

PLANNING ACT 2008
INFRASTRUCTURE PLANNING
(APPLICATIONS: PRESCRIBED FORMS AND PROCEDURE) REGULATIONS 2009
REGULATION 5 (2) (a)

PROPOSED PORT TERMINAL AT
FORMER TILBURY POWER STATION

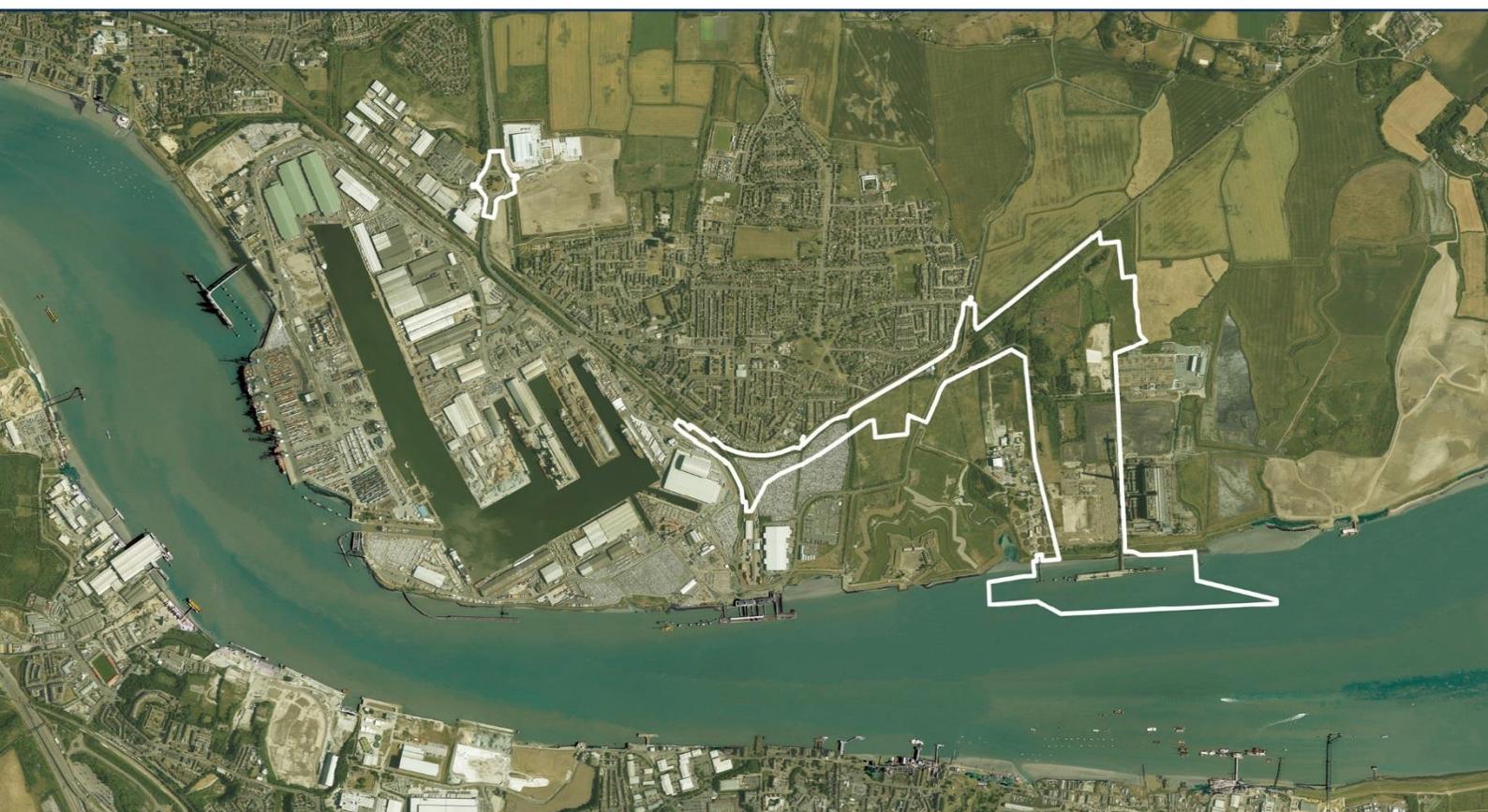
TILBURY2

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VOLUME 6 PART B

ES APPENDIX 11.B: TILBURY2 BENTHIC SURVEY REPORT

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TILBURY2



Tilbury Benthic Survey 2017 -
Results

For
Port of London Authority

Project No.: I-PLO-103

June 2017

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Summary

Thomson Unicomarine were commissioned by the Port of London Authority to undertake intertidal and subtidal sampling at the Tilbury2 site. Tilbury2 is proposed as a new port terminal on the north bank of the River Thames at Tilbury, Essex.

Intertidal and subtidal sampling was undertaken in June 2017. Particle Size Analysis and benthic fauna identification was carried out for each sample that was processed.

PSA results indicate that the intertidal and subtidal habitats are sandy mud and muddy sand, and are largely homogenous throughout the survey area.

Faunal identification showed the community in the area is composed of typical estuarine species that are characteristic of this area of the Thames Estuary.

Using the PSA and faunal identification results biotopes were assigned to the sample sites. The biotopes identified are, in the majority, similar to those identified in similar surveys undertaken in 2007 and 2008. Minor variations in biotopes are considered to be within the natural variation that would be expected within a dynamic estuarine area such as the Thames.

There were no protected or rare species, such as the tentacled lagoon worm (*Alkmaria romijni*) or the lagoon sea slug (*Tenellia adspersa*), identified in any of the samples.

1. Introduction

1.1 Development Background

- 1.1.1 The Port of Tilbury London Limited (PoTLL) is proposing a new port terminal on the north bank of the River Thames at Tilbury, a short distance to the east of the existing port. The proposed port terminal will be mainly built on previously developed land that formed the western part of the now redundant Tilbury Power Station. The proposed works will include:
- Improvements of, and extensions to, the existing jetty including the creation of a new Ro-Ro berth,
 - Dredging of berth pockets around the existing and extended jetty,
 - Dredging of the approach channel and
 - Removal of the Anglian Water jetty.
- 1.1.2 The proposed volumes of import/export of Ro-Ro units for the terminal exceed the threshold of 250,000 units per annum stated in the Planning Act 2008. This project (Tilbury2) therefore constitutes a Nationally Significant Infrastructure Project (NSIP) and will require a Development Consent Order (DCO). The DCO will be supported by an Environmental Statement and a Water Framework Directive Assessment.
- 1.1.3 Benthic surveys have previously been carried out at the site in 2007 and 2008.
- 1.1.4 It was identified at a meeting between the PoTLL, their consultants and the Environment Agency in March 2017 that a benthic survey should be undertaken to update and validate the data collected in 2007 and 2008.

1.2 The Brief and Objectives

- 1.1.5 Thomson Unicomarine (TU) were commissioned to carry out intertidal and subtidal benthic sampling at the Tilbury2 site. TU were also commissioned to carry out Particle Size Analysis (PSA) of the samples as well as detailed faunal identification of the samples. The results of the survey will inform the characterisation of the benthic environment at Tilbury2 through biotope classification
- 1.1.6 This report summarises the findings of the survey and sample analysis, describes the benthic environment through biotope classification, identifies the presence of any rare, protected or otherwise notable species or habitats present and identifies any potential impacts of the development.

2. Methodology

2.1 Survey methodology

- 2.1.1 Nine subtidal samples were collected by TU specialists on 1st June 2017 using a 0.1 m² Day grab. Sample locations 1, 4, 7, 8 and 9 replicate the sample locations from the 2007 and 2008 surveys (see Appendix 1, Figure 1). At each sampling location, one grab was taken for biological analysis and one for PSA.
- 2.1.2 The intertidal samples were collected on the 8th and 9th June 2017 by TU specialists (see Appendix 1, Figure 1). A 0.01m² corer was used to remove sediment. Samples were collected along four transects. On each transect sampling stations were located roughly in the upper, middle and lower shore which were established based on visual differences in the sediment. At each of these sampling stations three replicate 0.01 m² core sample were collected for biological analysis and one for PSA. In addition, single core samples were collected in between the top, middle and bottom sampling stations. At each of these stations a single 0.01 m² core sample was obtained for biological analysis and one for PSA.
- 2.1.3 All samples were visually inspected and observations of colour, smell, depth of RPD layer, texture and presence of surface features (accretions, algae, fauna, etc.) were recorded (see Table 1, Appendix 2).
- 2.1.4 Photographs were taken of the sediment for future reference.
- 2.1.5 Biological samples were washed over a 0.5 mm sieve, with all material retained on the sieve fixed in 10% formaldehyde. The location of all samples were recoded using GPS.

2.2 Laboratory methodology

- 2.2.1 Analysis of the grab samples was carried out using Thomson Unicomarine's standard operating procedures (Worsfold et al., 2010) which are in accordance with National Marine Biological Analytical Quality Control (NMBAQC) methodologies. All biological analysis was conducted at TU's Guildford Marine Sciences Laboratory by TU staff.
- 2.2.2 After several days in fixative, the biological samples were re-sieved at 0.5 mm and the biota extracted using low power stereo microscopes. In-house quality control procedures were carried out, to reduce the risk of biota being missed.
- 2.2.3 The extracted biota were preserved in 70% Industrial Denatured Alcohol (IDA). Animals removed from the samples were identified to the lowest taxonomic level possible (usually species) and individuals counted. Non-countable animals, such as colonial species, were

recorded as present “P”. High power compound microscopes were used to confirm the identity of some taxa.

- 2.2.4 Particle size analysis was carried out using graded sieves and laser diffraction following procedures laid out in the NMBAQC Scheme’s best practice guidelines (Mason, 2011) and Thomson Unicomarine’s PSA standard operating procedures (Finbow & Argent, 2012).
- 2.2.5 Any unanalysed replicate samples have been appropriately stored.

3. Results

3.1 Photographs

- 3.1.1 Photographs were taken of each sample and can be found in Appendix 2 along with a visual description of the sample, any distinctive odours, depth of the redox potential discontinuity (RPD) layer, texture and presence of surface features.
- 3.1.2 Subtidal samples 1 to 5 had no odour and either no RPD layer or a 5 cm RPD layer. Subtidal samples 6 to 9 did have an organic detritus smell and a larger RPD layer, up to 10 cm. These samples were made up of looser silt particles than 1 to 5 which were a muddy clay.
- 3.1.3 All intertidal samples were visually identified as of a mud/clay composition. Sample 16 was the only sample that did not have an organic detritus smell. It had a large RPD layer of 10 cm. All other samples had an organic detritus smell and had a small RPD layer of 1 cm.

3.2 Benthic fauna

- 3.2.1 A total of 29 species of benthic invertebrate were identified in the intertidal samples with from a maximum of 17 to as little as 1 species recorded in each sample (Appendix 3, Table 2). The abundance varied from between 50 and 26,000 individuals per 0.5 m². In each transect the highest number of individuals was found in the sample from the upper intertidal, and the lowest number of individuals was found in the lower- or sub-intertidal samples.
- 3.2.2 A total of 47 species were found in samples taken from the subtidal sites (Appendix 3, Table 3). Samples were more diverse than the intertidal samples with from 12 to 23 species identified in each sample. However, individuals within the subtidal samples were less abundant than in the intertidal samples, ranging from 1,675 to 8,370 individuals per 0.5 m².

- 3.2.3 The polychaete *Polydora* is dominant in all subtidal samples, except sample 9 where the oligochaete *Tubificoides* is dominant. All subtidal samples are characterised by high numbers of *Tubificoides* and the amphipod *Corophium*.
- 3.2.4 The intertidal samples are also dominated by the presence of *Tubificoides* and the numbers of *Corophium* increase in the seaward transect samples.
- 3.2.5 Both the intertidal and subtidal communities are characteristic and typical of the natural estuarine conditions within the Thames.
- 3.2.6 No protected, rare or otherwise notable species, such as the tentacled lagoon worm (*Alkmaria romijni*) or the lagoon sea slug (*Tenellia adspersa*) were identified in any of the samples.

3.3 PSA

- 3.3.1 PSA results are presented in Appendices 4 (Tables 4-7 - size and class stats) and 5 (Tables 8-10 - Wentworth Scale).
- 3.3.2 The sample from subtidal station 3 contained some larger gravel particles and was defined as 'gravelly sand'.
- 3.3.3 All other samples collected from the intertidal and subtidal sites were found to be a variation of muddy sand or sandy mud indicating that there is a high level of homogeneity in the sediment composition in the area. These findings are typical of the sediment composition of this stretch of the Thames.

3.4 Biotopes

- 3.4.1 From the PSA and faunal identification results biotopes were assigned, where possible, to each sample location. These are presented in Appendix 6, Tables 11 and 12. A map of the biotopes is presented in Appendix 1, Figure 2.
- 3.4.2 The biotope SS.SMu.SMuVS.PoICvol was assigned to all samples taken from the subtidal zone. The dominant *Polydora cornuta* species found in the majority of subtidal samples is very similar to *Polydora ciliata*, and as such this biotope has been selected accordingly.
- 3.4.3 This biotope was also identified within the 2007 and 2008 surveys in the majority of subtidal samples.
- 3.4.4 15 of the intertidal samples were assigned a biotope. The five samples where a biotope could not be assigned had too few species to confidently attribute the sample to a biotope.

3.4.5 Four different biotopes were identified in the remaining intertidal samples and are all variations of oligochaete dominated intertidal sediment habitats:

- LS.LMu.MEst.HedMac
- LS.LMu.MEst.HedMacScr
- LS.LMu.UEst.Hed.OI
- LS.LMu.UEst.Hed.Str

3.4.6 The 2007 and 2008 surveys identified only one intertidal biotope in the project area, LS.LMu.MEst.HedMacScr. The Hed.Mac biotope, and the variation Hed.MacScr, is the most abundant biotope found in the 2017 intertidal survey with 15 of the 20 samples characterised within this biotope group.

3.4.7 Although there has been a slight change in biotope composition in the project area since the 2007 and 2008 surveys, the change in biotopes does not represent material changes in the habitat or species present in the area. This is typical of estuarine habitats which are stable and homogenous in character.

4. Discussion

- 4.1.1 The results from the survey carried out at the Tilbury2 site indicate that the habitat and species composition has not significantly changed since the last surveys carried out in 2007 and 2008. Small changes in the biotope classification in the intertidal and subtidal zones are considered to be within the natural variation expected in estuarine areas.
- 4.1.2 No protected or rare species such as the tentacled lagoon worm (*A. romijni*) or the lagoon sea slug (*T. adspersa*) were identified in any of the samples.
- 4.1.3 The communities and habitats identified are considered typical for the dynamic estuarine conditions within this area of the Thames.

5. References

Finbow, L. and Argent, J. (2012) Thomson Unicomarine standard operating procedure for the processing of particle size samples Version 2.0: Thomson Unicomarine, February 2012.

Mason, C. (2011) NMBAQC's Best Practice Guidance, Particle Size Analysis (PSA) for Supporting Biological Analysis. National Marine Biological AQC Coordinating Committee, 2011.

Worsfold, T.M., Hall, D.J. & Ashelby, C.W., 2010. Unicomarine Procedural Guidelines and Quality Control Systems Version 5.0. Unicomarine, March 2010.

Appendix 1 - Mapping



Figure 1: Map of sampling locations

**Figure 2: Map of biotopes**

Appendix 2 - Sample photographs

Table 1: Sample photographs and visual description

Sample Number	Description	Photo
S1	Brown, no smell, no RPD layer, thick muddy clay	
S1 PSA	Brown, no smell, no RPD layer, thick muddy clay	
S2	Brown and yellow, no smell, no RPD layer, muddy clay, leaf litter	

S2 PSA	Brown and yellow, no smell, no RPD layer, muddy clay, leaf litter	
S3	Brown, no smell, 5 cm RPD layer, muddy silty clay, leaf litter	
S3 PSA	Brown, no smell, 5 cm RPD layer, muddy silty clay, leaf litter	

S4	Brown, no smell, no RPD layer, silty clay, leaf litter	
S4 PSA	Brown, no smell, no RPD layer, silty clay, leaf litter	
S5	Brown, no smell, 5 cm RPD layer, clay, leaf litter	

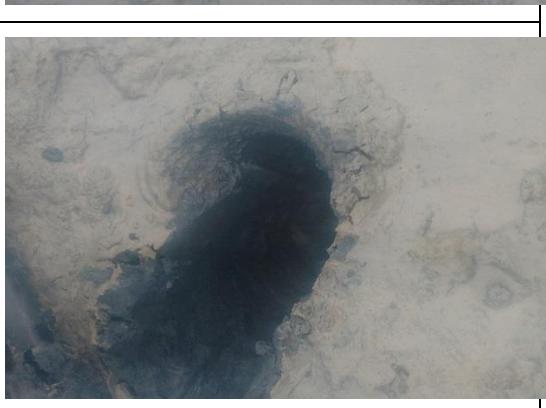
S5 PSA	Brown, no smell, 5 cm RPD layer, clay, leaf litter	
S6	Black/blue, organic detritus smell, 10 cm RPD layer, fluid silt, leaf litter	
S6 PSA	Black/blue, organic detritus smell, 10 cm RPD layer, fluid silt, leaf litter	

S7	Black/blue, organic detritus smell, 10 cm RPD layer, fluid silt	
S7 PSA	Black/blue, organic detritus smell, 10 cm RPD layer, fluid silt	
S8	Yellow, organic detritus smell, 5 cm RPD layer, clay/silt	

S8 PSA	Yellow, organic detritus smell, 5 cm RPD layer, clay/silt	
S9	Black/blue, organic detritus smell, 15 cm RPD layer, fluid silt	
S9 PSA	Black/blue, organic detritus smell, 15 cm RPD layer, fluid silt	

1 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
1 b	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
1 c	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

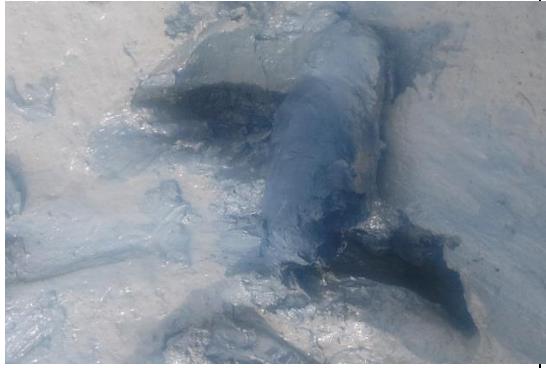
1 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
2 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
2 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

3 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
3 b	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
3 c	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
3 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

4 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
4 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
5 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
5 b	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

5 c	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
5 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
6 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

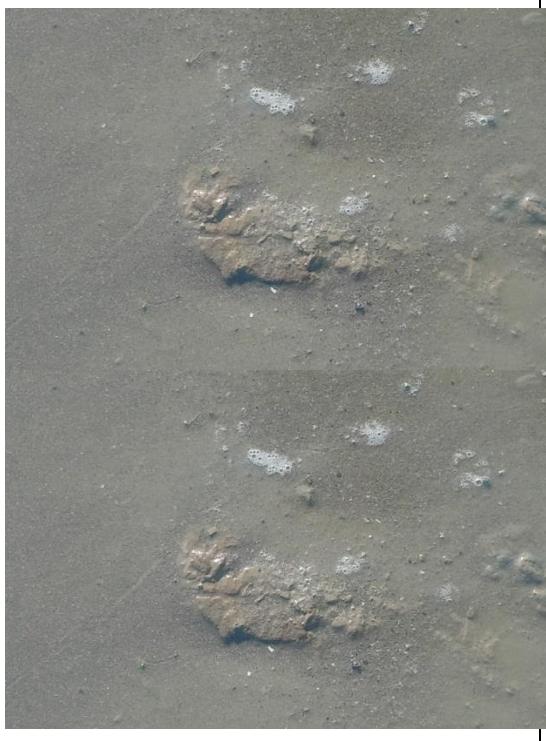
6 b	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
6 c	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
6 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

7 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
7 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
8 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

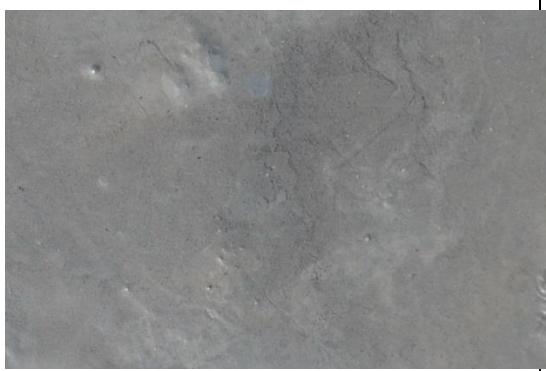
8 b	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
8 c	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
8 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

9 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
9 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
10 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

10 b	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
10 c	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
10 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

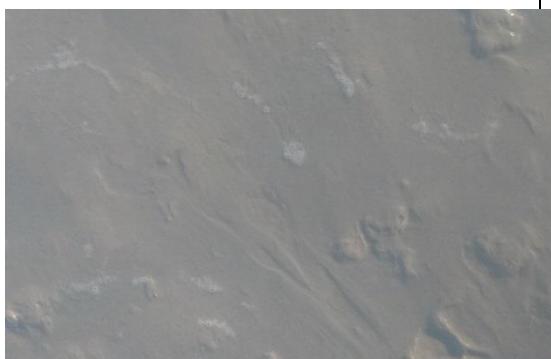
11 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
11 b	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
11 c	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

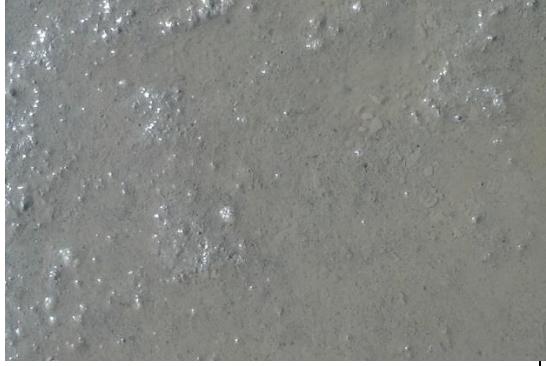
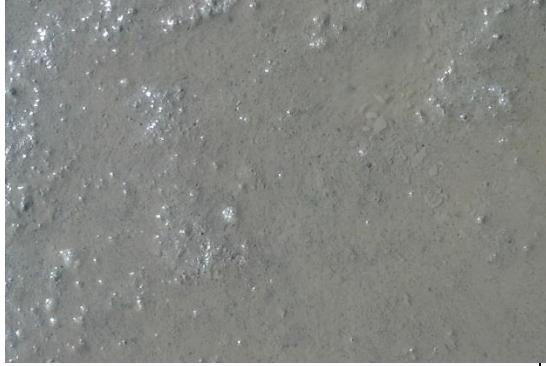
11 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
12 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
12 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
13 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

13 b	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
13 c	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
13 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
14 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

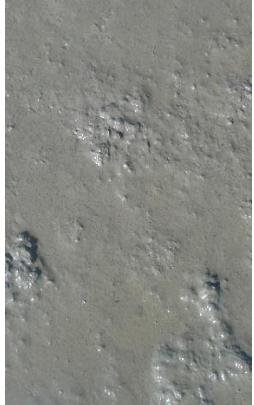
14 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
15 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
15 b	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

15 c	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
15 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
16 a	Black/blue, 10 cm RPD layer, mud/clay	
16 b	Black/blue, 10 cm RPD layer, mud/clay	

16 c	Black/blue, 10 cm RPD layer, mud/clay	
16 PSA	Black/blue, 10 cm RPD layer, mud/clay	
17 a	Black/blue, organic detritus smell, 1 cm RPD layer, fine mud/clay	
17 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, fine mud/clay	

18 a	Black/blue, organic detritus smell, 1 cm RPD layer, fine mud/clay	
18 b	Black/blue, organic detritus smell, 1 cm RPD layer, fine mud/clay	
18 c	Black/blue, organic detritus smell, 1 cm RPD layer, fine mud/clay	

18 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, fine mud/clay	
19 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
19 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

20 a	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
20 b	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
20 c	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	
20 PSA	Black/blue, organic detritus smell, 1 cm RPD layer, mud/clay	

Appendix 3 - Species abundance matrices

Table 2: Intertidal benthic invertebrate identification - raw results matrix

Tilbury Benthic Survey 2017		Samples																			
SDC	Taxon Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
D0491	Campanulariidae	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
HD0001	NEMATODA	-	-	-	8	12	2	1	5	3	32	-	-	14	25	7	-	26	1	4	49
K0001	ENTOPROCTA	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P0116	Eteone	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-
P0116	Eteone sp. A	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
P0118	Eteone cf. longa	-	-	1	3	-	-	-	-	-	3	-	1	-	4	2	-	9	10	4	-
P0458	Nereididae (juv.)	-	-	-	-	-	-	1	-	1	3	-	-	1	-	5	-	1	-	1	1
P0462	Hediste diversicolor	-	-	-	-	1	-	-	-	-	6	-	-	-	1	3	-	2	4	4	7
P0494	Nephtys	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-
P0776	Pygospio elegans	-	-	1	3	-	-	-	2	1	3	-	1	-	1	-	-	-	1	-	-
P0797	Streblospio	-	-	-	3	12	-	3	-	1	8	-	-	-	-	6	-	1	2	-	4
P0822	Cirratulidae	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
P0845	Tharyx	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	1
P0845	Tharyx robustus	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-
P0846	Tharyx killariensis	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	1	-	-
P0917	Heteromastus filiformis	-	-	-	-	1	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
P0928	Arenicolidae (juv.)	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1293	Manayunkia	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	3	-	1	8
	Baltidrilus costatus	-	-	-	8	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	2
P1490	Tubificoides benedii	-	-	81	133	127	1	15	9	51	126	1	5	11	11	104	3	126	18	42	59
P1498	Tubificoides pseudogaster (agg.)	-	-	-	-	7	-	-	-	-	18	-	-	-	-	9	-	3	4	-	2
R2432	Eusarsiella zostericola	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
S0097	AMPHIPODA	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
S0616	Corophium volutator	1	1	12	29	14	1	16	43	83	2	-	9	2	9	5	-	342	251	97	118

W0385	Peringia ulvae	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	
W1560	BIVALVIA	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	
W2029	Macoma balthica	-	-	-	3	5	-	1	-	2	-	1	-	3	-	-	-	1	2	11	17
W2068	<i>Scrobicularia plana</i>	-	-	-	-	2	-	-	3	1	3	-	-	-	1	-	-	2	2	4	3
W2068	<i>Scrobicularia plana</i> (juv.)	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	

Table 3: Subtidal benthic invertebrate identification - raw results matrix

Tilbury Benthic Survey 2017		Samples								
SDC	Taxon Name	S1	S2	S3	S4	S5	S6	S7	S8	S9
D0491	Campanulariidae	-	-	P	-	-	-	-	-	-
G0001	NEMERTEA	3	-	-	-	1	-	-	1	-
HD0001	NEMATODA	-	1	9	-	2	-	1	-	1
K0001	ENTOPROCTA	-	-	-	-	P	-	-	-	-
K0050	Barentsia	P	-	-	-	-	-	-	-	-
P0091	Pholoe	-	-	-	-	-	-	-	1	-
P0094	Pholoe inornata	3	-	4	-	-	-	-	-	-
P0116	Eteone	6	-	-	4	25	9	-	10	1
P0116	Eteone (Type 1)	5	-	-	-	1	-	-	1	-
P0118	Eteone cf. longa	3	5	33	-	5	1	8	1	-
P0178	Phyllodoce	3	1	2	6	6	2	1	7	-
P0458	Nereididae (juv.)	15	7	11	17	7	1	-	1	-
P0462	Hediste diversicolor	19	41	27	38	14	5	2	1	-
P0494	Nephtys	7	-	-	1	17	24	11	2	1
P0499	Nephtys hombergii	-	-	-	-	-	-	2	-	-
P0720	Spionidae	-	-	-	-	-	3	-	-	-
P0753	Polydora cornuta	827	966	361	863	244	41	59	205	-
P0776	Pygospio elegans	17	1	18	5	15	3	17	21	4
P0797	Streblospio	2	1	3	1	-	-	2	5	1
P0822	Cirratulidae	-	-	9	-	3	9	5	1	2

P0906	Capitella	-	-	-	-	-	1	-	-	-
P0917	Heteromastus filiformis	-	-	1	-	5	6	1	-	1
P0928	Arenicolidae (juv.)	4	-	2	-	-	-	-	-	-
P1139	Ampharete lindstroemi (agg.)	-	-	-	-	1	-	1	-	-
P1179	Terebellidae	1	-	-	-	-	-	-	-	-
P1479	Heterochaeta costata	-	-	-	1	-	-	-	-	-
P1490	Tubificoides benedii	1	7	64	18	25	38	49	29	119
P1498	Tubificoides pseudogaster (agg.)	-	-	2	1	2	1	1	1	2
P1501	Enchytraeidae	-	-	-	-	1	-	-	-	-
R0077	Balanus crenatus	-	32	-	-	5	-	-	-	-
R2432	Eusarsiella zostericola	20	-	5	-	1	3	4	-	1
S0452	Bathyporeia elegans	-	-	-	-	-	-	-	-	1
S0605	Corophium	-	-	1	-	-	-	-	-	-
S0616	Corophium volutator	719	342	576	573	1149	337	262	1385	201
S0805	Cyathura carinata	1	-	-	-	1	-	-	-	-
S1276	DECAPODA (megalopa)	-	1	-	-	-	-	-	-	-
S1584	Liocarcinus pusillus	-	1	-	-	-	-	-	-	-
	DIPTERA	-	1	-	-	-	-	-	-	-
	Chironomidae (larva)	-	1	-	-	-	-	-	-	-
W1560	BIVALVIA	-	-	-	1	-	-	-	-	-
W1691	Mytilidae (juv.)	2	1	2	-	1	-	-	-	-
W2029	Macoma balthica	1	-	1	-	-	5	-	-	-
W2068	Scrobicularia plana (juv.)	-	-	-	-	-	-	-	1	-
W2086	Veneridae (juv.)	4	-	-	-	1	-	-	-	-
Y0176	Einhornia crustulenta	P	P	P	-	P	-	-	-	-
Y0222	Amphiblestrum auritum	-	-	-	-	P	-	-	-	-

Appendix 4 - PSA Results

Table 4: PSA results matrix for subtidal samples

			Sample								
Sediment	mm	phi f	S1	S2	S3	S4	S5	S6	S7	S8	S9
V. coarse gravel	>32<64	<-5>-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse gravel	>16<32	<-4>-5	0.00	0.00	1.79	0.00	0.00	0.00	0.00	0.00	0.00
Medium gravel	>8<16	<-3>-4	0.00	0.00	7.39	0.00	0.00	0.00	0.00	0.00	0.00
Fine gravel	>4<8	<-2>-3	0.00	0.00	4.45	0.00	0.00	0.00	0.00	0.00	0.00
V. fine gravel	>2<4	<-1>-2	0.00	0.00	1.87	0.00	0.00	0.00	0.00	0.00	0.00
V. coarse sand	>1<2	<0>-1	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00	0.00
Coarse sand	>0.5<1	<1>0	0.00	6.60	3.13	9.21	0.25	3.25	1.08	2.42	1.47
Medium sand	>0.25<0.5	<2>1	3.51	8.73	8.41	10.39	3.42	10.44	7.16	6.94	5.84
Fine sand	>0.125<0.25	<3>2	11.66	7.59	16.89	10.52	10.04	25.56	33.60	14.04	10.34
V. fine sand	>0.0625<0.125	<4>3	13.50	6.35	11.40	6.76	21.55	16.76	24.30	13.26	10.13
V. coarse silt	>0.03125<0.0625	<5>4	16.71	9.31	7.72	9.49	18.02	8.68	5.92	12.50	13.24
Coarse silt	>0.015625<0.03125	<6>5	21.60	15.06	10.92	13.56	13.37	12.16	8.80	16.78	19.76
Medium silt	>0.007813<0.015625	<7>6	17.96	17.75	11.50	14.81	12.84	11.69	9.26	16.86	20.64
Fine silt	>0.003906<0.007813	<8>7	9.25	14.74	7.97	12.65	10.32	6.89	5.79	10.30	11.69
V. fine silt	>0.001953<0.003906	<5>5	3.63	8.78	3.79	7.85	6.21	2.83	2.50	4.37	4.30
Clay	<0.001953	>9	2.19	5.09	2.15	4.75	3.98	1.73	1.59	2.52	2.58
Statistics	Mean (phi)		5.07	5.23	3.29	4.88	5.10	4.05	3.94	4.88	5.17
	Sorting		1.89	2.68	3.54	2.78	2.08	2.13	1.94	2.20	2.10
	Skewness		-0.07	-0.25	-0.10	-0.16	0.21	0.35	0.51	-0.08	-0.18
	Kurtosis		0.92	0.86	1.11	0.75	0.87	0.80	0.88	0.83	0.93
	% Silt/Clay		71.34	70.73	44.04	63.12	64.74	43.98	33.87	63.34	72.21
	Textural Group*		Sandy Mud	Sandy Mud	Gravelly Mud	Sandy Mud	Sandy Mud	Muddy Sand	Muddy Sand	Sandy Mud	Sandy Mud

Table 5: PSA results matrix for intertidal samples 1-6

Sediment	mm	phi f	Samples					
			1	2	3	4	5	6
V. coarse gravel	>32<64	<-5>-6	0.00	0.00	0.00	0.00	0.00	0.00
Coarse gravel	>16<32	<-4>-5	0.00	0.00	0.00	0.00	0.00	0.00
Medium gravel	>8<16	<-3>-4	0.00	0.00	0.00	0.00	0.00	0.00
Fine gravel	>4<8	<-2>-3	0.00	0.00	0.00	0.00	0.00	0.00
V. fine gravel	>2<4	<-1>-2	0.00	0.00	0.00	0.00	0.00	0.00
V. coarse sand	>1<2	<0>-1	0.00	0.00	0.00	0.00	0.00	0.00
Coarse sand	>0.5<1	<1>0	0.77	2.52	1.64	1.52	1.13	2.38
Medium sand	>0.25<0.5	<2>1	11.27	6.62	5.35	4.88	3.10	8.32
Fine sand	>0.125<0.25	<3>2	36.84	24.27	28.20	28.73	11.16	19.62
V. fine sand	>0.0625<0.125	<4>3	19.04	22.54	25.80	26.40	14.97	14.72
V. coarse silt	>0.03125<0.0625	<5>4	6.13	9.49	8.37	7.72	12.08	10.74
Coarse silt	>0.015625<0.03125	<6>5	9.46	11.17	8.95	9.35	17.18	14.83
Medium silt	>0.007813<0.015625	<7>6	8.14	11.15	9.42	9.72	19.66	14.98
Fine silt	>0.003906<0.007813	<8>7	4.82	7.01	6.71	6.50	12.71	8.88
V. fine silt	>0.001953<0.003906	<5>5	2.16	3.24	3.45	3.23	5.28	3.56
Clay	<0.001953	>9	1.39	1.97	2.10	1.95	2.73	1.96
<hr/>								
Statistics	Mean (phi)		3.73	4.21	4.14	4.12	5.28	4.55
	Sorting		1.90	2.07	2.02	1.98	2.03	2.16
	Skewness		0.53	0.37	0.48	0.49	-0.11	0.06
	Kurtosis		0.90	0.84	0.88	0.86	0.82	0.77
	% Silt/Clay		32.09	44.04	39.00	38.47	69.65	54.96
	Textural Group*		<i>Muddy Sand</i>	<i>Muddy Sand</i>	<i>Muddy Sand</i>	<i>Muddy Sand</i>	<i>Sandy Mud</i>	<i>Sandy Mud</i>

Table 6: PSA results matrix for intertidal samples 7-13

Sediment	mm	phi f	Samples						
			7	8	9	10	11	12	13
V. coarse gravel	>32<64	<-5>-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse gravel	>16<32	<-4>-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium gravel	>8<16	<-3>-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine gravel	>4<8	<-2>-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V. fine gravel	>2<4	<-1>-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V. coarse sand	>1<2	<0>-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse sand	>0.5<1	<1>0	0.00	0.04	0.00	2.94	0.97	1.54	1.29
Medium sand	>0.25<0.5	<2>1	2.60	2.59	3.74	8.84	10.19	7.56	6.86
Fine sand	>0.125<0.25	<3>2	22.60	10.69	19.11	22.89	39.70	39.34	31.64
V. fine sand	>0.0625<0.125	<4>3	24.16	15.47	21.48	18.50	22.51	28.08	24.44
V. coarse silt	>0.03125<0.0625	<5>4	10.46	15.37	12.55	9.56	4.02	4.04	6.83
Coarse silt	>0.015625<0.03125	<6>5	12.95	19.21	14.26	12.81	7.55	5.93	8.51
Medium silt	>0.007813<0.015625	<7>6	12.69	17.99	13.69	12.10	7.00	5.88	8.84
Fine silt	>0.003906<0.007813	<8>7	8.14	11.00	8.60	7.20	4.53	4.09	6.31
V. fine silt	>0.001953<0.003906	<5>5	4.06	4.91	4.12	3.22	2.20	2.16	3.25
Clay	<0.001953	>9	2.34	2.73	2.47	1.93	1.33	1.36	2.03
Statistics	Mean (phi)		4.53	5.23	4.69	4.21	3.66	3.62	4.02
	Sorting		1.99	1.94	2.01	2.14	1.85	1.75	2.01
	Skewness		0.36	-0.03	0.21	0.28	0.55	0.52	0.50
	Kurtosis		0.80	0.88	0.80	0.82	1.19	1.67	0.89
	% Silt/Clay		50.63	71.22	55.67	46.83	26.63	23.47	35.77
	Textural Group*		Sandy Mud	Sandy Mud	Sandy Mud	Muddy Sand	Muddy Sand	Muddy Sand	Muddy Sand

Table 7: PSA results matrix for intertidal samples 14-20

Sediment	mm	phi f	Samples						
			14	15	16	17	18	19	20
V. coarse gravel	>32<64	<-5>-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse gravel	>16<32	<-4>-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium gravel	>8<16	<-3>-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine gravel	>4<8	<-2>-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V. fine gravel	>2<4	<-1>-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V. coarse sand	>1<2	<0>-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse sand	>0.5<1	<1>0	1.53	2.77	1.04	1.07	0.77	1.56	6.35
Medium sand	>0.25<0.5	<2>1	4.29	4.38	10.35	6.19	4.29	4.61	7.24
Fine sand	>0.125<0.25	<3>2	25.31	10.29	36.78	29.28	29.98	20.30	12.85
V. fine sand	>0.0625<0.125	<4>3	24.54	14.38	20.77	22.06	25.18	23.59	15.81
V. coarse silt	>0.03125<0.0625	<5>4	8.81	14.41	4.12	6.62	6.69	10.98	10.47
Coarse silt	>0.015625<0.03125	<6>5	11.08	19.65	7.60	10.19	9.34	11.77	13.80
Medium silt	>0.007813<0.015625	<7>6	11.24	18.19	8.44	10.90	10.54	12.55	15.70
Fine silt	>0.003906<0.007813	<8>7	7.35	10.00	6.10	7.59	7.57	8.30	10.53
V. fine silt	>0.001953<0.003906	<5>5	3.67	3.90	2.96	3.79	3.60	3.91	4.60
Clay	<0.001953	>9	2.17	2.02	1.84	2.32	2.05	2.43	2.65
Statistics			4.30	5.03	3.86	4.19	4.20	4.48	4.70
	Mean (phi)		2.02	2.04	2.03	2.09	2.01	2.06	2.37
	Sorting		0.43	-0.12	0.55	0.49	0.53	0.33	-0.03
	Skewness		0.82	0.92	0.90	0.80	0.80	0.82	0.85
	Kurtosis		44.32	68.18	31.06	41.40	39.79	49.94	57.76
	Textural Group*		<i>Muddy Sand</i>	<i>Sandy Mud</i>	<i>Muddy Sand</i>	<i>Muddy Sand</i>	<i>Muddy Sand</i>	<i>Muddy Sand</i>	<i>Sandy Mud</i>

Appendix 5 - PSA Wentworth Scale

Table 8: Subtidal samples

Station Code	S1	S2	S3	S4	S5	S6	S7	S8	S9
Pebble	0.00	0.00	13.63	0.00	0.00	0.00	0.00	0.00	0.00
Granule	0.00	0.00	1.87	0.00	0.00	0.00	0.00	0.00	0.00
V. coarse sand	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00	0.00
Coarse sand	0.00	6.60	3.13	9.21	0.25	3.25	1.08	2.42	1.47
Medium sand	3.51	8.73	8.41	10.39	3.42	10.44	7.16	6.94	5.84
Fine sand	11.66	7.59	16.89	10.52	10.04	25.56	33.60	14.04	10.34
V. fine sand	13.50	6.35	11.40	6.76	21.55	16.76	24.30	13.26	10.13
Silt Clay	71.34	70.73	44.04	63.12	64.74	43.98	33.87	63.34	72.21
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 9: Intertidal samples 1-10

Station Code	1	2	3	4	5	6	7	8	9	10
Pebble	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Granule	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V. coarse sand	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse sand	0.77	2.52	1.64	1.52	1.13	2.38	0.00	0.04	0.00	2.94
Medium sand	11.27	6.62	5.35	4.88	3.10	8.32	2.60	2.59	3.74	8.84
Fine sand	36.84	24.27	28.20	28.73	11.16	19.62	22.60	10.69	19.11	22.89
V. fine sand	19.04	22.54	25.80	26.40	14.97	14.72	24.16	15.47	21.48	18.50
Silt Clay	32.09	44.04	39.00	38.47	69.65	54.96	50.63	71.22	55.67	46.83
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 10: Intertidal samples 11-20

Station Code	11	12	13	14	15	16	17	18	19	20
Pebble	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Granule	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V. coarse sand	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse sand	0.97	1.54	1.29	1.53	2.77	1.04	1.07	0.77	1.56	6.35
Medium sand	10.19	7.56	6.86	4.29	4.38	10.35	6.19	4.29	4.61	7.24
Fine sand	39.70	39.34	31.64	25.31	10.29	36.78	29.28	29.98	20.30	12.85
V. fine sand	22.51	28.08	24.44	24.54	14.38	20.77	22.06	25.18	23.59	15.81
Silt Clay	26.63	23.47	35.77	44.32	68.18	31.06	41.40	39.79	49.94	57.76
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Appendix 6 - Biotope classification

Table 11: Intertidal biotopes

Sample	Biotope code	Biotope description
1 a	Not enough data	-
2 a	Not enough data	-
3 a	LS.LMu.MEst.HedMac	<i>Hediste diversicolor</i> and <i>Macoma balthica</i> in littoral sandy mud
4 a	LS.LMu.MEst.HedMac	<i>Hediste diversicolor</i> and <i>Macoma balthica</i> in littoral sandy mud
5 a	LS.LMu.MEst.HedMacScr	<i>Hediste diversicolor</i> , <i>Macoma balthica</i> and <i>Scrobicularia plana</i> in littoral sandy mud
6 a	Not enough data	-
7 a	LS.LMu.MEst.HedMacScr	<i>Hediste diversicolor</i> , <i>Macoma balthica</i> and <i>Scrobicularia plana</i> in littoral sandy mud
8 a	LS.LMu.MEst.HedMacScr	<i>Hediste diversicolor</i> , <i>Macoma balthica</i> and <i>Scrobicularia plana</i> in littoral sandy mud
9 a	LS.LMu.MEst.HedMacScr	<i>Hediste diversicolor</i> , <i>Macoma balthica</i> and <i>Scrobicularia plana</i> in littoral sandy mud
10 a	LS.LMu.MEst.HedMacScr	<i>Hediste diversicolor</i> , <i>Macoma balthica</i> and <i>Scrobicularia plana</i> in littoral sandy mud
11 a	Not enough data	-
12 a	LS.LMu.UEst.Hed.Ol	<i>Hediste diversicolor</i> and oligochaetes in littoral mud
13 a	LS.LMu.MEst.HedMac	<i>Hediste diversicolor</i> and <i>Macoma balthica</i> in littoral sandy mud
14 a	LS.LMu.MEst.HedMacScr	<i>Hediste diversicolor</i> , <i>Macoma balthica</i> and <i>Scrobicularia plana</i> in littoral sandy mud
15 a	LS.LMu.UEst.Hed.Str	<i>Hediste diversicolor</i> and <i>Streblospio shrubsolii</i> in littoral sandy mud
16 a	Not enough data	-
17 a	LS.LMu.MEst.HedMac	<i>Hediste diversicolor</i> and <i>Macoma balthica</i> in littoral sandy mud
18 a	LS.LMu.MEst.HedMac	<i>Hediste diversicolor</i> and <i>Macoma balthica</i> in littoral sandy mud
19 a	LS.LMu.MEst.HedMac	<i>Hediste diversicolor</i> and <i>Macoma balthica</i> in littoral sandy mud
20 a	LS.LMu.MEst.HedMac	<i>Hediste diversicolor</i> and <i>Macoma balthica</i> in littoral sandy mud

Table 12: Subtidal biotopes

Sample	Biotope code	Biotope description
S1	SS.SMu.SMuVS.PoCvol	<i>Polydora ciliata</i> and <i>Corophium volutator</i> in variable salinity infralittoral firm mud or clay
S2	SS.SMu.SMuVS.PoCvol	<i>Polydora ciliata</i> and <i>Corophium volutator</i> in variable salinity infralittoral firm mud or clay
S3	SS.SMu.SMuVS.PoCvol	<i>Polydora ciliata</i> and <i>Corophium volutator</i> in variable salinity infralittoral firm mud or clay
S4	SS.SMu.SMuVS.PoCvol	<i>Polydora ciliata</i> and <i>Corophium volutator</i> in variable salinity infralittoral firm mud or clay
S5	SS.SMu.SMuVS.PoCvol	<i>Polydora ciliata</i> and <i>Corophium volutator</i> in variable salinity infralittoral firm mud or clay
S6	SS.SMu.SMuVS.PoCvol	<i>Polydora ciliata</i> and <i>Corophium volutator</i> in variable salinity infralittoral firm mud or clay
S7	SS.SMu.SMuVS.PoCvol	<i>Polydora ciliata</i> and <i>Corophium volutator</i> in variable salinity infralittoral firm mud or clay
S8	SS.SMu.SMuVS.PoCvol	<i>Polydora ciliata</i> and <i>Corophium volutator</i> in variable salinity infralittoral firm mud or clay
S9	SS.SMu.SMuVS.PoCvol	<i>Polydora ciliata</i> and <i>Corophium volutator</i> in variable salinity infralittoral firm mud or clay

Appendix 7 - Sample locations

Sample	X	Y	Lat	Long
1	565595	175244	51.45197	0.381845
2	565595	175264	51.45214	0.381856
3	565593	175278	51.45227	0.381837
4	565590	175295	51.45243	0.381798
5	565589	175311	51.45257	0.381786
6	565865	175266	51.45208	0.385744
7	565868	175285	51.45226	0.385786
8	565866	175300	51.45239	0.385767
9	565864	175316	51.45254	0.385754
10	565864	175328	51.45264	0.385751
11	566161	175301	51.45231	0.390015
12	566163	175310	51.45239	0.390037
13	566162	175321	51.45249	0.390036
14	566162	175333	51.45259	0.390045
15	566163	175345	51.45271	0.390054
16	566631	175331	51.45244	0.396778
17	566622	175366	51.45276	0.396665
18	566611	175396	51.45303	0.396521
19	566601	175428	51.45332	0.396394
20	566590	175464	51.45364	0.396259
S-1	564749	175097	51.45089	0.369612
S-2	565092	175150	51.45127	0.374566

S-3	565438	175192	51.45155	0.379561
S-4	565601	175207	51.45164	0.38191
S-5	565822	175225	51.45173	0.385105
S-6	566042	175248	51.45187	0.38828
S-7	566299	175278	51.45207	0.39199
S-8	566813	175300	51.45211	0.39939
S-9	567289	175263	51.45164	0.406205