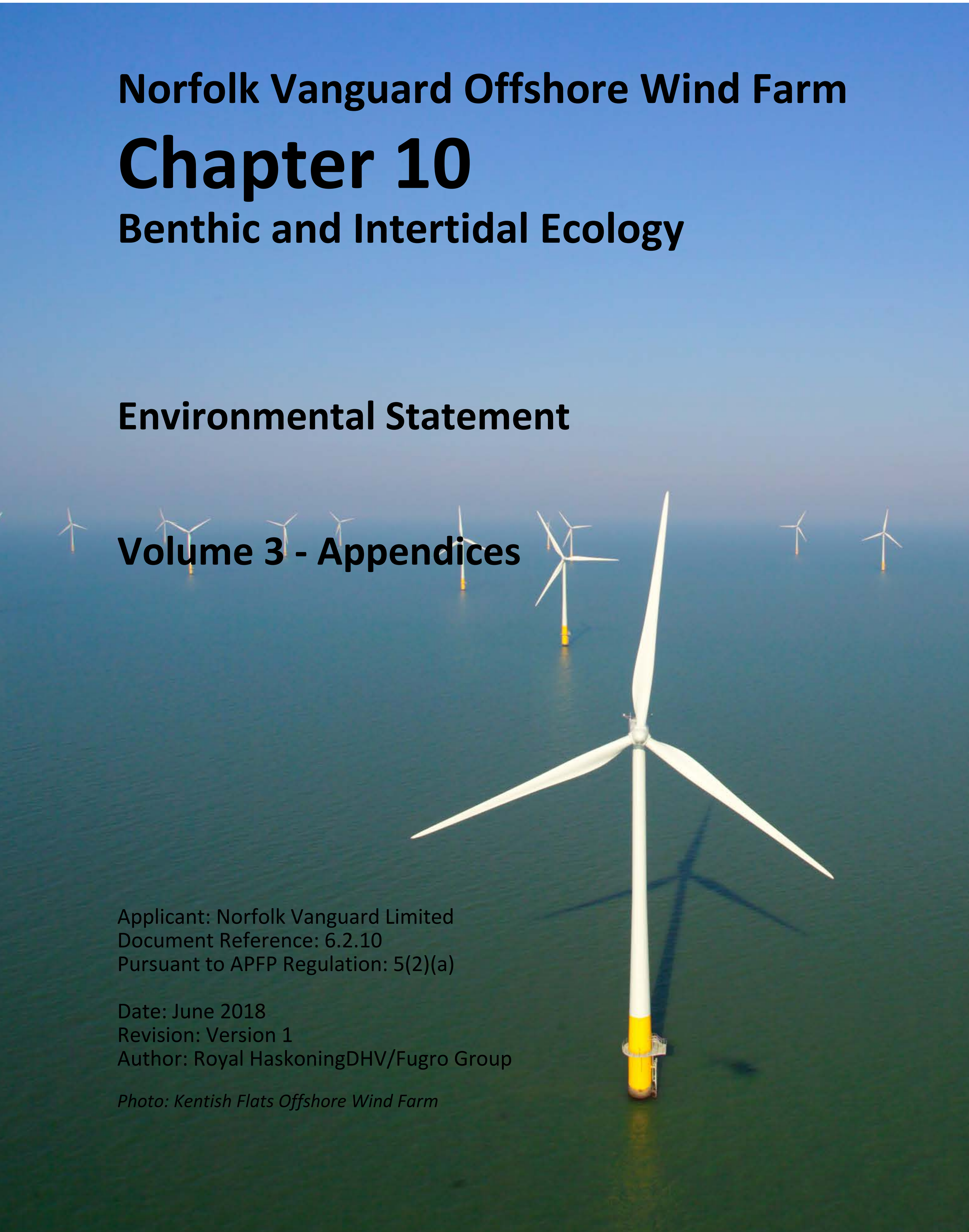
Norfolk Vanguard Offshore Wind Farm

Chapter 10

Benthic and Intertidal Ecology

Environmental Statement

Volume 3 - Appendices



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Author: Royal HaskoningDHV/Fugro Group

Photo: Kentish Flats Offshore Wind Farm

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Royal HaskoningDHV
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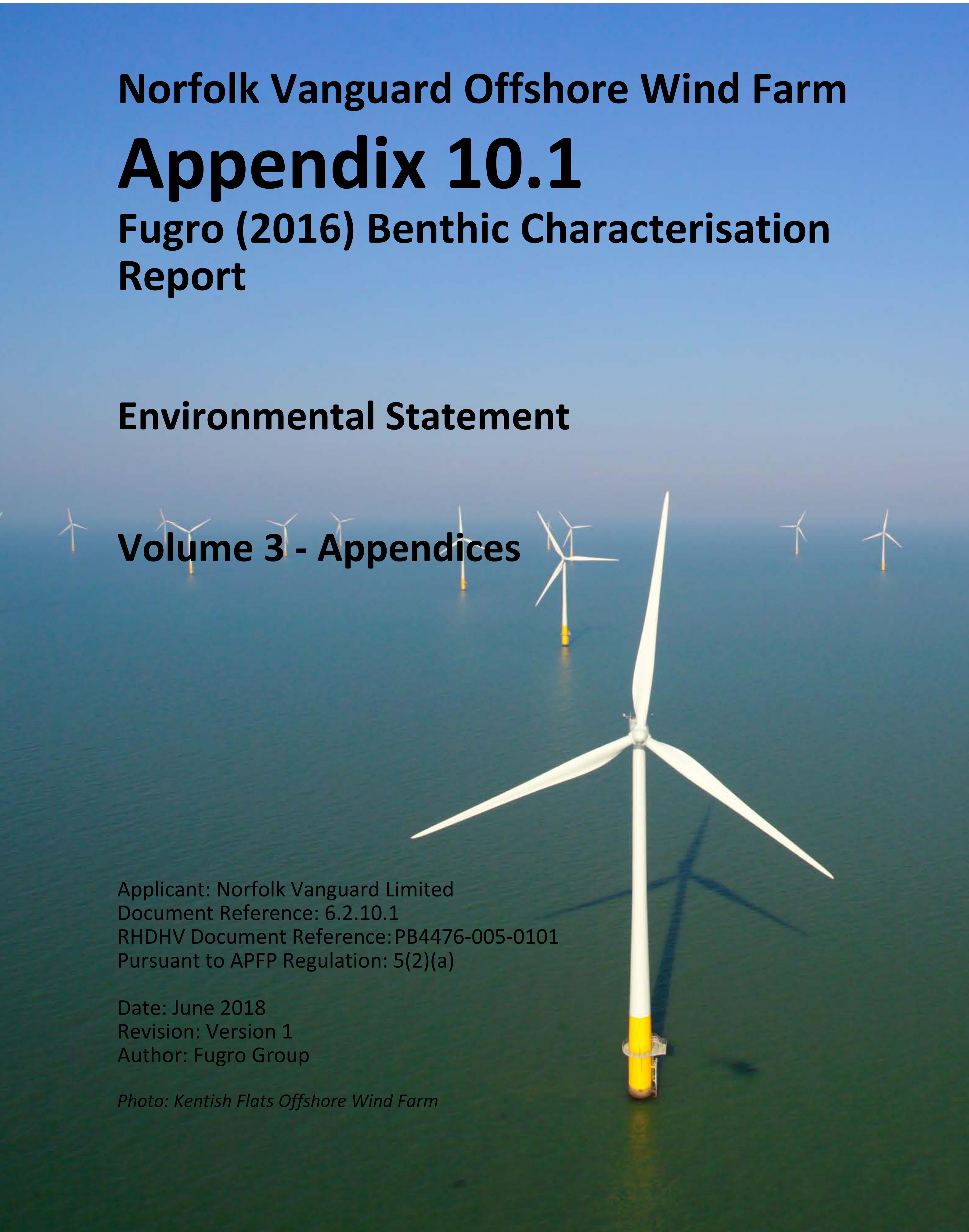
Norfolk Vanguard Offshore Wind Farm

Appendix 10.1

Fugro (2016) Benthic Characterisation Report

Environmental Statement

Volume 3 - Appendices



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Environmental Impact Assessment
Environmental Statement

Document Reference: PB4476-005-101

June 2018

For and on behalf of Norfolk Vanguard Limited
Approved by: Ruari Lean, Rebecca Sherwood
Signed: [redacted]
Date: 8th June 2018

FUGRO GROUP

Environmental Investigation Report Norfolk Vanguard Benthic Characterisation Report

UK Continental Shelf, North Sea

Fugro Document No.: 160976.2 (01)

Fugro (FSBV) Report No.: 160976.2 (01)

11 April 2018

Report 3 of 3

Fugro Group

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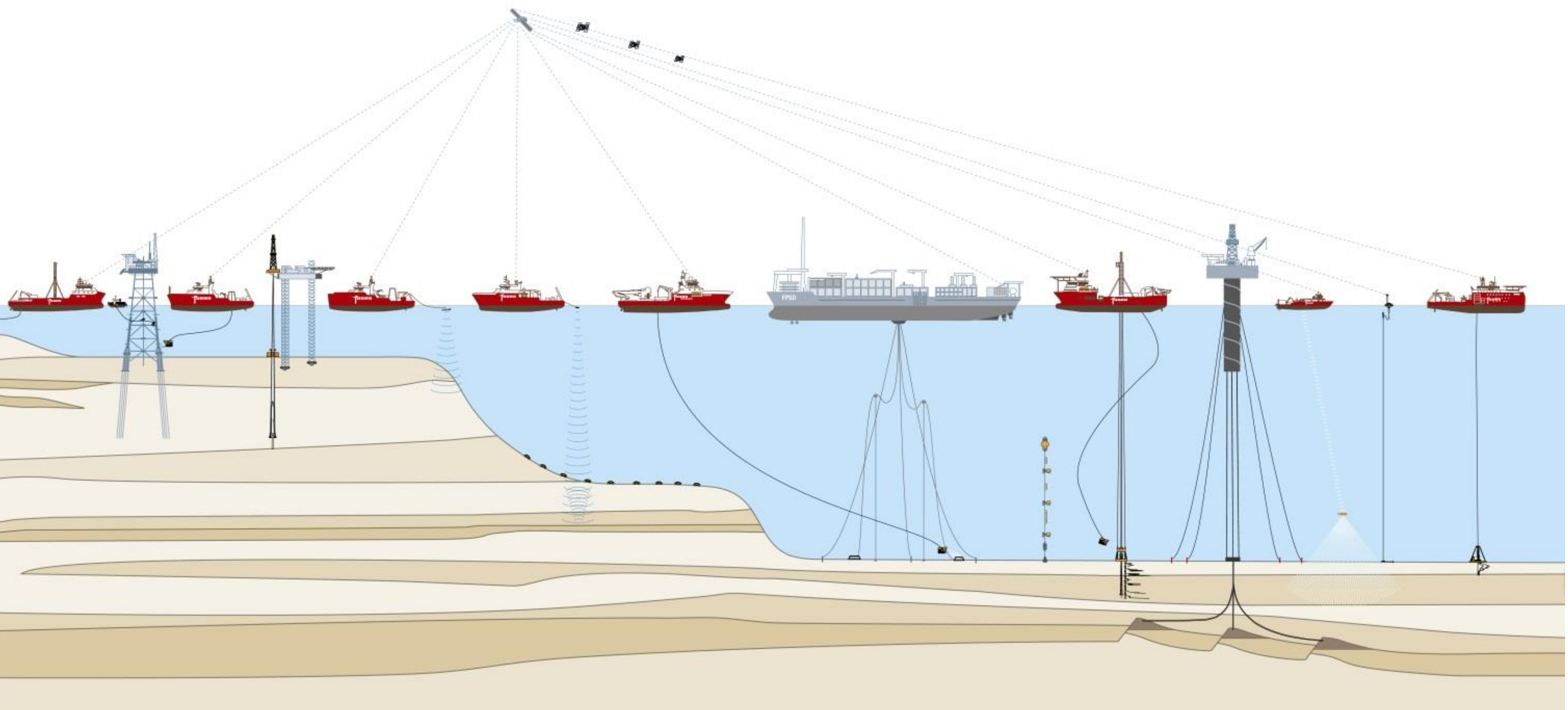
Final



Environmental Investigation Report Norfolk Vanguard Benthic Characterisation Report

UK Continental Shelf, North Sea

30 October to 10 November 2016
Fugro Project No.: 160976.2 (01)

Report 3 of 3

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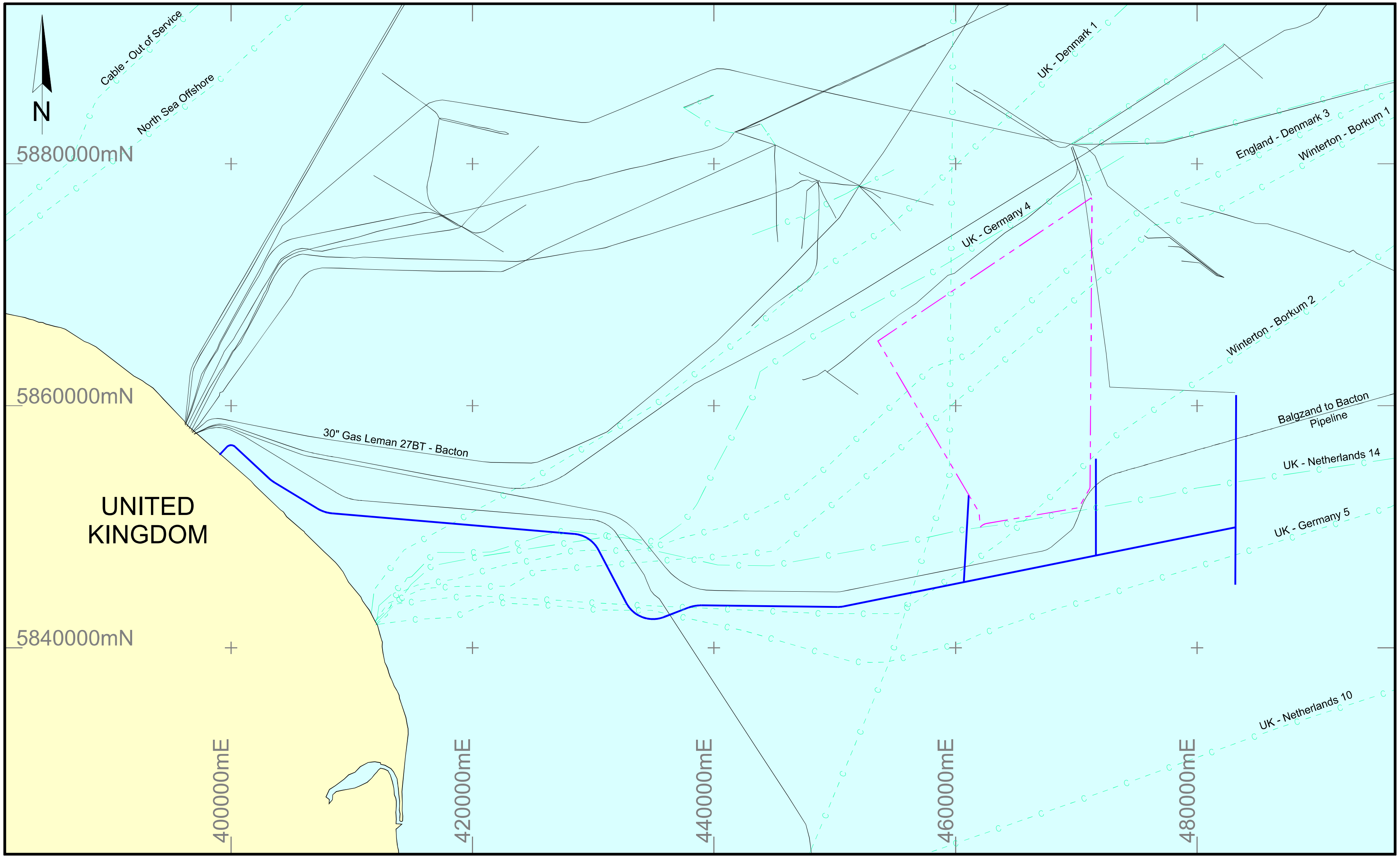
REPORT AMENDMENT SHEET

Issue No.	Report section	Page No.	Table No.	Figure No.	Description
2	Executive Summary	IV			Text slighyl modified to highlight comparability of benthic communities within survey area with those characteristic of the southern North Sea
2	1.3.2	14			Text in the first two paragraphs improved to include a more detailed description of the benthic communities at regional level
2	6.2.3	99			Text in first paragraph slighyl modified to highlight comparability of benthic communities within survey area with those characteristic of the southern North Sea
2	7	103-104			Text in eight paragraph slighyl modified to highlight comparability of benthic communities within survey area with those characteristic of the southern North Sea
2	8	107			New reference added
4	Annex C.5	2 of 4			Row 1, Station 01MS Easting Northings corrected
4a	Annex B	2 of 2			The Annex and all the paragraphs/sections referring to it were removed, under consultation for EIA.

KEYPLAN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EXECUTIVE SUMMARY

Environmental survey on the Norfolk Vanguard Arrays and Proposed Cable Corridor are required to assess the benthic communities and potential Annex I habitats using drop down video (DDV), grab samples of fauna, PSD and contaminants. The geophysical and subsequent grab sampling survey, required to inform the Environmental Impact Assessment (EIA) for Norfolk Vanguard, was carried out in autumn 2016.

DDV data were successfully collected at 68 stations, whilst grab data for both macrofauna and PSD were successfully collected at 65 and 66 stations respectively. The stations where attempts were made, but unsuccessful samples were collected, were all located in the section of the proposed cable corridor approaching the shore. Grab sampling for sediment contaminants were collected from 30 stations.

Analysis of the video footage showed the presence of two major habitats within the 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 characteristic of the habitat mainly located within the proposed cable corridor approaching the shore. The epibiotic communities reflected the sediment complexity, with the offshore sandier sediments hosting lower faunal diversity represented mainly by fish, echinoderms, crustaceans and molluscs. Sessile epifauna were recorded as absent or scarce. The nearshore coarser sediments comprised a rich and diverse epibenthic community, which included a variety of sessile epifauna. Characteristic epibenthic species included crustaceans, such as *Pagurus bernhardus*, *Necora puber* and species of *Liocarcinus*, together with echinoderms such as *Ophiura ophiura* and *Ophiura albida*, *Asterias rubens* and *Crossaster papposus*. Sessile colonial epifauna comprised bryozoans, notably, *Flustra foliacea* together with the sea anemone of the genus *Urticina*. Fish species recorded across the survey area included species of Callyonimidae and Soleide, as well as Ammodytidae.

The habitats and associated epibenthic communities recorded by the video footage were classified to biotopes where possible and/or to biotope complex.

In the current study, Ross worm *S. spinulosa* occurred in high abundance at a number of stations, which were therefore assessed for potential biogenic reef status. The majority of the stations assessed did not show evidence of reef formations. Evidence of low reef was found at three stations, low to medium reef at two stations and not reef to low reef at one station; however, at all stations these features were not observed to form continuous aggregate structures.

Areas of the seabed permanently submerged and rising to a depth < -20 m LAT were noted at the edges of the proposed cable corridor. These form part of the Annex I Sandbanks known to occur within the Haisborough, Hammond and Winterton SAC.

No chalk reef features were observed in the survey area but the presence of chalk reef cannot be discounted as it may not be visible at the surveyed sediment surface.

Results of grab samples analysis showed that the survey area comprised a mixed range of sediment types with slightly gravelly sand and gravelly sand been predominant both within the main sites and the

proposed cable corridor. The section of the proposed cable corridor approaching the shore presented more heterogeneous, coarser sediments, with higher percentage of the gravel fraction.

Organic content was relatively low across the study area and did not show any spatial pattern of distribution.

Sediment chemistry analysis returned metal concentrations below ER-L standards for the majority of metals included in the analysis. The only exception was Arsenic (As), the concentration of which was above ER-L, but below ER-M at two stations; these were, however, within concentration levels known to occur for the southwest region of the North Sea. Total hydrocarbon (THC) concentration levels from all stations tested were within the values recorded for this region of the North Sea and all single PAH concentrations were below guideline ER-L standards as well as below Cefas action levels AL1. The Levels of PCBs were below their guideline values at all stations. Organotin concentrations were below the Cefas revised action level AL1 for TBT and values were within the lower end of class C (2 μgkg^{-1} to <50 μgkg^{-1}) of the OSPAR integrated assessment of imposex/intersex with concentrations of TBT in sediments. These concentrations are not expected to affect the reproductive capability of sensitive gastropod species.

Results of the biological analyses indicated that, in terms of species diversity, most stations host a moderately rich community, whilst other stations are characterised by a less diverse and, in some areas, poor communities, typically associated with coarse to fine and less heterogeneous sandy sediment. These were comparable to the communities described the the wider southern North Sea. In terms of abundances (i.e. total number of individuals per stations), this was generally higher at stations where *S. spinulosa* was present as well as at stations characterised by coarser and mixed sediment. The higher species diversity and abundances of some stations is often related to the presence of coarser and heterogeneous sediment and by the presence of *S. spinulosa*; this reef-building organism 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 macrofauna. The multivariate analysis highlighted the presence of two major benthic communities (group c and group h) identified by grouping stations with similar fauna composition. These two groups mainly differed in the presence of the Ross worm *S. spinulosa* in one group (group c) and its absence, or limited presence in the other group (group h). Stations within group c were characterised by slightly gravelly sand, but also coarser and more heterogenous sediment such as gravelly sand, gravelly muddy sand, slightly gravelly muddy sand, muddy sandy gravel, sandy gravel and slightly gravelly muddy sand. The main characterising taxa including the polychaete *S. spinulosa*, Nemertea, the echinoderms *A. squamata*, Ophiuridae (juv.) and the long-clawed porcelain crab *P. longicornis*. Stations within group h were characterised by coarse to fine, 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 other groups identified by the multivariate analysis of faunal data included stations which exibited impoverished communities compared to those described from group c and group h, as well as stations where sediment composition supported a slightly different species composition. An example of the latter was at station 46CR, characterised by the presence of *B. candida* and a proportion of mud of approximately 62 %. The presence of *B. candida* potentially indicates the occurrence of pockets of compacted clay, as suggested by the video analysis, at this station where the dominant sediment of slightly shelly slightly gravelly sand was present with crumbly clay patches regularly observed throughout the video transect. Average infauna biomass in the current study was 7.7 g AFDW.m-2 and was comparable with the average macrofaunal biomass for the whole North Sea.

The stations characterised by the presence of *S. spinulosa* (group c) were distributed mainly along the proposed cable corridor and associated with a more heterogenous substrate; three stations were located to the west of the main site Norfolk Vanguard West where the presence of *S. spinulosa* was associated with a higher content of silt/clay. The stations characterised by the presence of species such as *N. cirrosa* and the absence of S. spinulosa (group h) were instead mainly distributed within the offshore main sites. The other groups were, as expected, distributed along the proposed cable corridor, with few also in parts of the main sites close to the cable corridor, reflecting the natural spatial variability of the seabed, particulatly approaching shallower coastal areas. The distribution also reflected the sediment distribution of the survey area.

Using video and grab data, biotopes were assigned to each station. Aided by the use of side scan sonar geophysical data, these were expanded to define areas of potential similar habitats. The biotope complex SS.SCS.CCS was the most common in the survey area, particularly within both main sites Norfolk Vanguard West and East. The biotope SS.SCS.CCS.MedLumVen, allocated to discrete points along the proposed cable corridor, was also assigned to sections of the proposed cable corridor, as an area where the biotope complex can potentially occur. The biotope SS.SBR.PoR.SspiMx was allocated to eight stations and areas where this biotope can potentially occur were also defined. The biotope complex SS.SMx.CMx was assigned to the section of the proposed cable corridor approaching the shore. Latest available geophysical data for the biotope assessment at the main site Norfolk Vanguard East were from a survey carried out in 2012. At the East site, the biotope complex SS.SCS.CCS was assigned as characterising the wider area. Current physical and biological data identified biotope complex SS.SCS.CCS at four stations, biotope complex SS.SSA.CFiSa at three stations and biotope compex mosaic SS.SSA.CFiSa/SS.SSA.MuSa at one station within this main site. The apparent discrepancy between the biotope describing the site and those describing the individual stations reflects the highly hydrodynamic nature of the survey area. Over the time span between the historical and the curret surveys the seabed characristics would have changed, with new areas of exposed finer sediment and mud/clay likely to have replaced the previously observed ones and the previously observed seabed fetaures likely to have moved.

No species of conservation importance were found, however the family Ammodytidae occurred in the survey area. *C.fornicata* was the only non-indigenous 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**

CONTENTS

ANNEXES

TABLES IN THE MAIN TEXT

FIGURES IN THE MAIN TEXT

ABBREVIATIONS

AFDW	Ash-Free Dry Weight
AfL	Agreements for Lease
Al	Alluminium
AL	Action Level
As	Arsenic
AOR	Anglian Offshore Region
BAP	Biodiversity Action Plan
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
cSAC	candidate Special Area of Conservation
DDV	Drop Down Video
DEFRA	Department for Environment Food & Rural Affairs
dGPS	differential Geo Positioning System
EAOW	East Anglia Offshore Wind
EcoQOs	Ecological Quality Objectives
EEC	European Economic Community
EIA	Environmental Impact Assessment
ER-L	Effects Range - Low
ER-M	Effects Range - Medium
EUNIS	European Nature Information System
GC – MS	Gas Chromatography - Mass Spectrometry
HC	Hydrocarbons
Hg	Mercury
HM	Heavy Metals
IDA	Industrial Denatured Alcohol
ISQGs	Interim Sediment Quality Guidelines
IUCN	International Union of Conservation of Nature
JNCC	Joint Nature Conservation Commttee
LSE	Likely Significant Effect
MCZ	Marine Conservation Zone
MDS	Multi-Dimensional Scaling
MNCR	Marine Nature Conservation Review
MPA	Marine Protected Area
MS	Main Site
N	Number of Individuals
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
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
SPR	Scottish Power Renewables

TBT	Tributyltin
TEL	Threshold Effects Levels
TOM	Total Organic Matter
UKAS	United Kingdom Accreditation Service
Z	Zinc
ZDA	Zone Development Agreement

1. INTRODUCTION

1.1 Study Background

In December 2009, The Crown Estate awarded the consortium company East Anglia Offshore Wind (EAOW) Ltd (a 50:50 joint venture owned by Vattenfall Wind Power Ltd (VWPL) and Scottish Power Renewables (UK) Limited (SPR)) the rights to develop Zone 5 (former East Anglia Zone) of The Crown Estate's UK Offshore Wind Round 3 tender process. These rights were granted through a Zone Development Agreement (ZDA) with The Crown Estate. The former East Anglia Zone is located off the coast of East Anglia and has a target capacity of 7.2GW.

The ZDA has now been dissolved, with VWPL securing project specific Agreements for Lease (AfL) from The Crown Estate for two projects within the northern part of what was Zone 5 (former East Anglia Zone). The first project to be developed is Norfolk Vanguard. Norfolk Vanguard will have a capacity of 1800 MW and is separated into two offshore areas with separate redline boundaries, Norfolk Vanguard East and Norfolk Vanguard West. Norfolk Vanguard East includes most of the area previously identified in the public domain as East Anglia FOUR with a slightly revised boundary.

A large benthic characterisation survey of the full extent of the East Anglia Zone, covering the Norfolk Vanguard East site and parts of the Norfolk Vanguard West site, was carried out between September 2010 and January 2011 using grab sampling with initial drop down video (DDV) of each sample location. Further survey was undertaken in the Norfolk Vanguard East site in 2012 as part of the then East Anglia FOUR development programme. In total, there were 28 grab samples from Norfolk Vanguard West and 42 grab samples from Norfolk Vanguard East: the sites were consisted mainly of sand and muddy sand, with areas of coarse sediment. Aggregations of *Sabellaria spinulosa* were found during these investigations. Epibenthic trawls were also collected.

1.2 Aims of the Study

Previous surveys supplied adequate design to provide a robust baseline from which to detect spatial changes to marine benthic fauna and the general benthic ecological conditions, but did not adequately cover the north east portion of the main site or the proposed cable corridor (Royal HaskoningDHV, 2016).

Environmental survey on the Norfolk Vanguard Arrays and Proposed Cable Corridor are required to assess the benthic communities and potential Annex I habitats using drop down video, grab samples for fauna, PSD and contaminants. Sample locations were selected as worst-case scenario and based of the geophysical data.

A geophysical and grab sampling survey is required to inform the Environmental Impact Assessment (EIA) for Norfolk Vanguard. The survey was carried out in autumn 2016.

1.3 Regional Context

The Benthic Review and Survey Plan Report (EMU Ltd., 2010) gave a detailed review of benthic environmental data in the Anglian region. In addition, the Anglian Offshore Dredging Association Marine Aggregates Regional Environmental Assessment (AODA MAREA) Scoping Report (EMU Ltd., 2008) and the Anglian MAREA Volume 1 (EMU Ltd., 2012) presented a regional overview of environmental data. To provide a regional benthic context, the following summarises relevant key information contained within these reports and the literature cited within.

1.3.1 Physical Environment

As consequence of the narrowing of the North Sea from north to south and the marked change in coastline orientation, wave conditions vary considerably over the Anglian Offshore Region (AOR). The winds on the north-west coastal region blow from between 325º N and 70º N and can generate waves over fetch lengths of greater than 200 km. On the south-west coastal region, such fetch lengths can only be generated over a much narrower range of wind directions of between 20º N and 60º N.

Tidal level variations along the coastline between Lowestoft and Great Yarmouth are relatively small, with mean spring tides having a range of about 1.9 m. Although weakening to the north and south, tidal currents are strong, regularly reaching in excess of 3 knots over much of the offshore part of the region.

At the eastern edge of the study area, the depth to seabed attains a maximum value of 30-40 m. Much of the regional coastline comprises glacial till cliffs, eroding since the end of the last Ice Age (7,500 to 10,000 years B.P.). In recent centuries these cliff edges have receded at a rate of approximately 1 m per year, producing substantial sediment quantities. This has subsequently been transported generally eastwards and southwards along the coastline forming barrier beaches across the valleys and areas of low land between the cliffs.

While sediment has accumulated at some locations along the coastline, producing wide beaches, much of the sand has been transported offshore to form large sandbanks. Sediments found in the Norfolk section of the AOR are mainly created from the erosion and transportation of rock material, whereas off the coast of Suffolk around 30% or more of the sediment is composed of shell material.

1.3.2 Biological Environment

Species distribution and abundances of the bentic communities of the North Sea are mainly determined by factors such as food availability, sediment composition and stability, hydrodynamics, temperature and salinity, as well as predation and competition (Rees et al., 2007). Faunal assemblages from the northern and deeper North Sea and known to be different than the one characterising the shallower sounthern North Sea (Künitzer et al. 1992).

Acoustic seabed imaging of a number of aggregate sites within the East Coast MAREA revealed the presence of mobile bedforms together with sandwaves and megaripples indicating mobile and unstable environments. Species diversity in sandy sediments in such environments is naturally lower due to the perturbed benthic environment resulting from large-scale, wave and tidally induced sand movements and related smothering and scouring. Typical species associated with these mobile sand substrates include the polychaetes *Ophelia borealis* and *Nephtys cirrosa* and the mysid shrimp *Gastrosaccus spinifer*. In the southern North Sea, the communities characterised by these species have been observed to have remained stable over time, despite a decrease in abundances (Rees et al., 2007).

Some “hotspots” of greater macrofaunal richness and diversity exist. These correspond with coarser gravel areas and patches of *S. spinulosa* (Ross worm) reef where microhabitat seabed conditions may be comparatively stable allowing settlement and colonisation by a wider range of less disturbance tolerant species. Consequently, there are likely to be specific locations at which the macrofaunal community deviates from that which typically occurs across the region, thus highlighting that it is not appropriate to extrapolate observations made during site specific studies.

Typical infaunal species associated with coarser gravel areas include the polychaetes *Pholoe baltica*, *Lagis koreni*, *Spiophanes bombyx* and *Scalibregma inflatum*, *Spirobranchus* spp. (keel worm), *Ophiura albida* (brittlestar), *Mysella bidentata* (bivalve), *Echinocyamus pusillus* (sea urchin), Bryozoa (sea mats) including *Electra monostachys* and *Flustra foliacea*, Hydrozoa (sea firs) such as *Sertularia argentea* and Actinaria (sea anemones).

Norfolk coastal habitats are comprised of mobile sands with some shingle, backed by defensive dune systems. Wave exposed sandy shores are mostly devoid of fauna, but in wetter low shore areas sand mason worm, *Lanice conchilega* and lug worm *Arenicola marina* aggregations are common (Irving, 1995). Much of the Suffolk coastline near-shore seabed comprises coarse and fine muddy sand with some clay deposits. Conspicuous taxa include the bivalves *Nucula* spp and *Macoma balthica* together with polychaete *Spiophanes bombyx*, the urchin *Echinocardium cordatum* and robust amphipods (Irving, 1998). In places behind the shingle and sand barrier there are saline lagoons fed by seawater percolation or via overtopping (see Barnes, 1989).

1.4 Nature Conservation

Sand and gravel habitats are listed as priority habitat under the UK Biodiversity Action Plan (BAP) Subtidal Sands and Gravels (UK BAP, 2008). The UK BAP was succeeded by the UK Post-2010 Biodiversity Framework in July 2012, however, the UK list of priority habitats remains an important reference source and has been used to draw up statutory lists of priority habitats under the relevant legislations in England, Scotland, Wales and Norther Ireland (JNCC, 2016a).

The proposed cable corridor survey area passes through the Haisborough, Hammond and Winterton candidate Special Area of Conservation (cSAC) / Site of Community Importance (SCI) and overlaps slightly with the Cromer Shoal Chalk Beds Marine Conservation Zone (MCZ). The locations of these protected areas with regard to the location of the proposed development are shown in Figure 1.1.

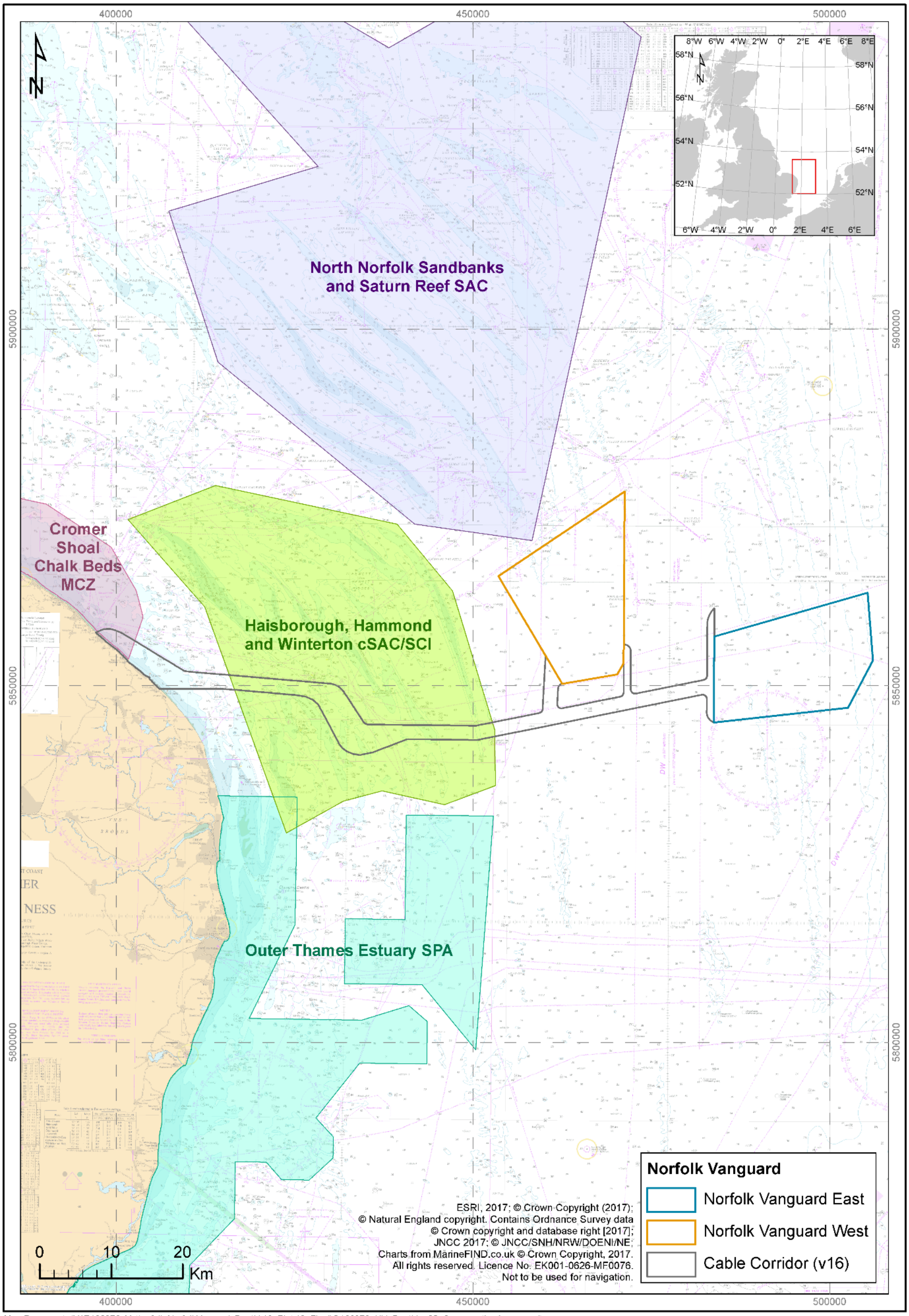

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Figure 1.1 Proposed Wind Farm Development and suroounding Protected Areas

1.4.1 Haisborough Hammond and Winterton Special Area of Conservation (cSAC/SCI)

The Haisborough, Hammond and Winterton site cSAC/SCI is located off the north-east coast of Norfolk and presents marine features which meet the descriptions for the two Annex I habitats 'Sandbanks slightly covered by sea water all the time' and 'Reefs' formed by *Sabellaria*.

The central sandbank ridge of the site consists of sinusoidal banks which have evolved over the last 5,000 years, originally associated with the coastal alignment at the time. The bank system consists of Haisborough Sand, Haisborough Tail, Hammond Knoll, Winterton Ridge and Hearty Knoll. Hewett Ridge and Smiths Knoll form an older (~7,000 years B.P.) sequence of sandbank ridges located along the outer site boundary. Inshore the Newarp Banks and North and Middle Cross Sands lie on the south-west corner of the site. These banks are believed to be geologically recent, their genesis dating to around the 5th Century AD. (JNCC 2016b).

S. spinulosa reefs were identified at Haisborough Tail, Haisborough Gat and between Winterton Ridge and Hewett Ridge. At these locations the reefs are described with elevation between 5 cm and 10 cm and patchiness of 30% to 100% coverage (JNCC 2016b).

As identified by the JNCC and Natural England (2013a) report, the Conservation Objectives for this SAC are:

- Maintain the Annex I Sandbanks in Favourable Condition, implying that existing evidence suggests the feature to be in favourable condition;
- Maintain or restore the Annex I reefs in Favourable Condition, implying that the feature is degraded to some degree.

1.4.2 Cromer Shoal Chalk Beds Marine Conservation Zone (MCZ)

The site was designated as MCZ in January 2016. It is an inshore site located 200 m off the north Norfolk coast, covering an area of 321 km^2, with maximum depth of 20 m. The site protects seaweed-dominated infralittoral rock (chalk) (DEFRA, 2016). As identified by DEFRA (2016) report, the Conservation Objectives for this MCZ are also to maintain favourable conditions for Moderate energy infralittoral rock, High energy infralittoral rock, Moderate energy circalittoral rock, High energy circalittoral rock, Subtidal chalk, Subtidal coarse sediment, Subtidal mixed sediments, Subtidal sand, Peat and clay exposures and North Norfolk Coast (subtidal geological feature).

1.4.3 Protected Areas in the Region and in Proximity of the Development

1.4.3.1 North Norfolk Sandbank and Saturn Reef Marine Protected Area (MPA)

The North Norfolk Sandbanks are the most extensive example of the offshore linear ridge sandbank type in UK waters and the outer banks represent the best example of tidal sandbanks in open sea in the UK. The inner banks show well developed sandwaves, whilst those associated to the outer bank are less developed. They extend from about 40 km (22 nautical miles) off the north-east coast of Norfolk to approximately 110 km (60 nautical miles) and north-west to south-east orientated and are believed to be slowly elongating in a north-easterly direction. The biological communities present on the sandbanks are representative of the infralittoral mobile sand biotope with typical species being the polychaete

N. cirrosa and the isopod *Eurydice pulchra.* The site as the whole MPA is considered a representative functioning example of Annex I feature Sandbank (JNCC, 2016c)

Areas of *S. spinulosa* reefs have been identified within this MPA, with extension of approximately 750 m by 500 m and variable density; however, these reefs were not located by recent surveys, whilst other areas of biogenic reefs were identified. This highlights the ephemeral nature of this feature, whilst indicating the favourable conditions for *S. spinulosa* reef formation within the MPA (JNCC, 2016c).

The MPA is also a Candidate Special Area of Conservation and Site of Community Importance (cSAC/SCI) (JNCC, 2016c).

1.4.3.2 Outer Thames Estuary Special Protected Areas (SPA)

Part of this SPA extends to the south of the proposed development. The site is designated for the protection of rare, vulnerable and migratory birds, particularly the Annex II species *Gavia stellata*. The red-throated diver counts, within the SPA, a wintering population of 6,466 individuals; the 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*. The conservation objective for this SPA include the maintenance and enhancement of the red-throated diver population (*G. stellata*) and to maintain its supporting habitats in favourable condition (JNCC and NE, 2013b).

1.4.4 Habitats of Nature Conservation Interest

1.4.4.1 *Sabellaria spinulosa* Reef Habitat

S. spinulosa, the Ross worm (polychaete), forms biogenic reef consisting of thousands of fragile sand-tubes. These consolidate together to create a solid structure rising above the seabed (reef) which allows the settlement of other species not found in adjacent habitats leading to a diverse community of epifaunal and infaunal species (JNCC, 2016c).

1.4.4.2 Sandbank Habitat

Sandbanks are defined as areas of sand form distinct elevated topographic features, predominantly surrounded by deeper water and slightly covered by seawater all the time. The top of the sandbank is usually in less than 20 m water depth. However, the sides of these sandbanks, can extend into deeper water up to 60 m. Sandbanks can be categorised by sediment type or by topography. The different sediments which can identify this feature are sublittoral coarse sediments, subtidal mixed sediments and sublittoral sands and muddy sands, with particles sometimes reaching the size of cobbles or boulders. For sandbanks identified through topography, there are sandy mounds, created by glacial processes, and current tidal sandbanks which can be relatively mobile with their extent and distribution being actively influenced by ongoing hydrodynamic processes (open shelf ridge sandbanks, estuary mouth sandbanks and headland associated banks). On and around the sandbank the primary and secondary productivity is very high, therefore a range of fish species (e.g. sandeels, dragonets, goby, lesser weaver, European plaice and common dab actively used these sites, making their conservation vitally important (JNCC, 2016a).

1.4.4.3 Chalk Reef Habitat

Chalk was laid down during the Cretaceous Period (over 65 million years ago), formed by the compression of tropical ocean phytoplanktonic diatoms known as coccoliths. This has been overlaid by subsequent geological events, mainly clay from glacial deposition. Chalk strata emerges in few areas of the UK such as the exposed chalk of the white cliffs of Dover, Flamborough Head and as the monumentally carved downs in the west. Off North Norfolk it emerges through the clay into a surrounding seabed of moving sand and gravel (Spray and Watson, 2011). In North Norfolk, especially at West Runton, the unicity of the feature is that it presents areas of rocky seabed where chalk is exposed both subtidally - and intertidally. The coastal chalk reef found in North Norfolk is 30 km long and recognised as the longest in the UK (Spray and Watson, 2011). As the wider area is characterised mainly by sand, the reef form an important habitat, hence its conservation importance, providing a home for a variety of small creatures which shelter and feed amongst seaweeds which find a stable surfaces to settle. They function as nursery areas for juvenile species as well as being home to lobsters and crabs. Other common species include sea squirts, hermit crabs and pipefish, a relative of the seahorse (DEFRA, 2016).

2. METHODOLOGIES

2.1 Survey Design

The benthic ecology study area was defined as the area of seabed within the proposed boundaries of the main site and proposed cable corridor options within which direct effects of the installation of turbine foundations, cables and scour protection material would occur.

The survey comprised seabed video, grab and contaminant sampling as summarised in Table 2.1. The proposed survey array is presented in Figure 2.1, whilst the actual sampling array is presented in Figure 2.2.

At each station, drop down video (DDV) was undertaken prior to grab analysis in order to determine the presence (or absence) of Annex I habitats, such as, but not restricted to, *S. spinulosa* reefs and other reef-building organisms. At each station a single grab was collected, but in the event of failed sampling (e.g. jaws remained opened or blocked, low sample volume) a second sample was attempted. At stations where the DDV revealed the presence of Annex I habitats, only one grab sample was taken and if the first sampling attempt was unsuccessful, no further attempts were made, and the sample accepted. At these stations, also no further sampling for contaminants analysis was completed.

Table 2.1: Summary of Sampling Techniques

Sampling Technique	Proposed Number of Sampling Stations	Actual Number of Samples	Purpose
Drop down video (DDV)	69	68	Collection of seabed video surveillance footage and static images of benthic habitat types and associated epifaunal communities
0.1 m^2 Hamon grab	69 FA 69 PSD	65 FA 66 PSD	Collection of quantitative sediment samples for determination of faunal content and particle size analysis (PSD)
0.1 m^2 Day grab	69 HC (A and B) 69 HM (A and B)	30 HC (A and B) 30 HM (A and B)	Collection of seabed sediment samples for contaminants analysis (heavy metals (HM) and polyaromatic hydrocarbons (HC)

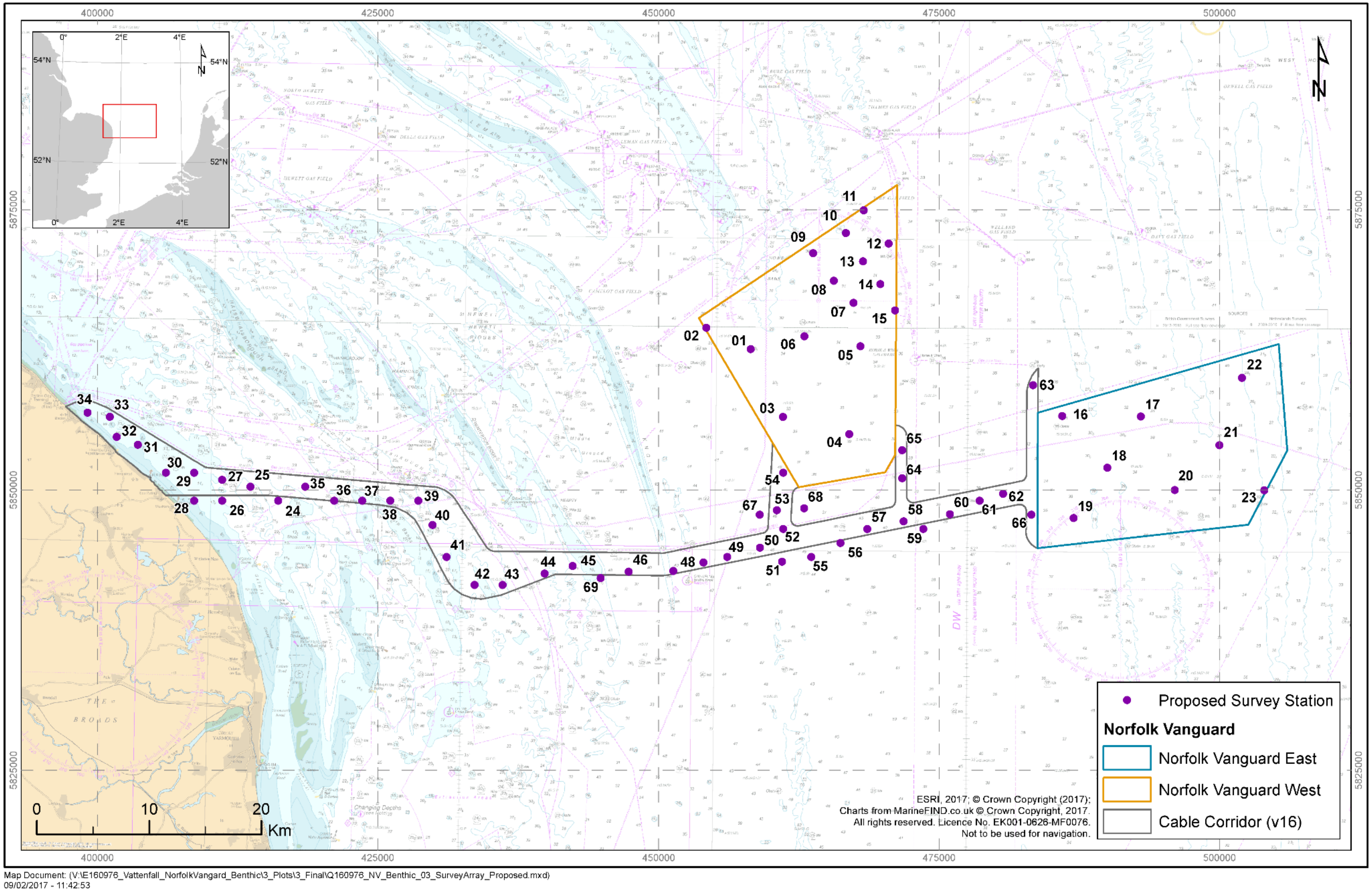
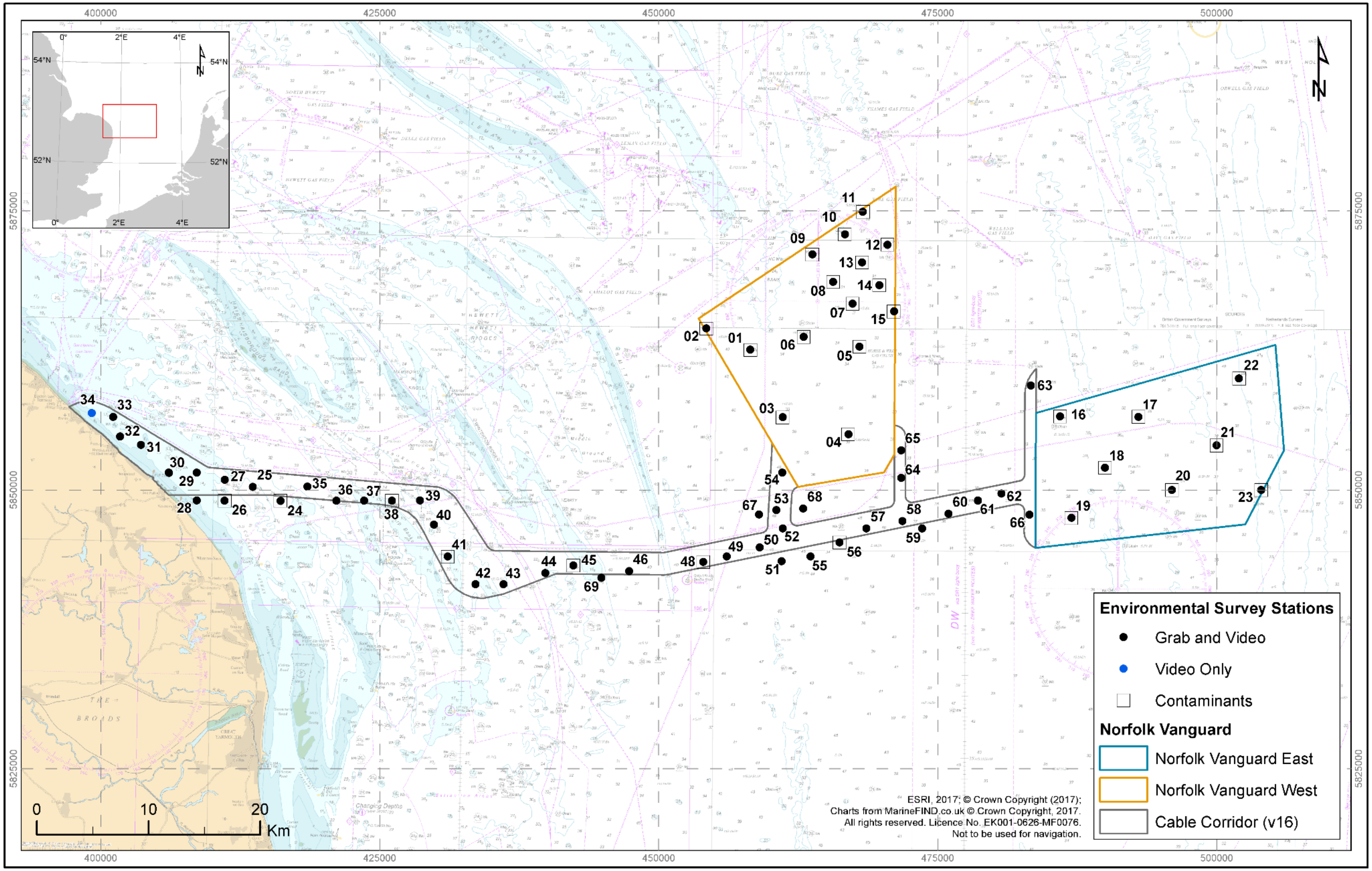


Figure 2.1: Proposed sampling array showing DDV and grab sampling at originally proposed stations



Map Document: (V:\E160976_Vattenfall_NorfolkVangard_Benthic\3_Plots\3_Final\Q160976_NV_Benthic_04_SurveyArray_Actual.mxd)
09/02/2017 - 11:45:22

Figure 2.2: Sampling array showing actual DDV and grab sampling stations

2.2 Sampling Survey

The benthic operations within Norfolk Vanguard development area were undertaken onboard the MV Victor Henson between 29 October and 10 November 2016.

Details of the rationale for proposed sampling array is presented in Annex B.1, whilst details of the actual seabed video and grab survey, including sampling coordinates and any associated field observations are provided in Annexes B.2 to B.6.

2.2.1 Seabed Drop Down Video (DDV) Footage and Photographic Stills Sampling

All grab sample stations were investigated using DDV prior to sampling. With the exception of station 47CR, which was dropped from the scope of work, video footage and still images were successfully collected at all stations. A camera suitable for use in natural high levels of turbidity was used in line with the surveys carried out in 2010/2011 (Royal HaskoningDHV, 2016).

At each location a short transect (up to 200 m or 10 minutes of seabed footage) was run acquiring continuous video footage and high quality still images approximately every 30 seconds. At all sampling stations the presence or absence of Annex I habitats shown in the DDV were noted and the grab was not re-deployed in areas where sensitive habitats or any hazardous obstructions were seen during seabed video sampling.

2.2.2 Sediment Grab Sampling for PSD and Macrofauna

Seabed sediment samples for macrofauna and PSD were collected using a 0.1 m^2 Mini Hamon grab. The positions of all benthic sample stations was recorded using dGPS with a nominal accuracy of 2 m. The position of each sample was taken at the time when the winch wire went slack, indicating that the grab was on the seabed. Upon retrieval of the grab sample, the sediment within the grab bucket was viewed in order to assess whether the sample was acceptable (i.e. had not been subject to partial washout during retrieval, had sealed correctly, and was of sufficient volume relating to depth of bite). When *Sabellaria* was noted in the grab, a bespoke in situ grab assessment form was used. For all grab samples, a description of the sediment surface, noting sediment type and characteristics, as well as conspicuous species, was recorded.

Of the proposed sampling stations (Table 2.1), the majority of samples were successfully collected. Exceptions were stations 29CR and 32CR, where low volume collected after three attempts lead to PSA samples only, station 47CR, which was dropped from the scope, and station 34CR, where after three failed attempts no sample was obtained for macrofauna and PSD.

Macrofauna and PSD sampling logs, including a description of the sediment (sediment features and conspicuous species), are presented in Annex B.3. Notes of samples attempted but unsuccessful, were also included.

Photographs of the sediment surface were taken prior to any sample processing (Annex B.4).

After taking 300 mL PSD sample, the sediment was gently washed over a 1 mm sieve with seawater. The material retained on the sieve was transferred into a pre-labelled bucket with lid, and fixed using 8% buffered formal saline solution.

2.2.3 Sediment Grab Sampling for Chemistry

Seabed sediment samples for chemistry analysis were collected using a 0.1 m^2 Day grab. Subsamples were taken from the surface of the day grab sample while retained in the grab as follows:

- Hydrocarbon samples (2 replicates) were collected using a metal scoop to a nominal depth of 2 cm and preserved in glass jars at -20 ºC;
- Heavy metal samples (2 replicates) were collected using a plastic scoop to a nominal depth of 2 cm and preserved in polythene bags at -20 ºC;
- Prior to any subsampling plastic scoops were pre-washed in saltwater and metal scoops were pre-cleaned using acetone.

Chemistry sampling log is presented in Annex B.5.

All physico-chemical samples were frozen and stored on the vessel until demobilisation and transfer to the analysis laboratory. Fugro is accredited by the United Kingdom Accreditation Service (UKAS) for sediment grab sampling and processing.

3. SAMPLE ANALYSIS

3.1 Seabed Video Footage and Photographic Stills Analysis

Video footage and still images collected at each station were analysed to assess the seabed habitat type and epibenthic communities. The analysis was carried out by reviewing the video footage from each station 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, as the less frequently occurring species would have been under represented from static image analysis alone. Species abundance was estimated using the industry standard SACFOR abundance scale (JNCC, 2015a) shown in Table 3.1, which uses the average species size to classify the population.

Table 3.1: 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

Potential sensitive habitats such as *Sabellaria* (biogenic) and chalk (geogenic) reefs and Sandbanks are known to occur in the wider area. If any of these habitats was encountered, additional analysis was undertaken to establish their status. The following sections describe the methods for assessment of *Sabellaria* (biogenic), geogenic reefs and Sandbanks.

3.1.1 *Sabellaria* Reef Assessment

Video footages and still images from each station were reviewed, noting the type of *S. spinulosa* aggregation present. This reef forming species was classified into the following categories:

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

The JNCC conducted a workshop and produced 'Defining and managing *Sabellaria spinulosa* reefs: Report of an inter-agency workshop' (Gubbay, 2007). The main focus of the workshop was seeking agreement on a definition of *S. spinulosa* reefs. Participants agreed that the simplest definition of *S. spinulosa* reef in the context of the Habitats Directive was 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. In seeking to provide greater guidance, the workshop participants tried to put some figures on the characteristics of elevation and patchiness which could be used in combination to determine whether an area might qualify as a reef. Table 3.2 below presents the criteria applied to each station analysed, which are the currently available guidelines for *Sabellaria* reef assessment.

Table 3.2: Range of Figures Proposed by Participants of the JNCC 2007 Workshop Used Together as a Measure of Reefiness

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 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 cm to 2 cm thick)
4. Many tubes overlapping but no incorporation or joining of stones (accretions 1 cm to 2 cm thick)
5. Stones joined by tubes; most tubes overlapping or connected (accretions >2 cm thick). (If 5, state maximum thickness)

3.1.2 Sandbanks Assessment

A section of the proposed cable corridor runs though the Haisborough, Hammond and Winterton SAC, within which Annex I habitats 'Sandbanks slightly covered by sea water all the time' are known to occur. In this technical report an attempt has been made to represent the topographical variability to assess whether the shape and depth of the seabed, in this area, is consistent with the Annex I definition, in accordance with the definition summarised by Duncan (2017), where, based on The Interpretation Manual of European Union Habitats – EUR25 (CEC, 2003, 2007 and 2013, as cited by Duncan, 2017), "Sandbanks which are slightly covered by sea water all the time" are defined by:

- Being permanently submerged;
- Top of bank is generally in < 20 m of water depth;
- Composed mainly of sandy sediment;
- May be non-vegetated or vegetated with *Zostera marina* (sea grass) and/or free living species of the Corallinaceae family (maerl)

Additional characteristics added to the original definition include:

- Predominantly surrounded by deeper water;
- "Banks where sandy sediments occur in a layer over hard substrata are classed as Sandbanks if the associated biota are dependent on the sand rather than on the underlying hard substrata"

3.1.3 Chalk Reef Assessment

Chalk reef features were not observed during the survey and therefore no assessment of reefiness was required.

3.2 Laboratory Analysis

3.2.1 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 sub-sample and oven dried at 105 ±5 °C to constant weight before sieving through a series of sieves with apertures corresponding to either 0.5 or 1 Phi intervals between 64000 µm to 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 sub-sample for laser analysis; a minimum of 3 triplicate analyses (mixed samples) or 1 triplicate analyses (sands) were analysed using the laser sizer at either 0.5 or 1 Phi intervals between < 1mm to < 3.9 µm. Laser diffraction was carried out using a Malvern Mastersizer 2000 using a Hydro 2000G dispersion unit.

3.2.2 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 3.3 to Table 3.6.

Table 3.3: 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 3.4: Sediment Chemistry Analysis – Total Hydrocarbons

Total Hydrocarbons	
Method Description	Ultrasonic extract of wet sediment, column chromatography clean-up, analysis by Gas Chromatography - Mass Spectrometry (GC – MS)
Minimum Reporting Value (mg/kg)	0.5
UKAS Accreditation	Y

Table 3.5: Sediment Chemistry Analysis – Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic Aromatic Hydrocarbons	
Method Description	Ultrasonic extract of wet sediment, column chromatography clean-up, analysis by GC - MS
Minimum Reporting Value (mg/kg)	Individual PAHs – 0.0001
	Alkylated PAHs – 0.001
UKAS Accreditation	N

Table 3.6: Sediment Chemistry Analysis – Trace Metals

Metals (Aqua Regia Digest)	
Method Description	Samples dried, sieved, digested and analysed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) Mercury is determined by Cold Vapour Atomic Fluorescence Spectroscopy (CV - AFS)
Method Reference	Subcontracted to a UKAS (ISO 17025) accredited laboratory
Fugro Minimum Reporting Value (mg/kg)	Selected metals: Al – 90 As –0.04 Cd –0.005 Cr –0.2 Cu –0.7 Pb –0.2 Hg –0.0005 Ni – 0.4 Sn –1 Zn –2
UKAS Accreditation	Y

3.2.3 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 EMU 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.

3.2.4 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 six groups 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):

- Polychaeta 15.5%;
- Oligochaeta 15.5%;
- Crustacea 22.5%;
- Mollusca 8.5%;
- Echinodermata 8.0%;
- Cnidaria 15.5%;
- Other Taxa 15.5%.

4. DATA ANALYSES

4.1 PSD Data Analysis

Data derived from the laboratory analysis, details of which can be found in Annex C.1, were analysed 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).

Data for the percentage composition retained within each sieve size classes were analysed using the Euclidean distance measure as recommended by Clarke and Gorley (2006) on normalised data. The 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, 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.

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 Sediment Chemistry Analysis

Tested contaminant analyses 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 (ER-L) and Effects Range Medium (ER-M) 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 (Long et al., 1995, NJDEP, 2009). Concentrations below the ER-L rarely cause adverse effects in marine organisms; concentrations above the ER-M, however, will often cause adverse effects in some marine organisms (OSPAR, 2009a).

Cefas Guideline Action Levels (AL) for the disposal of dredged material are non-statutory guidelines which form part of a wider body of evidence for assessment of disposal of dredged materials to sea. In general, concentrations of contaminants below Cefas Action Level 1 are of little concern with respect to possible effects on the marine environment. Concentrations above Action Level 2, however, suggest that the material is unsuitable for disposal at sea. Values between Levels 1 and 2 may prompt further investigatory work prior to disposal of the material to sea (CEFAS, 2003).

Canadian Sediment Guidelines for the Protection of Aquatic Life (CCME, 2014) values were also used to aid the assessment of the possible ecological significance of the levels of contaminants found. 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 guidelines are presented in the form of Interim Sediment Quality Guidelines (ISQGs) and PELs) Concentrations above ISQGs may cause some effects in sensitive species while concentrations exceeding the PEL are likely to cause effects in a wide range of species.

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 (see Table 4.1) 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 4.1 Assessment Classes for TBT (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

4.3 Macrofauna Data Analysis

The macrofaunal data set was imported into Primer v6 and analysed by means of univariate and multivariate analyses. Prior to analysis being undertaken, the faunal data set was subjected to a degree of rationalisation, specifically individuals which were identified belonging to specific phyla, but for which no heads were counted, were removed, as only presence was recorded. They were instead included in the biomass record.

Newly settled juvenile benthic species were also present in the dataset and, as these may at times dominate the macrofauna, their contribution to the community structure need to be addressed. Due to heavy post-settlement mortality, they should however be considered an ephemeral component and not representative of prevailing bottom conditions (OSPAR, 2004). The guideline also further states that "*Should juveniles appear among the ten most dominant organisms in the data set, the statistical analysis should be conducted both with and without these in order to evaluate their importance*". This was applied to the present study.

4.3.1 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 ($H'\text{Log}_2$) 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 is 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, ($H'\text{Log}_2$) 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).

4.3.2 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 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.

4.4 Biotope Classification

Biotope code allocations were made using the Marine Habitat Classification of the British Islands (JNCC, 2015). The task was carried out by an experienced ecologist practised in matching UK biotopes to field survey data with codes applied through experienced judgment and knowledge of the classification systems. All survey data were used to inform the biotope allocation process including the PSD and macrofaunal data and the videographic and photographic data.

4.5 Habitats and Species of Nature Conservation Interest

Habitats and Species encountered within the survey area and presented in this report were compared against UK Biodiversity Action Plan (BAP) priority species and habitats (JNCC, 2016d), International Union of Conservation of Nature (IUCN) Red List of Threatened Species (IUCN, 2016), The OSPAR

List of Threatened and/or Declining Species & Habitats (OSPAR Commission, 2017) and any observed species reported in sections 5.5.4

The proposed works overlap with the Haisborough Hammond and Winterton Special Area of Conservation (SAC), designated for Annex I habitat (‘Sandbanks slightly covered by sea water all the time’ and ‘*Sabellaria spinulosa* reefs’) and the Cromer Shoal Chalk Beds Marine Conservation Zone (MCZ), designated for features of conservation importance including subtidal chalk, peat and clay exposures and associated biodiversity.

5. RESULTS

5.1 Seabed Video Footage and Photographic Stills Analysis

Digital photographic stills and video footage were successfully acquired along all the proposed transects. Underwater visibility was generally good allowing the assessment of the nature of the seabed. However, at a number of stations the visibility was very poor, allowing for only a general description of the station.

All 69 video transects were completed. This section describes the finding of the video analysis, the details of which can be found in Annex D.1.

Stations within the offshore main site (MS), Norfolk Vanguard West and East, stations 01MS to 23MS, were generally described as sand or slightly shelly sand. The majority of these (15 stations) comprised slightly shelly rippled sand, whilst at the remaining 8 stations, the sediment was slightly coarser, with 5 stations (06MS, 08MS, 11MS, 17MS and part of 03MS) described as slightly shelly slightly gravelly rippled sand, and 3 stations (01MS, 02MS and part of 03MS) described as slightly gravelly, slightly pebbly rippled sand.

The proposed cable corridor was also mainly characterised by rippled sand or shelly rippled sand (stations 24CR to 26CR, stations 35CR to 42CR, stations 44CR to 46CR, stations 48CR to 57CR and stations 59CR to 69CR). At the other stations coarser sediments were observed. The transect at station 27CR the habitat observed was gravelly pebbly sand which became cobbely pebbly sand to then alternate mixed sediment of gravelly pebbly sand and cobbles and pebbles with sand. From station 28CR to station 34CR the seabed is characterised by sandy pebbly gravel, pebbly gravelly sand, pebbly sandy gravel, gravelly sandy pebbles, gravelly pebbly sand and pebbly gravel.

The fauna encountered in the survey area was similar in both the main sites and the proposed cable corridor. However, stations with coarser sediments hosted richer and more abundant communities. Epibenthic fauna comprised representatives from each of the main groups. Echinodermata recorded included the common starfish *Asterias rubens*, the sun star *Crossaster. papposus*, the brittlestars *O. albida* and *Ophiura ophiura*, the green sea urchin *Psammechinus miliaris* and the sea potato *Echinocardium cordatum*; Crustacea recorded included the hermit crab *Pagurus bernhardus*, the edible crab *Cancer pagurus*, the velvet swimming crab *Necora puber*, the swimming crab *Liocarcinus* sp. and shrimps; Polychaeta recorded included the reef forming Ross worm *S. spinulosa* and a cast of *Arenicola* sp.; Mollusca recorded included the gastropode *Calliostoma* sp., a cuttlefish *Sepia* sp. and *Mytilus* sp.. At stations 27CR two patches of mussel seeds were seen. The anemone *Urticina felina* was very common and the anthozoan *Alcyonium digitatum* was also present although not as common. Turf forming species included Hydroid/Bryozoa species, amongst which the hydroid *Nemertesia* sp. and *Flustra foliacea* were identified. Fish taxa were also encountered and included the sandeel *Ammodytes* sp., the solenette *Buglossidium luteum* and species belonging to the family Soleidae.

Aggregations of *S. spinulosa* were observed in the forms of crust clumps and potential reef features; at those stations where these presented characteristics of patchiness, elevation and consolidation, the stations were assessed for the presence of reef. The details of this analysis are presented in section 5.1.1.

The majority of the epibenthic fauna was observed associated with coarser sediments and *S. spinulosa* aggregations. At stations 09MS, 10MS, 11MS, 35CR. 36CR, 39CR, 56CR, 61CR and 69CR no fauna was recorded from the video and stills analysis.

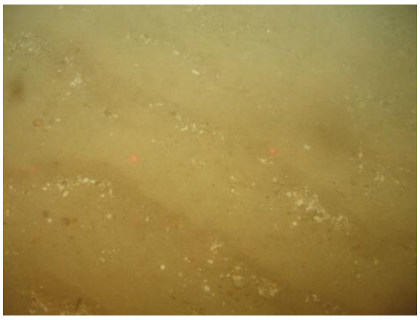
The most abundant taxon was the genus *Ophiura*, including both species *O. ophiura* and *O. albida*, which was also the most frequently occurring taxon recorded. Table 5.1 presents the top 10 most abundant and most frequent taxa recorded by the video and still analysis.

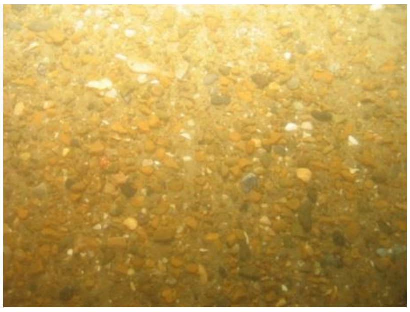
From the video analysis five main habitats were identified. These are summarised in Table 5.2

Table 5.1: Top Ten Most Frequent Species for Norfolk Vanguard from the Video and Stills Analysis

Conspicuous Taxa	Type of species	Frequency (%) N=69
Ophiura sp.	Echinodermata (brittlestar)	40%
Asterias rubens	Echinodermata (common starfish)	25%
Urticina sp.	Cnidaria (sea anemone)	13%
Liocarcinus sp.	Crustacea (swimming crab)	22%
Crossaster papossus	Echinodermata (sun star)	9%
Paguridae	Crustacea (hermit crab)	21%
Cancer pagurus	Crustacea (edible crab)	7%
Pagurus bernhardus	Crustacea (hermit crab)	13%
Pesciformes	Chordata (fish species)	13%
Ammodytidae	Chordata (sandeel)	12%

Table 5.2: Examples of Main Habitats Described by the DDV and Stills Analysis at Norfolk Vanguard

Station	Detailed Sediment Notes	Conspicuous Species	Photographic Example
04MS	Slightly shelly rippled sand	Pleuronectiformes Paguridae *Asterias rubens*	

Station	Detailed Sediment Notes	Conspicuous Species	Photographic Example
27CR	Gravelly pebbly sand covered in mussel shells	None	
29CR	Pebbly gravelly sand with *Sabellaria* clumps and crust.	*Sabellaria spinulosa* *Urticina* sp. Solasteridae Caridea *Cancer pagurus* *Flustra foliacea* Porifera *Crossaster papossus* *Asterias rubens* Rhodophycota *Henricia* sp.	
30CR	Pebbly sandy gravel with *Sabellaria* crusts, moribund tubes and occasional clumps.	*Sabellaria spinulosa* *Flustra foliacea* Hydroid/bryozoan turf *Urticina* sp. *Asterias rubens* *Crossaster papossus* *Liocarcinus* sp. *Nemertesia ramose* Bryozoan crusts	
43CR	Sand and gravel. The transect is characterised by alternating slightly shelly slightly gravelly sand and slightly shelly sand gravel, with areas presenting a range of percentage of gravel content.	*Sabellaria spinulosa* (clumps and crusts) *Pagurus bernhardus* *Urticina* sp. *Liocarcinus* sp. Hydroid/bryozoan turf Actinaria *Necora puber* *Flustra foliacea* *Spirobranchus* sp.	 

5.1.1 *Sabellaria* Reef Assessment

Of the 68 video transects analysed, 20 presented forms of *Sabellaria* aggregations with characteristics of patchiness, elevation and consolidation, and were therefore assessed for the presence of *Sabellaria* reef. Following the criteria described in section 1.4.4.1, elevation score ranged from LOW (2cm to 5 cm) at five stations, to NOT REEF/LOW (2 cm to 5 cm, but also < 2 cm along the transect) at six stations and NOT REEF at seven stations, patchiness score ranged from HIGH at two stations to LOW at six stations and NOT REEF at 11 stations and consolidation score ranged from HIGH at one station to MEDIUM at six stations, LOW/MEDIUM at three stations, LOW at one station, NOT REEF/LOW at one station and NOT REEF at six stations.

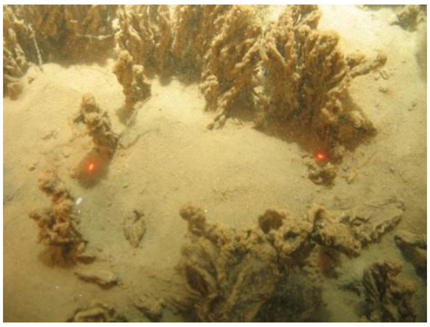
LOW REEF was assessed for stations 01MS, 25CR and 65CR. At station 01MS the reef was characterised by *Sabellaria* tubes which appeared to be subject to inundation of sand across the area, at station 25CR the reef was characterised by thin and thick crusts as well as clumps of consolidated tubes and at station 65CR the reef was characterised by areas with large clumps of intertwined upright tubes. LOW/MEDIUM REEF was assessed at station 19MS, where the reef was characterised by thick crusts and erect tubes; however, the station was also characterised by poor visibility which made difficult to ascertain consolidation. NOT REEF/LOW REEF was assessed at station 64CR, where the reef was characterised by small and large clumps throughout the video transect. NOT REEF was assessed for the remaining station.

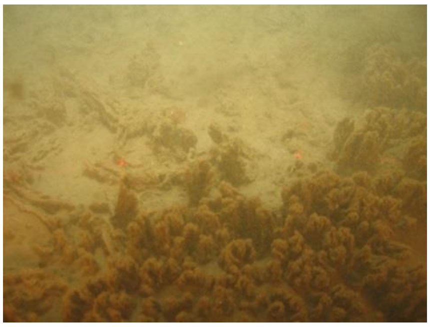
At station 40CR the whole length of the transect was characterised by the presence of *Sabellaria* in the form of large (diameter > 20 cm), scattered clumps, some of which formed by intertwined upright tubes, to which a HIGH consolidation score was applied; however, these were never observed forming a continuous feature, with elevations of 2-10 cm, determining a LOW (and occasionally MEDIUM) score for elevation. The scattered nature of the observed clumps determined a LOW patchiness score, whilst the non continuous reef features suggest that the majority of the transect does not present reef. A section of the video transect, however, presented larger clumps of intertwined elevated tubes, forming in places, continuous aggregated structures which were described as MEDIUM REFF.

At station 67CR the high concentration of suspended sediment determined very poor visibility for the whole length of the video transect. At this station occasionally large (diameter > 20 cm) of *Sabellaria* aggregations were seen, however the environmental local conditions did not allow for a full assessment.

The stations where *Sabellaria* reef was identified are presented in Table 5.3, whilst the full assessment is presented in Annex D.2 . The distribution across the survey area is shown in Figure 5.1

Table 5.3: *Sabellaria* Reef Stations

Station	Sediment Description	Representative Image	Overall Assessment
01MS	Rippled sand		LOW REEF
19MS	Sand and gravel		LOW/MEDIUM REEF
25CR	Shelly gravelly sand, interspersed with areas of rippled sand		LOW REEF
40CR Between 50º46.0707'N 01º57.5197'E and 50º46.0767'N 01º57.5008'E (WGS84)	Rippled sand interspersed with areas of sandy gravel		MEDIUM REEF
64CR	Shelly gravelly sand		NOT REEF/LOW

Station	Sediment Description	Representative Image	Overall Assessment
65 CR	Sand		LOW REEF

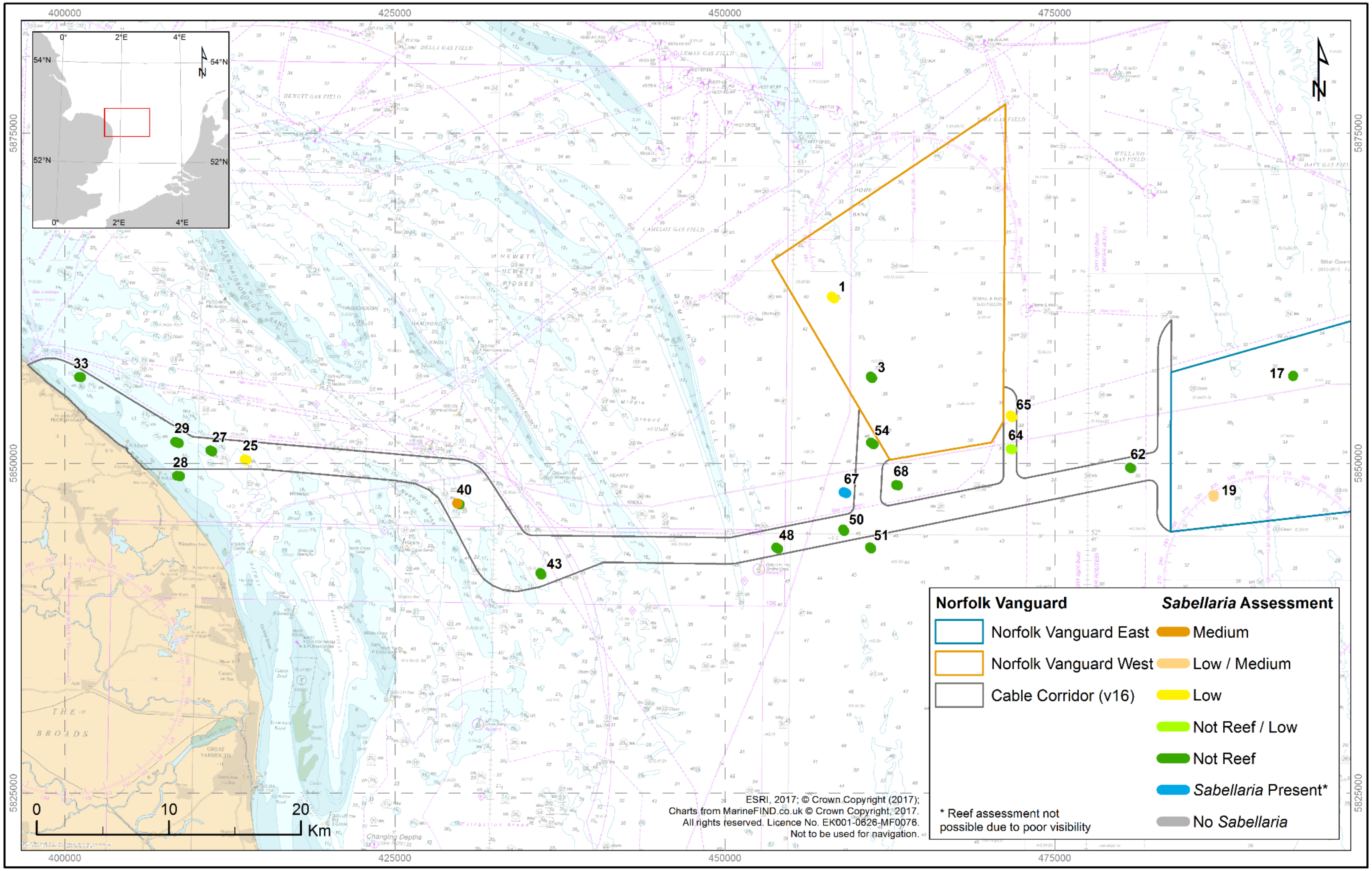


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Figure 5.1 *Sabellaria* assessment across the survey area

5.1.2 Sand Banks Assessment

The section of the proposed cable corridor assessed for sandbank features is shown in Figure 5.2.

The assessment based on topography showed areas of banks with the crest at depths < -20 m LAT. The dominant sediment type characterising the seabed within this section was slighty gravelly sand (9 stations), sand (two stations) and sandy gravel (one station), showing the prevalence of sandy sediment in the area, but also the presence of coarser sediment.

Benthic communities described at the stations located within this section of the proposed cable corridor included taxa typical of a predominantly sandy environment, such as the polychaete *N. cirrosa* and the amphipod *Gammaropsis maculata*, as well as taxa typically associated with coarser or mixed sediment, such as *S. spinulosa*.

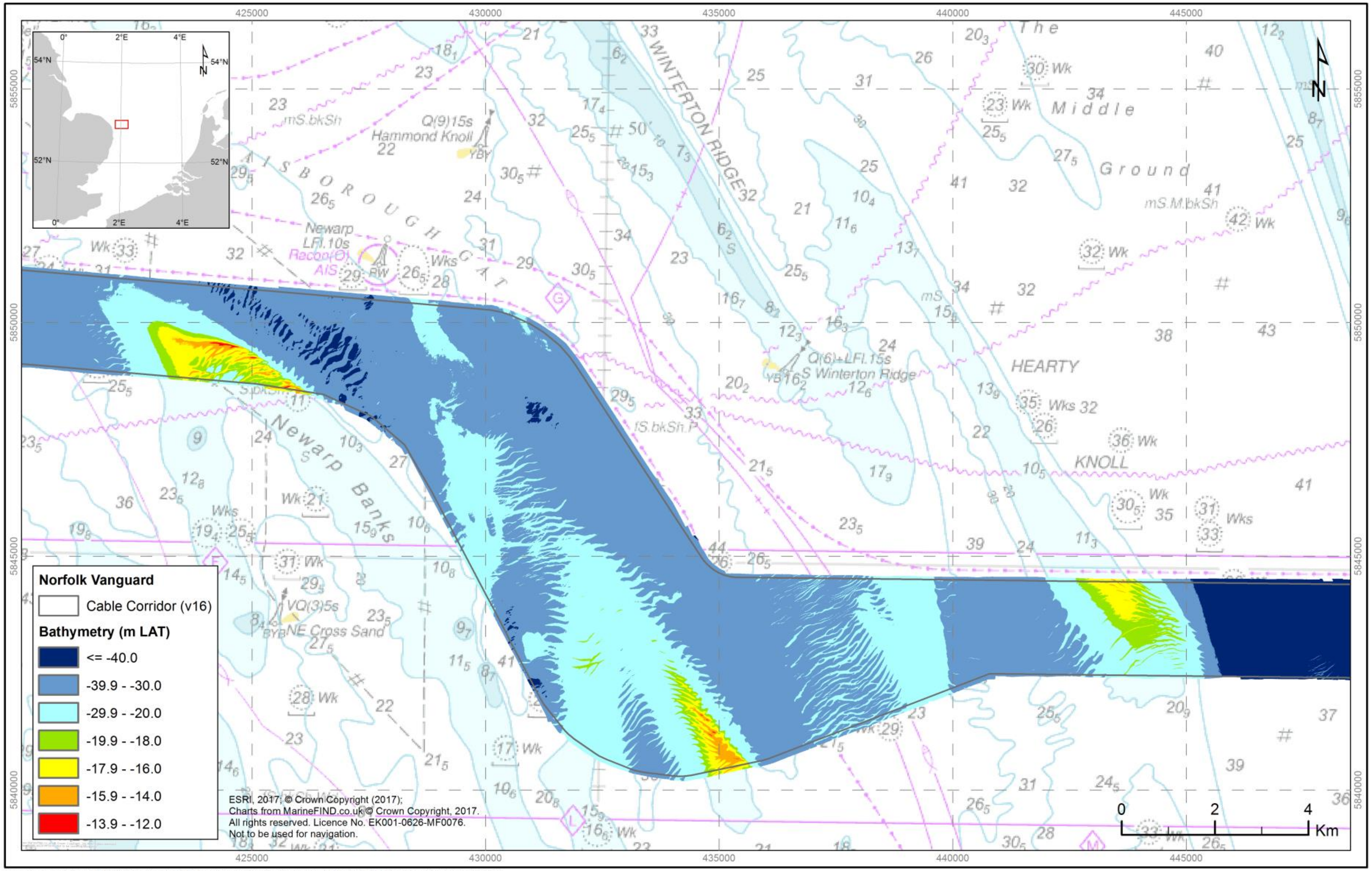

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Figure 5.2 Sandbank assessment based on Topography

5.2 Sediment Particle Size Distribution (PSD)

The dominant fraction was slightly gravelly sand ((g)S), described at 34 stations and accounting for 51% of the sediment characteristics; this was followed by sandy gravel (sG), described at 12 stations and accounting for 18% of sediment characteristics, gravelly muddy sand (gmS), described at 6 stations and accounting for 9% of the sediment characteristics, and gravelly sand (gS) and slightly gravelly muddy sand ((g)mS), described both at 4 stations and accounting for 6% of the sediment characteristics across the survey area. The remaining stations were described as muddy sandy gravel (msG), sand (S), slightly gravelly sandy mud ((g)sM) and gravel (G), all accounting for < 5% of the sediment characteristics of the survey area.

The dominant fraction (g)S was fairly uniformly distributed in the main sites (Norfolk Vanguard West and East) at 19 stations out of 23, with the other stations having some pockets of coarser/finer fractions described as slightly gravelly muddy sand ((g)mS), gravelly muddy sand (gmS) and gravelly sand (gS).

Along the proposed cable corridor, the dominant fraction was (g)S, followed by gS, accounting together for 59% of the sediment characteristics of the proposed cable corridor. At the remaining stations the sediment was characterised by gmS (14%), sG (9%), (g)sM (5%), msG (5%), S (5%), (g)mS (2%) and G (2%). These are presented in Figure 5.3 as well as examples of these fractions as observed in the field.

Higher proportion of mud (> 10%) was found at 11 stations. Stations 2MS, 12MS and 19MS in the main sites and stations 46CR, 48CR, 50CR, 52CR, 53CR, 58CR, 61CR and 62CR along the proposed cable corridor. Stations 46CR and 58CR were those with the proportion of mud higher than 60% of their sediment characteristics, being 61.9% and 60.2% respectively. These stations were mainly described as gravelly muddy sand (gmS), with three being described as slightly gravelly muddy sand ((g)mS) and two being described as gravelly sandy mud (gsM). Four stations (27CR, 29CR, 33CR and 43CR) were described as sandy gravel (sG), one station, 32CR, as gravel (G), two stations as muddy sandy gravel (msG) (30CR and 31CR) and two stations as sand (S) (37CR and 42CR). All these stations, which presented coarser sediment fractions were located inshore in the section of the proposed cable corridor closer to shore, with the exception of stations 42CR and 43CR, which were located in the middle part of the proposed cable corridor. One chalk boulder was observed at site 27CR.

The sediments in the survey area vary between extremely poorly sorted (eps), with a high sorting coefficient, and well sorted (ws), with a low sorting coefficient. Other sorting categories such as very poorly sorted (vps), poorly sorted (ps), moderately sorted (ms), moderately well sorted (mws) and well sorted (ws) were also recorded. Well sorted sediments can indicate a consistent input of energy with little fluctuation and characterised mainly the sampling locations within the main sites as well as few stations in the middle of the proposed cable corridor; on the contrary poorly sorted sediments can indicate the reverse, i.e. an inconsistent energy input and a consequently wide fluctuation in the sediment matrix and were characteristics of the sampling locations along the proposed cable corridor, particularly along the section approaching the shore.

Investigation of the particle size modal distribution showed that the majority of samples (72%) showed unimodal distribution with the remaining samples showing bimodal (22%), trimodal (4%) and polymodal (1%). Of the unimodal distribution almost the totality (96%) of samples peaked in the medium sand region (1.5 phi) and the remaining 4% of samples peaked in the coarse sand region (0.5 phi). Additional modal distribution peak (mode 2 and 3) was observed in the fine to very fine silt region (7.5 phi) and in the gravel to pebble region (-2.5 phi to -5.5 phi).

The sediment was coarse skewed for 30% of the samples and Symmetrical for 28% of the samples, fine skewed for 18% of the samples and very fine skewed for 15% of the samples. The remaining 9% of the samples were very coarse skewed Table 5.4.

The total organic matter (TOM) content in the sediments ranged from 0.24% at station 42 CR to 3.04% at station 46CR.

The station particle size distribution description and statistics, including TOM proportions are shown in Table 5.4 and Table 5.5, with the spatial distribution of sediment composition shown in Figure 5.4 and the distribution of the median particle size across the survey area shown in Figure 5.5. TOM across the survey area is presented in Figure 5.6.

Full results of the sediment particle size distribution analysis are provided in Annexes B.7.1 and B.7.2. The original Folk classification (Folk, 1954) was used to classify the sediment types present.

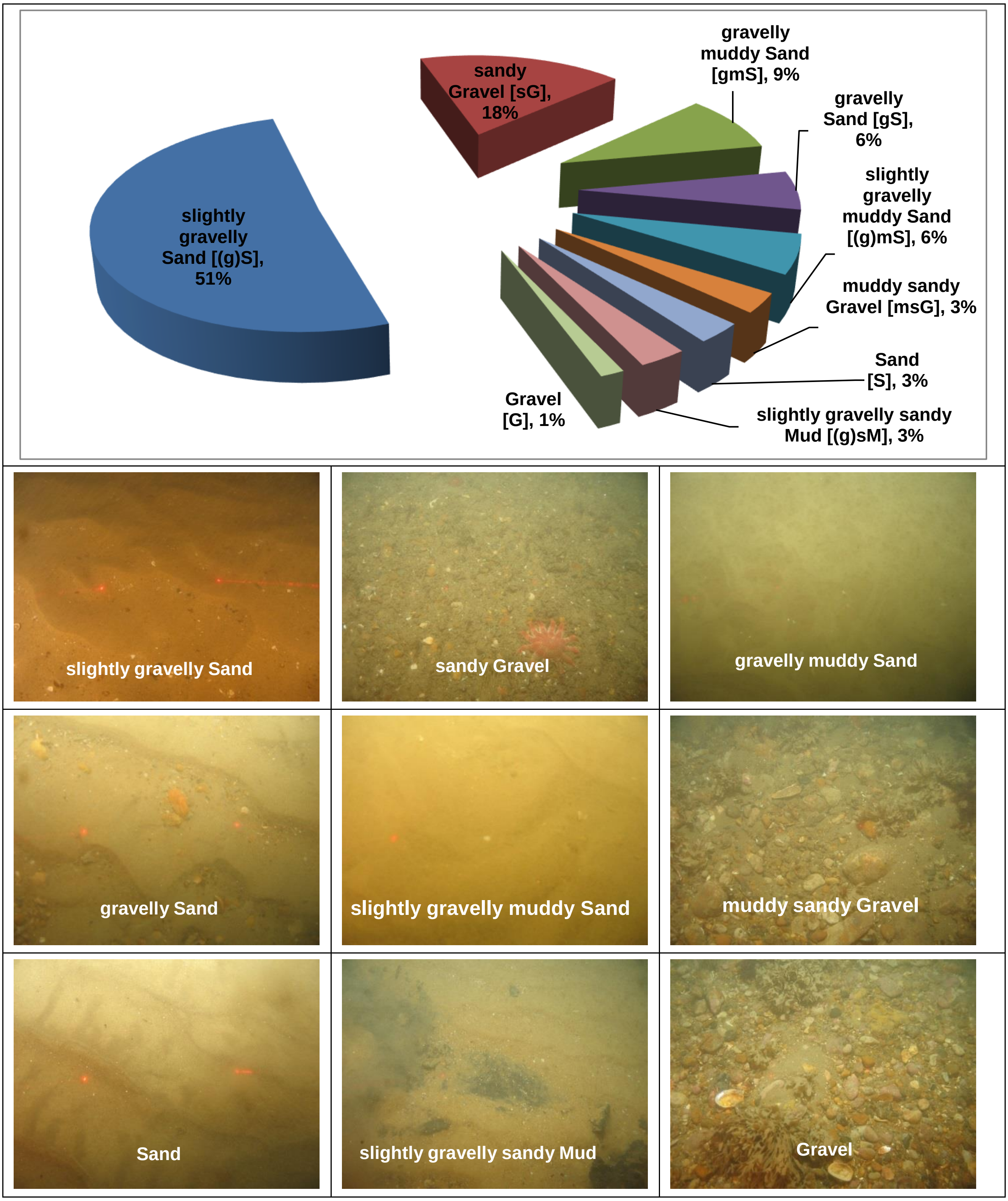

Figure 5.3: The proportions of Folk (1954) textural groups identified from the analysis of all sediment samples collected.

Table 5.4: Sediment Classification, Sorting and Skewness

Station	Sediment Classification		Sorting	Skewness	In-situ Sediment Description
	Folk	Wentworth			
1 MS	Slightly Gravelly Sand	Medium Sand	Poorly Sorted	Fine Skewed	Clayey silt with *Saberllaria* clumps and rubble
2 MS	Slightly Gravelly Muddy Sand	Very Fine Sand	Very Poorly Sorted	Very Fine Skewed	Clayey silt with shell fragments and *Sabellaria* rubble
3 MS	Gravelly Sand	Medium Sand	Moderately Sorted	Very Coarse Skewed	Slightly muddy sand with shells (mainly Oyster)
4 MS	Slightly Gravelly Sand	Medium Sand	Moderately Sorted	Coarse Skewed	Fine sand with medium to coarse sands with shell fragments
5 MS	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Coarse Skewed	Fine sand and shell fragments
6 MS	Slightly Gravelly Sand	Medium Sand	Moderately Sorted	Coarse Skewed	Silty sand
7 MS	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Symmetrical	Silt with clay lumps
8 MS	Slightly Gravelly Sand	Medium Sand	Moderately Sorted	Coarse Skewed	Fine sand and shell fragments
9 MS	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Coarse Skewed	Fine sand with shell fragments
10 MS	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Symmetrical	Fine sand
11 MS	Slightly Gravelly Sand	Medium Sand	Moderately Sorted	Coarse Skewed	Fine sand
12 MS	Slightly Gravelly Muddy Sand	Medium Sand	Poorly Sorted	Very Fine Skewed	Silt with shell fragments
13 MS	Slightly Gravelly Sand	Medium Sand	Moderately Sorted	Coarse Skewed	Silty sand with shell fragments
14 MS	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Coarse Skewed	Silty sand with shell fragments
15 MS	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Symmetrical	Silty sand and shell fragments
16 MS	Slightly Gravelly Sand	Medium Sand	Well Sorted	Fine Skewed	Fine sand with little shell fragments
17 MS	Slightly Gravelly Sand	Medium Sand	Moderately Sorted	Very Fine Skewed	Fine sand and shell fragments
18 MS	Slightly Gravelly Sand	Medium Sand	Well Sorted	Fine Skewed	Fine sand
19 MS	Gravelly Muddy Sand	Fine Sand	Very Poorly Sorted	Very Fine Skewed	Muddy gravelly sand
20 MS	Slightly Gravelly Sand	Medium Sand	Well Sorted	Fine Skewed	Fine sand with shell fragments
21 MS	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Fine Skewed	Silt with shell fragments
22 MS	Slightly Gravelly Sand	Medium Sand	Moderately Sorted	Symmetrical	Shelly gravelly sand
23 MS	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Fine Skewed	Fine sand with shell fragments

Station	Sediment Classification		Sorting	Skewness	In-situ Sediment Description
	Folk	Wentworth			
24 CR	Slightly Gravelly Sand	Coarse Sand	Moderately Sorted	Symmetrical	Fine sand with shell fragments
25 CR	Gravelly Sand	Medium Sand	Poorly Sorted	Very Coarse Skewed	Silt with shell fragments and *Sabellaria* rubble
26 CR	Gravelly Sand	Coarse Sand	Poorly Sorted	Very Coarse Skewed	Silt with shell fragments, *Sabellaria* rubble and some gravel
27 CR	Sandy Gravel	Pebble	Very Poorly Sorted	Fine Skewed	Fine Sand with gravel and pebbles
28 CR	Gravelly Muddy Sand	Coarse Sand	Very Poorly Sorted	Coarse Skewed	Silt, shell fragments and *Sabellaria* rubble
29 CR	Sandy Gravel	Pebble	Very Poorly Sorted	Very Fine Skewed	Cobbles, pebbles, gravel and silt
30 CR	Muddy Sandy Gravel	Granule	Very Poorly Sorted	Very Fine Skewed	Silt with pebbles and *Sabellaria* clumps
31 CR	Muddy Sandy Gravel	Granule	Very Poorly Sorted	Fine Skewed	Silt with gravel, pebbles and shell fragments
32 CR	Gravel	Pebble	Very Poorly Sorted	Very Fine Skewed	Silt with cobbles and pebble
33 CR	Sandy Gravel	Very Coarse Sand	Very Poorly Sorted	Coarse Skewed	Silty sand with pebbles, cobbles, shell fragments and *Sabellaria* rubble
35 CR	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Coarse Skewed	Fine sand
36 CR	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Fine Skewed	Fine sand
37 CR	Sand	Medium Sand	Moderately Well Sorted	Symmetrical	Fine sand
38 CR	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Symmetrical	Fine sand with shell fragments
39 CR	Slightly Gravelly Sand	Coarse Sand	Moderately Well Sorted	Symmetrical	Fine sand
40 CR	Slightly Gravelly Sand	Medium Sand	Moderately Sorted	Coarse Skewed	Fine sand with Sabellaria clumps
41 CR	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Symmetrical	Fine Sand
42 CR	Sand	Medium Sand	Well Sorted	Coarse Skewed	Fine Sand
43 CR	Sandy Gravel	Very Coarse Sand	Poorly Sorted	Coarse Skewed	(shelly) Gravelly Sand
44 CR	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Fine Skewed	Fine Sand
45 CR	Gravelly Sand	Medium Sand	Moderately Sorted	Coarse Skewed	Fine Sand
46 CR	Slightly Gravelly Sandy Mud	Medium Silt	Very Poorly Sorted	Symmetrical	Sandy (clayey) Mud
48 CR	Gravelly Muddy Sand	Coarse Sand	Extremely Poorly Sorted	Symmetrical	Muddy Sand with Oyster shells
49 CR	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Coarse Skewed	Fine to Medium Sand
50 CR	Gravelly Muddy Sand	Fine Sand	Very Poorly Sorted	Fine Skewed	Slightly muddy sand

Station	Sediment Classification		Sorting	Skewness	In-situ Sediment Description
	Folk	Wentworth			
51 CR	Gravelly Sand	Medium Sand	Poorly Sorted	Coarse Skewed	slightly muddy sand
52 CR	Gravelly Muddy Sand	Medium Sand	Extremely Poorly Sorted	Symmetrical	Clayey silt with consolidated lumps of clay
53 CR	Gravelly Muddy Sand	Fine Sand	Very Poorly Sorted	Very Fine Skewed	Clay/ Silt with shell fragments
54 CR	Gravelly Sand	Coarse Sand	Poorly Sorted	Very Coarse Skewed	slightly muddy sand with shell fragments
55 CR	Gravelly Sand	Coarse Sand	Poorly Sorted	Very Coarse Skewed	Muddy gravelly sand
56 CR	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Coarse Skewed	Fine to medium sand with a few shell fragments
57 CR	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Symmetrical	Fine sand with some shell fragments
58 CR	Slightly Gravelly Sandy Mud	Coarse Silt	Very Poorly Sorted	Symmetrical	muddy shelly sand over sandy silty clay, lots of *Sabellaria* tube fragments
59 CR	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Symmetrical	Fine sand and shell fragments
60 CR	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Symmetrical	Fine to medium sand
61 CR	Slightly Gravelly Muddy Sand	Very Fine Sand	Very Poorly Sorted	Very Fine Skewed	Muddy sand with clay
62 CR	Gravelly Muddy Sand	Fine Sand	Very Poorly Sorted	Very Fine Skewed	Muddy sand tubes of *Sabellaria* throughout, no elevation/crust, Polychaeta tubes
63 CR	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Fine Skewed	Fine sand with shell fragments
64 CR	Gravelly Sand	Medium Sand	Poorly Sorted	Symmetrical	Muddy sand with clay
65 CR	Gravelly Sand	Medium Sand	Poorly Sorted	Symmetrical	Muddy sand with clay
66 CR	Gravelly Sand	Medium Sand	Moderately Sorted	Coarse Skewed	Slighty muddy gravelly sand
67 CR	Gravelly Sand	Medium Sand	Poorly Sorted	Very Coarse Skewed	Clay / Silt with high proportion of *Sabellaria*
68 CR	Gravelly Sand	Medium Sand	Poorly Sorted	Coarse Skewed	Silt with shell fragments
69 CR	Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	Symmetrical	Fine Sand

Table 5.5: 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 [%]	
1 MS	40	353	1.5	-	-	4.3	87.8	8.0	1.00
2 MS	44	225	1.5	7.5	-	3.8	68.6	27.6	1.57
3 MS	44	396	1.5	-	-	5.6	93.4	1.0	0.66
4 MS	42	449	1.5	-	-	2.6	97.4	0.0	0.88
5 MS	39	393	1.5	-	-	1.7	98.3	0.0	1.01
6 MS	39	366	1.5	-	-	4.1	95.9	0.0	0.76
7 MS	38	371	1.5	-	-	0.5	99.5	0.0	0.83
8 MS	38	376	1.5	-	-	3.6	96.4	0.0	0.89
9 MS	38	369	1.5	-	-	1.1	98.9	0.0	0.56
10 MS	39	348	1.5	-	-	0.7	99.3	0.0	0.47
11 MS	38	357	1.5	-	-	3.5	96.5	0.0	0.90
12 MS	39	329	1.5	-	-	2.5	87.2	10.3	1.02
13 MS	38	372	1.5	-	-	4.3	93.6	2.1	0.88
14 MS	38	375	1.5	-	-	1.1	98.9	0.0	0.95
15 MS	39	364	1.5	-	-	2.2	97.8	0.0	0.82
16 MS	42	340	1.5	-	-	0.3	99.7	0.0	0.44
17 MS	40	306	1.5	-	-	0.7	94.0	5.3	0.61
18 MS	38	339	1.5	-	-	0.1	99.9	0.0	0.35
19 MS	41	263	1.5	7.5	-	7.5	68.8	23.7	1.63
20 MS	35	342	1.5	-	-	0.8	99.2	0.0	0.32
21 MS	35	320	1.5	-	-	0.1	99.9	0.0	0.38
22 MS	35	322	1.5	-	-	4.3	95.7	0.0	0.60
23 MS	31	317	1.5	-	-	1.4	98.6	0.0	0.50
24 CR	-	526	0.5	-	-	4.0	96.0	0.0	0.43
25 CR	35	252	2.5	-2.5	-	9.5	87.9	2.6	0.72
26 CR	30	493	1.5	-1.5	-	18.7	78.0	3.3	1.20
27 CR	26	6438	1.5	-5.47728	-3.5	61.1	38.1	0.9	1.14
28 CR	16	419	1.5	-4.48864	-	28.7	63.1	8.3	1.10
29 CR	22	9610	-5.47728	0.5	-	56.8	42.1	1.1	1.00
30 CR	18	7433	-4.48864	1.5	-	63.1	30.7	6.2	2.79
31 CR	14	2369	1.5	-4.48864	-	50.8	44.2	5.0	1.77
32 CR	14	24556	-5.47728	-	-	86.0	12.9	1.1	0.72
33 CR	15	1213	-4.48864	1.5	-	48.0	48.6	3.4	0.76
35 CR	-	390	1.5	-	-	0.7	99.3	0.0	0.30
36 CR	25	287	1.5	-	-	0.2	99.8	0.0	0.32
37 CR	22	364	1.5	-	-	0.0	100.0	0.0	0.27
38 CR	40	463	1.5	-	-	2.6	97.4	0.0	0.49
39 CR	32	532	0.5	-	-	0.1	99.9	0.0	0.29
40 CR	29	397	1.5	-	-	3.4	93.7	2.9	0.47
41 CR	38	470	1.5	-	-	0.0	100.0	0.0	0.29
42 CR	33	363	1.5	-	-	0.0	100.0	0.0	0.24

Station	Depth [m]	Median [µm]	Mode 1	Mode 2	Mode 3	Fractional Composition			TOM [%]
			Phi	Phi	Phi	Gravel [%]	Sand [%]	Mud [%]	
43 CR	35	976	0.5	-2.5	-	35.7	63.4	0.9	0.59
44 CR	32	292	1.5	-	-	0.0	100.0	0.0	0.29
45 CR	35	321	1.5	-	-	5.3	94.7	0.0	0.43
46 CR	42	28	2.5	6.5	-	0.5	37.6	61.9	3.04
48 CR	49	418	1.5	-4.48864	7.5	29.7	51.1	19.2	1.88
49 CR	48.5	386	1.5	-	-	1.4	98.6	0.0	0.78
50 CR	51	304	1.5	-3.5	7.5	16.6	62.4	21.0	1.27
51 CR	50	358	1.5	-	-	7.5	87.3	5.2	0.84
52 CR	49	366	1.5	-4.48864	-	24.4	54.4	21.2	1.78
53 CR	49	324	1.5	4.5	-	12.5	64.1	23.4	1.44
54 CR	49	405	1.5	-	-	13.0	85.8	1.2	0.86
55 CR	-	435	1.5	-	-	16.8	81.9	1.3	1.20
56 CR	44	417	1.5	-	-	1.7	98.3	0.0	0.36
57 CR	46	358	1.5	-	-	1.0	99.0	0.0	0.44
58 CR	43	28	1.5	6.5	-	2.1	37.7	60.2	1.43
59 CR	39	353	1.5	-	-	2.9	97.1	0.0	0.38
60 CR	43	362	1.5	-	-	0.1	99.9	0.0	0.37
61 CR	44	219	1.5	4.5	-	1.9	67.7	30.3	1.25
62 CR	42	240	1.5	7.5	-1.5	9.0	65.7	25.3	1.51
63 CR	39	328	1.5	-	-	0.3	99.7	0.0	0.29
64 CR	-	345	1.5	-	-	8.5	84.9	6.6	0.58
65 CR	-	364	1.5	-	-	12.5	79.9	7.7	0.66
66 CR	41	352	1.5	-	-	5.4	94.6	0.0	0.64
67 CR	49	402	1.5	-	-	9.4	88.1	2.6	1.01
68 CR	49	363	1.5	-	-	10.9	85.2	3.9	0.95
69 CR	23	332	1.5	-	-	0.4	99.6	0.0	0.33
Summary Statistics									
Mean	36.9	1099.1	1.1	0.8	2.5	10.7	83.2	6.0	0.8
SD	9.4	3318.8	1.6	4.9	5.8	18.0	21.8	12.5	0.6
Min	14.0	28.0	-5.5	-5.5	-3.5	0.0	12.9	0.0	0.2
Max	51.0	24556.0	2.5	7.5	7.5	86.0	100.0	61.9	3.0
Median	39.0	364.0	1.5	0.5	3.0	3.5	94.6	0.0	0.8

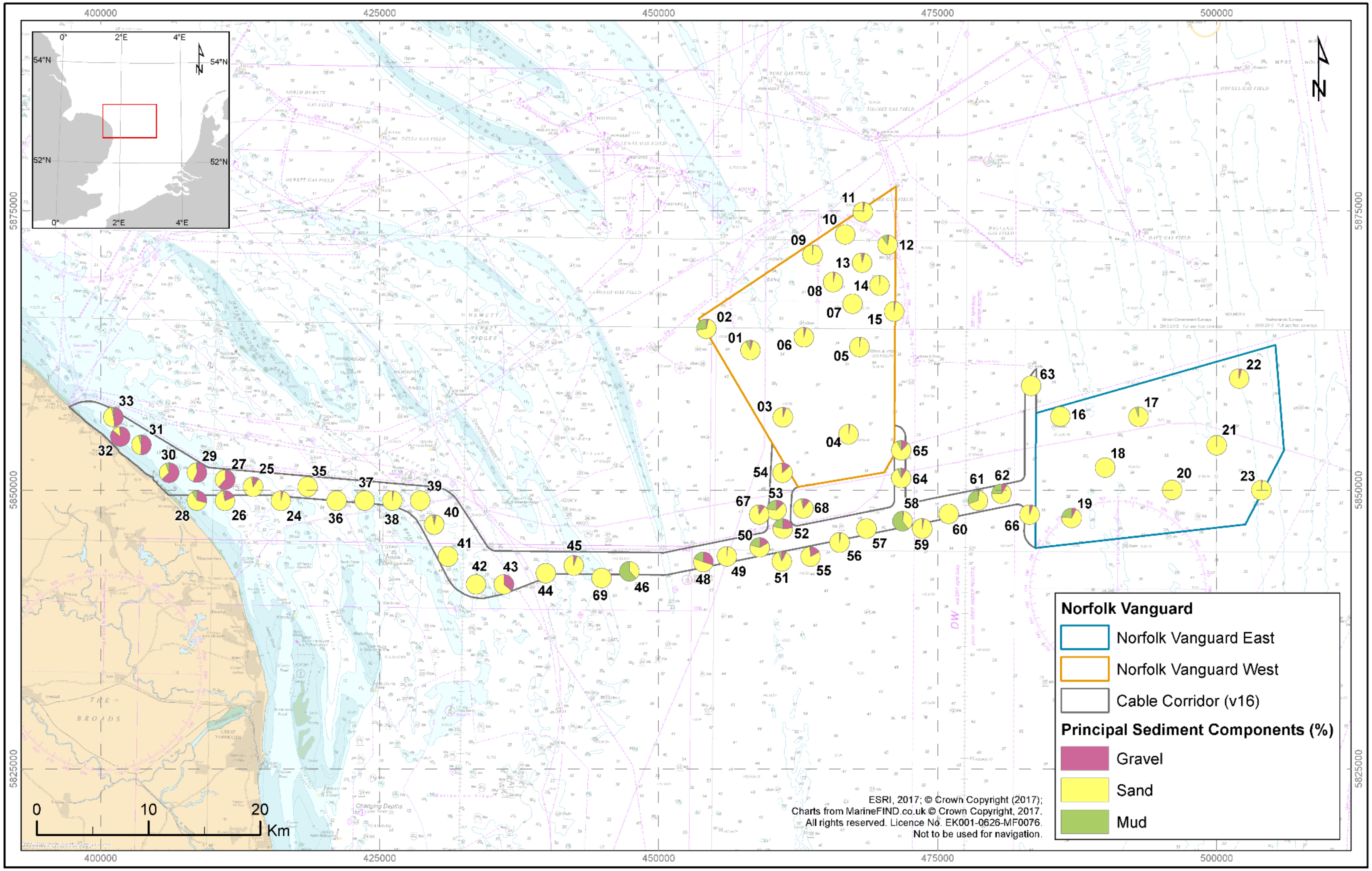

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Figure 5.4: Spatial distribution of the proportions of Gravel, Sand and Mud across the survey area

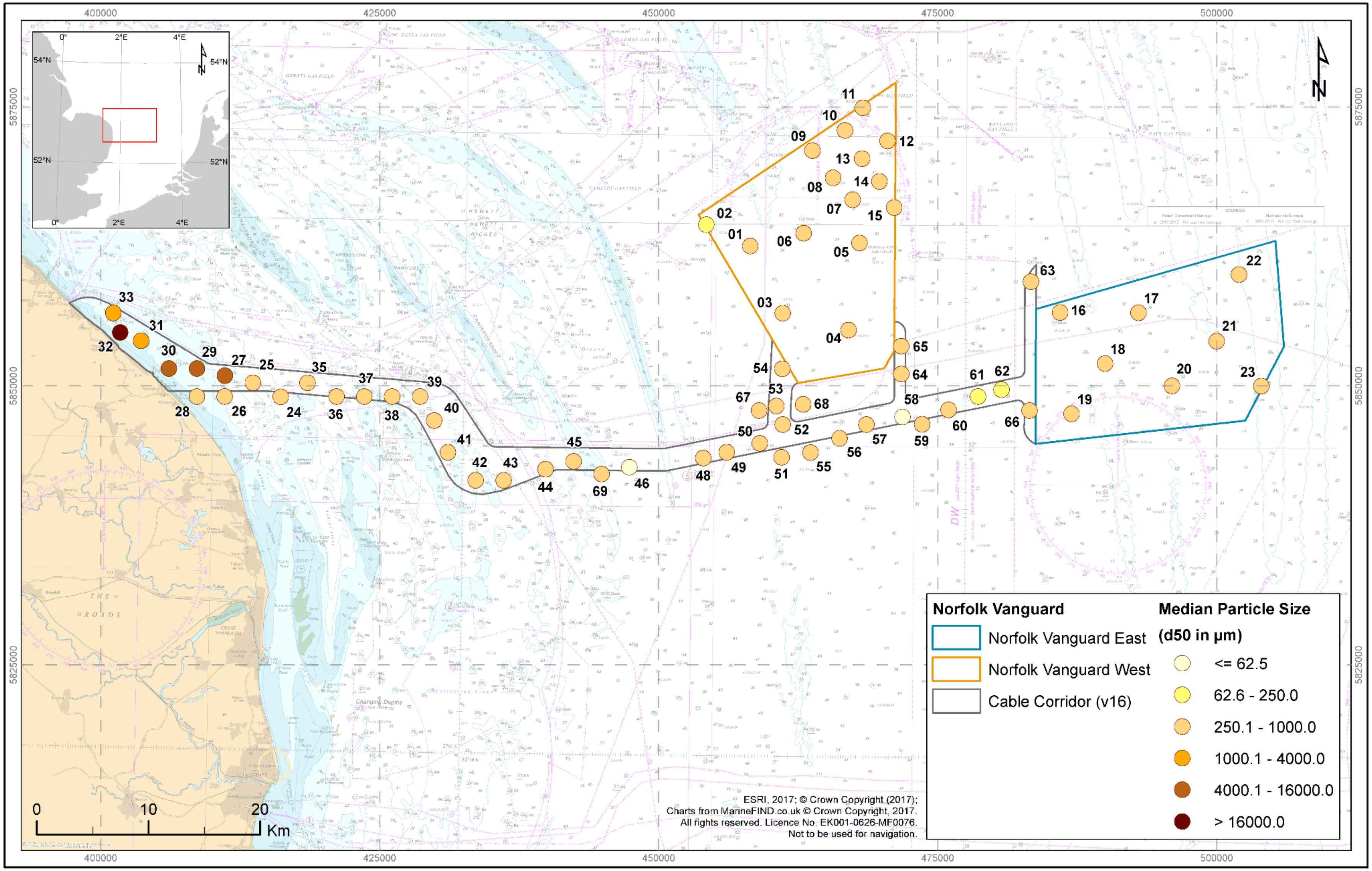

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Figure 5.5: Distribution of median sediment particle size (d50) across the survey area

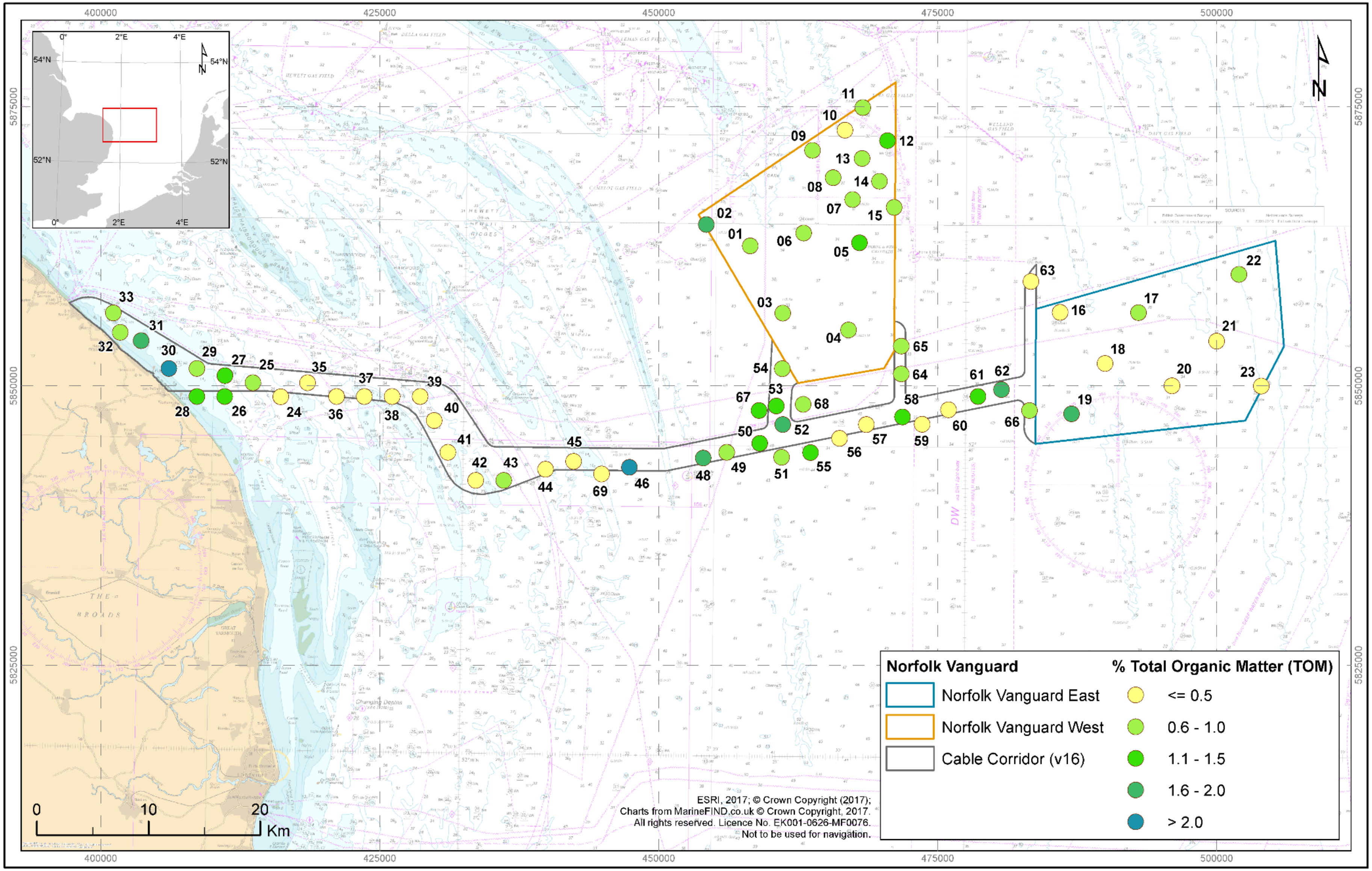

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Figure 5.6 TOM% distribution across the survey area

5.2.1 Multivariate Analysis

Data were further analysed using multivariate techniques as described in Annex C.1.

5.2.1.1 Hierarchical agglomerative clustering analysis

Figure 5.7 presents the ordinations of per cent fractional weight sediment data based on a Euclidean distance resemblance matrix. The grouping of the stations based on their sediment characteristics was obtained by cutting a slice through the dendrogram at a chosen level, identified after applying the SIMPROF routine set to a significance level of 5%. This process of defining coarser groups is appropriate provided that the resulting clusters are always supersets of the SIMPROF groups (Clarke et al., 2008).

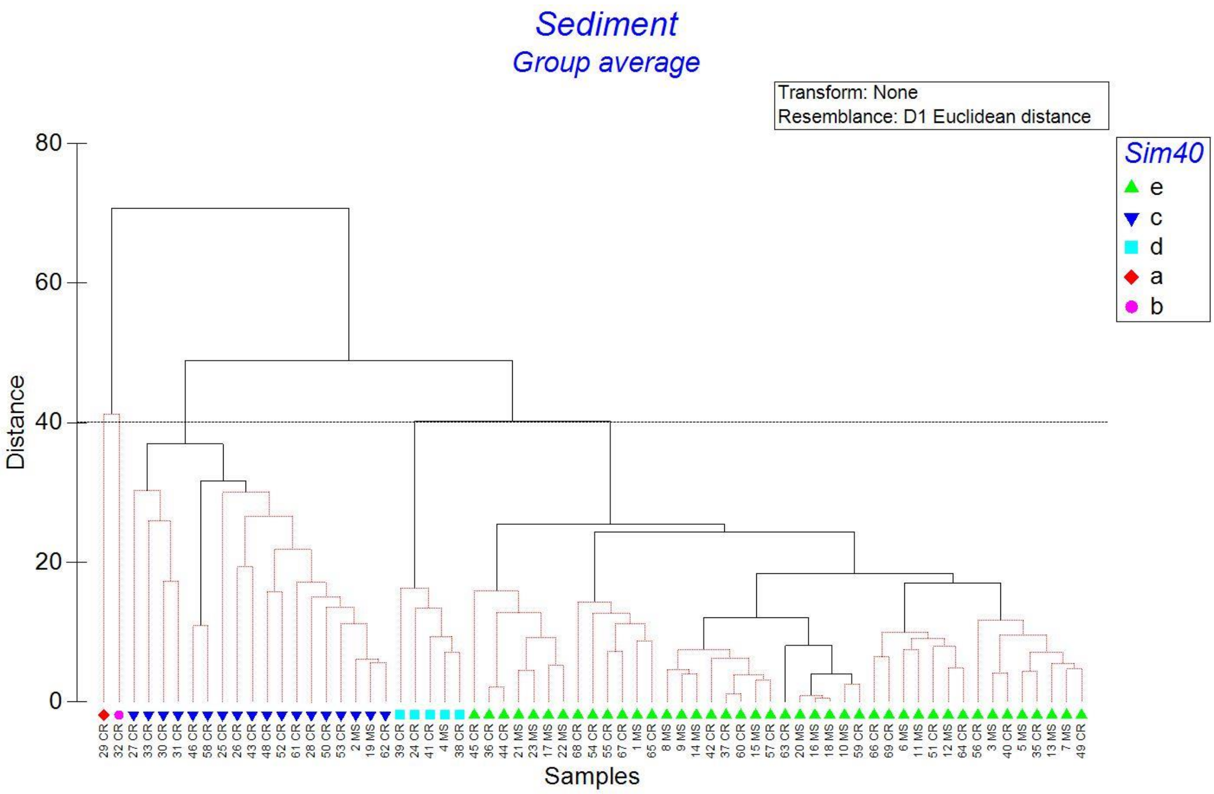

Figure 5.7: Dendrogram of the percentage fractional weight data with groupings by slice 40 based on Euclidean distance

Five groups were identified by the multivariate analysis and summarised in Table 5.6.

Table 5.6: Groups of Sediment Samples Identified by the Multivariate Analysis

Group	Stations	Median [µm]	Main Sediment Fraction [%]			Description (Folk)
			Mud	Sand	Gravel	
a ♦ Depth [m] 22	29 CR	5751.8	1.1	42.1	56.8	sG
b ● Depth [m] 14	32 CR	16978.2	1.1	12.9	86	G
c ▼ Depth [m] 34.1 ± 14.1	2 MS, 19 MS, 25CR, 26CR, 27 CR, 28 CR, 30 CR, 31 CR, 33 CR, 43 CR, 46 CR, 48 CR, 50 CR, 52 CR, 53 CR, 58 CR, 61 CR, 62 CR	2136 ± 4054	18.9 ± 18.6	51.2 ± 15.8	29.9 ± 25.8	(g)mS, (g)sM, gmS, sG, msG and G
d ■ 36.4 ± 1.8	4 MS, 24 CR, 38 CR, 39 CR, 41 CR	495 ± 23	0	98.1 ±1.7	1.9 ± 1.8	(g)S
e ▲ 38.1 ± 6.9	1 MS, 3 MS, 5 MS, 6 MS, 7 MS, 8 MS 9 MS, 10 MS, 11 MS, 12 MS, 13 MS, 14 MS, 15 MS, 16 MS, 17 MS, 18 MS, 20 MS, 21 MS, 22 MS, 23 MS, 35 CR, 36 CR, 37 CR, 40 CR, 42 CR, 44 CR, 45 CR, 49 CR, 51 CR, 54 CR, 55 CR, 56 CR, 57 CR, 59 CR, 60 CR, 63 CR, 64 CR, 65 CR, 66 CR, 67 CR, 68 CR, 69 CR	376 ± 71	1.4 ± 2.6	95.2 ± 5.7	3.4 ± 4.1	(g)S, gS, S, (g)mS

Group a was formed by the single station 29CR, which was classified as sandy gravel (sG) and mainly characterised by very coarse gravel (phi = -4 to -5), described as very poorly sorted (vps). Group b was also formed by a single station (32CR), which was classified as gravel (G) and almost exclusively characterised by coarse gravel (phi = -5), described as very poorly sorted (vps). Group c was formed by 18 stations. This group was more heterogeneous with two stations classified as (g)mS, two stations as (g)sM, seven stations as gmS, four stations as sG, two stations as msG and one station as G. The sediment in this group ranged from poorly sorted (ps) to extremely poorly sorted (eps). Group d was formed by five stations all classified as (g)S, mainly characterised by medium sand and coarse sand with the sediment in this group ranging from poorly sorted (ps) to well sorted (ws). The majority of the stations (42) formed group e and were characterised by fine to coarse sand, mainly classified as slightly gravelly sand ((g)S), with 10 stations classified as gravelly sand (gS), two as sand (S) and one as slightly gravelly muddy sand ((g)mS). The sediment in this group ranged from moderately sorted (ms) to moderately well sorted (mws).

These characteristics of the sediments are superimposed to the 2-dimensional MDS plots and presented in Figure 5.8. The distribution of identified cluster groups across the surevy area is illustrated in Figure 5.9.

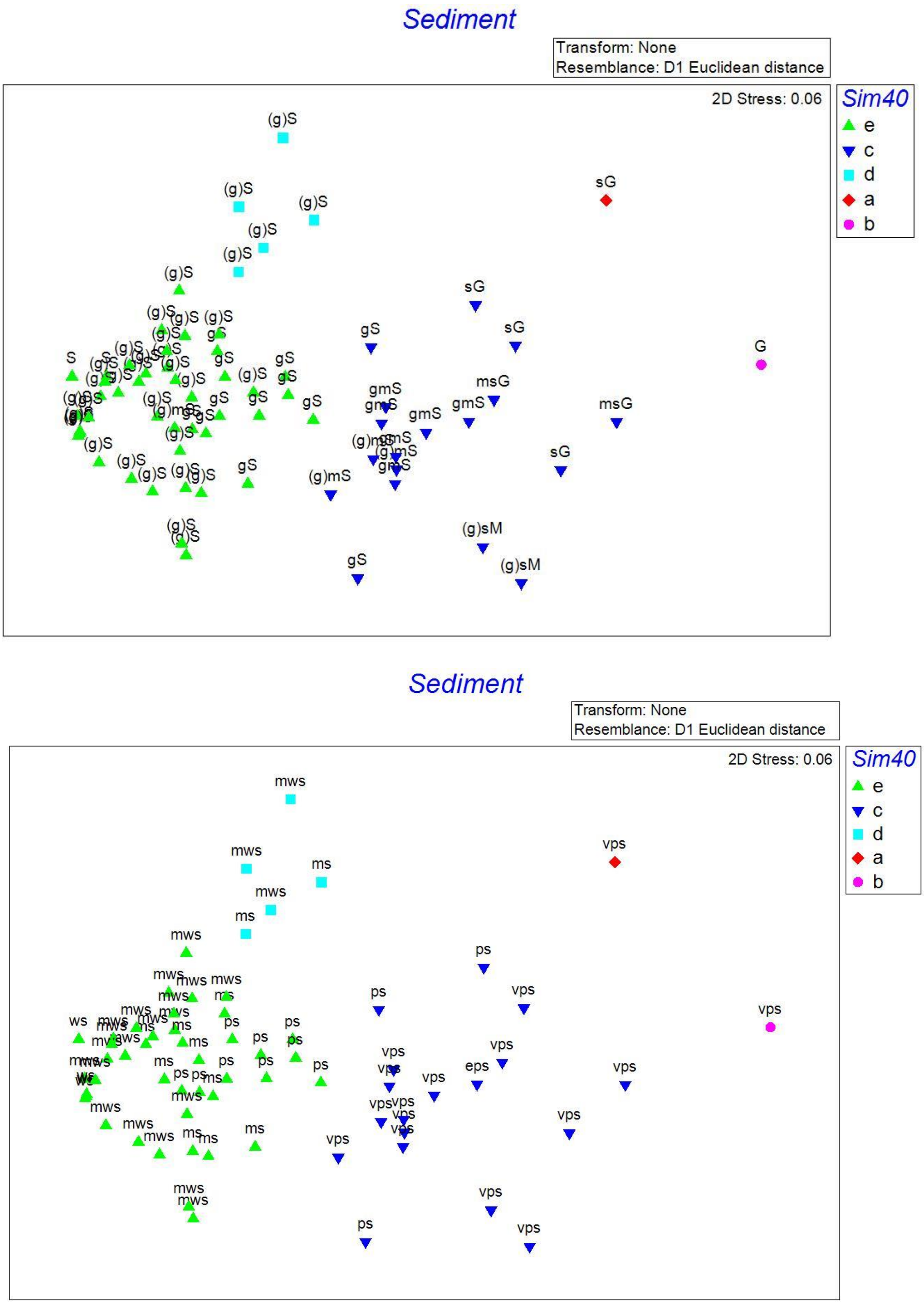

Figure 5.8: MDS Ordination of the Percentage Fractional Weight Data with Folk Classification 1954 (A) and sorting categories (B)

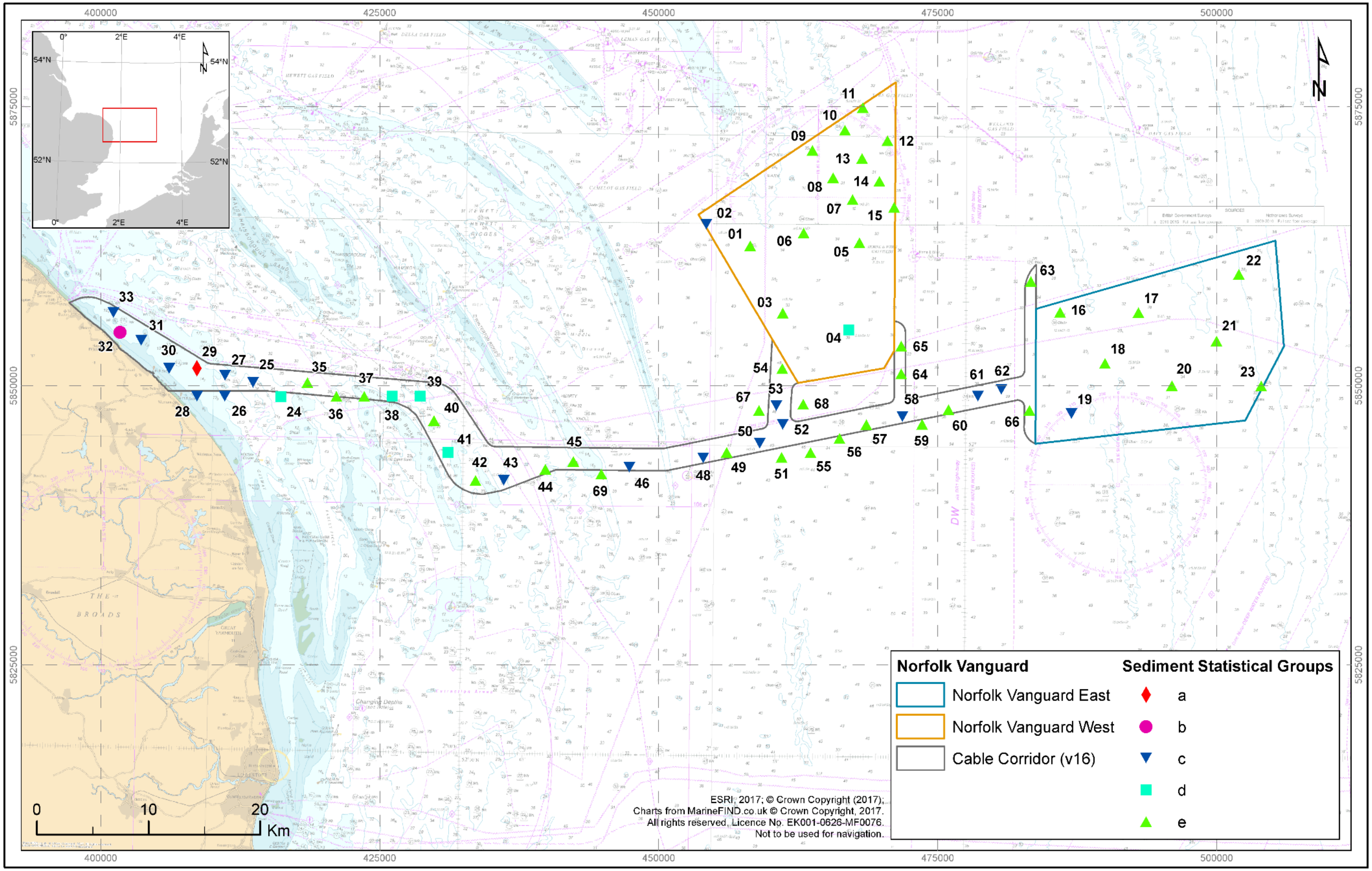

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Figure 5.9 Distribution of sediment cluster groups identified by hierarchical agglomerative cluster analysis across the survey area

5.2.1.2 Principal Component Analysis

To highlight the grain sizes which are driving the sediment characterisation, the principal component analysis (PCA) was undertaken. Figure 5.10 presents a PCA ordination plot for the percentage fractional sediment data used to identify the sediment fractions driving the variability of the sediment composition across the survey area. The principal component axis (PC1) was very strongly positively correlated with the percentage of 250µm (phi value 2), which includes the medium sand fraction and which accounts for 60.5% of the variation. The second principal component axes (PC2) was strongly positively correlated with the 500µm (phi value 1), which includes the coarse sand fraction and which accounts for a further 19% of the variation. The third principal component was very strongly positively correlated with the percentage of 16000µm (phi value 4), which includes the coarser gravel fraction and which accounts for a further 8.5% of the variation.

The 3D dimensional PCA can be considered a good description of the higher multi-dimensional space with PC1, PC2 and PC3 together accounting for 87.96% of the variability. The importance of the percentage of the 250µm, 500µm and 16000µm fractions in structuring the multivariate patterns seen is visible from the bubble plots in Figure 5.11. These fractions are broadly representative of the percentage of fine to medium sand and coarser gravel (Blott, 2010).

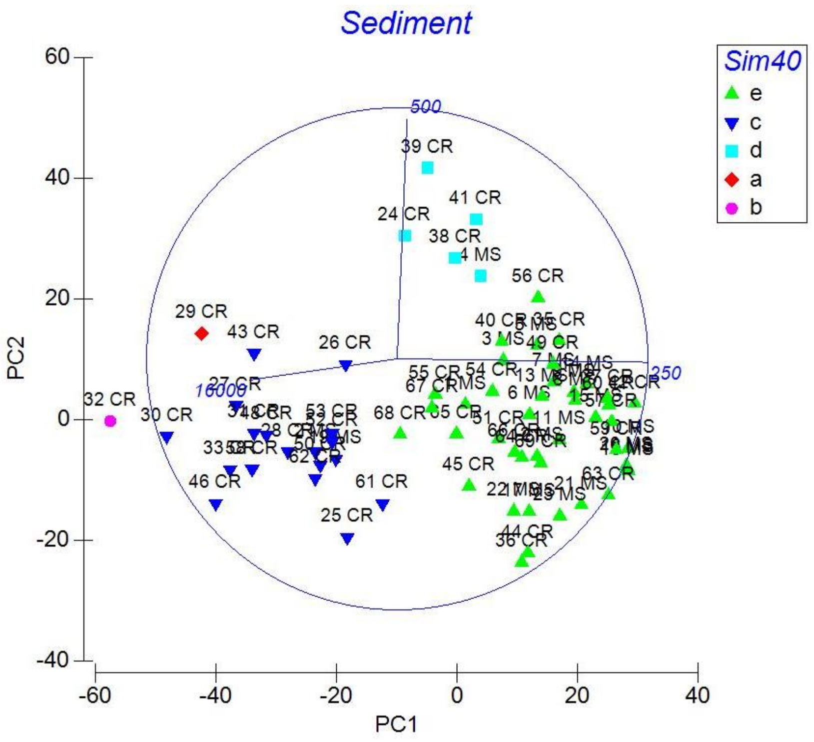

Figure 5.10: PCA ordination of particle sizes

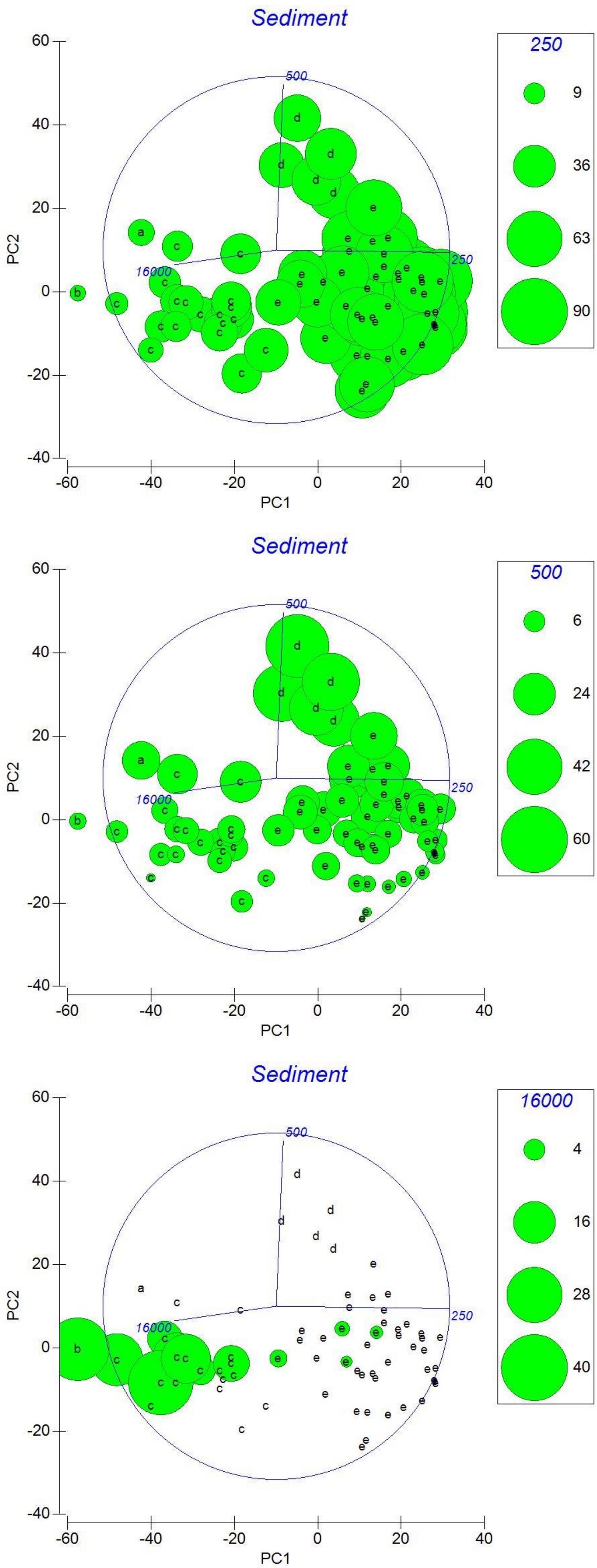

Figure 5.11: PCA ordination of particle sizes phi 2, 1 and -4 (% fine sand to coarser gravel) across the stations - the groups obtained by the multivariate analysis are overlaid

5.3 Sediment Chemistry

Contaminant samples were taken for the analysis of metals, polycyclic aromatic hydrocarbons (PAHs), Poly-Chlorinated Biphenyls (PCBs) and organotin compounds. The results of these analyses for a subset of 13 stations within the survey area are presented in Annex B.7.4. Results are compared against Effects Range Low (ER-L) standards and Effects Range Medium (ER M) standards. Values for metals have been compared against the relevant ER-L and ER-M standards and revised CEFAS Action Levels (AL) 1 and 2 for dredged material, where available. Where available results were also compared against the Canadian Sediment Guidelines for the Protection of Aquatic Life (CCME, 2014).

5.3.1 Metals

The seabed sediments collected were analysed for selected elements: arsenic, cadmium, chromium, copper, lead, lithium, manganese, nickel, vanadium and zinc. Concentrations of all metals analysed were below their correspondent ER-L standard. The only exception was Arsenic (As), which was below its ER-L standard at stations 20MS and 26CR. At the remaining stations, As levels were instead below the ER-M standard of 70 mg/Kg, ranging from 9.75 mg/Kg to 35.2 mg/Kg. Arsenic was also slightly above the CEFAS AL1 level of 20 mg/Kg at station 03MS, where its concentration was of 20.4 mg/Kg, below the CEFAS AL2 of 100 mg/Kg.

A similar pattern is observed where the results are compared against the Canadian Sediment Guidelines, with all metals being below the correspondent ISGQL levels, with the exception of Arsenic (As), which was below the As ISGQL standard of 7.24 mg/Kg at station 26CR. At all remaining stations As concentrations were below the PEL standard of 41.6 mg/Kg, ranging between 9.75 mg/Kg and 35.2 mg/Kg.

5.3.2 Hydrocarbons

Total hydrocarbons concentrations (THC) were between <0.9 $mgkg^{-1}$ at stations 38CR, 41CR and 56CR and 47.3 $mgkg^{-1}$ at station 48CR. All the single PAH concentrations were below the ER-L guideline value or below the CEFAS (2003) OSPAR value. Benzo(e)pyrene was below detection limit at the majority of the stations, but was detected at 5.8 μgKg^{-1} (0.006 $mgKg^{-1}$) at station 45CR, 6.05 μgKg^{-1} (0.006 $mgKg^{-1}$) at station 16MS and 7.03 μgKg^{-1} (0.007 $mgKg^{-1}$) at station 48CR. There are no guideline standards for this compound. No guideline standards are available for Dibenzothiophene, Perylene and Triphenylene; concentrations for these compounds were below detection limits at all stations, with the exception of Perylene, which was detected as 11.2 μgKg^{-1} at station 19MS. Also when compared with the Canadian Sediment Guidelines available, these were below the correspondent ISGQL standard. Total PAHs were calculated by summing up the concentrations of the single PAHs concentrations results at each station. Total PAHs were below detection limits at stations 06MS, 20MS, 24CR, 38CR and 41CR, whilst ranging between 10.2 μgKg^{-1} (0.1 $mgKg^{-1}$) and 83.3 μgKg^{-1} (0.8 $mgKg^{-1}$) at the other stations. Although these values were below the AL for Total Oil Hydrocarbons of 100μgg^{-1} (which equals to 100$mgKg^{-1}$), it is important to highlight that this standard includes, but it is not limited to, PAHs (CEFAS, 2003).

5.3.3 Poly-Chlorinated Biphenyls (PCBs)

No ER-L or ER- M standards exist for assessing adverse impacts associated with the presence of PCBs in the sediment. The only guideline available for these compounds is the sum of the concentration of all ICES7 PCBs (i.e. PCB – 028, PCB – 052, PCB – 101, PCB – 118, PCB – 138, PCB – 153 and PCB –

180) as indicated by the CEFAS AL1 of 0.1 mgkg^{-1} or <0.1 µgKg^{-1} (which equals to 0.0001 mgKg^{-1}). Levels were below their guideline values at all stations.

5.3.4 Organotins

Levels of TBT recorded in sediments were <4 µgKg^{-1} dw at all stations, with the exception of station 45CR, where the TBT concentration was 12.6 µgKg^{-1}. Values at all stations fell within Class C of the OSPAR reference levels OSPAR (2009 and Table 4.1).

At all stations, TBTs are below the revised CEFAS AL1 of 0.1 mgKg^{-1} (equivalent to 100 µgKg^{-1}) (CEFAS, 2003).

5.4 Macrofauna Data Analysis

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 and abundance data of fauna from the grab samples are presented in Annexes B.7.4 (infauna) and B.7.6 (epifauna).

5.4.1 Enumerated Fauna

Following the rationalisation process, the enumerated benthic fauna from grab samples comprised a total of 314 taxa, represented by 31,787 individuals.

Twenty-three taxa recorded were newly settled juveniles, with total abundance across the survey area ranged from 1 to 634 individuals. The juvenile taxon Ophiuridae (juv.) was the most abundant across the survey area with 634 individuals and was also recorded within the top ten most abundant taxa in the survey area. As the analysis showed that the presence of the juvenile component did not alter the community structure, the analysis was run including the juveniles. The alternative analysis, excluding juveniles, is presented in Annex D.2.

Of the juveniles, taxa belonging to the phylum Echinodermata were the most numerically dominant with 634 Ophiuridae juveniles present in 62% of the samples and 262 Ophiuroidea juveniles, present in 18% of the samples. Amphiuridae juveniles comprised only 2 individuals, recorded from station 65CR and only one Spatangoida juvenile individual was recorded at station 55CR. Following echinoderms, the most numerically abundant juveniles belonged to the phylum Cnidaria, including Ascidiacea (63 individuals, in 9% of the samples), Actinaria (5 individuals in 3% of the samples), Ascidiidae (4 individuals in 2% of the samples) and *Ascidia* (1 individual at station 28CR). The most abundant juvenile Crustacea taxon was Sessilia (Cirripedia) (15 individuals at station 30CR), followed by the genus *Ebalia* (4 individuals in 6% of the samples), the families Gnathiidae (1 individual at station 31CR) and Crangonidae (1 individual at station 06MS) and the genera *Inachus*, *Eurynome*, and *Mya* (all 1 individual at stations 28CR, 01MS and 67CR respectively). Mollusca taxa included the genus *Abra* (11 individuals at 11% of the samples) and the families Pectinidae (2 individuals at site 03 MS) and

Pharidae (2 individuals at station 01MS). Sipuncula were also present (4 individuals in 5% of the samples).

No enumerated taxa were removed from the dataset prior to the analysis.

5.4.1.1 Phyletic Composition

The phyletic composition of the enumerated benthic fauna is summarised in Table 5.7 and graphically represented in Figure 5.12.

Annelida were dominant in terms of taxa composition, accounting for 136 taxa, equivalent to 43% of the benthic diversity; they were followed by Crustacea (98 taxa, 31%) and Mollusca (42 taxa, 13%), whereas Echinodermata and “Other Taxa” comprised respectively 6% (with 19 taxa each) of the benthic faunal diversity. This was reflected also in the abundance, where Annelida were the most abundant with 23,605 individuals (74% of the benthic abundance, followed by Crustacea (3,480 individuals, 11%), “Other Taxa”, Echinodermata and Mollusca comprised 7% (2,297 individuals), 6% (1,866 individuals) and 2% (539 individuals) of the benthic abundance respectively.

Table 5.7: Phyletic Composition of Enumerated Fauna from Grab Samples

Taxonomic Group	Number of Taxa	Abundance [Number of Individuals]
Annelida (Polychaete)	136	23605
Crustacea (shrimps, prawns, crabs)	98	3480
Mollusca (bivalves, gastropods, chitons)	42	1866
Echinodermata (sea urchins, brittlestars, starfish)	19	539
Other taxa	19	2297
Total	**314**	**31787**

Note:
Other taxa included: Chordata, Cnidaria, Foraminifera, Hemichordata, Nemertea, Porifera, Phoronida, Platyhelminthes and Sipuncula

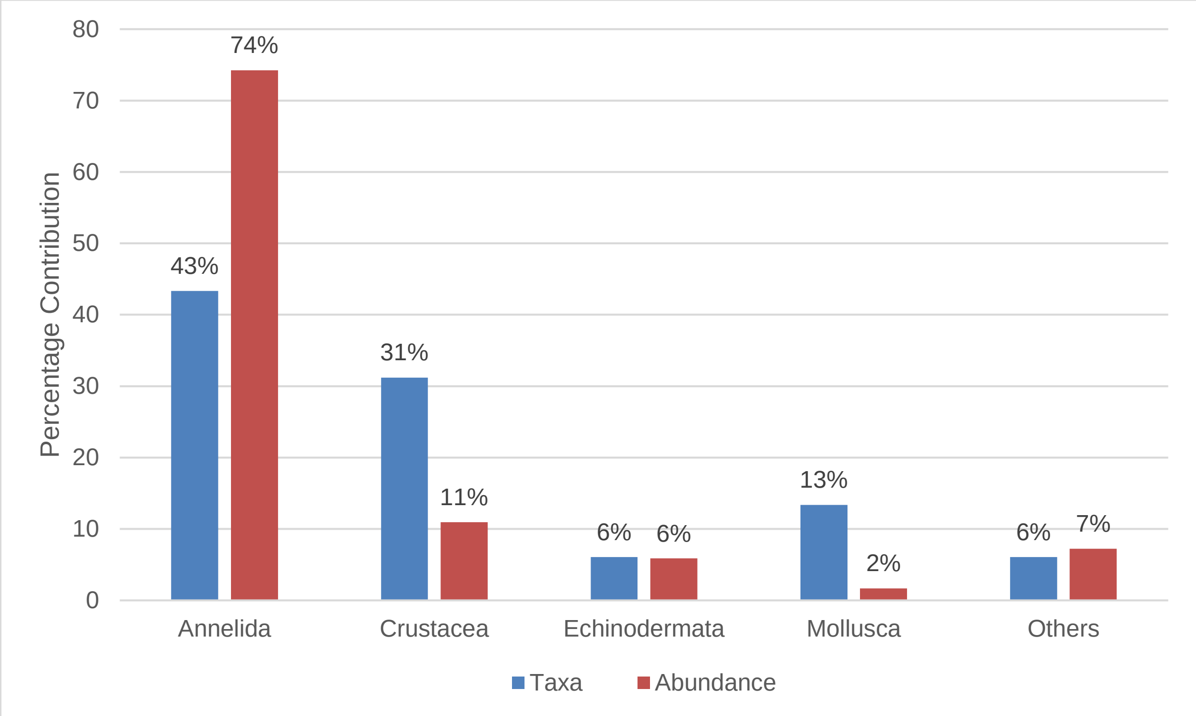

Figure 5.12: Percentage contribution to abundance of major taxonomic groups

Amongst the annelids, the Ross worm *S. spinulosa* was by far the most abundant species, accounting alone for nearly 72% of the annelid abundance (11,093 individuals). This was, however, the third most commonly occurring species, been recorded in 43% of samples. The polychaete *Pygospio elegans* was the second most abundant species, with 1,006 individuals accounting for 7% of the annelids' abundance; however, this species was only recorded at 2 stations along the proposed cable corridor (25CR and 27CR). The most widespread annelid species were *N. cirrosa* (96 individuals) and *Spiophanes bombyx* (267 individuals), which were present in 52% and 51% of the samples respectively. *O. borealis* with 270 individuals was the third most abundant species and recorded in 40% of the samples, whilst *Pholoe baltica* (168 individuals) and *Lagis koreni* (87 individuals) occurred in 33% of the samples. The remaining annelid species represented up to 1% of the total annelids and occurred 30% of the samples, maximum.

Crustaceans were dominated by the long-clawed porcelain crab *Pisidia longicornis*, which, with 1,032 individuals, accounted for 30% of this phylum's abundance. This species was also the second most widespread species, occurring in 33% of the samples. The Amphipoda *Ampelisca diadema* (446 individuals), *Abludomelita obtusata* (345 individuals), *Gammaropsis maculata* (334individuals), *Urothoe brevicornis* (179 individuals), *Austrominius modestus* (114 individuals), *Bathyporeia pelagica* (73 individuals) and *Ampelisca* spinipes (72 individuals) were amongst the top ten most abundant crustancean species. *U. brevicornis* was also the most widespread of the crustacean species, being recorded in 48% of the samples, whilst *A. diadema* was recorded in 13% of the samples, *A. obtusata* in 25% of the samples, *G. maculata* in 21% of the samples, *A. modestus* in 1% of the samples, *B. pelagica* in 6% of the samples and *A. spinipes* in 19% of the samples. The acorn barnacle *Balanus crenatus* was also fairly abundant, within the phylum, with 181 individuals; however, it was not very common, as it was recorded in 4% of the samples. The mud shrimp *Upogebia delatura* was amongst the top ten most abundant crustacean species with 79 individuals and recorded at 18% of the samples. The remaining species accounted for less than 60 individuals each and recorded in a maximum of 25% of the samples.

Amongst the molluscs, the bivalves *Kurtiella bidentata* (110 individuals), *Nucula nucleus* (103 individuals), *Abra alba* (91 individuals) and *Fabulina fabula* were the four most abundant species in the phylum. The bivalve *A. alba* was also the most frequently occurring (30% of samples), together with *F. fabula* (24% of the samples). *N. nucleus*, despite been the second most abundant species, only occurred in 4% of the samples. The remaining mollusc species each comprised less than 20 individuals and each were present in less than 15% of the samples.

Amongst the Echinodermata, the juveniles if the family Ophiuridae was the most abundant species, comprising 34% of the echinodems' abundance (634 individuals); these were also the most widespread of the echinoderms, been present in 60% of the samples. Other fairly abundant and frequently occurring echinoderms included the brittlestars *Amphipolis squamata* (416 individuals in 34% of the samples), *O. ophiura* (337 individuals in 31% of the samples), juveniles of the order Ophiuroidea (262 individuals in 27% of the samples) and the sea urchins *Echinocyamus pusillus* (140 individuals in 28% of the samples). The remaining echinoderm species each comprised less than 10 individuals and each occurred in less than 12% of the samples.

Other taxa were dominated by Actinaria (978 individuals) and Nemertea (832 individuals), which were also the most widespread of the other taxa, been in the 30% and 49% of the samples respectively. The sea squirt *Dendrodoa grossularia*, with 135 individuals comprised 6% of the other taxa'a abundance. *Phoronis* sp. (120 individuals) and Plathyelminthes (56 individuals) were in 12% and 18% of the samples respectively. The remaining species in this group counted less than 50 individuals each and occurred in less than 10% of the samples.

The most abundant and frequently occurring species from grab samples are presented in Table 5.8. The most numerous species *S. spinulosa* and the most frequently occurring taxon Ophiuridae (juv.) were both present at a number of stations within both the main sites and the proposed cable corridor.

Table 5.8: Top Ten Most Abundant and Frequently Recorded Taxa in Grab Samples

Most Abundant Taxa		Most Frequently Occurring Taxa [n=36]	
Taxa	**Total**	**Taxa**	**%**
Sabellaria spinulosa	11093	Ophiuridae (juv.)	62
Pisidia longicornis	1032	*Nephtys cirrosa*	54
Pygospio elegans	1006	*Spiophanes bombyx*	52
ACTINIARIA	978	NEMERTEA	51
NEMERTEA	832	*Urothoe brevicornis*	49
Ophiuridae (juv.)	634	*Sabellaria spinulosa*	45
Ampelisca diadema	446	*Ophelia borealis*	42
Amphipholis squamata	416	*Amphipholis squamata*	35
Abludomelita obtusata	345	*Pisidia longicornis*	34
Ophiura albida	337	*Pholoe baltica*	34

5.4.1.2 Sessile Colonial Epifauna from Grab Samples

The non-enumerated taxa (whole, damaged or fragments) included organisms belonging to:

- The Hydrozoa families Bougainvilliidae, in four samples; Tubulariidae, in six samples, Campanularidae, including the genera *Clytia*. and *Obelia* and the species *Clytia hemisphaerica*, in six samples and Sertulariidae, including the genera *Sertularia* and *Sertularella* and the species *Hydrallmania falcata* and *Sertularia distans*, in seven samples;

- The Bryozoa genus *Alcyonidium* occurred in 10 samples, the ?family Membraniporoidea, in 18 samples, the species *Amathia lendigera*, in two samples, *Amphiblestrum auritum*, in two samples, *Aspidelectra melolontha*, in 39 samples, *Bicellariella ciliata*, in five samples, *Callopora dumerilii*, in four samples, *Celleporella hyalina*, in two samples, *Conopeum reticulum*, in 10 samples, *Crisia aculeata*, in one sample, *Electra monostachys*, in 14 samples, *Electra pilosa*, in 12 samples, *Escharella immersa*, in two samples, *Flustra foliacea*, in six samples, *Cradoscrupocellaria reptans* in one sample, *Scruparia ambigua*, in one sample and *Vesicularia spinosa*, in one sample.

- The Ascidiacea species *Botrylloides leachii*, occurred in one sample and *Perophora listeria*, in two samples, the Ciliophora family Folliculinidae in 38 samples, the Entoprocta genus *Barentia*, in one sample, and Porifera, including the *Cliona* (agg.), in three samples.

5.4.1.3 Biomass

The results of the blotted wet weight biomass and the converted data (Eleftheriou and Basford, 1989) to ash free dry weight (AFDW) are presented in Annex B.7.8.

The overall distribution of biomass across the survey area was calculated using the total biomass from each station. The distribution shows variation in biomass from a minimum of 0.01 g to 5.78 g per 0.1 m^2. There is not an obvious spatial trend, however, with the highest peaks were recorded at Stations 40 CR, 50 CR, 61 CR, 62 CR, 64 CR, 65 CR, 67 CR and 68 CR.

Overall the biomass was largely distributed between three main Phyla (Figure 5.13), with Polychaeta contributing for 34% of the overall biomass, Crustacea contributing 32% and Echinodermata contributing 22%. Mollusca contributed 11% of the biomass, whilst the remaining phyla contributed each to up to 1% of the total biomass.

Within the prevalent sediment type, (g)S, the total biomass was 11.1 g. Of this, Polychaeta contributed 6.2 g, accounting for 56% of the total within these samples, Crustacea and Echinodermata accounted for 19.5% (2.2 g) and 14% (1.581 g) respectively, whilst Mollusca, Cnidaria, Oligochaeta and ‘Other Taxa’ accounted for less than 10% of the total biomass. Within the stations with the second most common sediment type, gravelly sand (gS), the total biomass was 20.4 g. Of this Polychaeta contributed 7.4 g, accounting for 37% of the total for these stations. Crustacea and Mollusca accounted for 35.5% (7.2 g) and 24% (4.9 g) of the total biomass for these stations. Echinodermata, Cnidaria, Oligochaeta and ‘Other Taxa’ accounted for less than 10% of the total biomass. These data are shown in Figure 5.14 and the distribution of the biomass across the survey area is presented in Figure 5.15.

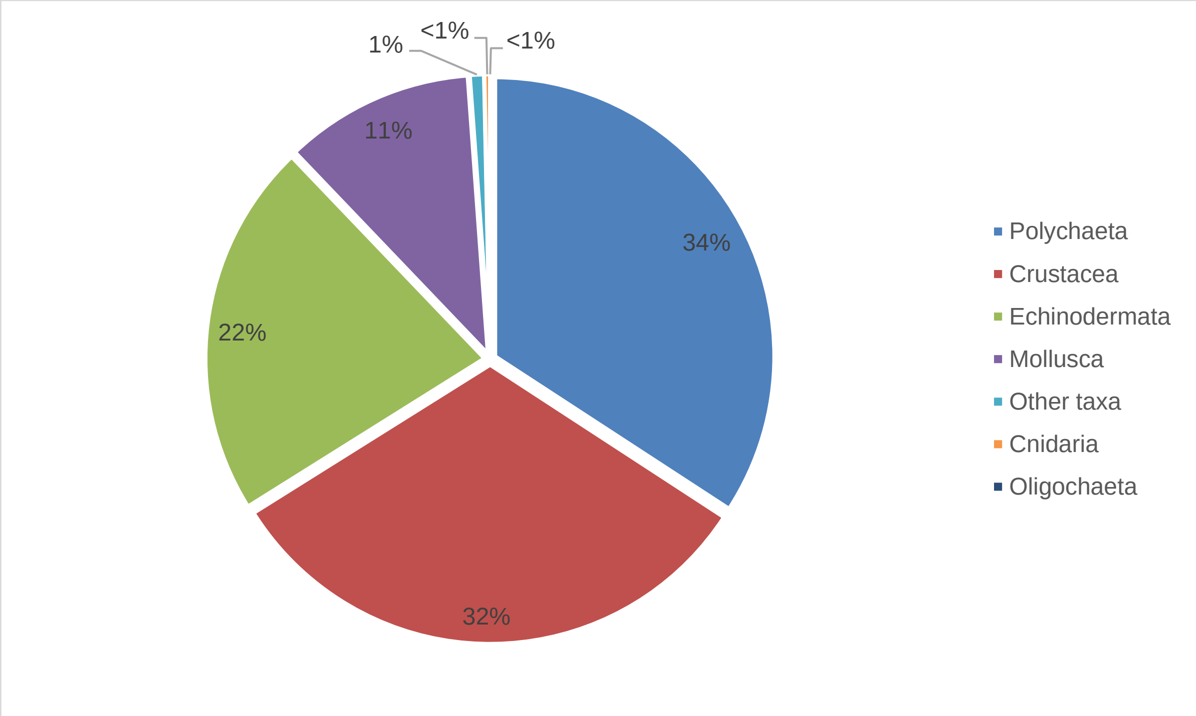

Figure 5.13: Total AFDW biomass (g/0.1 m^2) by phyla

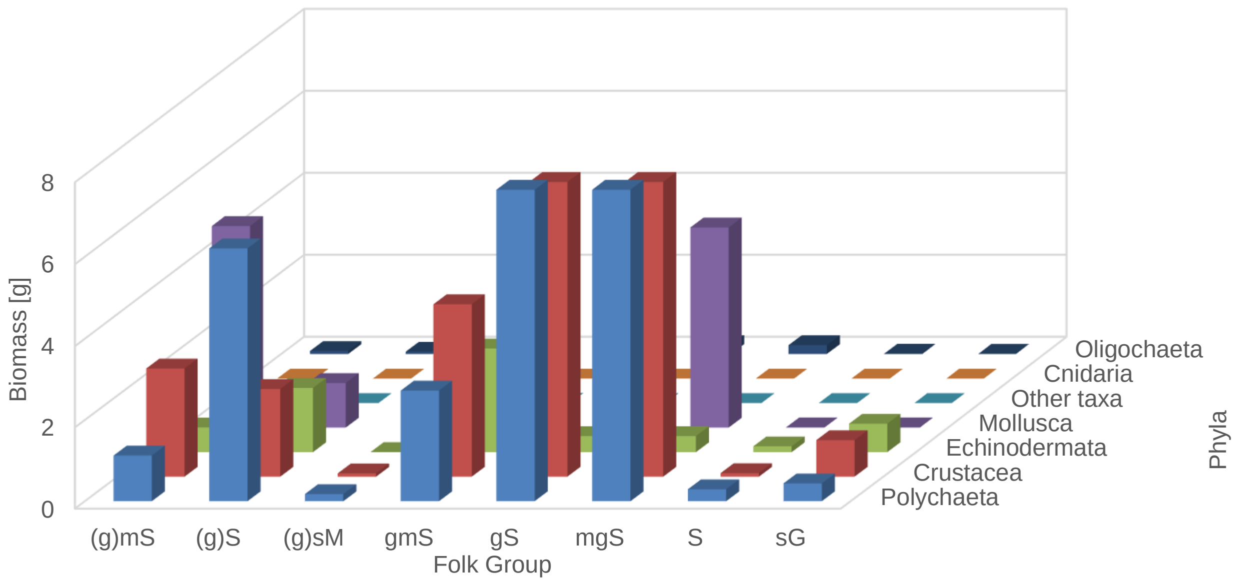

Figure 5.14: Total AFDW biomass (g/0.1 m^2) by phyla against Folk (1954)

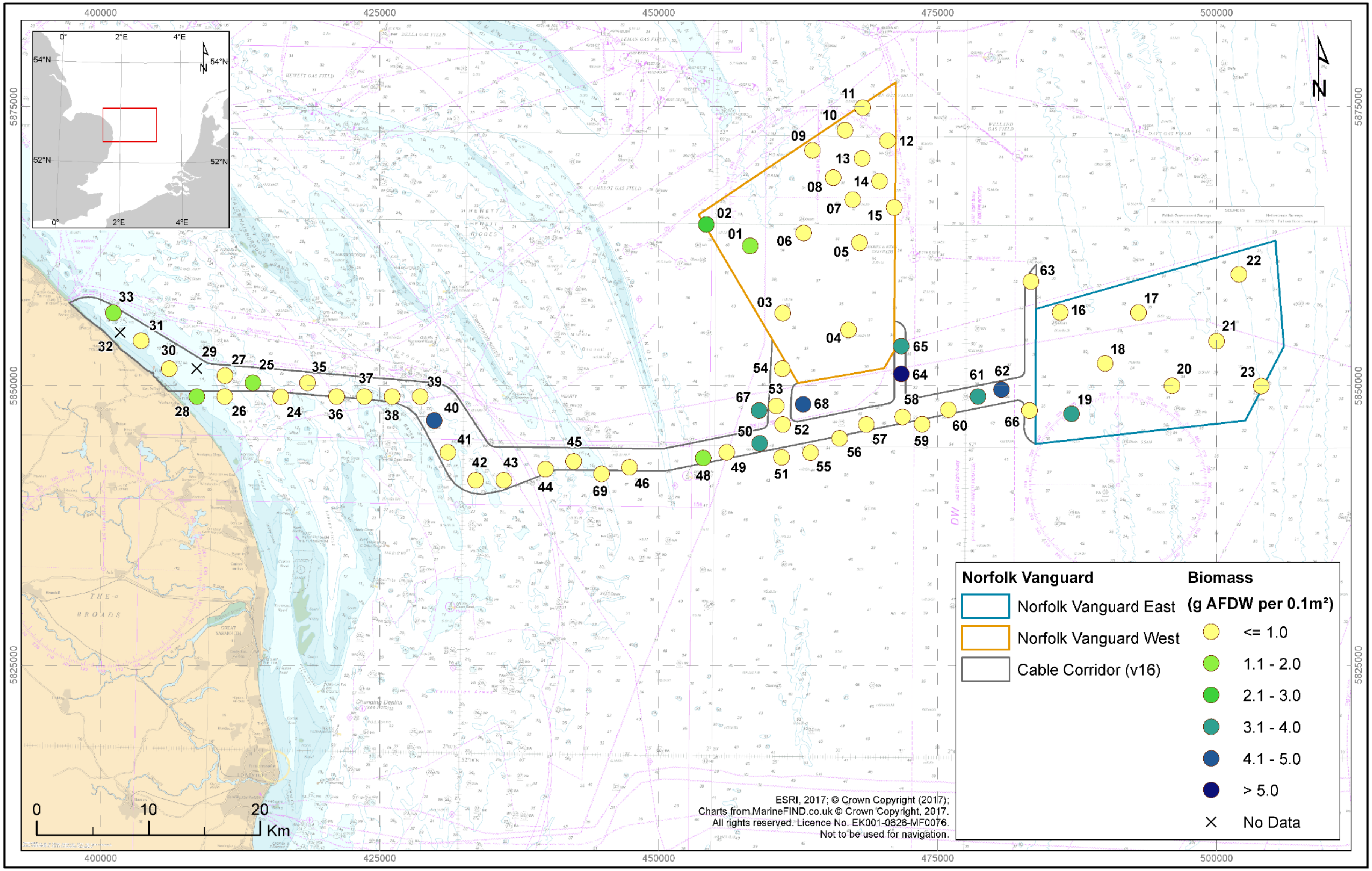

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Figure 5.15 Biomass distribution across the survey area

5.4.2 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.

The total number of taxa ranged from 1 (Sample 42 CR) to 87 (Sample 28 CR), with an average of 25 taxa across the survey area (Table 5.9). No overall pattern explaining the distribution of the number of taxa across the survey area was noted. However, it appeared to be higher corresponding to higher level s of mixed sediment. Faunal abundances were between 1 individual (Sample 42 CR) and 4,433 individuals (Sample 40 CR), with an average of 363 individuals across the survey area (Table 5.9). The distribution across the survey area is presented in Figure 5.16 and Figure 5.17 respectively.

Values of diversity were on average moderate ($H'\ log_2$ = 2.79), with five samples (7.7%) showing high diversity ($H'\ log_2 > 4$); 14 samples (21.5%) showing good diversity ($4 \leq H'\ log_2 \leq 3$); 34 samples (52.3%) showing moderate diversity ($3 \leq H' log_2 \leq 2$) and 11 (16.9%) showing poor diversity ($H'\ log_2 \leq 2$) (Table 5.9, Dauvin et al., 2012). The spatial distribution of species diversity within the survey area is shown in Figure 5.18.

Values of evenness were between 0.19 (Sample 40CR) and 1.00 (Sample 69CR) with an average of 0.75 across the survey area (Table 5.9). The lowest evenness value (J' = 0.2) in sample 40CR was associated with a numerical dominance of *S. spinulosa*, which accounted for 85% of the faunal abundance at this station. This was further confirmed by the value of high dominance (0.73) at this station. Conversely, the high value of evenness (J' = 1) in sample 60CR was associated with the presence, at this station, of only two species, the amphipod *Urothoe brevicornis* and the polychaete *O. borealis* which were both recorded with an abundance of two individuals; the station also showed no dominance (λ = 0). Evenness, dominance and diversity indices were not calculated at station 42CR where only one individual of *N. cirrosa* was recorded. Thus, values of low evenness corresponded well with values of high dominance, which ranged from 0 (69CR) to 0.73 (40CR). Higher dominance values (> 0.4) were associates with a numerical dominance of the polychaete species *S. spinulosa* at stations 01MS, 25CR, 40CR, 55CR, 64CR, 65CR and 67CR, which accounted for 65%, 10%, 85%, 68%, 65.5%, 69% and 68% of faunal abundance at each station respectively. At station 20MS the high dominance value (0.53) was associated with the amphipod *U. brevicornis* which accounted for 73% of the faunal abundance at this station. At station 25CR, the high dominance value (0.45) was associated with the numerical dominance of the polychaeta species *Pygospio elegans*, which accounted for 66% of the faunal abundance at this station. At station 36CR the high dominance value (0.45) was associated with the dominance of *Bathyporeia pelagica* which accounted for 69.5% of the faunal abundance at this station. Finally, at station 44CR, the higher dominance value was associated with the polychaete species *N. cirrosa*, which accounted for 57% of the faunal abundance at this station.

The distribution of Pielou's evenness index (J') and Simpson's dominance index (ʎ) across the survey area are presented in Figure 5.19 and Figure 5.20, respectively.

Table 5.9: Macrofaunal Community Statistics

Station	Numbers		Diversity Indices		Evenness
	Taxa [S]	Individuals [N]	Simpsons [d]	Shannon-Weiner [H' Log_2]	Pielou [J]
01MS	80	1132	11.23	2.583	0.4086
02MS	62	497	9.825	4.521	0.7593
03MS	35	264	6.098	3.037	0.592
04MS	5	8	1.924	2.156	0.9284
05MS	16	53	3.778	3.571	0.8928
06MS	21	57	4.947	3.762	0.8566
07MS	16	39	4.094	3.717	0.9293
08MS	13	90	2.667	2.451	0.6624
09MS	8	46	1.828	1.971	0.6571
10MS	10	34	2.552	2.387	0.7186
11MS	18	52	4.302	3.288	0.7884
12MS	15	35	3.938	3.427	0.8771
13MS	17	48	4.133	3.543	0.8668
14MS	11	22	3.235	2.959	0.8552
15MS	9	18	2.768	2.858	0.9017
16MS	6	34	1.418	2.312	0.8942
17MS	23	119	4.603	2.488	0.55
18MS	6	16	1.803	1.799	0.6959
19MS	61	831	8.925	4.415	0.7445
20MS	3	11	0.8341	1.096	0.6914
21MS	12	27	3.338	3.31	0.9232
22MS	8	33	2.002	2.285	0.7615
23MS	10	38	2.474	2.38	0.7165
24CR	9	16	2.885	3	0.9464
25CR	68	1515	9.149	2.452	0.4028
26CR	14	227	2.396	2.049	0.5381
27CR	25	71	5.63	3.832	0.8252
28CR	87	870	12.71	4.586	0.7117
30CR	57	492	9.034	3.827	0.6561
31CR	59	370	9.808	4.148	0.7051
33CR	53	781	7.807	2.934	0.5123
35CR	6	19	1.698	2.182	0.8439
36CR	9	95	1.757	1.64	0.5174
37CR	2	3	0.9102	0.9183	0.9183
38CR	6	10	2.171	2.522	0.9756
39CR	10	17	3.177	3.146	0.9471
40CR	34	4433	3.93	1.003	0.1972
41CR	3	5	1.243	1.371	0.865

Station	Numbers		Diversity Indices		Evenness
	Taxa [S]	Individuals [N]	Simpsons [d]	Shannon-Weiner [H' Log_2]	Pielou [J]
42CR	1	1	-	0	-
43CR	14	39	3.548	3.286	0.8631
44CR	3	6	1.116	1.252	0.7897
45CR	9	15	2.954	3.006	0.9484
46CR	4	5	1.864	1.922	0.961
48CR	44	738	6.511	3.264	0.5978
49CR	5	12	1.61	1.951	0.8402
50CR	51	409	8.314	3.872	0.6825
51CR	29	110	5.957	3.672	0.7559
52CR	8	14	2.652	2.753	0.9178
53CR	14	35	3.656	3.414	0.8967
54CR	13	39	3.276	2.95	0.7972
55CR	51	500	8.046	2.445	0.431
56CR	8	10	3.04	2.846	0.9488
57CR	7	10	2.606	2.646	0.9427
58CR	35	416	5.638	2.858	0.5572
59CR	14	28	3.901	3.231	0.8486
60CR	17	59	3.924	3.32	0.8124
61CR	15	35	3.938	3.437	0.8798
62CR	54	1059	7.609	3.745	0.6508
63CR	15	51	3.561	3.277	0.8388
64CR	55	1916	7.145	2.225	0.3849
65CR	75	3551	9.052	2.177	0.3495
66CR	19	59	4.414	3.583	0.8436
67CR	63	1743	8.307	2.189	0.3662
68CR	65	316	11.12	4.911	0.8155
69CR	2	2	1.443	1	1
Summary Statistics					
Minimum	1	1	0.83	0	0.20
Mean	24.57	363.17	4.57	2.79	0.75
Maximum	87	4433	12.71	4.911	1
SD	22.29	778.06	2.87	1.03	0.19

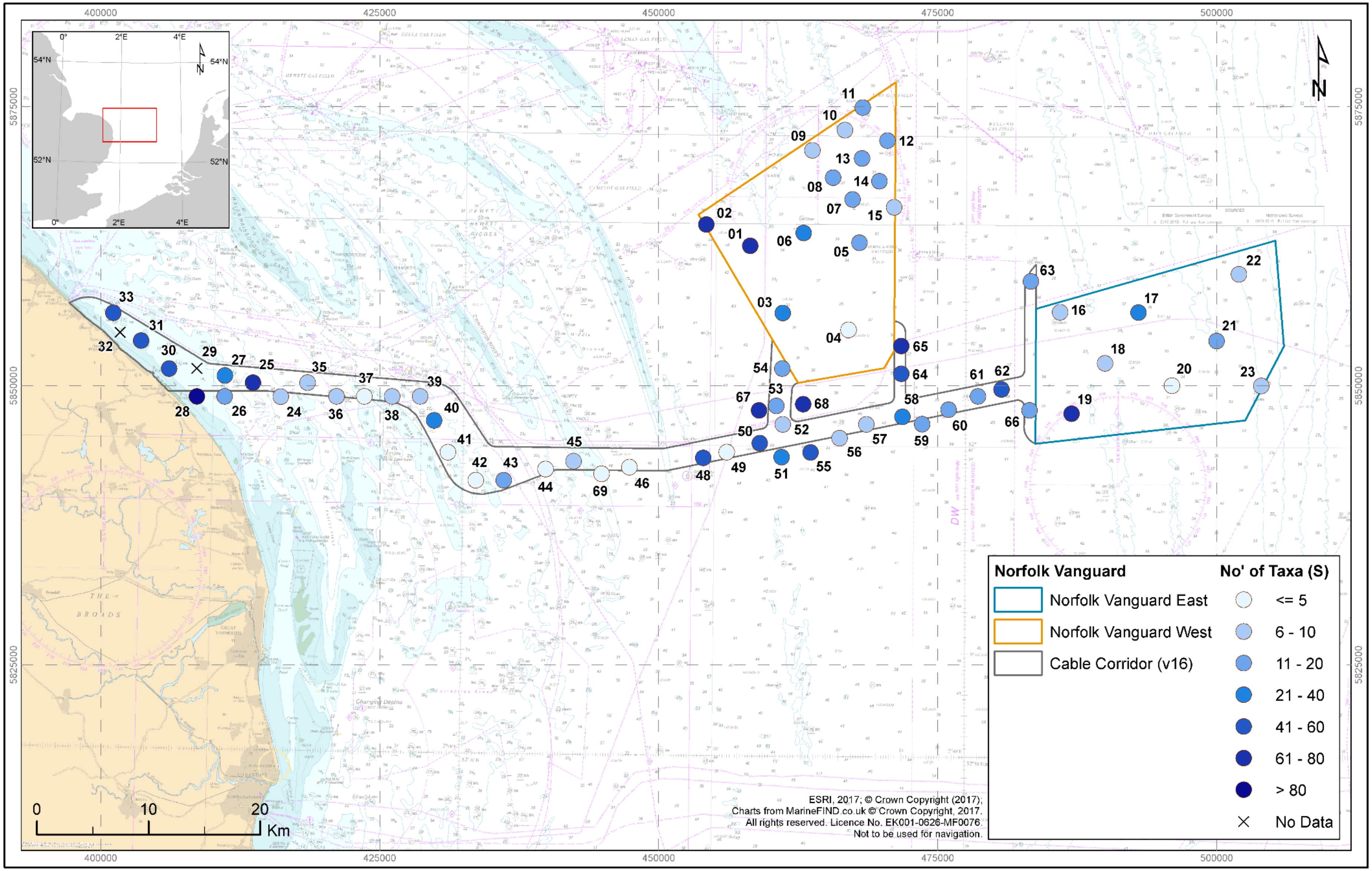

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Figure 5.16: Number of Taxa (S) from the grab samples across the survey area

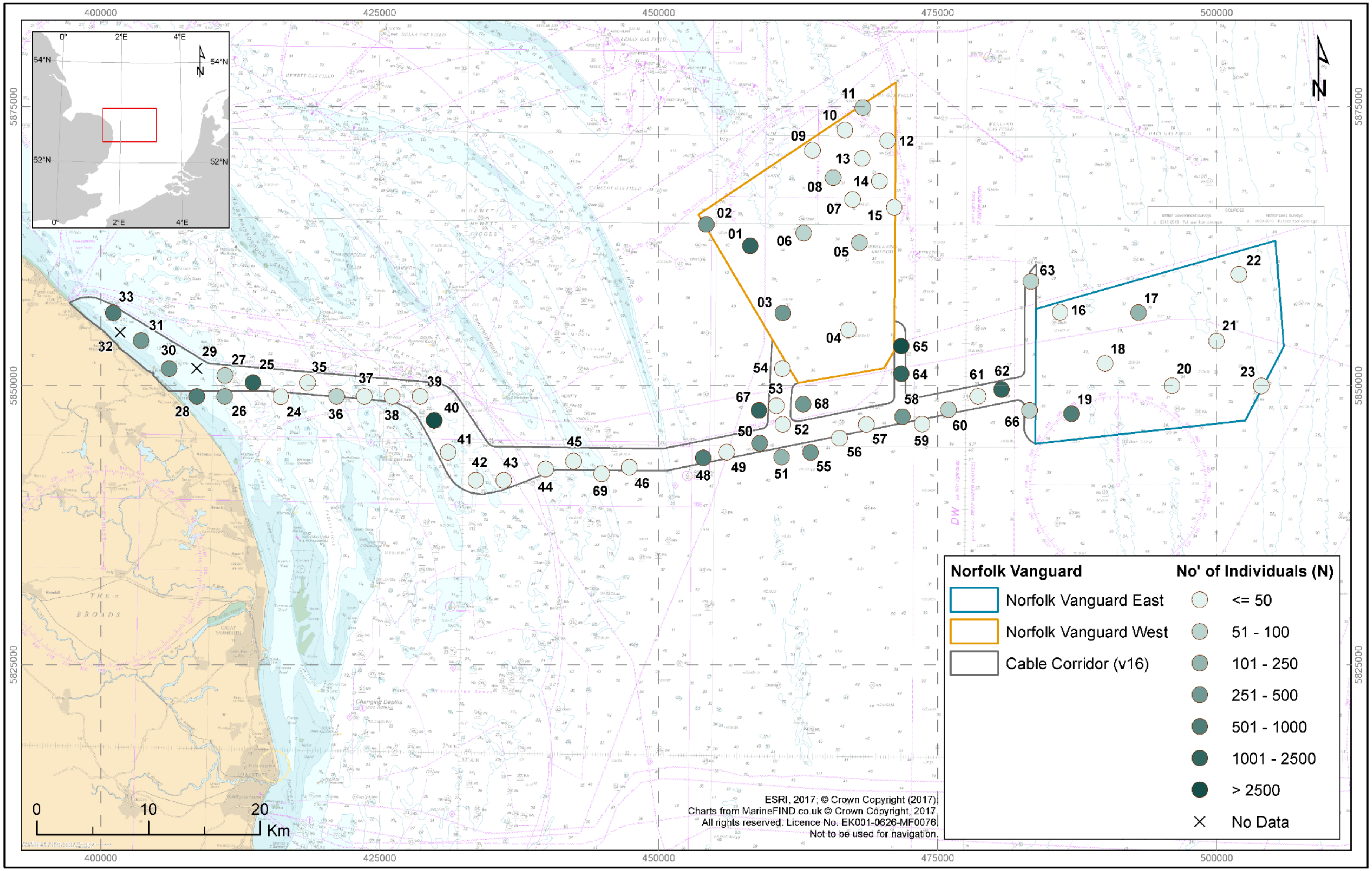

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Figure 5.17: Number of individuals (N) within the faunal grab samples across the survey area

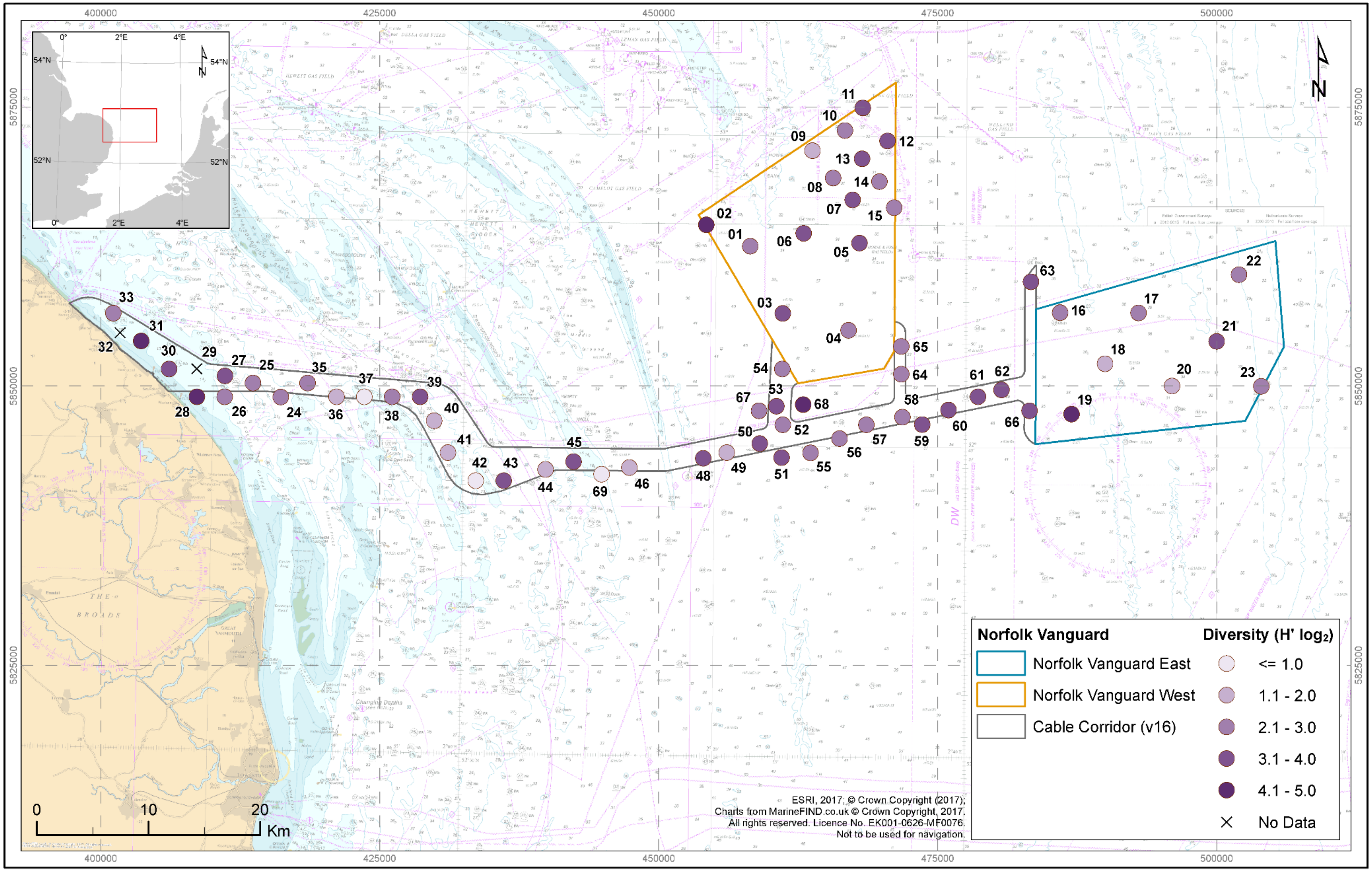

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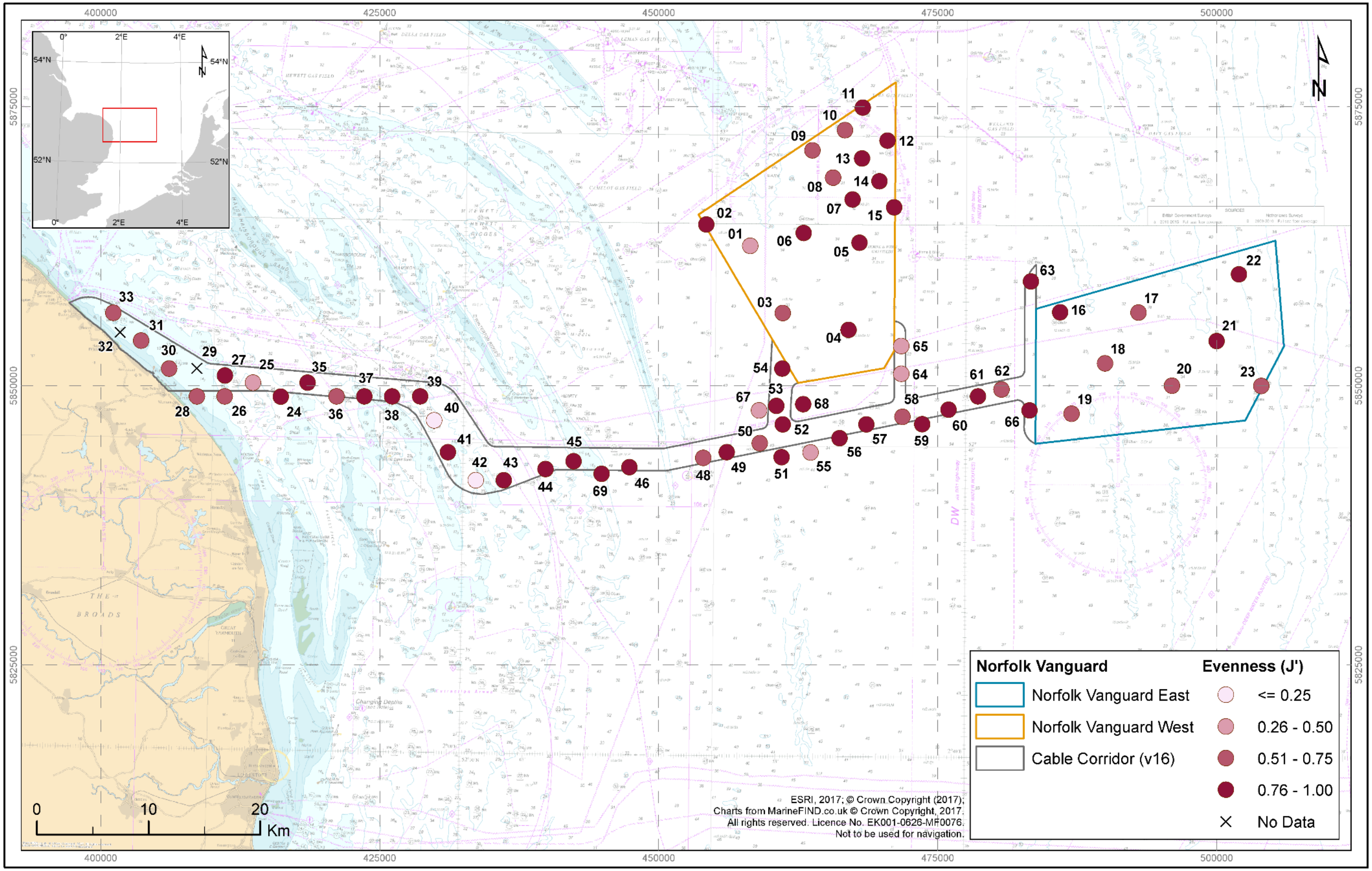
Figure 5.18: Taxonomic diversity based on Shannon-Weiner [H' Log_2] within the faunal grab samples



Map Document: (V:\E160976_Vattenfall_NorfolkVangard_Benthic\3_Plots\3_Final\Q160976_NV_Benthic_10_Evenness.mxd)
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Figure 5.19: The distribution of Pielou's evenness index (J') for grab samples across the survey area

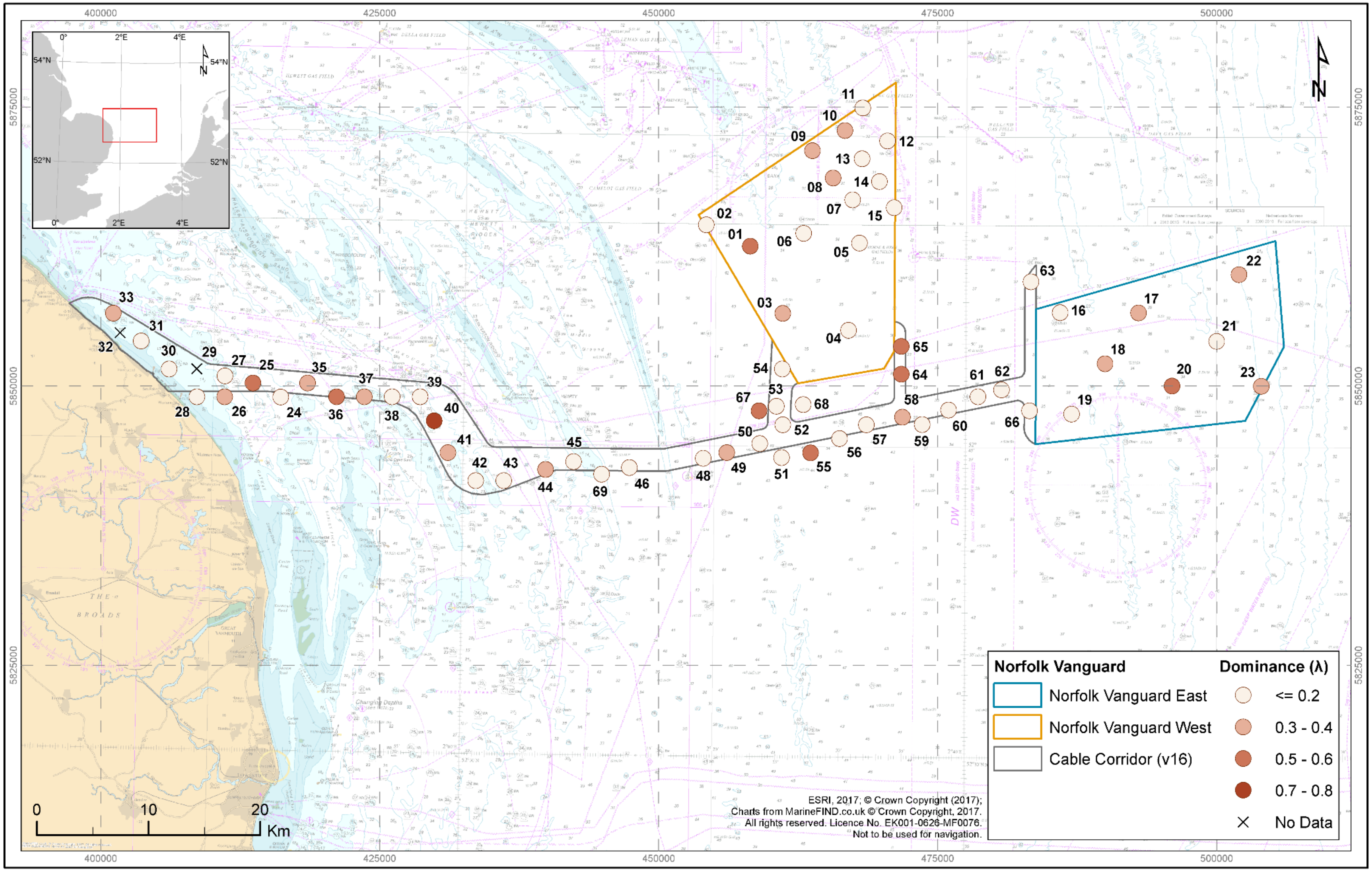

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Figure 5.20: The distribution of Simpson's dominance index (λ) for grab samples across the survey area

5.4.3 Multivariate Analysis

Prior to multivariate analysis, the enumerated faunal dataset was transformed. A fourth root transformation provided the best assessment of the enumerated faunal community, down-weighting the numerically dominant species (>1 000 individuals) which represented under 2% of the fauna, giving the right weight to the abundant taxa (> 100 individuals), which comprised 12% of the fauna, as well as to species with intermediate abundance (> 10 individuals), which represented 30% of the fauna, and the underlying community (≤ 10 individuals), which represented 56% of the fauna.

Community structure of the enumerated fauna within the survey area was assessed employing the hierarchical clustering analysis. 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. For this reason, the grouping of the stations based on their faunal composition was obtained by cutting a slice through the dendrogram at a chosen level, identified through applying the SIMPROF routine set to a significance level of 5%. This process of defining coarser groups is appropriate provided that the resulting clusters are always supersets of the SIMPROF groups (Clarke et al., 2008).

The dendrogram shows eight main groups of stations (Figure 5.21) and the description of the groups is presented in Table 5.10. Figure 5.22 illustrates the MDS, which is an ordination technique that arranges the samples on a two-dimensional plot, so that their relative distances from each other reflect their faunal similarities. The calculated stress coefficient of 0.16 resulting from their procedure indicates that the plot is a 'useful' representation of the multi-dimensional relationship between samples (Clarke and Warwick, 2001).

Group a comprised of a single sample characterised by slightly gravelly sandy mud, very poorly sorted, with a mean sediment particle size of 28 µm (coarse silt), in water depth of −42 m LAT. It comprised a relatively low faunal diversity and abundance. Characterising taxa included the bivalve *Barnea candida*, the brittlestar *Amphipholis squamata*, the polychaete *Glycera alba*, and the amphipod *Corophium volutator*.

Group b comprised of a single sample characterised by slightly gravelly sand, moderately well sorted, with a mean sediment particle size of 463 µm (medium sand), in water depth of −40 m LAT. Characterising taxa included the polychaetes *O. borealis*, *Notomastus*, *Spio goniocephala* and the amphipods *Ampelisca diadema*, *Eurydice spinigera*, *Pontocrates arcticus*.

Group c comprised of 19 samples. Six samples (32% of those forming the group) were characterised by slightly gravelly sand poorly sorted, four samples (21% of those forming the group) were characterised by gravelly muddy sand and the rest of the samples included gravelly sand, gravelly muddy sand, slightly gravelly muddy sand, muddy sandy gravel, sandy gravel and slightly gravelly muddy sand, with sorting index varying from very poorly sorted to moderately well sorted and a mean particle size ranging between 110 µm and 16978 µm (very fine sand to coarse gravel), in average water depth of −36 ± 13 m LAT. Characterising taxa included the polychaetes *S. spinulosa*, *P. baltica*, *Lumbrineris cingulata*, *Eunereis longissima* and *Glycera lapidum*, Nemertea, the echinoderms *A. squamata*, Ophiuridae (juv.), the long-clawed porcelain crab *P. longicornis* and Actinaria.

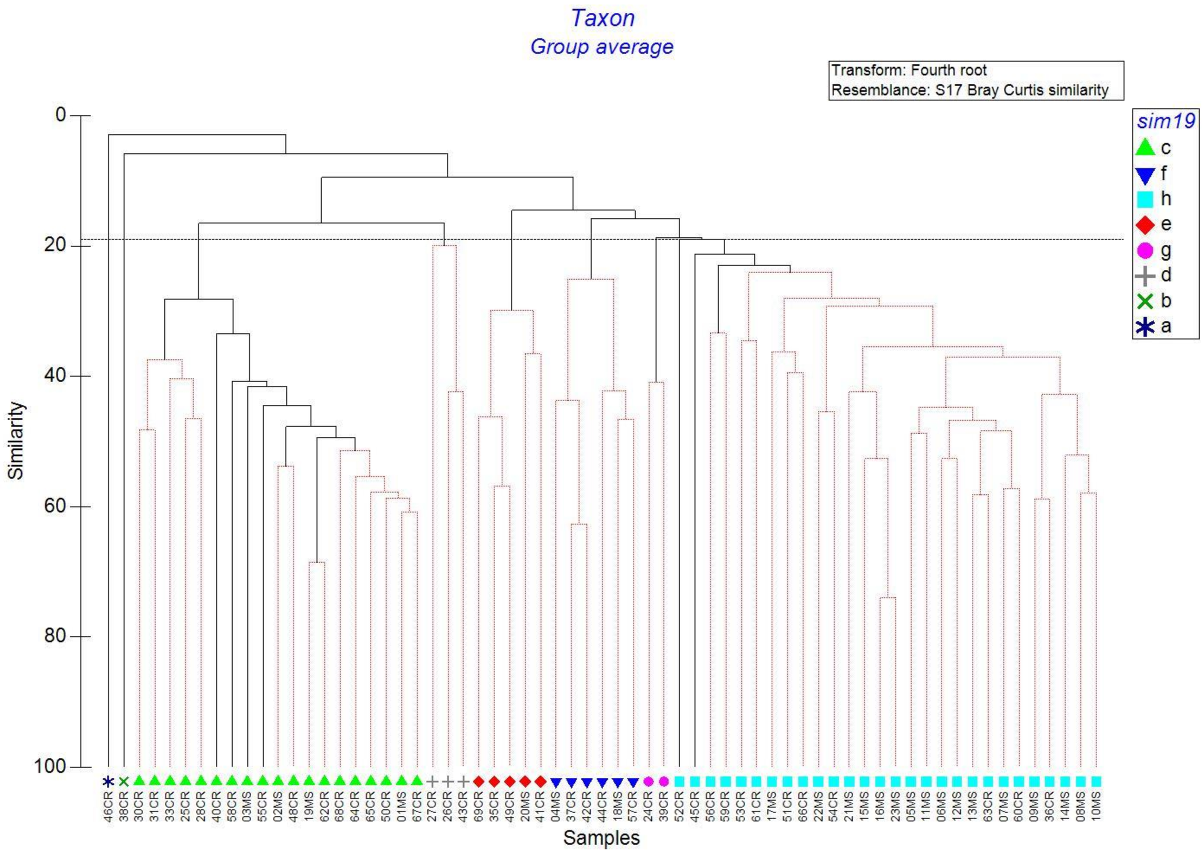


Figure 5.21: Dendrogram of Bray-Curtis similarity index of enumerated fauna from grab samples

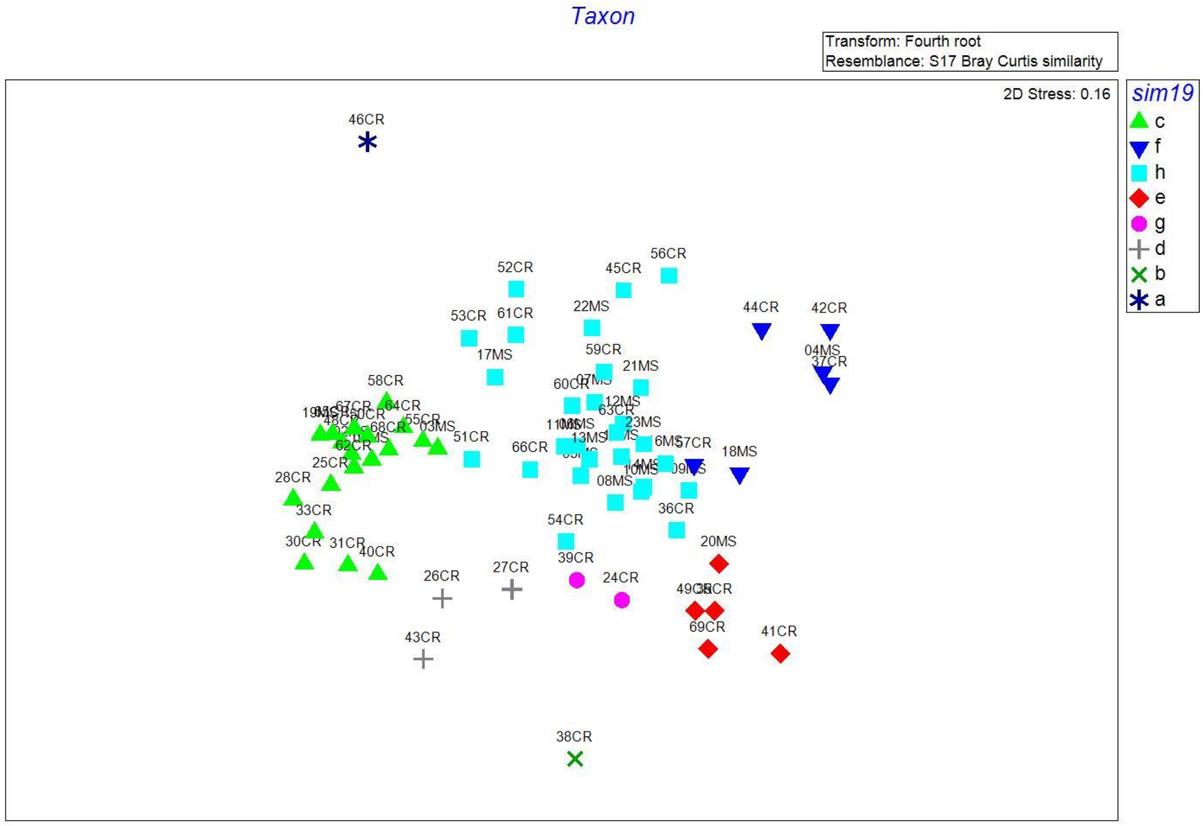


Figure 5.22: MDS plot of Bray-Curtis similarity index of enumerated fauna from grab samples

Table 5.10: Summary Attributes of the Faunal Group Derived from Multivariate Analysis of Enumerated Fauna from Grab samples

Group	Samples	Characterising Features	Species	Mean Abundance	Occurrence [% samples]
a ✱ Average similarity: N/A	46CR	S = 4 N = 5 Depth = 42 m Gravel = 0.5% Sand = 37.6% Mud = 61.9% D_{50} [µm]: 28	*Barnea candida* *Amphipholis squamata* *Glycera alba* *Corophium volutator*	2 1 1 1	40 20 20 20
b ✕ Average similarity: N/A	38CR	S = 6 N = 10 Depth = 40 m Gravel = 29.7% Sand = 51.1% Mud = 19.2% D_{50} [µm]: 463	*Ophelia borealis* *Ampelisca diadema* *Eurydice spinigera* *Pontocrates arcticus* *Notomastus* *Spio goniocephala*	2 2 2 2 1 1	20 20 20 20 10 10
c ▲ Average similarity: 38%	01MS, 02MS, 03MS, 19MS, 25CR, 28CR, 30CR, 31CR, 33CR, 40CR, 48CR, 50CR, 55CR, 58CR, 62CR, 64CR, 65CR, 67CR, 68CR	S: 57 ± 14 N: 1149 ± 1120 Depth [m]: 36.2 ± 13.4 Gravel: 18 ±18% Sand: 70 ±20% Mud: 12 ±15% D_{50} [µm]: 854 ± 1672	*Sabellaria spinulosa* *NEMERTEA* *Amphipholis squamata* *Ophiuridae (juv.)* *Pisidia longicornis* *Pholoe baltica* *Lumbrineris cingulata* *ACTINIARIA* *Eunereis longissima* *Glycera lapidum*	3.79 2.23 1.84 1.83 1.95 1.44 1.34 1.78 1.18 1.09	8.76 5.93 4.7 4.32 3.92 3.47 3.09 3.07 2.71 2.49
d + Average similarity: 27.5%	26CR, 27CR, 43CR	S: 18 ± 6 N: 112 ± 101 Depth [m]: 30 ± 4 Gravel: 39 ±21% Sand: 60±20% Mud: 2 ±1% D_{50} [µm]: 2636 ± 3302	NEMERTEA *Ophelia borealis* *Glycera lapidum* *Amphipholis squamata* *Socarnes erythrophthalmus* *Sabellaria spinulosa* *Protodorvillea kefersteini*	1.77 2.16 1.24 1.04 1.03 1.22 0.97	23.39 21.49 18.31 9.46 8.32 7.52 6.74
e ◆ Average similarity: 36.6%	20MS, 35CR, 41CR, 49CR, 69CR	S = 4 ± 2 N = 10 ± 7 Depth [m]: 36 ± 10 Gravel: 1 ±1% Sand: 99±1% Mud: 0% D_{50} [µm]: 384 ± 55	*Urothoe brevicornis* *Ophelia borealis*	1.38 0.81	77.55 18.39
f ▼ Average similarity: 33.84%	04MS, 18MS, 37CR, 42CR, 44CR, 57CR	S = 4 ± 2 N = 7 ± 5 Depth [m]: 35 ± 8 Gravel: 1 ±1% Sand: 99±1% Mud: 0% D_{50} [µm]: 361 ± 51	*Nephtys cirrosa* OPHIUROIDEA (juv.)	1.15 0.5	80.55 10.13

Group	Samples	Characterising Features	Species	Mean Abundance	Occurrence [% samples]
g Average similarity: 41.03%	24CR, 39CR	S = 9.5 ± 0.7 N = 16.5 ± 0.7 Depth [m]: 32 Gravel: 2 ±3% Sand: 98±3% Mud: 0% D_{50} [µm]: 529 ± 4	NEMERTEA *Nephtys cirrosa* *Pisidia longicornis* *Gammaropsis maculata*	1.19 1.3 1.09 1.09	27.16 27.16 22.84 22.84
h Average similarity: 30.40%	05MS, 06MS, 07MS, 08MS, 09MS, 10MS, 11MS, 12MS, 13MS, 14MS, 15MS, 16MS, 17MS, 21MS, 22MS, 23MS, 36CR, 45CR, 51CR, 52CR, 53CR, 54CR, 56CR, 59CR, 60CR, 61CR, 63CR, 66CR	S = 14 ± 5 N = 46 ± 28 Depth [m]: 40 ± 5 Gravel: 4 ±5% Sand: 93±12% Mud: 4 ± 8% D_{50} [µm]: 347 ± 39	*Nephtys cirrosa* *Ophiuridae (juv.)* *Spiophanes bombyx* *Urothoe brevicornis* *Fabulina fabula* *Ophelia borealis* *Scoloplos armiger* *Ophiura albida* NEMERTEA *Lagis koreni*	1.04 1.11 1.06 1.02 0.77 0.8 0.38 0.45 0.43 0.45	15.62 15.18 13.66 12.16 7.05 6.73 2.56 2.48 2.3 2.27

Notes:
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.

Group d comprised of three samples, characterised by sandy gravel, very poorly sorted and moderately well sorted (2 samples) and gravelly sand, poorly sorted, mean particle size ranging between 281 µm and 647 µm (medium to coarse sand) at an average water depth of −30 ± 4m LAT. Characterising taxa included Nemertea, the polychaetes *O. borealis*, *G. lapidum*, *S. spinulosa, Protodorvillea kefersteini*, the amphipod *Socarnes erythrophthalmus* and the echinoderms *A. squamata*.

Group e comprised of five samples, characterised by slightly gravelly sand, very poorly sorted to well sorted, and a mean particle size ranging between 140 µm and 1774 µm (fine to very coarse sand), at an average depth of -36 ± 10m LAT. Characterising species include the amphipoda *Urothoe brevicornis* and the polychaete *O. borealis*.

Group f comprised of six samples, characterised by slightly gravelly sand and sand, very poorly sorted to well sorted and a mean particle size ranging between 272 µm and 481 µm (medium sand) at an average depth of -35 ± 8m LAT. Characterising species include the polychaete *N. cirrosa* and the juvenile echinoderm taxon Ophiuroidea (juv.).

Group g comprised of two samples, characterised by slightly gravelly sand, moderately sorted to moderately well sorted and a mean particle size ranging between 300 µm and 479 µm (medium sand), at a depth of -32m LAT. Characterising species included Nemertea, the polychaete *N. cirrosa*, the long-clawed porcelain crab *P. longicornis* and the amphipod *Gammaropsis maculata*.

Group h comprised of 28 samples, 20 of these (71%) were characterised by slightly gravelly sand, moderately sorted and moderately well sorted, sand, gravelly sand and gravelly muddy sand, poorly sorted to moderately sorted, with mean particle size ranging between 109 µm and 476 µm (very fine to medium sand). Characterising species included the polychaetes *N. cirrosa*, *Spiophanes bombyx*, *O. borealis*, *Scoloplos armiger* and *Lagis koreni*, Nemertea, the echinoderms Ophiuridae (juv.), *O. albida*, the amphipod *Urothoe brevicornis* and the bivalve *F. fabula*.

The SIMPER analysis also highlighted the differences between groups in terms of species composition and their average abundances. The top five species contributing to this difference are presented in Table 5.11.

The taxa composition for the two main groups, group c and Group h, was similar and the differences between the two groups were mainly related to the average abundance of the polychaete *S. spinulosa*, Nemertea, the long-clawed porcelain crab *P. longicornis*, the brittlestar *Amphiura filiformis* and Actinaria.

As for group c and group h, the same taxa detereined the differences between group c and group f as well as between group c and group e, at stations within which these were not found. In addition to the abovementioned taxa, the taxon Ophiuridae (juv.) also contributed to the differences between group c and group b and between group c and group a. Differences between group c and group d were related to the average abundance of the polychaetes *S. spinulosa* and *O. borealis*, of which average abundance was higher at stations within group d. Moreover, Ophiuridae (juv.) and *P. baltica* also contributed to the differences between group c and goup g.

Taxa which determined the differences between group h and group f included the echinoderm taxon Ophiuridae (juv.), the polychaete *Spiophanes bombyx* and the bivalve *F. fabula*, which were not found at stations within group f, and the amphipod *U. brevisornis* and the polychaete *O. borealis* which were present in both groups in different average abundance. In addition to the abovementioned taxa, *N. cirrosa* also contributed to the difference between group h and group e. The amphipod *Gammaropsis maculata*, the long-clawed porcelain crab *P. longicornis,* Nemertea, which differed in average abundance, the echinoderm taxon Ophiuridae (juv.) and the polychaete *Spiophanes bombyx*, which were not found within the stations in group g, determined the differences between group h and group g. The polychaetes *O. borealis*, *S. spinulosa*, *G. lapidum*, the brittlestar *A squamata* and Nemertea, all recorded in both groups with different average abundance, determined the difference between group h and group d. The amphipod *A. diadema*, present in both groups in different average abundance, the amphipods *Eurydice spinigera* and *Pontocrates arcticus*, not recorded within samples of group H, as well as the echinoderm taxon Ophiuridae (juv.) and the polychaete *N. cirrosa*, not recorded within the samples of the group B, contributed to the difference between group H and group B. The amphipods *U. brevicornis* and *C. volutator*, the polychaete *N. cirrosa* and the echinoderm taxon Ohiuridae (juv.), not recorded within the samples of group A, as well as the bivalve *Barnea candida*, only recorded at stations within group A, determined the differences between group H and group A.

All the other groups differed from group a for the presence of their characterising species and the absence of the bivalve *B. candida*, which was recorded only at station 46CR (group a). The other groups also differed from group b due to the presence of their characterising species and the absence of the species characterising group b, such as crustaceans *A. diadema*, *Eurydice spinigera* and *Pontocrates* *arcticus*. Difference in the abundance of *O. borealis* between the two groups was also contributing to the dissimilarity between group b and group f as well as between group e and group b.

Group f and group e differed for the average abundance of the amphipod species *U. brevicornis*, *G. spinifer* and of the polychaete *O. borealis*, as well as for the absence of *N. cirrosa* and *F. fabula* from stations within group E.

Group G and group E differed due to species composition, particularly the absence of Nemertea, the amphipod *G. maculata*, the long-clawed porcelain crab *P. longicornis* and the polychaete *Microphthalmus similis*, as well as the difference in the average abundance of the amphipod *U. brevicornis*. Similarly, for the dissimilarity between group e and group g was characterised by the polychaete *N. cirrosa*, which was absent from stations within group e.

Differences between group f and group d were determined by different average abundance of the polychaete *O. borealis*, as well as different species composition, particularly Nemertea, the polychaetes *S. spinulosa* and *G. lapidum* and the echinoderm *A. squamata*. All these taxa did not occur at stations within group f. A similar pattern was evident for differences between group e and group d.

Differences between group f and group d were determined by different average abundance of the polychaete *O. borealis*, as well as different species composition, particularly the polychaete *G. lapidum*, the amphipod *Socarnes erythrophthalmus* and the echinoderm *A. squamata*. All these taxa did not occur at stations within group g. Also the amphipod *G. maculata*, which was not recorded at stations within group D, contributed to the differences.

As presented in Table 5.11, dissimilarity levels between groups vary between 81.22% for groups h and g and 100% for groups g, e, and b when compared with group a. The main species characterising the differences between groups are shown in Figure 5.23.

Figure 5.24 shows the distributions of the faunal clusters groups across the survey area. Group c, which included the stations characterised by the presence of the reef building Ross worm *S. spinulosa*, were distributed mainly along the proposed cable corridor both in a section approaching the main sites, as well as the section approaching the landfall. Three stations within this group were located to the west of the main site Norfolk Vanguard West. Group h, which included stations with no *S. spinulosa* and characterised by communities which are typical of sandy sediment (e.g. *N. cirrosa*) were distributed within the offshore main sites. The other groups, as expected, are distributed along the proposed cable corridor.

Table 5.11: Output of SIMPER Analysis Indicating Differences Between Groups

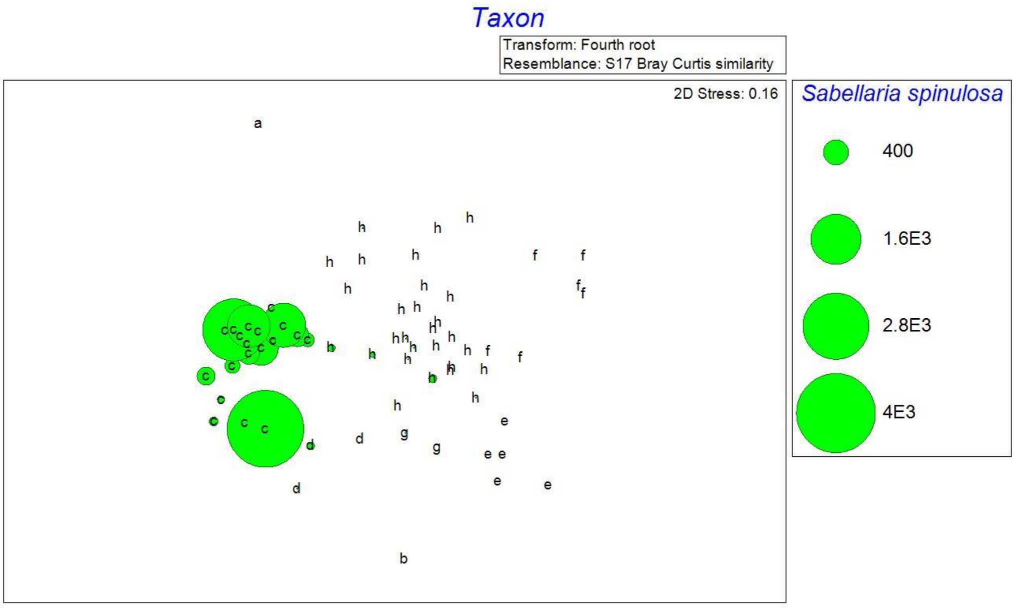
Taxa	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Groups c & f			Average dissimilarity = 97.98			
Species	Group c	Group f				
	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sabellaria spinulosa	3.79	0	4.51	1.78	4.6	4.6
NEMERTEA	2.23	0	2.65	3.78	2.71	7.31
Pisidia longicornis	1.95	0	2.38	1.45	2.43	9.74
Ophiuridae (juv.)	1.83	0	2.27	1.67	2.31	12.05

Taxa	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Amphipholis squamata	1.84	0	2.19	2.92	2.23	14.29
Groups c & h			Average dissimilarity = 87.98			
	Group c	Group h				
Sabellaria spinulosa	3.79	0.43	3.55	1.61	4.04	4.04
Pisidia longicornis	1.95	0.16	1.95	1.43	2.22	6.26
NEMERTEA	2.23	0.43	1.88	2.15	2.14	8.4
Amphipholis squamata	1.84	0.07	1.84	2.65	2.1	10.49
ACTINIARIA	1.78	0.19	1.71	1.33	1.94	12.44
Groups f & h			Average dissimilarity = 84.33			
	Group f	Group h				
Ophiuridae (juv.)	0	1.11	5.73	1.36	6.79	6.79
Spiophanes bombyx	0	1.06	5.1	1.63	6.05	12.84
Urothoe brevicornis	0.49	1.02	4.93	1.09	5.85	18.69
Fabulina fabula	0	0.77	3.89	0.96	4.61	23.3
Ophelia borealis	0.17	0.8	3.77	1	4.47	27.76
Groups c & e			Average dissimilarity = 98.17			
	Group c	Group e				
Sabellaria spinulosa	3.79	0	4.5	1.78	4.59	4.59
NEMERTEA	2.23	0	2.65	3.79	2.7	7.28
Pisidia longicornis	1.95	0	2.38	1.45	2.42	9.71
Amphipholis squamata	1.84	0	2.19	2.92	2.23	11.93
ACTINIARIA	1.78	0	2.05	1.32	2.09	14.02
Groups f & e			Average dissimilarity = 87.84			
	Group f	Group e				
Nephtys cirrosa	1.15	0	14.67	2.41	16.7	16.7
Urothoe brevicornis	0.49	1.38	14.51	1.44	16.52	33.22
Ophelia borealis	0.17	0.81	9.21	1.02	10.48	43.7
Gastrosaccus spinifer	0.4	0.4	6.46	0.83	7.35	51.06
OPHIUROIDEA (juv.)	0.5	0	5.14	0.9	5.86	56.91
Groups h & e			Average dissimilarity = 84.85			
	Group h	Group e				
Nephtys cirrosa	1.04	0	5.29	1.59	6.23	6.23
Ophiuridae (juv.)	1.11	0.24	5.12	1.29	6.04	12.27
Spiophanes bombyx	1.06	0	5.04	1.66	5.95	18.22
Ophelia borealis	0.8	0.81	4.13	1.14	4.86	23.08
Fabulina fabula	0.77	0	3.84	0.97	4.53	27.6
Groups c & g			Average dissimilarity = 89.66			
	Group c	Group g				
Sabellaria spinulosa	3.79	0.5	3.7	1.65	4.12	4.12
Ophiuridae (juv.)	1.83	0	2.09	1.69	2.33	6.46
Amphipholis squamata	1.84	0	2.03	2.94	2.26	8.72
ACTINIARIA	1.78	0	1.91	1.32	2.13	10.85
Pholoe baltica	1.44	0	1.56	2.37	1.74	12.59
Groups f & g			Average dissimilarity = 81.76			
	Group f	Group g				
NEMERTEA	0	1.19	8.1	5.66	9.9	9.9
Gammaropsis maculata	0	1.09	7.47	4.63	9.14	19.04
Pisidia longicornis	0	1.09	7.43	5.55	9.09	28.13
Microphthalmus similis	0	0.71	4.98	0.93	6.09	34.22
Urothoe brevicornis	0.49	0.59	4.53	1.04	5.54	39.76
Groups h & g			Average dissimilarity = 81.22			

Taxa	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
	Group h	Group g				
Ophiuridae (juv.)	1.11	0	4.23	1.47	5.2	5.2
Gammaropsis maculata	0.04	1.09	4.14	3.4	5.1	10.3
Spiophanes bombyx	1.06	0	3.81	1.71	4.7	15
Pisidia longicornis	0.16	1.09	3.7	2.34	4.55	19.55
NEMERTEA	0.43	1.19	3.3	1.57	4.06	23.61
Groups e & g			Average dissimilarity = 85.93			
	Group e	Group g				
Nephtys cirrosa	0	1.3	8.69	6.94	10.11	10.11
NEMERTEA	0	1.19	7.96	7.23	9.27	19.38
Gammaropsis maculata	0	1.09	7.35	5.4	8.55	27.94
Pisidia longicornis	0	1.09	7.31	6.94	8.5	36.44
Urothoe brevicornis	1.38	0.59	5.58	1.31	6.5	42.94
Groups c & d			Average dissimilarity = 83.44			
	Group c	Group d				
Sabellaria spinulosa	3.79	1.22	2.63	1.36	3.15	3.15
Ophelia borealis	0.17	2.16	1.97	1.75	2.36	5.52
Pisidia longicornis	1.95	0	1.93	1.49	2.31	7.83
Ophiuridae (juv.)	1.83	0.33	1.58	1.54	1.89	9.72
ACTINIARIA	1.78	0.33	1.54	1.33	1.84	11.56
Lumbrineris cingulata	1.34	0.33	1.08	1.58	1.3	18.58
Groups f & d			Average dissimilarity = 95.97			
	Group f	Group d				
Ophelia borealis	0.17	2.16	7.47	1.75	7.78	7.78
NEMERTEA	0	1.77	7.04	2.62	7.33	15.11
Sabellaria spinulosa	0	1.22	5.08	1.24	5.3	20.41
Glycera lapidum	0	1.24	4.9	3.18	5.11	25.52
Amphipholis squamata	0	1.04	4.51	1.31	4.7	30.22
Groups h & d			Average dissimilarity = 86.89			
	Group h	Group d				
Ophelia borealis	0.8	2.16	4.09	1.38	4.71	4.71
NEMERTEA	0.43	1.77	3.8	1.7	4.38	9.09
Sabellaria spinulosa	0.43	1.22	3.19	1.21	3.67	12.76
Glycera lapidum	0.08	1.24	3.19	2.61	3.67	16.43
Amphipholis squamata	0.07	1.04	2.95	1.31	3.39	19.82
Groups e & d			Average dissimilarity = 91.48			
	Group e	Group d				
NEMERTEA	0	1.77	6.98	2.66	7.64	7.64
Ophelia borealis	0.81	2.16	5.58	1.34	6.1	13.74
Sabellaria spinulosa	0	1.22	5.04	1.23	5.51	19.25
Glycera lapidum	0	1.24	4.87	3.25	5.32	24.57
Amphipholis squamata	0	1.04	4.47	1.32	4.89	29.46
Groups g & d			Average dissimilarity = 83.55			
	Group g	Group d				
Ophelia borealis	0.59	2.16	4.83	1.39	5.78	5.78
Glycera lapidum	0	1.24	3.89	3.54	4.65	10.43
Amphipholis squamata	0	1.04	3.52	1.26	4.21	14.63
Socarnes erythrophthalmus	0	1.03	3.43	1.28	4.11	18.74
Gammaropsis maculata	1.09	0	3.37	4.99	4.03	22.78
Groups c & b			Average dissimilarity = 96.97			
	Group c	Group b				

Taxa	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sabellaria spinulosa	3.79	0	4.38	1.76	4.51	4.51
NEMERTEA	2.23	0	2.57	3.74	2.66	7.17
Pisidia longicornis	1.95	0	2.31	1.43	2.38	9.55
Ophiuridae (juv.)	1.83	0	2.2	1.65	2.26	11.81
Amphipholis squamata	1.84	0	2.12	2.88	2.19	14
Groups f & b			Average dissimilarity = 97.66			
	Group f	Group b				
Ampelisca diadema	0	1.19	11.17	4.02	11.44	11.44
Eurydice spinigera	0	1.19	11.17	4.02	11.44	22.87
Pontocrates arcticus	0	1.19	11.17	4.02	11.44	34.31
Nephtys cirrosa	1.15	0	10.67	4.5	10.93	45.24
Ophelia borealis	0.17	1.19	10	2.05	10.24	55.48
Groups h & b			Average dissimilarity = 94.11			
	Group h	Group b				
Eurydice spinigera	0	1.19	5.43	3.98	5.77	5.77
Pontocrates arcticus	0	1.19	5.43	3.98	5.77	11.55
Ampelisca diadema	0.04	1.19	5.27	3.26	5.6	17.15
Ophiuridae (juv.)	1.11	0	5	1.42	5.31	22.46
Nephtys cirrosa	1.04	0	4.67	1.67	4.96	27.42
Groups e & b			Average dissimilarity = 85.55			
	Group e	Group b				
Urothoe brevicornis	1.38	0	12.4	5.58	14.5	14.5
Ampelisca diadema	0	1.19	10.86	5.26	12.69	27.19
Pontocrates arcticus	0	1.19	10.86	5.26	12.69	39.88
Eurydice spinigera	0.2	1.19	9.46	1.98	11.06	50.93
Notomastus	0	1	9.13	5.26	10.67	61.61
Groups g & b			Average dissimilarity = 81.82			
	Group g	Group b				
Nephtys cirrosa	1.3	0	7.46	12.22	9.11	9.11
NEMERTEA	1.19	0	6.83	24.65	8.35	17.46
Ampelisca diadema	0	1.19	6.83	24.65	8.35	25.81
Pontocrates arcticus	0	1.19	6.83	24.65	8.35	34.15
Gammaropsis maculata	1.09	0	6.3	6.16	7.7	41.86
Groups d & b			Average dissimilarity = 92.19			
	Group d	Group b				
NEMERTEA	1.77	0	6.37	2.37	6.91	6.91
Sabellaria spinulosa	1.22	0	4.59	1.05	4.98	11.88
Glycera lapidum	1.24	0	4.44	2.99	4.82	16.7
Ampelisca diadema	0	1.19	4.17	4.79	4.52	21.22
Eurydice spinigera	0	1.19	4.17	4.79	4.52	25.74
Groups c & a			Average dissimilarity = 96.47			
	Group c	Group a				
Sabellaria spinulosa	3.79	0	4.52	1.74	4.68	4.68
NEMERTEA	2.23	0	2.66	3.72	2.76	7.44
Pisidia longicornis	1.95	0	2.39	1.42	2.47	9.91
Ophiuridae (juv.)	1.83	0	2.27	1.63	2.35	12.27
ACTINIARIA	1.78	0	2.06	1.29	2.13	14.4
Groups f & a			Average dissimilarity = 97.15			
	Group f	Group a				
Barnea candida	0	1.19	15.05	3	15.49	15.49
Nephtys cirrosa	1.15	0	14.3	3.5	14.72	30.21

Taxa	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Amphipholis squamata	0	1	12.66	3	13.03	43.23
Corophium volutator	0	1	12.66	3	13.03	56.26
Glycera alba	0.17	1	11.23	1.69	11.56	67.82
Groups h & a			Average dissimilarity = 96.85			
	Group h	Group a				
Barnea candida	0	1.19	6.21	3.51	6.41	6.41
Ophiuridae (juv.)	1.11	0	5.69	1.39	5.88	12.29
Nephtys cirrosa	1.04	0	5.32	1.61	5.5	17.79
Urothoe brevicornis	1.02	0	5.29	1.17	5.46	23.25
Corophium volutator	0	1	5.22	3.51	5.39	28.64
Groups e & a			Average dissimilarity = 100.00			
	Group e	Group a				
Urothoe brevicornis	1.38	0	16.29	4.99	16.29	16.29
Barnea candida	0	1.19	14.35	4.04	14.35	30.63
Amphipholis squamata	0	1	12.06	4.04	12.06	42.7
Glycera alba	0	1	12.06	4.04	12.06	54.76
Corophium volutator	0	1	12.06	4.04	12.06	66.82
Groups g & a			Average dissimilarity = 100.00			
	Group g	Group a				
Nephtys cirrosa	1.3	0	8.74	13.36	8.74	8.74
NEMERTEA	1.19	0	8.01	21.02	8.01	16.76
Barnea candida	0	1.19	8.01	21.02	8.01	24.77
Gammaropsis maculata	1.09	0	7.4	5.91	7.4	32.16
Pisidia longicornis	1.09	0	7.35	13.36	7.35	39.52
Groups d & a			Average dissimilarity = 94.25			
	Group d	Group a				
Ophelia borealis	2.16	0	8.04	1.78	8.53	8.53
NEMERTEA	1.77	0	7.04	2.31	7.47	16
Sabellaria spinulosa	1.22	0	5.08	1.05	5.39	21.39
Glycera lapidum	1.24	0	4.9	2.86	5.2	26.59
Barnea candida	0	1.19	4.6	4.38	4.88	31.46
Groups b & a			Average dissimilarity = 100.00			
	Group b	Group a				
Ampelisca diadema	1.19	0	10.86	Undefined!	10.86	10.86
Ophelia borealis	1.19	0	10.86	Undefined!	10.86	21.73
Eurydice spinigera	1.19	0	10.86	Undefined!	10.86	32.59
Pontocrates arcticus	1.19	0	10.86	Undefined!	10.86	43.46
Barnea candida	0	1.19	10.86	Undefined!	10.86	54.32


Taxon
Transform: Fourth root
Resemblance: S17 Bray Curtis similarity
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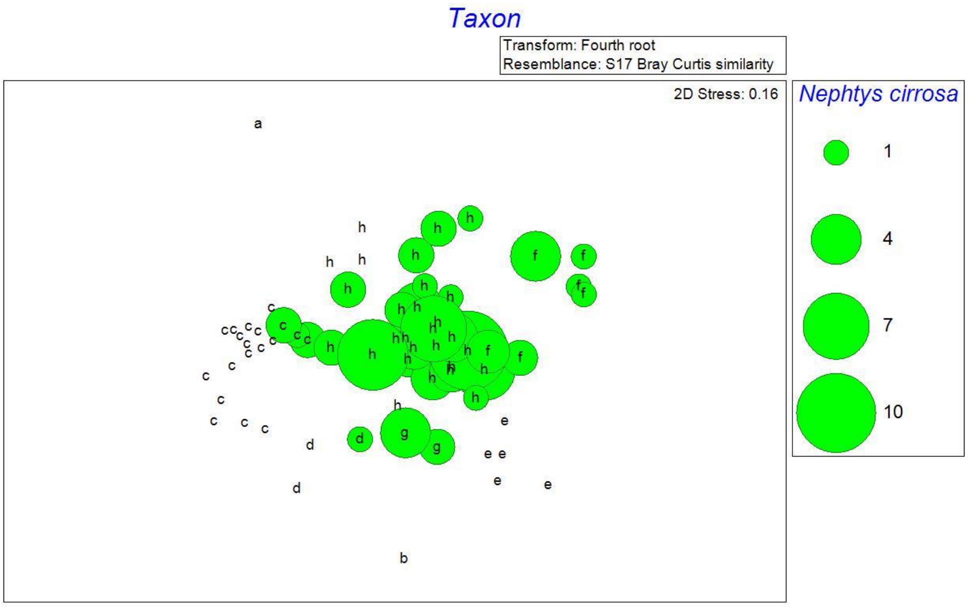
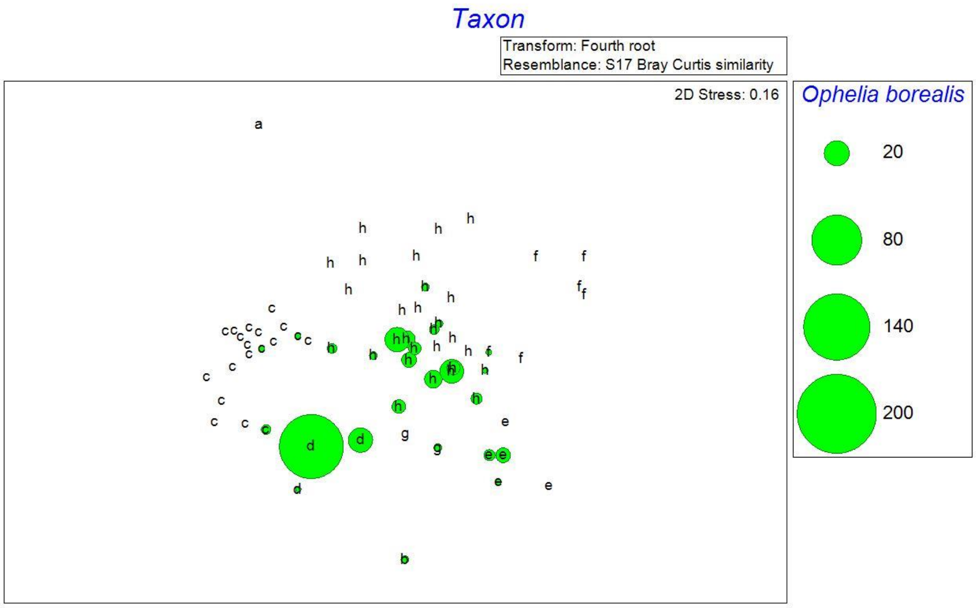
Sabellaria spinulosa
400
1.6E3
2.8E3
4E3


Taxon
Transform: Fourth root
Resemblance: S17 Bray Curtis similarity
2D Stress: 0.16
Nephtys cirrosa
1
4
7
10


Taxon
Transform: Fourth root
Resemblance: S17 Bray Curtis similarity
2D Stress: 0.16
Ophelia borealis
20
80
140
200

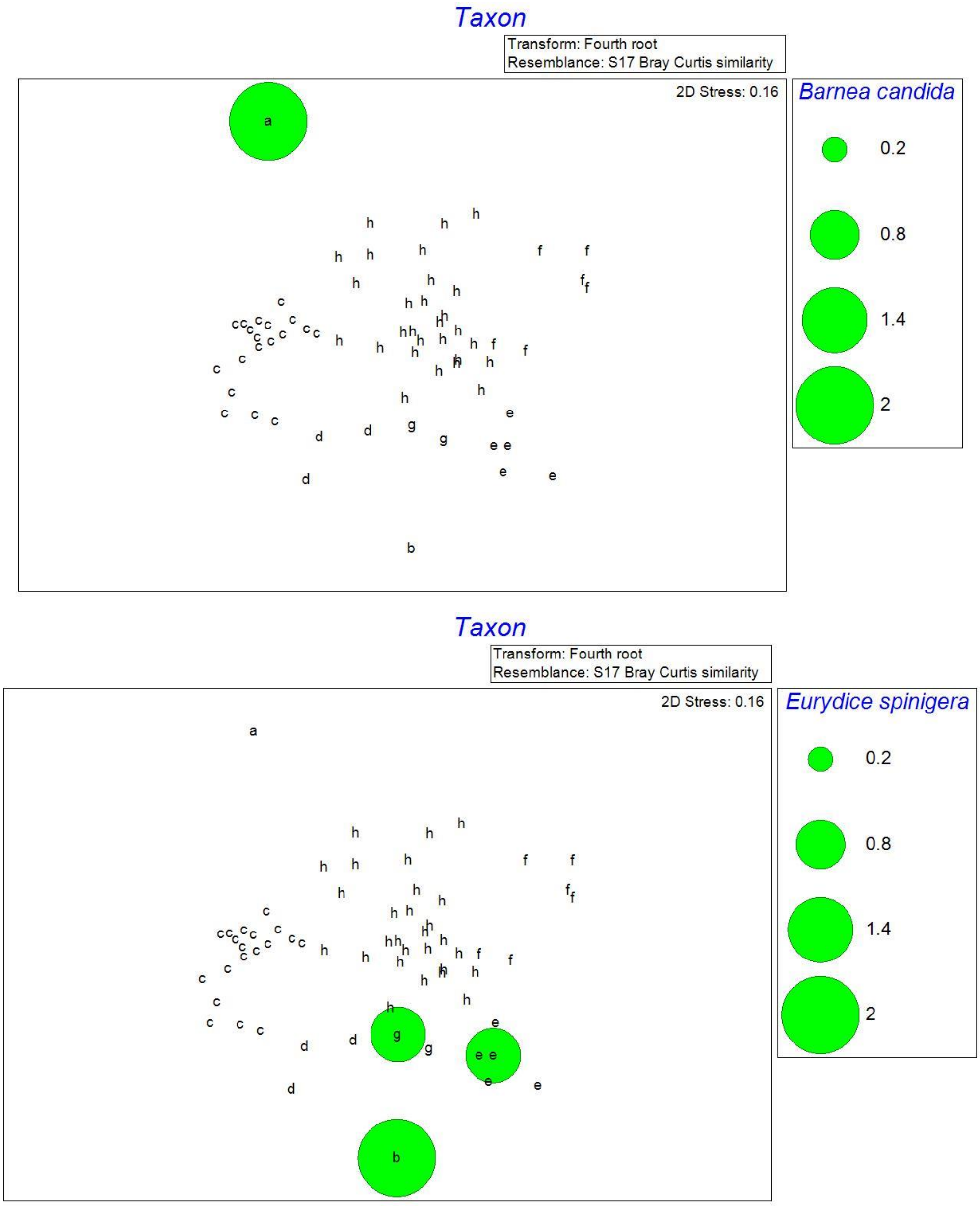
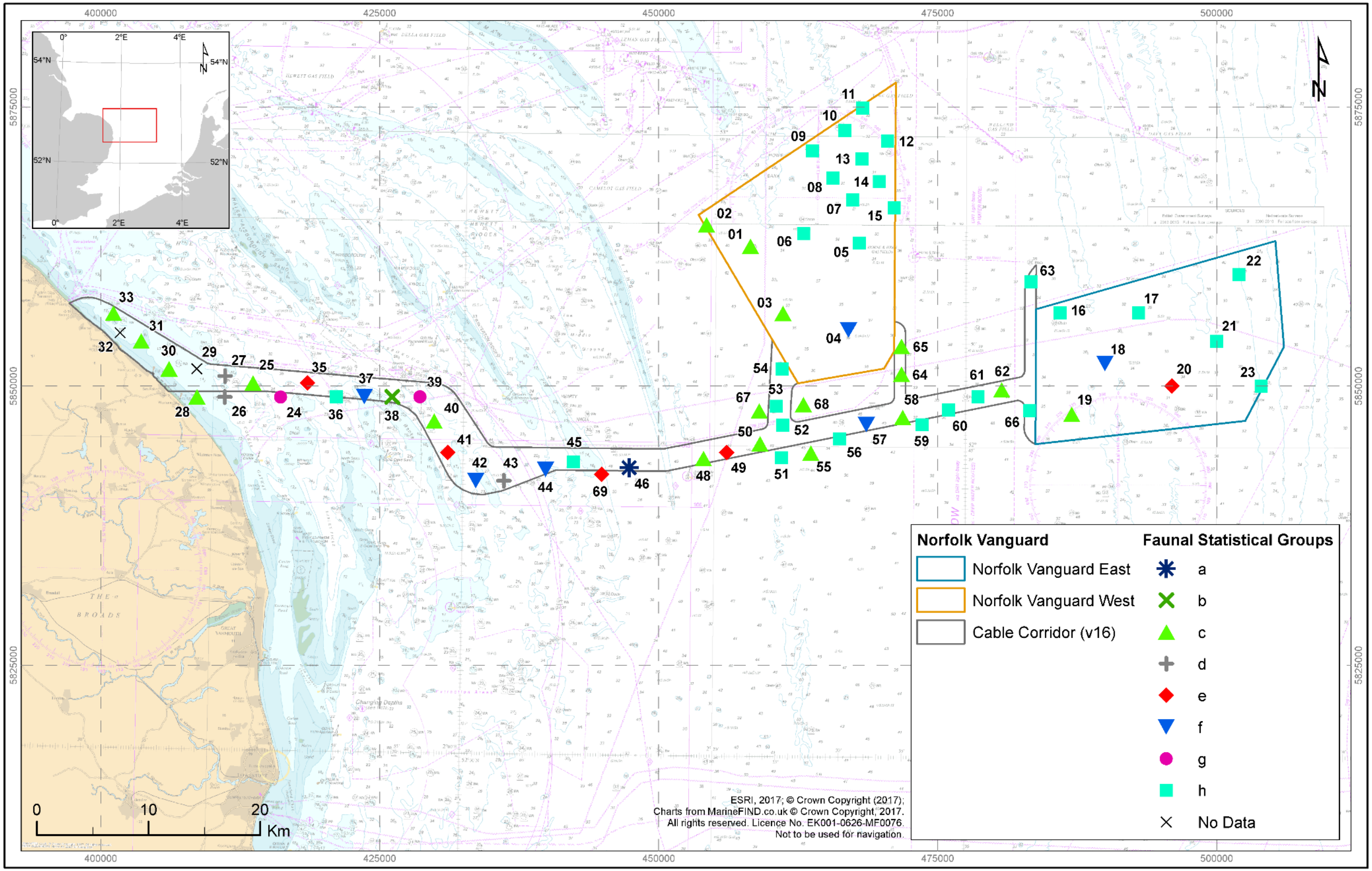


Figure 5.23: Main contributing Species to the differences between groups identified by the cluster analysis, overlaid with the relative abundance.



Map Document: (V:\E160976_Vattenfall_NorfolkVangard_Benthic\3_Plots\3_Final\Q160976_NV_Benthic_17_FaunaGroups.mxd)
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Figure 5.24 Distribution of fauna groups identified by hierarchical agglomerative cluster analysis across the survey area

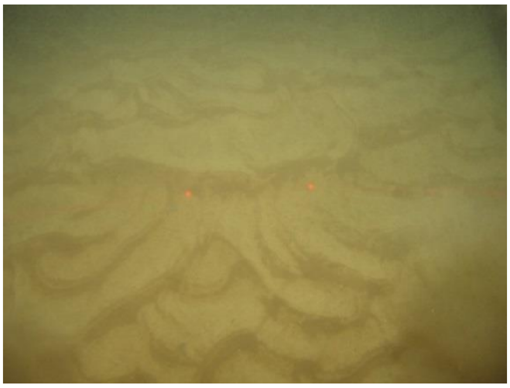
5.5 Biotope Classification

Biotope classification was undertaken following revision of seabed video footage in conjunction with the results of grab samples, with a view to providing 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

Table 5.12 presents the habitats assigned during the video analysis. For completeness, these habitats are listed in the table using the UK based JNCC (2015) codes.

Table 5.12 Habitats Identified from Seabed Video Footage, Classified Using JNCC Habitat Codes

JNCC Habitat Classification (2015)	
	
Circalittoral coarse sediment (SS.SCS.CCS)	Sublittoral sands and muddy sands (SS.SSa)
	
Circalittoral mixed sediment (SS.SMx.CMx)	*Sabellaria spinulosa* on stable circalittoral mixed sediment (SS.SBR.PoR.SspiMx)

5.5.1.1 Circalittoral Coarse Sediment (SS.SCS.CCS)

Assigned to 35 transects SS.SCS.CCS was the most commonly allocated biotope within the survey area. It is characterised by tide-swept circalittoral coarse sands, gravel and shingle generally at depths of over 15 m to 20 m and was assigned to those stations where the sediment was generally observed as being slightly pebbly slightly gravelly shelly rippled sand. It was characteristic of all the stations within

Norfolk Vanguard West and most stations within Norfolk Vanguard East. It was identified also along the proposed cable corridor with varying proportions of sand, shell, and gravel. Benthic assemblages associated with the sand, shell and gravel habitat included the polychaete *S. spinulosa*, and the brittlestar *Ophiura* sp. As the proportion of hard substrate increased, so did the number of epibenthic species.

5.5.1.2 Sublittoral Sands and muddy sands (SS.SSa)

This habitat was assigned to 14 transectes, or sections of transect, within the survey area, mainly along the proposed cable corridor, but also at a few stations within the main site, Norfolk Vanguard East. The sediment predominantly comprised slightly shelly rippled sand or slightly shelly muddy sand. The benthic community was characterised by common starfish *A. rubens*, brittlestar *Ophiura* sp., hermit crab *Pagurus bernhardus*, sandeels *Ammodytidae*, polychaete casts and hydroid/bryozoan turf.

5.5.1.3 Circalittoral Mixed Sediment

The habitat was recorded along seven transects along the proposed cable corridor and was found to comprise a mixture of rippled shelly sandy gravel with pebbles and occasionally cobbles. The benthic community was characterised by echinoderms such as dahlia anemones *Urticina felina*, common starfish *A. rubens* and common sunstar *C. papposus*, polychaete worms *S. spinulosa*, crustaceans including velvet swimming crab *Necora puber*, edible crabs *Cancer pagurus*, squat lobsters Galatheidae and hermit crabs. The hard substrate was also colonised by a mixed faunal turf, including Hornwrack *Flustra foliacea*.

5.5.1.4 *Sabellaria spinulosa* on Stable Circalittoral Mixed Sediment (SS.SBR.PoR.SspiMx)

The habitat was recorded along 12 transects and comprised mixed coarse sediment (sand, gravel, pebbles and cobbles). The benthic community was characterised by crusts or reef features of the Ross worm *S. spinulosa* and a mixed faunal turf. Species associated with the hard substrate were Hornwrack *F. foliacea*, mixed hydroid/bryozoan turf species and sponge crusts. Other species characterising this habitat included echinoderms such as common sunstar *C. papposus* and common starfish *A. rubens*, brittlestar *Ophiura* sp., crustacea such as the swimming crab *Liocarcinus* sp. and the velvet swimming crab, *N. puber*).

5.5.2 Grab Samples

Three biotope complexes and four main biotopes were identified following analysis of the macrofauna and PSD from the grab samples. These are:

- SS.SCS.CCS (Circalittoral coarse sediment);
- SS.SSA.CFiSa (Circalittoral fine sand);
- SS.SMu.CSaMu (Circalittoral sandy mud);
- SS.SCS.CCS.MedLumVen (*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel);
- SS.SCS.CCS.Pken (*Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand);
- SS.SSA.CFiSa.EpusOborApri (*Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand);
- SS.SBR.PoR.SspiMx (*Sabellaria spinulosa* on stable circalittoral mixed sediment).

The most common of these, assigned to 30 stations, was the biotope complex SS.SCS.CCS describing areas with higher percentage of coarse sand and gravel, and minor percentage of finer sand. With the aid of side scan sonar data, this biotope complex was also used to produce the biotope maps within the survey area and was identified characterising the Norfolk Vanguard West main site, as well as sections of the proposed cable corridor.

At stations where the content of finer sand fraction as well as silt fractions was higher, the biotope complex assigned was SS.SSA.CFiSa. This habitat can be found offshore and it is characterised by a wide range of echinoderms, including *Echinocyamus pusillus*, polychaetes and bivalves.

At station 46CR the biotope SS.SMu.CSaMu was assigned. The sediment composition at this station was 62% mud and and a significant fine to very fine sand fraction and with charcterising species the boring bivalve *B. candida*, the brittlestar *Amphipholis squamata*, the polychaete *G. alba* and the amphipod *Corophium volutator*.

The biotope SS.SCS.CCS.MedLumVen was assigned to nine stations. Characterising species included the polychaetes *Notomastus* sp., *Mediomastus fragilis*, *Lumbrineris* sp., *Lanice conchilega*, the echinoderms *A. squamata* and the amphipod *Ampelisca diadema*. The bivalve *Abra alba* was also common at these stations.

The biotope SS.SCS.CCS.Pken was assigned to two stations. Characterising species included the polychaetes *Protodorvillea kefersteini* and *G. lapidum*, Nemertea and the amphipods *Abludomelita obtusata* and *Ampelisca spinipes*. *S. spinulosa* was also found in low abundance at these stations. This biotope has been reported in the North Sea along the Norfolk/Lincolnshire coast and it is considered to be quite variable both spatially and temporally in terms of community structure and also sediment type which is often between the one characterising SS.SCS and SS.SMX complexes (JNCC, 2015). It is also considered an impoverished and less diverse biotope compared to SS.SCS.CCS.MedLumVen, possibly characterising disturbed or transitional variant of this biotope (JNCC, 2015).

The biotope SS.SSA.CFiSa.EpusOborApri was assigned to two stations. Characterising species included the pea urchin *Echinocyamus pusillus*, the polychaetes *O. borealis*, *N. cirrosa*, *S. bombyx* and the bivalve *Fabulina fabula*. This biotope is considered similar to SS.SCS.CCS.MedLumVen, but it occurs in finer sediments with a lower proportion of bivalves and it has been found in the central North Sea (JNCC, 2015).

The biotope SS.SBR.PoR.SspiMx was assigned to eight stations. These are generally described by variable proportions of mud, sand and gravel, with the Ross worm *S. spinulosa*, the polychaete *M. fragilis*, Nemertea and long-clawed porcelain crab *P.logicornis*, being the characterising species. The acorn barnacle *Balanus crenatus* was also found and amphipods species were also found. This biotope is typical of mixed sediments where the tube building *S. spinulosa* occurs at high abundances. Other taxa include sublittoral polychaete species such as *Protodorvillea kefersteini*, *Pholoe* and *Harmothoe* spp.. *Scoloplos armiger, M. fragilis*, *L. conchilega* and cirratulids, together with the bivalve *Abra alba*, and tube building amphipods such as *Ampelisca* spp. At the five stations located along the proposed cable corridor the biotope was associated with mixed sediment, whilst at the three stations located on the western side of the main site Norfolk Vanguard West (01MS, 02MS and 03MS) this biotope was associated with higher silt/clay content.

At three stations, 30CR, 31CR and 33CR, located in the part of the proposed cable corridor approaching the shore the sediment described was coarser, with gravel content > 50%. The biotope assigned to these stations based on grab data was SS.SCS.CCS.MedLumVen.

5.5.3 Biotope map

The distribution of the assigned biotopes across the survey area is illustrated in Figure 5.25. For main site Norfolk Vanguard East, current data were not available, therefore, historical data collected during a geophysical investigation carried out in 2012 (FugroEMU, 2013) were used.

Side scan sonar (SSS) data, in conjunction with video and grab data, allowed polygons to be defined, describing biotopes occurring within the survey area. These were identified as follows:

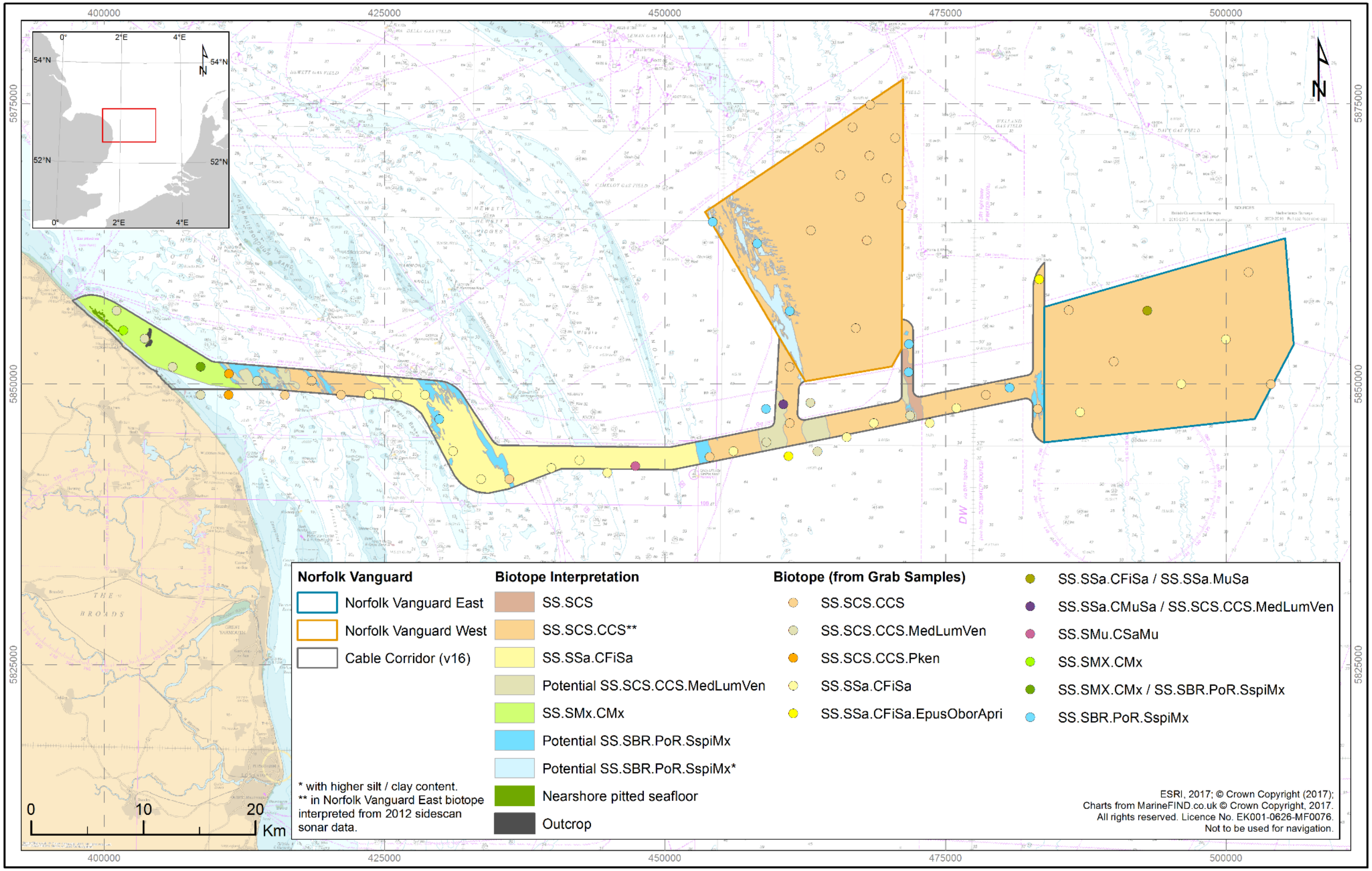
SS.SCS.CCS was most common in the survey area, particularly at both main sites Norfolk Vanguard West and East.

SS.SCS.CCS.MedLumVen was allocated to discrete points (grab stations) and, using side scan sonar (SSS) signatures defined from geophysical analyses, the biotope was also allocated to sections of the proposed cable corridor as areas where the biotope complex can potentially occur. This procedure differentiated these sections from the adjacent ones which showed a different geophysical signature (and to which the biotope complex SS.SCS.CCS was allocated). This biotope complex may in fact be quite temporally variable over time and may be closer to a biotope complex in which a number of biotopes or sub-biotopes may yet be defined and can be found amongst mosaics of cobble and lag gravel which often contain ridges of coarse gravelly sand with characteristics of these biotope (JNCC, 2015). One area where this biotope was extended from the discrete point encompassed and area of potential *Sabellaria* biotope SS.SBR.PoR.SspiMx.

The SSS data interpretation highlighted areas where the signature was defined as potential *Sabellaria*. To most of the survey stations located within these defined areas the SS.SBR.PoR.SspiMx biotope was allocated, indicating where SS.SBR.PoR.SspiMx can potentially occur.

Within the section of the proposed cable corridor approaching the shore, the SSS signature was different from the adjacent section and the biotope complex SS.SMx.CMx (Circalittoral mixed sediment) was assigned to this section.

The geophysical investigation highlighted an area of different SSS signature in the seafloor adjacent to the shoreline in 7-10 m depth. The appearance of the SSS signature suggested the presence of a cohesive or erosionally resistant substrate, such as clay (see Report 1, Volume 3). However, this section of the survey area overlaps the Cromer Shoal Chalk Beds Marine Conservation Zone and, therefore, the presence of chalk substrate cannot be dismissed. Ground-truthing data are not available and further investigation would be required to assess the nature of the area with a differently defined SSS signature.



Map Document: (V:\E160976_Vattenfall_NorfolkVangard_Benthic\3_Plots\3_Final\Q160976_NV_Benthic_15_Biotopes_rev1.mxd)
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Figure 5.25 Biotopes in the survey area

5.5.4 Habitats of Nature Conservation Interest

The assessment of the presence of *S. spinulosa* reef is presented in section 5.1.1.

The sandbank assessment is presented in section 5.1.2

No chalk reef features were observed in the survey area, but the presence of chalk reef cannot be discounted as it may not be visible at the surveyed sediment surface.

5.5.5 Species of Nature Conservation Interest

The family Ammodytidae (5 individuals at four stations) was the only family recorded which could potentially indicate the presence of *Ammodytes marinus* (sandeel). This species is listed as UK BAP species, Species of Principal Importance in England, Feature of Conservation Importance in England and Wales (Barnes, 2008). The species however, was not identified from video analysis, due to limitation of the sampling technique to accurately identify highly mobile species, nor from grab data.

Crepidula fornicata (five individuals at two sites) was the only non indigenous species identified within the species lists generated from video and grab data. *C. fornicata* is considered a non indigenous species of concern (Sewell and Sweet, 2011).

6. DISCUSSION

DDV data were successfully collected at 68 stations, whilst grab data for both macrofauna and PSD were successfully collected at 65 and 66 stations respectively. The stations where attempts were made, but unsuccessful samples were collected, were all located in the nearshore area of the proposed cable corridor, which was characterised by highly coarse sediment, with percentage of gravel ranging between 50.8% and 86%.

6.1 Seabed Video Footage

Analysis of the video footage showed the presence of two major habitats within the 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 characteristic of the habitat within the proposed cable corridor approaching the shore, as well as an area to the south west of Norfolk Vanguard West. The epibiotic communities reflected the sediment complexity, with the offshore sandier sediments hosting lower faunal diversity represented mainly by fish, echinoderms, crustaceans and molluscs, with sessile epifauna been absent or scarce. The nearshore coarser sediments comprised a rich and diverse epibenthic community, which included a variety of sessile epifauna.

The 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 bernhardus*, *N. puber* and species of *Liocarcinus*, together with echinoderms such as *O. ophiura* and *O. albida*, *A. rubens* and *C. papposus*. Sessile colonial epifauna comprised bryozoans, notably, *F. foliacea* together with the sea anemone of the genus *Urticina*. Fish species recorded across the survey area included species of Callyonimidae and Soleide, as well as Ammodytidae.

The habitats and associated epibenthic communities recorded by the video footage were classified to biotopes where possible and/or to biotope complex.

In the current study, Ross worm *S. spinulosa* frequency occurred in high abundance at a number of stations. Stations with high abundance of the Ross worm *S. spinulosa* tubes were assessed for potential biogenic reef status, in line with the criteria outlined in Gubbay (2007). The majority of the stations assessed did not show evidence of reef formations. At four stations evidence of low reef was found, whilst at two stations evidence of low to medium reef was found in sections of the video transects. However, at all stations these features were not observed to form continuous aggregate structures.

No chalk reef features were observed in the survey area but the presence of chalk reef cannot be discounted as it may not be visible at the surveyed sediment surface.

6.2 Grab Samples

6.2.1 Sediment Particle Size Determination (PSD)

Results of grab samples analysis showed that the survey area comprised a mixed range of sediment types from well sorted sands to very poorly sorted muddy sandy gravel. The sediment distribution identified within the survey area was predominantly slightly gravelly sand and gravelly sand within the main sites (Norfolk Vanguard West and Norfolk Vanguard East) and the proposed cable corridor. The section of the proposed cable corridor approaching the shore presented more heterogeneous, coarser sediments, with higher percentage of the gravel fraction.

The sediment types recorded within the survey area are typical of the southern North Sea region, which comprises sand and gravelly sand offshore, and up to at least 50 km from the coast off Holderness, Lincolnshire and North Norfolk. The regional sediment distribution generally reflects the level of hydrodynamic forcing (including waves) with fine sands and muds in the deeper waters, where tidal velocities and wave stirring are reduced, and coarse and medium sands in the highly mobile nearshore zones. Muddy sediments are also found locally in estuaries and embayments as well as offshore of some rivers/estuaries (HR Wallingford, 2002).

The bulk of seabed sediment of the central North Sea is characterised by substrates that have been reworked from strata due to local hydrodynamism (e.g. tides and sea waves). The reworked sediments form large areas of seabed sand and gravel, as well as the large-scale sandbanks which are typical of this North Sea region (BGS, 2002). These sandbanks are arranged in a linear formation, aligned along the axis of the principal tidal flows (DTI, 2001). The areas in between the sandbanks allow accumulation of different sediment types, including hard substrate.

The three main types of hard substrate occurring at or near the seabed comprise the unconsolidated gravel spreads, rock outcrops and hard cohesive sediments formed during the glaciations, the latter being patchily developed (DTI, 2001). Gravel spreads mostly occur in the nearshore areas with very strong tidal and sea-wave driven near-bottom currents. Granular to pebble size classes of gravel are mobile during peak tidal currents and storm waves, but are virtually static in areas below wave-base. 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). Large areas of rippled seabed and other un-cohesive cover comprise superficial sand and silt with various amount of gravel. Such cover is ubiquitous throughout much of the North Sea (BGS, 2002)

The majority of the stations presented unimodal and moderately well sorted sediments, whilst at few stations exhibited extreme bimodal and polymodal distributions, where very poorly sorted sediments were observed. This dstribution of the sediment particle size, would suggest that one major sediment transport process is likely to be predominant, but that different sediment sources are also present (Hein, 2007). These are likely to be represented by finer sediment material from the estuaries in this region 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.

Organic content was relatively low across the study area (average TOM 0.8%) and did not show any spatial pattern of distribution.

6.2.2 Sediment Chemistry

Metal concentrations were below each ER-L standards for the majority of the metals included in the analysis. The only exception was Arsenic (As), concentrations of which were above ER-L, but below ER-M at two stations. Background concentrations of metals such as Arsenic will vary naturally according to local geology (Cefas, 2005). Elevated concentrations of Arsenic near natural and anthropogenic sources could be high in the continental shelf sediments. In the south western North Sea concentrations of Arsenic are known to vary between <0.15 $mgKg^{-1}$ to 135 $mgKg^{-1}$ of dry wt arsenic, with highest concentrations found in the outer Thames and Humber estuaries, as well as along the Norfolk and Yorkshire coasts (Whalley et al., 1999 as cited by Neff, 2002). The concentration observed within the survey area are within those known for the southwest North Sea region.

Total PAH concentrations were below the Cefas action level AL1, however, the calculated value was based on a subset of PAHs and therefore needs to be considered carefully, as it could be an underestimate. Total hydrocarbons (THC) calculated at all stations were within the values recorded for this region of the North Sea. Previous studies investigating the concentrations of THC around the UK coasts, including the southern North Sea highlighted that the highest concentration from the sites visited was 120 μgg^{-1}, recorded in the gas field area off north Norfolk, and other high concentrations were recorded from sites from the central and northern North Sea (CEFAS, 2001). All PAH concentrations were below guideline ER-L standards used by CSEMP in reporting UK monitoring commitments as signatories to the OSPAR Convention. PAH concentrations are also below Cefas action levels applied in the disposal of dredged material (Cefas, 2003). Also, when compared with the Canadian Sediment Guidelines available, concentrations were below the corresponding ISGQL standard. For some PAHs calculated standard values are not available. The concentrations of the majority of these compounds were however below detection limits at most stations, with the exception of Benzo(e)pyrene, for which values were detected at two stations and Perylene, for which values were detected at one station. These two compounds are both 5 rings ($C_{20}H_{12}$) PAHs with a similar molecular weight of approximately 252; the compounds have an estimated background concentration of 0.016 $mgKg^{-1}$ for the southern sector of the North Sea (UKOOA, 2001). Therefore, the concentrations recorded at the survey stations are within estimated background concentrations.

PCBs are contaminants which are ubiquitous within the marine environment. These compounds do not occur naturally in the environment, but derive entirely from anthropogenic activities. Therefore, the background concentration excluding any anthropogenic input is zero (OSPAR, 2009c). Levels of PCBs were below their guideline values at all stations.

Organotin concentrations were all below the limit of detection used in the analysis. At <4 μgKg^{-1}, the recorded concentrations were also substantially below the Cefas revised action level for TBT which is set at 500 μgKg^{-1} for action level AL1. OSPAR produced an integrated assessment of imposex/intersex with concentrations of TBT in sediments. Six classes (A-F) were identified and it was found that most concentrations in coastal and offshore locations were in assessment class B or C and, as such, would not be expected to affect the reproductive capability of sensitive gastropod species. The concentrations recorded from the survey would place them in the lower end of class C (2 μgkg^{-1}-<50 μgkg^{-1}) and would not therefore present an issue in this respect.

6.2.3 Macrobenthic Communities

Results of the biological analyses indicated that, in terms of species diversity according to the scale indicated by Dauvin et al. (2012), most stations of the study area hosted a moderately rich community, whilst other stations were characterised by a less diverse, and occasionally particularly impoverished communities, typically associated with coarse to fine and less heterogeneous sandy sediment. This is comparable to the description of benthic communities, and their richness, for the wider southern North Sea provided by Künitzer et al. (1992). In terms of abundances (i.e. total number of individuals per stations), this was generally higher at stations where *S. spinulosa* was present, as well as at stations characterised by coarser and mixed sediment. The higher species diversity and abundances of some stations is often related to the presence of epibenthic species that, thanks to the presence of more heterogeneous sediment, find hard substrate for the settlement, as well as habitat structuring organisms which help increase the structural complexity of the habitat, which may provide an important microhabitat for smaller fauna (UK BAP, 2008). This observed distribution is likely to be associated with depth and sediment type, as also indicated by 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).

The multivariate analysis highlighted the presence of two major benthic communities, which were mainly separated by the presence of the Ross worm *S. spinulosa* in one community (group c) and its absence, or limited presence in the other community (group h).

The group where this reef-building polychaete occurred included, but was not limited to, those sites where coarser sediment was observed, generally hosting a richer community of fauna. The sediment heterogeneity of the first community defined by the presence of *S. spinulosa*, 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). Stations belonging to this group were distributed mainly along the proposed cable corridor both in a section approaching the main sites, as well as the section approaching the landfall. Three stations within this group were located to the west of the main site Norfolk Vanguard West; at these stations *S. spinulosa* was associated with highet silt/clay content.

The second main group was characterised by coarse to fine, 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*). Stations included in this group were distributed within the offshore main sites, as well as along the offshore section of the proposed cable corridor

The other groups included stations which represented impoverished communities of those of the main groups, as well as stations where sediment composition supported a slightly different species composition. An example of the latter was group a, formed by a single station characterised by the presence of *B. candida* and a proportion of mud of approximately 62%. *B. candida* is a boring bivalve of soft substrates such as peat, clay, mudstones, shales and chalk (NMW, 2016), indicating the presence of pockets of compacted clay, as suggested by the video anlaysis, at this station where the dominant sediment of slightly shelly slightly gravelly sand was present with crumbly clay patches regularly observed throughout the video transect at this station. These other groups, as expected, are distributed along the proposed cable corridor, with some stations also found in areas of the main sites closer to the proposed cable corridor and refelceting the spatial variability of the marine sediments, particulatly approaching shallower coastal areas.

Characteristics of patchiness, elevation and consolidation of *S. spinulosa*, which required a detailed assessment for the presence of reef, were identified at 20 stations; the assessment returned LOW REEF at three stations, LOW/MEDIUM REEF at one station, NOT REEF/LOW REEF at one station and NOT REEF at the remaining stations. In most parts of its geographical range *S. spinulosa* does not form reefs, but is 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. These crusts may be only seasonal features, been 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).

The lower diversity charchterising the stations of the remaining groups defined by the multivariate analysis is typical of sandy habitats subject to a degree of physical disturbance, such as that associated with tidal movement and/or wave action. This results in habitats that have low species richness and diversity than 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 preys, 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, 2016). 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 *F. 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).

Average infauna biomass in the current study was 7.7 g AFDW.m-^{2} and was comparable with the average macrofaunal biomass for a wider area of the North Sea, and based on average biomass calculated from approximately 200 stations, which is reported to be 7 g AFDW.m^{-2} (Heip et al., 1992, Heip and Craeymeersch, 1995).

Using video and grab data, biotopes were assigned to each single station; aided by the use of side scan sonar geophysical data, these were expanded to define areas of potential similar habitats. The biotope complex SS.SCS.CCS was the most common in the survey area, particularly within both main sites Norfolk Vanguard West and East. With regards to the Norfolk Vanguard East main site, the biotope interpretation was based on historical SSS data (FugroEMU, 2012); within this main site area, eight stations were investigated and, based on current data, the same biotope complex SS.SCS.CCS was assigned to four stations. The biotope complex SS.SSA.CFiSa was assigned to a further three stations and the complex mosaic SS.SSA.CFiSa/ SS.SSA.MuSa was assigned to the remaining station. The historical geophysical study (FugroEMU, 2013) highlighted that superficial sediments were classified as sand, with areas of muddy sand localised where the superficial sediments become thinner and the underlying Brown Bank Formation becomes exposed. This is known as the Late Pleistocene Brown Bank Formation and it is characterised by brackish-marine, grey-brown, silty clays, extensively bioturbated and with thin interbeds of shelly gravelly sand towards its base. The historical study also highlighted the presence of megaripples, sand waves, tidal sand ridges (up to 2-3 km wide and up to 17 m higher than the surrounding seabed, but with the crests at depths over 20 m) and sand ribbons within the survey area. The presence of these features indicates a highly hydrodynamic environment, which suggests that these features are likely to be mobile over time and therefore, their presence cannot be confirmed at the present time. Moreover, the biotopes characterised by finer sediments and identified within Norfolk Vanguard East main site, apparently in contrast with the historical SSS signature, are in reality reflecting this highly hydrodynamic environment. In the time span between the historical and the current surveys, the seabed characteristics would have changed: new areas of exposed finer sediment and mud/clay will likely replace the previously observed ones and the previously observed seabed features will have moved.

The biotope SS.SCS.CCS.MedLumVen, allocated to discrete points along the proposed cable corridor, was also allocated to sections of the proposed cable corridor, as an area where the biotope complex can potentially occur. The aim of these procedure was to differenciate these sections from the adjacent ones which showed a different geophysical signal (and to which the biotope complex SS.SCS.CCS was allocated). This biotope complex may infact be quite variable over time and may be closer to a biotope complex in which a number of biotopes or sub-biotopes may yet be defined and can be found amongst mosaics of cobble and lag gravel which often contain ridges of coarse gravelly sand with characteristics of these biotope (JNCC, 2015).

The biotope SS.SBR.PoR.SspiMx was also allocated to eight stations and, with the aid of the SSS data, areas where this biotope can potentially occur were highlighted. Despite the ephemeral nature of *S. spinulosa*, the substratum associated with SS.SBR.PoR.SspiMx is generally stable, indicating that the aggregate could be over a year old. However, depending on the location, the stability and the associated community are likely to depend on the frequency of the disturbance to the habitat. Winter storms may, for example, break up the *S. spinulosa* matrix associated with this biotope every few years. The depth at which it is found also plays an important role in this process. In areas where the biotope is periodically destroyed by storm events, a cyclical shift in biotopes may occur, from SS.SBR.PoR.SspiMx to other biotopes, such as SS.SCS.CCS.Pkef or SS.SSa.CMuSa.AalbNuc. (Tillin and Marschall, 2015).

The biotope complex SS.SMx.CMx (Circalittoral mixed sediment) was assigned to the section of the proposed cable corridor approaching the shore.

All these biotopes are in agreement with the main habitats known to occur, or expected to occur, in the southern North Sea (EMODNet, 2017).

6.3 Nature Conservation

LOW *Sabellaria* reef was assessed to be present at three stations, LOW/MEDIUM *Sabellaria* reef at one station and MEDIUM reef at one section of the video transect at one station. One station was assessed as presenting NOT REEF/LOW REEF. This was due to the fact that features of the different categories were observed in different sections of each transect analysed. At the other stations, *S. spinulosa* occurred in the forms of clumps or crusts occurred and were assessed as NOT REEF.

A section of the proposed cable route was assessed for the presence of sandbanks, based on topography. Areas of the seabed permanently submerged and rising to a depth < -20 m LAT were noted at the edges of the proposed cable corridor. These form part of the Annex I Sandbanks known to occur within the Haisborough, Hammond and Winterton cSAC/SCI. The sandbank type present at the Haisborough Hammond and Winterton cSAC/SCI is a current tidal sandbank. This type of sandbank can be relatively mobile, therefore their extent and distribution being actively influenced by ongoing hydrodynamic processes and change naturally over time (JNCC, 2016a).

No species of conservation importance were found, however, the family Ammodytidae occurred in the survey area. *C.fornicata* was the only non indigenous species found within the samples. These species are known to occur along the east coast of the UK south of Spurn Head in Yorkshire (Rayment, 2008).

7. CONCLUSIONS

Drop Down Video data were successfully collected at 68 stations, whilst grab data for both macrofauna and PSD were successfully collected at 65 and 66 stations respectively. Contaminants grab samples were successfully collected from 30 stations.

Analysis of the video footage showed the presence of two major habitats within the 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 characteristic of the habitat within the proposed cable corridor approaching the shore, as well as an area to the south west of the Norfolk Vanguard West. The epibiotic communities reflected the sediment complexity, with the offshore sandier sediments hosting lower faunal diversity, whilst the nearshore coarser sediments comprised a richer and diverse community.

Stations with high abundance of the Ross worm *S. spinulosa* tubes were assessed for potential biogenic reef status. The majority of the stations assessed did not show evidence of reef formations. At four stations evidence of low reef was found, whilst at two stations evidence of low to medium reef was found in sections of the video transects. However, at all stations, these features were not observed to form continuous aggregate structures.

Areas of the seabed permanently submerged and rising to a depth < -20 m LAT were noted at the edges of the proposed cable corridor. These form part of the Annex I Sandbanks known to occur within the Haisborough, Hammond and Winterton SAC.

No chalk reef features were observed in the survey area, but the presence of chalk reef cannot be discounted as it may not be visible at the surveyed sediment surface.

From grab samples analysis, the sediment distribution identified within the survey area was predominantly slightly gravelly sand and gravelly sand. The sediment types recorded within the survey area are typical of the southern North Sea region, which comprises sand and gravelly sand offshore.

Sediment chemistry analyses returned metal concentrations below ER-L standards for the majority of the metals tested. The only exception was Arsenic (As), the concentration of which was above ER-L, but below ER-M at two stations; these were, however, within those known to occur for the southwest region of the North Sea. Total hydrocarbons (THC) calculated at all stations were within the values recorded for this region of the North Sea and all single PAH concentrations were below guideline ER-L standards as well as below Cefas action levels AL1. The Levels of PCBs were below their guideline values at all stations. Organotin concentrations were below the Cefas revised action level AL1 for TBT and values fell in the lower end of class C (2 $\mu g kg^{-1}$-<50 $\mu g kg^{-1}$) of the OSPAR integrated assessment of imposex/intersex with concentrations of TBT in sediments. These concentrations are not expected to affect the reproductive capability of sensitive gastropod species.

The multivariate analysis highlighted the presence of two major benthic communities, which were mainly separated by the presence of the Ross worm *S. spinulosa* in group c and its absence, or limited presence, in group h. The stations characterised by the presence of *S. spinulosa* (group c) were distributed mainly along the proposed cable corridor and associated with a more heterogenous substrate; three stations were located to the west of the main site Norfolk Vanguard West where the presence of *S. spinulosa* was associated with a higher content of silt/clay. The stations characterised by the presence of species such as *N. cirrosa* and the absence of *S. spinulosa* (group h) were instead mainly distributed within the offshore main sites. The other groups highlighted by the multivariate analysis represented less rich communities, compared to those of the main groups, as well as stations where sediment composition supported a slightly different species composition. These were, as expected, distributed along the proposed cable corridor, with few of them also in the part of the main sites close to the cable corridor, reflecting the natural spatial variability of the seabed, particulatly approaching shallower coastal areas. The distribution also reflected the sediment distribution of the survey area. The described distribution and composition (diversity) of the benthic communities within the survey area were comparable to those of the benthic communities described for the southern North Sea.

The biotope complex SS.SCS.CCS was the most common in the survey area, particularly within the main sites Norfolk Vanguard West and East, whilst the biotope SS.SCS.CCS.MedLumVen was assigned to sections of the proposed cable corridor, as areas where the biotope complex can potentially occur. The biotope SS.SBR.PoR.SspiMx was also allocated to eight stations and, with the aid of the SSS data, areas where this biotope can potentially occur were highlighted. The majority of the sites were associated with mixed coarser sediment, whilst in the north-west of the main site Norfolk Vanguard West, SS.SBR.PoR.SspiMx was associated with higher percentage of silt/clay in sediment composition. Other biotopes were also allocated within the survey area and represented alterations of the abovementioned biotopes due to periodical disturbance.

No species of conservation importance were found and *C.fornicata* was the only non-indigenous species recorded.

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ANNEXES

A. GUIDELINES ON USE OF REPORT

This report (the ”Report”) was prepared as part of the services (the “Services”) provided by Fugro EMU Limited (‘’Fugro’’) for its client (the “Client”) and in accordance with the terms of the relevant contract between the two parties (the Contract”). The Services were performed by Fugro in accordance with the obligations in the Contract and based on requirements of the Client set out in the Contract or otherwise made known by the Client to Fugro and any other information affecting the Services at the time; save that the extent to which Fugro relied on Client or third party information in carrying out the Services was set out in the Contract.

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B. FIELD LOGS

B.1 PROPOSED SURVEY ARRAY

Station Number	Sample Type	ETRS 1989 UTM Zone 31N		Rationale
		Easting [m]	Northing [m]	
1MS	DDV/Grab	458 224	5 862 549	Microsited to same habitat for better coverage
2MS	DDV/Grab	454 265	5 864 463	Moved to similar habitat feature - Possible *Sabellaria*_Original Station representative by 1MS and 3MS
3MS	DDV/Grab	461 109	5 856 517	Microsited to clearer aspect of representative habitat
4MS	DDV/Grab	467 000	5 855 003	Representative habitat station
5MS	DDV/Grab	468 000	5 862 818	No Data
6MS	DDV/Grab	463 009	5 863 700	Microsited to feature_adjacent habitat covered by 4MS
7MS	DDV/Grab	467 378	5 866 688	Representative habitat station
8MS	DDV/Grab	465 628	5 868 643	Representative habitat station
9MS	DDV/Grab	463 795	5 871 108	No Data
10MS	DDV/Grab	466 699	5 872 908	Microsited to local features_surrounding habitats covered
11MS	DDV/Grab	468 303	5 874 933	Microsited to feature_Adjacent habitat covered by 12MS
12MS	DDV/Grab	470 514	5 871 981	Representative habitat station (NE corner NV West)
13MS	DDV/Grab	468 233	5 870 393	Representative habitat station
14MS	DDV/Grab	469 781	5 868 357	Representative habitat station
15MS	DDV/Grab	471 084	5 865 996	Representative habitat station
16MS	DDV/Grab	485 992	5 856 613	No Data
17MS	DDV/Grab	492 993	5 856 571	No Data
18MS	DDV/Grab	490 010	5 852 004	No Data
19MS	DDV/Grab	487 001	5 847 506	No Data
20MS	DDV/Grab	496 018	5 850 009	No Data
21MS	DDV/Grab	500 010	5 854 001	No Data
22MS	DDV/Grab	502 016	5 859 985	No Data
23MS	DDV/Grab	504 006	5 849 989	No Data
24CR	DDV/Grab	416 117	5 849 042	No Data
25CR	DDV/Grab	413 643	5 850 292	No Data
26CR	DDV/Grab	411 117	5 849 042	No Data
27CR	DDV/Grab	411 117	5 850 919	No Data
28CR	DDV/Grab	408 617	5 849 042	No Data
29CR	DDV/Grab	408 617	5 851 542	No Data
30CR	DDV/Grab	406 117	5 851 542	No Data
31CR	DDV/Grab	403 617	5 854 042	No Data
32CR	DDV/Grab	401 735	5 854 755	No Data
33CR	DDV/Grab	401 117	5 856 542	No Data
34CR	DDV/Grab	399 130	5 856 881	No Data
35CR	DDV/Grab	418 523	5 850 292	No Data
36CR	DDV/Grab	421 117	5 849 042	No Data
37CR	DDV/Grab	423 617	5 849 042	No Data

Station Number	Sample Type	ETRS 1989 UTM Zone 31N		Rationale
		Easting [m]	Northing [m]	
38CR	DDV/Grab	426 117	5 849 042	No Data
39CR	DDV/Grab	428 617	5 849 042	No Data
40CR	DDV/Grab	429 867	5 846 901	No Data
41CR	DDV/Grab	431 117	5 844 042	No Data
42CR	DDV/Grab	433 617	5 841 542	No Data
43CR	DDV/Grab	436 117	5 841 542	No Data
44CR	DDV/Grab	439 867	5 842 552	No Data
45CR	DDV/Grab	442 367	5 843 235	No Data
46CR	DDV/Grab	447 367	5 842 713	No Data
47CR	DDV/Grab	451 314	5 842 792	Dropped - Sand Ripples in SAC - Likely cover with SAC Stations
48CR	DDV/Grab	454 003	5 843 540	Representative habitat
49CR	DDV/Grab	456 117	5 844 042	Representative habitat
50CR	DDV/Grab	459 054	5 844 856	Microsited to possible feature_surrounding habitat covered by Stations
51CR	DDV/Grab	461 022	5 843 607	No Data _ Outside Proposed corridor
52CR	DDV/Grab	461 117	5 846 542	Representative habitat
53CR	DDV/Grab	460 545	5 848 212	Microsited to feature_original habitat representated by 53CR
54CR	DDV/Grab	461 117	5 851 542	Representative habitat
55CR	DDV/Grab	463 617	5 844 042	No Data _ Outside Proposed corridor
56CR	DDV/Grab	466 213	5 845 292	No Data _ Outside Proposed corridor
57CR	DDV/Grab	468 617	5 846 542	Representative habitat
58CR	DDV/Grab	471 849	5 847 208	Microsited to feature
59CR	DDV/Grab	473 617	5 846 542	No Data _ Outside Proposed corridor
60CR	DDV/Grab	475 987	5 847 855	Microsited to trough feature present on CR total
61CR	DDV/Grab	478 617	5 849 042	Representative habitat
62CR	DDV/Grab	480 721	5 849 656	Microsited to feature_surrounding representated by 61CR
63CR	DDV/Grab	483 386	5 859 345	No Data _ Outside Proposed corridor
64CR	DDV/Grab	471 733	5 851 066	Microsited to feature
65CR	DDV/Grab	471 732	5 853 561	Microsited to feature
66CR	DDV/Grab	483 239	5 847 792	No Data _ Outside Proposed corridor
67CR	DDV/Grab	459 020	5 847 804	No Data _ Outside Proposed corridor
68CR	DDV/Grab	462 984	5 848 367	No Data _ Outside Proposed corridor
69CR	DDV/Grab	444 867	5 842 140	No Data

Notes:
DDV = Drop Down Video

B.2 VIDEO TRANSECTS LOG

Date	Transect	Video File	Time [UTC]	Point on Line	ETRS 1989 UTM Z31N		Length [m]
					Easting [m]	Northing [m]	
03/11/2016	01MS	160976_NorfolkVanguard_1_MS	08:16:54	SOL	458 291.3	5 862 476.4	268
			08:25:33	EOL	458 089.3	5 862 653.2	
03/11/2016	02MS	160976_NorfolkVanguard_2_MS_02	09:01:32	SOL	454 325.7	5 864 386.2	214
			09:10:17	EOL	454 179.7	5 864 542.6	
03/11/2016	03MS	160976_NorfolkVanguard_3_MS	10:04:58	SOL	461 163.1	5 856 462.4	173
			10:10:41	EOL	461 040.0	5 856 583.8	
03/11/2016	04MS	160976_NorfolkVanguard_4_MS	10:53:45	SOL	467 054.1	5 854 936.8	164
			10:59:35	EOL	466 941.2	5 855 056.2	
03/11/2016	05MS	160976_NorfolkVanguard_5_MS	06:28:22	SOL	467 913.2	5 862 850.1	216
			06:33:22	EOL	468 109.8	5 862 759.8	
03/11/2016	06MS	160976_NorfolkVanguard_6_MS	07:30:00	SOL	463 071.1	5 863 682.1	117
			07:36:29	EOL	462 962.7	5 863 725.8	
03/11/2016	07MS	160976_NorfolkVanguard_7_MS	05:47:31	SOL	467 279.3	5 866 694.7	182
			05:52:21	EOL	467 461.6	5 866 701.6	
03/11/2016	08MS	160976_NorfolkVanguard_8_MS	05:15:19	SOL	465 545.7	5 868 673.9	55
			05:20:59	EOL	465 554.7	5 868 619.2	
03/11/2016	09MS	160976_NorfolkVanguard_9_MS	04:37:48	SOL	463 740.8	5 871 126.4	137
			04:42:07	EOL	463 873.7	5 871 093.0	
03/11/2016	10MS	160976_NorfolkVanguard_10_MS	03:46:49	SOL	466 620.1	5 872 939.0	165
			03:52:21	EOL	466 779.2	5 872 895.9	
03/11/2016	11MS	160976_NorfolkVanguard_11_MS	00:58:51	SOL	468 390.2	5 874 902.0	226
			01:05:02	EOL	468 172.5	5 874 964.1	
02/11/2016	12MS	160976_NorfolkVanguard_12_MS	00:10:06	SOL	470 490.5	5 871 991.6	176
			00:15:08	EOL	470 349.7	5 872 096.9	
01/11/2016	13MS	160976_NorfolkVanguard_13_MS	23:31:22	SOL	468 232.2	5 870 391.6	168
			23:40:48	EOL	468 119.2	5 870 515.5	
01/11/2016	14MS	160976_NorfolkVanguard_14_MS	22:55:24	SOL	469 825.4	5 868 296.7	198
			23:04:10	EOL	469 703.0	5 868 451.9	
01/11/2016	15MS	160976_NorfolkVanguard_15_MS	22:16:01	SOL	471 106.6	5 865 966.6	174
			22:24:40	EOL	470 977.6	5 866 084.0	
01/11/2016	16MS	160976_NorfolkVanguard_16_MS	17:47:58	SOL	486 016.9	5 856 578.6	168
			17:55:02	EOL	486 046.7	5 856 743.9	
01/11/2016	17MS	160976_NorfolkVanguard_17_MS	16:10:04	SOL	493 048.3	5 856 598.0	55
			16:36:07	EOL	493 057.0	5 856 652.0	
01/11/2016	18MS	160976_NorfolkVanguard_18_MS	09:25:18	SOL	490 042.1	5 851 927.5	148
			09:33:35	EOL	489 981.5	5 852 062.6	
01/11/2016	19MS	160976_NorfolkVanguard_19_MS	08:30:11	SOL	487 038.9	5 847 467.1	141
			08:36:43	EOL	486 989.7	5 847 599.6	
01/11/2016	20MS	160976_NorfolkVanguard_20_MS	10:15:56	SOL	496 030.2	5 849 923.1	156
			10:23:09	EOL	496 007.8	5 850 077.4	
01/11/2016	21MS	160976_NorfolkVanguard_21_MS	12:51:13	SOL	500 034.1	5 853 958.7	173
			13:00:07	EOL	499 937.1	5 854 102.4	
01/11/2016	22MS	160976_NorfolkVanguard_22_MS	14:35:11	SOL	502 017.8	5 860 023.0	306
			14:40:21	EOL	501 923.7	5 860 314.6	

Date	Transect	Video File	Time [UTC]	Point on Line	ETRS 1989 UTM Z31N		Length [m]
					Easting [m]	Northing [m]	
01/11/2016	23MS	160976_NorfolkVanguard_23_MS	11:16:37	SOL	504 026.5	5 849 918.4	134
			11:23:49	EOL	504 001.4	5 850 049.8	
31/10/2016	24CR	160976_NorfolkVanguard_24_CR	15:44:24	SOL	416 090.1	5 849 028.8	144
			15:50:07	EOL	416 232.4	5 849 047.3	
31/10/2016	25CR	160976_NorfolkVanguard_25_CR	15:03:12	SOL	413 607.1	5 850 300.5	148
			15:11:25	EOL	413 746.7	5 850 252.6	
31/10/2016	26CR	160976_NorfolkVanguard_26_CR	08:27:19	SOL	411 146.4	5 849 022.2	131
			08:37:28	EOL	411 039.7	5 849 098.5	
31/10/2016	27CR	160976_NorfolkVanguard_27_CR	08:56:54	SOL	411 167.1	5 850 889.6	202
			09:07:26	EOL	410 993.9	5 850 994.1	
31/10/2016	28CR	160976_NorfolkVanguard_28_CR	09:58:24	SOL	408 720.5	5 849 028.3	240
			10:08:32	EOL	408 483.1	5 849 062.6	
31/10/2016	29CR	160976_NorfolkVanguard_29_CR	09:27:58	SOL	408 631.1	5 851 533.7	315
			09:38:48	EOL	408 334.2	5 851 638.7	
31/10/2016	30CR	160976_NorfolkVanguard_30_CR	10:28:59	SOL	406 142.6	5 851 541.4	338
			10:37:38	EOL	405 840.0	5 851 692.7	
31/10/2016	31CR	160976_NorfolkVanguard_31_CR	11:04:02	SOL	403 541.2	5 854 074.8	127
			11:12:28	EOL	403 663.7	5 854 042.5	
31/10/2016	32CR	160976_NorfolkVanguard_32_CR	11:37:55	SOL	401 657.9	5 854 774.7	156
			11:45:44	EOL	401 804.4	5 854 720.9	
31/10/2016	33CR	160976_NorfolkVanguard_33_CR	13:10:11	SOL	401 054.0	5 856 549.6	157
			13:19:57	EOL	401 210.5	5 856 536.1	
31/10/2016	34CR	160976_NorfolkVanguard_34_CR	12:08:28	SOL	399 034.5	5 856 901.3	180
			12:18:56	EOL	399 212.7	5 856 878.8	
31/10/2016	35CR	160976_NorfolkVanguard_35_CR_03	16:22:10	SOL	418 519.7	5 850 295.8	131
			16:29:52	EOL	418 649.7	5 850 280.8	
30/10/2016	36CR	160976_NorfolkVanguard_36_CR	16:13:11	SOL	421 033.3	5 849 041.7	177
			16:23:54	EOL	421 208.7	5 849 017.7	
30/10/2016	37CR	160976_NorfolkVanguard_37_CR	16:49:56	SOL	423 532.5	5 849 058.4	204
			16:58:10	EOL	423 729.8	5 849 006.3	
30/10/2016	38CR	160976_NorfolkVanguard_38_CR	17:30:23	SOL	426 111.3	5 849 051.4	120
			17:39:59	EOL	425 999.3	5 849 095.2	
30/10/2016	39CR	160976_NorfolkVanguard_39_CR	18:29:55	SOL	428 652.9	5 849 017.9	148
			18:41;22	EOL	428 529.3	5 849 099.9	
30/10/2016	40CR	160976_NorfolkVanguard_40_CR_04	20:44:32	SOL	429 901.8	5 846 887.2	234
			20:58:51	EOL	429 687.4	5 846 981.6	
30/10/2016	41CR	160976_NorfolkVanguard_41_CR_02	21:35:35	SOL	431 126.5	5 844 035.7	160
			21:42:36	EOL	430 976.5	5 844 091.4	
30/10/2016	42CR	160976_NorfolkVanguard_42_CR	22:10:59	SOL	433 641.9	5 841 518.2	149
			22:17:18	EOL	433 511.9	5 841 590.6	
30/10/2016	43CR	160976_NorfolkVanguard_43_CR	22:38:46	SOL	436 106.5	5 841 549.1	174
			22:44:48	EOL	436 001.7	5 841 688.4	
30/10/2016	44CR	160976_NorfolkVanguard_44_CR	23:11:47	SOL	439 870.1	5 842 527.7	157
			23:17:19	EOL	439 840.7	5 842 681.6	
31/10/2016	45CR	160976_NorfolkVanguard_45_CR_02	23:36:53	SOL	442 362.9	5 843 235.9	163
			23:43:23	EOL	442 520.9	5 843 194.3	

Date	Transect	Video File	Time [UTC]	Point on Line	ETRS 1989 UTM Z31N		Length [m]
					Easting [m]	Northing [m]	
31/10/2016	46CR	160976_NorfolkVanguard_46_CR	03:43:48	SOL	447 266.9	5 842 749.1	172
			03:55:44	EOL	447 428.8	5 842 689.8	
31/10/2016	47CR	160976_NorfolkVanguard_47_CR	Dropped from the scope of work				
31/10/2016	48CR	160976_NorfolkVanguard_48_CR	22:20:22	SOL	454 034.8	5 843 516.2	190
			22:28:30	EOL	453 879.8	5 843 625.9	
31/10/2016	49CR	160976_NorfolkVanguard_49_CR	22:53:57	SOL	456 122.3	5 844 037.0	135
			23:01:56	EOL	456 005.0	5 844 103.7	
31/10/2016	50CR	160976_NorfolkVanguard_50_CR	23:29:25	SOL	459 046.8	5 844 874.9	156
			23:36:16	EOL	458 945.6	5 844 993.1	
01/11/2016	51CR	160976_NorfolkVanguard_51_CR	01:01:54	SOL	460 983.8	5 843 639.9	145
			01:06:58	EOL	461 094.3	5 843 545.4	
03/11/2016	52CR	160976_NorfolkVanguard_52_CR	14:21:28	SOL	461 065.2	5 846 558.4	205
			14:30:52	EOL	461 263.5	5 846 507.3	
03/11/2016	53CR	160976_NorfolkVanguard_53_CR_02	18:23:41	SOL	460 505.0	5 848 263.1	229
			18:29:48	EOL	460 694.2	5 848 133.9	
03/11/2016	54CR	160976_NorfolkVanguard_54_CR	19:09:39	SOL	461 058.4	5 851 585.3	256
			19:16:40	EOL	461 265.4	5 851 434.9	
01/11/2016	55CR	160976_NorfolkVanguard_55_CR	01:38:22	SOL	463 550.3	5 844 073.7	192
			01:46:12	EOL	463 728.5	5 844 003.2	
01/11/2016	56CR	160976_NorfolkVanguard_56_CR	02:16:25	SOL	466 145.3	5 845 339.9	288
			02:26:35	EOL	466 394.0	5 845 194.6	
01/11/2016	57CR	160976_NorfolkVanguard_57_CR	02:55:26	SOL	468 550.4	5 846 570.7	179
			03:02:12	EOL	468 711.0	5 846 491.2	
01/11/2016	58CR	160976_NorfolkVanguard_58_CR	03:32:32	SOL	471 779.3	5 847 219.1	158
			03:38:25	EOL	471 933.5	5 847 186.5	
01/11/2016	59CR	160976_NorfolkVanguard_59_CR	04:10:36	SOL	473 549.6	5 846 571.9	162
			04:16:46	EOL	473 693.6	5 846 497.2	
01/11/2016	60CR	160976_NorfolkVanguard_60_CR	04:50:05	SOL	475 915.9	5 847 874.8	209
			04:58:07	EOL	476 114.4	5 847 809.6	
01/11/2016	61CR	160976_NorfolkVanguard_61_CR	05:29:12	SOL	478 537.2	5 849 057.2	213
			05:36:23	EOL	478 744.8	5 849 009.9	
01/11/2016	62CR	160976_NorfolkVanguard_62_CR	06:41:02	SOL	480 829.9	5 849 620.8	175
			06:52:03	EOL	480 667.2	5 849 684.5	
01/11/2016	63CR	160976_NorfolkVanguard_63_CR	19:13:47	SOL	483 404.3	5 859 328.9	159
			19:20:27	EOL	483 294.7	5 859 443.6	
03/11/2016	64CR	160976_NorfolkVanguard_64_CR	12:20:22	SOL	471 783.3	5 851 054.1	156
			12:28:49	EOL	471 634.7	5 851 100.0	
03/11/2016	65CR	160976_NorfolkVanguard_65_CR	11:33:02	SOL	471 783.8	5 853 488.6	201
			11:38:25	EOL	471 643.5	5 853 633.1	
31/10/2016	66CR	160976_NorfolkVanguard_66_CR	07:49:35	SOL	483 325.8	5 847 770.3	163
			07:57:39	EOL	483 174.5	5 847 830.0	
03/11/2016	67CR	160976_NorfolkVanguard_67_CR_03	15:39:47	SOL	458 975.3	5 847 826.9	250
			15:49:51	EOL	459 201.8	5 847 721.0	
03/11/2016	68CR	160976_NorfolkVanguard_68_CR	13:32:50	SOL	462 967.6	5 848 361.5	160
			13:40:04	EOL	463 120.6	5 848 316.2	

Date	Transect	Video File	Time [UTC]	Point on Line	ETRS 1989 UTM Z31N		Length [m]
					Easting [m]	Northing [m]	
31/10/2016	69CR	160976_NorfolkVanguard_69_CR	01:55:00	SOL	444 858.6	5 842 148.4	177
			02:03:00	EOL	445 029.6	5 842 195.4	

Notes:
SOL = Start of Line
EOL = End of Line

B.3 MACROBENTHIC GRAB SAMPLING LOGS

Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Water Depth [m BSL]	Sample	Volume (L)	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
09/11/16	11:32	01MS	458 214.8	5 862 548.1	40	FA / PSD	10	M	Clayey silt with *Saberllaria* clumps and rubble	Patches of anoxic sediment	Ophiuridae
09/11/16	10:45	02MS	454 261.4	5 864 465.0	44	FA / PSD	10	M	Clayey silt with shell fragments and *Sabellaria* rubble	Patches of anoxic sediment	Decapoda, Ophiuridae
09/11/16	12:40	03MS	461 122.0	5 856 522.2	44	FA / PSD	6	mS	Slightly muddy sand with shells (mainly Oyster)	-	Buried *Sabellaria* tubes, Galatheidae, *Lagis* sp., Decapoda
09/11/16	13:38	04MS	467 012.2	5 854 998.3	42	FA / PSD	5	S	Fine sand with medium to coarse sands with shell fragments	-	Ophiuridae
09/11/16	08:52	05MS	467 993.7	5 862 824.5	39	FA / PSD	6	S	Fine sand and shell fragments	-	Tubes
09/11/16	09:50	06MS	463 003.9	5 863 700.2	39	FA / PSD	8	mS	Silty sand	Patches of anoxic sediment	Tubes, Polychaeta
09/11/16	07:59	07MS	467 372.7	5 866 689.1	38	FA / PSD	5	M	Silt with clay lumps	Patches of anoxic sediment	
09/11/16	06:42	08MS	465 631.4	5 868 645.9	38	FA / PSD	6	S	Fine sand and shell fragments	-	*Ammodytes* sp., Polychaeta
09/11/16	05:31	09MS	463 789.2	5 871 106.0	38	FA / PSD	8	S	Fine sand with shell fragments	-	Tubes, Polychaeta
09/11/16	04:13	10MS	466 705.8	5 872 909.5	39	FA / PSD	6	S	Fine sand	-	Tubes, *Ammodytes* sp.
09/11/16	03:33	11MS	468 299.4	5 874 922.8	38	FA / PSD	6	S	Fine sand	-	Tubes
09/11/16	02:40	12MS	470 514.0	5 871 972.6	39	FA / PSD	6	M	Silt with shell fragments	Patches of anoxic sediment	Tubes, Ophiuroidea and Echinoidea
09/11/16	01:57	13MS	468 225.3	5 870 381.8	38	FA / PSD	6	mS	Silty sand with shell fragments	Patches of anoxic sediment	Tubes, Echinoidea

Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Water Depth [m BSL]	Sample	Volume (L)	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
09/11/16	01:09	14MS	469 777.9	5 868 342.7	38	FA / PSD	8	mS	Silty sand with shell fragments	-	Polychaeta
09/11/16	00:19	15MS	471 099.3	5 866 001.6	39	FA / PSD	5	mS	Silty sand and shell fragments	-	
08/11/16	14:11	16MS	485 996.1	5 856 588.7	42	FA / PSD	9	S	Fine sand with little shell fragments	-	*Nephtys* sp.
08/11/16	13:06	17MS	493 003.8	5 856 561.2	40	FA / PSD	6	S	Fine sand and shell fragments	Anoxic layer 2 – 3 cm under surface	Smelt anoxic *Nepthys* sp., Goniadidae
08/11/16	11:40	18MS	490 010.2	5 852 009.0	38	FA / PSD	5	S	Fine sand	-	
08/11/16	16:11	19MS	487 006.0	5 847 499.4	41	FA / PSD	8	mgS	Muddy gravelly sand	Anoxic layer grey at depth of 1 – 2 cm below surface	Tubes, *Asterias rubens, Sabellaria* tubes (no elevation or crust)
08/11/16	10:53	20MS	496 019.6	5 850 006.2	35	FA / PSD	5	S	Fine sand with shell fragments	-	*Ammodytes* sp.
08/11/16	05:51	21MS	500 010.4	5 854 003.3	35	FA / PSD	5	M	Silt with shell fragments	-	
08/11/16	07:36	22MS	502 020.3	5 859 985.5	35	FA / PSD	5	sgS	Shelly gravelly sand	-	Echinoidea
08/11/16	09:54	23MS	504 012.8	5 849 988.9	31	FA / PSD	5	S	Fine sand with shell fragments	-	
05/11/16	07:57	24CR	416 124.5	5 849 025.8	30	FA / PSD	8	S	Fine sand with shell fragments	-	Tubes, Polychaeta
05/11/16	08:44	25CR	413 640.8	5 850 284.4	35	FA / PSD	5	M	Silt with shell fragments and *Sabellaria* rubble	-	Tubes, Ophiuroidea, Polychaeta, Crustacea
05/11/16	09:17	26CR	411 115.5	5 849 042.9	30	FA / PSD	12	gM	Silt with shell fragments, *Sabellaria* rubble and some gravel	-	Tubes, Ophiuroidea, Nereididae, Crustacea
10/11/16	09:15	27CR	411 124.3	5 850 919.1	26	FA / PSD	5	sG	Fine Sand with gravel and pebbles	-	Tubes

Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Water Depth [m BSL]	Sample	Volume (L)	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
05/11/16	09:50	28CR	408 611.3	5 849 051.0	16	FA / PSD	5	M	Silt, shell fragments and *Sabellaria* rubble	-	Tubes, Ascidiacea, Polychaeta
05/11/16	11:06	29CR	408 625.9	5 851 530.5	22	No sample	-	-	-	-	3 failed attempts for fauna
05/11/16	11:15	29CR	408 609.3	5 851 556.3	22	PSD	1		Cobbles, pebbles, gravel and silt	-	
05/11/16	10:32	30CR	406 115.3	5 851 532.8	18	PSD	N/A	M	Silt with pebbles and *Sabellaria* clumps	Streaks of anoxic sediment	Tubes, Polychaeta, Cirripedia, Serpulidae
05/11/16	10:36	30CR	406 113.8	5 851 550.9	18	FA	3	gM	Silt with cobbles, pebbles and gravel	Streaks of anoxic sediment	Tubes, Cirripedia, Ascidiacea, Macroalgae, Actinaria, Hydrozoa
10/11/16	08:20	31CR	403 620.2	5 854 052.4	14	FA / PSD	5	gM	Silt with gravel, pebbles and shell fragments	Patches of anoxic sediment	
10/11/16	07:45	32CR	401 727.4	5 854 760.1	14	No sample	-	-	--		3 failed attempts for Fauna
10/11/16	07:34	32CR	401 736.1	5 854 791.9	14	PSD	1	M	Silt with cobbles and pebble	Streaks of anoxic sediment	Macroalgae, Polychaetes
10/11/16	07:22	33CR	401 114.2	5 856 546.7	15	FA / PSD	5	mS	Silty sand with pebbles, cobbles, shell fragments and *Sabellaria* rubble	Streaks of anoxic sediment	Tubes, Decapoda, Polychaeta, Hydrozoa
05/11/16	06:56	34CR	399 123.2	5 856871.6	12	No sample	-	-	-	-	3 failed attempts for Fauna and PSA
05/11/16	06:24	35CR	418 524.2	5 850 293.0	-	FA / PSD	5	S	Fine sand	-	Polychaeta
05/11/16	05:47	36CR	421 125.4	5 849 042.0	25	FA / PSD	9	S	Fine sand	-	Tubes, Polychaeta
05/11/16	04:20	37CR	423 626.1	5 849 044.9	22	FA / PSD	12	S	Fine sand	-	
05/11/16	03:07	38CR	426 120.8	5 849 045.6	40	FA / PSD	>12	S	Fine sand with shell fragments	-	

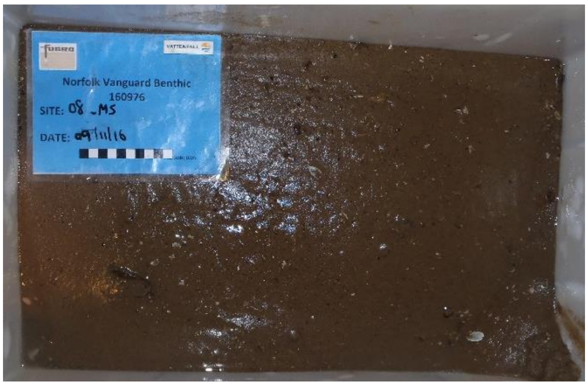
Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Water Depth [m BSL]	Sample	Volume (L)	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
05/11/16	02:29	39CR	428 619.2	5 849 051.1	32	FA / PSD	10	S	Fine sand	-	Tubes, Polychaeta, Crustacea
05/11/16	01:40	40CR	429 871.5	5 846 895.2	29	FA / PSD	9	S	Fine sand with *Sabellaria* clumps	-	Polychaeta
04/11/16	23:48	41CR	431 114.8	5 844 041.7	38	FA / PSD	10	S	Fine Sand		
04/11/16	23:07	42CR	433 610.0	5 841 539.6	33	FA / PSD	10	S	Fine Sand	Few patches of anoxic sediment	
04/11/16	21:40	43CR	436 115.7	5 841 544.2	35	FA / PSD	7	gS	shelly Gravelly Sand	-	*Sabellaria* tubes through the sample, but not protruding from the surface or forming crust. Possibly not living.
04/11/16	20:53	44CR	439 868.0	5 842 540.8	32	FA / PSD	8	S	Fine Sand	Very small anoxic mud nodules	
04/11/16	19:05	45CR	442 378.9	5 843 231.0	35	FA / PSD	5	S	Fine Sand	Occasional lump of anoxic mud	
04/11/16	16:53	46CR	447 368.2	5 842 713.8	42	FA / PSD	10	sM	Sandy (clayey) Mud	Layer of anoxic sediment at < 1 cm from surface	
-	-	47CR	-	-		-	-	-	-	-	Dropped from the scope of work
04/11/16	15:16	48CR	453 994.9	5 843 546.6	49	FA / PSD	11	mS	Muddy Sand with Oyster shells	-	Ophiuroidea, buried *Sabellaria* tubes
04/11/16	14:38	49CR	456 112.3	5 844 047.7	49	FA / PSD	6	S	Fine to Medium Sand	-	
04/11/16	13:33	50CR	459 051.8	5 844 857.1	52	FA / PSD	11	mS	Slightly muddy sand	Patches of anoxic sediment	*Liocarcinus* sp., Decapoda, Hydrozoa, Tubes (including *Sabellaria*)
04/11/16	12:46	51CR	461 023.3	5 843 602.8	50	FA / PSD	11	mS	Slightly muddy sand	-	Ophiuroidea, *Sabellaria* tubes

Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Water Depth [m BSL]	Sample	Volume (L)	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
04/11/16	11:32	52CR	461 118.3	5 846 540.7	49	FA / PSD	5	M	Clayey silt with consolidated lumps of clay	Patches of anoxic sediment	Tubes
04/11/16	09:27	53CR	460 549.1	5 848 195.6	49	FA / PSD	8	M	Clay/ Silt with shell fragments	Layer of sediment anoxia	
03/11/16	23:28	54CR	461 093.4	5 851 543.0	49	FA / PSD	7	mS	Slightly muddy sand with shell fragments	Patches of anoxic sediment	
09/11/16	17:39	55CR	463 608.5	5 844 032.0	-	FA / PSD	5	mgS	Muddy gravelly sand	-	Tubes, *Sabellaria* tubes, Decapda
09/11/16	16:19	56CR	466 214.0	5 845 295.1	44	FA / PSD	7	S	Fine to medium sand with a few shell fragments	-	Bivalvia
09/11/16	15:29	57CR	468 620.8	5 846 541.8	46	FA / PSD	5	S	Fine sand with some shell fragments	Patches of anoxic sediment, few samll black nodules	
08/11/16	21:41	58CR	471 849.8	5 847 211.6	43	FA / PSD	9	mS	Muddy shelly sand over sandy silty clay, lots of *Sabellaria* tube fragments	Grey annoxic layer < 1 cm	Ophiuroidea, *Psammechinus miliaris* and ?Ampharetidae tubes
08/11/16	21:13	59CR	473 619.7	5 846 552.0	39	FA / PSD	10	S	Fine sand and shell fragments	One streak of anoxic sediment	*Nephtys* sp., *Ammodytes* sp.
08/11/16	20:40	60CR	475 986.8	5 847 862.0	43	FA / PSD	8	S	Fine to medium sand	-	*Nephtys* sp.
08/11/16	19:06	61CR	478 617.6	5 849 048.3	44	PSD	2 -3	mS	Muddy sand with clay	Anoxic layer < 1 cm	
08/11/16	19:46	61CR	478 617.2	5 849 052.1	44	FA	5	mS	Muddy sand with clay	Anoxic layer < 1 cm	Casts, Echinodermata, *Lagis* sp.
08/11/16	18:27	62CR	480 718.3	5 849 672.7	42	FA / PSD	7	mS	Muddy sand	Patches and layer of grey/black anoxic layer at a depth > 3 cm	Bivalvia, ?Spionidae, *Lagis* tubes, *Liocarcinus* juv. tubes of *Sabellaria* throughout, no elevation/crust, Polychaeta tubes
08/11/16	15:03	63CR	483 372.7	5 859 344.4	39	FA / PSD	7	S	Fine sand with shell fragments	-	*Nephtys* sp.

Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Water Depth [m BSL]	Sample	Volume (L)	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
08/11/16	22:14	64CR	471 736.1	5 851 073.0	-	FA / PSD	-	mS	Muddy sand with clay	Streaks of anoxic sediment	*Sabellaria* tubes
08/11/16	22:47	65CR	471 741.1	5 853 563.0	-	FA / PSD	-	mS	Muddy sand with clay	Streaks of anoxic sediment	Tubes, Crustacea
08/11/16	17:17	66CR	483 239.3	5 847 789.3	41	FA / PSD	7	(m)gS	Slighty muddy gravelly sand	-	
04/11/16	11:00	67CR	459 002.8	5 847 800.1	49	FA / PSD	12	M	Clay/silt with high proportion of *Sabellaria*	Layer of sediment anoxia (5 mm below surface)	Decapoda Anthropogenic features: plastic bag
04/11/16	08:23	68CR	462 958.2	5 848 343.0	49	FA / PSD	8	M	Silt with shell fragments	Patches of anoxic sediment	Tubes, Ophiuroidea, Crustacea
04/11/16	17:39	69CR	444 874.9	5 842 119.0	23	FA / PSD	6	S	Fine Sand	Possible patches of anoxic sediment	

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

B.4 MACROFAUNA GRAB SAMPLE PHOTOS

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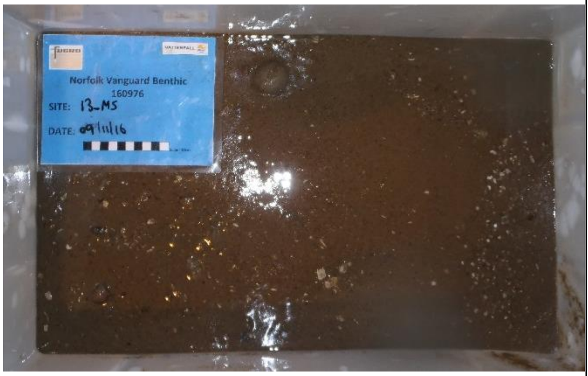
DATE: 09/11/16


Norfolk Vanguard Benthic
160976
SITE: 10_MS
DATE: 09/11/16


Norfolk Vanguard Benthic
160976
SITE: 11_MS
DATE: 09/11/16


Norfolk Vanguard Benthic
160976
SITE: 12_MS
DATE: 09/11/16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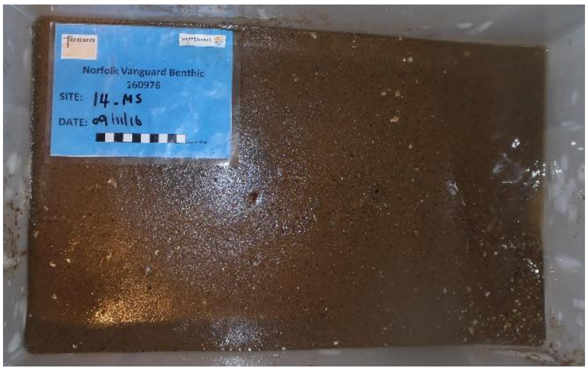
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DATE: 09/11/16


Norfolk Vanguard Benthic
160976
SITE: 16_MS
DATE: 08/11/16


VATTENFALL
Norfolk Vanguard Benthic
160976
SITE: 17-MS
DATE: 08/11/16


Norfolk Vanguard Benthic
160976
SITE: 18-MS
DATE: 08/11/16


Norfolk Vanguard Benthic
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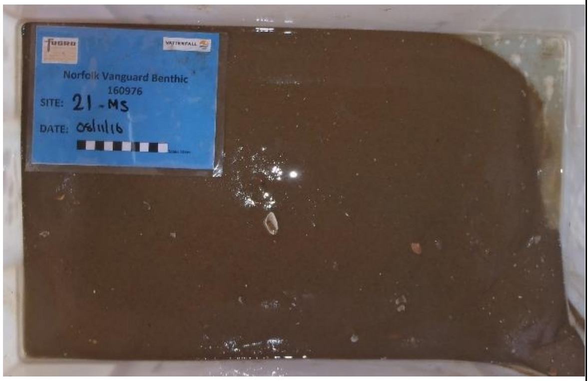
DATE: 08/11/16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DATE: 08/11/16


Norfolk Vanguard Benthic
160976
SITE: 23-MS
DATE: 08/11/16


VATTENFALL
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160976
SITE: 24-CR
DATE: 05/11/16


Norfolk Vanguard Benthic
160976
SITE: 25_CR
DATE: 05/11/16


Norfolk Vanguard Benthic
160976
SITE: 26_CR
DATE: 05/11/16


Norfolk Vanguard Benthic
160976
SITE: 27 -CR
DATE: 10/11/16


Norfolk Vanguard Benthic
160976
SITE: 28 _CR
DATE: 05/11/16


Norfolk Vanguard Benthic
160976
SITE: 30_CR
DATE: 05/11/16


Norfolk Vanguard Benthic
160976
SITE: 31 -CR
DATE: 10/11/16


Norfolk Vanguard Benthic
160976
SITE: 32 -CR
DATE: 10/11/16


Norfolk Vanguard Benthic
160976
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DATE: 10/11/16


Norfolk Vanguard Benthic
160976
SITE: 35_CR
DATE: 05/11/16


Norfolk Vanguard Benthic
160976
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DATE: 05/11/16


Norfolk Vanguard Benthic
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39_CR
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Norfolk Vanguard Benthic
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40_CR
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Norfolk Vanguard Benthic
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41_CR
04/11/16


Norfolk Vanguard Benthic
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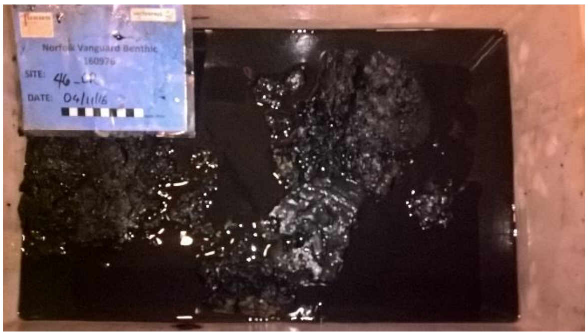
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DATE: 04/11/16


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160976
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DATE: 04/11/16


VATTENFALL
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160976
SITE: 50_CR


VATTENFALL
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DATE: 04/11/16


Norfolk Vanguard Benthic
160976
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DATE: 04/11/16


Norfolk Vanguard Benthic
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SITE: 53_CR
DATE: 04/11/16


Norfolk Vanguard Benthic
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DATE: 03/11/16


Norfolk Vanguard Benthic
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DATE: 09/11/16


Norfolk Vanguard Benthic
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160976
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DATE: 09/11/16


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160976
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Norfolk Vanguard Benthic
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Norfolk Vanguard Benthic
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Norfolk Vanguard Benthic
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Norfolk Vanguard Benthic
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62-CR
08/11/16


Norfolk Vanguard Benthic
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Norfolk Vanguard Benthic
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Norfolk Vanguard Benthic
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DATE: 08/11/16


Norfolk Vanguard Benthic
160976
SITE: 66-CR
DATE: 08/11/16


Norfolk Vanguard Benthic
160976
SITE: 67_CR
DATE: /11/16

Norfolk Vanguard Benthic
160976
SITE: 68 _CR
DATE: 04/11/16	SITE: 69 _CR
DATE: 04/11/16

B.5 CONTAMINANTS GRAB SAMPLING LOGS

Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Water Depth [m BSL]	Sample	Volume	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
09/11/16	11:37	01MS	458 222.8	5 862 544.0	40	HC/HM	10	M	Cleyey silt	Layer of anoxic sediment at depth of 1 cm under surface	
09/11/16	10:45	02MS	454 272.2	5 864 452.0	44	HC/HM	10	M	Cleyey silt	Layer of anoxic sediment at depth of 1 cm under surface	Ophiuroidea, Hydrozoa
09/11/16	12:46	03MS	461 096.5	5 856 510.6	44	HC/HM	7	mS	Slightly muddy sand with *Sabellaria*		*Liocarcinus* sp., Galatheidae, *Ammodytes* sp.
09/11/16	13:47	04MS	466 979.0	5 854 992.3	42	HC/HM	6	S	Fine sand with medium to coarse sand		
09/11/16	08:59	05MS	468 001.6	5 862 827.4	39	HC/HM	9	S	Fine sand with shell fragments		Ophiuroidea
09/11/16	09:56	06MS	462 995.3	5 863 702.1	39	HC/HM	6	S	Fine sand	Layer of anoxic sediment at depth 3 cm under surface	Tubes
09/11/16	08:06	07MS	467 385.0	5 866 692.6	38	HC/HM	6	M	Silt	Layer of anoxic sediment at depth 3 cm under surface	
09/11/16	06:56	08MS	465 630.4	5 868 643.1	38	HC/HM	10	S	Fine sand		
09/11/16	05:42	09MS	463 765.0	5 871 088.2	38	HC/HM	8	S	Fine sand and shell fragments		Tubes
09/11/16	04:25	10MS	466 690.8	5 872 906.3	39	HC/HM	8	S	Fine sand		Tubes
09/11/16	03:39	11MS	468 312.7	5 874 924.3	38	HC/HM	7	S	Fine sand		Tubes
09/11/16	02:45	12MS	470 509.3	5 871 979.2	39	HC/HM	8	M	Silt and shell fragments	Patches of anoxic sediment	Ophiuroidea
09/11/16	02:03	13MS	468 239.7	5 870 388.9	38	HC/HM	8	mS	Silty sand	Patches of anoxic sediment	Tubes
09/11/16	01:22	14MS	469 771.9	5 868 350.2	39	HC/HM	8	mS	Silty sand		
09/11/16	00:28	15MS	471 065.2	5 865 991.9	42	HC/HM	8	mS	Sandy mud (3-4 cm) over muddy sand and shell fragments		
08/11/16	14:18	16MS	485 995.0	5 856 594.6	40	HC/HM	7	sM	Fine sand	Layer of anoxic sediment at depth of 2 - 3 cm under surface	Ophiuroidea
08/11/16	13:14	17MS	493 005.3	5 856 576.3	33	HC/HM	7	S	Silty sand		Ophiuroidea

Date	Time [UTC]	Station	ETRS 1989 UTM Z31N		Water Depth [m BSL]	Sample	Volume	Sediment Type	Sediment Description		Notes/Conspicuous Fauna
			Easting [m]	Northing [m]							
08/11/16	11:47	18MS	490 006.2	5 852 005.6	41	HC/HM	8	mS		Layer of grey anoxic at depth of < 2 cm under surface	Tubes, *Sabellaria* tubes, *Asterias rubens*
08/11/16	16:37	19MS	486 986.2	5 847 494.3	35	HC/HM	7		Fine sand		
08/11/16	11:02	20MS	496 007.7	5 850 008.3	35	HC/HM	8	S	Silt		Echinoidea, Paguridae
08/11/16	09:08	21MS	500 014.5	5 853 999.0	35	HC/HM	6	M	Silt with shell pieces		
08/11/16	08:09	22MS	502 024.6	5 859 990.7	31	HC/HM	10	M	Fine sand		
08/11/16	09:59	23MS	504 006.1	5 849 997.9	30	HC/HM	8	S	Fine sand and shell fragments		Tubes, Polychaeta
05/11/16	08:27	24CR	416 108.2	5 849 045.1	30	HC/HM	10	S	Fine sand and shell fragments		Tubes, Polychaeta
04/11/16	09:23	26CR	411 116.9	5 849 036.6	30	HC/HM	10	M	Silt and shell pieces and *Sabellaria* rubble		Tubes, Ophiuroidea, Nereididae, Crustacea
05/11/16	03:13	38CR	426 116.9	5 849 044.5	40	HC/HM	10	S	Fine sand		*Ammodytes* sp.
05/11/16	00:02	41CR	431 116.0	5 844 027.0	38	HC/HM	8	S	Fine sand		
04/11/16	19:54	45CR	442 364.9	5 843 233.3	35	HC/HM	7	S	Fine sand and shells (occasional lump black mud)	Occasional patches of anoxic mud lumps	
04/11/16	15:55	48CR	454 001.0	5 843 551.0	49	HC/HM	10	mS	Muddy sand and tubes and shell		*Sabellaria* tubes
09/11/16	16:54	56CR	466 204.1	5 845 289.2	44	HC/HM	7	S	Fine to medium sand		

Notes:
BSL = Below sea level
HC = Samples for hydrocarbon analysis
HM = Samples for heavy metals analysis

B.6 CONTAMINANTS GRAB SAMPLES PHOTOS

	
01MS	02MS
	
03MS	05MS
	
06MS	07MS

	
08MS	09MS
	
10MS	11MS
	
12MS	13MS

	
14MS	15MS
	
16MS	17MS
	
18MS	19MS

	
20MS	21MS
	
22MS	23MS
	
24CR	26CR

	
38CR	41CR
	
45CR	48CR
	
56CR	

B.7 GRAB SAMPLING DATA

B.7.1 PSD Results

Sample ID:		01MS	02MS	03MS	04MS	05MS	06MS	07MS
TEXTURAL GROUP	SAMPLE TYPE:	Unimodal, Poorly Sorted	Bimodal, Very Poorly Sorted	Unimodal, Moderately Sorted	Unimodal, Moderately Sorted	Unimodal, Moderately Well Sorted	Unimodal, Moderately Sorted	Unimodal, Moderately Well Sorted
	FOLK [1954 ORIGINAL]:	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand	Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand
	FOLK [BGS MODIFIED]:	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand	Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Sand
	SEDIMENT NAME:	Slightly Very Fine Gravelly Medium Sand	Slightly Fine Gravelly Fine Silty Medium Sand	Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand	Slightly Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand	Slightly Fine Gravelly Medium Sand
METHOD OF MOMENTS Arithmetic [µm]	MEAN:	668.21	464.71	838.75	671.32	539.96	668.73	455.11
	SORTING:	1492.26	916.29	1763.00	970.37	599.07	1385.76	369.74
	SKEWNESS:	6.15	4.65	5.09	8.42	7.13	6.47	10.33
	KURTOSIS:	43.70	26.78	30.02	88.24	61.83	48.80	146.27
METHOD OF MOMENTS Geometric [µm]	MEAN:	302.16	115.65	444.41	493.62	422.82	405.33	381.56
	SORTING:	3.90	8.46	2.44	1.75	1.66	1.98	1.54
	SKEWNESS:	-1.93	-1.04	-0.08	1.80	1.67	2.31	0.98
	KURTOSIS:	10.65	3.56	14.69	9.27	9.17	10.63	7.76
METHOD OF MOMENTS Logarithmic [Phi]	MEAN:	1.73	3.11	1.17	1.02	1.24	1.30	1.39
	SORTING:	1.96	3.08	1.29	0.81	0.73	0.99	0.62
	SKEWNESS:	1.93	1.04	0.08	-1.80	-1.67	-2.31	-0.98
	KURTOSIS:	10.65	3.56	14.69	9.27	9.17	10.63	7.76
FOLK AND WARD METHOD [µm]	MEAN:	346.66	115.57	431.88	476.21	421.52	388.19	385.55
	SORTING:	2.77	8.17	2.00	1.65	1.60	1.76	1.57
	SKEWNESS:	-0.21	-0.48	0.32	0.23	0.17	0.21	0.09
	KURTOSIS:	2.83	1.30	1.70	0.87	1.11	1.66	1.31
FOLK AND WARD METHOD [Phi]	MEAN:	1.53	3.11	1.21	1.07	1.25	1.37	1.38
	SORTING:	1.47	3.03	1.00	0.72	0.68	0.81	0.65
	SKEWNESS:	0.21	0.48	-0.32	-0.23	-0.17	-0.21	-0.09
	KURTOSIS:	2.83	1.30	1.70	0.87	1.11	1.66	1.31

Sample ID:		01MS	02MS	03MS	04MS	05MS	06MS	07MS
FOLK AND WARD METHOD [Description]	MEAN:	Medium Sand	Very Fine Sand	Medium Sand	Medium Sand	Medium Sand	Medium Sand	Medium Sand
	SORTING:	Poorly Sorted	Very Poorly Sorted	Moderately Sorted	Moderately Sorted	Moderately Well Sorted	Moderately Sorted	Moderately Well Sorted
	SKEWNESS:	Fine Skewed	Very Fine Skewed	Very Coarse Skewed	Coarse Skewed	Coarse Skewed	Coarse Skewed	Symmetrical
	KURTOSIS:	Very Leptokurtic	Leptokurtic	Very Leptokurtic	Platykurtic	Leptokurtic	Very Leptokurtic	Leptokurtic
MODE 1 [µm]:		375.00	375.00	375.00	375.00	375.00	375.00	375.00
MODE 2 [µm]:		0.00	5.86	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	0.00
MODE 1 [Phi]:		1.50	1.50	1.50	1.50	1.50	1.50	1.50
MODE 2 [Phi]:		0.00	7.50	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	0.00
D10 [µm]:		134.25	5.16	236.89	270.85	256.39	198.05	226.84
D50 [µm]:		352.98	224.74	395.56	448.80	393.47	365.61	370.56
D90 [µm]:		846.94	862.34	920.35	926.46	826.01	831.31	730.12
(D90 / D10) [µm]:		6.31	167.12	3.89	3.42	3.22	4.20	3.22
(D90 - D10) [µm]:		712.69	857.18	683.46	655.61	569.63	633.26	503.28
(D75 / D25) [µm]:		1.93	10.16	1.97	2.11	1.79	1.72	1.67
(D75 - D25) [µm]:		235.54	388.79	286.62	362.99	237.73	201.34	192.14
D10 [Phi]:		0.24	0.21	0.12	0.11	0.28	0.27	0.45
D50 [Phi]:		1.50	2.15	1.34	1.16	1.35	1.45	1.43
D90 [Phi]:		2.90	7.60	2.08	1.88	1.96	2.34	2.14
(D90 / D10) [Phi]:		12.09	35.56	17.35	17.10	7.12	8.76	4.72
(D90 - D10) [Phi]:		2.66	7.38	1.96	1.77	1.69	2.07	1.69
(D75 / D25) [Phi]:		1.92	3.76	2.25	3.01	1.94	1.74	1.70

Sample ID:	01MS	02MS	03MS	04MS	05MS	06MS	07MS
(D75 - D25) [Phi]:	0.95	3.34	0.98	1.08	0.84	0.78	0.74
% GRAVEL [63000 - 2000 µm]:	4.26	3.78	5.62	2.57	1.68	4.09	0.52
% SAND [< 2000 - 63 µm]:	87.76	68.59	93.41	97.43	98.32	95.91	99.48
% MUD [< 63 µm]:	7.99	27.63	0.97	0.00	0.00	0.00	0.00
% V COARSE GRAVEL:	0.00	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	0.00
% MEDIUM GRAVEL:	1.24	0.00	1.75	0.43	0.00	1.01	0.00
% FINE GRAVEL:	1.51	1.92	2.57	0.81	0.86	1.51	0.28
% V FINE GRAVEL:	1.51	1.86	1.30	1.32	0.82	1.57	0.25
% V COARSE SAND:	1.51	3.77	1.67	3.53	1.61	1.83	0.51
% COARSE SAND:	17.68	11.45	22.68	35.34	24.33	15.31	19.76
% MEDIUM SAND:	52.87	28.09	59.28	54.90	64.73	63.71	67.58
% FINE SAND:	15.26	18.94	9.79	3.65	7.64	15.06	11.63
% V FINE SAND:	0.44	6.34	0.00	0.00	0.00	0.00	0.00
% V COARSE SILT:	2.06	4.72	0.00	0.00	0.00	0.00	0.00
% COARSE SILT:	0.88	4.69	0.00	0.00	0.00	0.00	0.00
% MEDIUM SILT:	1.52	4.97	0.35	0.00	0.00	0.00	0.00
% FINE SILT:	1.77	5.45	0.41	0.00	0.00	0.00	0.00
% V FINE SILT:	0.33	1.48	0.04	0.00	0.00	0.00	0.00
% CLAY:	1.42	6.34	0.17	0.00	0.00	0.00	0.00

SAMPLE ID:		08MS	09MS	10MS	11MS	12MS	13MS	14MS
TEXTURAL GROUP	SAMPLE TYPE:	Unimodal, Moderately Sorted	Unimodal, Moderately Well Sorted	Unimodal, Moderately Well Sorted	Unimodal, Moderately Sorted	Unimodal, Poorly Sorted	Unimodal, Moderately Sorted	Unimodal, Moderately Well Sorted
	FOLK [1954 ORIGINAL]:	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Sand	Slightly Gravelly Sand
	FOLK [BGS MODIFIED]:	Slightly Gravelly Sand	Slightly Gravelly Sand	Sand	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Sand	Slightly Gravelly Sand
	SEDIMENT NAME:	Slightly Very Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand	Slightly Medium Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Fine Silty Medium Sand	Slightly Coarse Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand
METHOD OF MOMENTS Arithmetic [µm]	MEAN:	615.09	471.39	434.02	593.29	499.34	916.32	485.46
	SORTING:	1028.10	464.63	694.53	1124.94	1101.31	2949.77	453.45
	SKEWNESS:	7.35	8.72	14.62	7.57	8.23	6.96	8.17
	KURTOSIS:	69.08	96.11	234.41	69.35	78.83	52.47	89.11
METHOD OF MOMENTS Geometric [µm]	MEAN:	421.66	384.95	351.75	389.38	242.02	393.91	397.98
	SORTING:	1.82	1.57	1.48	1.87	4.22	2.72	1.56
	SKEWNESS:	2.36	1.65	2.97	2.33	-2.30	-0.67	1.82
	KURTOSIS:	10.68	10.43	26.71	11.07	10.21	16.73	10.22
METHOD OF MOMENTS Logarithmic [Phi]	MEAN:	1.25	1.38	1.51	1.36	2.05	1.34	1.33
	SORTING:	0.87	0.65	0.56	0.91	2.08	1.44	0.64
	SKEWNESS:	-2.36	-1.65	-2.97	-2.33	2.30	0.67	-1.82
	KURTOSIS:	10.68	10.43	26.71	11.07	10.21	16.73	10.22
FOLK AND WARD METHOD [µm]	MEAN:	400.25	379.68	348.48	360.09	295.75	396.14	389.51
	SORTING:	1.68	1.54	1.42	1.66	2.66	1.76	1.51
	SKEWNESS:	0.29	0.10	-0.02	0.14	-0.45	0.21	0.18
	KURTOSIS:	1.73	1.36	1.32	1.77	3.69	1.77	1.30
FOLK AND WARD METHOD [Phi]	MEAN:	1.32	1.40	1.52	1.47	1.76	1.34	1.36
	SORTING:	0.75	0.62	0.51	0.73	1.41	0.82	0.60
	SKEWNESS:	-0.29	-0.10	0.02	-0.14	0.45	-0.21	-0.18
	KURTOSIS:	1.73	1.36	1.32	1.77	3.69	1.77	1.30
FOLK AND	MEAN:	Medium Sand	Medium Sand	Medium Sand	Medium Sand	Medium Sand	Medium Sand	Medium Sand

SAMPLE ID:		08MS	09MS	10MS	11MS	12MS	13MS	14MS
WARD METHOD [Description]	SORTING:	Moderately Sorted	Moderately Well Sorted	Moderately Well Sorted	Moderately Sorted	Poorly Sorted	Moderately Sorted	Moderately Well Sorted
	SKEWNESS:	Coarse Skewed	Coarse Skewed	Symmetrical	Coarse Skewed	Very Fine Skewed	Coarse Skewed	Coarse Skewed
	KURTOSIS:	Very Leptokurtic	Leptokurtic	Leptokurtic	Very Leptokurtic	Extremely Leptokurtic	Very Leptokurtic	Leptokurtic
MODE 1 [µm]:		375.00	375.00	375.00	375.00	375.00	375.00	375.00
MODE 2 [µm]:		0.00	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	0.00
MODE 1 [Phi]:		1.50	1.50	1.50	1.50	1.50	1.50	1.50
MODE 2 [Phi]:		0.00	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	0.00
D10 [µm]:		255.83	249.89	232.03	201.18	57.10	217.64	257.42
D50 [µm]:		376.09	368.88	348.48	356.92	329.19	371.94	375.07
D90 [µm]:		857.96	718.01	490.78	778.56	520.22	833.14	745.67
(D90 / D10) [µm]:		3.35	2.87	2.12	3.87	9.11	3.83	2.90
(D90 - D10) [µm]:		602.13	468.12	258.74	577.39	463.12	615.50	488.25
(D75 / D25) [µm]:		1.62	1.63	1.53	1.65	1.69	1.69	1.60
(D75 - D25) [µm]:		182.90	181.17	150.30	181.21	175.69	196.57	178.10
D10 [Phi]:		0.22	0.48	1.03	0.36	0.94	0.26	0.42
D50 [Phi]:		1.41	1.44	1.52	1.49	1.60	1.43	1.41
D90 [Phi]:		1.97	2.00	2.11	2.31	4.13	2.20	1.96
(D90 / D10) [Phi]:		8.90	4.19	2.05	6.41	4.38	8.35	4.62
(D90 - D10) [Phi]:		1.75	1.52	1.08	1.95	3.19	1.94	1.53
(D75 / D25) [Phi]:		1.65	1.64	1.51	1.64	1.62	1.72	1.63
(D75 - D25) [Phi]:		0.69	0.70	0.62	0.72	0.76	0.75	0.68

SAMPLE ID:	08MS	09MS	10MS	11MS	12MS	13MS	14MS
% GRAVEL [63000 - 2000 µm]:	3.56	1.09	0.67	3.50	2.55	4.33	1.08
% SAND [< 2000 - 63 µm]:	96.44	98.91	99.33	96.50	87.18	93.61	98.92
% MUD [< 63 µm]:	0.00	0.00	0.00	0.00	10.27	2.06	0.00
% V COARSE GRAVEL:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% COARSE GRAVEL:	0.00	0.00	0.00	0.00	0.00	1.43	0.00
% MEDIUM GRAVEL:	0.40	0.00	0.30	0.60	0.61	0.49	0.00
% FINE GRAVEL:	1.20	0.45	0.16	0.99	0.91	1.23	0.37
% V FINE GRAVEL:	1.96	0.64	0.21	1.91	1.02	1.18	0.71
% V COARSE SAND:	3.48	0.92	0.55	2.86	1.08	1.49	1.98
% COARSE SAND:	13.40	16.72	6.61	10.10	6.76	15.87	16.38
% MEDIUM SAND:	71.96	71.26	80.97	68.98	65.69	66.33	73.66
% FINE SAND:	7.61	10.01	11.21	14.57	13.55	9.92	6.89
% V FINE SAND:	0.00	0.00	0.00	0.00	0.09	0.00	0.00
% V COARSE SILT:	0.00	0.00	0.00	0.00	2.07	0.00	0.00
% COARSE SILT:	0.00	0.00	0.00	0.00	1.10	0.07	0.00
% MEDIUM SILT:	0.00	0.00	0.00	0.00	1.98	0.79	0.00
% FINE SILT:	0.00	0.00	0.00	0.00	2.43	0.77	0.00
% V FINE SILT:	0.00	0.00	0.00	0.00	0.51	0.08	0.00
% CLAY:	0.00	0.00	0.00	0.00	2.17	0.35	0.00

SAMPLE ID:		15MS	16MS	17MS	18MS	19MS	20MS	21MS
TEXTURAL GROUP	SAMPLE TYPE:	Unimodal, Moderately Well Sorted	Unimodal, Well Sorted	Unimodal, Moderately Sorted	Unimodal, Well Sorted	Bimodal, Very Poorly Sorted	Unimodal, Well Sorted	Unimodal, Moderately Well Sorted
	FOLK [1954 ORIGINAL]:	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Gravelly Muddy Sand	Slightly Gravelly Sand	Slightly Gravelly Sand
	FOLK [BGS MODIFIED]:	Slightly Gravelly Sand	Sand	Sand	Sand	Gravelly Muddy Sand	Sand	Sand
	SEDIMENT NAME:	Slightly Very Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand	Fine Gravelly Fine Silty Medium Sand	Slightly Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand
METHOD OF MOMENTS Arithmetic [µm]	MEAN:	510.75	379.44	353.32	372.06	772.48	410.73	345.76
	SORTING:	734.47	239.78	362.54	197.20	1925.56	487.36	136.33
	SKEWNESS:	9.67	14.46	10.24	16.85	4.54	10.57	6.15
	KURTOSIS:	124.43	295.85	141.37	439.76	24.70	120.13	103.35
METHOD OF MOMENTS Geometric [µm]	MEAN:	387.35	334.53	256.12	331.61	154.23	340.36	307.30
	SORTING:	1.65	1.39	2.55	1.37	8.34	1.47	1.41
	SKEWNESS:	2.43	0.89	-3.32	0.37	-0.91	2.60	-0.18
	KURTOSIS:	13.23	12.86	19.30	10.57	3.89	22.62	4.51
METHOD OF MOMENTS Logarithmic [Phi]	MEAN:	1.37	1.58	1.97	1.59	2.70	1.55	1.70
	SORTING:	0.73	0.47	1.35	0.45	3.06	0.56	0.49
	SKEWNESS:	-2.43	-0.89	3.32	-0.37	0.91	-2.60	0.18
	KURTOSIS:	13.23	12.86	19.30	10.57	3.89	22.62	4.51
FOLK AND WARD METHOD [µm]	MEAN:	363.52	340.24	282.15	338.99	140.06	341.66	304.35
	SORTING:	1.50	1.38	1.80	1.38	7.99	1.40	1.47
	SKEWNESS:	0.08	-0.15	-0.40	-0.16	-0.39	-0.11	-0.25
	KURTOSIS:	1.47	1.12	1.43	1.09	1.74	1.18	1.05
FOLK AND WARD METHOD [Phi]	MEAN:	1.46	1.56	1.83	1.56	2.84	1.55	1.72
	SORTING:	0.59	0.47	0.85	0.46	3.00	0.48	0.56
	SKEWNESS:	-0.08	0.15	0.40	0.16	0.39	0.11	0.25
	KURTOSIS:	1.47	1.12	1.43	1.09	1.74	1.18	1.05
FOLK AND	MEAN:	Medium Sand	Medium Sand	Medium Sand	Medium Sand	Fine Sand	Medium Sand	Medium Sand

SAMPLE ID:		15MS	16MS	17MS	18MS	19MS	20MS	21MS
WARD METHOD [Description]	SORTING:	Moderately Well Sorted	Well Sorted	Moderately Sorted	Well Sorted	Very Poorly Sorted	Well Sorted	Moderately Well Sorted
	SKEWNESS:	Symmetrical	Fine Skewed	Very Fine Skewed	Fine Skewed	Very Fine Skewed	Fine Skewed	Fine Skewed
	KURTOSIS:	Leptokurtic	Leptokurtic	Leptokurtic	Mesokurtic	Very Leptokurtic	Leptokurtic	Mesokurtic
MODE 1 [µm]:		375.00	375.00	375.00	375.00	375.00	375.00	375.00
MODE 2 [µm]:		0.00	0.00	0.00	0.00	5.86	0.00	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	1.50	1.50	1.50	1.50
MODE 2 [Phi]:		0.00	0.00	0.00	0.00	7.50	0.00	0.00
MODE 3 [Phi]:		0.00	0.00	0.00	0.00	0.00	0.00	0.00
D10 [µm]:		251.60	204.17	141.46	201.62	6.69	207.45	166.73
D50 [µm]:		363.52	340.24	305.79	338.99	263.17	341.66	320.49
D90 [µm]:		694.26	479.75	473.05	477.74	1056.57	481.97	470.09
(D90 / D10) [µm]:		2.76	2.35	3.34	2.37	157.95	2.32	2.82
(D90 - D10) [µm]:		442.66	275.59	331.59	276.12	1049.88	274.52	303.36
(D75 / D25) [µm]:		1.58	1.54	1.91	1.54	5.78	1.54	1.61
(D75 - D25) [µm]:		168.70	147.27	191.31	146.50	376.56	148.07	154.93
D10 [Phi]:		0.53	1.06	1.08	1.07	-0.08	1.05	1.09
D50 [Phi]:		1.46	1.56	1.71	1.56	1.93	1.55	1.64
D90 [Phi]:		1.99	2.29	2.82	2.31	7.22	2.27	2.58
(D90 / D10) [Phi]:		3.78	2.16	2.61	2.17	-90.99	2.15	2.37
(D90 - D10) [Phi]:		1.46	1.23	1.74	1.24	7.30	1.22	1.50
(D75 / D25) [Phi]:		1.59	1.50	1.71	1.49	3.23	1.50	1.53
(D75 - D25) [Phi]:		0.66	0.62	0.93	0.62	2.53	0.62	0.69

SAMPLE ID:	15MS	16MS	17MS	18MS	19MS	20MS	21MS
% GRAVEL [63000 - 2000 µm]:	2.15	0.31	0.69	0.14	7.54	0.78	0.06
% SAND [< 2000 - 63 µm]:	97.85	99.69	94.00	99.86	68.77	99.22	99.94
% MUD [< 63 µm]:	0.00	0.00	5.31	0.00	23.68	0.00	0.00
% V COARSE GRAVEL:	0.00	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	0.00
% MEDIUM GRAVEL:	0.17	0.00	0.00	0.00	2.00	0.00	0.00
% FINE GRAVEL:	0.58	0.09	0.22	0.06	2.79	0.69	0.00
% V FINE GRAVEL:	1.40	0.22	0.48	0.07	2.75	0.09	0.06
% V COARSE SAND:	1.90	0.25	0.78	0.23	2.67	0.22	0.14
% COARSE SAND:	11.30	4.63	3.45	4.33	10.53	4.73	3.35
% MEDIUM SAND:	75.34	80.68	63.55	80.81	31.60	80.59	72.38
% FINE SAND:	9.31	14.13	26.21	14.50	20.04	13.68	24.06
% V FINE SAND:	0.00	0.00	0.01	0.00	3.94	0.00	0.00
% V COARSE SILT:	0.00	0.00	1.25	0.00	3.60	0.00	0.00
% COARSE SILT:	0.00	0.00	0.92	0.00	3.92	0.00	0.00
% MEDIUM SILT:	0.00	0.00	1.10	0.00	4.98	0.00	0.00
% FINE SILT:	0.00	0.00	1.26	0.00	5.27	0.00	0.00
% V FINE SILT:	0.00	0.00	0.15	0.00	1.12	0.00	0.00
% CLAY:	0.00	0.00	0.62	0.00	4.79	0.00	0.00

SAMPLE ID:		22MS	23MS	24CR	25CR	26CR	27CR	28CR
TEXTURAL GROUP	SAMPLE TYPE:	Unimodal, Moderately Sorted	Unimodal, Moderately Well Sorted	Unimodal, Moderately Sorted	Bimodal, Poorly Sorted	Bimodal, Poorly Sorted	Trimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted
	FOLK [1954 ORIGINAL]:	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Gravelly Sand	Gravelly Sand	Sandy Gravel	Gravelly Muddy Sand
	FOLK [BGS MODIFIED]:	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Gravelly Sand	Gravelly Sand	Sandy Gravel	Gravelly Muddy Sand
	SEDIMENT NAME:	Slightly Very Fine Gravelly Medium Sand	Slightly Medium Gravelly Medium Sand	Slightly Very Fine Gravelly Coarse Sand	Fine Gravelly Fine Sand	Very Fine Gravelly Medium Sand	Sandy Very Coarse Gravel	Coarse Gravelly Very Coarse Silty Medium Sand
METHOD OF MOMENTS Arithmetic [µm]	MEAN:	545.87	447.41	733.54	760.39	1391.23	14964.73	3593.97
	SORTING:	997.90	1000.17	775.32	1462.15	2200.13	17797.69	6637.28
	SKEWNESS:	6.88	10.53	4.76	3.00	3.04	0.99	2.22
	KURTOSIS:	63.49	119.21	29.86	10.65	13.22	2.39	6.75
METHOD OF MOMENTS Geometric [µm]	MEAN:	345.51	316.33	545.36	302.04	583.11	3699.82	606.78
	SORTING:	1.97	1.67	1.83	3.31	3.79	7.73	8.18
	SKEWNESS:	2.13	2.95	1.04	-0.01	-0.68	-0.37	-0.39
	KURTOSIS:	9.07	20.47	5.45	7.57	6.74	2.07	3.95
METHOD OF MOMENTS Logarithmic [Phi]	MEAN:	1.53	1.66	0.87	1.73	0.78	-1.89	0.72
	SORTING:	0.98	0.74	0.87	1.73	1.92	2.95	3.03
	SKEWNESS:	-2.13	-2.95	-1.04	0.01	0.68	0.37	0.39
	KURTOSIS:	9.07	20.47	5.45	7.57	6.74	2.07	3.95
FOLK AND WARD METHOD [µm]	MEAN:	304.97	300.15	521.06	281.34	646.93	4270.68	744.85
	SORTING:	1.84	1.50	1.78	2.70	3.23	7.61	7.64
	SKEWNESS:	0.08	-0.24	0.09	0.32	0.32	-0.26	0.28
	KURTOSIS:	1.67	0.98	1.01	1.71	1.18	0.58	1.05
FOLK AND WARD METHOD [Phi]	MEAN:	1.71	1.74	0.94	1.83	0.63	-2.09	0.42
	SORTING:	0.88	0.58	0.83	1.44	1.69	2.93	2.93
	SKEWNESS:	-0.08	0.24	-0.09	-0.32	-0.32	0.26	-0.28
	KURTOSIS:	1.67	0.98	1.01	1.71	1.18	0.58	1.05
FOLK AND	MEAN:	Medium Sand	Medium Sand	Coarse Sand	Medium Sand	Coarse Sand	Fine Gravel	Coarse Sand

SAMPLE ID:		22MS	23MS	24CR	25CR	26CR	27CR	28CR
WARD METHOD [Description]	SORTING:	Moderately Sorted	Moderately Well Sorted	Moderately Sorted	Poorly Sorted	Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted
	SKEWNESS:	Symmetrical	Fine Skewed	Symmetrical	Very Coarse Skewed	Very Coarse Skewed	Fine Skewed	Coarse Skewed
	KURTOSIS:	Very Leptokurtic	Mesokurtic	Mesokurtic	Very Leptokurtic	Leptokurtic	Very Platykurtic	Mesokurtic
MODE 1 [µm]:		375.00	375.00	750.00	187.50	375.00	375.00	375.00
MODE 2 [µm]:		0.00	0.00	0.00	6000.00	3000.00	47250.00	23750.00
MODE 3 [µm]:		0.00	0.00	0.00	0.00	0.00	12000.00	0.00
MODE 1 [Phi]:		1.50	1.50	0.50	2.50	1.50	1.50	1.50
MODE 2 [Phi]:		0.00	0.00	0.00	-2.50	-1.50	-5.48	-4.49
MODE 3 [Phi]:		0.00	0.00	0.00	0.00	0.00	-3.50	0.00
D10 [µm]:		160.26	162.65	270.50	125.71	165.58	271.51	78.81
D50 [µm]:		321.70	317.41	526.00	251.93	492.93	6438.18	418.71
D90 [µm]:		622.63	475.12	988.85	1727.43	3672.56	44742.81	12783.19
(D90 / D10) [µm]:		3.89	2.92	3.66	13.74	22.18	164.79	162.20
(D90 - D10) [µm]:		462.37	312.47	718.36	1601.72	3506.98	44471.30	12704.37
(D75 / D25) [µm]:		1.84	1.69	2.25	2.65	3.81	52.39	14.74
(D75 - D25) [µm]:		194.91	167.00	432.92	268.87	817.83	23074.40	2707.10
D10 [Phi]:		0.68	1.07	0.02	-0.79	-1.88	-5.48	-3.68
D50 [Phi]:		1.64	1.66	0.93	1.99	1.02	-2.69	1.26
D90 [Phi]:		2.64	2.62	1.89	2.99	2.59	1.88	3.67
(D90 / D10) [Phi]:		3.86	2.44	116.64	-3.79	-1.38	-0.34	-1.00
(D90 - D10) [Phi]:		1.96	1.55	1.87	3.78	4.47	7.36	7.34
(D75 / D25) [Phi]:		1.72	1.59	4.26	2.16	-11.94	-0.25	-1.52
(D75 - D25) [Phi]:		0.88	0.76	1.17	1.41	1.93	5.71	3.88

SAMPLE ID:	22MS	23MS	24CR	25CR	26CR	27CR	28CR
% GRAVEL [63000 - 2000 µm]:	4.27	1.38	4.00	9.53	18.69	61.06	28.67
% SAND [< 2000 - 63 µm]:	95.73	98.62	96.00	87.87	78.00	38.07	63.08
% MUD [< 63 µm]:	0.00	0.00	0.00	2.59	3.31	0.87	8.25
% V COARSE GRAVEL:	0.00	0.00	0.00	0.00	0.00	19.80	0.00
% COARSE GRAVEL:	0.00	0.00	0.00	0.00	0.00	11.47	7.67
% MEDIUM GRAVEL:	0.30	0.66	0.00	0.00	2.20	15.28	7.19
% FINE GRAVEL:	1.19	0.15	1.31	6.34	6.58	11.05	6.99
% V FINE GRAVEL:	2.78	0.57	2.70	3.19	9.91	3.47	6.82
% V COARSE SAND:	2.95	1.10	5.29	2.20	7.42	1.27	5.21
% COARSE SAND:	4.07	2.45	43.92	6.47	23.22	9.47	9.60
% MEDIUM SAND:	60.85	68.74	41.51	32.14	32.90	20.67	25.48
% FINE SAND:	27.85	26.33	5.28	39.97	13.08	6.13	17.57
% V FINE SAND:	0.02	0.00	0.00	7.08	1.38	0.54	5.22
% V COARSE SILT:	0.00	0.00	0.00	0.18	0.73	0.35	2.54
% COARSE SILT:	0.00	0.00	0.00	0.89	0.70	0.03	1.13
% MEDIUM SILT:	0.00	0.00	0.00	0.37	0.74	0.19	1.25
% FINE SILT:	0.00	0.00	0.00	0.66	0.66	0.18	1.42
% V FINE SILT:	0.00	0.00	0.00	0.09	0.09	0.02	0.36
% CLAY:	0.00	0.00	0.00	0.40	0.39	0.10	1.55

SAMPLE ID:		29CR	30CR	31CR	32CR	33CR	35CR	36CR
TEXTURAL GROUP	SAMPLE TYPE:	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Unimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Unimodal, Moderately Well Sorted	Unimodal, Moderately Well Sorted
	FOLK [1954 ORIGINAL]:	Sandy Gravel	Muddy Sandy Gravel	Muddy Sandy Gravel	Gravel	Sandy Gravel	Slightly Gravelly Sand	Slightly Gravelly Sand
	FOLK [BGS MODIFIED]:	Sandy Gravel	Muddy Sandy Gravel	Muddy Sandy Gravel	Gravel	Sandy Gravel	Sand	Sand
	SEDIMENT NAME:	Sandy Very Coarse Gravel	Very Coarse Silty Sandy Coarse Gravel	Fine Silty Sandy Coarse Gravel	Coarse Gravel	Sandy Coarse Gravel	Slightly Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand
METHOD OF MOMENTS Arithmetic [µm]	MEAN:	22579.84	9649.68	8016.57	27237.85	9880.74	491.90	312.16
	SORTING:	22525.53	9272.13	9336.35	17194.63	11053.54	435.14	181.43
	SKEWNESS:	0.16	0.49	0.80	-0.11	0.41	9.73	17.04
	KURTOSIS:	1.07	1.72	2.02	1.69	1.23	118.70	455.01
METHOD OF MOMENTS Geometric [µm]	MEAN:	4873.24	2585.81	1772.19	13856.29	1862.12	411.03	274.16
	SORTING:	9.69	10.06	9.55	5.52	10.09	1.52	1.43
	SKEWNESS:	-0.42	-1.18	-0.81	-2.16	-0.38	1.47	0.27
	KURTOSIS:	2.07	4.06	3.75	8.12	2.47	10.01	5.96
METHOD OF MOMENTS Logarithmic [Phi]	MEAN:	-2.28	-1.37	-0.83	-3.79	-0.90	1.28	1.87
	SORTING:	3.28	3.33	3.26	2.46	3.33	0.61	0.52
	SKEWNESS:	0.42	1.18	0.81	2.16	0.38	-1.47	-0.27
	KURTOSIS:	2.07	4.06	3.75	8.12	2.47	10.01	5.96
FOLK AND WARD METHOD [µm]	MEAN:	5751.82	3292.88	2280.37	16978.15	1774.09	413.25	272.50
	SORTING:	7.88	8.29	7.34	4.03	7.76	1.53	1.52
	SKEWNESS:	-0.34	-0.58	-0.11	-0.57	0.18	0.20	-0.18
	KURTOSIS:	0.54	0.75	0.66	1.98	0.54	1.11	0.78
FOLK AND WARD METHOD [Phi]	MEAN:	-2.52	-1.72	-1.19	-4.09	-0.83	1.27	1.88
	SORTING:	2.98	3.05	2.88	2.01	2.96	0.61	0.60
	SKEWNESS:	0.34	0.58	0.11	0.57	-0.18	-0.20	0.18
	KURTOSIS:	0.54	0.75	0.66	1.98	0.54	1.11	0.78
FOLK AND	MEAN:	Fine Gravel	Very Fine Gravel	Very Fine Gravel	Coarse Gravel	Very Coarse Sand	Medium Sand	Medium Sand

SAMPLE ID:		29CR	30CR	31CR	32CR	33CR	35CR	36CR
WARD METHOD [Description]	SORTING:	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Moderately Well Sorted	Moderately Well Sorted
	SKEWNESS:	Very Fine Skewed	Very Fine Skewed	Fine Skewed	Very Fine Skewed	Coarse Skewed	Coarse Skewed	Fine Skewed
	KURTOSIS:	Very Platykurtic	Platykurtic	Very Platykurtic	Very Leptokurtic	Very Platykurtic	Mesokurtic	Platykurtic
MODE 1 [µm]:		47250.00	23750.00	375.00	47250.00	23750.00	375.00	375.00
MODE 2 [µm]:		750.00	375.00	23750.00	0.00	375.00	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	1.50	-5.48	-4.49	1.50	1.50
MODE 2 [Phi]:		0.50	1.50	-4.49	0.00	1.50	0.00	0.00
MODE 3 [Phi]:		0.00	0.00	0.00	0.00	0.00	0.00	0.00
D10 [µm]:		299.28	130.43	176.29	624.85	151.08	260.39	150.17
D50 [µm]:		9609.91	7432.89	2369.07	24556.01	1213.38	390.08	286.93
D90 [µm]:		54020.00	24005.73	23228.97	52185.09	26352.55	775.75	449.99
(D90 / D10) [µm]:		180.50	184.06	131.76	83.52	174.42	2.98	3.00
(D90 - D10) [µm]:		53720.72	23875.30	23052.68	51560.25	26201.47	515.36	299.82
(D75 / D25) [µm]:		72.99	36.07	41.78	2.98	72.85	1.67	1.92
(D75 - D25) [µm]:		42304.27	15526.31	13773.61	26121.94	19887.85	203.16	182.32
D10 [Phi]:		-5.76	-4.59	-4.54	-5.71	-4.72	0.37	1.15
D50 [Phi]:		-3.26	-2.89	-1.24	-4.62	-0.28	1.36	1.80
D90 [Phi]:		1.74	2.94	2.50	0.68	2.73	1.94	2.74
(D90 / D10) [Phi]:		-0.30	-0.64	-0.55	-0.12	-0.58	5.30	2.37
(D90 - D10) [Phi]:		7.50	7.52	7.04	6.38	7.45	1.57	1.58
(D75 / D25) [Phi]:		-0.14	-0.29	-0.41	0.70	-0.43	1.75	1.68
(D75 - D25) [Phi]:		6.19	5.17	5.38	1.57	6.19	0.74	0.94

SAMPLE ID:	29CR	30CR	31CR	32CR	33CR	35CR	36CR
% GRAVEL [63000 - 2000 µm]:	56.78	63.10	50.79	86.03	47.96	0.74	0.19
% SAND [< 2000 - 63 µm]:	42.15	30.68	44.22	12.91	48.64	99.26	99.81
% MUD [< 63 µm]:	1.07	6.22	4.99	1.06	3.40	0.00	0.00
% V COARSE GRAVEL:	44.05	0.00	0.00	35.97	0.00	0.00	0.00
% COARSE GRAVEL:	1.02	24.93	22.24	36.73	37.97	0.00	0.00
% MEDIUM GRAVEL:	6.70	24.20	15.23	8.35	2.55	0.00	0.00
% FINE GRAVEL:	2.40	8.22	10.08	3.26	4.37	0.45	0.04
% V FINE GRAVEL:	2.61	5.75	3.25	1.71	3.08	0.30	0.15
% V COARSE SAND:	3.20	3.64	2.13	1.42	2.83	0.33	0.03
% COARSE SAND:	19.58	6.47	8.83	3.76	6.79	24.35	0.42
% MEDIUM SAND:	14.10	10.18	23.40	5.06	20.42	68.60	61.62
% FINE SAND:	3.88	7.04	9.62	2.32	16.51	5.97	37.74
% V FINE SAND:	1.39	3.35	0.24	0.35	2.09	0.00	0.01
% V COARSE SILT:	0.06	1.66	0.89	0.20	0.64	0.00	0.00
% COARSE SILT:	0.20	0.95	0.63	0.17	0.66	0.00	0.00
% MEDIUM SILT:	0.29	1.14	0.87	0.20	0.61	0.00	0.00
% FINE SILT:	0.30	1.17	1.11	0.23	0.75	0.00	0.00
% V FINE SILT:	0.04	0.25	0.28	0.05	0.14	0.00	0.00
% CLAY:	0.18	1.06	1.21	0.21	0.60	0.00	0.00

SAMPLE ID:		37CR	38CR	39CR	40CR	41CR	42CR	43CR
TEXTURAL GROUP	SAMPLE TYPE:	Unimodal, Moderately Well Sorted	Unimodal, Moderately Well Sorted	Unimodal, Moderately Well Sorted	Unimodal, Moderately Sorted	Unimodal, Moderately Well Sorted	Unimodal, Well Sorted	Bimodal, Poorly Sorted
	FOLK [1954 ORIGINAL]:	Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Sand	Sandy Gravel
	FOLK [BGS MODIFIED]:	Sand	Slightly Gravelly Sand	Sand	Slightly Gravelly Sand	Sand	Sand	Sandy Gravel
	SEDIMENT NAME:	Moderately Well Sorted Medium Sand	Slightly Very Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Coarse Sand	Slightly Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand	Well Sorted Medium Sand	Sandy Fine Gravel
METHOD OF MOMENTS Arithmetic [µm]	MEAN:	414.47	638.95	584.91	667.26	544.04	409.78	2866.03
	SORTING:	148.24	693.83	203.82	1180.97	196.27	134.22	3637.89
	SKEWNESS:	1.42	5.98	1.16	6.41	0.70	1.74	1.60
	KURTOSIS:	4.54	43.92	14.57	50.93	7.15	5.78	4.37
METHOD OF MOMENTS Geometric [µm]	MEAN:	369.63	490.53	518.69	403.57	480.52	369.51	1193.99
	SORTING:	1.39	1.73	1.42	2.56	1.44	1.34	3.90
	SKEWNESS:	0.20	1.32	-0.09	-1.86	0.04	0.41	-0.16
	KURTOSIS:	4.34	7.29	1.62	17.47	1.76	5.46	3.32
METHOD OF MOMENTS Logarithmic [Phi]	MEAN:	1.44	1.03	0.95	1.31	1.06	1.44	-0.26
	SORTING:	0.47	0.79	0.51	1.35	0.52	0.42	1.96
	SKEWNESS:	-0.20	-1.32	0.09	1.86	-0.04	-0.41	0.16
	KURTOSIS:	4.34	7.29	1.62	17.47	1.76	5.46	3.32
FOLK AND WARD METHOD [µm]	MEAN:	363.87	478.69	518.61	429.19	481.51	363.18	1219.02
	SORTING:	1.44	1.61	1.53	1.80	1.54	1.38	3.99
	SKEWNESS:	0.05	0.08	-0.09	0.14	0.08	0.11	0.19
	KURTOSIS:	1.30	0.77	0.74	1.32	0.74	1.16	0.81
FOLK AND WARD METHOD [Phi]	MEAN:	1.46	1.06	0.95	1.22	1.05	1.46	-0.29
	SORTING:	0.53	0.69	0.61	0.85	0.62	0.47	2.00
	SKEWNESS:	-0.05	-0.08	0.09	-0.14	-0.08	-0.11	-0.19
	KURTOSIS:	1.30	0.77	0.74	1.32	0.74	1.16	0.81
FOLK AND WARD METHOD	MEAN:	Medium Sand	Medium Sand	Coarse Sand	Medium Sand	Medium Sand	Medium Sand	Very Coarse Sand

SAMPLE ID:		37CR	38CR	39CR	40CR	41CR	42CR	43CR
[Description]	SORTING:	Moderately Well Sorted	Moderately Well Sorted	Moderately Well Sorted	Moderately Sorted	Moderately Well Sorted	Well Sorted	Poorly Sorted
	SKEWNESS:	Symmetrical	Symmetrical	Symmetrical	Coarse Skewed	Symmetrical	Coarse Skewed	Coarse Skewed
	KURTOSIS:	Leptokurtic	Platykurtic	Platykurtic	Leptokurtic	Platykurtic	Leptokurtic	Platykurtic
MODE 1 [µm]:		375.00	375.00	750.00	375.00	375.00	375.00	750.00
MODE 2 [µm]:		0.00	0.00	0.00	0.00	0.00	0.00	6000.00
MODE 3 [µm]:		0.00	0.00	0.00	0.00	0.00	0.00	0.00
MODE 1 [Phi]:		1.50	1.50	0.50	1.50	1.50	1.50	0.50
MODE 2 [Phi]:		0.00	0.00	0.00	0.00	0.00	0.00	-2.50
MODE 3 [Phi]:		0.00	0.00	0.00	0.00	0.00	0.00	0.00
D10 [µm]:		254.06	266.38	291.10	233.71	280.27	259.03	246.47
D50 [µm]:		363.87	462.97	532.45	396.89	470.20	363.18	976.14
D90 [µm]:		622.38	908.44	885.37	885.95	859.63	565.58	8302.00
(D90 / D10) [µm]:		2.45	3.41	3.04	3.79	3.07	2.18	33.68
(D90 - D10) [µm]:		368.32	642.06	594.28	652.24	579.37	306.55	8055.53
(D75 / D25) [µm]:		1.57	2.14	1.99	1.96	2.01	1.53	8.56
(D75 - D25) [µm]:		164.77	372.63	364.74	285.24	342.32	154.57	3259.05
D10 [Phi]:		0.68	0.14	0.18	0.17	0.22	0.82	-3.05
D50 [Phi]:		1.46	1.11	0.91	1.33	1.09	1.46	0.03
D90 [Phi]:		1.98	1.91	1.78	2.10	1.84	1.95	2.02
(D90 / D10) [Phi]:		2.89	13.78	10.14	12.00	8.41	2.37	-0.66
(D90 - D10) [Phi]:		1.29	1.77	1.60	1.92	1.62	1.13	5.07
(D75 / D25) [Phi]:		1.57	3.13	3.21	2.24	2.82	1.53	-0.64
(D75 - D25) [Phi]:		0.65	1.10	1.00	0.97	1.00	0.61	3.10

SAMPLE ID:	37CR	38CR	39CR	40CR	41CR	42CR	43CR
% GRAVEL [63000 - 2000 µm]:	0.00	2.58	0.06	3.41	0.02	0.00	35.66
% SAND [< 2000 - 63 µm]:	100.00	97.42	99.94	93.66	99.98	100.00	63.41
% MUD [< 63 µm]:	0.00	0.00	0.00	2.93	0.00	0.00	0.93
% V COARSE GRAVEL:	0.00	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	0.00
% MEDIUM GRAVEL:	0.00	0.00	0.00	0.49	0.00	0.00	10.56
% FINE GRAVEL:	0.00	1.18	0.00	2.20	0.00	0.00	13.03
% V FINE GRAVEL:	0.00	1.40	0.06	0.72	0.02	0.00	12.07
% V COARSE SAND:	0.01	1.89	0.36	2.28	0.14	0.01	13.58
% COARSE SAND:	14.60	39.97	54.52	24.65	45.09	12.15	21.74
% MEDIUM SAND:	77.18	50.16	44.92	58.99	53.58	82.04	18.84
% FINE SAND:	8.21	5.41	0.14	6.88	1.17	5.80	8.64
% V FINE SAND:	0.00	0.00	0.00	0.86	0.00	0.00	0.61
% V COARSE SILT:	0.00	0.00	0.00	1.09	0.00	0.00	0.16
% COARSE SILT:	0.00	0.00	0.00	0.09	0.00	0.00	0.23
% MEDIUM SILT:	0.00	0.00	0.00	0.63	0.00	0.00	0.22
% FINE SILT:	0.00	0.00	0.00	0.67	0.00	0.00	0.27
% V FINE SILT:	0.00	0.00	0.00	0.09	0.00	0.00	0.01
% CLAY:	0.00	0.00	0.00	0.37	0.00	0.00	0.05

SAMPLE ID:		44CR	45CR	46CR	48CR	49CR	50CR	51CR
TEXTURAL GROUP	SAMPLE TYPE:	Unimodal, Moderately Well Sorted	Unimodal, Moderately Sorted	Bimodal, Very Poorly Sorted	Polymodal, Extremely Poorly Sorted	Unimodal, Moderately Well Sorted	Trimodal, Very Poorly Sorted	Unimodal, Poorly Sorted
	FOLK [1954 ORIGINAL]:	Slightly Gravelly Sand	Gravelly Sand	Slightly Gravelly Sandy Mud	Gravelly Muddy Sand	Slightly Gravelly Sand	Gravelly Muddy Sand	Gravelly Sand
	FOLK [BGS MODIFIED]:	Sand	Gravelly Sand	Sandy Mud	Gravelly Muddy Sand	Slightly Gravelly Sand	Gravelly Muddy Sand	Gravelly Sand
	SEDIMENT NAME:	Slightly Very Fine Gravelly Medium Sand	Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Fine Sandy Medium Silt	Coarse Gravelly Fine Silty Medium Sand	Slightly Very Fine Gravelly Medium Sand	Medium Gravelly Fine Silty Medium Sand	Very Fine Gravelly Medium Sand
METHOD OF MOMENTS Arithmetic [µm]	MEAN:	312.71	706.56	124.13	5947.37	516.89	1961.52	942.28
	SORTING:	111.83	1700.08	333.59	9644.06	485.68	3940.95	2697.87
	SKEWNESS:	4.32	5.50	12.17	1.26	6.98	2.08	7.15
	KURTOSIS:	98.92	34.41	193.76	2.66	68.41	5.48	58.72
METHOD OF MOMENTS Geometric [µm]	MEAN:	277.83	355.48	26.23	518.00	414.85	245.69	364.53
	SORTING:	1.42	2.23	7.62	16.42	1.62	10.99	3.60
	SKEWNESS:	-0.27	2.26	-0.38	-0.40	1.50	-0.55	-1.25
	KURTOSIS:	2.36	9.58	2.35	2.79	7.82	3.43	11.12
METHOD OF MOMENTS Logarithmic [Phi]	MEAN:	1.85	1.49	5.25	0.95	1.27	2.03	1.46
	SORTING:	0.51	1.16	2.93	4.04	0.70	3.46	1.85
	SKEWNESS:	0.27	-2.26	0.38	0.40	-1.50	0.55	1.25
	KURTOSIS:	2.36	9.58	2.35	2.79	7.82	3.43	11.12
FOLK AND WARD METHOD [µm]	MEAN:	276.17	306.93	30.64	654.69	413.18	247.25	381.96
	SORTING:	1.52	1.99	7.74	18.34	1.59	11.34	2.52
	SKEWNESS:	-0.19	0.13	-0.08	0.08	0.19	-0.12	0.13
	KURTOSIS:	0.80	1.61	0.95	1.00	1.27	2.08	2.83
FOLK AND WARD METHOD [Phi]	MEAN:	1.86	1.70	5.03	0.61	1.28	2.02	1.39
	SORTING:	0.60	0.99	2.95	4.20	0.67	3.50	1.33
	SKEWNESS:	0.19	-0.13	0.08	-0.08	-0.19	0.12	-0.13
	KURTOSIS:	0.80	1.61	0.95	1.00	1.27	2.08	2.83
FOLK AND	MEAN:	Medium Sand	Medium Sand	Coarse Silt	Coarse Sand	Medium Sand	Fine Sand	Medium Sand

SAMPLE ID:		44CR	45CR	46CR	48CR	49CR	50CR	51CR
WARD METHOD [Description]	SORTING:	Moderately Well Sorted	Moderately Sorted	Very Poorly Sorted	Extremely Poorly Sorted	Moderately Well Sorted	Very Poorly Sorted	Poorly Sorted
	SKEWNESS:	Fine Skewed	Coarse Skewed	Symmetrical	Symmetrical	Coarse Skewed	Fine Skewed	Coarse Skewed
	KURTOSIS:	Platykurtic	Very Leptokurtic	Mesokurtic	Mesokurtic	Leptokurtic	Very Leptokurtic	Very Leptokurtic
MODE 1 [µm]:		375.00	375.00	187.50	375.00	375.00	375.00	375.00
MODE 2 [µm]:		0.00	0.00	11.72	23750.00	0.00	12000.00	0.00
MODE 3 [µm]:		0.00	0.00	0.00	5.86	0.00	5.86	0.00
MODE 1 [Phi]:		1.50	1.50	2.50	1.50	1.50	1.50	1.50
MODE 2 [Phi]:		0.00	0.00	6.50	-4.49	0.00	-3.50	0.00
MODE 3 [Phi]:		0.00	0.00	0.00	7.50	0.00	7.50	0.00
D10 [µm]:		151.43	154.11	1.45	10.01	256.31	7.55	158.44
D50 [µm]:		291.73	321.26	27.94	418.19	385.99	303.95	358.10
D90 [µm]:		453.85	759.37	315.50	23210.43	820.64	9352.62	1301.64
(D90 / D10) [µm]:		3.00	4.93	217.58	2318.91	3.20	1238.86	8.22
(D90 - D10) [µm]:		302.41	605.27	314.05	23200.42	564.33	9345.07	1143.20
(D75 / D25) [µm]:		1.90	2.04	20.41	36.86	1.67	5.06	1.80
(D75 - D25) [µm]:		182.37	227.57	146.34	5403.45	199.71	543.56	212.74
D10 [Phi]:		1.14	0.40	1.66	-4.54	0.29	-3.23	-0.38
D50 [Phi]:		1.78	1.64	5.16	1.26	1.37	1.72	1.48
D90 [Phi]:		2.72	2.70	9.43	6.64	1.96	7.05	2.66
(D90 / D10) [Phi]:		2.39	6.79	5.67	-1.46	6.89	-2.19	-6.99
(D90 - D10) [Phi]:		1.58	2.30	7.77	11.18	1.68	10.27	3.04
(D75 / D25) [Phi]:		1.67	1.88	2.61	-1.10	1.74	5.16	1.80
(D75 - D25) [Phi]:		0.93	1.03	4.35	5.20	0.74	2.34	0.84

SAMPLE ID:	44CR	45CR	46CR	48CR	49CR	50CR	51CR
% GRAVEL [63000 - 2000 µm]:	0.03	5.31	0.49	29.70	1.41	16.65	7.54
% SAND [< 2000 - 63 µm]:	99.97	94.69	37.58	51.12	98.59	62.35	87.30
% MUD [< 63 µm]:	0.00	0.00	61.93	19.18	0.00	21.00	5.15
% V COARSE GRAVEL:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% COARSE GRAVEL:	0.00	0.00	0.00	22.18	0.00	0.00	1.13
% MEDIUM GRAVEL:	0.00	1.68	0.00	1.12	0.00	12.91	0.17
% FINE GRAVEL:	0.00	1.83	0.18	3.22	0.37	1.00	2.73
% V FINE GRAVEL:	0.03	1.81	0.31	3.18	1.04	2.73	3.51
% V COARSE SAND:	0.00	0.58	0.14	4.72	2.72	3.93	3.96
% COARSE SAND:	1.20	10.36	1.04	9.32	20.59	7.87	10.00
% MEDIUM SAND:	62.74	52.89	12.54	24.30	67.72	30.01	59.17
% FINE SAND:	35.99	29.89	15.41	9.54	7.57	18.35	14.17
% V FINE SAND:	0.04	0.97	8.45	3.25	0.00	2.19	0.00
% V COARSE SILT:	0.00	0.00	9.88	3.75	0.00	3.18	1.32
% COARSE SILT:	0.00	0.00	12.67	2.93	0.00	3.21	0.52
% MEDIUM SILT:	0.00	0.00	13.77	3.89	0.00	4.36	0.97
% FINE SILT:	0.00	0.00	11.90	4.03	0.00	4.96	1.23
% V FINE SILT:	0.00	0.00	2.59	0.87	0.00	1.00	0.21
% CLAY:	0.00	0.00	11.11	3.71	0.00	4.28	0.90

SAMPLE ID:		52CR	53CR	54CR	55CR	56CR	57CR	58CR
TEXTURAL GROUP	SAMPLE TYPE:	Bimodal, Extremely Poorly Sorted	Bimodal, Very Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Moderately Well Sorted	Unimodal, Moderately Well Sorted	Bimodal, Very Poorly Sorted
	FOLK [1954 ORIGINAL]:	Gravelly Muddy Sand	Gravelly Muddy Sand	Gravelly Sand	Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sandy Mud
	FOLK [BGS MODIFIED]:	Gravelly Muddy Sand	Gravelly Muddy Sand	Gravelly Sand	Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sandy Mud
	SEDIMENT NAME:	Coarse Gravelly Medium Silty Medium Sand	Very Fine Gravelly Very Coarse Silty Medium Sand	Medium Gravelly Medium Sand	Very Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sandy Medium Silt
METHOD OF MOMENTS Arithmetic [µm]	MEAN:	4134.77	1035.17	1773.00	1467.24	599.43	475.09	249.27
	SORTING:	7809.67	2143.07	4143.87	2596.45	935.02	810.52	696.60
	SKEWNESS:	1.86	3.77	3.75	3.07	10.00	12.35	6.37
	KURTOSIS:	4.85	18.15	17.66	12.04	114.96	168.87	49.22
METHOD OF MOMENTS Geometric [µm]	MEAN:	377.61	205.11	560.25	603.37	456.39	370.44	31.14
	SORTING:	14.02	9.44	3.45	3.36	1.63	1.55	10.36
	SKEWNESS:	-0.39	-0.95	0.65	-0.04	2.56	2.95	-0.18
	KURTOSIS:	3.04	3.78	7.55	7.01	15.03	22.10	2.16
METHOD OF MOMENTS Logarithmic [Phi]	MEAN:	1.41	2.29	0.84	0.73	1.13	1.43	5.01
	SORTING:	3.81	3.24	1.79	1.75	0.70	0.63	3.37
	SKEWNESS:	0.39	0.95	-0.65	0.04	-2.56	-2.95	0.18
	KURTOSIS:	3.04	3.78	7.55	7.01	15.03	22.10	2.16
FOLK AND WARD METHOD [µm]	MEAN:	454.88	216.68	506.95	630.65	446.94	358.19	34.42
	SORTING:	16.77	9.31	2.70	2.99	1.54	1.46	10.17
	SKEWNESS:	0.04	-0.30	0.52	0.51	0.24	0.04	0.00
	KURTOSIS:	1.49	1.61	2.02	1.32	0.85	1.39	0.88
FOLK AND WARD METHOD [Phi]	MEAN:	1.14	2.21	0.98	0.67	1.16	1.48	4.86
	SORTING:	4.07	3.22	1.43	1.58	0.62	0.55	3.35
	SKEWNESS:	-0.04	0.30	-0.52	-0.51	-0.24	-0.04	0.00
	KURTOSIS:	1.49	1.61	2.02	1.32	0.85	1.39	0.88
FOLK AND	MEAN:	Medium Sand	Fine Sand	Coarse Sand	Coarse Sand	Medium Sand	Medium Sand	Very Coarse Silt

SAMPLE ID:		52CR	53CR	54CR	55CR	56CR	57CR	58CR
WARD METHOD [Description]	SORTING:	Extremely Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Poorly Sorted	Moderately Well Sorted	Moderately Well Sorted	Very Poorly Sorted
	SKEWNESS:	Symmetrical	Very Fine Skewed	Very Coarse Skewed	Very Coarse Skewed	Coarse Skewed	Symmetrical	Symmetrical
	KURTOSIS:	Leptokurtic	Very Leptokurtic	Very Leptokurtic	Leptokurtic	Platykurtic	Leptokurtic	Platykurtic
MODE 1 [µm]:		375.00	375.00	375.00	375.00	375.00	375.00	375.00
MODE 2 [µm]:		23750.00	46.88	0.00	0.00	0.00	0.00	11.72
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	1.50	1.50	1.50	1.50
MODE 2 [Phi]:		-4.49	4.50	0.00	0.00	0.00	0.00	6.50
MODE 3 [Phi]:		0.00	0.00	0.00	0.00	0.00	0.00	0.00
D10 [µm]:		9.45	7.42	252.84	231.45	272.18	251.09	1.04
D50 [µm]:		366.04	323.98	405.45	434.83	417.05	358.19	27.63
D90 [µm]:		17832.38	2587.64	4257.12	3658.65	846.30	585.69	461.07
(D90 / D10) [µm]:		1887.89	348.92	16.84	15.81	3.11	2.33	444.38
(D90 - D10) [µm]:		17822.93	2580.22	4004.28	3427.20	574.12	334.60	460.03
(D75 / D25) [µm]:		10.93	7.27	2.30	3.26	1.88	1.56	37.74
(D75 - D25) [µm]:		1567.77	611.35	392.59	687.75	280.98	160.37	258.82
D10 [Phi]:		-4.16	-1.37	-2.09	-1.87	0.24	0.77	1.12
D50 [Phi]:		1.45	1.63	1.30	1.20	1.26	1.48	5.18
D90 [Phi]:		6.73	7.08	1.98	2.11	1.88	1.99	9.91
(D90 / D10) [Phi]:		-1.62	-5.16	-0.95	-1.13	7.80	2.58	8.87
(D90 - D10) [Phi]:		10.88	8.45	4.07	3.98	1.64	1.22	8.80
(D75 / D25) [Phi]:		-3.38	6.76	3.28	156.99	2.24	1.55	3.74
(D75 - D25) [Phi]:		3.45	2.86	1.20	1.70	0.91	0.64	5.24

SAMPLE ID:	52CR	53CR	54CR	55CR	56CR	57CR	58CR
% GRAVEL [63000 - 2000 µm]:	24.44	12.48	13.03	16.83	1.70	1.04	2.05
% SAND [< 2000 - 63 µm]:	54.35	64.14	85.79	81.86	98.30	98.96	37.74
% MUD [< 63 µm]:	21.20	23.38	1.17	1.31	0.00	0.00	60.21
% V COARSE GRAVEL:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% COARSE GRAVEL:	11.91	0.00	1.98	0.00	0.00	0.00	0.00
% MEDIUM GRAVEL:	6.45	2.50	5.22	4.27	0.49	0.40	0.00
% FINE GRAVEL:	3.48	3.31	3.07	4.72	0.47	0.22	1.00
% V FINE GRAVEL:	2.60	6.67	2.76	7.83	0.73	0.42	1.05
% V COARSE SAND:	2.62	7.39	3.92	8.01	1.01	0.69	1.75
% COARSE SAND:	7.57	10.33	15.29	15.35	30.29	10.71	3.98
% MEDIUM SAND:	34.16	31.63	58.71	48.73	64.97	78.05	18.88
% FINE SAND:	9.36	12.27	7.87	9.78	2.03	9.51	9.80
% V FINE SAND:	0.65	2.53	0.00	0.00	0.00	0.00	3.32
% V COARSE SILT:	3.88	5.39	0.00	0.00	0.00	0.00	8.06
% COARSE SILT:	4.06	3.84	0.00	0.00	0.00	0.00	12.06
% MEDIUM SILT:	4.49	3.84	0.45	0.50	0.00	0.00	13.45
% FINE SILT:	4.00	4.10	0.47	0.53	0.00	0.00	10.97
% V FINE SILT:	0.90	1.17	0.05	0.05	0.00	0.00	2.96
% CLAY:	3.87	5.03	0.20	0.22	0.00	0.00	12.70

SAMPLE ID:		59CR	60CR	61CR	62CR	63CR	64CR	65CR
TEXTURAL GROUP	SAMPLE TYPE:	Unimodal, Moderately Well Sorted	Unimodal, Moderately Well Sorted	Bimodal, Very Poorly Sorted	Trimodal, Very Poorly Sorted	Unimodal, Moderately Well Sorted	Unimodal, Poorly Sorted	Unimodal, Poorly Sorted
	FOLK [1954 ORIGINAL]:	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand	Gravelly Muddy Sand	Slightly Gravelly Sand	Gravelly Sand	Gravelly Sand
	FOLK [BGS MODIFIED]:	Slightly Gravelly Sand	Sand	Slightly Gravelly Muddy Sand	Gravelly Muddy Sand	Sand	Gravelly Sand	Gravelly Sand
	SEDIMENT NAME:	Slightly Medium Gravelly Medium Sand	Slightly Medium Gravelly Medium Sand	Slightly Fine Gravelly Very Coarse Silty Medium Sand	Very Fine Gravelly Fine Silty Medium Sand	Slightly Very Fine Gravelly Medium Sand	Fine Gravelly Medium Sand	Fine Gravelly Medium Sand
METHOD OF MOMENTS Arithmetic [µm]	MEAN:	602.53	424.93	331.84	701.75	357.51	922.99	1159.32
	SORTING:	1405.16	388.50	733.51	1476.47	190.27	2084.06	2349.61
	SKEWNESS:	7.25	24.60	7.31	3.90	12.62	4.08	3.38
	KURTOSIS:	57.05	726.74	65.40	21.25	259.14	19.95	14.44
METHOD OF MOMENTS Geometric [µm]	MEAN:	378.51	368.89	103.22	147.21	316.67	335.44	373.20
	SORTING:	1.80	1.42	7.01	8.43	1.39	4.06	4.87
	SKEWNESS:	3.46	1.18	-1.23	-0.85	0.34	-1.26	-1.15
	KURTOSIS:	19.07	12.68	4.06	3.61	9.32	9.72	7.63
METHOD OF MOMENTS Logarithmic [Phi]	MEAN:	1.40	1.44	3.28	2.76	1.66	1.58	1.42
	SORTING:	0.85	0.51	2.81	3.08	0.48	2.02	2.28
	SKEWNESS:	-3.46	-1.18	1.23	0.85	-0.34	1.26	1.15
	KURTOSIS:	19.07	12.68	4.06	3.61	9.32	9.72	7.63
FOLK AND WARD METHOD [µm]	MEAN:	352.72	362.13	109.62	135.47	317.78	327.66	403.14
	SORTING:	1.49	1.45	5.90	8.24	1.43	2.74	3.75
	SKEWNESS:	0.07	0.04	-0.64	-0.34	-0.23	-0.05	0.06
	KURTOSIS:	1.56	1.32	1.11	1.49	1.09	3.82	3.44
FOLK AND WARD METHOD [Phi]	MEAN:	1.50	1.47	3.19	2.88	1.65	1.61	1.31
	SORTING:	0.58	0.54	2.56	3.04	0.52	1.45	1.91
	SKEWNESS:	-0.07	-0.04	0.64	0.34	0.23	0.05	-0.06
	KURTOSIS:	1.56	1.32	1.11	1.49	1.09	3.82	3.44
FOLK AND	MEAN:	Medium Sand	Medium Sand	Very Fine Sand	Fine Sand	Medium Sand	Medium Sand	Medium Sand

SAMPLE ID:		59CR	60CR	61CR	62CR	63CR	64CR	65CR
WARD METHOD [Description]	SORTING:	Moderately Well Sorted	Moderately Well Sorted	Very Poorly Sorted	Very Poorly Sorted	Moderately Well Sorted	Poorly Sorted	Poorly Sorted
	SKEWNESS:	Symmetrical	Symmetrical	Very Fine Skewed	Very Fine Skewed	Fine Skewed	Symmetrical	Symmetrical
	KURTOSIS:	Very Leptokurtic	Leptokurtic	Leptokurtic	Leptokurtic	Mesokurtic	Extremely Leptokurtic	Extremely Leptokurtic
MODE 1 [µm]:		375.00	375.00	375.00	375.00	375.00	375.00	375.00
MODE 2 [µm]:		0.00	0.00	46.88	5.86	0.00	0.00	0.00
MODE 3 [µm]:		0.00	0.00	0.00	3000.00	0.00	0.00	0.00
MODE 1 [Phi]:		1.50	1.50	1.50	1.50	1.50	1.50	1.50
MODE 2 [Phi]:		0.00	0.00	4.50	7.50	0.00	0.00	0.00
MODE 3 [Phi]:		0.00	0.00	0.00	-1.50	0.00	0.00	0.00
D10 [µm]:		238.99	253.12	6.16	6.57	177.82	147.68	139.47
D50 [µm]:		352.72	362.13	219.34	239.85	328.15	345.37	364.15
D90 [µm]:		509.38	612.92	468.19	1657.40	469.74	980.35	3153.69
(D90 / D10) [µm]:		2.13	2.42	75.96	252.46	2.64	6.64	22.61
(D90 - D10) [µm]:		270.39	359.81	462.03	1650.83	291.92	832.66	3014.22
(D75 / D25) [µm]:		1.55	1.56	9.57	7.50	1.57	1.73	2.06
(D75 - D25) [µm]:		155.69	163.49	322.21	388.21	148.37	191.28	275.77
D10 [Phi]:		0.97	0.71	1.09	-0.73	1.09	0.03	-1.66
D50 [Phi]:		1.50	1.47	2.19	2.06	1.61	1.53	1.46
D90 [Phi]:		2.07	1.98	7.34	7.25	2.49	2.76	2.84
(D90 / D10) [Phi]:		2.12	2.81	6.71	-9.95	2.29	96.35	-1.72
(D90 - D10) [Phi]:		1.09	1.28	6.25	7.98	1.40	2.73	4.50
(D75 / D25) [Phi]:		1.53	1.57	3.21	3.51	1.50	1.69	2.16

SAMPLE ID:	59CR	60CR	61CR	62CR	63CR	64CR	65CR
(D75 - D25) [Phi]:	0.63	0.65	3.26	2.91	0.65	0.79	1.04
% GRAVEL [63000 - 2000 µm]:	2.93	0.13	1.93	9.00	0.27	8.46	12.48
% SAND [< 2000 - 63 µm]:	97.07	99.87	67.73	65.74	99.73	84.89	79.85
% MUD [< 63 µm]:	0.00	0.00	30.34	25.25	0.00	6.64	7.66
% V COARSE GRAVEL:	0.00	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	0.00
% MEDIUM GRAVEL:	1.29	0.09	0.03	0.41	0.00	2.31	2.95
% FINE GRAVEL:	0.59	0.00	1.25	4.21	0.02	4.29	5.75
% V FINE GRAVEL:	1.06	0.04	0.65	4.38	0.25	1.86	3.78
% V COARSE SAND:	1.36	0.32	0.52	3.68	0.18	1.35	2.81
% COARSE SAND:	5.87	13.52	3.81	7.85	2.59	6.36	10.83
% MEDIUM SAND:	79.15	77.41	39.49	28.15	77.30	63.36	52.22
% FINE SAND:	10.70	8.62	22.57	21.96	19.67	13.77	13.86
% V FINE SAND:	0.00	0.00	1.35	4.10	0.00	0.04	0.15
% V COARSE SILT:	0.00	0.00	7.29	3.94	0.00	1.68	1.74
% COARSE SILT:	0.00	0.00	6.38	4.38	0.00	0.66	0.80
% MEDIUM SILT:	0.00	0.00	5.11	5.51	0.00	1.24	1.46
% FINE SILT:	0.00	0.00	4.58	5.68	0.00	1.52	1.78
% V FINE SILT:	0.00	0.00	1.32	1.09	0.00	0.29	0.35
% CLAY:	0.00	0.00	5.66	4.66	0.00	1.25	1.52

SAMPLE ID:		66CR	67CR	68CR	69CR
TEXTURAL GROUP	SAMPLE TYPE:	Unimodal, Moderately Sorted	Unimodal, Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Moderately Well Sorted
	FOLK [1954 ORIGINAL]:	Gravelly Sand	Gravelly Sand	Gravelly Sand	Slightly Gravelly Sand
	FOLK [BGS MODIFIED]:	Gravelly Sand	Gravelly Sand	Gravelly Sand	Sand
	SEDIMENT NAME:	Fine Gravelly Medium Sand	Very Fine Gravelly Medium Sand	Very Fine Gravelly Medium Sand	Slightly Very Fine Gravelly Medium Sand
METHOD OF MOMENTS Arithmetic [µm]	MEAN:	723.82	943.14	1457.80	390.32
	SORTING:	1541.66	1608.89	4038.49	311.17
	SKEWNESS:	5.58	4.39	4.76	12.01
	KURTOSIS:	37.04	26.10	25.65	202.92
METHOD OF MOMENTS Geometric [µm]	MEAN:	398.05	474.79	429.01	328.68
	SORTING:	2.15	2.89	3.65	1.54
	SKEWNESS:	2.19	-0.33	0.43	0.77
	KURTOSIS:	8.92	8.31	6.57	7.02
METHOD OF MOMENTS Logarithmic [Phi]	MEAN:	1.33	1.07	1.22	1.61
	SORTING:	1.10	1.53	1.87	0.62
	SKEWNESS:	-2.19	0.33	-0.43	-0.77
	KURTOSIS:	8.92	8.31	6.57	7.02
FOLK AND WARD METHOD [µm]	MEAN:	358.80	489.77	404.49	317.24
	SORTING:	1.95	2.50	3.11	1.59
	SKEWNESS:	0.22	0.35	0.22	-0.08
	KURTOSIS:	1.98	1.30	1.71	1.27
FOLK AND WARD METHOD [Phi]	MEAN:	1.48	1.03	1.31	1.66
	SORTING:	0.96	1.32	1.64	0.67
	SKEWNESS:	-0.22	-0.35	-0.22	0.08
	KURTOSIS:	1.98	1.30	1.71	1.27
FOLK AND	MEAN:	Medium Sand	Medium Sand	Medium Sand	Medium Sand

SAMPLE ID:		66CR	67CR	68CR	69CR
WARD METHOD [Description]	SORTING:	Moderately Sorted	Poorly Sorted	Poorly Sorted	Moderately Well Sorted
	SKEWNESS:	Coarse Skewed	Very Coarse Skewed	Coarse Skewed	Symmetrical
	KURTOSIS:	Very Leptokurtic	Leptokurtic	Very Leptokurtic	Leptokurtic
MODE 1 [µm]:		375.00	375.00	375.00	375.00
MODE 2 [µm]:		0.00	0.00	0.00	0.00
MODE 3 [µm]:		0.00	0.00	0.00	0.00
MODE 1 [Phi]:		1.50	1.50	1.50	1.50
MODE 2 [Phi]:		0.00	0.00	0.00	0.00
MODE 3 [Phi]:		0.00	0.00	0.00	0.00
D10 [µm]:		177.06	175.86	133.60	168.38
D50 [µm]:		351.52	401.80	363.27	332.30
D90 [µm]:		886.35	1915.38	2312.32	553.01
(D90 / D10) [µm]:		5.01	10.89	17.31	3.28
(D90 - D10) [µm]:		709.29	1739.52	2178.72	384.64
(D75 / D25) [µm]:		1.76	2.78	2.85	1.70
(D75 - D25) [µm]:		201.72	497.34	427.77	178.88
D10 [Phi]:		0.17	-0.94	-1.21	0.85
D50 [Phi]:		1.51	1.32	1.46	1.59
D90 [Phi]:		2.50	2.51	2.90	2.57
(D90 / D10) [Phi]:		14.35	-2.67	-2.40	3.01
(D90 - D10) [Phi]:		2.32	3.45	4.11	1.72
(D75 / D25) [Phi]:		1.74	5.04	3.51	1.64
(D75 - D25) [Phi]:		0.82	1.48	1.51	0.77

SAMPLE ID:	66CR	67CR	68CR	69CR
% GRAVEL [63000 - 2000 µm]:	5.40	9.39	10.89	0.37
% SAND [< 2000 - 63 µm]:	94.60	88.05	85.18	99.63
% MUD [< 63 µm]:	0.00	2.56	3.93	0.00
% V COARSE GRAVEL:	0.00	0.00	0.00	0.00
% COARSE GRAVEL:	0.00	0.00	2.71	0.00
% MEDIUM GRAVEL:	1.18	1.02	1.01	0.00
% FINE GRAVEL:	2.23	3.23	2.93	0.18
% V FINE GRAVEL:	1.99	5.14	4.24	0.18
% V COARSE SAND:	2.73	9.84	5.88	0.23
% COARSE SAND:	10.76	15.80	13.68	11.01
% MEDIUM SAND:	61.20	47.47	42.42	65.14
% FINE SAND:	19.91	14.79	18.95	23.24
% V FINE SAND:	0.00	0.15	4.25	0.01
% V COARSE SILT:	0.00	1.39	2.71	0.00
% COARSE SILT:	0.00	0.16	0.06	0.00
% MEDIUM SILT:	0.00	0.34	0.46	0.00
% FINE SILT:	0.00	0.44	0.43	0.00
% V FINE SILT:	0.00	0.04	0.05	0.00
% CLAY:	0.00	0.19	0.23	0.00

B.7.2 PSD Fractional and Cumulative Data

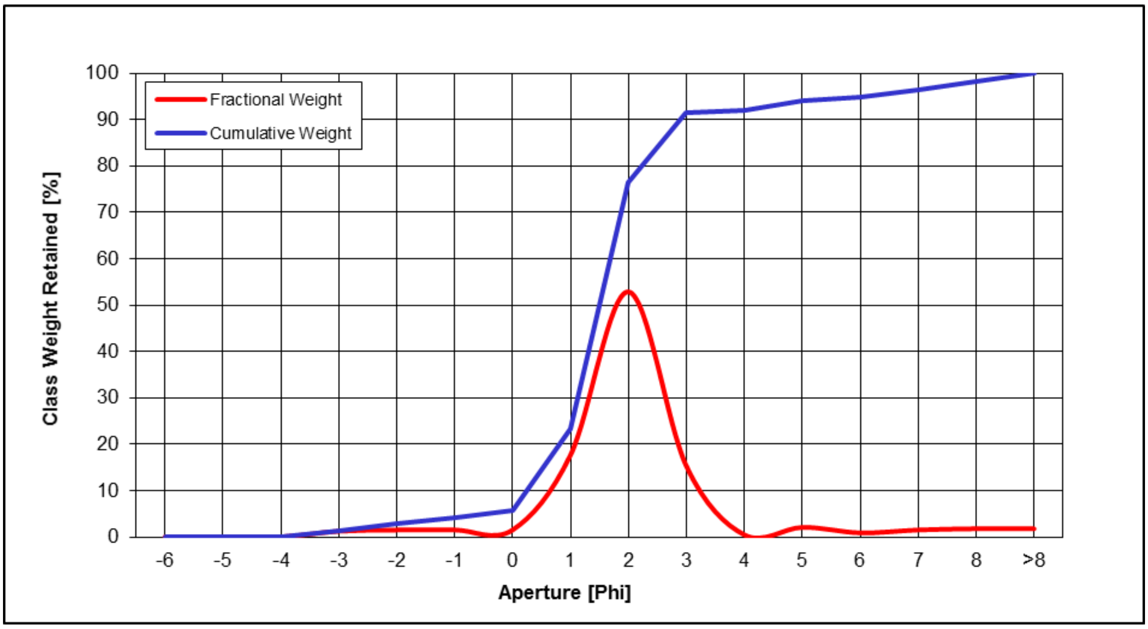
Based on Wentworth (1922) Grain Size Classification

Statistics Based on Folk and Ward (1957)

Station 01MS

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	1.2	1.2
4000.0	-2	1.5	2.7
2000.0	-1	1.5	4.3
1000.0	0	1.5	5.8
500.0	1	17.7	23.4
250.0	2	52.9	76.3
125.0	3	15.3	91.6
62.5	4	0.4	92.0
31.2	5	2.1	94.1
15.6	6	0.9	95.0
7.8	7	1.5	96.5
3.9	8	1.8	98.2
<3.9	>8	1.8	100.0
Total		100.0	100.0

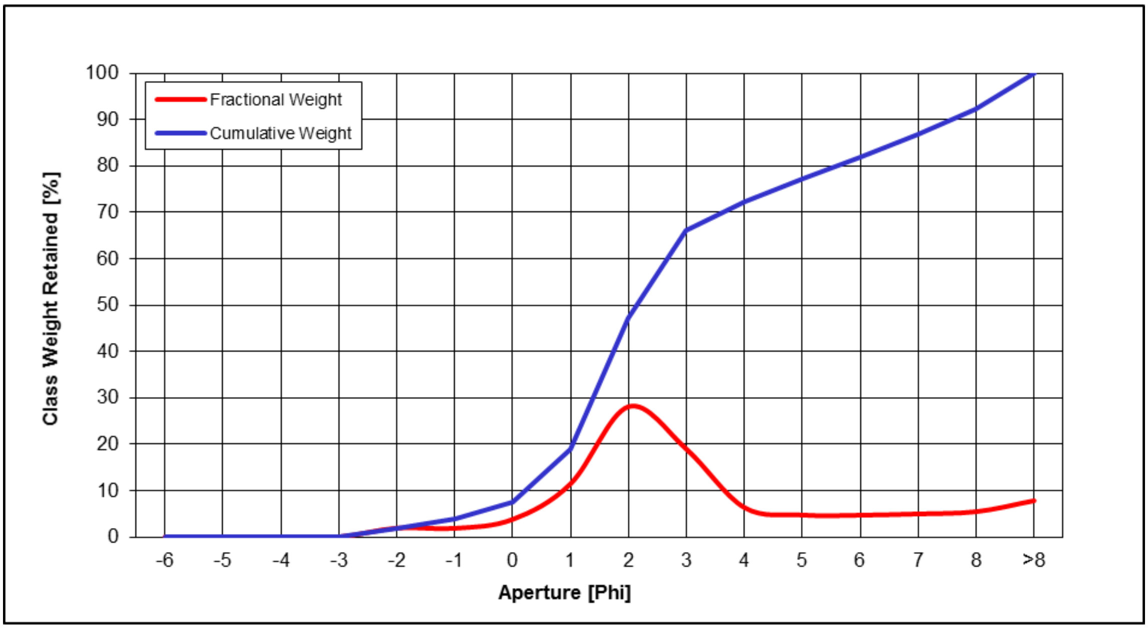
Sorting	1.47	Poorly Sorted
Skewness	0.21	Fine Skewed
Kurtosis	2.83	Very Leptokurtic
Mean [µm]	346.7	Medium Sand
Mean [phi]	1.53	
Median [µm]	353.0	Medium Sand
Median [phi]	1.50	
Gravel [%]	4.3	Slightly Gravelly Sand
Sand [%]	87.8	
Mud [%]	8.0	



Station 02MS

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	1.9	1.9
2000.0	-1	1.9	3.8
1000.0	0	3.8	7.6
500.0	1	11.5	19.0
250.0	2	28.1	47.1
125.0	3	18.9	66.0
62.5	4	6.3	72.4
31.2	5	4.7	77.1
15.6	6	4.7	81.8
7.8	7	5.0	86.7
3.9	8	5.4	92.2
<3.9	>8	7.8	100.0
Total		100.0	100.0

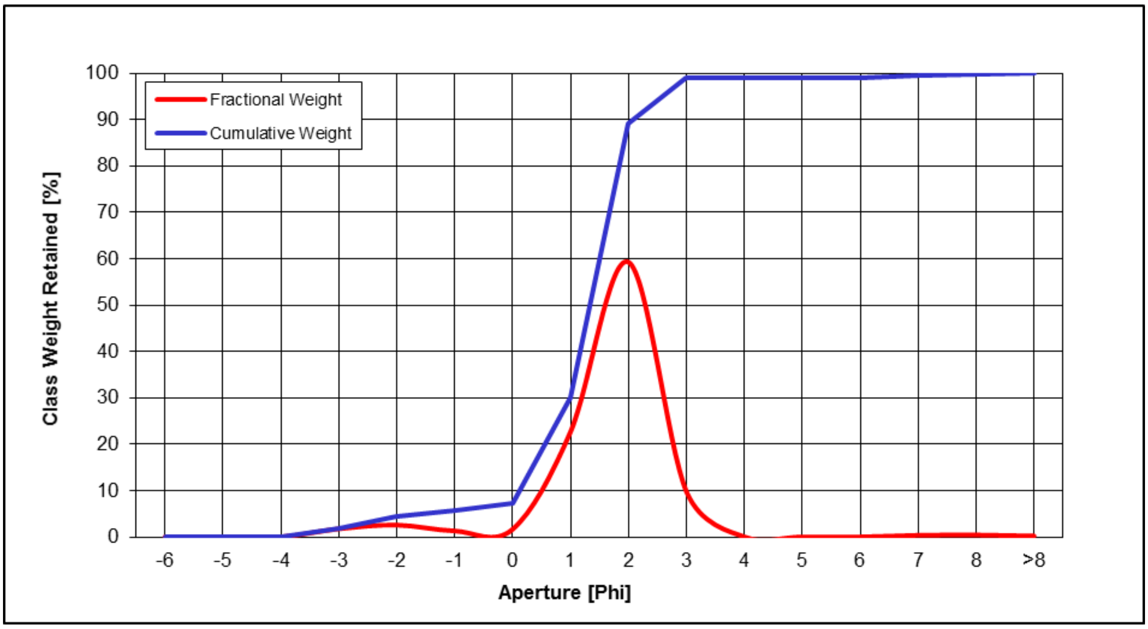
Sorting	3.03	Very Poorly Sorted
Skewness	0.48	Very Fine Skewed
Kurtosis	1.30	Leptokurtic
Mean [µm]	115.6	Very Fine Sand
Mean [phi]	3.11	
Median [µm]	224.7	Fine Sand
Median [phi]	2.15	
Gravel [%]	3.8	Slightly Gravelly Muddy Sand
Sand [%]	68.6	
Mud [%]	27.6	



Station 03MS

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	1.7	1.7
4000.0	-2	2.6	4.3
2000.0	-1	1.3	5.6
1000.0	0	1.7	7.3
500.0	1	22.7	30.0
250.0	2	59.3	89.2
125.0	3	9.8	99.0
62.5	4	0.0	99.0
31.2	5	0.0	99.0
15.6	6	0.0	99.0
7.8	7	0.4	99.4
3.9	8	0.4	99.8
<3.9	>8	0.2	100.0
Total		100.0	100.0

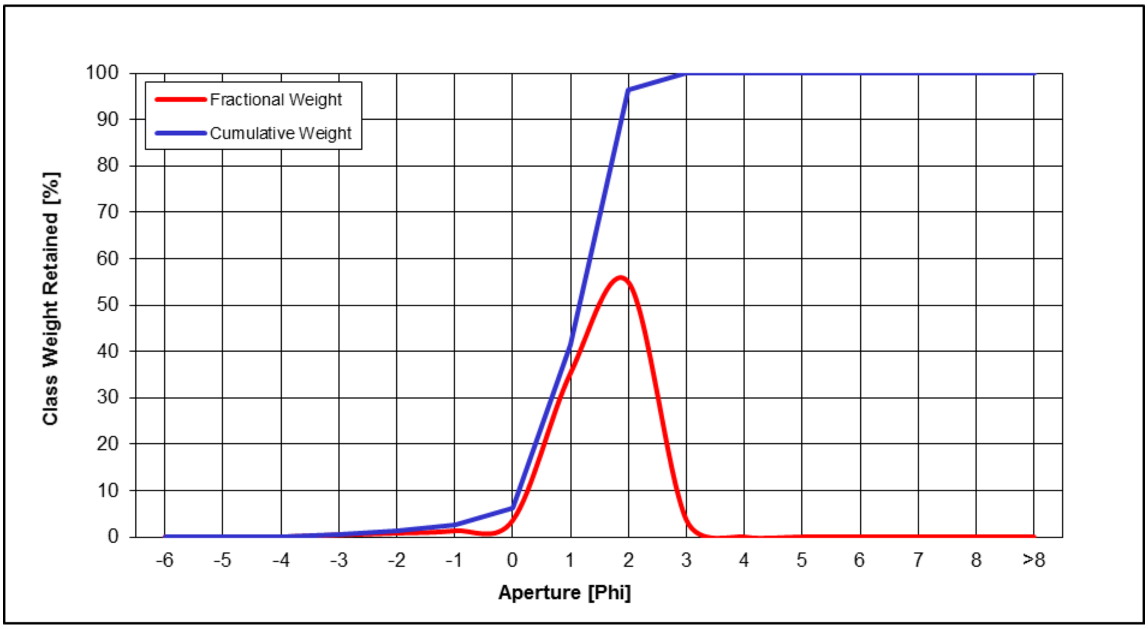
Sorting	1.00	Moderately Sorted
Skewness	-0.32	Very Coarse Skewed
Kurtosis	1.70	Very Leptokurtic
Mean [µm]	431.9	Medium Sand
Mean [phi]	1.21	
Median [µm]	395.6	Medium Sand
Median [phi]	1.34	
Gravel [%]	5.6	Gravelly Sand
Sand [%]	93.4	
Mud [%]	1.0	



Station 04MS

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	1.3	2.6
1000.0	0	3.5	6.1
500.0	1	35.3	41.4
250.0	2	54.9	96.3
125.0	3	3.7	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

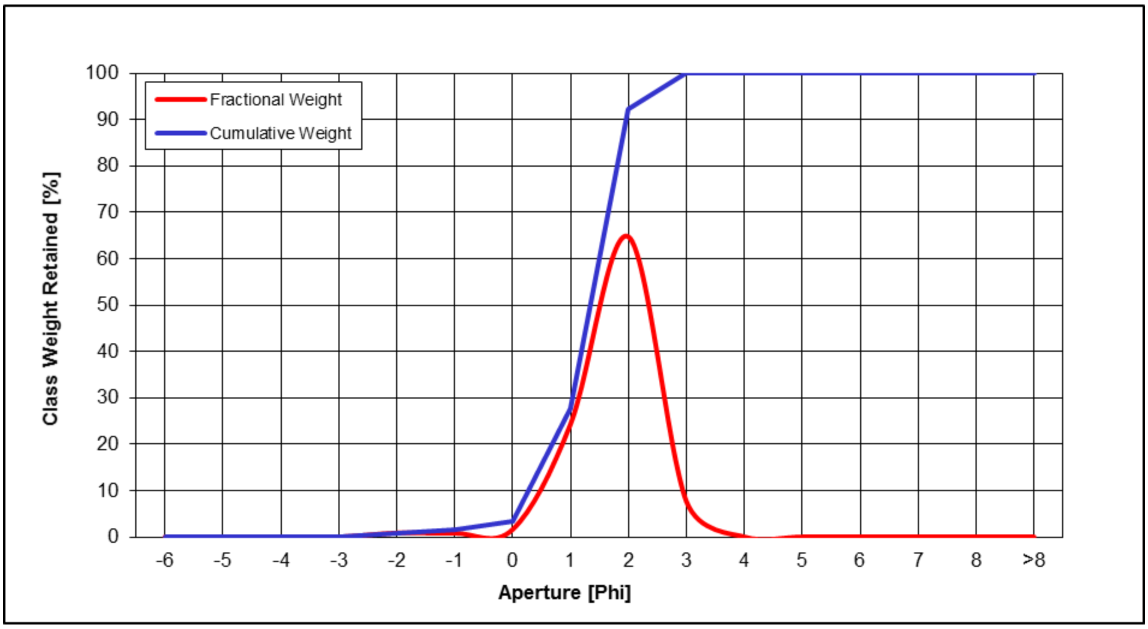
Sorting	0.72	Moderately Sorted
Skewness	-0.23	Coarse Skewed
Kurtosis	0.87	Platykurtic
Mean [µm]	476.2	Medium Sand
Mean [phi]	1.07	
Median [µm]	448.8	Medium Sand
Median [phi]	1.16	
Gravel [%]	2.6	Slightly Gravelly Sand
Sand [%]	97.4	
Mud [%]	0.0	



Station 05MS

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	0.9	0.9
2000.0	-1	0.8	1.7
1000.0	0	1.6	3.3
500.0	1	24.3	27.6
250.0	2	64.7	92.4
125.0	3	7.6	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

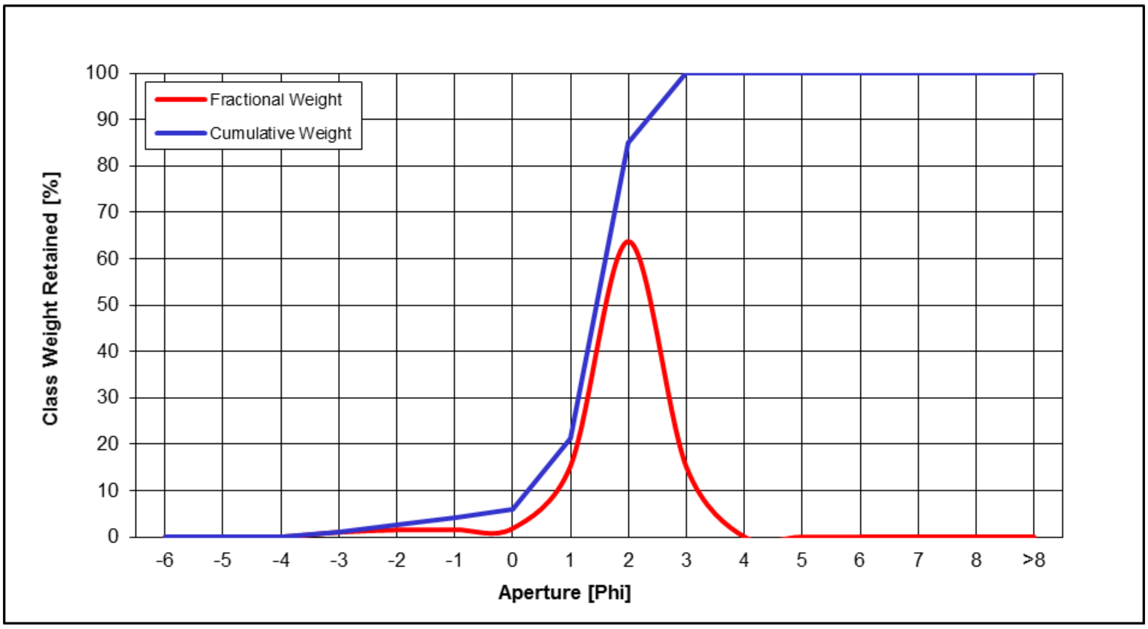
Sorting	0.68	Moderately Well Sorted
Skewness	-0.17	Coarse Skewed
Kurtosis	1.11	Leptokurtic
Mean [µm]	421.5	Medium Sand
Mean [phi]	1.25	
Median [µm]	393.5	Medium Sand
Median [phi]	1.35	
Gravel [%]	1.7	Slightly Gravelly Sand
Sand [%]	98.3	
Mud [%]	0.0	



Station 06MS

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	1.0	1.0
4000.0	-2	1.5	2.5
2000.0	-1	1.6	4.1
1000.0	0	1.8	5.9
500.0	1	15.3	21.2
250.0	2	63.7	84.9
125.0	3	15.1	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

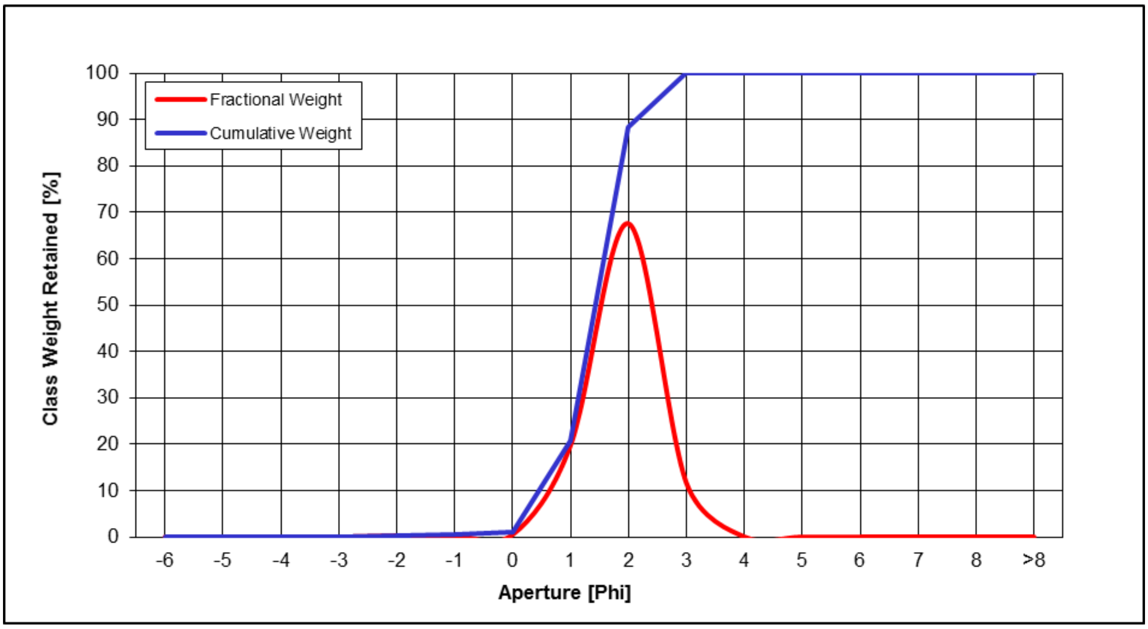
Sorting	0.81	Moderately Sorted
Skewness	-0.21	Coarse Skewed
Kurtosis	1.66	Very Leptokurtic
Mean [µm]	388.2	Medium Sand
Mean [phi]	1.37	
Median [µm]	365.6	Medium Sand
Median [phi]	1.45	
Gravel [%]	4.1	Slightly Gravelly Sand
Sand [%]	95.9	
Mud [%]	0.0	



Station 07MS

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	1.0
500.0	1	19.8	20.8
250.0	2	67.6	88.4
125.0	3	11.6	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

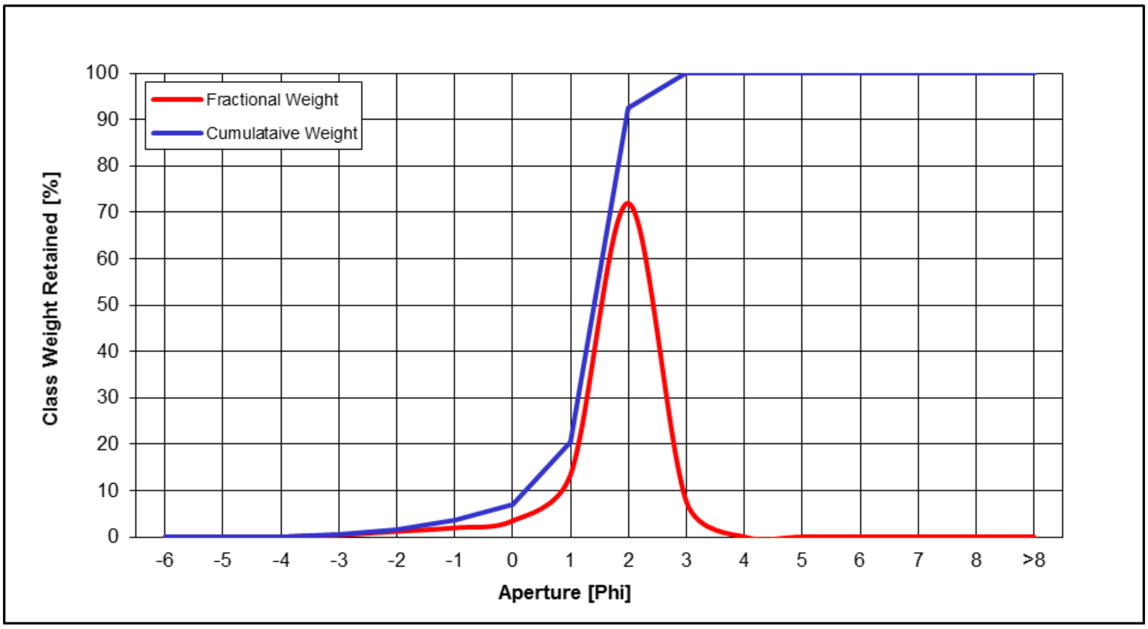
Sorting	0.65	Moderately Well Sorted
Skewness	-0.09	Symmetrical
Kurtosis	1.31	Leptokurtic
Mean [µm]	385.5	Medium Sand
Mean [phi]	1.38	
Median [µm]	370.6	Medium Sand
Median [phi]	1.43	
Gravel [%]	0.5	Slightly Gravelly Sand
Sand [%]	99.5	
Mud [%]	0.0	



Station 08MS

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	1.2	1.6
2000.0	-1	2.0	3.6
1000.0	0	3.5	7.0
500.0	1	13.4	20.4
250.0	2	72.0	92.4
125.0	3	7.6	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

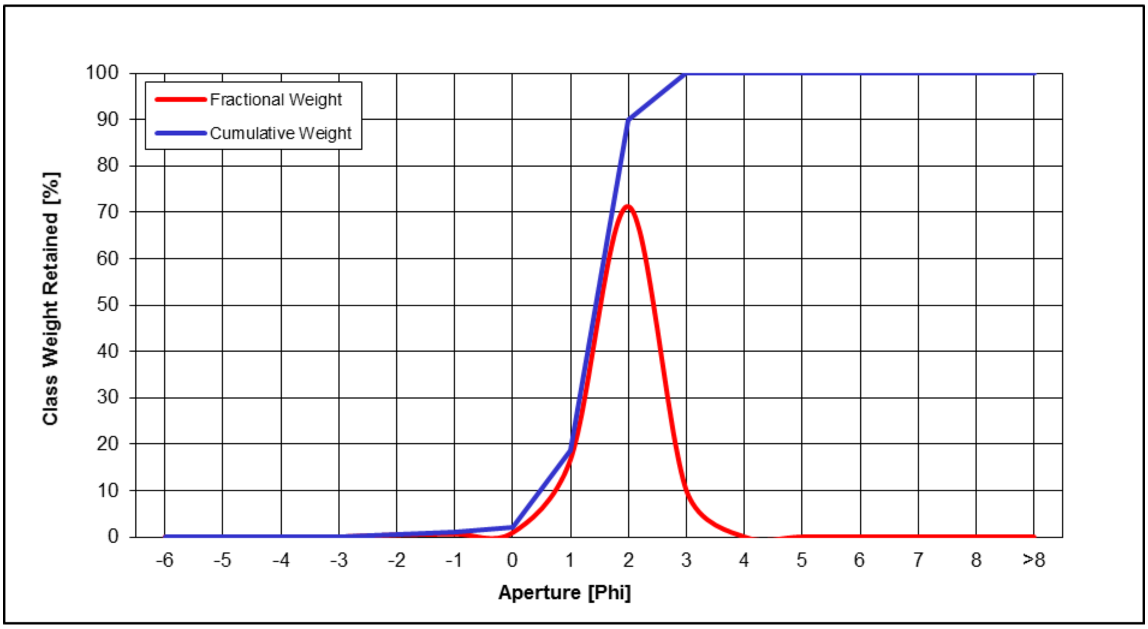
Sorting	0.75	Moderately Sorted
Skewness	-0.29	Coarse Skewed
Kurtosis	1.73	Very Leptokurtic
Mean [µm]	400.3	Medium Sand
Mean [phi]	1.32	
Median [µm]	376.1	Medium Sand
Median [phi]	1.41	
Gravel [%]	3.6	Slightly Gravelly Sand
Sand [%]	96.4	
Mud [%]	0.0	



Station 09MS

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	0.5	0.5
2000.0	-1	0.6	1.1
1000.0	0	0.9	2.0
500.0	1	16.7	18.7
250.0	2	71.3	90.0
125.0	3	10.0	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

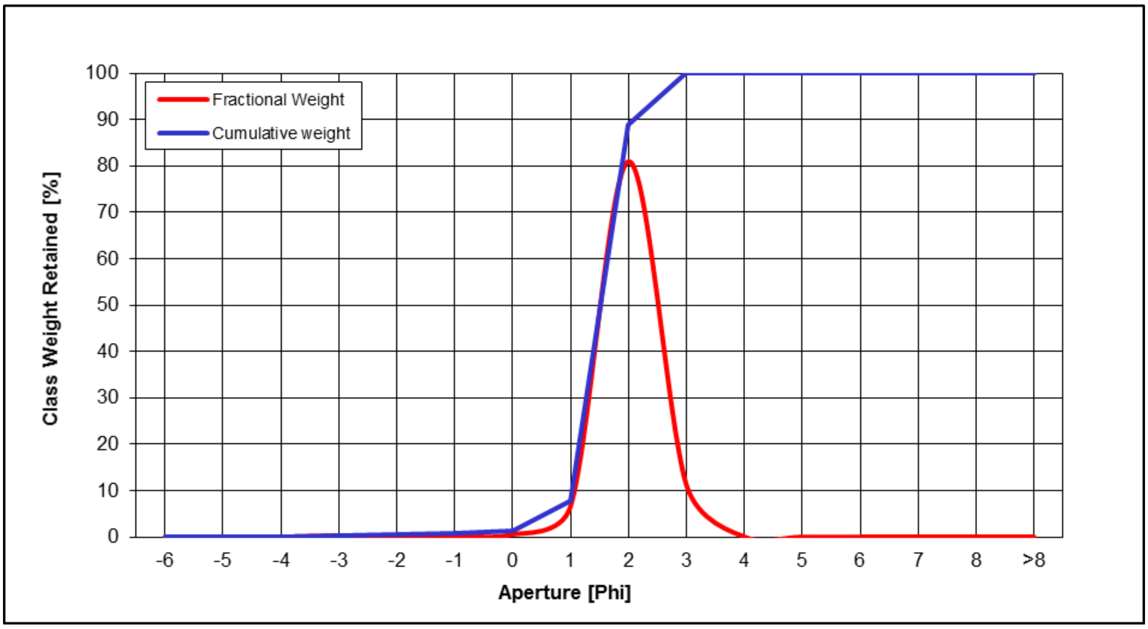
Sorting	0.62	Moderately Well Sorted
Skewness	-0.10	Coarse Skewed
Kurtosis	1.36	Leptokurtic
Mean [µm]	379.7	Medium Sand
Mean [phi]	1.40	
Median [µm]	368.9	Medium Sand
Median [phi]	1.44	
Gravel [%]	1.1	Slightly Gravelly Sand
Sand [%]	98.9	
Mud [%]	0.0	



Station 10MS

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	0.2	0.5
2000.0	-1	0.2	0.7
1000.0	0	0.6	1.2
500.0	1	6.6	7.8
250.0	2	81.0	88.8
125.0	3	11.2	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

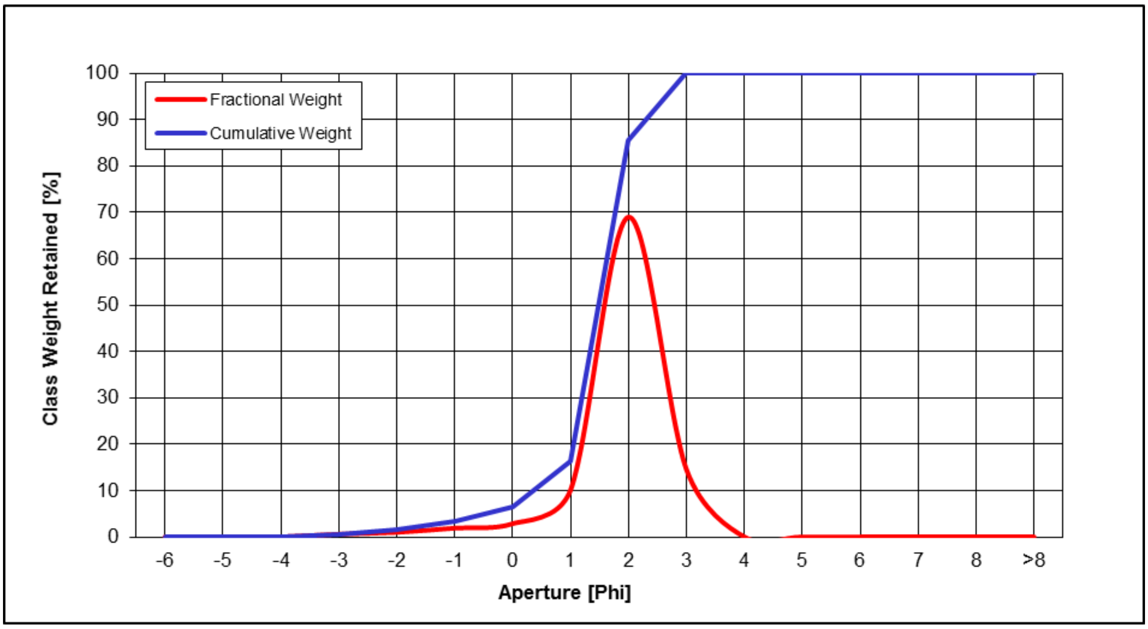
Sorting	0.51	Moderately Well Sorted
Skewness	0.02	Symmetrical
Kurtosis	1.32	Leptokurtic
Mean [µm]	348.5	Medium Sand
Mean [phi]	1.52	
Median [µm]	348.5	Medium Sand
Median [phi]	1.52	
Gravel [%]	0.7	Slightly Gravelly Sand
Sand [%]	99.3	
Mud [%]	0.0	



Station 11MS

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	0.6	0.6
4000.0	-2	1.0	1.6
2000.0	-1	1.9	3.5
1000.0	0	2.9	6.4
500.0	1	10.1	16.5
250.0	2	69.0	85.4
125.0	3	14.6	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

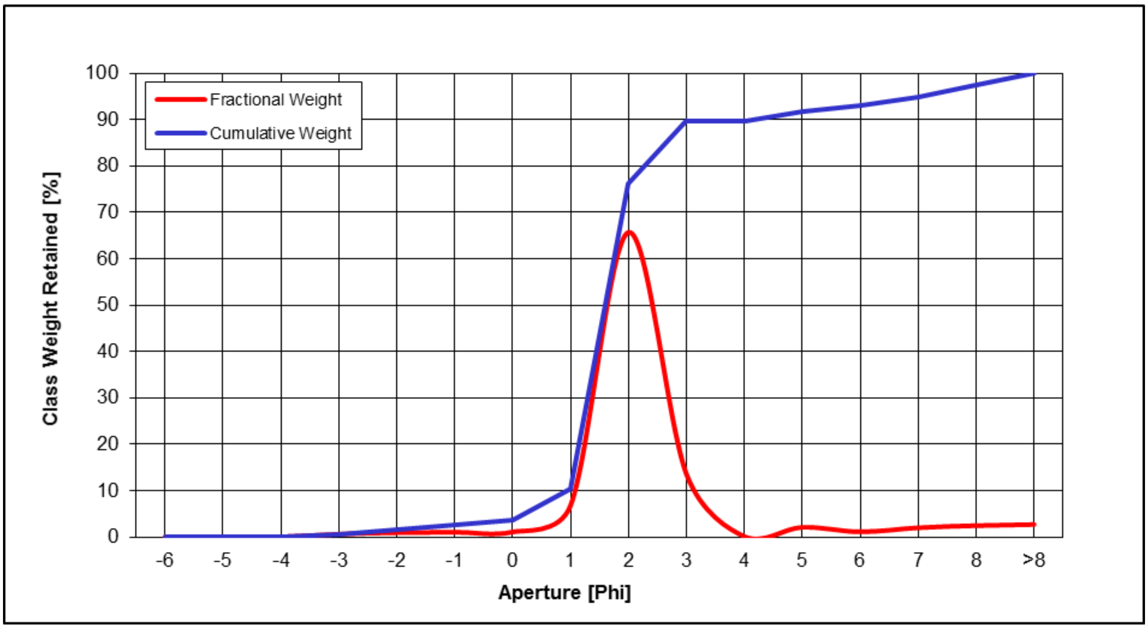
Sorting	0.73	Moderately Sorted
Skewness	-0.14	Coarse Skewed
Kurtosis	1.77	Very Leptokurtic
Mean [µm]	360.1	Medium Sand
Mean [phi]	1.47	
Median [µm]	356.9	Medium Sand
Median [phi]	1.49	
Gravel [%]	3.5	Slightly Gravelly Sand
Sand [%]	96.5	
Mud [%]	0.0	



Station 12MS

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	0.6	0.6
4000.0	-2	0.9	1.5
2000.0	-1	1.0	2.5
1000.0	0	1.1	3.6
500.0	1	6.8	10.4
250.0	2	65.7	76.1
125.0	3	13.6	89.6
62.5	4	0.1	89.7
31.2	5	2.1	91.8
15.6	6	1.1	92.9
7.8	7	2.0	94.9
3.9	8	2.4	97.3
<3.9	>8	2.7	100.0
Total		100.0	100.0

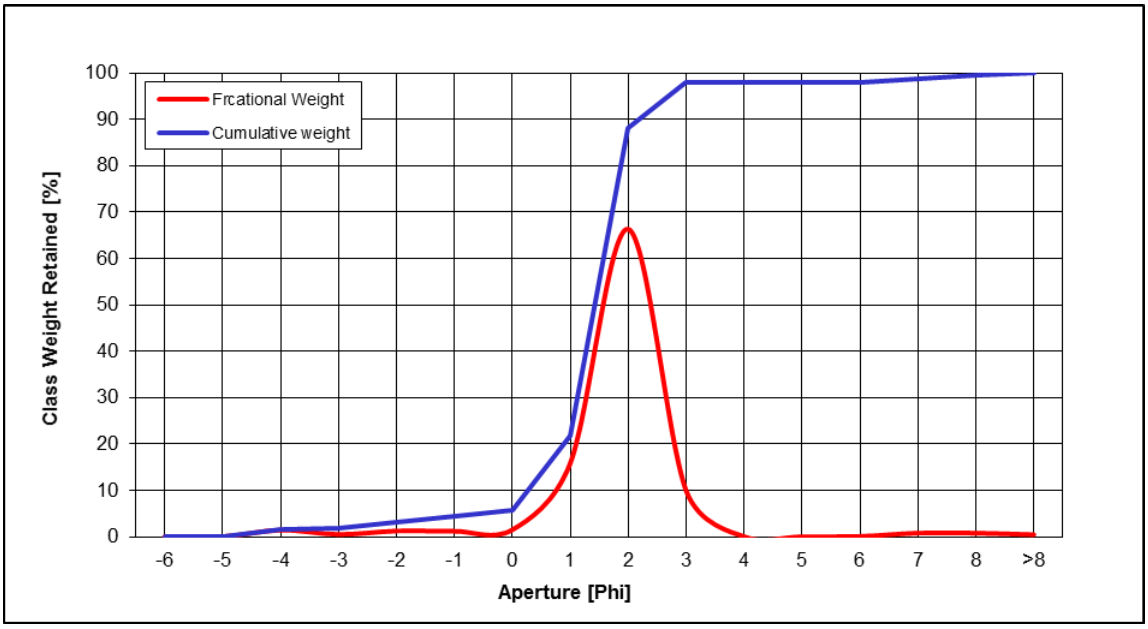
Sorting	1.41	Poorly Sorted
Skewness	0.45	Very Fine Skewed
Kurtosis	3.69	Extremely Leptokurtic
Mean [μm]	295.8	Medium Sand
Mean [phi]	1.76	
Median [μm]	329.2	Medium Sand
Median [phi]	1.60	
Gravel [%]	2.5	Slightly Gravelly Muddy Sand
Sand [%]	87.2	
Mud [%]	10.3	



Station 13MS

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	1.4	1.4
8000.0	-3	0.5	1.9
4000.0	-2	1.2	3.1
2000.0	-1	1.2	4.3
1000.0	0	1.5	5.8
500.0	1	15.9	21.7
250.0	2	66.3	88.0
125.0	3	9.9	97.9
62.5	4	0.0	97.9
31.2	5	0.0	97.9
15.6	6	0.1	98.0
7.8	7	0.8	98.8
3.9	8	0.8	99.6
<3.9	>8	0.4	100.0
Total		100.0	100.0

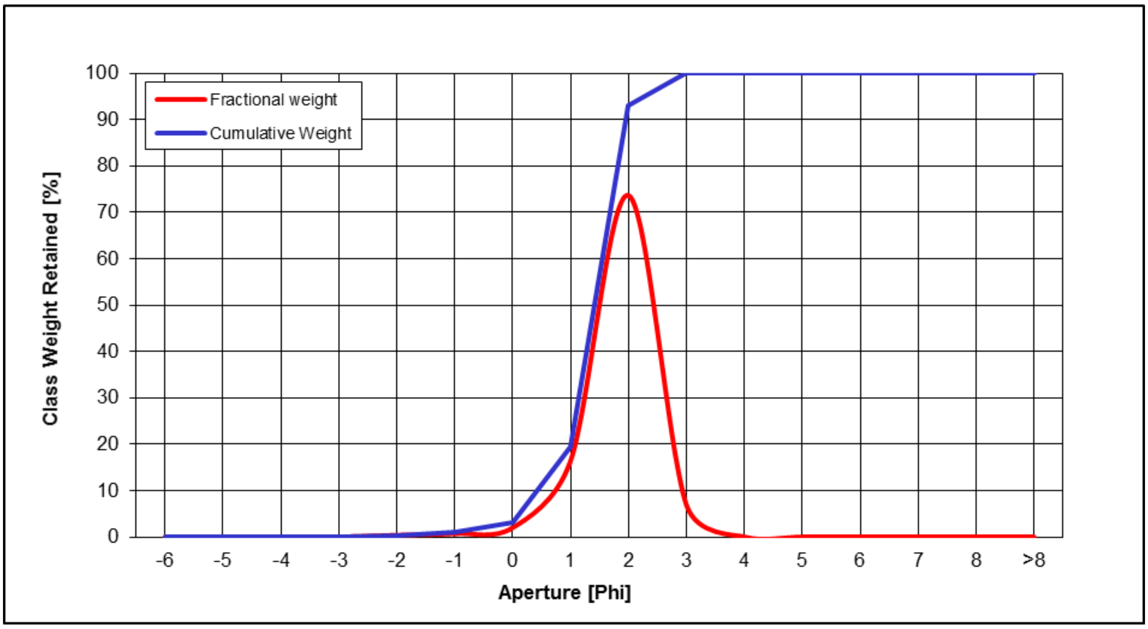
Sorting	0.82	Moderately Sorted
Skewness	-0.21	Coarse Skewed
Kurtosis	1.77	Very Leptokurtic
Mean [µm]	396.1	Medium Sand
Mean [phi]	1.34	
Median [µm]	371.9	Medium Sand
Median [phi]	1.43	
Gravel [%]	4.3	Slightly Gravelly Sand
Sand [%]	93.6	
Mud [%]	2.1	



Station 14MS

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	2.0	3.1
500.0	1	16.4	19.4
250.0	2	73.7	93.1
125.0	3	6.9	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

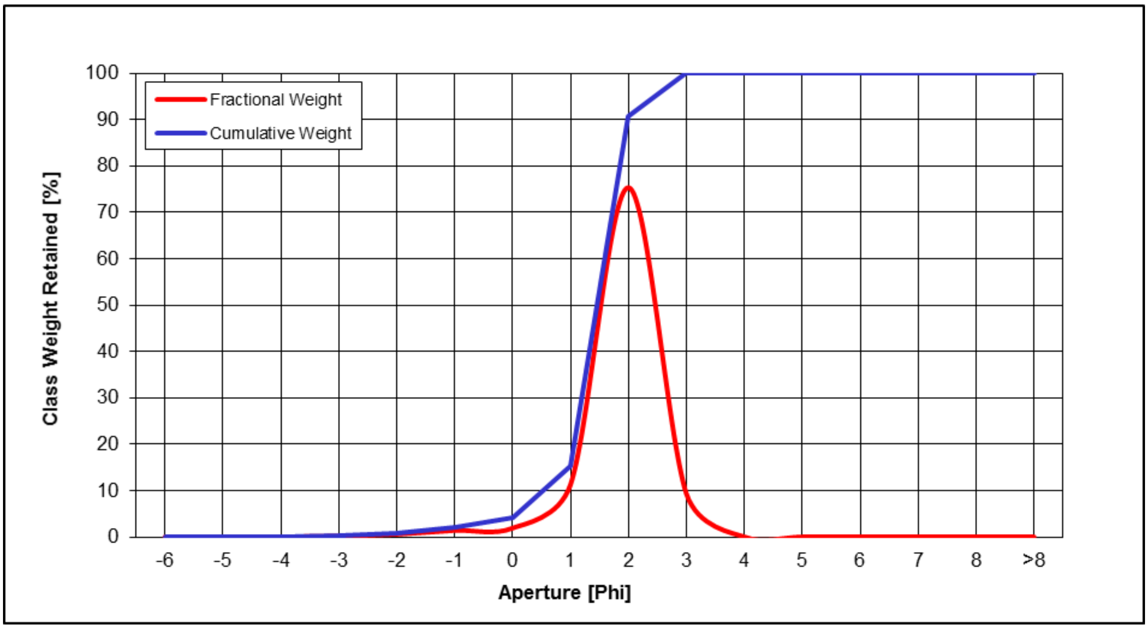
Sorting	0.60	Moderately Well Sorted
Skewness	-0.18	Coarse Skewed
Kurtosis	1.30	Leptokurtic
Mean [µm]	389.5	Medium Sand
Mean [phi]	1.36	
Median [µm]	375.1	Medium Sand
Median [phi]	1.41	
Gravel [%]	1.1	Slightly Gravelly Sand
Sand [%]	98.9	
Mud [%]	0.0	



Station 15MS

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	0.6	0.8
2000.0	-1	1.4	2.2
1000.0	0	1.9	4.1
500.0	1	11.3	15.4
250.0	2	75.3	90.7
125.0	3	9.3	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

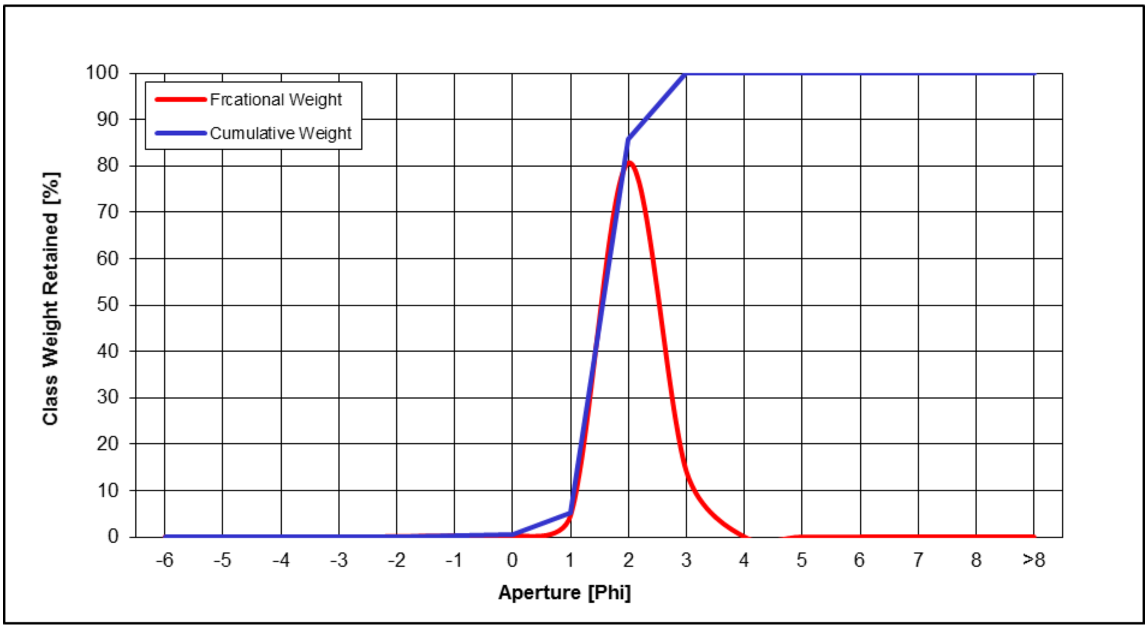
Sorting	0.59	Moderately Well Sorted
Skewness	-0.08	Symmetrical
Kurtosis	1.47	Leptokurtic
Mean [µm]	363.5	Medium Sand
Mean [phi]	1.46	
Median [µm]	363.5	Medium Sand
Median [phi]	1.46	
Gravel [%]	2.2	Slightly Gravelly Sand
Sand [%]	97.8	
Mud [%]	0.0	



Station 16MS

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	4.6	5.2
250.0	2	80.7	85.9
125.0	3	14.1	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

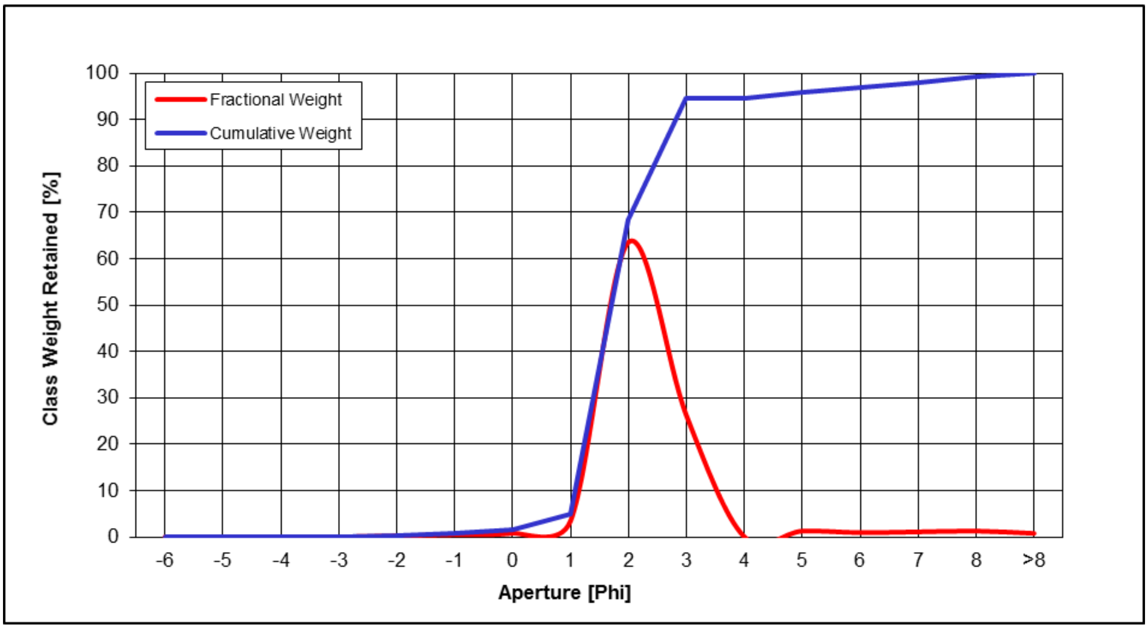
Sorting	0.47	Well Sorted
Skewness	0.15	Fine Skewed
Kurtosis	1.12	Leptokurtic
Mean [µm]	340.2	Medium Sand
Mean [phi]	1.56	
Median [µm]	340.2	Medium Sand
Median [phi]	1.56	
Gravel [%]	0.3	Slightly Gravelly Sand
Sand [%]	99.7	
Mud [%]	0.0	



Station 17MS

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	0.2	0.2
2000.0	-1	0.5	0.7
1000.0	0	0.8	1.5
500.0	1	3.4	4.9
250.0	2	63.5	68.5
125.0	3	26.2	94.7
62.5	4	0.0	94.7
31.2	5	1.3	95.9
15.6	6	0.9	96.9
7.8	7	1.1	98.0
3.9	8	1.3	99.2
<3.9	>8	0.8	100.0
Total		100.0	100.0

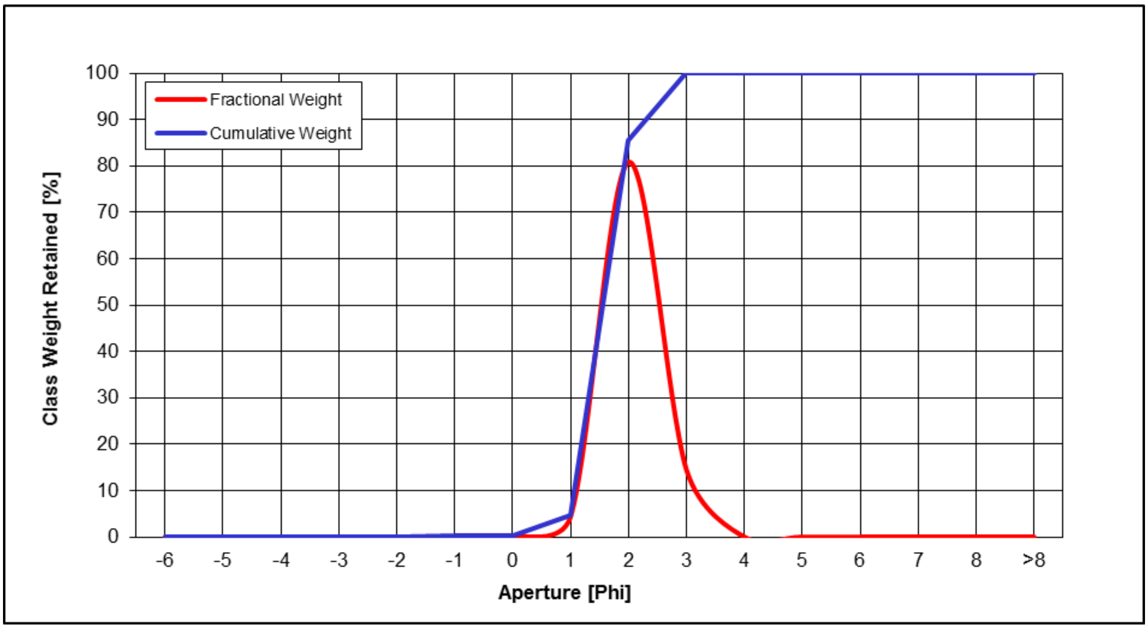
Sorting	0.85	Moderately Sorted
Skewness	0.40	Very Fine Skewed
Kurtosis	1.43	Leptokurtic
Mean [µm]	282.2	Medium Sand
Mean [phi]	1.83	
Median [µm]	305.8	Medium Sand
Median [phi]	1.71	
Gravel [%]	0.7	Slightly Gravelly Sand
Sand [%]	94.0	
Mud [%]	5.3	



Station 18MS

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	0.1	0.1
1000.0	0	0.2	0.4
500.0	1	4.3	4.7
250.0	2	80.8	85.5
125.0	3	14.5	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

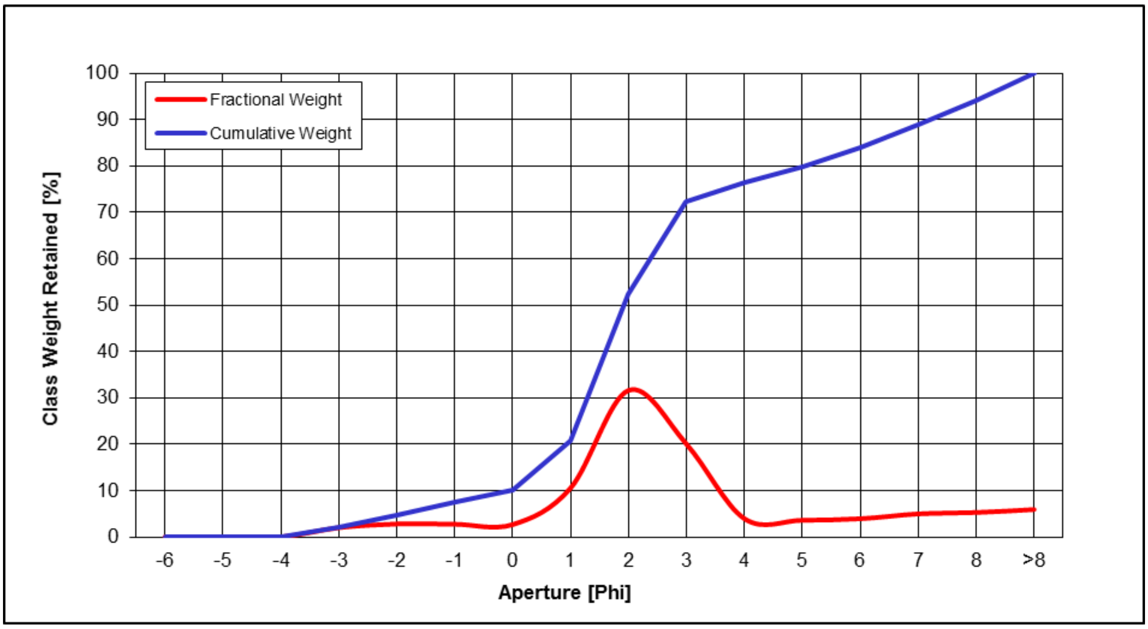
Sorting	0.46	Well Sorted
Skewness	0.16	Fine Skewed
Kurtosis	1.09	Mesokurtic
Mean [µm]	339.0	Medium Sand
Mean [phi]	1.56	
Median [µm]	339.0	Medium Sand
Median [phi]	1.56	
Gravel [%]	0.1	Slightly Gravelly Sand
Sand [%]	99.9	
Mud [%]	0.0	



Station 19MS

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	2.0	2.0
4000.0	-2	2.8	4.8
2000.0	-1	2.8	7.5
1000.0	0	2.7	10.2
500.0	1	10.5	20.7
250.0	2	31.6	52.3
125.0	3	20.0	72.4
62.5	4	3.9	76.3
31.2	5	3.6	79.9
15.6	6	3.9	83.8
7.8	7	5.0	88.8
3.9	8	5.3	94.1
<3.9	>8	5.9	100.0
Total		100.0	100.0

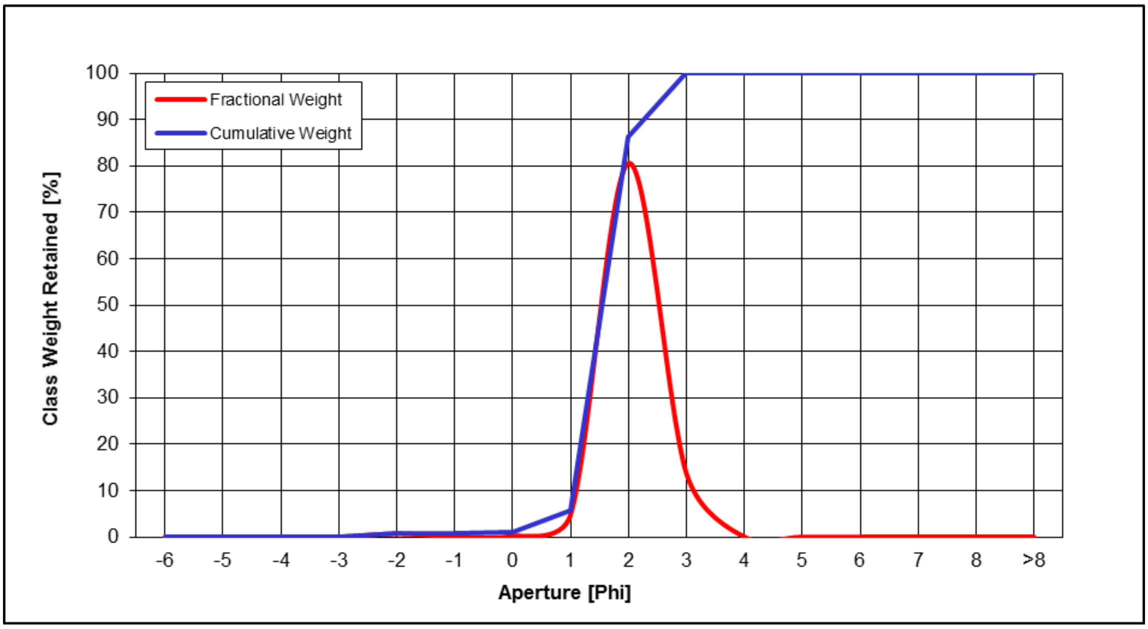
Sorting	3.00	Very Poorly Sorted
Skewness	0.39	Very Fine Skewed
Kurtosis	1.74	Very Leptokurtic
Mean [µm]	140.1	Fine Sand
Mean [phi]	2.84	
Median [µm]	263.2	Medium Sand
Median [phi]	1.93	
Gravel [%]	7.5	Gravelly Muddy Sand
Sand [%]	68.8	
Mud [%]	23.7	



Station 20MS

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	0.7	0.7
2000.0	-1	0.1	0.8
1000.0	0	0.2	1.0
500.0	1	4.7	5.7
250.0	2	80.6	86.3
125.0	3	13.7	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

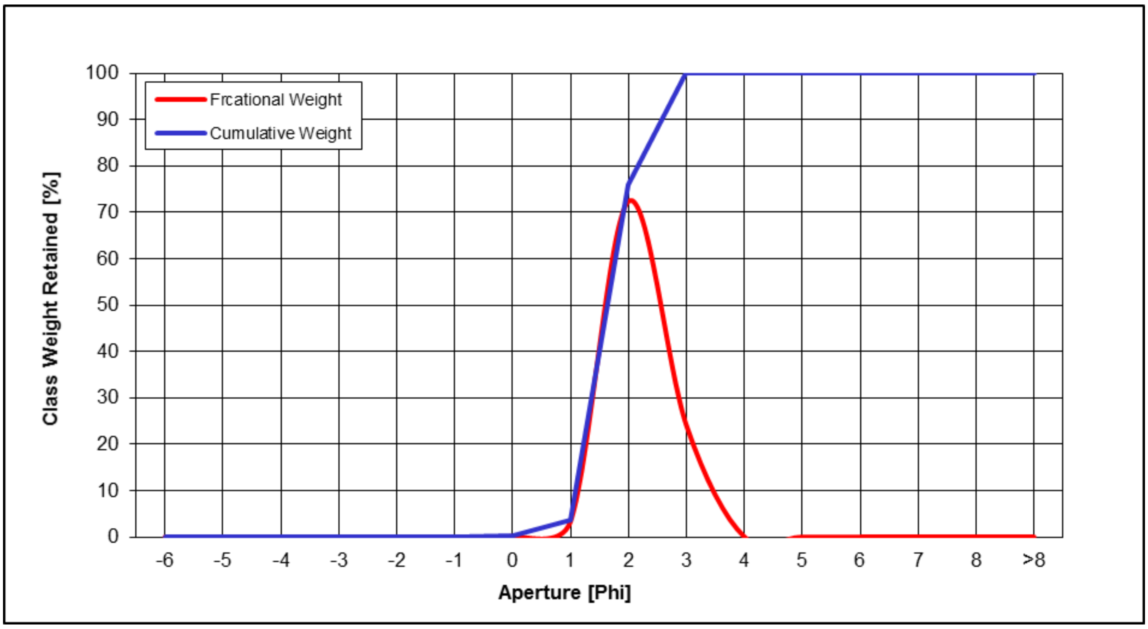
Sorting	0.48	Well Sorted
Skewness	0.11	Fine Skewed
Kurtosis	1.18	Leptokurtic
Mean [μm]	341.7	Medium Sand
Mean [phi]	1.55	
Median [μm]	341.7	Medium Sand
Median [phi]	1.55	
Gravel [%]	0.8	Slightly Gravelly Sand
Sand [%]	99.2	
Mud [%]	0.0	



Station 21MS

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	0.0	0.0
2000.0	-1	0.1	0.1
1000.0	0	0.1	0.2
500.0	1	3.4	3.6
250.0	2	72.4	75.9
125.0	3	24.1	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

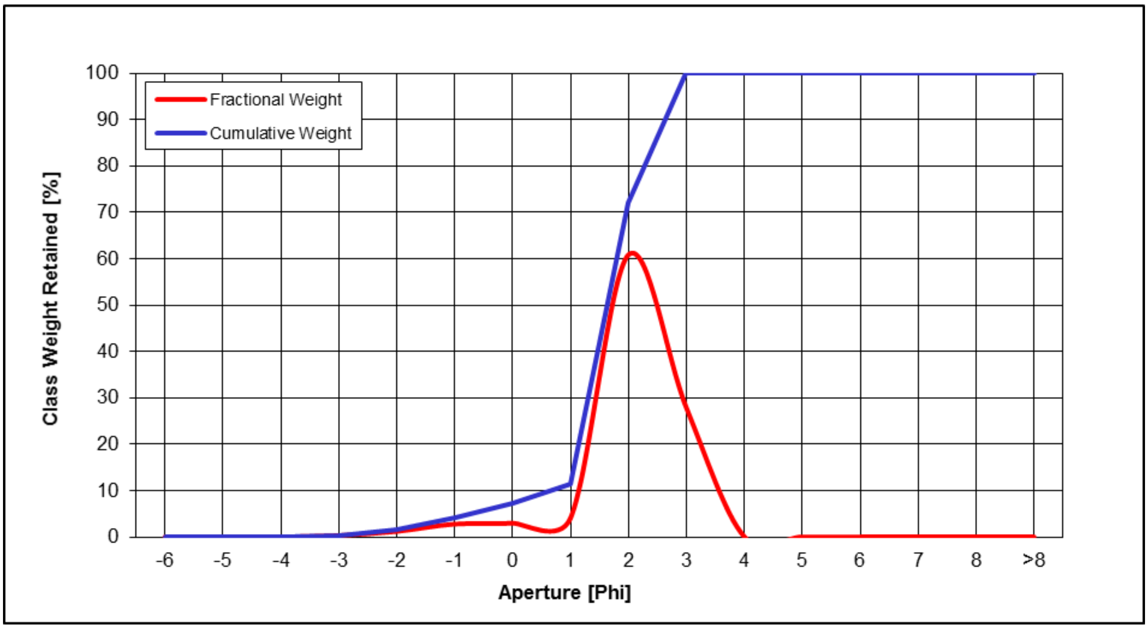
Sorting	0.56	Moderately Well Sorted
Skewness	0.25	Fine Skewed
Kurtosis	1.05	Mesokurtic
Mean [µm]	304.4	Medium Sand
Mean [phi]	1.72	
Median [µm]	320.5	Medium Sand
Median [phi]	1.64	
Gravel [%]	0.1	Slightly Gravelly Sand
Sand [%]	99.9	
Mud [%]	0.0	



Station 22MS

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	1.2	1.5
2000.0	-1	2.8	4.3
1000.0	0	2.9	7.2
500.0	1	4.1	11.3
250.0	2	60.8	72.1
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

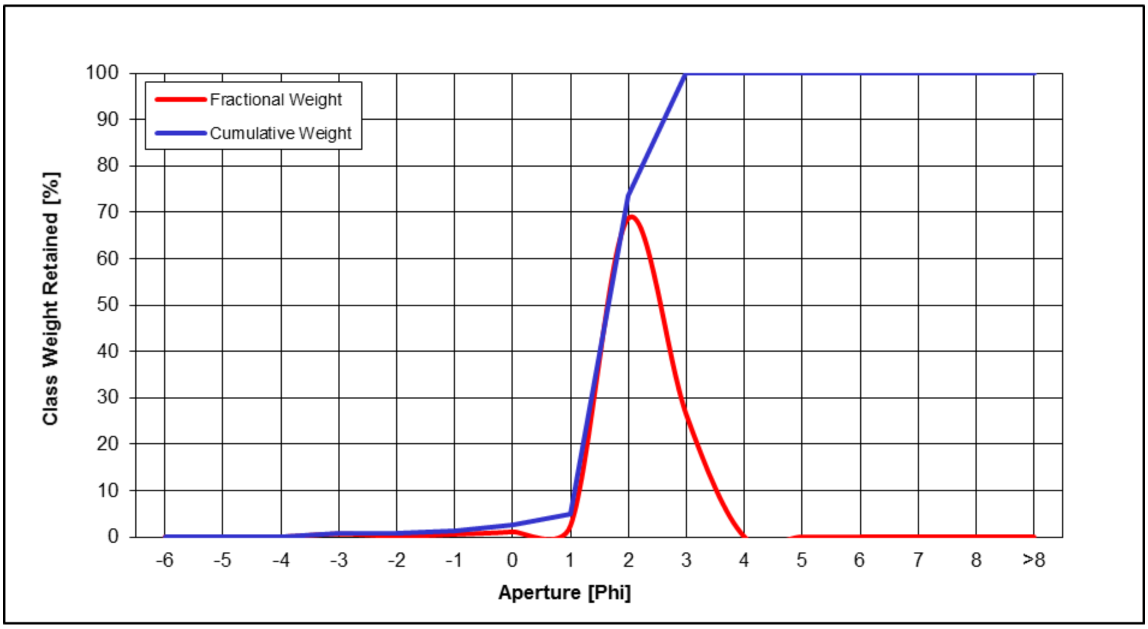
Sorting	0.88	Moderately Sorted
Skewness	-0.08	Symmetrical
Kurtosis	1.67	Very Leptokurtic
Mean [µm]	305.0	Medium Sand
Mean [phi]	1.71	
Median [µm]	321.7	Medium Sand
Median [phi]	1.64	
Gravel [%]	4.3	Slightly Gravelly Sand
Sand [%]	95.7	
Mud [%]	0.0	



Station 23MS

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	0.7	0.7
4000.0	-2	0.1	0.8
2000.0	-1	0.6	1.4
1000.0	0	1.1	2.5
500.0	1	2.5	4.9
250.0	2	68.7	73.7
125.0	3	26.3	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

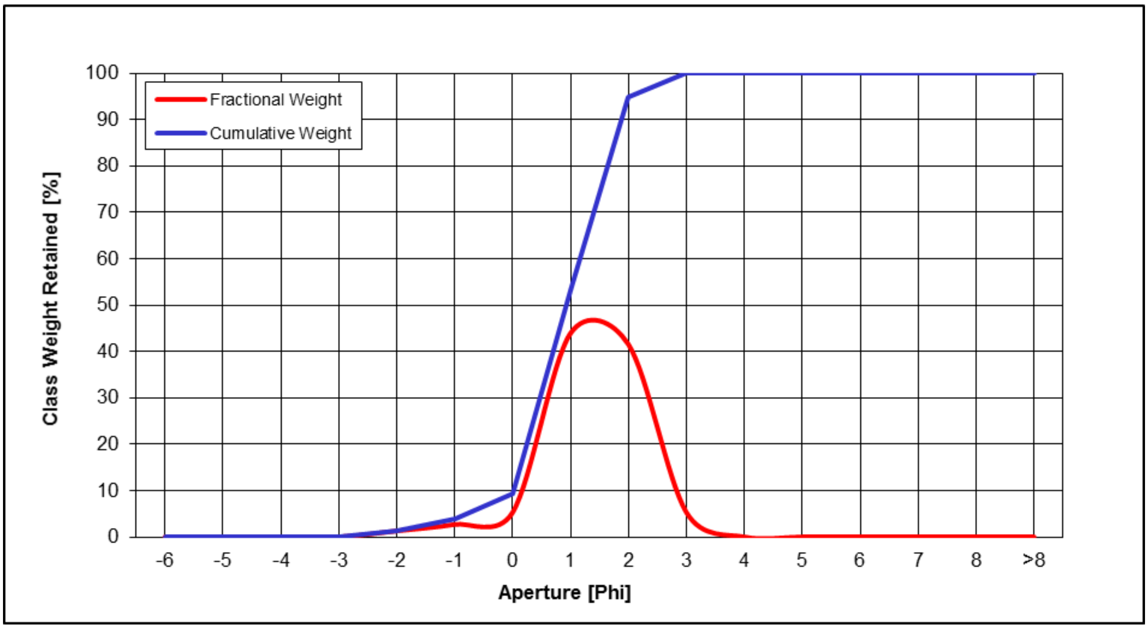
Sorting	0.58	Moderately Well Sorted
Skewness	0.24	Fine Skewed
Kurtosis	0.98	Mesokurtic
Mean [µm]	300.2	Medium Sand
Mean [phi]	1.74	
Median [µm]	317.4	Medium Sand
Median [phi]	1.66	
Gravel [%]	1.4	Slightly Gravelly Sand
Sand [%]	98.6	
Mud [%]	0.0	



Station 24CR

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	1.3	1.3
2000.0	-1	2.7	4.0
1000.0	0	5.3	9.3
500.0	1	43.9	53.2
250.0	2	41.5	94.7
125.0	3	5.3	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

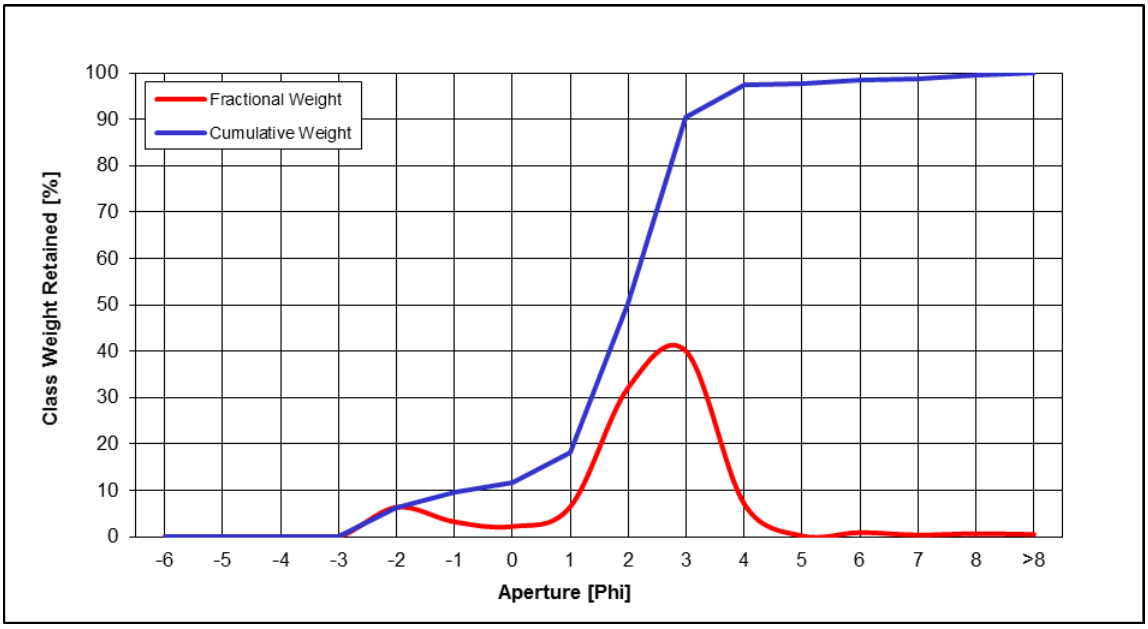
Sorting	0.83	Moderately Sorted
Skewness	-0.09	Symmetrical
Kurtosis	1.01	Mesokurtic
Mean [µm]	521.1	Coarse Sand
Mean [phi]	0.94	
Median [µm]	526.0	Coarse Sand
Median [phi]	0.93	
Gravel [%]	4.0	Slightly Gravelly Sand
Sand [%]	96.0	
Mud [%]	0.0	



Station 25CR

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	6.3	6.3
2000.0	-1	3.2	9.5
1000.0	0	2.2	11.7
500.0	1	6.5	18.2
250.0	2	32.1	50.4
125.0	3	40.0	90.3
62.5	4	7.1	97.4
31.2	5	0.2	97.6
15.6	6	0.9	98.5
7.8	7	0.4	98.8
3.9	8	0.7	99.5
<3.9	>8	0.5	100.0
Total		100.0	100.0

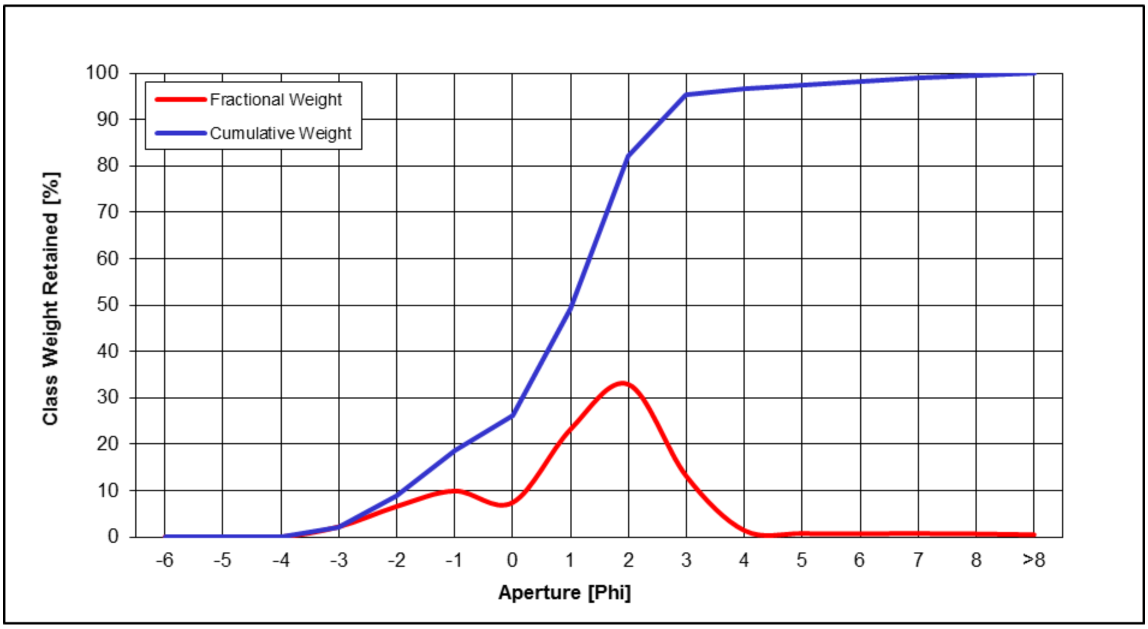
Sorting	1.44	Poorly Sorted
Skewness	-0.32	Very Coarse Skewed
Kurtosis	1.71	Very Leptokurtic
Mean [µm]	281.3	Medium Sand
Mean [phi]	1.83	
Median [µm]	251.9	Medium Sand
Median [phi]	1.99	
Gravel [%]	9.5	Gravelly Sand
Sand [%]	87.9	
Mud [%]	2.6	



Station 26CR

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	2.2	2.2
4000.0	-2	6.6	8.8
2000.0	-1	9.9	18.7
1000.0	0	7.4	26.1
500.0	1	23.2	49.3
250.0	2	32.9	82.2
125.0	3	13.1	95.3
62.5	4	1.4	96.7
31.2	5	0.7	97.4
15.6	6	0.7	98.1
7.8	7	0.7	98.9
3.9	8	0.7	99.5
<3.9	>8	0.5	100.0
Total		100.0	100.0

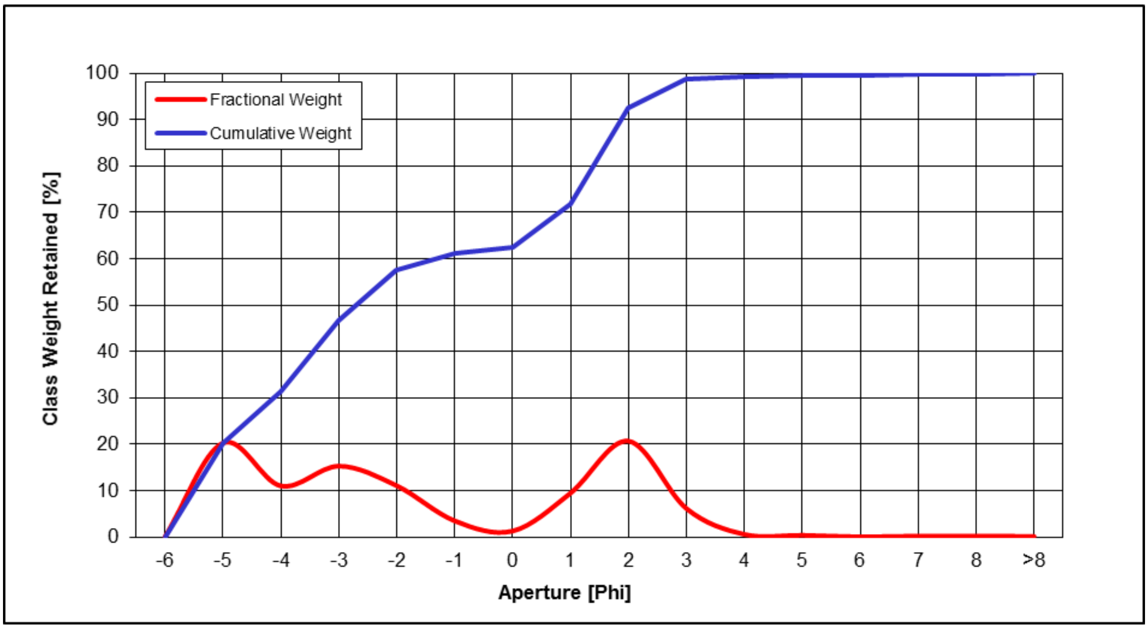
Sorting	1.69	Poorly Sorted
Skewness	-0.32	Very Coarse Skewed
Kurtosis	1.18	Leptokurtic
Mean [µm]	646.9	Coarse Sand
Mean [phi]	0.63	
Median [µm]	492.9	Medium Sand
Median [phi]	1.02	
Gravel [%]	18.7	Gravelly Sand
Sand [%]	78.0	
Mud [%]	3.3	



Station27CR

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	20.3	20.3
16000.0	-4	11.0	31.3
8000.0	-3	15.3	46.5
4000.0	-2	11.0	57.6
2000.0	-1	3.5	61.1
1000.0	0	1.3	62.3
500.0	1	9.5	71.8
250.0	2	20.7	92.5
125.0	3	6.1	98.6
62.5	4	0.5	99.1
31.2	5	0.4	99.5
15.6	6	0.0	99.5
7.8	7	0.2	99.7
3.9	8	0.2	99.9
<3.9	>8	0.1	100.0
Total		100.0	100.0

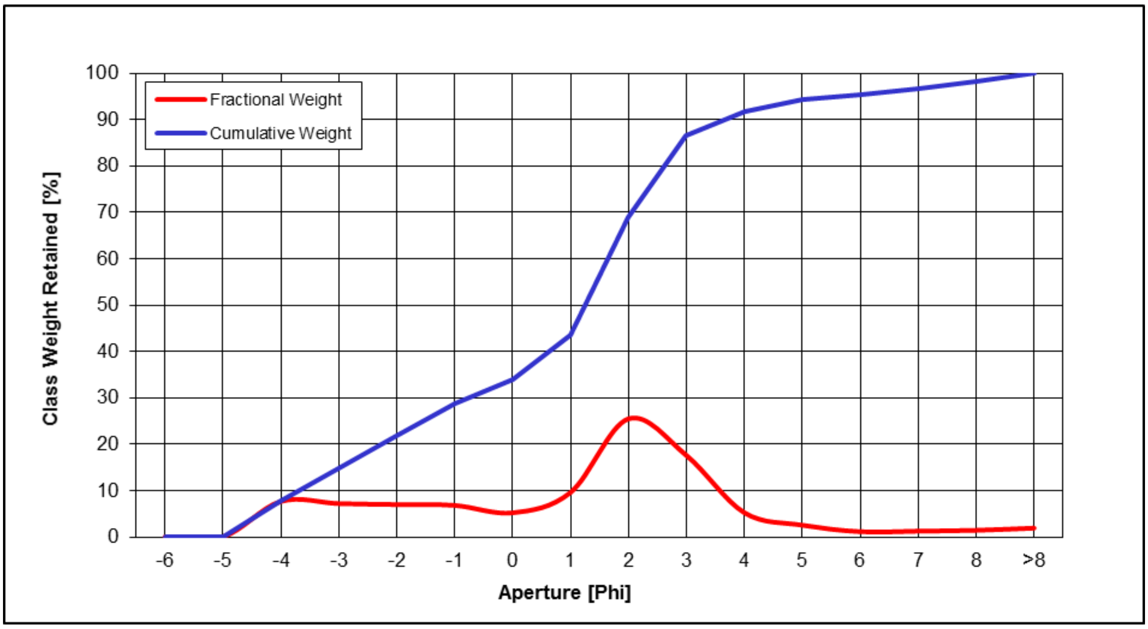
Sorting	2.93	Very Poorly Sorted
Skewness	0.26	Fine Skewed
Kurtosis	0.58	Very Platykurtic
Mean [µm]	4270.7	Pebble
Mean [phi]	-2.09	
Median [µm]	6438.2	Pebble
Median [phi]	-2.69	
Gravel [%]	61.1	Sandy Gravel
Sand [%]	38.1	
Mud [%]	0.9	



Station 28CR

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	7.7	7.7
8000.0	-3	7.2	14.9
4000.0	-2	7.0	21.9
2000.0	-1	6.8	28.7
1000.0	0	5.2	33.9
500.0	1	9.6	43.5
250.0	2	25.5	69.0
125.0	3	17.6	86.5
62.5	4	5.2	91.7
31.2	5	2.5	94.3
15.6	6	1.1	95.4
7.8	7	1.2	96.7
3.9	8	1.4	98.1
<3.9	>8	1.9	100.0
Total		100.0	100.0

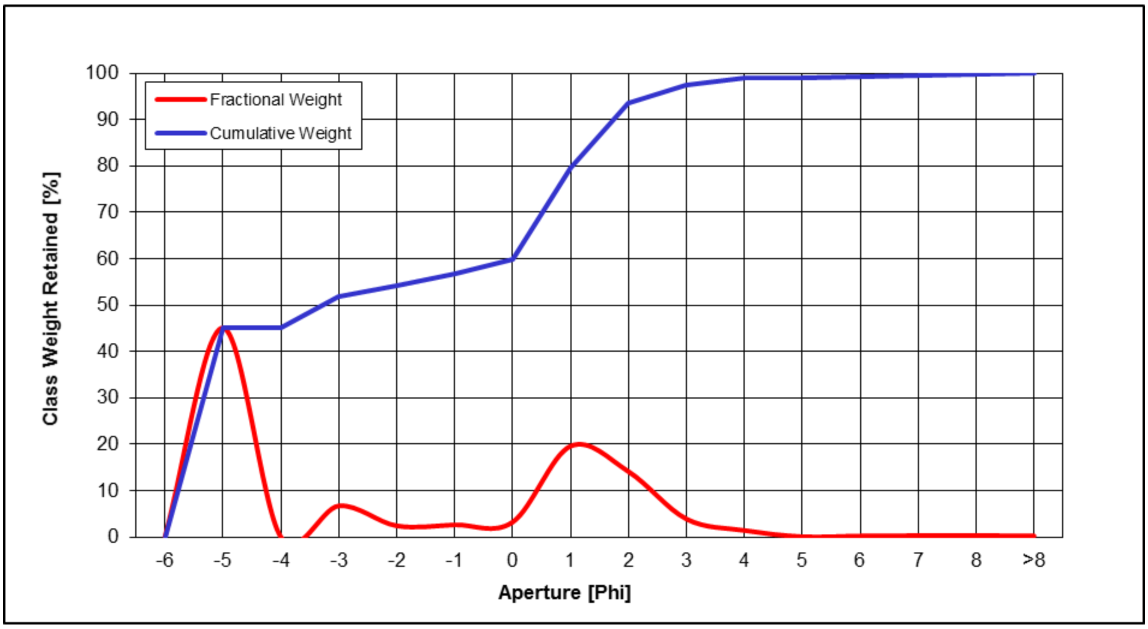
Sorting	2.93	Very Poorly Sorted
Skewness	-0.28	Coarse Skewed
Kurtosis	1.05	Mesokurtic
Mean [µm]	744.9	Coarse Sand
Mean [phi]	0.42	
Median [µm]	418.7	Medium Sand
Median [phi]	1.26	
Gravel [%]	28.7	Gravelly Muddy Sand
Sand [%]	63.1	
Mud [%]	8.3	



Station 29CR

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	45.1	45.1
16000.0	-4	0.0	45.1
8000.0	-3	6.7	51.8
4000.0	-2	2.4	54.2
2000.0	-1	2.6	56.8
1000.0	0	3.2	60.0
500.0	1	19.6	79.6
250.0	2	14.1	93.7
125.0	3	3.9	97.5
62.5	4	1.4	98.9
31.2	5	0.1	99.0
15.6	6	0.2	99.2
7.8	7	0.3	99.5
3.9	8	0.3	99.8
<3.9	>8	0.2	100.0
Total		100.0	100.0

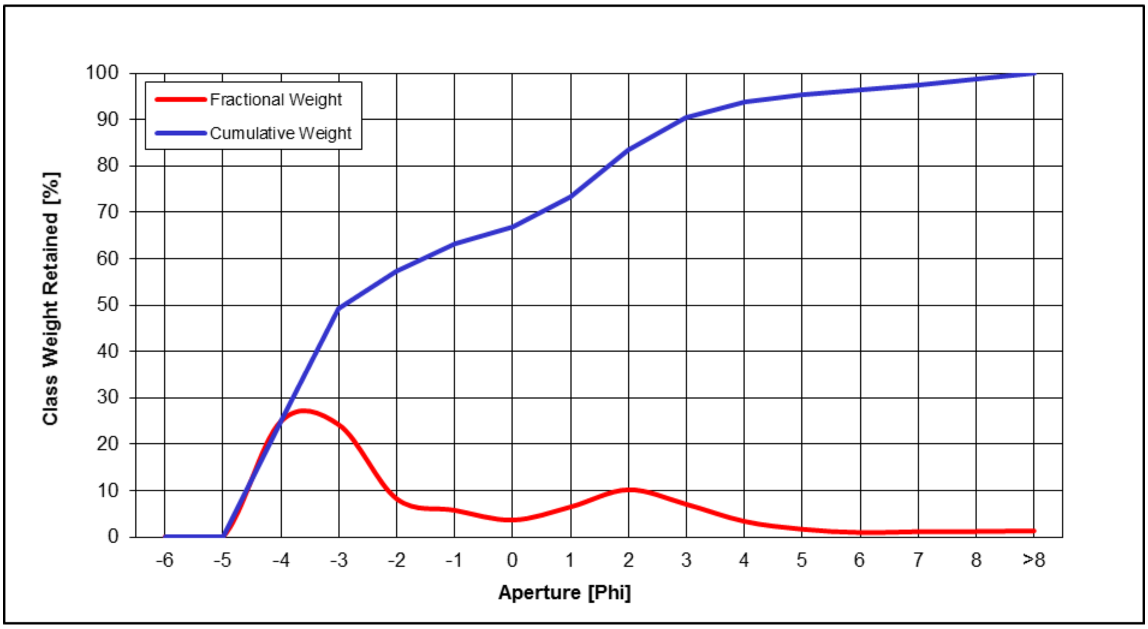
Sorting	2.98	Very Poorly Sorted
Skewness	0.34	Very Fine Skewed
Kurtosis	0.54	Very Platykurtic
Mean [µm]	5751.8	Pebble
Mean [phi]	-2.52	
Median [µm]	9609.9	Pebble
Median [phi]	-3.26	
Gravel [%]	56.8	Sandy Gravel
Sand [%]	42.1	
Mud [%]	1.1	



Station 30CR

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	24.9	24.9
8000.0	-3	24.2	49.1
4000.0	-2	8.2	57.4
2000.0	-1	5.8	63.1
1000.0	0	3.6	66.7
500.0	1	6.5	73.2
250.0	2	10.2	83.4
125.0	3	7.0	90.4
62.5	4	3.4	93.8
31.2	5	1.7	95.4
15.6	6	0.9	96.4
7.8	7	1.1	97.5
3.9	8	1.2	98.7
<3.9	>8	1.3	100.0
Total		100.0	100.0

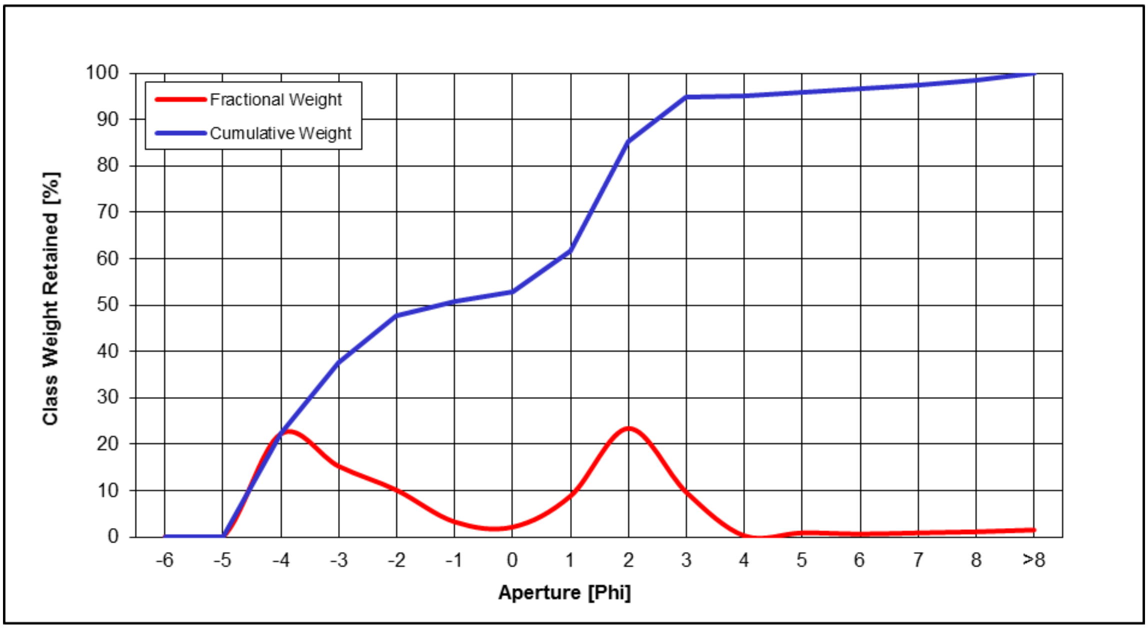
Sorting	3.05	Very Poorly Sorted
Skewness	0.58	Very Fine Skewed
Kurtosis	0.75	Platykurtic
Mean [µm]	3292.9	Granule
Mean [phi]	-1.72	
Median [µm]	7432.9	Pebble
Median [phi]	-2.89	
Gravel [%]	63.1	Muddy Sandy Gravel
Sand [%]	30.7	
Mud [%]	6.2	



Station 31CR

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	22.2	22.2
8000.0	-3	15.2	37.5
4000.0	-2	10.1	47.5
2000.0	-1	3.2	50.8
1000.0	0	2.1	52.9
500.0	1	8.8	61.8
250.0	2	23.4	85.2
125.0	3	9.6	94.8
62.5	4	0.2	95.0
31.2	5	0.9	95.9
15.6	6	0.6	96.5
7.8	7	0.9	97.4
3.9	8	1.1	98.5
<3.9	>8	1.5	100.0
Total		100.0	100.0

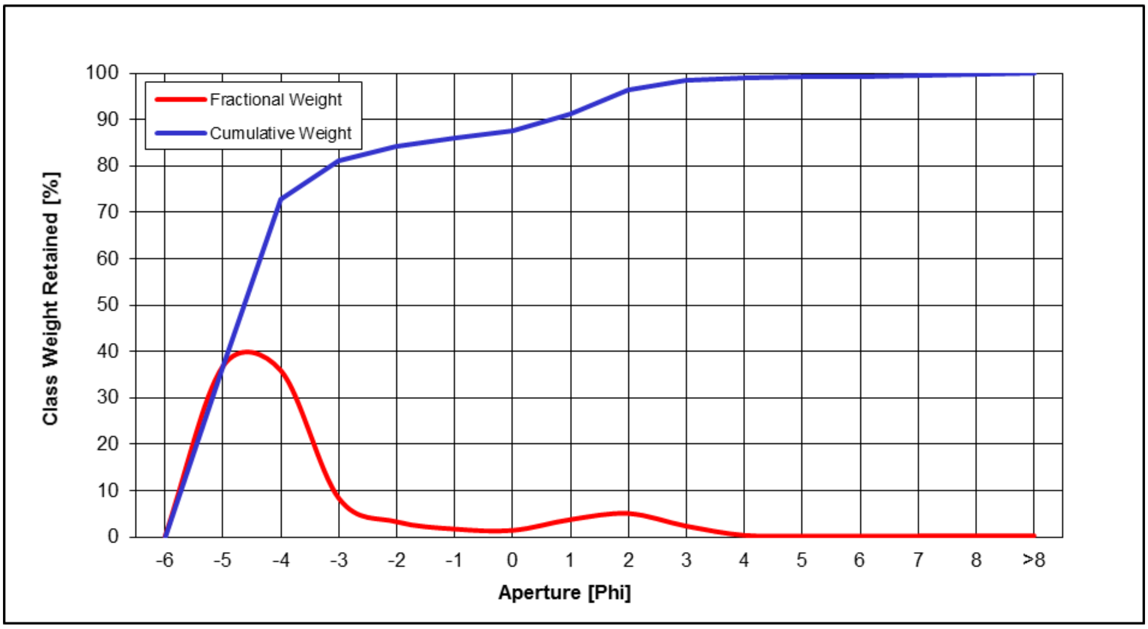
Sorting	2.88	Very Poorly Sorted
Skewness	0.11	Fine Skewed
Kurtosis	0.66	Very Platykurtic
Mean [µm]	2280.4	Granule
Mean [phi]	-1.19	
Median [µm]	2369.1	Granule
Median [phi]	-1.24	
Gravel [%]	50.8	Muddy Sandy Gravel
Sand [%]	44.2	
Mud [%]	5.0	



Station 32CR

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	36.8	36.8
16000.0	-4	35.9	72.7
8000.0	-3	8.4	81.1
4000.0	-2	3.3	84.3
2000.0	-1	1.7	86.0
1000.0	0	1.4	87.5
500.0	1	3.8	91.2
250.0	2	5.1	96.3
125.0	3	2.3	98.6
62.5	4	0.4	98.9
31.2	5	0.2	99.1
15.6	6	0.2	99.3
7.8	7	0.2	99.5
3.9	8	0.2	99.7
<3.9	>8	0.3	100.0
Total		100.0	100.0

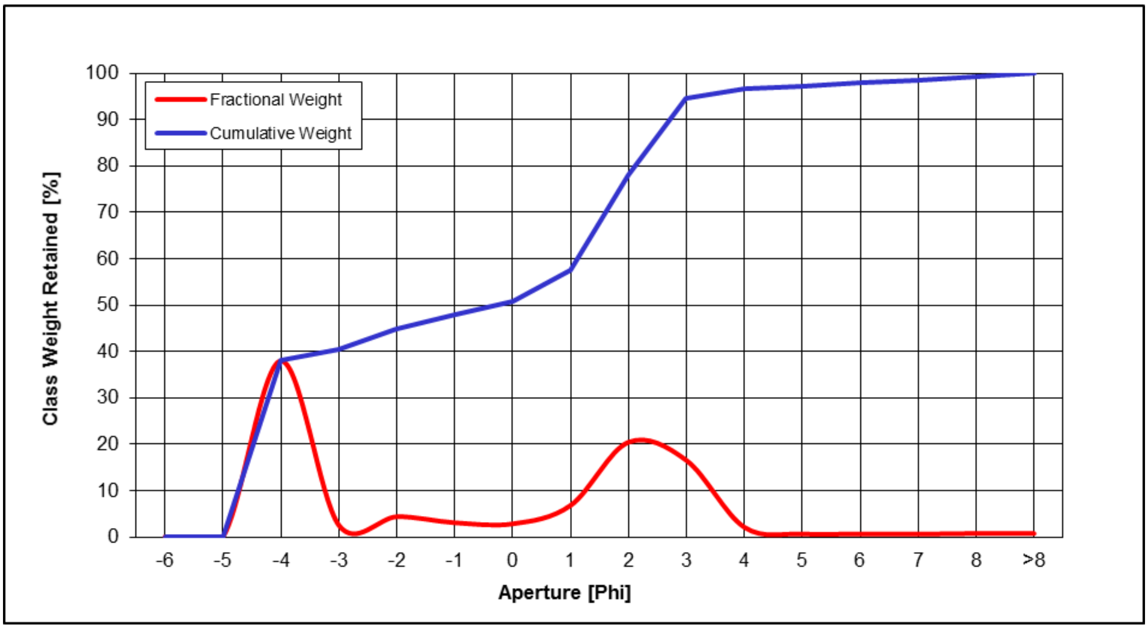
Sorting	2.01	Very Poorly Sorted
Skewness	0.57	Very Fine Skewed
Kurtosis	1.98	Very Leptokurtic
Mean [µm]	16978.2	Pebble
Mean [phi]	-4.09	
Median [µm]	24556.0	Pebble
Median [phi]	-4.62	
Gravel [%]	86.0	Gravel
Sand [%]	12.9	
Mud [%]	1.1	



Station 33CR

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	38.0	38.0
8000.0	-3	2.5	40.5
4000.0	-2	4.4	44.9
2000.0	-1	3.1	48.0
1000.0	0	2.8	50.8
500.0	1	6.8	57.6
250.0	2	20.4	78.0
125.0	3	16.5	94.5
62.5	4	2.1	96.6
31.2	5	0.6	97.2
15.6	6	0.7	97.9
7.8	7	0.6	98.5
3.9	8	0.7	99.3
<3.9	>8	0.7	100.0

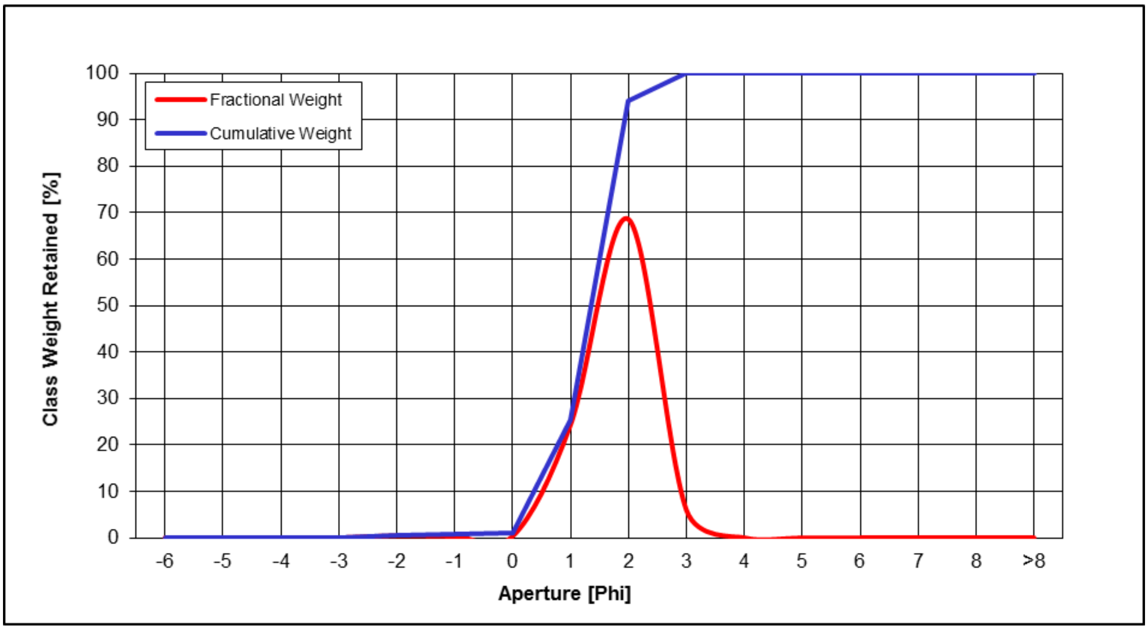
Total		100.0	100.0
Sorting	2.96	Very Poorly Sorted	
Skewness	-0.18	Coarse Skewed	
Kurtosis	0.54	Very Platykurtic	
Mean [µm]	1774.1	Very Coarse Sand	
Mean [phi]	-0.83		
Median [µm]	1213.4	Very Coarse Sand	
Median [phi]	-0.28		
Gravel [%]	48.0	Sandy Gravel	
Sand [%]	48.6		
Mud [%]	3.4		



Station 35CR

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	0.3	0.7
1000.0	0	0.3	1.1
500.0	1	24.4	25.4
250.0	2	68.6	94.0
125.0	3	6.0	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

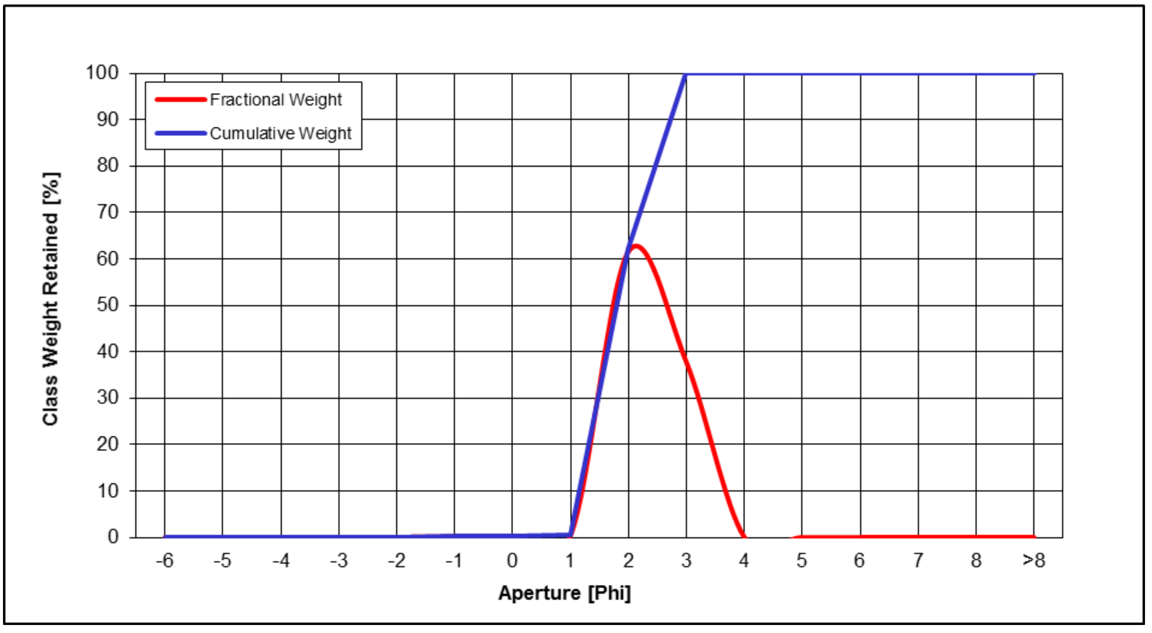
Total		100.0	100.0
Sorting	0.61	Moderately Well Sorted	
Skewness	-0.20	Coarse Skewed	
Kurtosis	1.11	Mesokurtic	
Mean [µm]	413.3	Medium Sand	
Mean [phi]	1.27		
Median [µm]	390.1	Medium Sand	
Median [phi]	1.36		
Gravel [%]	0.7	Slightly Gravelly Sand	
Sand [%]	99.3		
Mud [%]	0.0		



Station 36CR

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	0.0	0.0
2000.0	-1	0.1	0.2
1000.0	0	0.0	0.2
500.0	1	0.4	0.6
250.0	2	61.6	62.2
125.0	3	37.7	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

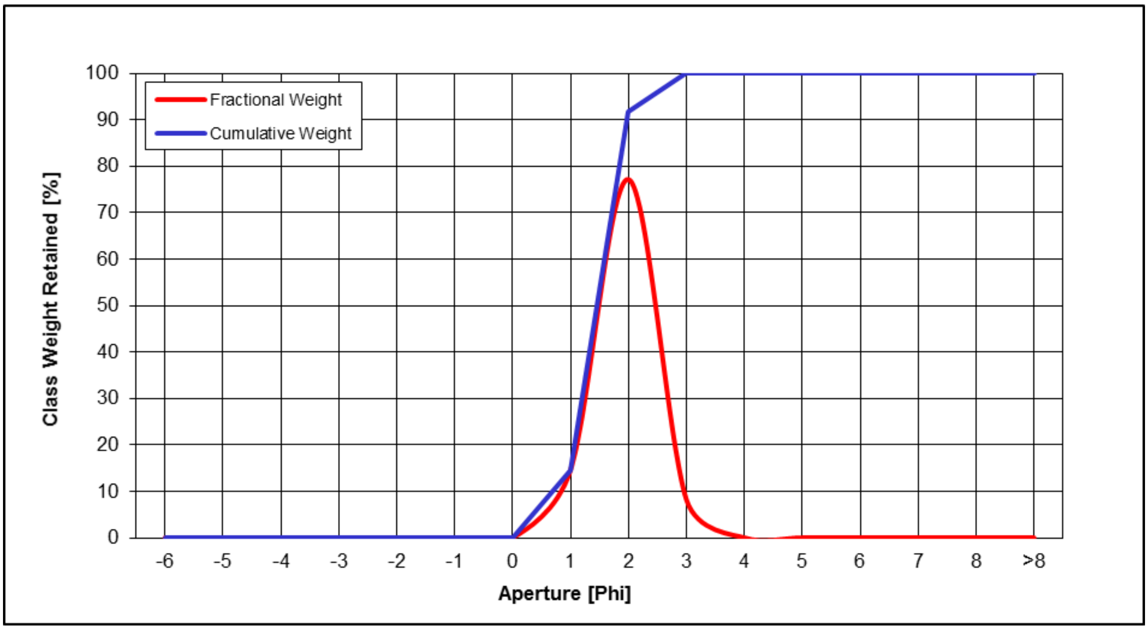
Sorting	0.60	Moderately Well Sorted
Skewness	0.18	Fine Skewed
Kurtosis	0.78	Platykurtic
Mean [µm]	272.5	Medium Sand
Mean [phi]	1.88	
Median [µm]	286.9	Medium Sand
Median [phi]	1.80	
Gravel [%]	0.2	Slightly Gravelly Sand
Sand [%]	99.8	
Mud [%]	0.0	



Station 37CR

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	0.0	0.0
2000.0	-1	0.0	0.0
1000.0	0	0.0	0.0
500.0	1	14.6	14.6
250.0	2	77.2	91.8
125.0	3	8.2	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

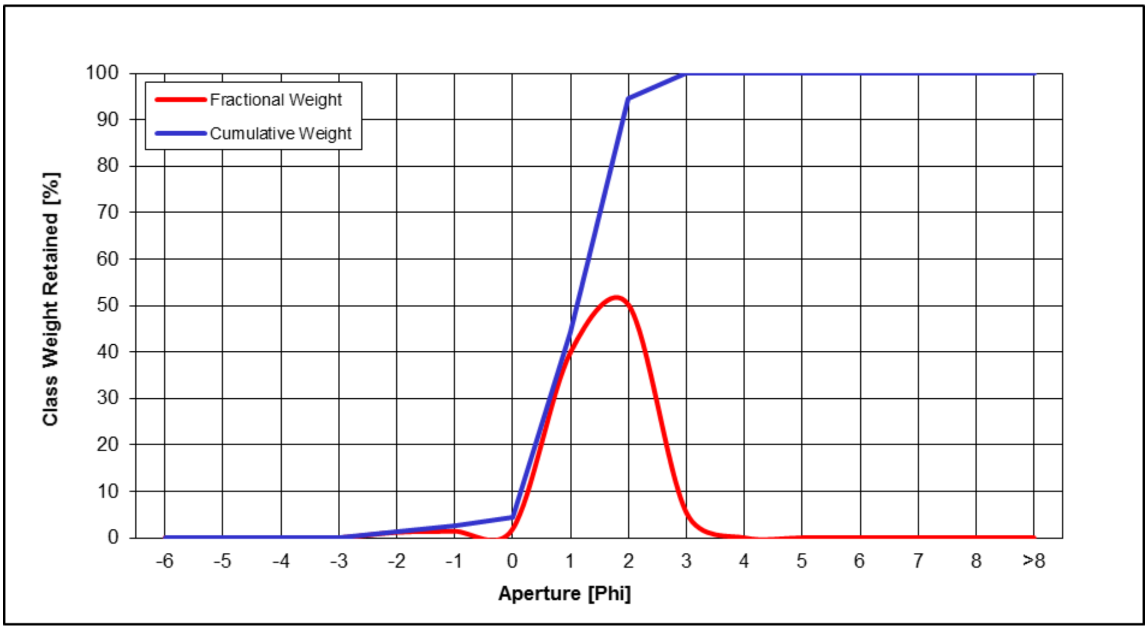
Sorting	0.53	Moderately Well Sorted
Skewness	-0.05	Symmetrical
Kurtosis	1.30	Leptokurtic
Mean [µm]	363.9	Medium Sand
Mean [phi]	1.46	
Median [µm]	363.9	Medium Sand
Median [phi]	1.46	
Gravel [%]	0.0	Sand
Sand [%]	100.0	
Mud [%]	0.0	



Station 38CR

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	1.2	1.2
2000.0	-1	1.4	2.6
1000.0	0	1.9	4.5
500.0	1	40.0	44.4
250.0	2	50.2	94.6
125.0	3	5.4	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

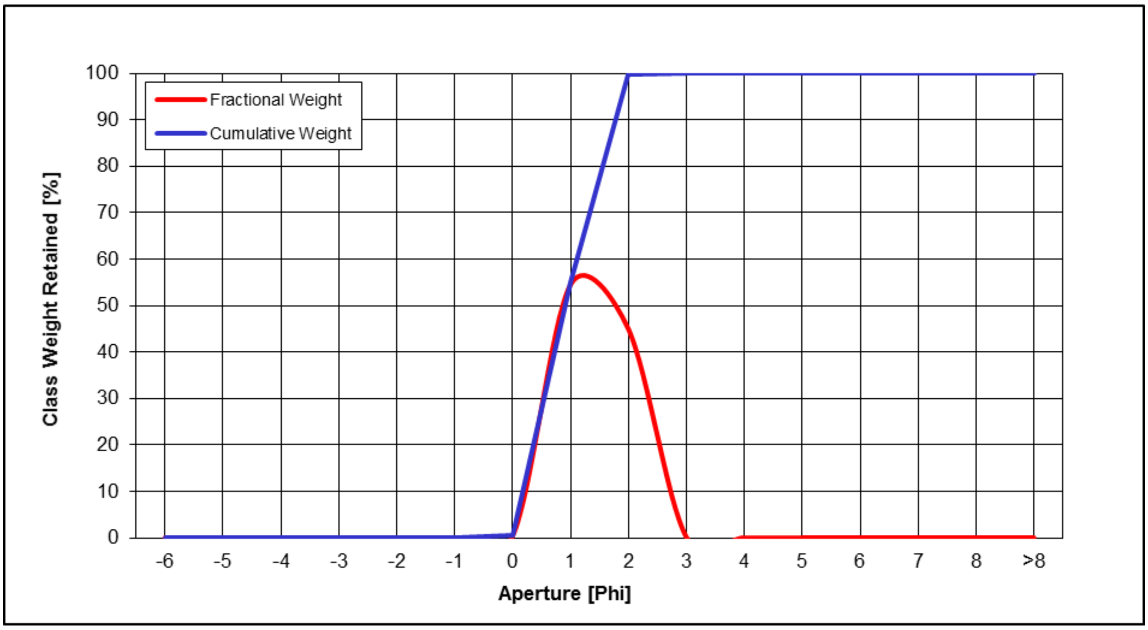
Sorting	0.69	Moderately Well Sorted
Skewness	-0.08	Symmetrical
Kurtosis	0.77	Platykurtic
Mean [µm]	478.7	Medium Sand
Mean [phi]	1.06	
Median [µm]	463.0	Medium Sand
Median [phi]	1.11	
Gravel [%]	2.6	Slightly Gravelly Sand
Sand [%]	97.4	
Mud [%]	0.0	



Station 39CR

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	0.0	0.0
2000.0	-1	0.1	0.1
1000.0	0	0.4	0.4
500.0	1	54.5	54.9
250.0	2	44.9	99.9
125.0	3	0.1	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

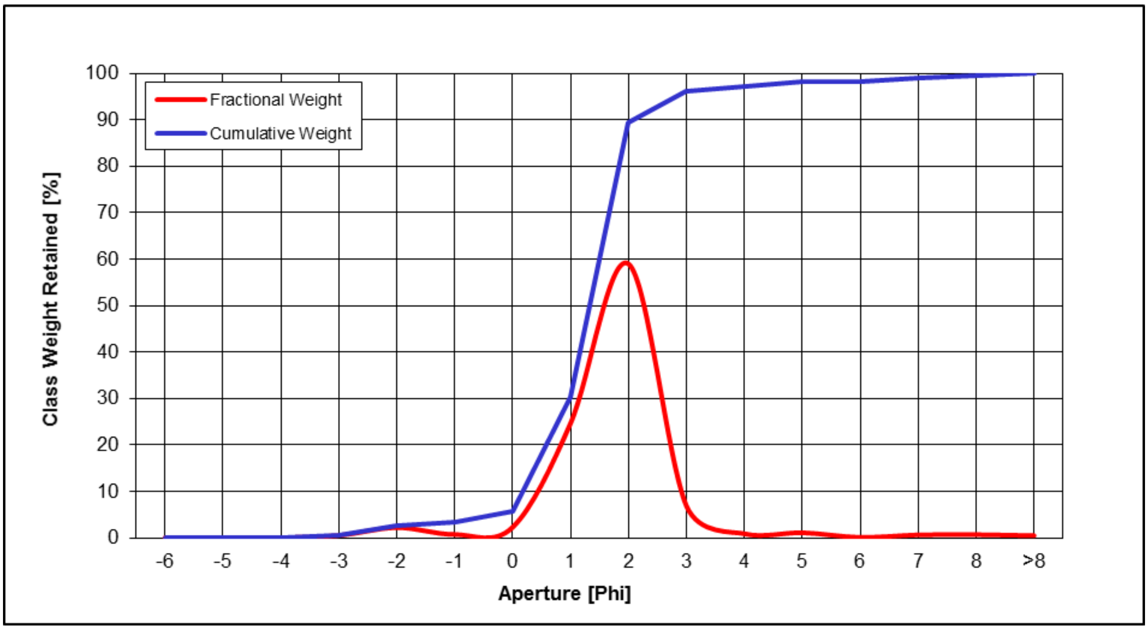
Sorting	0.61	Moderately Well Sorted
Skewness	0.09	Symmetrical
Kurtosis	0.74	Platykurtic
Mean [µm]	518.6	Coarse Sand
Mean [phi]	0.95	
Median [µm]	532.5	Coarse Sand
Median [phi]	0.91	
Gravel [%]	0.1	Slightly Gravelly Sand
Sand [%]	99.9	
Mud [%]	0.0	



Station 40CR

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	0.5	0.5
4000.0	-2	2.2	2.7
2000.0	-1	0.7	3.4
1000.0	0	2.3	5.7
500.0	1	24.7	30.3
250.0	2	59.0	89.3
125.0	3	6.9	96.2
62.5	4	0.9	97.1
31.2	5	1.1	98.2
15.6	6	0.1	98.2
7.8	7	0.6	98.9
3.9	8	0.7	99.5
<3.9	>8	0.5	100.0
Total		100.0	100.0

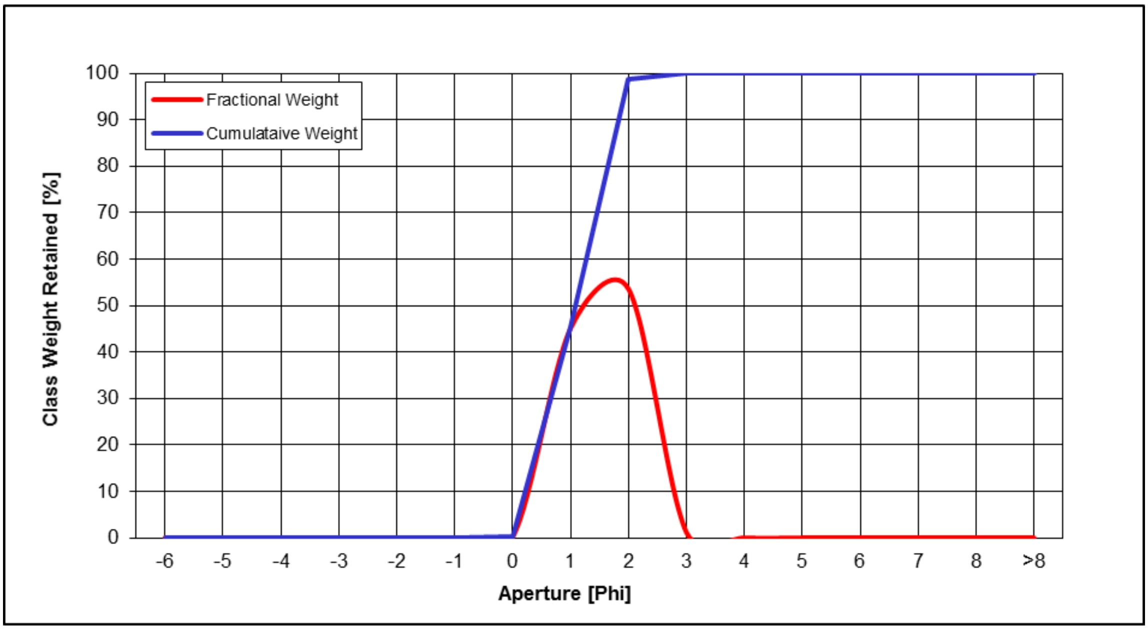
Sorting	0.85	Moderately Sorted
Skewness	-0.14	Coarse Skewed
Kurtosis	1.32	Leptokurtic
Mean [µm]	429.2	Medium Sand
Mean [phi]	1.22	
Median [µm]	396.9	Medium Sand
Median [phi]	1.33	
Gravel [%]	3.4	Slightly Gravelly Sand
Sand [%]	93.7	
Mud [%]	2.9	



Station: 41CR

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	0.0	0.0
2000.0	-1	0.0	0.0
1000.0	0	0.1	0.2
500.0	1	45.1	45.2
250.0	2	53.6	98.8
125.0	3	1.2	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

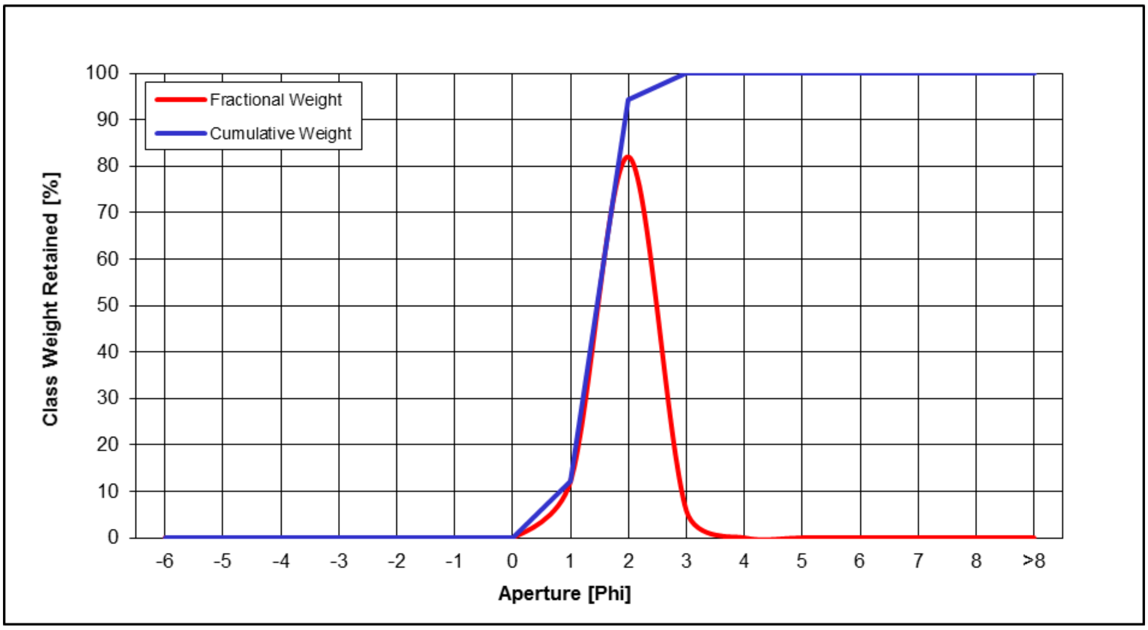
Sorting	0.62	Moderately Well Sorted
Skewness	-0.08	Symmetrical
Kurtosis	0.74	Platykurtic
Mean [µm]	481.5	Medium Sand
Mean [phi]	1.05	
Median [µm]	470.2	Medium Sand
Median [phi]	1.09	
Gravel [%]	0.0	Slightly Gravelly Sand
Sand [%]	100.0	
Mud [%]	0.0	



Station 42CR

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	0.0	0.0
2000.0	-1	0.0	0.0
1000.0	0	0.0	0.0
500.0	1	12.2	12.2
250.0	2	82.0	94.2
125.0	3	5.8	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

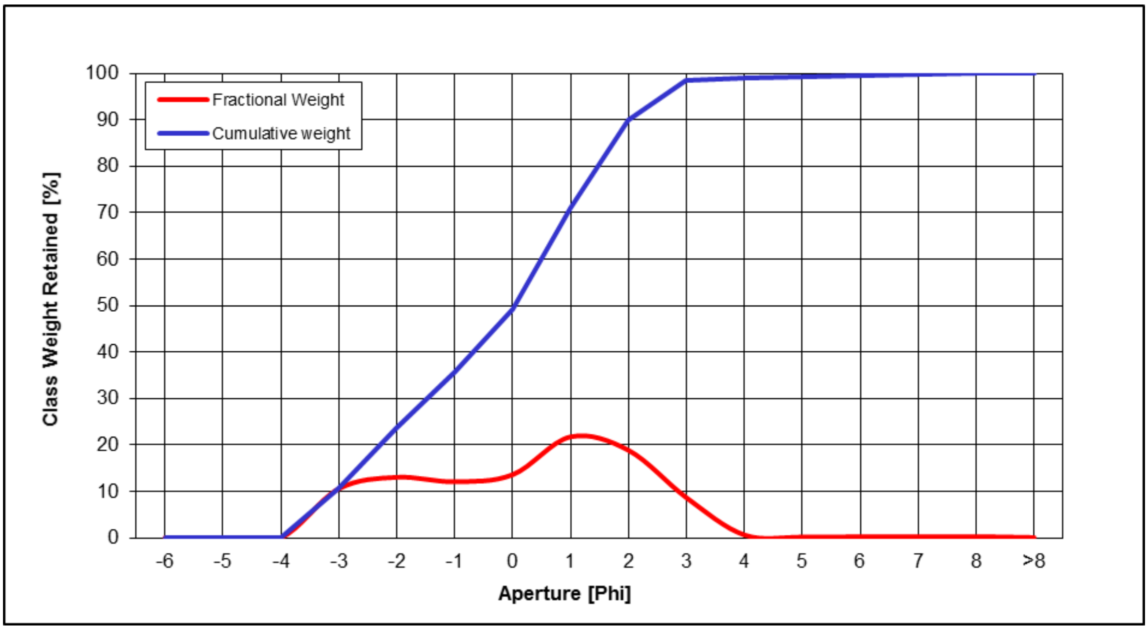
Sorting	0.47	Well Sorted
Skewness	-0.11	Coarse Skewed
Kurtosis	1.16	Leptokurtic
Mean [µm]	363.2	Medium Sand
Mean [phi]	1.46	
Median [µm]	363.2	Medium Sand
Median [phi]	1.46	
Gravel [%]	0.0	Sand
Sand [%]	100.0	
Mud [%]	0.0	



Station 43CR

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	10.6	10.6
4000.0	-2	13.0	23.6
2000.0	-1	12.1	35.7
1000.0	0	13.6	49.2
500.0	1	21.7	71.0
250.0	2	18.8	89.8
125.0	3	8.6	98.5
62.5	4	0.6	99.1
31.2	5	0.2	99.2
15.6	6	0.2	99.5
7.8	7	0.2	99.7
3.9	8	0.3	99.9
<3.9	>8	0.1	100.0
Total		100.0	100.0

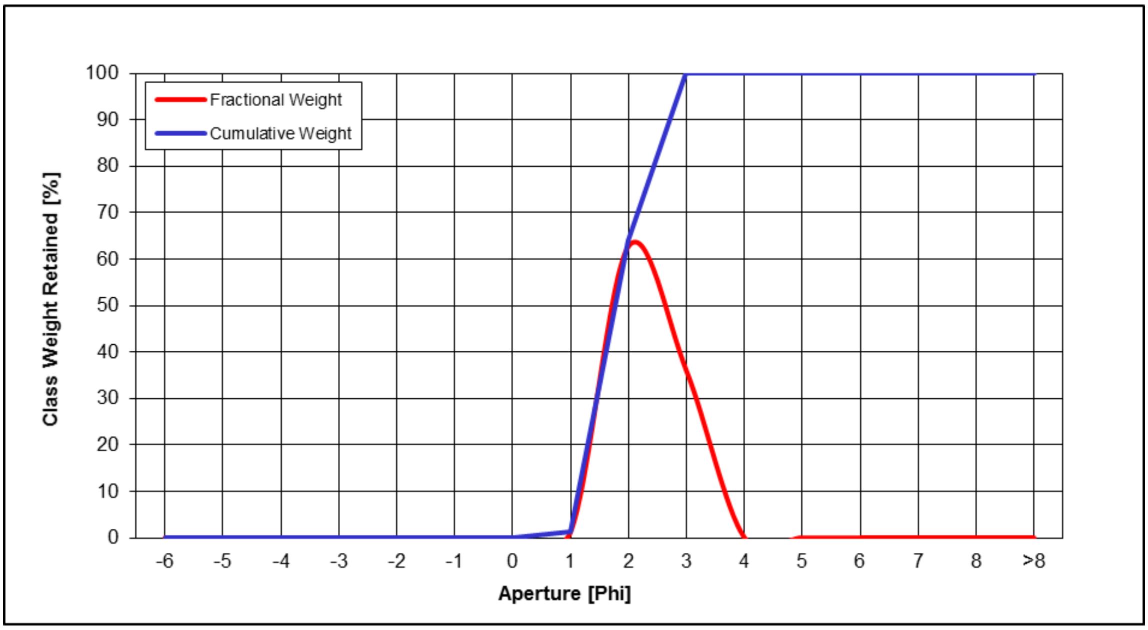
Sorting	2.00	Poorly Sorted
Skewness	-0.19	Coarse Skewed
Kurtosis	0.81	Platykurtic
Mean [µm]	1219.0	Very Coarse Sand
Mean [phi]	-0.29	
Median [µm]	976.1	Coarse Sand
Median [phi]	0.03	
Gravel [%]	35.7	Sandy Gravel
Sand [%]	63.4	
Mud [%]	0.9	



Station 44CR

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	0.0	0.0
2000.0	-1	0.0	0.0
1000.0	0	0.0	0.0
500.0	1	1.2	1.2
250.0	2	62.7	64.0
125.0	3	36.0	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

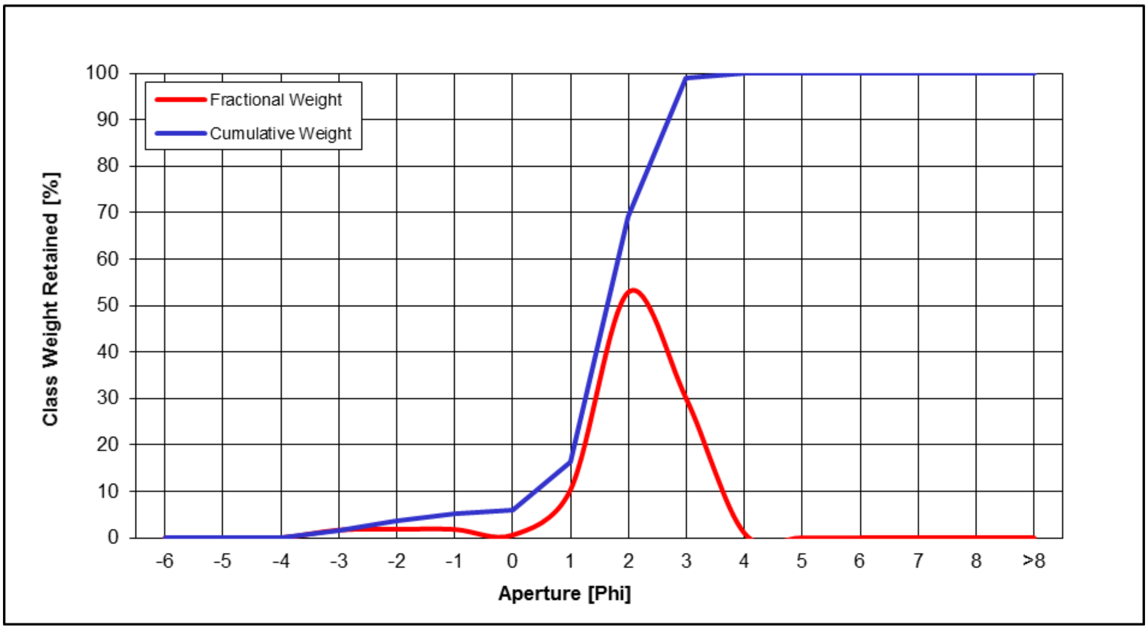
Sorting	0.60	Moderately Well Sorted
Skewness	0.19	Fine Skewed
Kurtosis	0.80	Platykurtic
Mean [µm]	276.2	Medium Sand
Mean [phi]	1.86	
Median [µm]	291.7	Medium Sand
Median [phi]	1.78	
Gravel [%]	0.0	Slightly Gravelly Sand
Sand [%]	100.0	
Mud [%]	0.0	



Station 45CR

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	1.7	1.7
4000.0	-2	1.8	3.5
2000.0	-1	1.8	5.3
1000.0	0	0.6	5.9
500.0	1	10.4	16.2
250.0	2	52.9	69.1
125.0	3	29.9	99.0
62.5	4	1.0	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

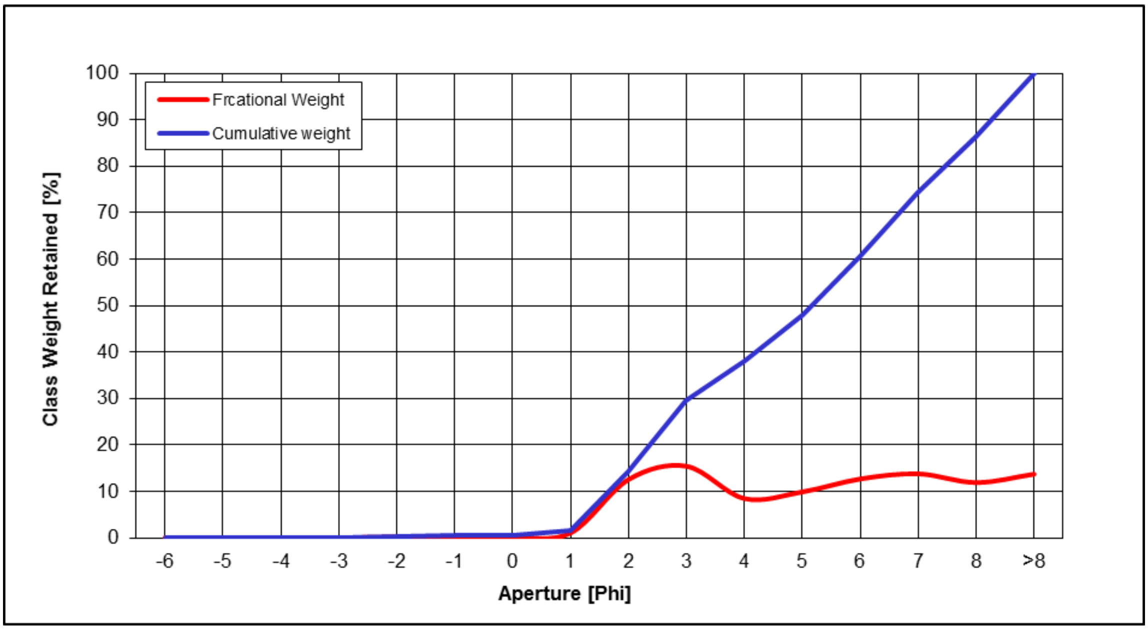
Sorting	0.99	Moderately Sorted
Skewness	-0.13	Coarse Skewed
Kurtosis	1.61	Very Leptokurtic
Mean [µm]	306.9	Medium Sand
Mean [phi]	1.70	
Median [µm]	321.3	Medium Sand
Median [phi]	1.64	
Gravel [%]	5.3	Gravelly Sand
Sand [%]	94.7	
Mud [%]	0.0	



Station 46CR

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	0.2	0.2
2000.0	-1	0.3	0.5
1000.0	0	0.1	0.6
500.0	1	1.0	1.7
250.0	2	12.5	14.2
125.0	3	15.4	29.6
62.5	4	8.4	38.1
31.2	5	9.9	48.0
15.6	6	12.7	60.6
7.8	7	13.8	74.4
3.9	8	11.9	86.3
<3.9	>8	13.7	100.0
Total		100.0	100.0

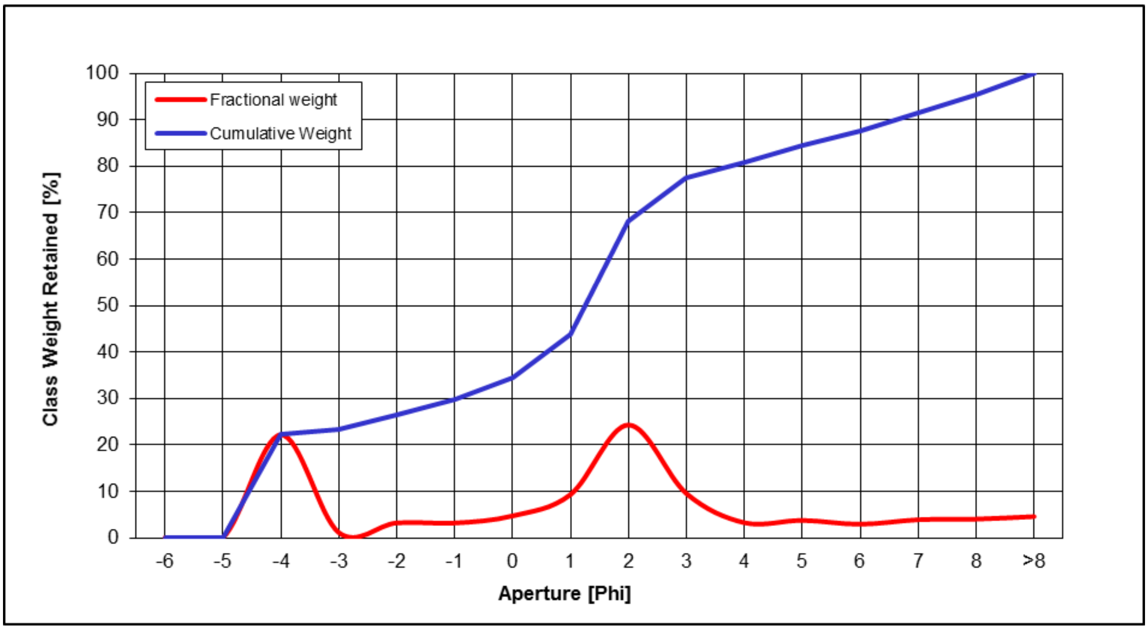
Sorting	2.95	Very Poorly Sorted
Skewness	0.08	Symmetrical
Kurtosis	0.95	Mesokurtic
Mean [µm]	30.6	Medium Silt
Mean [phi]	5.03	
Median [µm]	27.9	Medium Silt
Median [phi]	5.16	
Gravel [%]	0.5	Slightly Gravelly Sandy Mud
Sand [%]	37.6	
Mud [%]	61.9	



Station 48CR

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	22.2	22.2
8000.0	-3	1.1	23.3
4000.0	-2	3.2	26.5
2000.0	-1	3.2	29.7
1000.0	0	4.7	34.4
500.0	1	9.3	43.7
250.0	2	24.3	68.0
125.0	3	9.5	77.6
62.5	4	3.2	80.8
31.2	5	3.8	84.6
15.6	6	2.9	87.5
7.8	7	3.9	91.4
3.9	8	4.0	95.4
<3.9	>8	4.6	100.0
Total		100.0	100.0

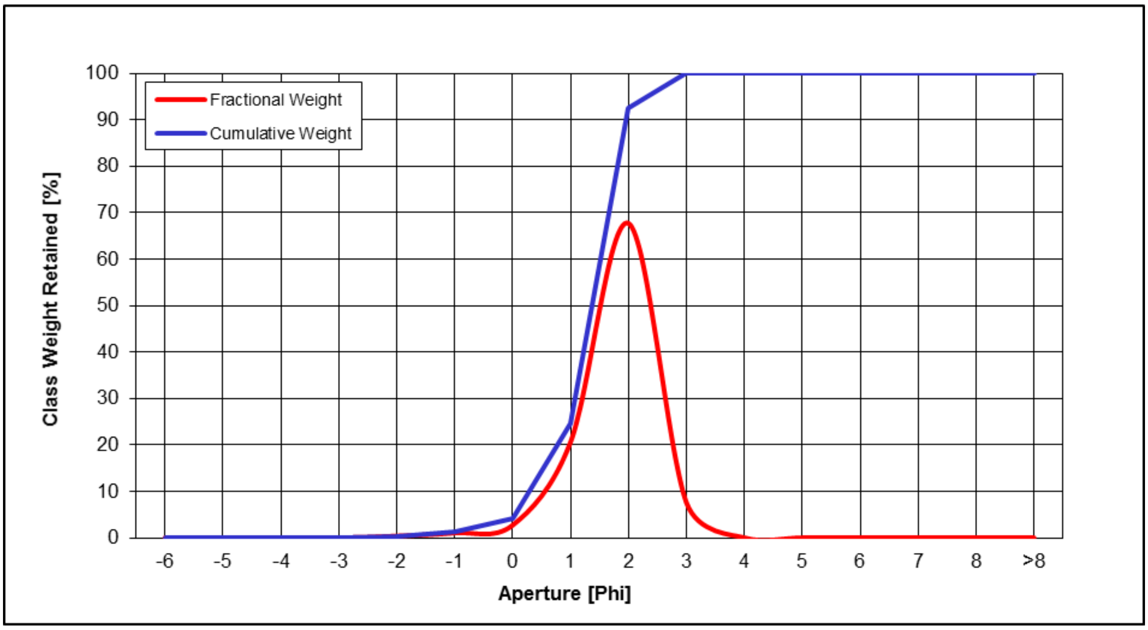
Sorting	4.20	Extremely Poorly Sorted
Skewness	-0.08	Symmetrical
Kurtosis	1.00	Mesokurtic
Mean [µm]	654.7	Coarse Sand
Mean [phi]	0.61	
Median [µm]	418.2	Medium Sand
Median [phi]	1.26	
Gravel [%]	29.7	Gravelly Muddy Sand
Sand [%]	51.1	
Mud [%]	19.2	



Station 49CR

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	1.0	1.4
1000.0	0	2.7	4.1
500.0	1	20.6	24.7
250.0	2	67.7	92.4
125.0	3	7.6	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

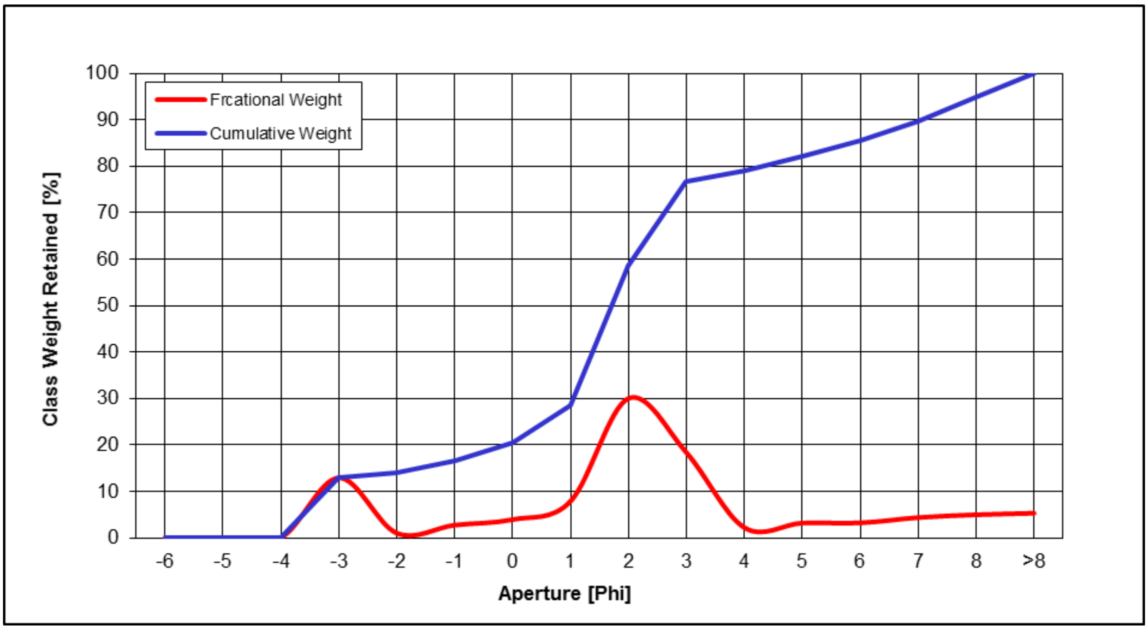
Sorting	0.67	Moderately Well Sorted
Skewness	-0.19	Coarse Skewed
Kurtosis	1.27	Leptokurtic
Mean [µm]	413.2	Medium Sand
Mean [phi]	1.28	
Median [µm]	386.0	Medium Sand
Median [phi]	1.37	
Gravel [%]	1.4	Slightly Gravelly Sand
Sand [%]	98.6	
Mud [%]	0.0	



Station 50CR

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	12.9	12.9
4000.0	-2	1.0	13.9
2000.0	-1	2.7	16.6
1000.0	0	3.9	20.6
500.0	1	7.9	28.4
250.0	2	30.0	58.5
125.0	3	18.4	76.8
62.5	4	2.2	79.0
31.2	5	3.2	82.2
15.6	6	3.2	85.4
7.8	7	4.4	89.8
3.9	8	5.0	94.7
<3.9	>8	5.3	100.0
Total		100.0	100.0

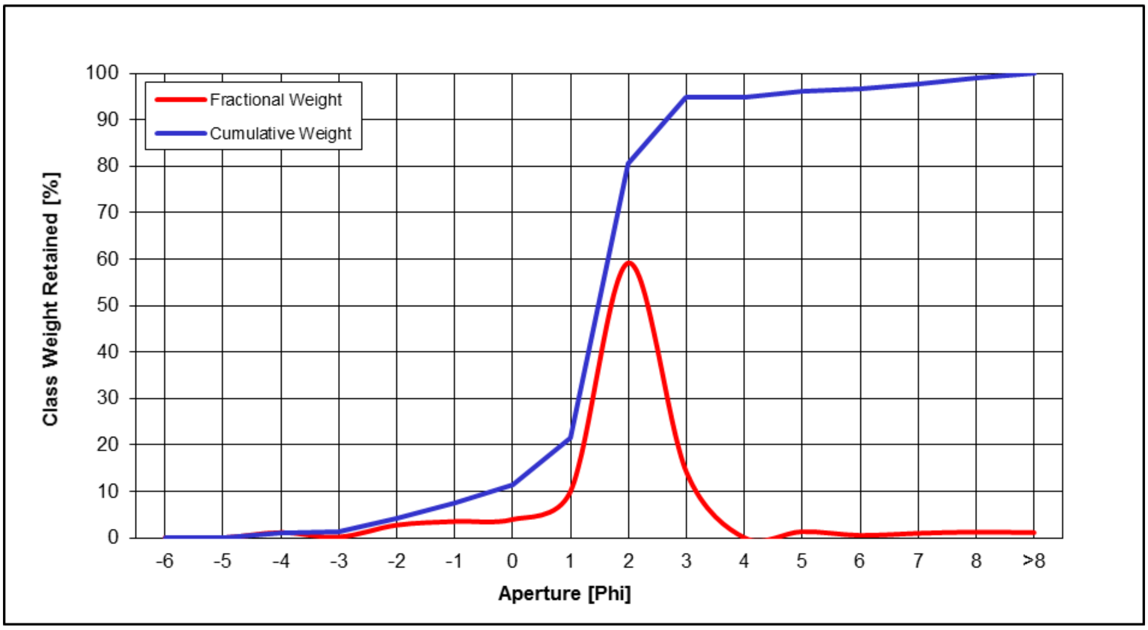
Sorting	3.50	Very Poorly Sorted
Skewness	0.12	Fine Skewed
Kurtosis	2.08	Very Leptokurtic
Mean [µm]	247.3	Fine Sand
Mean [phi]	2.02	
Median [µm]	304.0	Medium Sand
Median [phi]	1.72	
Gravel [%]	16.6	Gravelly Muddy Sand
Sand [%]	62.4	
Mud [%]	21.0	



Station 51CR

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	1.1	1.1
8000.0	-3	0.2	1.3
4000.0	-2	2.7	4.0
2000.0	-1	3.5	7.5
1000.0	0	4.0	11.5
500.0	1	10.0	21.5
250.0	2	59.2	80.7
125.0	3	14.2	94.8
62.5	4	0.0	94.8
31.2	5	1.3	96.2
15.6	6	0.5	96.7
7.8	7	1.0	97.7
3.9	8	1.2	98.9
<3.9	>8	1.1	100.0
Total		100.0	100.0

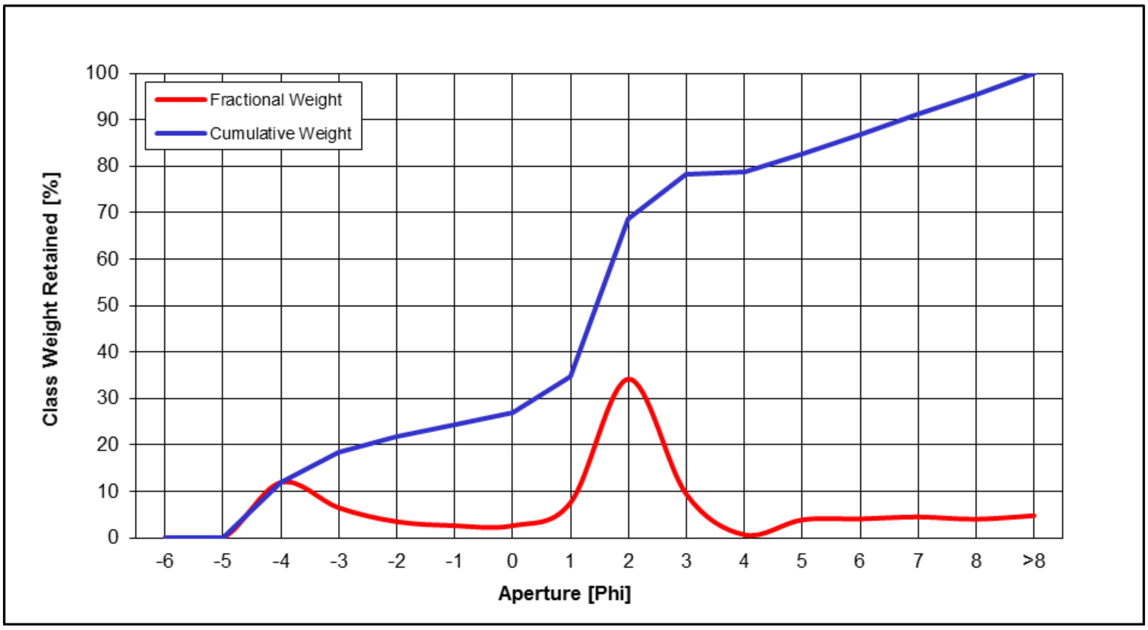
Sorting	1.33	Poorly Sorted
Skewness	-0.13	Coarse Skewed
Kurtosis	2.83	Very Leptokurtic
Mean [µm]	382.0	Medium Sand
Mean [phi]	1.39	
Median [µm]	358.1	Medium Sand
Median [phi]	1.48	
Gravel [%]	7.5	Gravelly Sand
Sand [%]	87.3	
Mud [%]	5.2	



Station 52CR

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	11.9	11.9
8000.0	-3	6.5	18.4
4000.0	-2	3.5	21.8
2000.0	-1	2.6	24.4
1000.0	0	2.6	27.1
500.0	1	7.6	34.6
250.0	2	34.2	68.8
125.0	3	9.4	78.1
62.5	4	0.7	78.8
31.2	5	3.9	82.7
15.6	6	4.1	86.7
7.8	7	4.5	91.2
3.9	8	4.0	95.2
<3.9	>8	4.8	100.0
Total		100.0	100.0

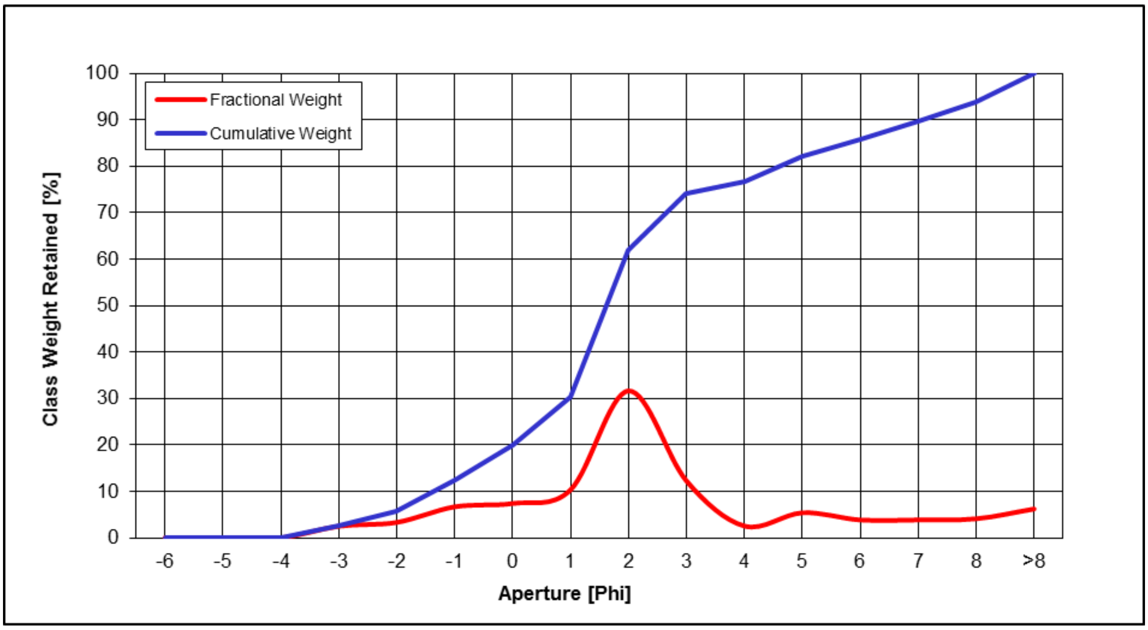
Sorting	4.07	Extremely Poorly Sorted
Skewness	-0.04	Symmetrical
Kurtosis	1.49	Leptokurtic
Mean [µm]	454.9	Medium Sand
Mean [phi]	1.14	
Median [µm]	366.0	Medium Sand
Median [phi]	1.45	
Gravel [%]	24.4	Gravelly Muddy Sand
Sand [%]	54.4	
Mud [%]	21.2	



Station 53CR

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	2.5	2.5
4000.0	-2	3.3	5.8
2000.0	-1	6.7	12.5
1000.0	0	7.4	19.9
500.0	1	10.3	30.2
250.0	2	31.6	61.8
125.0	3	12.3	74.1
62.5	4	2.5	76.6
31.2	5	5.4	82.0
15.6	6	3.8	85.9
7.8	7	3.8	89.7
3.9	8	4.1	93.8
<3.9	>8	6.2	100.0
Total		100.0	100.0

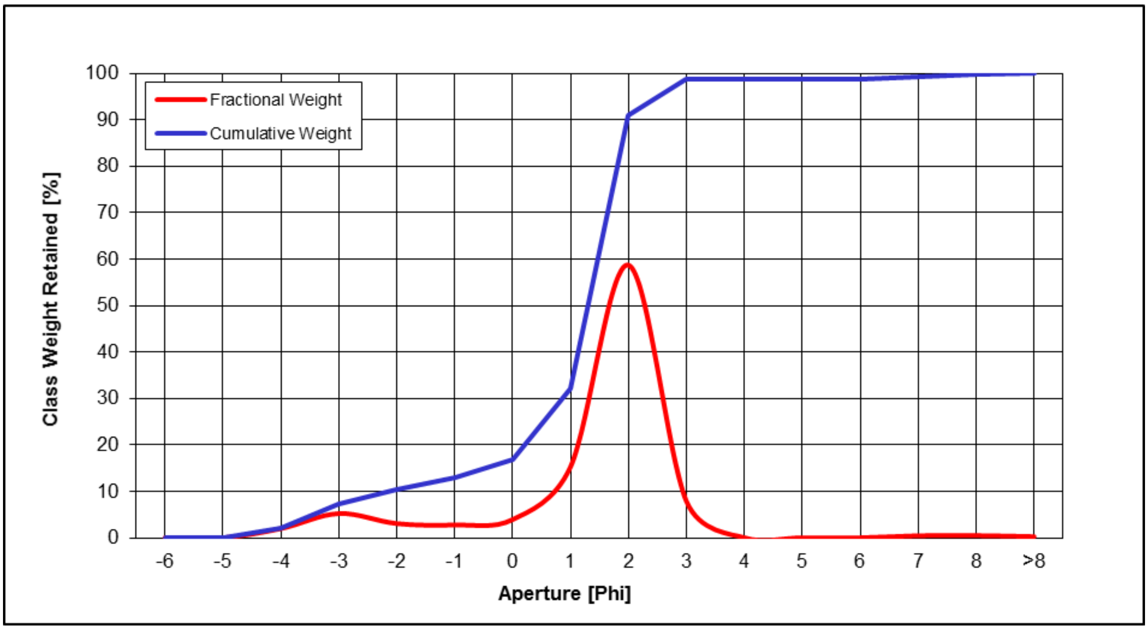
Sorting	3.22	Very Poorly Sorted
Skewness	0.30	Very Fine Skewed
Kurtosis	1.61	Very Leptokurtic
Mean [µm]	216.7	Fine Sand
Mean [phi]	2.21	
Median [µm]	324.0	Medium Sand
Median [phi]	1.63	
Gravel [%]	12.5	Gravelly Muddy Sand
Sand [%]	64.1	
Mud [%]	23.4	



Station 54CR

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	2.0	2.0
8000.0	-3	5.2	7.2
4000.0	-2	3.1	10.3
2000.0	-1	2.8	13.0
1000.0	0	3.9	17.0
500.0	1	15.3	32.2
250.0	2	58.7	91.0
125.0	3	7.9	98.8
62.5	4	0.0	98.8
31.2	5	0.0	98.8
15.6	6	0.0	98.8
7.8	7	0.5	99.3
3.9	8	0.5	99.7
<3.9	>8	0.3	100.0
Total		100.0	100.0

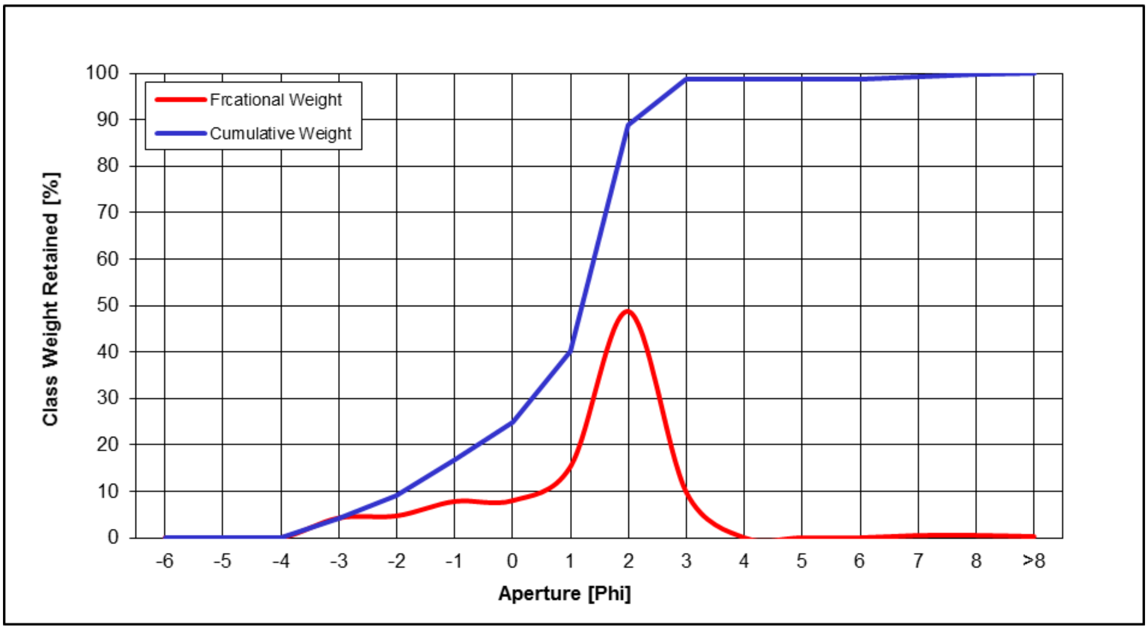
Sorting	1.43	Poorly Sorted
Skewness	-0.52	Very Coarse Skewed
Kurtosis	2.02	Very Leptokurtic
Mean [µm]	507.0	Coarse Sand
Mean [phi]	0.98	
Median [µm]	405.4	Medium Sand
Median [phi]	1.30	
Gravel [%]	13.0	Gravelly Sand
Sand [%]	85.8	
Mud [%]	1.2	



Station 55CR

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	4.3	4.3
4000.0	-2	4.7	9.0
2000.0	-1	7.8	16.8
1000.0	0	8.0	24.8
500.0	1	15.3	40.2
250.0	2	48.7	88.9
125.0	3	9.8	98.7
62.5	4	0.0	98.7
31.2	5	0.0	98.7
15.6	6	0.0	98.7
7.8	7	0.5	99.2
3.9	8	0.5	99.7
<3.9	>8	0.3	100.0
Total		100.0	100.0

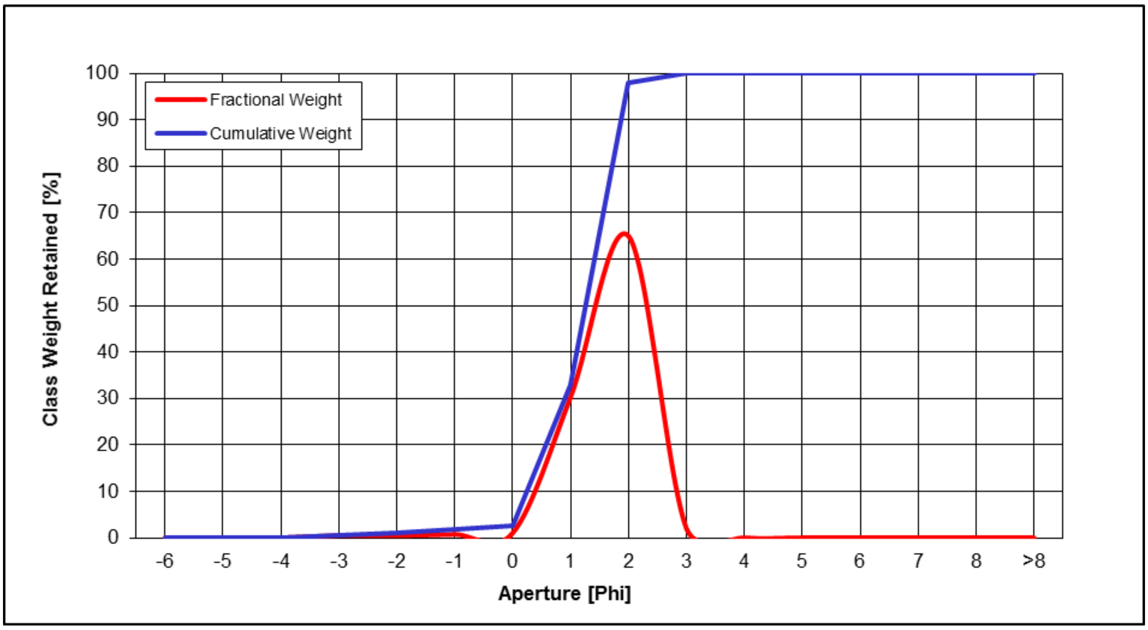
Sorting	1.58	Poorly Sorted
Skewness	-0.51	Very Coarse Skewed
Kurtosis	1.32	Leptokurtic
Mean [µm]	630.6	Coarse Sand
Mean [phi]	0.67	
Median [µm]	434.8	Medium Sand
Median [phi]	1.20	
Gravel [%]	16.8	Gravelly Sand
Sand [%]	81.9	
Mud [%]	1.3	



Station 56CR

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	0.5	0.5
4000.0	-2	0.5	1.0
2000.0	-1	0.7	1.7
1000.0	0	1.0	2.7
500.0	1	30.3	33.0
250.0	2	65.0	98.0
125.0	3	2.0	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

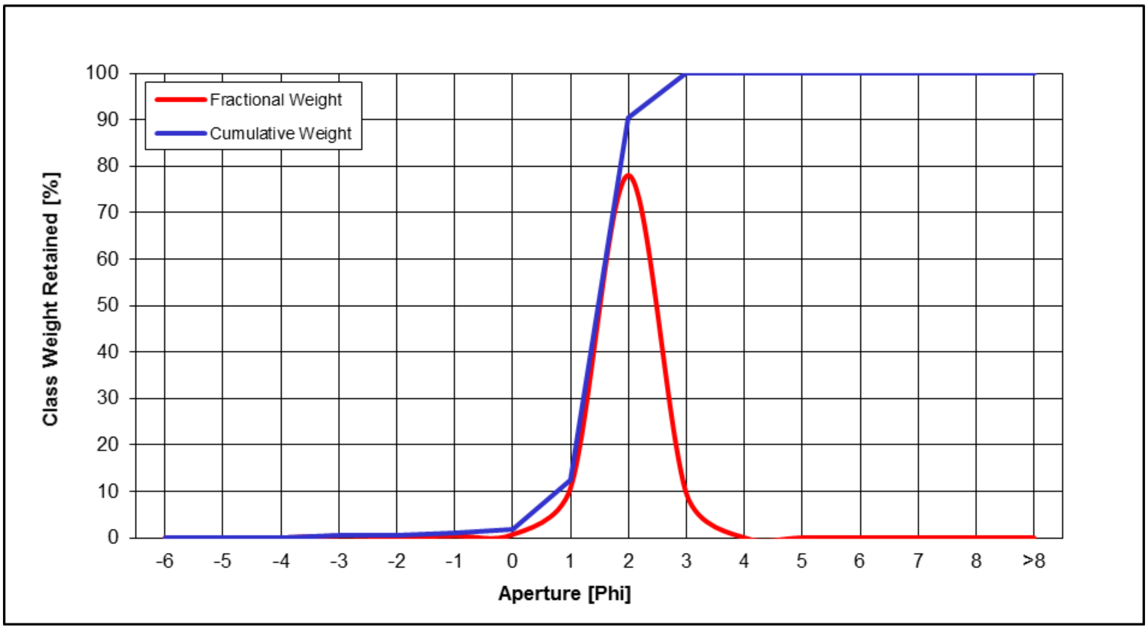
Sorting	0.62	Moderately Well Sorted
Skewness	-0.24	Coarse Skewed
Kurtosis	0.85	Platykurtic
Mean [µm]	446.9	Medium Sand
Mean [phi]	1.16	
Median [µm]	417.0	Medium Sand
Median [phi]	1.26	
Gravel [%]	1.7	Slightly Gravelly Sand
Sand [%]	98.3	
Mud [%]	0.0	



Station 57CR

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	0.2	0.6
2000.0	-1	0.4	1.0
1000.0	0	0.7	1.7
500.0	1	10.7	12.4
250.0	2	78.0	90.5
125.0	3	9.5	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

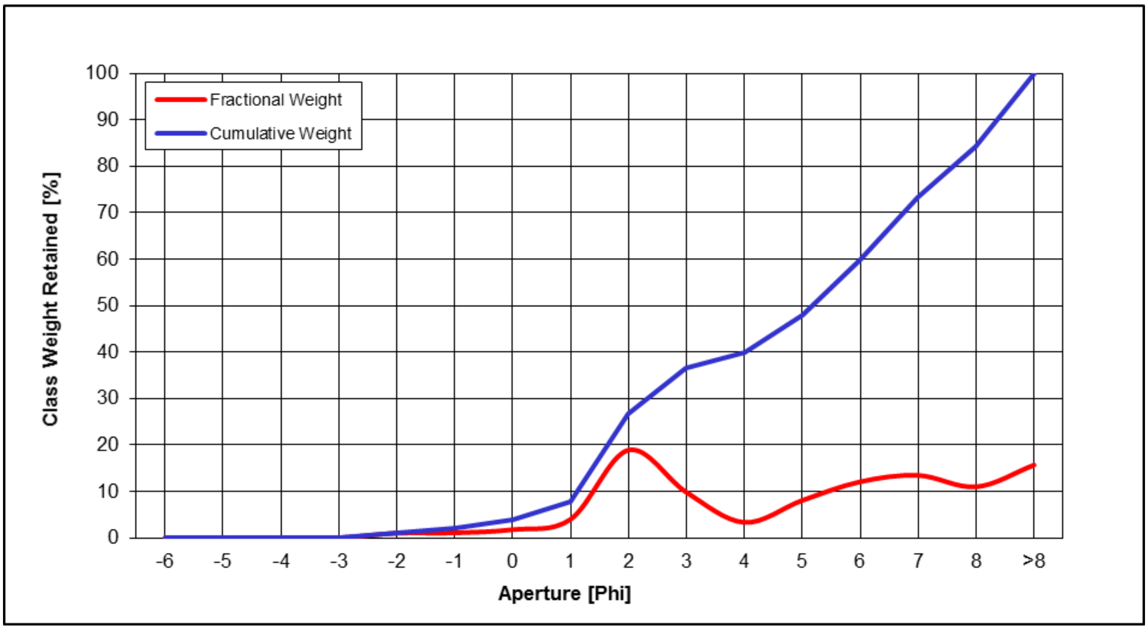
Sorting	0.55	Moderately Well Sorted
Skewness	-0.04	Symmetrical
Kurtosis	1.39	Leptokurtic
Mean [µm]	358.2	Medium Sand
Mean [phi]	1.48	
Median [µm]	358.2	Medium Sand
Median [phi]	1.48	
Gravel [%]	1.0	Slightly Gravelly Sand
Sand [%]	99.0	
Mud [%]	0.0	



Station 58CR

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	1.0	1.0
2000.0	-1	1.1	2.1
1000.0	0	1.8	3.8
500.0	1	4.0	7.8
250.0	2	18.9	26.7
125.0	3	9.8	36.5
62.5	4	3.3	39.8
31.2	5	8.1	47.9
15.6	6	12.1	59.9
7.8	7	13.4	73.4
3.9	8	11.0	84.3
<3.9	>8	15.7	100.0
Total		100.0	100.0

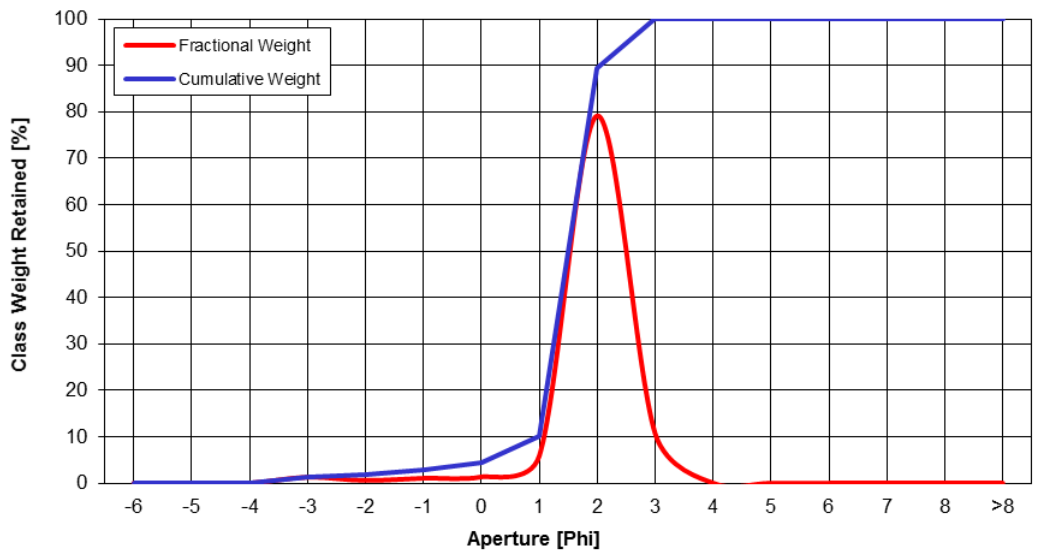
Sorting	3.35	Very Poorly Sorted
Skewness	0.00	Symmetrical
Kurtosis	0.88	Platykurtic
Mean [µm]	34.4	Coarse Silt
Mean [phi]	4.86	
Median [µm]	27.6	Medium Silt
Median [phi]	5.18	
Gravel [%]	2.1	Slightly Gravelly Sandy Mud
Sand [%]	37.7	
Mud [%]	60.2	



Station 59CR

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	1.3	1.3
4000.0	-2	0.6	1.9
2000.0	-1	1.1	2.9
1000.0	0	1.4	4.3
500.0	1	5.9	10.2
250.0	2	79.1	89.3
125.0	3	10.7	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

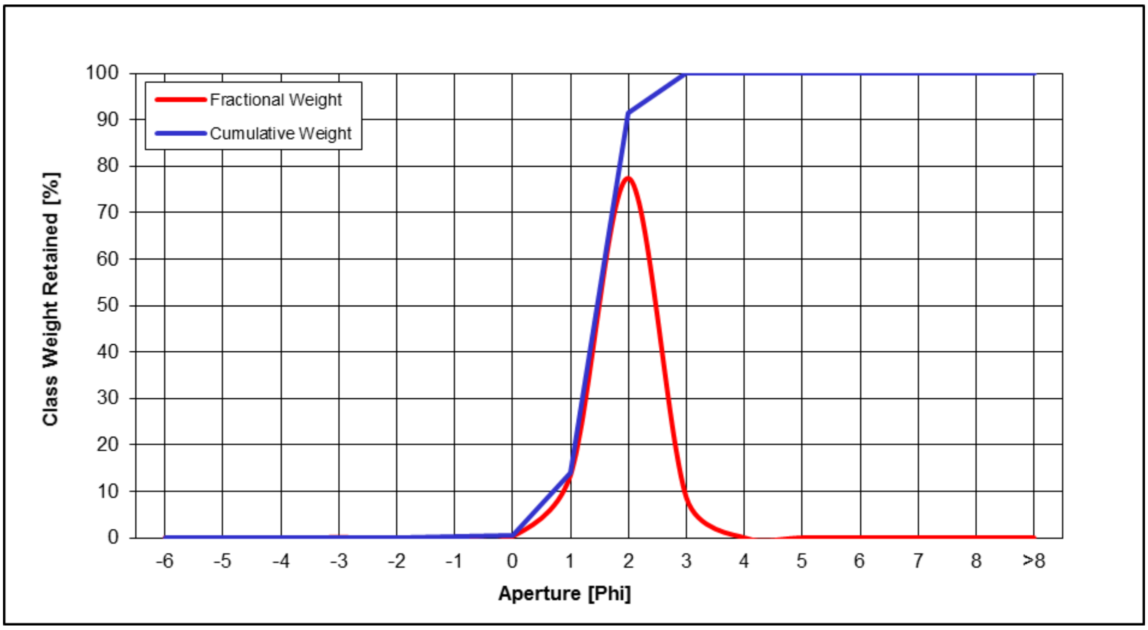
Sorting	0.58	Moderately Well Sorted
Skewness	-0.07	Symmetrical
Kurtosis	1.56	Very Leptokurtic
Mean [µm]	352.7	Medium Sand
Mean [phi]	1.50	
Median [µm]	352.7	Medium Sand
Median [phi]	1.50	
Gravel [%]	2.9	Slightly Gravelly Sand
Sand [%]	97.1	
Mud [%]	0.0	



Station 60CR

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	0.1	0.1
4000.0	-2	0.0	0.1
2000.0	-1	0.0	0.1
1000.0	0	0.3	0.5
500.0	1	13.5	14.0
250.0	2	77.4	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

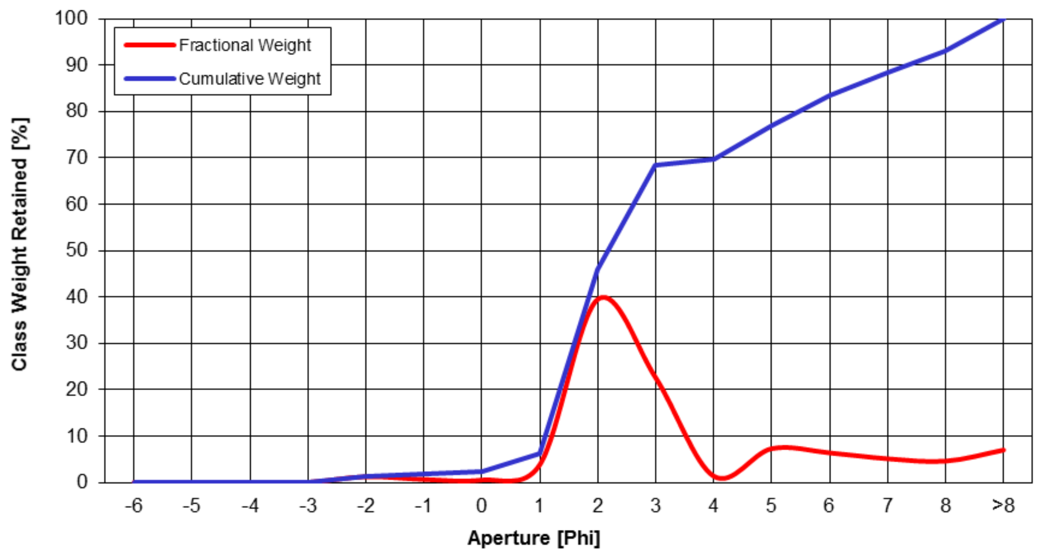
Sorting	0.54	Moderately Well Sorted
Skewness	-0.04	Symmetrical
Kurtosis	1.32	Leptokurtic
Mean [µm]	362.1	Medium Sand
Mean [phi]	1.47	
Median [µm]	362.1	Medium Sand
Median [phi]	1.47	
Gravel [%]	0.1	Slightly Gravelly Sand
Sand [%]	99.9	
Mud [%]	0.0	



Station 61CR

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	1.2	1.3
2000.0	-1	0.6	1.9
1000.0	0	0.5	2.4
500.0	1	3.8	6.3
250.0	2	39.5	45.7
125.0	3	22.6	68.3
62.5	4	1.3	69.7
31.2	5	7.3	76.9
15.6	6	6.4	83.3
7.8	7	5.1	88.4
3.9	8	4.6	93.0
<3.9	>8	7.0	100.0
Total		100.0	100.0

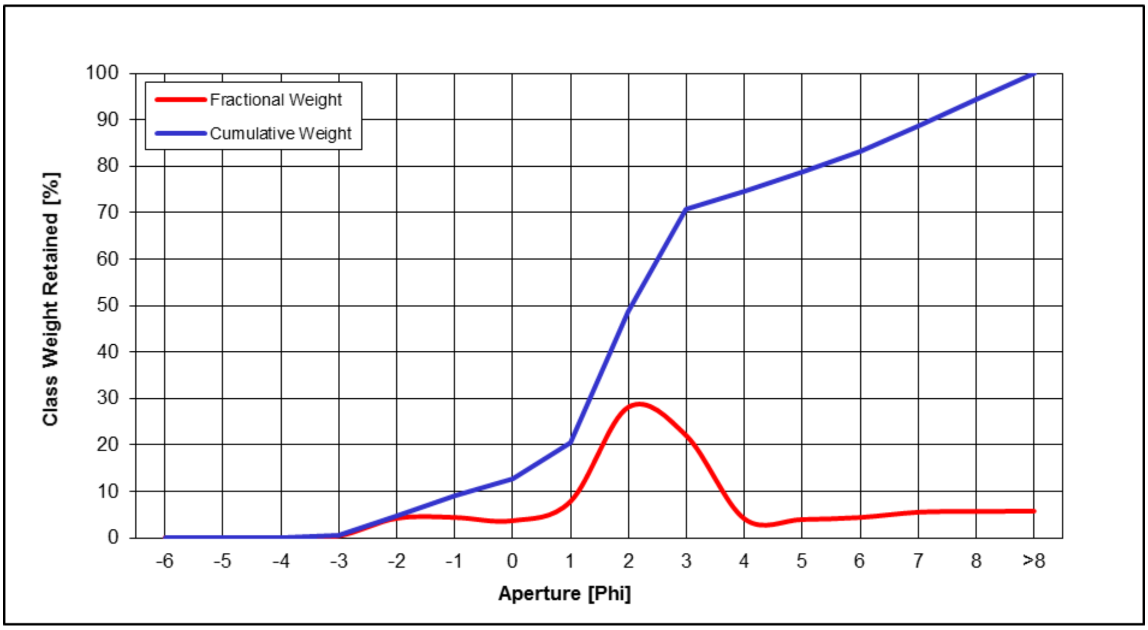
Sorting	2.56	Very Poorly Sorted
Skewness	0.64	Very Fine Skewed
Kurtosis	1.11	Leptokurtic
Mean [µm]	109.6	Very Fine Sand
Mean [phi]	3.19	
Median [µm]	219.3	Fine Sand
Median [phi]	2.19	
Gravel [%]	1.9	Slightly Gravelly Muddy Sand
Sand [%]	67.7	
Mud [%]	30.3	



Station 62CR

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	4.2	4.6
2000.0	-1	4.4	9.0
1000.0	0	3.7	12.7
500.0	1	7.9	20.5
250.0	2	28.1	48.7
125.0	3	22.0	70.6
62.5	4	4.1	74.7
31.2	5	3.9	78.7
15.6	6	4.4	83.1
7.8	7	5.5	88.6
3.9	8	5.7	94.3
<3.9	>8	5.7	100.0
Total		100.0	100.0

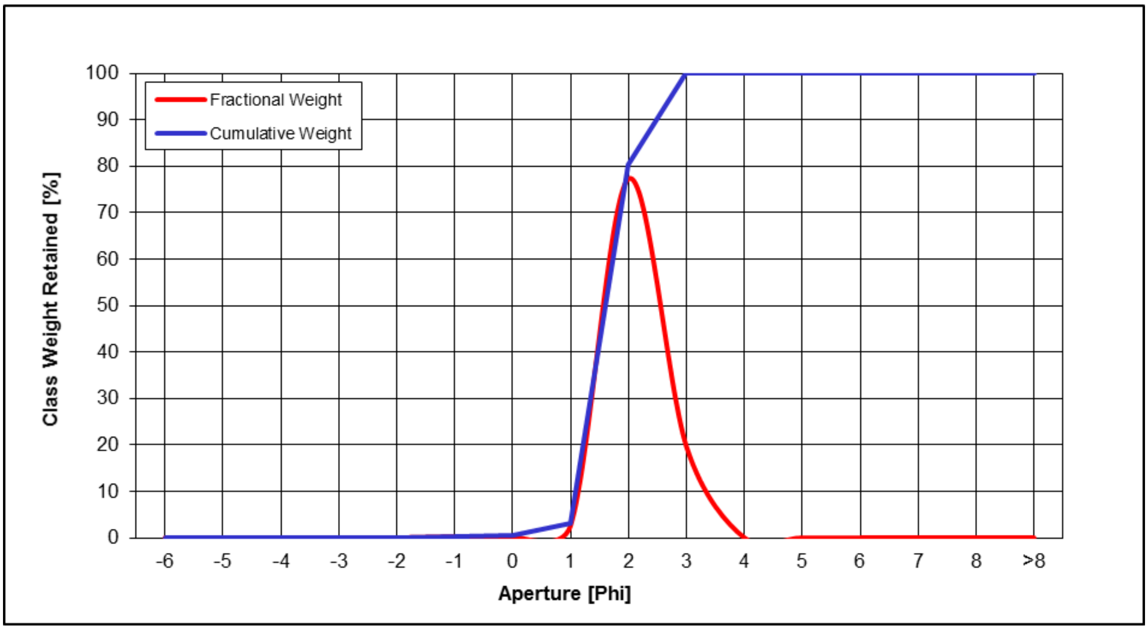
Sorting	3.04	Very Poorly Sorted
Skewness	0.34	Very Fine Skewed
Kurtosis	1.49	Leptokurtic
Mean [µm]	135.5	Fine Sand
Mean [phi]	2.88	
Median [µm]	239.9	Fine Sand
Median [phi]	2.06	
Gravel [%]	9.0	Gravelly Muddy Sand
Sand [%]	65.7	
Mud [%]	25.3	



Station 63CR

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	0.0	0.0
2000.0	-1	0.2	0.3
1000.0	0	0.2	0.4
500.0	1	2.6	3.0
250.0	2	77.3	80.3
125.0	3	19.7	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

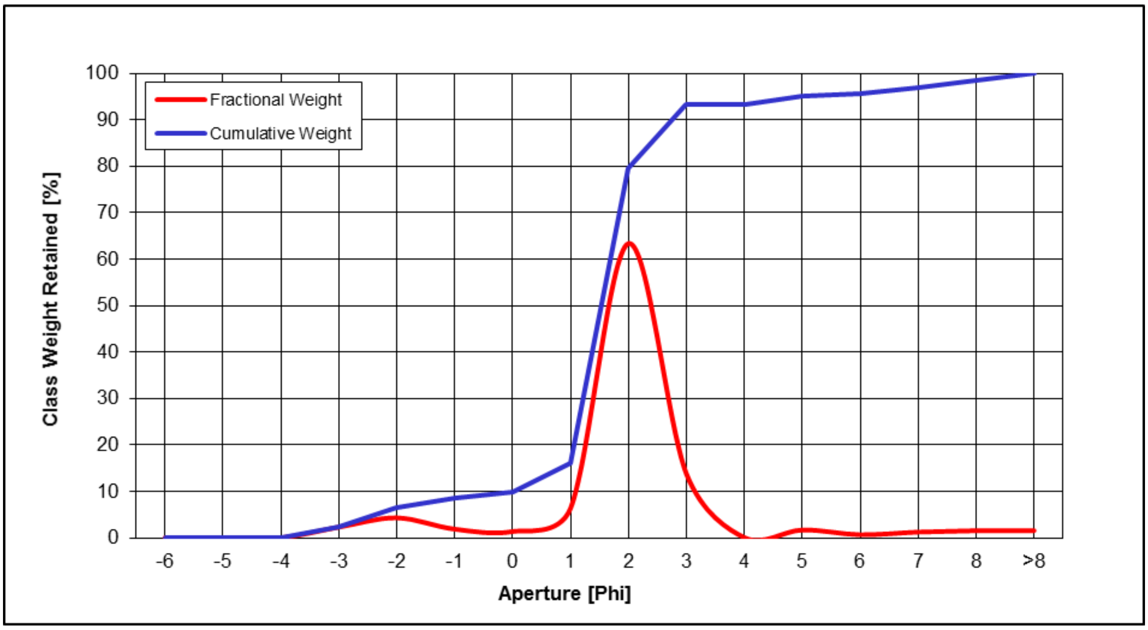
Sorting	0.52	Moderately Well Sorted
Skewness	0.23	Fine Skewed
Kurtosis	1.09	Mesokurtic
Mean [µm]	317.8	Medium Sand
Mean [phi]	1.65	
Median [µm]	328.2	Medium Sand
Median [phi]	1.61	
Gravel [%]	0.3	Slightly Gravelly Sand
Sand [%]	99.7	
Mud [%]	0.0	



Station 64CR

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	2.3	2.3
4000.0	-2	4.3	6.6
2000.0	-1	1.9	8.5
1000.0	0	1.4	9.8
500.0	1	6.4	16.2
250.0	2	63.4	79.5
125.0	3	13.8	93.3
62.5	4	0.0	93.4
31.2	5	1.7	95.0
15.6	6	0.7	95.7
7.8	7	1.2	96.9
3.9	8	1.5	98.5
<3.9	>8	1.5	100.0
Total		100.0	100.0

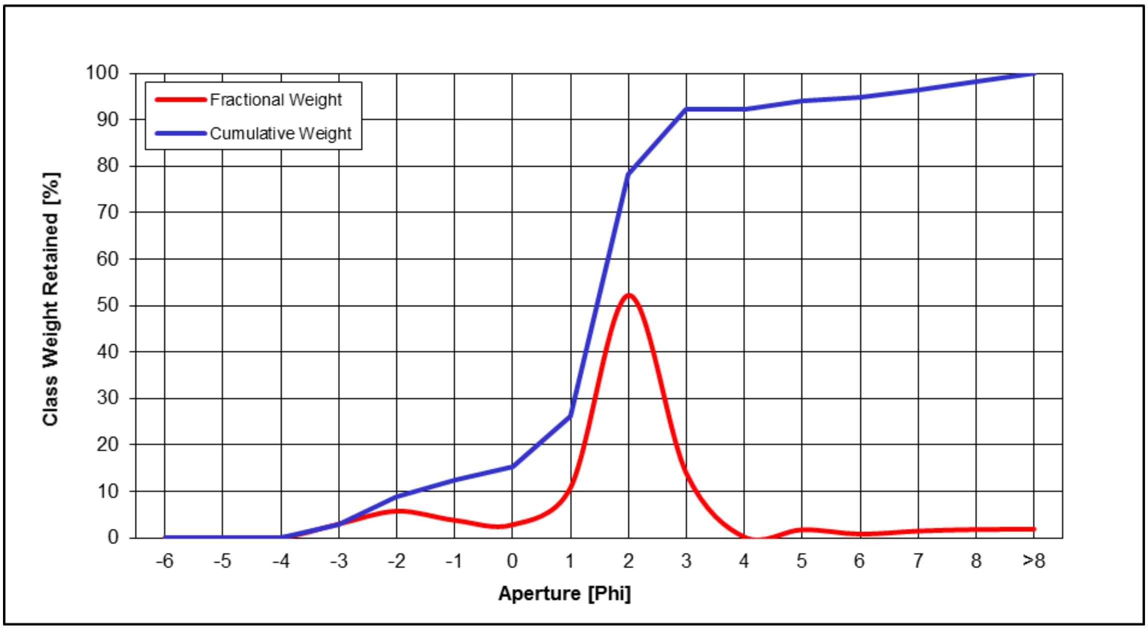
Sorting	1.45	Poorly Sorted
Skewness	0.05	Symmetrical
Kurtosis	3.82	Extremely Leptokurtic
Mean [µm]	327.7	Medium Sand
Mean [phi]	1.61	
Median [µm]	345.4	Medium Sand
Median [phi]	1.53	
Gravel [%]	8.5	Gravelly Sand
Sand [%]	84.9	
Mud [%]	6.6	



Station 65CR

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	3.0	3.0
4000.0	-2	5.8	8.7
2000.0	-1	3.8	12.5
1000.0	0	2.8	15.3
500.0	1	10.8	26.1
250.0	2	52.2	78.3
125.0	3	13.9	92.2
62.5	4	0.1	92.3
31.2	5	1.7	94.1
15.6	6	0.8	94.9
7.8	7	1.5	96.3
3.9	8	1.8	98.1
<3.9	>8	1.9	100.0
Total		100.0	100.0

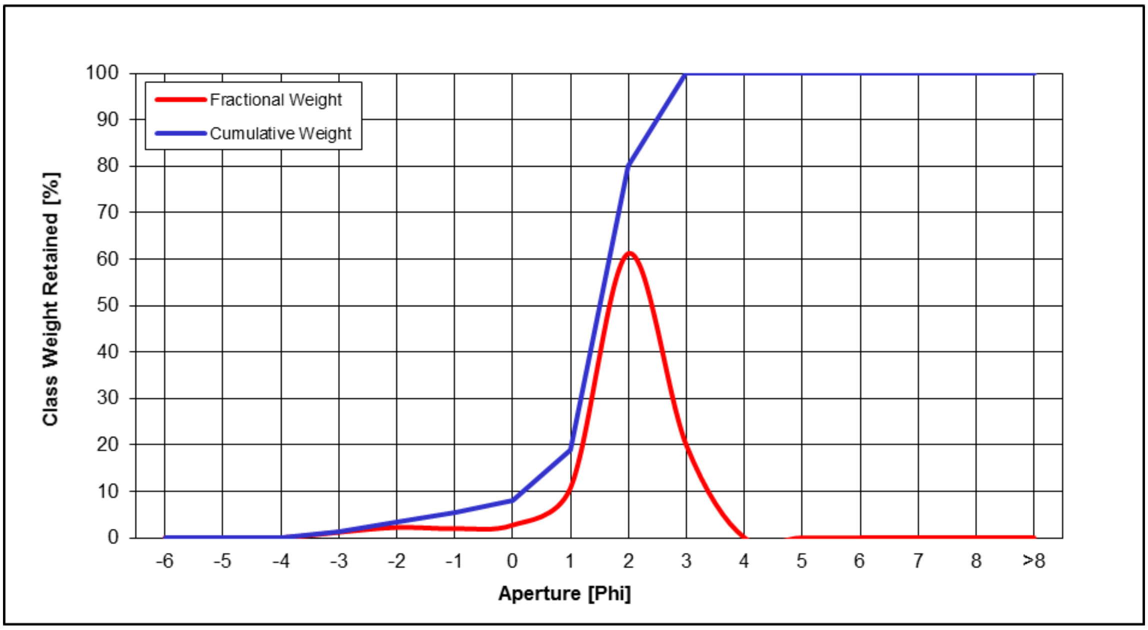
Sorting	1.91	Poorly Sorted
Skewness	-0.06	Symmetrical
Kurtosis	3.44	Extremely Leptokurtic
Mean [µm]	403.1	Medium Sand
Mean [phi]	1.31	
Median [µm]	364.2	Medium Sand
Median [phi]	1.46	
Gravel [%]	12.5	Gravelly Sand
Sand [%]	79.9	
Mud [%]	7.7	



Station 66CR

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	1.2	1.2
4000.0	-2	2.2	3.4
2000.0	-1	2.0	5.4
1000.0	0	2.7	8.1
500.0	1	10.8	18.9
250.0	2	61.2	80.1
125.0	3	19.9	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

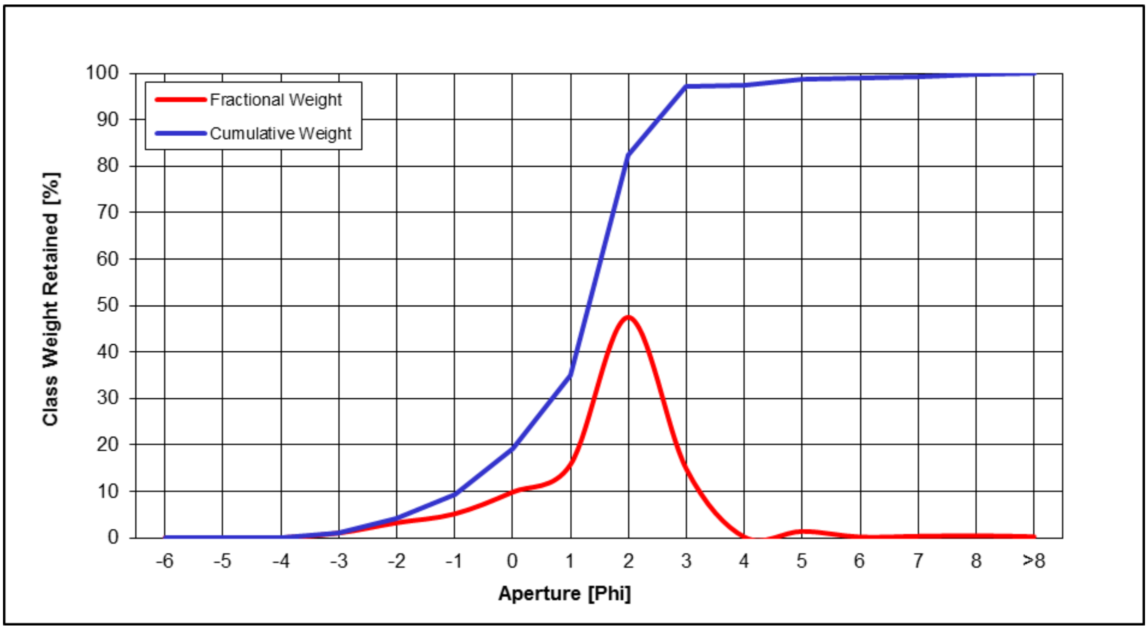
Sorting	0.96	Moderately Sorted
Skewness	-0.22	Coarse Skewed
Kurtosis	1.98	Very Leptokurtic
Mean [µm]	358.8	Medium Sand
Mean [phi]	1.48	
Median [µm]	351.5	Medium Sand
Median [phi]	1.51	
Gravel [%]	5.4	Gravelly Sand
Sand [%]	94.6	
Mud [%]	0.0	



Station 67CR

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	1.0	1.0
4000.0	-2	3.2	4.3
2000.0	-1	5.1	9.4
1000.0	0	9.8	19.2
500.0	1	15.8	35.0
250.0	2	47.5	82.5
125.0	3	14.8	97.3
62.5	4	0.2	97.4
31.2	5	1.4	98.8
15.6	6	0.2	99.0
7.8	7	0.3	99.3
3.9	8	0.4	99.8
<3.9	>8	0.2	100.0
Total		100.0	100.0

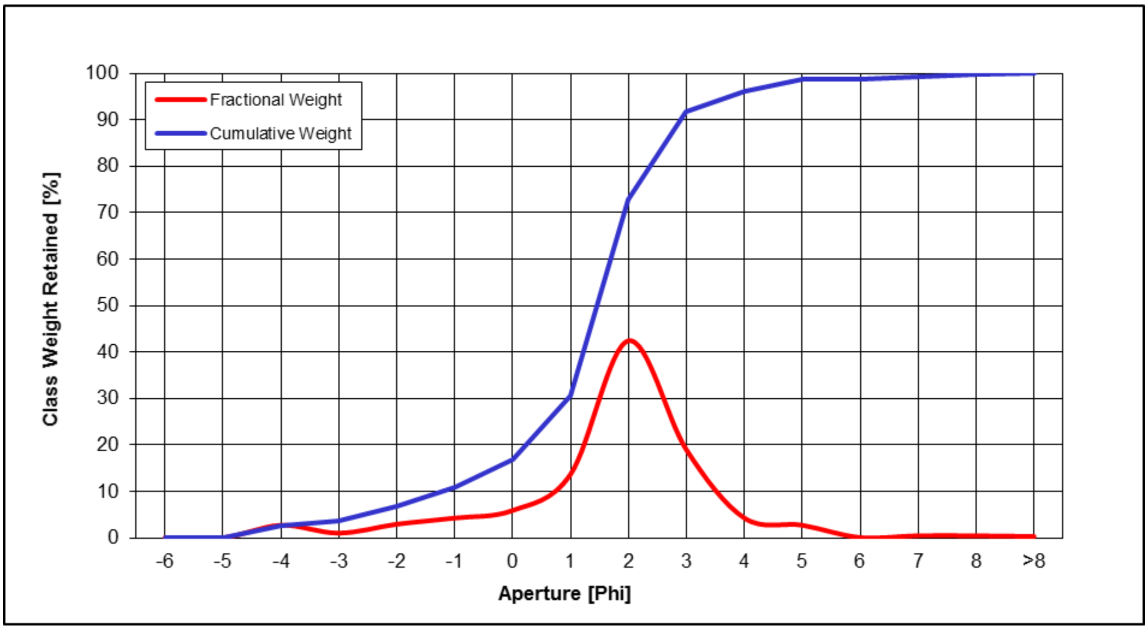
Sorting	1.32	Poorly Sorted
Skewness	-0.35	Very Coarse Skewed
Kurtosis	1.30	Leptokurtic
Mean [µm]	489.8	Medium Sand
Mean [phi]	1.03	
Median [µm]	401.8	Medium Sand
Median [phi]	1.32	
Gravel [%]	9.4	Gravelly Sand
Sand [%]	88.1	
Mud [%]	2.6	



Station 68CR

Aperture [µm]	Aperture [Phi]	Fractional [%]	Cumulative [%]
63000.0	-6	0.0	0.0
31500.0	-5	0.0	0.0
16000.0	-4	2.7	2.7
8000.0	-3	1.0	3.7
4000.0	-2	2.9	6.6
2000.0	-1	4.2	10.9
1000.0	0	5.9	16.8
500.0	1	13.7	30.5
250.0	2	42.4	72.9
125.0	3	19.0	91.8
62.5	4	4.2	96.1
31.2	5	2.7	98.8
15.6	6	0.1	98.8
7.8	7	0.5	99.3
3.9	8	0.4	99.7
<3.9	>8	0.3	100.0
Total		100.0	100.0

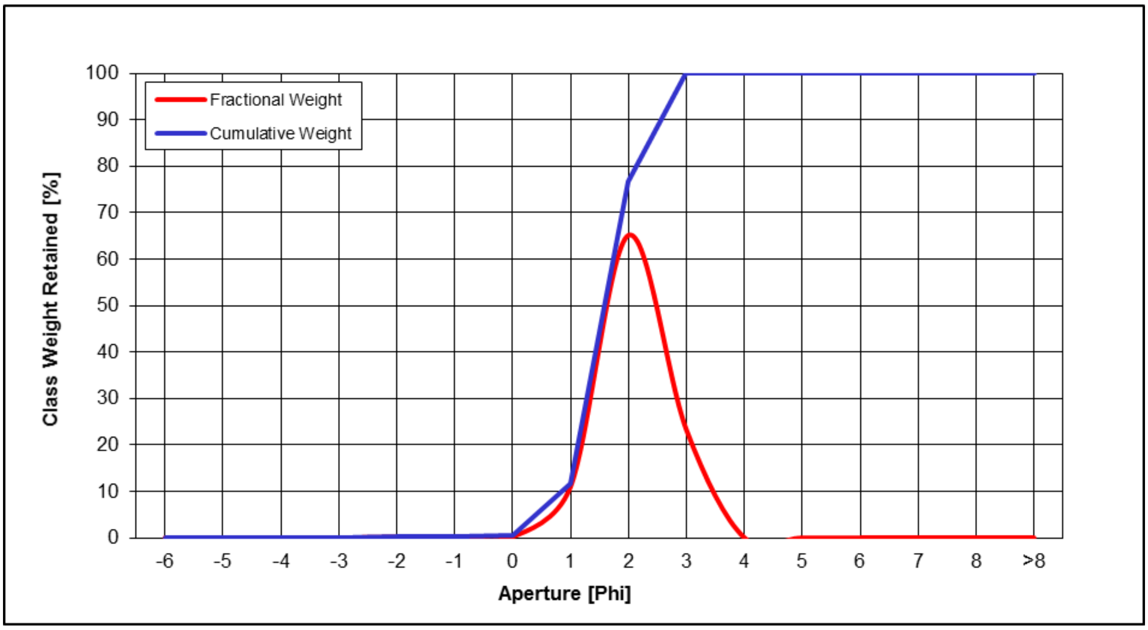
Sorting	1.64	Poorly Sorted
Skewness	-0.22	Coarse Skewed
Kurtosis	1.71	Very Leptokurtic
Mean [µm]	404.5	Medium Sand
Mean [phi]	1.31	
Median [µm]	363.3	Medium Sand
Median [phi]	1.46	
Gravel [%]	10.9	Gravelly Sand
Sand [%]	85.2	
Mud [%]	3.9	



Station 69CR

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	0.2	0.2
2000.0	-1	0.2	0.4
1000.0	0	0.2	0.6
500.0	1	11.0	11.6
250.0	2	65.1	76.7
125.0	3	23.2	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	0.08	Symmetrical
Kurtosis	1.27	Leptokurtic
Mean [µm]	317.2	Medium Sand
Mean [phi]	1.66	
Median [µm]	332.3	Medium Sand
Median [phi]	1.59	
Gravel [%]	0.4	Slightly Gravelly Sand
Sand [%]	99.6	
Mud [%]	0.0	



B.7.3 PSD Samples Certificate of Analysis

Certificate Number:	EP/16/4724	**Fugro EMU Job Number:**	160976
Job Reference:	Norfolk Vanguard 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:**	01/11/2016 – 10/11/2016
Date of Receipt:	16/11/2016	**Date of Analysis:**	21/11/2016 – 06/12/2016
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 2-10 of 10		
Laboratory Comments:	None		
Authorised Signature:			
Name:	James Hutchinson		
Position:	Sediment Laboratory Manager		
Issue Date:	08/12/2016		

- 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
- ^^Indicates subcontracted test
- DVIndicates relevant Deviating Code applies to test results

A UKAS TESTING LABORATORY

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B.7.4 Sediment Contaminats Analysis Results

National Laboratory Service

Analytical Report

Final Report

Report ID - 20102951 - 1

Batch description: FUGRO EMU LTD

UKAS TESTING 0754

Reported on: 06-Feb-2017

Client: Fugro EMU Ltd

Project: 13881 Vattenfall - Marine Sediment

Quote Description: Marine Sediment

Folder No: 003754514

Sampled on: 5-Nov-16 @ 08:27

Comments: 160976 NV24-CR HMA HCA

Quote No: 13881

Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	5.51	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	12.6	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	3.80	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	1.66	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	7.16	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	1.29	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	90.0	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	3.50	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	13.3	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	8.30	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	85.0	%	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 Clay Sediment					
Sample Preparation	Report	Text			LE	924
	Homogenised, Jaw Crushed & Sieved to <2mm					

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:	003754515	Sampled on:	4-Nov-16 @ 15:55
Comments:	160976NV 48-CR		
Quote No:	13881	Matrix:	Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	47.3	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	11.9	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	12.8	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	3.35	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	8.36	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	8.70	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	182	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	6.70	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	26.8	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	22.6	mg/kg		2.5	UKAS	LE	1041
Acenaphthene : Dry Wt	1.01	ug/kg		1	UKAS	LE	1051
Acenaphthylene : Dry Wt	<1	ug/kg		1	None	LE	1051
Anthracene : Dry Wt	1.29	ug/kg		1	UKAS	LE	1051
Benzo(a)anthracene : Dry Wt	4.15	ug/kg		1	UKAS	LE	1051
Benzo(a)pyrene : Dry Wt	5.58	ug/kg		1	UKAS	LE	1051
Benzo(b)fluoranthene : Dry Wt	7.59	ug/kg		1	UKAS	LE	1051
Benzo(e) pyrene : Dry Wt	7.03	ug/kg		5	UKAS	LE	1051
Benzo(ghi)perylene : Dry Wt	6.80	ug/kg		1	UKAS	LE	1051
Benzo(j)fluoranthene : Dry Wt	<10	ug/kg		10	None	LE	1051
Benzo(k)fluoranthene : Dry Wt	3.19	ug/kg		1	UKAS	LE	1051
Chrysene : Dry Wt	4.32	ug/kg		3	UKAS	LE	1051
Chrysene + Triphenylene : Dry Wt	6.29	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	8.09	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	5.28	ug/kg		1	UKAS	LE	1051
Naphthalene : Dry Wt	6.16	ug/kg		5	UKAS	LE	1051
Perylene : Dry Wt	<5	ug/kg		5	None	LE	1051
Phenanthrene : Dry Wt	9.58	ug/kg		5	UKAS	LE	1051
Pyrene : Dry Wt	6.99	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	71.9	%	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 Clay 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: 003754516
Sampled on: 4-Nov-16 @ 19:54
Comments: 160976 NV 45-CR
Quote No: 13881
Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	33.1	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	9.75	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	9.10	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	1.78	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	4.75	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	5.20	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	98.0	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	4.40	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	20.6	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	14.4	mg/kg		2.5	UKAS	LE	1041
Acenaphthene : Dry Wt	1.00	ug/kg		1	UKAS	LE	1051
Acenaphthylene : Dry Wt	<1	ug/kg		1	None	LE	1051
Anthracene : Dry Wt	1.11	ug/kg		1	UKAS	LE	1051
Benzo(a)anthracene : Dry Wt	3.92	ug/kg		1	UKAS	LE	1051
Benzo(a)pyrene : Dry Wt	5.10	ug/kg		1	UKAS	LE	1051
Benzo(b)fluoranthene : Dry Wt	6.95	ug/kg		1	UKAS	LE	1051
Benzo(e) pyrene : Dry Wt	5.80	ug/kg		5	UKAS	LE	1051
Benzo(ghi)perylene : Dry Wt	5.14	ug/kg		1	UKAS	LE	1051
Benzo(j)fluoranthene : Dry Wt	<10	ug/kg		10	None	LE	1051
Benzo(k)fluoranthene : Dry Wt	3.00	ug/kg		1	UKAS	LE	1051
Chrysene : Dry Wt	4.34	ug/kg		3	UKAS	LE	1051
Chrysene + Triphenylene : Dry Wt	6.18	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	8.79	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	4.52	ug/kg		1	UKAS	LE	1051
Naphthalene : Dry Wt	5.99	ug/kg		5	UKAS	LE	1051
Perylene : Dry Wt	<5	ug/kg		5	None	LE	1051
Phenanthrene : Dry Wt	9.53	ug/kg		5	UKAS	LE	1051
Pyrene : Dry Wt	7.39	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	18.8	ug/kg	3	UKAS	LE	897
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	12.6	ug/kg	3	UKAS	LE	897
Triphenyl Tin : Dry Wt as Cation	<3	ug/kg	2	UKAS	LE	897
		ELEVATED_MRV : Dry weight calculation				
Dry Solids @ 30°C	78.6	%	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 Clay Sediment					
Sample Preparation	Report	Text			LE	924
	Homogenised, Jaw Crushed & Sieved to <2mm					

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: 003754517

Sampled on: 5-Nov-16 @ 11:02

Comments: 160976 NV20-MS

Quote No: 13881

Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	1.00	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	7.89	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	4.90	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	<1	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	2.64	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	2.70	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	42.0	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	3.20	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	11.8	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	9.20	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	81.7	%	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					

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: 003754518

Sampled on: 9-Nov-16 @ 12:46

Comments: 160976NV 03_MS

Quote No: 13881

Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	10.0	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	20.4	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	5.30	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	1.45	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	5.12	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	3.30	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	129	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	3.40	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	19.9	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	12.0	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	1.53	ug/kg		1	UKAS	LE	1051
Benzo(b)fluoranthene : Dry Wt	2.34	ug/kg		1	UKAS	LE	1051
Benzo(e) pyrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Benzo(ghi)perylene : Dry Wt	1.87	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	1.86	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	1.50	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	1.60	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	78.5	%	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

Batch description: FUGRO EMU LTD

UKAS TESTING 0754

Reported on: 06-Feb-2017

Client: Fugro EMU Ltd

Project: 13881 Vattenfall - Marine Sediment

Quote Description: Marine Sediment

Folder No: 003754520

Sampled on: 9-Nov-16 @ 09:56

Comments: 160976 NV 06_MS

Quote No: 13881

Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	3.06	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	16.7	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	7.80	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	<1	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	5.96	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	3.20	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	140	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	3.50	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	17.5	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	13.3	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	81.5	%	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: 003754522

Sampled on: 8-Nov-16 @ 16:37

Comments: 160976 19_MS

Quote No: 13881

Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	11.8	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	17.3	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	15.8	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	2.87	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	6.61	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	9.50	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	119	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	7.50	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	29.1	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	21.3	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	1.92	ug/kg		1	UKAS	LE	1051
Benzo(a)pyrene : Dry Wt	2.36	ug/kg		1	UKAS	LE	1051
Benzo(b)fluoranthene : Dry Wt	3.27	ug/kg		1	UKAS	LE	1051
Benzo(e) pyrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Benzo(ghi)perylene : Dry Wt	2.42	ug/kg		1	UKAS	LE	1051
Benzo(j)fluoranthene : Dry Wt	<10	ug/kg		10	None	LE	1051
Benzo(k)fluoranthene : Dry Wt	1.41	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	3.95	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	2.33	ug/kg		1	UKAS	LE	1051
Naphthalene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Perylene : Dry Wt	11.2	ug/kg		5	None	LE	1051
Phenanthrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Pyrene : Dry Wt	3.51	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	<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	73.0	%	*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: 003754523

Sampled on: 9-Nov-16 @ 16:54

Comments: 160976 56_CR

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	35.2	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	4.00	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	<1	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	6.36	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	1.10	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	222	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	2.80	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	29.2	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	14.2	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	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	82.5	%	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:	003754524	Sampled on:	9-Nov-16 @ 10:54
Comments:	160976 NV 02_MS		
Quote No:	13881	Matrix:	Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	22.1	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	16.7	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	12.8	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	2.08	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	7.53	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	6.00	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	204	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	5.30	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	26.8	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	1.83	ug/kg		1	UKAS	LE	1051
Benzo(a)pyrene : Dry Wt	2.34	ug/kg		1	UKAS	LE	1051
Benzo(b)fluoranthene : Dry Wt	3.62	ug/kg		1	UKAS	LE	1051
Benzo(e) pyrene : Dry Wt	<5	ug/kg		5	UKAS	LE	1051
Benzo(ghi)perylene : Dry Wt	2.84	ug/kg		1	UKAS	LE	1051
Benzo(j)fluoranthene : Dry Wt	<10	ug/kg		10	None	LE	1051
Benzo(k)fluoranthene : Dry Wt	1.48	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	3.86	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	2.43	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	3.34	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	76.6	%	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					

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: 003754525

Sampled on: 8-Nov-16 @ 14:18

Comments: 160976 16_MS

Quote No: 13881

Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	26.2	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	<0.01	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	10.7	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	11.6	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	1.95	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	5.69	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	7.20	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	123	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	5.50	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	21.1	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	18.6	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	4.29	ug/kg		1	UKAS	LE	1051
Benzo(a)pyrene : Dry Wt	5.43	ug/kg		1	UKAS	LE	1051
Benzo(b)fluoranthene : Dry Wt	7.40	ug/kg		1	UKAS	LE	1051
Benzo(e) pyrene : Dry Wt	6.05	ug/kg		5	UKAS	LE	1051
Benzo(ghi)perylene : Dry Wt	5.26	ug/kg		1	UKAS	LE	1051
Benzo(j)fluoranthene : Dry Wt	<10	ug/kg		10	None	LE	1051
Benzo(k)fluoranthene : Dry Wt	3.41	ug/kg		1	UKAS	LE	1051
Chrysene : Dry Wt	4.18	ug/kg		3	UKAS	LE	1051
Chrysene + Triphenylene : Dry Wt	5.79	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	9.33	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	4.91	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	8.45	ug/kg		5	UKAS	LE	1051
Pyrene : Dry Wt	7.79	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	69.3	%	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 Clay Sediment					
Sample Preparation	Report	Text			LE	924
	Homogenised, Jaw Crushed & Sieved to <2mm					

Analytical Report

National Laboratory Service

Final Report

Report ID - 20102951 - 1

Batch description: FUGRO EMU LTD

UKAS TESTING 0754

Reported on: 06-Feb-2017

Client: Fugro EMU Ltd

Project: 13881 Vattenfall - Marine Sediment

Quote Description: Marine Sediment

Folder No: 003754530

Sampled on: 5-Nov-16 @ 03:13

Comments: 160976 NV 38_CR

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	10.0	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	2.20	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	<1	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	<2	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	0.500	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	35.0	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	1.30	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	9.00	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	5.80	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	84.3	%	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: 003754531

Sampled on: 5-Nov-16 @ 09:23

Comments: 160976 NV 26_CR

Quote No: 13881

Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Hydrocarbons : Total : Dry Wt as Ekofisk	5.02	mg/kg		0.9	UKAS	LE	402
Mercury : Dry Wt	0.0100	mg/kg		0.01	UKAS	LE	1042
Arsenic : Dry Wt	5.39	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	4.80	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	<1	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	3.59	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	2.75	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	92.0	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	2.25	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	11.1	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	9.90	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	1.42	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	1.11	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	2.81	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	1.02	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	2.30	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	80.0	%	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:	003754533	Sampled on:	5-Nov-16 @ 23:55
Comments:	160976 NV 41_CR		
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	11.4	mg/kg		1	UKAS	LE	1041
Cadmium : Dry Wt	<0.04	mg/kg		0.04	UKAS	LE	1041
Chromium : Dry Wt	<2	mg/kg		2	UKAS	LE	1041
Copper : Dry Wt	<1	mg/kg		1	UKAS	LE	1041
Lead : Dry Wt	2.34	mg/kg		2	UKAS	LE	1041
Lithium : Dry Wt	0.560	mg/kg		0.3	None	LE	1041
Manganese : Dry Wt	35.0	mg/kg		0.2	UKAS	LE	1041
Nickel : Dry Wt	1.26	mg/kg		1	UKAS	LE	1041
Vanadium : Dry Wt	8.30	mg/kg		0.1	UKAS	LE	1041
Zinc : Dry Wt	5.50	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	82.5	%	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					

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

NLS Leeds
Olympia House
Gelderd Lane
Gelderd Road
Leeds LS12 6DD

NLS Nottingham
Meadow Lane
Nottingham
NG2 3HN

NLS Starcross
Staplake Mount
Starcross
Exeter
EX6 8FD

B.7.5 Grab Infaunal Abundance Raw data

Taxon	APHIA	01MS	02MS	03MS	04MS	05MS	06MS	07MS	08MS	09MS	10MS	11MS	12MS	13MS	14MS	15MS	16MS	17MS	18MS	19MS	20MS	21MS	22MS	23MS
Astrorhiza	112299																							
Cerianthus lloydii	283798		1																	5				
PLATYHELMINTHES	793	4	3	3																18				
NEMERTEA	152391	69	32	4								1				P	1	7		63				1
SIPUNCULA (juv.)	1268		1																					
Golfingia elongata	175026																							
Nephasoma minutum	136060	1	10																					
Aphrodita aculeata	129840																							
Gattyana cirrhosa	130749																							
Harmothoe	129491	3		1																3				
Harmothoe extenuata	130762																			2				
Harmothoe impar	130770																			3				
Harmothoe clavigera	130760																							
Malmgrenia darbouxi	863197	2	3																	6				
Pettibonesia furcosetosa	236678																							
Harmothoe glabra	571832																							
Malmgrenia arenicolae	152276																			1				
Lepidonotus squamatus	130801	1																		3				
Pholoe baltica	130599	5	10	1			1					1						1		17				
Pholoe inornata	130601		5																					
Sthenelais	129595						1																	
Sthenelais boa	131074																			6				
Sthenelais limicola	131077							1						1				1						
Phyllodocidae	931																							
Eteone longa (agg.)	130616					1														8				
Hypereteone foliosa	152250																							
Phyllodoce groenlandica	334506																							
Phyllodoce lineata	334508					1																		
Phyllodoce longipes	130673	5		2																				

Taxon	APHIA	01MS	02MS	03MS	04MS	05MS	06MS	07MS	08MS	09MS	10MS	11MS	12MS	13MS	14MS	15MS	16MS	17MS	18MS	19MS	20MS	21MS	22MS	23MS
Phyllodoce maculata	334510																			5				
Phyllodoce mucosa	334512		1																	2				
Phyllodoce rosea	334514																	1						
Eulalia mustela	130631																							
Eulalia ornata	130632	20	12																					
Eulalia viridis	130639																			3				
Eumida	129446																			2				
Eumida bahusiensis	130641											1												
Eumida sanguinea (agg.)	130644	1																		6				
Glycera	129296																	1						
Glycera alba	130116	2	1				2					1	1							2			4	
Glycera lapidum	130123	12	6	2																1				
Glycera oxycephala	130126			1	1																			
Glycinde nordmanni	130136	1																						
Goniada maculata	130140	1	1	1			1	2	3						1			2					1	
Sphaerodorum gracilis	131100	2	4																					
Psamathe fusca	152249																			5				
Oxydromus pallidus	340203																							
Podarkeopsis capensis	130195	2					1											1		1				
Syllidia armata	130198																							
Microphthalmus similis	130176																							
Syllis licheri	238263																							
Syllis variegata	131458																							
Eusyllis blomstrandi	131290																							
Eusyllis lamelligera	131292																							
Odontosyllis fulgurans	131327																							
Syllides japonicus	131410																			1				
Parexogone hebes	757970																							
Exogone naidina	327985																							

Taxon	APHIA	01MS	02MS	03MS	04MS	05MS	06MS	07MS	08MS	09MS	10MS	11MS	12MS	13MS	14MS	15MS	16MS	17MS	18MS	19MS	20MS	21MS	22MS	23MS
Exogone verugera	333456	4		3																				
Sphaerosyllis taylori	131394																							
Myrianida	129659	6	8																					
Proceraea	129671																							
Eunereis longissima	130375	4	2	2																16				
Nereis zonata	130407	1	1																					
Aglaophamus agilis	130343			1					1							1								
Nephtys (juv.)	129370	1													1				1			2		
Nephtys caeca	130355	1																						
Nephtys cirrosa	130357			2	1	2	3	4	3	6	3	2	2	3	1		10	2	2			1	2	4
Nephtys hombergii	130359																							
Nephtys kersivalensis	130363																							
Nephtys longosetosa	130364																							
Marphysa bellii	130072		1																	1				
Lumbrineris	129337																							
Lumbrineris cingulata	130240	2	15															2		9				
Protodorvillea kefersteini	130041																							
Schistomeringos neglecta	130044																							
Schistomeringos rudolphi	154127	1																		2				
Scoloplos armiger	334772	5	1	2				1				2			1	2		1					1	1
Aricidea minuta	730747											1												
Poecilochaetus serpens	130711	9	1	2				3										1						
Aonides oxycephala	131106																			4				
Aonides paucibranchiata	131107	5																						
Atherospio guillei	478336																			3				
Laonice bahusiensis	131127																							
Dipolydora coeca (agg.)	131117																							
Dipolydora caulleryi	131116	8																						
Dipolydora flava	131118		1																					

Taxon	APHIA	01MS	02MS	03MS	04MS	05MS	06MS	07MS	08MS	09MS	10MS	11MS	12MS	13MS	14MS	15MS	16MS	17MS	18MS	19MS	20MS	21MS	22MS	23MS
Pseudopolydora pulchra	131169		2																					
Pygospio elegans	131170																							
Scolelepis bonnieri	131171								1					1										
Scolelepis squamata	157566																							
Spio armata	131180																							
Spio goniocephala	131184										1													
Spio symphyta	596189	1	1															9				1		
Spiophanes bombyx	131187	10		2		4	1	1		1	1	8		6	1	1		72				3		
Magelona alleni	130266																							
Magelona johnstoni	130269												1											
Aphelochaeta marioni	129938																							
Caulleriella alata	129943	3																		16				
Chaetozone christiei	152217							1														1		1
Chaetozone zetlandica	336485																							
Cirriformia tentaculata	129964																							
Flabelligera affinis	130103																							
Macrochaeta	129141				1																			
Capitella	129211																							
Mediomastus fragilis	129892																			51				
Notomastus	129220	1	6																	20				
Arenicola (juv.)	129206																							
Maldanidae	923																							
Leiochone johnstoni	221095																							
Euclymene oerstedii	130294																							
Praxillella affinis	130322																							
Ophelia	129413															1								
Ophelia borealis	130491	1				7	9		10	1	18	19	2	5	6									
Travisia forbesii	130512																							
Scalibregma celticum	130979																							

Taxon	APHIA	01MS	02MS	03MS	04MS	05MS	06MS	07MS	08MS	09MS	10MS	11MS	12MS	13MS	14MS	15MS	16MS	17MS	18MS	19MS	20MS	21MS	22MS	23MS
Scalibregma inflatum	130980	2	5															1		4				
Galathowenia oculata	146950																							
Owenia borealis	329882		2																	1				
Pectinariidae	980																							
Lagis koreni	152367	1		10		10	6	1				3	2	3						6				
Sabellaria spinulosa	130867	757	40	117		1	1		42					1						64				
Ampharete	129155																							
Ampharete lindstroemi (agg.)	129781		1																					
Amphicteis midas	129785																							
Terebellides stroemii	131573	1																						
Terebellidae	982																							
Pista maculata	868065																							
Lanice conchilega	131495		1																					
Loimia medusa	131499	1																		1				
Nicolea venustula	131507																							
Lysilla loveni	131500		1																					
Lysilla nivea	131501																							
Polycirrus	129710		3																	2				
Polycirrus denticulatus	131527	1	2																					
Polycirrus medusa	131531	1																						
Thelepus cincinnatus	131543		1																					
Sabellidae	985																							
Parasabella langerhansi	530926																							
Sabella pavonina	130967																							
Spirobranchus lamarcki	560033																							
Tubificoides pseudogaster (agg.)	137582	1																						
Grania	137349																							
Nymphon brevirostre	150520																							

Taxon	APHIA	01MS	02MS	03MS	04MS	05MS	06MS	07MS	08MS	09MS	10MS	11MS	12MS	13MS	14MS	15MS	16MS	17MS	18MS	19MS	20MS	21MS	22MS	23MS
Nymphon hirtum	134691																							
Achelia echinata	134599																							
Ammothella longipes	134614																							
Callipallene tiberi	134648																							
Callipallene brevirostris	134643																							
Anoplodactylus petiolatus	134723		1																					
Rissoides desmaresti	136135	1																						
Gastrosaccus spinifer	120020	1			2		2	2	2						1									
Heteromysis formosa	148701																			1				
Apherusa bispinosa	102160																							
Pontocrates (Type B)	101702																							
Pontocrates arcticus	102917																							
Synchelidium maculatum	102928	1																						
Parapleustes bicuspis	103008																							
Apolochus neapolitanus	236495																							
Leucothoe procera	102466																			6				
Stenothoe marina	103166	1																						
Urothoe	101789						1					1												
Urothoe brevicornis	103226					3	8	1	20	27	4	2	1	12	6	5	7		10		8	1		6
Urothoe elegans	103228	15																						
Urothoe poseidonis	103235	1					4	3		2			10	2				2						
Acidostoma neglectum	102495																							
Lysianassa ceratina	102605																							
Orchomene humilis	102665																							
Socarnes erythrophthalmus	148560																							
Nototropis guttatus	488957																							
Nototropis swammerdamei	488966																							
Ampelisca brevicornis	101891																							

Taxon	APHIA	01MS	02MS	03MS	04MS	05MS	06MS	07MS	08MS	09MS	10MS	11MS	12MS	13MS	14MS	15MS	16MS	17MS	18MS	19MS	20MS	21MS	22MS	23MS
Ampelisca diadema	101896																							
Ampelisca spinipes	101928	4	5																	1				
Bathyporeia elegans	103058									2				1			2							3
Bathyporeia guilliamsoniana	103060						1																	
Bathyporeia pelagica	103066									1														
Abludomelita obtusata	102788	2	1	17																4				
Cheirocratus (female)	101669			2																				
Cheirocratus assimilis	102794																		1					
Cheirocratus intermedius	102795																							
Othomaera othonis	534781																							
Megamphopus cornutus	102377																							
Gammaropsis maculata	102364	5		11																				
Photis longicaudata	102383																							
Ericthonius (female)	101567	1	2	4																				
Ericthonius punctatus	102408	1	2	1																				
Aoridae (female)	101368																							
Aora gracilis	102012																							
Leptocheirus hirsutimanus	102036																							
Corophium volutator	102101																							
Crassicorophium crassicorne	397383																							
Siphonoecetes kroyeranus	102111																					2		
Unciola crenatipalma	102057	5	1	1																				
Phtisica marina	101864																							
Pseudoprotella phasma	101871	1																						
Gnathiidae (juv.)	118278																							
Gnathia oxyuraea	118995																							
Eurydice spinigera	148637																							
Cleantis prismatica	119038																							

Taxon	APHIA	01MS	02MS	03MS	04MS	05MS	06MS	07MS	08MS	09MS	10MS	11MS	12MS	13MS	14MS	15MS	16MS	17MS	18MS	19MS	20MS	21MS	22MS	23MS
Bopyridae	1195																			2				
Pleurocrypta porcellanaelongicornis	593521																							
Bodotria scorpioides	110445	6	2	1														1						
Iphinoe trispinosa	110462	1																						
Diastylis bradyi	110472																							
CARIDEA	106674	1																						
Eualus	106986																							
Eualus cranchii	156083	1																						
Processa edulis crassipes	108336																							
Processa modica modica	108343			1																				
Crangonidae (juv.)	106782						1																	
Philocheras bispinosus bispinosus	108207													1										
Philocheras fasciatus	107559																							
Axius stirynchus	477515																			2				
Callianassa subterranea	107729	2	1	1																4				
Upogebia deltaura	107739	6	2																	29				
Anapagurus hyndmanni	107217																							
Pagurus bernhardus	107232																							
Pagurus cuanensis	107235																							
Galathea intermedia	107150	3																						
Galathea squamifera	107154																							
Pisidia longicornis	107188	35	13	56										1						151				
BRACHYURA	106673	1																						
Ebalia (juv.)	106889																			1				
Ebalia tuberosa	107301																							
Inachus (juv.)	106905																							
Macropodia parva	107344																							
Eurynome (juv.)	106901	1																						

Taxon	APHIA	01MS	02MS	03MS	04MS	05MS	06MS	07MS	08MS	09MS	10MS	11MS	12MS	13MS	14MS	15MS	16MS	17MS	18MS	19MS	20MS	21MS	22MS	23MS
Atelecyclus rotundatus	107273																							
Thia scutellata	107281																							
Cancer pagurus	107276																			3				
Liocarcinus	106925																							
Liocarcinus navigator	107392																							
Liocarcinus depurator	107387	1	4	1																				
Liocarcinus holsatus	107388																							
Liocarcinus pusillus	107393		1																					
Necora puber	107398																							
Pilumnus hirtellus	107418	1	1	1																2				
GASTROPODA	101																			2				
Gibbula tumida	141799																							
Gibbula cineraria	141782																							
Rissoa parva	141365																							
Onoba semicostata	141320																							
Crepidula fornicata	138963																							
Euspira nitida	151894		1									1						1				1		
Epitonium	137943		2																					
Epitonium clathrus	146905																			1				
Propebela rufa	367570																							
NUDIBRANCHIA (juv.)	1762	1																						
Fionoidea	412646		2																					
Goniodoris nodosa	140033																							
Doto (juv.)	137916																							
Embletonia pulchra	141638																							
BIVALVIA	105																							
Nucula nitidosa	140589																							
Nucula nucleus	140590																							
Mytilus edulis	140480	3																						

Taxon	APHIA	01MS	02MS	03MS	04MS	05MS	06MS	07MS	08MS	09MS	10MS	11MS	12MS	13MS	14MS	15MS	16MS	17MS	18MS	19MS	20MS	21MS	22MS	23MS
Musculus discors	140472																							
Pectinidae (juv.)	213			2																				
Aequipecten opercularis	140687		2																					
Anomiidae	214																							
Diplodonta rotundata	141883																							
Kurtiella bidentata	345281	1	21																	4				
Tellimya ferruginosa	146952												2											
Goodallia triangularis	138831																							
Parvicardium pinnulatum	181343																							
Spisula elliptica	140300											1	1	3									1	
Phaxas pellucidus	140737																							
Pharidae	23091																	1						
Pharidae (juv.)	23091	2																						
Fabulina fabula	146907						1	7	2	6	2		5	1		2	6	8				6		1
Donax vittatus	139604																							
Abra (juv.)	138474	2		1																				
Abra alba	141433		5			2	1	2				1		1										
Abra prismatica	141436					1						1											1	
Polititapes rhomboides	745846																							
Timoclea ovata	141929		1																					
Mya (juv.)	138211																							
Hiatella arctica	140103																							
Barnea candida	140767																							
Phoronis	128545	2	22																	32				
Crossaster papposus	124154																							
Asterias rubens	123776	1																		8				
OPHIUROIDEA	123084																			1				
OPHIUROIDEA (juv.)	123084		2	1			10						2			1		1	1	1		2		
Amphiuridae	123206																							

Taxon	APHIA	01MS	02MS	03MS	04MS	05MS	06MS	07MS	08MS	09MS	10MS	11MS	12MS	13MS	14MS	15MS	16MS	17MS	18MS	19MS	20MS	21MS	22MS	23MS
Amphiuridae (juv.)	123206																							
Amphiura filiformis	125080																							
Amphipholis squamata	125064	28	14	2														1		100				
Ophiuridae (juv.)	123200	11	78	3		7		4	1		1	4	3	5		4	8			33	2	3	12	19
Ophiura albida	124913		52	2		6		4	2		1				1								11	
Ophiura ophiura	124929					3	1		2				1											
Ophiocten affinis	124850	1			3	3		2							1									
ECHINOIDEA	123082																							
Psammechinus miliaris	124319	1																						
Echinocyamus pusillus	124273	2	4				1					2	1							3				1
SPATANGOIDA	123106		1																1					1
SPATANGOIDA (juv.)	123106																							
Echinocardium	123426					1							1											
Echinocardium cordatum	124392													1				1		1		4		
ENTEROPNEUSTA	1820	1																						
Ammodytes	125909								1		2										1			
ACTINIARIA	1360	19	69	1							1				2			1		76				
Balanus crenatus	106215																							
Dendrodoa grossularia	103882																							
Austrominius modestus	712167																							
ASCIDIACEA (juv.)	1839																							
SESSILIA (juv.)	106033																							
Sycon	131723																							
ACTINIARIA (juv.)	1360																							
Ascidiidae (juv.)	103443																							
Ascidia (juv.)	103483																							
Ascidiella scabra	103719																							
Urticina felina	100834																							

Taxon	APHIA	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
Astrorhiza	112299					43	1																	
Cerianthus lloydii	283798																							
PLATYHELMINTHES	793																					2		2
NEMERTEA	152391	2	15	28	2	5	4	18	1					2	8			11				40		56
SIPUNCULA (juv.)	1268							1																
Golfingia elongata	175026		1						5															
Nephasoma minutum	136060																							1
Aphrodita aculeata	129840								1															
Gattyana cirrhosa	130749					1			1															
Harmothoe	129491					11		1																2
Harmothoe extenuata	130762																							
Harmothoe impar	130770																							
Harmothoe clavigera	130760														2									
Malmgrenia darbouxi	863197		5												1									
Pettibonesia furcosetosa	236678					1																		
Harmothoe glabra	571832																							
Malmgrenia arenicolae	152276																							
Lepidonotus squamatus	130801		1			1			1						2									3
Pholoe baltica	130599		10			9	2		2											1		14		5
Pholoe inornata	130601		2			6	1	4	4															
Sthenelais	129595																							
Sthenelais boa	131074		1																			6		
Sthenelais limicola	131077																							
Phyllodocidae	931																							

Taxon	APHIA	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
Eteone longa (agg.)	130616		17															1				1		
Hypereteone foliosa	152250		3																					
Phyllodoce groenlandica	334506			1																				
Phyllodoce lineata	334508																							
Phyllodoce longipes	130673																					1		6
Phyllodoce maculata	334510																							1
Phyllodoce mucosa	334512		4		1	63	3	1																
Phyllodoce rosea	334514		7																	2				1
Eulalia mustela	130631			1																				
Eulalia ornata	130632														1							4		4
Eulalia viridis	130639					1																		
Eumida	129446					1																		
Eumida bahusiensis	130641					14																		
Eumida sanguinea (agg.)	130644		9						1						2									1
Glycera	129296																						1	
Glycera alba	130116																				1			1
Glycera lapidum	130123			4	1	1	2	1	2						2			3						2
Glycera oxycephala	130126				1																			
Glycinde nordmanni	130136																							
Goniada maculata	130140																					5		3
Sphaerodorum gracilis	131100					1									1							3		8
Psamathe fusca	152249						1								2									
Oxydromus pallidus	340203																							
Podarkeopsis capensis	130195																							

Taxon	APHIA	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
Syllidia armata	130198																							
Microphthalmus similis	130176	4																						
Syllis licheri	238263																	1						
Syllis variegata	131458		1			11	5	4	5															
Eusyllis blomstrandi	131290						1																	
Eusyllis lamelligera	131292						1																	
Odontosyllis fulgurans	131327					1			1															
Syllides japonicus	131410		2																					
Parexogone hebes	757970		1			1																		
Exogone naidina	327985						1		1															
Exogone verugera	333456				1																			
Sphaerosyllis taylori	131394					2																		
Myrianida	129659					1	2								4									5
Proceraea	129671						2																	
Eunereis longissima	130375		1			2		2														1		6
Nereis zonata	130407																							
Aglaophamus agilis	130343																							
Nephtys (juv.)	129370		1					1	2															1
Nephtys caeca	130355		3			1		1	1													1		2
Nephtys cirrosa	130357	2			1						1	1		4			1		4	2				
Nephtys hombergii	130359		1																					
Nephtys kersivalensis	130363																					1		
Nephtys longosetosa	130364																			1				
Marphysa bellii	130072																							1

Taxon	APHIA	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
Lumbrineris	129337																							
Lumbrineris cingulata	130240		6		1	11	5	4	8													3		9
Protodorvillea kefersteini	130041			4	5	5	4	3	1															
Schistomeringos neglecta	130044																	2						
Schistomeringos rudolphi	154127							1														1		
Scoloplos armiger	334772		7			16	1		5											1				
Aricidea minuta	730747																							
Poecilochaetus serpens	130711																							3
Aonides oxycephala	131106																							
Aonides paucibranchiata	131107						3	4										3						
Atherospio guillei	478336																							2
Laonice bahusiensis	131127						1																	
Dipolydora coeca (agg.)	131117					1																		
Dipolydora caulleryi	131116				1																	4		1
Dipolydora flava	131118		3			9			2															
Pseudopolydora pulchra	131169		1																					
Pygospio elegans	131170		1002		4																			
Scolelepis bonnieri	131171																							
Scolelepis squamata	157566																							
Spio armata	131180		1					1																
Spio goniocephala	131184												1											
Spio symphyta	596189				1	1																		
Spiophanes bombyx	131187		39		1		1				1									3				11
Magelona alleni	130266																					1		

Taxon	APHIA	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
Magelona johnstoni	130269																							
Aphelochaeta marioni	129938		1		1	2	1																	
Caulleriella alata	129943		1	2		6	2		1															
Chaetozone christiei	152217		1																					
Chaetozone zetlandica	336485		1																					1
Cirriformia tentaculata	129964		3			5	1	3	2															
Flabelligera affinis	130103																							
Macrochaeta	129141																							
Capitella	129211					2		1																
Mediomastus fragilis	129892		10			14	3	1	2													2	1	6
Notomastus	129220		30			27	3	2	5				1	1	2									
Arenicola (juv.)	129206					2																		
Maldanidae	923		2																					
Leiochone johnstoni	221095						1																	
Euclymene oerstedii	130294								32															
Praxillella affinis	130322							2																
Ophelia	129413																							
Ophelia borealis	130491	2		131	19					7	4		2		3			1					4	
Travisia forbesii	130512				6																			
Scalibregma celticum	130979					2	1																	
Scalibregma inflatum	130980		1			1																3		
Galathowenia oculata	146950								1															
Owenia borealis	329882																					1		1
Pectinariidae	980																							

Taxon	APHIA	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
Lagis koreni	152367								1													8		2
Sabellaria spinulosa	130867		145	37		208	53	64	34		1			1	3773			2				58		96
Ampharete	129155					1																		
Ampharete lindstroemi (agg.)	129781		7			5																5		1
Amphicteis midas	129785					11			2															
Terebellides stroemii	131573																							
Terebellidae	982																							
Pista maculata	868065					3	5	1																
Lanice conchilega	131495		13			131			2															2
Loimia medusa	131499																							
Nicolea venustula	131507		2			7																		
Lysilla loveni	131500																							
Lysilla nivea	131501		1																					
Polycirrus	129710					5	5		3									1				3		1
Polycirrus denticulatus	131527		30			36	4	11	17						1			1						
Polycirrus medusa	131531		2					5							9									
Thelepus cincinnatus	131543					1																		
Sabellidae	985		1																					
Parasabella langerhansi	530926		1																					
Sabella pavonina	130967								1															
Spirobranchus lamarcki	560033			1		3																		
Tubificoides pseudogaster (agg.)	137582																							
Grania	137349														5									

Taxon	APHIA	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
Nymphon brevirostre	150520					2																		
Nymphon hirtum	134691					1																		
Achelia echinata	134599		4			12	6	4																
Ammothella longipes	134614					1																		
Callipallene tiberi	134648						1																	
Callipallene brevirostris	134643							1							1									
Anoplodactylus petiolatus	134723		2		2	1		1														1		1
Rissoides desmaresti	136135																							
Gastrosaccus spinifer	120020									1	2	2											1	
Heteromysis formosa	148701																							
Apherusa bispinosa	102160						1																	
Pontocrates (Type B)	101702									1									1					
Pontocrates arcticus	102917												2											
Synchelidium maculatum	102928																							
Parapleustes bicuspis	103008		2			2																		
Apolochus neapolitanus	236495		1												9									
Leucothoe procera	102466																							
Stenothoe marina	103166														2									
Urothoe	101789																							
Urothoe brevicornis	103226				1			2		4	12			2	3	3							5	
Urothoe elegans	103228								2															4
Urothoe poseidonis	103235																							
Acidostoma neglectum	102495						3																	
Lysianassa ceratina	102605					7		1																

Taxon	APHIA	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
Orchomene humilis	102665							1																
Socarnes erythrophthalmus	148560			10														3						
Nototropis guttatus	488957		1		3			1																
Nototropis swammerdamei	488966	1																						
Ampelisca brevicornis	101891		4																					
Ampelisca diadema	101896		7			17	17	1	397				2									3		
Ampelisca spinipes	101928		10		1		2		43															
Bathyporeia elegans	103058	1									5									1				
Bathyporeia guilliamsoniana	103060				2																			
Bathyporeia pelagica	103066	1								5	66													
Abludomelita obtusata	102788		2		10	1	12	1						2	273									
Cheirocratus (female)	101669				1			3																
Cheirocratus assimilis	102794																							
Cheirocratus intermedius	102795							1																
Othomaera othonis	534781							1																
Megamphopus cornutus	102377																							
Gammaropsis maculata	102364	2	5			1								1	150									2
Photis longicaudata	102383																					2		
Ericthonius (female)	101567						3	2	1															
Ericthonius punctatus	102408						2	1	1															
Aoridae (female)	101368					1	2	1							1									
Aora gracilis	102012					1			1															
Leptocheirus hirsutimanus	102036						16	9																

Taxon	APHIA	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
Corophium volutator	102101																				1			
Crassicorophium crassicorne	397383		1																					
Siphonoecetes kroyeranus	102111																							
Unciola crenatipalma	102057				3	1		1	1						9							1		
Phtisica marina	101864																							
Pseudoprotella phasma	101871							1																
Gnathiidae (juv.)	118278							1																
Gnathia oxyuraea	118995						1	2																
Eurydice spinigera	148637									1			2	1										
Cleantis prismatica	119038				1																			
Bopyridae	1195																							
Pleurocrypta porcellanaelongicornis	593521		2																					
Bodotria scorpioides	110445		2			1									2							8		1
Iphinoe trispinosa	110462																							
Diastylis bradyi	110472																							
CARIDEA	106674																							
Eualus	106986																							
Eualus cranchii	156083		4			2									5									
Processa edulis crassipes	108336								1															
Processa modica modica	108343																							
Crangonidae (juv.)	106782																							
Philocheras bispinosus bispinosus	108207																							

Taxon	APHIA	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
Philocheras fasciatus	107559					1																		
Axius stirynchus	477515																							
Callianassa subterranea	107729																							2
Upogebia deltaura	107739																					4		2
Anapagurus hyndmanni	107217																							
Pagurus bernhardus	107232		1																					
Pagurus cuanensis	107235								1															
Galathea intermedia	107150		1											1	5							2		
Galathea squamifera	107154							1																
Pisidia longicornis	107188	1	2			1		1						2	124							24		6
BRACHYURA	106673																							
Ebalia (juv.)	106889								1															
Ebalia tuberosa	107301																					1		
Inachus (juv.)	106905					1																		
Macropodia parva	107344					13																		
Eurynome (juv.)	106901																							
Atelecyclus rotundatus	107273																							2
Thia scutellata	107281																							
Cancer pagurus	107276					2																		
Liocarcinus	106925																					1		
Liocarcinus navigator	107392					1																		
Liocarcinus depurator	107387								1															1
Liocarcinus holsatus	107388																							
Liocarcinus pusillus	107393																					1		

Taxon	APHIA	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
Necora puber	107398														1									
Pilumnus hirtellus	107418					1		1							3							1		3
GASTROPODA	101																							
Gibbula tumida	141799						1																	
Gibbula cineraria	141782					1	2	1																
Rissoa parva	141365					6		7			3				3									
Onoba semicostata	141320					2																		
Crepidula fornicata	138963							4																
Euspira nitida	151894																							
Epitonium	137943																							
Epitonium clathrus	146905																							
Propebela rufa	367570					1	1																	
NUDIBRANCHIA (juv.)	1762																							
Fionoidea	412646																							
Goniodoris nodosa	140033						1																	
Doto (juv.)	137916					2																		
Embletonia pulchra	141638																	1						
BIVALVIA	105																					1		
Nucula nitidosa	140589																							
Nucula nucleus	140590					5		1	97															
Mytilus edulis	140480																							
Musculus discors	140472								1															
Pectinidae (juv.)	213																							
Aequipecten opercularis	140687																							

Taxon	APHIA	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
Anomiidae	214						1																	
Diplodonta rotundata	141883																							
Kurtiella bidentata	345281		5			4																1		1
Tellimya ferruginosa	146952																							
Goodallia triangularis	138831															1		2						
Parvicardium pinnulatum	181343								1															
Spisula elliptica	140300						2	4																
Phaxas pellucidus	140737																							
Pharidae	23091																							
Pharidae (juv.)	23091																							
Fabulina fabula	146907																							
Donax vittatus	139604																							
Abra (juv.)	138474		4																			1		
Abra alba	141433		7			27	1	2	19						1					1		2		1
Abra prismatica	141436																							
Polititapes rhomboides	745846																							
Timoclea ovata	141929																							
Mya (juv.)	138211																							
Hiatella arctica	140103								1															
Barnea candida	140767																				2			
Phoronis	128545					3			2													3		2
Crossaster papposus	124154						1																	
Asterias rubens	123776																							1
OPHIUROIDEA	123084																							

Taxon	APHIA	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
OPHIUROIDEA (juv.)	123084		2			5													1					
Amphiuridae	123206															1								
Amphiuridae (juv.)	123206																							
Amphiura filiformis	125080																							
Amphipholis squamata	125064		7	5		22	11	6	2						11			7			1	12		38
Ophiuridae (juv.)	123200		7	1		3		4	2													132		85
Ophiura albida	124913		36						2													155		
Ophiura ophiura	124929																							
Ophiocten affinis	124850																							1
ECHINOIDEA	123082																							
Psammechinus miliaris	124319																							
Echinocyamus pusillus	124273																							
SPATANGOIDA	123106																							
SPATANGOIDA (juv.)	123106																							
Echinocardium	123426																							
Echinocardium cordatum	124392																							
ENTEROPNEUSTA	1820																							
Ammodytes	125909																							
ACTINIARIA	1360														12							214		9
Balanus crenatus	106215																							
Dendrodoa grossularia	103882																							
Austrominius modestus	712167																							
ASCIDIACEA (juv.)	1839																							
SESSILIA (juv.)	106033																							

Taxon	**APHIA**	**24CR**	**25CR**	**26CR**	**27CR**	**28CR**	**30CR**	**31CR**	**33CR**	**35CR**	**36CR**	**37CR**	**38CR**	**39CR**	**40CR**	**41CR**	**42CR**	**43CR**	**44CR**	**45CR**	**46CR**	**48CR**	**49CR**	**50CR**
Sycon	131723																							
ACTINIARIA (juv.)	1360																			3				
Ascidiidae (juv.)	103443																							
Ascidia (juv.)	103483																							
Ascidiella scabra	103719																							
Urticina felina	100834																							

Taxon	APHIA	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Astrorhiza	112299																			
Cerianthus lloydii	283798												1							
PLATYHELMINTHES	793								1				8		6	4		4	1	
NEMERTEA	152391	4		3	2	26			5		1		69		35	186	4	109	18	
SIPUNCULA (juv.)	1268															2				
Golfingia elongata	175026																			
Nephasoma minutum	136060	4				3										1			8	
Aphrodita aculeata	129840																			
Gattyana cirrhosa	130749																			
Harmothoe	129491								1				2		8	16		1	1	
Harmothoe extenuata	130762																			
Harmothoe impar	130770																			
Harmothoe clavigera	130760												1					2		
Malmgrenia darbouxi	863197												4		1	1		1	1	
Pettibonesia furcosetosa	236678																			
Harmothoe glabra	571832																		1	
Malmgrenia arenicolae	152276																			
Lepidonotus squamatus	130801												1		4	4		2	1	
Pholoe baltica	130599	2				1			4				26		4	37		4	11	
Pholoe inornata	130601					1						1				2				
Sthenelais	129595																			
Sthenelais boa	131074												2		1	4				
Sthenelais limicola	131077														1		1			
Phyllodocidae	931															2				

Taxon	APHIA	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Eteone longa (agg.)	130616												1					3	1	
Hypereteone foliosa	152250																			
Phyllodoce groenlandica	334506														1					
Phyllodoce lineata	334508									1										
Phyllodoce longipes	130673												3		6	2		14	1	
Phyllodoce maculata	334510												3			7		1		
Phyllodoce mucosa	334512																1			
Phyllodoce rosea	334514	2				1									2			3		
Eulalia mustela	130631																		1	
Eulalia ornata	130632															7		1		
Eulalia viridis	130639														1					
Eumida	129446															4				
Eumida bahusiensis	130641															5				
Eumida sanguinea (agg.)	130644					1									4	12		2	1	
Glycera	129296																			
Glycera alba	130116			4	1	3		1			1	1	7		6	2		6	4	
Glycera lapidum	130123	3			1	7			8							9		11	6	
Glycera oxycephala	130126									1										
Glycinde nordmanni	130136																	1	1	
Goniada maculata	130140	4	1			1					2		4	1	1	7		2	2	
Sphaerodorum gracilis	131100								1						2	3				
Psamathe fusca	152249												1		2	8		1		
Oxydromus pallidus	340203																		2	
Podarkeopsis capensis	130195	1			1								2		1				1	

Taxon	APHIA	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Syllidia armata	130198															1				
Microphthalmus similis	130176																			
Syllis licheri	238263																			
Syllis variegata	131458					2														
Eusyllis blomstrandi	131290																	1		
Eusyllis lamelligera	131292																			
Odontosyllis fulgurans	131327																			
Syllides japonicus	131410												2						1	
Parexogone hebes	757970					1													1	
Exogone naidina	327985																			
Exogone verugera	333456					11												1	24	
Sphaerosyllis taylori	131394																			
Myrianida	129659					2										5		3		
Proceraea	129671																			
Eunereis longissima	130375	2		3		1			2				12		7	16		4	6	
Nereis zonata	130407																			
Aglaophamus agilis	130343	1															1			
Nephtys (juv.)	129370									1								1	3	
Nephtys caeca	130355	1														7		4	1	
Nephtys cirrosa	130357	2				1	1	3		1	2			7	2		8			
Nephtys hombergii	130359																			
Nephtys kersivalensis	130363															1				
Nephtys longosetosa	130364																			
Marphysa bellii	130072														1	1			2	

Taxon	APHIA	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Lumbrineris	129337								1											
Lumbrineris cingulata	130240	1		1					12				14		3	15		4	1	
Protodorvillea kefersteini	130041																			
Schistomeringos neglecta	130044																			
Schistomeringos rudolphi	154127															8				
Scoloplos armiger	334772											1					2			
Aricidea minuta	730747																			
Poecilochaetus serpens	130711	1				1					1				7	2		1	6	
Aonides oxycephala	131106												8			1				
Aonides paucibranchiata	131107					4			1									2	1	
Atherospio guillei	478336																			
Laonice bahusiensis	131127																			
Dipolydora coeca (agg.)	131117																			
Dipolydora caulleryi	131116																			
Dipolydora flava	131118																			
Pseudopolydora pulchra	131169																			
Pygospio elegans	131170																			
Scolelepis bonnieri	131171						1							1						
Scolelepis squamata	157566						1													
Spio armata	131180						1													
Spio goniocephala	131184																			
Spio symphyta	596189			1							4									
Spiophanes bombyx	131187	9	1	4		7	1		7	9	3	8		1	16	3	7	18	6	
Magelona alleni	130266								1							2				

Taxon	APHIA	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Magelona johnstoni	130269																			
Aphelochaeta marioni	129938																			
Caulleriella alata	129943											1	27		17	40				
Chaetozone christiei	152217													1	1					
Chaetozone zetlandica	336485		1													1		1	1	
Cirriformia tentaculata	129964					1														
Flabelligera affinis	130103																	1		
Macrochaeta	129141																			
Capitella	129211																			
Mediomastus fragilis	129892			1		1							99			11		4		
Notomastus	129220								1				18			1		2	2	
Arenicola (juv.)	129206																			
Maldanidae	923																			
Leiochone johnstoni	221095																			
Euclymene oerstedii	130294																			
Praxillella affinis	130322																			
Ophelia	129413	1			1															
Ophelia borealis	130491	3			6	1		1		2				3			2			1
Travisia forbesii	130512																2			
Scalibregma celticum	130979																	1		
Scalibregma inflatum	130980					2			7			2	1		20	5	1	7	15	
Galathowenia oculata	146950																			
Owenia borealis	329882					2			6	1								1	4	
Pectinariidae	980		1																	

Taxon	APHIA	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Lagis koreni	152367			1		4				2		2	6	1	7	1		2	8	
Sabellaria spinulosa	130867	35	2			338							294		1255	2464	16	1180	14	
Ampharete	129155																			
Ampharete lindstroemi (agg.)	129781												1					2		
Amphicteis midas	129785												1							
Terebellides stroemii	131573															3		1		
Terebellidae	982															1				
Pista maculata	868065																			
Lanice conchilega	131495															2			1	
Loimia medusa	131499								2			1						2	2	
Nicolea venustula	131507																			
Lysilla loveni	131500																		1	
Lysilla nivea	131501																			
Polycirrus	129710					3							3			1				
Polycirrus denticulatus	131527	1														2				
Polycirrus medusa	131531																			
Thelepus cincinnatus	131543	1				1									2					
Sabellidae	985																			
Parasabella langerhansi	530926																			
Sabella pavonina	130967																			
Spirobranchus lamarcki	560033																			
Tubificoides pseudogaster (agg.)	137582															16		1		
Grania	137349															15				
Nymphon brevirostre	150520			2																

Taxon	APHIA	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Nymphon hirtum	134691																			
Achelia echinata	134599																			
Ammothella longipes	134614																			
Callipallene tiberi	134648																			
Callipallene brevirostris	134643																			
Anoplodactylus petiolatus	134723			2		4													1	
Rissoides desmaresti	136135															1			1	
Gastrosaccus spinifer	120020								1						1					
Heteromysis formosa	148701																			
Apherusa bispinosa	102160																			
Pontocrates (Type B)	101702																			
Pontocrates arcticus	102917																			
Synchelidium maculatum	102928									1										
Parapleustes bicuspis	103008																			
Apolochus neapolitanus	236495												1		2					
Leucothoe procera	102466																			
Stenothoe marina	103166																			
Urothoe	101789																			
Urothoe brevicornis	103226				14			2			2		1	3			2		1	1
Urothoe elegans	103228					2			3						5			6	1	
Urothoe poseidonis	103235					1					1		1	1						
Acidostoma neglectum	102495			1												2				
Lysianassa ceratina	102605																			
Orchomene humilis	102665																			

Taxon	APHIA	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Socarnes erythrophthalmus	148560																			
Nototropis guttatus	488957																			
Nototropis swammerdamei	488966																			
Ampelisca brevicornis	101891																			
Ampelisca diadema	101896				1														1	
Ampelisca spinipes	101928					1			1				1		1	1			1	
Bathyporeia elegans	103058																			
Bathyporeia guilliamsoniana	103060																			
Bathyporeia pelagica	103066																			
Abludomelita obtusata	102788					2			2				4		5			6	1	
Cheirocratus (female)	101669																		1	
Cheirocratus assimilis	102794																			
Cheirocratus intermedius	102795																			
Othomaera othonis	534781																			
Megamphopus cornutus	102377														1	1		1		
Gammaropsis maculata	102364	1											1		34	18		102	1	
Photis longicaudata	102383																			
Ericthonius (female)	101567																			
Ericthonius punctatus	102408																			
Aoridae (female)	101368																	1		
Aora gracilis	102012																			
Leptocheirus hirsutimanus	102036																			
Corophium volutator	102101																			
Crassicorophium crassicorne	397383																			

Taxon	APHIA	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Siphonoecetes kroyeranus	102111																			
Unciola crenatipalma	102057																		8	
Phtisica marina	101864														1					
Pseudoprotella phasma	101871																			
Gnathiidae (juv.)	118278																			
Gnathia oxyuraea	118995																			
Eurydice spinigera	148637																			
Cleantis prismatica	119038																			
Bopyridae	1195								1											
Pleurocrypta porcellanaelongicornis	593521																			
Bodotria scorpioides	110445					1			1				3		3	1		12	3	
Iphinoe trispinosa	110462																			
Diastylis bradyi	110472		1					1												
CARIDEA	106674																			
Eualus	106986															1				
Eualus cranchii	156083															3		2		
Processa edulis crassipes	108336																			
Processa modica modica	108343																			
Crangonidae (juv.)	106782																			
Philocheras bispinosus bispinosus	108207																			
Philocheras fasciatus	107559																			
Axius stirynchus	477515																		1	
Callianassa subterranea	107729	2				1			5				3		1	4			4	
Upogebia deltaura	107739	1				1			4				15			5		6	4	

Taxon	APHIA	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Anapagurus hyndmanni	107217								1											
Pagurus bernhardus	107232																			
Pagurus cuanensis	107235																			
Galathea intermedia	107150														3	16		2		
Galathea squamifera	107154																			
Pisidia longicornis	107188		3			1			3			1	80		229	166	2	130		
BRACHYURA	106673																			
Ebalia (juv.)	106889								1							1				
Ebalia tuberosa	107301																			
Inachus (juv.)	106905																			
Macropodia parva	107344					1														
Eurynome (juv.)	106901																			
Atelecyclus rotundatus	107273															1			1	
Thia scutellata	107281					1	1			1							1			
Cancer pagurus	107276														1					
Liocarcinus	106925																			
Liocarcinus navigator	107392																			
Liocarcinus depurator	107387															1				
Liocarcinus holsatus	107388																	1		
Liocarcinus pusillus	107393								1				1							
Necora puber	107398														2					
Pilumnus hirtellus	107418								1				5		10	19		9	1	
GASTROPODA	101												3							
Gibbula tumida	141799																			

Taxon	APHIA	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Gibbula cineraria	141782																			
Rissoa parva	141365																			
Onoba semicostata	141320																			
Crepidula fornicata	138963					1														
Euspira nitida	151894					1														
Epitonium	137943																			
Epitonium clathrus	146905					1							4			3				
Propebela rufa	367570																			
NUDIBRANCHIA (juv.)	1762	1																		
Fionoidea	412646																			
Goniodoris nodosa	140033																			
Doto (juv.)	137916																			
Embletonia pulchra	141638																			
BIVALVIA	105																			
Nucula nitidosa	140589				1															
Nucula nucleus	140590																			
Mytilus edulis	140480																			
Musculus discors	140472																			
Pectinidae (juv.)	213																			
Aequipecten opercularis	140687																			
Anomiidae	214																			
Diplodonta rotundata	141883																		1	
Kurtiella bidentata	345281			1		2							49			5			16	
Tellimya ferruginosa	146952										3	4			7			1		

Taxon	APHIA	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Goodallia triangularis	138831																			
Parvicardium pinnulatum	181343																			
Spisula elliptica	140300				1	1	3			1										
Phaxas pellucidus	140737														1			1		
Pharidae	23091																			
Pharidae (juv.)	23091																			
Fabulina fabula	146907										20	5		15	1					
Donax vittatus	139604													3						
Abra (juv.)	138474															2		1	1	
Abra alba	141433	1									1				4	11			1	
Abra prismatica	141436				1									4						
Polititapes rhomboides	745846												1							
Timoclea ovata	141929																			
Mya (juv.)	138211																	1		
Hiatella arctica	140103																			
Barnea candida	140767																			
Phoronis	128545												54							
Crossaster papposus	124154																			
Asterias rubens	123776												1							
OPHIUROIDEA	123084												1							
OPHIUROIDEA (juv.)	123084			2				1	206			1				9		14		
Amphiuridae	123206																			
Amphiuridae (juv.)	123206															2				
Amphiura filiformis	125080																	1	7	

Taxon	APHIA	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Amphipholis squamata	125064					1			6				15		31	76	1	19		
Ophiuridae (juv.)	123200	1	4	9	6	18			51	5	10	5	8	7	10	10	4	10	44	
Ophiura albida	124913	2			3	6			10	1			2		4	1	1		35	
Ophiura ophiura	124929										2								1	
Ophiocten affinis	124850										2								2	
ECHINOIDEA	123082												1							
Psammechinus miliaris	124319					1			1											
Echinocyamus pusillus	124273	20				13		1	57		2	1		1	12	5	2	1	11	
SPATANGOIDA	123106	1									2									
SPATANGOIDA (juv.)	123106					1														
Echinocardium	123426																			
Echinocardium cordatum	124392	2										1		2	2					
ENTEROPNEUSTA	1820																			
Ammodytes	125909									1										
ACTINIARIA	1360					9	1						182		121	236	1	4	4	
Balanus crenatus	106215												1							
Dendrodoa grossularia	103882																			
Austrominius modestus	712167																			
ASCIDIACEA (juv.)	1839																			
SESSILIA (juv.)	106033																			
Sycon	131723																			
ACTINIARIA (juv.)	1360					2														
Ascidiidae (juv.)	103443																			
Ascidia (juv.)	103483																			

Taxon	APHIA	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Ascidiella scabra	103719																			
Urticina felina	100834																			

B.7.6 Grab Sample Certificate of Analysis Infauna

Certificate Number	EP/17/0001	**Fugro GB Marine Ltd Job Number**	160976
Job Reference	Vattenfall Norfolk Vanguard		
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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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	23-11-16	**Date of Analysis**	23-11-16 to 09-01-17
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	9th January 2017		

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

B.7.7 Grab Epifaunal (Non-enumerated) Abundance Raw Data

Taxon	01MS	02MS	03MS	04MS	05MS	06MS	07MS	08MS	09MS	10MS	11MS	12MS	13MS	14MS	15MS	16MS	17MS	18MS	19MS	20MS	21MS	22MS	23MS
Balanus crenatus																							
Dendrodoa grossularia																							
Austrominius modestus																							
ASCIDIACEA (juv.)																							
SESSILIA (juv.)																							
Sycon																							
ACTINIARIA (juv.)																							
Ascidiidae (juv.)																							
Ascidia (juv.)																							
Ascidiella scabra																							
Urticina felina																							
Alcyonidium	P																		P				
Alcyonidium sp. (=*gelatinosum*?)																							
Amathia lendigera																							
Amphiblestrum auritum																							
Aspidelectra melolontha		P	P	P	P	P	P	P		P	P	P	P	P	P		P	P	P	P	P	P	P
Barentsia																							
Bicellariella ciliata																							
Botrylloides leachii																							
Bougainvilliidae					P																		
Callopora dumerilii																							
Campanulariidae		P																					
CAMPANULINIDA							P		P												P		P
Celleporella hyalina																							

Taxon	**01MS**	**02MS**	**03MS**	**04MS**	**05MS**	**06MS**	**07MS**	**08MS**	**09MS**	**10MS**	**11MS**	**12MS**	**13MS**	**14MS**	**15MS**	**16MS**	**17MS**	**18MS**	**19MS**	**20MS**	**21MS**	**22MS**	**23MS**
Cliona (agg.)																							
Clytia		P																					
Clytia hemisphaerica		P																					
Conopeum reticulum			P																				
Crisia aculeata																							
Electra monostachys			P								P	P											
Electra pilosa	P	P	P														P						
Escharella immersa																							
Flustra foliacea																							
Folliculinidae			P	P	P		P		P	P	P	P	P	P	P	P		P	P	P	P	P	P
Halecium		P																					
Hydrallmania falcata		P																					
Membraniporoidea		P	P		P			P											P				
Obelia	P	P																					
Perophora listeri																							
PORIFERA																							
Cradoscrupocellaria reptans																							
Scruparia ambigua																							
Sertularella		P																					
Sertularia	P	P	P																P				
Sertulariidae																							
Sertularia distans																							
Tubulariidae	P		P																				
Vesicularia spinosa																							

Taxon	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
Alcyonidium				P	P	P	P																
Alcyonidium sp. (=*gelatinosum*?)						P		P															
Amathia lendigera					P																		
Amphiblestrum auritum						P	P																
Aspidelectra melolontha																	P		P		P		P
Barentsia					P																		
Bicellariella ciliata					P	P		P						P									
Botrylloides leachii					P																		
Bougainvilliidae																							
Callopora dumerilii						P																	
Campanulariidae																							
CAMPANULINIDA																							
Celleporella hyalina			P		P																		
Cliona (agg.)		P																					
Clytia																							
Clytia hemisphaerica						P																	
Conopeum reticulum			P		P	P	P	P													P		
Crisia aculeata						P																	
Electra monostachys				P	P	P	P		P														
Electra pilosa					P	P	P																P
Escharella immersa						P	P																
Flustra foliacea				P	P	P	P	P						P									
Folliculinidae	P		P										P		P		P					P	P
Halecium																							

Taxon	24CR	25CR	26CR	27CR	28CR	30CR	31CR	33CR	35CR	36CR	37CR	38CR	39CR	40CR	41CR	42CR	43CR	44CR	45CR	46CR	48CR	49CR	50CR
Hydrallmania falcata					P																		
Membraniporoidea		P				P		P		P											P		P
Obelia																							P
Perophora listeri					P	P																	
PORIFERA						P	P																
Cradoscrupocellaria reptans						P																	
Scruparia ambigua																							
Sertularella																							
Sertularia						P																	
Sertulariidae						P	P																
Sertularia distans						P																	
Tubulariidae					P		P							P									P
Vesicularia spinosa																			P				

Taxon	**51CR**	**52CR**	**53CR**	**54CR**	**55CR**	**56CR**	**57CR**	**58CR**	**59CR**	**60CR**	**61CR**	**62CR**	**63CR**	**64CR**	**65CR**	**66CR**	**67CR**	**68CR**	**69CR**
Alcyonidium												P							
Alcyonidium sp. (=*gelatinosum*?)																			
Amathia lendigera																			
Amphiblestrum auritum																			
Aspidelectra melolontha	P	P	P	P	P	P	P	P	P		P	P	P						
Barentsia																			
Bicellariella ciliata					P														
Botrylloides leachii																			
Bougainvilliidae			P										P						
Callopora dumerilii																			
Campanulariidae					P														
CAMPANULINIDA																			
Celleporella hyalina																			
Cliona (agg.)																			
Clytia																			
Clytia hemisphaerica																			
Conopeum reticulum			P						P										
Crisia aculeata																			
Electra monostachys			P	P	P	P			P										
Electra pilosa			P		P										P				
Escharella immersa																			
Flustra foliacea																			
Folliculinidae	P	P	P		P	P	P	P	P				P						
Halecium																			

Taxon	51CR	52CR	53CR	54CR	55CR	56CR	57CR	58CR	59CR	60CR	61CR	62CR	63CR	64CR	65CR	66CR	67CR	68CR	69CR
Hydrallmania falcata																			
Membraniporoidea		P	P	P	P			P											
Obelia																			
Perophora listeri																			
PORIFERA																			
Cradoscrupocellaria reptans																			
Scruparia ambigua																			
Sertularella																			
Sertularia																			
Sertulariidae																			
Sertularia distans																			
Tubulariidae																			
Vesicularia spinosa																			

B.7.8 Grab Sample Certificate of Analysis Epifauna

Certificate Number	EP/17/0003	**Fugro GB Marine Ltd Job Number**	160976
Job Reference	Vattenfall Norfolk Vanguard		
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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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	23-11-16	**Date of Analysis**	23-11-16 to 09-01-17
Sample Matrix	Macrobenthic Species ABUNDANCE (EPIFAUNA)		
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	9th January 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.

B.7.9 Grab Faunal Biomass Raw Data

Station	Polychaeta [g/0.1 m^2]*	Crustacea [g/0.1 m^2]*	Mollusca [g/0.1 m^2]	Echinodermata [g/0.1 m^2]*	Cnidaria [g/0.1 m^2]*	Oligochaeta [g/0.1 m^2]*	Other Taxa [g/0.1 m^2]*
01MS	4.574	1.6646	0.0209	0.3517		0.0001	0.2183
02MS	2.5199	3.4421	3.6426	4.635	0.3667		0.2106
03MS	1.9397	1.4788	0.0045	0.3628			0.0166
04MS	0.02	0.0054		0.0293			
05MS	2.1286	0.0573	0.411	0.3667			
06MS	1.1727	0.051	0.7238	0.0726			
07MS	0.3098	0.0094	0.5363	0.0577			
08MS	1.1945	0.0701	0.2037	0.3866			
09MS	0.5063	0.1634	1.8159				
10MS	0.4174	0.0111	0.0954	0.0058			
11MS	1.2583	0.0105	0.1802	0.1316			0.0009
12MS	0.5818	0.022	2.8722	5.8521			
13MS	0.6325	0.0331	3.7495	4.3026			
14MS	0.6612	0.0274		0.0194			
15MS	0.0951	0.0176	0.8837	0.0195			0.0044
16MS	0.2388	0.0298	1.6409	0.0128			0.0082
17MS	0.5873	0.0085	1.2482	0.5127			0.0581
18MS	0.0594	0.0264		3.0625			
19MS	3.5685	6.9789	0.0106	6.2241	0.7673		0.2589
20MS		0.0269		0.0026			
21MS	0.0248	0.004	0.0668	0.4264			
22MS	0.0844		2.0713	1.2691			
23MS	0.0775	0.0236	0.0004	0.1072			0.011
24CR	0.2502	0.0106					0.0012
25CR	3.5199	0.4417	0.0308	3.8882			0.1137
26CR	1.6089	0.0043		0.0056			0.0455
27CR	0.6481	0.0443					0.0022
28CR	6.5663	0.418	0.3204	0.0222			0.0824
30CR	1.0633	0.1407	1.376	0.0341			0.012
31CR	0.8309	0.2005	0.4057	0.0227			0.0445
33CR	2.1065	3.4786	8.7459	0.0536			0.0176
35CR	0.4763	0.0409					
36CR	0.1638	0.1341	0.0074				
37CR	0.0062	0.0261					
38CR	0.7715	0.0145					
39CR	0.1632	0.2289					0.0106
40CR	22.0315	4.4945	0.0072	0.0185		0.0002	0.0357
41CR		0.0112	0.0026	0.0027			
42CR	0.044						
43CR	0.0747	0.002	0.0083	0.0049			0.0085
44CR	0.3879	0.0005		0.0001			
45CR	0.129	0.0011	0.002				
46CR	0.039	0.0013	0.0143	0.0003			
48CR	1.7029	0.6714	0.0561	7.3738			0.0884
49CR	0.4688	0.044					
50CR	3.4564	11.8748	0.4819	0.1339			0.1534
51CR	0.7995	0.0191	0.0219	1.8906			0.009
52CR	0.062	0.0087		0.0022			
53CR	0.7694	0.0062	0.001	0.0211			0.0098

Station	Polychaeta [g/0.1 m^2]*	Crustacea [g/0.1 m^2]*	Mollusca [g/0.1 m^2]	Echinodermata [g/0.1 m^2]*	Cnidaria [g/0.1 m^2]*	Oligochaeta [g/0.1 m^2]*	Other Taxa [g/0.1 m^2]*
54CR	0.1946	0.0487	0.3771	0.0266			0.0486
55CR	1.7289	0.8761	1.1197	0.497			0.0823
56CR	0.0405	0.0113	3.9712				
57CR	0.0854	0.0076		0.0496			
58CR	1.0954	0.3149		2.7288			0.0007
59CR	0.4895	1.2149	0.0597	0.0105			
60CR	0.2292	0.0125	1.7301	1.6141			0.0018
61CR	0.5854	0.0106	1.0621	41.352			
62CR	5.0224	3.6362	31.0431	0.2612	0.0368		0.2443
63CR	0.4045	0.0051	0.3354	0.084			
64CR	10.1155	7.9439	1.7509	23.8749			0.107
65CR	15.305	4.0224	0.5503	0.1123		0.0017	0.3558
66CR	0.4316	0.066		0.0591			0.2081
67CR	5.9242	3.824	0.0905	19.3002		0.0003	0.3389
68CR	7.561	9.588	0.9913	7.6339			0.0726
69CR	0.0185	0.0024					

Notes:
* = Blotted wet weights.

Station	Polychaeta [AFDW g/0.1 m^2]	Crustacea [AFDW g/0.1 m^2]	Mollusca [AFDW g/0.1 m^2]	Echinodermata [AFDW g/0.1 m^2]	Cnidaria [AFDW g/0.1 m^2]	Oligochaeta [AFDW g/0.1 m^2]	Other Taxa [AFDW g/0.1 m^2]
01MS	0.709	0.4245	0.0017	0.0299			0.0338
02MS	0.3906	0.8777	0.2914	0.394	0.0568		0.0326
03MS	0.3007	0.3771	0.0004	0.0308			0.0026
04MS	0.003	0.0014		0.0025			
05MS	0.3299	0.0146	0.033	0.0312			
06MS	0.1818	0.013	0.0579	0.0062			
07MS	0.0480	0.0024	0.0429	0.0049			
08MS	0.1851	0.0179	0.0163	0.0329			
09MS	0.0785	0.0417	0.1453				
10MS	0.0647	0.0028	0.0076	0.0005			
11MS	0.1950	0.0027	0.0144	0.0112			0.0001
12MS	0.0902	0.006	0.2298	0.4974			
13MS	0.0980	0.0084	0.3000	0.3657			
14MS	0.1025	0.0070		0.0016			
15MS	0.0147	0.0045	0.0707	0.0017			0.0007
16MS	0.0370	0.0076	0.1313	0.0011			0.0013
17MS	0.0910	0.0022	0.0999	0.0436			0.0090
18MS	0.0092	0.0067		0.2603			
19MS	0.5531	1.7796	0.0008	0.5290	0.1189		0.0401
20MS	-	0.0069		0.0002			
21MS	0.0038	0.001	0.0053	0.0362			
22MS	0.0131		0.1657	0.1079			
23MS	0.0120	0.0060		0.0091			0.0017
24CR	0.0388	0.0027		0.0000			0.0002
25CR	0.5456	0.1126	0.0025	0.3305			0.0176
26CR	0.2494	0.0011		0.0005			0.0071
27CR	0.1005	0.0113		0.0000			0.0003
28CR	1.0178	0.107	0.0256	0.0019			0.0128
30CR	0.1648	0.0359	0.110	0.0029			0.0019
31CR	0.1288	0.0511	0.0325	0.0019			0.0069
33CR	0.3265	0.8870	0.6997	0.0046			0.0027
35CR	0.0738	0.0104					
36CR	0.0254	0.0342	0.0006				
37CR	0.0010	0.0067					
38CR	0.1196	0.0037					
39CR	0.0253	0.0584					0.0016
40CR	3.4149	1.1461	0.0006	0.0016			0.0055
41CR	-	0.0029	0.0002	0.0002			
42CR	0.007						
43CR	0.0116	0.0005	0.0007	0.0004			0.0013
44CR	0.0601	0.0001					
45CR	0.020	0.0003	0.0002				
46CR	0.006	0.0003	0.0011				
48CR	0.2639	0.1712	0.0045	0.6268			0.0137
49CR	0.0727	0.011	0.0000				
50CR	0.5357	3.0281	0.0386	0.0114			0.0238
51CR	0.1239	0.0049	0.0018	0.1607			0.0014
52CR	0.0010	0.0022		0.0002			
53CR	0.1193	0.0016	0.0001	0.0018			0.0015

Station	Polychaeta [AFDW g/0.1 m²]	Crustacea [AFDW g/0.1 m²]	Mollusca [AFDW g/0.1 m²]	Echinodermata [AFDW g/0.1 m²]	Cnidaria [AFDW g/0.1 m²]	Oligochaeta [AFDW g/0.1 m²]	Other Taxa [AFDW g/0.1 m²]
54CR	0.0302	0.0124	0.0302	0.0023			0.0075
55CR	0.2680	0.2234	0.0896	0.0422			0.0128
56CR	0.0063	0.0029	0.3177				
57CR	0.0132	0.0019		0.0042			
58CR	0.1698	0.0803		0.2319			0.0001
59CR	0.0759	0.3098	0.0048	0.0009			
60CR	0.0355	0.0032	0.1384	0.1372			0.0003
61CR	0.0907	0.0027	0.0850	3.5149			
62CR	0.7785	0.9272	2.4834	0.0222	0.0057		0.0379
63CR	0.0627	0.0013	0.0268	0.0071			
64CR	1.5679	2.0257	0.1401	2.0294			0.0166
65CR	2.3723	1.0257	0.0440	0.0095		0.0003	0.0551
66CR	0.0669	0.017		0.0050			0.0323
67CR	0.9183	0.975	0.0072	1.6405			0.0525
68CR	1.172	2.445	0.0793	0.6489			0.0113
69CR	0.0029	0.0006					

Note:
AFDW – Ash Free Dry Weight

B.7.10 Grab Sample Certificate of Analysis Biomass

Certificate Number	EP/17/0002	**Fugro GB Marine Ltd Job Number**	160976
Job Reference	Vattenfall Norfolk Vanguard		
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	23-11-16	**Date of Analysis**	23-11-16 to 09-01-17
Sample Matrix	Macrobenthic Species BIOMASS (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	9th January 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.

C. DATA ANALYSIS

C.1 PARTICLE SIZE DISTRIBUTION DATA ANALYSIS

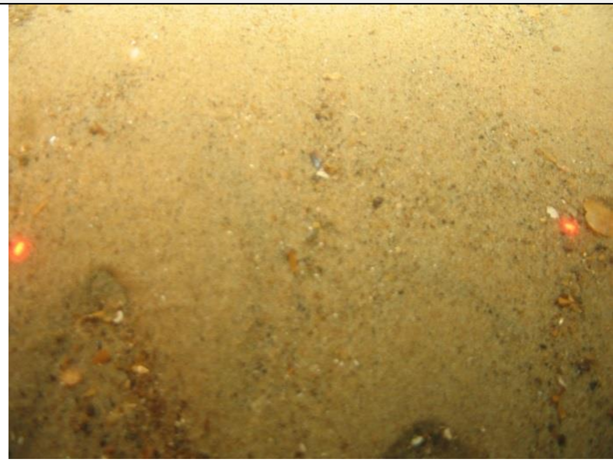
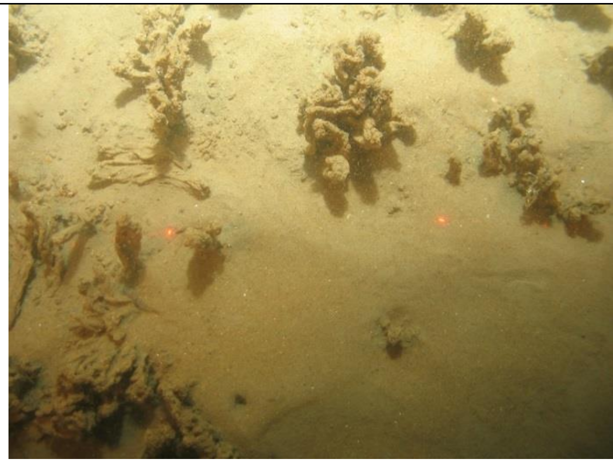
Sieve and laser data were merged and entered into the software GRADISTAT v8.0 (Blott and Pye, 2001) to derive statistics including percentage of each particle greater than each phi aperture size, mean and median grain size, bulk sediment classes (percentage silt, sand and gravel), skewness, sorting coefficients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

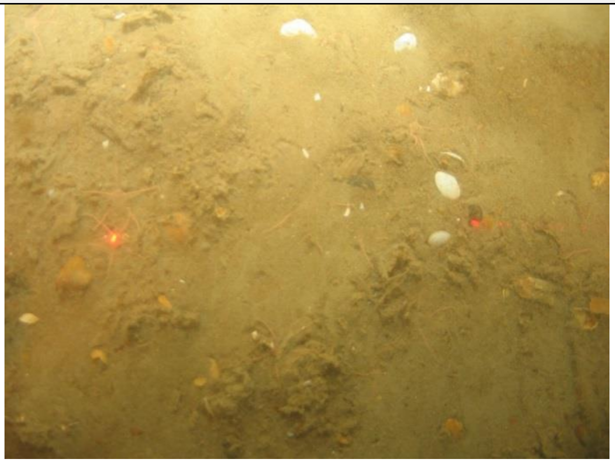
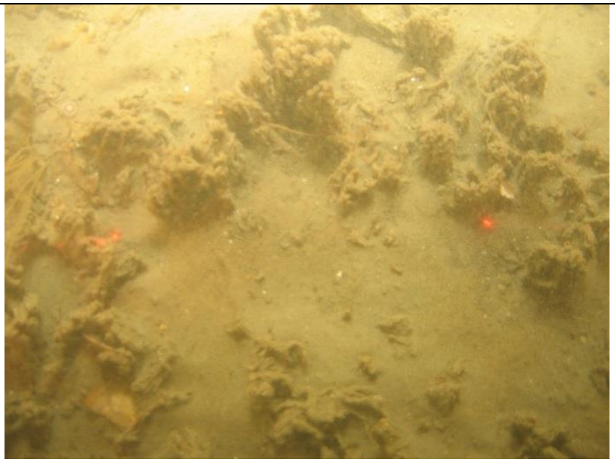
Table D.1: Sediment Particle Size Distribution Statistics

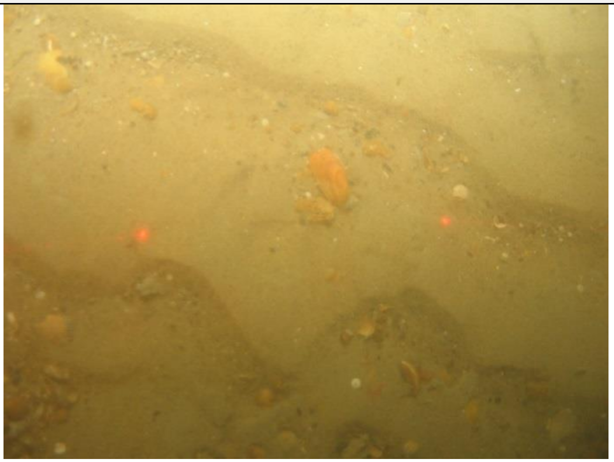
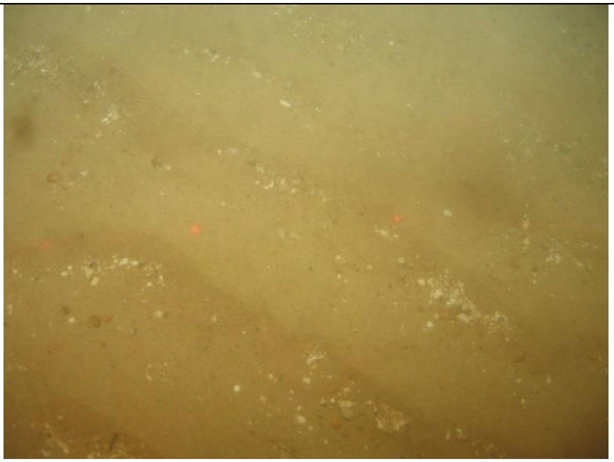
Distributional Statistic Measure	Description
Phi scale	A logarithmic scale which allows grain size data to be expressed in units of equal value for the purpose of graphical plotting and statistical calculations. The scale is based on the following relationship: $phi = -log_2 d$ where *d* is the grain 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

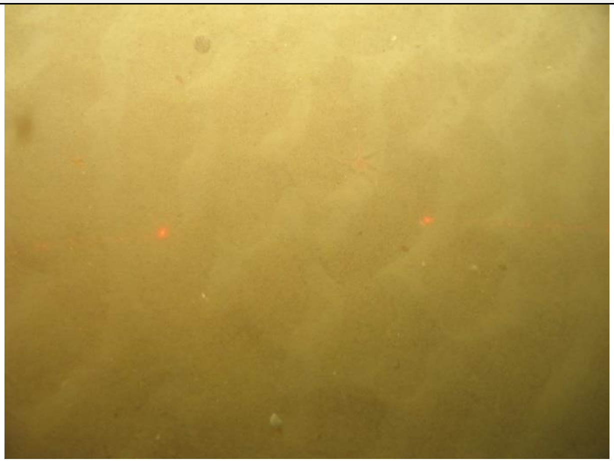
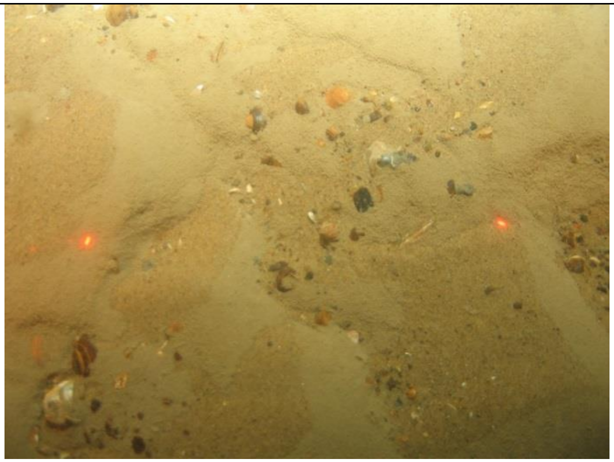
D. RESULTS

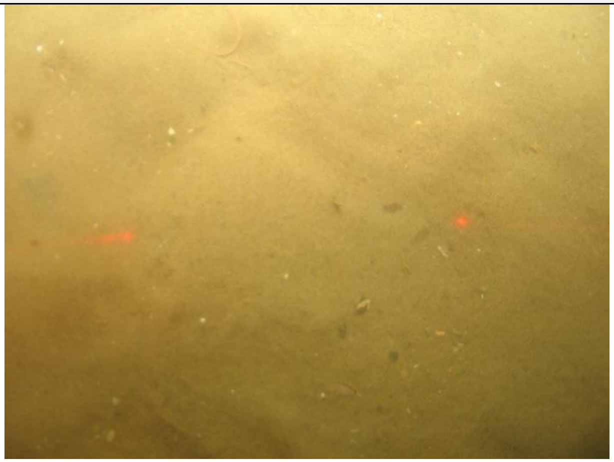
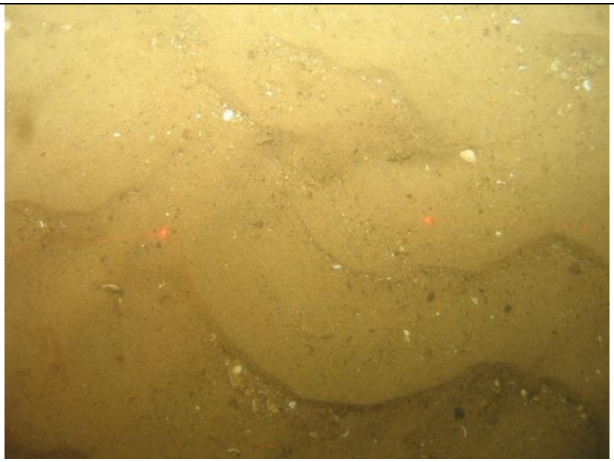
D.1 DROP DOWN VIDEO AND STILLS

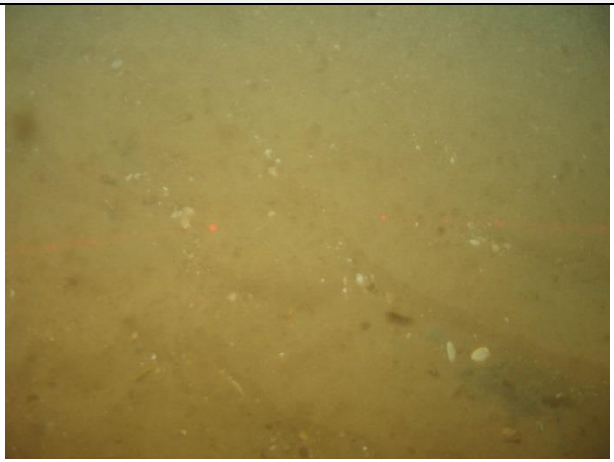
<table>
<tr><th>Station</th><th>General Description</th><th>Detailed Sediment Notes</th><th>Conspicuous Species</th><th>Estimated Abundance</th><th>Representative Image</th></tr>
<tr><td rowspan="2">01MS</td><td>Shelly sand</td><td>Slightly pebbly slightly gravelly shelly rippled sand with occasional cobbles</td><td>None</td><td>N/A</td><td></td></tr>
<tr><td>Sand</td><td>Slightly pebbly slightly gravelly rippled sand, Sabellaria tubes seen</td><td>Sabellaria spinulosa tubes
Liocarcinus sp.
Decapoda
Callionymidae
Paguridae
Asterias rubens
Pleuronectiformes
Gobiidae
Gadidae
Hydroid turf
Caridea
Galathea sp</td><td>F
O
O
O
O
O
O
O
O
R
P
P</td><td></td></tr>
</table>

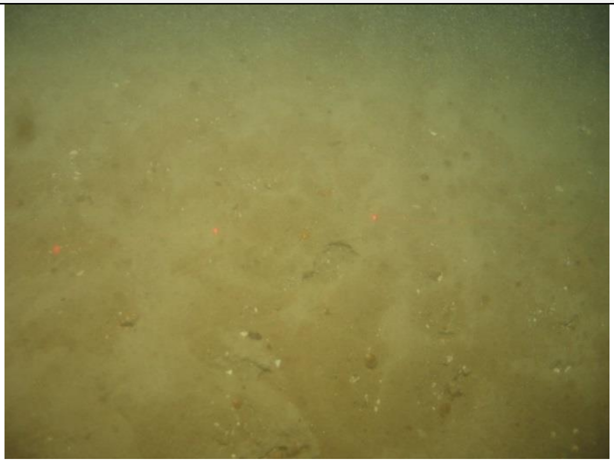
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
02MS	Sand	Shelly pebbly sand, *Sabellaria* tubes forming crusts present	*Asterias rubens* *Urticina* sp. *Ophiura* sp. Hydroid/bryozoan turf *Spirobranchus* sp. Cirripedia *Pecten maximus* *Ophiura albida* Ophiuridae Actinaria Setularidae Pectinidae	O R R P P P R R R P P P	
03MS	Sand	Slightly pebbly slightly gravelly rippled sand. *Sabellaria* tubes present	*Sabellaria spinulosa* *Asterias rubens* Paguridae Hydroid/bryozoan turf *Nemertesia antennina* Actinaria	O O R P P P	

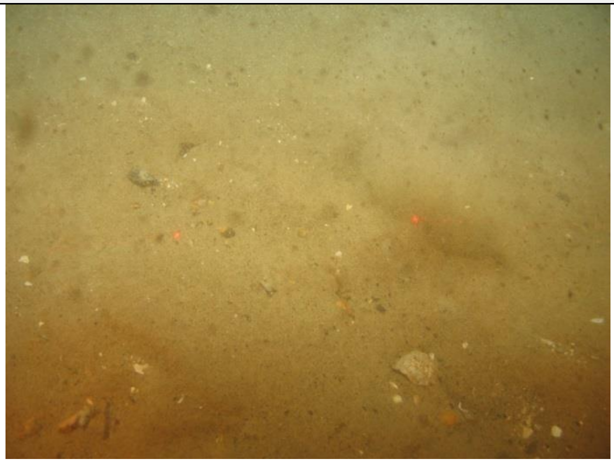
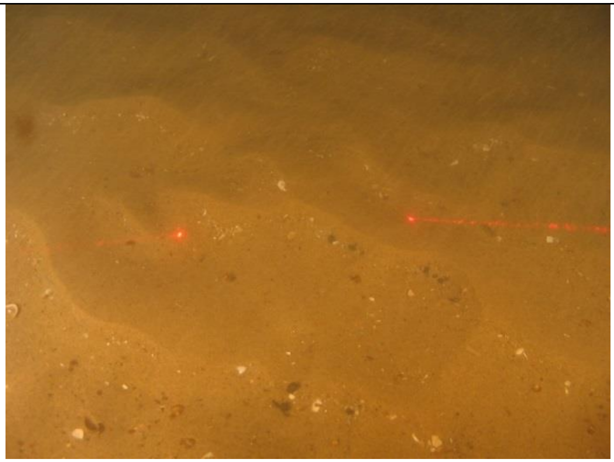
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
	Slightly shelly sand	Slightly pebbly slightly gravelly shelly rippled sand	Paguridae Hydroid/bryozoan meadow	R P	
04MS	Sand	Slightly shelly rippled sand	Pleuronectiformes Paguridae *Asterias rubens*	R R O	

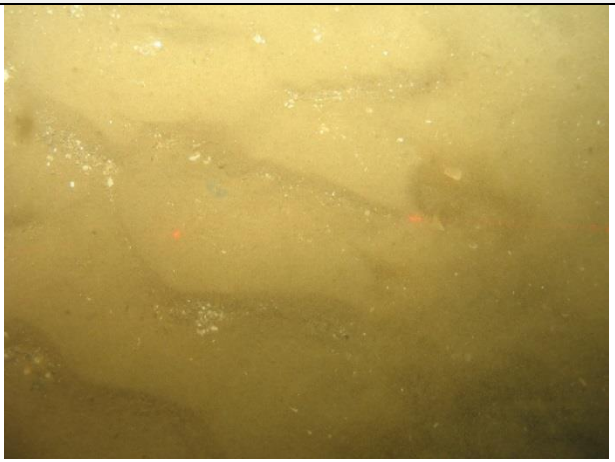
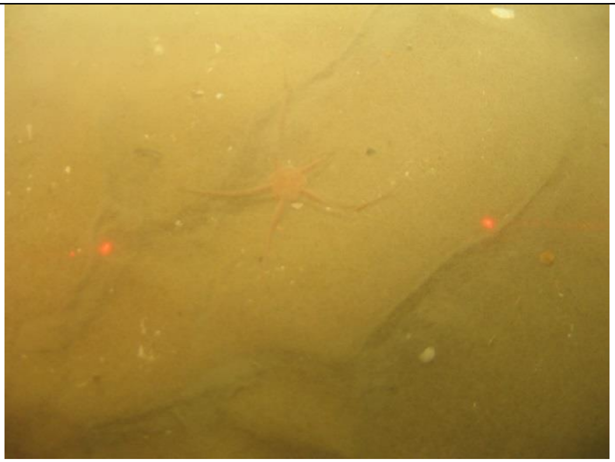
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
05MS	Sand	Slightly shelly rippled sand	*Ophiura albida* Hydroid/bryozoan turf	R P	
06MS	Sand	Slightly shelly slightly pebbly rippled sand	*Asterias rubens* Gadidae Hydroid/bryozoan meadow *Ophiura albida*	R O P R	

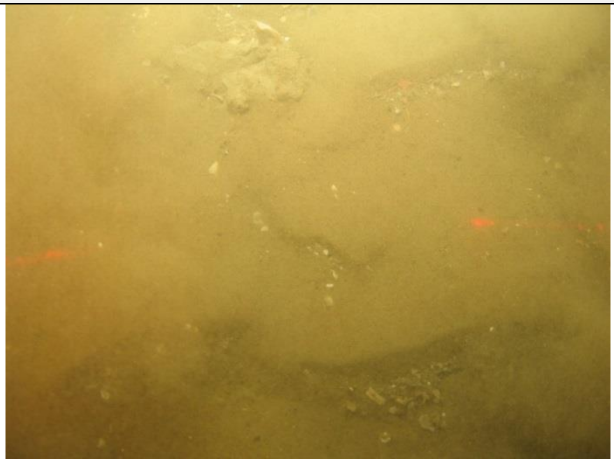
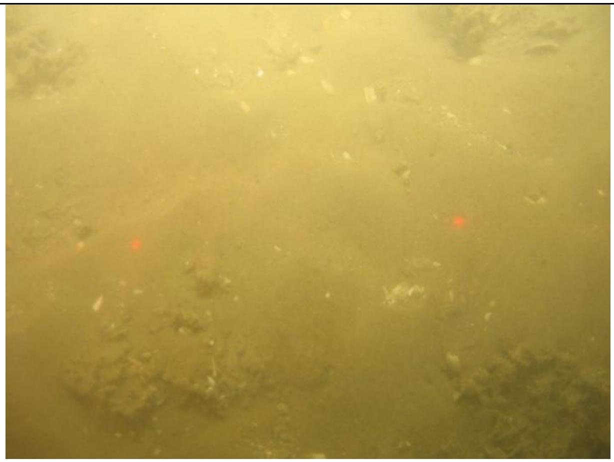
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
07MS	Sand	Slightly shelly rippled sand	*Pagurus bernhardus* Gobidae Ophiuridae	R R R	
08MS	Sand	Slightly shelly slightly gravelly rippled sand	Pleuronectiformes Ophiuridae Hydroid/bryozoan turf	R R P	

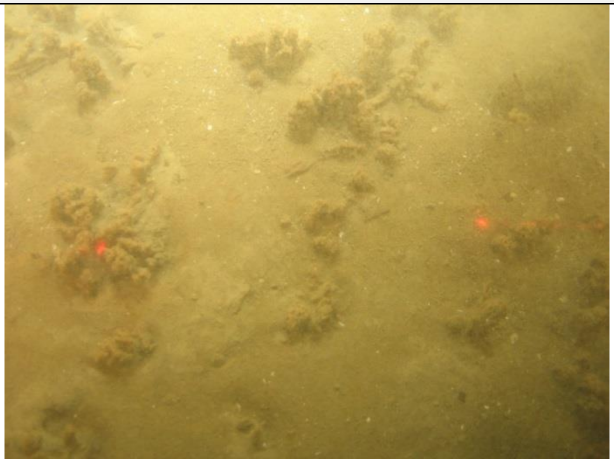
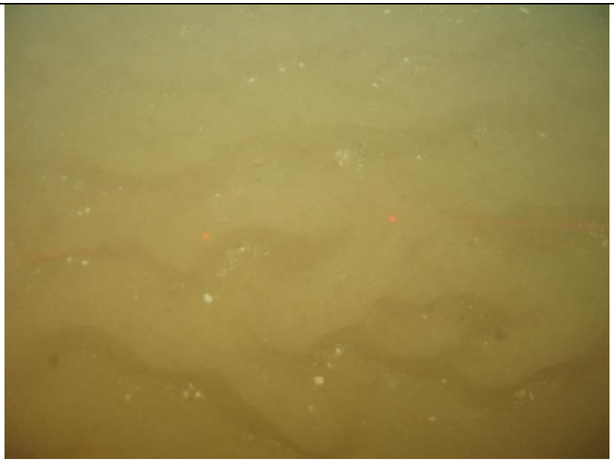
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
09MS	Sand	Slightly shelly gravelly rippled sand with occasional cobbles	Gadidae	O	
10MS	Sand	Slightly shelly rippled sand	Gadidae	O	

Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
11MS	Sand	Slightly shelly slightly gravelly rippled sand	None	N/A	
12MS	Sand	Slightly shelly slightly gravel rippled sand	*Liocarcinus* sp. Ophiuridae	O R	

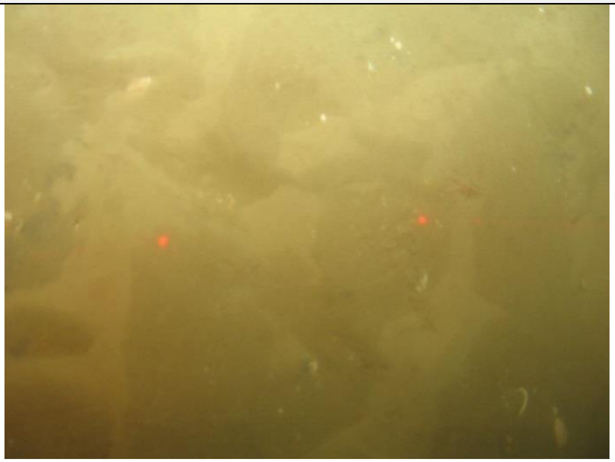
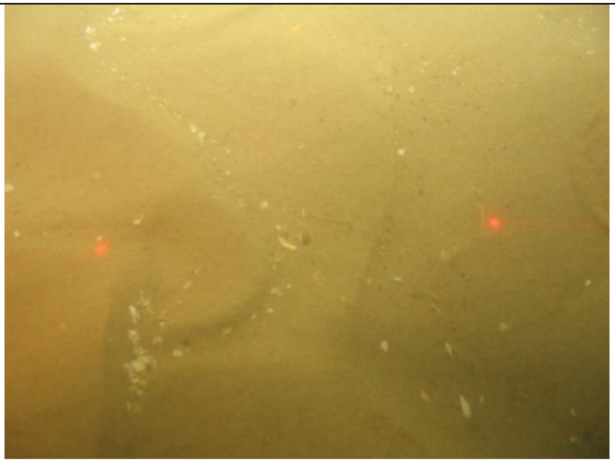
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
13MS	Sand	Slightly shelly rippled sand	Ophiuridae Paguridae Soleidae Hydroid/bryozoan turf	R R R P	
14MS	Sand	Slightly shelly rippled sand, one small patch of gravelly sand	Hydroid/bryozoan turf Soleidae Ophiuridae	P R R	

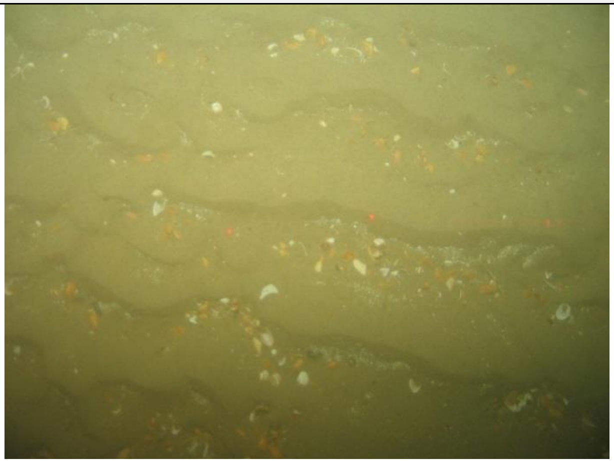
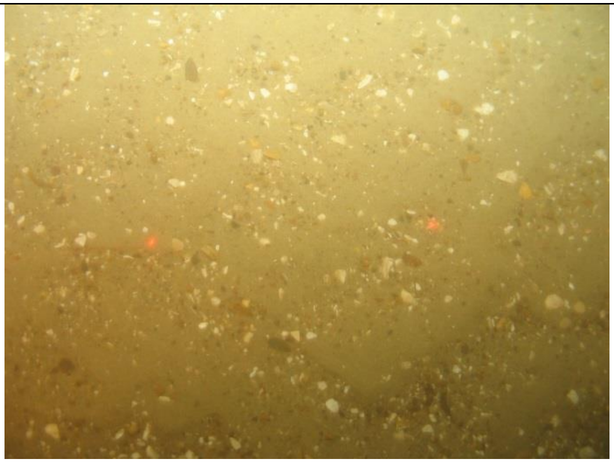
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
15MS	Sand	Slightly shelly rippled sand	*Ophiura ophiura* Solidae Paguridae Hydroid/bryozoan turf	R R R P	
16MS	Sand	Slightly shelly rippled sand	*Ophiura ophiura* Paguridae *Alcyonium digitatum* Ophiuridae	R R P R	

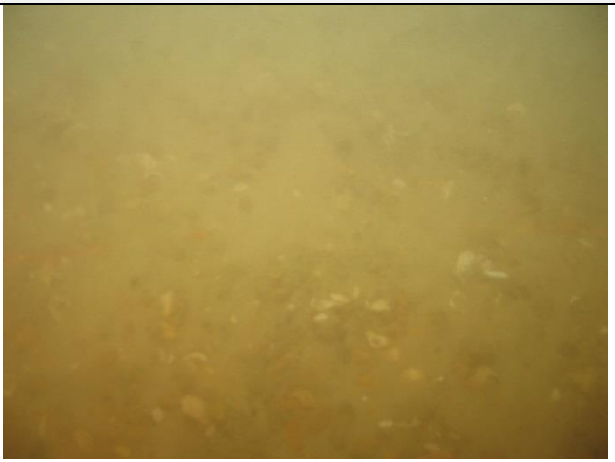
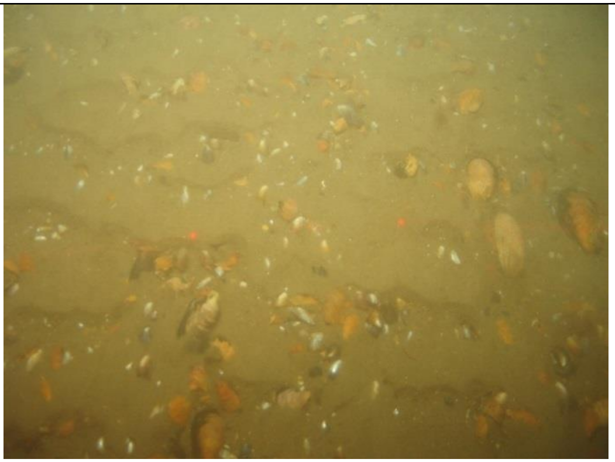
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
17MS	Sand	Slightly shelly rippled sand	*Ophiura* sp. Paguridae	R R	
	Sand	Slightly shelly rippled sand, occasional clumps of *Sabellaria*	*Sabellaria spinulosa* tubes *Ophiura albida* Soleidae Decapod (crab)	O R R R	

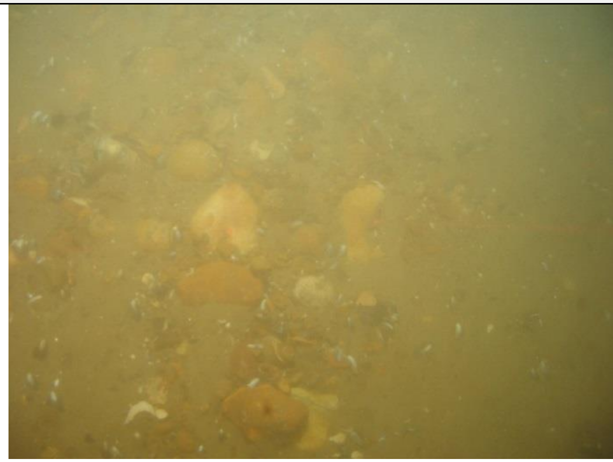
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
	Shelly sand	Slightly pebbly slightly gravelly rippled sand, *Sabellaria* tubes present	*Sabellaria spinulosa* tubes *Liocarcinus* sp.	O O	
18MS	Sand	Slightly shelly rippled sand	Soleidae Paguridae Ophiuridae *Ophiura ophiura*	R R R R	

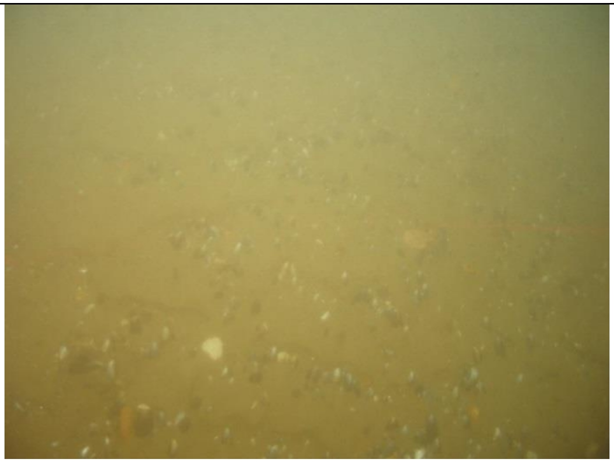
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
19MS	Sand	Mobile sand with high percentage cover of *Sabellaria* tubes present	*Asterias rubens* *Sabellaria* Paguridae *Liocarcinus* sp. Pesciformes	C A R O O	
20MS	Sand	Slightly shelly rippled sand. Poor visibility.	Ophiuridae	R	

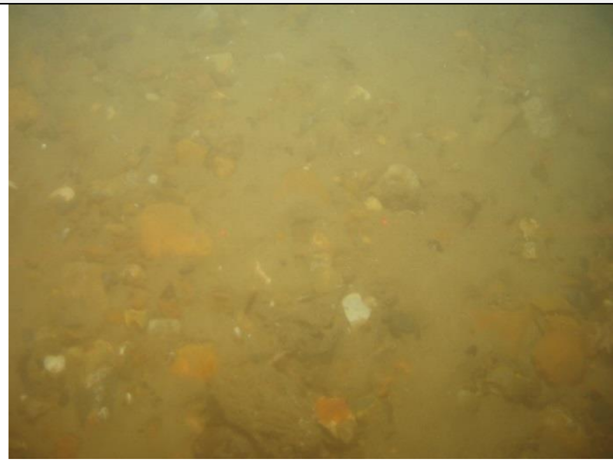
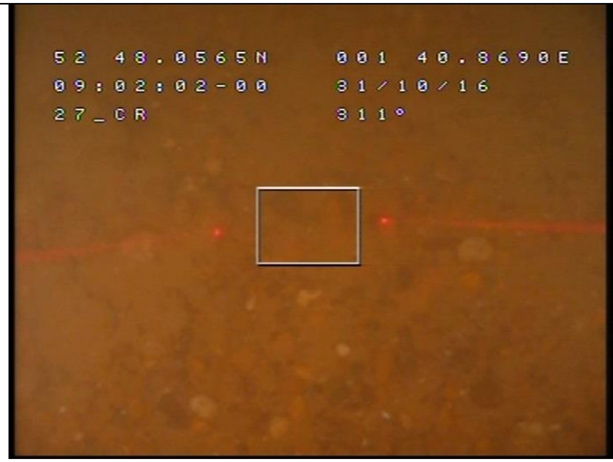
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
21MS	Sand	Slightly shelly rippled sand	*Ophiura* sp. Pesciformes *Soleidae*	R O R	
22MS	Sand	Slightly pebbly shelly rippled sand with a few isolated patches of dense pebbles	*Sabellaria spinulosa* tubes	P	

Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
23MS	Sand	Shelly rippled sand with a few pebbles	*Ophiura* sp.	R	
24CR	Shelly sand	Slightly pebbly shelly sand with ripples and waves	Pesciformes Pleuronectiformes *Sabellaria spinulosa* tubes	O O R	

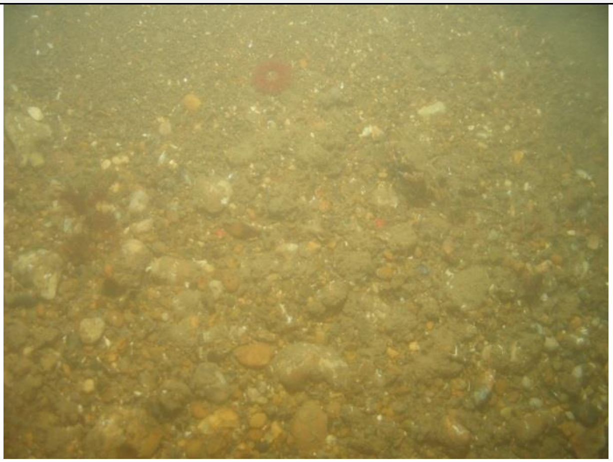
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
25CR	Shelly sand	Slightly pebbly slightly gravelly rippled sand.	*Sabellaria spinulosa* tubes *Liocarcinus* sp. Hydroid/bryozoan turf *Urticina* sp.	F O P R	
26CR	Shelly sand	Shelly rippled sand with high propotion of empty mussel shells.	Paguridae	R	

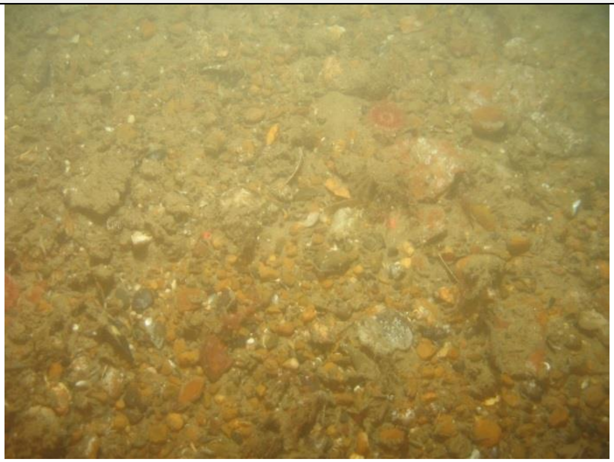
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
27CR	Gravelly pebbly sand	Gravelly pebbly sand	*Sabellaria spinulosa* *Spirobranchus* sp.	R P	
	Cobbley pebbly sand	Cobbley pebbly sand. One white (chalk?) boulder was present.	None	None	

Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
	Gravelly pebbly sand	Gravelly pebbly sand with high propotion of empty mussel shells	None	N/A	
	Shelly sand	Slightly pebbly shelly rippled sand	None	N/A	

Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
	Gravelly pebbly sand	Gravelly pebbly sand	*Flustra foliacea* Hydroid/bryozoan turf Paguridae *Sabellaria spinulosa* crust	P P R P	
	Cobbles and pebbles	Cobbles and pebbles with sand	*Urticina* sp. *Flustra foliacea* *Asterias rubens*	R P O	

Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
	Sandy pebbly gravel	Sand, pebbles and gravel with erect *Sabellaria* tubes present	*Sabellaria spinulosa* *Urticina* sp. *Ophiura* sp. *Asterias rubens* *Cancer pagurus*	O R R O O	
	Gravelly pebbly sand	Gravelly pebbly sand with empty mussel shells	*Asterias rubens* *Flustra foliacea* *Urticina* sp. *Liocarcinus* sp.	O P R O	

Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
28CR	Pebbly gravelly sand	Pebbly gravelly sand with occasional larger cobbles. *Sabellaria c*rusts were present A patch of mussel shells and a small patch of rippled sand were seen along the transect	*Urticina* sp. *Urticina felina* *Flustra foliacea* *Asterias rubens* *Sabellaria* *Neocora puber* Hydrozoa Pesciformes *Cancer pagurus* Solasteridae Callionymidae *Crossaster papossus* Paguridae *Liocarcinus* sp. *Nemertesia antennina* *Sagartia* sp. *Spirobranchus* sp. *Liocarcinus depurator* Rhodophycota Caridea *Lanice conchilega* *Crepidula fornicata* Bryozoan crusts *Sabella sp.* Porifera (encrusting) Ascidiacea *Agonus cataphractus* Hydroid/bryozoan turf Hydroid/bryozoan meadow Gobiidae *Hyas* sp. Actinaria	O R P O C O R O O O R O R R P O R P R R R R R R R R R R R R O R	

Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
29CR	Sandy pebbly gravel	Sandy pebbly gravel, sand overlying coarse substrate	*Flustra foliacea* *Urticina* sp. Cirripedia *Crossaster papposus* Hydroid/bryozoan turf *Sabellaria spinulosa* crusts	P O R O P R	

Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
	Pebbly sandy gravel	Pebbly gravelly sand with *Sabellaria* clumps and crusts present	*Sabellaria spinulosa* Callionymidae *Urticina* sp. *Cancer pagurus* Paguridae Hydrozoa *Crossaster papossus* Cirripedia Bryozoan crusts *Spirobranchus* sp. *Flustra foliacea* Hydroid/bryozoan turf Rhodophycota Caridea Porifera *Sabella* sp. Didemnidae Actinaria *Liocarcinus* sp. Cottidae *Nemertesia antennina*	F O R O R R O O R P R R R P R R R R O O R	

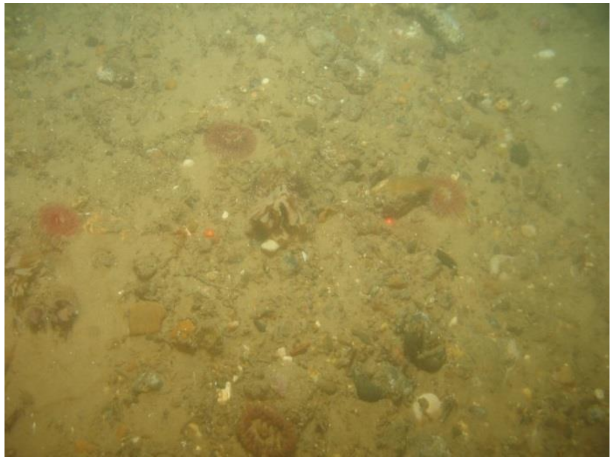
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
	Pebbly sandy gravel	Pebbly gravelly sand with *Sabellaria* clumps and crust. Some tube aggregations appear erect from seabed	*Sabellaria* *Urticina* sp. Solasteridae Caridae *Cancer pagurus* *Flustra foliacea* Porifera *Crossaster papossus* *Asterias rubens* Rhodophycota *Henricia* sp.	F F O P O P R O O R O	
30CR	Pebbly sandy gravel	Pebbly sandy gravel with *Sabellaria* crusts and occasional clumps. These appear erect from seabed.	*Sabellaria* crust *Flustra foliacea* Hydrozoa *Urticina* sp. *Asterias rubens* *Crossaster papossus* *Liocarcinus* sp. *Nemertesia ramosa* Bryozoan crusts Rhodophycota *Spirobranchus* sp. *Crepidula fornicata* Hydroid/bryozoan turf Cirripedia Corallinaceae *Gibbula* sp. Hydroid/bryozoan meadow *Sabella* sp. Porifera crusts Gobidae	O O R O O O O F R O P R O R R F R O R P	

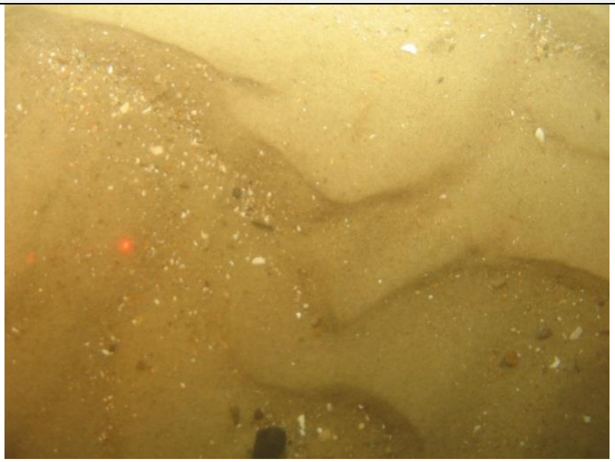
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
31CR	Pebbly sand	Slightly shelly pebbly rippled sand with occasional cobbles	*Flustra foliacea* Galathridae Porifera *Urticina* sp. *Crossaster papossus* *Asterias rubens* Hydroid/bryozoan turf Ascidiacea *Sabella* sp. Rhodophycota	R R R R O O R R R R	
	Gravelly sandy pebbles	Gravelly sandy pebbles with cobbles. Sand appears as a veneer over coarser substrate	*Flustra foliacea* *Urticina* sp. *Crossaster papossus* Hydroid/bryozoan turf Rhodophycota Porifera encrusting ?*Styela clava* Caridea *Urticina felina*	R R O O R R R P R	

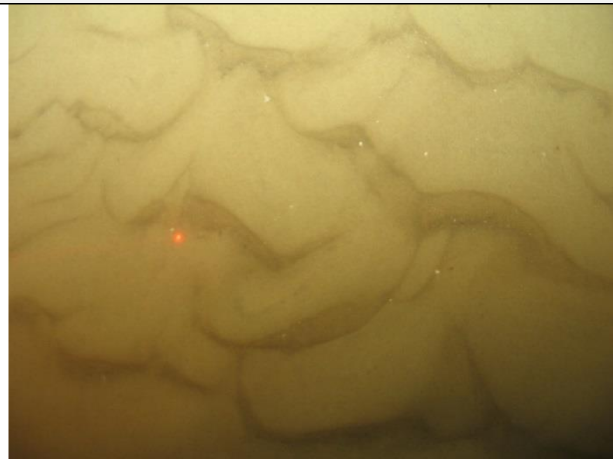
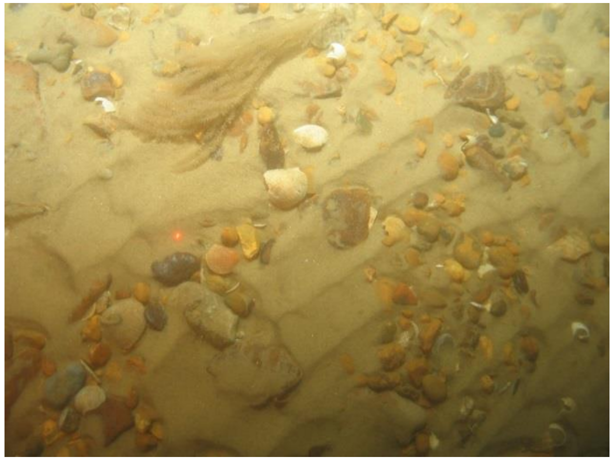
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
	Pebbly shelly sand	Pebbly shelly rippled sand	*Flustra foliacea* *Liocarcinus* sp. *Urticina* sp. *Sabellaria spinulosa* crusts Cirripedia Hydroid/bryozoan turf	R O R R R R	
	Gravelly pebbly sand	Gravelly pebbly sand with cobbles. Sand appears as a veneer over coarser substrate. Occasional patches of *Sabellaria* crust present along the transect	*Flustra foliacea* *Saberllaria spinulosa* crust *Urticina* sp. *Cancer pagurus* Hydroid/bryozoan turf *Crossaster papossus* Rhodophycota Cirripedia *Calliostoma zizyphinum* Caridea Gobidae *Liocarcinus* sp. *Pagurus bernhardus*	R C R O O O R R R P R O R	

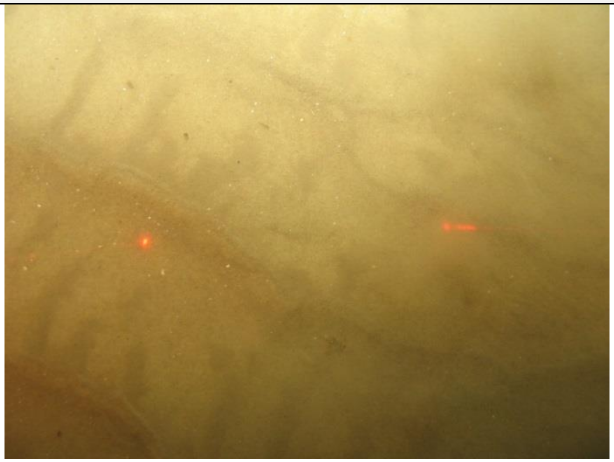
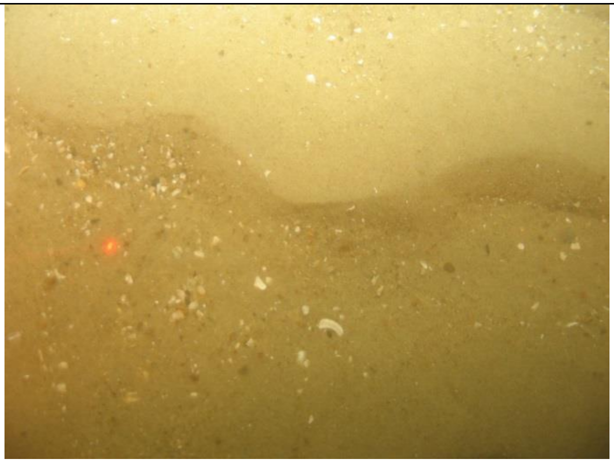
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
32CR	Pebbly gravel	Slightly sandy slightly shelly pebbly gravel with occasional cobbles	*Urticina* sp. *Crossaster pappossus* Rhodophycota *Liocarcinus* sp. Porifera crusts *Nemertesia* sp. *Corallinaceae* *Spirobranchus sp.* Bryozoan crusts Hydroid/bryozoan turf Hydroid/bryozoan meadow *Gibbula* sp. *Henricia* sp. *Nemertesia antennina* Cirripedia Caridea Decapoda *Crepidula fornicata* *Necora puber* *Paguridae* *Flustra foliacea*	R O R O R R O P O R R F O R R P O R O R R	

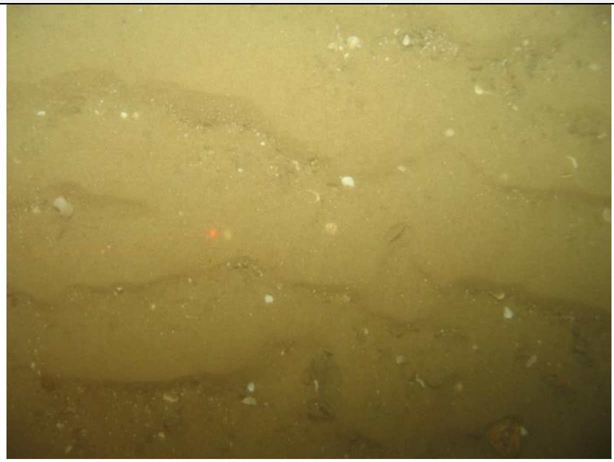
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
33CR	Pebbly sandy gravel	Pebbly sandy gravel with *Sabellaria* crust	*Flustra foliacea* *Urticina* sp. Hydroid/bryozoan turf *Crossaster papossus* *Cancer pagurus* *Sabellaria spinulosa* crust Porifera crusts Caridea *Liocarcinus* sp. Callionymidae *Ophiura albida* Ophiuridae Ascidiacea Hydroid/bryozoan meadow *Alcyonium diaphanum* Actinaria	F R F O O R R P O O R R R R P R	

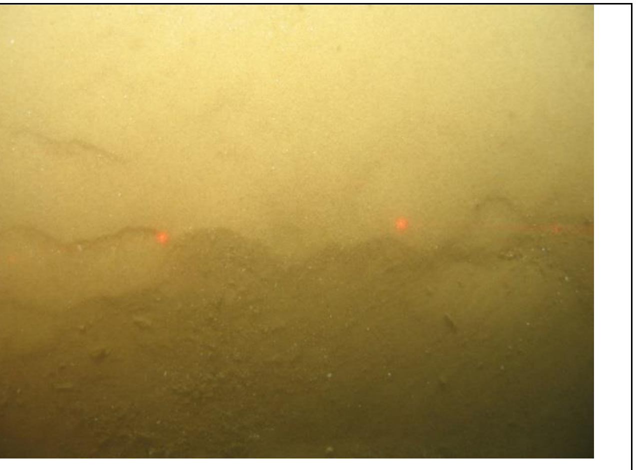
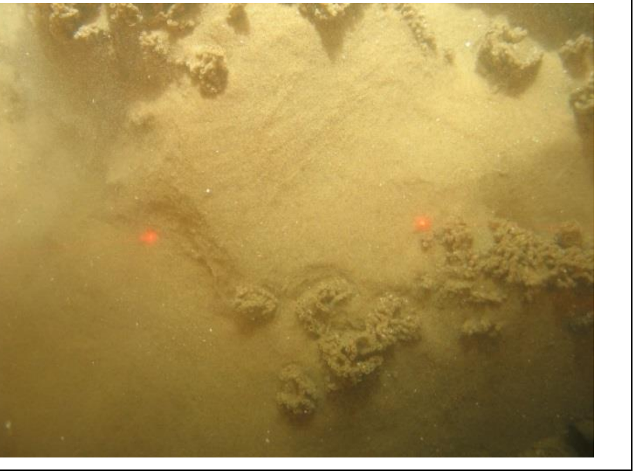
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
34CR	Gravel	Slightly shelly sand gravel with pebbles. Cobbles present.	*Calliostoma zizyphinum* *Flustra foliacea* Porifera crust Hydroid/bryozoan turf Rhodophycota *Necora puber* *Cancer pagurus* *Crossaster papposus* *Asterias rubens* *Urticina* sp. Decapoda *Pagurus bernhardus* *Sabellaria* custs Bryozoan crusts Caridea Actinaria *Galathea* sp. Corallinacea *Spirobranchus* sp. *Nemertesia antennina* *Gibbula* sp. *Dysidea fragilis*	R F R P R O O O O O F O O R R P R R P O F R	

Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
35CR	Sand	Slightly shelly slightly gravelly rippled sand	On cobbles *Spirobranchus* sp. Bryozoan crusts	 P R	

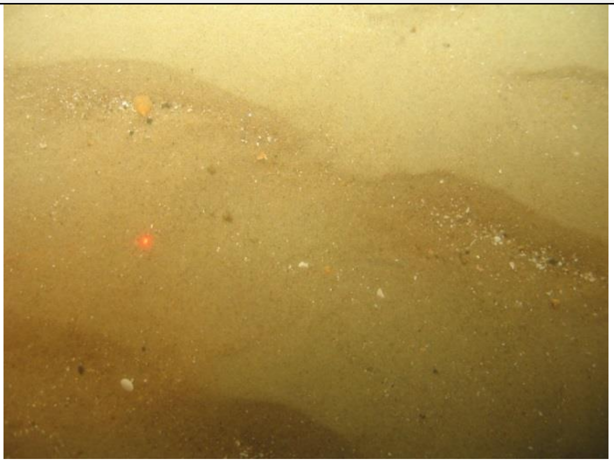
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
36CR	Sand	Slightly shelly rippled sand throughout. Gravelly patches are visible and the percentage of gravel increases towards the end of the transect	Hydroiod/bryozoan turf	R	 

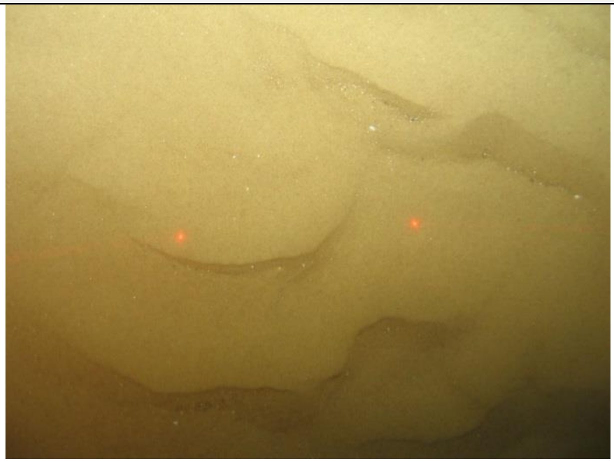
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
37CR	Sand	Slightly shelly rippled silty sand	Ammodytidae Hydroid/bryozoan meadow	O R	
38CR	Sand	Slightly shelly slightly gravelly rippled sand	Ammodytidae	O	

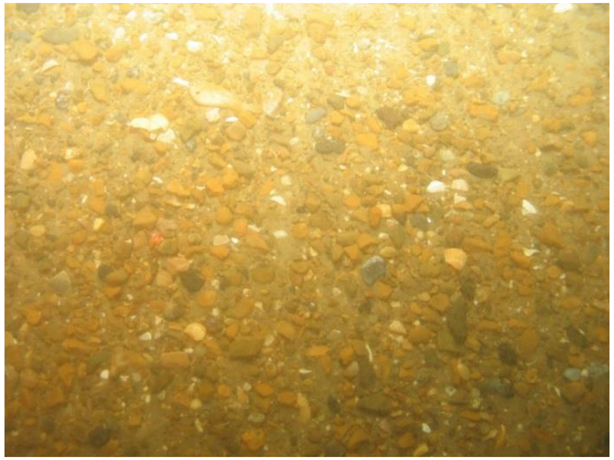
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
39CR	Sand	Slightly shelly slightly gravelly rippled sand.	None	N/A	

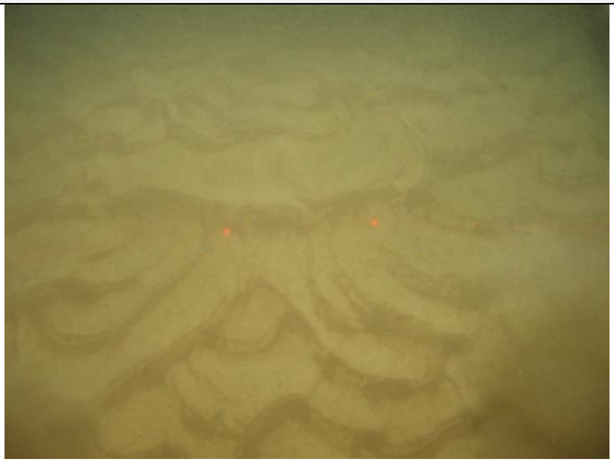
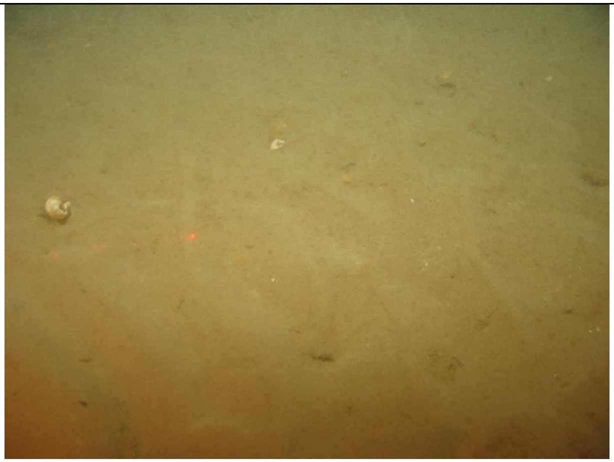
40CR	Sand	Slightly shelly slightly gravelly sand with ripples. Few gravel patches present.	*Sabellaria spinulosa* tubes *Sabellaria spinulosa* crust Hydroid/bryozoan turf *Asterias rubens* *Liocarcinus* sp. Ammodytidae Decapoda (crab) Caridea	P P P O O O O P	 

Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
					

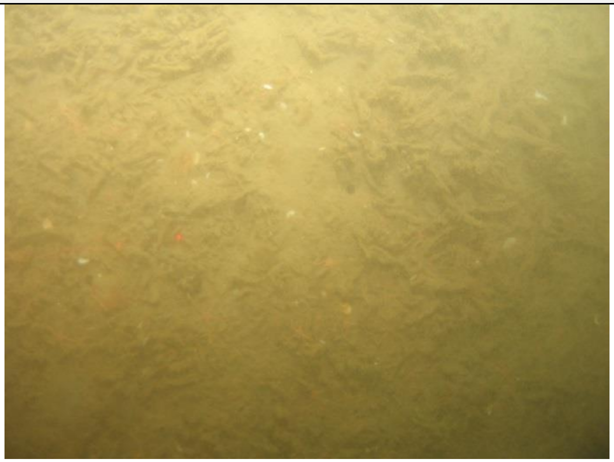
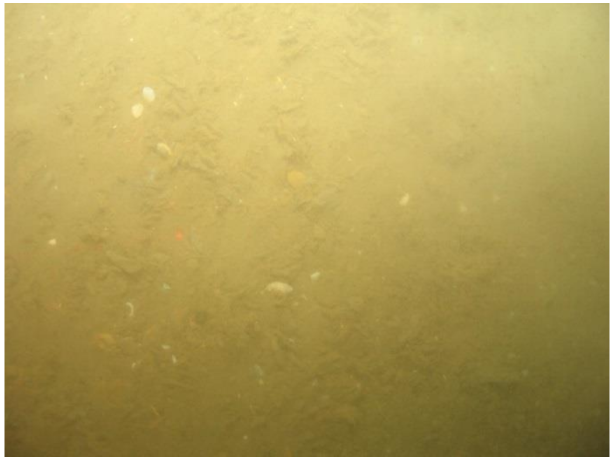
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
41CR	Sand	Slightly shelly slightly gravelly sand. Four *Sabellaria* clumps were notes on gravel. These appeared to be moribund.	Cephalopoda *Pagurus bernhardus*	O O	 

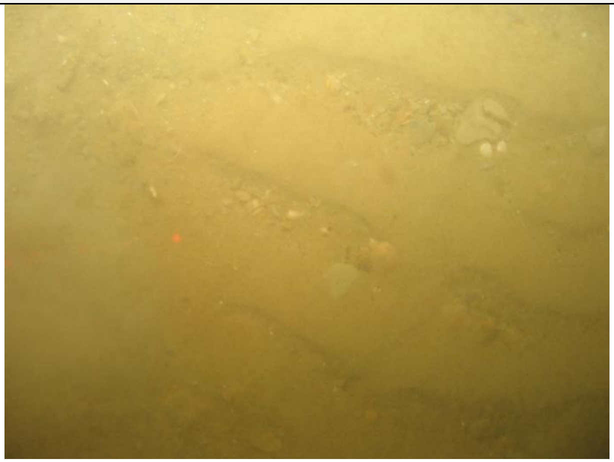
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
42CR	Sand	Slightly shelly rippled sand	Ammodytidae	O	

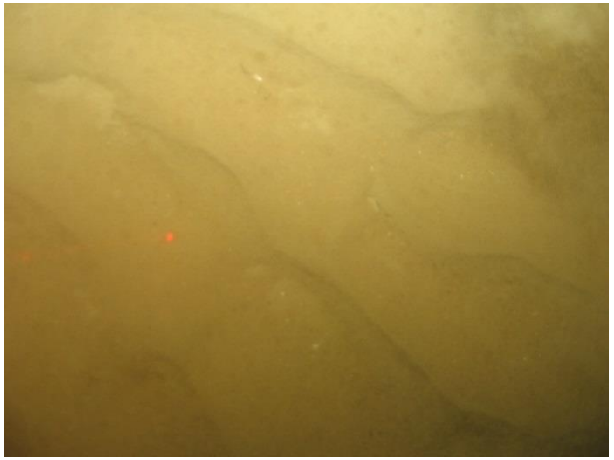
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
43CR	Sand and Gravel	The transect is characterised by alternating slightly shelly slightly gravelly sand and slightly shelly sand gravel, with areas presenting a range of percentage of gravel content.	*Sabellaria* clumps and crusts *Pagurus bernhardus* *Urticina* sp. *Liocarcinus* sp. Hydroid/bryozoan turf Actinaria *Necora puber* *Flustra foliacea* *Spirobranchus* sp.	P O R O R R O R P	 

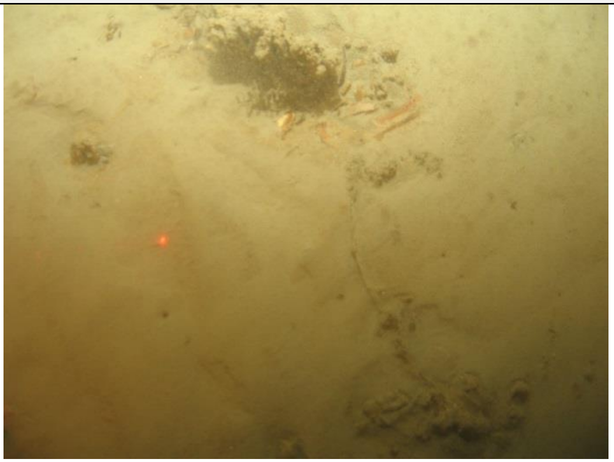
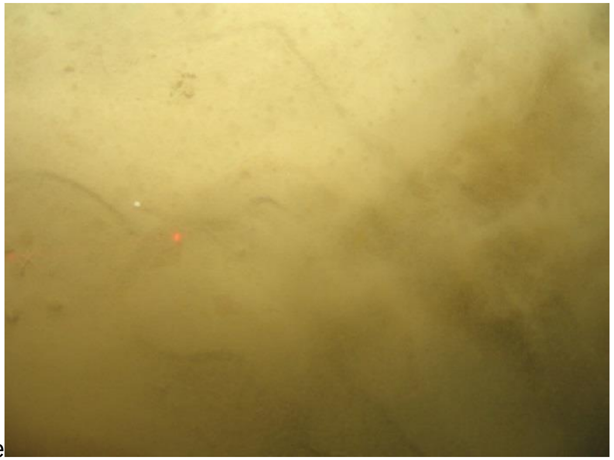
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
44CR	Sand	Rippled silty sand	*Pagurus bernhardus* Ammodytidae	O O	
45CR	Sand	Slightly shelly slightly gravelly rippled silty sand	*Pagurus bernhardus* Pesciformes Polychaete casts	O O P	

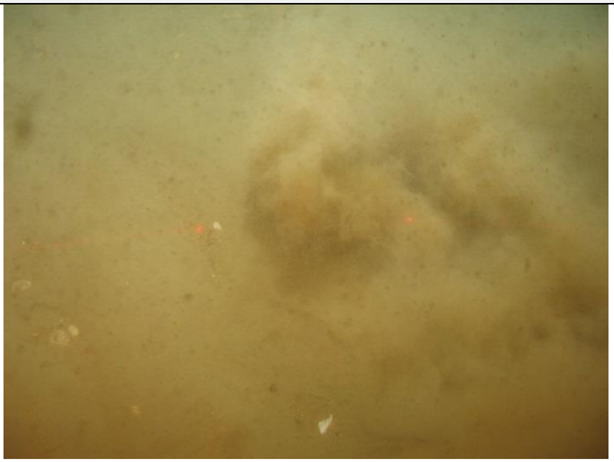
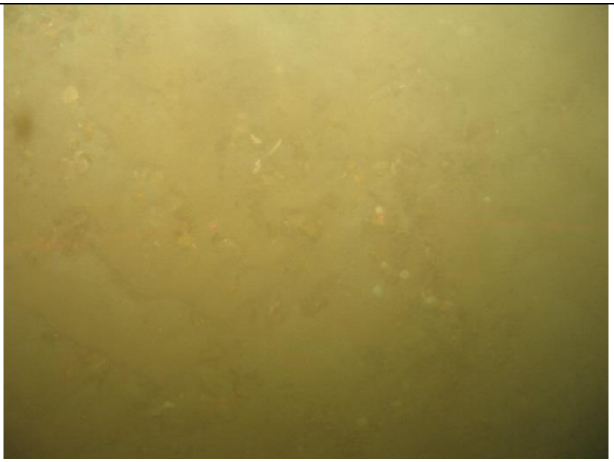
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
46CR	Sand	Slightly shelly slightly gravelly sand with crumbly clay patches regularly seen throughout the transect. Two *Sabellaria* clumps were present, but considered dead.	Ophiuridae *Pagurus bernhardus* *Sabellaria* clumps (possibly moribund)	R O P	

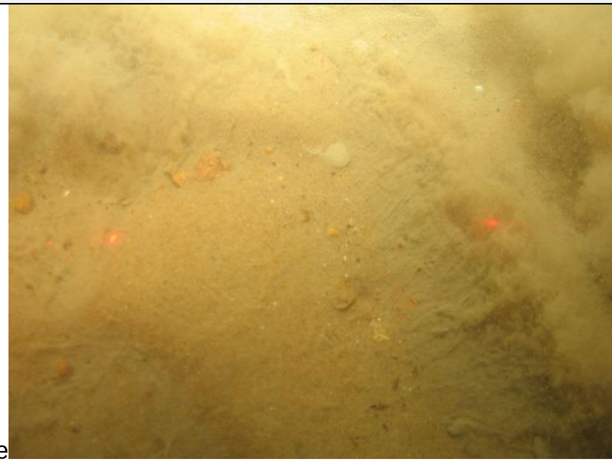
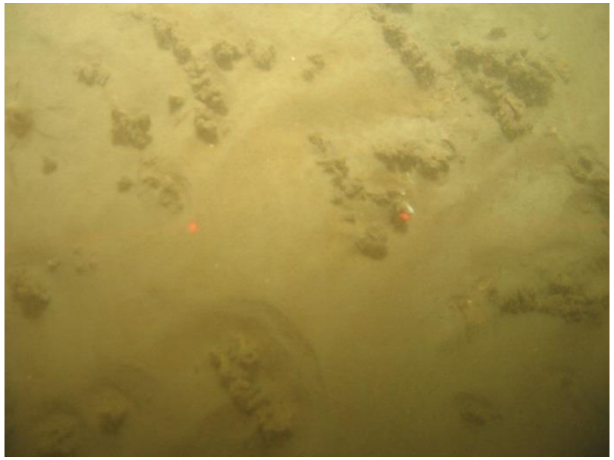
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
48CR	Sand	Slightly shelly gravelly sand. The entire transect is characterised by the presence of *Sabellaria spinulosa.*	*Sabellaria* tubes clumps *Ophiura* sp. Actinaria Hexacorallia *Psammechinus miliaris* *Asterias rubens* *Liocarcinus* sp. ?*Cancer pagurus* Unidentified fish Hydroid/bryozoan turf Actinaria Caridea	F A R R R F O O O R O P	 

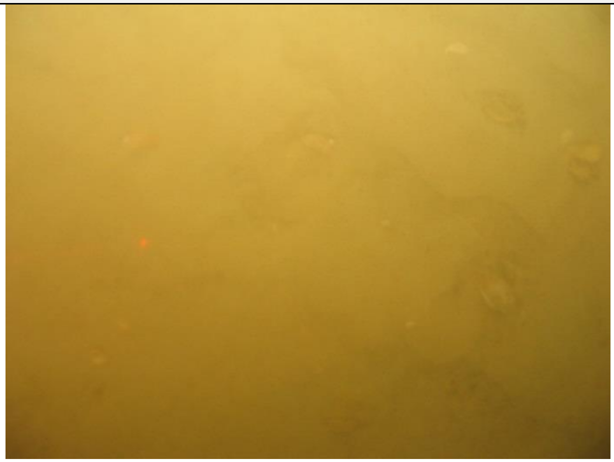
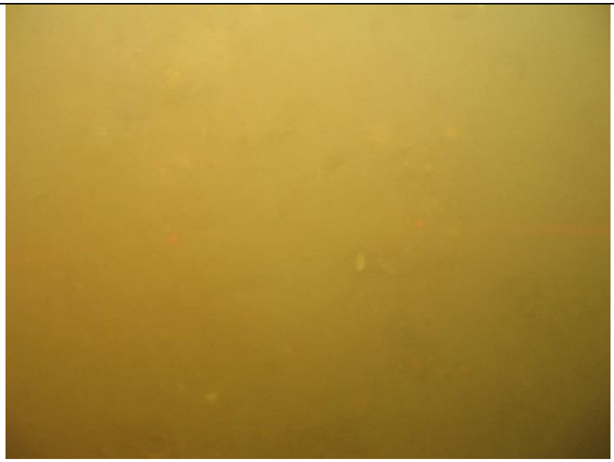
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
49CR	Sand	Slightly shelly gravelly sand for most of the transect, interspaced by areas of slightly shelly muddy sand. Possible clay outcrop seen. Limited visibility at times.	*Ophiura albida* *Ophiura ophiura* Paguridae	O R R	 

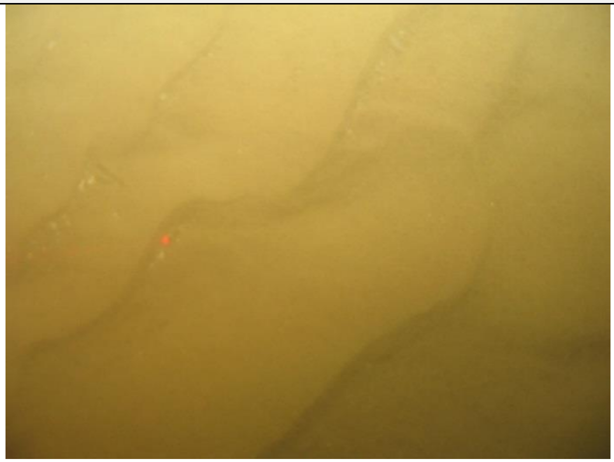
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
50CR	Sand	Slightly shelly slightly gravelly rippled muddy sand	*Sabellaria spinulosa* clumps *Ophiura albida* Hydroid/bryozoan turf *Asterias rubens* Paguridae	P O P O R	 

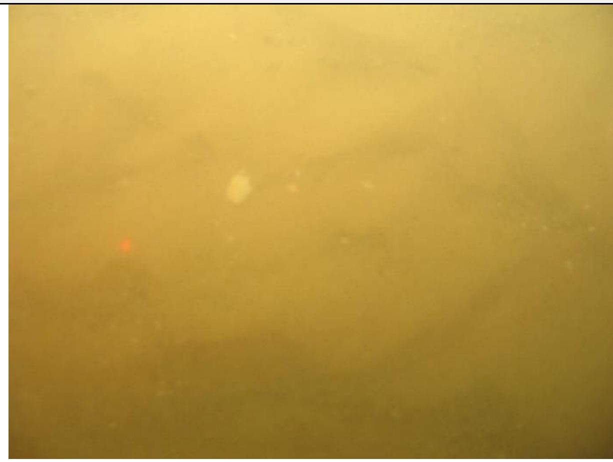
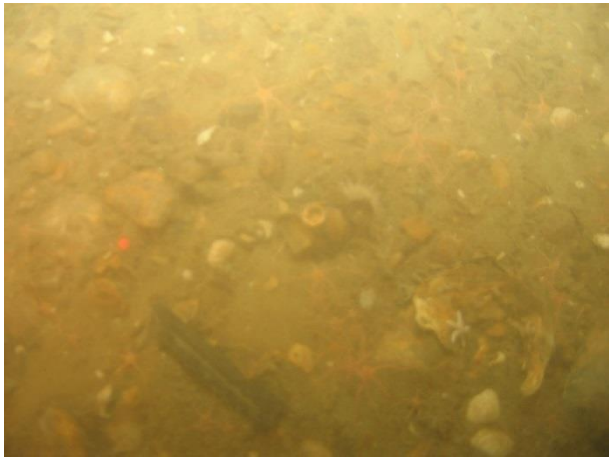
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
51CR	Sand	Slightly shelly slightly gravelly muddy sand. At the beginning and at the end of the transect *Sabellaria* clumps are visible.	*Ophiura albida* Hydroid/bryozoan turf Unidentified fish *Sabellaria* tubes *Ophiura ophiura*	O P O P R	 e

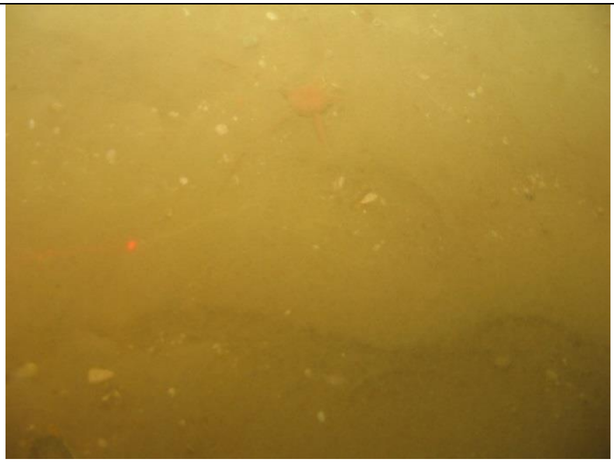
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
52CR	Sand	Slightly shelly slightly gravelly muddy sand	Hydroid/bryozoan turf	P	
53CR	Sand	Slightly shelly gravelly muddy sand with pebbles.	*Ophiura* sp. Hydroid/bryozoan turf	O P	

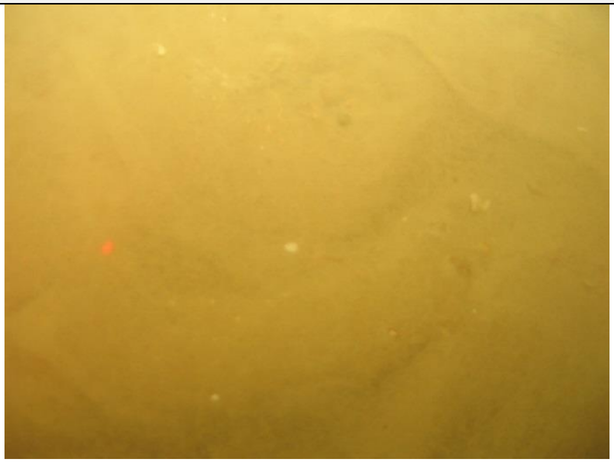
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
54CR	Sand	The station is characterised by slightly shelly gravelly sand. A section of the transect shows sparse Sabellaria clumps	Ammodytidae *Sabellaria spinolsa* clumps Porifera/bryozoa crust *Ophiura ophiura* *Ophiura albida* Hydroid/bryozoan turf	O P P O R R	 e 

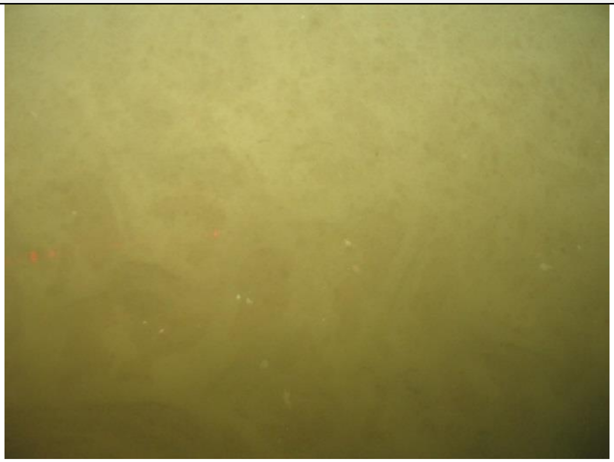
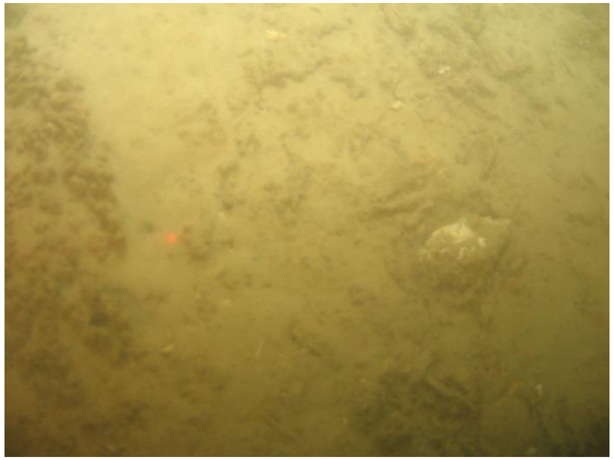
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
55CR	Sand	The seabed is not visible for the majority of the transect length due to suspended sediment. Where the seabed is visible, the seabed looks consistently slightly shelly gravelly rippled sand throughout.	*Sabellaria spinulosa* small tubes clump	P	
56CR	Sand	The seabed is not visible for the majority of the transect length due to suspended sediment. Where the seabed is visible, the seabed looks consistently slightly shelly slightly gravelly rippled sand throughout.	Ophiuridae	R	

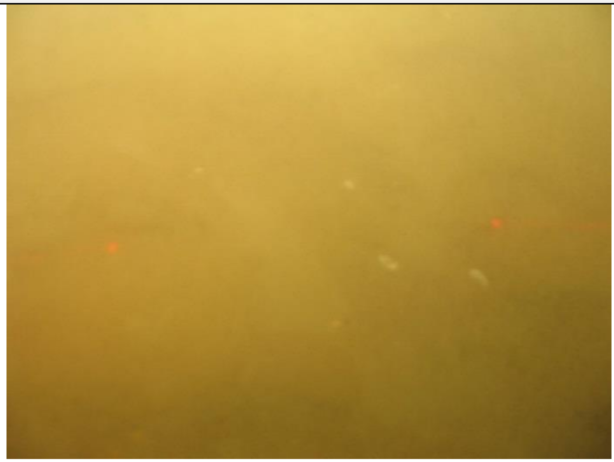
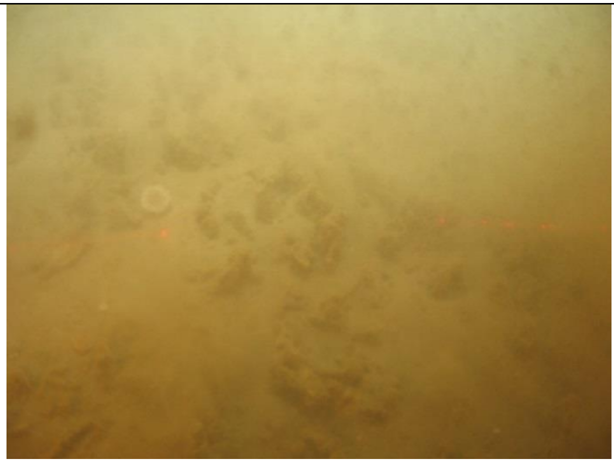
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
57CR	Sand	Slightly shelly rippled sand. Reduced visibility.	*Ophiura* sp. ? *Echinocardium* sp.	R R	

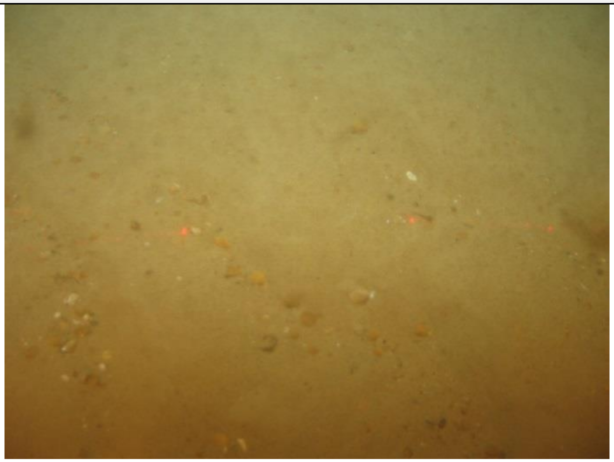
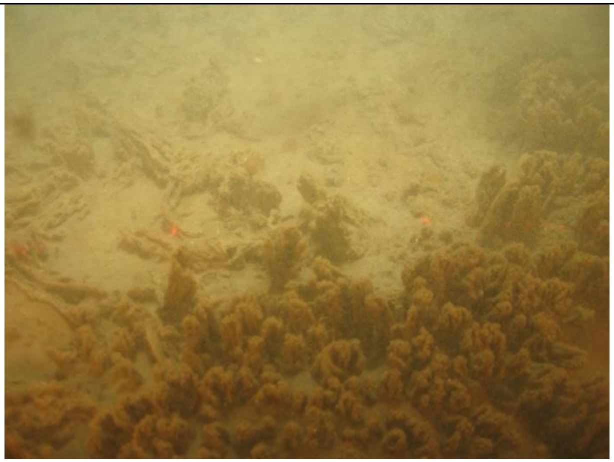
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
58CR	Gravelly Sand	At the beginning of the transect the seabed is characterised by slightly shelly slightly gravelly sand. As the transect progresses the sediment becomes gravelly sand with pebbles to the end of the transect.	*Asterias rubens* Actinaria Hydroid/bryozoan meadow *Ophiura albida*	O F R P	 

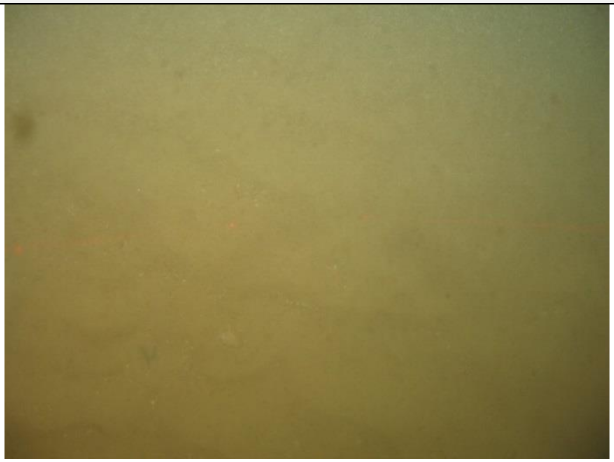
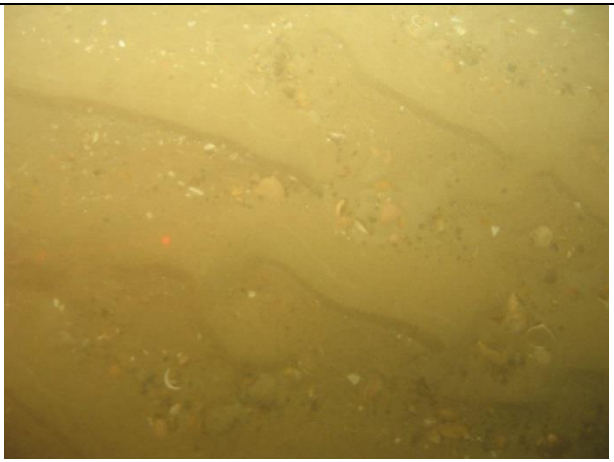
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
59CR	Sand	The seabed at this station is mainly described as Slightly shelly slightly gravelly rippled sand. As the transect progresses patches of shelly gravelly rippled sand are seen with few pebbles.	*Ophiura ophiura*	R	
60CR	Sand	Slightly shelly slightly gravelly rippled sand with occasional pebble. Limited visibility due to suspended sediment.	*Ophiura ophiura*	O	

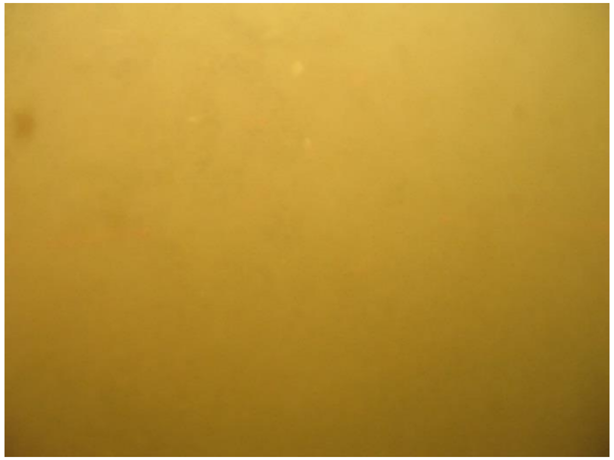
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
61CR	Sand	Slightly shelly slightly gravelly sand with occasional pebble	None	NA	

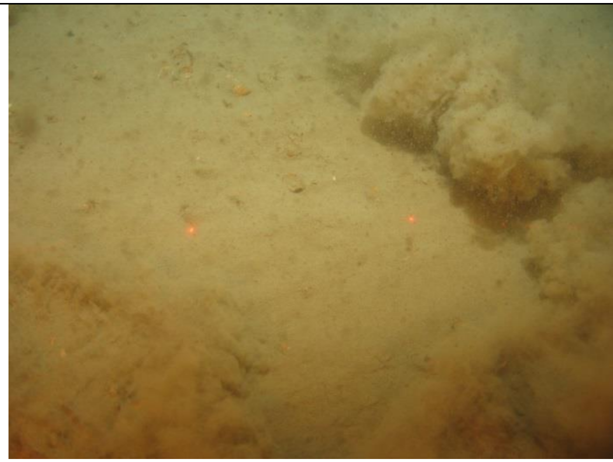
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
62CR	Sand	The sediment at the start of the transect is slightly shelly sand. As the transect progresses it becomes gradually slightly shelly gravelly sand with pebbles.	*Ophiura albida* *Sabellaria spinulosa* clumps *Asterias rubens* *Liocarcinus* sp. *Pagurus* sp.	F C F O O	 

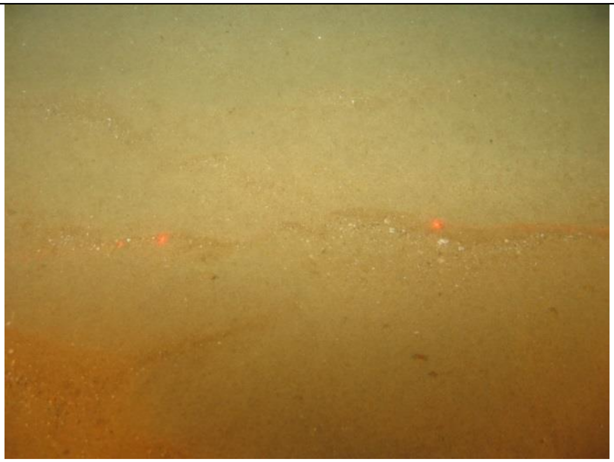
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
63CR	Sand	Slightly shelly muddy rippled sand. Limited visibility.	Ammodytidae	O	
64CR	Sand	Slightly shelly, slightly gravelly rippled sand. Visibility at times reduced by suspended sediment.	*Sabellaria spinulosa* tubes *Liocarcinus* sp. Actinaria Hydroid/bryozoa turf Asteroidea *Pagurus bernhardus* Soleidae Pesciformes (Triglidae?) Bryozoa crust	O O R R R O O O R	

Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
		Slightly shelly, slightly gravelly rippled sand. Visibility at times reduced by suspended sediment.	Ammodytidae	O	
65CR	Sand	Slightly shelly, slightly gravelly rippled sand. Visibility reduced by suspended sediment.	*Sabellaria spinulosa* clumps *Pagurus bernhardus* *Liocarcinus* sp. *Ophiura ophiura* Hexacorallia (Actinaria?)	C O O O R	

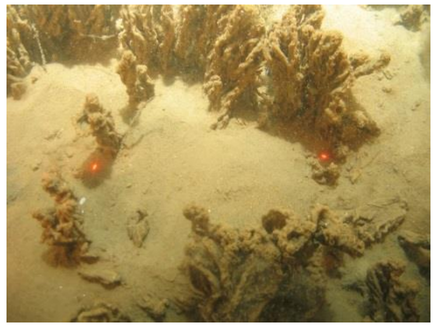
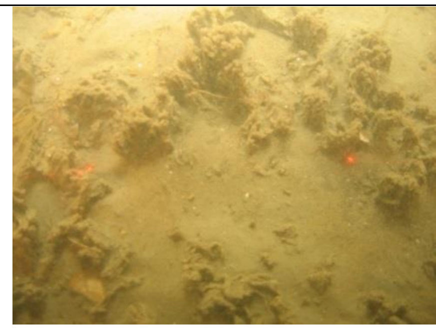
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
			None	N/A	
66CR	Sand	Slightly shelly, gravelly rippled sand. Visibility very poor.	*Echinocardium cordatum* Pesciformes ?Ammodytidae	O O O	

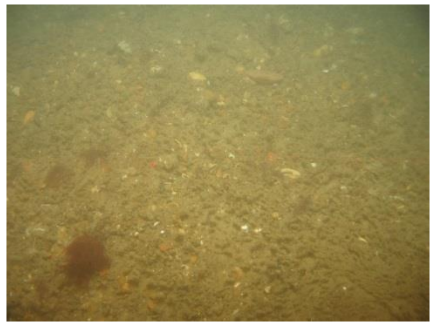
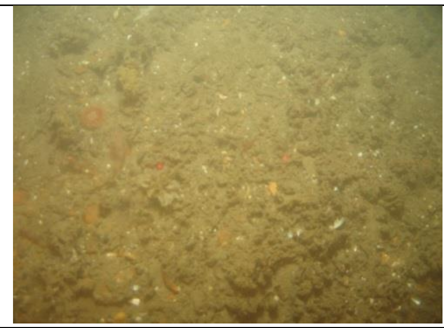
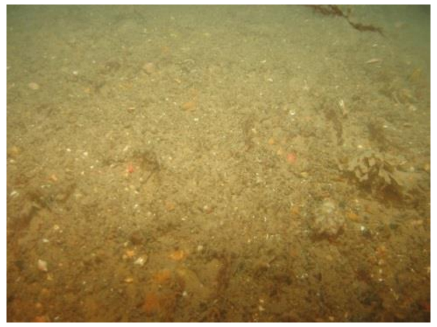
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
67CR	Sand	Shelly, gravelly sand. Due to the high turbidity of the station with re-suspended sediment, the seabed is not visible along the entire transect and a proper description is therefore not possible to complete. Only Ssabellaria agglomerates were visible, but not quantifiable, whilst it was not possible to assess the presence and abundance of any other faunal taxa	*Sabellaria spinulosa* tubes	P	

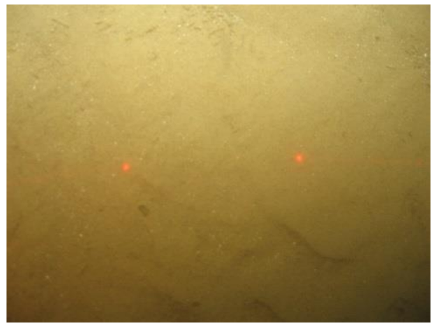
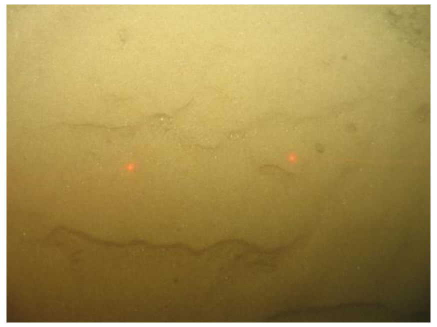
Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
68CR	Sand	Rippled Slightly Shelly and Slightly Gravelly Sand. The sand appears to be mobile and a number of bore holes are visible.	*Sabellaria spinulosa* clumps *Inachus* sp. Hydroid/bryozoan turf Paguridae *Ophiura ophiura*	O R R R F	
	Sand	Slightly shelly, slighlty gravelly rippled Sand. Despite suitable environment no *Sabellaria* was visible in this section of the transect. The sand appears to be mobile and a number of bore holes are present.	*Ophiura ophiura*	F	

Station	General Description	Detailed Sediment Notes	Conspicuous Species	Estimated Abundance	Representative Image
	Sand	Slightly shelly, slighlty gravelly rippled sand. The sand appears to be mobile and a number of bore holes are visible.	*Sabellaria spinulosa* clumps Hydroid/bryozoan turf Paguridae *Ophiura ophiura* *Liocarcinus* sp.	O R R F O	
69CR	Sand	Rippled Slightly Shelly and Slightly Gravelly Sand. Visibility very poor.	None	NA	

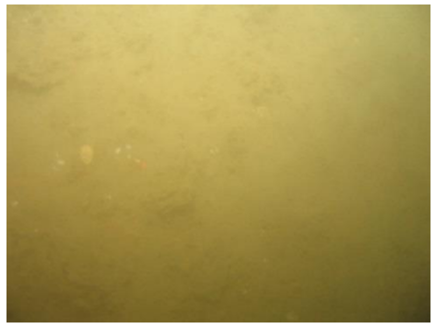
D.2 SABELLARIA ASSESSMENT

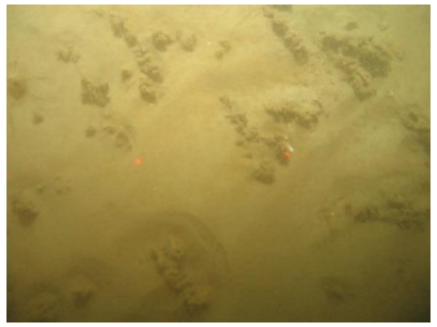
Station	Sediment Description	*Sabellaria* form present					*Sabellaria* Characteristics			Representative Image	Reef Definition Based on			Overall Assessment
		Absent	Moribund Tubes	Crusts	Clumps	Potential Reef	Elevation	Patchiness	Brief Description of *Sabellaria* Recorded		Elevation	Patchiness	Consolidation	
01MS	Rippled sand	N	Y	N	Y	Y	2 – 5 cm	12%	Clumps of consolidated upright tubes of *Sabellaria* were present, together with clumps of moribund tubes. In places the elevation of the tubes above the surrounding seabed was in the range of 5 – 10 cm. However, the average tube height across the area was in the region of 2 – 5 cm. The *Sabellaria* tubes appeared to be subject to inundation of sand across the area.		LOW	LOW	MEDIUM/HIGH	LOW
03MS	Rippled Sand	N	Y	N	Y	Y	2 – 5 cm	8%	Clumps of consolidated upright tubes of *Sabellaria* were present, together with clumps of moribund tubes. In places the elevation of the tubes above the surrounding seabed was in the range of 5 – 10 cm. However, the average tube height across the area was in the region of 2 – 5 cm.		LOW	NOT REEF	MEDIUM	NOT REEF
17MS	Rippled Sand	N	Y	N	Y	N	2 – 5 cm	7%	Small clumps (< 10 cm) of consolidated upright tubes of *Sabellaria* were present, together with clumps of moribund tubes. The average tube height across the area was in the region of 2 – 5 cm.		LOW	NOT REEF	MEDIUM	NOT REEF
19MS	Sand and gravel	N	Y	Y	N	Y	< 2 5 cm	~55%	*Sabellaria* tubes were present, and appeared to be thick crusts and erect tubes. Consolidation was difficult to ascertain due to the poor underwater visibility, however tubes appeared to be as discrete tubes only, and as upright consolidated tubes.		NOT REEF/ LOW	HIGH	LOW/MEDIUM	LOW/MEDIUM
25CR	Shelly gravelly sand, interspersed with areas of rippled sand	N	N	Y	Y	Y	2 – 5 cm	12%	Thin and thick crusts together with clumps of consolidated tubes. The average elevation was in the region of 2-5 cm.		LOW	LOW	LOW/MEDIUM	LOW

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	
27CR	Sandy pebbly gravel with cobbles	N	Y	Y	Y	N	< 2 - 5cm	9%	Thin and thick crusts and small clumps of *Sabellaria* tubes were present for a small proportion of the transect. Some larger aggregations of intertwined tubes (~30 cm in diameter) of *Sabellaria* were present. The majority of the Sabellaria recorded was in the form of thick crusts and small clumps.		NOT REEF/ LOW	NOT REEF	LOW/MEDIUM	NOT REEF
28CR	Pebbly sandy gravel, interspersed with small areas of gravelly sand	N	Y	Y	N	N	< 2 cm	7%	Thin and thick *Sabellaria* crusts on the mixed sediments. In places, the tubes were found to protrude from the substrate. However the elevation was less than 2 cm, and the tubes did not form consolidated intertwined clumps.		NOT REEF	NOT REEF	NOT REEF	NOT REEF
29CR	Pebbly sandy gravel with cobbles	N	Y	Y	Y	N	< 2 - 5 cm	>13%	Thin and thick *Sabellaria* crusts on the mixed sediments. Small clumps of intertwined upright tubes (with an elevation of approximately 2 – 5 cm) were present along a section of transect, however this form was a minor proportion of the overall *Sabellaria* observed.		NOT REEF/ LOW	LOW	NOT REEF/LOW	NOT REEF
33CR	Pebbly sandy gravel	N	Y	Y	N	N	< 2 cm	3%	Thin and thick crusts of *Sabellaria*. A large proportion of individual moribund tubes were present.		NOT REEF	NOT REEF	NOT REEF	NOT REEF

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	
40 CR Excluding between 50º46.0707N 01º57.5197E and 50º46.0767N 01º57.5008E	Rippled sand interspersed with areas of sandy gravel	N	Y	N	Y	Y	2 - 10 cm	5%	The whole length of the transect was characterised by the presence of *Sabellaria* tubes in the form of large clumps (>20 cm in diameter) of intertwined upright tubes. Small clumps of moribund intertwined *Sabellaria* tubes were lying on the seabed. The clumps of *Sabellaria* were scattered throughout the transect, resulting in a low percentage cover. The *Sabellaria* upright clumps, did not form a continuous feature. Elevation above the seabed was between 2 and 10 cm, which varied between clumps recorded.	   	LOW/ MEDIUM	NOT REEF	HIGH	NOT REEF
40CR Between 50º46.0707N 01º57.5197E and 50º46.0767N 01º57.5008E	Rippled sand interspersed with areas of sandy gravel	N	Y	N	Y	Y	5 – 10 cm	24%	Large clumps of intertwined elevated *Sabellaria* tubes, forming in places, continuous aggregated structures.		MEDIUM	MEDIUM	HIGH	MEDIUM

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	
43CR	Rippled gravelly sand	N	Y	Y	Y	N	<2 – 5 cm	2%	*Sabellaria* was observed at this station in both small clumps and larger clumps of upright intertwined tubes. Both these forms were scattered throughout the transect. Some of these features were >20 cm in diameter, however did not form continuous features. The overall the patchiness along the whole transect does not exceed 10%.	  	NOT REEF/ LOW	NOT REEF	MEDIUM	NOT REEF

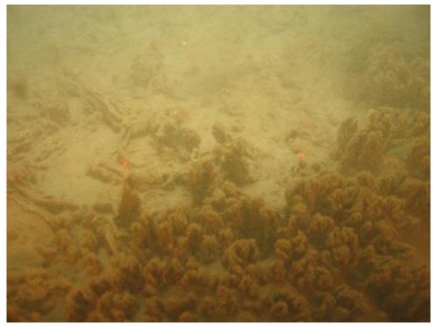
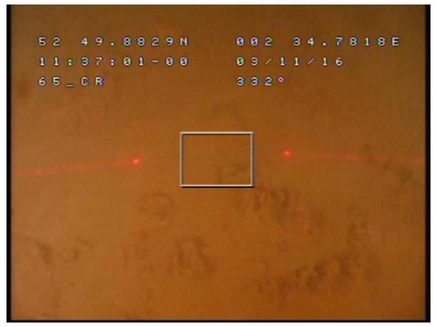
Station	Sediment Description	*Sabellaria* form present					*Sabellaria* Characteristics			Representative Image	Reef Definition Based on			Overall Assessment
		Absent	Moribund Tubes	Crusts	Clumps	Potential Reef	Elevation	Patchiness	Brief Description of *Sabellaria* Recorded		Elevation	Patchiness	Consolidation	
48CR	Gravelly sand interspersed with rippled sand	N	Y	Y	Y	N	< 2 cm	16%	Thin and thickCRusts of *Sabellaria* tubes were evident along the entire transect. *Sabellaria* forming clumps of upright tubes, with an elevation in the region of 2 – 5 cm was observed along the transect. However, these clumps were only occasionally observed, with the majority of *Sabellaria* present recorded as thin or thick crusts.	  	NOT REEF	LOW	NOT REEF	NOT REEF
50 CR	Rippled shelly sand	N	Y	N	Y	N	< 2 cm	2%	The beginning of the transect is characterised by the presence of *Sabellaria* clumps. They appear to be small, patchy and with an elevation of < 2 cm throughout the areas where they are visible.	 	NOT REEF	NOT REEF	NOT REEF	NOT REEF

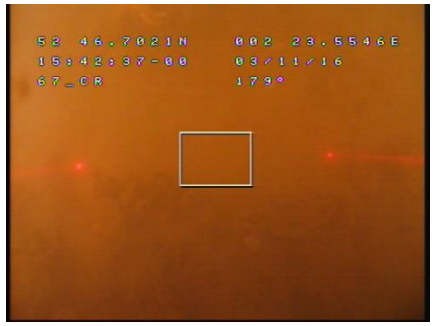
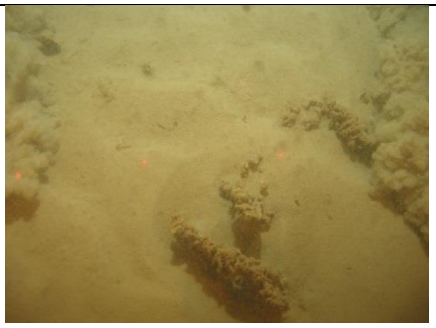
Station	Sediment Description	*Sabellaria* form present					*Sabellaria* Characteristics			Representative Image	Reef Definition Based on			Overall Assessment
		Absent	Moribund Tubes	Crusts	Clumps	Potential Reef	Elevation	Patchiness	Brief Description of *Sabellaria* Recorded		Elevation	Patchiness	Consolidation	
51CR	Sand	N	Y	N	Y	N	< 2 cm	<10%	*Sabellaria* clumps are visible at the beginning and at the end of the transect. They are generally small and with an average elevation below 2 cm. A few of these clumps present overlapping tubes.	 e 	**NOT REEF**	**NOT REEF**	**NOT REEF**	**NOT REEF**
54CR	Slightly shelly gravelly sand	N	N	N	Y	N	< 2 CM	<10%	The station is characterised by slightly shelly gravelly sand. A section of the transect shows sparse small *Sabellaria* clumps. These are very sparse and only in one area few clumps reach elevation above 2 cm. Some clumps present overlapping tubes, but never reach elevation above 2 cm. The patchiness is constantly low throughout the area were *Sabellaria* is visible.	 	**NOT REEF**	**NOT REEF**	**NOT REEF**	**NOT REEF**

<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>62CR between 52º47.7745N, 02º42.8755E and 52º47.7922N, 02º42.8196E</td><td>Rippled shelly sand</td><td>N</td><td>Y</td><td>N</td><td>Y</td><td>N</td><td>< 2 cm</td><td>>30%</td><td>Sabellaria tubes clumps are visible throughout this section of the transect. The tubes were in the form of tubes protruding from the sediment surface, with an elevation of < 2 cm.</td><td>

</td><td>NOT REEF</td><td>HIGH</td><td>LOW</td><td>NOT REEF</td></tr>
<tr><td>64CR</td><td>Shelly gravelly sand</td><td>N</td><td>Y</td><td>N</td><td>Y</td><td>N</td><td><2 - 5 cm</td><td>15%</td><td>Sabellaria was observed as small and large clumps throughout the transect. Their size varied showing areas with small clumps (< 5 cm in elevation.</td><td>


</td><td>NOT REEF/ LOW</td><td>LOW</td><td>MEDIUM</td><td>NOT REEF/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	
65CR	Sand	N	Y	N	Y	Y	2 - 5 cm	15%	*Sabellaria* was observed as small clumps, found as scattered across the whole transect. In some places intertwined upright tubes formed larger clumps (>20 cm in diameter).		LOW	LOW	MEDIUM	LOW

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	
67CR	Sand				P		N/A	N/A	*Sabellaria* clumps, as well as potential reef features were visible at this station. Unfortunately, the high turbidity of the station, due to re-suspended sediment, caused the seabed not to be visible for the entire trasnect. This did not allow for a full assessment of the characteristics of the *Sabellaria* features observed.	 	N/A	N/A	N/A	N/A
68CR	Sand	N	Y	N	Y	N	< 2 cm	<10%	*Sabellaria* was observed as small clumps. These are always patchy and very sparse. They are quite small with some connection between tubes, with only occasional clumps presenting thicker aggregations. The elevation of the tubes varied along the transect between < 2 cm to clumps with an elevation between 2 and 5 cm.	 	NOT REEF/ LOW	NOT REEF	MEDIUM	NOT REEF

D.3 MACROFAUNA DATA ANALYSIS WITHOUT JUVENILES

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.

The total number of taxa ranged from 1 (Sample 42 CR) to 79 (Sample 28 CR), with an average of 23 ± 22 taxa across the survey area (Table E3.1). No overall pattern in the distribution of the number of taxa across the survey area was noted, however, it appeared to be higher in correspondence of more mixed sediment. Faunal abundances were between 1 individual (Sample 42 CR) and 114 individuals (Sample 28 CR), with an average of 31 ±32 individuals across the survey area (Table E3.1).

Values of diversity were on average moderate ($H'\ log_2$ = 2.69), with four samples (6%) showing high diversity ($H'\ log_2 > 4$); 21 samples (32%) showing good diversity ($4 \leq H'\ log_2 \leq 3$); 26 samples (40%) showing moderate diversity ($3 \leq H' log_2 \leq 2$) and 14 (21.5%) showing poor diversity ($H'\ log_2 \leq 2$) (Table E3.1, Dauvin et al., 2012).

Values of evenness were between 0.20 (Sample 40CR) and 1.00 (Sample 69CR) with an average of 0.75 across the survey area (Table E3.1). The lowest evenness value (J' = 0.20) in sample 40CR was associated with a numerical dominance of *S. spinulosa*, which accounted for 85% of the faunal abundance at this station. This was further confirmed by the value of high dominance (0.73) at this station. Conversely, the high value of evenness (J' = 1) in sample 60CR was associated with the presence, at this station, of only two species, the amphipod *Urothoe brevicornis* and the polychaete *O. borealis* which were both recorded with the abundance of 2 individuals; the station also showed no dominance ($\lambda = 0$). Eveness, dominance and diversity indices were not calculated at station 42CR where only one individual of *N. cirrosa* was recorded. Thus, values of low evenness corresponded well with values of high dominance, which ranged from 0 (69CR) to 0.73 (40CR). Higher dominance values (> 0.4) were associates with a numerical dominance of the polychaete species *S. spinulosa* at station 01MS, 25CR, 40CR, 55CR, 64CR, 65CR and 67CR, which accounted for 68%, 10%, 85%, 71%, 66%, 70% and 69% of faunal abundance at each station respectively. At station 20MS the high dominance value (0.78) was associated with the amphipod *U. brevicornis* which accounted for 89% of the faunal abundance at this station. At station 25CR the high dominance value (0.45) was associated with the numerical dominance of the polychaete species *Pygospio elegans*, which accounted for 67% of the faunal abundance at this station. At station 36CR the high dominance value (0.45) was associated with the dominance of *Bathyporeia pelagica* which accounted for 69.5% of the faunal abundance at this station. Finally, at station 44CR the higher dominance value was associated with the polychaete species *N. cirrosa*, which accounted for 80% of the faunal abundance at this station.

Table E3.1: Macrofaunal Community Statistics

Station	Numbers		Diversity Indices		Evenness
	Taxa [S]	Individuals [N]	Simpsons [d]	Shannon-Weiner [H' Log_2]	Pielou [J]
01MS	74	1114	10.41	2.476	0.3987
02MS	59	416	9.617	4.584	0.7793
03MS	31	257	5.406	2.888	0.5829
04MS	5	8	1.924	2.156	0.9284
05MS	15	46	3.657	3.466	0.8872
06MS	19	46	4.701	3.68	0.8664
07MS	15	35	3.938	3.61	0.9241
08MS	12	89	2.451	2.39	0.6666
09MS	8	46	1.828	1.971	0.6571
10MS	9	33	2.288	2.262	0.7136
11MS	17	48	4.133	3.138	0.7677
12MS	13	30	3.528	3.146	0.8501
13MS	16	43	3.988	3.417	0.8542
14MS	10	21	2.956	2.82	0.8489
15MS	7	13	2.339	2.5	0.8904
16MS	5	26	1.228	1.993	0.8586
17MS	22	118	4.402	2.438	0.5468
18MS	4	14	1.137	1.292	0.6458
19MS	58	796	8.533	4.33	0.7391
20MS	2	9	0.4551	0.5033	0.5033
21MS	9	20	2.67	2.809	0.886
22MS	7	21	1.971	2.104	0.7495
23MS	9	19	2.717	2.76	0.8708
24CR	9	16	2.885	3	0.9464
25CR	64	1501	8.614	2.382	0.3971
26CR	12	225	2.031	1.985	0.5536
27CR	24	70	5.414	3.778	0.8241
28CR	79	851	11.56	4.471	0.7093
30CR	55	459	8.811	3.65	0.6314
31CR	54	323	9.173	3.998	0.6947
33CR	49	774	7.216	2.869	0.5109
35CR	6	19	1.698	2.182	0.8439
36CR	9	95	1.757	1.64	0.5174
37CR	2	3	0.9102	0.9183	0.9183
38CR	6	10	2.171	2.522	0.9756
39CR	10	17	3.177	3.146	0.9471
40CR	34	4433	3.93	1.003	0.1972
41CR	3	5	1.243	1.371	0.865
42CR	1	1	-	0	-
43CR	14	39	3.548	3.286	0.8631
44CR	2	5	0.6213	0.7219	0.7219
45CR	8	12	2.817	2.855	0.9518
46CR	4	5	1.864	1.922	0.961
48CR	42	605	6.401	3.137	0.5818
49CR	5	12	1.61	1.951	0.8402
50CR	49	323	8.308	3.939	0.7015
51CR	27	108	5.553	3.588	0.7546

Station	Numbers		Diversity Indices		Evenness
	Taxa [S]	Individuals [N]	Simpsons [d]	Shannon-Weiner [H' Log_2]	Pielou [J]
52CR	7	10	2.606	2.646	0.9427
53CR	12	24	3.461	3.355	0.936
54CR	12	33	3.146	2.754	0.7683
55CR	48	479	7.615	2.258	0.4043
56CR	8	10	3.04	2.846	0.9488
57CR	6	9	2.276	2.419	0.9359
58CR	32	158	6.123	3.774	0.7547
59CR	12	22	3.559	2.981	0.8315
60CR	16	49	3.854	3.208	0.8019
61CR	13	29	3.564	3.216	0.8692
62CR	53	1051	7.474	3.709	0.6476
63CR	14	44	3.435	3.129	0.8219
64CR	54	1906	7.017	2.189	0.3804
65CR	69	3525	8.326	2.114	0.3461
66CR	18	55	4.242	3.46	0.8299
67CR	58	1716	7.653	2.082	0.3554
68CR	62	268	10.91	4.98	0.8364
69CR	2	2	1.443	1	1
Summary Statistics					
Minimum	1	1	0.46	0	0.20
Mean	23	347	4.33	2.69	0.75
Maximum	79	4433	11.56	4.98	1.00
SD	22	779	2.83	1	0.19

Multivariate Analysis

Prior to multivariate analysis, the enumerated faunal dataset was transformed. A fourth root transformation provided the best assessment of the enumerated faunal community, down-weighting the numerically dominant species (> 1000 individuals) which represented under 2% of the fauna, giving the right weight to the abundant taxa (> 100 individuals), which comprised 12% of the fauna, as well as to species with intermediate abundance (> 10 individuals), which represented 30% of the fauna, and the underlying community (≤ 10 individuals), which represented 56% of the fauna.

Community structure of the enumerated fauna within the survey area was assessed employing the hierarchical clustering analysis. 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. For this reason, the grouping of the station based on their faunal composition was obtained by cutting a slice through the dendrogram at a chosen level. This was identified after applying the SIMPROF routine set to a significance level of 5%. This process of defining coarser groups is appropriate provided that the resulting clusters are always supersets of the SIMPROF groups (Clarke et al., 2008).

The dendrogram shows 9 main groups of stations (Figure E3.1) and the description of the groups is presented in Table E3.2. Figure E3.2 presents the MDS which is an ordination technique, which arranges the samples on a two-dimensional plot, so that their relative distances from each other reflect their faunal similarities. The stress coefficient of 0.16 resulting from their procedure indicates that the plot is a ‘useful’ representation of the multi-dimensional relationship between samples (Clarke and Warwick, 2001).

Group a comprised a single sample characterised by slightly gravelly sandy mud, very poorly sorted, with a mean sediment particle size of 28 µm (coarse silt), in water depth of −42 m LAT. It comprised a relatively low faunal diversity and abundance. Characterising taxa included the bivalve *Barnea candida*, the brittlestar *A. squamata*, the polychaete *G. alba*, and the amphipod *C. volutator*.

Group b comprised a single sample characterised by slightly gravelly sand, moderately well sorted, with a mean sediment particle size of 463 µm (medium sand), in water depth of −40 m LAT. Characterising taxa included the polychaetes *O. borealis*, *Notomastus*, *Spio goniocephala* and the amphipods *Ampelisca diadema*, *Eurydice spinigera*, *Pontocrates arcticus.*

Group c comprised 2 samples characterised by slightly gravelly sand and gravelly sand very poorly sorted and a mean particle size ranging between 324 µm and 6438 µm (medium to coarse sand), average water depth of −37 ± 16 m LAT. Characterising taxa included NEMERTEA, the polychaetes *Spiophanes bombyx*, *Lumbrineris cingulata* and *Spio symphyta* and the sea spider *Anoplodactylus pediolatus.*

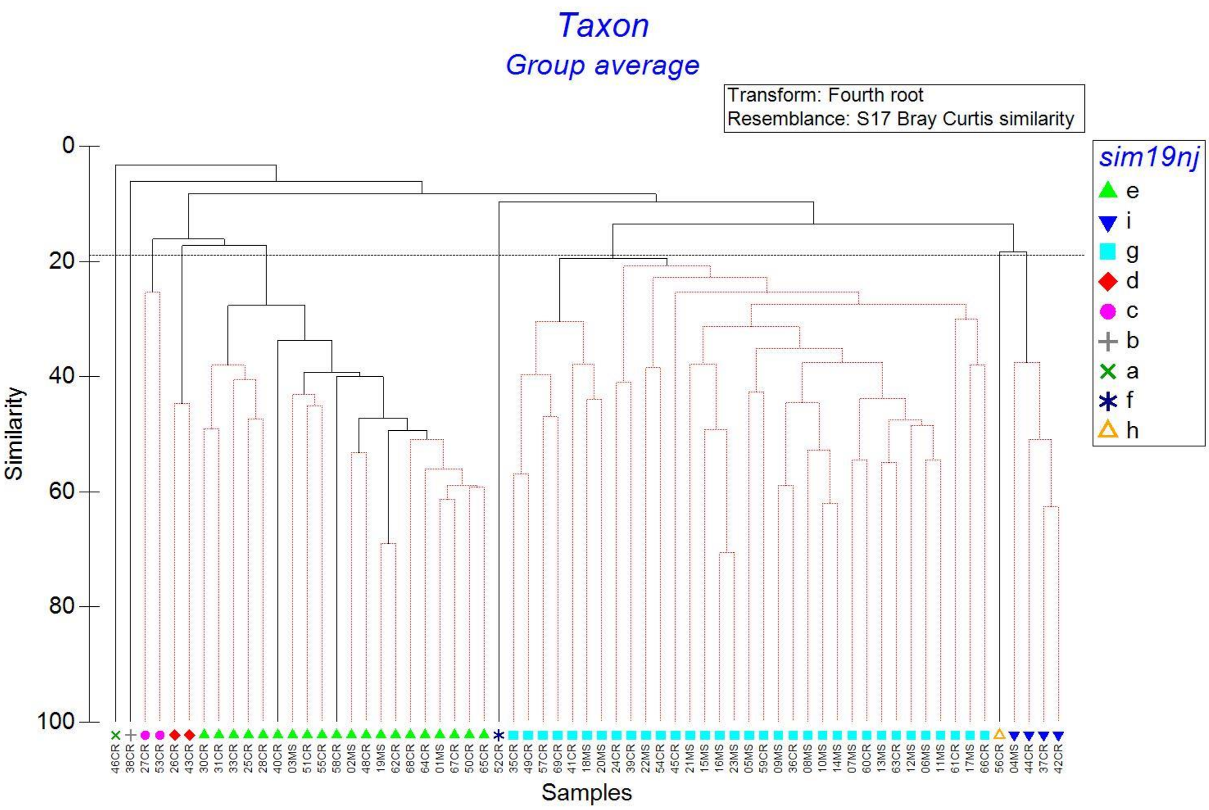


Figure E3.1: Dendrogram of Bray-Curtis similarity index of enumerated fauna from grab samples

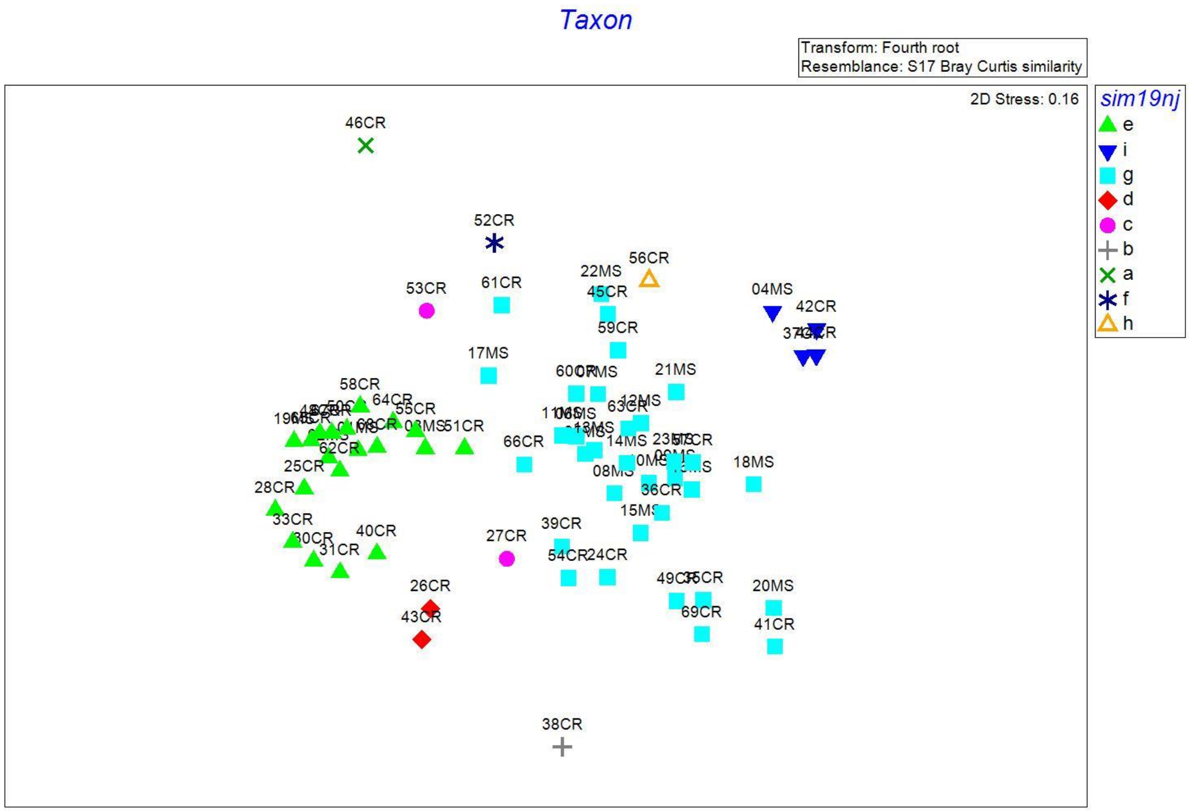


Figure E3.2: MDS plot of Bray-Curtis similarity index of enumerated fauna from grab samples

Table E3.2: Summary Attributes of the Faunal Group Derived from Multivariate Analysis of Enumerated Fauna from Grab samples

Group	Samples	Characterising Features	Species	Mean Abundance	Occurrence [% samples]
a ✕ Average similarity: N/A	46CR	S = 4 N = 5 Depth [m]= 42 Gravel = 0.5% Sand = 37.6% Mud = 61.9% D_{50} [µm]: 28	*Barnea candida* *Amphipholis squamata* *Glycera alba* *Corophium volutator*	2 1 1 1	40 20 20 20
b + Average similarity: N/A	38CR	S = 6 N = 10 Depth [m]= 40 Gravel = 29.7% Sand = 51.1% Mud = 19.2% D_{50} [µm]: 463	*Ophelia borealis* *Ampelisca diadema* *Eurydice spinigera* *Pontocrates arcticus* *Notomastus* *Spio goniocephala*	2 2 2 2 1 1	20 20 20 20 10 10
c ● Average similarity: 25%	27CR, 53CR	S = 18±8 N = 47±32 Depth [m]= 37.5±16.2 Gravel = 37±34% Sand = 51±18% Mud = 12±16% D_{50} [µm]: 3381±4323	NEMERTEA *Anoplodactylus petiolatus* *Spiophanes bombyx* *Lumbrineris cingulata* *Spio symphyta*	1.25 1.19 1.21 1 1	22 22 19 19 19

Group	Samples	Characterising Features	Species	Mean Abundance	Occurrence [% samples]
d Average similarity: 44.71%	26CR, 43CR	S: 13 ± 1 N: 132 ± 131 Depth [m]: 32.5 ± 3.5 Gravel: 27 ±12% Sand: 71±10% Mud: 2 ±2% D_{50} [µm]: 2636 ± 3302	NEMERTEA *Amphipholis squamata* *Glycera lapidum* *Socarnes erythrophthalmus* *Sabellaria spinulosa* *Ophelia borealis*	2.06 1.56 1.37 1.55 1.83 2.19	22.38 18.38 16.17 16.17 14.61 12.29
e Average similarity: 36.6%	01MS, 02MS, 03MS, 19MS, 25CR, 28CR, 30CR, 31CR, 33CR, 40CR, 48CR, 50CR, 51CR, 55CR, 58CR, 62CR, 64CR, 65CR, 67CR, 68CR	S = 54 ± 13 N = 1103 ± 1141 Depth [m]: 36 ± 13 Gravel: 18 ±18% Sand: 70±20% Mud: 12±14% D_{50} [µm]: 853 ± 1672	*Sabellaria spinulosa* NEMERTEA *Amphipholis squamata* *Pholoe baltica* *Pisidia longicornis*	3.72 2.19 1.75 1.43 1.85	9.66 6.5 4.61 3.92 3.83
f Average similarity: N/A	52CR	S = 7 N = 10 Depth [m]: 49 Gravel: 24% Sand: 54% Mud: 21% D_{50} [µm]: 366	*Pisidia longicornis* *Sabellaria spinulosa* *Spiophanes bombyx* *Goniada maculata* *Chaetozone zetlandica*	3 2 1 1 1	30 20 10 10 10
g Average similarity: 26.94%	05MS, 06MS, 07MS, 08MS, 09MS, 10MS, 11MS, 12MS, 13MS, 14MS, 15MS, 16MS, 17MS, 18MS, 20MS, 21MS, 22MS, 23MS, 24CR, 35CR, 36CR, 39CR, 41CR, 45CR, 49CR, 54CR, 57CR, 59CR, 60CR, 61CR, 63CR, 66CR, 69CR	S = 10 ± 5 N = 33± 26 Depth [m]: 38±5 Gravel: 2 ±3% Sand: 96±6% Mud: 1±5% D_{50} [µm]: 361 ± 59	*Urothoe brevicornis* *Nephtys cirrosa* *Ophelia borealis* *Spiophanes bombyx* *Fabulina fabula*	1.2 0.98 0.83 0.74 0.66	30.12 18.94 12.03 7.98 6.46
h Average similarity: N/A	56CR	S = 8 N = 10 Depth [m]: 44 Gravel: 2% Sand: 98% Mud: 0% D_{50} [µm]: 417	*Spisula elliptica* *Spiophanes bombyx* *Nephtys cirrosa* ACTINIARIA *Scolelepis bonnieri*	3 1 1 1 1	30 10 10 10 10

Group	Samples	Characterising Features	Species	Mean Abundance	Occurrence [% samples]
i Average similarity: 46.27%	04MS, 37CR, 42CR, 44CR	S = 3±2 N = 4±3 Depth [m]: 32±8 Gravel: 1% Sand: 99% Mud: 0% D_{50} [µm]: 367±64	*Nephtys cirrosa* *Gastrosaccus spinifer*	1.10 0.59	88.87 11.13

Notes:
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

Group d comprised two samples, characterised by slightly gravelly sand, poorly sorted with mean particle size ranging between 493 µm and 976 µm (medium to coarse sand) at an average water depth of −32.5 ± 3.5m LAT. Characterising taxa included NEMERTEA, the polychaetes *O. borealis*, *G. lapidum*, *S. spinulosa,* the amphipod *Socarnes erythrophthalmus* and the echinoderms *A. squamata*.

Group e comprised 20 samples. Nine of these (45%) were characterised by slightly gravelly sand, very poorly sorted sediment, five (25%) were characterised by gravelly sand, poorly sorted sediment, three (15%) were characterised by gravelly muddy sand, extremely poorly sorted to moderately sorted sediment, two (5%) were characterised by slightly gravelly sandy mud, very poorly sorted and one station characterised by sand gravel, very poorly sorted. The mean particle size ranging between 28 µm and 7433 µm (coarse silt to fine gravel), at an average depth of -36 ± 13m LAT. Characterising species include Nemertea, the polychaetes *S. spinulosa* and *P. baltica*, the long-clawed porcelain crab *P. longicornis* and the brittlestar *A. squamata*.

Group f comprised a single sample, characterised by gravelly sand, extremely poorly sorted and a mean particle size ranging between 366 µm (medium sand) at a depth of -49m LAT. Characterising species include the polychaete the long-clawed porcelain crab *P. longicornis*, the polychaetes *S. spinulosa*, *S. bombyx*, *G. maculate* and *C. zetlandica*.

Group g comprised 33 samples. Fifteen of these (45%) were characterised by slightly gravelly sand, moderately sorted to moderately well sorted and a mean particle size ranging between 219 µm and 532 µm (fine to coarse sand), at an average depth of -38 ± 5 m LAT. Characterising species included the polychaetes *N. cirrosa*, O. borealis and *S. bombyx*, the amphipod *U. brevicornis* and the bivalve *Fabulina fabula*.

Group h comprised a single sample characterised by gravelly sand, moderately well sorted, with mean particle size of 417 µm (medium sand). Characterising species include the polychaetes *N. cirrosa*, *Spiophanes bombyx* and *Scoloplos armiger*, Actinaria and the bivalve *Spisula elliptica*.

Group i comprised four samples characterised by slightly gravelly sand, gravelly sand and gravelly muddy sand, moderately sorted to well sorted, with a mean particle size ranging between 292 µm and

449 µm (medium sand). Characterising species include the polychaete *N. cirrosa* and the amphipod *G. spinifer*.

The SIMPER analysis also highlighted the differences between groups in terms of species composition and their average abundances. The top 5 species contributing to this difference are presented in Table E3.3.

The taxa composition for the two main groups, Group e and Group g, was similar and the differences between the two groups were mainly related to the average abundance of the polychaete *S. spinulosa*, Nemertea, the long-clawed porcelain crab *P. longicornis*, the brittlestar *Amphiura filiformis* and Actinaria.

The same taxa also determined the differences between group e and group i as well as between group e and group b, at stations within which these species were not found. In addition to the abovementioned, the polychaete *P. baltica* also contributed to the differences between group e and group c. between group e and group a, between group e and group f and between group e and group h. For all the groups the difference was due to the species being found only at stations within group e and absent from stations within the other groups. The only exception to this was the difference in average abundance of *S. spinulosa* between group e and group f. Differences between group e and group d were related to the average abundance of the polychaetes *S. spinulosa* and *O. borealis* and Actinaria, as well as the presence of *P. longicornis* and the lack of the amphipod *Socarnes erythrophthalmus* in group e.

The taxa determining the differences between group g and group i included the different average abundance of the polychaete *N. cirrosa* and the amphipod *G. spinifer*, as well as the different species composition including the amphipod *U. brevicornis*, and the polychaetes *O. borealis* and *S. bombyx* which only occurred at stations within group G. Different average abundance of species, including NEMERTEA, the polychaetes *S. spinulosa* and *O. borealis*, the echinoderm *A. squamata*, together with the amphipod *S. erythrophthalmus*, which did not occur at stations within group I, were driving the dissimilarity between group g and group d. Different average abundance of species, such as the polychaetes L. cingulate and O. borealis, NEMERTEA and the amphipod *U. brevicornis*, together with the sae spider *Anoplodactylus petiolatus* which did not occur at stations within group g, were responsible for the dissimilarity of group g and group c. Average abundance of the amphipod *A.diadema*, the isopod *Eurydice spinigera* and the polychaete *Notomastus*, together with the amphipods *U. brevicornis* and *P.articus*, which did not occur at stations within group b and g respectively, were driving the dissimilarity between group g and group b. Finally, with the exception of *A. squamata* which occurred with different average abundance, in both groups, different taxa composition determined the observed dissimilarity between group g and group a. Different species composition and difference in the average abundance of *P. longicornis* and *S. spinulosa* determined the dissimilarity between group g and group f, whilst different species composition and difference in the average abundance of *Thia scutellata* and *Spisula elliptica* the dissimilarity between group g and group h.

All the other groups differed from group a for the presence of their characterising species and the absence of the bivalve *B. candida*, which was recorded only at station 46CR (group a). The other groups also differed from group b for the presence of their characterising species and the absence of the species characterising group b, such as *O. borealis*, *A. diadema*, *Eurydice spinigera* and *Pontocrates arcticus*.

Taxa composition was also driving observed dissimilarities between group d and group h, between group c and group h, between group I and group h and between group f and group h. Also group i and group f, group c and group f and group d and group f differed in taxa composition, whilst taxa composition, together with different average abundance of *O. borealis* determined the observed dissimilarity between group d and group c.

As presented in Table E3.3, dissimilarity levels between groups vary between 81.22% for groups h and G and 100% for groups g, e, and b when compared with group a. The main species characterising the differences between groups are presented in Figure E.3.3.

Table E3.3 Output of SIMPER Analysis Indicating Differences Between Groups

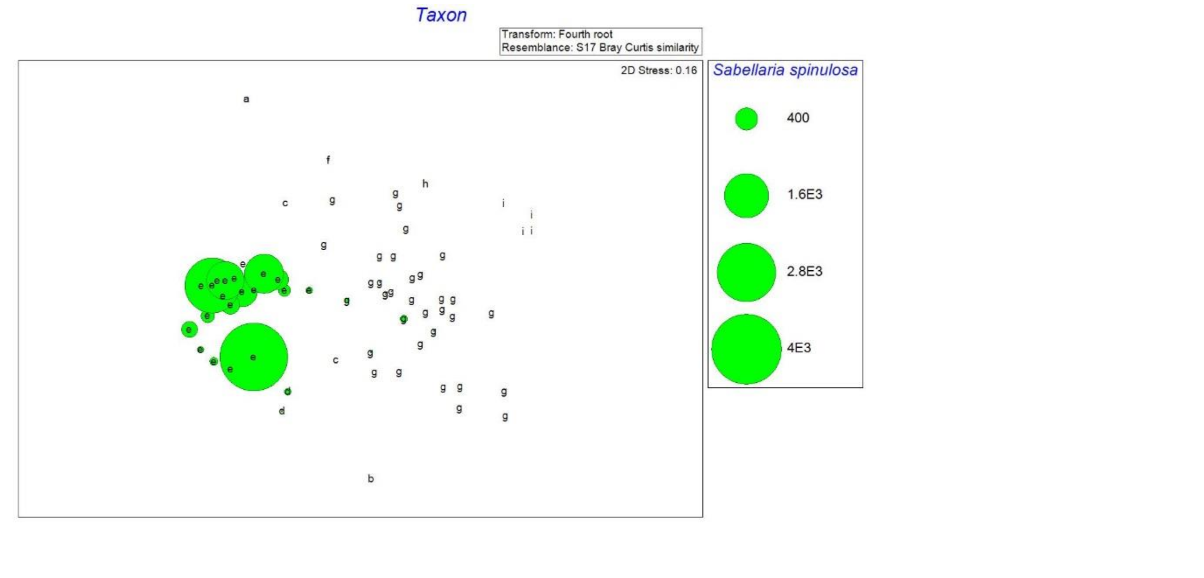
Taxa	Av. Abund	Av. Abund	Av. Diss	Diss/SD	Contrib%	Cum.%
Groups e & i			**Average Dissimilarity = 98.83**			
Species	**Group e**	**Group i**				
	Av. Abund	**Av. Abund**	**Av. Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
Sabellaria spinulosa	3.72	0	4.95	1.89	5.01	5.01
NEMERTEA	2.19	0	2.94	3.74	2.97	7.98
Pisidia longicornis	1.85	0	2.45	1.35	2.48	10.46
Amphipholis squamata	1.75	0	2.26	2.36	2.29	12.75
ACTINARIA	1.69	0	2.1	1.24	2.12	14.87
Groups e & g			**Average Dissimilarity = 91.34**			
	Group e	**Group g**				
Sabellaria spinulosa	3.72	0.29	4.08	1.75	4.47	4.47
NEMERTEA	2.19	0.35	2.18	2.26	2.38	6.86
Pisidia longicornis	1.85	0.16	2.07	1.34	2.26	9.12
Amphipholis squamata	1.75	0.06	1.96	2.25	2.14	11.26
ACTINIARIA	1.69	0.13	1.83	1.25	2	13.26
Groups i & g			**Average Dissimilarity = 87.11**			
	Group i	**Group g**				
Urothoe brevicornis	0	1.2	10.16	1.22	11.67	11.67
Ophelia borealis	0	0.83	5.89	0.94	6.77	18.43
Nephtys cirrosa	1.1	0.98	4.84	0.71	5.55	23.99
Gastrosaccus spinifer	0.59	0.24	4.54	0.83	5.21	29.2
Spiophanes bombyx	0	0.74	4.18	1	4.8	34
Groups c & e			**Average Dissimilarity = 98.17**			
	Group c	**Group e**				
Sabellaria spinulosa	3.79	0	4.5	1.78	4.59	4.59
NEMERTEA	2.23	0	2.65	3.79	2.7	7.28
Pisidia longicornis	1.95	0	2.38	1.45	2.42	9.71
Amphipholis squamata	1.84	0	2.19	2.92	2.23	11.93
ACTINIARIA	1.78	0	2.05	1.32	2.09	14.02
Groups e & d			**Average Dissimilarity = 82.74**			
	Group e	**Group d**				
Sabellaria spinulosa	3.72	1.83	2.3	1.21	2.78	2.78
Ophelia borealis	0.23	2.19	2.23	1.51	2.69	5.47
Pisidia longicornis	1.85	0	2.01	1.39	2.43	7.9
Socarnes erythrophthalmus	0	1.55	1.77	3.3	2.14	10.04
ACTINARIA	1.69	0.5	1.57	1.32	1.9	11.94
Groups i & d			**Average Dissimilarity = 100**			
	Group i	**Group d**				
Ophelia borealis	0	2.19	10.2	1.85	10.2	10.2
NEMERTEA	0	2.06	9.85	9.93	9.85	20.05
Sabellaria spinulosa	0	1.83	8.61	3.06	8.61	28.66

Taxa	Av. Abund	Av. Abund	Av. Diss	Diss/SD	Contrib%	Cum.%
Amphipholis squamata	0	1.56	7.53	7.35	7.53	36.2
Socarnes erythrophthalmus	0	1.55	7.38	7.96	7.38	43.57
Groups g & d			**Average Dissimilarity = 90.75**			
	Group g	**Group d**				
NEMERTEA	0.35	2.06	5.89	2.39	6.49	6.49
Sabellaria spinulosa	0.29	1.83	5.5	1.95	6.06	12.56
Ophelia borealis	0.83	2.19	5.43	1.35	5.98	18.54
Socarnes erythrophthalmus	0	1.55	5.23	4.37	5.76	24.3
Amphipholis squamata	0.06	1.56	5.18	3.49	5.7	30.01
Groups e & c			**Average Dissimilarity = 83.58**			
	Group e	**Group c**				
Sabellaria spinulosa	3.72	0	3.94	1.93	4.72	4.72
Pisidia longicornis	1.85	0	1.96	1.37	2.34	7.06
Amphipholis squamata	1.75	0	1.82	2.36	2.17	9.23
ACTINARIA	1.69	0	1.7	1.23	2.04	11.27
Pholoe baltica	1.43	0	1.52	2.36	1.82	13.09
Groups i & c			**Average Dissimilarity = 96.06**			
	Group i	**Group c**				
NEMERTEA	0	1.25	5.9	2.55	6.14	6.14
Spiophanes bombyx	0	1.21	5.9	2	6.14	12.28
Anoplodactylus petiolatus	0	1.19	5.52	2.9	5.74	18.02
Lumbrineris cingulata	0	1	4.64	2.9	4.83	22.85
Spio symphyta	0	1	4.64	2.9	4.83	27.68
Groups g & c			**Average Dissimilarity = 85.61**			
	Group e	**Group g**				
Anoplodactylus petiolatus	0	1.19	3.87	3.07	4.52	4.52
Lumbrineris cingulata	0.04	1	3.2	2.78	3.74	8.27
Ophelia borealis	0.83	1.04	3.17	1.26	3.7	11.97
NEMERTEA	0.35	1.25	3.16	1.46	3.69	15.66
Urothoe brevicornis	1.2	0.5	3.14	1.13	3.67	19.33
Groups d & c			**Average Dissimilarity = 86.45**			
	Group d	**Group c**				
Sabellaria spinulosa	1.83	0	4.76	2.32	5.5	5.5
Ophelia borealis	2.19	1.04	4.63	1.25	5.35	10.85
Amphipholis squamata	1.56	0	4.12	4.27	4.76	15.61
Socarnes erythrophthalmus	1.55	0	4.05	3.94	4.69	20.3
Spiophanes bombyx	0	1.21	3.28	2.48	3.79	24.1
Groups e & b			**Average Dissimilarity = 96.66**			
	Group e	**Group b**				
Sabellaria spinulosa	3.72	0	4.67	1.89	4.84	4.84
NEMERTEA	2.19	0	2.77	3.77	2.87	7.7
Pisidia longicornis	1.85	0	2.32	1.34	2.4	10.1
Amphipholis squamata	1.75	0	2.14	2.35	2.22	12.32
ACTINIARIA	1.69	0	1.99	1.22	2.06	14.38
Groups i & b			**Average Dissimilarity = 100.00**			
	Group i	**Group b**				
Ampelisca diadema	0	1.19	12.82	5.5	12.82	12.82
Ophelia borealis	0	1.19	12.82	5.5	12.82	25.64
Eurydice spinigera	0	1.19	12.82	5.5	12.82	38.47
Pontocrates arcticus	0	1.19	12.82	5.5	12.82	51.29
Nephtys cirrosa	1.1	0	11.91	3.9	11.91	63.2
Groups g & b			**Average Dissimilarity = 91.13**			
	Group g	**Group b**				
Urothoe brevicornis	1.2	0	7.1	1.51	7.79	7.79
Pontocrates arcticus	0	1.19	6.91	2.79	7.59	15.38
Ampelisca diadema	0.03	1.19	6.77	2.52	7.43	22.8

Taxa	Av. Abund	Av. Abund	Av. Diss	Diss/SD	Contrib%	Cum.%
Eurydice spinigera	0.06	1.19	6.53	2.31	7.17	29.97
Notomastus	0.03	1	5.64	2.43	6.19	36.16
Groups d & b			**Average Dissimilarity = 91.24**			
	Group d	**Group b**				
Species	**Av. Abund**	**Av. Abund**	**Av. Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
NEMERTEA	2.06	0	8.23	10.55	9.02	9.02
Sabellaria spinulosa	1.83	0	7.21	2.32	7.91	16.92
Amphipholis squamata	1.56	0	6.28	7.73	6.89	23.81
Socarnes erythrophthalmus	1.55	0	6.17	7.04	6.76	30.57
Glycera lapidum	1.37	0	5.47	51.58	6	36.57
Groups c & b			**Average Dissimilarity = 96.63**			
	Group c	**Group b**				
Species	**Av. Abund**	**Av. Abund**	**Av.D iss**	**Diss/SD**	**Contrib%**	**Cum.%**
NEMERTEA	1.25	0	4.88	2.28	5.05	5.05
Spiophanes bombyx	1.21	0	4.85	1.7	5.02	10.07
Ampelisca diadema	0	1.19	4.57	2.69	4.73	14.8
Anoplodactylus petiolatus	1.19	0	4.57	2.69	4.73	19.53
Eurydice spinigera	0	1.19	4.57	2.69	4.73	24.26
Groups e & a			**Average Dissimilarity = 96.44**			
	Group e	**Group a**				
Species	**Av. Abund**	**Av. Abund**	**Av. Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
Sabellaria spinulosa	3.72	0	4.84	1.87	5.02	5.02
NEMERTEA	2.19	0	2.87	3.72	2.98	8
Pisidia longicornis	1.85	0	2.4	1.34	2.49	10.5
ACTINIARIA	1.69	0	2.06	1.22	2.14	12.63
Pholoe baltica	1.43	0	1.87	2.25	1.94	14.57
Groups i & a			**Average Dissimilarity = 100.00**			
	Group i	**Group a**				
Barnea candida	0	1.19	17.96	4.1	17.96	17.96
Nephtys cirrosa	1.1	0	16.67	3.43	16.67	34.63
Amphipholis squamata	0	1	15.1	4.1	15.1	49.73
Glycera alba	0	1	15.1	4.1	15.1	64.83
Corophium volutator	0	1	15.1	4.1	15.1	79.93
Groups g & a			**Average Dissimilarity = 96.82**			
	Group g	**Group a**				
Urothoe brevicornis	1.2	0	8.61	1.4	8.9	8.9
Barnea candida	0	1.19	8.35	2.25	8.63	17.52
Corophium volutator	0	1	7.02	2.25	7.25	24.78
Amphipholis squamata	0.06	1	6.81	1.96	7.03	31.81
Nephtys cirrosa	0.98	0	5.86	1.4	6.05	37.86
Groups d & a			**Average Dissimilarity = 91.04**			
	Group d	**Group a**				
Ophelia borealis	2.19	0	9.52	1.4	10.46	10.46
NEMERTEA	2.06	0	9.17	11.53	10.07	20.53
Sabellaria spinulosa	1.83	0	8.03	2.36	8.82	29.35
Socarnes erythrophthalmus	1.55	0	6.87	7.46	7.55	36.9
Glycera lapidum	1.37	0	6.1	36.42	6.7	43.61
Groups c & a			**Average Dissimilarity = 94.45**			
	Group c	**Group a**				
NEMERTEA	1.25	0	5.47	2.11	5.79	5.79
Spiophanes bombyx	1.21	0	5.45	1.61	5.77	11.56
Anoplodactylus petiolatus	1.19	0	5.11	2.44	5.42	16.97
Barnea candida	0	1.19	5.11	2.44	5.42	22.39
Amphipholis squamata	0	1	4.3	2.44	4.55	26.94
Groups b & a			**Average Dissimilarity = 100.00**			
	Group b	**Group a**				
Ampelisca diadema	1.19	0	10.86	Undefined!	10.86	10.86

Taxa	Av. Abund	Av. Abund	Av. Diss	Diss/SD	Contrib%	Cum.%
Ophelia borealis	1.19	0	10.86	Undefined!	10.86	21.73
Eurydice spinigera	1.19	0	10.86	Undefined!	10.86	32.59
Pontocrates arcticus	1.19	0	10.86	Undefined!	10.86	43.46
Barnea candida	0	1.19	10.86	Undefined!	10.86	54.32
Groups e & f			**Average Dissimilarity = 90.71**			
	Group e	**Group f**				
Sabellaria spinulosa	3.72	1.19	3.3	1.59	3.63	3.63
NEMERTEA	2.19	0	2.74	3.79	3.03	6.66
Amphipholis squamata	1.75	0	2.12	2.35	2.34	9
ACTINIARIA	1.69	0	1.97	1.22	2.18	11.18
Pholoe baltica	1.43	0	1.79	2.29	1.97	13.14
Groups i & f			**Average Dissimilarity = 100.00**			
	Group i	**Group f**				
Pisidia longicornis	0	1.32	13.11	5.9	13.11	13.11
Sabellaria spinulosa	0	1.19	11.84	5.9	11.84	24.95
Nephtys cirrosa	1.1	0	11	4.01	11	35.96
Spiophanes bombyx	0	1	9.96	5.9	9.96	45.92
Goniada maculata	0	1	9.96	5.9	9.96	55.88
Groups g & f			**Average Dissimilarity = 89.31**			
	Group g	**Group f**				
Urothoe brevicornis	1.2	0	6.77	1.54	7.58	7.58
Pisidia longicornis	0.16	1.32	6.56	1.96	7.34	14.92
Sabellaria spinulosa	0.29	1.19	5.93	1.92	6.64	21.56
Chaetozone zetlandica	0	1	5.54	2.94	6.21	27.77
Pectinariidae	0	1	5.54	2.94	6.21	33.98
Groups d & f			**Average Dissimilarity = 90.73**			
	Group d	**Group f**				
Ophelia borealis	2.19	0	8.32	1.39	9.17	9.17
NEMERTEA	2.06	0	7.99	10.33	8.81	17.98
Amphipholis squamata	1.56	0	6.1	7.85	6.72	24.7
Socarnes erythrophthalmus	1.55	0	5.99	6.94	6.6	31.3
Glycera lapidum	1.37	0	5.31	57.67	5.86	37.16
Groups c & f			**Average Dissimilarity = 92.54**			
	Group c	**Group f**				
Species	**Av. Abund**	**Av. Abund**	**Av. Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
Pisidia longicornis	0	1.32	4.91	2.76	5.3	5.3
NEMERTEA	1.25	0	4.73	2.33	5.11	10.42
Sabellaria spinulosa	0	1.19	4.44	2.76	4.79	15.21
Anoplodactylus petiolatus	1.19	0	4.44	2.76	4.79	20
Lumbrineris cingulata	1	0	3.73	2.76	4.03	24.03
Groups b & f			**Average Dissimilarity = 100.00**			
	Group b	**Group f**				
Pisidia longicornis	0	1.32	9.23	Undefined!	9.23	9.23
Sabellaria spinulosa	0	1.19	8.34	Undefined!	8.34	17.57
Ampelisca diadema	1.19	0	8.34	Undefined!	8.34	25.9
Ophelia borealis	1.19	0	8.34	Undefined!	8.34	34.24
Eurydice spinigera	1.19	0	8.34	Undefined!	8.34	42.58
Groups a & f			**Average Dissimilarity = 100.00**			
	Group a	**Group f**				
Pisidia longicornis	0	1.32	11.25	Undefined!	11.25	11.25
Sabellaria spinulosa	0	1.19	10.17	Undefined!	10.17	21.42
Barnea candida	1.19	0	10.17	Undefined!	10.17	31.59
Amphipholis squamata	1	0	8.55	Undefined!	8.55	40.14
Spiophanes bombyx	0	1	8.55	Undefined!	8.55	48.69
Groups e & h			**Average Dissimilarity = 95.12**			
	Group e	**Group h**				
Sabellaria spinulosa	3.72	0	4.58	1.9	4.81	4.81

Taxa	Av. Abund	Av. Abund	Av. Diss	Diss/SD	Contrib%	Cum.%
NEMERTEA	2.19	0	2.71	3.8	2.85	7.67
Pisidia longicornis	1.85	0	2.27	1.35	2.39	10.05
Amphipholis squamata	1.75	0	2.1	2.35	2.21	12.26
Pholoe baltica	1.43	0	1.77	2.3	1.86	14.12
Groups i & h			**Average Dissimilarity = 81.60**			
	Group i	**Group h**				
Spisula elliptica	0	1.32	12.11	6.33	14.84	14.84
ACTINIARIA	0	1	9.2	6.33	11.28	26.12
Spiophanes bombyx	0	1	9.2	6.33	11.28	37.4
Scolelepis bonnieri	0	1	9.2	6.33	11.28	48.67
Thia scutellata	0	1	9.2	6.33	11.28	59.95
Groups g & h			**Average Dissimilarity = 84.22**			
	Group g	**Group h**				
Urothoe brevicornis	1.2	0	6.44	1.56	7.65	7.65
Spisula elliptica	0.19	1.32	6.11	1.92	7.25	14.9
Spio armata	0	1	5.28	3.09	6.27	21.17
Scolelepis squamata	0	1	5.28	3.09	6.27	27.44
Thia scutellata	0.06	1	5.04	2.39	5.98	33.42
Groups d & h			**Average Dissimilarity = 96.40**			
	Group d	**Group h**				
Ophelia borealis	2.19	0	8.07	1.39	8.37	8.37
NEMERTEA	2.06	0	7.75	10.11	8.04	16.41
Sabellaria spinulosa	1.83	0	6.79	2.3	7.05	23.46
Amphipholis squamata	1.56	0	5.91	7.98	6.13	29.59
Socarnes erythrophthalmus	1.55	0	5.81	6.84	6.02	35.61
Groups c & h			**Average Dissimilarity = 90.06**			
	Group c	**Group h**				
Spisula elliptica	0	1.32	4.76	2.84	5.28	5.28
NEMERTEA	1.25	0	4.58	2.39	5.09	10.37
Anoplodactylus petiolatus	1.19	0	4.3	2.84	4.77	15.14
ACTINIARIA	0	1	3.61	2.84	4.01	19.15
Lumbrineris cingulata	1	0	3.61	2.84	4.01	23.17
Groups b & h			**Average Dissimilarity = 100.00**			
	Group b	**Group h**				
Spisula elliptica	0	1.32	8.73	Undefined!	8.73	8.73
Ampelisca diadema	1.19	0	7.89	Undefined!	7.89	16.62
Ophelia borealis	1.19	0	7.89	Undefined!	7.89	24.51
Eurydice spinigera	1.19	0	7.89	Undefined!	7.89	32.4
Pontocrates arcticus	1.19	0	7.89	Undefined!	7.89	40.29
Groups a & h			**Average Dissimilarity = 100.00**			
	Group a	**Group h**				
Spisula elliptica	0	1.32	10.52	Undefined!	10.52	10.52
Barnea candida	1.19	0	9.51	Undefined!	9.51	20.03
ACTINIARIA	0	1	8	Undefined!	8	28.03
Amphipholis squamata	1	0	8	Undefined!	8	36.03
Spiophanes bombyx	0	1	8	Undefined!	8	44.02
Groups f & h			**Average Dissimilarity = 87.36**			
	Group f	**Group h**				
Pisidia longicornis	1.32	0	8.32	Undefined!	9.52	9.52
Spisula elliptica	0	1.32	8.32	Undefined!	9.52	19.04
Sabellaria spinulosa	1.19	0	7.52	Undefined!	8.6	27.65
ACTINIARIA	0	1	6.32	Undefined!	7.24	34.88
Nephtys cirrosa	0	1	6.32	Undefined!	7.24	42.12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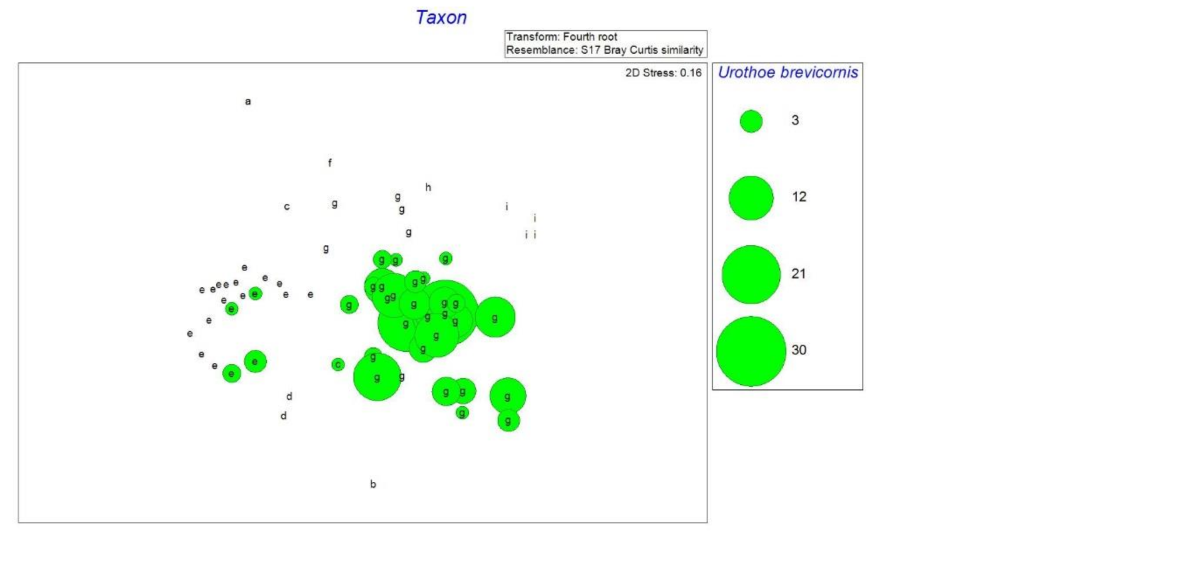
Resemblance: S17 Bray Curtis similarity
2D Stress: 0.16
Sabellaria spinulosa
400
1.6E3
2.8E3
4E3


Taxon
Transform: Fourth root
Resemblance: S17 Bray Curtis similarity
2D Stress: 0.16
Urothoe brevicornis
3
12
21
30

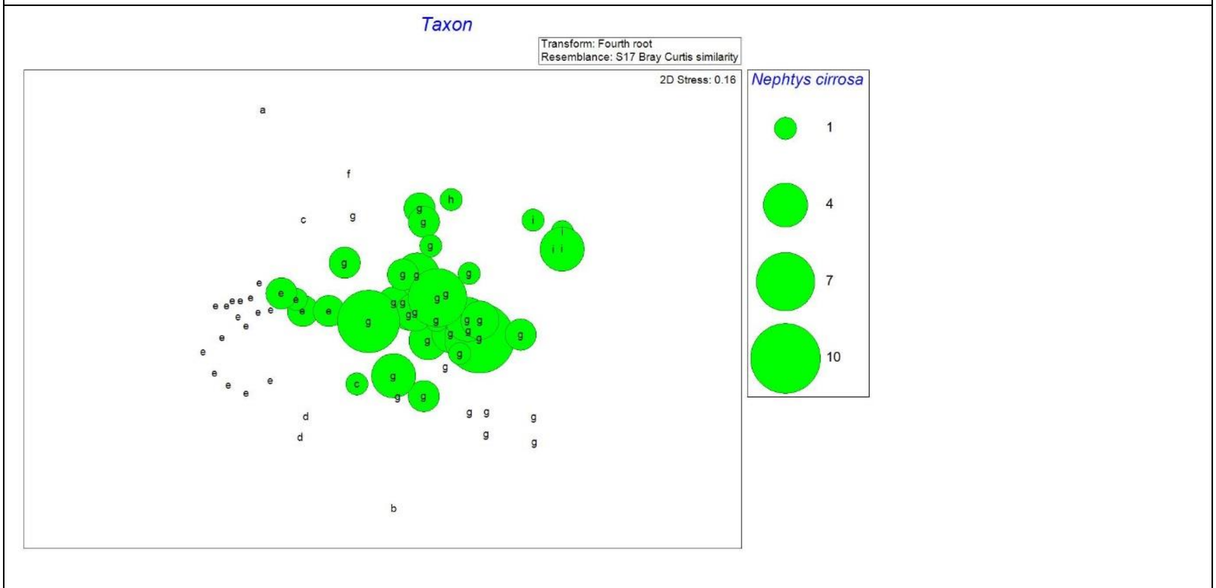

Taxon
Transform: Fourth root
Resemblance: S17 Bray Curtis similarity
2D Stress: 0.16
Nephtys cirrosa
1
4
7
10

Figure E3.3: Species mainly contributing to the differences between groups identifed by the cluster analysis, overlaid with their relative abundance.

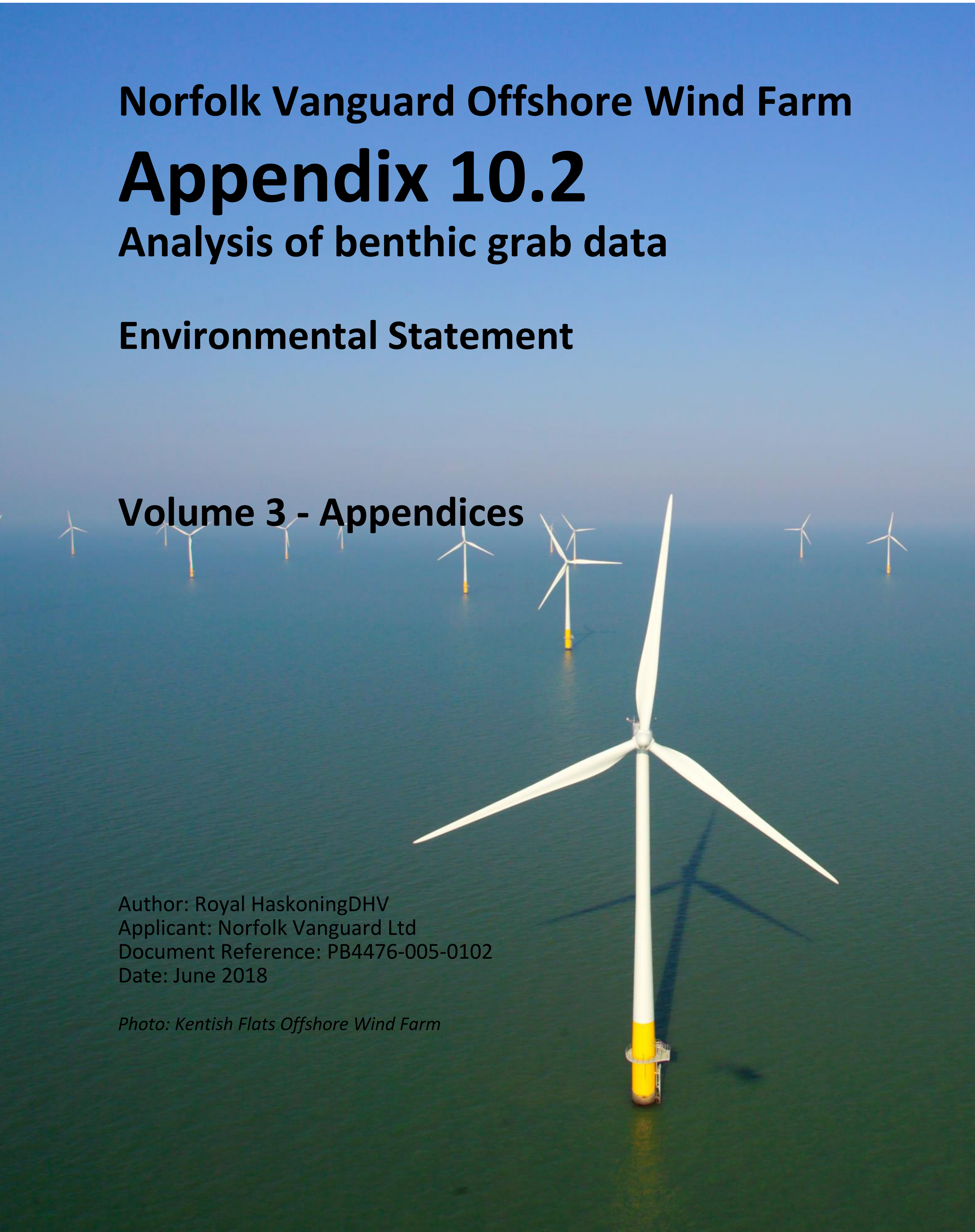
Norfolk Vanguard Offshore Wind Farm

Appendix 10.2

Analysis of benthic grab data

Environmental Statement

Volume 3 - Appendices



Author: Royal HaskoningDHV
Applicant: Norfolk Vanguard Ltd
Document Reference: PB4476-005-0102
Date: June 2018

Photo: Kentish Flats Offshore Wind Farm

Environmental Impact Assessment
Environmental Statement

Document Reference: PB4476-005-0102

June 2018

For and on behalf of Norfolk Vanguard Ltd

Approved by: Ruari Lean, Rebecca Sherwood

Signed:

Date: 8th June 2018

For and on behalf of Royal HaskoningDHV

Drafted by: David Tarrant

Approved by: Paolo Pizzolla

Signed: pp

Date: 23rd May 2018

Date	Issue No.	Remarks / Reason for Issue	Author	Checked	Approved
28/03/18	00	First draft for Internal review	DT	GK	
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23/05/18	01F	Final for ES submission	DT	GK	PP

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Tables

Plates

Glossary

ANOSIM	Analysis of Similarity
MDS	Multi-Dimensional Scaling
PRIMER	Plymouth Routines in Multivariate Ecological Research
PSD	Particle Size Distribution
SIMPER	Similarity Percentages
SIMPROF	Similarity Profile Analysis
ZEA	Zone Environmental Appraisal
PSD	Particle Size Distribution

Terminology

Dendrogram	A method for arranging samples to show how they relate to each other.
Diversity index	Indication of how diverse a sample is.
Fractional Composition [of sediment]	The percentage of three fractional components (Mud, Sand and Gravel) that make up each sediment sample.
Multivariate statistical analyses	Analysis which considers more than one variable in the same test.
Infaunal	Organisms that live within the sediment
Infaunal Community	The range of different species which occur in a set area.

10 ANALYSIS OF COMBINED BENTHIC GRAB DATA

10.1 Introduction

1. This appendix contains the results of analysis that was conducted to characterise the infaunal communities which exist across the former East Anglia Zone and within the Norfolk Vanguard offshore project area.

2. As outlined in Chapter 10 Benthic Ecology, data from separate survey campaigns have been used to inform the Benthic Ecology baseline. These include: Zone Environmental Appraisal (ZEA) surveys undertaken in 2010/11; surveys of the former East Anglia FOUR site undertaken in 2013 and site-specific surveys of the Norfolk Vanguard offshore project area undertaken in 2016. Data have been collected using three different methodologies:

- Grab samples to characterise the infauna (animals living within the sediment);
- Video footage to identify the presence and extent of biogenic reefs (reef structures created by organisms); and
- Beam trawls during the ZEA surveys to characterise the epifauna (animals living attached to the sea bed).

3. The analysis reported within this appendix was conducted on the grab sample data only as, of the three sample techniques this is the only one where samples are of a quantifiable and equivalent size.

4. There are two main types of analysis that are reported in this appendix:

- Section 10.2 provides comparison of the broad make up of community structure in terms of the overall taxa within the samples; and
- Section 10.3 provides statistical analysis of the different communities found within the data using species level analysis.

5. Table 10.1 illustrates the number of grab samples which were included in the different analysis.

Table 10.1 Sample numbers included within the analyses

Study Area	Number of grab samples (Infauna and sediment)	
	Taxonomic comparison	Statistical analysis
2011 ZEA Surveys	566	566
2012 East Anglia FOUR surveys	5	Not used
2016 Norfolk Vanguard Surveys	65	65
Total	**636**	**631**

10.2 Taxonomic comparison

6. A total of 566 benthic grabs samples were collected during the ZEA survey for characterisation purposes, 65 during the Norfolk Vanguard surveys as well as five samples collected during the East Anglia FOUR survey. From these, 523 taxa were identified, with an average of 94 individuals and 16 taxa recorded per sample. Of these grab samples, 46 were taken within NV East, 47 taken within NV West and 53 from within the Norfolk Vanguard offshore cable corridor.

7. Analyses of the ZEA data along with the site specific data show that across the former East Anglia Zone, polychaete worms were the most abundant class of taxa contributing to 62% of the abundance (Plate 10.1) and were the most diverse group, making the largest contribution (40%) to the taxonomic richness (Plate 10.2). The ZEA report (EAOW, 2012a) shows that echinoderms (brittlestars, starfish and sea urchins) represent the largest contribution to biomass across the former zone (as ash-free dry weight (AFDW) in grams) (37%) followed by annelids (32%).

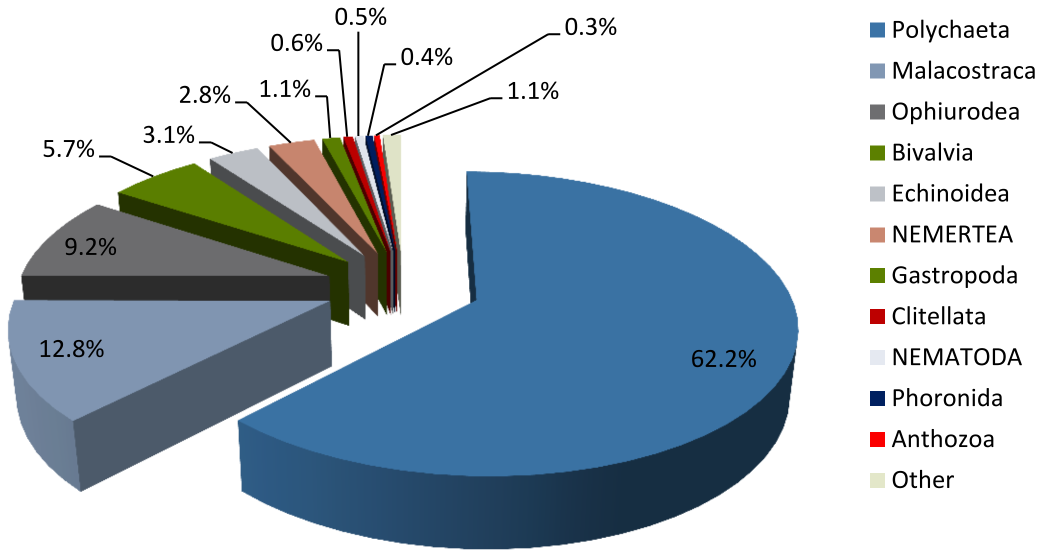


Plate 10.1 Infaunal breakdown for the former East Anglia Zone area (Includes data from Zone, Norfolk Vanguard and East Anglia surveys): Number of individuals by class. Where species identification to class is not possible, species are displayed by phylum (for example Nemertea and Nematoda).

8. Within the top ten taxa recorded across the former East Anglia Zone (using both ZEA and site specific data), the most abundant were the Ross worm *Sabellaria spinulosa* (19,259 individuals recorded), the polychaete worm *Spiophanes bombyx* (3,730 individuals recorded), unidentified species from the class Ophiuroidea (brittlestars) and the long-clawed porcelain crab *Pisidia longicornis*. Together these accounted for nearly 45.5% of the total abundance. Overall abundance across the former East Anglia Zone was low with the majority of samples containing less than 200 individuals. Twelve samples contained 1,000 or more individuals.

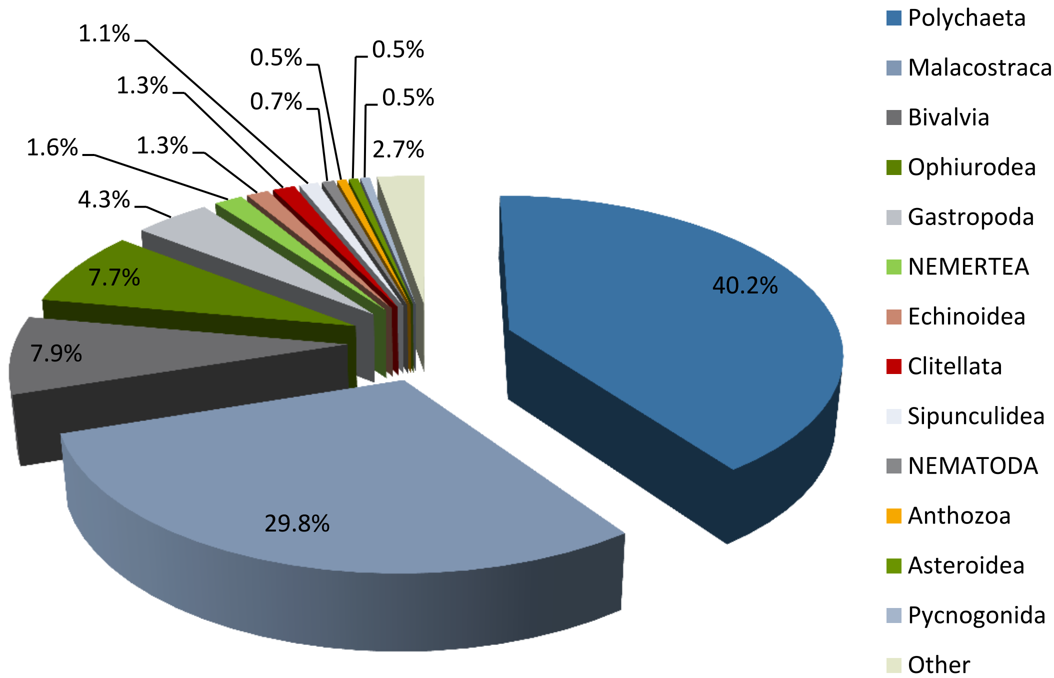
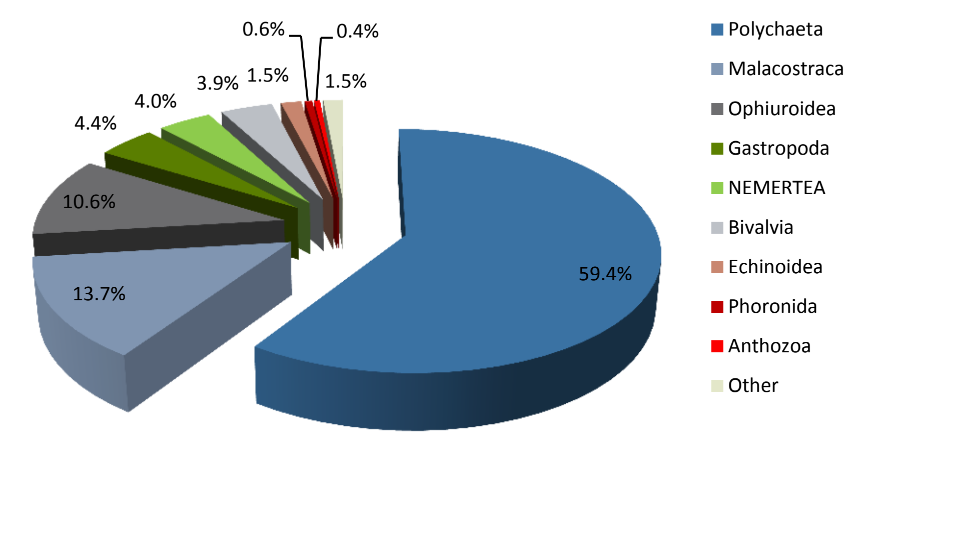


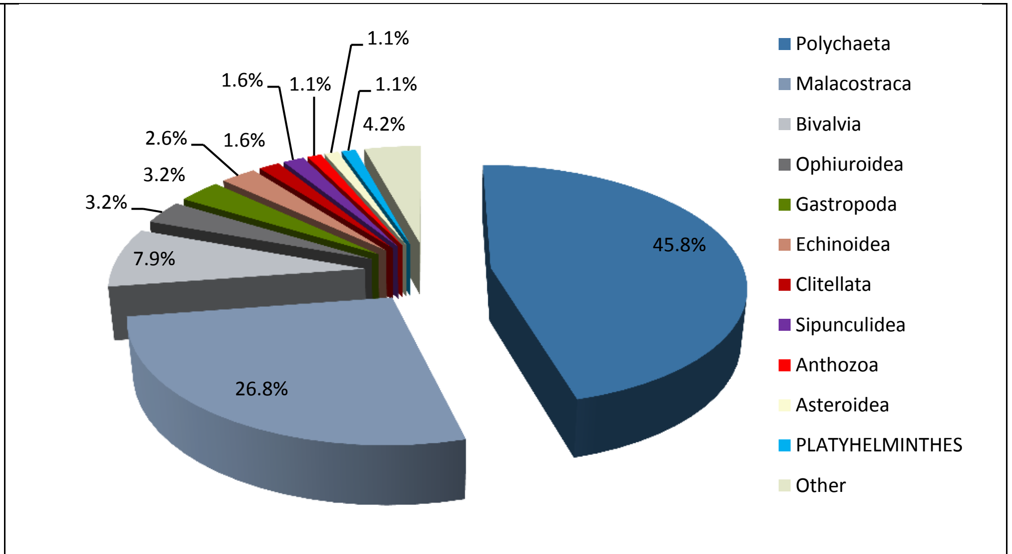
Plate 10.2 Infaunal breakdown for the former East Anglia Zone area (Includes data from Zone, Norfolk Vanguard and East Anglia surveys): Number of species by class. Where species identification to class is not possible, species are displayed by phylum (for example Nemertea and Nematoda).

10.2.1.1 NV East and NV West

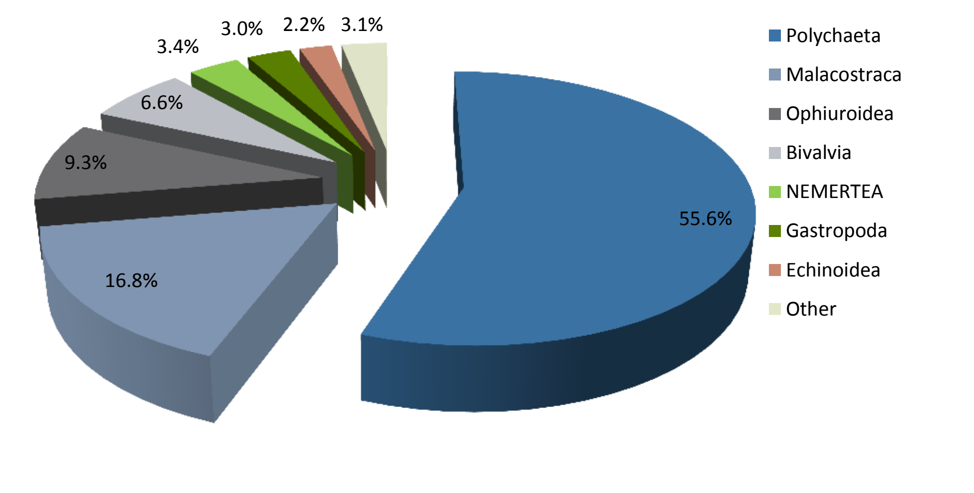
9. The infaunal communities within NV East and NV West are dominated by many of the same species groups as the former East Anglia Zone (Plate 10.3 and Plate 10.1). Polychaete worms are the most numerous class in terms of individuals followed by Malacostraca (a class of Crustacea). The mean abundance is 95.07 individuals per sample within NV East and 55.77 within NV West, both of which are less than the ZEA average which is 95.84. The mean number of species in NV West is 17.43 which is slightly higher than the mean number recorded across the former zone which is 15.73. The mean number of species recorded from samples within NV East is 13.69 which is slightly lower than the mean number found across the former Zone.



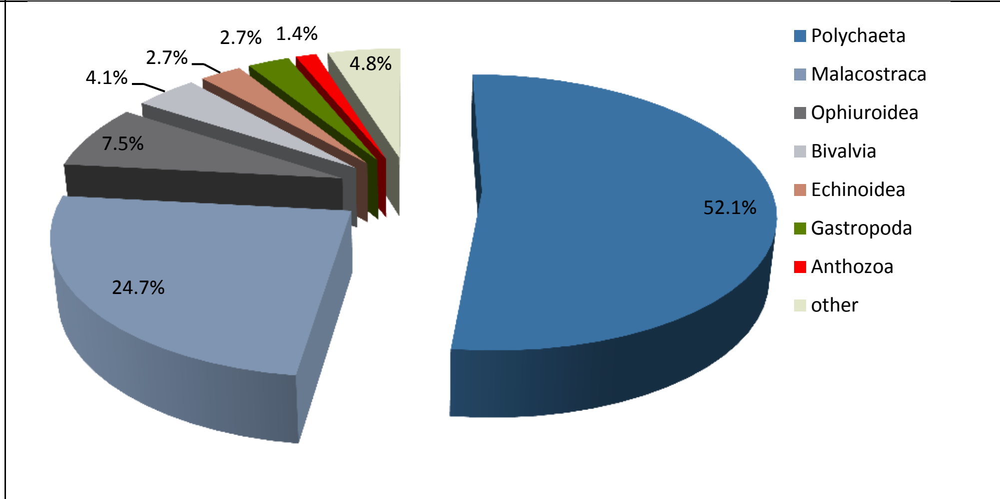
(a) NV West: Number of individuals by class



(b) NV West: Number of Species by class



(c) NV East: Number of individuals by class



(d) NV East: Number of Species by class

Plate 10.3 Infaunal breakdown for the OWF sites (Includes data from Zone, Norfolk Vanguard and East Anglia surveys): Number of individuals (a and c) species (b and d) by class. Where species identification to class is not possible, species are displayed by phylum (for example Nemertea and Nematoda).

10.2.1.2 Offshore cable corridor

10. The offshore cable corridor was also dominated by polychaetes and Malacostraca Plate 10.4, with Ophiuroidea (brittlestars) and Nemertea (ribbon worms) also contributing. In terms of species diversity in the offshore cable corridor, the most diverse group were again the polychaetes, Malacostraca and Ophiuroidea, with gastropods and bivalves also contributing.

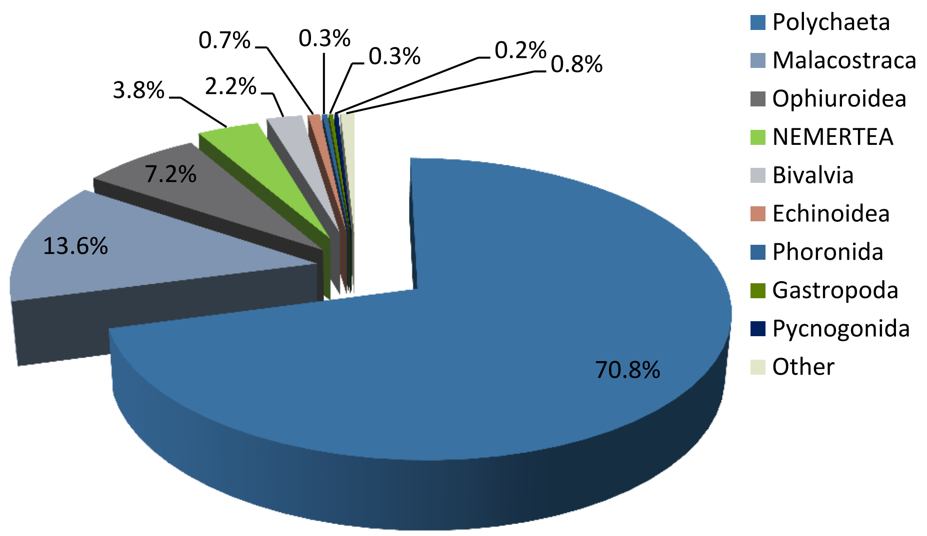


Plate 10.4 Infaunal breakdown for the offshore cable corridor (Includes data from Zone and Norfolk Vanguard surveys): Number of individuals by class. Where species identification to class is not possible, species are displayed by phylum (for example Nemertea and Nematoda).

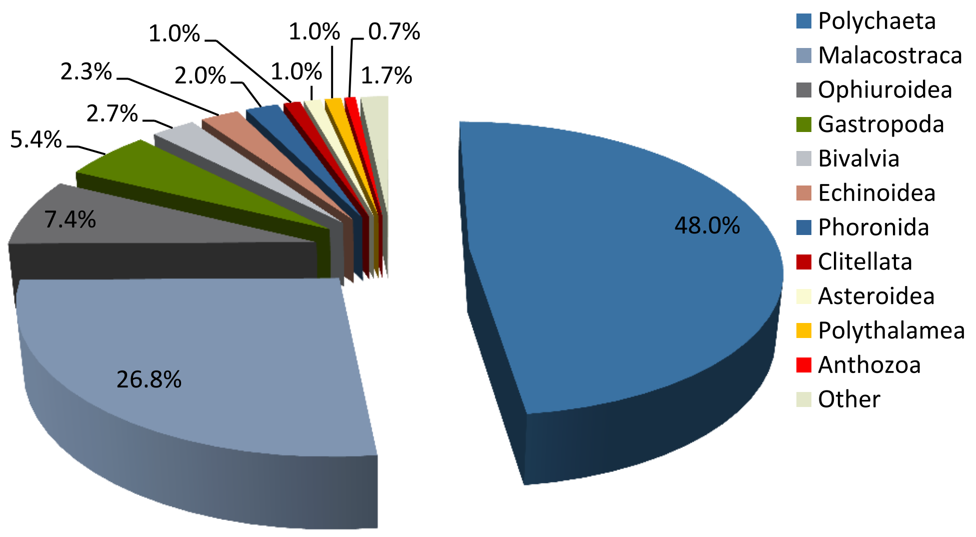


Plate 10.5 Infaunal breakdown for the offshore cable corridor (Includes data from Zone and Norfolk Vanguard surveys): Number of species by class. Where species identification to class is not possible, species are displayed by phylum (for example Nemertea and Nematoda).

11. In conclusion, Plate 10.1 to Plate 10.5 illustrate that the benthic species composition of NV East, NV West and the offshore cable corridor is broadly similar to that found across the former Zone.

10.3 Statistical Analysis of the Benthic Infaunal Communities

12. Table 10.1 shows the number of samples which have been acquired from two survey campaigns. Further detail regarding the different surveys is provided in Chapter 10 Benthic Ecology (section 10.5.2) and in Appendix 10.1 of the ES chapter. The five samples from East Anglia FOUR surveys were not included in the statistical analysis as these samples were significantly different to both the ZEA and Norfolk Vanguard samples. This was attributed to different methods for processing the samples rather than actually reflecting different communities.

10.3.1 Methods

10.3.1.1 Diversity indices

13. The following univariate diversity index tests were conducted using the Plymouth Marine Laboratories PRIMER v6 (Plymouth Routines in Multivariate Ecological Research) suite of programs (Clarke and Warwick, 2001; Clarke and Gorley, 2006):

- Shannon Wiener diversity index;
    - The Shannon Wiener diversity index is a measure of biodiversity based on the number of species present and the number of individuals of each species. If a few species dominate, the index value is low. A greater number of species or a more even distribution of individuals of each species both result in an increase in Shannon's diversity.
- Simpson’s dominance index.
    - Simpson’s dominance index is a measure of the probability that two individuals randomly selected from a sample will belong to the same species. Simpson's dominance index ranges from 0 (all taxa are equally present) to 1.0 (one taxon dominates the community completely).

10.3.1.2 Multivariate analysis

14. Multivariate statistical analyses were also conducted using the Plymouth Marine Laboratories (PRIMER) v6 suite of programs (Clarke and Warwick, 2001; Clarke and Gorley, 2006).

15. Particle size distribution (PSD) data were imported into PRIMER as environmental data and was then normalised. The transformed data were then subjected to hierarchical clustering to identify sample groupings based on the Euclidean distance. The process ends with a single cluster containing all stations and is best expressed as a dendrogram showing the sequential clustering of stations against relative

similarity. To best describe the environmental differences between samples, the groups were identified on the basis of a slice at a Euclidean distance of 8.51, as indicated by the SIMPROF test in PRIMER.

16. Sediment data were also provided as a Fractional Composition (the percentage of Mud, Sand and Gravel components of each sample). This data were also subjected to the same analysis as the PSD data.

17. Infaunal data for multivariate analysis were imported into PRIMER and initially subjected to fourth root transformation to reduce the influence of any highly abundant taxa allowing less abundant species a greater role in driving the emergent multivariate patterns. The transformed data were then organised into a resemblance matrix using a Bray Curtis index of similarity.

18. The approach to the Norfolk Vanguard benthic sample collection relied on the fact that the ZEA data which was collected in 2011 were still valid. In order to assess whether the data collected during the Norfolk Vanguard survey were broadly comparable to the ZEA data, an MDS (further detail provided below) plot was produced with samples identified by survey.

19. As part of the Norfolk Vanguard Evidence Plan Process (EPP) (see Chapter 7, Technical consultation Norfolk Vanguard PEIR) and consultation on the Preliminary Environmental Information Report, the Marine Management Organisation requested that further analysis be undertaken to compare the ZEA and Norfolk Vanguard survey data on a site specific basis. This included selecting only the ZEA and Norfolk Vanguard survey samples taken from within the Norfolk Vanguard offshore project area and undertaking cluster analysis with a 30% slice (as determined by a SIMPROF test) and MDS analysis (see further details below on the methodology for these analyses). The objective being to reduce the number of samples thereby increasing the similarity slice and reducing the stress within the MDS plots. Thus further detail on the comparability of the two data sets is provided.

20. The full data set was then subjected to hierarchical clustering to identify sample groupings based on the same Bray Curtis index of similarity. This process combines samples into groups starting with the highest mutual similarities and then gradually lowers the similarity level at which groups are formed. The process ends with a single cluster containing all stations and is best expressed as a dendrogram showing the sequential clustering of stations against relative similarity.

21. To best describe the ecological differences between sites, the groups were identified on the basis of a slice at 20% similarity for the infaunal communities. This was informed by a SIMPROF test which confirmed that a 20% slice was a reasonable cut off. Similarity slices at around 20% are commonly used for a data set of this size and

the multivariate analysis for the original ZEA data used a 20% cut off point as did the East Anglia THREE multivariate assessment (EATL, 2015).

22. The MDS (Multi-dimensional Scaling) procedure uses the same similarity matrix as that used by the cluster analysis to produce an ordination of stations which is multidimensional. This is carried out to satisfy the between-samples relationships indicated by the similarity matrix. This multi-dimensional ordination is then reduced to a 2 or 3 dimensional representation that is a more accessible and useable representation. The representativeness of these 2-dimensional versions, in comparison to the multi-dimensional array, is indicated by a stress level. The closer this stress level is to zero, the better the representation.

23. Analysis of similarity (ANOSIM) were performed on the full data set to assess if the differences between groups were significant. Caution should be applied when interpreting these results as the groups we originally determined by the exploratory Cluster analysis and therefore will be predetermined to be different.

24. Similarity Percentage (SIMPER) analyses were applied to the data to rank species in terms of their contribution to both the within (internal) group similarity and "between" group dissimilarity and thereby assist the assessment of the distinctiveness of each community identified and the identification of the characterising taxa.

10.3.2 Results

10.3.2.1 Diversity Indices

25. Values for the Shannon Wiener diversity index test ranged from 0.487 to 3.536 (with a mean of 2.12 and values for the Simpson's dominance index ranged from 0.2197 to 1 (with a mean of 0.85).

26. Sample 042CR contained only 1 organism (*Nephtys cirrosa*) and therefore a diversity index cannot be calculated for this sample.

10.3.2.2 Particle size distribution

27. Nine distinct sediment groups were identified from the PSD data with a slice at a Euclidean distance of 8.51. At this level four groups (a, b, d and e) only contained one sample and therefore could be counted as outliers. The resultant dendrogram which contains all 631 samples was very large and therefore it is not possible to display within this report, the MDS plot is displayed below. The stress revealed by 2–dimensional representation (Plate 10.6) is given as 0.1 (top right corner of the MDS plot). This indicates that the 2-Dimensional image of the multi-dimensional space is a good representation.

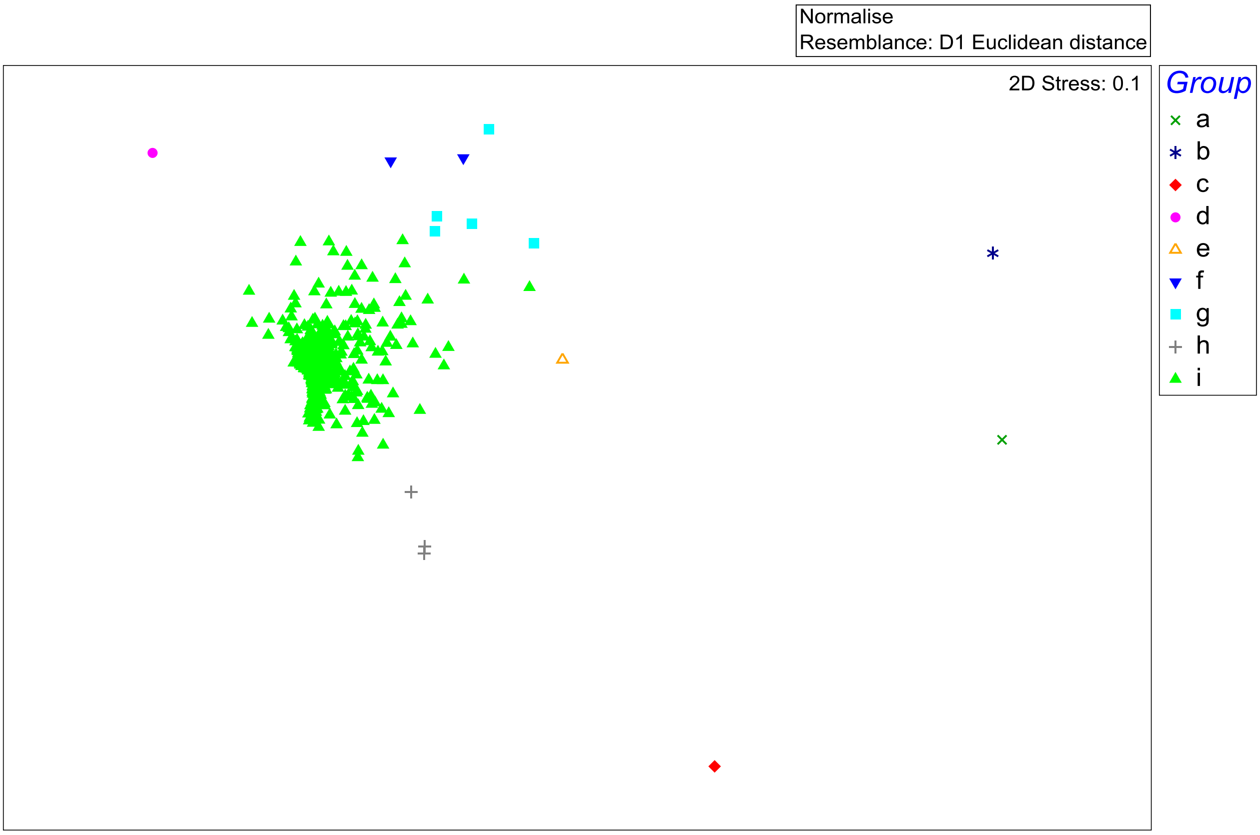


Plate 10.6 MDS 2D Dimensional Plot Showing PSD data groupings based on a Euclidean distance of 8.5.

28. Plate 10.6 shows that the vast majority of samples (over 97%) fell within group i with 5 in group g, 3 in group h and 2 in group f.

10.3.2.3 Fractional Composition

29. Analysis of the Fractional Composition data identified three distinct groups at a Euclidean distance of 4.4. The resultant dendrogram which contains all 631 samples was very large and therefore it is not possible to display within this report, the MDS plot is displayed below. The stress (Plate 10.7) is given as 0.01 indicating that the 2-demensional image of the multi-dimensional space is a good representation.

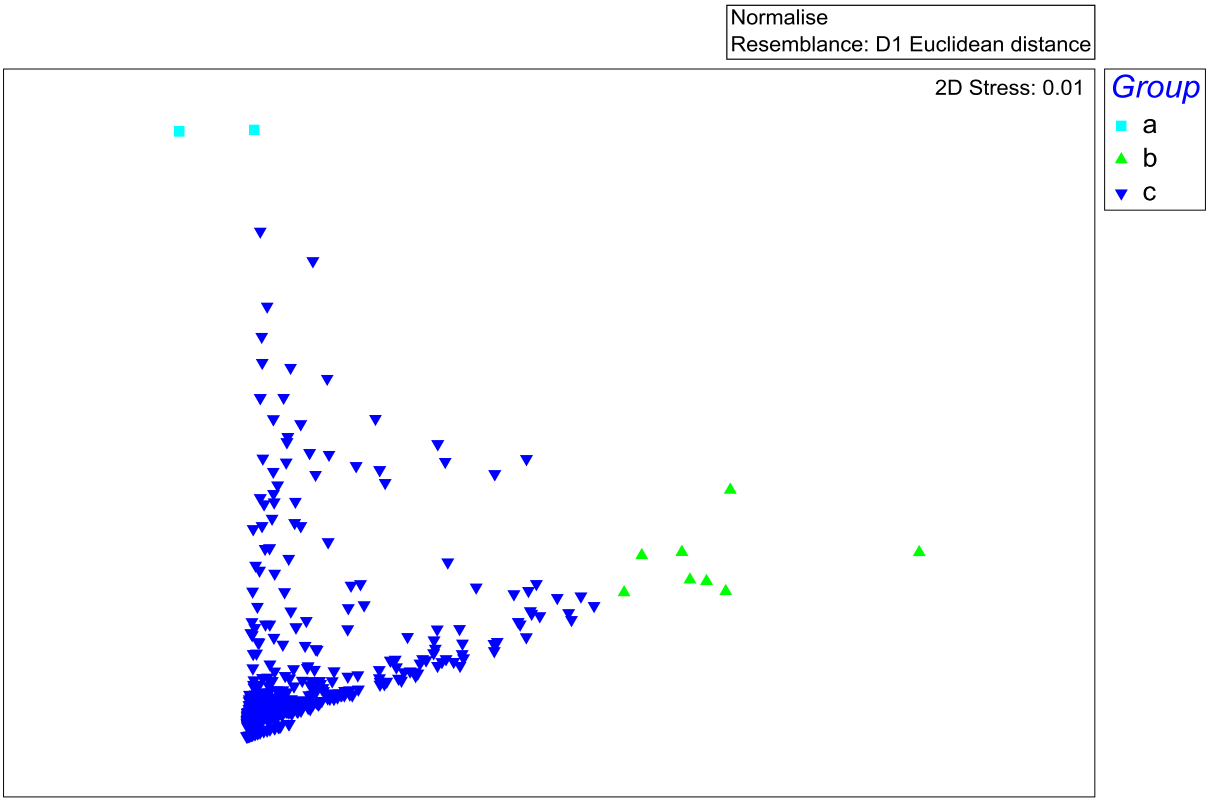


Plate 10.7 MDS 2-Dimensional Plot Showing Fractional Component data groupings based on a Euclidean distance of 4.46.

30. Plate 10.7 shows that the vast majority of samples (over 98%) fell within group c with seven in group b and 2 in group f. Group (a) have higher mud content and group (b) have higher gravel content. Group a is comprised of samples from the Norfolk Vanguard surveys and are all are located within the offshore cable corridor. Group b is comprised of five samples from the Norfolk Vanguard offshore cable corridor and two for the ZEA surveys.

10.3.2.4 Infaunal communities

31. Some data rationalisation was undertaken before performing multivariate analysis on the full grab sample dataset. Only the enumerated components of the species

recorded in the grabs was included. Where a presence or number of species per volume (i.e. 3per cm^2) was recorded a value of 1 was used in the data.

32. The MDS plots displayed below (Plate 10.8 and Plate 10.9) show infaunal communities identified within the combined data set. Samples collected during the Vanguard surveys are well interspersed with the ZEA samples indicating that the samples are broadly similar and suitable for analysis as combined data set. It also indicates that there has been little change in benthic communities between the ZEA surveys and the Norfolk Vanguard surveys.

33. 2 and 3-dimensional plots have been displayed as the stress level on the 2-demensional plot is relatively high (0.25) indicating that the two-dimensional image is a relatively poor representation of the multidimensional space.

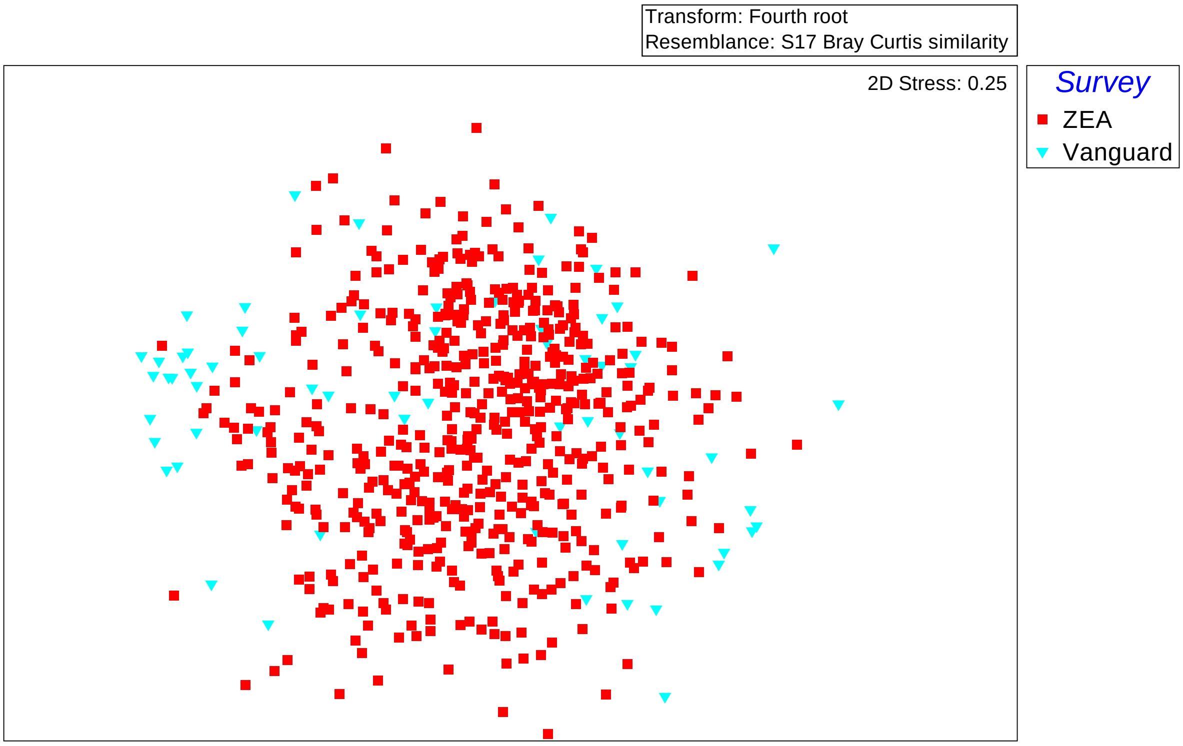


Plate 10.8 MDS 2D Dimensional Plot showing the relationship between samples collected during the Norfolk Vanguard and ZEA surveys.

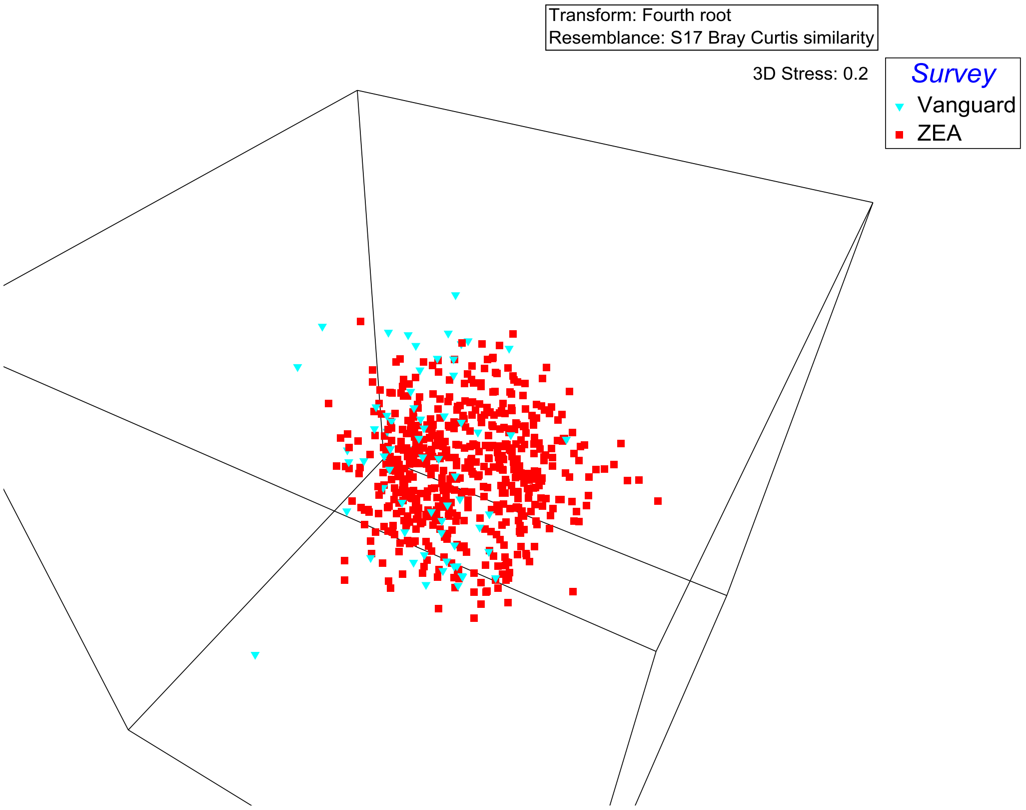


Plate 10.9 MDS 3D Dimensional Plot showing the relationship between samples collected during the Norfolk Vanguard and ZEA surveys.

34. As part of the consultation on the PEIR, the MMO requested further evidence to be provided that the data collected during the Norfolk Vanguard surveys are comparable to the data collected during the ZEA surveys. Plate 10.10 shows the resultant dendrogram from the cluster analysis which was undertaken on those samples which were collected from both surveys, within the Norfolk Vanguard offshore project area only. This shows the samples are well distributed within the dendrogram and are therefore comparable. Further evidence of this comparability is provided in the MDS plots in Plate 10.11 and Plate 10.12.

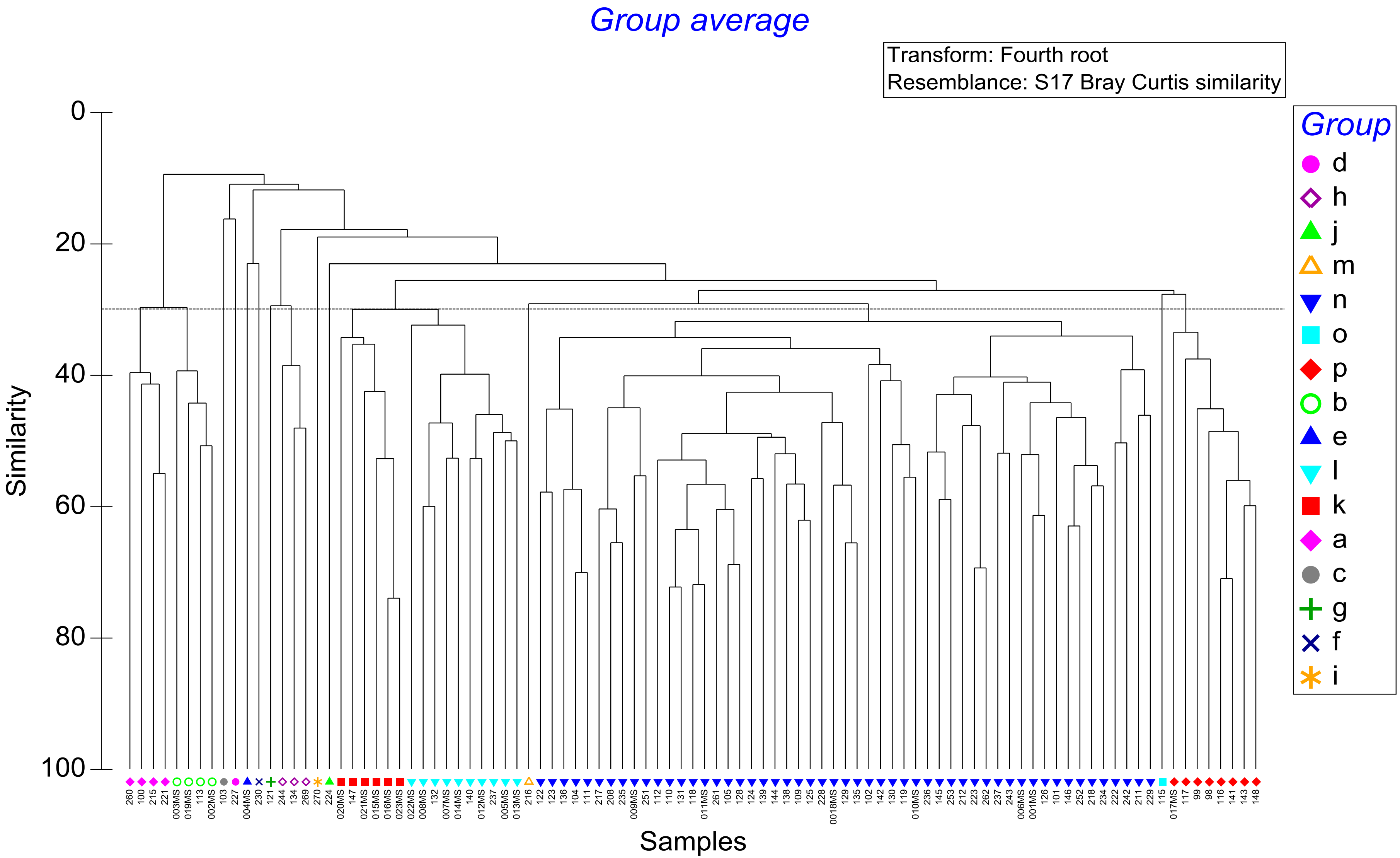


Plate 10.10 Dendrogram showing the results of the infaunal cluster analysis groupings based on 30% similarity slice for samples (ZEA and Norfolk Vanguard Survey) within the Norfolk Vanguard OWF sites (Samples from the Norfolk Vanguard surveys can be identified by the MS suffix)

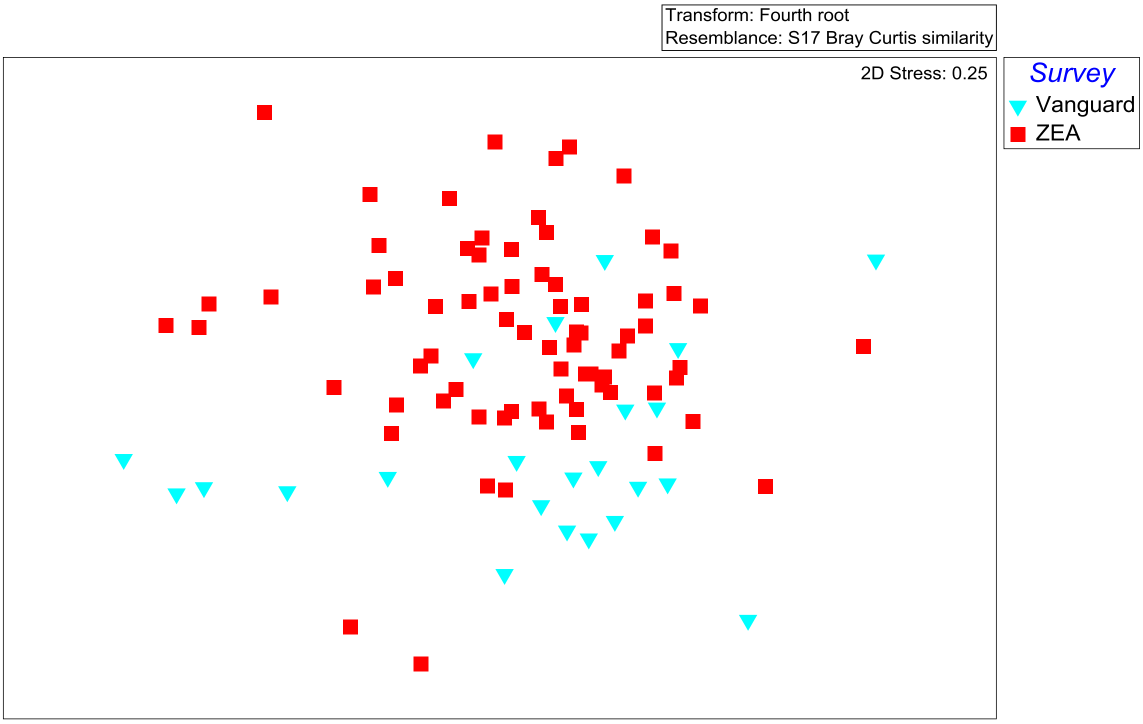


Plate 10.11 MDS 2-Dimensional plot showing the relationship of infaunal communities sampled from within the OWF sites from Norfolk Vanguard and ZEA surveys.

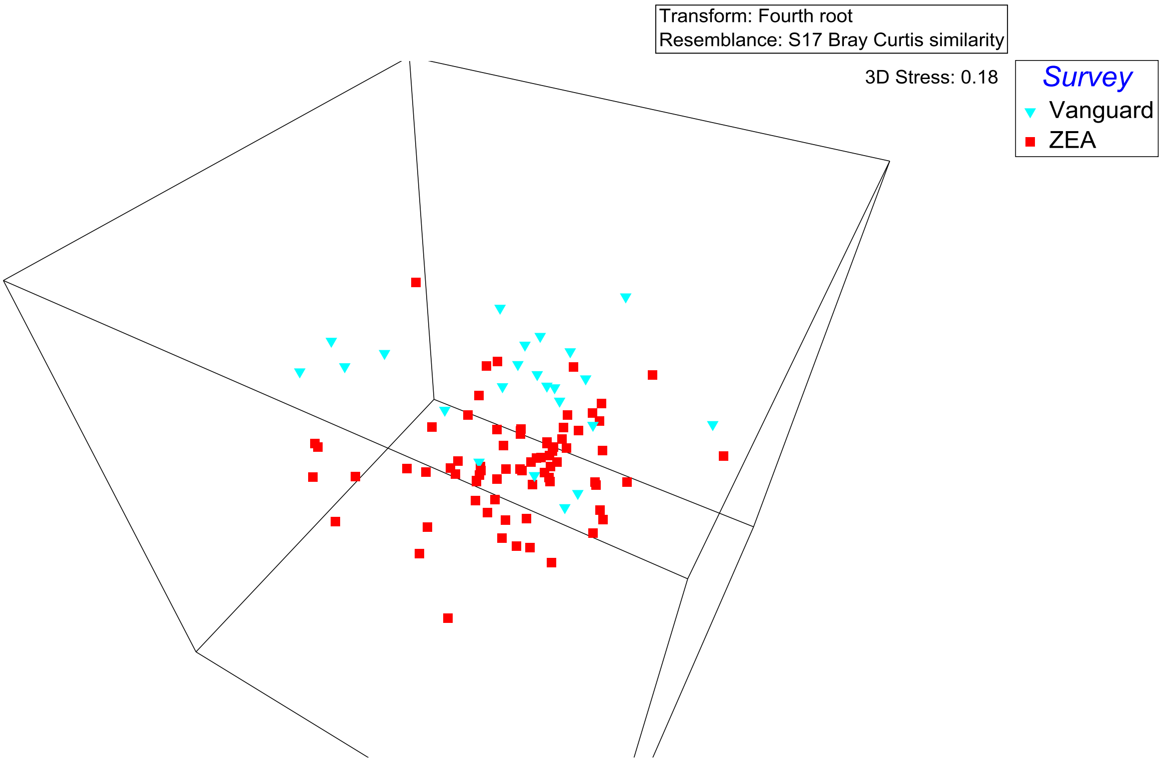


Plate 10.12 MDS 3- Dimensional plot showing the relationship of infaunal communities sampled from within the OWF sites from Norfolk Vanguard and ZEA surveys.

35. Once it was established that the Norfolk Vanguard survey data was comparable to the ZEA data the two data sets were combined and cluster analysis was undertaken on the combined data set.

36. The resultant dendrogram which contains all 631 samples was very large and therefore it is not possible to display within this report, the MDS plots are displayed below.

37. Eighteen distinct infaunal communities were identified at a 20% similarity slice. At this level seven groups (a,b,c,f,h,k and q) only contained one sample and therefore can be viewed as outliers. A summary of these groups is provided in Table 10.2. The outliers occurred as a result of either very few or no organisms being present in the grab sample or an aggregation of one species dominating that sample.

Table 10.2 description of groups which contained only one sample

Group	Description
a	Sample 046CR is distinct from all other groups as it only contained 5 individuals (1 *Corophium volutator*, 1 *Glycera alba*, 2 *Barnea candida* and 1 *Amphipholis squamata*)
b	Sample 254 is distinct from all other groups as it only contained 5 individuals (1 *Aonides paucibranchiata*, 2 unidentified copepods and 2 *Pontocrates altamarinus*).
c	Sample 355 is distinct from all other groups and was dominated by Nemertea (7 individuals) and *Pisione remota* (8 individuals). 21 individuals across 7 species were identified in this sample compared with an average of 96.4 individuals and 15.8 species across all samples.
f	Sample 448 is distinct from all other groups as it only contained 4 individuals (1 *Nephtys longosetosa*, 1 *Gastrosaccus spinifer*, 1 *Eurydice spinigera* and 1 unidentified Ophiuroidea).
h	Sample 103 is distinct from all other groups and is dominated by *Capitella* (48 of the 54 individuals) with 1 Ophiuridae, 1 *Lagis koreni*, 3 *Spiophanes bombyx* and 1 *Spio decorate* also present .
k	Sample 027CR is distinct from all other groups. It contains 24 species, 70 individuals and is dominated by *Abludomelita obtusata* (10 individuals) and *Travisia forbesii* (19 individuals)
q	Sample 470 is distinct from all other groups. It contains 13 species, 30 individuals and is dominated by brittle stars the majority of which are either identified to the class Ophiuridae (6 individuals) or to the family Ophiuroidea (8 individuals).

38. The MDS plots provided in Plate 10.13 and Plate 10.14 illustrate the relationship between the 18 groups. The stress revealed by 2–dimensional representation (Plate 10.13) is 0.25 (top right corner of the MDS plot). This indicates that although still potentially a useful representation of the multi-dimensional space the image is stretched and could be misinterpreted. For this reason, Plate 10.14 presents a 3-dimensional representation of the same MDS plot, which shows at lower stress level (0.2). 0.2 is still considered to be a relatively high stress level and is a consequence of the high number of samples within the data. Therefore the Plate 10.13 and Plate

10.14 should be interpreted with caution as some of the relationships between infaunal communities will not be apparent.

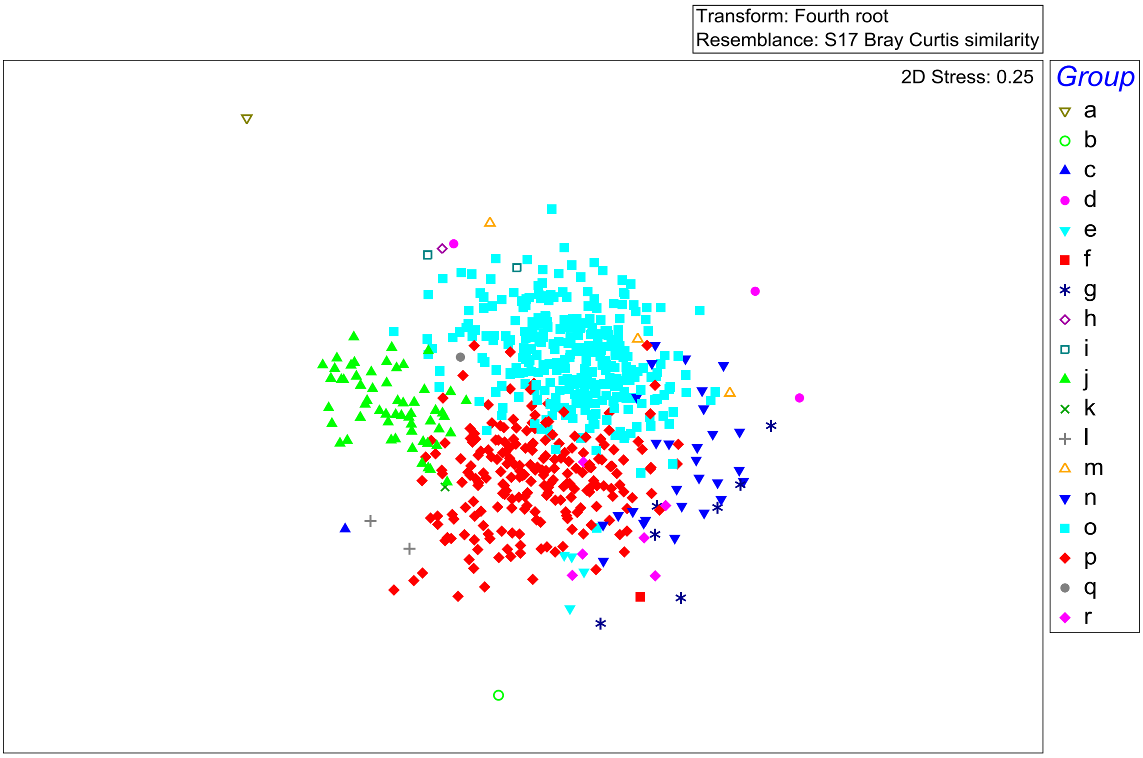


Plate 10.13 MDS 2D Dimensional Plot Showing Groupings Based on 20% Similarity Slice of Faunal Data.

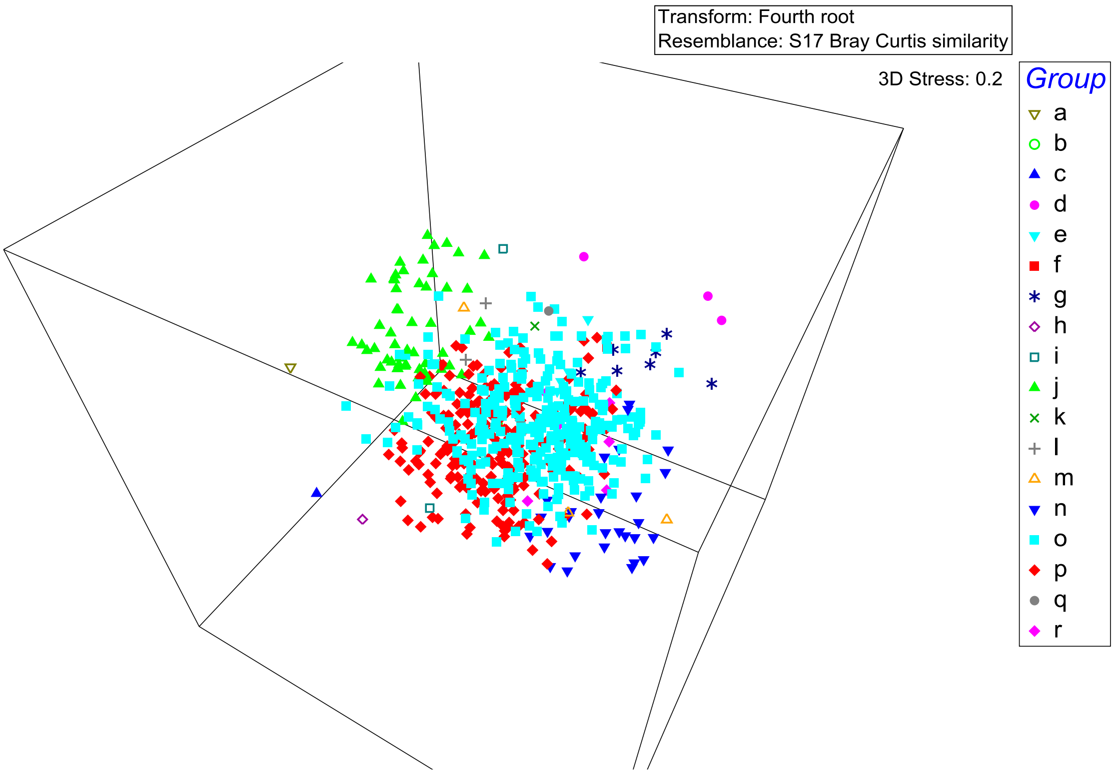


Plate 10.14 MDS 3D Dimensional Plot Showing Groupings Based on 20% Similarity Slice of Faunal Data.

10.3.2.4.1 NV East and NV West

39. Five groups (j, m, n, o, and p) were found within NV West (Volume 2, Figure 10.6) all of which apart from m were common across the former Zone. Six groups (d, h, j, n, o and p) were found within NV East (Volume 2, Figure 10.6). Groups j, n, o and p were common across the former zone however groups d, h and m were not.

40. Group h is one of the outliers discussed above. This sample, which is located on the northern boundary of NV East, was collected during the ZEA surveys and was dominated by 48 individuals from the genus *Capitella*. Six other individual organisms were also present; these were three other polychaete species (one *Lagis koreni*, one *Spio decorata* and three *S.bombyx*) and one individual from the class Ophiuroidea. Overall this sample is very low diversity thus it has been identified statistically as a separate faunal community.

41. Group d contains three samples, one located centrally within NV East, one in the offshore cable corridor and one located in the southern part of former zone. Both the samples within the Norfolk Vanguard offshore project area were collected during the Norfolk Vanguard surveys and the sample to the south was collected during the ZEA survey. The sample within NV East contains eight individuals of the amphipod *Urothoe brevicornis* which is the species that defines the group (see Table 10.4) as well as two individuals from the family Ophiuridae and one sandeel. Overall this sample has very low species abundance and diversity.

42. The main defining taxa of the other groups found within NV East and NV West were:

- Group j: Nemertea, and the polychaete worms *S.spinulosa* and *S.bombyx*;
- Group m: the polychaete worms *Scoloplos armiger, Nephtys cirrosa* and the bivalve *Abra alba*;
- Group n: the polychaete worm *N. cirrosa*;
- Group o: the polychaete worm *S.bombyx, N. cirrosa* and *Polinices pulchellus*; and
- Group p: the polychaete worms *N. cirrosa* and *S. bombyx* as well as Nemertea (ribbon worms);

43. Both NV West and NV West were dominated by group o (Volume 2, Figure 10.6).

44. As requested by the MMO as part of the EPP, the infaunal groups have been plotted by location and by survey in Figure 1 (2011 ZEA survey) and Figure 2 (2016 Norfolk Vanguard survey). By comparing these two Figures it can be seen that the faunal groups are broadly similar across the different data sets, adding weight to the argument that the data set is appropriate to analysis as one and that the

communities have not noticeably changed between the 2011 and 2016 surveys. Figure 10.6 in Chapter 10 Benthic Ecology shows both data sets on one single figure.

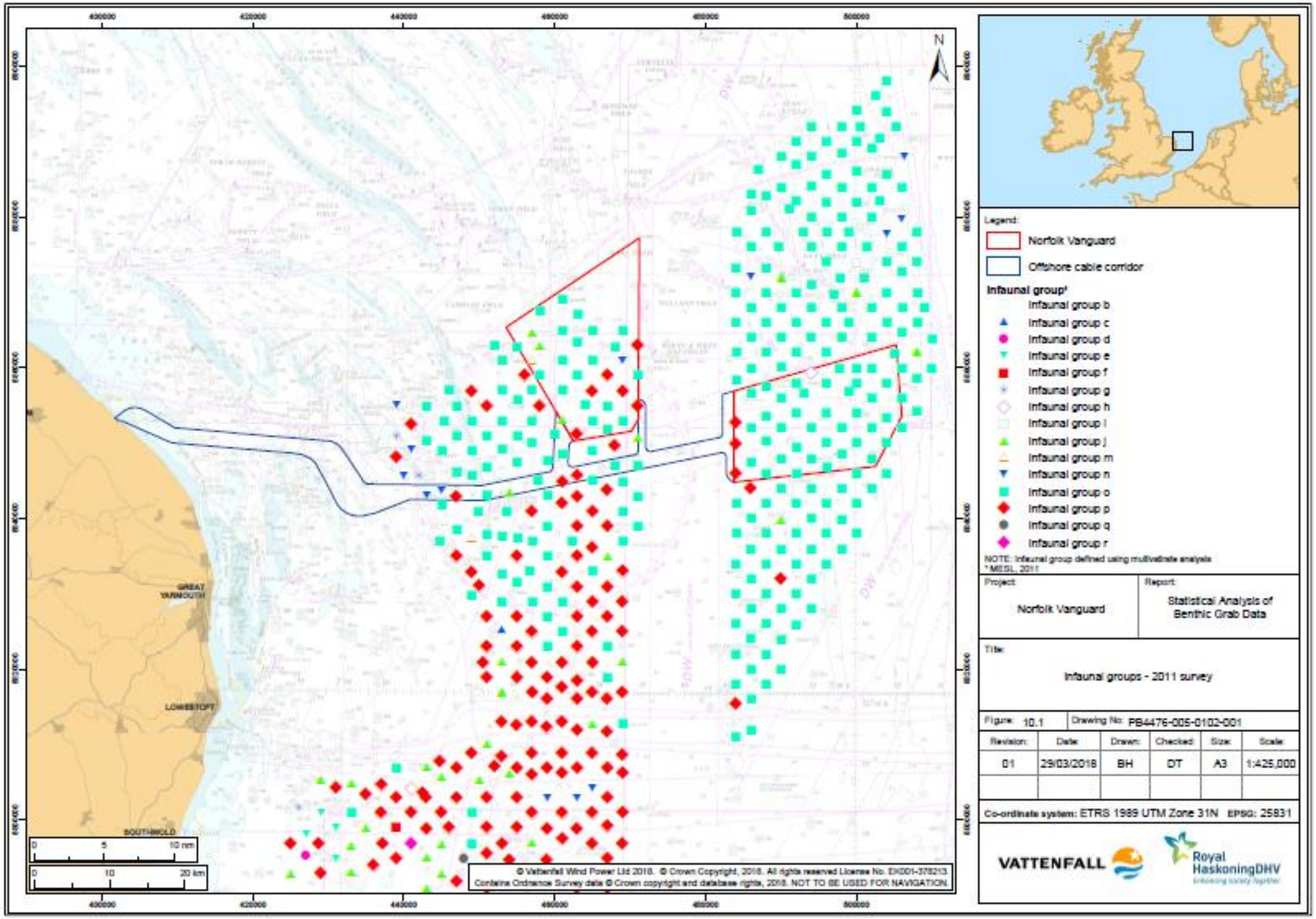


Figure 1 Infaunal Groups from 2011 surveys of the former East Anglia Zone

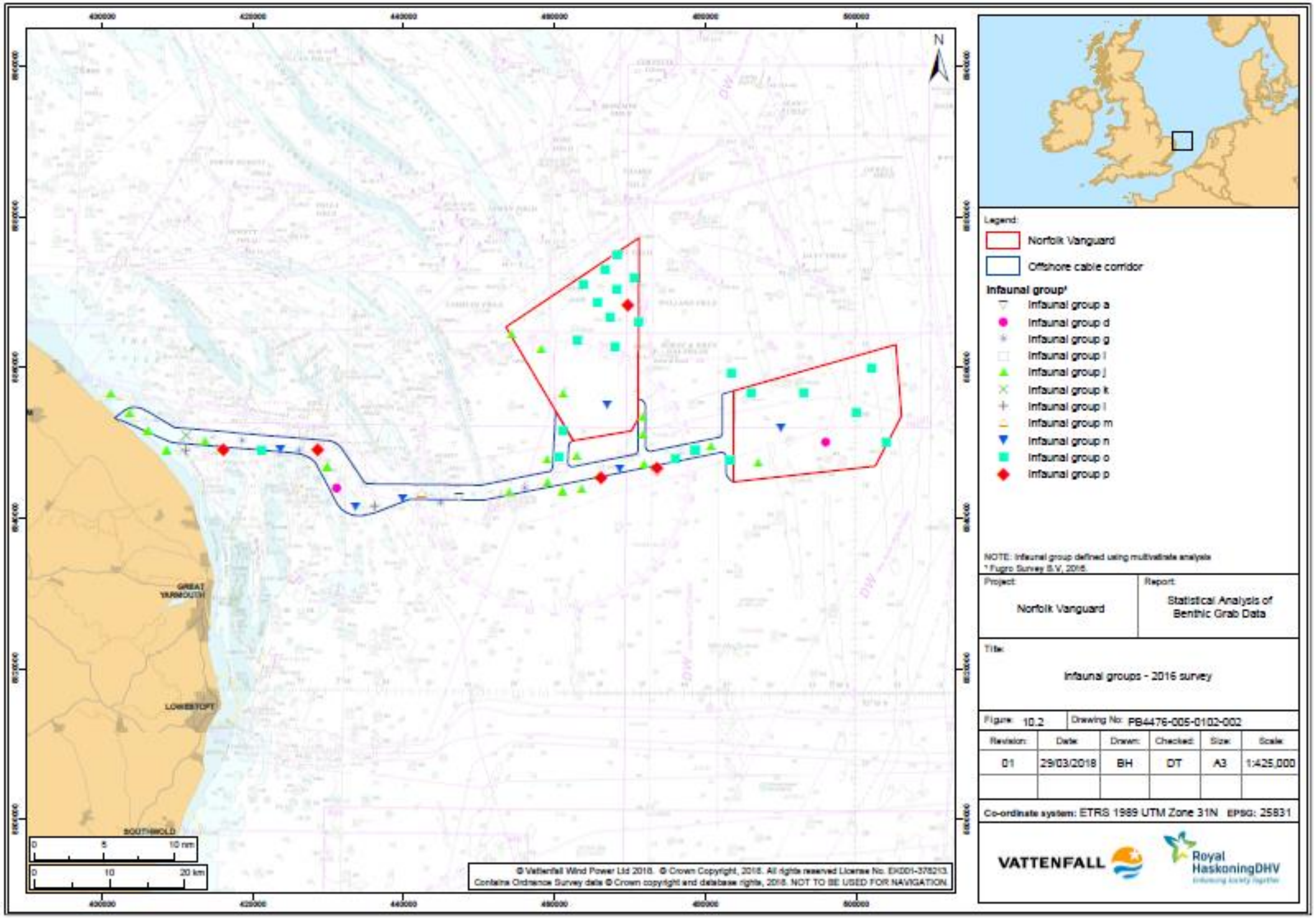


Figure 2 Infaunal Groups from the 2016 Norfolk Vanguard survey

10.3.2.4.2 The Offshore cable corridor

45. The offshore cable corridor contains 11 different faunal communities. The greater range of faunal communities is to be expected as the depth range across the offshore cable corridor is far greater than that within the offshore wind farm sites (Chapter 8 Marine Geology, Oceanography and Physical Processes). The groups identified within the offshore cable corridor are described in Table 10.3.

Table 10.3 description of groups within the offshore cable corridor (OCC = Offshore Cable corridor)

Group	No. of samples in OCC	No. samples in full data set	Description
a	1	1	Outlier as described above in Table 10.2
d	1	1	Outlier as described above in Table 10.2
g	3	7	This was characterised by *Ophelia borealis*, *Urothoe brevicornis* and *Eurydice spinigera* (Table 10.4). It was identified at two locations in the nearshore part of the offshore cable corridor and 1 location in the mid-section of cable corridor. It was also identified at 3 locations close to the offshore cable corridor (Figure 10.6) as well as 1 location in the south west of the former Zone.
i	1	2	This community featured very few individuals (14 and 9) and very few species (8 in each sample). Species common across both samples included *Goniada maculata*, *Spiophanes bombyx* and *Chaetozone sp* (See Table 10.4). The community was identified in the eastern side of the cable corridor just south of NV West. The other example of this community was identified to the North of NV East and was recorded from the ZEA data.
j	10	57	This community which is characterised Nemertea, *S.spinulosa* and *S. bombyx* (Table 10.4) by was common within the former Zone (Figure 10.6).
k	1	1	This community was identified from one sample within the near shore section of the offshore cable corridor, a description is provided in Table 10.2.

Group	No. of samples in OCC	No. samples in full data set	Description
l	1	2	This community which was dominated by Nemertea, *Amphipholis squamata* and *Glycera lapidum* was found at 1 location in the mid-section of the offshore cable corridor an one location to the south of the offshore cable corridor (Figure 10.6). Both sample were identified from the Norfolk Vanguard survey and both were located to west of the furthest extent of the ZEA surveys.
m	1	3	This community which is characterised by *Scoloplos armiger*, *Nephtys cirrosa* and *Abra alba* (Table 10.4) was identified in the site specific survey data at one location in the midshore section of the offshore cable corridor (Figure 10.6) it was also identified two other locations within the ZEA data, one just to the south of the offshore cable corridor and the other in near the southern extent of the ZEA survey.
n	6	28	This community was very common across the former zone (see Figure 10.6 and Table 10.4 for further detail).
o	11	299	This community was the most common across the former zone (see Figure 10.6 and Table 10.4 for further detail).
p	4		This community was also common across the former zone (see Figure 10.6 and Table 10.4 for further detail).

10.3.2.4.3 Community/group definition

46. ANOSIM showed that there was a significant difference between groups (*P= 0.1%* and *R* = 0.58) with most groups being significantly different from one another. Groups where significant differences were not observed included any comparison with groups listed in Table 10.2 and some of the comparisons with: group d (with l, m and i) group l (d, i and m) and group m (with d and i).

47. The SIMPER Analysis was used to identify which species were responsible for the between group similarity, which is displayed in Table 10.4 and the between group dissimilarity which is provided in Table 10.5

Table 10.4 Within Group similarity results of the SIMPER analysis (showing the top three species responsible for the similarity)

Group	Average Similarity (%)	Top 3 species responsible for similarity (% contribution to similarity)	Group	Average Similarity (%)	Top 3 species responsible for similarity (% contribution to similarity)
a	Only one sample in group so no between group similarity		j	31.48	Nemertea (7.54) *Sabellaria spinulosa* (6.88) *Spiophanes bombyx* (5.39)
b	Only one sample in group so no between group similarity		k	Less than 2 samples in group	
c	Only one sample in group so no between group similarity		l	44.71	Nemertea (22.38) *Amphipholis squamata* (18.38) *Glycera lapidum* (16.17)
d	30.18	*Urothoe brevicornis* (79.83) *Goodallia triangularis (*20.17)	m	27.09	*Scoloplos armiger* (63.12) *Nephtys cirrosa* (19.39) *Abra alba* 17.49
e	37.37	*Polycirrus* (38.12) *Ophelia borealis* (20.31) *Spisula* sp.(17.72)	n	28.25	*Nephtys cirrosa* (72.33) *Gastrosaccus spinifer* (7.08) *Nephtys* sp. (4.52)
f	Less than 2 samples in group.		o	29.53	*Spiophanes bombyx* (16.25*)* *Nephtys cirrosa* (12.50) *Polinices pulchellus* (7.68)
g	37.31	*Ophelia borealis* (42.24) *Urothoe brevicornis* (28.78) *Eurydice spinigera* (13.48)	p	26.35	*Nephtys cirrosa* (15.85) *Spiophanes bombyx* (12.10) Nemertea (9.98)
h	Less than 2 samples in group.		q	Less than 2 individuals in sample	
i	23.38	*Goniada maculata* (50.00) *Spiophanes bombyx* (39.00)	r	30.57	*Moerella pygmaea* (21.41) *Spisula* sp. (17.79) *Ophiocten affinis* (12.05)

Table 10.5 Between group dissimilarity results of the SIMPER analysis (red = 100%, orange = between 95 and 99.9%, yellow = between 90 and 94.9%, green between 85 and 89.99% and blue between 80 and 84.99%)

	Group																	
Group	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
a		100	100	100	100	100	100	100	100	97.59	100	91.04	93.03	99.39	97.78	99.67	100	100
b	100		100	100	90.41	100	94.43	100	100	97.64	100	95.08	100	96.04	98.38	94.71	100	94.39
c	100	100		100	96.59	100	98.25	100	100	94.17	93.58	87.79	91.32	98.28	94.65	91.94	100	96.22
d	100	100	100		84.98	100	82.37	100	92.4	95.59	92.16	91.46	100	95.45	91.27	95.95	87.78	91.79
e	100	90.41	96.59	84.98		100	82.41	100	96.77	94.56	87.97	85.03	100	92.61	89.18	83.01	85.87	84.88
f	100	100	100	100	100		80.52	100	100	97.51	100	100	94.75	88.89	93.04	91.85	89.61	94.58
g	100	94.43	98.25	82.37	82.41	80.52		100	100	96.77	96.77	90.59	100	92.05	89.86	89.44	91.53	86.29
h	100	100	100	100	100	100	100		87.09	93.93	94.36	100	88.98	96.13	89.13	90.24	81.99	98.21
i	100	100	100	92.4	96.77	100	100	87.09		89.76	89.16	93.84	93.68	96.25	84.46	90.25	91.6	96.16
j	97.59	97.64	94.17	95.59	94.56	97.51	96.77	93.93	89.76		83.63	83.8	95.2	96.25	88.92	85.45	91.19	94.07
k	100	100	93.58	92.16	87.97	100	88.49	94.36	89.16	83.63		81.13	94.37	91.17	86.23	90.25	86.3	89.97
l	91.04	95.08	87.79	91.46	85.03	100	90.59	100	93.84	83.8	81.13		100	97.62	94.76	85.45	100	95.14
m	93.03	100	91.32	100	100	94.75	100	88.98	93.68	95.2	94.37	100		84.82	82.29	82.98	93.37	92.88
n	99.39	96.04	98.28	95.45	92.61	88.89	92.05	98.78	96.13	96.25	91.17	97.62	84.82		83.95	84.65	93.34	84.92
o	97.78	98.38	94.65	91.27	89.18	93.04	89.86	89.13	84.46	88.92	86.23	94.76	82.29	83.95		81.03	82.7	86.4
p	99.67	94.71	91.94	95.95	83.01	91.85	89.44	90.24	90.25	85.45	82.98	86.34	89.04	84.65	81.03		82.4	80.51
q	100	94.71	100	87.78	85.87	89.61	91.53	81.99	91.6	91.6	86.3	100	93.37	93.34	82.7	82.4		80.09
r	100	94.39	96.22	91.79	84.88	94.58	86.29	98.21	96.16	94.07	89.97	95.14	92.88	84.92	86.4	80.51	80.09	

10.4 References

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