Net Zero Teesside – Environmental Statement

Planning Inspectorate Reference: EN010103

Volume III – Appendices

Appendix 14A: Intertidal Benthic Ecology Survey Report

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended)

Prepared by: AECOM

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14A. Intertidal Benthic Ecology Survey Report

14.1 Introduction

Project Background

14.1.1 Net Zero Teesside Power Limited (NZT Power) and Net Zero North Sea Storage Limited (NZNS Storage), together the Applicants are seeking Development Consent for the construction, operation, maintenance and decommissioning of the Net Zero Teesside (NZT) Carbon Capture, Usage and Storage (CCUS) Project (the Proposed Development). The Proposed Development comprises the construction, operation and decommissioning of a CCUS facility comprising a gas-fired generating station with an electrical output of up to 860 MWe, together with equipment required for the capture and compression of carbon dioxide (CO_2) emissions from the power generating station. In addition, there is a need for the provision of supporting infrastructure and connections to support the power generating station and to facilitate the development of a wider industrial carbon capture network on Teesside, the construction of which also forms part of the Proposed Development. The Proposed Development also includes high-pressure compression of CO_2 and the onshore section of a pipeline to export the captured CO_2 for off-shore storage.

14.1.2 The Proposed Development forms the onshore part of the wider NZT Project; further details related to this are provided in Chapter 4: Proposed Development (ES Volume I, Document Ref 6.2).

14.1.3 As a Nationally Significant Infrastructure Project (NSIP) under the Planning Act 2008, the construction and operation of the Proposed Onshore Scheme must be authorised by a Development Consent Order (DCO), issued by the Secretary of State for Business, Energy and Industrial Strategy. An application for a Marine Licence, made to the Marine Management Organisation (MMO), for all marine construction works and activities carried out below the Mean High Water mark is also required under the Marine and Coastal Access Act 2009.

Aims and Objectives

14.1.4 The purpose of this report is to present the results of the Phase I and Phase II intertidal benthic surveys undertaken for this project, and to highlight key intertidal benthic receptors that may be affected by the development.

14.1.5 This report is intended to form part of the benthic ecological baseline characterisation study that will be undertaken to inform the various assessments required to obtain development consent.

Study Area

14.1.6 The intertidal Study Area extends from the south bank of the Tees Estuary to Redcar, encompassing South Gare breakwater and Coatham Sands. The spatial extent of the intertidal study area was chosen on the basis that it encompasses the respective intertidal habitats and species found within the vicinity of the Proposed Development. Figure 14A-1 indicates the boundary of this Study Area.

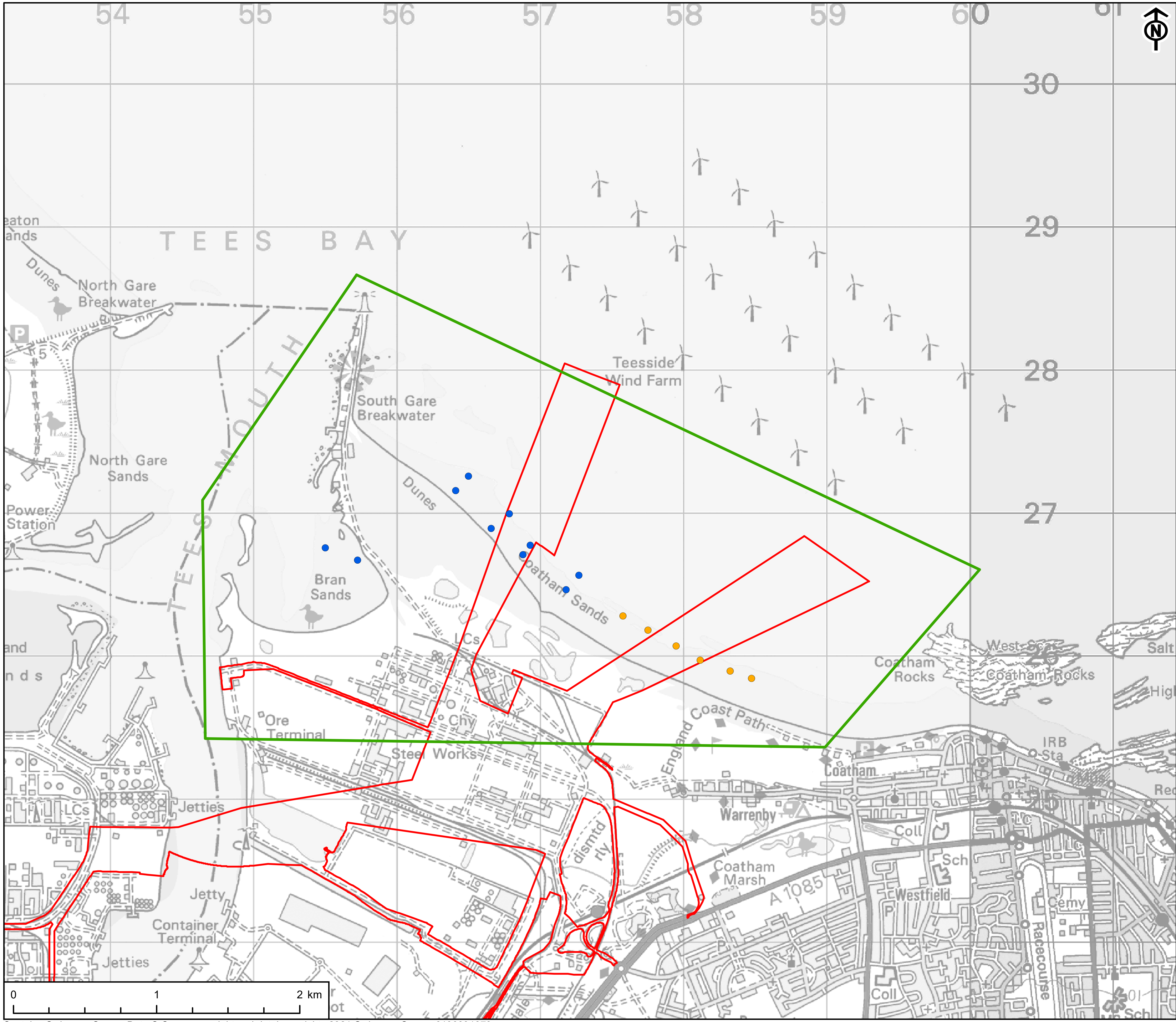
Structure of Report

14.1.7 This report is structured as follows:

- **Section 14.2: Methodology** – summarises the methodology for undertaking the Phase I and Phase II intertidal benthic surveys as well as the approaches taken for sample and data analysis;
- **Section 14.3: Results** – outlines the results of the Phase I and Phase II intertidal benthic surveys;
- **Section 14.4: Discussion** – Discusses the results of the project-specific surveys in relation to existing publicly available information; and
- **Section 14.5: Summary of Findings** – provides a summary of the findings of the project-specific surveys and a desk-based study for intertidal benthic ecology.

Figure 14A-1: Intertidal Phase I study area and Phase II sampling stations

Project Management Initials: RL Designer: LC Checked: AR Approved: RG



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PROJECT

NET ZERO TEESSIDE PROJECT

Net Zero Teesside

APPLICANTS

NZT POWER LTD. AND NZNS STORAGE LTD.

KEY

- Site Boundary
- Phase I Intertidal Study Area
- Phase II Intertidal Sample Location - 2019
- Phase II Intertidal Sample Location - 2021

TITLE

FIGURE 14A-1
INTERTIDAL PHASE I STUDY AREA AND PHASE II SAMPLING STATIONS

REFERENCE

NZT_210511_IBS_14A-1_v5

SHEET NUMBER	DATE
1 of 1	11/05/21

14.2 Methodology

Field Surveys

14.2.1 The intertidal Phase I and Phase II surveys were undertaken in order to characterise the intertidal habitats and species present within the study area. An initial desk-based study was undertaken to identify any protected areas and habitats and species expected to be present within the study area (Figure 14A-1). The surveys took place around low tide on the 15th and 16th October 2019 by two experienced AECOM marine ecologists.

14.2.2 The Phase I survey methodology comprised a walkover survey involving a full visual assessment of the intertidal study area in order to characterise the habitats and species present. A total of nine transects distributed across the study area were walked vertically down through the intertidal zone. Stations were placed within the upper, middle and lower shore environments where detailed visual assessments took place in order to identify and map the extent and distribution of the broad marine habitat types and species present. There was a total of 27 sampling stations.

14.2.3 All field surveys were undertaken in accordance with the procedural guidelines outlined in the Marine Monitoring Handbook (Davies *et al.*, 2001). Photographs were taken and target notes recorded at the sampling stations and where any marine ecological features of interest were observed. The presence of any marine algae was also recorded, and notes were taken of any conspicuous fauna, as well as any evidence of, or potential for, the presence of protected and/or notable marine species.

14.2.4 The intertidal Phase II survey was undertaken in conjunction with the Phase I survey and involved taking intertidal cores for laboratory-based macroinvertebrate analysis, Particle Size Distribution (PSD) and chemical analysis. In total, 10 sampling stations were located across the intertidal zone between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS) (Figure 14A-1). At each station, triplicate 0.01 m^2 sediment cores to a depth of approximately 15 cm were taken. A sub-sample was removed for PSD analysis whilst the remaining sample was sieved through a 1 mm mesh and transferred to a suitably sized container and preserved using a 4% formalin solution for subsequent faunal analysis by a third-party laboratory. An additional core sample was also taken and the sediment transferred to the appropriate containers for chemical analysis by a third-party laboratory.

14.2.5 Following consultation with the MMO in December 2020, where details were outlined for the proposed replacement of the outfall infrastructure to run along the CO_2 corridor, it was agreed that additional intertidal Phase II sampling would be undertaken. As such, six additional core samples were taken at low tide on the 5th February 2021 by experienced marine ecologists, at the stations shown in Figure 14A-1. The methodology follows that used in 2019 and is described further below, although no additional chemical analysis was undertaken in 2021.

Laboratory and Data Analysis

Particle Size Distribution

14.2.6 PSD analysis was undertaken by Ocean Ecology Limited (OEL) which is a North East Atlantic Marine Biological Quality Control (NMBAQC) participating laboratory. The analysis was completed in line with NMBAQC protocols (Mason, 2016), using dry sieving for the >1 mm fraction and laser diffraction for the fine fraction residue (<1 mm). Further information can be found in Annex A.

14.2.7 The dry sieve and laser data were merged for each sample with the results expressed as a percentage of the whole sample. Once the data was merged, PSD statistics and sediment classifications were generated from the percentages of the sediment determined for each sediment fraction using the Gradistat v8 software (Blott, 2010).

14.2.8 Sediment descriptions were defined by their size class based on the Wentworth classification system (Wentworth, 1922) (Table 14A-1). Statistics such as mean and median grain size, sorting coefficient, skewness and bulk sediment classes (percentage silt, sand and gravel) were also derived in accordance with the Folk classification (Folk, 1954).

Table 14A-1: Classification used for defining sediment type based on the Wentworth Classification System (Wentworth, 1922)

Wentworth Scale	Phi units (φ)	Sediment Type
≥256 mm	≥8	Boulders
64 - 256 mm	-8 to -6	Cobble
4 - 64 mm	-6 to -2	Pebble
2 - 4 mm	-2 to -1	Granule
1 - 2 mm	-1 to 0	Very coarse sand
0.5 - 1 mm	0 to 1	Coarse sand
250 - 500 µm	1 to 2	Medium sand
125 - 250 µm	2 to 3	Fine sand
63 - 125 µm	3 to 4	Very fine sand
15.63 - 63 µm	4 to 5	Coarse silt
7.81 - 15.63 µm	5 to 6	Medium silt
3.91 - 7.81 µm	6 to 7	Fine silt
1.95 - 3.91 µm	7 to 8	Very fine silt
<1.95 µm	8 to 10	Clay

Sediment Chemistry Analysis

14.2.9 All chemical and metal analysis was undertaken by SOCOTEC UK Limited in accordance with MMO Marine Licensing Requirements. Table 14A-2 summarises the analytics.

Table 14A-2: MMO marine sediment analysis carried out by SOCOTEC UK Ltd.

Determinand	Limit of Detection	Method/Instrument
Organic matter (Total Organic Carbon)	0.02%	Carbonate removal and sulphurous acid/combustion at 800°`C/NDIR
Metals suite (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc)	0.015 – 2 mg/kg	Aqua-regia extraction & ICP-MS
Organotins (DBT, TBT)	0.001 mg/kg	Acid digest and solvent extraction GC-MS
Polycyclic Aromatic Hydrocarbons (DTI 2-6 ring aromatics + EPA 16)	1 µg/kg	Solvent extraction & GC-MS
Total Hydrocarbon Content	1 mg/kg	Ultra-violet fluorescence spectroscopy
Polychlorinated Biphenyls (25 congeners including ICES 7)	0.00008 mg/kg	Solvent extraction & GC Triple Quad
Organochlorine pesticides	0.0001mg/kg	Solvent extraction & GC Triple Quad

Macrofaunal Analysis

14.2.10 Macrobenthic analysis was undertaken by OEL in line with the NMBAQC Processing Requirement Protocol (PRP) (Worsfold and Hall, 2010).

14.2.11 All biota present was identified to species level, where possible, and enumerated by trained benthic taxonomists using the most up to date taxonomic literature and checked against existing reference collections and the World Register of Marine Species (WoRMS) for the latest taxonomic nomenclature. Colonial taxa (e.g. hydroids and bryozoans) were identified to species level where possible and recorded as present (P).

14.2.12 Major group biomass (Annelida, Crustacea, Mollusca, Echinodermata and Other taxa) was measured to the nearest 0.0001 g blotted wet weight. As a standard, the conventional conversion factors as defined by Eleftheriou and Basford (1989) were then applied to provide equivalent dry weight biomass (Ash Free Dry Weight). The conversion factors applied were:

- Annelida = 15.5 %;
- Crustacea = 22.5 %;
- Mollusca = 8.5 %;
- Echinodermata = 8.0%; and
- Other = 15.5 %.

14.2.13 A single reference collection preserved in 70% IDA of all taxa identified was retained for Quality Assurance (QA) purposes.

14.2.14 The macrofaunal community structure and diversity was analysed using the following parameters:

- abundance (N);
- biomass (g);
- species richness (S) (total number of species); and
- species diversity (H' loge) (Shannon-Wiener index).

14.2.15 The PRIMER v7 software package (Clarke and Gorley, 2015) was utilised to undertake multivariate statistical analysis on the macrobenthic dataset. In order to fully investigate the multivariate patterns in the data, a suite of analytical routines was employed – further information can be found in Section 14.3.

Habitat Classification

14.2.16 Environmental, PSD and macrofaunal data obtained during the surveys was used to classify the habitats present in accordance with the European Union Nature Information System (EUNIS) classification system shown in Table 14A-3 (EEA, 2012). This classification system uses standard descriptions called 'biotopes', which categorise habitats based on the marine zone, the physical nature of the habitat and the biological communities observed. For example, marine habitats can be divided into littoral (also known as intertidal) and subtidal zones, and then classified according to the physical nature of the substratum, either rock or sediment, and the biological community found. Habitats observed were recorded to the lowest level possible.

Table 14A-3: Example of the five-level EUNIS classification system (EEA, 2012)

Level	Habitat Detail
1. Environment	Marine (A)
2. General Habitats	Sublittoral sediment (A5)
3. Broad Scale Habitat	Sublittoral sand (A5.2)
4. Biotope Complexes	Infralittoral fine sand (A5.23)
5. Biotopes	[*Fucus vesiculosus*] on variable salinity mid eulittoral boulders and stable mixed substrata (A1.323)

14.3 Results

Intertidal Phase I Survey

14.3.1 Results from the intertidal Phase I survey indicate that the study area can be divided into four physically and biologically distinct areas; Coatham Sands, South Gare Breakwater, Paddy's Hole and Bran Sands (Figure 14A-1). These areas showed ecological variability which is likely to be due to abiotic differences including the level of wave exposure and substrate composition. The location of each area and the distribution of the associated biotopes is shown in Figure 14A-2. Due to the high mobility and variable spatial distribution of the biotopes and biotope complexes found to be present, biotope mapping across Coatham Sands is limited to broad scale habitat types.

14.3.2 Coatham Sands consists of an extensive area of exposed intertidal sandflats running for approximately 4 km from Redcar to South Gare breakwater. This area was characterised by a number of littoral sand biotopes, all of which fall within the EUNIS broad scale habitat type 'littoral sand and muddy sand' (A2.2) and are comprised of clean sands (no more than 25% silt and clay content). These habitats are subject to high wave exposure and as a result of this, are relatively mobile and exhibit low biological diversity.

14.3.3 The most widespread biotope found at Coatham Sands was 'barren or amphipod-dominated mobile sand shores' (EUNIS A2.22) being present at 15 out of 18 stations distributed across this region of the study area (Annex B). In addition to this, the biotope 'talitrids on the upper shore and strandline' (EUNIS A2.211) was present at one station towards the southern end of Coatham Sands, and 'polychaetes in littoral fine sand' (EUNIS A2.231) was present at two stations towards the northern end. The biotopes 'barren or amphipod-dominated mobile sand shores' (EUNIS A2.22) and 'polychaetes in littoral fine sand' (EUNIS A2.231) both fall within the Annex I habitat 'mudflats and sandflats not covered by seawater at low tide' although are not a qualifying feature of any nearby designated site. With the exception of lugworm casts (*Arenicola* sp.), identified towards the northern end of Coatham Sands, very little evidence of benthic faunal activity was observed across Coatham Sands.

14.3.4 Bran Sands is located to the west of Coatham Sands on the other side of the dune system, within the mouth of the Tees Estuary. This site was characterised by homogenous intertidal muddy sandflats, typified by the biotope '[*Cerastoderma edule*] and polychaetes in littoral muddy sand' (EUNIS A2.242). This biotope which is representative of intertidal mudflats qualifies as both an Annex I priority habitat type and representative of UK habitats of principal importance under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 although is not a qualifying feature of any nearby designated site. The location of Bran Sands means that it is comparatively sheltered from wave exposure, thereby allowing silt deposition and the formation of more muddy substrates. This muddy and sheltered habitat has allowed a more productive community of polychaetes and shellfish to develop compared to Coatham Sands. In particular, the intertidal Phase I survey identified higher abundances of the common cockle (*Cerastoderma edule*) and the lugworm (*Arenicola marina*).

14.3.5 South Gare breakwater is an area of coastal protection located to the north of Coatham Sands. It is comprised of loose cobbles/boulders which covers much of the intertidal zone. This area is highly exposed to wave action and therefore substrates are relatively mobile. As a result of this, very low diversity and abundance of species and habitats was observed in this area during the intertidal Phase I survey. South Gare breakwater is characterised by the biotope '[*Semibalanus balanoides*] on exposed to moderately exposed or vertical sheltered eulittoral rock' (EUNIS A1.113), which qualifies as Annex I reef habitat. Despite this, the area does not represent a high quality naturally occurring example. Species identified within this area include the barnacle *Semibalanus balanoides*, and the seaweeds sea lettuce (*Ulva* sp.) and purple laver (*Porphyra umbilicalis*). The invasive non-native seaweed species (INNS) wakame (*Undaria pinnatifida*) was also observed sporadically in low quantities within this area.

14.3.6 Paddy's Hole is an artificial bay built into the western side of South Gare breakwater and functions as a harbour for inshore fishing vessels. Substrata within the bay is composed of similar material to that of South Gare breakwater; primarily loose cobbles/boulders. Paddy's Hole is sheltered from wave exposure and therefore the community composition differs from that found at South Gare breakwater, with dense coverage of bladder wrack (*Fucus vesiculosus*) found throughout the area. This area was found to be characterised by the biotope '[*Fucus vesiculosus*] on variable salinity mid eulittoral boulders and stable mixed substrata' (EUNIS A1.323), which qualifies as an Annex I priority habitat type and is representative of UK habitats of principal importance under Section 41 of the NERC Act 2006. However, the area does not represent a high quality naturally occurring example of this habitat type.

14.3.7 Table 14A-4 provides a summary of all intertidal biotopes present within the study area, including those listed for protection under the Habitats Directive and under Section 41 of the NERC Act 2006. Further description of these habitats is provided on page 14-14.

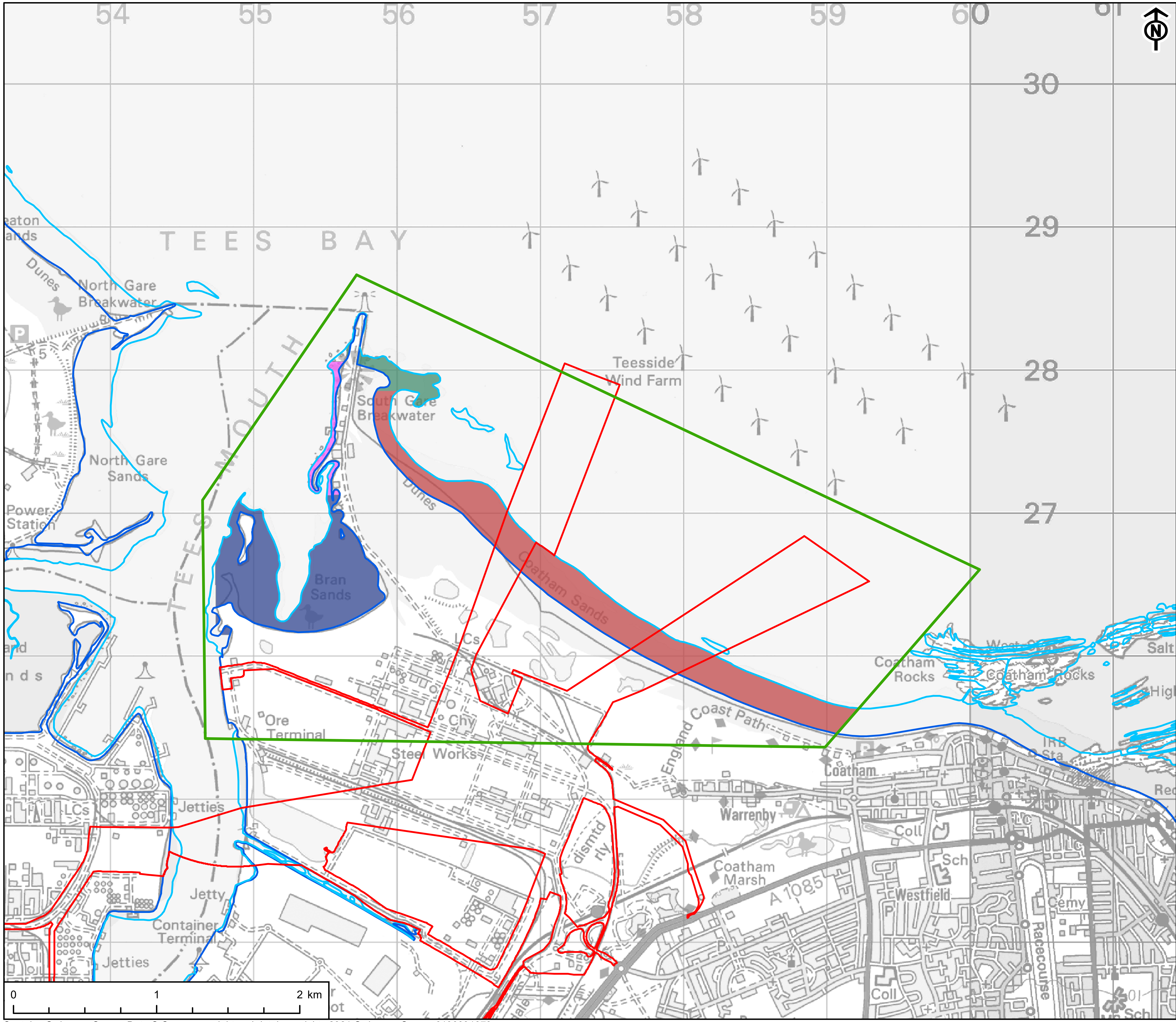
Table 14A-4: Summary of intertidal biotopes found within the study area during the Intertidal Phase I survey

Broad Scale Habitat	Biotope Complexes & Biotopes	Annex I Habitat Type	Section 41 of the NERC Act
A2.2 - Littoral sand and muddy sand	A2.211 - Talitrids on the upper shore and strandline	-	-
	A2.22 - Barren or amphipod-dominated mobile sand shores	Mudflats and sandflats not covered by seawater at low tide	-
	A2.231 - Polychaetes in littoral fine sand	Mudflats and sandflats not covered by seawater at low tide	-
	A2.242 - [*Cerastoderma edule*] and polychaetes in littoral muddy sand	Mudflats and sandflats not covered by seawater at low tide	Intertidal mudflats
A1.1 - High energy littoral rock	A1.113 - [*Semibalanus balanoides*] on exposed to moderately exposed or vertical sheltered eulittoral rock	Reef	-
A1.3 - Low energy littoral rock	A1.323 - [*Fucus vesiculosus*] on	Reef	Estuarine rocky habitats

Broad Scale Habitat	Biotope Complexes & Biotopes	Annex I Habitat Type	Section 41 of the NERC Act
	variable salinity mid eulittoral boulders and stable mixed substrata		

Figure 14A-2: Intertidal Phase I broad scale habitat map

Project Management Initials: RL Designer: LC Checked: AR Approved: RG



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PROJECT

NET ZERO TEESSIDE PROJECT

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KEY

- Site Boundary
- Phase I Intertidal Study Area
- Mean High Water Spring
- Mean Low Water Spring

Intertidal Phase I Broad Scale EUNIS Biotope

- A1.113, [Semibalanus balanoides] on exposed to moderately exposed or vertical sheltered eulittoral rock
- A1.323, [Fucus vesiculosus] on variable salinity mid eulittoral boulders and stable mixed substrata
- A2.2, Littoral sand and muddy sand
- A2.242, [Cerastoderma edule] and polychaetes in littoral muddy sand

TITLE

FIGURE 14A-2
INTERTIDAL PHASE I BROAD SCALE HABITAT MAP

REFERENCE

NZT_210511_IBS_14A-2_v5

SHEET NUMBER	DATE
1 of 1	11/05/21

Habitat Descriptions

14.3.8 The following descriptions are based upon those outlined within the EUNIS habitat classification system (EEA, 2012):

Littoral sand and muddy sand

A2.211 - Talitrids on the upper shore and strandline

14.3.9 Communities of sandhoppers (talitrid amphipods) often occur on shores where strandlines of decomposing seaweeds and other debris accumulate. The biotope occurs most frequently on medium and fine sand shores. The decaying debris provides humidity and cover for the sandhoppers. The distribution of this biotope is relatively mobile, with debris being moved with tidal influx and wave action. This biotope typically supports very low biodiversity and biomass (Figure 14A-4).

Figure 14A-4: Biotope A2.211 at Coatham Sands

Figure 14A-3: Biotope A2.22 at Coatham Sands

A2.22 - Barren or amphipod-dominated mobile sand shores

14.3.10 This biotope is characterised by shores consisting of clean mobile sands, with no mud present. Shells and stones may occasionally be present on the surface. Sand may be dunned or rippled as a result of wave action or tidal currents. The sands are non-cohesive and have relatively low water retention, particularly on the upper shore, and are thus subject to drying between tides. This biotope typically supports a very low biodiversity and biomass (Figure 14A-3).

A2.231 - Polychaetes in littoral fine sand

14.3.11 This biotope can be found on both exposed and sheltered beaches composed of medium to fine sand, with low mud content. The sediments are relatively stable and remain damp throughout the tidal cycle. An anoxic sub-layer is typically absent. This biotope predominantly occurs on the lower shore but may also be found at the middle shore (Figure 14A-6).

Figure 14A-6: Biotope A2.231 at Coatham

Figure 14A-5: Biotope A2.242 at Bran Sands

<u>*2.242* - Cerastoderma edule and polychaetes in littoral muddy sand</u>

14.3.12 This biotope is typically found on the mid to lower shore where sediment remains saturated with seawater most of the time. Sheltered areas are favoured, allowing fine silt deposits to accumulate on the shore with fine sand. This biotope often has high species diversity and biomass. Polychaetes and cockles typically dominate (Figure 14A-5).

High energy littoral rock

<u>A1.113 - Semibalanus balanoides on exposed to moderately exposed or vertical sheltered eulittoral rock</u>

14.3.13 This biotope is generally found on exposed to moderately exposed mid to upper eulittoral rock and boulders. Species diversity is very low, generally dominated by the barnacle *S. balanoides*. Biomass is also generally low. Seaweed species such as sea lettuce (*Ulva* sp.) and bladder wrack (*F. serratus*) may be found sheltered behind boulders (Figure 14A-8).

Figure 14A-8: Biotope A1.113 at South Gare breakwater

Figure 14A-7: Biotope A1.323 at Paddy's Hole

Low energy littoral rock

A1.323 - Fucus vesiculosus on variable salinity mid eulittoral boulders and stable mixed substrata

14.3.14 Present in sheltered to extremely sheltered mid eulittoral pebble/boulder dominated habitats. Fucoid seaweeds often occupy all available space forming a dense canopy over the substrata (Figure 14A-7).

Intertidal Phase II Survey

Particle Size Distribution

14.3.15 Sediment types at each sampling station, as described by the Folk (1954) classification system, are summarised in Table 14A-5. There was little variation between stations, with all of them being dominated by sandy sediments and a generally low mud content (sediments < 63 µm). Mud content was highest at Stations 1 and 2 which were located within the estuary at Bran Sands. This corresponds with observations made during the Phase I survey. In addition to mud, Stations 1 and 2 had a low quantity of gravel (sediments >2000 µm) present and therefore classified as ‘slightly gravelly sand’. Gravel was also present at station 8 which classified as ‘slightly gravelly sand’. All other sites consisted entirely of either ‘medium’ or ‘fine’ sand (sediments 63 – 2000 µm).

14.3.16 The sediment types at the additional sampling stations (stations A – F), taken in February 2021, were consistent with the other stations on Coatham Sands, being dominated by sandy sediments and a generally low mud content (sediments < 63 µm).

Table 14A-5: Summarised PSD data as classified by Folk (1954)

Station	Textural Group Classification	Folk and Ward Description	Folk and Ward Sorting	Mean µm	Mean phi	Major Sediment Fractions (%)			Modified Folk
						Gravel	Sand	Mud	
1	Slightly gravelly sand	Medium Sand	Moderately Sorted	270.9	1.884	0.3	94.3	5.4	(g)S
2	Slightly gravelly sand	Medium Sand	Moderately Sorted	269.9	1.889	0.4	92.6	7.0	(g)S
3	Sand	Medium Sand	Moderately Well Sorted	292.5	1.774	0.0	100.0	0.0	S
4	Sand	Medium Sand	Moderately Well Sorted	288.8	1.792	0.0	100.0	0.0	S
5	Sand	Medium Sand	Moderately Well Sorted	299.4	1.740	0.0	100.0	0.0	S
6	Sand	Medium Sand	Moderately Well Sorted	286.5	1.803	0.0	100.0	0.0	S
7	Sand	Medium Sand	Moderately Well Sorted	267.1	1.905	0.0	100.0	0.0	S
8	Slightly gravelly sand	Fine Sand	Moderately Well Sorted	231.6	2.110	3.5	96.5	0.0	(g)S
9	Sand	Fine Sand	Moderately Well Sorted	228.0	2.133	0.0%	100.0%	0.0%	S
10	Sand	Medium Sand	Moderately Sorted	302.4	1.725	0.0%	100.0%	0.0%	S
A*	Sand	Fine Sand	Well Sorted	247.3	2.015	0.0%	100.0%	0.0%	S
B*	Sand	Fine Sand	Moderately Well Sorted	248.4	2.009	0.0%	100.0%	0.0%	S
C*	Slightly gravelly sand	Fine Sand	Moderately Well Sorted	240.7	2.054	0.6%	99.4%	0.0%	(g)S
D*	Sand	Medium Sand	Moderately Sorted	278.5	1.844	0.0%	100.0%	0.0%	S
E*	Sand	Medium Sand	Poorly Sorted	445.3	1.167	0.0%	100.0%	0.0%	S
F*	Sand	Fine Sand	Moderately Sorted	241.0	2.053	0.0%	100.0%	0.0%	S

* Intertidal phase II core samples taken in February 2021

Sediment Chemistry

14.3.17 Sediment samples for contaminant analysis were collected at each of the 10 intertidal sampling stations. Samples were analysed for heavy and trace metals, Polycyclic Aromatic Hydrocarbons (PAHs), Total Hydrocarbon Content (THC), Organotins, Polychlorinated Biphenyls (PCB) and Organochlorine concentrations.

Heavy and Trace Metals

14.3.18 Concentrations of eight heavy and trace metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc) were analysed from sediments taken at each of the 10 sampling stations. In the absence of any statutory thresholds, sediment concentrations have been compared to guidelines published by the Centre for Environment, Fisheries and Aquaculture Science (Cefas, 2003), and the Canadian Council of Ministers of the Environment (CCME, 1999) where applicable (i.e. no Cefas threshold available), to determine whether there is evidence of contamination.

14.3.19 The Cefas guidelines relate to the disposal of dredge material. In general, contaminant levels in dredged material which fall below Action Level 1 (AL1) are of no concern. However, levels above Action Level 2 (AL2) generally suggest that the dredged material is not suitable for sea disposal. Contaminant levels between AL1 and AL2 typically require further investigation.

14.3.20 The Canadian sediment quality guidelines consist of Threshold Effects Levels (TELs) and Probable Effects Level (PELs) (CCME, 1999) which have been derived from field research which has looked at the associations between chemicals and biological effects and the establishment of cause and effect relationships in certain marine organisms. At levels above the TEL, adverse effects may occasionally occur and at levels above the PEL, adverse effects may occur frequently (CCME, 1999).

14.3.21 With the exception of arsenic, none of the heavy/trace metal concentrations sampled exceeded either Cefas or Canadian sediment quality guidelines at any of the sampling stations. Whilst arsenic was recorded at all 10 stations, concentrations at Station 5 (7.8 mg/Kg dry weight) exceeded the TEL (7.24 mg/Kg dry weight). Despite this, arsenic concentrations at this site remained below AL1 (20mg/Kg dry weight). A full summary of metal concentrations against the associated guidance thresholds can be found in Annex C.

Hydrocarbon Concentrations (PAHs and THC)

14.3.22 Concentrations of a range of PAHs as well as THC for all 10 sampling stations are presented in Annex C. Where available, PAH concentrations were compared to Effects Range Low (ERL) and Effects Range Medium (ERM) levels published by Long *et al*. (1995) as well as TELs and PELs (CCME, 1999).

14.3.23 ERL and ERM concentrations are not thresholds of toxicity but delineate concentration ranges with associated probabilities of toxicity. Concentrations below the ERL represent a range in which detrimental effects on marine ecology would rarely be observed. Concentrations equal to or above the ERL, but below the ERM, represent a range within which effects could be occasionally expected. Finally, concentrations equalling or exceeding the ERM represent a range within which effects could frequently be expected.

14.3.24 Similarly, Canadian TEL and PEL concentrations can be used as an assessment tool for identifying sediments in which adverse biological effects may occur (CCME, 1999). However, TELs and PELs should be treated as indicative, as they have been designed specifically for Canada and are based on the protection of pristine environments and species which may have different sensitivities to those in the North Sea.

14.3.25 Samples from all 10 sampling stations had a PAH concentration below Canadian TELs and PELs, and below ERL and ERM values (Long *et al*., 1995). THCs were also generally very low, with the exception of Stations 1 and 2 where THC levels of 10.0 mg/Kg (dry weight) and 31.5 mg/Kg (dry weight) were present, respectively. The United Kingdom Offshore Operators Association regards a value of 50 mg/kg to be the lower limit for a biological effect for THC (UKOOA, 2002).

Organotins

14.3.26 Samples collected for contaminant analysis were analysed for the organotins: Dibutyltine and Tributyltin. All concentrations of organotins were found to be below the limit of detection (Annex C).

Polychlorinated Biphenyls (PCBs)

14.3.27 All concentrations of PCBs sampled were below Cefas AL1 (0.01 mg/Kg dry weight) and the Canadian TELs (21.5 mg/Kg dry weight). Station 9 had the highest concentration of PCBs at 0.00118 mg/Kg (dry weight). All other stations exhibited concentrations of ≤0.00008 mg/kg (Annex C).

Organochlorines

14.3.28 Organochlorines were compared to Cefas (2003) AL1 thresholds as well as OSPAR Background Concentration (BC) levels (OSPAR, 1998). BCs are assessment tools intended to represent the concentrations of certain hazardous substances that would be expected in the North-East Atlantic if certain industrial developments had not happened. They represent the concentrations of those substances at “remote” sites, or in “pristine” conditions based on contemporary or historical data respectively, in the absence of significant mineralisation and/or oceanographic influences. In this way, they relate to the background values referred to in the OSPAR Hazardous Substances Strategy (OSPAR, 1998).

14.3.29 In the majority of instances, organochlorine concentrations fell below the limit of detection. The only exception was at Station 9; although elevated concentrations of three organochlorines were detected, concentrations remained below the OSPAR BC thresholds (0.050 mg/Kg dry weight). No comparative Cefas AL threshold is available for these substances.

Macrobenthos

14.3.30 The macrobenthic community identified within the intertidal study area exhibited low richness, diversity and abundance. In total, 23 taxa were recorded with a mean (± standard deviation (SD)) of 2.2 (± 1.7) taxa per sample. Shannon diversity (H’) indices ranged from zero, where no or a single taxon was recorded (n = 10), to 1.4. The mean (± SD) abundance was 8.1 (± 15.8) individuals per sample. These values exclude records of eggs, epitoke (the sexually mature pelagic life cycle stage of some polychaete species), megalopa (the final larval stage of a decapod crustacean), juvenile, parasitic, and zoea (early larval stage of a decapod crustacean) taxa. Appendix D presents the abundance of each taxon and biomass per major group (Annelida, Crustacea, Mollusca, Echinodermata and Others), in all samples collected across the survey area.

14.3.31 Figure 14A-9 illustrates the relative contributions to total abundance, species richness and biomass of the major taxonomic groups of macrofauna sampled within the intertidal study area. The 'other' group which is made up of predominately nematodes dominated the assemblage in terms of abundance, accounting for 34.4% of all individuals recorded across all areas. Annelids were the second greatest contributors to overall abundance (27.9%) followed by crustaceans, particularly amphipods, and molluscs which had similar abundances (17.6% and 20.1%, respectively). Annelids dominated species with a total of 11 taxa recorded, accounting for 45.5% of taxa identified across all stations. Crustaceans were the second most diverse group, accounting for 36.4% of taxa identified. Molluscs and 'others' both accounted for comparatively few taxa across all stations (9.1% each). Molluscs dominated the macrobenthos biomass within the intertidal study area, contributing 96.9% across all stations. This reflects a relatively high abundance of larger fauna. Despite having higher abundance overall, annelids and 'others' contributed 2.6% and 0.1% to total biomass, respectively. Crustaceans contributed 0.4% to total biomass across all stations.

14.3.32 Figure 14A-10 and Figure 14A-11 indicate that although nematodes dominated total abundance, they were not prevalent at all stations, occurring only 56.7% of the time (i.e. within 17 out of a possible 30 samples). The non-nematode species contributing most to total abundance (the mudsnail, *Peringia ulvae* and the polychaete, *Scolelepis (Scolelepis) squamata*) were also those which were most prevalent within samples. *Pontocrates arenarius* was also relatively prevalent within samples (30% occurrence) but contributed only 6.6% to total abundance. Species that contributed the least to total abundance where generally those which also occurred less frequently within samples (e.g. *Paraonis fulgens, Bathyporeia elegans* and *Macomangulus tenuis*).

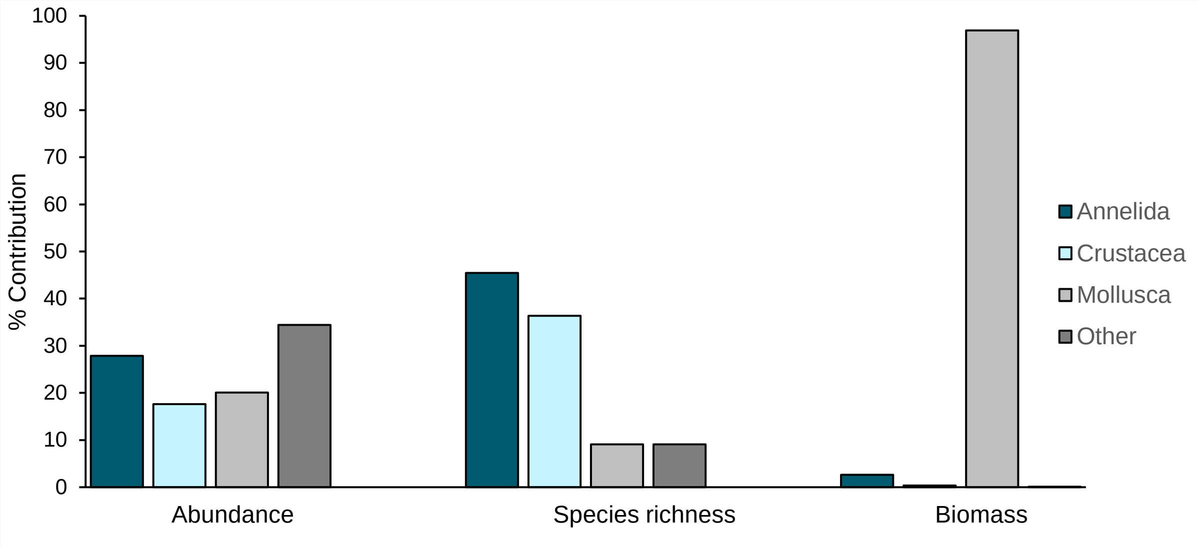

Figure 14A-9: Relative contribution of the major taxonomic groups to the total abundance, biomass and diversity of the macrobenthic communities sampled within the intertidal study area

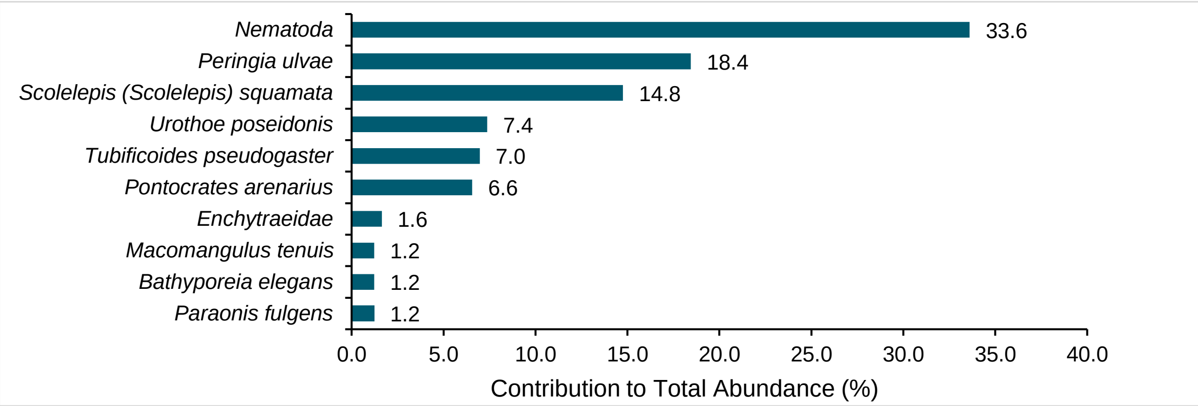

Figure 14A-10: Percentage contributions of the top 10 taxa to total abundance

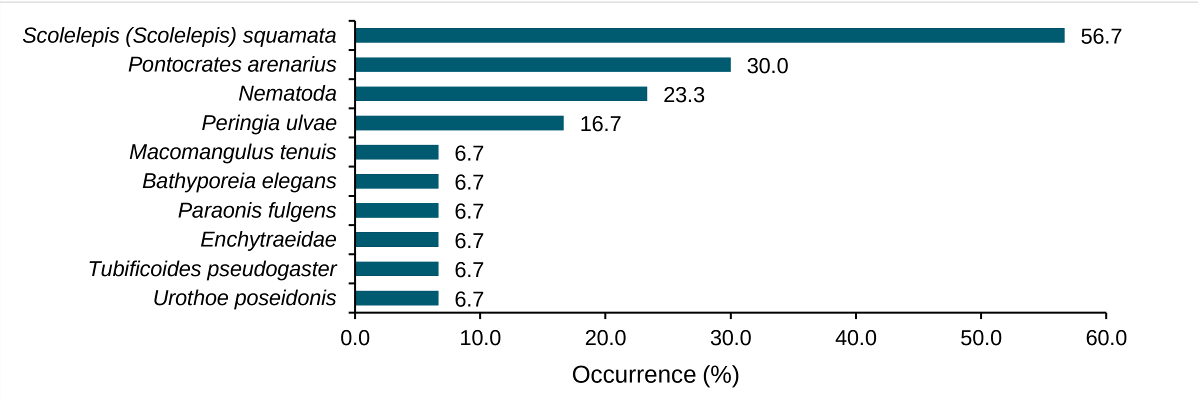

Figure 14A-11: Percentage occurrence of the top 10 taxa

14.3.33 Table 14A-6 presents average abundance, richness and diversity indices for each of the 10 sampling stations. Stations 1 and 2, located in Bran Sands, exhibited the highest abundance, species richness and diversity. Considerably fewer taxa and individuals were recorded at the other sampling stations located at Coatham Sands. Although one fewer taxon was recorded at Station 2 compared to Station 1, the diversity was higher which suggests that individuals recorded here are more evenly distributed between fewer taxa (i.e. no single species dominates).

Table 14A-6: Average abundance, species richness, diversity and biomass recorded at each of the 10 sampling stations

Station Number	Abundance (N)	Richness (S)	Diversity (H' loge)	Biomass (g)
1	52	11	1.5	1.244
2	11	10	1.6	0.280
3	1	1	0.0	<0.001
4	2	2	0.5	0.002
5	1	2	0.6	0.001
6	3	4	1.1	0.017
7	5	5	1.3	0.001
8	3	4	1.2	0.001
9	4	4	1.2	0.001
10	5	5	1.3	0.014

14.3.34 The difference in macrobenthic community composition between sampling stations was assessed using multi-variate analysis. A non-metric Multidimensional Scaling (MDS) plot[1] (Figure 14A-12) of intertidal macrofauna abundance data showed some clustering of station samples, with the species assemblages at Stations 1 and 2 suggesting divergence from Stations 3 to 10, and from each other. The MDS plot also suggests that in general, within station variability was limited, although in a few cases replicate data did show dissimilarity. Similarly, an MDS plot of the intertidal macrofauna biomass data (Figure 14A-13), also showed a clustering of samples from Stations 3 to 10, with dissimilarity between some but not all samples taken from Stations 1 and 2 (Station 1: Sample A vs. B and C; Station 2: Sample A and B vs. C).

14.3.35 The statistical significance of these patterns was determined through one-way analysis of similarities (ANOSIM) testing. The results of the one-way ANOSIM test of abundance data averaged for each station demonstrated that overall there was a statistically significant but small differences (Global $R = 0.378$, $p = 0.001$). Furthermore, the one-way ANOSIM test for intertidal macrofauna biomass data averaged for each station also showed a statistically significant but only slight differences (Global $R = 0.211$, $p = 0.001$). However, pairwise comparisons showed no significant difference between any two station both in terms of abundance and biomass.

[1] An MDS plot is a visual representation of the relative dissimilarity (distance) among samples. This is based on a Bray-Curtis analysis of similarities, which assesses the similarity of the community composition (i.e. the species present and their abundance) between samples.

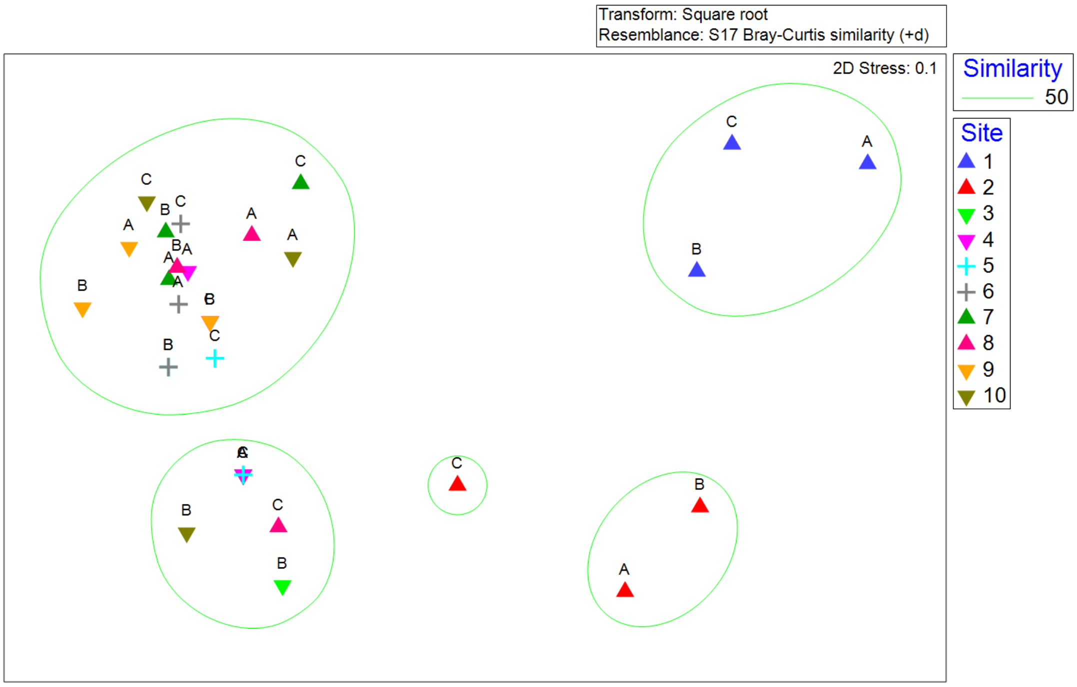

Figure 14A-12: Non-metric multidimensional scaling (MDS) plot of intertidal macrofauna abundance data from October 2019

14.3.36 Similarity Percentage (SIMPER) analysis[2] results showed that dissimilarity between Stations 1 and 2 was driven by the high relative abundances of Nematoda, mudsnail and *Tubificoides pseudogaster* as well as the absence of *Urothoe poseidonis* at Station 1 compared to Station 2. Combined, these taxa contributed 64.4% to total dissimilarity between Stations 1 and 2. Dissimilarity between the stations located in Bran Sands (Stations 1 and 2) and those located on Coatham Sands (Stations 3 – 10) was driven by the presence / absence of species rather than variations in relative abundances. For example, differences between Station 1 and Stations 3 – 10 was driven predominately by an absence of nematodes, mudsnail and *T. pseudogaster* at Stations 3 – 10. Combined these taxa contributed 58.4 – 63.9% to total dissimilarity between Station 1 and Stations 3 – 10. Similarly, differences between Station 2 and Stations 3 – 10 were driven predominately by a presence of *U. poseidonis* and mudnail at Station 2 but an absence of *S. squamata* compared with Stations 3 – 10. Differences between Stations 3 to 10 were generally driven by a variable abundance of the polychaete *S. squamata* as well as various amphipods species.

14.3.37 The results of the SIMPER analysis of average biomass data for each intertidal station showed that higher relative biomass of Mollusca at Stations 1 and 2 compared with all other stations (3 – 10) was the primarily driver of dissimilarity between these stations.

[2] Similarity Percentage (SIMPER) tests can be used to determine the individual taxa that contribute to the differences between groups of samples and the similarities between samples within a group. The SIMPER analysis uses a percentage contribution to dissimilarity as a measure of importance.

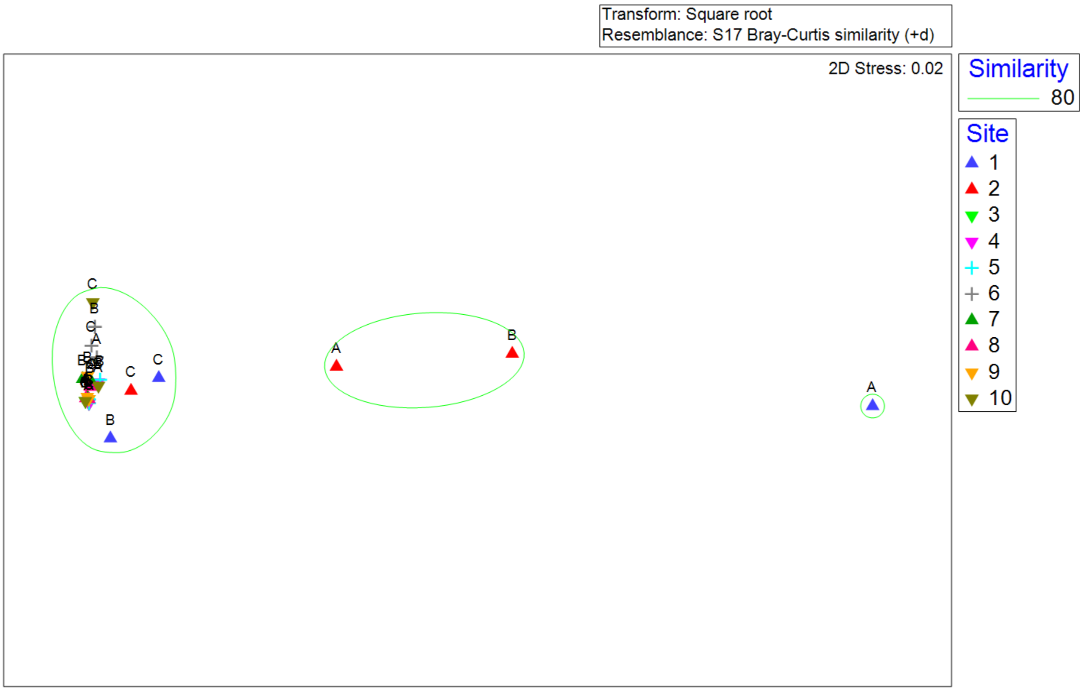

Figure 14A-13: Non-metric multidimensional scaling (MDS) plot of intertidal macrofauna biomass data from October 2019

Additional Intertidal Phase II Sampling

14.3.38 The additional intertidal Phase II sampling (undertaken in February 2021) identified a macrobenthic community which exhibited a similarly low richness, diversity and abundance to that recorded during the 2019 sampling (see Table 14A-7). In total, five taxa were recorded, including nematodes, the polychaete species *Paraonis fulgens* and *Scolelepis (Scolelepis) squamata*, and the amphipod species *Bathyporeia pelagica* and *P. arenarius*. These taxa were all recorded during the 2019 intertidal sampling and are not considered to be rare.

14.3.39 The mean species richness recorded across all six core samples (± SD) was 1.5 (± 0.8) taxa per sample. Shannon diversity (H') indices ranged from zero, where no or a single taxon was recorded, to 0.7. The mean (± SD) abundance was 2.2 (± 1.5) individuals per sample. The species richness, diversity and abundance recorded in 2021 were all comparable to that sampled in Coatham Sands in 2019.

Table 14A-7: Average abundance, species richness, diversity and biomass recorded at each of the six additional sampling stations (taken in February 2021)

Station	Abundance (N)	Richness (S)	Diversity (H' loge)	Biomass (g)
A	2	2	0.7	0.0008
B	3	2	0.6	0.0051
C	1	1	0	0.0016
D	4	2	0.7	0.0013
E	0	0	0	0

Station	Abundance (N)	Richness (S)	Diversity (H' loge)	Biomass (g)
F	3	2	0.6	0.0140

14.3.40 Any statistical significance in the difference between sampling in 2019 and 2021 was determined through one-way analysis of similarities (ANOSIM) testing. The results of the one-way ANOSIM test of abundance data demonstrated that overall there was no statistically significant differences in the macrobenthic community abundance (Global R = -0.080, p = 0.702) and biomass (Global R = -0.074, p = 0.646) between sampling in 2019 and 2021.

14.3.41 Annex E presents the abundance of each taxon and biomass per major group (Annelida, Crustacea, Mollusca, Echinodermata and Others), in all samples collected in February 2021 across the survey area.

14.4 Discussion

14.4.1 The intertidal study area is situated within a highly industrial region, with a broad variety of industries, including steelmaking and chemical manufacture, utilising land and resources within close proximity to the marine environment. A proportion of the coastal intertidal zone has been modified in order to accommodate and protect these industries. As a result of this, the intertidal zone is comprised of a combination of benthic features, such as breakwaters, that would not naturally be present in the area, as well as those that are naturally occurring.

14.4.2 The Intertidal Phase I survey indicated the study area can be divided into four physically and biologically distinct areas; Coatham Sands, South Gare Breakwater, Paddy's Hole and Bran Sands. These areas show ecological variability due to abiotic differences including the level of wave exposure and substrate composition. Results of the Phase II survey found that infaunal communities' samples in Coatham Sands and Bran Sands were also significantly different.

14.4.3 South Gare Breakwater and Paddy's Hole are both rocky intertidal habitats with similar substrata composition (loose cobbles/boulders). South Gare Breakwater is subject to high wave exposure, whereas Paddy's Hole is sheltered within the estuary mouth. As a result of the differing levels of wave exposure, the two areas support different ecological communities. South Gare Breakwater is sparsely populated by a small number of species well adapted to the high exposure conditions including the barnacle S. *balanoides*, and the seaweeds *Ulva* sp. and purple laver. Paddy's Hole also has low species diversity but comparatively higher abundance, with a dense coverage of bladder wrack throughout. Both South Gare Breakwater and Paddy's Hole are present within the study area as a result of human development.

14.4.4 Coatham Sands and Bran Sands are both examples of intertidal habitat that occur naturally. However, Coatham Sands is located directly south of the Tees Estuary and is subject to relatively high wave exposure, whereas Bran Sands is located within the Tees Estuary and is comparatively sheltered. Sediment substrata is relatively homogenous and dominated by sand across both Coatham and Bran Sands (>92% sand at all intertidal Phase II stations). Bran Sands differs slightly from Cotham Sands as the sediment contains both gravel and mud fractions, neither of which are present at stations sampled at Coatham Sands (with the exception of Station 8).

14.4.5 The differences in wave exposure and mud content between Coatham Sands and Bran Sands is likely to be linked to biological differences observed between the two areas. However, although Bran Sands exhibited higher abundances, species richness, diversity and biomass of infaunal communities compared to Coatham Sands, differences in abundance and biomass between these two areas were not found to be statistically significant although small but significant differences were found across the survey area as a whole.

14.4.6 Overall abundance and species richness of infaunal communities was considered to be low across the study area, with only 23 taxa recorded across the 10 sampling stations. The additional intertidal survey in February 2021 corresponded with the results of the 2019 survey, where relatively low abundance, biomass, species richness and diversity were also recorded in intertidal sediments. Furthermore, no new species were recorded during the February 2021 survey.

14.4.7 The results from both the 2019 and 2021 sampling corresponds with pre-consent intertidal surveys undertaken for Teesside Offshore Windfarm (TOW) where intertidal samples were found to be of generally low diversity and abundance across Coatham Sands (EDF Energy, 2004). The samples primarily consisted of the amphipods: *P. arenarius* and *Bathyoporeia* spp. and the polychaetes *S. squamata* and *Nephtys* sp. (EDF Energy, 2004). Biotope characterisations also correspond with pre-consent surveys for TOW. EUNIS biotopes identified for TOW included A2.211 - Talitrids on the upper shore and strandline, A2.221 - Barren littoral coarse sand, and A2.223 - Amphipods and [*Scolelepis*] spp. in littoral medium-fine sand (EDF Energy, 2004).

14.4.8 In addition to pre-consent surveys for TOW (EDF Energy, 2004), the species and biotopes recorded within the intertidal zone in 2019 and 2021 are also comparable to those reported within the Pre-Construction FEPA Monitoring Report for TOW (Lancaster *et al.*, 2011), as well as the Marine Nature Conservation Review (MNCR) Newbiggin to Saltburn survey which was undertaken in 1993. This suggests that intertidal habitats and species have not changed significantly over the past few decades and are relatively stable both across Tees Bay and over time.

14.4.9 All of the biotopes identified within the study area, with the exception of A2.211 - Talitrids on the upper shore and strandline, are representative of Annex I and/ or UK habitats of principal importance under Section 41 of the NERC Act 2006. However, they are not high-quality examples nor are they qualifying features of any nearby designated site. Furthermore, no protected species were identified within the study area. A single INNS (the seaweed wakame) was observed sporadically in low quantities around South Gare Breakwater.

14.4.10 Despite the industrialised nature of the surrounding area, chemical analysis results of the sediment samples taken during the intertidal Phase II survey (collected in 2019 only) indicated that soft sediment shores within the study area (Coatham and Bran Sands) did not contain contaminants likely to harm benthic habitats and/or species. Samples from all ten stations presented individual PAH, Organotin, PCB and Organochlorine concentrations which were either below limit of detection or below relevant standards. Furthermore, with the exception of arsenic at Station 5, none of the heavy or trace metals concentrations exceeded the Cefas AL's (Cefas, 2003) or threshold levels prescribed by CCME (1999).

14.4.11 Although arsenic concentrations at Station 5 were found to exceed the Canadian TEL there was no exceedance of the PEL or the Cefas AL1. Concentrations above the TEL only imply occasional adverse effects; macrofaunal analysis found no evidence of an effect. Elevated metal sediment concentrations do not necessarily imply toxicity to benthic communities (Rees *et al.,* 2007) as the bioavailability of these metals is often more important than simply concentration levels.

14.5 Baseline Evolution

14.5.1 Benthic ecology baseline conditions can be influenced by a variety of factors including pollution, coastal development and climate change. These factors can influence not only the distribution of habitats and the abundance of associated flora and fauna but also life history processes including growth and reproduction.

14.5.2 Within the study area, climate change impacts due to factors such as increasing sea surface levels and warming sea temperatures are considered to be one of the principle ways in which baseline conditions are likely to evolve during the life cycle of the Project and is therefore considered in further detail below.

14.5.3 Future UK Climate Projections 2018 (UKCP18) from the Met Office for the Stockton-on-Tees area (The Met Office, 2019) based on a 1981 – 2000 baseline[3], uses a range of possible scenarios, classified as Representative Concentration Pathways (RCPs), to inform different future emission trends. RCP 8.5 has been used for the purposes of this assessment as a worst-case scenario.

14.5.4 Based on RCP 8.5, there is a 50% probability that sea levels will have risen 8 cm by 2022 (commencement of construction) and 11 cm by 2026 (commencement of operation). By 2051 (the end of the Proposed Developments operational lifespan) this may increase further to 26 cm above the 1981 – 2000 baseline.

14.5.5 The implications of sea level rise to intertidal habitats and communities are dependent on the topography of the shoreline; low lying or gentle sloping coastal environments such as Coatham Sands are vulnerable to greater impacts.

14.5.6 An increase of 8 – 11 cm prior to and throughout the construction phase of the Proposed Development would be expected to result in a potential shift in the distribution of intertidal benthic communities higher up the shoreline in

[3] This baseline has been selected as it provides projections for 20-year time periods (e.g. 2020 – 2039).

line with the sea level rise This in itself is unlikely to alter the intertidal benthic baseline present within the study area although the area could be subject to coastal squeeze resulting in a loss of sand and mudflats.

14.5.7 There is evidence to suggest that indirect effects associated with sea-level rise could also have an effect. Oceanographic variables such as currents and wave action could be altered by changes to sea level, which can have effects on hydromorphology and specifically the sediment particle size distribution (Yamanaka *et al*., 2010). Any change to the composition of sediment substrata within the study area would likely alter the intertidal benthic habitats and species present. Coastal hydromorphology is subject to complex oceanographic systems and so the potential impacts of sea level rise are difficult to predict with any certainty.

14.5.8 Sea temperature change projections are more variable and less specific to the Teesside region. Under RCP 8.5 a rise in global sea surface temperatures of 1.5˚C by 2050 is predicted, increasing to a 3.2°C rise by 2100 relative to 1870 – 1899 temperatures. In UK waters, mean annual sea temperatures have risen by 0.8°C since 1870 and have continued to show consistent warming trends since the 1970s onwards (Genner *et al*., 2017). According to Lowe *et al*. (2009), the seas around the UK are projected to be 1.5 – 4 ºC warmer by 2100.

14.5.9 Increased sea temperatures have already had effects on marine communities in UK waters, with warm-water invertebrate species increasing in abundance and extending distribution northwards, and cold-water species decreasing in abundance and retreating northwards (Mieszkowska, 2012; 2013a). However, the evidence of the effects of climate change on soft sediment communities is less conclusive (Mieszkowska *et al*., 2013b) and so it is currently difficult to predict what localised changes, if any, may occur within the vicinity of the Proposed Development as a result of increasing sea temperatures.

14.6 Summary of Findings

14.6.1 The MMO, and their specialist advisers, Cefas, have been involved throughout the evolution of the intertidal benthic baseline and impact assessment.

14.6.2 Teesside is a highly industrial region, and as a result of this, the study area is composed of both natural and anthropogenically modified intertidal benthic features.

14.6.3 The intertidal study area can be divided into four biologically distinct areas; Coatham Sands, South Gare Breakwater, Paddy’s Hole and Bran Sands. South Gare Breakwater and Paddy’s Hole are not naturally occurring habitats. Coatham Sands and Bran Sands are both natural habitats but exhibit differing macrofaunal communities due to variations in exposure conditions and substrate types.

14.6.4 Overall, biological diversity and abundance of macrofaunal communities was low across the study area which corresponds with previous studies undertaken in the area. A number of biotopes identified are representative of Annex I and UK habitats of principal importance under Section 41 of the

NERC Act 2006, although do not represent qualifying features of any nearby designated sites. In several cases, these habitats were also considered to be poor quality examples. No protected species were found to be present within the study area.

14.6.5 No contaminants were found in concentrations of concern to intertidal benthic habitats and species. Arsenic had one minor exceedance at Station 5, but no other heavy/trace metals, PAHs, PCBs, Organotins or Organochlorines exceeded relevant threshold values at any stations.

14.6.6 Prior to and during the construction and operational phase of the Proposed Development, the intertidal benthic baseline is likely to evolve as a result of climate change due to increases to both sea level and sea temperatures. This baseline evolution could result in a shift in the distribution of intertidal habitats as well as increased abundance of warm-water species, and decreased abundance of cold-water species present within the study area. However, it is not possible to predict with any certainty the magnitude of potential changes to baseline conditions as a result of climate change or any other pressure.

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Annex A - Particle Size Distribution (PSD) analysis methodologies

Introduction

The method used involved drying all sediments at 80°C for at least 24 hours prior to dry-sieving all samples and only laser sizing the <2 mm fraction if >5 % of the whole sample was found to be <63 µm. Oven drying sediment causes the aggregation of particles in muddy sediments (>5 % mud) and for these reasons, such sediments should not be oven dried prior to particle size analysis (Mason, 2016). Therefore, a visual assessment of all thawed sediment samples was undertaken prior to drying to ensure the optimal analysis technique was used. Due to the obvious presence of mud in a large proportion of samples, some with a considerable mud content in excess of 5 %, all samples were analysed via a combination of both dry sieving (>1 mm fraction) and laser sizing (<1 mm fraction).

Sample Preparation

Frozen sediment samples were first transferred to a drying oven and thawed at 80°C for at least six hours prior to visual assessment of sediment type and wet sieving over a 1 mm sieve. Before any further processing (e.g. sieving or sub-sample removal), samples were mixed thoroughly with a spatula and all conspicuous fauna (>1 mm) which appeared to have been alive at the time of sampling were removed from the sample.

Dry Sieving

The >1 mm fraction was then returned to a drying oven and dried at 80°C for at least 24 hours prior to dry sieving. Once dry, the sediment sample was run through a series of Endecott BS 410 test sieves (nested at 0.5 φ intervals) using a Retsch AS200 sieve shaker to fractionate the samples into particle size classes. The dry sieve mesh apertures used are given in Table A-1.

Table A-1: Sieve series employed for Particle Size Distribution (PSD) analysis by dry sieving (mesh size in mm)

Sieve aperture (mm)

63	45	31.5	16	11.2	8	5.6	4	2.8	2	1.4	1

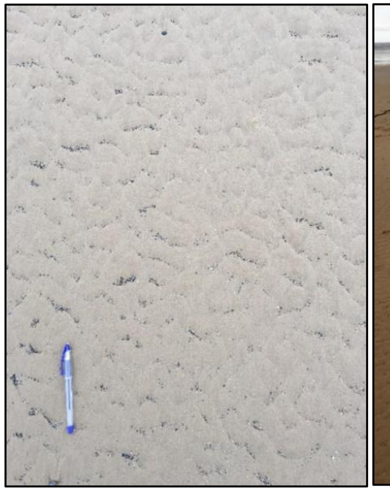
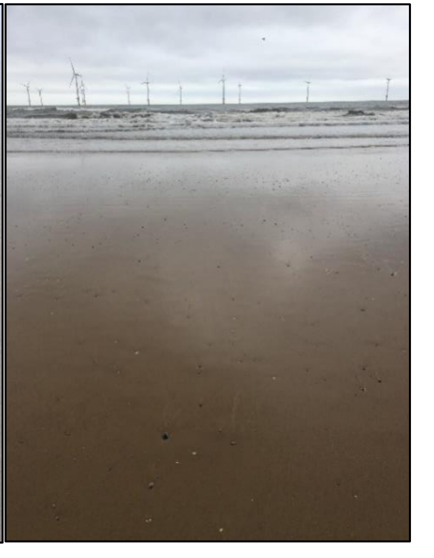
The sample was transferred onto the coarsest sieve at the top of the sieve stack, which was then shaken for a standardised period of 20 minutes. The sieve stack was then checked to ensure the components of the sample had been fractioned as far down the sieve stack as their diameter would allow. A further 10 minutes of shaking was undertaken if there was evidence that particles had not been properly sorted (e.g. veneers of silt overlying coarse fractions).

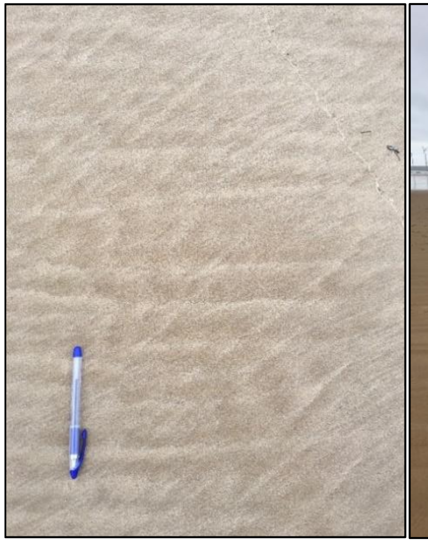
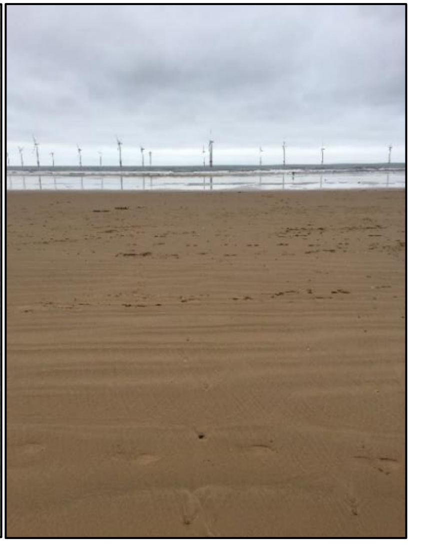
Laser Diffraction

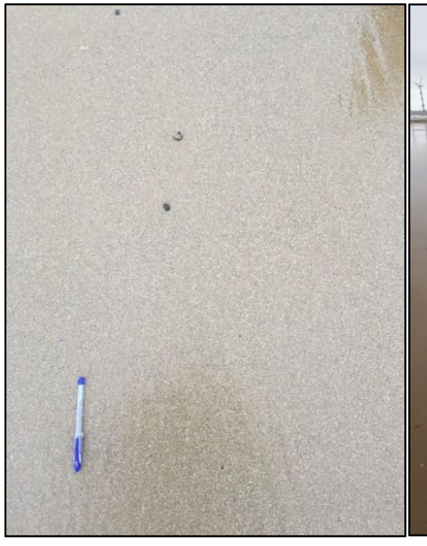
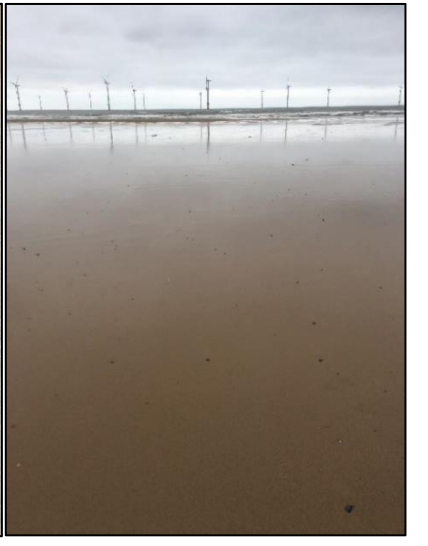
The fine fraction residue (<1 mm sediments) was transferred to a suitable container and allowed to settle for 24 hours before excess water was syphoned from above the sediment surface. The fine fraction was analysed by laser diffraction using a wet element Beckman Coulter LS 13320. Due to the silty nature of the sediments, ultrasound was used to agitate particles and prevent aggregation of fines.

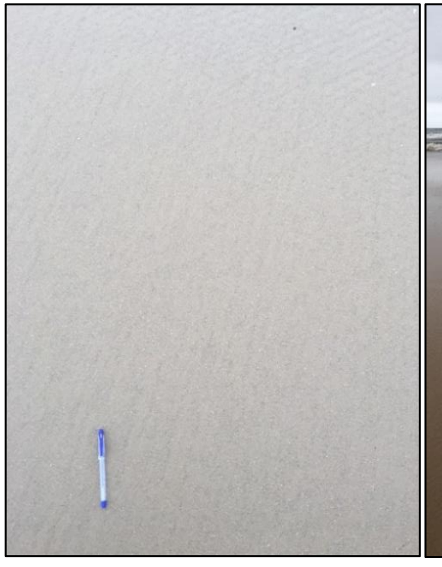
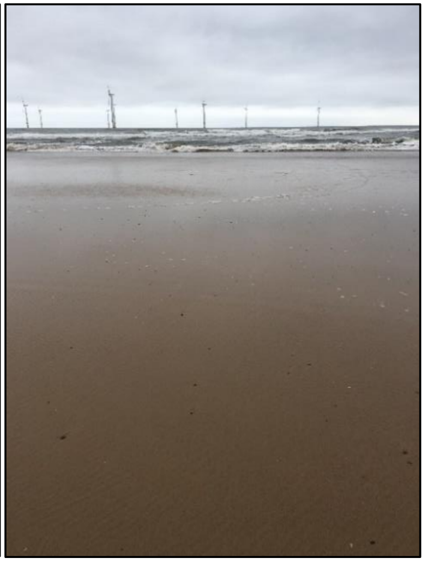
Annex B – Phase I Survey Log

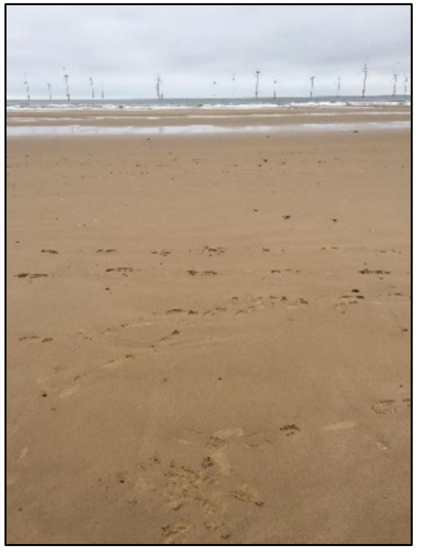
Station No. and coordinates	Shore Zone	Biotope and description	Photos
Coatham Sands 1 54.6202, -01.0849	Upper	A2.211 - Talitrids on the upper shore and strandline	 

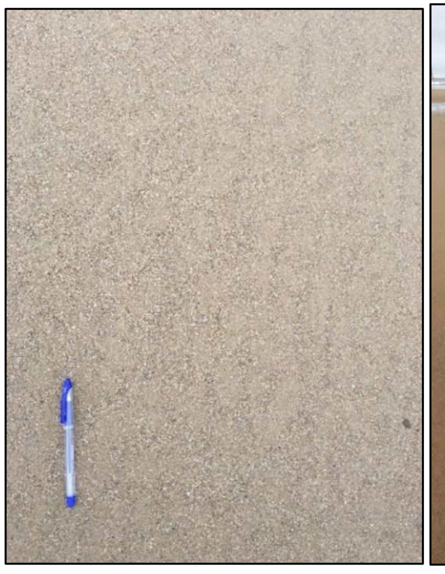
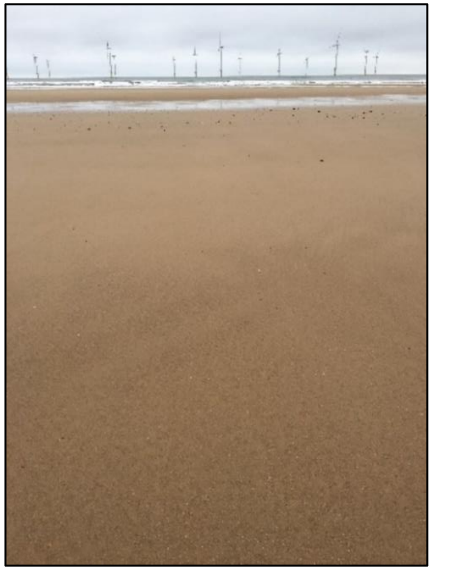
Station No. and coordinates	Shore Zone	Biotope and description	Photos
	Middle	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible	 
	Lower	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible	 

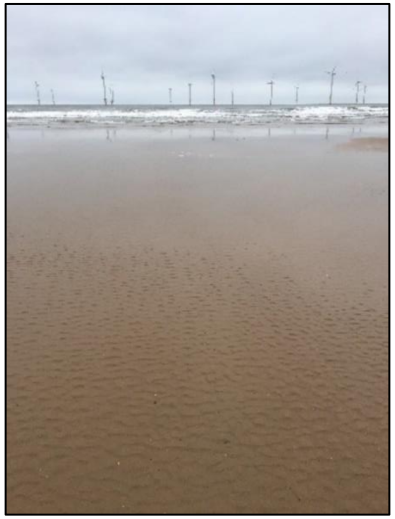
Station No. and coordinates	Shore Zone	Biotope and description	Photos
Coatham Sands 2 54.6221, -01.0956	Upper	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible	 

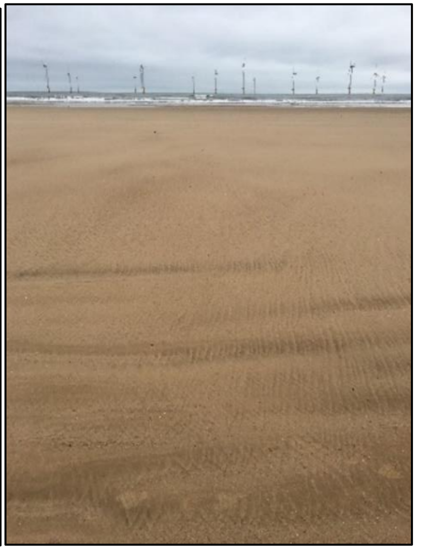
Station No. and coordinates	Shore Zone	Biotope and description	Photos
	Middle	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible	 

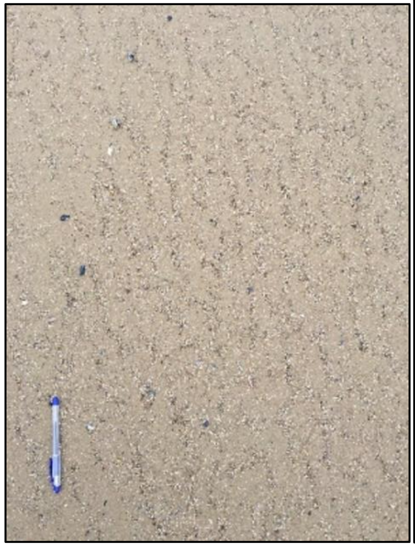
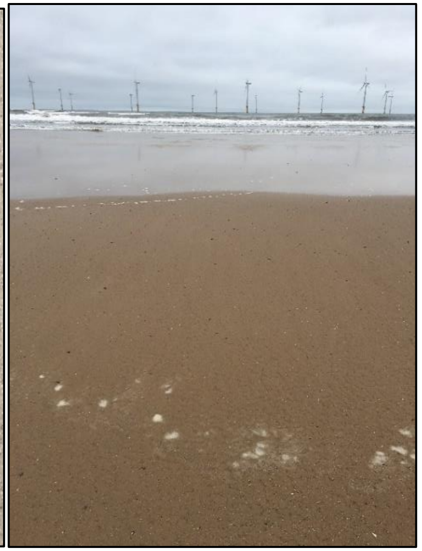
Station No. and coordinates	Shore Zone	Biotope and description	Photos	
	Lower	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible		

Station No. and coordinates	Shore Zone	Biotope and description	Photos
Coatham Sands 3 54.6246, -01.1040	Upper	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible	 

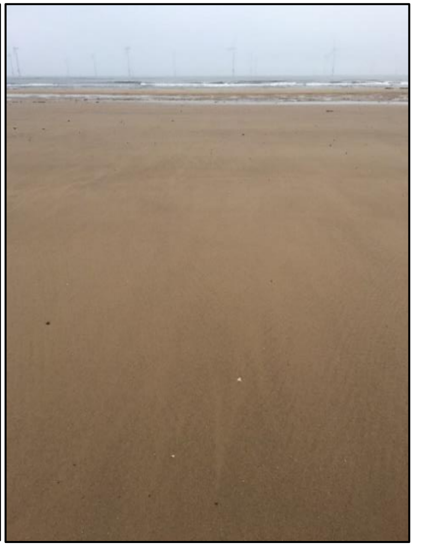
Station No. and coordinates	Shore Zone	Biotope and description	Photos
	Middle	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible	 

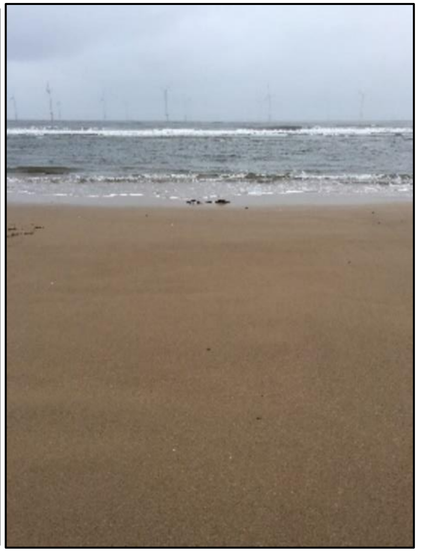
Station No. and coordinates	Shore Zone	Biotope and description	Photos
	Lower	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible	 
Coatham Sands 4 54.6279, -01.1139	Upper	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible	 

Station No. and coordinates	Shore Zone	Biotope and description	Photos
	Middle	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible	 

Station No. and coordinates	Shore Zone	Biotope and description	Photos
	Lower	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible	 

Station No. and coordinates	Shore Zone	Biotope and description	Photos
Coatham Sands 5 54.6321, -01.1228	Upper	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible	 

Station No. and coordinates	Shore Zone	Biotope and description	Photos
	Middle	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible	 

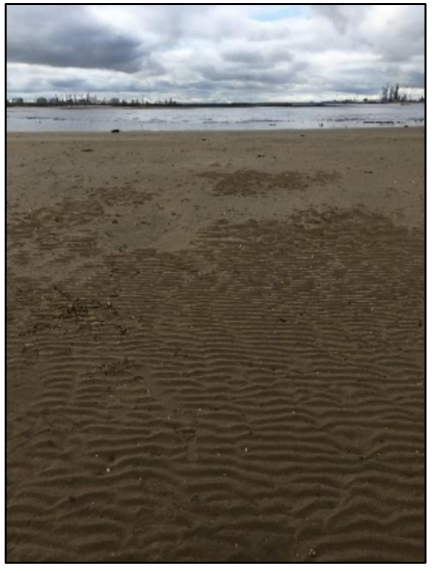
Station No. and coordinates	Shore Zone	Biotope and description	Photos
	Lower	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible	 

Station No. and coordinates	Shore Zone	Biotope and description	Photos
Coatham Sands 6 54.6368, -01.1321	Upper	A2.22 - Barren or amphipod-dominated mobile sand shores No life visible Breakwater present offshore from this transect	 

Station No. and coordinates	Shore Zone	Biotope and description	Photos
	Middle	A2.231 - Polychaetes in littoral fine sand *Arenicola* sp. casts visible	 

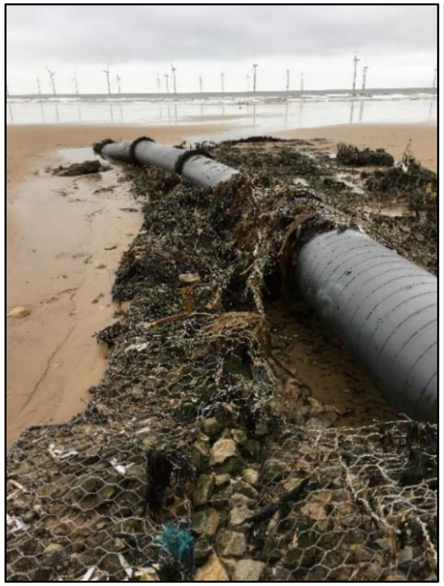
Station No. and coordinates	Shore Zone	Biotope and description	Photos
	Lower	A2.231 - Polychaetes in littoral fine sand *Arenicola* sp. casts visible Washed up macroalgae and shell fragments present, likely due to protection from breakwater, enabling debris to accumulate	 

Station No. and coordinates	Shore Zone	Biotope and description	Photos
Bran Sands 54.6332, -01.1386	Upper	A2.242 - *Cerastoderma edule* and polychaetes in littoral muddy sand *Arenicola* sp. casts visible *Cerastoderma edule* visible Seaweeds *Fucus ceranoides* and green algae (likely *Ulva* sp. or cladophora species) present on boulders Barnacle *Semibalanus balanoides* present on boulders	 

Station No. and coordinates	Shore Zone	Biotope and description	Photos
	Middle	A2.242 - *Cerastoderma edule* and polychaetes in littoral muddy sand *Arenicola* sp. casts visible *Cerastoderma edule* visible	 

Station No. and coordinates	Shore Zone	Biotope and description	Photos
	Lower	A2.242 - *Cerastoderma edule* and polychaetes in littoral muddy sand *Arenicola* sp. casts visible *Cerastoderma edule* visible	 

Station No. and coordinates	Shore Zone	Biotope and description	Photos
South Gare Breakwater 54.6431, -01.1353	Upper Middle Lower	A1.113 - *Semibalanus balanoides* on exposed to moderately exposed or vertical sheltered eulittoral rock Seaweeds *Ulva* sp. and *Porphyra umbilicalis* present within this boulder breakwater habitat. Very little diversity and abundance likely due to the exposed and mobile nature of this habitat.	 
Paddy's hole 54.6332, -01.1386	Upper Middle Lower	A1.323 - *Fucus vesiculosus* on variable salinity mid eulittoral boulders and stable mixed substrata Paddy's hole is a man-made bay built into the southern side of the estuary. Intertidal habitat consists of loose rocky material covered by *Fucus vesiculosus.*	

Station No. and coordinates	Shore Zone	Biotope and description	Photos
Feature photo 54.6230, -01.0985	Upper Middle Lower	Disused pipeline encountered on Coatham Sands. The hard substrata offered by the pipeline and pipeline protection has enabled the settlement of organisms such as macroalgae that would not naturally be present on this area of intertidal sandflat.	 

Station No. and coordinates	Shore Zone	Biotope and description	Photos
Feature photo	Lower	Shallow redox layer indicated by the change in sediment colour at Bran Sands lower shore station.	
Feature photo	Middle	Coal dust was present extensively at strand lines along the length of Coatham Sands. This was one of the most visible sources of pollution encountered.	

Station No. and coordinates	Shore Zone	Biotope and description	Photos
Species photo	Upper	Barnacles *Semibalanus balanoides* present on boulders at the Bran Sands upper shore station.	

Station No. and coordinates	Shore Zone	Biotope and description	Photos
Species photo	Upper	*Fucus ceranoides* and green algae (*Ulva* sp. or Cladophora species) at Bran Sands upper shore station.	

Station No. and coordinates	Shore Zone	Biotope and description	Photos
Species photo	Upper	*Cerastoderma edule* present at Bran Sands upper shore station.	
Species photo	Lower	Tubeworm *Lanice conchilega* at Bran Sands lower shore station.	

Station No. and coordinates	Shore Zone	Biotope and description	Photos
Species photo	Lower	Cast of lugworm (*Arenicola marina*) at Coatham Sands lower shore station.	

Annex C – Chemical Analysis Results

Table C-1: Trace and heavy metal sediment concentrations against Cefas (2003) and Canadian guidelines (CCME, 1999)

			Sites										UK CEFAS Guidelines		Canadian Guidelines	
Units	Limit of Detection	Matrix	1	2	3	4	5	6	7	8	9	10	AL1	AL2	TEL	PEL
mg/Kg (Dry Weight)	0.5	Arsenic	5.4	6.1	5.8	6.9	7.8	5.9	6.5	6.9	5.6	7.0	20	100	7.24	41.60
	0.04	Cadmium	0.05	<0.04	<0.04	<0.04	<0.04	<0.04	0.05	0.04	<0.04	0.05	0.4	5.0	0.7	4.2
	0.5	Chromium	5.3	4.4	3.8	4.3	4.3	3.6	4.2	5.3	4.4	4.4	40	400	52.3	160
	0.5	Copper	4.8	5.0	4.8	4.7	4.3	4.6	4.6	4.4	4.9	5.3	40	400	18.7	108
	0.015	Mercury	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	0.020	<0.015	0.3	3.0	0.13	0.70
	0.5	Nickel	3.6	3.1	3.1	3.6	3.6	3.0	3.4	4.0	3.3	3.6	20	200	15.9	42.8
	0.5	Lead	12.8	11.8	9.4	10.8	12.0	9.1	10.2	10.9	9.9	11.4	50	500	30.2	112
	2	Zinc	28.4	22.8	25.2	33.2	30.6	26.0	29.0	30.6	26.0	37.2	130	800	124	271

Table C-2 PAH sediment concentrations against Canadian guidelines (CCME, 1999) and ERLs/ ERMs (Long *et al*., 1995)

			Sites										Canadian Guidelines		Long *et al.* (1995)	
Units	**Limit of Detection**	**Matrix**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**TEL**	**PEL**	**ERL**	**ERM**
µg/Kg (Dry Weight)	1.0	**Acenaphthene**	<1	2.35	<1	<1	<1	<1	<1	<1	<1	<1	**6.71**	**88.9**	**16**	**500**
		Acenaphthylene	<1	1.72	<1	<1	<1	<1	<1	<1	<1	<1	**5.87**	**128**	**44**	**640**
		Anthracene	1.62	5.00	<1	<1	<1	<1	<1	<1	<1	<1	**46.9**	**245**	**85**	**1100**
		Benzo[a]anthracene	2.74	8.67	1.35	<1	<1	<1	1.35	<1	<1	<1	**74.8**	**693**	**261**	**1600**
		Benzo[a]pyrene	3.15	8.70	<1	<1	<1	<1	<1	<1	<1	<1	**88.8**	**763**	**430**	**1600**
		Benzo[b]fluoranthene	3.42	8.28	1.54	1.51	<1	<1	1.96	<1	<1	<1	**-**	**-**	**-**	**-**
		Benzo[ghi]perylene	3.03	7.42	<1	<1	<1	<1	<1	<1	<1	<1	**-**	**-**	**85**	**-**
		Benzo[e]pyrene	3.58	8.57	1.47	1.31	<1	<1	1.76	<1	<1	<1	**-**	**-**	**-**	**-**
		Benzo[k]fluoranthene	1.91	3.39	<1	<1	<1	<1	<1	<1	<1	<1	**-**	**-**	**-**	**-**
		C1-naphthalenes	15.5	52.4	7.71	4.85	3.39	4.86	4.47	2.99	10.4	3.97	**-**	**-**	**-**	**-**
		C1-phenanthrene	7.97	25.0	4.48	3.03	2.49	2.34	3.70	2.50	3.99	2.71	**-**	**-**	**-**	**-**

			Sites										Canadian Guidelines		Long *et al.* (1995)	
		C2-naphthalenes	13.7	43.1	5.38	4.36	2.73	3.90	3.34	2.69	7.48	3.00	**-**	**-**	**-**	**-**
		C3-naphthalenes	12.0	37.5	5.18	3.18	2.57	2.98	3.91	2.53	6.15	2.56	**-**	**-**	**-**	**-**
		Chrysene	3.43	9.87	1.77	1.39	1.44	<1	1.76	1.38	<1	1.41	**108**	**846**	**-**	**384**
		Diben[ah]anthracene	<1	1.59	<1	<1	<1	<1	<1	<1	<1	<1	**6.22**	**135**	**63**	**260**
		Fluoranthene	6.14	18.2	3.80	3.17	3.23	2.42	3.54	3.00	2.65	3.29	**113**	**1494**	**600**	**5100**
		Fluorene	1.86	4.32	<1	<1	<1	<1	<1	<1	<1	<1	**21.2**	**144**	**19**	**540**
		Indeno[1,2,3-cd]pyrene	2.22	5.38	<1	<1	<1	<1	<1	<1	<1	<1	**-**	**-**	**240**	**-**
		Naphthalene	5.96	18.6	2.88	2.33	1.49	1.80	1.95	1.21	2.95	1.70	**34.6**	**391**	**160**	**2100**
		Perylene	<1	2.28	<1	<1	<1	<1	<1	<1	<1	<1	**-**	**-**	**-**	**-**
		Phenanthrene	6.60	21.3	4.01	2.50	2.20	1.91	2.92	1.86	3.25	2.41	**86.7**	**544**	**240**	**1500**
		Pyrene	6.74	16.5	3.48	3.19	3.24	2.36	3.74	2.83	2.61	3.44	**153**	**1398**	**665**	**2600**
mg/Kg	1.0	**Total Hydrocarbon Content**	10.0	31.5	<1	<1	<1	<1	1.69	<1	<1	<1	**-**	**-**	**-**	**-**

Table C-3 Organotin sediment concentrations against Cefas (2003) standards

			Sites										UK CEFAS Guidelines	
Units	**Limit of Detection**	**Matrix**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**AL1**	**AL2**
mg/Kg (Dry Weight)	0.001	**Dibutyltin**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.1**	**1.0**
		Tributyltin	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.1**	**1.0**

Table C-4 PCB sediment concentrations against Cefas (2003) and Canadian guidelines (CCME 1999)

			Sites										CEFAS		Canadian Guidelines	
Units	**Limit of Detection**	**Matrix**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**AL1**	**AL2**	**TEL**	**PEL**
mg/Kg (Dry Weight)	0.00008	**Total PCBs**	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	0.00118	0.00008	**0.01**	**0.20**	**21.5**	**189**

Table C-5 Organochlorine sediment concentrations against Cefas (2003) standards and OSPAR BCs (OSPAR, 1998)

			Stations										CEFAS	OSPAR
Units	**Limit of Detection**	**Matrix**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**AL1**	**BC**
mg/Kg (Dry Weight)	0.0001	**alpha-Hexachlorcyclohexane**	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00027	<0.00010	**-**	**0.050**
		beta-Hexachlorcyclohexane	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**-**	**-**
		gamma-Hexachlorcyclohexane	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00024	<0.00010	**-**	**0.050**
		Dieldrin	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**0.005**	**0.050**
		Hexachlorobenzene	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00023	<0.00010	**-**	**0.050**
		p,p'-Dichorodiphenyldicloroethane	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**-**	**-**
		p,p'-Dichorodiphenyldicloroethylene	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	0.050
		p,p'-Dichorodiphenyltrichloroethane	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.001	-

Annex D – Macrofaunal Data

Table D-1: Macrofauna abundance per sample. ‘P’ denotes presence only.

Station/Replicate	1A	1B	1C	2A	2B	2C	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	6C	7A	7B	7C	8A	8B	8C	9A	9B	9C	10A	10B	10C
Annelida																														
Capitella	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Enchytraeidae	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eteone longa	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Magelona filiformis	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nephtys	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paraonis fulgens	-	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phyllodoce mucosa	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pygospio elegans	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scolelepis (Scolelepis) squamata	-	-	-	-	-	-	-	-	-	2	3	-	-	1	1	1	1	3	1	3	3	2	2	-	1	2	3	4	-	3
Spio goniocephala	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tubificoides pseudogaster	1	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustacea																														
Bathyporeia elegans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-
Bathyporeia pelagica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-
Bathyporeia sarsi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-

Station/Replicate	1A	1B	1C	2A	2B	2C	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	6C	7A	7B	7C	8A	8B	8C	9A	9B	9C	10A	10B	10C
Eurydice inermis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Eurydice pulchra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Haustorius arenarius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Pontocrates arenarius	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	1	2	3	-	1	2	-	2	-	-	-	-	3
Urothoe poseidonis	-	-	-	9	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mollusca																														
Cerastoderma edule	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Macomangulus tenuis	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peringia ulvae	26	4	12	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Truncatelloidea	9	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nemertea																														
Nemertea	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nematoda																														
Nematoda	48	18	11	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	1	-	-

Table D-2: Macrofauna biomass (g) per sample by major group

Station/Replicate	Annelida	Crustacea	Mollusca	Echinodermata	Other
1A	0.0027	-	3.6447	-	0.0031
1B	-	-	0.0037	-	0.0011
1C	0.0073	-	0.0101	-	0.0001
2A	0.0058	0.0041	0.1629	-	0.0001
2B	0.0011	0.004	0.6563	-	0.0001
2C	0.0027	-	0.004	-	-
3A	-	-	-	-	-
3B	0.0001	-	-	-	-
3C	-	0.0001	-	-	-
4A	0.0019	0.0001	-	-	-
4B	0.0026	-	-	-	-
4C	-	-	-	-	-
5A	-	-	-	-	-
5B	0.0035	-	-	-	-
5C	0.0001	-	-	-	-
6A	0.0102	0.0001	-	-	-
6B	0.0284	-	-	-	-
6C	0.0105	0.0018	-	-	-
7A	0.0001	0.0001	-	-	-
7B	0.001	0.0014	-	-	-
7C	0.0014	0.0002	-	-	0.0001
8A	0.0001	0.0001	-	-	0.0001
8B	0.001	0.0001	-	-	-
8C	0.0001	-	-	-	-
9A	0.0001	0.0001	-	-	-
9B	0.0019	0.001	-	-	-
9C	0.0001	-	-	-	-
10A	0.0018	-	-	-	0.0001
10B	-	0.0001	-	-	-
10C	0.0374	0.0034	-	-	-

Annex E – Macrofaunal Data – Additional Sampling 2021

Table E-3: Macrofauna abundance per sample.

Station	A	B	C	D	E	F
Annelida						
Paraonis fulgens	1	-	-	-	-	-
Scolelepis (Scolelepis) squamata	-	2	-	-	-	1
Crustacea						
Bathyporeia pelagica	-	-	1	-	-	-
Pontocrates arenarius	-	-	-	2	-	2
Nematoda						
Nematoda	1	1	-	2	-	-

Table E-4: Macrofauna biomass (g) per sample by major group

Station/Replicate	Annelida	Crustacea	Mollusca	Echinodermata	Other
A	0.0007	-	-	-	0.0001
B	0.0050	-	-	-	0.0001
C	-	0.0016	-	-	-
D	-	0.0012	-	-	0.0001
E	-	-	-	-	-
F	0.0127	0.0013	-	-	-