Port of Mostyn

Mostyn Energy Park Extension

Environmental Statement

Appendix 8.1: Marine Ecology Surveys Summary Report

December 2022





Innovative Thinking - Sustainable Solutions

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Document Information

Document History and Authorisation		
Title	Mostyn Energy Park Extension	
	Environmental Statement Appendix 8.1: Marine Ecology Surveys Summary Report	
Commissioned by	Port of Mostyn	
Issue date	December 2022	
Document ref	R.4052 App 8.1	
Project no	R/5036/4	
Date	**Version**	**Revision Details**
11/11/2022	1	Initial draft version for client review
12/12/2022	2	Issued for client use

Prepared (PM)	Approved (QM)	Authorised (PD)
E San Martin	N J Frost	D O;Brien

Suggested Citation

ABPmer, (2022). Mostyn Energy Park Extension, Environmental Statement Appendix 8.1: Marine Ecology Surveys Summary Report, ABPmer Report No. R.4052 App 8.1. A report produced by ABPmer for Port of Mostyn, December 2022.

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1 Introduction

This report has been prepared by ABPmer for the Port of Mostyn and provides a summary of the results of the following baseline marine ecology surveys undertaken as part of the Mostyn Energy Park Extension (MEPE) Project (also referred to as the proposed development):

- **Phase 1 Intertidal habitat survey**: In order to characterise the intertidal habitats and species present within the footprint of the proposed development, a Phase 1 Intertidal Habitat Survey was undertaken in October 2021. The purpose of the survey was to map the intertidal habitats present, identify the main characterising species and also the presence of any habitats/species of conservation interest;
- **Intertidal benthic sampling:** Core sampling of the intertidal sediments was undertaken in October 2021 to help better understand the intertidal faunal communities present within the footprint of the proposed development; and
- **Subtidal benthic sampling**: A subtidal benthic ecology survey was undertaken in March 2022 to help better understand the subtidal faunal communities present within the footprint of the proposed development.

The survey methodologies are detailed in Section 2 and the results of the intertidal and subtidal surveys are presented in Sections 3. Overall summary conclusions are then provided in Section 4.

2 Methodology

2.1 Phase 1 intertidal habitat survey

The survey was undertaken at low water on 8 October 2021 which coincided with a spring tidal phase. The survey focused on intertidal habitat within the proposed development footprint and was undertaken using a combination of foot access (where considered safe) and a dedicated two-person hovercraft.

The approach was based on the standardised Phase 1 mapping methodology detailed in the Marine Monitoring Handbook, procedural guidance No 3-1 (Wyn and Brazier, 2001) and Countryside Council for Wales (CCW) Handbook for Marine Intertidal Phase 1 Survey and Mapping (Wyn *et al.*, 2000). Habitats in the area were mapped as polygons using the Marine Habitat Classification for Britain & Ireland (MHCBI) v15.03 to Biotope Class Levels 4 or 5 (JNCC, 2015).

The boundaries of habitats were mapped to their full extent using Global Positioning System (GPS) and detailed notes on species present and abundance were recorded.

Anecdotal ornithology observations were also recorded during the survey.

2.2 Intertidal benthic sampling

The intertidal benthic sampling survey was undertaken concurrently with the Phase 1 intertidal habitat survey on 8 October 2021 using a hovercraft to access the shoreline safely.

Seven stations were sampled (Figure 1). At each of these stations a sample was collected using a 0.01 m^2 hand-held corer (to a depth of approximately 15 cm) for macrofaunal analysis (faunal composition, abundance and biomass). An additional core sample was also collected at each station for Particle Size Analysis (PSA) and Total Organic Carbon (TOC).

Field notes were also made about the nature of the habitats at each of the sampling points. Information recorded included details on the sediment type, evidence of bird feeding (e.g. footprints), the specific characteristics of the habitat at the precise point where the samples were retrieved and general characteristics of the wider habitat. A photographic record of the sediment type and the broader habitat appearance was also taken.

All infaunal samples were immediately delivered to the laboratory once the survey was complete, where samples were sieved (using a 0.5 mm sieve) and fixed ahead of analysis.

Anecdotal ornithology observations were also recorded during the survey.

Figure 1. The location of the intertidal core and subtidal grab sample stations

2.3 Subtidal benthic sampling

The subtidal grab sampling survey was undertaken by Hull Marine Laboratory on 26 March 2022. The sampling methods followed the established and recognised procedures outlined in the Recommended Operational Guidelines (ROG) for Grab Sampling and Sorting and Treatment of Samples (Guerra and Freitas, 2013) and the Marine Monitoring Handbook, Procedural Guideline No 3-9 (Thomas, 2000).

Six stations were sampled in the channel (Figure 1). At each station, a benthic sample was collected using a 0.1 m² Day Grab for macrofauna analysis (faunal composition, abundance and biomass). An additional sample was also taken at each station for determination of PSA and TOC.

At each site, up to three attempts were made to retrieve a suitable sample (i.e. a grab containing sufficient volume of sediment for analysis). The sediment depths within the grab which were used for sample acceptance were a minimum of 7 cm for muddy or soft sediments and 5 cm for hard packed or coarse sediments. Anything less than these values was only retained if no other viable sample was collected.
Each grab sample was photographed upon successful retrieval and transferred into a labelled plastic bucket. All infaunal samples were immediately delivered to the laboratory once the survey was complete, where samples were sieved (using a 0.5 mm sieve) and fixed ahead of analysis.

2.4 Laboratory analysis

The benthic macrofaunal analysis was undertaken by Hull Marine Laboratory. The laboratory is National Marine Biological Analytical Quality Control Scheme (NMBAQC) accredited.

Faunal samples were sorted from the sieve residue using low power binocular microscopes. All of the macroinfaunal specimens were identified to species level (where practicable) and enumerated. This work was undertaken in adherence with ISO 16665 standards and the NMBAQC Scheme Guidelines.

The PSA sample analysis was undertaken using the NMBAQC standardised methodology. The analysis was carried out using a Mastersizer laser diffractor which produces detailed sedimentary profiles for fine sediments (clay, sand and silts). TOC was undertaken using Loss-on-Ignition (LOI) analysis with a muffle furnace and oven. Samples were oven dried before being weighed and placed in the muffle furnace for 4 hours at 475 °C and re-weighed.

3 Results

3.1 Phase 1 intertidal habitat survey

The habitats recorded in the survey are described in more detail below. The section has been structured so that habitats and species recorded on the upper and mid shore are described first, followed by those habitats observed on the lower shore. Finally, ornithology observations made during the survey are summarised. The spatial distribution of intertidal habitats recorded are shown in Figure 2.

3.1.1 Upper and mid shore habitats

The eastern side of the breakwater comprised tipped slag waste deposits from the historic iron industry[1] which have partly fragmented into artificial hard substrate of varying sizes (rock, boulders and cobble-sized deposits) grading into mud closer to the lower shore. The upper shore consisted of steep crags and overhangs which were colonised in relatively sparse patches by the spiral wrack *Fucus spiralis* (LR.LLR.F.Fspi: *Fucus spiralis* on sheltered upper eulittoral rock) although it is noted that the slag waste deposits are an artificial rather than natural form of rock and generally and generally considered more porous in nature. Above this zone, green algae and lichens were present.

1 The 1899 breakwater was constructed from industrial slag waste from the Darwen and Mostyn Iron Works. Slag is a by-product of smelting ores and used metals.

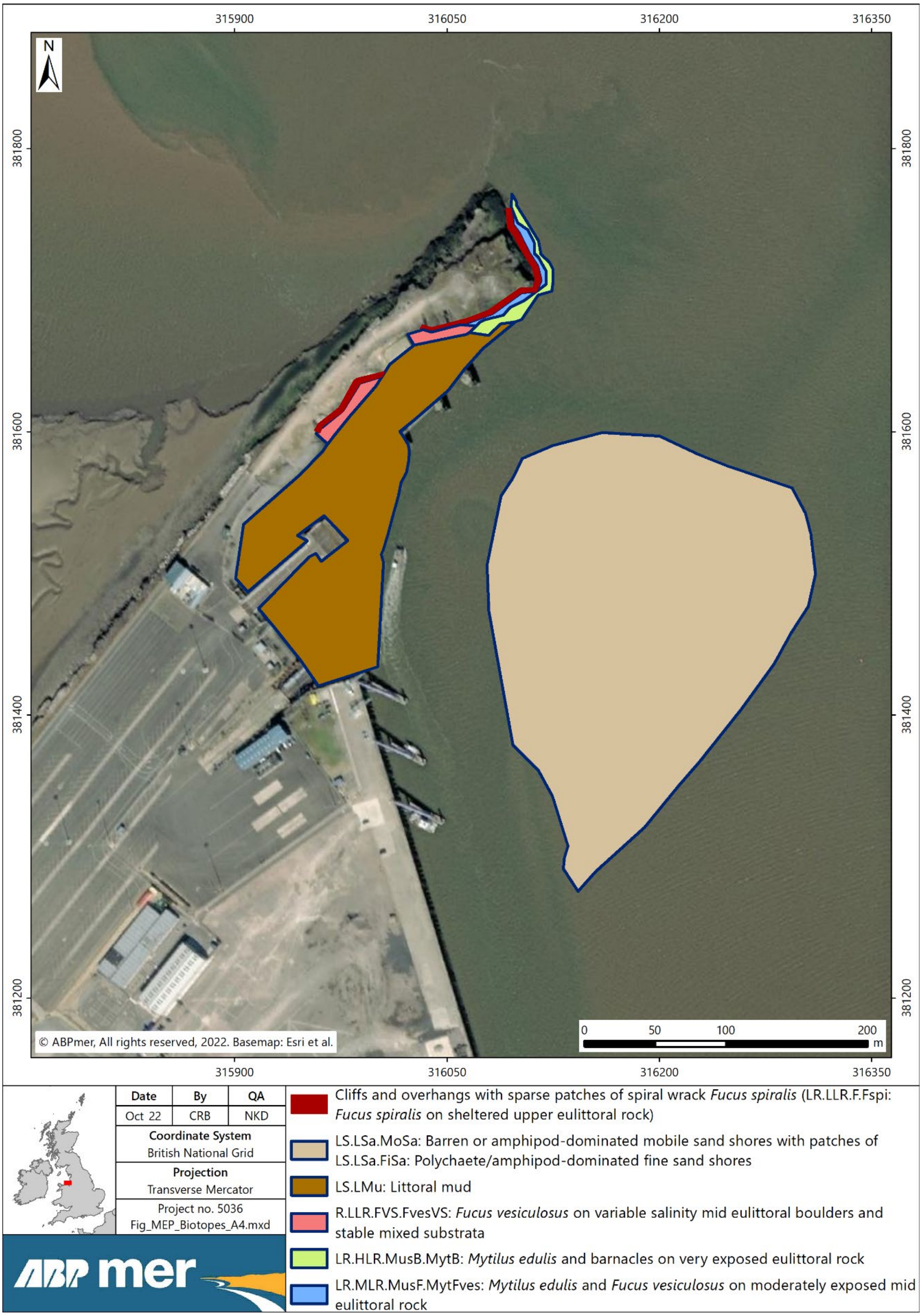

Figure 2. Intertidal habitats recorded in the Phase 1 habitat survey

Image 1. Key species recorded during the Phase 1 habitat survey on the eastern breakwater: Common starfish (top left); shore crab and mussels (top right), bladder wrack (bottom left) and common periwinkle (bottom right).

3.1.2 Lower and mid shore habitats

Mid shore habitats consisted of areas of hardened rock and boulder-sized slag waste deposits which were colonised by the bladder wrack *Fucus vesiculosus,* along with barnacles and patches of mussels *Mytilus edulis* (Image 1). The common periwinkle *Littorina littorea* was also recorded and shore crabs *Carcinus maenas* were observed under boulder-sized slag deposits and in crevices. The habitat is most appropriately assigned to LR.MLR.MusF.MytFves (*Mytilus edulis* and *Fucus vesiculosus* on moderately exposed mid eulittoral rock) and R.LLR.FVS.FvesVS (*Fucus vesiculosus* on variable salinity mid eulittoral boulders and stable mixed substrata) although, as noted above, this hard substrate is a by-product of the historic iron industry rather than naturally formed.

The lower shore consisted predominantly of barnacle covered rock-sized slag deposits with aggregations of mussels *Mytilus edulis* (Image 2). A layer of mud was present overlying some of the boulder-sized slag deposits in the area. Macroalgae was largely absent. Occasional common starfish *Asterias rubens* were also recorded on the lower shore near the sublittoral fringe (Image 1). The habitat is most appropriately assigned to LR.HLR.MusB.MytB (*Mytilus edulis* and barnacles on very exposed eulittoral rock[2]) although, as noted above, this hard substrate is artificial and not naturally formed.

The hard substrate habitat of the breakwater provides a similar ecological function to the 'estuarine rocky habitats' Habitat of Principal Importance in Wales listed under the Natural Environment and Rural Communities (NERC) Act 2006 Section 42 but given its artificial nature, it is not strictly considered to be characteristic of this habitat.

Image 2. Mussels and barnacles on the lower shore of the eastern side of the breakwater

Intertidal habitat adjacent to the eastern side of the breakwater, in the area of the ferry Ro-Ro Terminal and old Airbus berthing facility, consisted of LS.LMu (Littoral mud) which was soft, unconsolidated and fluid in nature (Image 3). Infaunal sampling in this area (see below), found this habitat to be highly impoverished and could not easily be assigned to any of the JNCC MHCBI biotopes. Although this soft/fluid sandy mud habitat did not have the standard and more stable structure and form characteristic of intertidal mudflat, it should be noted that 'Intertidal mudflats' are a Habitat of Principal Importance in Wales listed under the NERC Act 2006 Section 42.

The intertidal sandbank within the Port of Mostyn harbour area (known as 'Bug Bank') consisted of tide-swept fine sand (Figure 2 and Image 4). Very occasional lugworm casts *Arenicola marina* were recorded. Based on visual observations as well as infaunal samples collected in this area (see below), the habitat is most appropriately assigned to LS.LSa.MoSa (Barren or amphipod-dominated mobile sand shores) with patches of LS.LSa.FiSa (Polychaete/amphipod-dominated fine sand shores).

[2] This biotope is also known to occur on vertical and steep bedrock on moderately exposed shores (https://mhc.jncc.gov.uk/biotopes/jnccmncr00000358) as is the case on the breakwater.

Image 3. Soft/fluid sandy mud habitat in the vicinity of the ferry terminal

Image 4. Clean sand habitat of the Bug Bank

3.1.3 Ornithology observations

Small numbers of Oystercatcher (< 5 birds), as well as flocks of Herring Gull were recorded loafing and more occasionally feeding on the Bug Bank (Image 5).

Small flocks of Turnstone and the occasional Oystercatcher were also recorded feeding on the eastern side of the breakwater.

Image 5. Oystercatchers and herring gulls loafing on the Bug Bank

3.2 Benthic sampling

The species recorded in the samples collected from the intertidal and subtidal surveys are summarised below in Section 3.2.1 and Section 3.2.2 respectively, including key characterising species and any species of particular note (such as protected species or non-native species).

The laboratory results are presented in Annex A (macrofauna) and Annex B (sediment analysis). Summary information on the sedimentary and ecological conditions at the sites based on these results is presented in Table 1 and Table 2.

3.2.1 Intertidal samples

The sediment from the samples collected around the ferry structures and below the breakwater (Stations INT 1 to INT 3) consisted of soft/fluid sandy mud (Table 1 and Image 3). The TOC in the samples ranged between approximately 3.7 % and 4.8 % (Table 1).

The number of taxa at these sites ranged from 4 to 5 and the number of individuals from 0 to 1,400 organisms per m^2. The infaunal samples were impoverished and characterised by low numbers of the mud shrimp *Corophium volutator*, mud snail *Peringia ulvae*, the oligochaete *Tubificoides benedii,* polychaetes (including the tube-dwelling deposit feeder *Streblospio shrubsolii*, and tube-dwelling *Pygospio elegans* which is a deposit/suspension feeder) and clams (*Tellinoidea* spp. and Baltic tellin *Limecola balthica*).

These species are all considered commonly occurring, not protected and typical of estuarine mudflat habitat. However, the number of species and abundance levels recorded in the samples are much lower than recorded in ecologically richer mudflat habitats in the nearby local area. For example, over 20 taxa and number of organisms typically in the range of 20,000-50,000 per m^2 have been regularly recorded in benthic core samples collected on the inner Mostyn Bank. Key species such as *Corophium volutator* and *Tubificoides benedii* occurred in numbers exceeding over 7000-10,000 m^2 in these samples (ABPmer, 2012; ABPmer, 2013; Port of Mostyn, 2013). This is expected given that the mudflat habitat on the Mostyn Bank is considered much more stable than the fluid/soft sandy mud observed within the harbour.

The sediment from the samples collected from the lower shore sandflat habitat of Bug Bank (Stations INT 4 to INT 7) consisted of fine sand or muddy sand with a limited silt content and TOC (Table 1). Samples were impoverished with the number of taxa found in the samples ranging from 0 (Station INT 6) to 7 (Station INT 4) and the number of individuals ranging from 0 organisms per m² (Station INT 6) to 1,000 organisms per m² (Station INT 4). The samples were characterised by low numbers of the polychaete *Nephtys* spp, isopod *Eurydice pulchra,* mud shrimp *Corophium volutator,* bivalve *Kurtiella bidentata,* mud snail *Peringia ulvae* and oligochaete *Tubificoides benedii.* All the species recorded from the samples in this sandflat habitat are considered commonly occurring in the region and not protected.

Table 1. Intertidal benthic survey results

Station	Sediment Type	TOC (%)	No. of Taxa (per m²)	No. of Individuals (per m²)	Total Biomass (g per m²)	Key Characterising Species (Number per m² shown in brackets)
INT 1	Sandy mud	3.68	5	800	0.26	*Corophium volutator* (300) *Streblospio shrubsolii* (200) *Nematoda* (100) *Tubificoides benedii* (100) *Tellinoidea* (100)
INT 2	Sandy mud	4.19	5	1,400	0.25	*Pygospio elegans* (600) *Nematoda* (300) *Streblospio shrubsolii* (200) *Peringia ulvae* (200) *Limecola balthica* (100)
INT 3	Sandy mud	4.84	4	400	0.10	*Nematoda* (100) *Streblospio shrubsolii* (100) *Corophium volutator* (100) *Peringia ulvae* (100)
INT 4	Muddy sand	0.53	7	1,000	1.01	*Nephtys* (200) *Corophium volutator* (200) *Peringia ulvae* (200) *Eteone longa* (100) *Nephtys cirrosa* (100) *Eurydice pulchra* (100) *Kurtiella bidentata* (100)
INT 5	Sand	0.36	4	500	0.05	*Tellinoidea* (200) *Pygospio elegans* (100) *Tubificoides benedii* (100) *Corophium volutator* (100)
INT 6	Sand	0.45	0	0	0	
INT 7	Sand	0.69	2	200	0.02	*Nematoda* (100) *Nephtys* (100)

3.2.2 Subtidal samples

The sediment in samples collected on the subtidal survey consisted of gravel with muddy sand, sandy mud or sand (Table 2). The TOC in the samples ranged between approximately 0.4 % and 4.6 % (Table 2). The samples consisted of impoverished fauna, with the number of taxa ranging from 2 (Station SUB 1) to 10 (Stations SUB 2 and SUB 6). The number of individuals was variable and ranged from 30 organisms per m² (Station SUB 1) to 650 organisms per m² (Station SUB 3). The range in total species biomass in the samples was between 0.0008 gram per m² at Station SUB 1 and 52.60 grams per m² at Station SUB 4 (which was primarily attributed to the European green crab *Carcinus maenas*).

The samples were impoverished and predominantly characterised by low numbers of the polychaete *Nephtys sp.* (particularly *Nephtys hombergii),* oligochaete *Tubificoides benedii*, nematodes and juvenile blue mussel *Mytilus edulis*.

Table 2. Subtidal benthic survey results

Station	Sediment Type	TOC (%)	No. of Taxa (per m^2)	No. of Individuals (per m^2)	Total Biomass (g per m^2)	Key Characterising Species (Number per m^2 shown in brackets)
SUB 1	Slightly Gravelly Sandy Mud	3.27	2	30	0.008	*Mytilus edulis* (20) *Austrominius modestus* (10)
SUB 2	Slightly Gravelly Sandy Mud	4.55	10	400	0.98	*Tubificoides benedii* (130) *Nematoda* (120) *Limecola balthica* (40) *Mytilus edulis* (30) *Streblospio shrubsolii* (20)
SUB 3	Slightly Gravelly Sandy Mud	3.46	6	650	4.78	*Nephtys hombergii* (470) *Nephtys* (60) *Mytilus edulis* (50) *Tharyx* (40) *Limecola balthica* (20)
SUB 4	Slightly Gravelly Muddy Sand	0.74	8	140	52.60	*Nephtys hombergii* (60) *Tubificoides benedii (20)* *Nematoda* (10) *Eteone longa* (10) *Tubificoides pseudogaster* (10) *Carcinus maenas* (10) *Tellinoidea* (10) *Macomangulus tenuis* (10)
SUB 5	Slightly Gravelly Sand	0.51	6	160	6.26	*Tubificoides benedii* (70) *Nephtys* (30) *Eteone longa* (20) *Peringia ulvae* (20) *Nephtys hombergii* (10) *Limecola balthica* (10)
SUB 6	Slightly Gravelly Sand	0.37	10	270	0.59	*Nephtys* (80) *Tubificoides benedii* (60) *Nephtys cirrosa* (50) *Nephtys hombergii* (20)

These characterising species dominated the assemblage and contributed almost entirely to the total abundances of organisms recorded at most of the sites. Other species recorded included the bivalve *Limecola balthica* and polychaete *Eteone longa*. The species recorded from the samples are all considered commonly occurring and the assemblage is very similar to that recorded in previous surveys in this area (GoBe Consultants Ltd., 2011; ERM, 2009). For example, previous benthic grab sampling in the shallow infralittoral zone directly below the eastern part of the breakwater also recorded a very impoverished fauna (5-8 taxa and 207-1,104 individuals/m^2) dominated by errant polychaetes (such as *N. hombergii*), the oligochaete *T. benedii* and juvenile mussel *M. edulis* (ERM, 2009). No protected species were recorded, with only one non-native species recorded (the acorn barnacle *Austrominius modestus*).

4 Summary

The baseline marine ecology surveys undertaken for the MEPE Project recorded a range of habitats and species within the proposed development footprint.

The eastern side of the breakwater comprised tipped slag waste deposits from the historic iron industry which have partly fragmented into artificial hard substrate of varying sizes (rock, boulders and cobble-sized deposits) grading into sand and silt closer to the lower shore. The habitat was colonised by algae (including wracks *Fucus* spp.), barnacles, mussel aggregations, periwinkles, shore crabs and also the common starfish on the lower shore and provided a similar ecological function to the 'estuarine rocky habitats' Habitat of Principal Importance in Wales listed under the NERC Act 2006 Section 42.

Intertidal habitat adjacent to the eastern side of the breakwater, in the area of the ferry Ro-Ro terminal and old Airbus berthing facility, consisted of sandy mud habitat which was fluid in nature and highly impoverished with a very low number of species recorded within it. Although this soft/fluid sandy mud habitat did not have the standard and more stable structure and form characteristic of intertidal mudflat, it should be noted that 'Intertidal mudflats' are a Habitat of Principal Importance in Wales listed under the NERC Act 2006 Section 42 and mudflat '*mudflats and sandflats not covered by seawater at low tide*' is a qualifying feature of the Dee Estuary Special Area of Conservation (SAC) and supporting habitat of the Dee Special Protection Area (SPA) and Ramsar. However, all the species recorded in the samples are considered commonly occurring, not protected and typical of estuarine mudflat habitat. Furthermore, the number of species and abundance levels recorded in the samples are much lower than have been recorded in the ecologically richer and more stable mudflat habitats of the nearby local area such as on the Mostyn Bank. This soft/fluid sandy mud is, therefore, considered to comprise a poorer quality and more unstable habitat that is not representative of the ecological structure and function of intertidal mudflat found beyond the immediate area of the harbour.

The intertidal sandflat within the Port of Mostyn harbour area (known as 'Bug Bank') was also characterised by a low number of species in very low abundances. All the species recorded from the samples in this sandflat habitat were considered commonly occurring in the region and not protected. However, it is recognised that sandflats '*mudflats and sandflats not covered by seawater at low tide*' is a qualifying feature of the Dee Estuary SAC and supporting habitat of the Dee SPA and Ramsar site.

The subtidal benthic samples from within the channel consisted of slightly gravelly sand, slightly gravelly muddy sand or slightly gravelly sandy mud. Samples were typically impoverished and characterised by commonly occurring polychaetes, oligochaetes, nematodes, crustaceans and bivalves. No subtidal species considered nationally rare or protected were recorded, with the assemblages observed considered characteristic of estuarine communities found more widely in the Dee Estuary.

5 References

ABPmer (2012). Mostyn Energy Park: Benthic Invertebrate Survey (September 2011). ABP Marine Environmental Research Ltd, Report No. R.1968

ABPmer, (2013). Mostyn Dredge and Disposal-Ecological Phase 2 Monitoring Work (2012 Autumn Equinox Surveys). ABP Marine Environmental Research Ltd, Report No. R.2032

Countryside Council for Wales (CCW). (2002). CCW Phase 1 intertidal survey of the Dee Estuary.

ERM (2009). Port of Mostyn Breakwater Quay Development Environmental Statement

GoBe Consultants. (2011). Port of Mostyn – Wind Farm Service Vessel Pontoon Facility - Environmental Statement. Prepared for RWE Npower Renewables Ltd.
Guerra, M.T and Freitas, R. (2013). Recommended Operational Guidelines (ROG) for grab sampling and sorting and treatment of samples. Mesh Atlantic.

ISO 16665: (2014) Water quality -- Guidelines for quantitative sampling and sample processing of marine soft-bottom macrofaunal. International Organization for Standardization.

JNCC (2015). The Marine Habitat Classification for Britain and Ireland Version 15.03 [Online]. [Date accessed]. Available from: jncc.defra.gov.uk/MarineHabitatClassification.

Port of Mostyn. (2013). Mostyn Energy Park Development (MEP) at the Port of Mostyn. Environmental Statement Volume 1 - EIA Text July 2013.

Thomas, N.S. (2000). Procedural Guideline No. 3-9 Quantitative sampling of sublittortal sediment biotopes and species using remote-operated grabs. In Davies J., Baxter J., Bradley M., Connor D., Khan J., Murray E., Sanderson W., Turnbull C. & Vincent M. 2001. Marine Monitoring Handbook, 405 pp.

Wyn, G. and Brazier, P. (2001). Procedural Guideline No. 3-1 - In situ intertidal biotope recording. In Davies J., Baxter J., Bradley M., Connor D., Khan J., Murray E., Sanderson W., Turnbull C. & Vincent M. 2001. Marine Monitoring Handbook, 405 pp.

Wyn, G., Brazier, D. P. and McMath A. J., (2000). CCW handbook for marine intertidal Phase 1 survey and mapping. CCW Marine Sciences Report: 00/06/0.

6 Abbreviations/Acronyms

CCW	Countryside Council for Wales
GIS	Geographical Information System
GPS	Global Positioning System
ISO	International Organization for Standardization
JNCC	Joint Nature Conservation Committee
MHCBI	Marine Habitat Classification for Britain & Ireland
NERC	Natural Environment and Rural Communities
NMBAQC	National Marine Biological Analytical Quality Control Scheme
PSA	Particle Size Analysis
ROG	Recommended Operational Guidelines
TOC	Total Organic Carbon
UK	United Kingdom

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Annexes

Innovative Thinking - Sustainable Solutions

A Macrofauna Results

A.1 ABPmer Mostyn 2021/2022 - Abundance

MCS Code		Species	Sub 1	Sub 2	Sub 3	Sub 4	Sub 5	Sub 6	Int 1	Int 2	Int 3	Int 4	Int 5	Int 6	Int 7
HD	1	*Nematoda*		12	1	1			1	3	1				1
P	92	*Pholoe inornata*						1							
P	118	*Eteone longa*		1		1	2	1				1			
P	494	*Nephtys*		1	6		3	8				2			1
P	498	*Nephtys cirrosa*						5				1			
P	499	*Nephtys hombergii*			47	6	1	2							
P	776	*Pygospio elegans*								6			1		
P	799	*Streblospio shrubsolii*		2					2	2	1				
P	847	*Tharyx*			4										
P	1490	*Tubificoides benedii*		13		2	7	6	1				1		
P	1498	*Tubificoides pseudogaster*		1		1		1							
R	68	*Austrominius modestus*	1												
S	616	*Corophium volutator*							3		1	2	1		
S	854	*Eurydice pulchra*										1			
S	1594	*Carcinus maenas*				1									
W	385	*Peringia ulvae*		2			2	1		2	1	2			
W	1695	*Mytilus edulis*	2	3	5			1							
W	1906	*Kurtiella bidentata*						1				1			
W	2007	*Tellinoidea*				1			1				2		
W	2012	*Macomangulus tenuis*				1									
W	2029	*Macoma balthica*		4	2		1			1					
Y	135	*Amathia lendigera*						P							
Y	187	*Flustra foliacea*				P									
ZM	443	*Plocamium cartilagineum*									P				
ZM	507	*Ceramium*								P	P				
ZM	655	*Polysiphonia*									P				
ZR	305	*Halopteris filicina*									P				
ZS	156	*Ulva intestinalis*							P	P	P				
ZG	1	*Actinopterygii*		1											
		Total number of taxa	**2**	**10**	**6**	**9**	**6**	**11**	**6**	**7**	**9**	**7**	**4**	**0**	**2**
		Total number of individuals	**3**	**40**	**65**	**14**	**16**	**27**	**8**	**14**	**4**	**10**	**5**	**0**	**2**
		Total number of individuals (m2)	**30**	**400**	**650**	**140**	**160**	**270**	**800**	**1400**	**400**	**1000**	**500**	**0**	**200**

A.2 ABPmer Mostyn 2021/2022 - Biomass

MCS Code		Species	Sub 1	Sub 2	Sub 3	Sub 4	Sub 5	Sub 6	Int 1	Int 2	Int 3	Int 4	Int 5	Int 6	Int 7
HD	1	*Nematoda*		0.0001	0.0001	0.0001			0.0001	0.0001	0.0001				0.0001
P	92	*Pholoe inornata*						0.0001							
P	118	*Eteone longa*		0.0001		0.0001	0.0007	0.0001				0.0008			
P	494	*Nephtys*		0.0018	0.0086		0.0013	0.0059				0.0001			0.0001
P	498	*Nephtys cirrosa*						0.0182				0.007			
P	499	*Nephtys hombergii*			0.4511	0.1952	0.0035	0.028							
P	776	*Pygospio elegans*								0.0012			0.0001		
P	799	*Streblospio shrubsolii*		0.0001					0.0002	0.0002	0.0001				
P	847	*Tharyx*			0.0011										
P	1490	*Tubificoides benedii*		0.0031		0.0002	0.0045	0.0021	0.0001				0.0001		
P	1498	*Tubificoides pseudogaster*		0.0001		0.0001		0.0001							
R	68	*Austrominius modestus*	-												
S	616	*Corophium volutator*							0.0021		0.0007	0.0001	0.0001		
S	854	*Eurydice pulchra*										0.0006			
S	1594	*Carcinus maenas*				5.0188									
W	385	*Peringia ulvae*		0.0017			0.0019	0.0001		0.0007	0.0001	0.0002			
W	1695	*Mytilus edulis*	0.0008	0.0007	0.0009			0.0001							
W	1906	*Kurtiella bidentata*						0.0043				0.0013			
W	2007	*Tellinoidea*				0.0001			0.0001				0.0002		
W	2012	*Macomangulus tenuis*				0.0458									
W	2029	*Macoma balthica*		0.0897	0.0163		0.6138			0.0003					
Y	135	*Amathia lendigera*						-							
Y	187	*Flustra foliacea*				-									
ZM	443	*Plocamium cartilagineum*									-				
ZM	507	*Ceramium*								-	-				
ZM	655	*Polysiphonia*									-				
ZR	305	*Halopteris filicina*									-				
ZS	156	*Ulva intestinalis*							-	-	-				
ZG	1	*Actinopterygii*		0.0001											
		Total number of taxa	**2**	**10**	**6**	**9**	**6**	**11**	**6**	**7**	**9**	**7**	**4**	**0**	**2**
		Total biomass	**0.0008**	**0.0975**	**0.4781**	**5.2604**	**0.6257**	**0.059**	**0.0026**	**0.0025**	**0.001**	**0.0101**	**0.0005**	**0**	**0.0002**
		Total biomass (m2)	**0.008**	**0.975**	**4.781**	**52.604**	**6.257**	**0.59**	**0.26**	**0.25**	**0.1**	**1.01**	**0.05**	**0**	**0.02**

B Sediment Analysis Results

GRADISTAT
Version 4.0

A Grain Size Distribution and Statistics Package for the Analysis of Unconsolidated Sediments by Sieving or Laser Granulometer

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The development of this program was inspired by Dave Thornley and John Jack at the Postgraduate Research Institute for Sedimentology at the University of Reading, UK, and the Department of Geology at Royal Holloway University of London, UK. It is provided in Microsoft Excel format to allow both spreadsheet and graphical output. The program is best suited to analyse data obtained from sieve or laser granulometer analysis. The user is required to input the mass or percentage of sediment retained on sieves spaced at any intervals, or the percentage of sediment detected in each bin of a Laser Granulometer. The following sample statistics are then calculated using the Method of Moments in Microsoft Visual Basic programming language: mean, mode(s), sorting (standard deviation), skewness, kurtosis, D_{10}, D_{50}, D_{90}, D_{90}/D_{10}, D_{90}-D_{10}, D_{75}/D_{25} and D_{75}-D_{25}. Grain size parameters are calculated arithmetically and geometrically (in microns) and logarithmically (using the phi scale) (Krumbein and Pettijohn, 1938[1]; Table 1). Linear interpolation is also used to calculate statistical parameters by the Folk and Ward (1957)[2] graphical method and derive physical descriptions (such as "very coarse sand" and "moderately sorted"). The program also provides a physical description of the textural group which the sample belongs to and the sediment name (such as "fine gravelly coarse sand") after Folk (1954)[3]. Also included is a table giving the percentage of grains falling into each size fraction, modified from Udden (1914)[4] and Wentworth (1922)[5] (see Table 2). In terms of graphical output, the program provides graphs of the grain size distribution and cumulative distribution of the data in both metric and phi units, and displays the sample grain size on triangular diagrams. Samples may be analysed singularly, or up to 250 samples may be analysed together.

The program is ideal for the rapid analysis of sieve data and is freely available from the author at the above address. Please note that the copyright for the program is held by author, and any distribution or use of the program should be acknowledged to him.

S. Blott October 2000

[1]Krumbein, W.C. and Pettijohn, F.J. (1938) *Manual of Sedimentary Petrography*. Appleton-Century-Crofts, New York.

[2]Folk, R.L. and Ward, W.C. (1957) Brazos River bar: a study in the significance of grain size parameters. *Journal of Sedimentary Petrology*, **27**, 3-26.

[3]Folk, R.L. (1954) The distinction between grain size and mineral composition in sedimentary-rock nomenclature. *Journal of Geology*, **62**, 344-359.

[4]Udden, J.A. (1914) Mechanical composition of clastic sediments. *Bulletin of the Geological Society of America*, **25**, 655-744.

[5]Wentworth, C.K. (1922) A scale of grade and class terms for clastic sediments. *Journal of Geology*, **30**, 377-392.

Instructions on the Use of the GRADISTAT Program

Single Sample Analysis

1. Switch to the "Single Sample Data Input" sheet if it is not already active. Enter the aperture sizes of the sieves or Laser Granulometer bins used in the analysis into the cells in column B. Sizes may be entered either in ascending or descending numerical order. For convenience, you can click on one of the standard sieve or Laser Granulometer size intervals and GRADISTAT will enter the size classes for you. Any non-standard sieve sizes can be used, although some of the statistics may not be calculated if you have not used sieves with at least whole phi intervals. See the section below if the sample contains unanalysed sediment, such as material retained in the pan after sieving. At least one size class larger than the largest particles in the sample should also be entered. A large area to the right of the data columns is provided for the cut and paste of data from other spreadsheets, such as the import of Laser Granulometer data.

2. Enter the weight or percentage of sample beside each size class in column C. When you have finished, make sure there are no data further down the spreadsheet which could cause an error. The program will accept data down to row 230.

3. Enter the sample identity, analyst, date and initial sample weight (optional) at the top of the "Single Sample Data Input" sheet.

4. Click the "Calculate Statistics" button and wait a few moments for the program to finish running. When the dialog box appears, click "OK".

5. The results are summarised on the "Single Sample Statistics" sheet, which includes a distribution histogram of the sample. Select "Print..." from the file menu to print the Summary Statistics page. The data is also shown on triangular diagrams on the "Gravel Sand Mud" and "Sand Silt Clay" sheets. Further cumulative and distribution plots are given on other sheets.

Multiple Sample Analysis

1. Switch to the "Multiple Sample Data Input" sheet. Enter the aperture sizes of the sieves or Laser Granulometer bins used in the analysis into the cells in column B. The aperture sizes must be the same for all the samples. Sizes may be entered either in ascending or descending numerical order. For convenience, you can click on one of the standard sieve or Laser Granulometer size intervals and GRADISTAT will enter the size classes for you. Any non-standard sieve sizes can be used, although some of the statistics may not be calculated if you have not used sieves with at least whole phi intervals. See the section below if samples contain unanalysed sediment, such as material retained in the pan after sieving. At least one size class larger than the largest particles in the sample should also be entered.

2. Enter the weight or percentage of sample in column C onwards. Make sure there are no data further down the spreadsheet which could cause an error. The program will accept data down to row 230.

3. Enter the sample identity, analyst, date and initial sample weight (optional) in the green cells above each sample listing.

4. If you require a Summary Statistics printout for each sample, select a tick in the option box.

5. Click the "Calculate Statistics" button and wait for the program to finish running (this may take several minutes). GRADISTAT will give a warning if it detects a sample whose combined weight is greater than the given sample weight. Click "OK" when prompted on the dialog boxes.

6. The resulting statistics for all samples are summarised on the "Multiple Sample Statistics" sheet. The data for each sample included in the analysis are also shown on triangular diagrams on the "Gravel Sand Mud" and "Sand Silt Clay" sheets. Cumulative and distribution plots will show the results for the last sample in the analysis. If graphical plots for other samples are required, use separate single sample analyses (above).

Unanalysed Sediment

Occasionally, samples may contain sediment in a size fraction of unspecified size, such as material retained in the pan after sieving. Ideally, the whole size range in a sample should be analysed, and this may require f th l i f di t i i i th ft i i Th l th tit f di t i i i further analysis of sediment remaining in the pan after sieving. The larger the quantity of sediment remaining in the pan, the less accurate the calculation of grain size statistics, with statistics calculated by the Method of Moments being most susceptible. Errors in Folk and Ward parameters become significant only when more than 5% of the sample is undetermined. If the sample contains sediment in the pan the user should do one of the following:

1. Enter the weight or percentage of sample in the pan with a class size of zero (or leave the class size blank). GRADISTAT calculates the statistics assuming all sediment in the pan is larger than 10 ϕ (1 μm). The grain size distribution graphs do not however plot the quantity of sediment in the pan.

2. Enter the weight or percentage of sample in the pan with a class size which the user considers to be the lower size limit of sediment in the pan. GRADISTAT calculates the statistics assuming all sediment in the pan is larger than this value and plots this quantity on the grain size distribution graphs.

The above two options are recommended where there is less than 1% of the sample remaining in the pan.

3. Do not enter the quantity of sediment in the pan at all. GRADISTAT calculates the statistics ignoring the sediment in the pan as if it were not present in the sample. This is recommended where there is more than 1% of the sample remaining in the pan.

Samples containing more than 5% of sediment in the pan should ideally be analysed using a different technique, such as sedimentation or laser granulometry. Great care must however be taken when merging data obtained by different methods.

Graph Scales

The size scale used in graphical plots is dependent upon the range of sizes specified on the sample input sheets: the first and last values provide the extreme values on the graphs. While one size class larger than the largest particles in the sample should be entered, other size classes outside the grain size range of the sample have no influence on the statistical calculations. These classes may be deleted to narrow the size scale on graphs. Note that unused size classes within the size range of the sample should also be deleted, otherwise GRADISTAT assumes that zero sample weight was present in those size classes.

Table 1. *Statistical formulae used in the calculation of grain size parameters.* f is the frequency in percent; m is the mid-point of each class interval in metric (m_m) or phi (m_ϕ) units; P_x and ϕ_x are grain diameters, in metric or phi units respectively, at the cumulative percentile value of x.

(a) Arithmetic Method of Moments

Mean	Standard Deviation	Skewness	Kurtosis
$\bar{x}_a = \frac{\Sigma f m_m}{100}$	$\sigma_a = \sqrt{\frac{\Sigma f (m_m - \bar{x}_a)^2}{100}}$	$Sk_a = \frac{\Sigma f (m_m - \bar{x}_a)^3}{100 \sigma_a^3}$	$K_a = \frac{\Sigma f (m_m - \bar{x}_a)^4}{100 \sigma_a^4}$

(b) Geometric Method of Moments

Mean	Standard Deviation	Skewness	Kurtosis
$\bar{x}_g = \exp \frac{\Sigma f \ln m_m}{100}$	$\sigma_g = \exp \sqrt{\frac{\Sigma f (\ln m_m - \ln \bar{x}_g)^2}{100}}$	$Sk_g = \frac{\Sigma f (\ln m_m - \ln \bar{x}_g)^3}{100 \ln \sigma_g^3}$	$K_g = \frac{\Sigma f (\ln m_m - \ln \bar{x}_g)^4}{100 \ln \sigma_g^4}$

Sorting (σ_g)		Skewness (Sk_g)		Kurtosis (K_g)	
Very well sorted	< 1.27	Very fine skewed	< $^{-}$1.30	Very platykurtic	< 1.70
Well sorted	1.27 – 1.41	Fine skewed	$^{-}$1.30 – $^{-}$0.43	Platykurtic	1.70 – 2.55
Moderately well sorted	1.41 – 1.62	Symmetrical	$^{-}$0.43 – $^{+}$0.43	Mesokurtic	2.55 – 3.70
Moderately sorted	1.62 – 2.00	Coarse skewed	$^{+}$0.43 – $^{+}$1.30	Leptokurtic	3.70 – 7.40
Poorly sorted	2.00 – 4.00	Very coarse skewed	> $^{+}$1.30	Very leptokurtic	> 7.40
Very poorly sorted	4.00 – 16.00				
Extremely poorly sorted	> 6.00				

(c) Logarithmic Method of Moments

Mean	Standard Deviation	Skewness	Kurtosis
$\bar{x}_\phi = \frac{\Sigma f m_\phi}{100}$	$\sigma_\phi = \sqrt{\frac{\Sigma f (m_\phi - \bar{x}_\phi)^2}{100}}$	$Sk_\phi = \frac{\Sigma f (m_\phi - \bar{x}_\phi)^3}{100 \sigma_\phi^3}$	$K_\phi = \frac{\Sigma f (m_\phi - \bar{x}_\phi)^4}{100 \sigma_\phi^4}$

Sorting (σ_ϕ)		Skewness (Sk_ϕ)		Kurtosis (K_ϕ)	
Very well sorted	< 0.35	Very fine skewed	> $^{+}$1.30	Very platykurtic	< 1.70
Well sorted	0.35 – 0.50	Fine skewed	$^{+}$0.43 – $^{+}$1.30	Platykurtic	1.70 – 2.55
Moderately well sorted	0.50 – 0.70	Symmetrical	$^{-}$0.43 – $^{+}$0.43	Mesokurtic	2.55 – 3.70
Moderately sorted	0.70 – 1.00	Coarse skewed	$^{-}$0.43 – $^{-}$1.30	Leptokurtic	3.70 – 7.40
Poorly sorted	1.00 – 2.00	Very coarse skewed	< $^{-}$1.30	Very leptokurtic	> 7.40
Very poorly sorted	2.00 – 4.00				
Extremely poorly sorted	> 4.00				

(d) Logarithmic (Original) Folk and Ward (1957) Graphical Measures

Mean	Standard Deviation	Skewness	Kurtosis
$M_Z = \frac{\phi_{16} + \phi_{50} + \phi_{84}}{3}$	$\sigma_I = \frac{\phi_{84} - \phi_{16}}{4} + \frac{\phi_{95} - \phi_5}{6.6}$	$Sk_I = \frac{\phi_{16} + \phi_{84} - 2\phi_{50}}{2(\phi_{84} - \phi_{16})} + \frac{\phi_5 + \phi_{95} - 2\phi_{50}}{2(\phi_{95} - \phi_5)}$	$K_G = \frac{\phi_{95} - \phi_5}{2.44(\phi_{75} - \phi_{25})}$

Sorting (σ_I)		Skewness (Sk_I)		Kurtosis (K_G)	
Very well sorted	< 0.35	Very fine skewed	$^{+}$0.3 to $^{+}$1.0	Very platykurtic	< 0.67
Well sorted	0.35 – 0.50	Fine skewed	$^{+}$0.1 to $^{+}$0.3	Platykurtic	0.67 – 0.90
Moderately well sorted	0.50 – 0.70	Symmetrical	$^{+}$0.1 to $^{-}$0.1	Mesokurtic	0.90 – 1.11
Moderately sorted	0.70 – 1.00	Coarse skewed	$^{-}$0.1 to $^{-}$0.3	Leptokurtic	1.11 – 1.50
Poorly sorted	1.00 – 2.00	Very coarse skewed	$^{-}$0.3 to $^{-}$1.0	Very leptokurtic	1.50 – 3.00
Very poorly sorted	2.00 – 4.00			Extremely leptokurtic	> 3.00
Extremely poorly sorted	> 4.00				

(e) Geometric Folk and Ward (1957) Graphical Measures

Mean	tandard Deviation
$M_G = \exp \frac{\ln P_{16} + \ln P_{50} + \ln P_{84}}{3}$	$\sigma_G = \exp\left(\frac{\ln P_{16} - \ln P_{84}}{4} + \frac{\ln P_5 - \ln P_{95}}{6.6}\right)$
Skewness	**Kurtosis**
$Sk_G = \frac{\ln P_{16} + \ln P_{84} - 2(\ln P_{50})}{2(\ln P_{84} - \ln P_{16})} + \frac{\ln P_5 + \ln P_{95} - 2(\ln P_{50})}{2(\ln P_{25} - \ln P_5)}$	$K_G = \frac{\ln P_5 - \ln P_{95}}{2.44(\ln P_{25} - \ln P_{75})}$

Sorting (σ_G)		Skewness (Sk_G)		Kurtosis (K_G)	
Very well sorted	< 1.27	Very fine skewed	$^{-}0.3$ to $^{-}1.0$	Very platykurtic	< 0.67
Well sorted	1.27 – 1.41	Fine skewed	$^{-}0.1$ to $^{-}0.3$	Platykurtic	0.67 – 0.90
Moderately well sorted	1.41 – 1.62	Symmetrical	$^{-}0.1$ to $^{+}0.1$	Mesokurtic	0.90 – 1.11
Moderately sorted	1.62 – 2.00	Coarse skewed	$^{+}0.1$ to $^{+}0.3$	Leptokurtic	1.11 – 1.50
Poorly sorted	2.00 – 4.00	Very coarse skewed	$^{+}0.3$ to $^{+}1.0$	Very leptokurtic	1.50 – 3.00
Very poorly sorted	4.00 – 16.00			Extremely leptokurtic	> 3.00
Extremely poorly sorted	> 6.00				

Table 2. *Size scale adopted in the GRADISTAT program, modified from Udden (1914) and Wentworth (1922).*

Grain Size phi	Grain Size mm	Descriptive term	
		Very Large	Boulder
-10	1024		
		Large	Boulder
-9	512		
		Medium	Boulder
-8	256		
		Small	Boulder
-7	128		
		Very small	Boulder
-6	64		
		Very coarse	Gravel
-5	32		
		Coarse	Gravel
-4	16		
		Medium	Gravel
-3	8		
		Fine	Gravel
-2	4		
		Very fine	Gravel
-1	2		
		Very coarse	Sand
0			
	microns	Coarse	Sand
1	500		
		Medium	Sand
2	250		
		Fine	Sand
3	125		
		Very fine	Sand
4	3		
		Very coarse	Silt
5	1		
		Coarse	Silt
6	6		
		Medium	Silt
7			
		Fine	Silt
8			
		Very fine	Silt
9			
		Clay	

B.1 Intertidal PSA

SAMPLE STATISTICS

		Site 01	Site 02	Site 03	Site 04	Site 05	Site 06	Site 07
	ANALYST AND DATE:	IMD, 5/11/2022	IMD, 5/11/2022	IMD, 5/11/2022	IMD, 5/11/2022	IMD, 5/11/2022	IMD, 5/11/2022	IMD, 5/11/2022
	SIEVING ERROR:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	SAMPLE TYPE:	Bimodal, Very Poorly Sorted	Bimodal, Poorly Sorted	Bimodal, Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Moderately Well Sorted	Unimodal, Moderately Well Sorted	Unimodal, Poorly Sorted
	TEXTURAL GROUP:	Sandy Mud	Sandy Mud	Sandy Mud	Muddy Sand	Sand	Sand	Sand
	SEDIMENT NAME:	Very Fine Sandy Medium Silt	Very Fine Sandy Medium Silt	Very Fine Sandy Medium Silt	Medium Silty Fine Sand	Moderately Well Sorted Fine Sand	Moderately Well Sorted Fine Sand	Poorly Sorted Fine Sand
METHOD OF MOMENTS Arithmetic (µm)	MEAN ($\bar{x}_a$):	60.47	32.74	39.71	172.6	203.3	233.7	218.5
	SORTING (σ_a):	79.92	52.74	66.24	100.8	80.41	90.89	105.9
	SKEWNESS (Sk_a):	2.868	4.526	4.636	0.092	0.499	0.101	0.032
	KURTOSIS (K_a):	16.08	38.58	34.13	2.638	3.036	3.268	2.959
METHOD OF MOMENTS Geometric (µm)	MEAN ($\bar{x}_g$):	25.83	14.54	17.42	112.5	182.2	201.3	165.8
	SORTING (σ_g):	4.001	3.372	3.442	3.457	1.620	1.978	2.693
	SKEWNESS (Sk_g):	-0.058	0.372	0.306	-1.752	-1.767	-3.465	-2.480
	KURTOSIS (K_g):	2.019	2.568	2.555	5.088	10.19	18.64	9.151
METHOD OF MOMENTS Logarithmic (φ)	MEAN ($\bar{x}_\phi$):	5.275	6.103	5.843	3.153	2.457	2.312	2.593
	SORTING (σ_ϕ):	2.000	1.754	1.783	1.790	0.696	0.984	1.429
	SKEWNESS (Sk_ϕ):	0.058	-0.372	-0.306	1.752	1.767	3.465	2.480
	KURTOSIS (K_ϕ):	2.019	2.568	2.555	5.088	10.19	18.64	9.151
FOLK AND WARD METHOD (µm)	MEAN (M_G):	25.86	14.73	17.68	114.7	186.9	222.7	202.8
	SORTING (σ_G):	4.125	3.508	3.552	3.185	1.536	1.475	2.164
	SKEWNESS (Sk_G):	-0.023	0.184	0.143	-0.605	-0.060	-0.069	-0.377
	KURTOSIS (K_G):	0.760	0.955	0.897	2.324	1.047	1.033	2.378
FOLK AND WARD METHOD (φ)	MEAN (M_Z):	5.273	6.085	5.822	3.124	2.420	2.167	2.302
	SORTING (σ_I):	2.044	1.810	1.828	1.671	0.619	0.561	1.113
	SKEWNESS (Sk_I):	0.023	-0.184	-0.143	0.605	0.060	0.069	0.377
	KURTOSIS (K_G):	0.760	0.955	0.897	2.324	1.047	1.033	2.378
FOLK AND WARD METHOD (Description)	MEAN:	Coarse Silt	Medium Silt	Coarse Silt	Very Fine Sand	Fine Sand	Fine Sand	Fine Sand
	SORTING:	Very Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Moderately Well Sorted	Moderately Well Sorted	Poorly Sorted
	SKEWNESS:	Symmetrical	Coarse Skewed	Coarse Skewed	Very Fine Skewed	Symmetrical	Symmetrical	Very Fine Skewed
	KURTOSIS:	Platykurtic	Mesokurtic	Platykurtic	Very Leptokurtic	Mesokurtic	Mesokurtic	Very Leptokurtic
	MODE 1 (µm):	84.50	9.184	9.184	181.0	181.0	256.0	256.0
	MODE 2 (µm):	9.184	84.50	84.50				
	MODE 3 (µm):							
	MODE 1 (φ):	3.613	6.859	6.859	2.487	2.487	1.987	1.987
	MODE 2 (φ):	6.859	3.613	3.613				
	MODE 3 (φ):							
	D_{10} (µm):	4.077	3.152	3.691	11.61	110.8	127.4	78.43
	D_{50} (µm):	25.94	12.49	15.21	170.2	188.6	224.0	211.3
	D_{90} (µm):	150.2	89.56	99.52	295.8	311.7	364.3	365.3
	(D_{90} / D_{10}) (µm):	36.84	28.41	26.96	25.48	2.813	2.860	4.657
	(D_{90} - D_{10}) (µm):	146.1	86.40	95.82	284.2	200.9	237.0	286.8
	(D_{75} / D_{25}) (µm):	10.30	5.593	6.219	2.087	1.768	1.688	1.828
	(D_{75} - D_{25}) (µm):	76.49	27.33	36.20	122.7	109.5	116.4	127.4
	D_{10} (φ):	2.735	3.481	3.329	1.757	1.682	1.457	1.453
	D_{50} (φ):	5.268	6.323	6.039	2.555	2.406	2.158	2.243
	D_{90} (φ):	7.938	8.309	8.082	6.428	3.174	2.973	3.672
	(D_{90} / D_{10}) (φ):	2.902	2.387	2.428	3.658	1.887	2.041	2.528
	(D_{90} - D_{10}) (φ):	5.203	4.828	4.753	4.671	1.492	1.516	2.220
	(D_{75} / D_{25}) (φ):	1.945	1.506	1.581	1.509	1.414	1.418	1.476
	(D_{75} - D_{25}) (φ):	3.364	2.484	2.637	1.061	0.822	0.756	0.870
	% GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% SAND:	33.3%	15.1%	18.5%	83.3%	98.3%	96.2%	90.7%
	% MUD:	66.7%	84.9%	81.5%	16.7%	1.7%	3.8%	9.3%
	% V COARSE GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% COARSE GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% MEDIUM GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% FINE GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% V FINE GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% V COARSE SAND:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% COARSE SAND:	0.3%	0.1%	0.3%	0.0%	0.0%	0.1%	0.3%
	% MEDIUM SAND:	2.9%	0.7%	1.4%	21.1%	25.7%	38.6%	35.0%
	% FINE SAND:	11.4%	4.8%	4.9%	48.7%	57.2%	51.9%	48.0%
	% V FINE SAND:	18.7%	9.4%	11.8%	13.5%	15.5%	5.6%	7.4%
	% V COARSE SILT:	13.4%	11.3%	13.1%	1.0%	0.2%	0.4%	0.7%
	% COARSE SILT:	13.3%	16.9%	17.6%	3.8%	0.9%	1.3%	2.6%
	% MEDIUM SILT:	16.2%	22.6%	22.0%	4.6%	0.5%	0.8%	2.5%
	% FINE SILT:	14.3%	20.3%	18.0%	4.2%	0.1%	0.7%	2.1%
	% V FINE SILT:	8.3%	12.2%	9.6%	2.8%	0.0%	0.6%	1.3%
	% CLAY:	1.1%	1.7%	1.3%	0.3%	0.0%	0.0%	0.1%

B.2 Intertidal TOC

Crucible ID	Sample	Weight of crucible (g)	Weight of crucible + wet sample (g)	Weight of crucible + dry sample @105 (g)	Weight of crucible + dry sample @475 (g)	Weight of dry material @105 (g)	Weight of dry material @475 (g)	LOI475
1	1	36.85	88.12	67.25	66.13	30.40	29.28	3.68
2	2	36.57	86.17	65.22	64.02	28.65	27.45	4.19
3	3	36.56	72.87	56.39	55.43	19.83	18.87	4.84
4	4	35.58	88.75	77.17	76.95	41.59	41.37	0.53
5	5	35.07	82.59	73.54	73.40	38.47	38.33	0.36
6	6	36.70	98.58	85.72	85.50	49.02	48.80	0.45
7	7	36.16	86.18	75.29	75.02	39.13	38.86	0.69

B.3 Subtidal PSA

	SAMPLE STATISTICS								
		lot = 1	lot = 1	lot = 1	lot = 1	lot = 1	lot = 1	lot = 1	lot = 1
	ANALYST AND DATE:	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022
	SIEVING ERROR:								
	SAMPLE TYPE:	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted
	TEXTURAL GROUP:	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand
	SEDIMENT NAME:	y Very Fine Gravelly Fine Silty Fine	y Very Fine Gravelly Fine Silty Fine	y Very Fine Gravelly Fine Silty Fine	y Very Fine Gravelly Fine Silty Fine	y Very Fine Gravelly Fine Silty Fine	y Very Fine Gravelly Fine Silty Fine	y Very Fine Gravelly Fine Silty Fine	y Very Fine Gravelly Fine Silty Fine
METHOD OF	MEAN ($\bar{x}_a$):	155.8	154.3	153.9	151.1	151.5	152.0	151.8	150.1
MOMENTS	SORTING (σ_a):	512.2	512.0	512.2	511.6	511.8	512.1	511.6	511.7
Arithmetic (μm)	SKEWNESS (Sk_a):	14.80	14.82	14.81	14.88	14.86	14.83	14.88	14.88
	KURTOSIS (K_a):	256.3	256.8	256.4	258.1	257.5	257.0	258.0	258.0
METHOD OF	MEAN ($\bar{x}_g$):	42.75	42.22	41.84	41.00	40.93	41.23	41.47	40.37
MOMENTS	SORTING (σ_g):	6.294	6.265	6.267	6.220	6.229	6.190	6.218	6.230
Geometric (μm)	SKEWNESS (Sk_g):	-0.392	-0.383	-0.370	-0.350	-0.343	-0.343	-0.369	-0.340
	KURTOSIS (K_g):	2.117	2.117	2.111	2.090	2.083	2.099	2.115	2.092
METHOD OF	MEAN ($\bar{x}_\phi$):	4.548	4.566	4.579	4.608	4.611	4.600	4.592	4.631
MOMENTS	SORTING (σ_ϕ):	2.654	2.647	2.648	2.637	2.639	2.630	2.637	2.639
Logarithmic (ϕ)	SKEWNESS (Sk_ϕ):	0.392	0.383	0.370	0.350	0.343	0.343	0.369	0.340
	KURTOSIS (K_ϕ):	2.117	2.117	2.111	2.090	2.083	2.099	2.115	2.092
FOLK AND	MEAN (M_G):	46.53	45.62	44.94	44.82	44.43	43.88	45.42	43.84
WARD METHOD	SORTING (σ_G):	5.955	5.931	5.957	5.840	5.865	5.875	5.841	5.867
(μm)	SKEWNESS (Sk_G):	-0.471	-0.456	-0.435	-0.450	-0.434	-0.404	-0.462	-0.429
	KURTOSIS (K_G):	0.673	0.671	0.672	0.663	0.663	0.665	0.668	0.665
FOLK AND	MEAN (M_Z):	4.426	4.454	4.476	4.480	4.492	4.510	4.461	4.512
WARD METHOD	SORTING (σ_I):	2.574	2.568	2.574	2.546	2.552	2.555	2.546	2.553
(ϕ)	SKEWNESS (Sk_I):	0.471	0.456	0.435	0.450	0.434	0.404	0.462	0.429
	KURTOSIS (K_G):	0.673	0.671	0.672	0.663	0.663	0.665	0.668	0.665
FOLK AND	MEAN:	Very Coarse Silt	Very Coarse Silt	Very Coarse Silt	Very Coarse Silt	Very Coarse Silt	Very Coarse Silt	Very Coarse Silt	Very Coarse Silt
WARD METHOD	SORTING:	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted
(Description)	SKEWNESS:	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed
	KURTOSIS:	Platykurtic	Platykurtic	Platykurtic	Very Platykurtic	Very Platykurtic	Very Platykurtic	Very Platykurtic	Very Platykurtic
	MODE 1 (μm):	213.4	213.4	213.4	213.4	213.4	213.4	213.4	213.4
	MODE 2 (μm):	6.669	6.669	6.669	6.669	6.669	6.669	6.669	6.669
	MODE 3 (μm):								
	MODE 1 (ϕ):	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250
	MODE 2 (ϕ):	7.250	7.250	7.250	7.250	7.250	7.250	7.250	7.250
	MODE 3 (ϕ):								
	D_{10} (μm):	3.110	3.101	3.089	3.142	3.134	3.150	3.149	3.105
	D_{50} (μm):	88.41	84.58	81.12	81.85	79.51	75.13	84.31	77.89
	D_{90} (μm):	301.0	297.8	299.4	288.4	291.7	295.8	289.5	288.5
	(D_{90} / D_{10}) (μm):	96.79	96.04	96.93	91.80	93.08	93.91	91.94	92.92
	(D_{90} - D_{10}) (μm):	297.9	294.7	296.3	285.3	288.5	292.7	286.4	285.4
	(D_{75} / D_{25}) (μm):	24.30	24.20	24.32	24.25	24.45	24.25	23.84	24.29
	(D_{75} - D_{25}) (μm):	186.5	184.2	183.6	180.8	181.4	182.4	180.7	178.6
	D_{10} (ϕ):	1.732	1.748	1.740	1.794	1.778	1.757	1.788	1.793
	D_{50} (ϕ):	3.500	3.564	3.624	3.611	3.653	3.734	3.568	3.682
	D_{90} (ϕ):	8.329	8.333	8.338	8.314	8.318	8.310	8.311	8.331
	(D_{90} / D_{10}) (ϕ):	4.809	4.768	4.793	4.635	4.679	4.729	4.647	4.646
	(D_{90} - D_{10}) (ϕ):	6.597	6.586	6.599	6.520	6.540	6.553	6.523	6.538
	(D_{75} / D_{25}) (ϕ):	2.948	2.932	2.930	2.911	2.920	2.921	2.902	2.898
	(D_{75} - D_{25}) (ϕ):	4.603	4.597	4.604	4.600	4.612	4.600	4.575	4.602
	% GRAVEL:	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
	% SAND:	53.6%	53.2%	52.8%	52.6%	52.3%	51.8%	53.0%	52.1%
	% MUD:	45.8%	46.2%	46.6%	46.8%	47.1%	47.6%	46.4%	47.2%
	% V COARSE GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% COARSE GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% MEDIUM GRAVEL:	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
	% FINE GRAVEL:	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
	% V FINE GRAVEL:	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
	% V COARSE SAND:	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
	% COARSE SAND:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% MEDIUM SAND:	14.1%	13.7%	13.8%	12.8%	13.1%	13.6%	12.8%	12.7%
	% FINE SAND:	26.4%	26.1%	25.5%	26.7%	26.2%	25.1%	26.8%	26.0%
	% V FINE SAND:	12.7%	12.9%	13.0%	12.6%	12.6%	12.6%	12.9%	13.0%
	% V COARSE SILT:	5.1%	5.4%	5.6%	4.8%	5.1%	6.2%	4.8%	5.1%
	% COARSE SILT:	6.6%	6.6%	6.6%	6.8%	6.7%	6.6%	6.8%	6.8%
	% MEDIUM SILT:	9.5%	9.5%	9.5%	10.1%	10.0%	9.8%	10.0%	10.0%
	% FINE SILT:	11.5%	11.5%	11.6%	12.0%	12.0%	11.9%	11.8%	12.1%
	% V FINE SILT:	8.2%	8.2%	8.3%	8.3%	8.3%	8.3%	8.1%	8.4%
	% CLAY:	5.0%	5.0%	5.0%	4.8%	4.8%	4.7%	4.9%	4.9%

	SAMPLE STATISTICS								
		lot = 1	**Average**	**lot = 2**	**lot = 2**	**lot = 2**	**Average**	**lot = 3**	**lot = 3**
	ANALYST AND DATE:	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022
	SIEVING ERROR:								
	SAMPLE TYPE:	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted
	TEXTURAL GROUP:	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud
	SEDIMENT NAME:	y Very Fine Gravelly Fine Silty Fine	y Very Fine Gravelly Fine Silty Fine	Very Fine Gravelly Very Fine Sandy	Very Fine Gravelly Very Fine Sandy	Very Fine Gravelly Very Fine Sandy	Very Fine Gravelly Very Fine Sandy	Fine Gravelly Very Fine Sandy Ver	Fine Gravelly Very Fine Sandy Ver
METHOD OF	MEAN ($\bar{x}_a$):	151.1	152.4	36.86	38.18	39.20	38.08	45.61	46.64
MOMENTS	SORTING (σ_a):	511.8	511.9	57.87	61.83	64.44	61.44	70.53	71.72
Arithmetic (μm)	SKEWNESS (Sk_a):	14.87	14.85	7.738	7.067	6.613	7.101	21.76	20.75
	KURTOSIS (K_a):	257.7	257.3	281.4	220.4	188.6	225.2	1067.0	996.8
METHOD OF	MEAN ($\bar{x}_g$):	40.85	41.40	14.25	14.41	14.53	14.40	19.37	19.69
MOMENTS	SORTING (σ_g):	6.226	6.238	4.162	4.217	4.258	4.212	4.294	4.321
Geometric (μm)	SKEWNESS (Sk_g):	-0.347	-0.360	0.100	0.114	0.127	0.114	-0.268	-0.269
	KURTOSIS (K_g):	2.093	2.101	2.212	2.222	2.230	2.222	2.069	2.072
METHOD OF	MEAN ($\bar{x}_\phi$):	4.613	4.594	6.133	6.117	6.104	6.118	5.690	5.666
MOMENTS	SORTING (σ_ϕ):	2.638	2.641	2.057	2.076	2.090	2.075	2.102	2.111
Logarithmic (ϕ)	SKEWNESS (Sk_ϕ):	0.347	0.360	-0.100	-0.114	-0.127	-0.114	0.268	0.269
	KURTOSIS (K_ϕ):	2.093	2.101	2.212	2.222	2.230	2.222	2.069	2.072
FOLK AND	MEAN (M_G):	44.17	44.83	14.50	14.57	14.62	14.56	19.91	20.28
WARD METHOD	SORTING (σ_G):	5.872	5.884	4.297	4.333	4.365	4.331	4.297	4.328
(μm)	SKEWNESS (Sk_G):	-0.431	-0.442	0.149	0.147	0.149	0.148	-0.162	-0.168
	KURTOSIS (K_G):	0.664	0.666	0.800	0.797	0.800	0.799	0.737	0.740
FOLK AND	MEAN (M_Z):	4.501	4.479	6.108	6.101	6.095	6.101	5.650	5.624
WARD METHOD	SORTING (σ_I):	2.554	2.557	2.103	2.115	2.126	2.115	2.103	2.114
(ϕ)	SKEWNESS (Sk_I):	0.431	0.442	-0.149	-0.147	-0.149	-0.148	0.162	0.168
	KURTOSIS (K_G):	0.664	0.666	0.800	0.797	0.800	0.799	0.737	0.740
FOLK AND	MEAN:	Very Coarse Silt	Very Coarse Silt	Medium Silt	Medium Silt	Medium Silt	Medium Silt	Coarse Silt	Coarse Silt
WARD METHOD	SORTING:	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted
(Description)	SKEWNESS:	Very Fine Skewed	Very Fine Skewed	Coarse Skewed	Coarse Skewed	Coarse Skewed	Coarse Skewed	Fine Skewed	Fine Skewed
	KURTOSIS:	Very Platykurtic	Very Platykurtic	Platykurtic	Platykurtic	Platykurtic	Platykurtic	Platykurtic	Platykurtic
	MODE 1 (μm):	213.4	213.4	6.669	6.669	6.669	6.669	75.45	75.45
	MODE 2 (μm):	6.669	6.669	75.45	75.45	75.45	75.45	6.669	6.669
	MODE 3 (μm):								
	MODE 1 (ϕ):	2.250	2.250	7.250	7.250	7.250	7.250	3.750	3.750
	MODE 2 (ϕ):	7.250	7.250	3.750	3.750	3.750	3.750	7.250	7.250
	MODE 3 (ϕ):								
	D_{10} (μm):	3.116	3.122	2.480	2.468	2.464	2.471	2.738	2.755
	D_{50} (μm):	78.73	81.13	11.92	12.03	12.09	12.01	23.46	24.14
	D_{90} (μm):	290.9	293.7	103.2	104.5	106.0	104.6	111.9	114.1
	(D_{90} / D_{10}) (μm):	93.37	94.09	41.61	42.35	43.02	42.32	40.88	41.42
	(D_{90} - D_{10}) (μm):	287.8	290.6	100.7	102.0	103.5	102.1	109.2	111.3
	(D_{75} / D_{25}) (μm):	24.37	24.27	9.981	10.21	10.32	10.17	11.77	11.83
	(D_{75} - D_{25}) (μm):	180.5	182.1	43.21	44.14	44.62	43.99	61.91	62.78
	D_{10} (ϕ):	1.781	1.768	3.276	3.258	3.238	3.258	3.159	3.132
	D_{50} (ϕ):	3.667	3.624	6.391	6.377	6.370	6.380	5.414	5.373
	D_{90} (ϕ):	8.326	8.323	8.655	8.662	8.665	8.661	8.513	8.504
	(D_{90} / D_{10}) (ϕ):	4.674	4.709	2.642	2.659	2.676	2.659	2.695	2.715
	(D_{90} - D_{10}) (ϕ):	6.545	6.556	5.379	5.404	5.427	5.403	5.353	5.372
	(D_{75} / D_{25}) (ϕ):	2.912	2.920	1.758	1.770	1.776	1.768	1.916	1.922
	(D_{75} - D_{25}) (ϕ):	4.607	4.601	3.319	3.352	3.367	3.346	3.557	3.564
	% GRAVEL:	0.6%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% SAND:	52.3%	52.6%	20.0%	20.2%	20.4%	20.2%	27.7%	28.1%
	% MUD:	47.1%	46.7%	80.0%	79.8%	79.6%	79.8%	72.3%	71.9%
	% V COARSE GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% COARSE GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% MEDIUM GRAVEL:	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% FINE GRAVEL:	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% V FINE GRAVEL:	0.3%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% V COARSE SAND:	0.5%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% COARSE SAND:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% MEDIUM SAND:	13.0%	13.3%	1.0%	1.4%	1.7%	1.4%	0.8%	1.0%
	% FINE SAND:	26.0%	26.1%	5.5%	5.4%	5.4%	5.4%	6.3%	6.7%
	% V FINE SAND:	12.8%	12.8%	13.4%	13.4%	13.3%	13.4%	20.5%	20.4%
	% V COARSE SILT:	5.3%	5.3%	12.3%	12.6%	12.7%	12.5%	18.0%	18.0%
	% COARSE SILT:	6.7%	6.7%	11.7%	11.5%	11.4%	11.5%	9.9%	9.9%
	% MEDIUM SILT:	9.8%	9.8%	17.0%	16.7%	16.5%	16.7%	12.5%	12.3%
	% FINE SILT:	12.0%	11.8%	19.8%	19.7%	19.6%	19.7%	15.4%	15.3%
	% V FINE SILT:	8.4%	8.3%	12.7%	12.8%	12.8%	12.7%	10.7%	10.7%
	% CLAY:	4.8%	4.9%	6.5%	6.6%	6.6%	6.6%	5.7%	5.7%

SAMPLE STATISTICS

		lot = 3	Average	lot = 4	lot = 4	lot = 4	Average	lot = 5	lot = 5
	ANALYST AND DATE:	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022
	SIEVING ERROR:								
	SAMPLE TYPE:	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Poorly Sorted
	TEXTURAL GROUP:	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand	Slightly Gravelly Sand	Slightly Gravelly Sand
	SEDIMENT NAME:	Fine Gravelly Very Fine Sandy Ver	Fine Gravelly Very Fine Sandy Ver	y Very Fine Gravelly Fine Silty Fine	y Very Fine Gravelly Fine Silty Fine	y Very Fine Gravelly Fine Silty Fine	y Very Fine Gravelly Fine Silty Fin	Slightly Very Fine Gravelly Fine San	Slightly Very Fine Gravelly Fine San
METHOD OF MOMENTS Arithmetic (μm)	MEAN ($\bar{x}_a$):	46.78	46.35	186.5	187.6	187.4	187.1	183.3	183.7
	SORTING (σ_a):	71.94	71.40	147.7	148.0	147.6	147.8	299.9	300.0
	SKEWNESS (Sk_a):	20.58	21.02	12.21	12.13	12.23	12.19	29.15	29.13
	KURTOSIS (K_a):	984.9	1015.2	313.1	310.4	313.8	312.4	1122.2	1121.2
METHOD OF MOMENTS Geometric (μm)	MEAN ($\bar{x}_g$):	19.75	19.60	122.0	122.9	123.3	122.7	128.2	128.4
	SORTING (σ_g):	4.321	4.312	3.529	3.524	3.491	3.515	2.871	2.872
	SKEWNESS (Sk_g):	-0.270	-0.269	-2.058	-2.068	-2.070	-2.065	-2.326	-2.329
	KURTOSIS (K_g):	2.075	2.072	6.699	6.748	6.748	6.732	9.409	9.427
METHOD OF MOMENTS Logarithmic (ϕ)	MEAN ($\bar{x}_\phi$):	5.662	5.673	3.035	3.025	3.019	3.026	2.964	2.961
	SORTING (σ_ϕ):	2.111	2.108	1.819	1.817	1.803	1.813	1.521	1.522
	SKEWNESS (Sk_ϕ):	0.270	0.269	2.058	2.068	2.070	2.065	2.326	2.329
	KURTOSIS (K_ϕ):	2.075	2.072	6.699	6.748	6.748	6.732	9.409	9.427
FOLK AND WARD METHOD (μm)	MEAN (M_G):	20.33	20.17	165.7	166.6	166.6	166.3	155.7	156.0
	SORTING (σ_G):	4.328	4.318	2.554	2.556	2.545	2.552	2.255	2.258
	SKEWNESS (Sk_G):	-0.170	-0.167	-0.442	-0.442	-0.441	-0.442	-0.362	-0.361
	KURTOSIS (K_G):	0.741	0.739	2.550	2.569	2.580	2.566	2.243	2.244
FOLK AND WARD METHOD (ϕ)	MEAN (M_Z):	5.620	5.632	2.594	2.586	2.585	2.588	2.683	2.680
	SORTING (σ_I):	2.114	2.110	1.353	1.354	1.348	1.351	1.173	1.175
	SKEWNESS (Sk_I):	0.170	0.167	0.442	0.442	0.441	0.442	0.362	0.361
	KURTOSIS (K_G):	0.741	0.739	2.550	2.569	2.580	2.566	2.243	2.244
FOLK AND WARD METHOD (Description)	MEAN:	Coarse Silt	Coarse Silt	Fine Sand	Fine Sand	Fine Sand	Fine Sand	Fine Sand	Fine Sand
	SORTING:	Very Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted
	SKEWNESS:	Fine Skewed	Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed	Very Fine Skewed
	KURTOSIS:	Platykurtic	Platykurtic	Very Leptokurtic	Very Leptokurtic	Very Leptokurtic	Very Leptokurtic	Very Leptokurtic	Very Leptokurtic
	MODE 1 (μm):	75.45	75.45	213.4	213.4	213.4	213.4	150.9	150.9
	MODE 2 (μm):	6.669	6.669						
	MODE 3 (μm):								
	MODE 1 (ϕ):	3.750	3.750	2.250	2.250	2.250	2.250	2.750	2.750
	MODE 2 (ϕ):	7.250	7.250						
	MODE 3 (ϕ):								
	D_{10} (μm):	2.760	2.751	14.27	14.58	15.01	14.61	66.25	66.42
	D_{50} (μm):	24.28	23.96	178.8	179.8	179.6	179.4	161.4	161.7
	D_{90} (μm):	114.3	113.4	318.6	320.1	319.2	319.3	292.1	292.9
	(D_{90} / D_{10}) (μm):	41.40	41.23	22.33	21.96	21.26	21.85	4.410	4.409
	(D_{90} - D_{10}) (μm):	111.5	110.7	304.3	305.5	304.2	304.7	225.9	226.4
	(D_{75} / D_{25}) (μm):	11.79	11.80	1.991	1.982	1.971	1.981	1.975	1.975
	(D_{75} - D_{25}) (μm):	62.73	62.47	120.9	121.0	120.0	120.6	110.1	110.3
	D_{10} (ϕ):	3.129	3.140	1.650	1.643	1.648	1.647	1.775	1.772
	D_{50} (ϕ):	5.364	5.383	2.483	2.476	2.477	2.479	2.631	2.629
	D_{90} (ϕ):	8.501	8.506	6.131	6.100	6.058	6.097	3.916	3.912
	(D_{90} / D_{10}) (ϕ):	2.716	2.709	3.715	3.712	3.677	3.702	2.206	2.208
	(D_{90} - D_{10}) (ϕ):	5.371	5.366	4.481	4.457	4.410	4.450	2.141	2.141
	(D_{75} / D_{25}) (ϕ):	1.921	1.919	1.487	1.485	1.481	1.484	1.454	1.454
	(D_{75} - D_{25}) (ϕ):	3.560	3.560	0.993	0.987	0.979	0.986	0.982	0.982
	% GRAVEL:	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%
	% SAND:	28.1%	27.9%	85.9%	86.0%	86.1%	86.0%	90.5%	90.6%
	% MUD:	71.9%	72.0%	14.0%	13.9%	13.8%	13.9%	9.3%	9.2%
	% V COARSE GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% COARSE GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% MEDIUM GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% FINE GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
	% V FINE GRAVEL:	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
	% V COARSE SAND:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
	% COARSE SAND:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% MEDIUM SAND:	1.0%	0.9%	22.5%	22.9%	22.7%	22.7%	15.9%	16.0%
	% FINE SAND:	6.7%	6.6%	51.6%	51.5%	51.8%	51.6%	54.1%	54.0%
	% V FINE SAND:	20.4%	20.4%	11.7%	11.5%	11.5%	11.6%	20.4%	20.4%
	% V COARSE SILT:	18.1%	18.0%	0.9%	0.9%	0.9%	0.9%	0.3%	0.3%
	% COARSE SILT:	9.9%	9.9%	2.8%	2.7%	2.7%	2.7%	2.1%	2.1%
	% MEDIUM SILT:	12.3%	12.4%	2.8%	2.8%	2.7%	2.8%	2.0%	1.9%
	% FINE SILT:	15.2%	15.3%	3.6%	3.6%	3.6%	3.6%	2.3%	2.3%
	% V FINE SILT:	10.6%	10.7%	2.5%	2.5%	2.5%	2.5%	1.7%	1.7%
	% CLAY:	5.7%	5.7%	1.4%	1.4%	1.3%	1.4%	0.9%	0.9%

SAMPLE STATISTICS

		lot = 5	Average	lot = 6	lot = 6	lot = 6	Average
	ANALYST AND DATE:	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022	Olly, 5/6/2022
	SIEVING ERROR:						
	SAMPLE TYPE:	Unimodal, Poorly Sorted	Unimodal, Poorly Sorted	Unimodal, Moderately Sorted	Unimodal, Moderately Sorted	Unimodal, Moderately Sorted	Unimodal, Moderately Sorted
	TEXTURAL GROUP:	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand
	SEDIMENT NAME:	Slightly Very Fine Gravelly Fine San	Slightly Very Fine Gravelly Fine San	Slightly Medium Gravelly Fine Sand	Slightly Medium Gravelly Fine Sand	Slightly Medium Gravelly Fine Sand	Slightly Medium Gravelly Fine Sand
METHOD OF MOMENTS Arithmetic (μm)	MEAN ($\bar{x}_a$):	183.2	183.4	246.5	245.6	246.1	246.1
	SORTING (σ_a):	299.9	299.9	486.9	486.8	486.8	486.9
	SKEWNESS (Sk_a):	29.15	29.14	23.90	23.92	23.92	23.91
	KURTOSIS (K_a):	1122.4	1122.0	632.0	632.8	632.6	632.5
METHOD OF MOMENTS Geometric (μm)	MEAN ($\bar{x}_g$):	127.9	128.2	187.1	185.6	186.1	186.3
	SORTING (σ_g):	2.877	2.873	2.261	2.302	2.300	2.288
	SKEWNESS (Sk_g):	-2.327	-2.328	-2.621	-2.699	-2.704	-2.677
	KURTOSIS (K_g):	9.399	9.412	14.73	14.85	14.90	14.84
METHOD OF MOMENTS Logarithmic (ϕ)	MEAN ($\bar{x}_\phi$):	2.967	2.964	2.418	2.429	2.426	2.424
	SORTING (σ_ϕ):	1.524	1.523	1.177	1.203	1.202	1.194
	SKEWNESS (Sk_ϕ):	2.327	2.328	2.621	2.699	2.704	2.677
	KURTOSIS (K_ϕ):	9.399	9.412	14.73	14.85	14.90	14.84
FOLK AND WARD METHOD (μm)	MEAN (M_G):	155.5	155.7	208.3	207.8	208.2	208.1
	SORTING (σ_G):	2.259	2.257	1.649	1.645	1.642	1.646
	SKEWNESS (Sk_G):	-0.363	-0.362	-0.137	-0.138	-0.134	-0.136
	KURTOSIS (K_G):	2.250	2.246	1.173	1.173	1.162	1.170
FOLK AND WARD METHOD (ϕ)	MEAN (M_Z):	2.685	2.683	2.263	2.267	2.264	2.265
	SORTING (σ_I):	1.176	1.175	0.721	0.718	0.716	0.719
	SKEWNESS (Sk_I):	0.363	0.362	0.137	0.138	0.134	0.136
	KURTOSIS (K_G):	2.250	2.246	1.173	1.173	1.162	1.170
FOLK AND WARD METHOD (Description)	MEAN:	Fine Sand	Fine Sand	Fine Sand	Fine Sand	Fine Sand	Fine Sand
	SORTING:	Poorly Sorted	Poorly Sorted	Moderately Sorted	Moderately Sorted	Moderately Sorted	Moderately Sorted
	SKEWNESS:	Very Fine Skewed	Very Fine Skewed	Fine Skewed	Fine Skewed	Fine Skewed	Fine Skewed
	KURTOSIS:	Very Leptokurtic	Very Leptokurtic	Leptokurtic	Leptokurtic	Leptokurtic	Leptokurtic
	MODE 1 (μm):	150.9	150.9	213.4	213.4	213.4	213.4
	MODE 2 (μm):						
	MODE 3 (μm):						
	MODE 1 (ϕ):	2.750	2.750	2.250	2.250	2.250	2.250
	MODE 2 (ϕ):						
	MODE 3 (ϕ):						
	D_{10} (μm):	66.14	66.27	109.5	109.4	109.7	109.5
	D_{50} (μm):	161.3	161.5	211.1	210.6	211.0	210.9
	D_{90} (μm):	291.8	292.3	353.5	352.1	352.7	352.8
	(D_{90} / D_{10}) (μm):	4.412	4.410	3.229	3.217	3.215	3.221
	(D_{90} - D_{10}) (μm):	225.7	226.0	244.0	242.6	243.0	243.2
	(D_{75} / D_{25}) (μm):	1.976	1.975	1.881	1.876	1.878	1.878
	(D_{75} - D_{25}) (μm):	110.0	110.1	134.3	133.4	133.8	133.9
	D_{10} (ϕ):	1.777	1.775	1.500	1.506	1.503	1.503
	D_{50} (ϕ):	2.632	2.631	2.244	2.247	2.245	2.245
	D_{90} (ϕ):	3.918	3.915	3.191	3.192	3.188	3.191
	(D_{90} / D_{10}) (ϕ):	2.205	2.206	2.127	2.119	2.121	2.122
	(D_{90} - D_{10}) (ϕ):	2.142	2.141	1.691	1.686	1.685	1.687
	(D_{75} / D_{25}) (ϕ):	1.454	1.454	1.506	1.502	1.504	1.504
	(D_{75} - D_{25}) (ϕ):	0.982	0.982	0.912	0.908	0.909	0.909
	% GRAVEL:	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%
	% SAND:	90.5%	90.5%	94.9%	94.9%	95.0%	95.0%
	% MUD:	9.3%	9.3%	4.8%	4.8%	4.8%	4.8%
	% V COARSE GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% COARSE GRAVEL:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	% MEDIUM GRAVEL:	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%
	% FINE GRAVEL:	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
	% V FINE GRAVEL:	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
	% V COARSE SAND:	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
	% COARSE SAND:	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%
	% MEDIUM SAND:	15.8%	15.9%	34.4%	34.2%	34.4%	34.3%
	% FINE SAND:	54.0%	54.0%	52.3%	52.6%	52.5%	52.5%
	% V FINE SAND:	20.5%	20.4%	8.0%	8.0%	8.0%	8.0%
	% V COARSE SILT:	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
	% COARSE SILT:	2.1%	2.1%	1.4%	1.2%	1.2%	1.3%
	% MEDIUM SILT:	1.9%	2.0%	0.9%	0.9%	0.9%	0.9%
	% FINE SILT:	2.3%	2.3%	1.2%	1.3%	1.3%	1.3%
	% V FINE SILT:	1.8%	1.7%	0.7%	0.9%	0.9%	0.8%
	% CLAY:	0.9%	0.9%	0.2%	0.2%	0.2%	0.2%

B.4 Subtidal TOC

Site	Organic content (%)
1	3.265230364
2	4.554876584
3	3.462654695
4	0.739623124
5	0.506977037
6	0.374356859

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