comprising of sand with shell fragment. Little epibiota was observed, represented by starfish, paguridae and *S. spinulosa*.

Habitats and biotopes across the survey area are presented in Figure 5.34 and Figure 5.35.

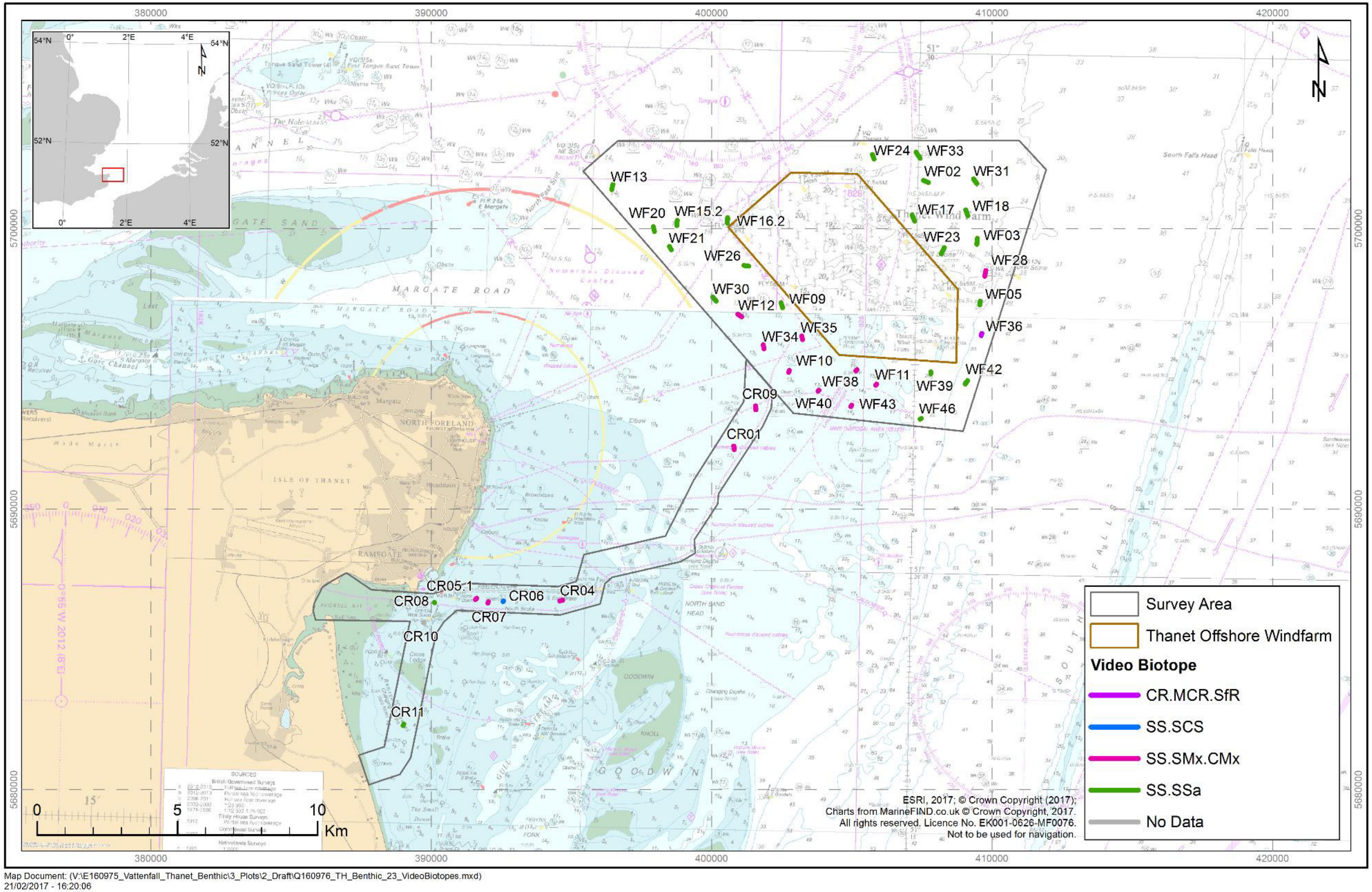


Figure 5.34: Broad scale habitats identified by the seabed video footage

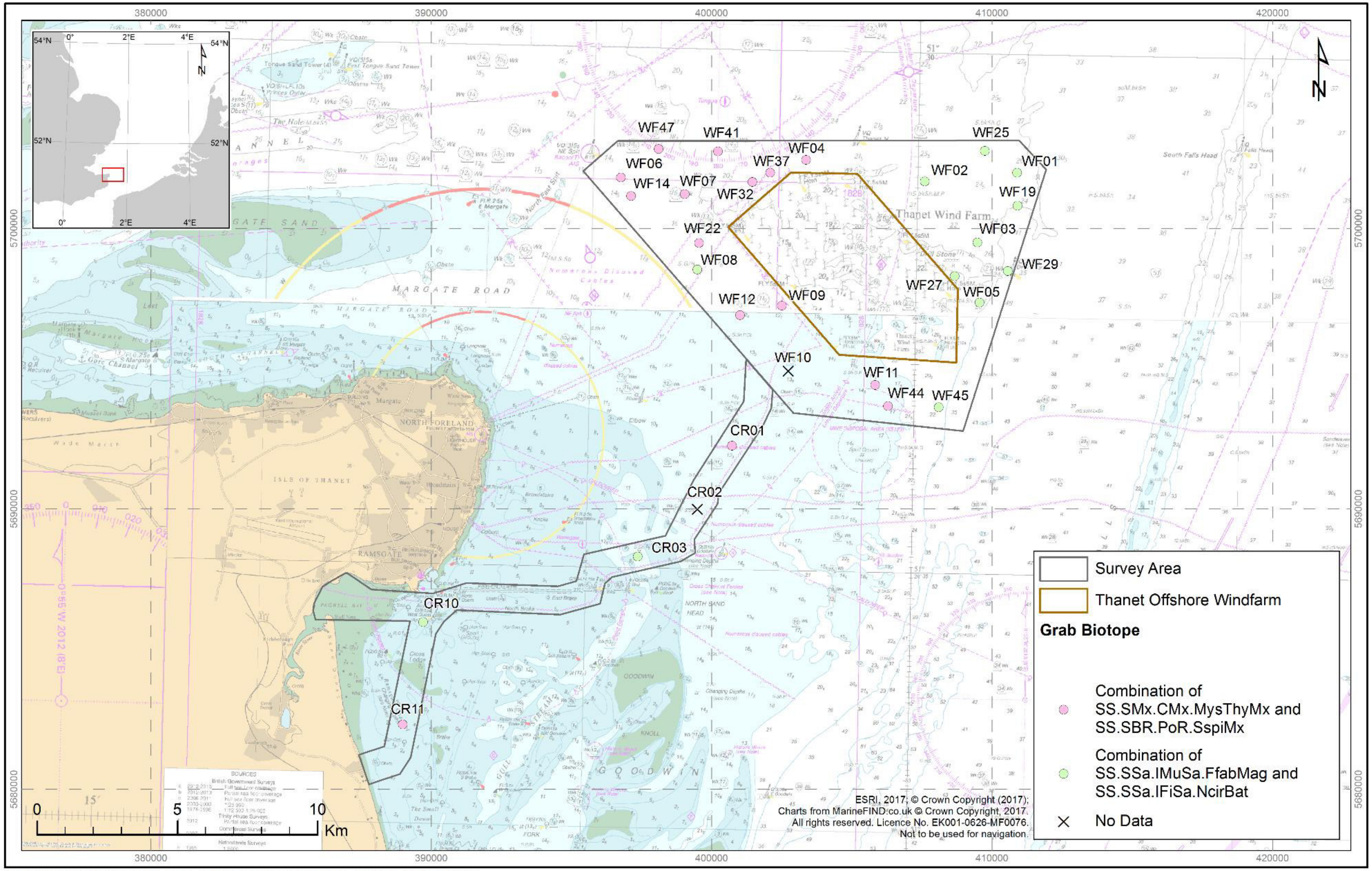


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Figure 5.35: Biotopes identified by the grab samples analysis

5.6 Sediment Chemistry

5.6.1 Metals

Results of seabed sediment metal concentrations are presented in Table 5.16, together with sediment quality guidelines and standards.

Metal concentrations below the detection limit were recorded with respect to cadmium and mercury, at all stations but WF47, located within the north-west section of the proposed wind farm extension. The only other concentration below the detection limit was recorded with respect to copper, at station WF01, located within the northeast section of the proposed wind farm extension.

When compared with the guidelines levels, the highest arsenic concentration (60.1 $mg.kg^{-1}$), recorded at the shallow near shore station CR10, was below the CSEMP ERM and between action levels AL1 and AL2 of Cefas guidelines. Arsenic concentration at the remaining stations was between 10 $mg.kg^{-1}$ (WF47) and 34.4 $mg.kg^{-1}$ (WF29), both values being above the CSEMP ERL and Canadian TEL, with three of these stations, namely WF01, WF29 and WF12, showing arsenic levels between Cefas AL1 and AL2 (Table 5.16).

The concentrations of all other metals analysed in the study were below the marine sediment quality standards referred to (Table 5.16).

Table 5.16: Sediment Metal Concentrations [$mg.kg^{-1}$] at sampling stations

Station	As	Cd	Cr	Cu	Pb	Mn	Ni	V	Zn	Hg	Li
CR03	18.1	<0.04	13.4	1.14	5	127	4.8	21	16.6	<0.01	2.53
CR04	12	<0.04	12.1	1.82	5.54	162	4.9	20.9	17.7	<0.01	6
CR10	60.1	<0.04	8.7	1.67	10.3	417	7.8	43	33	<0.01	3
WF01	26.3	<0.04	6.7	<1	7	166	3.8	25	17	<0.01	2.8
WF12	26	<0.04	9.2	1.44	9.91	180	4.8	35.3	30	<0.01	3.7
WF29	34.4	<0.04	7.4	1.46	9.67	204	4.8	34	23.2	<0.01	5.2
WF47	10	0.054	19.7	3.96	10.4	159	8.3	32.6	29.4	0.0173	10.9
Clean Seas Environment Monitoring Programme Guidelines											
ERL	8.2	1.2	81	34	46.7	-	20.9	-	150	0.15	-
ERM	70	9.6	370	270	218	-	52	-	410	0.71	-
Canadian Sediment Quality Guidelines											
ISQG/TEL	7.2	0.7	52.3	18.7	30.2	-	-	-	124	0.13	-
PEL	41.6	4.2	160	108	112	-	-	-	271	0.7	-
%<ISQG	3	6	4	9	6	-	-	-	4	8	-
ISQG<%< PEL	13	20	15	22	26	-	-	-	27	24	-
%>PEL	47	71	53	56	58	-	-	-	65	37	-
CEFAS Guideline Action Levels											
Action Level 1	20	0.4	40	40	50	-	20	-	130	0.3	-
Action Level 2	100	5.0	400	400	500	-	200	-	800	3.0	-

ISQG/TEL = interim marine sediment quality guideline/threshold effect levels
PEL = probable effect levels
% = incidence of adverse biological effects

5.6.2 Hydrocarbons

Results of hydrocarbon analysis, including total hydrocarbons and polycyclic aromatic hydrocarbons, are presented in Table 5.17 and assessed in conjunction with the Canadian marine sediment quality guidelines as presented in Table 5.18.

Table 5.17: Hydrocarbons Concentrations (Dry Weight)

Analyte	Unit	Station						
		CR03	CR04	CR10	WF01	WF12	WF29	WF47
Hydrocarbons	mg/kg	<0.9	16	<0.9	<0.9	7.37	8.45	34.9
Acenaphthene	ug/kg	<1	<1	<1	<1	<1	<1	<1
Acenaphthylene	ug/kg	<1	<1	<1	<1	<1	<1	<1
Anthracene	ug/kg	<1	<1	<1	<1	<1	<1	1.48
Benzo(a)anthracene	ug/kg	<1	3.44	<1	<1	<1	1.16	6.91
Benzo(a)pyrene	ug/kg	<1	6.08	<1	<1	<1	2.04	10.9
Benzo(b)fluoranthene	ug/kg	<1	9.14	<1	<1	1.5	2.65	12.7
Benzo(e) pyrene	ug/kg	<5	9.4	<5	<5	<5	<5	9.07
Benzo(ghi)perylene	ug/kg	<1	9.41	<1	<1	<1	1.95	9.85
Benzo(j)fluoranthene	ug/kg	<10	<10	<10	<10	<10	<10	<10
Benzo(k)fluoranthene	ug/kg	<1	3.99	<1	<1	<1	1.18	6
Chrysene + Triphenylene	ug/kg	<3	4.38	<3	<3	<3	<3	9.27
Chrysene	ug/kg	<3	3.11	<3	<3	<3	<3	6.62
Dibenzo(ah)anthracene	ug/kg	<1	2	<1	<1	<1	<1	1.81
Dibenzothiophene	ug/kg	<5	<5	<5	<5	<5	<5	<5
Fluoranthene	ug/kg	<1	5.53	<1	<1	1.44	2.46	13.4
Fluorene	ug/kg	<5	<5	<5	<5	<5	<5	<5
Indeno(1,2,3-c,d)pyrene	ug/kg	<1	8.63	<1	<1	<1	2.04	10.2
Naphthalene	ug/kg	<5	<5	<5	<5	<5	<5	<5
Perylene	ug/kg	<5	<5	<5	<5	<5	<5	6.96
Phenanthrene	ug/kg	<5	<5	<5	<5	<5	<5	8.6
Pyrene	ug/kg	<1	4.97	<1	<1	1.51	2.2	12.6
Triphenylene	ug/kg	<2	<2	<2	<2	<2	<2	2.65

Table 5.18: Canadian Sediment Quality Guidelines Concentrations (Dry Weight) [$\mu g.kg^{-1}$]

Analyte	ISQG/TEL	PEL	%<ISQG	ISQG<%<PEL	%>PEL
Naphthalene	34.60	391.0	3	19	71
Acenaphthylene	5.87	128.0	7	14	51
Acenaphthene	6.71	88.9	8	29	57
Fluorene	21.20	144.0	12	20	70
Phenanthrene	86.70	544.0	8	23	78
Anthracene	46.90	245.0	9	20	75
Fluoranthene	113.00	149.0	10	20	80
Pyrene	153.00	1398.0	7	19	83
Benzo(a)anthracene	74.80	693.0	9	16	78
Chrysene	108.00	846.0	9	19	72
Benzo(a)pyrene	88.80	763.0	8	22	71
Dibenzo(ah)anthracene	6.22	135.0	16	12	65

ISQG/TEL = interim marine sediment quality guideline/threshold effect levels
PEL = probable effect levels
% = incidence of adverse biological effects

Quantifiable concentrations of hydrocarbons were recorded in samples from stations CR04, WF12, WF29 and WF47. Of these, station WF12 showed the lowest total hydrocarbon concentration (7.37 mg.kg^{-1}), with quantifiable values recorded with respect to benzo(b)fluoranthene, fluoranthene and pyrene. Station WF47 showed the highest total hydrocarbon concentration (34.9 mg.kg^{-1}), with 16 out of the 22 hydrocarbons analysed showing quantifiable concentrations (Table 5.17).

When compared to quality standards, all values were consistently below the Canadian marine sediment quality guidelines (Table 5.18).

5.6.3 Polychlorinated Biphenyls (PCB) and Organotins

Results of Polychlorinated Biphenyls (PCBs) (Table 5.19) and Organotins (Table 5.20) concentrations, were consistently below the limit of detection at all stations sampled.

Table 5.19: Polychlorinated Biphenyls (PCBs) (Dry Weight) [µg.kg^{-1}]

Analyte	Station						
	CR10	WF01	WF29	WF12	CR04	CR03	WF47
PCB - 028	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB - 052	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB - 101	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB - 118	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB - 138	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB - 153	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB - 180	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Table 5.20: Organanotins (Dry Weight as Cation) [µg.kg^{-1}]

Analyte	Station						
	CR10	WF01	WF29	WF12	CR04	CR03	WF47
Dibutyl Tin	<4	<4	<4	<4	<4	<4	<4
Dioctyl Tin	<4	<4	<4	<4	<4	<4	<4
Tetrabutyl Tin	<2	<2	<3	<2	<2	<2	<3
Tributyl	<4	<4	<4	<4	<4	<4	<4
Triphenyl Tin	<2	<2	<3	<2	<2	<2	<3
Dibutyl Tin	<4	<4	<4	<4	<4	<4	<4
Dioctyl Tin	<4	<4	<4	<4	<4	<4	<4

6. DISCUSSION

6.1 Seabed Video Footage

Analysis of the seabed video footage showed the presence of two major habitats within the study area, one featuring heterogeneous sediment, comprising of mix of sand and gravel, including pebbles, cobbles, shells and shell fragments; and one featuring predominantly sand, often with shell fragments. In addition, coarse sediment habitat, comprising of cobbles and pebbles, and soft rock habitat comprising of chalk overlain with sand, were recorded at individual stations. Some of these habitats are common in areas subject to strong tidal currents, typical of this part of the southern North Sea, where tidal current speed from the eastern English Channel increases in the Strait of Dover, owing to the restriction of the channel and the presence of tidal sand ridges aligned with the direction of the flow (Jones et al., 2005). High turbidity at the time of the survey resulted in very low underwater visibility which allowed only for broad qualitative assessment of the seabed video footage.

The habitat and associated epibiotic communities recorded by the seabed video footage were broadly comparable to those reported for the shallower sediment areas of the southern North Sea (Callaway et al., 2002 and Jennings et al., 1999). Characteristic epibenthic species included crustaceans, such as *Pagurus berhardus* together with molluscs, notably *Calliostoma*. Other notable motile species included echinoderms, such as *Asterias rubens*, *Psammechinus miliaris* and Ophiuridae. Sessile colonial epifauna comprised bryozoans, inlcuding, *Alcyionium digitatum* and less often *Flustra foliacea*, together with sea anemones (Actiniaria and *Urticina felina*) and sea sponges.

The habitats and associated epibenthic communities recorded by the video footage were classified to biotopes were possible and/or to biotope complex, which were subsequently assessed in terms of ecological and conservation importance (details in section 6.2.5).

Two stations showed high abundances of the Ross worm *Sabellaria spinulosa* tubes and were therefore assessed for potential biogenic reef, in line with the criteria outlined in Gubbay (2007). The overall assessment for station WF28, within the eastern area of the proposed wind farm extension, was of low resemblance to *S. spinulosa* reef; the overall assessment for station WF46, within the southern area of the proposed wind farm extension, was of no resemblance to *S. spinulosa* reef. These results are in line with the reported distribution of *S. spinulosa* within the North Sea, where this species occurs mostly as solitary or in small groups encrusting pebbles, shell and bedrock. Where conditions are favourable, much more extensive thin crusts can be formed, sometimes covering extensive areas of seabed. However, these crusts may be only seasonal features, being broken up during winter storms and quickly reforming through new settlement the following spring. These crusts are not considered to constitute true *S. spinulosa* reef habitats because of their ephemeral nature, which does not provide a stable biogenic habitat enabling associated species to become established in areas where they would otherwise be absent (UK BAP, 2008). Under a narrow set of environmental conditions, *S. spinulosa* can form reefs consisting of hundreds or thousands of worm tubes that stand proud of the seafloor and extend over large areas of gravel and sandy seafloors usually at the edge of sand banks, drop offs and channels. These structures are very variable in height, size and patchiness. They can be temporarily variable in their stability and favour areas of high turbidity and sediment load with moderate tidal currents and suspended particulate food matter (Limpenny et al. 2010).

Chalk overlain by sand at station WF36, within the south-eastern area of the proposed wind farm extension, was classified as not reef, following assessment using the criteria outlined in Irving (2009) and Limpenny et al. (2010). Chalk reef habitats characteristically support a wide range of species, some of which are unique to this type of substrata. The chalk found at Thanet is soft and easily bored by animals, specifically by piddocks such as *Barnea* spp., *Pholas dactylus*, *Hiatella artica* and *Petricola pholadiformis* (Jones et al., 2005).

Bore holes were present in the chalk at station WF36, however, the seabed showed low relief with no distinctness from the surrounding substrate. This concurs with the literature of the east Kent coast area, which report the bedrock being rarely exposed on the seafloor, and where it is exposed, it is often in the form of chalk platforms (Jones et al., 2005).

6.2 Grab Samples

6.2.1 Sediment Particle Size Distribution (PSD)

Sediments across the survey area comprised a mix of gravel, sand and mud, with varying percentages of each major sediment particle. The sediment sorting coefficient reflected the heterogeneity of the sediment, with predominantly sandy stations being moderately well sorted and the more mixed sediment stations being very poorly sorted. A broad pattern of sediment distribution was identified, with the most offshore stations generally comprising sandier mobile sediment. Moving inshore within the survey area, the sediment became progressively more heterogeneous, with samples accounting for conspicuous percentages of gravel and mud.

The sediment types recorded within the survey area are typical of the southern North Sea region off the north-east Kent coast, which is reported to largely comprise of a mix of sand and gravel. The oldest seafloor comprises of marine and estuarine sediments from rivers that once extended further north into the North Sea. Resting upon these are marine, estuarine and glacial deposits, the latter often overlain by stiff clay. The sediments reworked from these deposits form much of the modern seabed and their distribution is largely influenced by the present shape and topography of the seafloor. The pattern of reworking is a key factor controlling the distribution of benthic habitats (Jones et al., 2005).

Gravel mostly occur in the nearshore areas with very strong tidal and sea-wave driven near-bottom currents (DTI, 2001) whereas further offshore the sediment is mainly sand with patches of gravel, sandy mud and sandy gravel (Jones et al., 2005). Cobbles and pebbles were noted in the field logs as well as from the video and image analysis. Granular to pebbles size classes of gravel are likely to be mobilised during peak tidal currents and storm waves, but are virtually static in areas below wave-base (DTI, 2001). The immediate source of large pebbles, cobbles and boulder size classes of seabed gravel are therefore likely to be local and probably originate from older gravelly formations that have been submerged during rising sea level. The significance of gravel spreads, particularly those occurring as an interlocking pebble-gravel armour, and with cobble and boulder size gravel clasts, is associated with providing a relatively stable substrate (BGS, 2002).

The multimodal distribution of the sediment particle size, recorded in several samples during the current study, suggests different sediment sources (Hein, 2007). These are likely to be represented by finer sediment material from the Thames estuary and physical disturbance from storms, wave action, extreme tidal flows and anthropogenic activities such as dredging, dumping and commercial fishing, all of which can cause fluctuation in the rate and amount of deposition of finer sediment.

6.2.2 Seabed Sediment Chemistry

Organic content, in the form of total organic matter showed a moderate relationship with finer particle sediment size, as would be expected, as the distribution of organic carbon within the marine sediment form the North Sea is reported to closely follow that of the fine grained material (North Sea Task Force, 1993). Average concentration of carbon across the North Sea has been reported in the region of 0.3 %, which is lower than the average of the current study (1.05 %), with the exception of deeper areas, (e.g. Moray Firth and Fladen Grounds), where organic carbon concentrations are reported to range between 0.8 % and 1.3 % (North Sea Task Force, 1993). Organic carbon is an important parameter in sediments, both as an adsorber (scavenger) of contaminants and as an indicator of organic matter input (from land based sources or in situ plankton production) (North Sea Task Force, 1993).

6.2.3 Sediment Chemistry

Metal concentrations in sediment samples were below the marine sediment quality guidelines for most of the metals included in the analysis. The only exception was arsenic, concentrations of which was below the CSEMP ERM, but above the ERL, and between Cefas AL1 and AL2. Natural sources of arsenic in the marine environment include (but are not limited to) remobilisation and erosion of arsenic-rich rocks (Research Council of Norway, 2012), which vary naturally according to local geology. Anthropogenic sources include mining and smelting (Research Council of Norway, 2012) as well as burning of fossil fuel (ICES, 2004). Due to the high natural occurrence of this metal, it is often difficult to precisely discern between natural and anthropogenic sources of this metal (OSPAR, 2005). However, high arsenic concentrations in the outer Thames estuary, as well as the south-west Dogger Bank and Norfolk may be associated with a history of arsenical waste disposal in the Thames estuary (Whalley et al., 1999). The arsenic concentrations in the current study are within the range reported for the southern North Sea: < 0.15 $mgKg^{-1}$ to 135 $mgKg^{-1}$ of dry weight arsenic (Whalley et al., 1999).

Quantifiable, but below the standards, concentrations of cadmium and mercury at station WF47, within the north-western of the development site, may be associated with the high mud content at this station, as finer sediment offers a bigger surface to volume ratio for metals to sorb onto (Davis, 2004). Cadmium and mercury in the marine environment are predominantly of anthropogenic origin (UNEP, 1990), with rivers being dominant sources compared to direct discharge (OSPAR, 2005).

Sediment hydrocarbon concentrations, were below the limit of detection in samples from three out of the seven station investigated and, where quantifiable, concentrations were below the Canadian marine sediment quality guidelines and are therefore unlikely to pose a threat to the marine environment.

Polychlorinated biphenyls and organotins levels were consistently below the limit of detection in all samples.

6.2.4 Macrobenthic Communities

Results of the biological analysis of grab samples showed relatively rich macrobentic communities, with overall moderate diversity, the latter assessed according to Dauvin et al. (2012). Overall the fauna was numerically dominated by the ross worm *Sabellaria spinulosa*, although the occurrence of this species was restricted across the survey area. Molluscs were mainly represented by bivalves, with *Kurtiella* (formerly *Mysella*) *bidentata* and *Nucula nitidosa* being numerically dominant, whereas crustaceans were dominated by amphipods. Echinoderms comprised brittlestars and sea urchins, which were also recorded by the seabed video footage, together with sea anemones of the Actiniaria order. Epifaunal communities were represented mainly by low-lying bryozoans and less often poriferans and cnidarians, the latter also being recorded by the seabed video footage.

The benthic communities identified by the grab sampling were found to be broadly associated with the sediment type, in line with the current literature which report bathymetry and granulometry as being the major physical variables affecting macrofaunal occurrence and distribution in the North Sea (Glémarec, 1973; Künitzer et al., 1992; Reiss et al., 2010; Callaway et al., 2002; McGlade, 2002; ICES, 2008). This was further confirmed by the results of the multivariate analysis, which highlighted the presence of two major benthic communities, to include: one characterised by coarse, heterogeneous sediment type, hosting fauna typical of relatively stable benthic communities (e.g. *Sabellaria* spinulosa) and epifaunal species (e.g. *Alcyinium digitatum*); and one community characterised by finer, less heterogeneous sandy sediment, hosting overall lower faunal richness and diversity, with fauna typical of communities adapted to withstand physical disturbance as a result of hydrodynamism (e.g. crustacean amphipods, and selected polychaete worms such *as N. cirrosa*).

The seabed heterogeneity of the coarse sediment community, is likely to have enhanced species diversity and abundance, by providing a greater number of microhabitats, including hard substrate for the settlement of epifaunal species, which in turn increase the structural complexity of the habitat and may provide an important microhabitat for smaller fauna such as amphipods and shrimps (UK BAP, 2008). Similarly, the presence of *S. spinulosa* may also contribute to the overall species diversity of the habitat, as the rigid tube which this polychaete builds from sand and shell fragments provides structure and stability within the sediment, enabling the influx and establishment of other species (Limpenny et al., 2010). The high abundance of *Spiophanes bombyx* was, however, also indicative of a certain degree of surface sediment disturbance (De-Bastos, and Marshall, 2016).

The lower diversity of the sandy sediment community identified, is typical of habitats subject to a degree of physical disturbance, such as those associated with tidal movement and/or wave action. This results in habitats that have low species richness and diversity than those of more complex heterogeneous sediments and, for the most part, consist of the more actively swimming amphipods and robust polychaetes characterised by flexible body structures and ability of rapid burrowing if disturbed, as well as high reproductive rates (Tillin 2016). The macrobenthic infauna of this community include animals which feed largely on particulate matter in/on the sand, and which are themselves preyed upon by populations of juvenile flatfish, and other infaunal predators. Therefore, their number is likely to be closely related to that of their prey, which includes other polychaetes and small crustaceans. Stochastic recruitment events of *N. cirrosa* populations may be very important to the population size of other polychaetes present and may therefore create a degree of variation in community composition (Tillin 2016b). Similarly, the presence of small percentages of gravel and mud contributes to a degree of sediment compactness which allows the establishment of species such as *Fabulina fabula* and *Magelona*. These species occur in generally more compacted sand, with less sediment transport, representing a transitional area between the more dynamic offshore and relatively stable nearshore environments (Tillin and Rayment, 2016).

The two major groups identified by the multivariate analysis were classified in terms of biotopes, taking also into consideration results of the seabed video footage. The biotopes were subsequently assessed in relation to their ecological and conservation importance, drawing upon current legislation and guidelines (section 6.2.5).

Infauna biomass in the current study was high, particularly when compared to the average macrofaunal biomass for the whole North Sea, which is reported to be 7g AFDW.m^{-2} (Heip et al., 1992), compared to 16 g AFDW.m-^{2} of the current study. These results are in line with those reported for the North Sea, which indicate an increase of biomass towards the shallower southern North Sea reaching highest values south of the Dogger Bank (North Sea Task Force, 1993).

6.2.5 Habitats of Nature Conservation Interest

Biotopes can be illustrative of habitats of conservation importance at national (e.g. UK Post-2010 Biodiversity Framework (UK BAP Habitats)) and international level (e.g. Habitats Directive (92/43/EEC) (Annex I Habitats) and OSPAR Convention (OSPAR Priority Habitats)).

The relationships between the habitats and biotopes recorded within the Thanet EOWF survey area, and habitats of conservation importance have been assessed and are summarised in Table 6.1.

SS.SSa.IMuSa.FfabMag (A5.242) is contained within the Marine Strategy Framework Directive (MSFD) Predominant Habitat type: Shallow sublittoral sand (Coates et al., 2016). This biotope is also contained within the Habitat of Principal Importance (HPI): Subtidal sands and gravels (Natural England, 2014), which is, in turn, a UK Biodiversity Action Plan (BAP) Priority Habitat (UK BAP, 2008). Subtidal sands and gravels habitat was also a Feature of Conservation Importance (FOCI) within MCZ, until March 2013, when JNCC and Natural England advised Defra that this habitat should no longer be listed on the MCZ FOCI (JNCC, 2016a). It is currently regarded as a habitat of conservation importance (HOCI) within MCZ (JNCC, 2010). The ecological importance of this biotope is associated with its role in providing important feeding and nursery areas for flatfish (Tillin and Rayment, 2016).

The ecological importance of SS.SSA.IFiSa.NcirBat is associated with predatory fish and bird species which this biotope supports in addition to its own biological community. In particular, the sand eel, *Ammodytes* sp., is an important prey species for bird populations, e.g. guillemot, razorbill, puffin and terns. The arctic tern and puffin rely on populations of sand eel as their predominant food source. The sand eel is also an important food source for wintering birds such as scoters, little terns and the red-throated diver (Tillin, 2016).

SS.SMX.CMx.MysThyMx (A5.433) is contained within the broadscale habitat Subtidal mixed sediments, which is a Predominant Habitat type under the MSFD. Within the Thanet Coast MCZ Subtidal mixed sediments are extensive, stretching from Herne bay, in an almost unbroken line, round to the south-easternmost edge of the MCZ to Ramsgate. The subtidal mixed sediments are found at the extreme low water mark and can extend to deep offshore. Consisting of mixed gravelly sands, gravel and shingle laying on top of sandy or muddy substrates, this feature provides an ideal habitat for many benthic marine species (Natural England, 2016).

Sabellaria spinulosa on stable circalittoral mixed sediment (A5.611) is contained within the Annex I feature: biogenic reef, which is a UK BAP (UK BAP, 2008) and OSPAR (OSPAR, 2013) Priority Habitat, as well as a FOCI within MCZs. The biotope is also contained within the MSFD Predominant Habitat: Shallow sublittoral rock and biogenic reef (Haynes et al. 2014). Within the context of the current study, two of the stations surveyed by underwater video footage were assessed in relation to potential reefs. Results showed low resemblance to *Sabellaria* reef structures only at one station. The ecological importance of this biotope is associated with the increased sediment stability which the polychaete tubes offer, enabling other species to establish themselves, increasing the overall diversity of the habitat.

Table 6.1: Relationships Between EUNIS/JNCC Biotopes and Habitats of Conservation Interest Within Thanet EOWF Survey Area

Biotope Code EUNIS (JNCC) and Name	Relationship	Broad-scale Habitat/ Habitat Type	Designation/Status
SS.SSA.IFiSa.NcirBat (A5.233) *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand	Contained within	Subtidal sands and gravels	HPI; UK BAP Priority Habitat; HOCI within MCZ
		Shallow sublittoral sand	MSFD Predominant Habitat
SS.SSa.IMuSa.FfabMag (A5.242) *Fabulina fabula and Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	Contained within	Subtidal sands and gravels	HPI; UK BAP Priority Habitat; HOCI within MCZ
		Shallow sublittoral sand	MSFD Predominant Habitat
SS.SMX.CMx.MysThyMx (A5.433) *Mysella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment	May occur within (whe enough mud is present)	Sheltered muddy gravels	HOCI within MCZ
	Contained within	Subtidal mixed sediments	MSFD Predominant Habitat
SS.SBR.PoR.SspiMx (A5.611) *Sabellaria spinulosa* on stable circalittoral mixed sediment	Contained within	Biogenic Reefs	EC Habitat Directive Annex I Habitat; OSPAR Priority Habitats; UK BAP Priority Habitat; HPI; HOCI within MCZ.
		Shallow sublittoral rock and biogenic reef	MSFD Predominant Habitat
SS.SCS (A5.1) Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Contained within	Subtidal sands and gravels	HPI; UK BAP Priority Habitat; HOCI within MCZ
	Corresponds to	Subtidal coarse sediment	MSFD Predominant Habitat
CR.MCR.SfR (A4.23) Soft rock communities	Contained within	Geogenic Reefs	EC Habitat Directive Annex I Habitat
		Moderate energy circalittoral rock	MSFD Predominant Habitat
		Shallow sublittoral rock and biogenic reef	MSFD Predominant Habitat

Biotope Code EUNIS (JNCC) and Name	Relationship	Broad-scale Habitat/ Habitat Type	Designation/Status
	May occur within	Subtidal chalk/Peat and clay exposures	HOCI within MCZ
SS.SSa (A5.2) Sublittoral Sands (and muddy sands)	Contained within	Subtidal sands and gravels	HPI; UK BAP Priority Habitat; HOCI within MCZ
		Shallow sublittoral sand/shelf sublittoral sand	MSFD Predominant Habitat
A5.44 (SS.SMx.CMx) Circalittoral mixed sediments	May occur within	Sandbanks which are slightly covered by sea water all the time	EC Habitat Directive Annex I Habitat
	Partially overlaps	Sheltered muddy gravels	HOCI within MCZ
	Contained within	Subtidal mixed sediments	MCZ BSH
		Shallow sublittoral mixed sediment/shelf sublittoral mixed sediments	MSFD Predominant Habitat

MPA = Marine Protected Area; MCZ = Marine Conservation Area; MSDF = Marine Strategy Framework Directive; FOCI = Feature of conservation importance; UKBAP = United Kingdom Biodiversity Action Plan; EC = European Community; BSH = Broadscale Habitat; HOCI = Habitat of Conservation Importance

Note: Priority Habitats are also referred to as Habitats of Principal Importance (HPI), defined by Natural England as "*all the habitats in England that were identified as requiring action in the UK BAP and continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework*"(Natural England, 2014).

No species of conservation importance were found. *C. fornicata* was the only non-native species found within the samples. This species is common in the English Channel and known to occur along the east coast of the UK south of Spurn Head in Yorkshire (Rayment, 2008).

7. CONCLUSIONS

Analysis of the video footage was limited mainly to qualitative assessment due to poor underwater visibility at the time of the survey. Where visible, results showed the presence of two major habitats within the Thanet EOWF survey area, one featuring predominantly sandy sediments, characteristic of the offshore stations, and one featuring highly heterogeneous seabed sediment, comprising a mix of coarse sand and gravel, including pebbles, cobbles and boulders, and characteristic of the inshore stations.

The epibiotic communities reflected the sediment complexity, with the offshore sandier sediments hosting lower faunal diversity represented mainly, echinoderms, crustaceans and molluscs, with sessile epifauna being absent or scarce and represented mainly by low-lying bryozoans.

Stations featuring coarser sediments generally comprised more epibenthic community which included a variety of sessile epifauna.

Of the two stations assessed in relation to *Sabellaria spinulosa* reefs, only one, WF28, showed low resemblance to reef structures, whereas station WF46 showed no resemblance and was therefore classified as not reef. Subtidal chalk was recorded at station WF36, in form of flat bedrock overlain by sand.

Results of the grab samples analysis showed a mixed range of sediment types from moderately well sorted sands to very poorly sorted muddy sandy gravel.

In general, the seabed sediments across the survey area were highly heterogeneous. However, an overall pattern of sediment distribution could be identified with coarser sediments characterising sites to the south-west of the proposed wind farm extension area and parts of the cable route.

No pattern of spatial distribution between organic content and particle sediment size was identified, with the results of the correlation analysis showing only a moderate correlation with percentage of mud.

Results of the biological analyses indicated the presence of moderately rich and diverse invertebrate benthic communities, the occurrence and distribution of which was broadly associated with the sediment type. Two major communities were identified which differed based on the seabed sediment characteristics: one featuring highly heterogeneous sediment and hosting relatively high faunal diversity and abundance including epibiotic organisms; the other featuring sandier sediment and hosting low taxa and abundance, represented predominantly by infaunal organisms.

The habitats and associated epibenthic communities recorded by the video footage, and following analysis of the grab samples, were classified to biotopes were possible and/or to habitat/biotope complex, in line with the JNCC and the EUNIS classification systems. These were subsequently assessed in terms of ecological and conservation importance drawing from current marine nature legislation.

No species of conservation importance were recorded and the slipper limpet *Crepidula fornicata* was the only non-native species found.

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FUGRO GROUP

Environmental Investigation Report
Thanet Benthic Characterisation Report
UK Continental Shelf, North Sea

Fugro Document No.: 160975.2 (01)

Fugro (FSBV) Report No.: 160975.2 (01)

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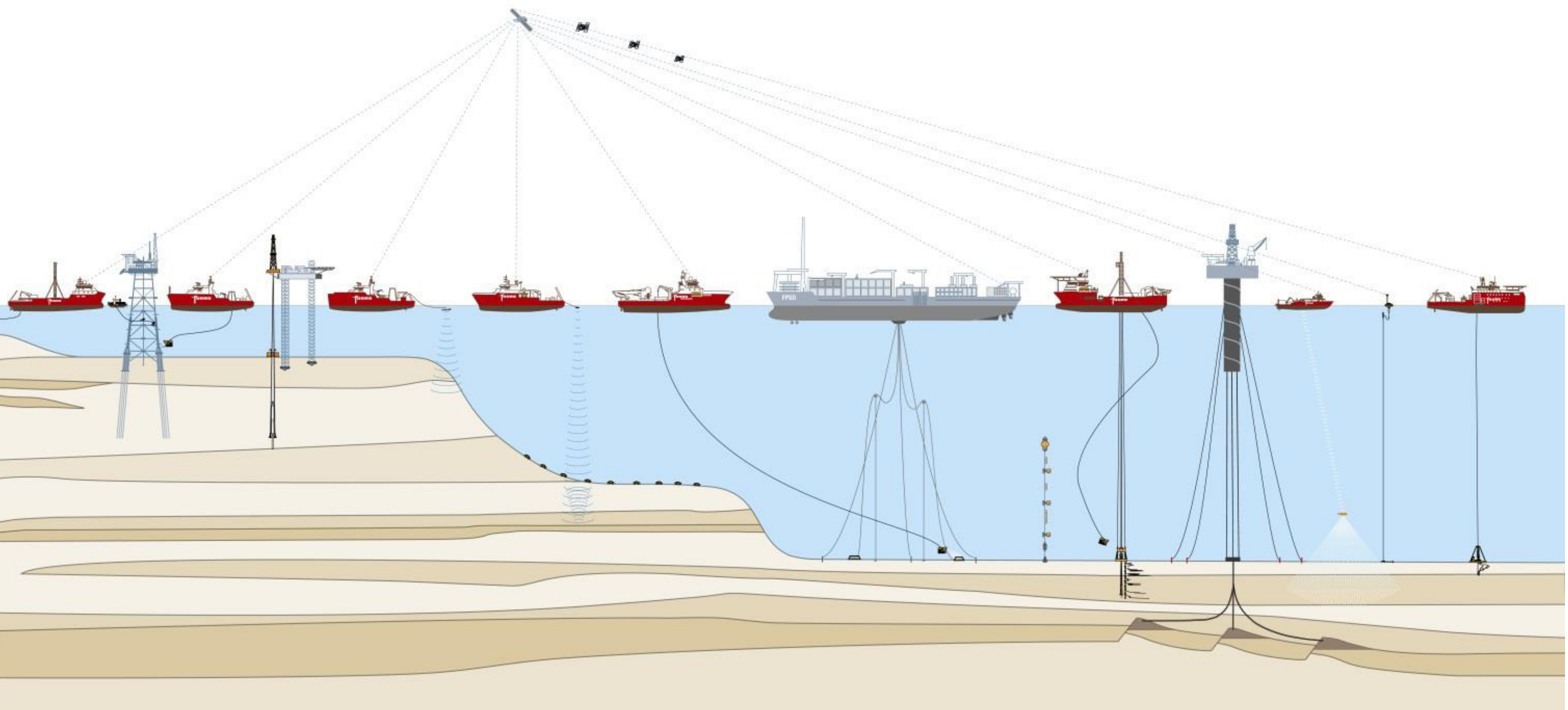
Report 3 of 3

Fugro Group

Final



Environmental Investigation Report
Thanet Extension Offshore Wind Farm
Thanet Benthic Characterisation Report
UK Continental Shelf, North Sea

30 October to 10 November 2016
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Report 3 of 3

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ANNEXES

A. GUIDELINES ON USE OF REPORT

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B. CORRESPONDENCE WITH NATURAL ENGLAND

C. FIELD LOGS

C.1 PROPOSED SURVEY ARRAY

Station Number	Sample Type	ETRS 1989 UTM Zone 31N		Rationale
		Easting [m]	Northing [m]	
CR01	Grab and camera	400 731	5 692 258	Predetermined
CR02	Grab	399 475	5 689 998	Predetermined
CR03	Grab	397 362	5 688 325	Predetermined
CR04	Grab and camera	394 643	5 686 781	Predetermined
CR05	Grab and camera	391 544	5 686 862	Predetermined
CR06	Camera	392 573	5 686 754	Predetermined
CR07	Camera	392 023	5 686 712	Predetermined
CR08	Camera	390 118	5 686 670	Predetermined
CR09	Camera	401 523	5 693 650	Predetermined
WF01	Grab	410 896	5 701 995	Predetermined
WF02	Grab and camera	407 599	5 701 673	Predetermined
WF03	Grab and camera	409 487	5 699 500	Predetermined
WF04	Grab	403 358	5 702 438	Predetermined
WF05	Grab and camera	409 569	5 697 347	Predetermined
WF06	Grab	396 764	5 701 795	Predetermined
WF07	Grab	399 042	5 701 231	Predetermined
WF08	Grab	399 597	5 698 534	Predetermined
WF09	Grab and camera	402 504	5 697 247	Predetermined
WF10	Grab and camera	402 744	5 694 913	Predetermined
WF11	Grab and camera	405 846	5 694 429	Predetermined
WF12	Grab and camera	401 014	5 696 904	Predetermined
WF13	Camera	396 451	5 701 478	Predetermined
WF14	Grab	397 113	5 701 164	Predetermined
WF15.2	Camera	398 758	5 700 183	This station was relocated from the original station WF15 (398 568E, 5 700 569N), in order to survey substrate identified from the acoustic data.
WF16.2	Camera	400 567	5 700 375	This station was relocated from the original station WF16 (400 122E, 5 700 718N), in order to survey substrate identified from the acoustic data
WF17	Camera	407 150	5 700 436	Predetermined
WF18	Camera	409 101	5 700 585	Predetermined
WF19	Grab	410 920	5 700 817	Predetermined
WF20	Camera	397 923	5 699 973	Predetermined
WF21	Camera	398 535	5 699 295	Predetermined
WF22	Grab	399 543	5 699 494	Predetermined
WF23	Camera	408 225	5 699 163	Predetermined
WF24	Camera	405 761	5 702 570	Predetermined
WF25	Grab	409 746	5 702 752	Predetermined
WF26	Camera	401 230	5 698 667	Predetermined
WF27	Grab	408 655	5 698 303	Predetermined
WF28	Camera	409 746	5 698 386	Predetermined
WF29	Grab	410 606	5 698 452	Predetermined
WF30	Camera	400 139	5 697 460	Predetermined

Station Number	Sample Type	ETRS 1989 UTM Zone 31N		Rationale
		Easting [m]	Northing [m]	
WF31	Camera	409 383	5 701 710	Predetermined
WF32	Grab	401 462	5 701 677	Predetermined
WF33	Camera	407 332	5 702 652	Predetermined
WF34	Camera	401 862	5 695 809	Predetermined
WF35	Camera	403 238	5 696 126	Predetermined
WF36	Camera	409 609	5 696 232	Predetermined
WF37	Grab	402 073	5 701 991	Predetermined
WF38	Camera	405 143	5 694 941	Predetermined
WF39	Camera	407 810	5 694 878	Predetermined
WF40	Camera	403 788	5 694 221	Predetermined
WF41	Grab	400 221	5 702 768	Predetermined
WF42	Camera	409 059	5 694 518	Predetermined
WF43	Camera	404 961	5 693 674	Predetermined
WF44	Grab	406 286	5 693 671	Predetermined
WF45	Grab	408 106	5 693 629	Predetermined
WF46	Camera	407 432	5 693 203	Predetermined
WF47	Grab	398 105	5 702 851	Predetermined

C.2 VIDEO TRANSECTS LOG

Date	Transect	Video File	Time [UTC]	Point on Line	ETRS 1989 UTM Z31N Easting [m]	ETRS 1989 UTM Z31N Northing [m]	Length [m]*
13/11/2016	CR01	160975_ThanetOWF_CR_01	13:49:46	SOL	400 782	5 692 253	126
			13:56:12	EOL	400 801	5 692 128	
13/11/2016	CR04	160975_ThanetOWF_CR_04	14:42:21	SOL	394 684	5 686 756	108
			14:50:46	EOL	394 577	5 686 738	
03/12/2016	CR05.1	160975_ThanetOWF_CR_05.1	09:03:54	SOL	391 576	5 686 782	62
			09:14:59	EOL	391 616	5 686 830	
02/12/2016	CR06	160975_ThanetOWF_CR_06	17:43:21	SOL	392 571	5 686 733	27
			17:57:11	EOL	392 553	5 686 712	
03/12/2016	CR07	160975_ThanetOWF_CR_07	08:15:37	SOL	392 018	5 686 658	42
			08:27:26	EOL	392 031	5 686 698	
05/12/2016	CR08•	160975_ThanetOWF_CR_08	07:39:27	SOL	390 118	5 686 667	220
			07:50:46	EOL	390 110	5 686 684	
13/11/2016	CR09	160975_ThanetOWF_CR_09	13:26:45	SOL	401 564	5 693 683	143
			13:35:09	EOL	401 573	5 693 540	
05/12/2016	CR10°	160975_ThanetOWF_CR_10	08:47:21	SOL	389 727	5 685 962	10
			09:03:47	EOL	389 718	5 685 958	
05/12/2016	CR11	160975_ThanetOWF_CR_11	09:39:56	SOL	388 995	5 682 291	54
			09:50:51	EOL	389 015	5 682 341	
11/11/2016	WF02	160975_ThanetOWF_WF_04	22:08:04	SOL	407 549	5 701 724	193
			22:14:54	EOL	407 725	5 701 645	
11/11/2016	WF03	160975_ThanetOWF_WF_03	18:46:07	SOL	409 459	5 699 440	218
			18:54:25	EOL	409 471	5 699 657	
11/11/2016	WF05	160975_ThanetOWF_WF_05	17:10:47	SOL	409 555	5 697 282	134
			17:17:25	EOL	409 574	5 697 415	
12/11/2016	WF09	160975_ThanetOWF_WF_09	04:20:03	SOL	402 532	5 697 181	189
			04:26:00	EOL	402 468	5 697 360	
13/11/2016	WF10	160975_ThanetOWF_WF_10	12:57:41	SOL	402 765	5 694 948	75
			13:04:23	EOL	402 743	5 694 877	
13/11/2016	WF11	160975_ThanetOWF_WF_11	11:10:55	SOL	405 882	5 694 457	51
			11:16:22	EOL	405 845	5 694 421	
12/11/2016	WF12	160975_ThanetOWF_WF_12	03:55:20	SOL	401 069	5 696 857	169
			04:00:04	EOL	400 931	5 696 955	
12/11/2016	WF13	160975_ThanetOWF_WF_13	01:31:27	SOL	396 476	5 701 587	198
			01:38:13	EOL	396 437	5 701 393	
12/11/2016	WF15.2	160975_ThanetOWF_WF_15	00:54:55	SOL	398 772	5 700 295	184
			01:02:26	EOL	398 753	5 700 112	
11/11/2016	WF16.2	160975_ThanetOWF_WF_16	00:14:23	SOL	400 567	5 700 390	189
			00:21:04	EOL	400 558	5 700 201	
11/11/2016	WF17	160975_ThanetOWF_WF_17	21:44:43	SOL	407 143	5 700 483	230
			21:58:47	EOL	407 239	5 700 273	
11/11/2016	WF18	160975_ThanetOWF_WF_18	21:16:43	SOL	409 061	5 700 674	223
			21:25:07	EOL	409 133	5 700 463	
12/11/2016	WF20	160975_ThanetOWF_WF_20	01:56:42	SOL	397 913	5 700 067	168
			02:03:09	EOL	397 954	5 699 904	
12/11/2016	WF21	160975_ThanetOWF_WF_21	02:15:06	SOL	398 495	5 699 369	140
			02:22:35	EOL	398 561	5 699 246	

Date	Transect	Video File	Time [UTC]	Point on Line	ETRS 1989 UTM Z31N Easting [m]	ETRS 1989 UTM Z31N Northing [m]	Length [m]*
11/11/2016	WF23	160975_ThanetOWF_WF_23	19:14:53	SOL	408 183	5 699 105	244
			19:23:27	EOL	408 295	5 699 322	
11/11/2016	WF24	160975_ThanetOWF_WF_24	23:07:08	SOL	405 726	5 702 645	175
			23:14:00	EOL	405 788	5 702 481	
12/11/2016	WF26	160975_ThanetOWF_WF_26(2)	03:00:32	SOL	401 146	5 698 693	174
			03:05:28	EOL	401 317	5 698 661	
11/11/2016	WF28	160975_ThanetOWF_WF_28	17:44:53	SOL	409 732	5 698 308	208
			17:54:29	EOL	409 779	5 698 511	
12/11/2016	WF30	160975_ThanetOWF_WF_30	03:27:14	SOL	400 161	5 697 417	199
			03:33:29	EOL	400 029	5 697 566	
11/11/2016	WF31	160975_ThanetOWF_WF_31	20:56:08	SOL	409 335	5 701 772	201
			21:02:35	EOL	409 453	5 701 609	
11/11/2016	WF33	160975_ThanetOWF_WF_33	22:31:35	SOL	407 284	5 702 728	269
			22:42:17	EOL	407 436	5 702 507	
12/11/2016	WF34	160975_ThanetOWF_WF_34	05:25:13	SOL	401 863	5 695 716	144
			05:35:34	EOL	401 839	5 695 858	
12/11/2016	WF35	160975_ThanetOWF_WF_35	05:00:14	SOL	403 243	5 696 051	130
			05:06:46	EOL	403 209	5 696 177	
13/11/2016	WF36	160975_ThanetOWF_WF_36(2)	08:35:48	SOL	409 610	5 696 189	80
			08:42:55	EOL	409 633	5 696 266	
13/11/2016	WF38	160975_ThanetOWF_WF_38	11:36:50	SOL	405 180	5 694 973	57
			11:47:41	EOL	405 139	5 694 934	
13/11/2016	WF39	160975_ThanetOWF_WF_39	09:31:21	SOL	407 814	5 694 894	69
			09:36:28	EOL	407 816	5 694 825	
13/11/2016	WF40	160975_ThanetOWF_WF_40	12:25:00	SOL	403 828	5 694 248	56
			12:33:30	EOL	403 787	5 694 209	
13/11/2016	WF42	160975_ThanetOWF_WF_42	09:02:23	SOL	409 042	5 694 461	150
			09:10:34	EOL	409 126	5 694 585	
13/11/2016	WF43	160975_ThanetOWF_WF_43	10:22:13	SOL	404 993	5 693 712	59
			10:28:29	EOL	404 959	5 693 664	
13/11/2016	WF46	160975_ThanetOWF_WF_46	09:53:08	SOL	407 472	5 693 238	50
			09:58:28	EOL	407 431	5 693 208	

Notes:
UTC = Universal tiem coordinated
SOL = Start of line
EOL = End of line
* = High levels of suspended sediments meant that the seabed was not visible for the entire length of many of the video transects. The length of the transect is defined as the position at which the video system reached the seabed to the position it was retrieved from the seabed

C.3 MACROBENTHIC GRAB SAMPLING LOGS

Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Sample	Volume (L)	Water Depth (m BSL)	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
13/11/2016	18:33	CR01	400 728.4	5 692 261.0	FA/PSD	5	16	gmS	Gravelly muddy sand with cobbles and pebbles		Tubes, *Ophiothrix fragilis, Alcyonium digitatum*, *Spirobranchus* sp., Terebellidae
13/11/2016	17:12	CR02	399 487.1	5 689 997.8	PSD only	2	13	gS	Gravelly sand with cobbles and pebbles		Tubes, *Spirobranchus* sp., *Alcyonium digitatum*, *Psammechinus miliaris*. Three attempts were made, with all samples retrieved being low in volume. A faunal sample was therefore not obtained.
13/11/2016	16:27	CR03	397 367.7	5 688 311.8	FA/PSD	12	12	S	Fine sand with small proportion of shell fragments		
13/11/2016	15:41	CR04	394 639.4	5 686 768.6	No Sample	NA	NA	NA	NA	-	Three unsuccesful attempts were made, therefore no samples were obtained.
05/12/2016	14:38	CR05.1	391 627.0	5 686 838.1	No Sample	< 1	16	S	Slightly shelly sand	-	Original location moved due to the presence of a marker buoy at proposed station. Three unsuccesful attempts were made, therefore no samples were obtained.
05/12/2016	13:32	CR10	389 721.3	5 685 970.1	FA/PSD	6	8	S	Slightly shelly sand		
05/12/2016	11:42	CR11	388 984.4	5 682 323.5	PSD only	4	7	gS	Slightly muddy, pebbley, gravelly sand	-	Three attempts were made, with samples discarded due to pebbles preventing closure. A PSD only sample was reatined and is considered representative only.
12/11/2016	23:11	WF01	410 905.2	5 702 003.6	PSD only	3	35	S	Fine sand and pebbles		

Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Sample	Volume (L)	Water Depth (m BSL)	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
12/11/2016	23:17	WF01	410 895.8	5 701 992.2	FA only	5	35	S	Fine sand and pebbles (with one1 flat cobble, compacted sand)		*Nephtys* sp.
13/11/2016	01:03	WF02	407 604.9	5 701 676.9	FA/PSD	12	33	mS	Fine sand with clay patches and shell fragments	Patches of anoxic sediment	
12/11/2016	22:00	WF03	409 479.4	5 699 504.4	FA/PSD	11	31	mS	Muddy sand (few pebbles and black mud nodules)	Patches of anoxic sediment, black mud nodules through sample	
13/11/2016	01:46	WF04	403 369.3	5 702 450.1	FA/PSD	10	27	mS	Fine sand overlaying mud	Patches of anoxic sediment	Tubes, Ophiuridae
12/11/2016	19:33	WF05	409 553.2	5 697 364.1	FA/PSD	12	33	S	Fine to medium sand over clay	Layer of clay from 10 cm	
12/11/2016	07:07	WF06	396 765.9	5 701 820.1	FA/PSD	5	19	M	Mud with shell fragments		Tubes,Ophiuridae
13/11/2016	04:16	WF07	399 038.5	5 701 228.3	FA/PSD	10	21	mS	Fine sand overlaying mud	Patches of anoxic sediment	Tubes, Echinoidea, Actinaria
14/11/2016	00:01	WF08	399 488.3	5 698 539.6	FA/PSD	8	24	mS	Fine sand overlaying silt	Patches of anoxic sediment	
13/11/2016	22:40	WF09	402 501.7	5 697 247.9	FA/PSD	7	21	mgS	Cobbles, pebbles and muddy gravelly sand		*Sabellaria* tubes (no elevation, no crust)
13/11/2016	22:04	WF10	402 736.4	5 694 915.6	PSD only	2	22	mgS	Cobbles, pebbles and muddy gravelly sand		Hydroid. Three attempts were made. Only one successful but with low volume. PSD only taken
13/11/2016	21:27	WF11	405 835.1	5 694 421.4	FA/PSD	6	21	gmS	Pebbles and gravelly muddy sand		Ophiuridae

Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Sample	Volume (L)	Water Depth (m BSL)	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
13/11/2016	23:18	WF12	401 019.2	5 696 897.2	PSD only	3	20	mgS	Large cobbles and muddy gravelly sand		*Spirobranchus* sp.
13/11/2016	23:22	WF12	401 011.4	5 696 911.1	FA only	5	20	mgS	Pebbles (incl. Chalk) and muddy gravellly sand		Terebellidae and *Spirobranchus* sp.
13/11/2016	05:05	WF14	397 125.4	5 701 160.2	FA/PSD	10	21	mS	Fine sand overlaying mud	Patches of anoxic sediment 1cm	Tubes, Echinoidea, Cardiidae, Decapoda, Actinaria
12/11/2016	22:27	WF19	410 914.2	5 700 819.2	FA/PSD	6	40	mS	Muddy sand with some shell fragments	Patches of anoxic sediment, black nodules	
13/11/2016	05:57	WF22	399 548.4	5 699 485.6	FA/PSD	8	21	gM	Silt with gravel, pebbles and cobbles	Streaks of anoxic sediment	Tubes, Echinoidea
13/11/2016	00:23	WF25	409 744.1	5 702 768.0	FA/PSD	12	29	S	Fine sand and shell fragments		Polychaeta
12/11/2016	20:22	WF27	408 666.1	5 698 302.7	FA/PSD	10	21	mS	Fine (to medium) sand over grey/black stiff sandy mud	Layer of sandy mud > 5 cm	
12/11/2016	21:14	WF29	410 567.8	5 698 486.2	FA/PSD	10	40	mS	Slightly muddy fine to medium sand (some pebbles and one cobble)	Patches of anoxic sediment	Tubes, *Nephtys* sp. A cardinal buoy close to the south
13/11/2016	03:01	WF32	401 453.7	5 701 661.4	FA/PSD	5	25	mS	Fine sand overlaying mud	Patches of anoxic sediment	Tubes, Echinoidea, Ophiuridae, Actinaria
13/11/2016	02:20	WF37	402 088.2	5 701 993.6	FA/PSD	8	25	mS	Fine sand overlaying mud	Patches of anoxic sediment	Tubes, Echinoidea, Ophiuridae, polychaetes
13/11/2016	03:34	WF41	400 227.0	5 702 751.8	FA/PSD	10	24	mS	Fine sand overlaying mud	Patches of anoxic sediment	Tubes, Echinoidea, Cariidae, Actinaria
13/11/2016	20:33	WF44	406 290.9	5 693 671.4	FA only	> 4	22	mgS	Pebbles (including chalk) and muddy gravellly sand		Tubes, Ophiuridae. Three attempts made, but only one successful and sufficient for fauna only

Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Sample	Volume (L)	Water Depth (m BSL)	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
13/11/2016	19:51	WF45	408 100.9	5 693 626.6	FA/PSD	7	27	mS	Slightly muddy fine to medium sand (some pebbles present)	Patches and layers of anoxic sediment > 10 cm and black muddy nodules	
12/11/2016	08:20	WF47	398 107.6	5 702 838.4	FA/PSD	8	23	M	Mud with shell fragments	Patches of anoxic sediment	Tubes, Echinoidea, Ophiuridae

Notes:
UTC = Universal time coordinated
BSL = Below sea level
FA = Sample for faunal analysis
PSD = Sample for particle size distribution analysis

C.4 MACROFAUNA GRAB SAMPLE PHOTOS

CR01

CR02

CR03

CR10

CR11

WF01

WF02

WF03

WF04

WF05

WF06

WF07

WF08

WF09

WF10

WF11

WF12

WF14

WF19

WF22

WF25

WF27

WF29

WF32

WF37

WF41

WF44

WF45

WF47

C.5 CONTAMINANTS GRAB SAMPLING LOGS

Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Sample	Water Depth (m BSL)	Volume (L)	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
13/11/2016	18:37	CR01	400 720.1	5 692 256.0	HC/HM	16	NA	NA	NA	-	Three attempts were made and in all instances a stone caught in the jaws. Therefore no samples were obtained.
13/11/2016	17:21	CR02	399 464.1	5 689 989.1	HC/HM	13	NA	NA	NA		Three attempts were made and in all instances a stone caught in the jaws. Therefore no samples were obtained.
13/11/2016	16:30	CR03	397 370.0	5 688 318.3	HC/HM	12	10	S	Fine sand		
13/11/2016	15:51	CR04	394 634.2	5 686 776.1	HC/HM	9.5	>1.5	mS	Sandy mud/muddy sand		Mussel seed and *Asterias rubens*
05/12/2016	14:38	CR05.1	391 614.8	5 686 839.1	HC/HM	9	NA	NA	NA		Three attempts were made, but in all instances low volumes were collected. Therefore no sample was obtained.
05/12/2016	13:45	CR10	389 720.2	5 685 962.3	HC/HM	8.4	6	S	Slightly shelly sand		
12/11/2016	23:26	WF01	410 898.6	5 702 010.4	HC/HM	35	7	S	Fine sand		
13/11/2016	01:08	WF02	407 610.6	5 701 662.8	HC/HM	33	9	S	Fine sand		
11/11/2016	12:59	WF03	409 487.2	5 699 494.8	HC/HM	28	8	mS	Muddy sand (mud nodules on surface)	Patches of nodules at the surface and a layer at 2 cm	
13/11/2016	01:51	WF04	403 356.8	5 702 426.3	HC/HM	27	9	mS	Fine sand (1 cm) overlaying mud	Layer 1 cm	Tubes, Ophiuridae
11/11/2016	11:52	WF05	409 570.2	5 697 348.1	HC/HM	28	10	S	Fine sand		
12/11/2016	07:24	WF06	396 756.0	5 701 790.4	HC/HM	19	8	mS	Silty sand		Tubes

Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Sample	Water Depth (m BSL)	Volume (L)	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
13/11/2016	04:24	WF07	399 049.4	5 701 214.4	HC/HM	21	8	mS	Fine sand overlaying mud	Layer 1 cm	Tubes, Ophiuridae
14/11/2016	00:06	WF08	399 484.9	5 698 533.1	HC/HM	24	8	mS	Fine sand overlaying mud	Layer 1 cm	
13/11/2016	22:44	WF09	402 508.5	5 697 246.2	HC/HM	21	NA	NA	NA	-	Three unsuccessful attempts were made. Therefore no samples were obtained.
13/11/2016	22:12	WF10	402 754.1	5 694 911.0	HC/HM	22	NA	NA	NA	-	Three attempts were made and in all instances cobbles were collected. Therefore no samples were obtained.
13/11/2016	23:27	WF12	401 020.6	5 696 904.1	HC/HM	20	5	(m)gS	Pebble and slightly muddy gravelly sand		
13/11/2016	05:09	WF14	397 105.0	5 701 174.4	HC/HM	21	8	mS	Fine sand overlaying mud	Layer 1 cm	Tubes, Ophiuridae
12/11/2016	22:34	WF19	410 921.7	5 700 826.7	HC/HM	40	7	mS	Slightly muddy sand		*Buccinum undatum* (juvenile)
13/11/2016	06:01	WF22	399 547.9	5 699 507.1	HC/HM	21	-	-	-	-	Three attempts were made and in all instances a pebble caught in the jaws. Therefore no samples were obtained.
13/11/2016	00:27	WF25	409 743.5	5 702 752.5	HC/HM	29	10	S	Fine sand and shell fragments		
11/11/2016	12:25	WF27	408 641.4	5 698 340.8	HC/HM	27	8	S	Fine to medium shelly sand		
12/11/2016	21:23	WF29	410 572.4	5 698 491.2	HC/HM	40	6	mS	Muddy sand (film of mud and mud nodules at surface	Patches < 2 cm	
13/11/2016	03:05	WF32	401 451.5	5 701 670.6	HC/HM	25	8	mS	Fine sand (1 cm) overlaying mud	Layer 1 cm	Tubes, Ophiuridae
13/11/2016	02:24	WF37	402 072.2	5 701 980.6	HC/HM	21	10	mS	Fine sand (1 cm) overlaying mud	Layer 1 cm	Tubes, Ophiuridae

Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Sample	Water Depth (m BSL)	Volume (L)	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
13/11/2016	03:38	WF41	400 215.2	5 702 767.7	HC/HM	24	8	mS	Fine sand overlaying mud	Layer 1 cm	Tubes, Ophiuridae
13/11/2016	20:40	WF44	406 283.9	5 693 662.0	HC/HM	22	-	-	-	-	Three attempts were made and in all instances a pebble caught in the jaws. Therefore no samples were obtained.
13/11/2016	20:03	WF45	408 101.3	5 693 619.7	HC/HM	27	-	-	-	-	Three attempts were made and in all instances a pebble caught in the jaws. Therefore no samples were obtained.
12/11/2016	08:31	WF47	398 106.3	5 702 853.8	HC/HM	23	10	M	Mud with clay	Layer, Mud 3 cm, clay below top 3 cm	Ophiuridae

Notes:
UTC = Universal time coordinated
BSL = Below sea level
UTC = Universal time coordinated
HM = Heavy metals
HC = Hydrocarbons

C.6 CONTAMINANTS GRAB SAMPLES PHOTOS

	
CR03	**CR04**
No photo	
CR10	**WF01**
	
WF02	**WF03**

	
WF04	**WF05**
	
WF06	**WF07**
	
WF08	**WF12**

	
WF14	**WF19**
	
WF25	**WF27**
	
WF29	**WF32**

WF37

WF41

WF47

D. GRAB ANALYSIS DATA

D.1 PSD RESULTS

Sample ID:		CR01	CR02	CR03	CR10	WF01	WF02	WF03
Textural group	Sample Type:	Trimodal, Very Poorly Sorted	Unimodal, Very Poorly Sorted	Unimodal, Moderately Well Sorted	Unimodal, Moderately Well Sorted	Bimodal, Very Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Very Poorly Sorted
	Folk [1954 Original]:	Sandy Gravel	Gravel	Slightly Gravelly Sand	Slightly Gravelly Sand	Sandy Gravel	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand
	Folk [Bgs Modified]:	Sandy Gravel	Gravel	Slightly Gravelly Sand	Sand	Sandy Gravel	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand
	Sediment Name:	Sandy Very Coarse Gravel	Very Coarse Gravel	Slightly Very Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand	Sandy Medium Gravel	Slightly Fine Gravelly Medium Silty Medium Sand	Slightly Fine Gravelly Fine Silty Medium Sand
Method of Moments Arithmetic [µm]	Mean:	27562.12	51658.98	404.33	497.12	4807.76	671.79	492.53
	Sorting:	21183.26	32853.91	468.87	315.83	7757.82	1086.34	830.32
	Skewness:	-0.24	-0.60	8.60	7.70	1.62	5.48	5.48
	Kurtosis:	1.20	1.47	93.43	111.15	4.17	41.52	35.39
Method of Moments Geometric [µm]	Mean:	8870.13	23472.64	318.08	421.50	1095.80	281.97	189.46
	Sorting:	8.93	6.80	1.64	1.54	5.22	5.47	6.45
	Skewness:	-1.27	-1.82	1.68	0.66	0.82	-1.78	-1.70
	Kurtosis:	4.08	6.10	9.86	5.23	2.02	6.66	5.59
Method of Moments Logarithmic [phi]	Mean:	-3.15	-4.55	1.65	1.25	-0.13	1.83	2.40
	Sorting:	3.16	2.77	0.71	0.62	2.38	2.45	2.69
	Skewness:	1.27	1.82	-1.68	-0.66	-0.82	1.78	1.70
	Kurtosis:	4.08	6.10	9.86	5.23	2.02	6.66	5.59
Folk and Ward Method [µm]	Mean:	9317.13	29186.04	300.64	427.80	1172.33	327.86	192.66
	Sorting:	7.56	4.90	1.62	1.59	5.35	3.99	4.69
	Skewness:	-0.80	-0.89	-0.07	0.15	0.67	-0.43	-0.61
	Kurtosis:	0.61	1.29	1.18	0.99	0.66	2.39	2.69
Folk and Ward Method [Phi]	Mean:	-3.22	-4.87	1.73	1.22	-0.23	1.61	2.38
	Sorting:	2.92	2.29	0.69	0.67	2.42	2.00	2.23
	Skewness:	0.80	0.89	0.07	-0.15	-0.67	0.43	0.61
	Kurtosis:	0.61	1.29	1.18	0.99	0.66	2.39	2.69

Sample ID:		CR01	CR02	CR03	CR10	WF01	WF02	WF03
Folk and Ward Method [Description]	Mean:	Medium Gravel	Coarse Gravel	Medium Sand	Medium Sand	Very Coarse Sand	Medium Sand	Fine Sand
	Sorting:	Very Poorly Sorted	Very Poorly Sorted	Moderately Well Sorted	Moderately Well Sorted	Very Poorly Sorted	Poorly Sorted	Very Poorly Sorted
	Skewness:	Very Fine Skewed	Very Fine Skewed	Symmetrical	Coarse Skewed	Very Coarse Skewed	Very Fine Skewed	Very Fine Skewed
	Kurtosis:	Very Platykurtic	Leptokurtic	Leptokurtic	Mesokurtic	Very Platykurtic	Very Leptokurtic	Very Leptokurtic
Mode 1 [µM]:		47250.00	76754.83	375.00	375.00	375.00	375.00	375.00
Mode 2 [µM]:		12000.00	0.00	0.00	0.00	12000.00	0.00	0.00
Mode 3 [µM]:		375.00	0.00	0.00	0.00	0.00	0.00	0.00
Mode 1 [PHI]:		-5.48	-6.24	1.50	1.50	1.50	1.50	1.50
Mode 2 [PHI]:		-3.50	0.00	0.00	0.00	-3.50	0.00	0.00
Mode 3 [PHI]:		1.50	0.00	0.00	0.00	0.00	0.00	0.00
D10 [µm]:		324.97	718.75	160.33	258.35	255.26	20.75	8.85
D50 [µm]:		32309.54	67708.57	317.80	402.00	468.85	425.01	335.66
D90 [µm]:		55123.73	85405.28	490.15	815.44	17268.45	943.28	771.20
(D90 / D10) [µm]:		169.63	118.83	3.06	3.16	67.65	45.45	87.10
(D90 - D10) [µm]:		54798.76	84686.53	329.82	557.09	17013.19	922.53	762.34
(D75 / D25) [µm]:		45.26	6.04	1.79	1.86	19.70	2.62	2.33
(D75 - D25) [µm]:		44119.72	65331.34	183.74	262.79	5995.05	431.08	267.41
D10 [Phi]:		-5.78	-6.42	1.03	0.29	-4.11	0.08	0.37
D50 [Phi]:		-5.01	-6.08	1.65	1.31	1.09	1.23	1.57
D90 [Phi]:		1.62	0.48	2.64	1.95	1.97	5.59	6.82
(D90 / D10) [Phi]:		-0.28	-0.07	2.57	6.63	-0.48	66.36	18.19
(D90 - D10) [Phi]:		7.41	6.89	1.61	1.66	6.08	5.51	6.44
(D75 / D25) [Phi]:		0.00	0.59	1.66	2.10	-0.62	3.67	2.12
(D75 - D25) [Phi]:		5.50	2.60	0.84	0.90	4.30	1.39	1.22
% Gravel [63000 - 2000 µm]:		73.50	86.99	1.08	0.47	30.41	4.56	2.90
% Sand [< 2000 - 63 µm]:		24.75	12.23	98.92	99.53	69.59	81.05	78.77
% Mud [< 63 µm]:		1.76	0.78	0.00	0.00	0.00	14.40	18.33
% V Coarse Gravel:		50.72	62.42	0.00	0.00	0.00	0.00	0.00

Sample ID:	CR01	CR02	CR03	CR10	WF01	WF02	WF03
% Coarse Gravel:	7.11	10.36	0.00	0.00	11.27	0.00	0.00
% Medium Gravel:	10.20	7.30	0.00	0.00	12.43	0.24	0.00
% Fine Gravel:	3.67	4.64	0.43	0.10	3.82	2.20	1.78
% V Fine Gravel:	1.80	2.27	0.65	0.37	2.89	2.12	1.13
% V Coarse Sand:	1.46	1.39	1.84	1.07	2.89	2.56	1.03
% Coarse Sand:	8.81	3.40	5.24	28.71	12.47	34.26	16.17
% Medium Sand:	10.03	4.50	63.99	62.71	45.60	36.78	51.99
% Fine Sand:	3.53	2.47	27.85	7.03	8.63	5.04	9.22
% V Fine Sand:	0.92	0.47	0.00	0.00	0.00	2.40	0.35
% V Coarse Silt:	0.39	0.17	0.00	0.00	0.00	2.98	2.89
% Coarse Silt:	0.22	0.13	0.00	0.00	0.00	2.40	2.37
% Medium Silt:	0.30	0.13	0.00	0.00	0.00	3.21	3.75
% Fine Silt:	0.37	0.16	0.00	0.00	0.00	2.92	4.24
% V Fine Silt:	0.09	0.04	0.00	0.00	0.00	0.55	0.96
% Clay:	0.39	0.16	0.00	0.00	0.00	2.34	4.12

Sample ID:		WF04	WF05	WF06	WF07	WF08	WF09	WF10
Textural Group	Sample Type:	Unimodal, Very Poorly Sorted	Unimodal, Moderately Sorted	Unimodal, Poorly Sorted	Unimodal, Very Poorly Sorted	Unimodal, Poorly Sorted	Bimodal, Very Poorly Sorted	Unimodal, Poorly Sorted
	Folk [1954 Original]:	Slightly Gravelly Muddy Sand	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand	Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Muddy Sandy Gravel	Gravel
	Folk [Bgs Modified]:	Muddy Sand	Sand	Muddy Sand	Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Muddy Sandy Gravel	Gravel
	Sediment Name:	Slightly Fine Gravelly Fine Silty Medium Sand	Slightly Very Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Very Coarse Silty Medium Sand	Medium Gravelly Fine Silty Fine Sand	Slightly Very Fine Gravelly Fine Silty Medium Sand	Fine Silty Sandy Very Coarse Gravel	Very Coarse Gravel
Method of Moments Arithmetic [µm]	Mean:	321.53	513.80	293.65	858.22	336.22	23506.94	33715.99
	Sorting:	391.70	450.03	321.31	2350.20	687.13	22291.31	18210.70
	Skewness:	8.75	8.02	8.51	4.11	12.18	0.06	-0.79
	Kurtosis:	119.75	91.29	133.64	19.01	185.02	1.09	1.94
Method of Moments Geometric [µm]	Mean:	147.37	387.09	159.75	180.81	158.95	3871.58	17978.93
	Sorting:	5.63	2.39	4.26	6.34	4.77	16.75	5.48
	Skewness:	-1.82	-4.05	-2.16	-0.88	-2.03	-0.90	-2.40
	Kurtosis:	5.91	28.42	8.49	5.51	7.66	3.10	9.31
Method of Moments Logarithmic [Phi]	Mean:	2.76	1.37	2.65	2.47	2.65	-1.95	-4.17
	Sorting:	2.49	1.26	2.09	2.66	2.25	4.07	2.45
	Skewness:	1.82	4.05	2.16	0.88	2.03	0.90	2.40
	Kurtosis:	5.91	28.42	8.49	5.51	7.66	3.10	9.31
Folk and Ward Method [µm]	Mean:	171.50	428.51	196.01	194.97	203.89	5819.17	25434.98
	Sorting:	4.15	1.66	3.24	4.67	3.23	12.27	3.44
	Skewness:	-0.54	0.09	-0.33	-0.12	-0.37	-0.65	-0.69
	Kurtosis:	1.91	1.09	1.70	2.55	2.13	0.67	1.95
Folk and Ward Method [Phi]	Mean:	2.54	1.22	2.35	2.36	2.29	-2.54	-4.67
	Sorting:	2.05	0.73	1.69	2.22	1.69	3.62	1.78
	Skewness:	0.54	-0.09	0.33	0.12	0.37	0.65	0.69
	Kurtosis:	1.91	1.09	1.70	2.55	2.13	0.67	1.95

Sample ID:		WF04	WF05	WF06	WF07	WF08	WF09	WF10
Folk and Ward Method [Description]	Mean:	Fine Sand	Medium Sand	Fine Sand	Fine Sand	Fine Sand	Fine Gravel	Coarse Gravel
	Sorting:	Very Poorly Sorted	Moderately Sorted	Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Very Poorly Sorted	Poorly Sorted
	Skewness:	Very Fine Skewed	Symmetrical	Very Fine Skewed	Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed
	Kurtosis:	Very Leptokurtic	Mesokurtic	Very Leptokurtic	Very Leptokurtic	Very Leptokurtic	Very Platykurtic	Very Leptokurtic
Mode 1 [µm]:		375.00	375.00	375.00	187.50	375.00	47250.00	47250.00
Mode 2 [µM]:		0.00	0.00	0.00	0.00	0.00	375.00	0.00
Mode 3 [µM]:		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mode 1 [Phi]:		1.50	1.50	1.50	2.50	1.50	-5.48	-5.48
Mode 2 [Phi]:		0.00	0.00	0.00	0.00	0.00	1.50	0.00
Mode 3 [Phi]:		0.00	0.00	0.00	0.00	0.00	0.00	0.00
D10 [µm]:		9.49	253.96	38.25	15.89	18.87	140.08	752.36
D50 [µm]:		259.41	401.97	218.31	214.41	229.17	17352.60	35932.10
D90 [µm]:		607.97	832.29	553.45	927.98	490.24	54081.76	56307.85
(D90 / D10) [µm]:		64.06	3.28	14.47	58.39	25.98	386.07	74.84
(D90 - D10) [µm]:		598.48	578.32	515.20	912.09	471.37	53941.67	55555.50
(D75 / D25) [µm]:		3.13	1.92	3.19	3.05	2.63	113.84	2.97
(D75 - D25) [µm]:		276.99	276.58	258.07	263.40	228.60	42636.76	31535.05
D10 [Phi]:		0.72	0.26	0.85	0.11	1.03	-5.76	-5.82
D50 [Phi]:		1.95	1.31	2.20	2.22	2.13	-4.12	-5.17
D90 [Phi]:		6.72	1.98	4.71	5.98	5.73	2.84	0.41
(D90 / D10) [Phi]:		9.36	7.47	5.52	55.41	5.57	-0.49	-0.07
(D90 - D10) [Phi]:		6.00	1.71	3.85	5.87	4.70	8.59	6.23
(D75 / D25) [Phi]:		2.27	2.19	2.19	2.19	1.97	-0.26	0.72
(D75 - D25) [Phi]:		1.65	0.94	1.67	1.61	1.39	6.83	1.57
% Gravel [63000 - 2000 µm]:		0.46	0.86	0.35	7.22	1.03	59.16	87.38
% Sand [< 2000 - 63 µm]:		81.62	96.81	87.55	78.29	85.34	34.59	11.68
% Mud [< 63 µm]:		17.92	2.33	12.10	14.49	13.63	6.25	0.94
% V Coarse Gravel:		0.00	0.00	0.00	0.00	0.00	44.38	60.32

Sample ID:	WF04	WF05	WF06	WF07	WF08	WF09	WF10
% Coarse Gravel:	0.00	0.00	0.00	0.00	0.00	6.25	14.73
% Medium Gravel:	0.00	0.00	0.00	3.67	0.20	3.40	10.18
% Fine Gravel:	0.26	0.39	0.12	1.92	0.36	2.79	1.14
% V Fine Gravel:	0.20	0.47	0.22	1.63	0.47	2.34	1.00
% V Coarse Sand:	0.48	1.58	0.26	2.11	0.83	2.48	1.06
% Coarse Sand:	12.62	28.55	11.00	6.17	7.10	7.94	3.81
% Medium Sand:	38.49	60.38	32.59	27.01	36.60	13.42	4.75
% Fine Sand:	24.30	6.30	29.63	33.81	35.37	8.38	1.73
% V Fine Sand:	5.73	0.00	14.06	9.19	5.44	2.37	0.33
% V Coarse Silt:	3.09	0.00	2.97	2.19	1.91	1.05	0.19
% Coarse Silt:	2.44	0.08	1.45	2.36	2.37	0.84	0.11
% Medium Silt:	3.32	0.75	1.94	2.58	2.32	1.04	0.15
% Fine Silt:	4.08	0.79	2.34	3.28	3.00	1.36	0.20
% V Fine Silt:	0.94	0.13	0.64	0.77	0.76	0.37	0.06
% Clay:	4.04	0.58	2.76	3.30	3.27	1.58	0.24

Sample ID:		WF11	WF12	WF14	WF19	WF22	WF25	WF27
Textural Group	Sample Type:	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Poorly Sorted	Bimodal, Very Poorly Sorted	Unimodal, Moderately Sorted	Unimodal, Very Poorly Sorted
	Folk [1954 Original]:	Sandy Gravel	Sandy Gravel	Slightly Gravelly Muddy Sand	Slightly Gravelly Sand	Muddy Sandy Gravel	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand
	Folk [Bgs Modified]:	Sandy Gravel	Sandy Gravel	Slightly Gravelly Muddy Sand	Slightly Gravelly Sand	Muddy Sandy Gravel	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand
	Sediment Name:	Sandy Very Coarse Gravel	Sandy Coarse Gravel	Slightly Medium Gravelly Very Coarse Silty Fine Sand	Slightly Very Fine Gravelly Medium Sand	Fine Silty Sandy Medium Gravel	Slightly Very Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Fine Silty Medium Sand
Method of Moments Arithmetic [µm]	Mean:	29818.74	19619.84	292.46	576.28	4426.80	704.34	407.31
	Sorting:	20293.36	17686.00	1115.08	859.28	7473.21	1103.00	786.25
	Skewness:	-0.49	0.39	9.78	7.28	1.74	6.22	10.99
	Kurtosis:	1.47	1.81	101.13	80.45	4.68	51.49	151.28
Method of Moments Geometric [µm]	Mean:	10415.93	5430.62	94.00	307.27	588.70	466.16	142.64
	Sorting:	8.91	9.59	5.23	3.89	10.52	1.97	7.27
	Skewness:	-1.45	-1.06	-1.46	-2.31	-0.34	1.59	-1.45
	Kurtosis:	4.52	3.65	6.11	11.21	3.34	7.04	4.35
Method of Moments Logarithmic [phi]	Mean:	-3.38	-2.44	3.41	1.70	0.76	1.10	2.81
	Sorting:	3.16	3.26	2.39	1.96	3.40	0.98	2.86
	Skewness:	1.45	1.06	1.46	2.31	0.34	-1.59	1.45
	Kurtosis:	4.52	3.65	6.11	11.21	3.34	7.04	4.35
Folk and Ward method [µm]	Mean:	9482.97	6341.29	110.71	363.08	789.10	449.24	137.68
	Sorting:	7.41	7.76	3.69	2.90	10.01	1.90	6.46
	Skewness:	-0.80	-0.66	-0.45	-0.15	0.29	0.24	-0.65
	Kurtosis:	0.68	0.62	2.00	2.34	0.92	1.26	1.67
Folk and Ward Method [phi]	Mean:	-3.25	-2.66	3.18	1.46	0.34	1.15	2.86
	Sorting:	2.89	2.96	1.88	1.54	3.32	0.92	2.69
	Skewness:	0.80	0.66	0.45	0.15	-0.29	-0.24	0.65
	Kurtosis:	0.68	0.62	2.00	2.34	0.92	1.26	1.67

Sample ID:		WF11	WF12	WF14	WF19	WF22	WF25	WF27
Folk and Ward Method [Description]	Mean:	Medium Gravel	Fine Gravel	Very Fine Sand	Medium Sand	Coarse Sand	Medium Sand	Fine Sand
	Sorting:	Very Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Poorly Sorted	Very Poorly Sorted	Moderately Sorted	Very Poorly Sorted
	Skewness:	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed	Fine Skewed	Coarse Skewed	Coarse Skewed	Very Fine Skewed
	Kurtosis:	Platykurtic	Very Platykurtic	Very Leptokurtic	Very Leptokurtic	Mesokurtic	Leptokurtic	Very Leptokurtic
Mode 1 [µM]:		47250.00	23750.00	187.50	375.00	187.50	375.00	375.00
Mode 2 [µM]:		375.00	375.00	0.00	0.00	12000.00	0.00	0.00
Mode 3 [µM]:		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mode 1 [PHI]:		-5.48	-4.49	2.50	1.50	2.50	1.50	1.50
Mode 2 [PHI]:		1.50	1.50	0.00	0.00	-3.50	0.00	0.00
Mode 3 [Phi]:		0.00	0.00	0.00	0.00	0.00	0.00	0.00
D10 [µm]:		336.50	267.45	8.88	134.80	70.70	237.49	6.27
D50 [µm]:		33237.10	18260.21	140.52	359.38	363.03	414.86	304.46
D90 [µm]:		55436.66	46086.60	369.10	974.08	16065.40	950.38	740.08
(D90 / D10) [µm]:		164.74	172.32	41.56	7.23	227.23	4.00	118.00
(D90 - D10) [µm]:		55100.16	45819.15	360.22	839.27	15994.70	712.89	733.81
(D75 / D25) [µm]:		28.62	48.56	2.95	2.22	32.33	2.17	4.56
(D75 - D25) [µm]:		44160.92	29188.70	144.56	301.53	5027.35	351.53	361.33
D10 [Phi]:		-5.79	-5.53	1.44	0.04	-4.01	0.07	0.43
D50 [Phi]:		-5.05	-4.19	2.83	1.48	1.46	1.27	1.72
D90 [Phi]:		1.57	1.90	6.82	2.89	3.82	2.07	7.32
(D90 / D10) [Phi]:		-0.27	-0.34	4.74	76.30	-0.95	28.25	16.85
(D90 - D10) [Phi]:		7.36	7.43	5.38	2.85	7.83	2.00	6.88
(D75 / D25) [Phi]:		0.12	-0.14	1.71	2.33	-1.11	2.81	2.97
(D75 - D25) [Phi]:		4.84	5.60	1.56	1.15	5.01	1.12	2.19
% Gravel [63000 - 2000 µm]:		74.60	65.88	1.29	3.51	30.82	4.65	1.27
% Sand [< 2000 - 63 µm]:		23.62	31.82	79.60	88.95	60.52	95.35	74.88
% Mud [< 63 µm]:		1.77	2.30	19.11	7.54	8.65	0.00	23.85
% V Coarse Gravel:		52.97	21.67	0.00	0.00	0.00	0.00	0.00

Sample ID:	WF11	WF12	WF14	WF19	WF22	WF25	WF27
% Coarse Gravel:	16.48	35.07	0.00	0.00	10.06	0.00	0.00
% Medium Gravel:	3.09	4.34	0.82	0.22	11.13	0.38	0.30
% Fine Gravel:	1.05	3.35	0.16	0.54	6.10	1.75	0.29
% V Fine Gravel:	1.02	1.45	0.31	2.74	3.53	2.52	0.67
% V Coarse Sand:	1.22	2.01	0.56	5.80	3.63	3.33	0.77
% Coarse Sand:	8.16	10.09	2.41	18.15	7.46	27.58	18.33
% Medium Sand:	10.52	13.31	13.12	47.31	17.52	53.65	41.40
% Fine Sand:	3.19	5.37	39.25	17.09	24.35	10.80	12.73
% V Fine Sand:	0.53	1.04	24.26	0.60	7.57	0.00	1.64
% V Coarse Silt:	0.35	0.46	3.90	1.77	0.99	0.00	3.98
% Coarse Silt:	0.21	0.29	2.75	0.94	1.57	0.00	3.37
% Medium Silt:	0.30	0.36	3.03	1.21	1.51	0.00	4.79
% Fine Silt:	0.39	0.47	3.69	1.60	1.97	0.00	5.39
% V Fine Silt:	0.10	0.14	1.09	0.38	0.50	0.00	1.19
% Clay:	0.41	0.59	4.66	1.64	2.13	0.00	5.12

Sample ID:		WF29	WF32	WF37	WF41	WF45	WF47
Textural Group	Sample Type:	Unimodal, Moderately Well Sorted	Unimodal, Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Very Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Very Poorly Sorted
	Folk [1954 Original]:	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand
	Folk [Bgs Modified]:	Slightly Gravelly Sand	Muddy Sand	Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Sand	Muddy Sand
	Sediment Name:	Slightly Very Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Fine Silty Fine Sand	Slightly Very Fine Gravelly Fine Silty Medium Sand	Slightly Fine Gravelly Fine Silty Fine Sand	Slightly Fine Gravelly Medium Sand	Slightly Fine Gravelly Very Coarse Silty Fine Sand
Method of Moments Arithmetic [µm]	Mean:	602.40	268.56	301.71	264.13	425.10	205.21
	Sorting:	948.36	315.52	345.94	565.27	639.78	504.82
	Skewness:	8.87	9.83	8.26	8.61	7.50	9.85
	Kurtosis:	95.35	158.71	119.75	84.57	63.49	109.21
Method of Moments Geometric [µm]	Mean:	441.05	145.12	152.07	106.92	257.02	77.41
	Sorting:	1.73	4.41	4.88	5.50	3.48	5.68
	Skewness:	2.09	-2.21	-2.02	-1.67	-2.91	-1.49
	Kurtosis:	11.47	8.28	7.15	5.81	14.06	5.07
Method of Moments Logarithmic [phi]	Mean:	1.18	2.78	2.72	3.23	1.96	3.69
	Sorting:	0.79	2.14	2.29	2.46	1.80	2.51
	Skewness:	-2.09	2.21	2.02	1.67	2.91	1.49
	Kurtosis:	11.47	8.28	7.15	5.81	14.06	5.07
Folk and Ward Method [µm]	Mean:	434.22	187.28	194.58	123.51	306.07	83.08
	Sorting:	1.60	3.14	3.45	4.17	2.28	4.72
	Skewness:	0.19	-0.31	-0.37	-0.50	-0.43	-0.56
	Kurtosis:	0.98	2.11	1.97	1.94	3.30	2.03
Folk and Ward Method [phi]	Mean:	1.20	2.42	2.36	3.02	1.71	3.59
	Sorting:	0.68	1.65	1.79	2.06	1.19	2.24
	Skewness:	-0.19	0.31	0.37	0.50	0.43	0.56
	Kurtosis:	0.98	2.11	1.97	1.94	3.30	2.03

Sample ID:		WF29	WF32	WF37	WF41	WF45	WF47
Folk and Ward Method [Description]	Mean:	Medium Sand	Fine Sand	Fine Sand	Very Fine Sand	Medium Sand	Very Fine Sand
	Sorting:	Moderately Well Sorted	Poorly Sorted	Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Very Poorly Sorted
	Skewness:	Coarse Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed
	Kurtosis:	Mesokurtic	Very Leptokurtic	Very Leptokurtic	Very Leptokurtic	Extremely Leptokurtic	Very Leptokurtic
Mode 1 [µm]:		375.00	187.50	375.00	187.50	375.00	187.50
Mode 2 [µm]:		0.00	0.00	0.00	0.00	0.00	0.00
Mode 3 [µm]:		0.00	0.00	0.00	0.00	0.00	0.00
Mode 1 [Phi]:		1.50	2.50	1.50	2.50	1.50	2.50
Mode 2 [Phi]:		0.00	0.00	0.00	0.00	0.00	0.00
Mode 3 [Phi]:		0.00	0.00	0.00	0.00	0.00	0.00
D10 [µm]:		259.89	22.07	15.70	7.97	139.62	5.93
D50 [µm]:		404.12	198.78	224.13	170.39	330.27	132.62
D90 [µm]:		851.13	473.36	563.92	421.88	489.86	334.56
(D90 / D10) [µm]:		3.27	21.45	35.91	52.91	3.51	56.39
(D90 - D10) [µm]:		591.24	451.30	548.21	413.90	350.24	328.62
(D75 / D25) [µm]:		1.89	2.57	2.91	3.15	1.64	3.26
(D75 - D25) [µm]:		272.31	202.11	249.23	186.28	164.39	145.78
D10 [Phi]:		0.23	1.08	0.83	1.25	1.03	1.58
D50 [Phi]:		1.31	2.33	2.16	2.55	1.60	2.91
D90 [Phi]:		1.94	5.50	5.99	6.97	2.84	7.40
(D90 / D10) [Phi]:		8.36	5.10	7.25	5.60	2.76	4.68
(D90 - D10) [Phi]:		1.71	4.42	5.17	5.73	1.81	5.82
(D75 / D25) [Phi]:		2.16	1.85	2.10	1.88	1.57	1.76
(D75 - D25) [Phi]:		0.92	1.36	1.54	1.65	0.71	1.71
% Gravel [63000 - 2000 µm]:		2.30	0.37	0.43	1.18	1.69	0.93
% Sand [< 2000 - 63 µm]:		97.70	87.81	85.28	80.34	90.54	75.07

Sample ID:	WF29	WF32	WF37	WF41	WF45	WF47
% Mud [< 63 µm]:	0.00	11.83	14.29	18.48	7.77	24.00
% V Coarse Gravel:	0.00	0.00	0.00	0.00	0.00	0.00
% Coarse Gravel:	0.00	0.00	0.00	0.00	0.00	0.00
% Medium Gravel:	0.41	0.00	0.00	0.00	0.00	0.00
% Fine Gravel:	0.82	0.13	0.15	0.78	1.07	0.61
% V Fine Gravel:	1.06	0.23	0.28	0.40	0.62	0.32
% V Coarse Sand:	1.42	0.34	0.55	0.50	0.57	0.40
% Coarse Sand:	26.99	7.00	10.92	2.46	5.67	0.96
% Medium Sand:	62.80	29.06	33.05	23.90	70.33	13.30
% Fine Sand:	6.49	40.00	32.09	39.71	13.97	37.62
% V Fine Sand:	0.00	11.40	8.68	13.77	0.00	22.79
% V Coarse Silt:	0.00	0.65	2.06	2.47	1.70	5.10
% Coarse Silt:	0.00	2.34	2.25	3.08	0.79	3.44
% Medium Silt:	0.00	2.08	2.51	3.02	1.40	3.68
% Fine Silt:	0.00	2.84	3.29	3.94	1.84	4.48
% V Fine Silt:	0.00	0.74	0.79	1.13	0.39	1.38
% Clay:	0.00	3.18	3.40	4.84	1.66	5.92

D.1.1 PSD Fractional and Cumulative Data

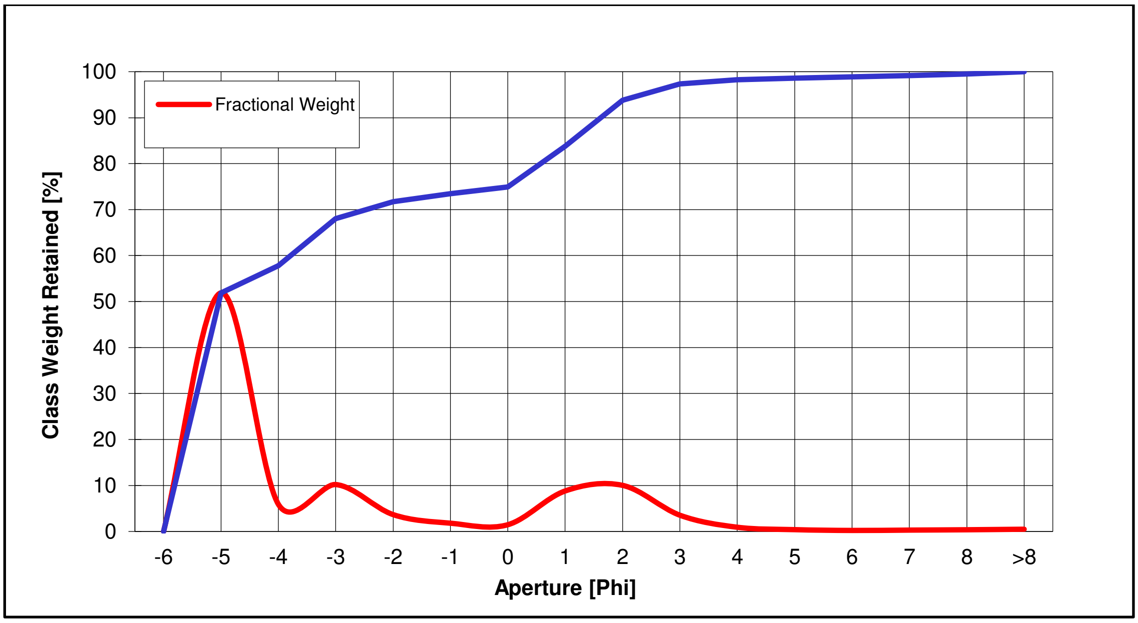
Based on Wentworth (1922) Grain Size Classification

Statistics Based on Folk and Ward (1957)

CR01

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	51.9	51.9
16000.0	-4	5.9	57.8
8000.0	-3	10.2	68.0
4000.0	-2	3.7	71.7
2000.0	-1	1.8	73.5
1000.0	0	1.5	75.0
500.0	1	8.8	83.8
250.0	2	10.0	93.8
125.0	3	3.5	97.3
62.5	4	0.9	98.2
31.2	5	0.4	98.6
15.6	6	0.2	98.9
7.8	7	0.3	99.1
3.9	8	0.4	99.5
<3.9	>8	0.5	100.0
Total		100.0	100.0

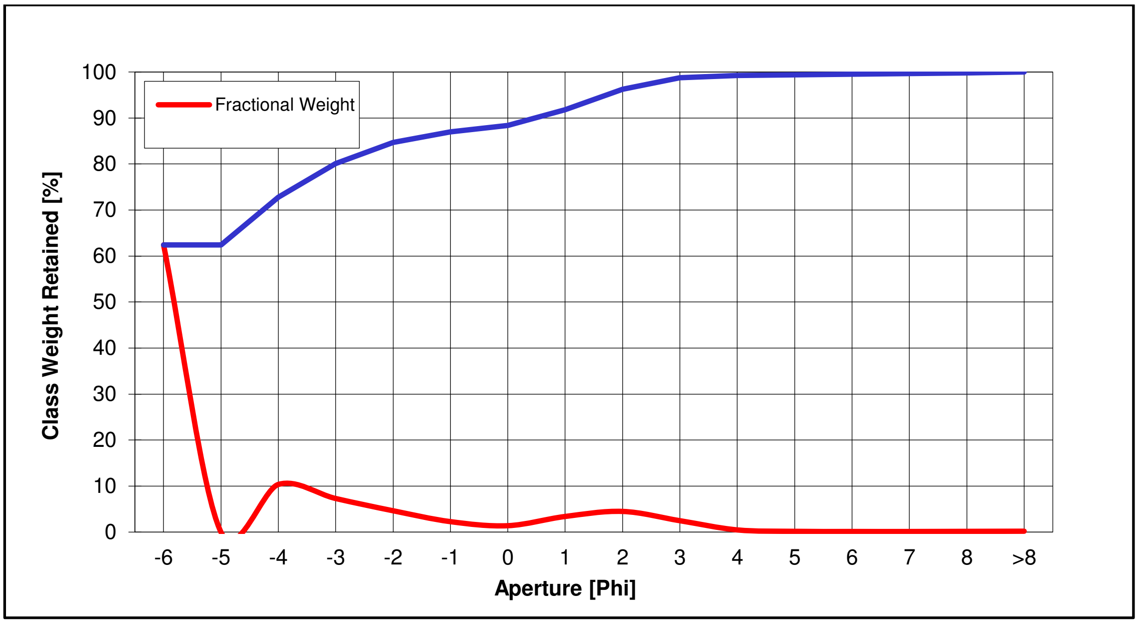
Sorting	2.92	Very Poorly Sorted
Skewness	0.80	Very Fine Skewed
Kurtosis	0.61	Very Platykurtic
Mean [µm]	9317.1	Pebble
Mean [phi]	-3.22	
Median [µm]	32309.5	Pebble
Median [phi]	-5.01	
Gravel [%]	73.5	Sandy Gravel
Sand [%]	24.7	
Mud [%]	1.8	



CR02

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	62.4	62.4
31500.0	-5	0.0	62.4
16000.0	-4	10.4	72.8
8000.0	-3	7.3	80.1
4000.0	-2	4.6	84.7
2000.0	-1	2.3	87.0
1000.0	0	1.4	88.4
500.0	1	3.4	91.8
250.0	2	4.5	96.3
125.0	3	2.5	98.7
62.5	4	0.5	99.2
31.2	5	0.2	99.4
15.6	6	0.1	99.5
7.8	7	0.1	99.6
3.9	8	0.2	99.8
<3.9	>8	0.2	100.0
Total		100.0	100.0

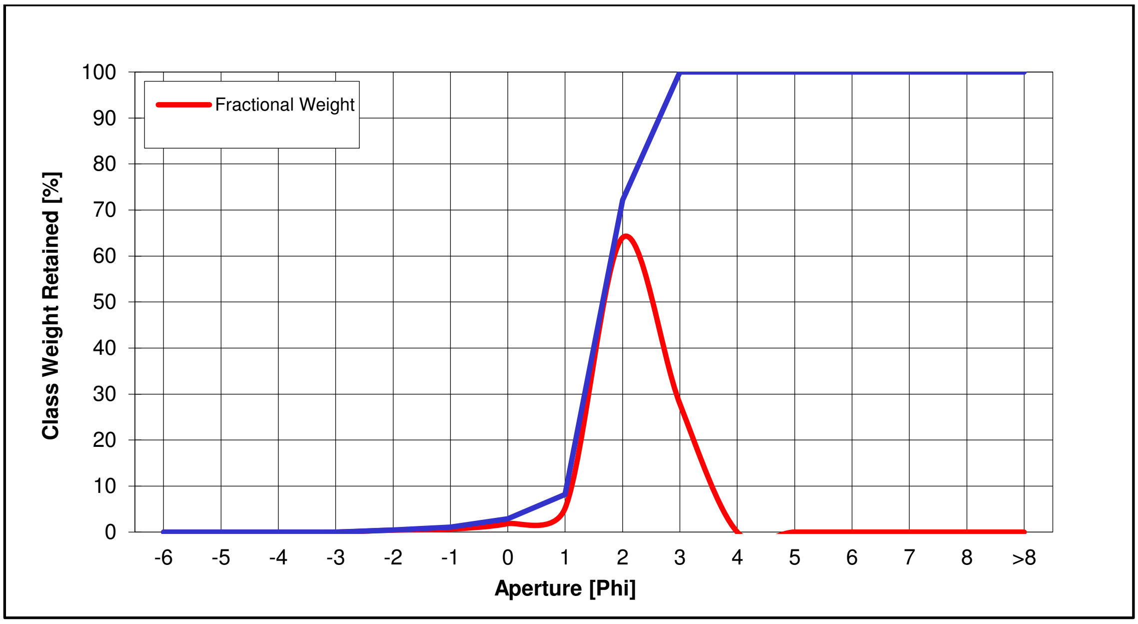
Sorting	2.29	Very Poorly Sorted
Skewness	0.89	Very Fine Skewed
Kurtosis	1.29	Leptokurtic
Mean [µm]	29186.0	Pebble
Mean [phi]	-4.87	
Median [µm]	67708.6	Cobble
Median [phi]	-6.08	
Gravel [%]	87.0	Gravel
Sand [%]	12.2	
Mud [%]	0.8	



CR03

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.0	0.0
4000.0	-2	0.4	0.4
2000.0	-1	0.7	1.1
1000.0	0	1.8	2.9
500.0	1	5.2	8.2
250.0	2	64.0	72.2
125.0	3	27.8	100.0
62.5	4	0.0	100.0
31.2	5	0.0	100.0
15.6	6	0.0	100.0
7.8	7	0.0	100.0
3.9	8	0.0	100.0
<3.9	>8	0.0	100.0
Total		**100.0**	**100.0**

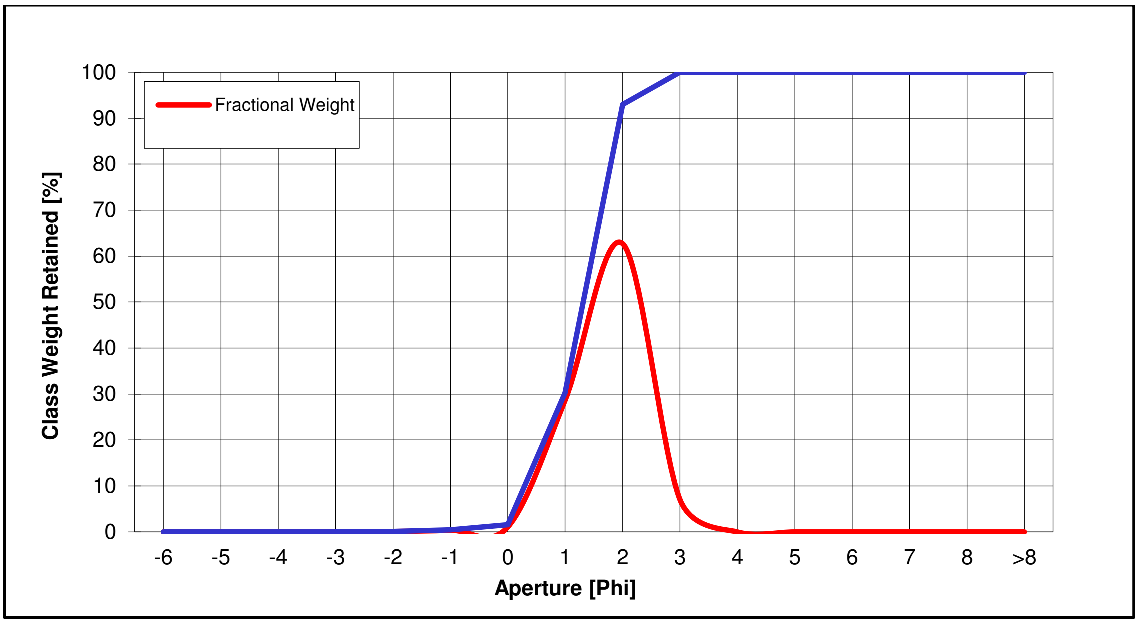
Sorting	0.69	Moderately Well Sorted
Skewness	0.07	Symmetrical
Kurtosis	1.18	Leptokurtic
Mean [µm]	300.6	Medium Sand
Mean [phi]	1.73	
Median [µm]	317.8	Medium Sand
Median [phi]	1.65	
Gravel [%]	1.1	Slightly Gravelly Sand
Sand [%]	98.9	
Mud [%]	0.0	



CR10

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.0	0.0
4000.0	-2	0.1	0.1
2000.0	-1	0.4	0.5
1000.0	0	1.1	1.5
500.0	1	28.7	30.3
250.0	2	62.7	93.0
125.0	3	7.0	100.0
62.5	4	0.0	100.0
31.2	5	0.0	100.0
15.6	6	0.0	100.0
7.8	7	0.0	100.0
3.9	8	0.0	100.0
<3.9	>8	0.0	100.0
Total		**100.0**	**100.0**

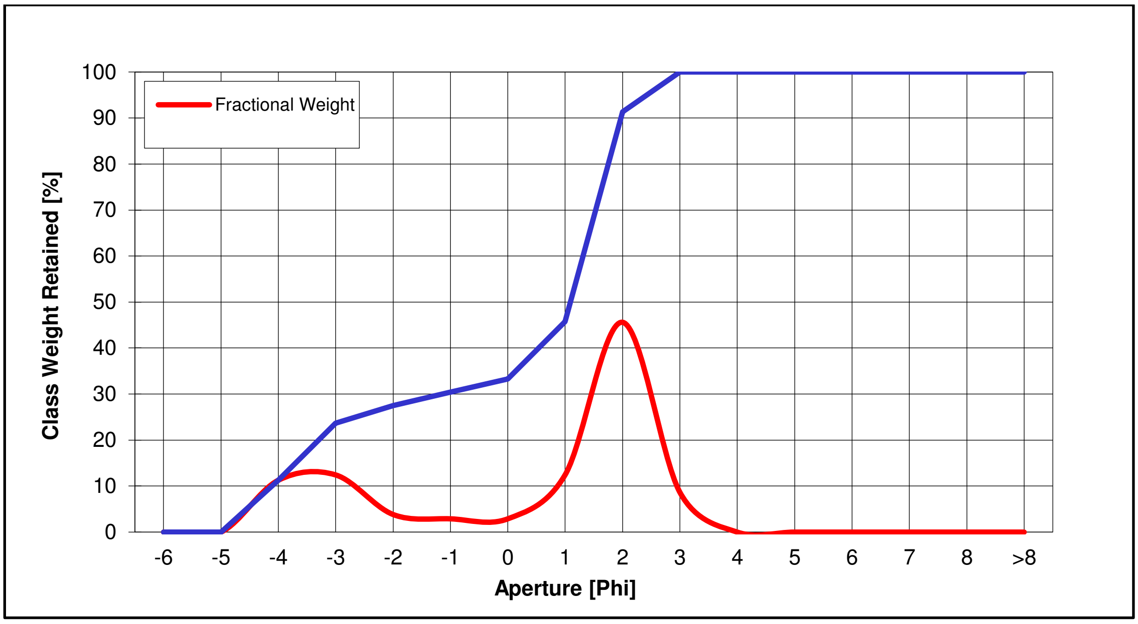
Sorting	0.67	Moderately Well Sorted
Skewness	-0.15	Coarse Skewed
Kurtosis	0.99	Mesokurtic
Mean [µm]	427.8	Medium Sand
Mean [phi]	1.22	
Median [µm]	402.0	Medium Sand
Median [phi]	1.31	
Gravel [%]	0.5	Slightly Gravelly Sand
Sand [%]	99.5	
Mud [%]	0.0	



WF01

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	11.3	11.3
8000.0	-3	12.4	23.7
4000.0	-2	3.8	27.5
2000.0	-1	2.9	30.4
1000.0	0	2.9	33.3
500.0	1	12.5	45.8
250.0	2	45.6	91.4
125.0	3	8.6	100.0
62.5	4	0.0	100.0
31.2	5	0.0	100.0
15.6	6	0.0	100.0
7.8	7	0.0	100.0
3.9	8	0.0	100.0
<3.9	>8	0.0	100.0
Total		**100.0**	**100.0**

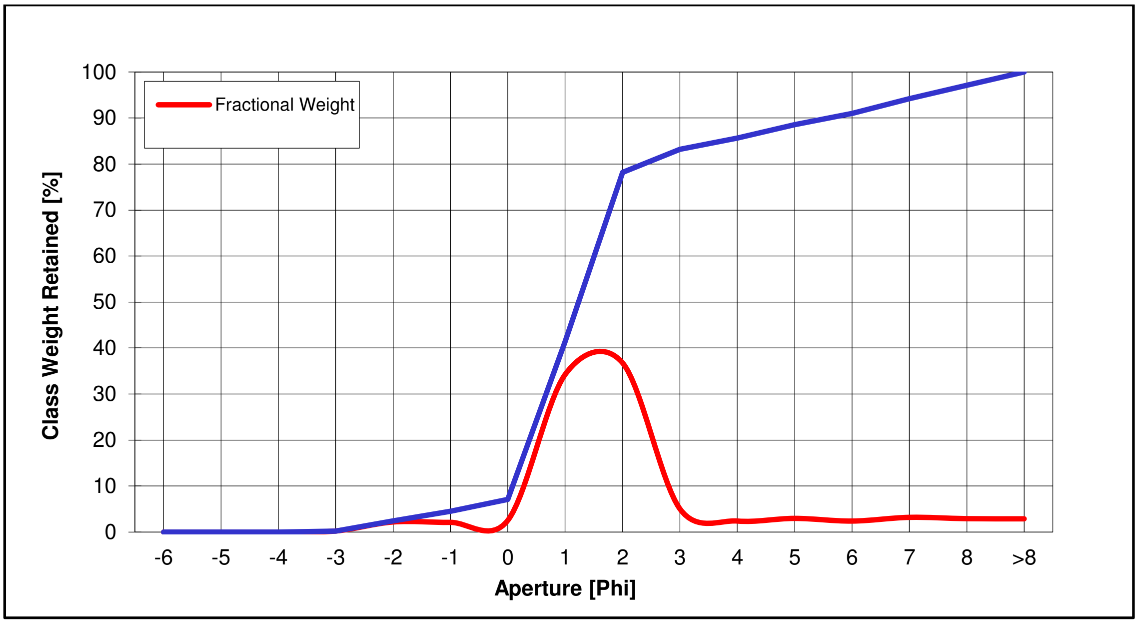
Sorting	2.42	Very Poorly Sorted
Skewness	-0.67	Very Coarse Skewed
Kurtosis	0.66	Very Platykurtic
Mean [µm]	1172.3	Very Coarse Sand
Mean [phi]	-0.23	
Median [µm]	468.9	Medium Sand
Median [phi]	1.09	
Gravel [%]	30.4	Sandy Gravel
Sand [%]	69.6	
Mud [%]	0.0	



WF02

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.2	0.2
4000.0	-2	2.2	2.4
2000.0	-1	2.1	4.6
1000.0	0	2.6	7.1
500.0	1	34.3	41.4
250.0	2	36.8	78.2
125.0	3	5.0	83.2
62.5	4	2.4	85.6
31.2	5	3.0	88.6
15.6	6	2.4	91.0
7.8	7	3.2	94.2
3.9	8	2.9	97.1
<3.9	>8	2.9	100.0
Total		**100.0**	**100.0**

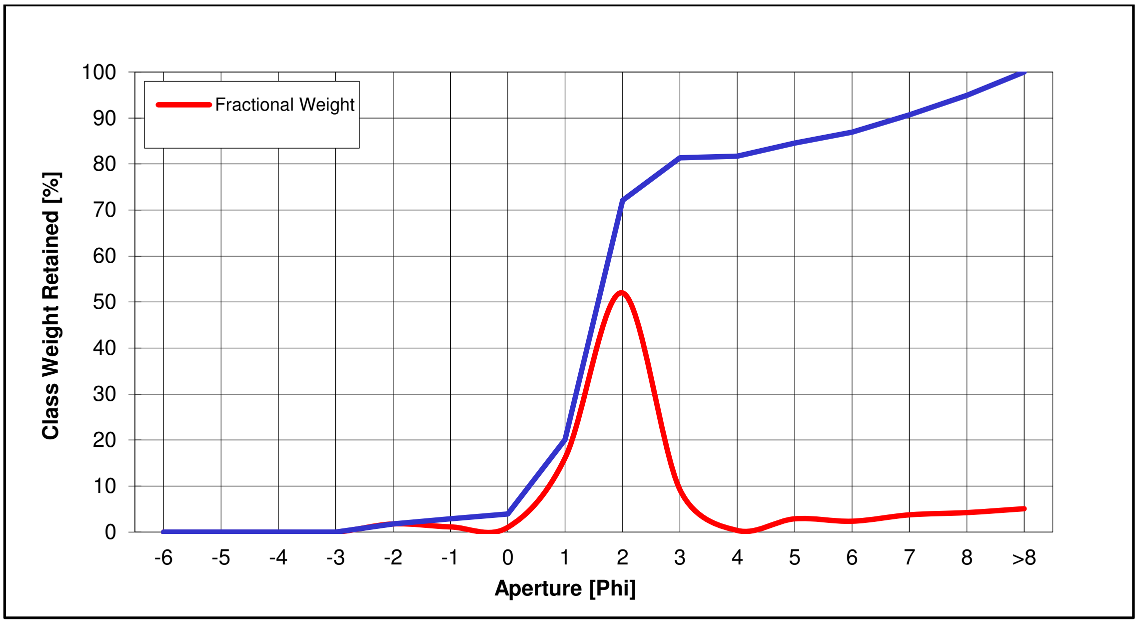
Sorting	2.00	Poorly Sorted
Skewness	0.43	Very Fine Skewed
Kurtosis	2.39	Very Leptokurtic
Mean [µm]	327.9	Medium Sand
Mean [phi]	1.61	
Median [µm]	425.0	Medium Sand
Median [phi]	1.23	
Gravel [%]	4.6	Slightly Gravelly Muddy Sand
Sand [%]	81.0	
Mud [%]	14.4	



WF03

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.0	0.0
4000.0	-2	1.8	1.8
2000.0	-1	1.1	2.9
1000.0	0	1.0	3.9
500.0	1	16.2	20.1
250.0	2	52.0	72.1
125.0	3	9.2	81.3
62.5	4	0.4	81.7
31.2	5	2.9	84.6
15.6	6	2.4	86.9
7.8	7	3.8	90.7
3.9	8	4.2	94.9
<3.9	>8	5.1	100.0
Total		**100.0**	**100.0**

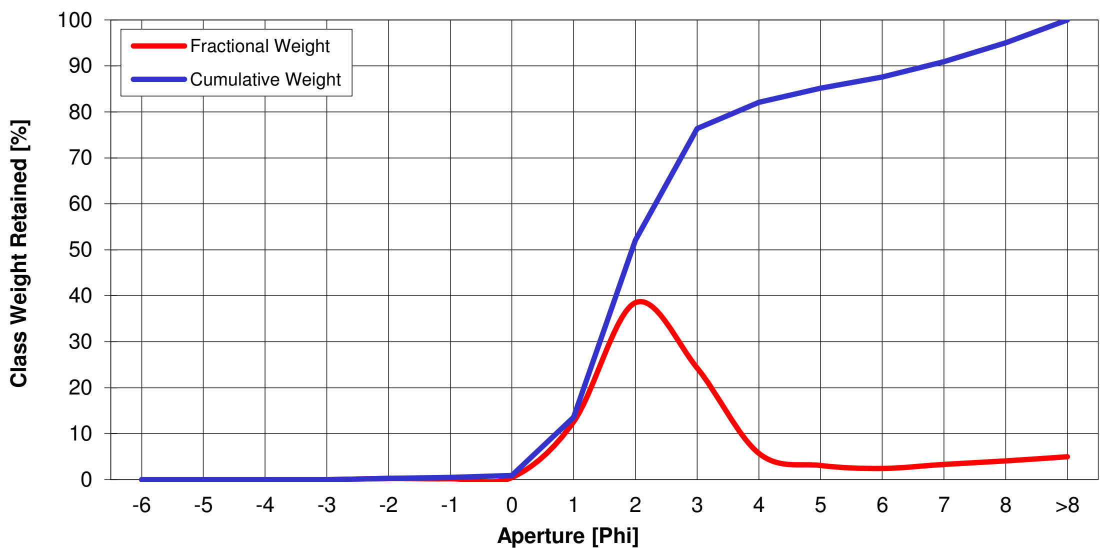
Sorting	2.23	Very Poorly Sorted
Skewness	0.61	Very Fine Skewed
Kurtosis	2.69	Very Leptokurtic
Mean [µm]	192.7	Fine Sand
Mean [phi]	2.38	
Median [µm]	335.7	Medium Sand
Median [phi]	1.57	
Gravel [%]	2.9	Slightly Gravelly Muddy Sand
Sand [%]	78.8	
Mud [%]	18.3	



WF04

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.0	0.0
4000.0	-2	0.3	0.3
2000.0	-1	0.2	0.5
1000.0	0	0.5	0.9
500.0	1	12.6	13.6
250.0	2	38.5	52.1
125.0	3	24.3	76.4
62.5	4	5.7	82.1
31.2	5	3.1	85.2
15.6	6	2.4	87.6
7.8	7	3.3	90.9
3.9	8	4.1	95.0
<3.9	>8	5.0	100.0
Total		**100.0**	**100.0**

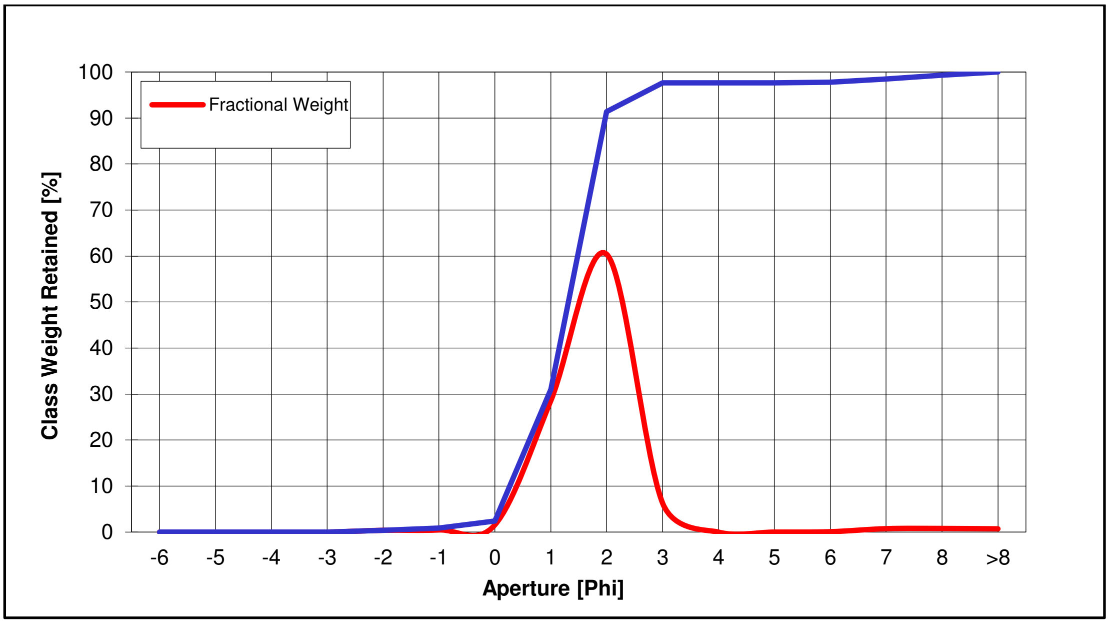
Sorting	2.05	Very Poorly Sorted
Skewness	0.54	Very Fine Skewed
Kurtosis	1.91	Very Leptokurtic
Mean [µm]	171.5	Fine Sand
Mean [phi]	2.54	
Median [µm]	259.4	Medium Sand
Median [phi]	1.95	
Gravel [%]	0.5	Slightly Gravelly Muddy Sand
Sand [%]	81.6	
Mud [%]	17.9	



WF05

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.0	0.0
4000.0	-2	0.4	0.4
2000.0	-1	0.5	0.9
1000.0	0	1.6	2.4
500.0	1	28.6	31.0
250.0	2	60.4	91.4
125.0	3	6.3	97.7
62.5	4	0.0	97.7
31.2	5	0.0	97.7
15.6	6	0.1	97.8
7.8	7	0.7	98.5
3.9	8	0.8	99.3
<3.9	>8	0.7	100.0
Total		**100.0**	**100.0**

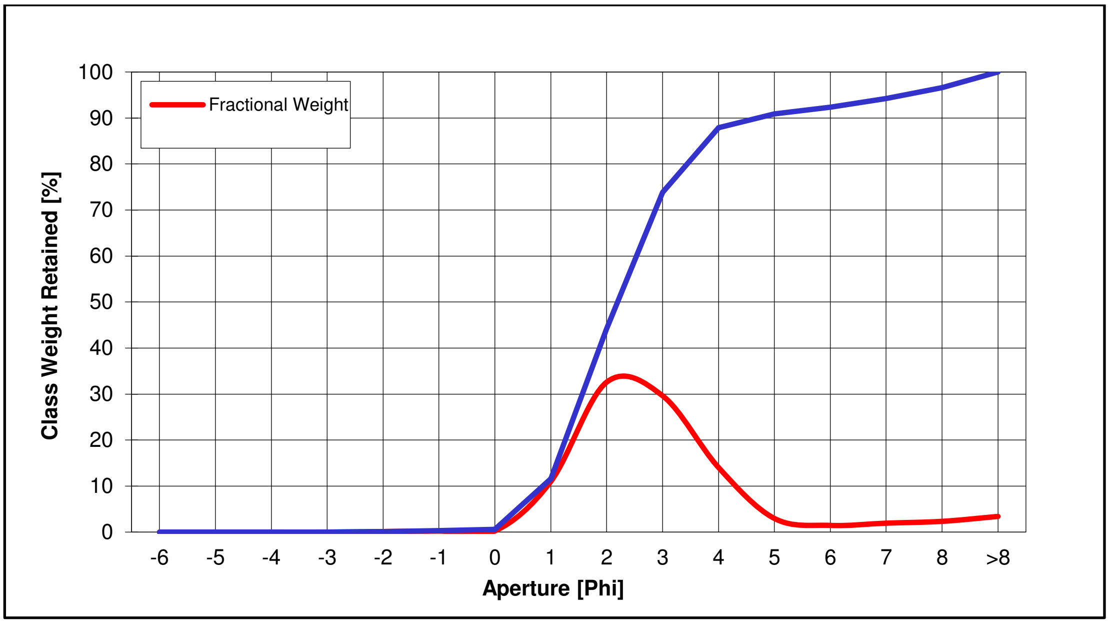
Sorting	0.73	Moderately Sorted
Skewness	-0.09	Symmetrical
Kurtosis	1.09	Mesokurtic
Mean [µm]	428.5	Medium Sand
Mean [phi]	1.22	
Median [µm]	402.0	Medium Sand
Median [phi]	1.31	
Gravel [%]	0.9	Slightly Gravelly Sand
Sand [%]	96.8	
Mud [%]	2.3	



WF06

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.0	0.0
4000.0	-2	0.1	0.1
2000.0	-1	0.2	0.3
1000.0	0	0.3	0.6
500.0	1	11.0	11.6
250.0	2	32.6	44.2
125.0	3	29.6	73.8
62.5	4	14.1	87.9
31.2	5	3.0	90.9
15.6	6	1.5	92.3
7.8	7	1.9	94.3
3.9	8	2.3	96.6
<3.9	>8	3.4	100.0
Total		**100.0**	**100.0**

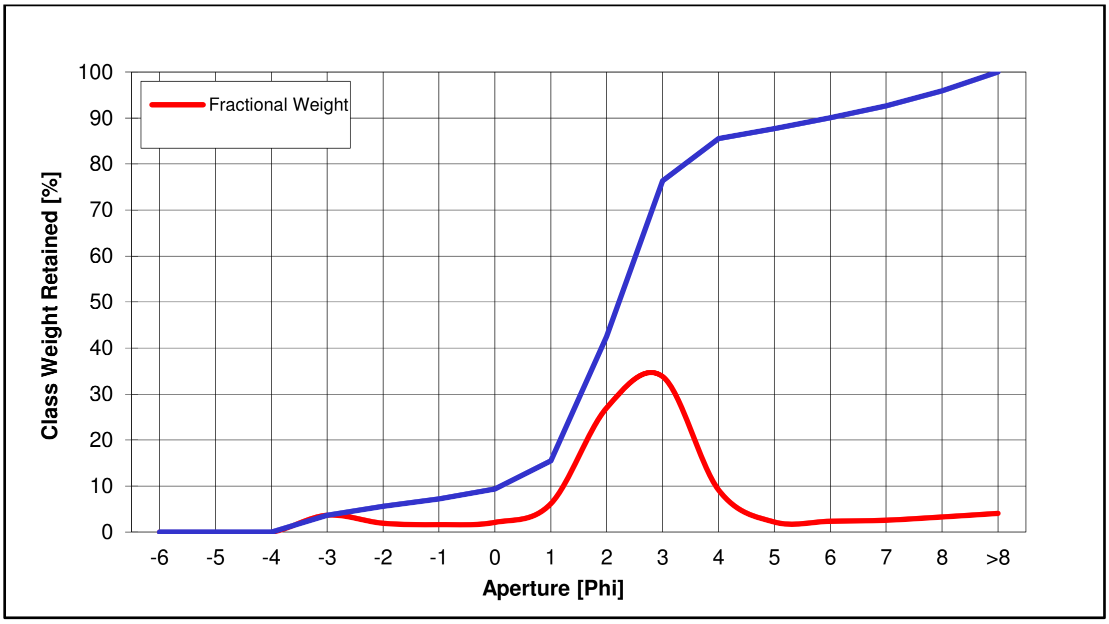
Sorting	1.69	Poorly Sorted
Skewness	0.33	Very Fine Skewed
Kurtosis	1.70	Very Leptokurtic
Mean [µm]	196.0	Fine Sand
Mean [phi]	2.35	
Median [µm]	218.3	Fine Sand
Median [phi]	2.20	
Gravel [%]	0.3	Slightly Gravelly Muddy Sand
Sand [%]	87.5	
Mud [%]	12.1	



WF07

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	3.7	3.7
4000.0	-2	1.9	5.6
2000.0	-1	1.6	7.2
1000.0	0	2.1	9.3
500.0	1	6.2	15.5
250.0	2	27.0	42.5
125.0	3	33.8	76.3
62.5	4	9.2	85.5
31.2	5	2.2	87.7
15.6	6	2.4	90.1
7.8	7	2.6	92.6
3.9	8	3.3	95.9
<3.9	>8	4.1	100.0
Total		**100.0**	**100.0**

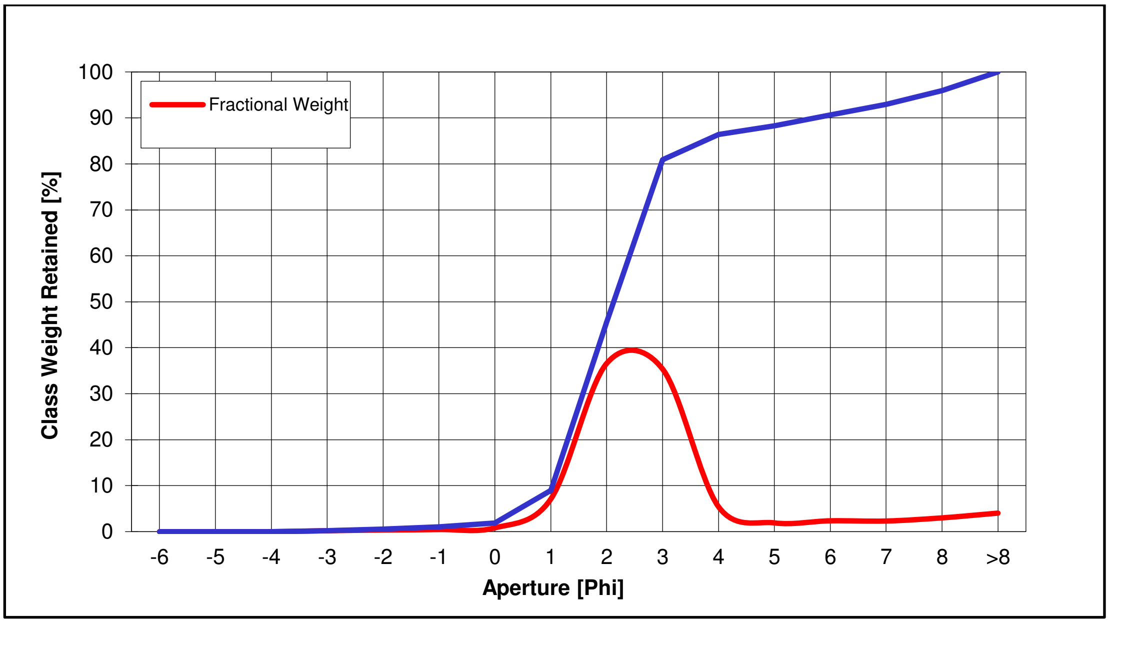
Sorting	2.22	Very Poorly Sorted
Skewness	0.12	Fine Skewed
Kurtosis	2.55	Very Leptokurtic
Mean [µm]	195.0	Fine Sand
Mean [phi]	2.36	
Median [µm]	214.4	Fine Sand
Median [phi]	2.22	
Gravel [%]	7.2	Gravelly Muddy Sand
Sand [%]	78.3	
Mud [%]	14.5	



WF08

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.2	0.2
4000.0	-2	0.4	0.6
2000.0	-1	0.5	1.0
1000.0	0	0.8	1.9
500.0	1	7.1	9.0
250.0	2	36.6	45.6
125.0	3	35.4	80.9
62.5	4	5.4	86.4
31.2	5	1.9	88.3
15.6	6	2.4	90.6
7.8	7	2.3	93.0
3.9	8	3.0	96.0
<3.9	>8	4.0	100.0
Total		**100.0**	**100.0**

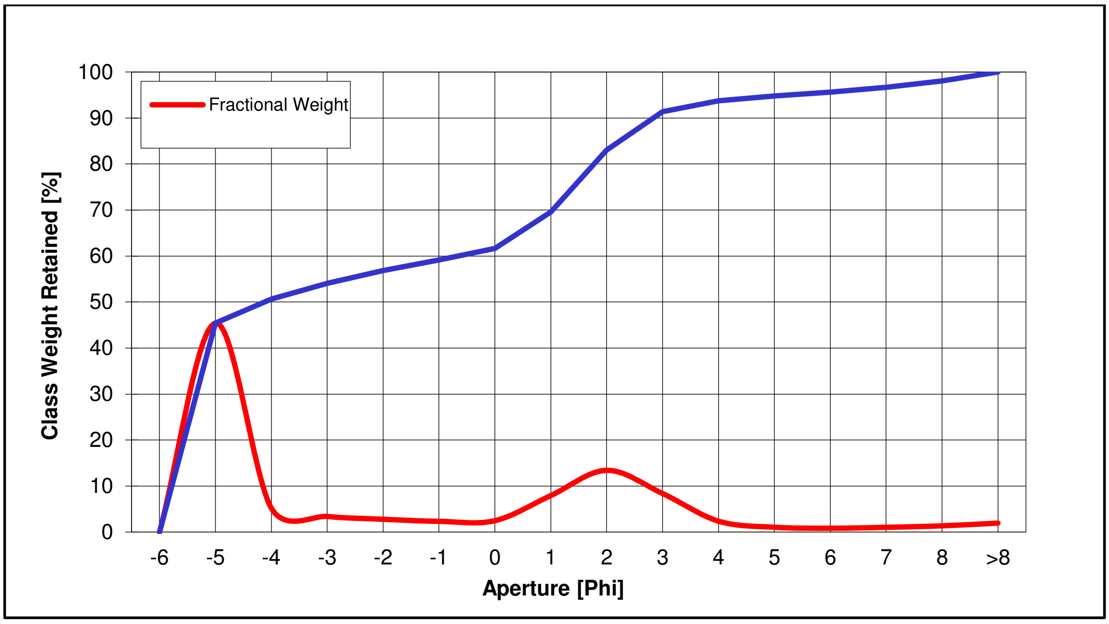
Sorting	1.69	Poorly Sorted
Skewness	0.37	Very Fine Skewed
Kurtosis	2.13	Very Leptokurtic
Mean [µm]	203.9	Fine Sand
Mean [phi]	2.29	
Median [µm]	229.2	Fine Sand
Median [phi]	2.13	
Gravel [%]	1.0	Slightly Gravelly Muddy Sand
Sand [%]	85.3	
Mud [%]	13.6	



WF09

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	45.4	45.4
16000.0	-4	5.2	50.6
8000.0	-3	3.4	54.0
4000.0	-2	2.8	56.8
2000.0	-1	2.3	59.2
1000.0	0	2.5	61.6
500.0	1	7.9	69.6
250.0	2	13.4	83.0
125.0	3	8.4	91.4
62.5	4	2.4	93.8
31.2	5	1.1	94.8
15.6	6	0.8	95.6
7.8	7	1.0	96.7
3.9	8	1.4	98.0
<3.9	>8	2.0	100.0
Total		**100.0**	**100.0**

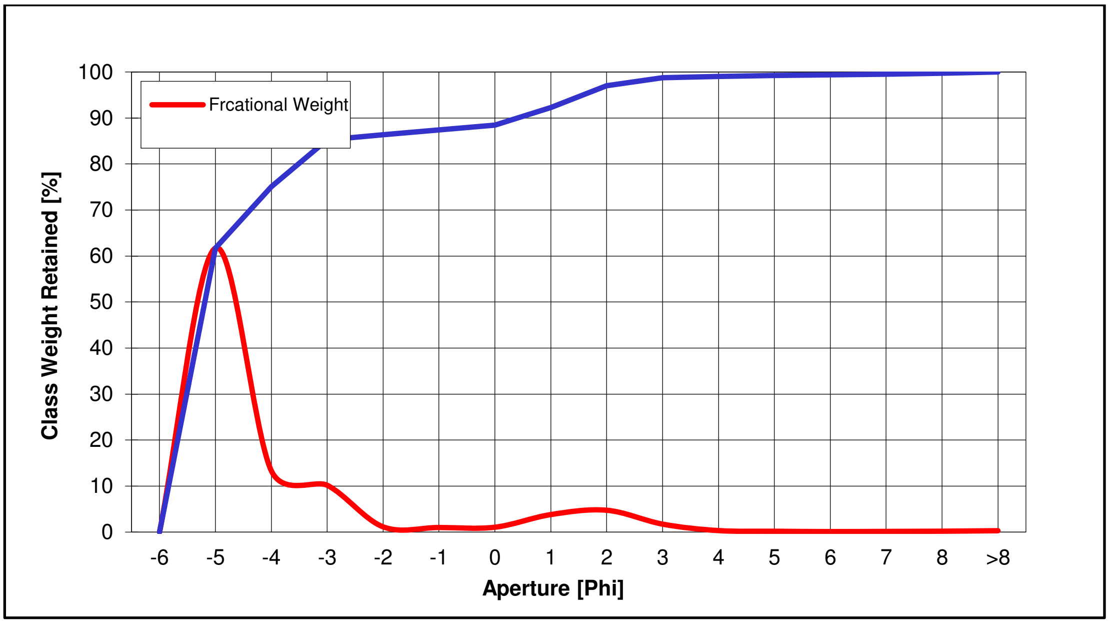
Sorting	3.62	Very Poorly Sorted
Skewness	0.65	Very Fine Skewed
Kurtosis	0.67	Very Platykurtic
Mean [µm]	5819.2	Pebble
Mean [phi]	-2.54	
Median [µm]	17352.6	Pebble
Median [phi]	-4.12	
Gravel [%]	59.2	Muddy Sandy Gravel
Sand [%]	34.6	
Mud [%]	6.2	



WF10

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	61.7	61.7
16000.0	-4	13.3	75.1
8000.0	-3	10.2	85.2
4000.0	-2	1.1	86.4
2000.0	-1	1.0	87.4
1000.0	0	1.1	88.4
500.0	1	3.8	92.2
250.0	2	4.8	97.0
125.0	3	1.7	98.7
62.5	4	0.3	99.1
31.2	5	0.2	99.2
15.6	6	0.1	99.4
7.8	7	0.1	99.5
3.9	8	0.2	99.7
<3.9	>8	0.3	100.0
Total		**100.0**	**100.0**

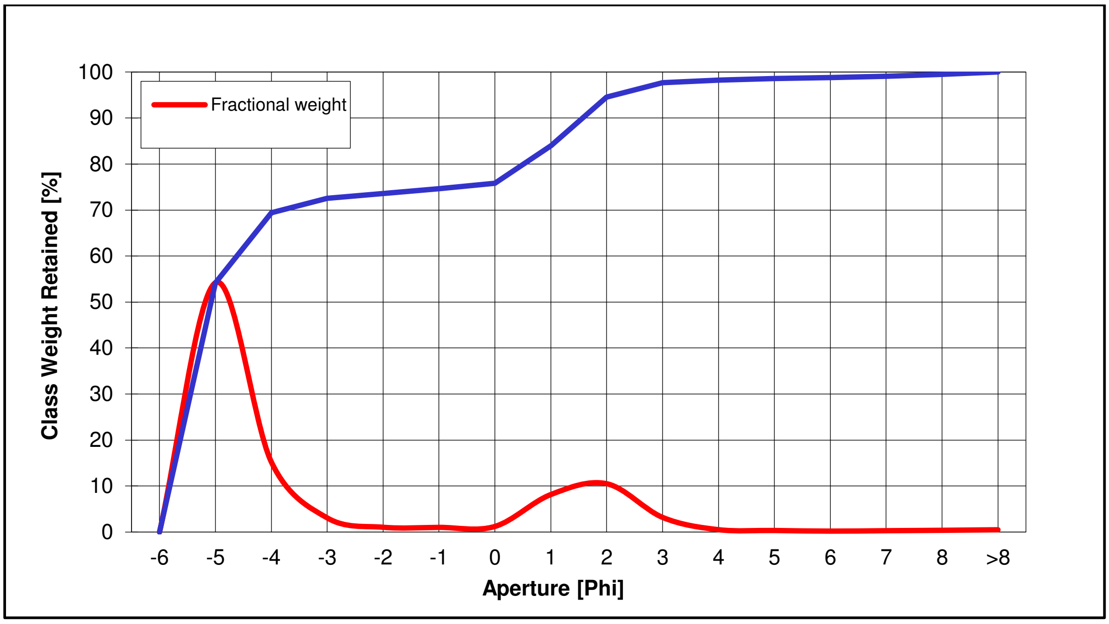
Sorting	1.78	Poorly Sorted
Skewness	0.69	Very Fine Skewed
Kurtosis	1.95	Very Leptokurtic
Mean [µm]	25435.0	Pebble
Mean [phi]	-4.67	
Median [µm]	35932.1	Pebble
Median [phi]	-5.17	
Gravel [%]	87.4	Gravel
Sand [%]	11.7	
Mud [%]	0.9	



WF11

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	54.2	54.2
16000.0	-4	15.2	69.4
8000.0	-3	3.1	72.5
4000.0	-2	1.1	73.6
2000.0	-1	1.0	74.6
1000.0	0	1.2	75.8
500.0	1	8.2	84.0
250.0	2	10.5	94.5
125.0	3	3.2	97.7
62.5	4	0.5	98.2
31.2	5	0.4	98.6
15.6	6	0.2	98.8
7.8	7	0.3	99.1
3.9	8	0.4	99.5
<3.9	>8	0.5	100.0
Total		**100.0**	**100.0**

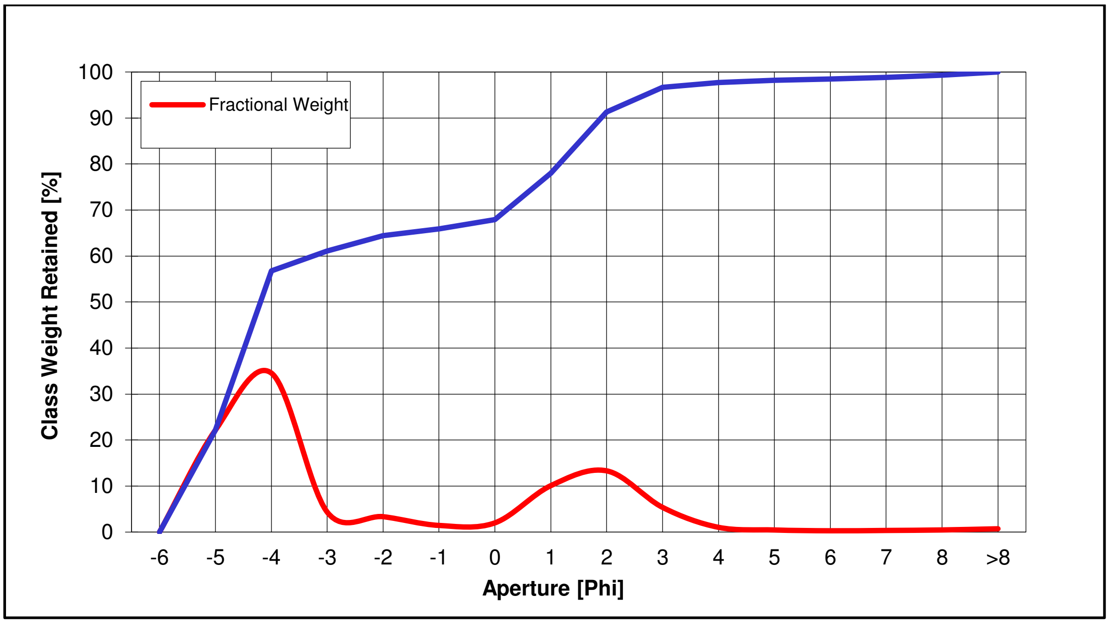
Sorting	2.89	Very Poorly Sorted
Skewness	0.80	Very Fine Skewed
Kurtosis	0.68	Platykurtic
Mean [µm]	9483.0	Pebble
Mean [phi]	-3.25	
Median [µm]	33237.1	Pebble
Median [phi]	-5.05	
Gravel [%]	74.6	Sandy Gravel
Sand [%]	23.6	
Mud [%]	1.8	



WF12

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	22.2	22.2
16000.0	-4	34.6	56.7
8000.0	-3	4.3	61.1
4000.0	-2	3.4	64.4
2000.0	-1	1.4	65.9
1000.0	0	2.0	67.9
500.0	1	10.1	78.0
250.0	2	13.3	91.3
125.0	3	5.4	96.7
62.5	4	1.0	97.7
31.2	5	0.5	98.2
15.6	6	0.3	98.5
7.8	7	0.4	98.8
3.9	8	0.5	99.3
<3.9	>8	0.7	100.0
Total		**100.0**	**100.0**

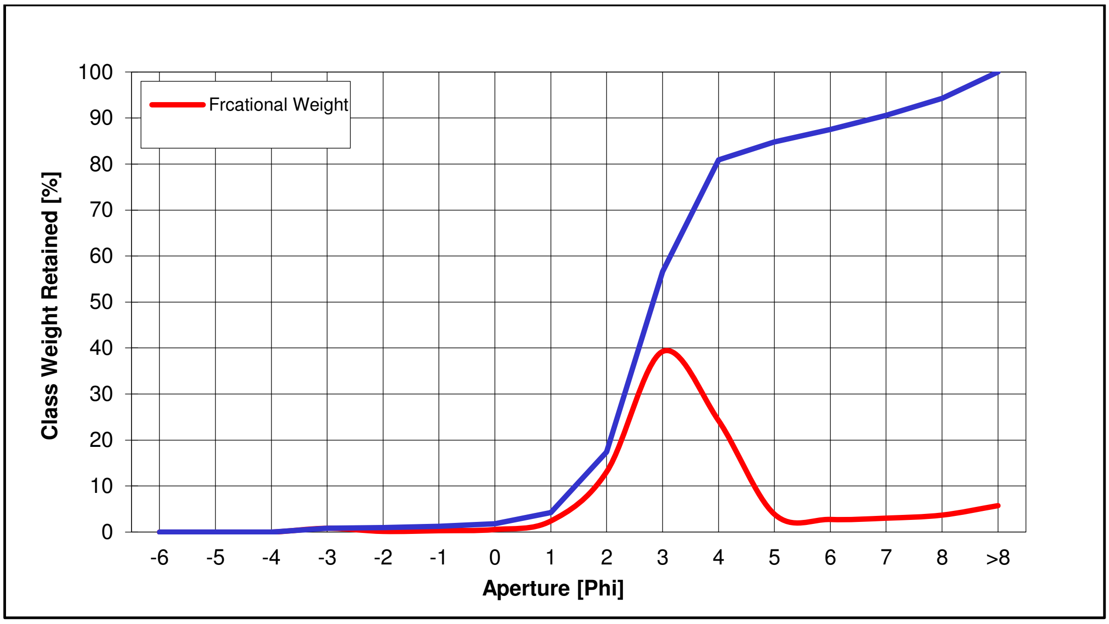
Sorting	2.96	Very Poorly Sorted
Skewness	0.66	Very Fine Skewed
Kurtosis	0.62	Very Platykurtic
Mean [µm]	6341.3	Pebble
Mean [phi]	-2.66	
Median [µm]	18260.2	Pebble
Median [phi]	-4.19	
Gravel [%]	65.9	Sandy Gravel
Sand [%]	31.8	
Mud [%]	2.3	



WF14

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.8	0.8
4000.0	-2	0.2	1.0
2000.0	-1	0.3	1.3
1000.0	0	0.6	1.8
500.0	1	2.4	4.3
250.0	2	13.1	17.4
125.0	3	39.3	56.6
62.5	4	24.3	80.9
31.2	5	3.9	84.8
15.6	6	2.7	87.5
7.8	7	3.0	90.6
3.9	8	3.7	94.3
<3.9	>8	5.7	100.0
Total		**100.0**	**100.0**

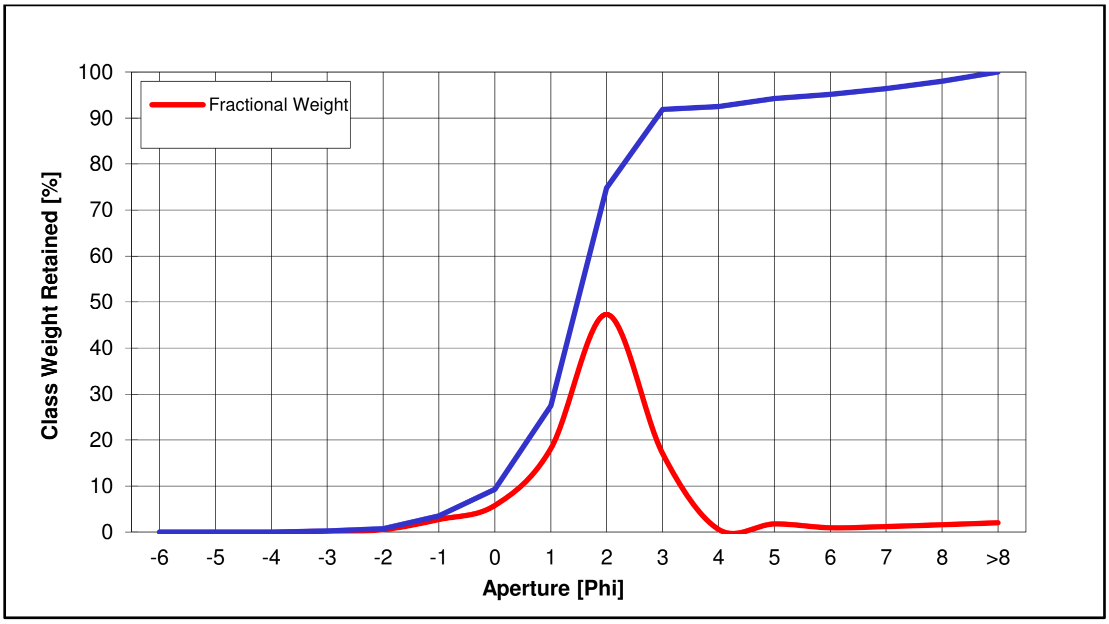
Sorting	1.88	Poorly Sorted
Skewness	0.45	Very Fine Skewed
Kurtosis	2.00	Very Leptokurtic
Mean [µm]	110.7	Very Fine Sand
Mean [phi]	3.18	
Median [µm]	140.5	Fine Sand
Median [phi]	2.83	
Gravel [%]	1.3	Slightly Gravelly Muddy Sand
Sand [%]	79.6	
Mud [%]	19.1	



WF19

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.2	0.2
4000.0	-2	0.5	0.8
2000.0	-1	2.7	3.5
1000.0	0	5.8	9.3
500.0	1	18.1	27.5
250.0	2	47.3	74.8
125.0	3	17.1	91.9
62.5	4	0.6	92.5
31.2	5	1.8	94.2
15.6	6	0.9	95.2
7.8	7	1.2	96.4
3.9	8	1.6	98.0
<3.9	>8	2.0	100.0
Total		**100.0**	**100.0**

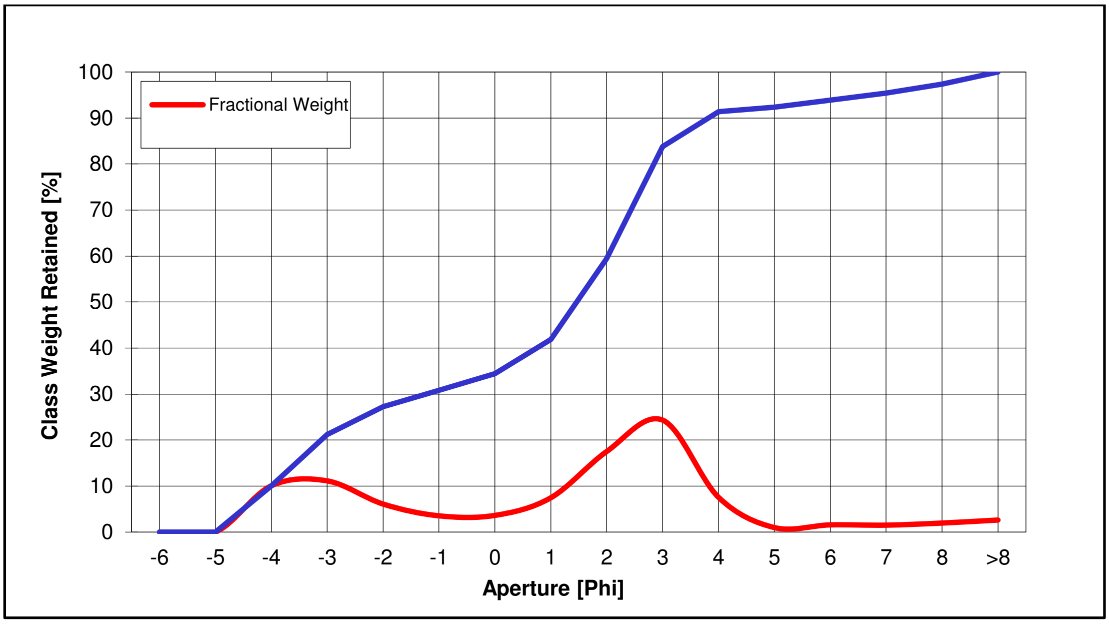
Sorting	1.54	Poorly Sorted
Skewness	0.15	Fine Skewed
Kurtosis	2.34	Very Leptokurtic
Mean [µm]	363.1	Medium Sand
Mean [phi]	1.46	
Median [µm]	359.4	Medium Sand
Median [phi]	1.48	
Gravel [%]	3.5	Slightly Gravelly Sand
Sand [%]	88.9	
Mud [%]	7.5	



WF22

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	10.1	10.1
8000.0	-3	11.1	21.2
4000.0	-2	6.1	27.3
2000.0	-1	3.5	30.8
1000.0	0	3.6	34.4
500.0	1	7.5	41.9
250.0	2	17.5	59.4
125.0	3	24.3	83.8
62.5	4	7.6	91.3
31.2	5	1.0	92.3
15.6	6	1.6	93.9
7.8	7	1.5	95.4
3.9	8	2.0	97.4
<3.9	>8	2.6	100.0
Total		**100.0**	**100.0**

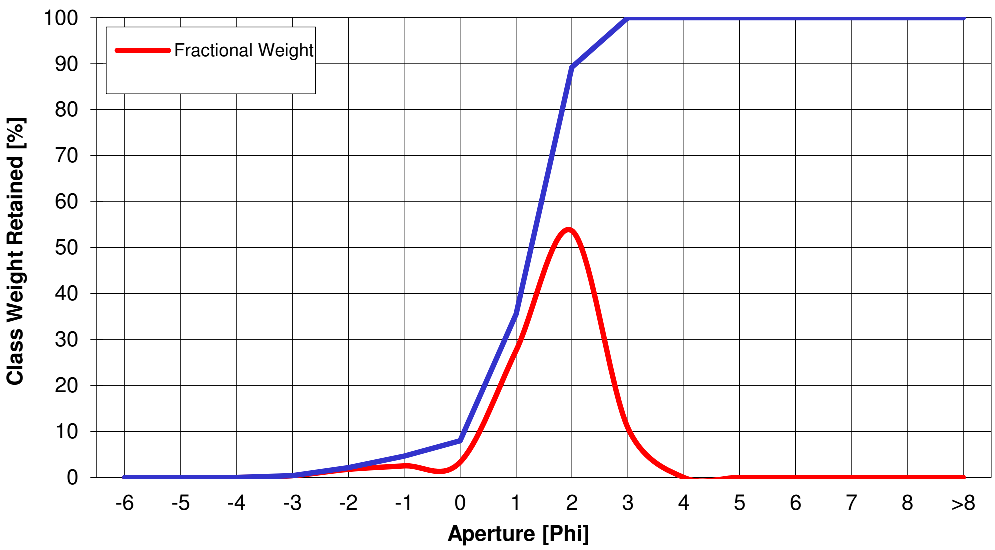
Sorting	3.32	Very Poorly Sorted
Skewness	-0.29	Coarse Skewed
Kurtosis	0.92	Mesokurtic
Mean [µm]	789.1	Coarse Sand
Mean [phi]	0.34	
Median [µm]	363.0	Medium Sand
Median [phi]	1.46	
Gravel [%]	30.8	Muddy Sandy Gravel
Sand [%]	60.5	
Mud [%]	8.7	



WF25

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.4	0.4
4000.0	-2	1.8	2.1
2000.0	-1	2.5	4.6
1000.0	0	3.3	8.0
500.0	1	27.6	35.6
250.0	2	53.6	89.2
125.0	3	10.8	100.0
62.5	4	0.0	100.0
31.2	5	0.0	100.0
15.6	6	0.0	100.0
7.8	7	0.0	100.0
3.9	8	0.0	100.0
<3.9	>8	0.0	100.0
Total		**100.0**	**100.0**

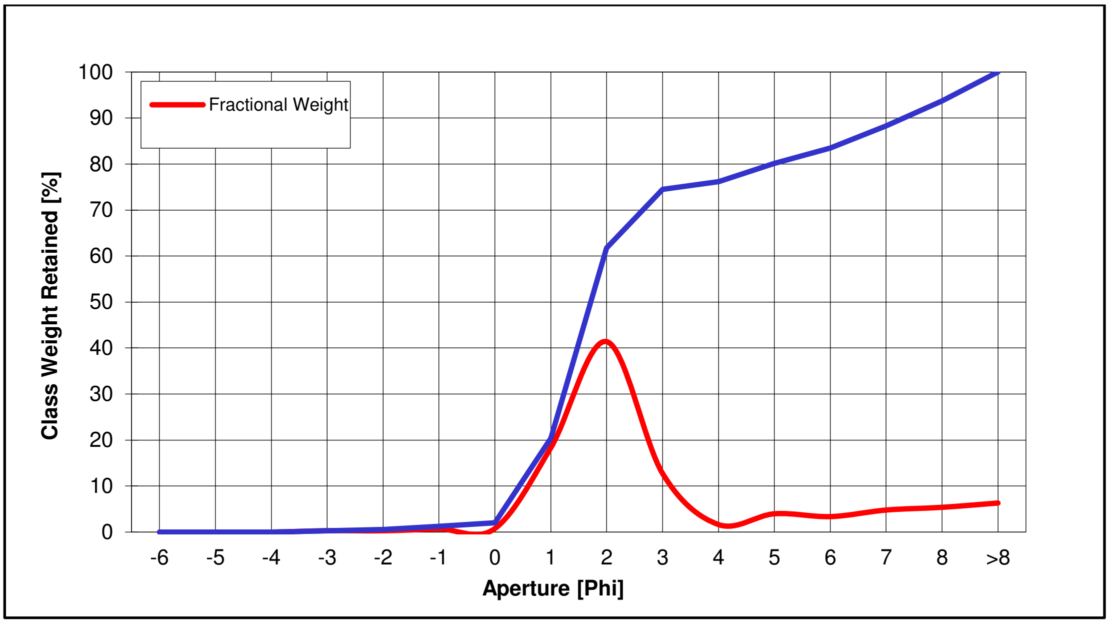
Sorting	0.92	Moderately Sorted
Skewness	-0.24	Coarse Skewed
Kurtosis	1.26	Leptokurtic
Mean [µm]	449.2	Medium Sand
Mean [phi]	1.15	
Median [µm]	414.9	Medium Sand
Median [phi]	1.27	
Gravel [%]	4.6	Slightly Gravelly Sand
Sand [%]	95.4	
Mud [%]	0.0	



WF27

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.3	0.3
4000.0	-2	0.3	0.6
2000.0	-1	0.7	1.3
1000.0	0	0.8	2.0
500.0	1	18.3	20.4
250.0	2	41.4	61.8
125.0	3	12.7	74.5
62.5	4	1.6	76.1
31.2	5	4.0	80.1
15.6	6	3.4	83.5
7.8	7	4.8	88.3
3.9	8	5.4	93.7
<3.9	>8	6.3	100.0
Total		**100.0**	**100.0**

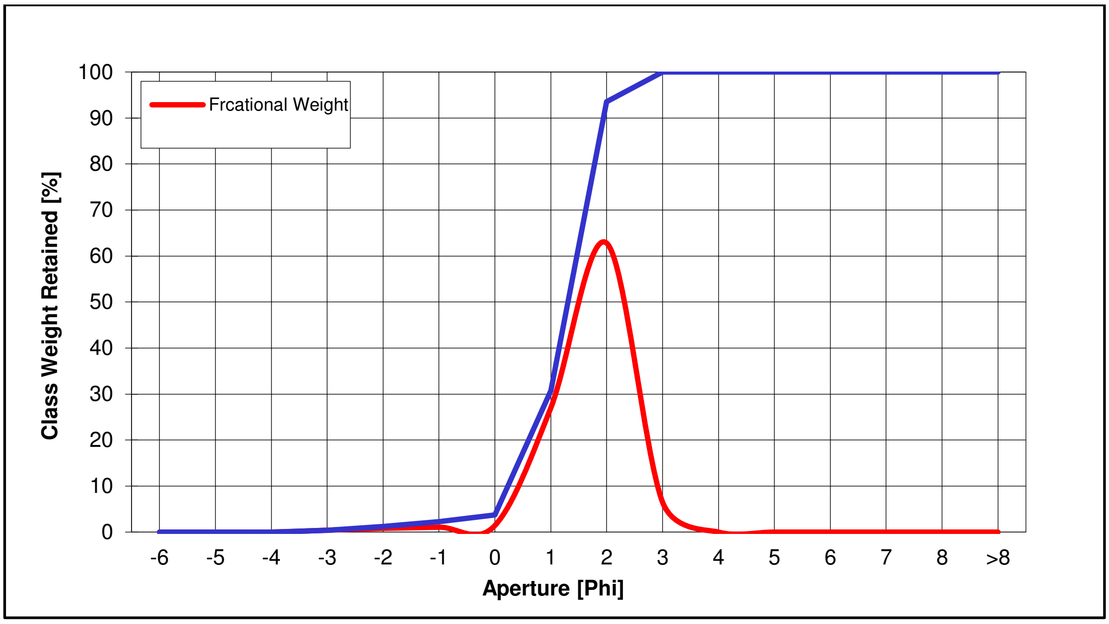
Sorting	2.69	Very Poorly Sorted
Skewness	0.65	Very Fine Skewed
Kurtosis	1.67	Very Leptokurtic
Mean [µm]	137.7	Fine Sand
Mean [phi]	2.86	
Median [µm]	304.5	Medium Sand
Median [phi]	1.72	
Gravel [%]	1.3	Slightly Gravelly Muddy Sand
Sand [%]	74.9	
Mud [%]	23.9	



WF29

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.4	0.4
4000.0	-2	0.8	1.2
2000.0	-1	1.1	2.3
1000.0	0	1.4	3.7
500.0	1	27.0	30.7
250.0	2	62.8	93.5
125.0	3	6.5	100.0
62.5	4	0.0	100.0
31.2	5	0.0	100.0
15.6	6	0.0	100.0
7.8	7	0.0	100.0
3.9	8	0.0	100.0
<3.9	>8	0.0	100.0
Total		**100.0**	**100.0**

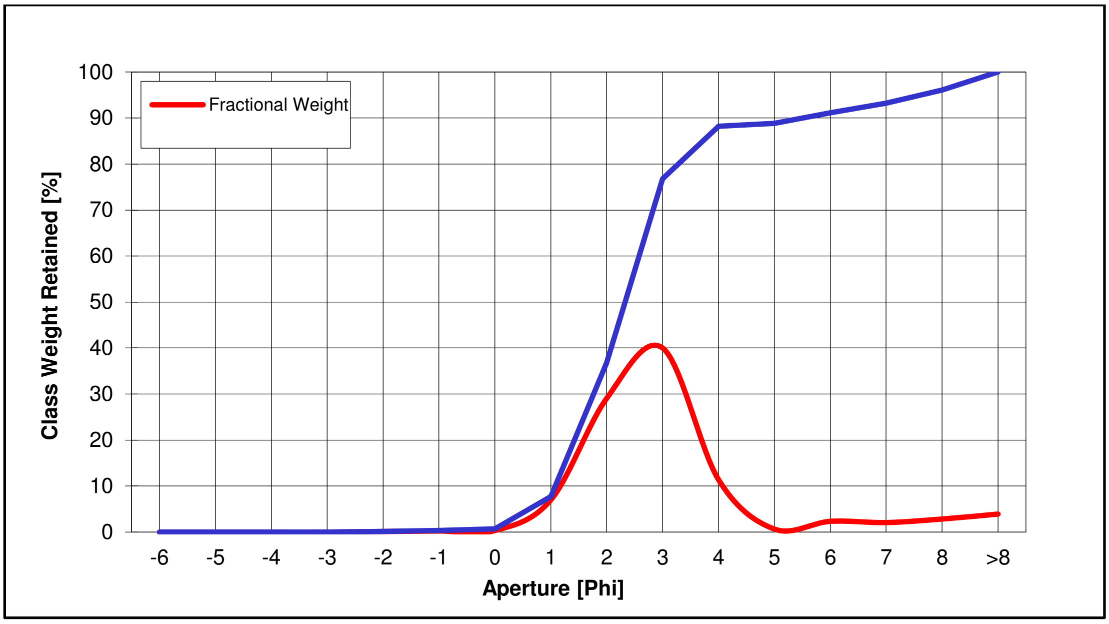
Sorting	0.68	Moderately Well Sorted
Skewness	-0.19	Coarse Skewed
Kurtosis	0.98	Mesokurtic
Mean [µm]	434.2	Medium Sand
Mean [phi]	1.20	
Median [µm]	404.1	Medium Sand
Median [phi]	1.31	
Gravel [%]	2.3	Slightly Gravelly Sand
Sand [%]	97.7	
Mud [%]	0.0	



WF32

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.0	0.0
4000.0	-2	0.1	0.1
2000.0	-1	0.2	0.4
1000.0	0	0.3	0.7
500.0	1	7.0	7.7
250.0	2	29.1	36.8
125.0	3	40.0	76.8
62.5	4	11.4	88.2
31.2	5	0.7	88.8
15.6	6	2.3	91.2
7.8	7	2.1	93.2
3.9	8	2.8	96.1
<3.9	>8	3.9	100.0
Total		**100.0**	**100.0**

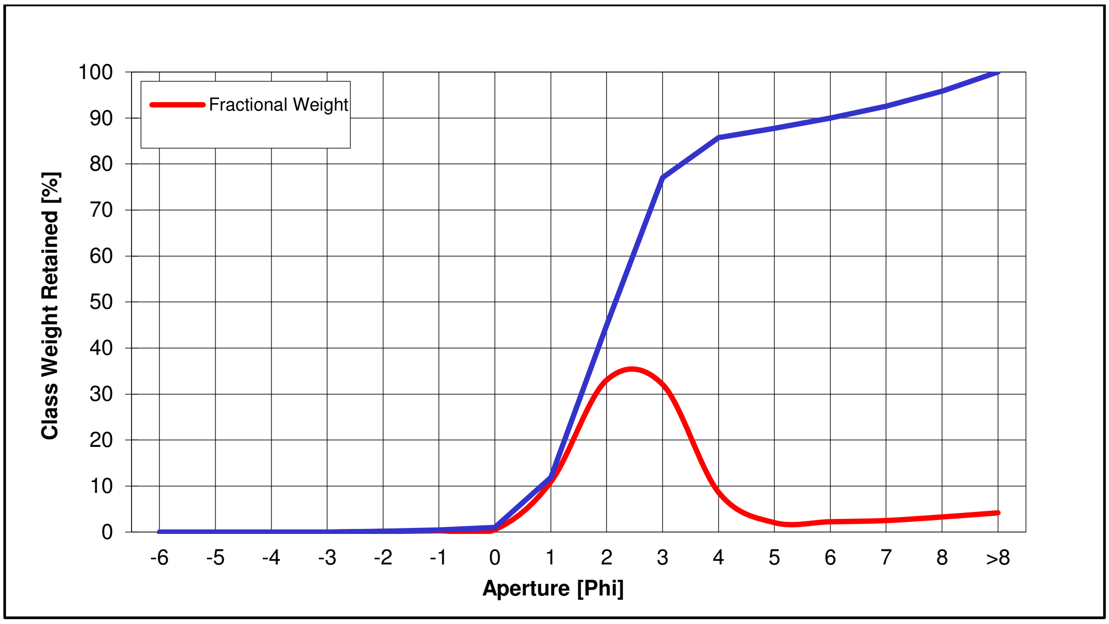
Sorting	1.65	Poorly Sorted
Skewness	0.31	Very Fine Skewed
Kurtosis	2.11	Very Leptokurtic
Mean [µm]	187.3	Fine Sand
Mean [phi]	2.42	
Median [µm]	198.8	Fine Sand
Median [phi]	2.33	
Gravel [%]	0.4	Slightly Gravelly Muddy Sand
Sand [%]	87.8	
Mud [%]	11.8	



WF37

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.0	0.0
4000.0	-2	0.1	0.1
2000.0	-1	0.3	0.4
1000.0	0	0.5	1.0
500.0	1	10.9	11.9
250.0	2	33.0	44.9
125.0	3	32.1	77.0
62.5	4	8.7	85.7
31.2	5	2.1	87.8
15.6	6	2.2	90.0
7.8	7	2.5	92.5
3.9	8	3.3	95.8
<3.9	>8	4.2	100.0
Total		**100.0**	**100.0**

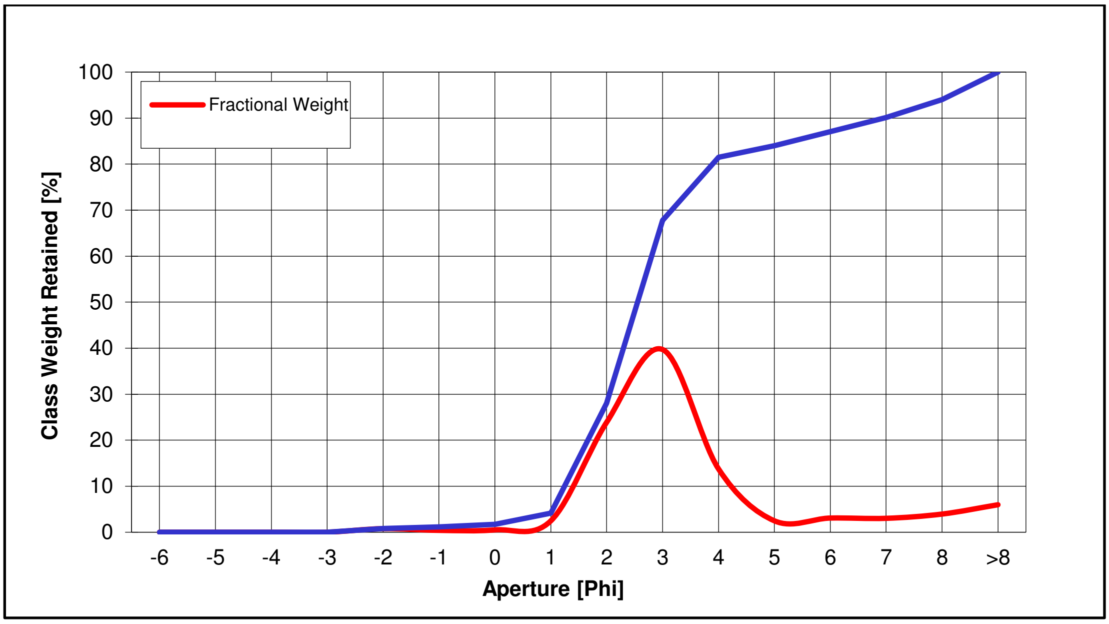
Sorting	1.79	Poorly Sorted
Skewness	0.37	Very Fine Skewed
Kurtosis	1.97	Very Leptokurtic
Mean [µm]	194.6	Fine Sand
Mean [phi]	2.36	
Median [µm]	224.1	Fine Sand
Median [phi]	2.16	
Gravel [%]	0.4	Slightly Gravelly Muddy Sand
Sand [%]	85.3	
Mud [%]	14.3	



WF41

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.0	0.0
4000.0	-2	0.8	0.8
2000.0	-1	0.4	1.2
1000.0	0	0.5	1.7
500.0	1	2.5	4.1
250.0	2	23.9	28.0
125.0	3	39.7	67.7
62.5	4	13.8	81.5
31.2	5	2.5	84.0
15.6	6	3.1	87.1
7.8	7	3.0	90.1
3.9	8	3.9	94.0
<3.9	>8	6.0	100.0
Total		100.0	100.0

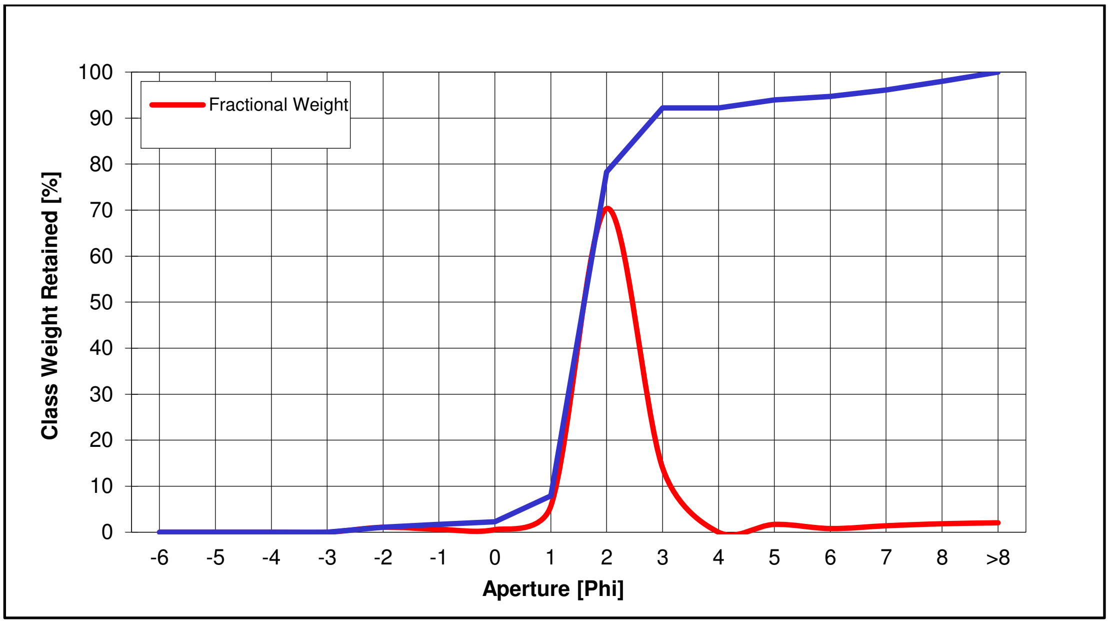
Sorting	2.06	Very Poorly Sorted
Skewness	0.50	Very Fine Skewed
Kurtosis	1.94	Very Leptokurtic
Mean [µm]	123.5	Very Fine Sand
Mean [phi]	3.02	
Median [µm]	170.4	Fine Sand
Median [phi]	2.55	
Gravel [%]	1.2	Slightly Gravelly Muddy Sand
Sand [%]	80.3	
Mud [%]	18.5	



WF45

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.0	0.0
4000.0	-2	1.1	1.1
2000.0	-1	0.6	1.7
1000.0	0	0.6	2.3
500.0	1	5.7	7.9
250.0	2	70.3	78.3
125.0	3	14.0	92.2
62.5	4	0.0	92.2
31.2	5	1.7	93.9
15.6	6	0.8	94.7
7.8	7	1.4	96.1
3.9	8	1.8	98.0
<3.9	>8	2.0	100.0
Total		100.0	100.0

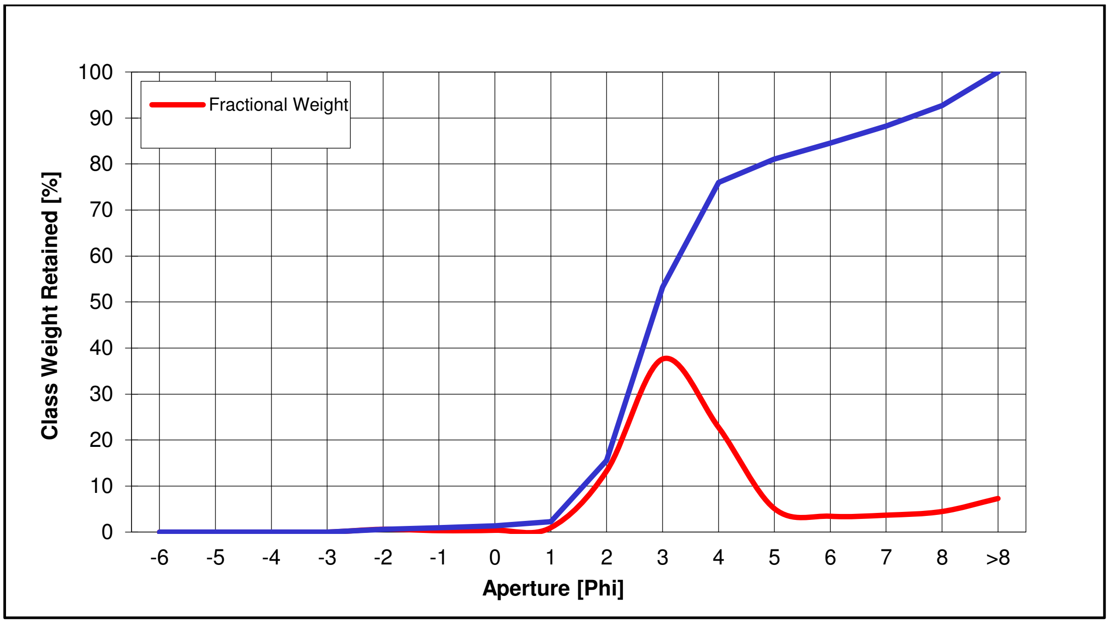
Sorting	1.19	Poorly Sorted
Skewness	0.43	Very Fine Skewed
Kurtosis	3.30	Extremely Leptokurtic
Mean [µm]	306.1	Medium Sand
Mean [phi]	1.71	
Median [µm]	330.3	Medium Sand
Median [phi]	1.60	
Gravel [%]	1.7	Slightly Gravelly Sand
Sand [%]	90.5	
Mud [%]	7.8	



WF47

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	0.0	0.0
8000.0	-3	0.0	0.0
4000.0	-2	0.6	0.6
2000.0	-1	0.3	0.9
1000.0	0	0.4	1.3
500.0	1	1.0	2.3
250.0	2	13.3	15.6
125.0	3	37.6	53.2
62.5	4	22.8	76.0
31.2	5	5.1	81.1
15.6	6	3.4	84.5
7.8	7	3.7	88.2
3.9	8	4.5	92.7
<3.9	>8	7.3	100.0
Total		**100.0**	**100.0**

Sorting	2.24	Very Poorly Sorted
Skewness	0.56	Very Fine Skewed
Kurtosis	2.03	Very Leptokurtic
Mean [µm]	83.1	Very Fine Sand
Mean [phi]	3.59	
Median [µm]	132.6	Fine Sand
Median [phi]	2.91	
Gravel [%]	0.9	Slightly Gravelly Muddy Sand
Sand [%]	75.1	
Mud [%]	24.0	



D.1.2 PSD Samples Certificate of Analysis

Certificate Number:	EP/17/4728	**Fugro EMU Job Number:**	160975
Job Reference:	Thanet Extension Benthic Survey		
Prepared For		**Prepared By**	
Vattenfall		**James Hutchinson** **Fugro EMU Limited** Trafalgar Wharf (Unit 16) Hamilton Road Portchester Portsmouth PO6 4PX United Kingdom	
		Phone: +44 (0) 2392 205500 **Email:** sediment@fugroemu.com **Web:** www.fugroemu.com	

Sampling Undertaken By:	Fugro EMU	**Sampling Date:**	12/11/2016 – 05/12/2016
Date of Receipt:	16/11/2016 – 06/12/2016	**Date of Analysis:**	03/01/2017 – 09/01/2017
Sample Matrix:	Marine Sediments		
Method Reference:	Particle Size Distribution by Dry Sieving – Fugro EMU MET/01 based on BS1377: 1990: Parts 1 – 2, and *Fugro EMU MET/48 based on the NMBAQC PSA SOP for supporting biological data. *Particle Size Distribution by Laser Diffraction – Fugro EMU MET/50 based on BS ISO 13320: 2009. *Organic Content by Loss on Ignition @ 440°C for 4 hours – Fugro EMU MET/01 based on clause 4 of BS1377: Part 3: 1990.		
Test Results:	Refer to pages 2-5 of 5		
Laboratory Comments:	None		
Authorised Signature:	J. R. Hut		
Name:	James Hutchinson		
Position:	Sediment Laboratory Manager		
Issue Date:	11/01/2017		

- Further information on methods of analysis may be obtained from the above address
- Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
- *Indicates determinand not included in UKAS accreditation
- Test results reported relate only to those items tested
- [Sub]Indicates subcontracted test
- [DS]Indicates relevant Deviating Code applies to test results

A UKAS TESTING LABORATORY
UKAS TESTING 1272

FUGRO EMU LIMITED
CERTIFICATE OF ANALYSIS

Test Results: Particle Size Distribution by Dry Sieving (63000 - 1000 µm) and Laser Diffraction (<1000 - < 3.91 µm) @ 1 Phi Intervals
Fugro EMU Job Number: 160975
Job Reference: Thanet Extension Benthic Survey

SAMPLE ID:	CR01	CR02	CR03	WF01	WF02	WF03	WF04	WF05	WF06
LAB ID:	WL032616	WL032617	WL032618	WL032619	WL032620	WL032621	WL032622	WL032623	WL032624
Aperture [µm]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]
63000	0.00	62.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31500	51.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16000	5.93	10.36	0.00	11.27	0.00	0.00	0.00	0.00	0.00
8000	10.20	7.30	0.00	12.43	0.24	0.00	0.00	0.00	0.00
4000	3.67	4.64	0.43	3.82	2.20	1.78	0.26	0.39	0.12
2000	1.80	2.27	0.65	2.89	2.12	1.13	0.20	0.47	0.22
1000	1.46	1.39	1.84	2.89	2.56	1.03	0.48	1.58	0.26
500	8.81	3.40	5.24	12.47	34.26	16.17	12.62	28.55	11.00
250	10.03	4.50	63.99	45.60	36.78	51.99	38.49	60.38	32.59
125	3.53	2.47	27.85	8.63	5.04	9.22	24.30	6.30	29.63
63	0.92	0.47	0.00	0.00	2.40	0.35	5.73	0.00	14.06
31.25	0.39	0.17	0.00	0.00	2.98	2.89	3.09	0.00	2.97
15.63	0.22	0.13	0.00	0.00	2.40	2.37	2.44	0.08	1.45
7.81	0.30	0.13	0.00	0.00	3.21	3.75	3.32	0.75	1.94
3.91	0.37	0.16	0.00	0.00	2.92	4.24	4.08	0.79	2.34
< 3.91	0.49	0.19	0.00	0.00	2.89	5.08	4.98	0.71	3.40
TOTAL:	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

FUGRO EMU LIMITED
CERTIFICATE OF ANALYSIS

Test Results: Particle Size Distribution by Dry Sieving (63000 - 1000 µm) and Laser Diffraction (<1000 - < 3.91 µm) @ 1 Phi Intervals
Fugro EMU Job Number: 160975
Job Reference: Thanet Extension Benthic Survey

SAMPLE ID:	WF07	WF08	WF09	WF10	WF11	WF12	WF14	WF19	WF22
LAB ID:	WL032625	WL032626	WL032627	WL032628	WL032629	WL032630	WL032631	WL032632	WL032633
Aperture [µm]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]
63000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31500	0.00	0.00	45.41	61.72	54.20	22.17	0.00	0.00	0.00
16000	0.00	0.00	5.21	13.33	15.24	34.57	0.00	0.00	10.06
8000	3.67	0.20	3.40	10.18	3.09	4.34	0.82	0.22	11.13
4000	1.92	0.36	2.79	1.14	1.05	3.35	0.16	0.54	6.10
2000	1.63	0.47	2.34	1.00	1.02	1.45	0.31	2.74	3.53
1000	2.11	0.83	2.48	1.06	1.22	2.01	0.56	5.80	3.63
500	6.17	7.10	7.94	3.81	8.16	10.09	2.41	18.15	7.46
250	27.01	36.60	13.42	4.75	10.52	13.31	13.12	47.31	17.52
125	33.81	35.37	8.38	1.73	3.19	5.37	39.25	17.09	24.35
63	9.19	5.44	2.37	0.33	0.53	1.04	24.26	0.60	7.57
31.25	2.19	1.91	1.05	0.19	0.35	0.46	3.90	1.77	0.99
15.63	2.36	2.37	0.84	0.11	0.21	0.29	2.75	0.94	1.57
7.81	2.58	2.32	1.04	0.15	0.30	0.36	3.03	1.21	1.51
3.91	3.28	3.00	1.36	0.20	0.39	0.47	3.69	1.60	1.97
< 3.91	4.07	4.04	1.95	0.30	0.51	0.72	5.75	2.03	2.62
TOTAL:	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

FUGRO EMU LIMITED
CERTIFICATE OF ANALYSIS

Test Results: Particle Size Distribution by Dry Sieving (63000 - 1000 µm) and Laser Diffraction (<1000 - < 3.91 µm) @ 1 Phi Intervals
Fugro EMU Job Number: 160975
Job Reference: Thanet Extension Benthic Survey

SAMPLE ID:	WF25	WF27	WF29	WF32	WF37	WF41	WF45	WF47
LAB ID:	WL032634	WL032635	WL032636	WL032637	WL032638	WL032639	WL032640	WL032641
Aperture [µm]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]	Fractional [%]
63000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8000	0.38	0.30	0.41	0.00	0.00	0.00	0.00	0.00
4000	1.75	0.29	0.82	0.13	0.15	0.78	1.07	0.61
2000	2.52	0.67	1.06	0.23	0.28	0.40	0.62	0.32
1000	3.33	0.77	1.42	0.34	0.55	0.50	0.57	0.40
500	27.58	18.33	26.99	7.00	10.92	2.46	5.67	0.96
250	53.65	41.40	62.80	29.06	33.05	23.90	70.33	13.30
125	10.80	12.73	6.49	40.00	32.09	39.71	13.97	37.62
63	0.00	1.64	0.00	11.40	8.68	13.77	0.00	22.79
31.25	0.00	3.98	0.00	0.65	2.06	2.47	1.70	5.10
15.63	0.00	3.37	0.00	2.34	2.25	3.08	0.79	3.44
7.81	0.00	4.79	0.00	2.08	2.51	3.02	1.40	3.68
3.91	0.00	5.39	0.00	2.84	3.29	3.94	1.84	4.48
< 3.91	0.00	6.32	0.00	3.92	4.19	5.97	2.04	7.30
TOTAL:	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

FUGRO EMU LIMITED
CERTIFICATE OF ANALYSIS

Test Results: Organic Content by Loss on Ignition @ 440°C for 4 hours
Fugro EMU Job Number: 160975
Job Reference: Thanet Extension Benthic Survey

Sample ID	Lab ID	% Organic Content [<2mm]
CR01	WL032616	1.11
CR02	WL032617	1.15
CR03	WL032618	0.52
WF01	WL032619	0.66
WF02	WL032620	1.24
WF03	WL032621	1.51
WF04	WL032622	1.34
WF05	WL032623	0.83
WF06	WL032624	1.14
WF07	WL032625	1.29
WF08	WL032626	1.25
WF09	WL032627	1.43
WF10	WL032628	1.15
WF11	WL032629	1.15
WF12	WL032630	1.19
WF14	WL032631	1.30
WF19	WL032632	0.79
WF22	WL032633	1.34
WF25	WL032634	0.69
WF27	WL032635	1.01
WF29	WL032636	0.60
WF32	WL032637	0.94
WF37	WL032638	0.97
WF41	WL032639	1.11
WF45	WL032640	0.67
WF47	WL032641	1.22

D.2 Chemistry Analysis Results and Certificate of the Analysis

Client: Fugro EMU Ltd

Project: 13881 Vattenfall - Marine Sediment

Quote Description: Marine Sediment

Folder No: 003754519

Sampled on: 5-Dec-16 @ 13:45

Comments: 160975 CR10

Quote No: 13881

Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	<0.9	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	60.1	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	8.70	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	1.67	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	10.3	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	3.00	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	417	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	7.80	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	43.0	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	33.0	mg/kg		2.5	UKAS	LE	1041
Acenaphthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Acenaphthylene : Dry Wt	<1	ug/kg		1	None	LE	1051
Anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(a)anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(a)pyrene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(b)fluoranthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(e) pyrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Benzo(ghi)perylene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(j)fluoranthene : Dry Wt	<10	ug/kg		10	None	LE	1051
Benzo(k)fluoranthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Chrysene : Dry Wt	<3	ug/kg		3	UKAS	LE	1051
Chrysene + Triphenylene : Dry Wt	<3	ug/kg		3	None	LE	1051
Dibenzo(ah)anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Dibenzothiophene : Dry Wt	<5	ug/kg		5	None	LE	1051
Fluoranthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Fluorene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Naphthalene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Perylene : Dry Wt	<5	ug/kg		5	None	LE	1051
Phenanthrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Pyrene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Triphenylene : Dry Wt	<2	ug/kg		2	None	LE	1051
PCB - 028 : Dry Wt	<0.1	ug/kg		0.1	UKAS	LE	685
PCB - 052 : Dry Wt	<0.1	ug/kg		0.1	UKAS	LE	685

PCB - 101 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 118 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 138 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 153 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 180 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg	3	None	LE	897
		ELEVATED_MRV : Dry weight calculation				
Tetrabutyl Tin : Dry Wt as Cation	<2	ug/kg	2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Triphenyl Tin : Dry Wt as Cation	<2	ug/kg	2	UKAS	LE	897
Dry Solids @ 30°C	82.9	%	0.5	None	LE	1130
Accreditation Assessment	2	No.	1	None	LE	924
Additional Material Present	Report	Text			LE	924
	Plant+Stones+Shells					
Drying Method	Report	Text			LE	924
	Air dried at 30°C					
Rejected Matter Description	Report	Text			LE	924
	No material removed					
Sample Colour	Report	Text			LE	924
	Brown					
Sample Matrix	Report	Text			LE	924
	Sandy Sediment					
Sample Preparation	Report	Text			LE	924
	Homogenised, Jaw Crushed & Sieved to <2mm					

National Laboratory Service

Analytical Report

Final Report

Report ID - 20102951 - 1

UKAS TESTING 0754

Batch description: FUGRO EMU LTD

Reported on: 06-Feb-2017

Client: Fugro EMU Ltd

Project: 13881 Vattenfall - Marine Sediment

Quote Description: Marine Sediment

Folder No: 003754521

Sampled on: 12-Nov-16 @ 23:26

Comments: 160975 WF01

Quote No: 13881

Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	<0.9	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	26.3	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	6.70	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	<1	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	7.00	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	2.80	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	166	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	3.80	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	25.0	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	17.0	mg/kg		2.5	UKAS	LE	1041
Acenaphthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Acenaphthylene : Dry Wt	<1	ug/kg		1	None	LE	1051
Anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(a)anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(a)pyrene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(b)fluoranthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(e) pyrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Benzo(ghi)perylene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(j)fluoranthene : Dry Wt	<10	ug/kg		10	None	LE	1051
Benzo(k)fluoranthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Chrysene : Dry Wt	<3	ug/kg		3	UKAS	LE	1051
Chrysene + Triphenylene : Dry Wt	<3	ug/kg		3	None	LE	1051
Dibenzo(ah)anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Dibenzothiophene : Dry Wt	<5	ug/kg		5	None	LE	1051
Fluoranthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Fluorene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Naphthalene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Perylene : Dry Wt	<5	ug/kg		5	None	LE	1051
Phenanthrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Pyrene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Triphenylene : Dry Wt	<2	ug/kg		2	None	LE	1051
PCB - 028 : Dry Wt	<0.1	ug/kg		0.1	UKAS	LE	685
PCB - 052 : Dry Wt	<0.1	ug/kg		0.1	UKAS	LE	685

PCB - 101 : Dry Wt	<0.1	ug/kg	*0.1*	UKAS	LE	685
PCB - 118 : Dry Wt	<0.1	ug/kg	*0.1*	UKAS	LE	685
PCB - 138 : Dry Wt	<0.1	ug/kg	*0.1*	UKAS	LE	685
PCB - 153 : Dry Wt	<0.1	ug/kg	*0.1*	UKAS	LE	685
PCB - 180 : Dry Wt	<0.1	ug/kg	*0.1*	UKAS	LE	685
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg	*3*	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg	*3*	None	LE	897
		ELEVATED_MRV : Dry weight calculation				
Tetrabutyl Tin : Dry Wt as Cation	<2	ug/kg	*2*	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg	*3*	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Triphenyl Tin : Dry Wt as Cation	<2	ug/kg	*2*	UKAS	LE	897
Dry Solids @ 30°C	81.0	%	*0.5*	None	LE	1130
Accreditation Assessment	2	No.	*1*	None	LE	924
Additional Material Present	Report	Text			LE	924
	Stones and Shells					
Drying Method	Report	Text			LE	924
	Air dried at 30°C					
Rejected Matter Description	Report	Text			LE	924
	No material removed					
Sample Colour	Report	Text			LE	924
	Brown					
Sample Matrix	Report	Text			LE	924
	Sandy Sediment					
Sample Preparation	Report	Text			LE	924
	Homogenised, Jaw Crushed & Sieved to <2mm					

Client: Fugro EMU Ltd

Project: 13881 Vattenfall - Marine Sediment

Quote Description: Marine Sediment

Folder No: 003754526

Sampled on: 12-Nov-16 @ 21:23

Comments: 160975 WF29

Quote No: 13881

Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	8.45	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	34.4	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	7.40	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	1.46	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	9.67	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	5.20	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	204	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	4.80	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	34.0	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	23.2	mg/kg		2.5	UKAS	LE	1041
Acenaphthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Acenaphthylene : Dry Wt	<1	ug/kg		1	None	LE	1051
Anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(a)anthracene : Dry Wt	1.16	ug/kg		1	UKAS	LE	1051
Benzo(a)pyrene : Dry Wt	2.04	ug/kg		1	UKAS	LE	1051
Benzo(b)fluoranthene : Dry Wt	2.65	ug/kg		1	UKAS	LE	1051
Benzo(e) pyrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Benzo(ghi)perylene : Dry Wt	1.95	ug/kg		1	UKAS	LE	1051
Benzo(j)fluoranthene : Dry Wt	<10	ug/kg		10	None	LE	1051
Benzo(k)fluoranthene : Dry Wt	1.18	ug/kg		1	UKAS	LE	1051
Chrysene : Dry Wt	<3	ug/kg		3	UKAS	LE	1051
Chrysene + Triphenylene : Dry Wt	<3	ug/kg		3	None	LE	1051
Dibenzo(ah)anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Dibenzothiophene : Dry Wt	<5	ug/kg		5	None	LE	1051
Fluoranthene : Dry Wt	2.46	ug/kg		1	UKAS	LE	1051
Fluorene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	2.04	ug/kg		1	UKAS	LE	1051
Naphthalene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Perylene : Dry Wt	<5	ug/kg		5	None	LE	1051
Phenanthrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Pyrene : Dry Wt	2.20	ug/kg		1	UKAS	LE	1051
Triphenylene : Dry Wt	<2	ug/kg		2	None	LE	1051
PCB - 028 : Dry Wt	<0.1	ug/kg		0.1	UKAS	LE	685
PCB - 052 : Dry Wt	<0.1	ug/kg		0.1	UKAS	LE	685

PCB - 101 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 118 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 138 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 153 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 180 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg	3	None	LE	897
		ELEVATED_MRV : Dry weight calculation				
Tetrabutyl Tin : Dry Wt as Cation	<3	ug/kg	2	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Tributyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Triphenyl Tin : Dry Wt as Cation	<3	ug/kg	2	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Dry Solids @ 30°C	77.2	%	0.5	None	LE	1130
Accreditation Assessment	2	No.	1	None	LE	924
Additional Material Present	Report	Text			LE	924
	Stones and Shells					
Drying Method	Report	Text			LE	924
	Air dried at 30°C					
Rejected Matter Description	Report	Text			LE	924
	No material removed					
Sample Colour	Report	Text			LE	924
	Brown					
Sample Matrix	Report	Text			LE	924
	Sandy Sediment					
Sample Preparation	Report	Text			LE	924
	Homogenised, Jaw Crushed & Sieved to <2mm					

Client: Fugro EMU Ltd
Project: 13881 Vattenfall - Marine Sediment
Quote Description: Marine Sediment
Folder No: 003754527
Sampled on: 13-Nov-16 @ 23:27
Comments: 160975 WF12
Quote No: 13881
Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	7.37	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	26.0	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	9.20	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	1.44	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	9.91	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	3.70	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	180	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	4.80	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	35.3	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	30.0	mg/kg		2.5	UKAS	LE	1041
Acenaphthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Acenaphthylene : Dry Wt	<1	ug/kg		1	None	LE	1051
Anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(a)anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(a)pyrene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(b)fluoranthene : Dry Wt	1.50	ug/kg		1	UKAS	LE	1051
Benzo(e) pyrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Benzo(ghi)perylene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(j)fluoranthene : Dry Wt	<10	ug/kg		10	None	LE	1051
Benzo(k)fluoranthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Chrysene : Dry Wt	<3	ug/kg		3	UKAS	LE	1051
Chrysene + Triphenylene : Dry Wt	<3	ug/kg		3	None	LE	1051
Dibenzo(ah)anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Dibenzothiophene : Dry Wt	<5	ug/kg		5	None	LE	1051
Fluoranthene : Dry Wt	1.44	ug/kg		1	UKAS	LE	1051
Fluorene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Naphthalene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Perylene : Dry Wt	<5	ug/kg		5	None	LE	1051
Phenanthrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Pyrene : Dry Wt	1.51	ug/kg		1	UKAS	LE	1051
Triphenylene : Dry Wt	<2	ug/kg		2	None	LE	1051
PCB - 028 : Dry Wt	<0.1	ug/kg		0.1	UKAS	LE	685
PCB - 052 : Dry Wt	<0.1	ug/kg		0.1	UKAS	LE	685

PCB - 101 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 118 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 138 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 153 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 180 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg	3	None	LE	897
		ELEVATED_MRV : Dry weight calculation				
Tetrabutyl Tin : Dry Wt as Cation	<2	ug/kg	2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Triphenyl Tin : Dry Wt as Cation	<2	ug/kg	2	UKAS	LE	897
Dry Solids @ 30°C	83.2	%	0.5	None	LE	1130
Accreditation Assessment	2	No.	1	None	LE	924
Additional Material Present	Report	Text			LE	924
	Stones and Shells					
Drying Method	Report	Text			LE	924
	Air dried at 30°C					
Rejected Matter Description	Report	Text			LE	924
	No material removed					
Sample Colour	Report	Text			LE	924
	Brown					
Sample Matrix	Report	Text			LE	924
	Sandy Sediment					
Sample Preparation	Report	Text			LE	924
	Homogenised, Jaw Crushed & Sieved to <2mm					

Client:	Fugro EMU Ltd	Project:	13881 Vattenfall - Marine Sediment
		Quote Description:	Marine Sediment
Folder No:	003754528	Sampled on:	13-Nov-16 @ 15:51
Comments:	160975 CR04		
Quote No:	13881	Matrix:	Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	16.0	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	12.0	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	12.1	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	1.82	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	5.54	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	6.00	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	162	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	4.90	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	20.9	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	17.7	mg/kg		2.5	UKAS	LE	1041
Acenaphthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Acenaphthylene : Dry Wt	<1	ug/kg		1	None	LE	1051
Anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(a)anthracene : Dry Wt	3.44	ug/kg		1	UKAS	LE	1051
Benzo(a)pyrene : Dry Wt	6.08	ug/kg		1	UKAS	LE	1051
Benzo(b)fluoranthene : Dry Wt	9.14	ug/kg		1	UKAS	LE	1051
Benzo(e) pyrene : Dry Wt	9.40	ug/kg		5	UKAS	LE	1051
Benzo(ghi)perylene : Dry Wt	9.41	ug/kg		1	UKAS	LE	1051
Benzo(j)fluoranthene : Dry Wt	<10	ug/kg		10	None	LE	1051
Benzo(k)fluoranthene : Dry Wt	3.99	ug/kg		1	UKAS	LE	1051
Chrysene : Dry Wt	3.11	ug/kg		3	UKAS	LE	1051
Chrysene + Triphenylene : Dry Wt	4.38	ug/kg		3	None	LE	1051
Dibenzo(ah)anthracene : Dry Wt	2.00	ug/kg		1	UKAS	LE	1051
Dibenzothiophene : Dry Wt	<5	ug/kg		5	None	LE	1051
Fluoranthene : Dry Wt	5.53	ug/kg		1	UKAS	LE	1051
Fluorene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	8.63	ug/kg		1	UKAS	LE	1051
Naphthalene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Perylene : Dry Wt	<5	ug/kg		5	None	LE	1051
Phenanthrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Pyrene : Dry Wt	4.97	ug/kg		1	UKAS	LE	1051
Triphenylene : Dry Wt	<2	ug/kg		2	None	LE	1051
PCB - 028 : Dry Wt	<0.1	ug/kg		0.1	UKAS	LE	685
PCB - 052 : Dry Wt	<0.1	ug/kg		0.1	UKAS	LE	685

PCB - 101 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 118 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 138 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 153 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 180 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg	3	None	LE	897
		ELEVATED_MRV : Dry weight calculation				
Tetrabutyl Tin : Dry Wt as Cation	<2	ug/kg	2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Triphenyl Tin : Dry Wt as Cation	<2	ug/kg	2	UKAS	LE	897
Dry Solids @ 30°C	77.6	%	0.5	None	LE	1130
Accreditation Assessment	2	No.	1	None	LE	924
Additional Material Present	Report	Text			LE	924
	Stones and Shells					
Drying Method	Report	Text			LE	924
	Air dried at 30°C					
Rejected Matter Description	Report	Text			LE	924
	No material removed					
Sample Colour	Report	Text			LE	924
	Brown					
Sample Matrix	Report	Text			LE	924
	Sandy Sediment					
Sample Preparation	Report	Text			LE	924
	Homogenised, Jaw Crushed & Sieved to <2mm					

Client: Fugro EMU Ltd
Project: 13881 Vattenfall - Marine Sediment
Quote Description: Marine Sediment
Folder No: 003754529
Sampled on: 13-Nov-16 @ 16:30
Comments: 160975 CR03
Quote No: 13881
Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	<0.9	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	18.1	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	13.4	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	1.14	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	5.00	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	2.53	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	127	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	4.80	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	21.0	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	16.6	mg/kg		2.5	UKAS	LE	1041
Acenaphthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Acenaphthylene : Dry Wt	<1	ug/kg		1	None	LE	1051
Anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(a)anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(a)pyrene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(b)fluoranthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(e) pyrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Benzo(ghi)perylene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Benzo(j)fluoranthene : Dry Wt	<10	ug/kg		10	None	LE	1051
Benzo(k)fluoranthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Chrysene : Dry Wt	<3	ug/kg		3	UKAS	LE	1051
Chrysene + Triphenylene : Dry Wt	<3	ug/kg		3	None	LE	1051
Dibenzo(ah)anthracene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Dibenzothiophene : Dry Wt	<5	ug/kg		5	None	LE	1051
Fluoranthene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Fluorene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Naphthalene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Perylene : Dry Wt	<5	ug/kg		5	None	LE	1051
Phenanthrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Pyrene : Dry Wt	<1	ug/kg		1	UKAS	LE	1051
Triphenylene : Dry Wt	<2	ug/kg		2	None	LE	1051
PCB - 028 : Dry Wt	<0.1	ug/kg		0.1	UKAS	LE	685
PCB - 052 : Dry Wt	<0.1	ug/kg		0.1	UKAS	LE	685

PCB - 101 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 118 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 138 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 153 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
PCB - 180 : Dry Wt	<0.1	ug/kg	0.1	UKAS	LE	685
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg	3	None	LE	897
		ELEVATED_MRV : Dry weight calculation				
Tetrabutyl Tin : Dry Wt as Cation	<2	ug/kg	2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<4	ug/kg	3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Triphenyl Tin : Dry Wt as Cation	<2	ug/kg	2	UKAS	LE	897
Dry Solids @ 30°C	81.8	%	0.5	None	LE	1130
Accreditation Assessment	2	No.	1	None	LE	924
Additional Material Present	Report	Text			LE	924
	Stones and Shells					
Drying Method	Report	Text			LE	924
	Air dried at 30°C					
Rejected Matter Description	Report	Text			LE	924
	No material removed					
Sample Colour	Report	Text			LE	924
	Brown					
Sample Matrix	Report	Text			LE	924
	Sandy Sediment					
Sample Preparation	Report	Text			LE	924
	Homogenised, Jaw Crushed & Sieved to <2mm					

Client:	Fugro EMU Ltd	Project:	13881 Vattenfall - Marine Sediment
		Quote Description:	Marine Sediment
Folder No:	003754532	Sampled on:	Date Not Supplied
Comments:	160975 WF47		
Quote No:	13881	Matrix:	Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	34.9	mg/kg	DA	0.9	UKAS	LE	402
Mercury : Dry Wt	0.0173	mg/kg	DA	0.01	UKAS	LE	1042
Arsenic : Dry Wt	10.0	mg/kg	DA	1	UKAS	LE	1041
Cadmium : Dry Wt	0.0540	mg/kg	DA	0.04	UKAS	LE	1041
Chromium : Dry Wt	19.7	mg/kg	DA	2	UKAS	LE	1041
Copper : Dry Wt	3.96	mg/kg	DA	1	UKAS	LE	1041
Lead : Dry Wt	10.4	mg/kg	DA	2	UKAS	LE	1041
Lithium : Dry Wt	10.9	mg/kg	DA	0.3	None	LE	1041
Manganese : Dry Wt	159	mg/kg	DA	0.2	UKAS	LE	1041
Nickel : Dry Wt	8.29	mg/kg	DA	1	UKAS	LE	1041
Vanadium : Dry Wt	32.6	mg/kg	DA	0.1	UKAS	LE	1041
Zinc : Dry Wt	29.4	mg/kg	DA	2.5	UKAS	LE	1041
Acenaphthene : Dry Wt	<1	ug/kg	DA	1	UKAS	LE	1051
Acenaphthylene : Dry Wt	<1	ug/kg	DA	1	None	LE	1051
Anthracene : Dry Wt	1.48	ug/kg	DA	1	UKAS	LE	1051
Benzo(a)anthracene : Dry Wt	6.91	ug/kg	DA	1	UKAS	LE	1051
Benzo(a)pyrene : Dry Wt	10.9	ug/kg	DA	1	UKAS	LE	1051
Benzo(b)fluoranthene : Dry Wt	12.7	ug/kg	DA	1	UKAS	LE	1051
Benzo(e) pyrene : Dry Wt	9.07	ug/kg	DA	5	UKAS	LE	1051
Benzo(ghi)perylene : Dry Wt	9.85	ug/kg	DA	1	UKAS	LE	1051
Benzo(j)fluoranthene : Dry Wt	<10	ug/kg	DA	10	None	LE	1051
Benzo(k)fluoranthene : Dry Wt	6.00	ug/kg	DA	1	UKAS	LE	1051
Chrysene : Dry Wt	6.62	ug/kg	DA	3	UKAS	LE	1051
Chrysene + Triphenylene : Dry Wt	9.27	ug/kg	DA	3	None	LE	1051
Dibenzo(ah)anthracene : Dry Wt	1.81	ug/kg	DA	1	UKAS	LE	1051
Dibenzothiophene : Dry Wt	<5	ug/kg	DA	5	None	LE	1051
Fluoranthene : Dry Wt	13.4	ug/kg	DA	1	UKAS	LE	1051
Fluorene : Dry Wt	<5	ug/kg	DA	5	UKAS	LE	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	10.2	ug/kg	DA	1	UKAS	LE	1051
Naphthalene : Dry Wt	<5	ug/kg	DA	5	UKAS	LE	1051
Perylene : Dry Wt	6.96	ug/kg	DA	5	None	LE	1051
Phenanthrene : Dry Wt	8.60	ug/kg	DA	5	UKAS	LE	1051
Pyrene : Dry Wt	12.6	ug/kg	DA	1	UKAS	LE	1051
Triphenylene : Dry Wt	2.65	ug/kg	DA	2	None	LE	1051
PCB - 028 : Dry Wt	<0.1	ug/kg	DA	0.1	UKAS	LE	685
PCB - 052 : Dry Wt	<0.1	ug/kg	DA	0.1	UKAS	LE	685

PCB - 101 : Dry Wt	<0.1	ug/kg	DA	0.1	UKAS	LE	685
PCB - 118 : Dry Wt	<0.1	ug/kg	DA	0.1	UKAS	LE	685
PCB - 138 : Dry Wt	<0.1	ug/kg	DA	0.1	UKAS	LE	685
PCB - 153 : Dry Wt	<0.1	ug/kg	DA	0.1	UKAS	LE	685
PCB - 180 : Dry Wt	<0.1	ug/kg	DA	0.1	UKAS	LE	685
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg	DA	3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation					
Dioctyl Tin : Dry Wt as Cation	<4	ug/kg	DA	3	None	LE	897
		ELEVATED_MRV : Dry weight calculation					
Tetrabutyl Tin : Dry Wt as Cation	<3	ug/kg	DA	2	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation					
Tributyl Tin : Dry Wt as Cation	<4	ug/kg	DA	3	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation					
Triphenyl Tin : Dry Wt as Cation	<3	ug/kg	DA	2	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation					
Dry Solids @ 30°C	68.6	%	DA	0.5	None	LE	1130
Accreditation Assessment	2	No.	DA	1	None	LE	924
Additional Material Present	Report	Text	DA			LE	924
	Stones and Shells						
Drying Method	Report	Text	DA			LE	924
	Air dried at 30°C						
Rejected Matter Description	Report	Text	DA			LE	924
	No material removed						
Sample Colour	Report	Text	DA			LE	924
	Brown						
Sample Matrix	Report	Text	DA			LE	924
	Sandy Clay Sediment						
Sample Preparation	Report	Text	DA			LE	924
	Homogenised, Jaw Crushed & Sieved to <2mm						

Method Description Summary for all samples in batch Number 20102951

402	LE I Hydrocardons by fluorescence
685	LE O OCP_PAH_PCB in Marine Biota and Sediment - solvent extracted, determined by GCMS QQQ
897	LE O Organotins (GCMS) 01 - acetic acid/methanol extracted; derivatised; determined GCMS (SIM); from "as received" sample
924	Sample Preparation; Dry Solids (30°C); from "as received" sample
1041	LE M Metals ICP-MS Sediment - microwave aqua regia digested, determined by ICPMS, samples are sieved to <2000um.
1042	LE M Mercury CSEMP - microwave aqua regia digeste, acidic SnCl2 reduced, determined by CV-AFS. Samples are sieved to <2000um.
1051	LE O OCP_PAH_PCB in Marine Biota and Sediment - solvent extracted, determined by GCMS QQQ
1130	LE P Soil Preparation 01: The sample is air-dried at <30ºC in a controlled environment until a constant weight it achieved.

Steve Moss
Laboratory Site Manager

Any additional accompanying reports received should be used in conjunction with the formal PDF and not as a standalone report. The formal PDF report provides full details of the accreditation status, sample deviation information and any other relevant related information.

All reporting limits quoted are those achievable for clean samples of the relevant matrix. No allowance is made for instances when dilutions are necessary owing to the nature of the sample or insufficient volume of the sample being available. In these cases higher reporting limits may be quoted and will be above the MRV.
Minimum Reporting Value (MRV). A minimum concentration selected for reporting purposes (i.e. the less than value), which is higher than the statistically derived method limit of detection.

Solid sample results are determined on a "dried" sample fraction except for parameters where the method description identifies that "as received" sample was used.

Uncertainty of Measurement information relating to sample results is supplied upon request. Uncertainty is estimated from the performance of routine quality control standards, using the calculation 2 X Relative Standard Deviation + Bias. This is based on the guidance issued by the UKTAG Chemistry task team - Guidance on the implementation of the Quality Assurance/Quality Control requirements' associated with Commission Directive 2009/90/EC, Article 4 (UoM = 2 X %RSD), with a contribution added for the bias.

Key to Results Flags:

DA Sampling date/time has not been provided and no assessment of sample stability can be made. It is possible that the results may be compromised.

The analysis start date specified is the date of the first test, dates for other analysis are available on request.

Please note all samples will be retained for 10 working days for aqueous samples and 30 working days for solid samples after reporting unless otherwise agreed with Customer Services
Key to Accreditation: UKAS = Methodology accredited to ISO/IEC 17025:2005, MCertS = Methodology accredited to MCertS Performance Standard for testing of soils, none = Methodology not accredited
Key to Lab ID: LE = Leeds, NM = Nottingham, SX = Starcross, SC = Sub-Contracted outside NLS, FI = Field Data - outside NLS, NLS = Calculated
Any subsequent version of this report denoted with a higher version number will supersede this and any previous versions

END OF TEST REPORT

D.3 Grab Infaunal Abundance Raw Data

Taxon	APHIA ID	CR01	CR03	CR10	CR11	WF01	WF02	WF03	WF04	WF05	WF06	WF07	WF08	WF09	WF11	WF12	WF14	WF19	WF22	WF25	WF27
PLATYHELMINTHES	793															2			1		
NEMERTEA	152391				1				3		2	3		14	4	3			8		
CHAETOGNATHA	2081												1								
SIPUNCULA (juv.)	1268																				
Golfingia elongata	175026				1									3							
Aphrodita (juv.)	129194																				
Aphrodita aculeata	129840																1				
Subadyte pellucida	130833	1																			
Gattyana cirrhosa	130749													1							
Harmothoe	129491	2			1									1							
Malmgrenia darbouxi	863197														1						
Lepidonotus squamatus	130801				1									1							
Pholoe baltica	130599	2							2		2	1		5	1		2		5		
Pholoe inornata	130601																1				
Sthenelais boa	131074				1							1		1			1				
Sthenelais limicola	131077										1	1									
Eteone longa (agg.)	130616								2		1	1					3				
Phyllodoce rosea	334514								1		1	1			2				2		
Eulalia bilineata	130624														1						
Eulalia ornata	130632													15							
Eumida sanguinea (agg.)	130644	1													1						
Glycera	129296													1							
Glycera alba	130116	1					1		1			4		1					4		
Glycera lapidum (agg.)	130123	2					3							5	2						
Glycera oxycephala	130126			2																	
Glycinde nordmanni	130136								1			1					1		1		
Goniada maculata	130140								1	1			1	4		1	1		2		
Sphaerodorum gracilis	131100											1							1		
Podarkeopsis capensis	130195								1			4		1	1		1		1		

Taxon	APHIA ID	CR01	CR03	CR10	CR11	WF01	WF02	WF03	WF04	WF05	WF06	WF07	WF08	WF09	WF11	WF12	WF14	WF19	WF22	WF25	WF27
Syllis armillaris	131415													1	1						
Syllis garciai	131431				1																
Odontosyllis fulgurans	131327														1						
Eunereis longissima	130375	2			9				1			2		3	1		1				
Nephtys (juv.)	129370						1					1									
Nephtys caeca	130355														1						
Nephtys cirrosa	130357	1		4			1	6		1								2		3	
Nephtys hombergii	130359								4			4					8	2			2
Nephtys kersivalensis	130363				1									2							
Nephtys longosetosa	130364												1							1	
Marphysa bellii	130072													3					1		
Marphysa sanguinea	130075	1																			
Lysidice unicornis	742232														1						
Lumbrineris cingulata	130240	9			14							1		15	6	3	1		1		
Schistomeringos rudolphi	154127													2					1		
Paradoneis lyra	130585													2	1	1					
Poecilochaetus serpens	130711														1						
Aonides oxycephala	131106	1			1									6		2					
Aonides paucibranchiata	131107				1										1						
Laonice bahusiensis	131127															1					
Dipolydora coeca (agg.)	131117															1					
Dipolydora caulleryi	131116													5	2						
Dipolydora flava	131118	1												2	2	1					
Pseudopolydora pulchra	131169								1										1		
Spio goniocephala	131184			1		1														1	
Spiophanes	129626								1												
Spiophanes bombyx	131187								27		43	9			2	1	6		9		
Magelona alleni	130266													1							

Taxon	APHIA ID	CR01	CR03	CR10	CR11	WF01	WF02	WF03	WF04	WF05	WF06	WF07	WF08	WF09	WF11	WF12	WF14	WF19	WF22	WF25	WF27
Magelona johnstoni	130269							7			1							4	1		
Aphelochaeta marioni	129938	1										2			1						
Caulleriella alata	129943	5			3		1							3	2	1			1		
Chaetozone setosa	129955			3																	
Chaetozone zetlandica	336485	1			2			1							1						
Dodecaceria	129246														1						
Pherusa plumosa	130113		1																		
Mediomastus fragilis	129892													12	7	2					
Notomastus	129220	2			9									6		4		1	2		4
Arenicolidae (juv.)	922				2										1						
Leiochone	146991														1						
Leiochone johnstoni	221095														2						
Euclymene oerstedii	130294						1				8	45	1	1		3	54		46		1
Praxillella affinis	130322				2										3	1					
Ophelia borealis	130491		1	3						1											
Scalibregma celticum	130979				2											2					
Scalibregma inflatum	130980	2									1			3		2	1				
Galathowenia oculata	146950											5		2	4	1			6		
Owenia borealis	329882								30		7	2		1	1		6		4		
Lagis koreni	152367								16		7	4		4			10		10		
Sabellaria	129520													1							
Sabellaria spinulosa	130867											1		181		1	9		12		
Ampharete lindstroemi (agg.)	129781				2				2			1		7	1	4	1		1		
Terebellides stroemii	131573															1					
Lanice conchilega	131495																				
Loimia medusa	131499	1														1			1		
Nicolea venustula	131507	1												1		1					
Polycirrus	129710				1									2	1						
Polycirrus denticulatus	131527													2							

Taxon	APHIA ID	CR01	CR03	CR10	CR11	WF01	WF02	WF03	WF04	WF05	WF06	WF07	WF08	WF09	WF11	WF12	WF14	WF19	WF22	WF25	WF27
Thelepus setosus	131544																				
Sabella	129549				2																
Sabella pavonina	130967				45																
Spirobranchus lamarcki	560033	6													5	5					
Spirobranchus	129582													1	1	1					
Limnodrilus	137388										7										
Tubificoides amplivasatus	137570												1								
Tubificoides swirencoides	137584				2																
Nymphon brevirostre	150520															1					
Achelia echinata	134599	1														2					
Ammothella longipes	134614														1						
Anoplodactylus petiolatus	134723											1		4					1		
Leucothoe incisa	102460								1												
Urothoe brevicornis	103226					7	17			21											
Urothoe elegans	103228												1		1						
Urothoe poseidonis	103235							1													
Harpinia antennaria	102960											1					4		2		
Acidostoma neglectum	102495													2							
Nototropis guttatus	488957				1																
Ampelisca diadema	101896				10									2							
Ampelisca spinipes	101928	1										1		1		1	1				
Ampelisca tenuicornis	101930											1							1		
Bathyporeia elegans	103058																				
Bathyporeia pelagica	103066																				
Bathyporeia tenuipes	103076												1								
Abludomelita obtusata	102788													1			2				
Cheirocratus intermedius	102795																				

Taxon	APHIA ID	CR01	CR03	CR10	CR11	WF01	WF02	WF03	WF04	WF05	WF06	WF07	WF08	WF09	WF11	WF12	WF14	WF19	WF22	WF25	WF27
Gammaropsis maculata	102364				1																
Ericthonius (female)	101567															1					
Ericthonius punctatus	102408															1					
Siphonoecetes kroyeranus	102111																				
Unciola crenatipalma	102057													8		1					
Pseudoprotella phasma	101871														1						
Gnathia oxyuraea	118995				1									3							
Anthura gracilis	118467	1													1	1					
Cleantis prismatica	119038				2																
Pseudione hyndmanni	118240											2									
Bodotria scorpioides	110445	1																			
Diastylis	110398																				
Diastylis lucifera (?, juv)	110483																	1			
Eualus cranchii	156083	1																			
Crangonidae	106782																				
Philocheras trispinosus	107562					1															
Pagurus	106854															1					
Pagurus bernhardus	107232	1										1									
Galathea intermedia	107150																				
Pisidia longicornis	107188	2			2											1					
Ebalia tuberosa	107301													1							
Corystes cassivelaunus	107277																1				
Atelecyclus rotundatus	107273				1																
Liocarcinus navigator	107392				1																
Liocarcinus marmoreus	107390											1									
Pilumnus hirtellus	107418													1							
Leptochiton	138117																				
Leptochiton asellus	140199	1													1						
Gibbula cineraria	141782	3			2																

Taxon	APHIA ID	CR01	CR03	CR10	CR11	WF01	WF02	WF03	WF04	WF05	WF06	WF07	WF08	WF09	WF11	WF12	WF14	WF19	WF22	WF25	WF27
Tornus subcarinatus	141690	4																			
Crepidula fornicata	138963				2																
Euspira catena	140528																				
Euspira nitida	151894											1									
Epitonium clathrus	146905													2							
Buccinum undatum	138878				2																
Tritia incrassata	876825																1				
Tritia reticulata	876821								4												
?Tritonia plebeia	141738	1																			
BIVALVIA	105				1																
Nucula (juv.)	138262										1	1					3		1		
Nucula hanleyi	140588														1						
Nucula nitidosa	140589								9		4	21					11		1		
Nucula nucleus	140590				7						1	3			1		2				
Mytilidae (juv.)	211																				
Mytilus edulis	140480													1		2					
Aequipecten opercularis	140687																1				
Thyasira flexuosa	141662											2									
Diplodonta rotundata	141883																		1		
Kurtiella bidentata	345281	2			7				74		6	13	1				29			1	
Tellimya ferruginosa	146952											5					2				
Acanthocardia echinata	138992																2				
Laevicardium crassum	139004				1																
Mactra stultorum	140299								1												
Spisula subtruncata	140302								1		2	1					4		1		
Lutraria lutraria	140295																1				
Ensis ensis	140733			1																	
Phaxas pellucidus	140737											5					1		1		
Fabulina fabula	146907								10		14	1					2				

Taxon	APHIA ID	CR01	CR03	CR10	CR11	WF01	WF02	WF03	WF04	WF05	WF06	WF07	WF08	WF09	WF11	WF12	WF14	WF19	WF22	WF25	WF27
Asbjornsenia pygmaea	879714				3																
Abra (juv.)	138474				5						1	1		1			1				
Abra alba	141433	2			4				5		1										1
Polititapes rhomboides	745846													1							
Timoclea ovata	141929										1	1		1			1		3		
Myidae	247													1							
Sphenia binghami	140432														1						
Corbula gibba	139410								1			3									
Thracia villosiuscula	141651																				
Phoronis	128545	2							1		1	2			1						
Asterias rubens	123776													1							
OPHIUROIDEA (juv.)	123084										2		1	53		4	6		3		
Ophiothrix fragilis	125131	1													1						
Amphiuridae (juv.)	123206								12			2					8		1		
Acrocnida brachiata	236130		1																		
Amphipholis squamata	125064	6												41	1	6					
Ophiuridae	123200								1												
Ophiuridae (juv.)	123200	43			1				22			20	3	1	17	6	10		6	1	
Ophiura albida	124913								17		1	12		3	4	1	4		7		
Ophiura ophiura	124929								7								1				
ECHINOIDEA	123082							1													
ECHINOIDEA (juv.)	123082	3																			
Psammechinus miliaris	124319														1						
Echinocardium cordatum	124392											4									
ENTEROPNEUSTA	1820														1						

Notes:
APHIA ID = World Register of Marine Species (WoRMS) taxon code
Juv. = Juvenile
agg. = Aggregate species

Taxon	APHIA ID	WF29	WF32	WF37	WF41	WF44	WF45	WF47
PLATYHELMINTHES	793					3		
NEMERTEA	152391				2	1		
CHAETOGNATHA	2081							
SIPUNCULA (juv.)	1268					1		
Golfingia elongata	175026							
Aphrodita (juv.)	129194		1					
Aphrodita aculeata	129840							
Subadyte pellucida	130833							
Gattyana cirrhosa	130749							
Harmothoe	129491					1		
Malmgrenia darbouxi	863197							
Lepidonotus squamatus	130801					1		
Pholoe baltica	130599		4	4	3	2		5
Pholoe inornata	130601							
Sthenelais boa	131074					3		
Sthenelais limicola	131077							
Eteone longa (agg.)	130616		1	3				
Phyllodoce rosea	334514			1	2			
Eulalia bilineata	130624							
Eulalia ornata	130632					2		
Eumida sanguinea (agg.)	130644							
Glycera	129296							
Glycera alba	130116			1				1

Taxon	APHIA ID	WF29	WF32	WF37	WF41	WF44	WF45	WF47
Glycera lapidum (agg.)	130123							
Glycera oxycephala	130126							
Glycinde nordmanni	130136					1		1
Goniada maculata	130140							1
Sphaerodorum gracilis	131100							1
Podarkeopsis capensis	130195		1	3				
Syllis armillaris	131415							
Syllis garciai	131431							
Odontosyllis fulgurans	131327							
Eunereis longissima	130375					1		
Nephtys (juv.)	129370							
Nephtys caeca	130355							
Nephtys cirrosa	130357	3					1	
Nephtys hombergii	130359		3	7	2			6
Nephtys kersivalensis	130363					1		
Nephtys longosetosa	130364							
Marphysa bellii	130072							
Marphysa sanguinea	130075							
Lysidice unicornis	742232							
Lumbrineris cingulata	130240				1	9		1
Schistomeringos rudolphi	154127							
Paradoneis lyra	130585					1		
Poecilochaetus serpens	130711							

Taxon	APHIA ID	WF29	WF32	WF37	WF41	WF44	WF45	WF47
Aonides oxycephala	131106							
Aonides paucibranchiata	131107							
Laonice bahusiensis	131127							
Dipolydora coeca (agg.)	131117							
Dipolydora caulleryi	131116							
Dipolydora flava	131118					4		
Pseudopolydora pulchra	131169							
Spio goniocephala	131184							
Spiophanes	129626							
Spiophanes bombyx	131187		2	21	15			1
Magelona alleni	130266							1
Magelona johnstoni	130269			1				
Aphelochaeta marioni	129938							
Caulleriella alata	129943		1	1		4		
Chaetozone setosa	129955							
Chaetozone zetlandica	336485							
Dodecaceria	129246							
Pherusa plumosa	130113							
Mediomastus fragilis	129892		1	1				
Notomastus	129220				2	1		
Arenicolidae (juv.)	922	1						
Leiochone	146991							

Taxon	APHIA ID	WF29	WF32	WF37	WF41	WF44	WF45	WF47
Leiochone johnstoni	221095							
Euclymene oerstedii	130294				1	2	1	67
Praxillella affinis	130322							
Ophelia borealis	130491	2						
Scalibregma celticum	130979							
Scalibregma inflatum	130980							1
Galathowenia oculata	146950					1		
Owenia borealis	329882			26	13	1		5
Lagis koreni	152367		1	37	6			2
Sabellaria	129520							
Sabellaria spinulosa	130867	5	1		3	85		
Ampharete lindstroemi (agg.)	129781		2	1	1	2		
Terebellides stroemii	131573							
Lanice conchilega	131495							1
Loimia medusa	131499							
Nicolea venustula	131507							
Polycirrus	129710							
Polycirrus denticulatus	131527							
Thelepus setosus	131544					1		
Sabella	129549							
Sabella pavonina	130967							
Spirobranchus lamarcki	560033					3		
Spirobranchus	129582					1		

Taxon	APHIA ID	WF29	WF32	WF37	WF41	WF44	WF45	WF47
Limnodrilus	137388							
Tubificoides amplivasatus	137570							
Tubificoides swirencoides	137584							
Nymphon brevirostre	150520							
Achelia echinata	134599					2		
Ammothella longipes	134614							
Anoplodactylus petiolatus	134723					2		
Leucothoe incisa	102460		3	2	2			
Urothoe brevicornis	103226	8						
Urothoe elegans	103228					1		
Urothoe poseidonis	103235							
Harpinia antennaria	102960							
Acidostoma neglectum	102495							
Nototropis guttatus	488957							
Ampelisca diadema	101896					5		
Ampelisca spinipes	101928					1		
Ampelisca tenuicornis	101930				1			
Bathyporeia elegans	103058						1	
Bathyporeia pelagica	103066						1	
Bathyporeia tenuipes	103076							
Abludomelita obtusata	102788							
Cheirocratus intermedius	102795				1			

Taxon	APHIA ID	WF29	WF32	WF37	WF41	WF44	WF45	WF47
Gammaropsis maculata	102364							
Ericthonius (female)	101567							
Ericthonius punctatus	102408							
Siphonoecetes kroyeranus	102111				1			
Unciola crenatipalma	102057					1		
Pseudoprotella phasma	101871							
Gnathia oxyuraea	118995							
Anthura gracilis	118467							
Cleantis prismatica	119038							
Pseudione hyndmanni	118240							
Bodotria scorpioides	110445					1		
Diastylis	110398			1				
Diastylis lucifera (?, juv)	110483							
Eualus cranchii	156083							
Crangonidae	106782		1					
Philocheras trispinosus	107562							
Pagurus	106854							
Pagurus bernhardus	107232							
Galathea intermedia	107150					1		
Pisidia longicornis	107188					8		
Ebalia tuberosa	107301					2		
Corystes cassivelaunus	107277							
Atelecyclus rotundatus	107273							

Taxon	APHIA ID	WF29	WF32	WF37	WF41	WF44	WF45	WF47
Liocarcinus navigator	107392							
Liocarcinus marmoreus	107390							
Pilumnus hirtellus	107418							
Leptochiton	138117					1		
Leptochiton asellus	140199							
Gibbula cineraria	141782					4		
Tornus subcarinatus	141690							
Crepidula fornicata	138963					2		
Euspira catena	140528				1			
Euspira nitida	151894				1			
Epitonium clathrus	146905							
Buccinum undatum	138878							
Tritia incrassata	876825							
Tritia reticulata	876821							
Tritonia plebeia (?)	141738							
BIVALVIA	105							
Nucula (juv.)	138262			8	7			2
Nucula hanleyi	140588							
Nucula nitidosa	140589			31	13			21
Nucula nucleus	140590							2
Mytilidae (juv.)	211							1
Mytilus edulis	140480	1				4		
Aequipecten opercularis	140687							1

Taxon	APHIA ID	WF29	WF32	WF37	WF41	WF44	WF45	WF47
Thyasira flexuosa	141662							1
Diplodonta rotundata	141883							
Kurtiella bidentata	345281		3	65	5	3		27
Tellimya ferruginosa	146952		27	26	11			8
Acanthocardia echinata	138992				1			2
Laevicardium crassum	139004							
Mactra stultorum	140299							
Spisula subtruncata	140302			1				1
Lutraria lutraria	140295							
Ensis ensis	140733							
Phaxas pellucidus	140737							1
Fabulina fabula	146907		1	6				
Asbjornsenia pygmaea	879714							
Abra (juv.)	138474		3		1	1		
Abra alba	141433		6	2				1
Polititapes rhomboides	745846							
Timoclea ovata	141929							
Myidae	247							
Sphenia binghami	140432					2		
Corbula gibba	139410				2			
Thracia villosiuscula	141651					1		
Phoronis	128545					2		3
Asterias rubens	123776							
OPHIUROIDEA (juv.)	123084		2		1	33		

Taxon	APHIA ID	WF29	WF32	WF37	WF41	WF44	WF45	WF47
Ophiothrix fragilis	125131							
Amphiuridae (juv.)	123206			1				2
Acrocnida brachiata	236130			1	1			
Amphipholis squamata	125064					3		
Ophiuridae	123200							1
Ophiuridae (juv.)	123200		1	10	9	60		15
Ophiura albida	124913		4	5	8	4		9
Ophiura ophiura	124929		1					1
ECHINOIDEA	123082							
ECHINOIDEA (juv.)	123082							
Psammechinus miliaris	124319							
Echinocardium cordatum	124392		14	7	6			3
ENTEROPNEUSTA	1820							

Notes:
APHIA ID = World Register of Marine Species (WoRMS) taxon code
Juv. = Juvenile
agg. = Aggregate species

D.4 Grab Sample Certificate of Analysis Infauna

Certificate Number	EP/17/0005	Fugro GB Marine Ltd Job Number	160975
Job Reference	Vattenfall Thanet		
Prepared For		Prepared By	

Seamus Whyte Fugro GB Marine Limited Trafalgar Wharf (Unit 16) Hamilton Road Portchester Portsmouth PO6 4PX United Kingdom	**Grant Rowe** Fugro GB Marine Limited Y Plas Aberystwyth Road Machynlleth Powys SY20 8ER United Kingdom

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Web	www.fugro.com	Web	www.fugro.com

Sampling Undertaken By	Fugro GB Marine Limited	Sampling Date	October/November 2016
Date of Receipt	21-11-16	Date of Analysis	12-12-16 to 24-01-17
Sample Matrix	Macrobenthic Species ABUNDANCE (Infauna)		
Method Reference	TM23_001		
Test Results	Please double click on symbol:		
Laboratory Comments	None		
Deviating Codes	None		
Authorised Signature			
Name	Grant Rowe		
Position	Principal Taxonomist/QC Manager		
Issue Date	26th January 2017		

- Further information on methods of analysis may be obtained from the above address;
- Test results reported relate only to those items tested;
- SubIndicates subcontracted test;
- DSIndicates relevant deviating code applies to test results.

A. DEVIATING SAMPLE - CRITERIA

Code and Criteria	Description	Reporting Comment
DS1 - Damaged container(s)/ packaging	Sample was received in a damaged container which may have resulted in contamination or loss of integrity of the sample.	*Sample was received in a damaged container. The results reported may not be representative of the sample at the time of sampling.*
DS2 - Unsuitable container	Sample was received in an unsuitable container that is known to have an effect on the analysis.	*Sample was received in an unsuitable container. The results reported may not be representative of the sample at the time of sampling.*
DS3 - Incorrect or no sample preservation	Sample was received with no preservative, an incorrect preservative, or in a condition which indicates inappropriate sample storage, where specific criteria are referenced in the method.	*Sample was received in a condition unsuitable for the test. The results reported may not be representative of the sample at the time of sampling.*
DS4 - Missing date/time details	Sample date/time details were not recorded at time of sampling or not provided to the laboratory.	*Sampling date/time was not provided and therefore assessment of sample stability cannot be made. The test results may have been compromised.*
DS5 - Error in sample labelling/details	Sample information is missing, unreadable, conflicting or incorrect. Analysis was undertaken but traceability of results cannot be guaranteed against sample location.	*Incorrect/incomplete sample details have been provided. The traceability of results may have been compromised.*
DS6 - Sample received outside holding time	The date and time information provided with the sample indicate the sample was received at the laboratory outside of the holding time.	*Sample was received outside analysis holding time. The results reported may not be representative of the sample at the time of sampling.*
DS7 - Analysis commenced after holding time	The sample was received at the laboratory within its holding time but an analytical issue led to delay in commencement of analysis which exceeded the holding time.	*The holding time expired prior to analysis being undertaken. The results reported may not be representative of the sample at the time of sampling.*
DS8 - Insufficient analysis material	Insufficient material was received which meant that analysis could not be undertaken, or the analysis could not be carried out in accordance with the method.	*Insufficient sample material was received. The test results may not be representative of the sample at the time of sampling.*
DS9 - Sample contamination	Sample was received in a satisfactory condition but cross-contamination has occurred due to an analytical issue which has resulted in loss of sample integrity.	*The sample integrity may have been compromised due to an analytical issue. The results reported may not be representative of the sample at the time of sampling and are outside the scope of UKAS accreditation.*
Note: Where it is agreed with the client that a deviating sample should not be tested, then the report should state "Sample not analysed" and the relevant deviating sample code recorded.		

- Further information on methods of analysis may be obtained from the above address;
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- ^{Sub}Indicates subcontracted test;
- ^{DS}Indicates relevant deviating code applies to test results.

D.5 Grab Epifaunal (Non-Enumerated) Abundance Raw Data

Species	APHIA ID	CR01	CR03	CR10	CR11	WF01	WF02	WF03	WF04	WF05	WF06	WF07	WF08	WF09	WF11	WF12	WF14	WF19	WF22	WF25	WF27	WF29	WF32	WF37	WF41	WF44	WF45	WF47
Folliculinidae	1692			P			P			P	P	P	P					P	P	P	P	P					P	
PORIFERA	558				P																							
Cliona (agg.)	132026				P											P												
Microcionidae	131641				P																							
Tubulariidae	1603														P													
Bougainvilliidae	1594																								P	P		
Hydrallmania falcata	117890															P												
Sertularella 'gaudichaudi'	117901																									P		
Sertularia	117234	P													P	P										P		
Clytia	117030	P																										
Alcyonium digitatum	125333	P														P												
ACTINIARIA	1360	5					1							257		3				1						11		
Barentsia	111795																									P		
Verruca stroemia	106257															1												
Alcyonidium	110993				P								P													P	P	
Amathia lendigera	111659				P																							
Membraniporoidea	153579			P	P	P	P	P			P		P	P	P	P	P			P		P		P	P	P		P
Conopeum reticulum	111351				P				P		P	P		P			P		P				P	P	P		P	P
Electra monostachys	111354								P	P		P	P	P		P	P			P	P	P				P		
Electra pilosa	111355															P										P		
Aspidelectra melolontha	111350					P	P	P	P	P		P	P	P	P		P			P	P	P		P	P			P
Bicellariella ciliata	111147																									P		
Scrupocellaria scruposa	111250				P																							
Escharella immersa	111484	P			P										P	P										P		
Schizomavella	110829	P			P								P		P	P										P		

Species	APHIA ID	CR01	CR03	CR10	CR11	WF01	WF02	WF03	WF04	WF05	WF06	WF07	WF08	WF09	WF11	WF12	WF14	WF19	WF22	WF25	WF27	WF29	WF32	WF37	WF41	WF44	WF45	WF47
ASCIDIACEA juv.	1839														2											2		
Dendrodoa grossularia	103882																									4		
Corallinaceae	143691				P																							

Notes:
APHIA ID = World Register of Marine Species (WoRMS) taxon code
Juv. = Juvenile
agg. = Aggregate species
P = Present

D.5.1 Grab Sample Certificate of Analysis Epifauna

Certificate Number	EP/17/004	Fugro GB Marine Ltd Job Number	160975
Job Reference	Vattenfall Thanet (Epifauna)		
Prepared For		Prepared By	
Seamus Whyte Fugro GB Marine Limited Trafalgar Wharf (Unit 16) Hamilton Road Portchester Portsmouth PO6 4PX United Kingdom		Camilla Robins Fugro GB Marine Limited Trafalgar Wharf (Unit 16) Hamilton Road Portchester Portsmouth PO6 4PX United Kingdom	
Phone	+44 (0) 2392 205500	Phone	+44 (0) 2392 205500
Email	sg.whyte@fugro.com	Email	c.robins@fugro.com
Web	www.fugro.com	Web	www.fugro.com

Sampling Undertaken By	Fugro GB Marine Limited	Sampling Date	October/November 2016
Date of Receipt	21/11/2016	Date of Analysis	21/11/2016– 12/01/2017
Sample Matrix	Macrobenthic Species ABUNDANCE (EPIFAUNA)		
Method Reference	TM23_001		
Test Results	Please double click on symbol:		
Laboratory Comments			
Deviating Codes	None		
Authorised Signature	C. Robins		
Name	Camilla Robins		
Position	Senior Marine Taxonomist		
Issue Date	24/01/2017		

- Further information on methods of analysis may be obtained from the above address;
- Test results reported relate only to those items tested;
- Sub Indicates subcontracted test;
- DS Indicates relevant deviating code applies to test results.

A. DEVIATING SAMPLE - CRITERIA

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DS8 - Insufficient analysis material	Insufficient material was received which meant that analysis could not be undertaken, or the analysis could not be carried out in accordance with the method.	*Insufficient sample material was received. The test results may not be representative of the sample at the time of sampling.*
DS9 - Sample contamination	Sample was received in a satisfactory condition but cross-contamination has occurred due to an analytical issue which has resulted in loss of sample integrity.	*The sample integrity may have been compromised due to an analytical issue. The results reported may not be representative of the sample at the time of sampling and are outside the scope of UKAS accreditation.*

Note:
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- Test results reported relate only to those items tested;
- [Sub]Indicates subcontracted test;
- [DS]Indicates relevant deviating code applies to test results.

D.6 GRAB FAUNAL BIOMASS RAW DATA

Station	Other Taxa [g/0.1 m^2]*	Crustace* [g/0.1 m^2]*	Echinodermata [g/0.1 m^2]*	Mollusca [g/0.1 m^2]*	Oligochaeta [g/0.1 m^2]*	Polychaeta [g/0.1 m^2]*
CR01	0.0289	0.0619	2.6099	0.0602		9.1676
CR03			0.0392			0.367
CR10				0.0292		0.2676
CR11	0.0883	3.2278	0.0047	24.165	0.0002	17.0533
WF01		0.0548				0.0035
WF02		0.055				0.0635
WF03		0.0047	0.0009			0.1697
WF04	0.1113	0.0011	2.7723	2.1104		3.5271
WF05		0.1076				0.1041
WF06	0.0329		0.3672	2.0042	0.0016	2.0594
WF07	0.0612	0.2104	0.0477	9.4275		3.164
WF08	0.0012	0.0021	0.065	0.0032	0.0002	0.0196
WF09	0.8423	0.0854	3.1263	0.0457		3.717
WF11	0.0457	0.0069	0.6299	0.1854		0.1722
WF12	0.0347	0.0513	0.0422	0.0019		1.6876
WF14		0.9398	1.6949	5.5315		2.7552
WF19		0.0007				0.2129
WF22	0.2728	0.0022	0.6747	0.3832		1.2745
WF25			0.0012	0.0012		1.9784
WF27				0.0352		0.7546
WF29		0.0449		0.0004		0.2188
WF32	0.0855	0.0109	149.6288	3.7414		0.2906
WF37		0.0064	44.9748	1.5809		6.2932
WF41	0.0053	0.0074	50.4324	44.5986		0.8764
WF44	0.0211	0.1521	0.4857	0.1175		0.6775
WF45		0.0018				0.0336
WF47	0.0709		49.5599	2.8477		3.6597

Notes:
* = Blotted wet weights

Station	Other Taxa [AFDW g/0.1 m^2]	Crustacea [AFDW g/0.1 m^2]	Echinodermata [AFDW g/0.1 m^2]	Mollusca [AFDW g/0.1 m^2]	Oligochaeta [AFDW g/0.1 m^2]	Polychaeta [AFDW g/0.1 m^2]
CR01	0.0045	0.0158	0.2218	0.0048		1.4210
CR03			0.0033			0.0569
CR10				0.0023		0.0415
CR11	0.0137	0.8231	0.0004	1.933		2.6433
WF01		0.0140				0.0005
WF02		0.0140				0.0098
WF03		0.0012	0.0001			0.0263
WF04	0.0173	0.0003	0.2356	0.1688		0.5467
WF05		0.0274				0.0161
WF06	0.0051		0.0312	0.1603	0.0002	0.3192
WF07	0.0095	0.0537	0.0041	0.7542		0.4904
WF08	0.0002	0.0005	0.006	0.0003		0.0030
WF09	0.1306	0.0218	0.2657	0.0037		0.5761
WF11	0.0071	0.0018	0.0535	0.0148		0.0267
WF12	0.0054	0.0131	0.0036	0.0002		0.2616
WF14		0.2396	0.1441	0.4425		0.4271
WF19		0.0002				0.0330
WF22	0.0423	0.0006	0.0573	0.0307		0.1975
WF25			0.0001	0.0001		0.3067
WF27				0.0028		0.1170
WF29		0.0114				0.0339
WF32	0.0133	0.0028	12.7184	0.2993		0.0450
WF37		0.0016	3.8229	0.1265		0.9754
WF41	0.0008	0.0019	4.2868	3.5679		0.1358
WF44	0.0033	0.0388	0.0413	0.0094		0.1050
WF45		0.0005				0.0052
WF47	0.0110		4.2126	0.2278		0.5673

Notes:
AFDW = Ash Free Dry Weight

D.6.1 Grab Sample Certificate of Analysis Biomass

Certificate Number	EP/17/0006	**Fugro GB Marine Ltd Job Number**	160975
Job Reference	Vattenfall Thanet		

Prepared For		**Prepared By**	
Seamus Whyte Fugro GB Marine Limited Trafalgar Wharf (Unit 16) Hamilton Road Portchester Portsmouth PO6 4PX United Kingdom		**Grant Rowe** Fugro GB Marine Limited Y Plas Aberystwyth Road Machynlleth Powys SY20 8ER United Kingdom	
Phone	+44 (0) 2392 205500	**Phone**	+44 (0) 2392 205606
Email	sg.whyte@fugro.com	**Email**	g.rowe@fugro.com
Web	www.fugro.com	**Web**	www.fugro.com

Sampling Undertaken By	Fugro GB Marine Limited	**Sampling Date**	October/November 2016
Date of Receipt	21-11-16	**Date of Analysis**	12-12-16 to 24-01-17
Sample Matrix	Macrobenthic Species BIOMASS		
Method Reference	TM23_001		
Test Results	Please double click on symbol:		
Laboratory Comments	None		
Deviating Codes	None		
Authorised Signature			
Name	Grant Rowe		
Position	Principal Taxonomist/QC Manager		
Issue Date	26th January 2017		

- Further information on methods of analysis may be obtained from the above address;
- Test results reported relate only to those items tested;
- SubIndicates subcontracted test;
- DSIndicates relevant deviating code applies to test results.

Fugro GB Marine Limited. Incorporated in England No. 1135456. Reg. Office: Fugro House, Hithercroft Road, Wallingford, Oxfordshire, OX10 9RB

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E. DATA ANALYSIS

E.1 Particle Size Distribution Data Analysis

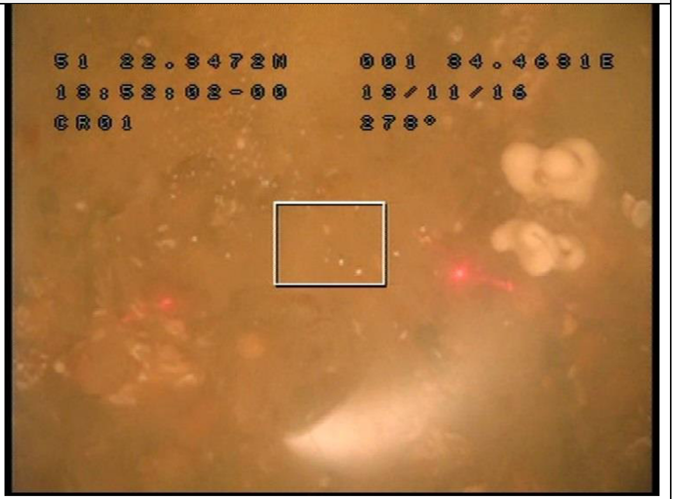
Sieve and laser data were merged and entered into the software GRADISTAT v8.0 (Blott and Pye, 2001) to derive statistics including percentage of each particle greater than each phi aperture size, mean and median grain size, bulk sediment classes (percentage silt, sand and gravel), skewness, sorting coefficients and Folk classification (Folk, 1954). These statistics are summarised in Table D.1.

Table D.1: Sediment Particle Size Distribution Statistics

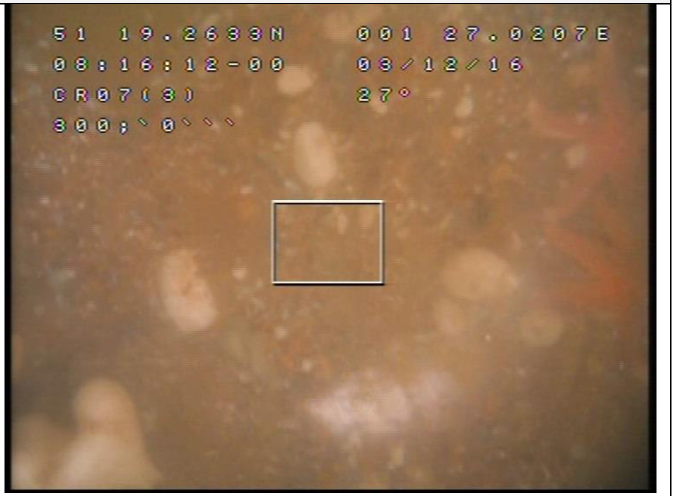
Distributional Statistic Measure	Description
Phi scale	A logarithmic scale which allows grain size data to be expressed in units of equal value for the purpose of graphical plotting and statistical calculations. The scale is based on the following relationship: $phi = -log_2 d$ where *d* is the grain size diameter in mm
Median or D_{50}	Measure of central tendency. Defined as the value where half of the sample particle size grain reside above this point and half below it.
Mode	Peak of the frequency distribution. The mode represents the particle size (or size range) most commonly found in the distribution
Sorting	A measure of the range of grain size present and the magnitude of the spread or scatter of these around the mean
Percentiles (D_{10}, D_{50}, D_{90})	Defined as the maximum particle diameter below which 10%, 50% or 90% of the sample particle grain size occurs, respectively. Monitoring the percentiles allows assessing changes in the main particle size, as well as changes at the extremes of the distribution
Skewness	A degree of symmetry – skewness reflects sorting in the tails of a grain size data set. Data set that have a tail of excess fines particles are said to positively skewed or fine skewed; data sets with a tail of excess coarse particles are negatively skewed or coarse skewed
Kurtosis	The degree of sharpness or peakedness in a grain size frequency distribution curve

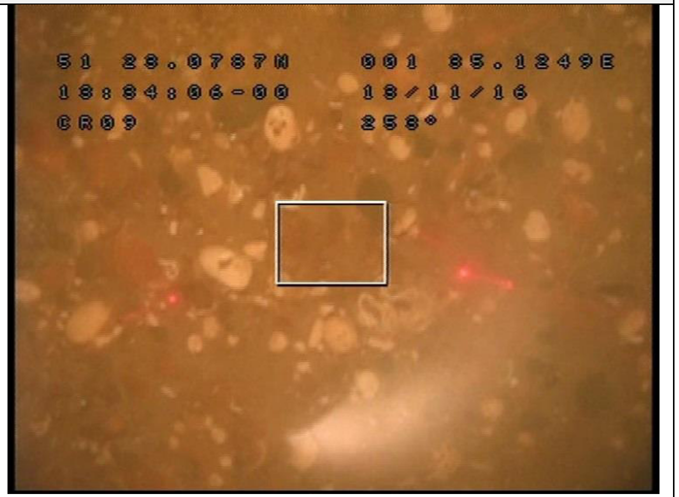
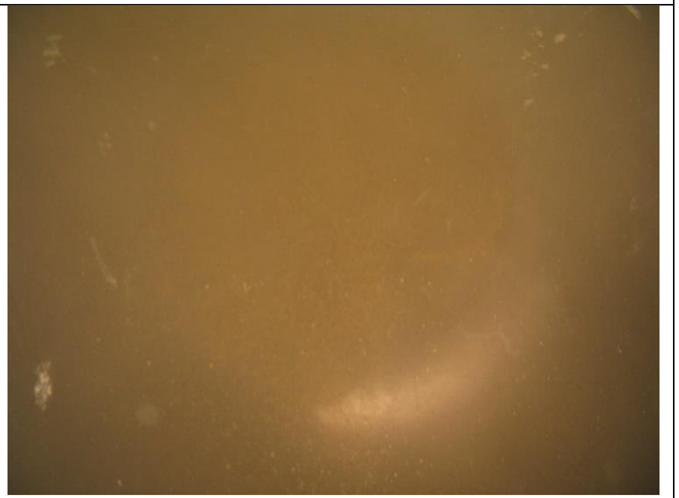
F. VIDEO ANALYSIS RESULTS

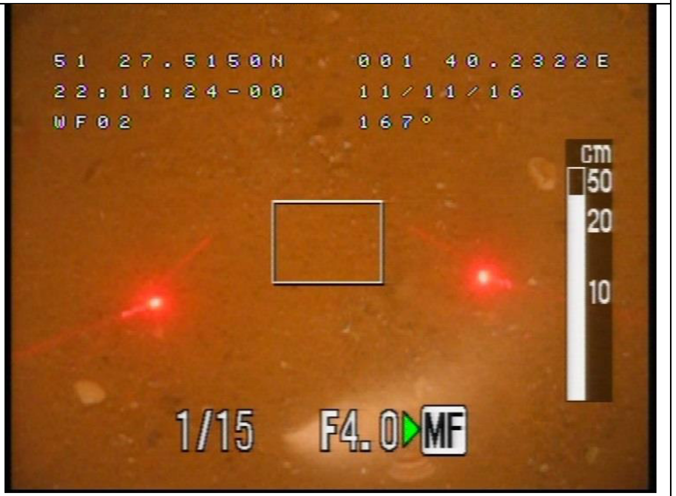
F.1 Drop Down Video and Stills

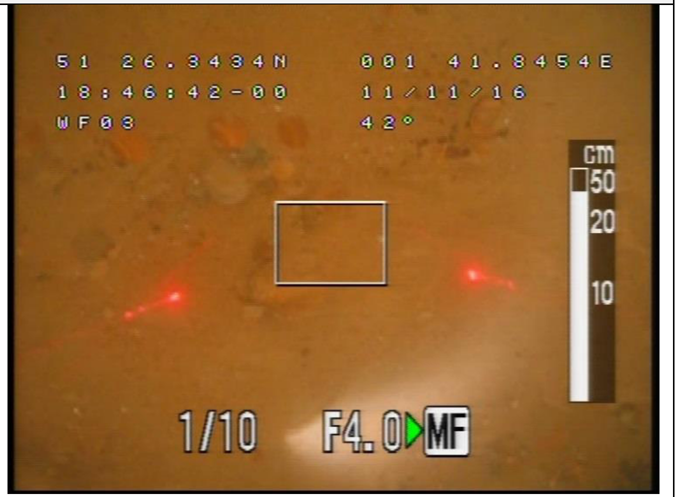
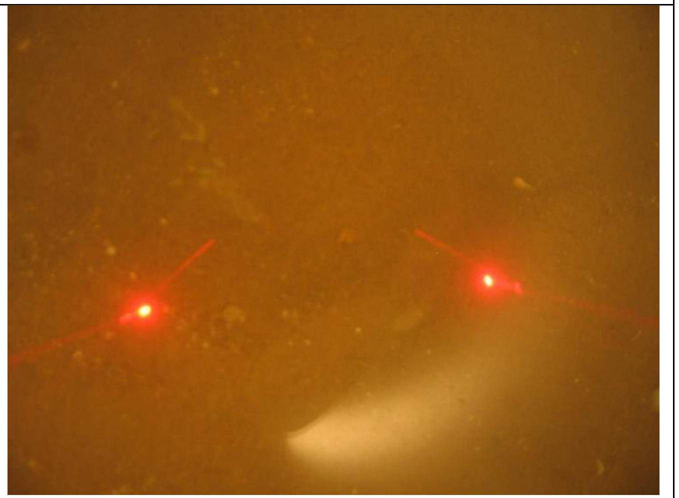
Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
CR01	Gravelly pebbly sand	Sand with shells, shell fragments, pebbles and cobbles	Asteroidea *Asterias rubens* Actiniaria *Urticina felina* *Spirobranchus* sp. *Alcyonium digitatum* Hydroid/bryozoan turf	
CR04	Gravelly pebbly sand	Sand with shells, shell fragments, pebbles and cobbles	*Asterias rubens* Actiniaria *Urticina felina* *Alcyonium digitatum* Paguridae Hydroid/bryozoan turf *Mytilus edulis*	

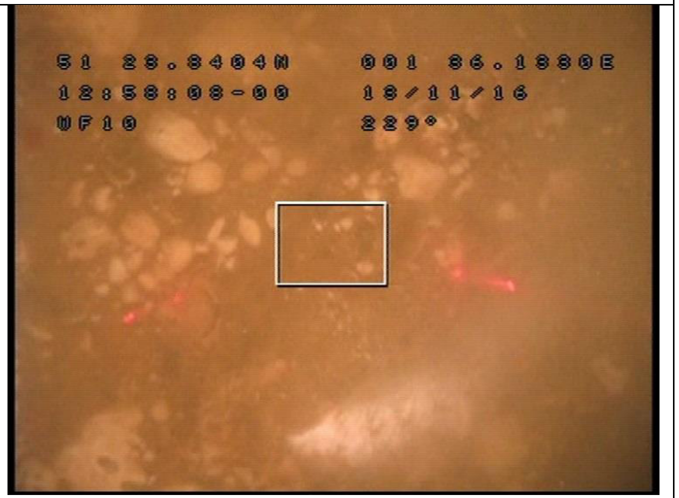
Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
CR05	Gravelly pebbly sand	Sand with shells, shell fragments, pebbles and cobbles	*Asterias rubens* Actiniaria *Alcyonium digitatum* Porifera *Flustra foliacea*	
CR06	Cobbles and pebbles	Pebbles and cobbles	*Asterias rubens* Actiniaria	

Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
CR07	Gravelly pebbly sand	Sand with shells, shell fragments, pebbles and cobbles	*Asterias rubens* Actiniaria *Urticina felina* *Spirobranchus* sp. *Alcyonium digitatum* Hydroid/bryozoan turf	
CR08	Sand	Muddy sand with clay	*Asterias rubens*	

Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
CR09	Gravelly pebbly sand	Sand with shells, shell fragments pebbles and cobbles	*Ophiothrix fragilis* Actiniaria *Spirobranchus* sp. *Alcyonium digitatum*	
CR10	No visibility	No visibility	No visibility	

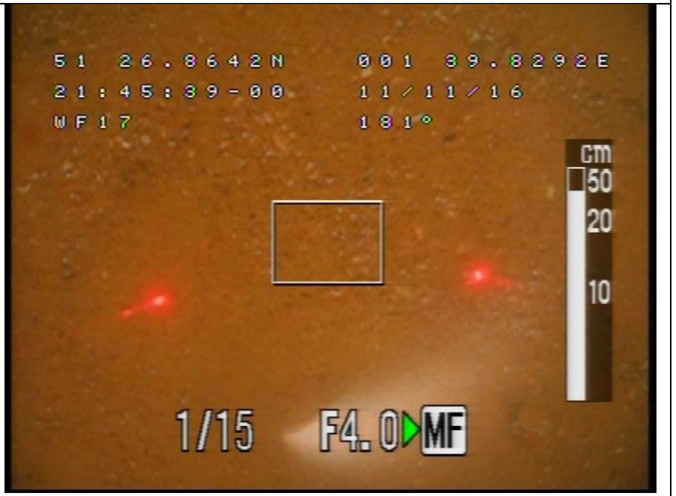
Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
CR11		Muddy sand	Asteroidea	
WF02	Sand	Sand with shell fragments	Asteroidea *Sabellaria spinulosa*	

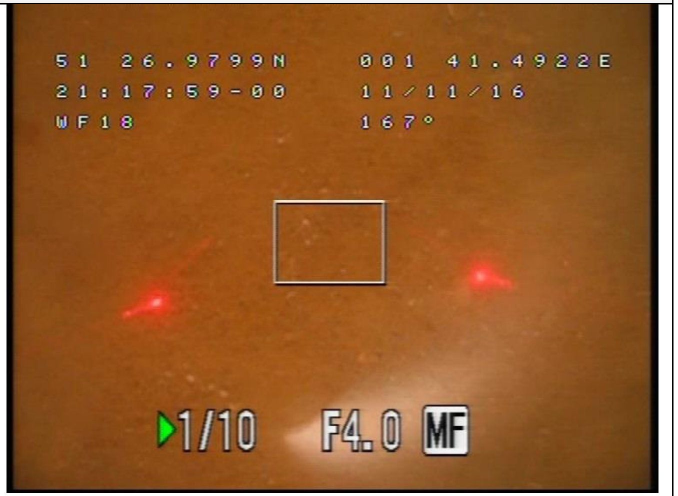
Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF03	Sand	Sand with shell fragments	Paguridae	
WF05	Sand	Sand with shell fragments	None	

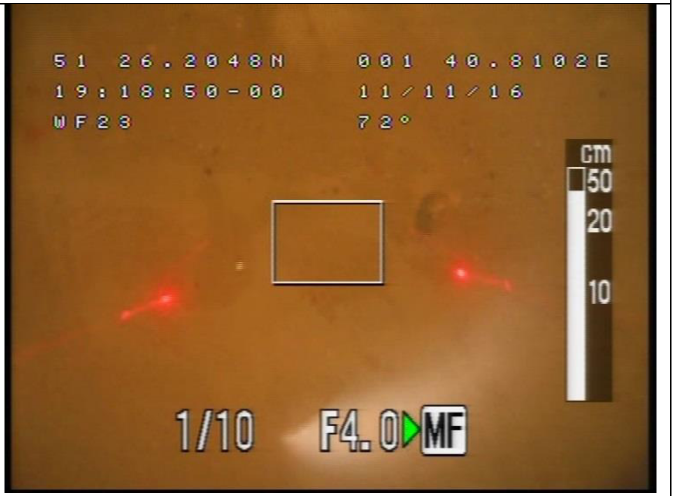
Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF09	Sand	Sand with shell fragments	*Asterias rubens*	
WF10	Gravelly pebbly sand	Sand with shells, shell fragments, pebbles and cobbles	Actiniaria *Spirobranchus* sp. *Alcyonium digitatum*	

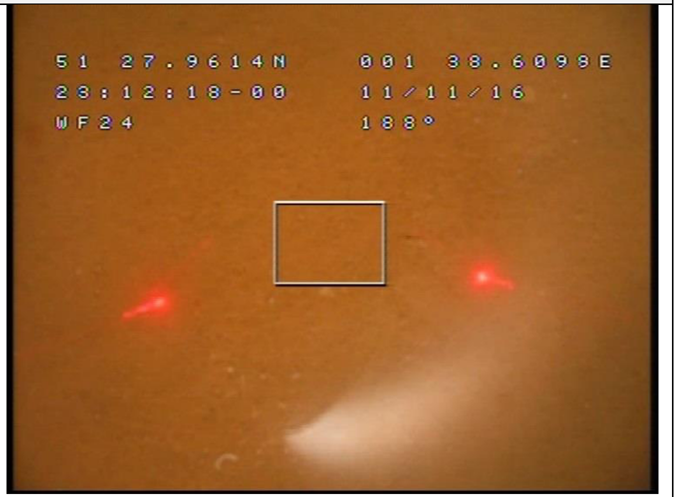
Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF11	Gravelly pebbly sand	Sand with shells, shell fragments, pebbles and cobbles	Ophiuroidea *Urticina* sp. *Spirobranchus* sp. *Alcyonium digitatum* *Psammechinus miliaris*	
WF12	Gravelly pebbly sand	Sand with shells, shell fragments, pebbles and cobbles	Ophiuroidea *Spirobranchus* sp.	

Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF13	Sand	Sand with shells and shell fragments	Asteroidea Ophiuroidea	
WF15	Sand	Sand with shells and shell fragments	Asteroidea Ophiuroidea Actiniaria *Spirobranchus* sp. Hydroid/bryozoan turf	

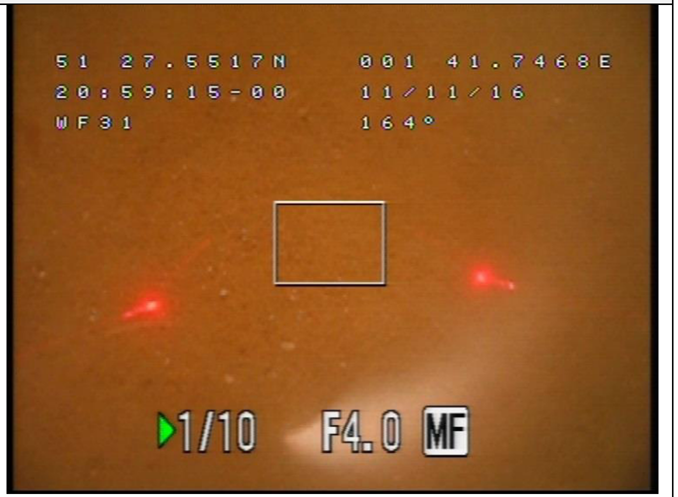
Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF16	Sand	Sand with fragments	Asteroidea Ophiuroidea	
WF17	Sand	Sand with shell fragments	None	

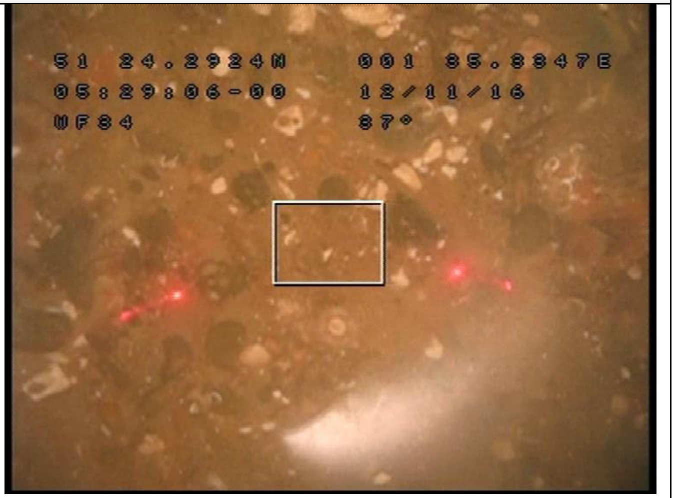
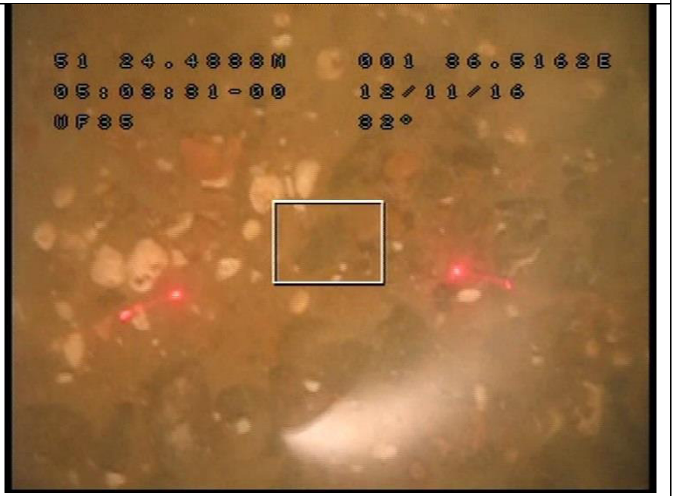
Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF18	Sand	Sand with shell fragments	*Pagurus bernhardus*	
WF20	Sand	Sand with shell fragments	Gastropoda Ophiuroidea Actiniaria	

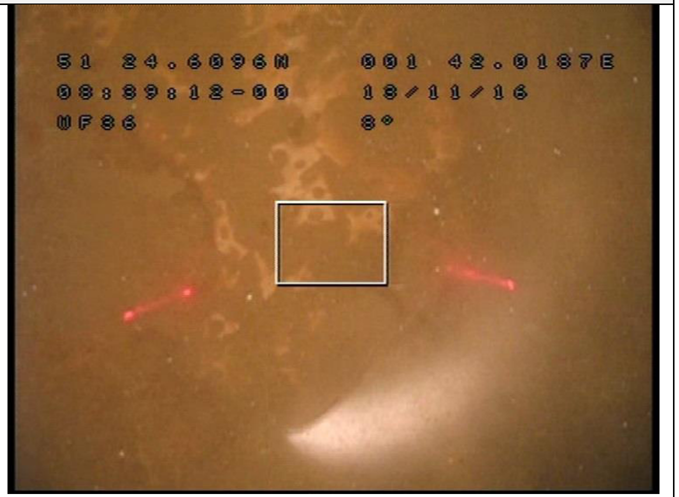
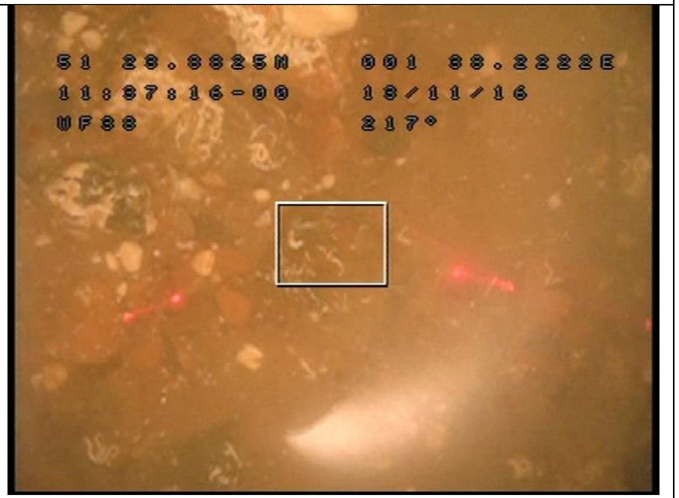
Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF21	Sand	Sand with shell fragments	Ophiuroidea	
WF23	Sand	Sand with shell fragments	Asteroidea Actiniaria Paguridae *Sabellaria spinulosa* Hydroid/bryozoan turf	

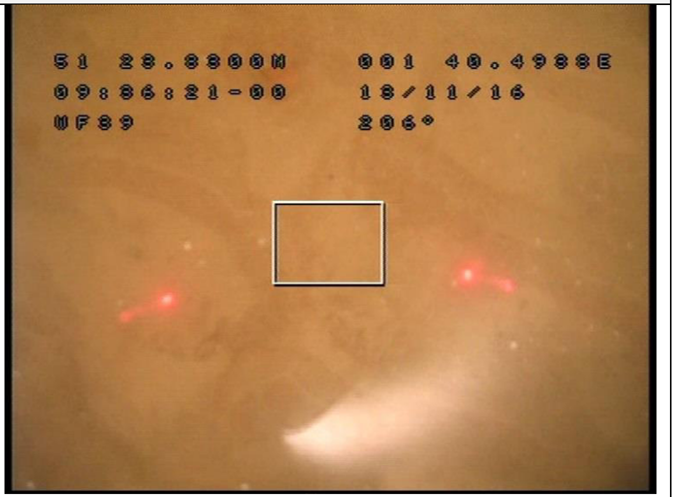
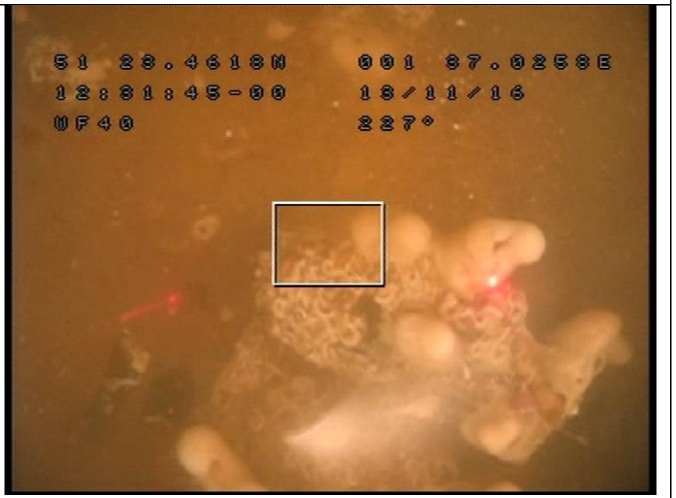
Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF24	Sand	Sand with shell fragments	None	
WF26	Sand	Sand with shell fragments, occasional pebble	Ophiuroidea Hydroid/bryozoan turf	

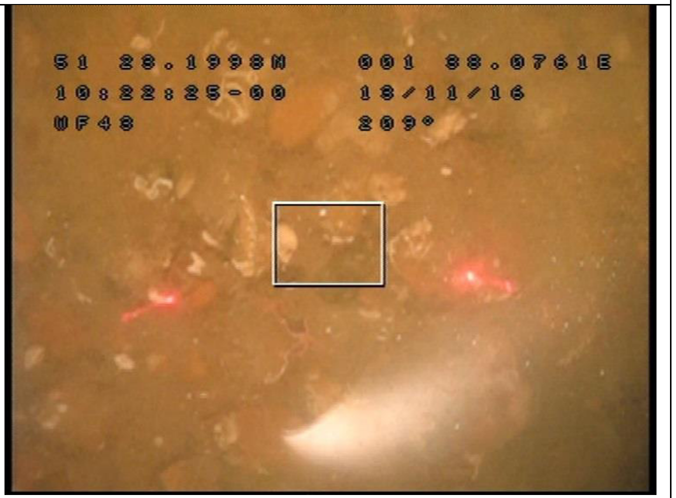
Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF28	Pebbly sand	Sand with patch of pebbles and shells	Asteroidea Actiniaria Paguridae *Sabellaria spinulosa* Hydroid/bryozoan turf	
WF30	Sand	Sand with shell fragments	Asteroidea	

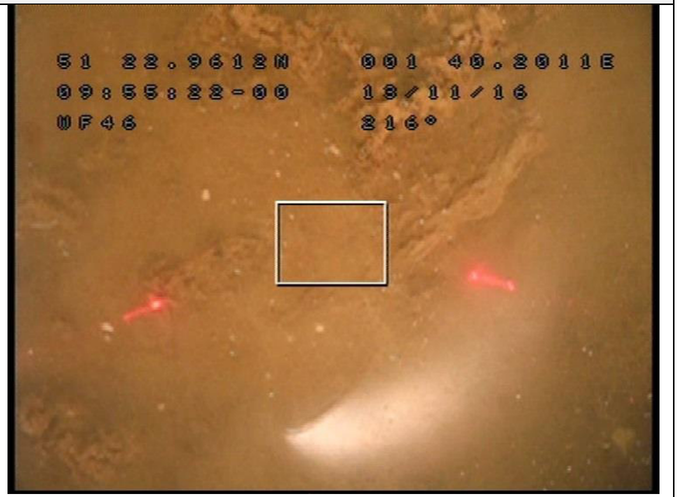
Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF31	Sand	Sand with shell fragments	None	
WF33	Sand	Sand with shell fragments	Asteroidea Paguridae	

Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF34	Gravelly pebbly sand	Sand with shell fragments, pebbles and pieces of chalk	*Asterias rubens* Actiniaria *Urticina felina* *Spirobranchus* sp. *Alcyonium digitatum* *Calliostoma* sp. Porifera *Sabellaria spinulosa* Hydroid/bryozoan turf Brachyura	
WF35	Gravelly pebbly sand	Sand with shell fragments, pebbles, occasional cobbles and pieces of chalk	Asteroidea Ophiuroidea Actiniaria *Urticina felina* *Spirobranchus* sp. Porifera	

Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF36	Sand	Sand overlying chalk	Asteroidea	
WF38	Gravelly pebbly sand	Sand with shells, shell fragments, pebbles and cobbles	Ophiuroidea Actiniaria *Urticina felina* *Spirobranchus* sp. *Alcyonium digitatum* Porifera Paguridae Hydroid/bryozoan turf	

Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF39	Sand	Sand with shell fragments	Paguridae Hydroid/bryozoan turf *Calliostoma* sp.	
WF40	Gravelly pebbly sand	Sand with shells, shell fragments, pebbles and cobbles	Asteroidea *Spirobranchus* sp. *Alcyonium digitatum* *Calliostoma zizyphinum* Paguridae Hydroid/bryozoan turf	

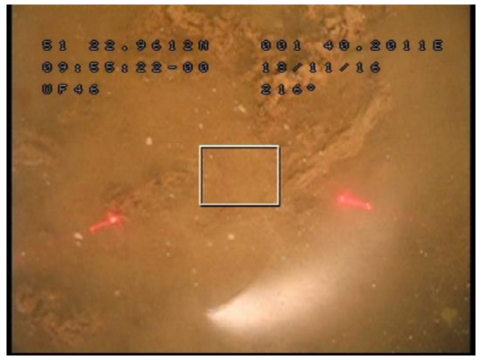
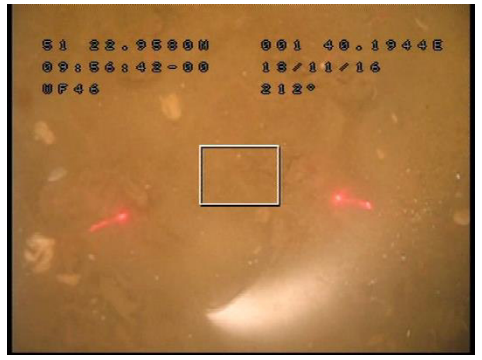
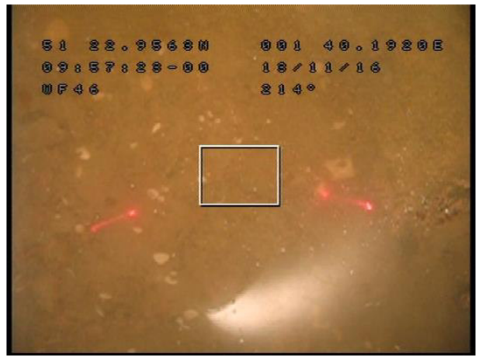
Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF42	Sand	Sand with shell fragments and occasional pebbles	None	
WF43	Gravelly pebbly sand	Sand with shells, shell fragments, pebbles and cobbles	Ophiuroidea *Spirobranchus* sp. *Alcyonium digitatum* *Sabellaria spinulosa* Paguridae Hydroid/bryozoan turf Unidentified fish (Pisces)	

Site	General Description	Detailed Sediment Notes	Conspicuous Species	Representative Image
WF46	Sand	Sand with shell fragments	Ophiuroidea Actiniaria *Sabellaria spinulosa* Paguridae	

F.2 *Sabellaria* Assessment

<table>
<tr><th rowspan="2">Station</th><th rowspan="2">Sediment Description</th><th colspan="5">Sabellaria form present</th><th colspan="3">Sabellaria Characteristics</th><th rowspan="2">Representative Image</th><th colspan="3">Reef Definition Based on</th><th rowspan="2">Overall Assessment</th></tr>
<tr><th>Absent</th><th>Moribund Tubes</th><th>Crusts</th><th>Clumps</th><th>Potential Reef</th><th>Elevation</th><th>Patchiness</th><th>Brief Description of Sabellaria Recorded</th><th>Elevation</th><th>Patchiness</th><th>Consolidation</th></tr>
<tr><td>WF28</td><td>Sand with patch of pebbles and shells</td><td>N</td><td>Y</td><td>N</td><td>Y</td><td>N</td><td>2 - 5 cm</td><td>12 %</td><td>Sabellaria was observed at this station in both small clumps and larger clumps of upright intertwined tubes. Some were also embedded in the sand, with moribund clumps also present. The elevation of the tubes from the sediment varied along the transect ranging between < 2 cm and occasionally > 5 cm.</td><td>


</td><td>LOW</td><td>LOW</td><td>LOW/MEDIUM</td><td>LOW</td></tr>
</table>

Station	Sediment Description	*Sabellaria* form present					*Sabellaria* Characteristics			Representative Image	Reef Definition Based on			Overall Assessment
		Absent	Moribund Tubes	Crusts	Clumps	Potential Reef	Elevation	Patchiness	Brief Description of *Sabellaria* Recorded		Elevation	Patchiness	Consolidation	
WF46	Sand with shell fragments	N	Y	N	Y	N	< 2 cm	7 %	*Sabellaria* was observed at this station in small clumps mostly embedded in the sand, with moribund tubes also present.	  	**NOT REEF**	**NOT REEF**	**NOT REEF**	**NOT REEF**