


Fylde Marine Conservation Zones Baseline Survey Report 2015

Project Code: 201415_MCZ_011

Authors: Clare Miller & Ben Green

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Authors: Clare Miller & Ben Green

Produced by:

Environment Agency
Estuarine and Coastal Monitoring & Assessment Service
Kingfisher House
Orton Goldhay
Peterborough
Cambridgeshire
PE2 5ZR

Email: enquiries@environment-agency.gov.uk
Website: www.environment-agency.gov.uk

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During the survey planning phase for the Fylde MCZ baseline survey, the following marine specialists generously contributed their valuable time and expertise:

Dr Mike Young	Senior Specialist, Natural England

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Non-Technical Summary

The Environment Agency conducted a subtidal baseline survey of the Fylde MCZ on behalf of Natural England between the 11th and 13th February 2015,

The aim was to undertake a grab survey of the designated sediment broadscale habitat features of the Fylde MCZ (Figure 1) (**A5.2 Subtidal Sand** and **A5.3 Subtidal Mud**) and other habitats, in order to obtain improved evidence, potentially ascribe condition and provide a baseline dataset which can then be used to detect macrofauna community change over time and support future monitoring. A drop-down camera survey was also attempted on the 16th August 2015, but was unsuccessful due to poor visibility.

The key findings of the baseline survey were:

- 52 faunal samples were collected inside of the MCZ, 30 outside of the site. Subtidal Mud (A5.3) was predominant in the north of the MCZ, and west of the site. Subtidal Sand was prevalent in the centre and south of the MCZ. This is different to the site assessment document (SAD), which reported that the site was 100% A5.2 subtidal sand (Table 1).

- 7239 individuals were sampled across 172 taxa. Subtidal mud sediments in the north of the survey area were significantly more diverse than the subtidal sand sediments in the south. Taxa richness was lower in the subtidal sand sediment near the mouth of the Ribble Estuary. Infaunal quality of subtidal sand samples from inside the MCZ (equivalent to 'good ecological status) was significantly lower than sand sampled from outside the MCZ boundary (equivalent to 'high ecological status').

- Eleven different biotopes were found across the survey area. Mud communities were characterised by varying abundances of *Amphiura*, *Kurtiella*, *Pholoe* and *Nucula*, whilst sand communities were characterised by varying combinations of bivalves *Kurtiella, Chamalea, Phaxus, Nucula* and *Corbula.*

Table 1. Presence and extent of subtidal features of Fylde MCZ listed in the SAD (Irish Seas Conservation Zones, 2011), and recorded in this baseline survey.

Feature Code / Name	Extent according to SAD (km^2)	Presence according to the newly acquired data	Accordance between SAD and newly acquired data	General management approach
Broadscale Habitats				
Subtidal Sand (A5.2)	260.27 km^2	30 PSA records	✓	Maintain
Subtidal Mud (A5.3)	Not proposed	22 PSA records	×	N/A
Habitat FOCI				
Subtidal Sands & Gravels (not designated)	199.71 km^2	30 PSA records	✓	N/A

1. Introduction

The Marine and Coastal Access Act 2009 requires the UK Government to create a coherent network of Marine Conservation Zones (MCZs) in British waters. MCZs will exist alongside other Marine Protected Areas (MPAs), including Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Sites of Special Scientific Interest (SSSIs) and Ramsar sites to help conserve marine biodiversity, in particular habitats and species of European and national importance.

Through Defra, and with written advice from the Statutory Nature Conservation Bodies* (SNCBs), four regional projects were established to identify potential MCZs within the UK Exclusive Economic Zone (EEZ). These projects were called Net Gain (North Sea), Balanced Seas (South East waters), Finding Sanctuary (South West waters) and Irish Sea Conservation Zones (Irish Sea) (see http://jncc.defra.gov.uk/mczmap accessed 17 June 2015). They combined stakeholder consultation with existing scientific data to propose recommended MCZs and Reference Areas (rMCZ & rRA) in their region that would contribute to the MCZ network. The four projects reported in September 2011, each producing a ‘final recommendations’ report, which contained Site Assessment Documents (SADs) for each of the rMCZs (Irish Seas Conservation Zones, 2011). Following a report review by an independent scientific advisory panel, a programme of habitat verification surveys was commissioned by Defra to strengthen the scientific evidence base for some of the rMCZs. During the next two years, the programme was coordinated by Cefas and involved a range of service providers from both the public and private sector. The SNCBs considered the additional evidence and sent final site recommendations to the Environment Minister for formal designation.

On the 21st November 2013, the UK Government announced the designation of 27 MCZs in the first tranche, which included the Fylde MCZ. The site has been created to protect a species-rich Subtidal Sand broadscale habitat (A5.2).

On the 30th January 2015, the UK Government opened a public consultation on the designation of a second tranche of 23 proposed Marine Conservation Zones. In addition to the second tranche, the Fylde MCZ was included in a list of tranche 1 MCZs which would have additional features recommended for inclusion to help fill gaps in the network. The additional feature proposed for the Fylde MCZ was Subtidal Mud (A5.3), which was formally designated in January 2016, following interpretation of data from Kaiser et al. (2006) that was not used in the original MCZ recommendations.

Following designation, Natural England started a baseline monitoring programme across all Tranche 1 MCZs, specifically targeting the features present both inside and outside each site boundary. The initial datasets gathered will be used to inform future monitoring and management of the sites.

*Natural England and the Joint Nature Conservation Committee (JNCC)

1.1 Survey Aim and Objectives

Overall Survey Aim

To undertake a grab survey of the designated sediment broadscale habitat feature of the Fylde MCZ (Figure 1), **Subtidal Sand** and **Subtidal Mud** (which was only a proposed broadscale habitat at the time of the survey planning), in order to obtain improved evidence, potentially ascribe condition and provide a baseline dataset which can then be used to detect change in macrofauna community composition over time and support future monitoring.

Survey objectives

a) To undertake a survey which would support a statistically based comparison/ assessment of the designated broadscale habitats both over time and whether located inside or outside the site boundary.

b) To provide incidental records of key characterising species present in the site.

1.2 Survey Team

The Fylde MCZ was surveyed between the 11th February and 16th August 2015. The survey team comprised of a collaboration of marine specialists from the Environment Agency and Natural England listed below. The coastal survey vessel *Mersey Guardian*, staffed and operated by Briggs Marine (Figure 1, Annex 7.1) was used to conduct the survey work reported here.

Environment Agency Estuarine and Coastal Monitoring and Assessment Service Survey Officers	Matt Emery Nina Godsell Clare Miller Richard Pritchard Graham Sloane
Natural England Marine Advisor	Emily Hardman

Figure 1. Coastal survey vessel *Mersey Guardian* operated by Briggs Marine.

1.3 Site Description

The Fylde MCZ is located in Liverpool Bay between 3 and 20 km off the Fylde coast and Ribble Estuary (Figure 2). The depth of the seabed within the site ranges from almost being exposed on low tide (approximately 35 cm depth) to 22 metres at its deepest (Defra, 2013). The MCZ is also adjacent to the Shell Flat and Lune Deep Special Area of Conservation (SAC) and is co-located within (and its western boundary aligns with) the Liverpool Bay Special Protection Area (SPA). This SPA provides protection for bird features including the common scoter (*Melanitta nigra*) and red-throated diver (*Gavia stellata*) and their supporting habitats. The Fylde MCZ also partially overlaps the Mersey Mouth Water Framework Directive (WFD) surveillance water body.

The MCZ protects an area of approximately 260 km^2 consisting of subtidal mud and sand sediment habitats. These habitats are known to support rich bivalve mollusc populations including the small nut-shell (*Nucula nitidosa*), razor shell (*Pharus legumen*) and the white furrow shell (*Abra alba*)*.*The site also includes important nursery and spawning grounds for several commercially important fish species including sole (*Solea solea*), plaice (*Pleuronectes platessa*) and whiting (*Merlangius merlangus*).

Detailed site information can be found in Irish Seas Conservation Zones (2011) and Defra (2013).

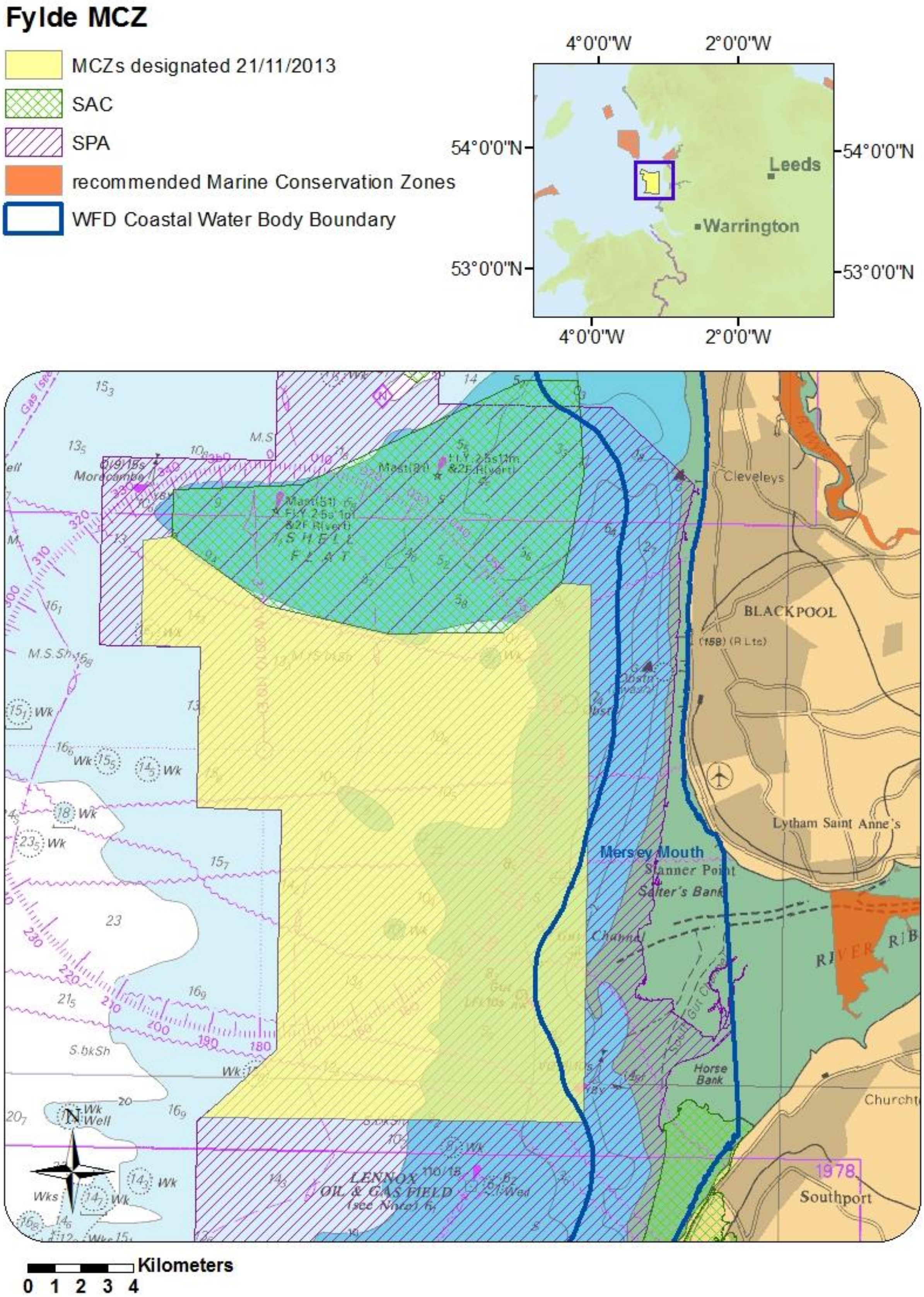


Figure 2. Location of the Fylde Marine Conservation Zone (MCZ) in the context of other proposed MCZs and European designations off the north west of England.

2. Survey Design and Methods

2.1 Survey Design

No acoustic data or full infauna community datasets were available to assist in planning the survey. Sediment particle size and selected bivalve species abundance from data collected in 2003 by Kaiser *et al*. (2006) provided partial information on the broadscale habitats present in the site and was used to supplement the existing UKSeaMap 2010 modelled data (McBreen *et al.*, 2011) and to inform the survey design.

A systematic sampling approach was used to ensure adequate geographic coverage across the site, although sample positions were randomised. The survey was designed with a 'Before-After, Control-Impact' (BACI) approach. Although power analysis could not be undertaken due to the lack of available data, a representative number of stations were placed outside of the MCZ boundary (to the west and south of the MCZ, up to a distance of 11 km from the site boundary) to provide the 'before, impact' dataset in order to inform future monitoring surveys and management approaches. Ninety target sampling stations were selected for the baseline MCZ survey (Figure 3), thirty of which were outside the MCZ boundary and sixty within.

Numerous underwater obstructions, wrecks and submarine cables were identified by the Environment Agency Estuarine and Coastal Monitoring and Assessment Service on review of UKHO Admiralty charts, consequently sample points were not placed within 1 km of any hazard.

A 'notification of an exempt activity form' was submitted to the Marine Management Organisation prior to the survey being carried out.

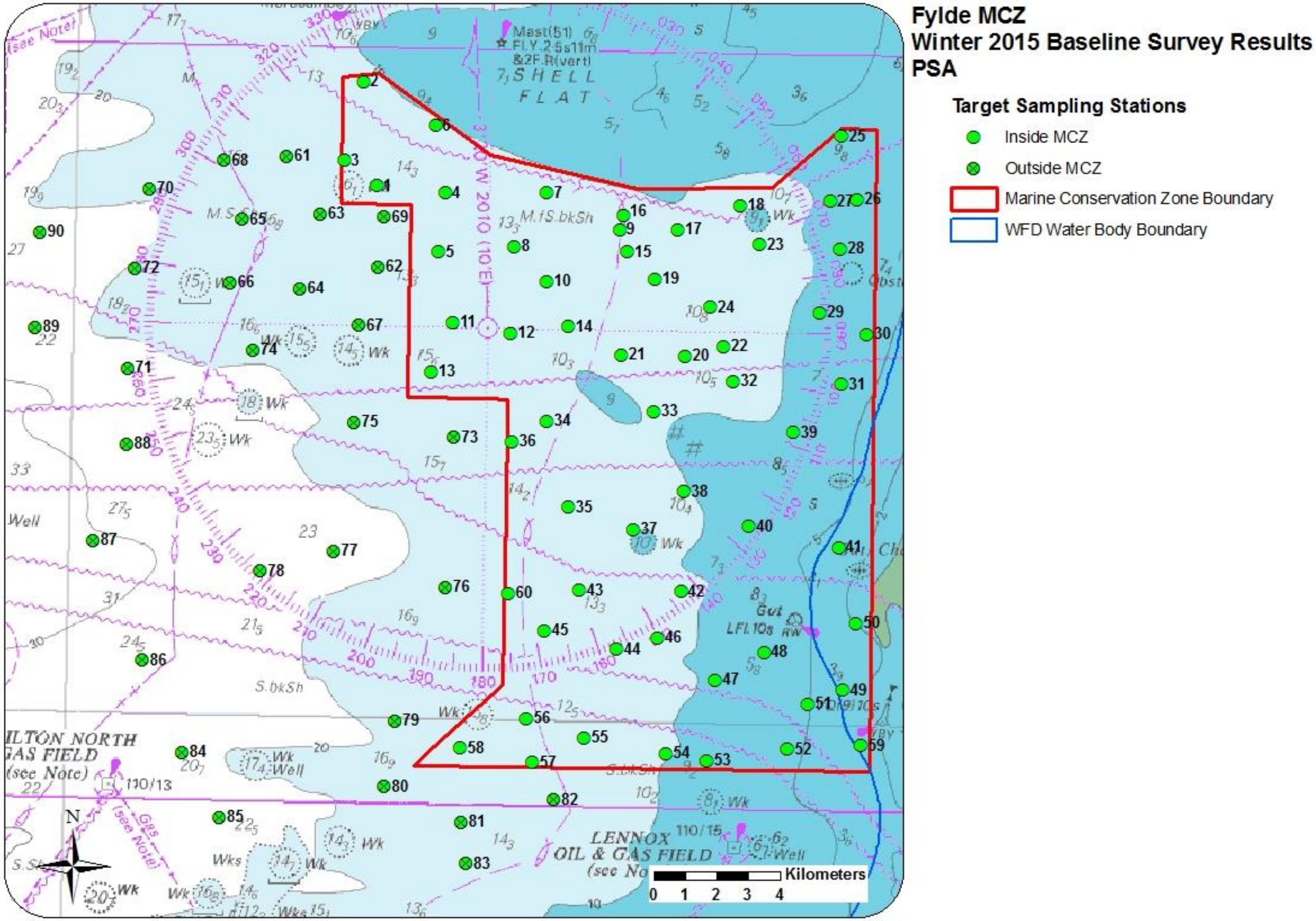


Figure 3. The Fylde Marine Conservation Zone (MCZ) Winter 2015 baseline survey plan

2.2 Sample Collection Methodology

A Day grab (Figure 4), with a sampling area of 0.1 m^2 was deployed from the stern gantry of the survey vessel to recover sediment from the seabed as described in the Environment Agency Water Framework Directive (WFD) operational instructions (Environment Agency, 2012; 2014). Sampling positions were recorded (fixed) using Hydropro data acquisition software when the gear contacted the seabed. The mid-point of the vessel's stern gantry was used as the default offset for position fixing (see Annex 7.2.1 for further details).

The EA WFD sampling methodology required two similar samples; the first was used to obtain a fauna sample (minimum depth of 5 cm in sand habitat and 7 cm in mud habitat) and the second solely to obtain a sub-sample for particle size analysis. A general description of the sediment and a preliminary habitat assessment using a modified folk classification system (Long, 2006) was recorded.

The sample was also inspected for a Redox Potential Discontinuity (RPD) or 'black layer'; if present, the depth below the surface was recorded. The faunal sample was then processed, by washing over a sieve (1.0 mm mesh). The retained material was photographed on the sieve and preserved in a buffered 8 % formaldehyde solution for transfer ashore to a specialist laboratory for analysis. Further grab attempts were made to acquire a second sample containing similar material to the first (grabs with dissimilar material were discarded). A full depth-integrated core of sediment (approx. volume of 500 ml) was taken from the second sample for particle size analysis.

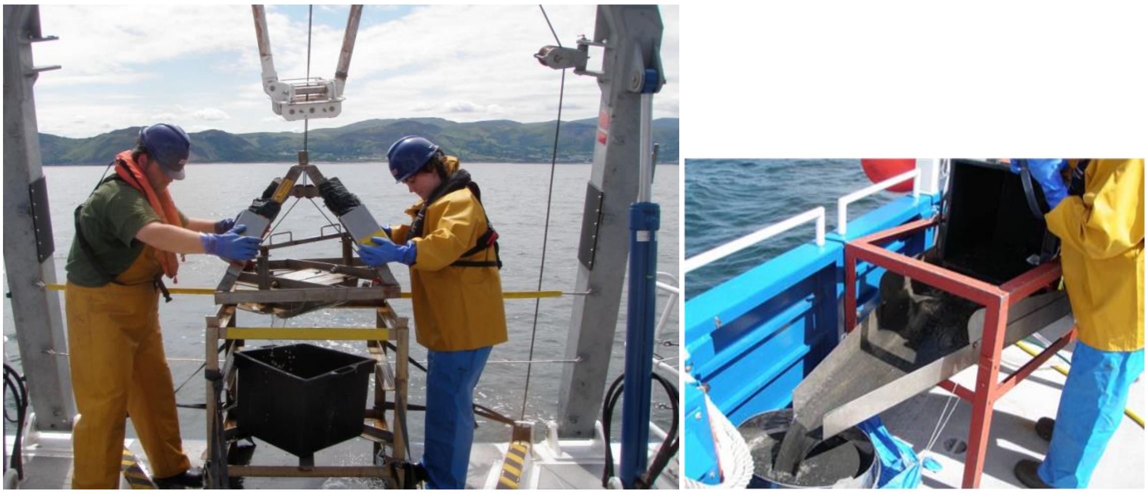


Figure 4. Day grab (left) and equipment for sieving benthic fauna samples (right).

2.3 Sample Analysis

2.3.1 Particle Size Analysis (PSA)

Full depth-integrated cores removed from the Day grab samples were analysed by the National Laboratory Service (NLS). The results of the particle size analysis were categorised into Folk classifications and EUNIS (European Nature Information System) Level 3 classifications based on the modified Folk seabed sediment classification system (Long, 2006) (Figure 5) and the Wentworth particle size boundaries (Table 2). Sample quality was controlled through the NMBAQC (National Marine Biological Analytical Quality Control) scheme managed by specialists at Cefas (Mason, 2011).

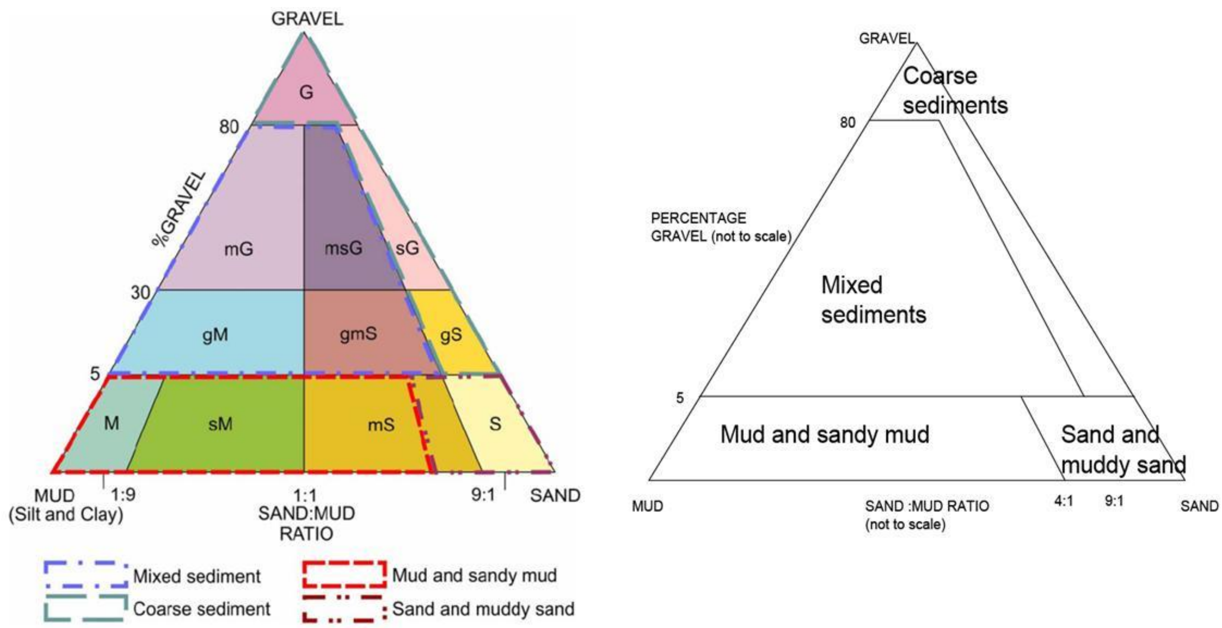


Figure 5. Simplified sediment classification of the Folk triangle for UK SeaMap (Long, 2006). Abbreviations are: G – gravel, mG – muddy gravel, msG – muddy sandy gravel, sG – sandy gravel, gM – gravelly mud, gmS – gravelly muddy sand, gS – gravelly sand, M – mud, sM – sandy mud, mS – muddy sand, S – sand.

Table 2. Sediment grade terms and size limits (Wentworth, 1922).

Size	Grade Terms
>256 mm	Boulder
64 - 256 mm	Cobble
4 - <64 mm	Pebble
>2000 µm - <4000 µm	Gravel
63 – 2000 µm	Sand
<63 µm	Mud

2.3.2 Macrobenthic Analysis and Biotope Classification

The macrobenthic analysis was undertaken by specialists at the Institute of Estuarine and Coastal Studies (IECS) following the NMBAQC guidelines for sample processing (Worsfold et al., 2010). Fauna were identified to the lowest taxonomic level possible and counted.

The performance of the laboratory undertaking the macrobenthic analysis was assessed through Natural England submitting two samples to Year 22 of the 'Macrobenthic Own Sample' module of the National Marine Biological Analytical Quality Control Scheme (NMBAQC).

All samples analysed were assigned to both the JNCC 04.06 (Connor et al., 2004) and EUNIS biotope classification schemes (level 5) by combining the biota data with the associated PSA results.

Univariate metrics calculated for each sample included number of taxa (richness) (S), total number of individuals (N) and Infaunal quality index (IQI, a multimetric index combining richness, species evenness and the AZTI Marine Biotic Index (AMBI)).

The IQI score falls into in to one of five ecological status classes used for Water Framework Directive assessment (WFD-UKTAG, 2014), the boundaries of which are as follows:

- High: > 0.75
- Good: 0.75 - 0.64 (> 0.64 could be considered equivalent to favourable condition)
- Moderate: 0.64 - 0.44
- Poor: 0.44 - 0.24
- Bad: < 0.24

Non-parametric Mann-Whitney tests were used to identify if there were significant differences in univariate metrics for each broadscale habitat between samples collected inside and outside of the MCZ.

PERMANOVA analysis (Anderson et al. 2007) using Primer 6 software was used to identify changes in macrofauna community structure for each broadscale habitat between samples collected inside and outside of the MCZ.

SIMPER analysis was used to identify the species characterising the distinct communities identified through cluster analysis (combined with SIMPROF test to identify significantly different clusters of samples) of each broadscale habitat.

3. Results

3.1 Grab Samples

Viable grab samples for faunal and particle size analyses were collected from eighty one stations using a Day grab (Figure 6). Station 15 was repeated for fauna after a crack in the sample container was found. At four stations (28, 29, 30 and 32) only particle size analysis samples were collected due to insufficient sediment for faunal analysis. The fauna samples were photographed before and after the on-board processing phase; these images and supporting field notes are presented in Annex 7.6.

3.2 Particle Size Analysis

The EUNIS classification results (Figure 7) show the northern part of the MCZ to be predominately A5.3 Subtidal Mud broadscale habitat, which extends west outside of the site boundary. The southern area inside the MCZ boundary is dominated by A5.2 Subtidal Sand, which again extends south and west of the site boundary. Only one station (88) in the west outside the MCZ boundary was recorded as A5.4 Subtidal Mixed Sediments.

Folk classification results (Figure 8) and particle size fraction results (Figure 9, 10) show that slightly gravelly sand stations, with minimal mud (< 63 µm) fractions were present in the south of the survey area. The percentage content of mud increased moving north in the MCZ, with muddy sands (between 10 – 20 % mud) present in the centre of the site. Moving further north, the mud fractions increased further to become sandy muds (> 50 % mud fraction) in the MCZ. This area of the MCZ had the highest proportion of mud sampled in the survey, with stations 13, 17 and 18 all containing more than 70 % mud (< 63 µm particles).

To the west of the survey area, stations in deeper water had varied distribution of particle size fractions with station 88 the only station that contained a gravel fraction high enough to be classified as gravelly muddy sand.

The particle size fraction results (Figure 9, 10) show stations in the south of the survey area had a higher sand (63 – 2000 µm) fraction than mud or gravel. Stations in the north of the survey area had wider fraction variation between mud, sand and gravel. Stations in deeper water in the west of the survey area had varied distribution of particle size fractions with station 88 the only station that contained a gravel fraction.

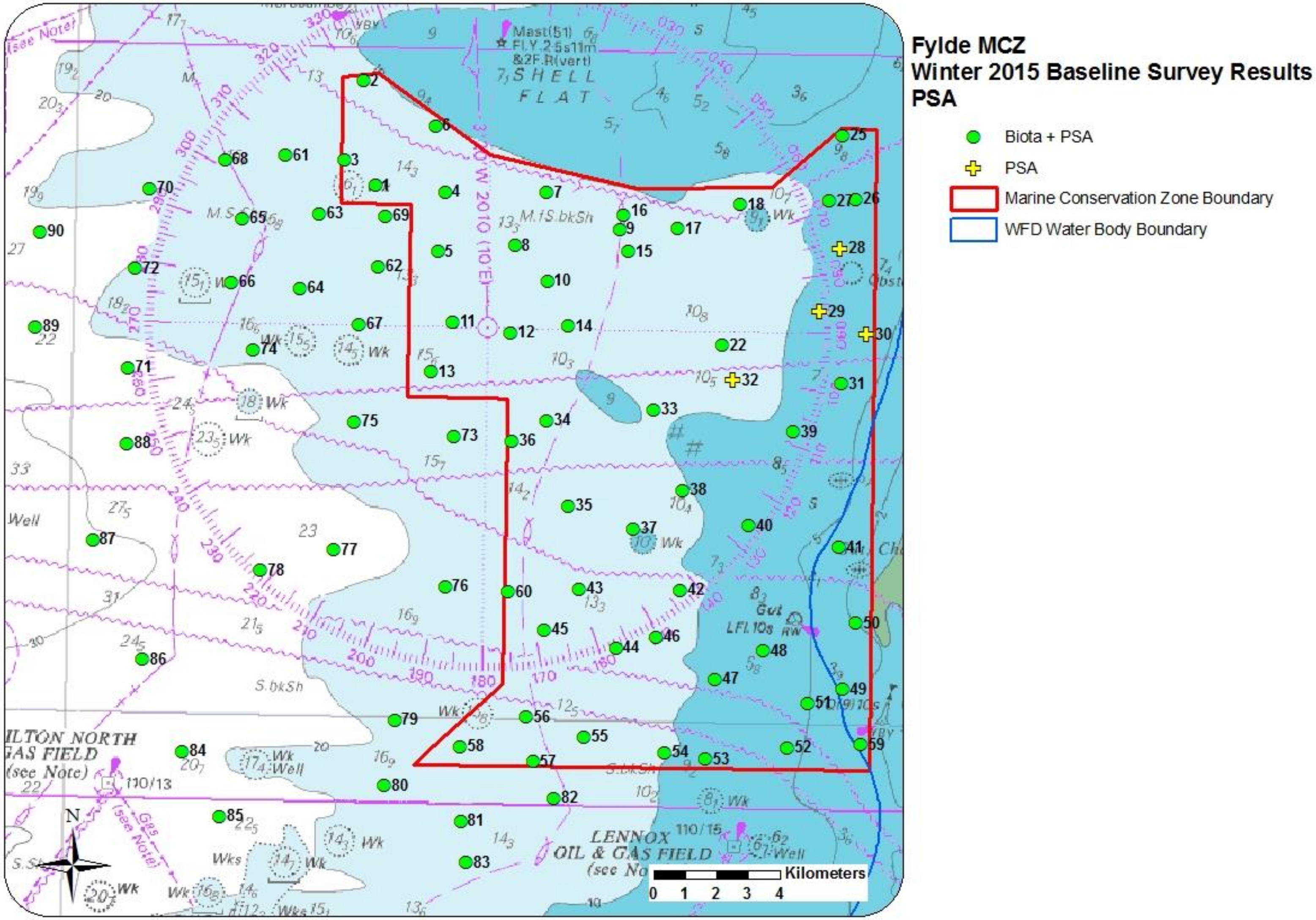


Figure 6. Fylde Marine Conservation Zone (MCZ) Winter 2015 baseline survey Day grab samples.

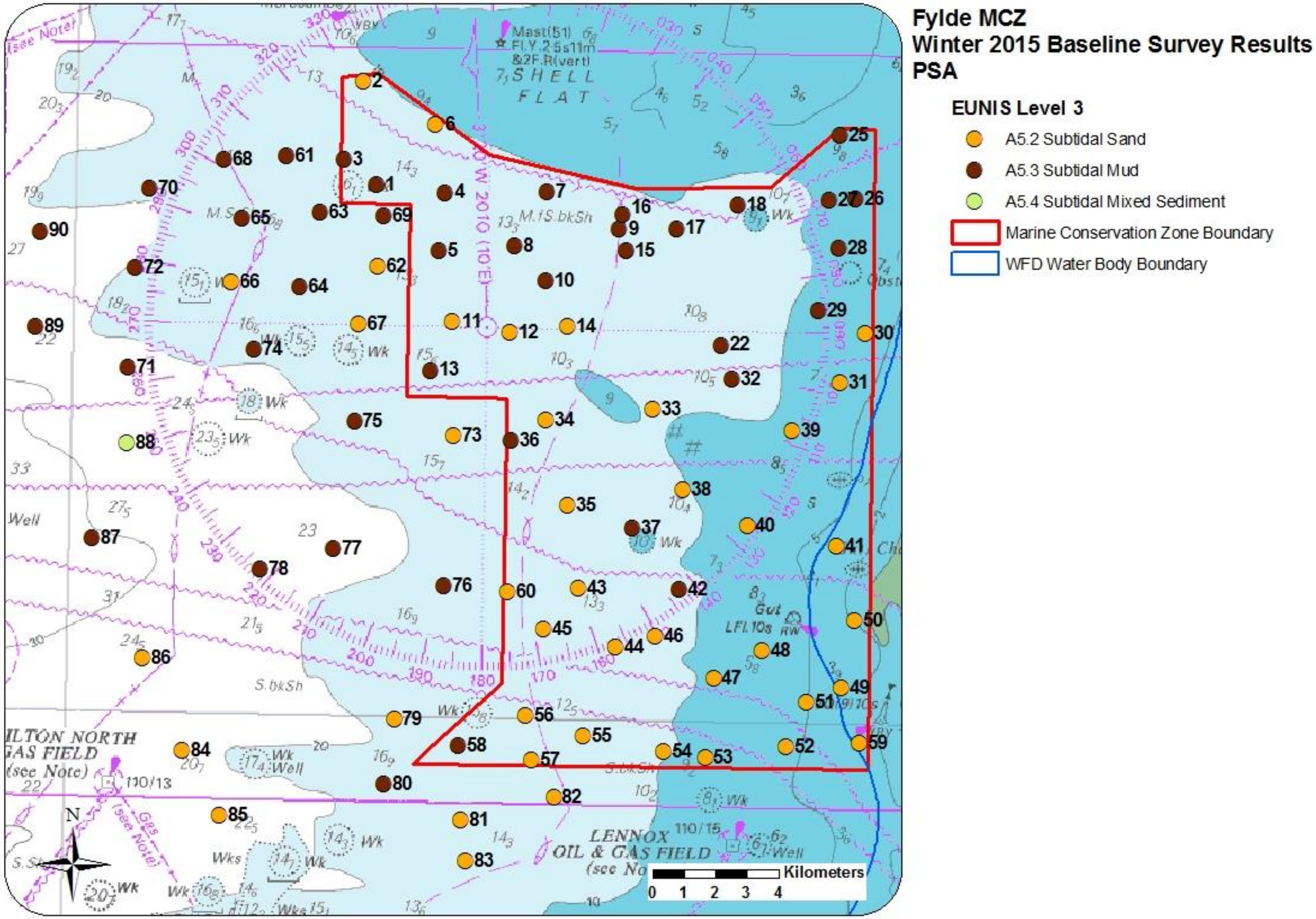


Figure 7. The Fylde Marine Conservation Zone (MCZ) 2015 baseline survey 0.1 m^2 Day grab sampling positions. Particle size results categorised by EUNIS Level 3 habitat. The samples were collected from inside and outside the MCZ boundary for comparison.

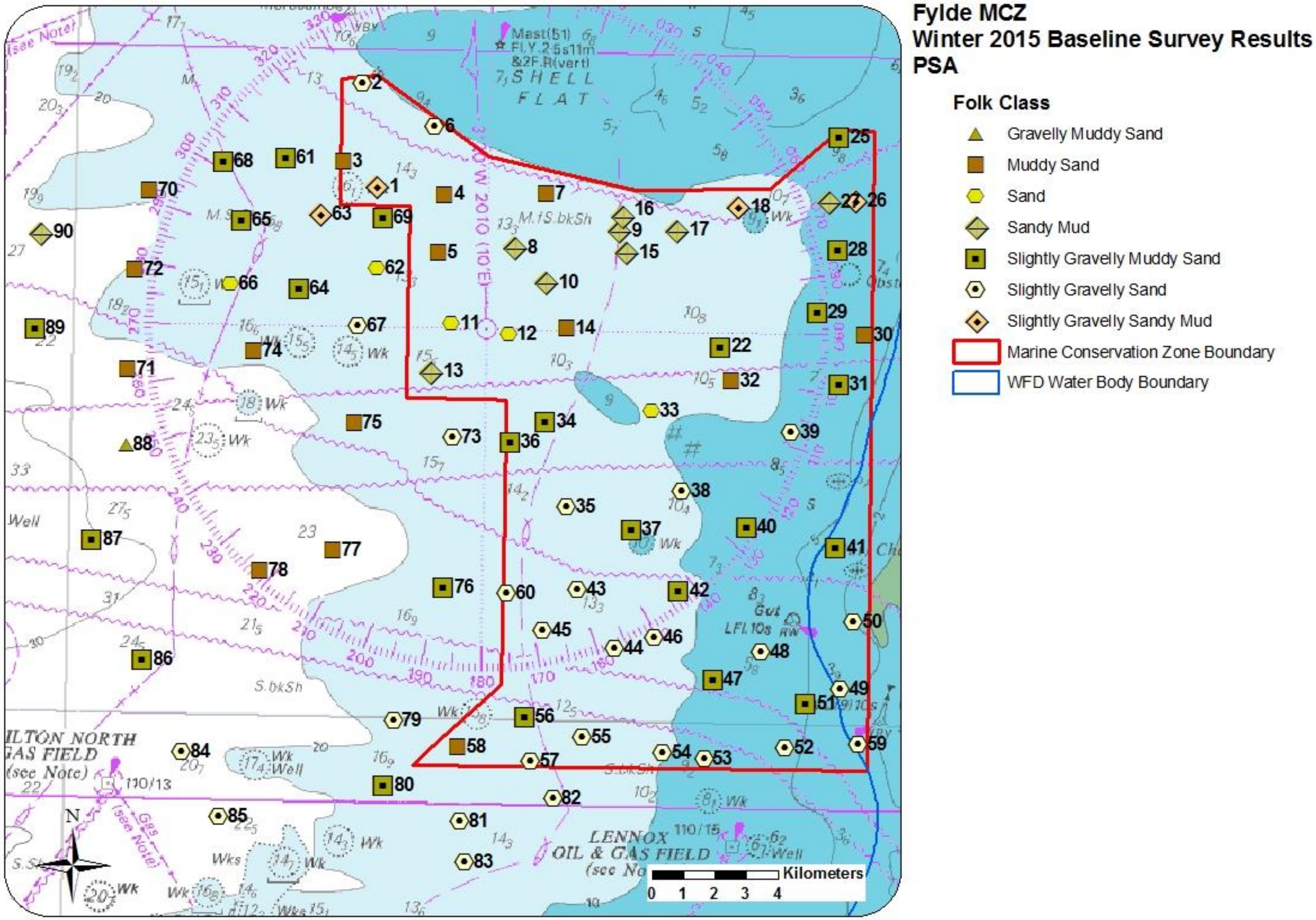


Figure 8. The Fylde Marine Conservation Zone (MCZ) 2015 baseline survey 0.1 m^2 Day grab sampling positions. Particle size results categorised by Folk Class. The samples were collected from inside and outside the MCZ boundary for comparison

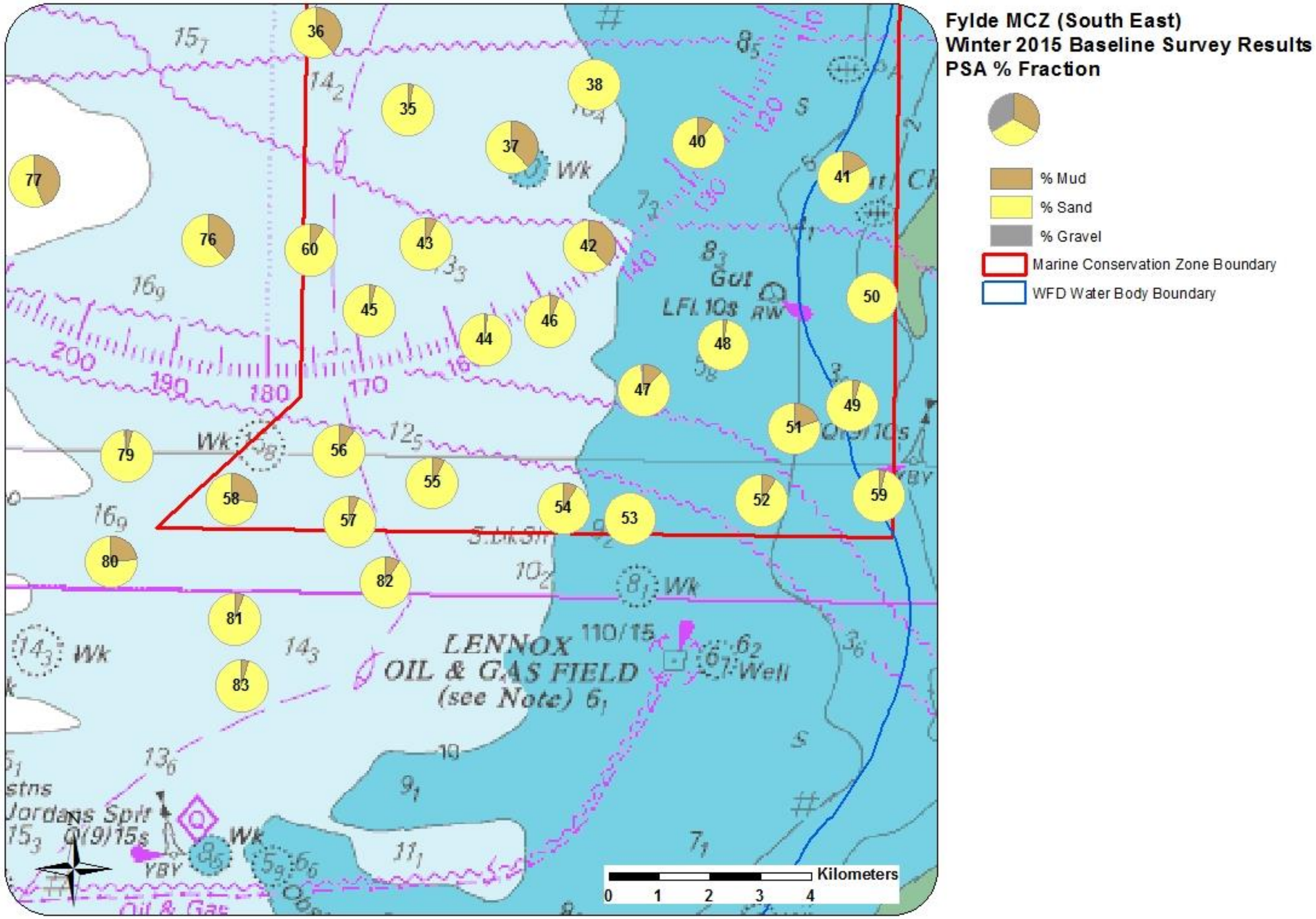


Figure 9. The Fylde Marine Conservation Zone (MCZ) 2015 baseline survey 0.1 m^2 Day grab sampling positions (South East). Particle size results categorised by percentage fraction. The samples were collected from inside and outside the MCZ boundary for comparison.

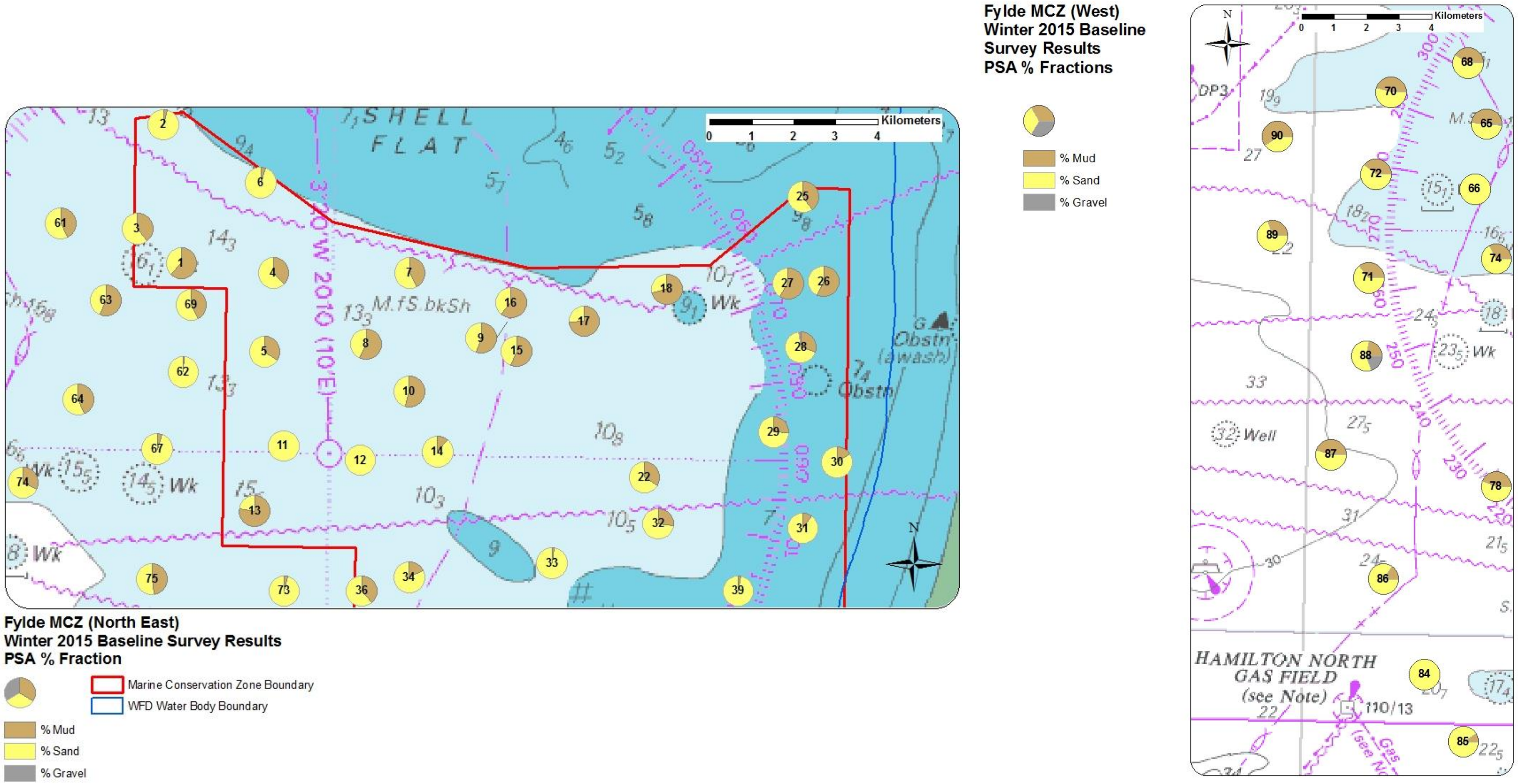


Figure 10. The Fylde Marine Conservation Zone (MCZ) 2015 baseline survey 0.1 m^2 Day grab sampling positions for the (a, left) north East area of the MCZ and (b, right) western area outside of the site boundary. Particle size results categorised by percentage fraction. The samples were collected from inside and outside the MCZ boundary for comparison.

3.3 Macrobenthic Invertebrates

Invertebrate Abundance & Species Richness

A total of 7239 invertebrates were found in the 82 fauna grab samples collected from the Fylde baseline survey area and sieved over a 1 mm mesh (Figure 11). The highest number of individuals (562) was picked from the sample collected at station 15, located in the north of the MCZ. The samples collected within A5.3 Subtidal mud broadscale habitat contained significantly higher numbers of individuals than those collected in the A5.2 Subtidal Sand ($W = 474.5$, $P < 0.001$). There was no significant difference ($P > 0.05$) in abundance between samples collected inside and outside the MCZ for either broadscale habitat.

Overall, 172 individual taxa were identified across all the grab samples. The richest grab sample was collected from station 88, the single mixed sediment located in the west of the survey area, outside the MCZ (Figure 12). It was found to contain 41 different taxa including the only recording of *Sabellaria spinulosa* from this survey. Conversely, stations 51 and 52 (inside the MCZ) were found to be relatively species poor with four taxa found in each sample respectively. The number of taxa was found to be generally fewer in the south of the survey area near the mouth of the Ribble Estuary where subtidal sediment was classified as A5.2 subtidal sand. As with the abundance, there were significantly more species recorded in the Subtidal mud broadscale habitat inside the MCZ than in the Subtidal sand habitat ($W = 489.5$, $P < 0.001$). There was no significant difference ($P > 0.05$) in taxa richness between samples collected inside and outside the MCZ for either broadscale habitat.

Two nationally rare species were recorded (as listed by Sanderson, 1996). The hydroid *Obelia bidentata* was recorded at station 5 on muddy sand inside the MCZ. A single specimen of the thumbnail crab *Thia scutellata* was recorded at station 84, on slightly gravelly sand outside of the MCZ boundary.

No non-native species were recorded from the infauna samples.

Infaunal Quality Index and other indices

Fifty four stations were classified as good ecological status, seventeen as high and ten as moderate using the infaunal quality index (IQI, Figure 13). Stations with good and high status were distributed inside and outside of the MCZ boundary. However, all moderate status stations were found within the MCZ boundary, close to the mouth of the Ribble Estuary. Overall, the mean IQI status of the A5.2 Subtidal Sand broadscale habitat inside the MCZ was 0.68, equivalent to good ecological status. This was significantly lower than the subtidal sand sampled outside of the MCZ, which had a mean IQI status of 0.75 (high status) ($W = 518.0$, $P < 0.001$). There was no significant difference in the mean IQI status between A5.3 Subtidal Mud broadscale habitat stations sampled inside and outside the MCZ ($W = 418.0$, $P = 0.377$).

Table 3. Mean (± standard error) macrobenthic species abundance, richness, infaunal quality index (IQI) and other univariate indices of the Day grab samples for the three different broadscale habitats collected inside and outside of the Fylde MCZ.

	Sample number	Taxa richness (S sample^{-1})	Abundance (N sample^{-1})	Shannon Index H'(log^{e})	Hill's N1	Simpson's Eveness (1-λ')	IQI
Inside MCZ							
A5.2 Subtidal Sand	30	10.60 ± 0.9	25.00 ± 4.1	1.97 ± 0.1	7.75 ± 0.6	0.87 ± 0.02	0.68 ± 0.01
A5.3 Subtidal Mud	22	25.82 ± 1.3	333.00 ± 37.2	1.81 ± 0.1	6.70 ± 0.4	0.71 ± 0.02	0.69 ± 0.01
Outside MCZ							
A5.2 Subtidal Sand	11	11.91 ± 1.3	21.2 ± 2.8	2.23 ± 0.1	9.89 ± 1.2	0.92 ± 0.02	0.75 ± 0.01
A5.3 Subtidal Mud	18	25.89 ± 1.3	267.10 ± 36.5	1.80 ± 0.1	6.76 ± 0.9	0.68 ± 0.03	0.71 ± 0.01
A5.4 Subtidal Mixed	1	42	154	3.16	23.51	0.94	0.76

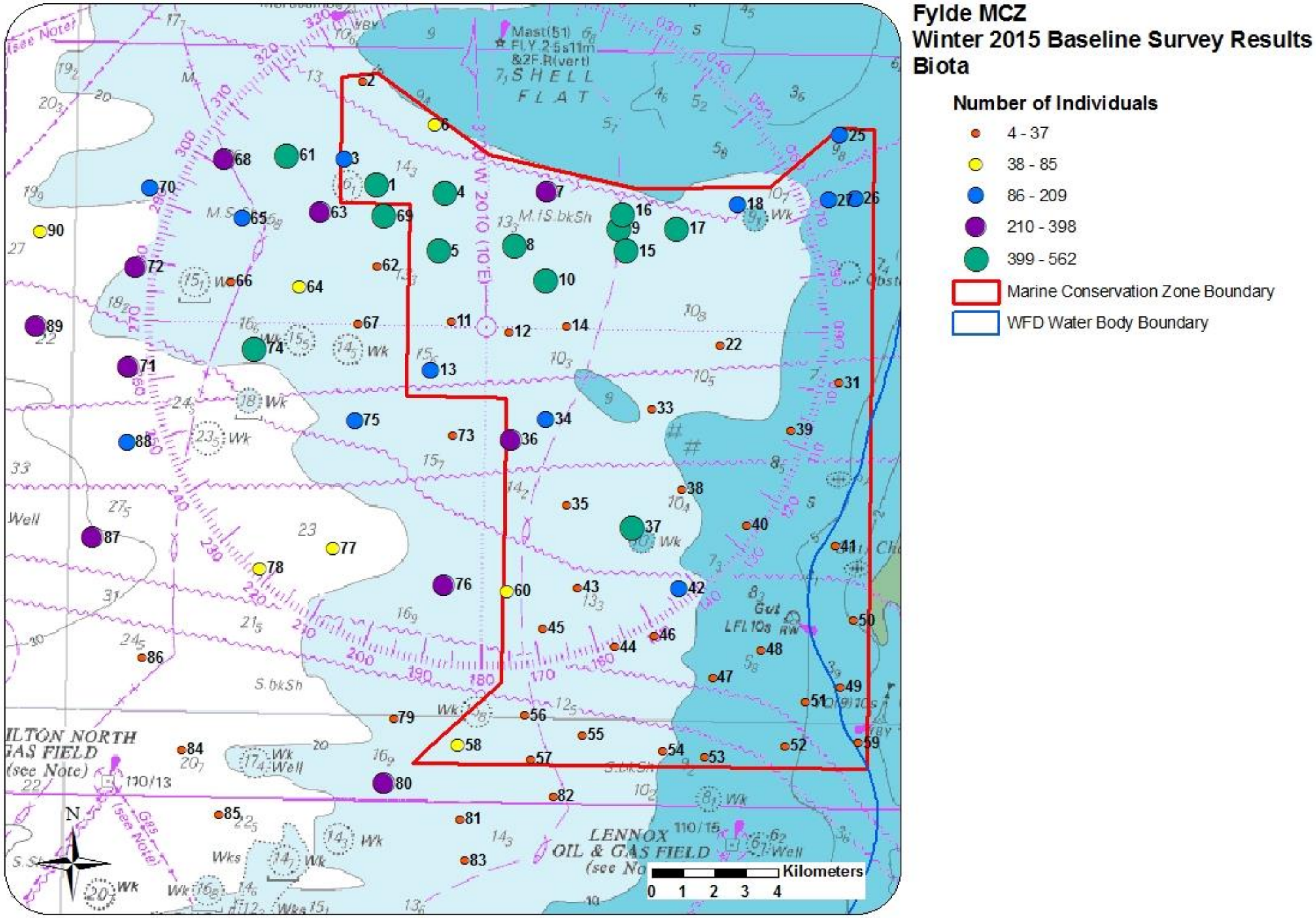


Figure 11. The Fylde Marine Conservation Zone (MCZ) 2015 baseline survey 0.1 m^2 Day grab sampling positions. Invertebrate abundance (number of individuals) at each station is displayed using the Jenks natural breaks classification method. The samples were collected from inside and outside the MCZ boundary for comparison.

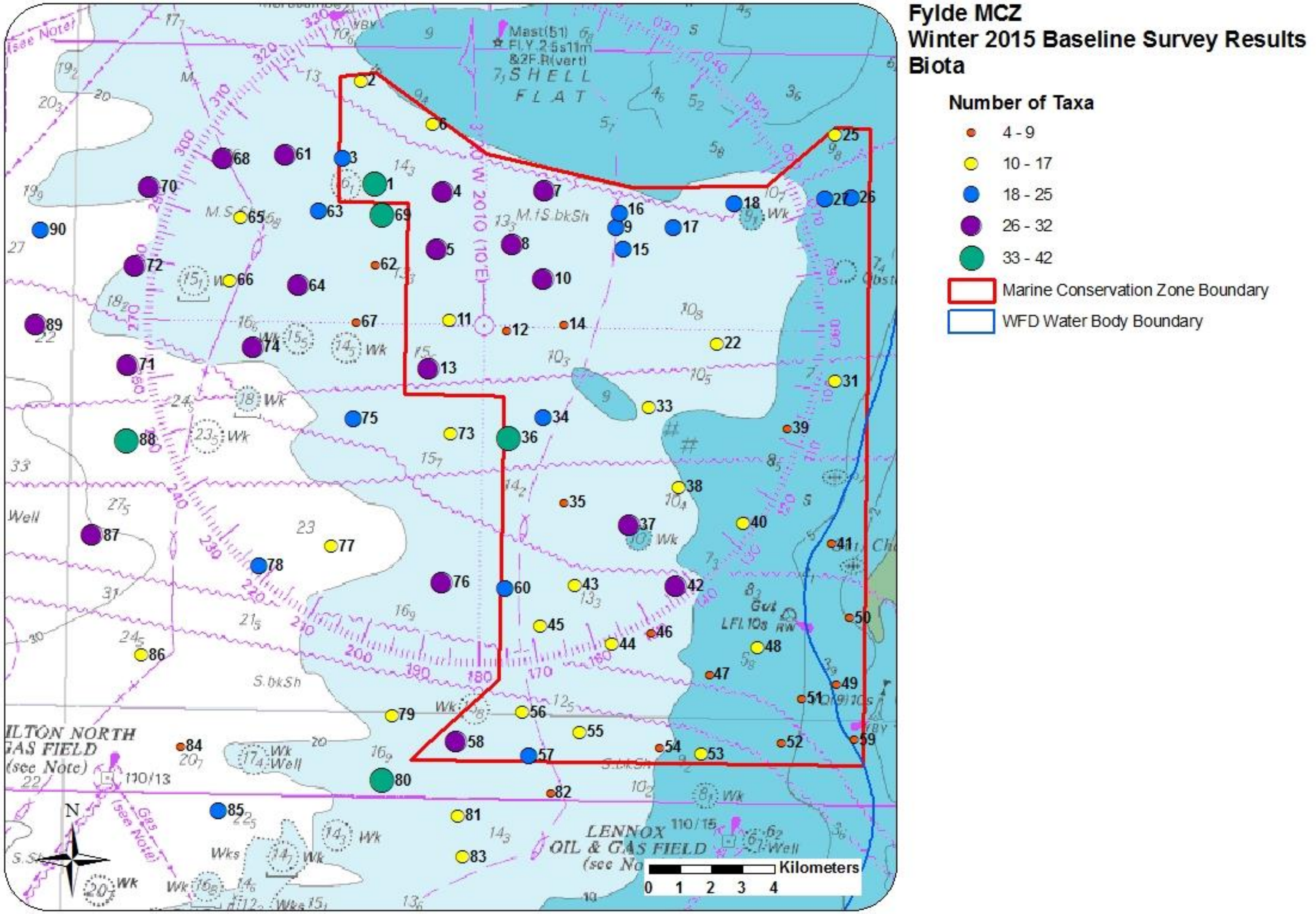


Figure 12. The Fylde Marine Conservation Zone (MCZ) 2015 baseline survey 0.1 m2 Day grab sampling positions. Species richness (number of taxa) at each station is displayed using the Jenks natural breaks classification method. The samples were collected from inside and outside the MCZ boundary for comparison.

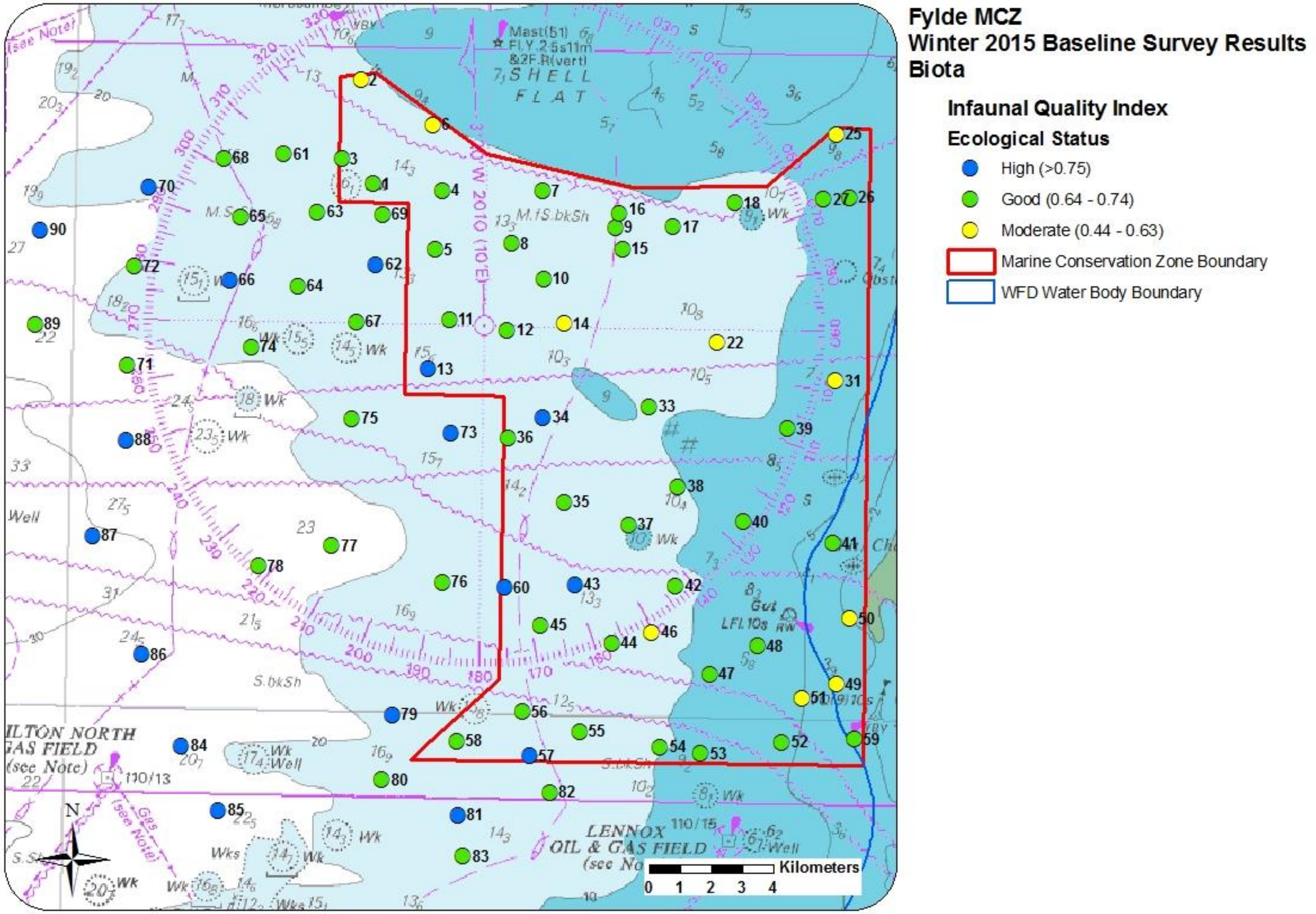


Figure 13. The Fylde Marine Conservation Zone (MCZ) 2015 baseline survey 0.1 m^2 Day grab sampling positions. Ecological quality ratios were calculated (1 = pristine, 0 = fully-degraded) to produce a status for each sample according to the Water Framework Directive (WFD) Infaunal Quality Index (IQI) classification procedure (WFD-UKTAG, 2014).

3.4 Community Structure and Biotope Classification

Biotopes

Eleven different biotopes were observed in total, seven within the MCZ boundary and four outside the boundary. There was distinct spatial variation in biotopes both inside and outside the MCZ boundary (Figure 14). The south of the survey area within the MCZ boundary was dominated by an infralittoral coarse sediment biotope complex (A5.135/A5.133 SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen) but was present in A5.2 subtidal sand sediment type. These stations were characterised by *Glycera lapidum or Moerella spp.*

The north of the survey area (inside and outside of the MCZ boundary) was dominated by SS.SMU.CSaMu.AfilMysAnit (A5.351 *Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud) biotope, present mostly in the A5.3 Subtidal Mud broadscale habitat.

The centre of the survey area, recorded a combination of biotopes present in the north and south of the MCZ, with the biotope SS.SSA.CMuSa.AalbNuc (A5.261, *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand) frequently present.

Four stations recorded unique biotope classifications (59, 84, 85 and 88). Several stations differed in their broadscale habitat assigned through PSA analysis and through biotope characterisation. Stations 39, 41, 44, 46-49, 51-57, 62, 79, 67 and 81-85 were all identified as A5.2 subtidal sand through the PSA sample, but the communities were characterised as infralittoral and circalittoral subtidal coarse sediment biotopes (Blan, Glap, MoeVen, SLan).

Community Structure

Multi-dimensional scaling ordination (MDS) of the community data showed that the samples were coarsely grouped into broadscale habitats. The relative dispersion of the sample points indicated that subtidal sand samples had a significantly more varied macrofauna community than the subtidal mud samples (Figure 15a). There was a significant difference in community structure between samples collected from inside or outside the MCZ boundary for both the subtidal mud (t = 1.76, P < 0.007), and subtidal sand (t = 1.48, P < 0.006) broadscale habitats.

Cluster analysis of the whole dataset showed that there were 11 significantly distinct groups containing 2 or more samples (Figure 15c), which did not completely align with the assigned biotopes (Figure 15b). There were also 9 samples that were significantly distinct from all other samples collected (these were aggregated together as 'group 12' for displaying on MDS plots).

The groups that contained subtidal mud samples (groups 1 - 7) were primarily characterised by varying abundances of four key species - the brittlestar *A. filiformis*, the bivalves *Kurtiella bidentata* and *N. nitidosa* and the polychaete *Pholoe baltica* (Table 5). The four groups that contained mostly lower-diversity subtidal sand samples (8 – 11) were characterised by a wider range of species, ranging from a low-abundance bivalve-dominated community (Group 10), to a mixed polychaete and bivalve community (Group 9).

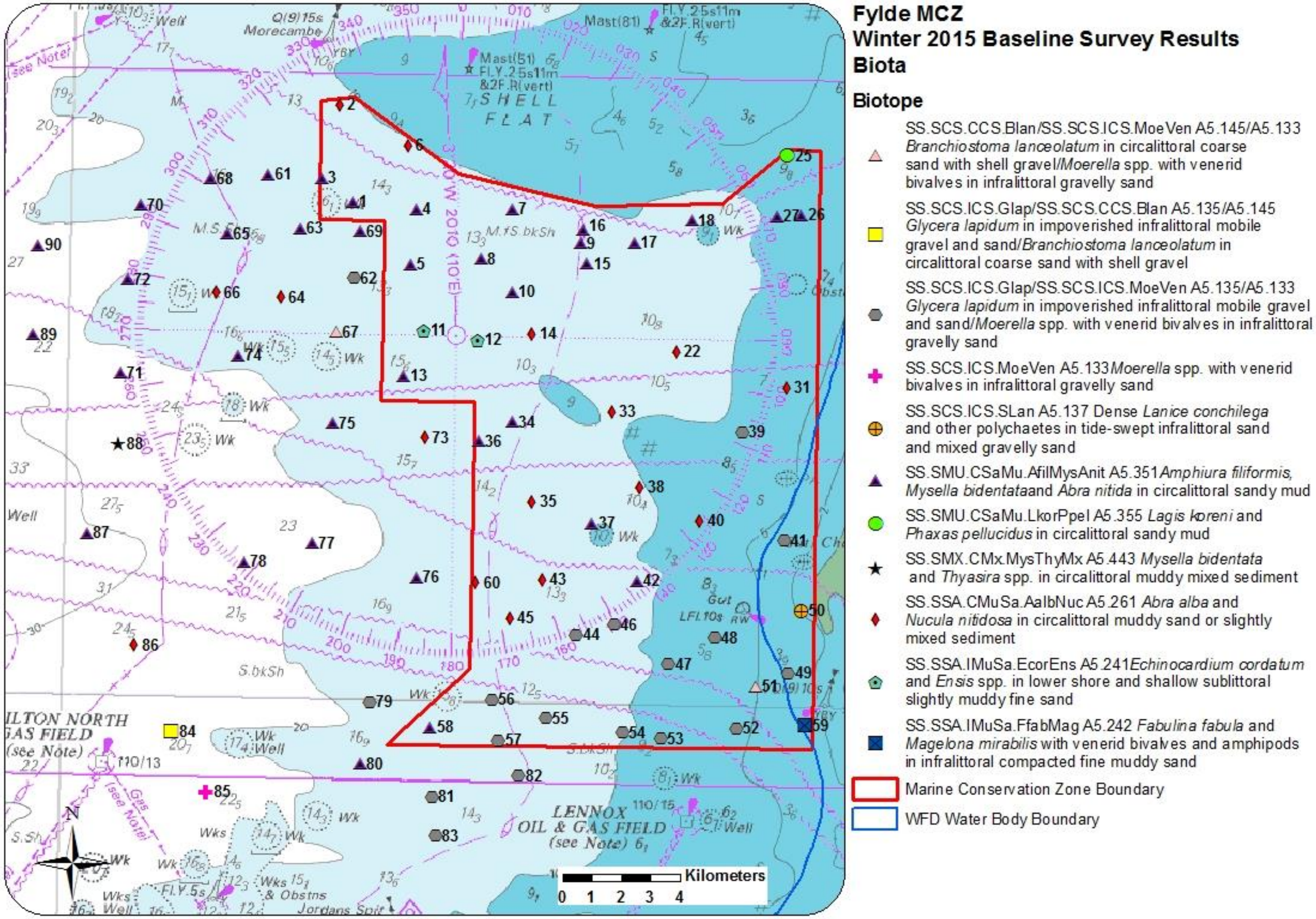


Figure 14. The Fylde Marine Conservation Zone (MCZ) 2015 baseline survey 0.1 m^2 Day grab sampling positions. The macrobenthic fauna and particle size data was combined to produce a level 5 biotope classification (JNCC v.04.06 and EUNIS) for each sample.

Table 4. The top 5 macrofauna species characterising (contributing to the Bray-Curtis similarity (%) the 11 significantly distinct groups identified by cluster analysis. The mean species richness (*S*) and predominant broadscale habitat is given for each group.

Species	**Mean abundance (n sample^{-1})**	**% contribution**	**Species**	**Mean abundance (n sample^{-1})**	**% contribution**	**Species**	**Mean abundance (n sample^{-1})**	**% contribution**
Group 1 - 2 samples, mean *S* = 18.5, subtidal mud			**Group 2** - 2 samples, mean *S* = 25.5 subtidal mud			**Group 3 –** 4 samples, mean *S* = 31.0, subtidal mud		
Phoronis	9.5	21.1	*Amphiura filiformis*	70.0	64.4	*Amphiura filiformis*	181.3	58.3
Nephtys incisa	5.5	10.5	*Kurtiella bidentata*	30.5	17.8	*Phoronis*	54.0	16.4
Magelona alleni	3.0	10.5	*Magelona alleni*	5.0	4.0	*Kurtiella bidentata*	41.3	11.5
Nucula nitidosa	2.5	10.5	Nemertea	3.5	2.0	*Nucula nitidosa*	9.0	1.9
Abra nitida	2.5	10.5	*Leuckartiara octona*	1.5	1.0	*Pholoe baltica*	7.8	1.7
Group 4 – 6 samples, mean *S* = 25.0, subtidal mud			**Group 5** – 9 samples, mean *S* = 29.9, subtidal mud			**Group 6** – 4 samples, mean *S* = 29.8, subtidal mud		
Kurtiella bidentata	251.0	58.3	*Amphiura filiformis*	234.6	57.0	*Amphiura filiformis*	166.0	61.1
Amphiura filiformis	133.5	28.1	*Kurtiella bidentata*	142.4	30.7	*Kurtiella bidentata*	89.0	23.5
Nucula nitidosa	13.5	2.9	*Pholoe baltica*	15.8	3.0	*Pholoe baltica*	10.3	2.3
Pholoe baltica	13.0	2.4				*Nucula nitidosa*	6.3	1.9
						Nemertea	4.3	1.3
Group 7 – 7 samples, mean *S* = 23.9, sub. mud & sand			**Group 8** – 16 samples, mean S = 12.5, sub. sand & mud			**Group 9** – 16 samples, mean *S* = 11.1 subtidal sand		
Amphiura filiformis	45.9	35.9	*Nucula nitidosa*	9.4	53.1	*Ophelia*	4.0	32.6
Kurtiella bidentata	25.9	22.5	*Lumbrineris cingulata*	2.2	7.9	*Kurtiella bidentata*	1.6	16.1
Nucula nitidosa	9.9	9.6	*Kurtiella bidentata*	9.1	7.0	*Glycera tridactyla*	1.3	11.7
Pholoe baltica	6.3	5.6	*Chamelea striatula*	1.7	7.0	*Nephtys cirrosa*	0.9	6.8
Nemertea	4.9	4.6	*Phaxas pellucidus*	1.5	5.4	*Nucula nitidosa*	0.7	5.5
Group 10 – 5 samples, mean *S* = 7.0, subtidal sand			**Group 11** – 2 samples, mean *S* = 7.0, subtidal sand			**Group 12 –** 9 samples, subtidal mud, sand & mixed		
Corbula gibba	1.8	45.7	*Glycera tridactyla*	1.5	100.0	(combination of single-sample clusters)		
Chamelea striatula	1.2	21.7						
Dosinia	0.8	10.2						
Ensis	0.4	5.4						
Nucula nitidosa	0.4	5.1						

	Hydroid		Echinoderm		Mollusc		Annelid		Other

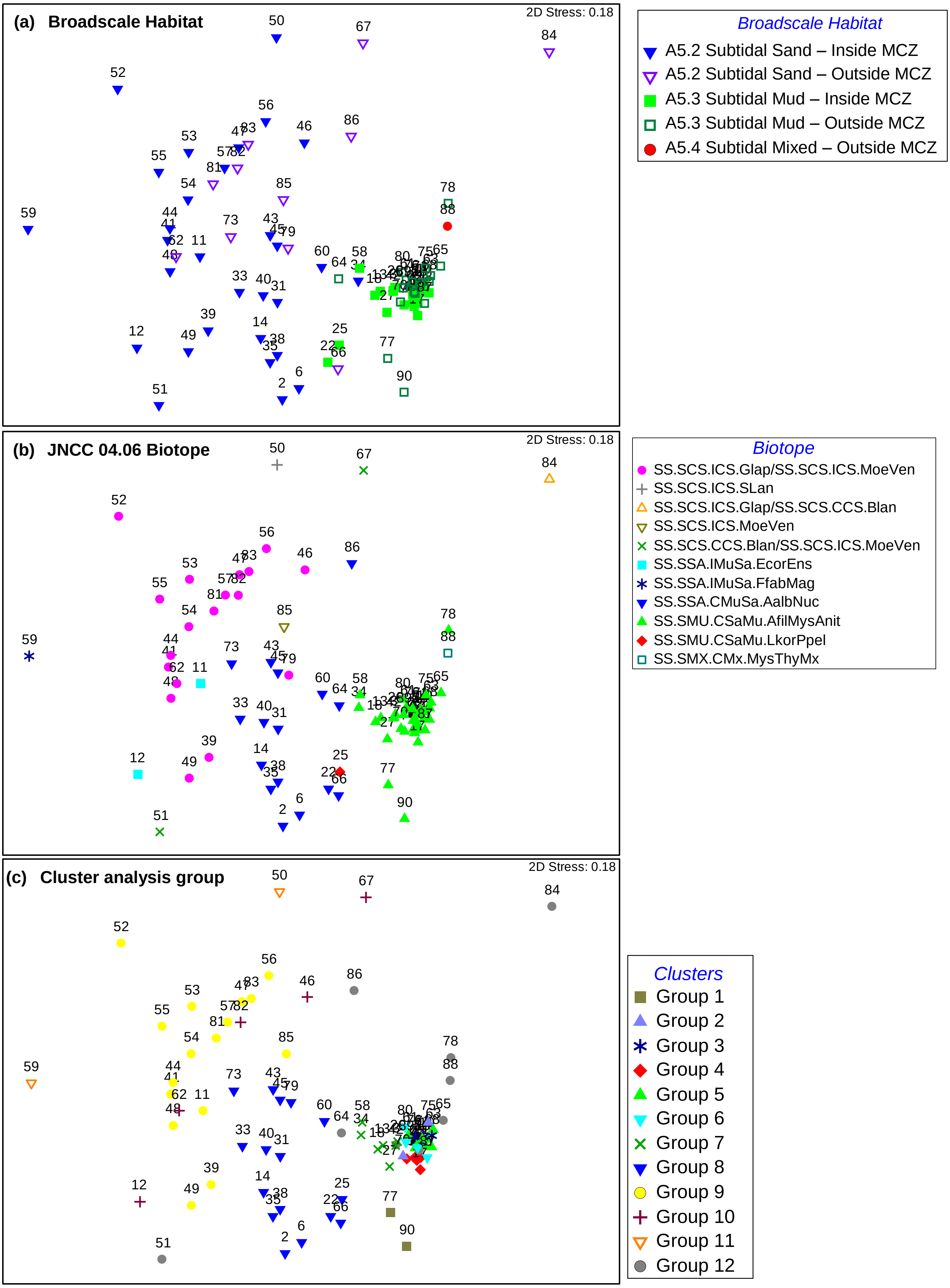


Figure 15. nMDS plots of square-root transformed macrofauna communities by (a, top) broadscale habitat (determined by PSA), (b, middle) assigned JNCC 04.06 biotope and (c, bottom) distinct cluster group determined using the SIMPROF test. Note group 12 is an aggregation of single-sample clusters in order to facilitate viewing.

4. Discussion & Conclusions

The results presented in this report provide the first comprehensive macrofauna dataset from the Fylde Marine Conservation Zone. This data provides the theoretical ‘Before’ stage of the ‘Before-after, control-impact (BACI) experimental design, with the ‘Control’ (outside MCZ) and ‘Impact’ (inside MCZ) samples which up to now have been subjected to the same measures and mechanisms. Following designation, measures could now be implemented within the site boundary that may change the macrofauna community, with the aim of maintaining favourable condition of the Subtidal Sand and Subtidal Mud broadscale habitats. Subsequent monitoring of the site may be able to identify any changes in the macrofaunal community to see if any implemented measures are benefitting the features. Power analysis was undertaken on the univariate metric results for each broadscale habitat (Table 5). This can be used to predict the number of samples that need to be collected in a future survey in order to have statistical confidence in any observed changes, e.g. 23 samples should be needed to detect a 20 % change in species richness at 80 % power in Subtidal Mud (α = 0.05).

This survey recorded the presence of the Subtidal Mud broadscale habitat across a large part of the northern sector of the MCZ, with samples of mud present in small areas across the rest of the site (Table 6). This differs significantly from the habitat distribution in the site assessment document (SAD), which recorded the entire site to be subtidal sand. Combining the results of this survey with suitable acoustic data will enable a detailed habitat map to be created, which will be able to provide updated extents for both the Subtidal Sand and Subtidal Mud broadscale habitats.

The macrofauna found in Fylde MCZ includes key characterising bivalve species identified by Kaiser et al. (2006) that are considered prey items for the common scoter *M. nigra,* a designated species of the overlapping Liverpool Bay SPA. These include the nut shell *N. nitidosa* (present in 63 out of 82 samples), the razor shells *Phaxus pellucidus* (present in 45 samples) and *Pharus legumen* (present in 14 samples), the clam *C.hamelea striatula* (present in 49 samples) and furrow shells *Abra* spp*.* (present in 38 samples). Also abundant were other key macrofaunal species that provide food for benthic predators such as flatfish, including the brittlestar *A. filiformis* (present in 50 samples) and bivalve *K. bidentata* (present in 62 samples). *A. filiformis, N. nitidosa* and *K. bidentata* frequently occurred in the subtidal mud samples, and their varying abundances drove the dissimilarity between the significantly different clusters even though they all fell under the same *Afil.Mys.Anit* biotope.

The Infaunal Quality Index scored both features of the site at ‘Good Ecological Status’, which could be considered equivalent to favourable condition. Stations from outside of the site boundary had a significantly higher IQI score. This may be because most of the samples collected from outside of the site boundary were further offshore than the samples collected from within the MCZ, and therefore could be subject to less pressure from the coast, such as organic enrichment or contaminants.

Table 5. Power analysis: number of samples required to detect a 10% or 20% change from the mean ($\bar{x}$) of a benthic metric at a particular level of statistical power (where α = 0.05), using community data from A5.2 Subtidal Sand or A5.3 Subtidal Mud samples collected from inside Fylde MCZ during the 2015 baseline survey.

		Number of samples required to detect…			
		A5.2 Subtidal Sand		A5.3 Subtidal Mud	
Benthic metric	**Power level**	**10 % change from $\bar{x}$**	**20 % change from $\bar{x}$**	**10 % change from $\bar{x}$**	**20 % change from $\bar{x}$**
Species Richness *S*	90 %	439	111	116	30
	80 %	329	83	87	23
	70 %	259	66	69	18
Abundance *N*	90 %	1722	432	578	146
	80 %	1287	323	432	109
	70 %	1012	254	340	86
Shannon Index H'(log^e)	90 %	88	23	114	30
	80 %	66	18	86	23
	70 %	52	14	68	18
Simpsons Index (1-λ')	90%	28	8	50	14
	80%	21	6	38	11
	70%	17	5	30	9
IQI	90 %	25	8	15	5
	80 %	19	6	12	4
	70 %	15	5	10	1

Conclusions

The Environment Agency conducted a grab survey of the sediment features of the Fylde MCZ between the 11th and 13th February 2015. The objectives of the survey were to obtain a baseline dataset of the designated feature both inside and outside of the MCZ boundary.

- During the 2015 baseline survey of the Fylde MCZ, viable samples were collected from 82 stations using a 0.1 m^2 Day. Two designated sediment broadscale habitats were recorded inside the MCZ boundary: Subtidal sand (30 records) and Subtidal Mud (22 records). Subtidal mud was predominately present in the northern quarter of the site, and extended outside of the site boundary to the west. Subtidal sand was predominant in the southern half of the site.

- 7,239 individuals across 172 taxa were recorded in the grab survey, including the nationally rare hydroid *O. bidentata* inside the site boundary. No non-native species were identified inside the site. The resulting communities roughly corresponded to twelve sediment biotopes or biotope complexes. The highest richness was recorded at station 88, a subtidal mixed sediments sample outside of the MCZ (subtidal mixed sediments were not found inside the MCZ). There was no significant difference in species richness or abundance between samples collected inside and outside the MCZ for either broadscale habitat.

- Infaunal quality index (IQI) classifications showed that both the Subtidal sand and Subtidal mud broadscale habitats inside the MCZ were assessed at good ecological status, which could be considered equivalent to favourable condition. Subtidal sand sampled outside of the MCZ had a significantly higher infaunal quality (assessed at high ecological status).

5. References

Anderson, M.J., Gorley, R.N., Clarke K.R., 2007. PERMANOVA+ for PRIMER: a guide to software and statistical methods, PRIMER-E, Plymouth.

Connor, D.W., Allen, J.H., Golding, N., Howell, K.L., Lieberknecht, L.M., Northen, K.O. and Reker, J.B., 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05. In JNCC (2015) The Marine Habitat Classification for Britain and Ireland Version 15.03 [online] Available at: www.jncc.defra.gov.uk/MarineHabitatClassification [Accessed: 22/07/2015].

Environment Agency, 2014. Sampling and processing marine benthic invertebrates. Operational Instruction 009_07 (internal document). Bristol, UK.

Environment Agency, 2012. Water Framework Directive (WFD) sampling of macrobenthic invertebrates in Transitional and Coastal Waters. Operational Instruction 104_10 (internal document). Bristol, UK.

Defra, 2013. Fylde MCZ Factsheet. 2013. [online]
Available from: http://publications.naturalengland.org.uk/publication/4933233460379648 [accessed 09/11/2015]

Irish Seas Conservation Zones. 2011. Final recommendations for Marine Conservation Zones in the Irish Sea, August 2011 [online].
Available from: http://www.irishseaconservation.org.uk/node/92 [Accessed 09/11/2015].

Kaiser, M.J., Galanidi, M., Showler, D.A., Elliott, A.J., Caldow, R.W.G., Rees, E.I.S., Stillman, R.A., Sutherland, W.J. 2006. Distribution and behaviour of Common Scoter *Melanitta nigra* relative to prey resources and environmental parameters. Ibis 148, 110-128.

Long, D. 2006. BGS detailed explanation of seabed sediment modified Folk classification. Mapping European Seabed Habitats (MESH) project document. Available at: http://www.searchmesh.net/PDF/GMHM3_Detailed_explanation_of_seabed_sediment_classification.pdf [Accessed 29/06/2015].

Mason, C., 2011. NMBAQC's Best Practice Guidance. Particle Size Analysis (PSA) for Supporting Biological Analysis. National Marine Biological Analytical Quality Control Scheme Coordinating Committee, 72pp, December 2011.

McBreen, F., Askew, N., Cameron, A., Connor, D., Ellwood, H., Carter, A., 2011. UK SeaMap 2010 Predictive mapping of seabed habitats in UK waters. Joint Nature Conservation Committee Report 446.

Sanderson, W.G., 1996. Rare benthic marine flora and fauna in great Britain: the development of criteria for assessment. Joint Nature Conservation Committee Report No.. 240. JNCC, Peterborough, UK.

Wentworth, C.K. 1922. A scale of grade and class terms for clastic sediments. The Journal of Geology 30, 377-392.

WFD-UKTAG, 2014. UKTAG Transitional and Coastal Water Assessment Method: Benthic Invertebrate Fauna: Infaunal Quality Index. Water Framework Directive – United Kingdom Advisory Group (WFD-UKTAG). Available at: http://www.wfduk.org/resources%20/coastal-and-transitional-waters-benthic-invertebrate-fauna [Accessed 17/07/2015].

Worsfold, T. M., Hall, D. J. and O'Reilly, M. (Ed.) 2010. Guidelines for processing marine macrobenthic invertebrate samples: a Processing Requirements Protocol version 1.0. National Marine Biological Analytical Quality Control Scheme Coordinating Committee. 33pp, June 2010.
Available at:
http://www.nmbaqcs.org/scheme-components/invertebrates/reports/ [Accessed 21/07/2015].

6. General List of Abbreviations

BSH	Broadscale Habitat
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CS	Camera Sledge
CSV	Coastal Survey Vessel
DC	Drop Video Camera
Defra	Department for Environment, Food and Rural Affairs
DG	Day Grab
EA	Environment Agency
ECMAS	Estuarine and Coastal Monitoring and Assessment Service
ENG	Ecological Network Guidance
EQR	Ecological Quality Ratio
EQSD	Environmental Quality Standards Directive
EUNIS	European Nature Information System
FOCI	Features Of Conservation Importance
JNCC	Joint Nature Conservation Committee
IFCA	Inshore Fisheries and Conservation Authority
IQI	Infaunal Quality Index
MESH	Mapping European Seabed Habitats
MHM	Mini-Hamon Grab
mSNCI	marine Sites of Nature Conservation Importance
NLS	National Laboratory Services
NMBAQC	National Marine Biological Analytical Quality Control Scheme
PSA	Particle Size Analysis
REC	Regional Environmental Characterisation
rMCZ	recommended Marine Conservation Zone
rRA	recommended Reference Area
RSG	Regional Stakeholder Group
(c)SAC	(Candidate) Special Area of Conservation
SAD	Site Assessment Document
SEPA	Scottish Environment Protection Agency
SNCB	Statutory Nature Conservation Body
SOCI	Species Of Conservation Importance

SOP	Standard Operating Procedure
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
UKHO	United Kingdom Hydrographic Office
UTC	Coordinated Universal Time
WFD	Water Framework Directive

7. Annexes

7.1 Coastal Survey Vessel General Information

Briggs Marine and Environmental Services
Seaforth House, Seaforth Place, Burntisland, Fife,
KY3 9AX
Tel: + 44 (0) 1592 872939
Email:marketing@briggsmarine.com
www.briggsmarine.com

Mersey Guardian

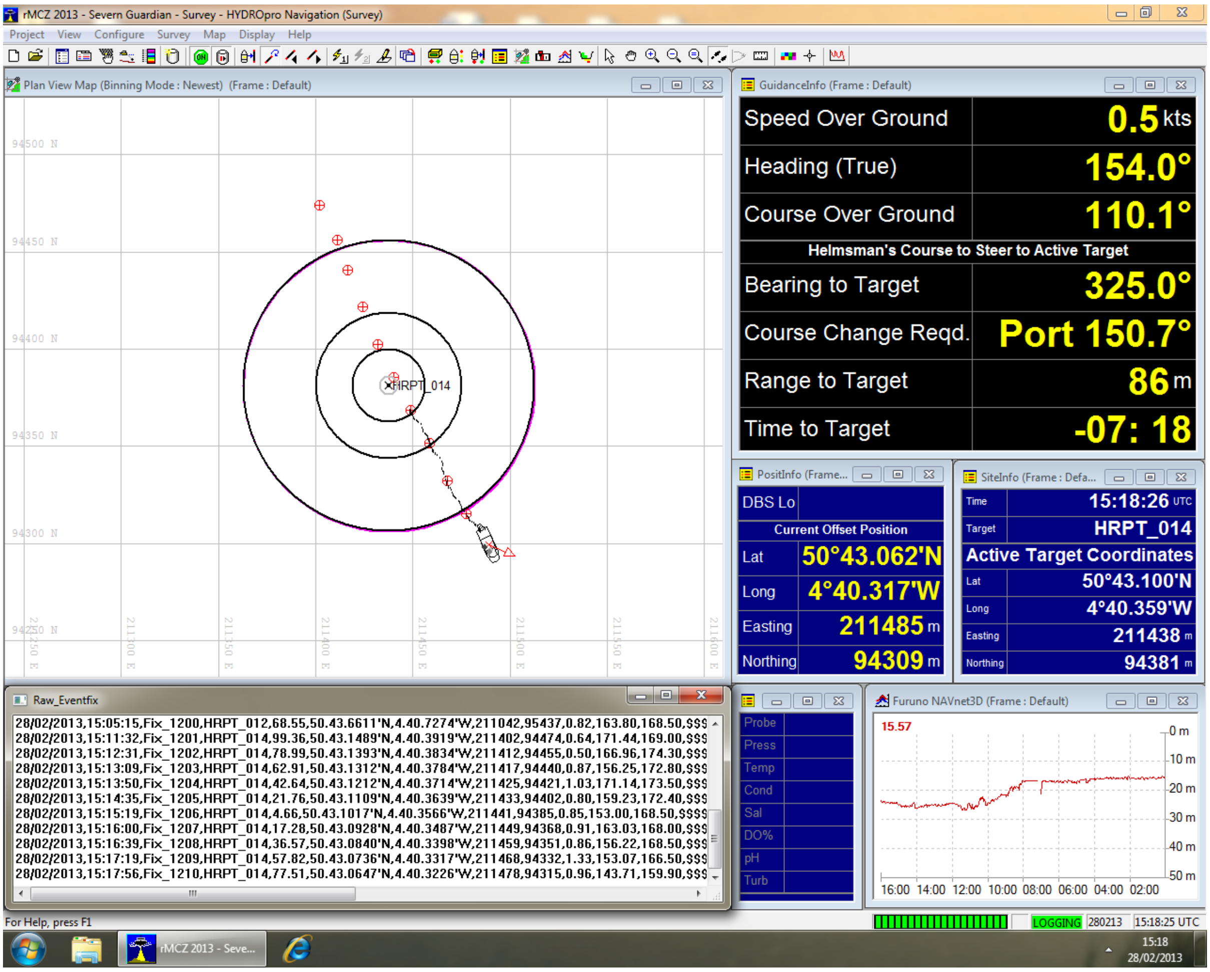
General Information
Length: 18.3m
Beam: 6.3m
Draft (baseline): 1.15m
Draught (skegs): 2.2m
Displacement (light ship): 22T
Displacement (full load): 30T
Service Speed: 16 knots
Maximum Speed: 18 knots

Main Equipment
Main Engines: 2 x Volvo D9-MH 261bkW @ 2200rpm. Twin Disc MGX-5075 integral vee-drive
Crew: 7
Scientific Officers: Up to 10
Accommodation: 3 x twin cabins and mess
Data network to share information around vessel
Wetlab/bench for processing water, sediment and ecology samples
A fridge/freezer for sample storage
Dry lab space for two computers and data processing
Large aft deck working area

7.2 Survey Equipment

7.2.1 Navigation and Positioning

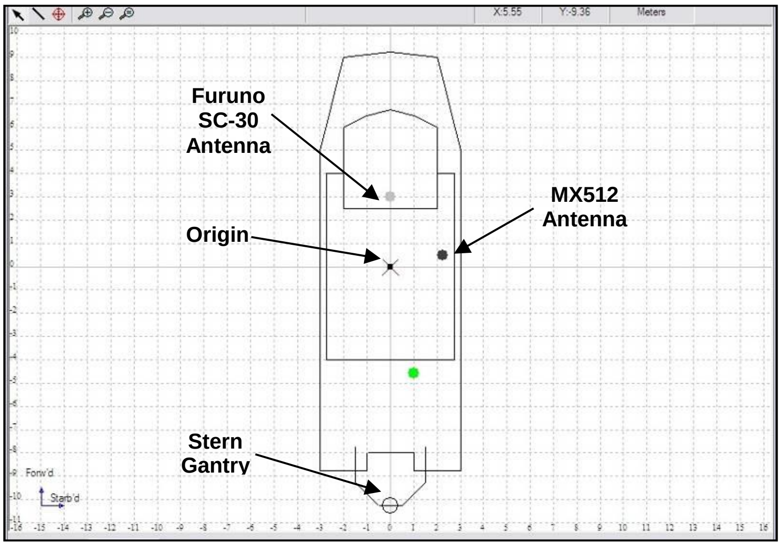
Trimble® HYDRO*pro*™ software is utilised for real-time navigation and survey data acquisition.



Trimble® HYDRO*pro*™ software screen grab displaying real-time navigation and survey data acquisition (manual fixes).

Navigational and survey equipment offsets on the Coastal Survey Vessel *Mersey Guardian* (Environment Agency Estuarine and Coastal Monitoring and Assessment Service).

NMEA Device	Make/Model	Offset Name	Offset (m)		
			X (Starb'd)	Y (Forw'd)	Z +ve (Up)
Gyrocompass	*Simrad Robertson RGC50*	*n/a*	-	-	-
Navigation Echosounder	*Furuno DFF1, 525ST-MSD transducer*	*n/a*	-	-	-
Survey Echosounder	*Kongsberg EA400*	*n/a*	-	-	-
Origin	*n/a*	*Origin*	*0.0*	*0.0*	*0.0*
Navigation GPS (Secondary)	*Furuno SC-30 DGPS*	*Furuno SC-30 Antenna*	*0.0*	*3.0*	*0.0*
Survey GPS (Primary)	*SIMRAD MX512 DGPS*	*MX512 Antenna*	*2.25*	*0.5*	*0.0*
n/a	*n/a*	*Sediment Grab (Stern Gantry)*	*0.0*	*-10.25*	*0.0*



Trimble® HYDROpro™ vessel editor screen showing survey equipment offsets from the origin (Environment Agency Estuarine and Coastal Monitoring and Assessment Service).

7.2.2 SeaSpyder Drop Camera System

STR
SUBSEA TECHNOLOGY & RENTALS

SEASPYDER DROP CAMERA SYSTEM

Surface Control Unit & Processor

The SeaSpyder Underwater Drop Camera System is part of a family of field proven camera systems manufactured by STR for the marine survey and environmental communities. The SeaSpyder is ideally suited for operation in shallow-medium water depths with the standard system having a working depth range of 500m. For applications demanding a deeper rating, a "telemetry" model is offered which operates over longer cable lengths for operation down to 1000m. Both models are fitted with a new generation digital SLR Camera offering high resolution digital stills and HD Video for the highest imagery detail. The high specification digital SLR Camera offers an impressive 18.0 mega pixels resolution and both manual and automatic focus for achieving the sharpest images. The captured digital stills are framed with the aid of dedicated real-time video and can be transferred to the topside 'on the fly' for rapid online review.

A 19" rack mount Surface Control Unit and powerful topside processor give full remote control of the camera via the easy to use SeaView GUI software. As standard, the purpose designed camera deployment frame is fitted with a subsea electronics and camera housing, high power underwater flash, an array of four high intensity LED lamps and dual scaling laser pointers to provide accurate imagery scaling. There is the option to install additional sensors with the availability of three user defined serial interfaces with optional power.

SYSTEM FEATURES

- Latest generation 18 Mega Pixels Digital SLR Camera
- Full remote control of camera functions including automatic and manual focus control
- 'On-the-fly' image download
- Real time HD Video
- High intensity LED Lamps
- Dual lasers for precise imagery scaling
- High speed digital telemetry link to camera and sensors
- Additional user defined RS232 ports and 24VDC power interfaces

7.3 EA underwater video procedure_version 2.4 (STR Systems)

The procedure outlined below has developed through a series of discussions involving the Environment Agency, Cefas and Natural England. Due to the heterogeneous nature of the inshore coastal seabed habitat, strong tidal streams, various underwater hazards and no dynamic positioning system, a flexible approach is recommended for the underwater video camera deployment. The procedure must be used in accordance with the MESH 'recommended operating guidelines (ROG) for underwater video and photographic imaging techniques' (Coggan et al., 2007).

Important points to remember:

- **Select stern gantry offset in Hydropro**
- **Synchronise all survey equipment (camera, laptops, etc.) with primary survey GPS time (UTC).**
- **Ensure the correct date, station code, STN number, time and position are displayed on the video overlay and Clapperboard.**

Overlay Example:

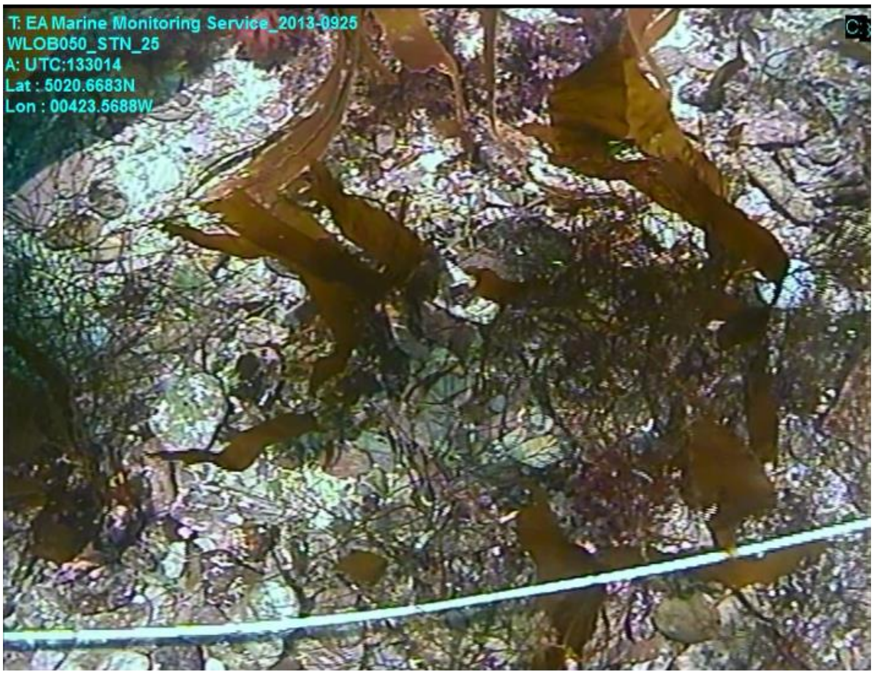
EA Marine Monitoring Service_2013-0925

WLOB050_STN_25 *(annotate if station has been attempted on a previous occasion)*

UTC: 133014 (*real time feed from survey GPS*)

Lat: 5020.6683N (*real time feed from survey GPS*)

Lon: 00423.5688W (*real time feed from survey GPS*)



Clapperboard Example:

- **Alter the stills prefix to the correct station code.**

PBSR096_STN_? *(? = sequential 'STN or event' number expressed as an integer i.e. no leading zeros – refer to previous survey period for starting number)*

The software will then automatically add '_01, _02, _03......' as the stills are captured – you may need to adjust the number of leading zeros.

Final stills code format saved to the laptop:

PBSR096_STN_12_01

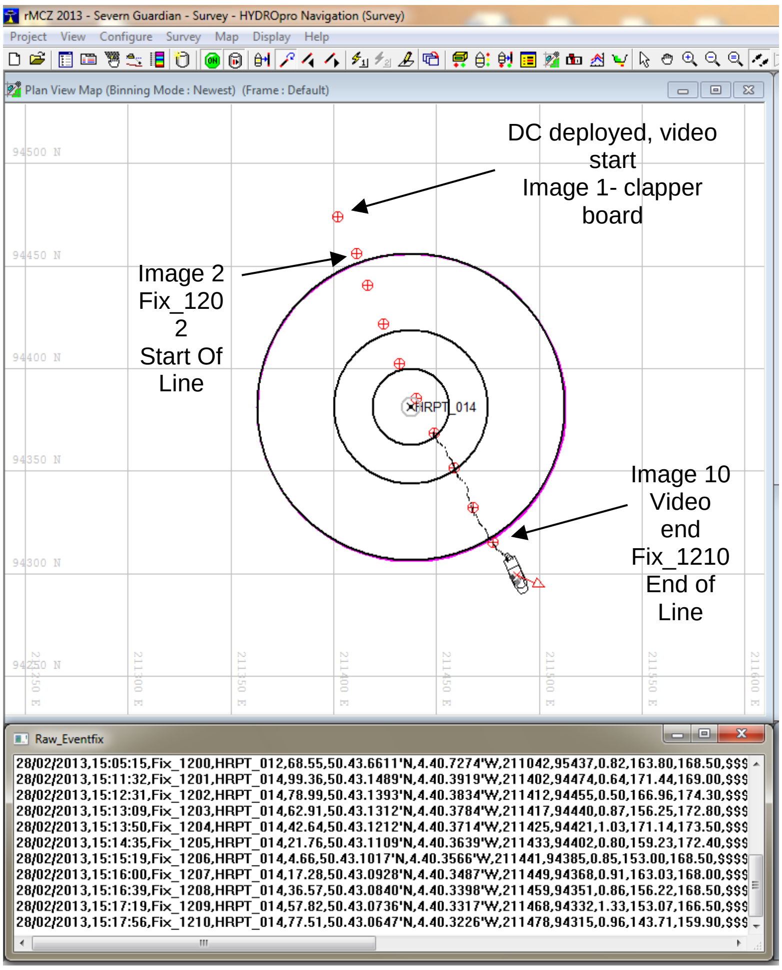
PBSR096_STN_12_02

PBSR096_STN_12_03

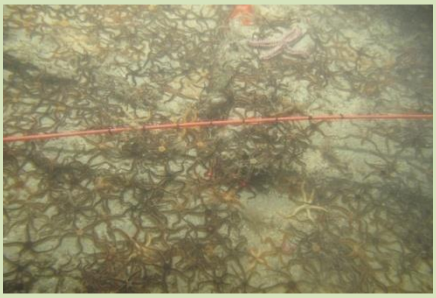
- **The field of view scale bar/laser points should be set up/calibrated prior to the survey commencing. Laser pointers are ineffective in moderate/poor visibility conditions; a rope with a visible scale will be required as a replacement**
- **Set the image resolution to Large Normal (14.7 Mega Pixels, 18 sec upload time)**
- **Check that he camera settings are appropriate for the conditions; that the LED lights are on if required and ensure the video is recording throughout the deployment.**

- **If a broad-scale habitat (BSH) boundary is detected extend the deployment to gather as much information on habitat extent as possible.**
- **Take extra stills if habitat/species FOCI are observed – note these in the survey log.**
- **If possible, work a downhill seabed profile to avoid slack cable during deployment.**
- **Beware of sudden depth changes when surveying rocky areas.**
- **Abandon the station if survey conditions are hazardous.**

Video Camera Type	Survey Conditions	Deployment
Drop down	Good visibility	*Deploy camera initially working across the Hydropro 75 m <u>radius</u> target area, as shown in the diagram below. Hover/rest camera above/on the seabed; take a still every 15 m. If tide/wind conditions do not allow a survey line to be followed across the bull ring, use the outer circle as a guide to ensure a distance of 150 m is covered (minimum) nearby.
	Poor visibility	Hover/rest camera above/on the seabed, take a still every 15 m. If the visibility is very poor, retrieve the equipment after taking 3-4 stills.



7.4 Underwater Visibility Scale

Example image	Scale	Definition
	Excellent	clear, sharp images - no suspended particulate matter
	Good	seabed features and epifauna clearly discernible
	Moderate	seabed features discernible - epifauna difficult to discern
	Poor	both seabed features and epifauna difficult to discern, low confidence in preliminary habitat assessment
	Very Poor	no seabed features or epifauna visible

7.5 MCZ Video Logsheet

MCZ Video Logsheet (v1)

Station data

Contract Code:__________ Vessel: Mersey Guardian Date: 16/08/2015

MCZ Name: Fylde Station Code: FLDO_90

Nav-Log filename:__________ Sampling Gear: DC Water Depth: 34 m

Cable Out: 34 (metres). Speed Over Ground (SOG): 0·44 (knots)

Notes on Station: (including any times & adjustments to Cable Out) Position Reference Point: Stern Gantry

Poor visibility

Sample data

Digital Video Tape label:__________

Filename on Hard-Drive: FLDO_2FGL40815_GT090_STN_1_A1_0012_132627

No. of camera stills: 12 Stills folder name: FLDO_2FGL40815_GT090_STN_1

	GPS Time hh:mm		Fix No	Position in Lat/Long (WGS84)	DV tape counter Mins	Secs
Start of Video (SOV)	13	10	1965	53° 48·17N; 03° 31·0W		
End of Video (EOV)	13	28	1978	53° 48·20N; 03° 31·20W		

Visual / Video notes: (ground-type, terrain, visibility, species, FOCI, sketch of transect)

Poor vis – hard to distinguish habitat / species

Broad-scale habitats observed

Infralittoral Rock		Circalittoral Rock		Sediment habitats		Others	
high energy		high energy		subtidal mixed		macrophyte dominated sed's	
mod.energy		mod.energy		subtidal coarse			
low energy		low energy		subtidal mud		biogenic reef	
				subtidal sand		deep-sea bed	

Completed by:………………… Checked by:………………… Entered by:…………………

7.6 Day Grab Sample Images

Day grab sample images captured during the Fylde MCZ 2015 baseline survey. Fauna samples were photographed before and after sieving over a 1 mm mesh. Field notes include sample depths, EUNIS code and Folk sediment descriptions. A 0.5 litre full-depth core of material was removed from a second grab for particle size analysis.

Fauna Sample (prior to sieving)	Sieved sample	PSA Grab

FLDO01 | Sample depth in grab = 12.5 cm | A5.3 Subtidal Mud

No Sieve Photograph

FLDO02 | Sample depth in grab = 5 cm | A5.2 Subtidal Sand



FLDO03 | Sample depth in grab = 12.5 cm | A5.3 Subtidal Mud



FLDO04 | Sample depth in grab = 12 cm | A5.3 Subtidal Mud



FLDO05 | Sample depth in grab = 12 cm | A5.3 Subtidal Mud

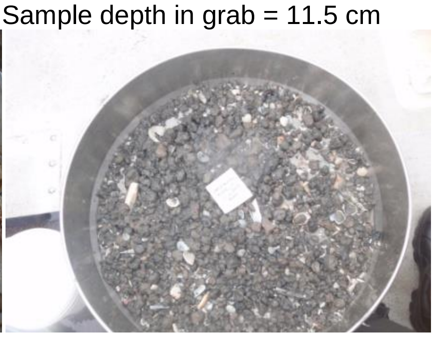
Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
		
FLDO06	Sample depth in grab = 4 cm	A5.2 Subtidal Sand
		
FLDO07	Sample depth in grab = 12.5 cm	A5.3 Subtidal Mud
		
FLDO08	Sample depth in grab = 13 cm	A5.3 Subtidal Mud
		
FLDO09	Sample depth in grab = 12 cm	A5.3 Subtidal Mud
		

Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO10	Sample depth in grab = 13.5 cm	A5.3 Subtidal Mud
		
FLDO11	Sample depth in grab = 6 cm	A5.2 Subtidal Sand
		
FLDO12	Sample depth in grab = 7 cm	A5.2 Subtidal Sand
		
FLDO13	Sample depth in grab = 11.5 cm	A5.2 Subtidal Mud
		
FLDO14	Sample depth in grab = 5.5 cm	A5.2 Subtidal Sand
		

Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO15 	Sample depth in grab = 12.5cm 	A5.3 Subtidal Mud 
FLDO15b 	Sample depth in grab = 9.5 cm 	No PSA taken due to replicate site
FLDO16 	Sample depth in grab = 12 cm 	A5.3 Subtidal Mud 
FLDO17 	Sample depth in grab = 11.5 cm 	A5.3 Subtidal Mud 
FLDO18 	Sample depth in grab = 12 cm 	A5.3 Subtidal Mud 

Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO22	Sample depth in grab = 5.5 cm	A5.3 Subtidal Mud
		
FLDO25	Sample depth in grab = 12.5 cm	A5.3 Subtidal Mud
		
FLDO26	Sample depth in grab = 7.5 cm	A5.3 Subtidal Mud
		
FLDO27	Sample depth in grab = 12 cm No sieve photograph	A5.3 Subtidal Mud
		
FLDO28 PSA only	Sample depth in grab = 6 cm PSA only	A5.3 Subtidal Mud
		

Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO29 PSA only	Sample depth in grab = 2.5 cm PSA only	A5.3 Subtidal Mud 
FLDO30 PSA only	Sample depth in grab = 4 cm PSA only	A5.2 Subtidal Sand 
FLDO31 	Sample depth in grab = 4.5 cm 	A5.2 Subtidal Sand 
FLDO32 PSA only	Sample depth in grab = 4 cm PSA only	A5.3 Subtidal Mud 
FLDO33 	Sample depth in grab = 6 cm 	A5.2 Subtidal Sand 

Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO34	Sample depth in grab = 10.5 cm	A5.2 Subtidal Sand
		
FLDO35	Sample depth in grab = 6.5 cm	A5.2 Subtidal Sand
		
FLDO36	Sample depth in grab = 11 cm	A5.3 Subtidal Mud
		
FLDO37	Sample depth in grab = 11.5 cm	A5.3 Subtidal Mud
		
FLDO38	Sample depth in grab = 5.5 cm	A5.2 Subtidal Sand
		

Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO39	Sample depth in grab = 5 cm	A5.2 Subtidal Sand
		
FLDO40	Sample depth in grab = 5 cm	A5.2 Subtidal Sand
		
FLDO41	Sample depth in grab = 5 cm	A5.2 Subtidal Sand
		
FLDO42	Sample depth in grab = 13 cm	A5.3 Subtidal Mud
		
FLDO43	Sample depth in grab = 6.5 cm	A5.2 Subtidal Sand
		

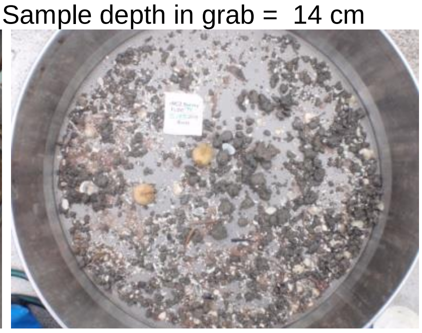
Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO44	Sample depth in grab = 6 cm	A5.2 Subtidal Sand
		
FLDO45	Sample depth in grab = 7.5 cm	A5.2 Subtidal Sand
		
FLDO46	Sample depth in grab = 6.5 cm	A5.2 Subtidal Sand
		
FLDO47	Sample depth in grab = 5.5 cm	A5.2 Subtidal Sand
		
FLDO48	Sample depth in grab = 5 cm	A5.2 Subtidal Sand
		

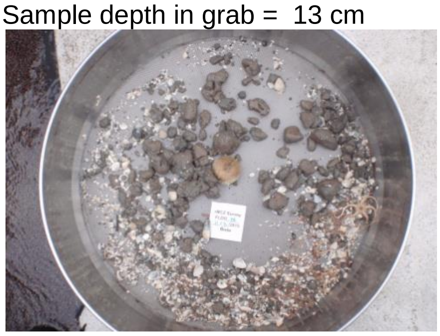
Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO49	Sample depth in grab = 4 cm	A5.2 Subtidal Sand
		
FLDO50	Sample depth in grab = 5 cm	A5.2 Subtidal Sand
		
FLDO51	Sample depth in grab = 5.5 cm No sieve photograph	A5.2 Subtidal Sand
		
FLDO52	Sample depth in grab = 6 cm	A5.2 Subtidal Sand
		
FLDO53	Sample depth in grab = 7 cm No sieve photograph	A5.2 Subtidal Sand
		

Fauna Sample (prior to sieving)	**Sieved sample**	**PSA Grab**
FLDO54 	Sample depth in grab = 6 cm 	A5.2 Subtidal Sand 
FLDO55 	Sample depth in grab = 5 cm 	A5.2 Subtidal Sand 
FLDO56 	Sample depth in grab = 6.5 cm 	A5.2 Subtidal Sand 
FLDO57 	Sample depth in grab = 5.5 cm 	A5.2 Subtidal Sand 
FLDO58 	Sample depth in grab = 9.5 cm 	A5.3 Subtidal Mud 

Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO59 	Sample depth in grab = 5 cm 	A5.2 Subtidal Sand 
FLDO60 	Sample depth in grab = 6 cm 	A5.2 Subtidal Sand 
FLDO61 	Sample depth in grab = 12 cm 	A5.3 Subtidal Mud 
FLDO62 	Sample depth in grab = 7 cm 	A5.2 Subtidal Sand 
FLDO63 	Sample depth in grab = 13.5 cm No sieve photograph	A5.3 Subtidal Mud 

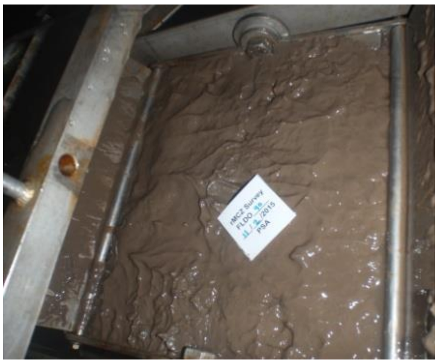
Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO64 	Sample depth in grab = 8 cm 	A5.3 Subtidal Mud 
FLDO65 	Sample depth in grab = 12.5cm 	A5.3 Subtidal Mud 
FLDO66 	Sample depth in grab = 9.5 cm 	A5.2 Subtidal Sand 
FLDO67 	Sample depth in grab = 5.5 cm 	A5.2 Subtidal Sand 
FLDO68 	Sample depth in grab = 12.5 cm 	A5.3 Subtidal Mud 

Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO69 	Sample depth in grab = 11.5 cm 	A5.3 Subtidal Mud 
FLDO70 	Sample depth in grab = 12.5 cm No sieve photograph	A5.3 Subtidal Mud 
FLDO71 	Sample depth in grab = 12 cm 	A5.3 Subtidal Mud 
FLDO72 	Sample depth in grab = 14 cm 	A5.3 Subtidal Mud 
FLDO73 	Sample depth in grab = 7 cm 	A5.2 Subtidal Sand 

Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO74	Sample depth in grab = 12 cm	A5.3 Subtidal Mud
		
FLDO75	Sample depth in grab = 12.5 cm	A5.3 Subtidal Mud
		
FLDO76	Sample depth in grab = 13 cm	A5.3 Subtidal Mud
		
FLDO77	Sample depth in grab = 14 cm	A5.3 Subtidal Mud
		
FLDO78	Sample depth in grab = 13 cm	A5.3 Subtidal Mud
		

Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO79	Sample depth in grab = 7.5 cm	A5.2 Subtidal Sand
		
FLDO80	Sample depth in grab = 12 cm	A5.3 Subtidal Mud
		
FLDO81	Sample depth in grab = 8 cm	A5.2 Subtidal Sand
		
FLDO82	Sample depth in grab = 6.5 cm	A5.2 Subtidal Sand
		
FLDO83	Sample depth in grab = 6.5 cm	A5.2 Subtidal Sand
		

Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO84	Sample depth in grab = 6 cm	A5.2 Subtidal Sand
		
FLDO85	Sample depth in grab = 7.5 cm	A5.2 Subtidal Sand
		
FLDO86	Sample depth in grab = 7.5 cm	A5.2 Subtidal Sand
		
FLDO87	Sample depth in grab = 14 cm	A5.3 Subtidal Mud
		
FLDO88	Sample depth in grab = 10 cm	A5.4 Subtidal Mixed Sediment
		

Fauna Sample (prior to sieving)	Sieved sample	PSA Grab
FLDO89	Sample depth in grab = 13 cm	A5.3 Subtidal Mud
		
FLDO90	Sample depth in grab = 14 cm	A5.3 Subtidal Mud
		

7.7 Seabed Images

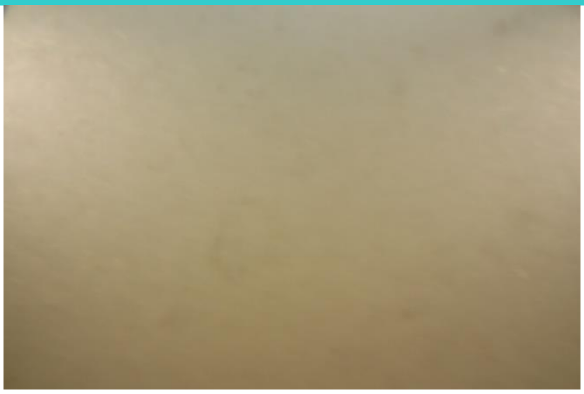
Video footage and digital photographs of the seabed were collected for broadscale habitat characterisation at ten stations within the Fylde MCZ targeting A5.3 subtidal mud and associated epifauna. Throughout the survey, the underwater visibility encountered was poor to very poor (see Annex 7.4 for the visibility assessment scale). Where possible, a preliminary field assessment of the sediment typology was carried out for each station using the method described in Section 2.2.

A representative selection of the survey images is presented below. Due to the poor visibility, no preliminary habitat data was available to map.

Table 6. A representative selection of seabed images captured during the Fylde MCZ habitat verification survey. The field notes include preliminary habitat descriptions and epifauna observations (laser points and rope divisions spaced 10 cm apart).

Station	Field Notes	Image
FLDO01	Very poor visibility	
FLDO08	Very poor visibility	

Station	Field Notes	Image
FLDO09	Very poor visibility	
FLDO10	Very poor visibility	
FLDO13	Very poor visibility	
FLDO18	Very poor visibility	

Station	Field Notes	Image
FLDO27	Very poor visibility	
FLDO63	Very poor visibility	
FLDO74	Very poor visibility	
FLDO90	Poor visibility	

7.8 Macrofauna Analysis Results

Station (FLDO_)	OSGB36 Easting	OSGB36 Northing	Taxa richness (S)	No. of individuals (abundance) (N)	Shannon Index (H' log^{e})	Simpson's Evenness (1-λ')	Hills N1 Index	Infaunal Quality Index (IQI)	EUNIS L3 Broadscale Habitat (derived from PSA)	Associated JNCC 04.06 Biotope (derived from community data)	Station Inside/Outside MCZ Boundary?
1	310872	436675	34	511	1.55	0.64	4.73	0.71	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
2	310470	439992	10	37	1.57	0.67	4.80	0.63	A5.2 Subtidal Sand	SS.SSA.CMuSa.AalbNuc	Inside
3	309854	437480	22	209	1.52	0.61	4.59	0.66	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
4	313094	436448	32	447	1.62	0.68	5.07	0.68	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
5	312861	434563	31	440	1.43	0.61	4.19	0.69	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
6	312789	438570	12	45	1.99	0.83	7.34	0.63	A5.2 Subtidal Sand	SS.SSA.CMuSa.AalbNuc	Inside
7	316323	436442	28	399	1.96	0.73	7.13	0.66	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
8	315305	434747	30	538	1.50	0.65	4.50	0.70	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
9	318652	435272	24	475	1.54	0.66	4.64	0.67	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
10	316326	433619	29	460	1.58	0.66	4.86	0.72	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
11	313328	432322	11	11	2.40	1.00	11.00	0.71	A5.2 Subtidal Sand	SS.SSA.IMuSa.EcorEns	Inside
12	315174	431976	6	7	1.75	0.95	5.74	0.68	A5.2 Subtidal Sand	SS.SSA.IMuSa.EcorEns	Inside
13	312632	430734	27	127	2.20	0.79	8.99	0.83	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
14	316995	432180	6	17	1.61	0.82	5.01	0.58	A5.2 Subtidal Sand	SS.SSA.CMuSa.AalbNuc	Inside
15	318895	434560	27	435	1.48	0.61	4.37	0.68	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
15b	318874	434575	23	563	1.30	0.59	3.69	0.66	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
16	318764	435740	25	505	1.63	0.67	5.11	0.69	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
17	320483	435289	23	487	1.36	0.58	3.90	0.69	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
18	322461	436055	20	129	2.33	0.84	10.27	0.70	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
22	321915	431576	11	30	2.01	0.84	7.45	0.62	A5.3 Subtidal Mud	SS.SSA.CMuSa.AalbNuc	Inside
25	325721	438247	14	154	1.24	0.51	3.47	0.53	A5.3 Subtidal Mud	SS.SMU.CSaMu.LkorPpel	Inside
26	326142	436230	23	187	2.16	0.79	8.65	0.72	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
27	325315	436166	23	121	2.48	0.88	11.93	0.73	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
31	325691	430342	13	36	1.92	0.79	6.80	0.63	A5.2 Subtidal Sand	SS.SSA.CMuSa.AalbNuc	Inside
33	319726	429520	11	30	1.72	0.71	5.59	0.71	A5.2 Subtidal Sand	SS.SSA.CMuSa.AalbNuc	Inside
34	316322	429172	20	123	2.37	0.88	10.65	0.79	A5.2 Subtidal Sand	SS.SMU.CSaMu.AfilMysAnit	Inside
35	316989	426458	6	13	1.41	0.72	4.10	0.73	A5.2 Subtidal Sand	SS.SSA.CMuSa.AalbNuc	Inside
36	315196	428536	37	357	2.20	0.78	8.99	0.74	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
37	319053	425737	31	464	1.95	0.77	7.02	0.73	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
38	320649	426954	13	35	2.00	0.80	7.38	0.70	A5.2 Subtidal Sand	SS.SSA.CMuSa.AalbNuc	Inside
39	324148	428821	9	13	2.03	0.91	7.63	0.67	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Inside
40	322733	425824	12	25	2.10	0.86	8.16	0.69	A5.2 Subtidal Sand	SS.SSA.CMuSa.AalbNuc	Inside
41	325595	425147	8	9	2.04	0.97	7.72	0.67	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Inside
42	320562	423778	27	202	2.06	0.73	7.87	0.72	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
43	317342	423820	13	28	2.15	0.87	8.61	0.76	A5.2 Subtidal Sand	SS.SSA.CMuSa.AalbNuc	Inside
44	318510	421945	11	11	2.40	1.00	11.00	0.71	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Inside
45	316247	422515	13	29	2.35	0.92	10.54	0.72	A5.2 Subtidal Sand	SS.SSA.CMuSa.AalbNuc	Inside
46	319807	422297	7	13	1.73	0.85	5.66	0.56	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Inside
47	321653	420948	8	19	1.68	0.77	5.39	0.69	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Inside
48	323201	421841	16	25	2.58	0.94	13.17	0.70	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Inside
49	325728	420628	6	17	1.38	0.72	3.98	0.53	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Inside
50	326140	422734	7	7	1.95	1.00	7.00	0.58	A5.2 Subtidal Sand	SS.SCS.ICS.SLan	Inside
51	324603	420193	4	4	1.39	1.00	4.00	0.50	A5.2 Subtidal Sand	SS.SCS.CCS.Blan/SS.SCS.ICS.MoeVen	Inside
52	323973	418765	4	6	1.33	0.87	3.78	0.65	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Inside
53	321369	418395	10	22	1.67	0.71	5.33	0.73	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Inside
54	320076	418622	7	15	1.84	0.89	6.31	0.67	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Inside
55	317494	419106	10	25	2.05	0.87	7.75	0.70	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Inside
56	315639	419742	13	18	2.43	0.95	11.34	0.73	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Inside
57	315868	418328	21	36	2.78	0.94	16.08	0.75	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Inside
58	313548	418796	27	86	2.78	0.91	16.10	0.74	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Inside
59	326288	418863	7	13	1.73	0.85	5.66	0.65	A5.2 Subtidal Sand	SS.SSA.IMuSa.FfabMag	Inside
60	315066	423729	24	61	2.71	0.92	15.03	0.78	A5.2 Subtidal Sand	SS.SSA.CMuSa.AalbNuc	Inside

61	308004	437621	28	513	1.48	0.61	4.41	0.69	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
62	310961	434090	8	10	2.03	0.96	7.58	0.76	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Outside
63	309084	435770	24	314	1.55	0.64	4.71	0.67	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
64	308454	433390	26	64	2.81	0.93	16.63	0.73	A5.3 Subtidal Mud	SS.SSA.CMuSa.AalbNuc	Outside
65	306615	435609	15	164	1.14	0.46	3.13	0.66	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
66	306272	433583	12	34	2.14	0.88	8.51	0.76	A5.2 Subtidal Sand	SS.SSA.CMuSa.AalbNuc	Outside
67	310325	432236	6	6	1.79	1.00	6.00	0.68	A5.2 Subtidal Sand	SS.SCS.CCS.Blan/SS.SCS.ICS.MoeVen	Outside
68	306065	437488	31	335	1.64	0.63	5.16	0.69	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
69	311162	435683	33	492	1.53	0.63	4.61	0.70	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
70	303686	436583	28	143	2.19	0.77	8.92	0.75	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
71	302995	430861	28	326	1.78	0.68	5.95	0.71	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
72	303209	434029	28	338	1.74	0.63	5.70	0.71	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
73	313362	428674	13	20	2.46	0.95	11.68	0.80	A5.2 Subtidal Sand	SS.SSA.CMuSa.AalbNuc	Outside
74	306962	431441	28	442	1.51	0.57	4.52	0.69	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
75	310197	429149	23	149	1.63	0.66	5.12	0.72	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
76	313072	423901	28	387	1.73	0.67	5.62	0.71	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
77	309535	425073	15	51	2.02	0.81	7.52	0.70	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
78	307185	424417	18	61	1.95	0.74	7.00	0.65	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
79	311462	419657	17	24	2.73	0.97	15.33	0.75	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Outside
80	311151	417568	33	387	1.67	0.68	5.33	0.71	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
81	313571	416424	12	25	2.08	0.84	7.97	0.76	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Outside
82	316528	417153	8	13	1.93	0.90	6.86	0.73	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Outside
83	313744	415113	11	22	2.18	0.90	8.82	0.70	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.ICS.MoeVen	Outside
84	304714	418658	9	23	1.81	0.80	6.11	0.80	A5.2 Subtidal Sand	SS.SCS.ICS.Glap/SS.SCS.CCS.Blan	Outside
85	305902	416589	21	37	2.92	0.97	18.59	0.76	A5.2 Subtidal Sand	SS.SCS.ICS.MoeVen	Outside
86	303440	421588	14	20	2.43	0.93	11.34	0.76	A5.2 Subtidal Sand	SS.SSA.CMuSa.AalbNuc	Outside
87	301853	425394	27	321	1.69	0.70	5.43	0.75	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
88	302942	428464	42	154	3.16	0.94	23.51	0.76	A5.4 Subtidal Mixed Sediment	SS.SMX.CMx.MysThyMx	Outside
89	300025	432177	31	275	1.56	0.57	4.74	0.70	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside
90	300189	435199	22	46	2.84	0.94	17.20	0.81	A5.3 Subtidal Mud	SS.SMU.CSaMu.AfilMysAnit	Outside

7.9 Sediment Particle Size Analysis (PSA) Results

Sample (FLDO_)	Water depth (m)	PSA grab OSGB36 Easting	PSA grab OSGB36 Northing	Mud/Silt (<63 µm) fraction	Very fine sand (63-125 µm)	Fine sand (125-250 µm)	Medium sand (250-500 µm)	Coarse sand (500-1000 µm)	Very coarse sand (1-2 mm)	Very fine gravel (2-4 mm)	Fine gravel (4-8 mm)	Medium gravel (>8 mm)	Folk Classification	EUNIS L3 Broadscale Habitat
1	22.41	310903	436667	61.49	24.60	9.70	3.20	0.58	0.05	0.05	0.08	0.27	Slightly Gravelly Sandy Mud	A5.3 Subtidal Mud
2	19.14	310471	439978	3.70	30.49	44.60	20.62	0.29	0.13	0.10	0.11	0.00	Slightly Gravelly Sand	A5.2 Subtidal Sand
3	21.54	309855	437484	39.67	38.10	20.87	1.35	0.00	0.00	0.00	0.00	0.00	Muddy Sand	A5.3 Subtidal Mud
4	19.72	313092	436428	37.88	39.10	20.84	2.06	0.17	0.00	0.00	0.00	0.00	Muddy Sand	A5.3 Subtidal Mud
5	20.30	312879	434555	34.54	5.52	36.70	23.20	0.00	0.00	0.00	0.00	0.00	Muddy Sand	A5.3 Subtidal Mud
6	15.30	312787	438584	5.21	48.80	44.40	0.79	0.00	0.29	0.24	0.24	0.00	Slightly Gravelly Sand	A5.2 Subtidal Sand
7	16.55	316333	436435	42.18	42.50	15.29	0.00	0.00	0.00	0.00	0.00	0.00	Muddy Sand	A5.3 Subtidal Mud
8	18.28	315296	434736	57.65	22.80	16.00	3.56	0.00	0.00	0.00	0.00	0.00	Sandy Mud	A5.3 Subtidal Mud
9	18.47	318656	435265	55.61	40.80	3.60	0.00	0.00	0.00	0.00	0.00	0.00	Sandy Mud	A5.3 Subtidal Mud
10	19.05	316322	433614	54.20	14.95	23.80	7.04	0.00	0.00	0.00	0.00	0.00	Sandy Mud	A5.3 Subtidal Mud
11	18.18	313331	432314	0.99	0.00	11.88	71.40	15.52	0.19	0.04	0.04	0.00	Sand	A5.2 Subtidal Sand
12	16.36	315159	431973	0.00	0.00	20.39	62.00	17.55	0.00	0.00	0.00	0.00	Sand	A5.2 Subtidal Sand
13	20.78	312644	430761	76.77	6.55	11.87	3.84	0.00	0.26	0.06	0.09	0.57	Sandy Mud	A5.3 Subtidal Mud
14	18.18	316999	432177	11.30	0.57	54.70	33.49	0.00	0.00	0.00	0.00	0.00	Muddy Sand	A5.2 Subtidal Sand
15	18.47	318876	434568	56.27	30.30	11.76	1.64	0.05	0.00	0.00	0.00	0.00	Sandy Mud	A5.3 Subtidal Mud
16	18.09	318747	435723	61.26	26.60	11.41	0.81	0.00	0.00	0.00	0.00	0.00	Sandy Mud	A5.3 Subtidal Mud
17	18.09	320484	435280	73.73	16.88	6.19	2.81	0.38	0.00	0.00	0.00	0.00	Sandy Mud	A5.3 Subtidal Mud
18	16.26	322448	436041	71.12	21.10	5.35	1.97	0.12	0.09	0.08	0.13	0.06	Slightly Gravelly Sandy Mud	A5.3 Subtidal Mud
22	16.26	321915	431566	33.79	39.00	24.20	2.48	0.30	0.14	0.09	0.05	0.00	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
25	14.63	325698	438235	39.44	24.90	28.10	7.21	0.01	0.06	0.08	0.06	0.08	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
26	15.21	326185	436227	57.23	31.50	8.16	2.35	0.06	0.09	0.11	0.17	0.33	Slightly Gravelly Sandy Mud	A5.3 Subtidal Mud
27	16.17	325335	436178	59.08	32.50	8.42	0.00	0.00	0.00	0.00	0.00	0.00	Sandy Mud	A5.3 Subtidal Mud
28	15.11	325636	434664	30.52	39.40	16.02	7.95	3.41	0.39	0.34	0.33	1.61	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
29	15.21	324991	432640	25.82	52.30	16.62	3.04	1.55	0.39	0.19	0.10	0.02	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
30	13.00	326506	431928	15.54	24.09	39.10	20.59	0.73	0.00	0.00	0.00	0.00	Muddy Sand	A5.2 Subtidal Sand
31	13.00	325685	430352	9.76	24.92	46.20	17.03	0.98	0.62	0.41	0.09	0.03	Slightly Gravelly Muddy Sand	A5.2 Subtidal Sand
32	15.30	322246	430461	26.89	31.60	34.90	6.65	0.00	0.00	0.00	0.00	0.00	Muddy Sand	A5.3 Subtidal Mud
33	15.98	319720	429527	2.12	0.01	41.15	56.73	0.00	0.00	0.00	0.00	0.00	Sand	A5.2 Subtidal Sand
34	19.05	316320	429188	18.38	2.57	9.71	41.60	27.08	0.17	0.13	0.17	0.14	Slightly Gravelly Muddy Sand	A5.2 Subtidal Sand
35	17.99	317005	426469	3.26	0.05	8.66	64.00	23.15	0.78	0.10	0.00	0.00	Slightly Gravelly Sand	A5.2 Subtidal Sand
36	19.75	315195	428538	38.15	5.48	28.10	24.60	2.12	0.54	0.50	0.34	0.15	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
37	16.65	319049	425730	38.42	9.18	18.95	24.50	7.43	0.67	0.34	0.27	0.24	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
38	15.50	320676	426960	0.82	1.95	39.30	48.40	7.82	0.80	0.58	0.26	0.10	Slightly Gravelly Sand	A5.2 Subtidal Sand
39	14.06	324152	428841	3.07	8.60	54.40	32.20	1.00	0.34	0.13	0.06	0.19	Slightly Gravelly Sand	A5.2 Subtidal Sand
40	14.25	322723	425820	10.49	3.03	46.50	37.80	1.40	0.34	0.17	0.19	0.09	Slightly Gravelly Muddy Sand	A5.2 Subtidal Sand
41	9.64	325587	425143	16.62	8.43	49.80	24.26	0.00	0.16	0.27	0.17	0.27	Slightly Gravelly Muddy Sand	A5.2 Subtidal Sand
42	15.88	320573	423776	38.12	10.86	25.80	20.45	4.35	0.16	0.10	0.08	0.08	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
43	18.38	317357	423820	6.45	0.46	15.63	62.50	14.10	0.40	0.23	0.15	0.06	Slightly Gravelly Sand	A5.2 Subtidal Sand
44	17.42	318520	421932	1.70	0.28	16.15	62.40	19.03	0.15	0.09	0.13	0.13	Slightly Gravelly Sand	A5.2 Subtidal Sand
45	18.86	316238	422516	3.83	0.45	10.69	60.10	24.20	0.35	0.18	0.14	0.07	Slightly Gravelly Sand	A5.2 Subtidal Sand
46	16.55	319802	422292	5.56	0.76	8.86	48.80	34.90	0.73	0.25	0.16	0.00	Slightly Gravelly Sand	A5.2 Subtidal Sand
47	14.54	321648	420939	12.33	2.86	8.15	44.80	28.56	1.74	1.07	0.39	0.14	Slightly Gravelly Muddy Sand	A5.2 Subtidal Sand
48	11.46	323217	421831	2.50	3.46	52.30	39.70	1.25	0.42	0.19	0.14	0.08	Slightly Gravelly Sand	A5.2 Subtidal Sand
49	8.30	325738	420634	4.70	9.74	55.70	28.34	0.20	0.32	0.33	0.18	0.43	Slightly Gravelly Sand	A5.2 Subtidal Sand
50	7.91	326157	422763	0.55	9.88	56.90	31.31	1.02	0.19	0.07	0.05	0.00	Slightly Gravelly Sand	A5.2 Subtidal Sand
51	9.64	324620	420184	19.62	4.96	38.70	34.70	1.12	0.27	0.14	0.04	0.45	Slightly Gravelly Muddy Sand	A5.2 Subtidal Sand
52	10.41	323971	418758	8.96	1.16	25.27	49.70	13.62	0.81	0.33	0.11	0.00	Slightly Gravelly Sand	A5.2 Subtidal Sand
53	14.06	321381	418404	0.59	0.69	29.41	56.90	12.05	0.19	0.09	0.01	0.00	Slightly Gravelly Sand	A5.2 Subtidal Sand
54	15.40	320075	418608	8.67	3.08	37.60	42.30	7.69	0.25	0.17	0.05	0.17	Slightly Gravelly Sand	A5.2 Subtidal Sand
55	17.22	317481	419111	7.96	0.57	33.10	51.80	5.28	0.48	0.21	0.12	0.40	Slightly Gravelly Sand	A5.2 Subtidal Sand

56	18.47	315645	419735	10.03	0.60	7.88	55.50	25.43	0.18	0.11	0.07	0.20	Slightly Gravelly Muddy Sand	A5.2 Subtidal Sand
57	17.90	315852	418346	5.47	0.07	25.92	60.80	7.37	0.21	0.12	0.04	0.00	Slightly Gravelly Sand	A5.2 Subtidal Sand
58	20.58	313529	418793	26.74	1.31	27.42	40.80	3.69	0.00	0.00	0.00	0.00	Muddy Sand	A5.3 Subtidal Mud
59	7.34	326289	418861	4.10	7.87	48.60	37.00	1.93	0.28	0.19	0.09	0.04	Slightly Gravelly Sand	A5.2 Subtidal Sand
60	19.91	315087	423706	8.17	0.64	18.75	57.60	13.71	0.39	0.29	0.32	0.13	Slightly Gravelly Sand	A5.2 Subtidal Sand
61	22.98	308028	437612	42.99	13.36	10.79	26.70	5.81	0.09	0.14	0.10	0.09	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
62	20.39	310942	434075	1.04	0.00	8.12	64.90	25.79	0.10	0.04	0.03	0.00	Sand	A5.2 Subtidal Sand
63	23.65	309104	435781	56.63	13.89	16.95	12.19	0.13	0.08	0.09	0.05	0.00	Slightly Gravelly Sandy Mud	A5.3 Subtidal Mud
64	22.98	308442	433420	43.48	3.15	17.10	32.40	3.50	0.21	0.07	0.02	0.19	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
65	25.67	306619	435591	48.84	14.67	12.70	18.25	3.99	0.22	0.18	0.16	1.00	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
66	21.93	306260	433583	0.86	0.00	16.82	70.00	12.02	0.13	0.04	0.02	0.00	Sand	A5.2 Subtidal Sand
67	20.49	310324	432238	5.08	0.66	7.44	58.10	28.45	0.13	0.06	0.04	0.00	Slightly Gravelly Sand	A5.2 Subtidal Sand
68	22.50	306040	437471	41.39	11.14	25.20	20.70	1.03	0.19	0.14	0.03	0.17	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
69	22.70	311135	435673	41.68	7.37	28.30	21.77	0.12	0.13	0.14	0.17	0.21	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
70	23.56	303682	436572	45.25	3.61	21.26	28.20	1.72	0.00	0.00	0.00	0.00	Muddy Sand	A5.3 Subtidal Mud
71	27.78	302989	430864	35.85	2.94	7.09	46.00	8.16	0.00	0.00	0.00	0.00	Muddy Sand	A5.3 Subtidal Mud
72	24.52	303219	434046	39.30	2.87	18.46	35.20	4.16	0.00	0.00	0.00	0.00	Muddy Sand	A5.3 Subtidal Mud
73	20.49	313348	428658	3.33	0.06	11.18	60.90	23.61	0.54	0.26	0.19	0.03	Slightly Gravelly Sand	A5.2 Subtidal Sand
74	22.5	307003	431442	32.45	0.89	18.78	44.50	3.33	0.00	0.00	0.00	0.00	Muddy Sand	A5.3 Subtidal Mud
75	23.56	310201	429147	47.71	7.37	12.23	22.50	10.12	0.00	0.00	0.00	0.00	Muddy Sand	A5.3 Subtidal Mud
76	21.54	313063	423893	37.74	6.72	17.34	30.10	7.45	0.22	0.17	0.20	0.04	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
77	26.63	309525	425064	43.82	21.39	26.00	7.37	1.38	0.00	0.00	0.00	0.00	Muddy Sand	A5.3 Subtidal Mud
78	28.84	307180	424433	43.57	16.04	27.60	10.99	1.77	0.00	0.00	0.00	0.00	Muddy Sand	A5.3 Subtidal Mud
79	23.27	311462	419649	3.46	1.00	5.41	48.00	37.20	3.30	0.99	0.30	0.36	Slightly Gravelly Sand	A5.2 Subtidal Sand
80	22.70	311146	417554	23.06	3.12	26.22	37.90	8.51	0.67	0.17	0.03	0.30	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
81	20.10	313588	416431	5.98	1.03	14.98	51.30	25.72	0.40	0.26	0.26	0.05	Slightly Gravelly Sand	A5.2 Subtidal Sand
82	17.32	316555	417154	9.23	1.63	17.47	47.60	23.06	0.58	0.20	0.13	0.08	Slightly Gravelly Sand	A5.2 Subtidal Sand
83	19.53	313728	415112	4.45	0.04	14.35	61.50	18.81	0.36	0.22	0.10	0.10	Slightly Gravelly Sand	A5.2 Subtidal Sand
84	25.67	304714	418652	0.00	0.00	5.04	46.00	47.50	1.05	0.34	0.08	0.00	Slightly Gravelly Sand	A5.2 Subtidal Sand
85	28.26	305901	416584	9.24	2.02	29.80	41.70	16.03	0.62	0.34	0.14	0.08	Slightly Gravelly Sand	A5.2 Subtidal Sand
86	31.05	303448	421589	15.57	4.26	25.70	34.30	18.24	1.09	0.56	0.12	0.11	Slightly Gravelly Muddy Sand	A5.2 Subtidal Sand
87	37.77	301836	425415	45.25	6.49	24.80	15.44	6.90	0.96	0.17	0.01	0.00	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
88	32.97	302927	428453	22.66	8.05	20.03	17.36	8.39	3.45	3.50	4.27	12.29	Gravelly Muddy Sand	A5.4 Subtidal Mixed Sediment
89	28.36	300032	432156	30.06	3.81	34.50	30.48	0.65	0.09	0.08	0.10	0.22	Slightly Gravelly Muddy Sand	A5.3 Subtidal Mud
90	33.45	300191	435204	59.83	19.43	18.31	2.42	0.00	0.00	0.00	0.00	0.00	Sandy Mud	A5.3 Subtidal Mud

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