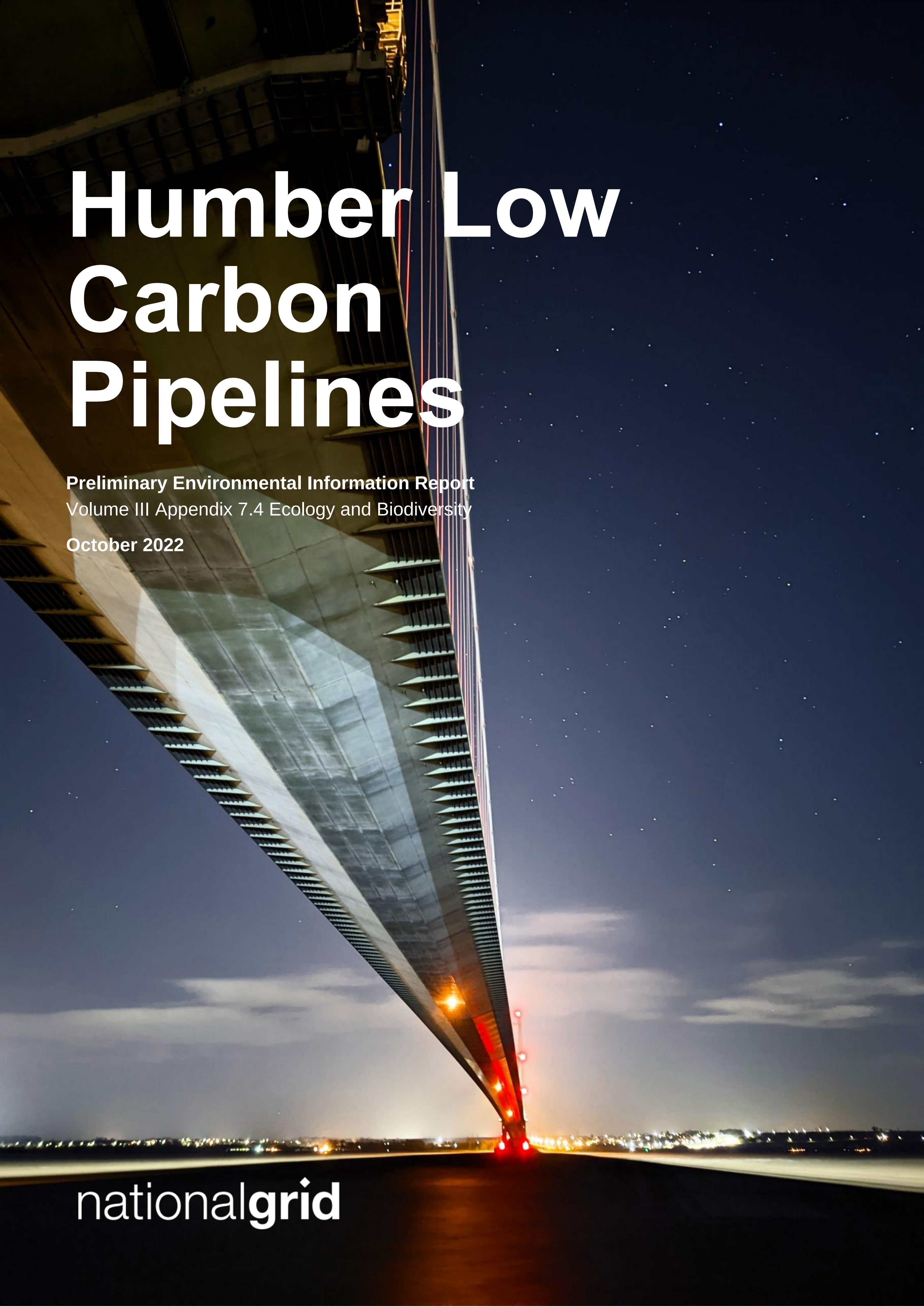


Humber Low Carbon Pipelines

Preliminary Environmental Information Report

Volume III Appendix 7.4 Ecology and Biodiversity

October 2022

nationalgrid

Contents

1. Introduction

1.1 Scope of the Document

1.1.1 This report is Appendix 7.4 of the Preliminary Environmental Information Report (PEIR) and has been prepared in support of the Humber Low Carbon Pipelines (HLCP) project (i.e. ‘the Project’, the boundary for which is hereafter referred to as ‘Proposed Order Limits’). It relates to the intertidal environment and marine ecology and aims to:

- Present baseline information in relation to the intertidal environment and marine ecology and the Proposed Order Limits in support of ecological impact assessment (presence within Chapter 7: Ecology and Biodiversity (Volume II));
- Identify the requirement for any additional survey of assessment to be completed and the proposed timescales.

1.1.2 Section 4 of the Conservation Strategy (Appendix 7.1 (Volume III)) details the scope and methodology for surveying the intertidal environment. Impact assessment, the need for mitigation and/or compensation, and the identification of potential opportunities to enhance the existing ecological baseline are not included within this report. Such information is presented in Chapter 7: Ecology and Biodiversity (Volume II).

1.1.3 This report presents the results of a desk study and initial results of an intertidal survey, which together provide the baseline for assessment. It also sets out the proposed location and timings for further surveys which will be undertaken in the appropriate survey season prior to commencement of site enabling, or establishment works. Only an initial analysis of sediment data has been undertaken ion this interim field report to support the PEIR and full analysis of all samples taken will be carried out and this report will be updated as a full survey report to support the Environmental Statement (ES).

1.2 Mitigation Hierarchy

1.2.1 The Mitigation Hierarchy (Ref 7.4.1) is a sequential process that has been adopted through Project evolution to avoid, mitigate and compensate negative ecological impacts and effects. The intertidal environment and marine ecology have been identified as an Important Ecological Feature and thus the findings of this Technical Appendix have been (and will continue to be) used to inform changes to the Proposed Order Limits and construction techniques.

1.3 Legislation

1.3.1 A full summary of the international, national, and local legislation, planning policy and guidance relevant to the Ecology and Biodiversity assessment for the Project is outlined in the PEIR.

2. Methodology

2.1 Overview

2.1.1 The survey was conducted by two RSK marine ecologists on 15 and 16 June 2022.

2.1.2 An initial walkover survey was conducted to coincide with the spring low tide on 15 June 2022 (1.00 m above CD at 13:04 BST).

2.1.3 Sampling of the intertidal sediments was undertaken on 16 June 2022 and timed to coincide with low-water (0.90 m above CD at 13:54 BST) for maximum exposure of the intertidal area.

2.1.4 Three stations were sampled at upper, middle and lower shore levels on three transects perpendicular to the shoreline (a total of nine initial sampled stations).

2.1.5 Upper shore stations were taken just below the strandline from the most recent high tide, while the lower shore stations were sampled as close to low water as possible, with middle shore station calculated to be approximately half-way between these points.

2.1.6 The central transect was based on the design co-ordinates provided for the potential micro tunnel exit pit included in the Front End Engineering and Design (FEED) information from bp (project proponents for the offshore CCS pipeline), and stations were located using a hand-held GPS unit (Garmin GPS60, accurate to ~5 m or less). Positions of the stations sampled are presented in Table 2.1 and Insert 2.1. The sampling plan shows the central transect orientated approximately along the proposed design line of the pipeline landfall with transects on either side at distances of approximately 100 m to the north and south of the central transect. An additional transect was also sampled further to the north (Extra North; Table 2.1 and Insert 2.1), approximately 150 m north of the other transects to cover more of the potential landfall corridor and to accommodate any potential changes in the landfall design beyond the FEED information going forward in the project.

Maxar, Microsoft, Map data © OpenStreetMap contributors, Microsoft, Facebook, Inc. and its affiliates, Esri Community maps contributors, Map layer by Esri National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Insert 2.1: Upper, middle and lower shore sediment sample stations along the four transects carried out at Easington

Table 2.1 Co-ordinates of stations sampled in June 2022

Station	Latitude (North)	Longitude (East)
Upper North (UN)	53.66430	000.11406
Middle North (MN)	53.66455	000.11464
Lower North (LN)	53.66471	000.11491
Upper Centre (UC)	53.66358	000.11497
Middle Centre (MC)	53.66376	000.11554
Lower Centre (LC)	53.66401	000.11605
Upper South (US)	53.66289	000.11586
Middle South (MS)	53.66303	000.11639
Lower South (LS)	53.66329	000.11707
Upper Extra North (UXN)	53.66547	000.11275
Middle Extra North (MXN)	53.66563	000.11310

Station	Latitude (North)	Longitude (East)
Lower Extra North (LXN)	53.66572	000.11338

2.2 Intertidal walkover

2.2.1 An intertidal walkover survey was undertaken throughout the potential landfall corridor to identify predominant biotopes. Mapping and sampling protocols followed standard methodologies (e.g. Ref 7.4.2).

2.2.2 The intertidal walkover concentrated on a 500 m wide corridor (250 m either side of the proposed central transect). The predominant habitat and any obvious fauna were noted, and georeferenced photographs were taken to provide further information to support the biotope mapping, which will be produced following analysis of sediment infauna.

2.2.3 Additional notes were taken on the predominant habitat at the sampled stations on each of the transects.

2.2.4 Biotope descriptions used in this report are those according to The Marine Habitat Classification for Britain and Ireland Version 22.04 (Ref 7.4.3), with the information on the shallower biotopes taken from the Version 04.05 manual (Ref 7.4.4).

2.3 Surface sediment physico-chemistry

2.3.1 At the nine primary stations on the three core transects sampled and also at the additional transect stations (XN), two half litre samples were collected for Particle Size Analysis (PSA) and Total Organic Content and heavy and trace metals, while a 120 ml sample was taken for parameters including the US EPA-16 Polyaromatic Hydrocarbons (PAHs) and Total Petroleum Hydrocarbons (TPHs).

2.3.2 For PSA, TOC, and heavy and trace metals the samples of approximately 500 ml volume were taken using a plastic spoon from the surface 5 cm of exposed intertidal sediment at each sampled station. All these samples were stored in labelled plastic tubs (2 per station – 1 for PSA and TOC and the other for heavy and trace metals). A 120 ml sample was also collected using a plastic spoon from the surface sediment and stored in labelled amber glass jars for various analyses of hydrocarbons.

2.3.3 All samples for laboratory physico-chemical analyses were kept as cool as possible after collection and dispatched to the laboratory the day following demobilisation under Chain of Custody. All physico-chemical analysis was undertaken by SOCOTEC UK Limited at Burton on Trent. Raw data for the physico-chemical analyses are presented in Appendix A.

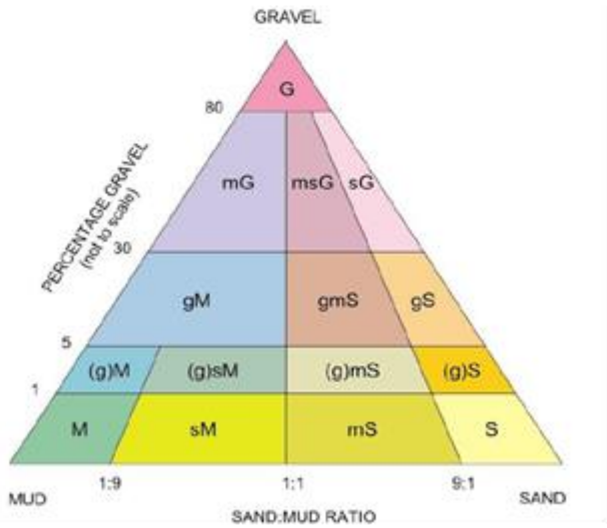
2.3.4 Sediments are classified according to Folk (Ref 7.4.5) (Insert 2.2) based on their relative contents of gravel (>2 mm), sand (>63 µm to 2 mm) and mud (<63 µm). Sediments have also been classified by the laboratory according to Ward.

2.3.5 Total Organic Content was analysed by acid digestion, combustion at 1600^{oC} and IR analysis, on wet sediment.

2.3.6 Analysis of trace and heavy metals was carried out on samples that were oven dried at less than 35°^{C}. Determination of aluminium, barium, iron and lithium were analysed in marine sediments by HF/Boric and two-stage microwave digestion followed by ICP-OES analysis. The presence of arsenic, cadmium, chromium, copper, lead, nickel, tin, vanadium and zinc were analysed by HF/Boric and two-stage microwave digestion followed by ICP-MS analysis. Mercury analysis was carried out by nitric acic/peroxide extraction followed by ICP-MS analysis.

2.3.7 PAH analysis was carried out by solvent extraction and clean up followed by GC-MS analysis, on wet sediment.

2.3.8 TPH analysis was carried out on wet sediment, by solvent extraction and clean up followed by GC-FID analysis.



Insert 2.2 Folk scale of sediment classification

2.4 Benthic infauna

2.4.1 At the nine core stations on the northern, central and southern transects, three replicate samples were collected for the analysis of sediment macrofauna samples, labelled A-C, using a trowel to excavate a core of sediment of approximately 225 cm^2 in surface area to a depth of 15 cm. No samples for sediment macrofauna were collected at the additional transect stations to the north of the three core transects (XN) due to time constraints and as this was an additional set of results that it was decided to sample in the field.

2.4.2 Sediment was then placed in double-labelled plastic pots prior to being sieved in seawater over a 0.5 mm aperture sieve within four hours of collection. All sieved samples were then fixed in 4% buffered formal saline solution in double labelled plastic pots. The samples were then transported to a specialist benthic laboratory (Hebog Environmental in North Wales) within 36 hours of sampling for detailed taxonomic analysis.

2.4.3 On the shore, all pits that remain from the cores were filled in with surrounding sediment to reduce risk to any members of the public who may be on the beach.

2.4.4 Due to the time consuming nature of detailed identification and enumeration analysis of benthic macrofaunal samples, data from this analysis is not presented in this interim field report and will be presented in an updated survey report to accompany the ES.

3. Results

3.1 Intertidal walkover

Initial intertidal walkover

3.1.1 The beach to the north of the landfall area is a relatively flat, sandy shoreline backed with 20+ m high earth cliffs (Insert 3.1). These cliffs are very heavily eroding at the northern extent of the intertidal walkover area (Insert 3.2) close to and within the southern boundary of the Dimlington Cliff SSSI.

Insert 3.1 Beach profile looking north

Insert 3.2 Evidence of cliff erosion

3.1.2 The intertidal area at the northern extent is wider but with a shallower overall beach profile with rippled sand (Insert 3.3), and there is no upper shore strandline noted as the most recent high tide is evidenced to extend to the base of the cliffs and with increased distance north the cliff is wet from the tide increasingly high on the cliffs. The mid to lower shore at the northern most extent of the survey area is dominated by an exposed clay platform (Insert 3.4), with no evidence of piddocks (burrowing bivalves, which can generate a habitat of conservation importance). Much of the beach shelves moderately in the mid and lower shore, with a medium grained sand veneer covering the underlying clay platform.

Insert 3.3 Rippled sand

Insert 3.4 Clay platform at mid-lower shore

3.1.3 There is evidence of recent cliff fall on the beach (Insert 3.5), with large clay/soil boulders along the beach that are derived from erosion of the cliffs themselves (Insert 3.6).

Insert 3.5 Evidence of recent cliff fall

Insert 3.6 Examples of clay boulders

3.1.4 There is limited anthropogenic activity although there is evidence of anthropogenic debris along and above the strandline (Insert 3.7), mainly in the form of detached commercial fishing gear including pots, pot markers, rope and net.

Insert 3.7 Anthropogenic debris

3.1.5 The most recent high tide mark is further down the shore away from the base of the cliff with increased distance southwards within the intertidal walkover area, with the most recent high tide at least 25 m from the cliff face at the southern extent. As such, there is less evidence of erosion at the base of the cliffs and the cliffs are shallower and appear more stable (5-20 m in height) and more vegetated (Insert 3.8). There is also more evidence of attempts at cliff stabilisation works that have been partially successful.

Insert 3.8 Vegetated cliff showing older cliff errosion

3.1.6 The beach gradient becomes steeper (Insert 3.9) towards the southern extent of the intertidal walkover area due to retention or accumulation of beach material as a consequence of the engineering that has been put in place to protect Easington Terminal. The beach material becomes increasingly shingle based in this area also (Insert 3.10). On the upper shore. material has built up creating a level accumulation of beach material at the base of the cliff above which the beach profile is steeper.

Insert 3.9 Beach profile looking south

Insert 3.10 Shingle beach at the mid shore to the south

3.1.7 At the southern extent of the intertidal walkover area, the intertidal area is much broader, possibly due to the sea defences at the Easington terminals on up-tide side.

The strandline contains drift seaweed, which is predominantly horn wrack, with some red seaweed and fucoids (Insert 3.11).

Insert 3.11 Strandline looking south

3.1.8 More boulders are in evidence above the strandline (Insert 3.12), and then again along the mid-lower shore. The upper shore is sand, with shingle on the mid shore (Insert 3.13).

Insert 3.12 Beach profile at the mobile phone tower

Insert 3.13 Shingle beach at mid-low shore

3.1.9 There is a sheet piled metal groyne in line with the mobile phone tower, approximately halfway between the central and southern transect (Insert 3.14). It is understood that this is in place where an existing pipeline landfall is present.

Insert 3.14 Piled metal sheet groyne

3.1.10 There are talitrid burrows (Insert 3.15) evident in the sand on the upper-mid shore at the southern extent of the intertidal walkover area and oystercatchers[1] (*Haematopus ostralegus*) were also observed. Sand martins[2] *(Riparia riparia*) were also seen feeding on the sand along the strandline and nests were observed from 53°40’05.9” N, 00°06’34.4” E and then continuing south in the top of the cliff (Insert 3.16 and Insert 3.17).

Insert 3.15 Talitrid burrows

Insert 3.16 Sand martins flying above nests

[1] Amber on the UK Birds of Conservation Concern (BoCC) Red List

[2] Green on the UK BoCC Red List

Insert 3.17 Sand martins flying around nests

3.1.11 Potting was observed offshore and there are two windfarms visible from the beach: Humber Gateway to the south and Westernmost Rough to the north.

Station descriptions

3.1.12 This section provides an overview of the four transect stations, including a biotope type based on the Marine Habitat Classification for Britain and Ireland Version 04.05 (Ref 7.4.4; Ref 7.4.3).

3.1.13 The most recent spring tide strandline of the north transect was at the cliff base although the cliff base was relatively dry, while the most recent strandline of the central and south transects was about 10 m out from the cliff base as a consequence of the increased build up of beach sediments. The most recent strandlines of all transects contained typical flotsam, pebbles, drift algae and litter.

3.1.14 For all upper stations the top surface sediment was medium sand, with shingle, sand and stones below 10 cm diameter. At the upper north (UN) station there were some cliff deposits (clay material) visible in the sediments, while the lower shore around the middle north (MN) was starting to expose the clay platform, which could be observed along much of the mid and lower shore.

3.1.15 The sediments at the mid shore stations were a matrix of sand and shingle, with the stations located just above the transition onto the lower shore dominated by a flatter intertidal, while the mid shore was of a more sloping, but still wet sand and shingle shore.

3.1.16 The lower stations were primary located within or close to the exposed clay platform, with sediments of sand and shingle, which forms an overlying veneer. The medium sand was wet on the flatter lower intertidal area, with water running back down the shore from the mid shore.

3.1.17 The sediment characteristics and incidental observations suggest the biotopes on the beach at the Easington landfall primarily are **LS.LSa.MoSa** (Barren or amphipod-dominated mobile sand shores) and/or **LS.LCS.Sh** (Shingle (pebble) and gravel shores).

3.1.18 There were no obvious redox potential discontinuity (RPD) layers visible in any samples, which is expected as sediments are fairly coarse and consequently well oxygenated to the depths at which excavations were made.

3.1.19 There was no obvious surface fauna, which is expected as the beach is subject to moderate to heavy exposure, although talitrid burrows were evident at the upper station (UC) of the centre transect. This location potentially corresponds to the biotope **LS.LSa.St.Tal** (Talitrids on the upper shore and strandline).

3.1.20 The intertidal shoreline narrows with increased distance north within the surveyed area, with the clay and shingle at the lower shore being closer to the cliffs and no obvious recent high tide strandline. The beach also shelves to a greater extent. As noted above – the high water mark can be observed by a wet line on the cliffs and the soft clay rock of the cliffs is evidencing erosion.

3.1.21 Further details and photographs of each station are included in Appendix C.

3.2 Surface sediment physico-chemistry

Particle size analysis

3.2.1 Summary particle size analysis (PSA) data from surface sediment samples are presented in Table 3.1**.**

3.2.2 Sediment type was relatively consistent across the survey area, with the largest proportion of material shown to be sand, which was found at all of the shore levels. Each location was shown to have either sand, gravelly sand or slightly gravelly sand. Very little silt was shown at any shore level.

3.2.3 The upper shore had medium sand across the survey area. Here, particles across the transect area were almost entirely sand, with 100% being sand at the two most northerly locations. The two southern areas also had high sand content; the most southern position had 99% sand and the central transect had 97.4% sand.

3.2.4 The mid-shore consisted of sandy gravel or gravelly sand. This level of the shore consistently showed a higher percentage of gravel within each of the transect positions, compared to the upper and lower shore. The sand in the mid-shore area was either coarse or very coarse. These results support the field observations of sand at the upper shore and shingle at the mid-shore, as discussed in Section 3.1 and shown in Insert 3.10. This change in sediment type from the upper to mid shore is also shown in Insert 3.18.

Insert 3.18 Beach profile changing from upper to mid shore

3.2.5 At the lower shore, the southern and central transects had fine and medium sand respectively. This then became coarse sand to the north and very course sand at the most northerly transect position. Of all the lower shore positions, only the most northern transect area was shown to have sandy gravel, with a higher percentage of gravel being found compared to the areas that were further south.

3.2.6 In conclusion, the upper shore areas mostly consist of sand, with the mid-shore showing an increase in gravel. This gravel content was most evident in the most northern area of the survey area. Here, the lower shore also had relatively higher gravel content compared to the other transects to the south. The sand at the lower shore became coarser towards the north, compared to the south. This was reflected also in field observations, which indicate a much narrower shoreline with increased distance north, with much less sediment accumulation, particularly finer fractions, which are not retained as easily.

3.2.7 The sediment granulometry results do not reflect the predominant lower shoreline exposed clay, as the sampling only samples sediments. This exposed clay is discussed in the field observations (Section 3.1).

Total Organic Carbon (TOC)

3.2.8 Total Organic Carbon (TOC) results, as % by weight of surface sediments are presented in Table 3.1.

3.2.9 Values ranged from 0.08% in the upper shore of the most northerly transect, to 0.25% on the lower shore of the northerly transect. Highest levels were recorded on the north transect, not the extra north transect.

3.2.10 The upper shore level had lower TOC levels than the mid and lower shore at each of the transects reflecting the greater proportion of fine sediments at these locations. Although, at the southern transect, the upper and lower shore had the same TOC content, with the mid shore being higher.

3.2.11 These low values are as expected for a moderate to high-energy exposed sandy beach.

Table 3.1: Summary particle size analysis (PSA) data from surface sediment samples at Easington

Station	% Gravel >2 mm	% Sand 63 µm-2mm	% silt <63 µm	Average particle size (µm)		Classification (Ref 7.4.5)	Classification Folk and Ward	TOC %
				Mean	Median			
EAS - US	0.00	99.0	0.97	376.580529	1.4089698	S: Sand	Medium Sand	0.12
EAS – MS	32.4	66.8	0.81	828.942204	0.2706568	sG: Sandy Gravel	Coarse Sand	0.19
EAS – LS	1.92	96.1	2.02	240.326972	2.0569295	(g)S: Slightly Gravelly Sand	Fine Sand	0.12
EAS - UC	2.56	97.4	0.00	339.260444	1.5595347	(g)S: Slightly Gravelly Sand	Medium Sand	0.15
EAS – MC	37.6	61.8	0.62	1090.274019	-0.1246904	sG: Sandy Gravel	Very Coarse Sand	0.21
EAS – LC	3.33	94.9	1.73	398.726611	1.3265280	(g)S: Slightly Gravelly Sand	Medium Sand	0.23
EAS – UN	0.00	100	0.00	402.599045	1.3125844	S: Sand	Medium Sand	0.11
EAS – MN	20.7	78.4	0.91	620.038983	0.6895695	gS: Gravelly Sand	Coarse Sand	0.19
EAS – LN	5.10	93.5	1.39	725.708977	0.4625370	gS: Gravelly Sand	Coarse Sand	0.25
EAS – UXN	0.00	100	0.00	304.901436	1.7135850	S: Sand	Medium Sand	0.08
EAS – MXN	40.2	58.7	1.14	1174.361120	-0.2318761	sG: Sandy Gravel	Very Coarse Sand	0.22
EAS - LXN	34.9	64.2	0.90	1094.560703	-0.1303520	sG: Sandy Gravel	Very Coarse Sand	0.19

Heavy and Trace Metals

3.2.12 Results for concentrations of metals in the sediment samples are shown in Table 3.2.

3.2.13 The results indicate a certain pattern in terms of the concentrations of metals found in the area. The lowest levels of metals were generally found at the upper shore of the southern transect area. Here, the lowest, or equal lowest levels of arsenic, barium, cadmium, chromium, copper, iron, lead, nickel, tin, vanadium and zinc were found. In all transect locations, the upper shore areas do not show highest levels for any of the metal concentrations, suggesting they are lower here, than at other levels on the shoreline.

3.2.14 The lower shore of the most northern transect (LXN) had the highest levels of seven of the metals analysed (arsenic, barium, chromium, iron, lead nickel and vanadium) and equal highest of another two metals. This suggests metal concentrations on this transect are higher than the southern transects, or higher on the shoreline.

3.2.15 The mid-shore on the most northern transect (MXN) had the highest levels of aluminium, lithium and zinc, whilst the mid-shore at the southern transect had the highest levels of copper. The copper concentration ranged from 5.6 (US) to 28.6 mg/kg (US). If this elevated station was not included then the range would be 5.6 to 12.7 mg/kg. This high level of copper appears to be an elevated outlier within the results, with a particularly high concentration at this station.

3.2.16 No cadmium was detected above the detection limit of 0.2 mg/kg, at any stations.

3.2.17 Aluminium ranged from 10600 mg/kg (UXN) to 24900 mg/kg (MXN). Aluminium concentrations in particular are typically directly linked to particle size, with high concentrations associated with lower grain sizes. Interestingly, the locations generally showed higher concentrations of aluminium in the mid-shore however, where the particle sizes were generally larger and were shown to have coarse or very coarse sand.

3.2.18 Other elevated outliers, which were noticeable, were often observed for the values shown at the most northern transect on the lower shore, with the mid-shore also showing some high values. Barium concentrations at the lower shore, on the most northern transect (LXN) were shown to be 540 mg/kg, however, without this value, barium ranged from 152 to 297 mg/kg.

3.2.19 Iron was also shown to have high concentrations at lower and mid-shore of the most northern transect, compared to the other stations, with values of 54800 mg/kg and 43300 mg/kg respectively. Without these two stations, the range was 9040 to 29100 mg/kg.

3.2.20 In conclusion, many of the metal concentrations are highest at the most northern transect area on the mid-shore or lower shore (MXN and LXN). Within the transects, areas of higher levels of metal concentrations were shown to be at the mid-shore area for the two more southernly transects. At the northern end of the survey area, the lower shore then shows the highest metals concentrations for many of the metals. The upper shore areas appear to have the lowest levels of metal concentrations throughout the survey area.

Table 3.2: Summary of metal concentrations found in surface sediment samples at Easington

	mg/kg													
Sample location	Aluminium as Al	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Iron as Fe	Lead as Pb	Lithium as Li	Mercury as Hg	Nickel as Ni	Tin as Sn	Vanadium as V	Zinc as Zn
EAS - US	12700	3.90	152	<0.2	9.30	5.60	9040	5.80	10.5	0.02	6.00	<1.0	13.7	16.9
EAS - MS	20800	7.10	226	<0.2	25.1	28.6	22700	7.70	16.5	0.03	13.5	1.00	39.8	39.6
EAS - LS	14100	5.60	257	<0.2	20.9	6.60	14000	7.60	11.3	0.02	7.60	<1.0	23.6	24.5
EAS - UC	12100	5.00	168	<0.2	12.1	6.30	14400	6.40	9.90	0.01	7.20	<1.0	19.2	21.8
EAS - MC	22800	7.00	245	<0.2	22.9	10.7	20900	8.00	17.7	0.02	12.5	1.10	35.5	30.3
EAS - LC	16200	5.30	189	<0.2	14.4	6.20	15000	7.50	13.9	0.02	9.10	<1.0	23.3	21.0
EAS - UN	12400	5.00	156	<0.2	10.3	5.80	13200	6.70	10.2	<0.01	7.20	<1.0	15.7	22.2
EAS - MN	20700	9.60	297	<0.2	28.8	8.70	29100	9.20	16.1	0.02	15.7	1.00	40.5	33.5
EAS - LN	21600	8.00	236	<0.2	21.8	7.50	22000	9.40	17.4	0.02	12.3	1.10	31.1	38.1
EAS - UXN	10600	7.20	204	<0.2	12.4	7.50	20200	9.80	8.10	<0.01	9.20	1.00	21.8	31.5
EAS - MXN	24900	9.40	269	<0.2	28.6	9.50	43300	12.9	18.9	0.02	20.5	1.20	47.7	49.5
EAS - LXN	23200	16.4	540	<0.2	34.6	12.7	54800	13.4	16.8	0.03	28.3	1.20	52.7	42.7

Lowest result

Highest result

Table 3.3: Summary of highest metal concentrations within each transect area at Easington

	mg/kg													
Sample location	**Aluminium as Al**	**Arsenic as As**	**Barium as Ba**	**Cadmium as Cd**	**Chromium as Cr**	**Copper as Cu**	**Iron as Fe**	**Lead as Pb**	**Lithium as Li**	**Mercury as Hg**	**Nickel as Ni**	**Tin as Sn**	**Vanadium as V**	**Zinc as Zn**
EAS - US	12700	3.90	152	<0.2	9.30	5.60	9040	5.80	10.5	0.02	6.00	<1.0	13.7	16.9
EAS - MS	20800	7.10	226	<0.2	25.1	28.6	22700	7.70	16.5	0.03	13.5	1.00	39.8	39.6
EAS - LS	14100	5.60	257	<0.2	20.9	6.60	14000	7.60	11.3	0.02	7.60	<1.0	23.6	24.5
EAS - UC	12100	5.00	168	<0.2	12.1	6.30	14400	6.40	9.90	0.01	7.20	<1.0	19.2	21.8
EAS - MC	22800	7.00	245	<0.2	22.9	10.7	20900	8.00	17.7	0.02	12.5	1.10	35.5	30.3
EAS - LC	16200	5.30	189	<0.2	14.4	6.20	15000	7.50	13.9	0.02	9.10	<1.0	23.3	21.0
EAS - UN	12400	5.00	156	<0.2	10.3	5.80	13200	6.70	10.2	<0.01	7.20	<1.0	15.7	22.2
EAS - MN	20700	9.60	297	<0.2	28.8	8.70	29100	9.20	16.1	0.02	15.7	1.00	40.5	33.5
EAS - LN	21600	8.00	236	<0.2	21.8	7.50	22000	9.40	17.4	0.02	12.3	1.10	31.1	38.1
EAS - UXN	10600	7.20	204	<0.2	12.4	7.50	20200	9.80	8.10	<0.01	9.20	1.00	21.8	31.5
EAS - MXN	24900	9.40	269	<0.2	28.6	9.50	43300	12.9	18.9	0.02	20.5	1.20	47.7	49.5
EAS - LXN	23200	16.4	540	<0.2	34.6	12.7	54800	13.4	16.8	0.03	28.3	1.20	52.7	42.7

Highest result

Polycyclic Aromatic Hydrocarbons (PAHs)

3.2.21 A summary of raw data for Polycyclic Aromatic Hydrocarbons (PAHs) in the sediment samples is shown in Table 3.4. Many of the analytes were shown to have the highest concentrations at the upper shore on the southern transect (US), or the lower shore at the most northern transect (LXN). The lowest values for the analytes were found at the upper shore, on the most northern transect (UXN).

3.2.22 The analytes include napthalenes, phenathrenes and dibenzothiophenes (NPD). The sum of the NPD concentrations ranged from 24 µg/kg (dry weight) at UXN station to 141 µg/kg (dry weight) at US position. If these two stations are not included, then the range is from 48.4 to 113 µg/kg (dry weight). At three of the four transects, the sum of the concentrations of NPDs were highest at the lower shore positions.

3.2.23 The sum of all fractions analysed ranged from 48.7 µg/kg (dry weight) at the UXN station to 298 µg/kg (dry weight) at the LXN station. The sum of all fractions in the analysis were higher at the lower shore, on three of the four transects.

3.2.24

3.2.25

3.2.26 Table 3.5 shows the concentrations of the 16 priority PAHs, defined by the US Environmental Protection Agency (EPA). The concentrations of the EPA 16 PAHs ranged from 11.89 µg/kg (dry weight) at the upper shore of the most northerly transect (UXN) to 165.8 µg/kg (dry weight) on the lower shore of the most northerly transect (LXN). The concentrations at the other stations were considerably lower than position LXN, with the second highest concentration being 54.21 µg/kg (dry weight) at the upper shore, on the southern transect (US).

Table 3.4: Summary of PAH data found in surface sediment samples at Easington (µg/kg (dry weight))

	Sample Station											
	EAS - US	EAS - MS	EAS - LS	EAS - UC	EAS - MC	EAS - LC	EAS - UN	EAS - MN	EAS - LN	EAS - UXN	EAS - MXN	EAS - LXN
Analyte	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Naphthalene	4.44	3.70	1.90	1.79	2.56	2.63	1.85	2.08	4.13	1.50	3.34	1.92
C1 Naphthalenes	14.4	8.86	6.40	5.82	7.94	8.04	5.40	6.29	12.2	3.48	9.78	6.45
C2 Naphthalenes	18.5	8.44	6.64	6.61	8.46	10.3	5.77	6.97	13.3	3.10	12.1	8.98
C3 Naphthalenes	19.0	10.1	7.33	6.06	6.99	10.1	5.49	7.79	12.8	2.94	12.1	9.64
C4 Naphthalenes	13.7	8.65	7.07	5.25	6.87	8.61	4.28	5.82	13.1	2.57	8.94	6.33
Sum Naphthalenes	**70.1**	**39.8**	**29.3**	**25.5**	**32.8**	**39.7**	**22.8**	**29.0**	**55.5**	**13.6**	**46.3**	**33.3**
Phenanthrene / Anthracene	10.6	5.56	7.33	4.33	5.16	5.59	6.15	4.11	7.95	2.68	7.28	37.1
C1 178	15.1	9.87	8.29	6.33	7.37	8.70	6.29	6.74	12.42	3.00	12.3	16.4
C2 178	17.9	11.6	8.43	5.51	8.47	9.50	6.04	7.42	12.91	2.70	13.7	11.9
C3 178	15.7	8.05	5.78	3.73	5.16	6.38	3.61	5.99	9.76	2.00	9.68	5.73
Sum 178	**59.3**	**35.1**	**29.8**	**19.9**	**26.2**	**30.2**	**22.1**	**24.3**	**43.0**	**10.4**	**42.9**	**71.2**
Dibenzothiophene	1.27	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.00	2.31
C1 Dibenzothiophenes	3.29	2.07	1.49	1.23	1.51	1.77	1.18	1.30	2.37	<1	2.31	2.42
C2 Dibenzothiophenes	3.73	2.81	2.08	1.35	1.68	2.13	1.33	1.52	2.83	<1	3.05	2.27
C3 Dibenzothiophenes	3.13	2.33	1.49	1.10	1.35	1.80	1.05	1.30	2.48	<1	2.14	1.20
Sum Dibenzothiophenes	**11.4**	**7.21**	**5.06**	**<4**	**4.54**	**5.70**	**<4**	**4.12**	**7.68**	**<4**	**8.50**	**8.20**
Fluoranthene / pyrene	8.99	7.08	11.2	4.45	4.90	6.10	10.2	4.56	7.70	2.89	6.72	49.1
C1 202	12.0	10.2	7.57	5.64	5.89	6.75	4.81	5.74	9.37	2.49	9.58	9.63
C2 202	13.2	10.9	7.35	5.82	6.41	7.46	5.60	6.27	11.9	2.98	10.9	13.0
C3 202	10.2	7.41	5.83	4.22	4.61	5.70	3.59	4.72	7.57	2.08	7.30	6.08
Sum 202	**44.4**	**35.6**	**32.0**	**20.1**	**21.8**	**26.0**	**24.3**	**21.3**	**36.5**	**10.4**	**34.5**	**77.8**
Benzoanthracene / Chrysene	6.54	4.95	6.54	2.02	3.51	2.89	5.55	2.33	5.40	<2	5.51	21.4
C1 228	8.43	5.83	4.82	3.18	3.97	4.44	4.05	3.55	6.64	1.93	6.39	8.98
C2 228	11.6	7.17	5.63	3.68	4.75	5.75	4.28	4.33	7.48	2.01	7.94	6.97
Sum 228	**26.5**	**17.9**	**17.0**	**8.87**	**12.2**	**13.1**	**13.9**	**10.2**	**19.5**	**5.33**	**19.9**	**37.3**

	Sample Station											
	EAS - US	**EAS - MS**	**EAS - LS**	**EAS - UC**	**EAS - MC**	**EAS - LC**	**EAS - UN**	**EAS - MN**	**EAS - LN**	**EAS - UXN**	**EAS - MXN**	**EAS - LXN**
Analyte	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Benzofluoranthenes / benzopyrenes	10.8	7.27	10.4	<4	6.21	6.43	9.46	5.51	8.18	<4	8.85	31.1
C1 252	11.3	8.67	6.47	4.75	5.84	6.62	5.38	5.02	8.37	3.15	9.36	9.87
C2 252	11.2	7.85	5.36	3.57	5.64	5.29	4.72	3.78	6.24	2.38	7.4	9.19
Sum 252	**33.3**	**23.8**	**22.2**	**12.1**	**17.7**	**18.3**	**19.6**	**14.3**	**22.8**	**7.21**	**25.63**	**50.1**
Dibenzoanthracene / Indenopyrene / Benzoperylene	8.71	4.15	4.90	<3	3.46	3.35	5.37	<3	4.88	<3	5.95	16.2
C1 276	2.83	2.45	1.64	1.03	1.53	1.33	1.40	1.18	2.09	<1	2.13	2.33
C2 276	2.78	1.37	<1	<1	1.04	1.15	1.22	1.02	1.61	<1	1.38	1.77
Sum 276	**14.3**	**7.96**	**6.54**	**<5**	**6.02**	**5.83**	**7.99**	**<5**	**8.59**	**<5**	**9.47**	**20.3**
Sum of all fractions	259	167	142	93.8	121	139	114	108	194	48.7	187	298
Sum of NPD fraction	141	82.1	64.2	49.1	63.5	75.6	48.4	57.3	106	24.0	97.7	113
NPD / 4-6 ring PAH ratio	1.19	0.96	0.83	1.10	1.10	1.19	0.74	1.13	1.21	0.97	1.09	0.61

Lowest result

Highest result

Table 3.5: US Environmental Protection Agency (EPA) priority PAHs surface sediment samples at Easington (µg/kg (dry weight))

	Sample station											
	EAS - US	EAS - MS	EAS - LS	EAS - UC	EAS - MC	EAS - LC	EAS - UN	EAS - MN	EAS - LN	EAS - UXN	EAS - MXN	EAS - LXN
Analyte	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Naphthalene	4.44	3.70	1.90	1.79	2.56	2.63	1.85	2.08	4.13	1.50	3.34	1.92
Acenaphthylene	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Acenaphthene	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.86
Fluorene	1.75	<1	<1	<1	<1	1.05	<1	<1	1.40	<1	1.16	1.52
Phenanthrene	10.6	5.56	6.05	4.33	5.16	5.59	6.15	4.11	7.95	2.68	7.28	32.0
Dibenzothiophene	1.27	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.00	2.31
Anthracene	<1	<1	1.29	<1	<1	<1	<1	<1	<1	<1	<1	5.13
Fluoranthene	3.71	2.45	5.62	1.89	2.05	2.55	5.48	1.94	3.28	1.34	2.73	28.8
Pyrene	5.28	4.63	5.62	2.56	2.85	3.55	4.76	2.61	4.42	1.54	3.99	20.3
Benzo[a]anthracene	1.78	1.64	2.63	<1	1.01	<1	2.25	<1	1.54	<1	1.65	10.3
Chrysene	4.77	3.30	3.91	2.02	2.50	2.89	3.29	2.33	3.86	1.39	3.87	11.1
Benzo[b]fluoranthene	2.64	2.02	2.90	1.32	1.84	1.76	2.54	1.66	2.05	<1	2.29	8.99
Benzo[k]fluoranthene	<1	<1	1.32	<1	<1	<1	1.01	<1	<1	<1	<1	4.23
Benzo[e]pyrene	5.92	3.45	3.87	2.49	3.20	3.42	3.53	2.81	4.34	1.69	4.51	8.66
Benzo[a]pyrene	2.25	1.80	2.27	<1	1.17	1.24	2.38	1.04	1.80	<1	2.04	9.17
Perylene	1.08	<1	1.02	<1	<1	<1	<1	<1	1.06	<1	<1	3.32
Indeno[123,cd]pyrene	1.32	<1	1.35	<1	<1	<1	1.59	<1	<1	<1	1.02	6.68
Dibenzo[a,h]anthracene	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.69
Benzo[ghi]perylene	7.40	4.15	3.55	2.53	3.46	3.35	3.77	2.60	4.88	1.75	4.93	7.82
Sum of EPA 16	54.21	32.7	43.3	18.93	25.8	28.03	38.6	21.18	40.71	11.89	39.81	165.8

Lowest result

Highest result

TPH (Total Petroleum Hydrocarbons)

3.2.27 A summary of the TPH analytes found in the surface sediment samples at Easington, is shown in Table 3.6. Total oils ranged from 2260 µg/kg (dry weight) at the most northerly transect on the upper shore (UXN) to 15500 µg/kg (dry weight) on the most southerly transect at the upper shore station (US). The higher level of total oils found at this location is consistent with the high sum of all fractions observed in the PAH analysis. Furthermore, the lower levels of total oil found at the UXN location is consistent with the lower sum of all fractions observed in the PAH analysis.

3.2.28 Although the LXN location had the highest sum of all fractions observed in the PAH analysis, it had relatively low levels of total oil, in comparison to a number of the other stations. Other stations showed a positive correlation between total oil and the sum of all fractions in the PAH analysis, as would be expected due to the association between the two parameters.

3.2.29 The total n-alkanes concentrations ranged from 216 µg/kg (dry weight) at the UXN station, to 1240 µg/kg (dry weight) at the US station. The analysis showed a positive correlation between total oil and total n-alkanes, as would be expected between the two parameters.

3.2.30 The total n-alkanes also showed a positive correlation with the sum of all fractions observed in the PAH analysis, although the LXN station did again not fit the general pattern observed.

Table 3.6: Summary of TPH data found in surface sediment samples at Easington (µg/kg (dry weight))

	Sample station											
	EAS - US	EAS - MS	EAS - LS	EAS - UC	EAS - MC	EAS - LC	EAS - UN	EAS - MN	EAS - LN	EAS - UXN	EAS - MXN	EAS - LXN
Analyte	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
nC10	16.5	13.8	19.6	8.80	10.2	13.1	7.29	11.3	14.0	4.82	31.2	6.85
nC11	43.4	33.1	27.5	17.6	24.2	28.6	15.0	22.0	33.9	9.53	60.1	13.4
nC12	55.9	41.1	43.5	20.8	31.0	29.7	18.3	24.3	51.9	9.94	49.0	17.0
nC13	81.8	50.1	46.4	23.7	32.2	41.7	19.9	27.5	60.1	9.16	64.7	14.9
nC14	78.2	46.0	53.2	22.5	27.8	43.8	26.8	33.9	56.7	13.5	59.5	18.5
nC15	87.6	46.7	57.2	25.9	43.4	51.1	23.6	31.7	58.5	10.2	60.7	24.9
nC16	73.8	39.8	54.7	23.9	32.9	39.9	21.2	28.9	59.5	10.5	47.6	23.5
nC17	93.4	47.2	59.3	28.5	38.2	46.5	23.3	34.2	56.5	10.7	55.0	19.9
pristane	146	105	82.7	39.0	52.3	71.8	31.9	49.1	90.4	13.8	85.0	29.6
nC18	90.4	44.1	55.5	27.3	34.1	43.9	27.1	30.5	53.6	12.6	52.8	41.6
phytane	59.8	62.5	28.0	17.9	23.8	30.3	22.0	22.1	23.6	12.2	33.0	20.1
nC19	66.8	30.9	54.4	24.7	27.5	33.1	21.8	28.7	46.5	10.5	46.1	17.2
nC20	56.8	34.7	52.2	22.0	27.8	25.4	20.8	26.8	42.3	9.38	46.8	16.4
nC21	60.6	31.8	53.4	24.3	29.8	41.0	27.6	27.5	49.4	11.7	51.9	20.3
nC22	46.8	25.1	55.0	19.7	23.2	30.3	18.8	19.7	35.4	8.48	43.8	15.0

nC23	53.4	33.8	56.5	23.5	27.0	34.7	22.4	27.2	42.7	11.2	49.6	16.9
nC2	43.1	26.4	47.9	18.9	22.2	27.7	18.3	22.4	32.2	9.33	43.0	18.3
nC25	56.1	30.4	42.6	26.5	24.0	33.6	21.0	26.3	38.4	10.1	40.2	26.9
nC26	46.6	21.5	46.1	16.6	18.0	23.5	15.8	19.0	26.5	9.00	33.8	15.2
nC27	38.8	21.6	34.9	20.4	17.2	28.6	14.3	19.4	30.0	8.17	31.6	15.2
nC28	26.8	13.8	28.6	11.8	9.68	14.4	13.0	10.3	16.6	7.38	26.0	9.86
nC29	37.9	17.2	30.0	19.1	14.1	21.0	11.8	14.8	18.1	10.4	30.9	11.7
nC30	21.3	11.5	16.0	8.81	14.5	11.1	9.63	7.90	11.4	5.16	13.6	6.69
nC31	19.1	9.90	12.7	10.2	8.92	10.9	9.42	8.99	12.1	5.57	14.8	9.80
nC32	11.7	9.38	11.9	4.40	3.72	4.59	5.08	6.96	6.91	3.11	14.6	6.78
nC33	9.86	4.85	4.01	6.74	5.61	6.89	4.96	4.91	9.72	3.46	6.18	3.98
nC34	4.29	3.78	2.70	4.46	2.00	2.40	2.76	1.34	2.11	2.00	2.93	3.86
nC35	5.91	2.72	<1	5.07	1.10	<1	1.98	<1	2.50	<1	17.4	1.96
nC36	4.12	2.37	<1	<1	<1	<1	<1	<1	<1	<1	2.61	1.27
nC37	4.88	2.75	<1	1.04	<1	<1	<1	<1	<1	<1	3.86	<1
Total Oil	15,500	11,000	8,180	4,770	6,610	8,010	4,330	5,260	10,500	2,260	9,710	5,280
Total n-alkanes	1,240	696	966	467	550	688	422	517	868	216	1,000	398
Carbon Preference Index	1.14	1.09	0.98	1.23	1.14	1.22	1.06	1.12	1.12	1.05	1.14	0.98
Pristane	146	105	82.7	39.0	52.3	71.8	31.9	49.1	90.4	13.8	85.0	29.6
Phytane	59.8	62.5	28.0	17.9	23.8	30.3	22.0	22.1	23.6	12.2	33.0	20.1
Pristane / Phytane ratio	2.45	1.68	2.95	2.17	2.20	2.37	1.45	2.22	3.83	1.13	2.57	1.47

3.3 Benthic infauna

Results not included in this interim survey report – these will be included when available from the laboratory

4. Discussion

Initial Intertidal Walkover

4.1.1 The key intertidal habitat in the Holderness Inshore MCZ is littoral sand, which the initial intertidal walkover confirms, with sand, gravelly sand or slightly gravelly sand present at all stations.

4.1.2 The observations during the initial intertidal walkover suggest the biotopes on the beach are LS.LSa.MoSa (Barren or amphipod-dominated mobile sand shores) and/or LS.LCS.Sh (Shingle (pebble) and gravel shores), which also correspond with the biotopes expected along the Holderness coast. There is also potentially the LS.LSa.St.Tal (Talitrids on the upper shore and strandline) biotope present. These biotope classifications will be further refined based on the infaunal analysis, which will be included in the ES.

4.1.3 Exposures of clay bedrock have been observed along the Holderness coast and have been classified as the EUNIS biotope: 'Communities on soft circalittoral rock', with evidence of burrowing piddocks (*Pholas dactylus*) observed in the area. While clay bedrock exposures were observed on the lower shore during the initial intertidal walkover, no evidence of piddocks was seen.

4.1.4 No biotopes of conservation importance were recorded during the initial intertidal walkover, nor were any epibenthic or infaunal species of conservation importance.

4.1.5 During the initial intertidal walkover oystercatcher and a variety of gulls were observed over the intertidal area and nearshore areas, possibly little gull (*Hydrocoloeus minutus*), great black-backed gull (*Larus marinus*), common gull (*Larus canus*), or herring gull (*Larus argentatus*). Sand martins were also observed nesting in the cliffs at the northernmost extent of the survey area, where the cliffs are rapidly eroding. Of these species none are on the Red List of the UK Birds of Conservation Concern (BoCC) but oystercatcher and great black-backed gulls are on the Amber List of the BoCC.

Sediment Physico-Chemistry

4.1.6 Sand consistently accounted for the highest proportion of material found at each of the sample stations across the shore. There was very little, or no mud found within the sediment, which would be expected on a relatively exposed beach.

4.1.7 TOC is low at all areas of the shore, but this is typical for a sandy, exposed beach, which is subject to a degree of moderate to high energy hydrodynamic conditions. Typically, TOC is positively correlated with finer material in sediments due to the increased surface area for binding with particles. This may reflect the low TOC, given the small proportion of material that consisted of fine material (<63 µm), throughout the area.

Heavy and Trace Metals

4.1.8 Metal concentrations varied throughout the area surveyed, but were generally higher at the mid and lower shores, than the upper shore. This however, may be attributed to the percentage of fine sediments sampled at these stations.

4.1.9 To determine the degree of any anthropogenic contamination in marine sediments, it is useful to compare observed metal concentrations in sediment with the following values:

- OSPAR (North-east Atlantic)
  - Background Reference (BC)
  - Ecotoxicological Assessment Criteria (EAC), with lower and upper limits.
- Cefas Action Levels
  - Cefas Action Levels provide guidelines for dredged material that are to be assessed for disposal at sea. The levels are used as part of a 'weight of evidence' to assess the material and its suitability for disposal. With regards to the disposal of dredged material, values above the Action Level 1 limit would require further consideration and testing. Contaminants below Action Level 1 are considered to be of no concern.

    Cefas Action Levels provide a useful guideline to compare the values observed at Easington in relation to the degree of contamination present. While it is recognised that these levels are suited to disposal of dredged material. They can provide an indication of which specific contaminants exceed values that may be of concern.

    The metal concentrations from the sediment samples taken, in comparison to the international reference values described above, are shown in Table 4.1.

Table 4.1 Metal concentrations within sediment samples at Easington, compared to OSPAR reference values

Metal	2022 Easington sediment sample station range	OSPAR				CEFAS	
		BC levels	EAC Lower Limits	EAC Upper Limits	Upper Limit Exceeded?	Action Level 1 Limit	Action Level 1 exceeded?
	mg/kg dry weight						
As	3.9 – 16.4	15	1	10	Yes	20	No
Cd	<0.02	0.2	0.1	1	No	0.4	No
Cr	9.30 – 34.6	60	5	50	No	40	No
Cu	5.60 – 28.6	20	5	50	No	40	No
Hg	<0.01 – 0.03	0.05	0.05	0.5	No	0.3	No
Ni	6.00 – 28.3	30	5	50	No	20	Yes
Pb	5.80 – 13.4	25	5	50	No	50	No
Zn	16.9 – 49.5	90	10	100	No	130	No

4.1.10 It is also informative to compare observed values with reference data available from the UK. These data are presented in Table 4.2.

Table 4.2 Metal concentrations within sediment samples at Easington, compared to reference data from the UK

Metal	2022 Easington sediment sample station range	Liverpool Bay[1]	Cumbrian Coast[2]	Scottish MInches[3]	North Sea[4]
	mg/kg dry weight				
As	3.9 – 16.4	No data	No data	4.3	1.2 – 33 (mean 11)
Cd	<0.02	0.3 – 2.1	0.007 – 0.46	0.018	0.01 0.38 (mean 0.05)
Cr	9.30 – 34.6	0.5 – 35.9	10.7 – 85.8	57	No data
Cu	5.60 – 28.6	1.8 – 33.7	1.8 – 49.4	7.3	0.1 – 87 (mean 14)
Hg	<0.01 – 0.03	0.01 – 1.44	0.005 – 0.17	0.05	75% <0.025
Ni	6.00 – 28.3	1.2 – 16.5	No data	6.4	1.5 – 113 (mean 23)
Pb	5.80 – 13.4	6.9 - 101	10.3 – 69.7	24	1.7 – 288 (mean 21)
Zn	16.9 – 49.5	9.4 - 327	22.4 – 129.4	45	3 – 510 (mean 39)

Sources: 1 Ref 7.4.6; 2 Ref 7.4.7; 3 **Error! Reference source not found.**; 4 Ref 7.4.9

4.1.11 Results from the samples show that the metal concentrations are generally low in comparison with the reference levels used for comparison.

4.1.12 The metal concentrations are generally well below the levels that may result in biological harm. Arsenic was the only metal to exceed both the OSPAR BC and OSPAR EAC upper limit and was only exceeded at one sample station. However, the highest concentration of 16.4 mg/kg observed, was still lower than the highest value observed in background reference data from the North Sea and was not greatly higher than the mean value of 11 mg/kg, as shown in Table 4.2. Previous work suggests that arsenic in the nearshore sediments off the north-east coast of Norfolk showed elevated levels, when there was normalization of arsenic to iron, whilst levels in the Humber were closer to the predicted value (Ref 7.4.10). Arsenic was also below the CEFAS Action Level 1 limit, suggesting this is not a concern at the levels observed.

4.1.13 Copper was the only other metal which exceeded the OSPAR BC level at one sample station, and this was below the OSPAR EAC upper limit and the CEFAS Action Level 1 limit. These minimal elevations of copper and arsenic are considered to be minor.

4.1.14 Nickel was the only metal to exceed the CEFAS Action Level 1 limit. These elevations were only observed at two stations; the mid and lower shore on the most northerly transect. This elevation in concentration showed only a slightly increased value to the mean concentration observed in previous sediment samples in the North sea (Table 4.2) and was below the OSPAR EAC upper limit.

4.1.15 All other metals in the analysis were below the CEFAS level 1 limit and the OSPAR EAC upper limit. These are therefore considered to be of no concern.

4.1.16 In general, concentrations of metals were similar, or lower than metal concentrations encountered at other referenced locations around the UK coast, particularly when compared to those observed in the North Sea.

4.1.17 It was observed that the metals concentrations observed in the samples from northern-most transect had highest levels of metals. It is likely that elevations of metals are of terrigenous origin considering the increased levels of erosion of the cliffs here. As noted, there was much evidence of terrestrial derived material on the beach itself in the form of clay boulders, as well as more evidence of cliff slumping and direct wave erosion of the cliff base.

Hydrocarbons

4.1.18 To assess the levels of hydrocarbons in the sediment samples at the Easington landfall, the concentrations can be compared against international standards, shown in Table 4.3. The OSPAR BC levels relate to background concentrations and the OSPAR BAC levels relate to background assessment concentrations.

Table 4.3 Sample PAH concentration levels compared to international standards

PAH	2022 Easington sediment sample station range	OSPAR BC*	OSPAR BAC*
	(µg/kg (dry weight))		
Acenaphthene	<1 – 1.86	-	-
Acenaphthylene	<1	-	-
Anthracene	<1 – 5.13	3	5
Benzo[a]anthracene	<1 – 10.3	9	16
Benzo[a]pyrene	<1 – 9.17	15	30
Benzo[b]fluoranthene	<1 – 8.99	-	-
Benzo[ghi]perylene	1.75 – 7.82	45	80
Benzo[k]fluoranthene	<1 – 4.23	-	-
Chrysene	1.39 – 11.1	11	20
Dibenzo[a,h]anthracene	<1 – 1.69	-	-
Fluoranthene	1.34 – 28.8	20	39

Fluorene	<1 – 1.75	-	-
Indeno[123,cd]pyrene	<1 – 6.68	50	103
Naphthalene	1.50 – 4.44	5	8
Phenanthrene	4.11 - 32	17	32
Pyrene	1.54 - 20.3	13	24

*Note the BC and BAC sediment figures are listed as a dry weight normalised to 2.5% organic carbon, whereas the Easington samples were not normalised. (BC = background concentration, BAC = background assessment concentration)

4.1.19 With the exception of fluorene and naphthalene, the PAH concentrations were highest at the stations on the lower shore, towards the most northerly end of the survey area. Many of the PAHs were recorded below both the background concentration (BC) level and the background assessment concentration (BAC) level. Although the highest levels of fluoranthene and pyrene were above the BC level, they were still below the BAC level.

4.1.20 With the exception of anthracene and phenanthrene, all PAH analytes were below the OSPAR BAC concentration levels. Anthracene was slightly above the OSPAR BAC concentration at only one sample station, with a value of 5.13 µg/kg (dry weight), compared to the BAC threshold of 5 µg/kg (dry weight). The highest recorded level of phenanthrene was 32 µg/kg (dry weight), which is equal to the OSPAR BAC level for this analyte. Both of the maximum levels of these analytes were found at the lower shore on the most northerly area of the survey area.

4.1.21 Given that all other stations across the area showed PAHs to be below both the BC level and BAC level, this suggests the PAH contamination over the survey area is typically low. A number of locations had PAHs that were below the detection level for the analysis, further supporting the low levels of PAHs observed in the area. The fact that higher levels of PAHs were recorded at the northernmost part of the survey area, where increasing evidence of cliff erosion was observed could support the conclusion that the elevated levels were more recently derived from this terrigenous material.

4.1.22 The TPH analysis showed the total oil was highest at the upper shore on the southern transect. Many of the locations, showed a positive correlation between the total oil and sum of all fractions in the PAH analysis, which would be expected, given the association between these two parameters. The sum of all fractions in the PAH analysis, also showed a positive correlation with the total n-alkanes, which would again be expected. Only one station, (LXN) did not appear to fit these correlations. All stations showed a positive correlation between the total oil and total n-alkanes.

5. References

Ref 7.4.1 CIEEM (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine. September 2018 Available at: https://cieem.net/wp-content/uploads/2019/02/Combined-EclA-guidelines-2018-compressed.pdf [last accessed 27.06.2022].

Ref 7.4.2 Wyn G., Brazier, P., Birch, K., Bunker, A., Cooke, A., Jones, M., Lough, N., McMath, A. and Roberts, S. (2006), Handbook for Marine Intertidal Phase 1 Biotope Mapping Survey. Report from Countryside Council for Wales

Ref 7.4.3 JNCC (2022), The Marine Habitat Classification for Britain and Ireland Version 22.04. [08 July 2022]. Available from: https://mhc.jncc.gov.uk/

Ref 7.4.4 Connor, D.W., Allen, J.H., Golding, N., Howell, K.L., Lieberknecht, L.M., Northern, K.O. and Reker, J.B. (2004), The Marine Habitat Classification for Britain and Ireland Version 04.05 ISBN 1 861 07561 8. In: JNCC (2022) The Marine Habitat Classification for Britain and Ireland Version 22.04. [08 July 2022]. Available from: https://mhc.jncc.gov.uk/resources#version0405 p

Ref 7.4.5 Folk, R.L. (1954), The distinction between grain size and mineral composition in sedimentary rock nomenclature. *Journal of Geology* 62 (4): 344-359

Ref 7.4.6 Taylor, D. (1986). Changes in the distribution patterns of trace metals in sediments of the Mersey Estuary in the last decade. Science of the Total Environment 49: 257–295.

Ref 7.4.7 Nixon, E. (1995). Report on Irish Sea Monitoring as part of European Union LIFE Programme (UK/006). Fisheries Research Centre, Dublin

Ref 7.4.8 Davies, I.M. & Others, A. 1999? An investigation into the distribution of trace organic contaminants in Scottish coastal sediments. Unpublished report for DETR Marine and Land Based Inputs to the Sea Research Programme.

Ref 7.4.9 NSTF. (1993) North Sea Quality Status Report 1993. North Sea Task Force. Oslo and Paris Commissions. International Council for the Exploration of the Sea. Olsen & Olsen, Fredensborg.

Ref 7.4.10 Whalley, C., Rowlatt, S., M., Bennett and D, Lovell (1999) Total Arsenic in Sediments from the Western North Sea and the Humber Estuary, Marine Pollution Bulletin,Volume 38, Issue 5

Appendix A – Raw Sediment Data

Station	Treatment	Textural Group Classification	Folk and Ward Description	Folk and Ward Sorting	Mean µm	Mean phi	Sorting Coefficient	Skewness	Kurtosis	Major Sediment Fractions		
										% Gravel	% Sand	% Mud
MAR01459.001	Sediment	S: Sand	Medium Sand	Moderately Well Sorted	376.580529	1.4089698	0.534511045	0.0910823	1.0396545	0.00%	99.03%	0.97%
MAR01459.002	Sediment	sG: Sandy Gravel	Coarse Sand	Poorly Sorted	828.942204	0.2706568	1.892481926	-0.1804476	0.6657108	32.39%	66.80%	0.81%
MAR01459.003	Sediment	(g)S: Slightly Gravelly Sand	Fine Sand	Moderately Sorted	240.326972	2.0569295	0.810297516	-0.1398930	1.3542774	1.92%	96.06%	2.02%
MAR01459.004	Sediment	(g)S: Slightly Gravelly Sand	Medium Sand	Moderately Well Sorted	339.260444	1.5595347	0.543737920	-0.0314969	1.0442758	2.56%	97.44%	0.00%
MAR01459.005	Sediment	sG: Sandy Gravel	Very Coarse Sand	Very Poorly Sorted	1090.274019	-0.1246904	2.008130824	-0.0655547	0.7205202	37.56%	61.82%	0.62%
MAR01459.006	Sediment	(g)S: Slightly Gravelly Sand	Medium Sand	Poorly Sorted	398.726611	1.3265280	1.011057186	-0.0979195	1.2294628	3.33%	94.94%	1.73%
MAR01459.007	Sediment	S: Sand	Medium Sand	Moderately Sorted	402.599045	1.3125844	0.718897337	-0.1455021	1.1837866	0.00%	100.00%	0.00%
MAR01459.008	Sediment	gS: Gravelly Sand	Coarse Sand	Poorly Sorted	620.038983	0.6895695	1.711704593	-0.4564867	0.8345458	20.66%	78.43%	0.91%
MAR01459.009	Sediment	gS: Gravelly Sand	Coarse Sand	Moderately Sorted	725.708977	0.4625370	0.980978531	0.0885008	1.1867886	5.10%	93.51%	1.39%
MAR01459.010	Sediment	S: Sand	Medium Sand	Moderately Well Sorted	304.901436	1.7135850	0.560856306	-0.1140002	1.0214681	0.00%	100.00%	0.00%
MAR01459.011	Sediment	sG: Sandy Gravel	Very Coarse Sand	Poorly Sorted	1174.361120	-0.2318761	1.919651222	0.0556318	0.7035896	40.18%	58.68%	1.14%
MAR01459.012	Sediment	sG: Sandy Gravel	Very Coarse Sand	Poorly Sorted	1094.560703	-0.1303520	1.911243840	-0.1369408	0.8068586	34.90%	64.20%	0.90%

Aperture	MAR01459.001	MAR01459.002	MAR01459.003	MAR01459.004	MAR01459.005	MAR01459.006	MAR01459.007	MAR01459.008	MAR01459.009	MAR01459.010	MAR01459.011	MAR01459.012
63000.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45000.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22400.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16000.000	0.000	0.000	0.000	1.271	1.121	0.000	0.000	0.000	0.000	0.000	0.000	1.152
11200.000	0.000	0.000	0.000	0.898	3.383	0.000	0.000	0.562	0.000	0.000	2.926	4.026
8000.000	0.000	3.153	0.000	0.230	2.822	0.000	0.000	2.130	0.000	0.000	2.860	2.651
5600.000	0.000	4.856	0.132	0.123	6.434	0.000	0.000	3.135	0.000	0.000	5.982	4.491
4000.000	0.000	7.006	0.205	0.000	7.623	0.599	0.000	3.688	0.121	0.000	9.644	6.397
2800.000	0.000	9.791	0.690	0.030	8.635	1.092	0.000	5.462	1.098	0.000	10.656	8.218
2000.000	0.000	7.582	0.890	0.006	7.546	1.634	0.000	5.686	3.878	0.000	8.112	7.962
1400.000	0.000	6.755	1.193	0.036	7.350	2.792	3.160	6.660	9.723	0.040	8.057	8.857
1000.000	0.000	5.353	1.106	0.153	6.189	3.935	3.078	6.198	15.606	1.955	6.111	6.204
707.000	1.441	5.411	1.245	0.896	6.330	7.869	5.262	3.836	21.892	1.495	4.324	5.315
500.000	18.245	6.165	3.650	9.954	7.589	15.274	16.868	6.074	22.198	5.774	6.315	9.056
353.600	38.883	7.249	10.875	32.128	7.350	23.259	30.834	13.375	12.180	23.081	9.521	12.294
250.000	29.016	12.991	24.124	35.731	10.371	21.463	27.338	20.201	5.597	38.417	11.238	11.857
176.800	9.021	15.222	30.807	15.595	11.343	12.649	11.379	15.797	3.147	24.948	8.456	6.824
125.000	1.806	6.793	17.558	2.543	4.715	5.419	1.827	5.375	1.889	4.193	3.457	2.594
88.390	0.519	0.728	4.447	0.407	0.442	1.755	0.254	0.731	0.938	0.097	0.881	0.944
62.500	0.097	0.137	1.055	0.000	0.136	0.530	0.000	0.185	0.338	0.000	0.321	0.256
44.190	0.099	0.122	0.446	0.000	0.097	0.331	0.000	0.137	0.216	0.000	0.216	0.136
31.250	0.078	0.067	0.215	0.000	0.054	0.202	0.000	0.091	0.144	0.000	0.138	0.089
22.097	0.055	0.054	0.128	0.000	0.036	0.112	0.000	0.054	0.123	0.000	0.088	0.051
15.625	0.052	0.038	0.077	0.000	0.022	0.075	0.000	0.030	0.096	0.000	0.062	0.037
11.049	0.064	0.047	0.092	0.000	0.030	0.107	0.000	0.046	0.120	0.000	0.072	0.056
7.813	0.055	0.045	0.092	0.000	0.031	0.113	0.000	0.047	0.123	0.000	0.072	0.062
5.524	0.038	0.033	0.073	0.000	0.025	0.096	0.000	0.036	0.103	0.000	0.063	0.057
3.906	0.024	0.022	0.053	0.000	0.019	0.075	0.000	0.025	0.075	0.000	0.050	0.047
2.762	0.020	0.019	0.047	0.000	0.017	0.061	0.000	0.023	0.052	0.000	0.041	0.039
1.953	0.029	0.025	0.061	0.000	0.022	0.059	0.000	0.031	0.042	0.000	0.039	0.038
1.381	0.045	0.037	0.086	0.000	0.031	0.067	0.000	0.044	0.044	0.000	0.044	0.042
0.977	0.059	0.046	0.104	0.000	0.037	0.074	0.000	0.054	0.047	0.000	0.047	0.045
0.691	0.064	0.049	0.109	0.000	0.039	0.074	0.000	0.056	0.046	0.000	0.045	0.044
0.488	0.064	0.047	0.103	0.000	0.037	0.068	0.000	0.054	0.041	0.000	0.041	0.040
0.345	0.059	0.042	0.092	0.000	0.033	0.060	0.000	0.048	0.035	0.000	0.035	0.034
0.244	0.052	0.037	0.079	0.000	0.029	0.051	0.000	0.042	0.029	0.000	0.029	0.028
0.173	0.043	0.030	0.063	0.000	0.023	0.040	0.000	0.034	0.022	0.000	0.022	0.022
0.122	0.034	0.023	0.050	0.000	0.018	0.031	0.000	0.026	0.017	0.000	0.017	0.017
0.086	0.023	0.016	0.034	0.000	0.012	0.021	0.000	0.018	0.011	0.000	0.012	0.012
	0.014	0.009	0.020	0.000	0.007	0.013	0.000	0.011	0.007	0.000	0.007	0.007

		Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Method No	SEDOES*	SEDMS*	SEDOES*	SEDMS*	SEDMS*	SEDMS*	SEDOES*	SEDMS*	SEDOES*	TMMS1*	SEDMS*	SEDMS*	SEDMS*	SEDMS*
		Limit of Detection	10	0.5	1	0.2	2	2	45	1.2	2	0.01	2	1	1	3
		Accreditation	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	N	N	UKAS	UKAS	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Aluminium as Al**	**Arsenic as As**	**Barium as Ba**	**Cadmium as Cd**	**Chromium as Cr**	**Copper as Cu**	**Iron as Fe**	**Lead as Pb**	**Lithium as Li**	**Mercury as Hg**	**Nickel as Ni**	**Tin as Sn**	**Vanadium as V**	**Zinc as Zn**
EAS - US	MAR01459.001	Sediment	12700	3.90	152	<0.2	9.30	5.60	9040	5.80	10.5	0.02	6.00	<1.0	13.7	16.9
EAS - MS	MAR01459.002	Sediment	20800	7.10	226	<0.2	25.1	28.6	22700	7.70	16.5	0.03	13.5	1.00	39.8	39.6
EAS - LS	MAR01459.003	Sediment	14100	5.60	257	<0.2	20.9	6.60	14000	7.60	11.3	0.02	7.60	<1.0	23.6	24.5
EAS - UC	MAR01459.004	Sediment	12100	5.00	168	<0.2	12.1	6.30	14400	6.40	9.90	0.01	7.20	<1.0	19.2	21.8
EAS - MC	MAR01459.005	Sediment	22800	7.00	245	<0.2	22.9	10.7	20900	8.00	17.7	0.02	12.5	1.10	35.5	30.3
EAS - LC	MAR01459.006	Sediment	16200	5.30	189	<0.2	14.4	6.20	15000	7.50	13.9	0.02	9.10	<1.0	23.3	21.0
EAS - UN	MAR01459.007	Sediment	12400	5.00	156	<0.2	10.3	5.80	13200	6.70	10.2	<0.01	7.20	<1.0	15.7	22.2
EAS - MN	MAR01459.008	Sediment	20700	9.60	297	<0.2	28.8	8.70	29100	9.20	16.1	0.02	15.7	1.00	40.5	33.5
EAS - LN	MAR01459.009	Sediment	21600	8.00	236	<0.2	21.8	7.50	22000	9.40	17.4	0.02	12.3	1.10	31.1	38.1
EAS - UXN	MAR01459.010	Sediment	10600	7.20	204	<0.2	12.4	7.50	20200	9.80	8.10	<0.01	9.20	1.00	21.8	31.5
EAS - MXN	MAR01459.011	Sediment	24900	9.40	269	<0.2	28.6	9.50	43300	12.9	18.9	0.02	20.5	1.20	47.7	49.5
EAS - LXN	MAR01459.012	Sediment	23200	16.4	540	<0.2	34.6	12.7	54800	13.4	16.8	0.03	28.3	1.20	52.7	42.7
		Reference Material (% Recovery)	91	96	96	90	104	96	95	92	114	102	99	90	102	96
		QC Blank	<10	<0.5	<1	<0.2	<2	<2	<45	<1.2	<2	<0.01	<2	<1	<1	<3

						Client Reference:	**EAS - US**	**EAS - MS**	**EAS - LS**	**EAS - UC**	**EAS - MC**	**EAS - LC**	**EAS - UN**	**EAS - MN**	**EAS - LN**	**EAS - UXN**	**EAS - MXN**	**EAS - LXN**	**Reference Material (% Recovery)**	**QC Blank**
						SOCOTEC Ref:	MAR01459.001	MAR01459.002	MAR01459.003	MAR01459.004	MAR01459.005	MAR01459.006	MAR01459.007	MAR01459.008	MAR01459.009	MAR01459.010	MAR01459.011	MAR01459.012		
Analyte	**Mass**	**Accreditation**	**Method No**	**Limit of Detection**	**Units**	**Date Extracted**	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment		
Naphthalene	128	UKAS	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	4.44	3.70	1.90	1.79	2.56	2.63	1.85	2.08	4.13	1.50	3.34	1.92	85	<1
C1 Naphthalenes	142	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	14.4	8.86	6.40	5.82	7.94	8.04	5.40	6.29	12.2	3.48	9.78	6.45	84	<1
C2 Naphthalenes	156	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	18.5	8.44	6.64	6.61	8.46	10.3	5.77	6.97	13.3	3.10	12.1	8.98	N.D	<1
C3 Naphthalenes	170	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	19.0	10.1	7.33	6.06	6.99	10.1	5.49	7.79	12.8	2.94	12.1	9.64	N.D	<1
C4 Naphthalenes	184	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	13.7	8.65	7.07	5.25	6.87	8.61	4.28	5.82	13.1	2.57	8.94	6.33	N.D	<1
Sum Naphthalenes	-	N	ASC/SOP/303/304	5	μg/Kg (Dry Weight)	05/07/2022	70.1	39.8	29.3	25.5	32.8	39.7	22.8	29.0	55.5	13.6	46.3	33.3	85	<5
Phenanthrene / Anthracene	178	UKAS	ASC/SOP/303/304	2	μg/Kg (Dry Weight)	05/07/2022	10.6	5.56	7.33	4.33	5.16	5.59	6.15	4.11	7.95	2.68	7.28	37.1	80	<2
C1 178	192	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	15.1	9.87	8.29	6.33	7.37	8.70	6.29	6.74	12.42	3.00	12.3	16.4	N.D	<1
C2 178	206	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	17.9	11.6	8.43	5.51	8.47	9.50	6.04	7.42	12.91	2.70	13.7	11.9	N.D	<1
C3 178	220	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	15.7	8.05	5.78	3.73	5.16	6.38	3.61	5.99	9.76	2.00	9.68	5.73	N.D	<1
Sum 178	-	N	ASC/SOP/303/304	5	μg/Kg (Dry Weight)	05/07/2022	59.3	35.1	29.8	19.9	26.2	30.2	22.1	24.3	43.0	10.4	42.9	71.2	80	<5
Dibenzothiophene	184	UKAS	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	1.27	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.00	2.31	85	<1
C1 Dibenzothiophenes	198	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	3.29	2.07	1.49	1.23	1.51	1.77	1.18	1.30	2.37	<1	2.31	2.42	N.D	<1
C2 Dibenzothiophenes	212	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	3.73	2.81	2.08	1.35	1.68	2.13	1.33	1.52	2.83	<1	3.05	2.27	N.D	<1
C3 Dibenzothiophenes	226	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	3.13	2.33	1.49	1.10	1.35	1.80	1.05	1.30	2.48	<1	2.14	1.20	N.D	<1
Sum Dibenzothiophenes	-	N	ASC/SOP/303/304	4	μg/Kg (Dry Weight)	05/07/2022	11.4	7.21	5.06	<4	4.54	5.70	<4	4.12	7.68	<4	8.50	8.20	85	<4
Fluoranthene / pyrene	202	N*	ASC/SOP/303/304	2	μg/Kg (Dry Weight)	05/07/2022	8.99	7.08	11.2	4.45	4.90	6.10	10.2	4.56	7.70	2.89	6.72	49.1	78	<2
C1 202	216	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	12.0	10.2	7.57	5.64	5.89	6.75	4.81	5.74	9.37	2.49	9.58	9.63	N.D	<1
C2 202	230	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	13.2	10.9	7.35	5.82	6.41	7.46	5.60	6.27	11.9	2.98	10.9	13.0	N.D	<1
C3 202	244	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	10.2	7.41	5.83	4.22	4.61	5.70	3.59	4.72	7.57	2.08	7.30	6.08	N.D	<1
Sum 202	-	N	ASC/SOP/303/304	5	μg/Kg (Dry Weight)	05/07/2022	44.4	35.6	32.0	20.1	21.8	26.0	24.3	21.3	36.5	10.4	34.5	77.8	78	<5
Benzoanthracene / Chrysene	228	UKAS	ASC/SOP/303/304	2	μg/Kg (Dry Weight)	05/07/2022	6.54	4.95	6.54	2.02	3.51	2.89	5.55	2.33	5.40	<2	5.51	21.4	86	<2
C1 228	242	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	8.43	5.83	4.82	3.18	3.97	4.44	4.05	3.55	6.64	1.93	6.39	8.98	N.D	<1
C2 228	256	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	11.6	7.17	5.63	3.68	4.75	5.75	4.28	4.33	7.48	2.01	7.94	6.97	N.D	<1
Sum 228	-	N	ASC/SOP/303/304	4	μg/Kg (Dry Weight)	05/07/2022	26.5	17.9	17.0	8.87	12.2	13.1	13.9	10.2	19.5	5.33	19.9	37.3	86	<4
Benzofluoranthenes /benzopyrenes	252	UKAS	ASC/SOP/303/304	4	μg/Kg (Dry Weight)	05/07/2022	10.8	7.27	10.4	<4	6.21	6.43	9.46	5.51	8.18	<4	8.85	31.1	94	<4
C1 252	266	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	11.3	8.67	6.47	4.75	5.84	6.62	5.38	5.02	8.37	3.15	9.36	9.87	N.D	<1
C2 252	280	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	11.2	7.85	5.36	3.57	5.64	5.29	4.72	3.78	6.24	2.38	7.4	9.19	N.D	<1
Sum 252	-	N	ASC/SOP/303/304	6	μg/Kg (Dry Weight)	05/07/2022	33.3	23.8	22.2	12.1	17.7	18.3	19.6	14.3	22.8	7.21	25.63	50.1	94	<6
Dibenzoanthracene / Indenopyrene /Benzoperylene	276	UKAS	ASC/SOP/303/304	3	μg/Kg (Dry Weight)	05/07/2022	8.71	4.15	4.90	<3	3.46	3.35	5.37	<3	4.88	<3	5.95	16.2	95	<3
C1 276	290	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	2.83	2.45	1.64	1.03	1.53	1.33	1.40	1.18	2.09	<1	2.13	2.33	N.D	<1
C2 276	304	N	ASC/SOP/303/304	1	μg/Kg (Dry Weight)	05/07/2022	2.78	1.37	<1	<1	1.04	1.15	1.22	1.02	1.61	<1	1.38	1.77	N.D	<1
Sum 276	-	N	ASC/SOP/303/304	5	μg/Kg (Dry Weight)	05/07/2022	14.3	7.96	6.54	<5	6.02	5.83	7.99	<5	8.59	<5	9.47	20.3	95	<5
Sum of all fractions	-	N	ASC/SOP/303/304	34	μg/Kg (Dry Weight)	05/07/2022	259	167	142	93.8	121	139	114	108	194	48.7	187	298	86	<34
Sum of NPD fraction	-	N	ASC/SOP/303/304	14	μg/Kg (Dry Weight)	05/07/2022	141	82.1	64.2	49.1	63.5	75.6	48.4	57.3	106	24.0	97.7	113	83	<14
NPD / 4-6 ring PAH ratio	-	N	ASC/SOP/303/304	-	μg/Kg (Dry Weight)	05/07/2022	1.19	0.96	0.83	1.10	1.10	1.19	0.74	1.13	1.21	0.97	1.09	0.61	98	-

						Client Reference:	EAS - US	EAS - MS	EAS - LS	EAS - UC	EAS - MC	EAS - LC	EAS - UN	EAS - MN	EAS - LN	EAS - UXN	EAS - MXN	EAS - LXN	Reference Material (% Recovery)	QC Blank
						SOCOTEC Ref:	MAR01459.001	MAR01459.002	MAR01459.003	MAR01459.004	MAR01459.005	MAR01459.006	MAR01459.007	MAR01459.008	MAR01459.009	MAR01459.010	MAR01459.011	MAR01459.012		
Analyte	Mass	Accreditation	Method No	Limit of Detection	Units	Date Extracted	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment		
Naphthalene	128	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	4.44	3.70	1.90	1.79	2.56	2.63	1.85	2.08	4.13	1.50	3.34	1.92	85	<1
Acenaphthylene	152	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	83	<1
Acenaphthene	154	N*	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.86	84	<1
Fluorene	166	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	1.75	<1	<1	<1	<1	1.05	<1	<1	1.40	<1	1.16	1.52	86	<1
Phenanthrene	178	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	10.6	5.56	6.05	4.33	5.16	5.59	6.15	4.11	7.95	2.68	7.28	32.0	81	<1
Dibenzothiophene	184	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	1.27	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.00	2.31	85	<1
Anthracene	178	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	<1	<1	1.29	<1	<1	<1	<1	<1	<1	<1	<1	5.13	80	<1
Fluoranthene	202	N*	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	3.71	2.45	5.62	1.89	2.05	2.55	5.48	1.94	3.28	1.34	2.73	28.8	79	<1
Pyrene	202	N*	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	5.28	4.63	5.62	2.56	2.85	3.55	4.76	2.61	4.42	1.54	3.99	20.3	78	<1
Benzo[a]anthracene	228	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	1.78	1.64	2.63	<1	1.01	<1	2.25	<1	1.54	<1	1.65	10.3	87	<1
Chrysene	228	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	4.77	3.30	3.91	2.02	2.50	2.89	3.29	2.33	3.86	1.39	3.87	11.1	85	<1
Benzo[b]fluoranthene	252	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	2.64	2.02	2.90	1.32	1.84	1.76	2.54	1.66	2.05	<1	2.29	8.99	86	<1
Benzo[k]fluoranthene	252	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	<1	<1	1.32	<1	<1	<1	1.01	<1	<1	<1	<1	4.23	101	<1
Benzo[e]pyrene	252	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	5.92	3.45	3.87	2.49	3.20	3.42	3.53	2.81	4.34	1.69	4.51	8.66	99	<1
Benzo[a]pyrene	252	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	2.25	1.80	2.27	<1	1.17	1.24	2.38	1.04	1.80	<1	2.04	9.17	90	<1
Perylene	252	N	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	1.08	<1	1.02	<1	<1	<1	<1	<1	1.06	<1	<1	3.32	101	<1
Indeno[123,cd]pyrene	276	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	1.32	<1	1.35	<1	<1	<1	1.59	<1	<1	<1	1.02	6.68	97	<1
Dibenzo[a,h]anthracene	278	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.69	97	<1
Benzo[ghi]perylene	276	UKAS	ASC/SOP/303/304	1	µg/Kg (Dry Weight)	05/07/2022	7.40	4.15	3.55	2.53	3.46	3.35	3.77	2.60	4.88	1.75	4.93	7.82	92	<1

					Client Reference:	EAS - US	EAS - MS	EAS - LS	EAS - UC	EAS - MC	EAS - LC	EAS - UN	EAS - MN	EAS - LN	EAS - UXN	EAS - MXN	EAS - LXN	Reference Material (% Recovery)	QC Blank
					SOCOTEC Ref:	MAR01459.001	MAR01459.002	MAR01459.003	MAR01459.004	MAR01459.005	MAR01459.006	MAR01459.007	MAR01459.008	MAR01459.009	MAR01459.010	MAR01459.011	MAR01459.012		
Analyte	Accreditation	Method No	Limit of Detection	Units	Date Extracted	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment		
nC10	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	16.5	13.8	19.6	8.80	10.2	13.1	7.29	11.3	14.0	4.82	31.2	6.85	86	<1
nC11	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	43.4	33.1	27.5	17.6	24.2	28.6	15.0	22.0	33.9	9.53	60.1	13.4	N.D	<1
nC12	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	55.9	41.1	43.5	20.8	31.0	29.7	18.3	24.3	51.9	9.94	49.0	17.0	84	<1
nC13	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	81.8	50.1	46.4	23.7	32.2	41.7	19.9	27.5	60.1	9.16	64.7	14.9	N.D	<1
nC14	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	78.2	46.0	53.2	22.5	27.8	43.8	26.8	33.9	56.7	13.5	59.5	18.5	81	<1
nC15	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	87.6	46.7	57.2	25.9	43.4	51.1	23.6	31.7	58.5	10.2	60.7	24.9	N.D	<1
nC16	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	73.8	39.8	54.7	23.9	32.9	39.9	21.2	28.9	59.5	10.5	47.6	23.5	95	<1
nC17	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	93.4	47.2	59.3	28.5	38.2	46.5	23.3	34.2	56.5	10.7	55.0	19.9	N.D	<1
pristane	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	146	105	82.7	39.0	52.3	71.8	31.9	49.1	90.4	13.8	85.0	29.6	N.D	<1
nC18	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	90.4	44.1	55.5	27.3	34.1	43.9	27.1	30.5	53.6	12.6	52.8	41.6	94	<1
phytane	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	59.8	62.5	28.0	17.9	23.8	30.3	22.0	22.1	23.6	12.2	33.0	20.1	N.D	<1
nC19	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	66.8	30.9	54.4	24.7	27.5	33.1	21.8	28.7	46.5	10.5	46.1	17.2	N.D	<1
nC20	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	56.8	34.7	52.2	22.0	27.8	25.4	20.8	26.8	42.3	9.38	46.8	16.4	74	<1
nC21	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	60.6	31.8	53.4	24.3	29.8	41.0	27.6	27.5	49.4	11.7	51.9	20.3	N.D	<1
nC22	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	46.8	25.1	55.0	19.7	23.2	30.3	18.8	19.7	35.4	8.48	43.8	15.0	93	<1
nC23	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	53.4	33.8	56.5	23.5	27.0	34.7	22.4	27.2	42.7	11.2	49.6	16.9	N.D	<1
nC24	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	43.1	26.4	47.9	18.9	22.2	27.7	18.3	22.4	32.2	9.33	43.0	18.3	91	<1
nC25	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	56.1	30.4	42.6	26.5	24.0	33.6	21.0	26.3	38.4	10.1	40.2	26.9	N.D	<1
nC26	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	46.6	21.5	46.1	16.6	18.0	23.5	15.8	19.0	26.5	9.00	33.8	15.2	85	<1
nC27	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	38.8	21.6	34.9	20.4	17.2	28.6	14.3	19.4	30.0	8.17	31.6	15.2	N.D	<1
nC28	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	26.8	13.8	28.6	11.8	9.68	14.4	13.0	10.3	16.6	7.38	26.0	9.86	81	<1
nC29	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	37.9	17.2	30.0	19.1	14.1	21.0	11.8	14.8	18.1	10.4	30.9	11.7	N.D	<1
nC30	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	21.3	11.5	16.0	8.81	14.5	11.1	9.63	7.90	11.4	5.16	13.6	6.69	77	<1
nC31	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	19.1	9.90	12.7	10.2	8.92	10.9	9.42	8.99	12.1	5.57	14.8	9.80	N.D	<1
nC32	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	11.7	9.38	11.9	4.40	3.72	4.59	5.08	6.96	6.91	3.11	14.6	6.78	73	<1
nC33	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	9.86	4.85	4.01	6.74	5.61	6.89	4.96	4.91	9.72	3.46	6.18	3.98	N.D	<1
nC34	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	4.29	3.78	2.70	4.46	2.00	2.40	2.76	1.34	2.11	2.00	2.93	3.86	70	<1
nC35	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	5.91	2.72	<1	5.07	1.10	<1	1.98	<1	2.50	<1	17.4	1.96	N.D	<1
nC36	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	4.12	2.37	<1	<1	<1	<1	<1	<1	<1	<1	2.61	1.27	61	<1
nC37	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	4.88	2.75	<1	1.04	<1	<1	<1	<1	<1	<1	3.86	<1	N.D	<1
Total Oil	N	ASC/SOP/303/306	100	µg/Kg (Dry Weight)	05/07/2022	15,500	11,000	8,180	4,770	6,610	8,010	4,330	5,260	10,500	2,260	9,710	5,280	N.D	<100
Total n alkanes	N	ASC/SOP/303/306	28	µg/Kg (Dry Weight)	05/07/2022	1,240	696	966	467	550	688	422	517	868	216	1,000	398	82	<28
Carbon Preference Index	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	1.14	1.09	0.98	1.23	1.14	1.22	1.06	1.12	1.12	1.05	1.14	0.98	N.D	-
Pristane	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	146	105	82.7	39.0	52.3	71.8	31.9	49.1	90.4	13.8	85.0	29.6	N.D	<1
Phytane	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	59.8	62.5	28.0	17.9	23.8	30.3	22.0	22.1	23.6	12.2	33.0	20.1	N.D	<1
Pristane / phytane ratio	N	ASC/SOP/303/306	1	µg/Kg (Dry Weight)	05/07/2022	2.45	1.68	2.95	2.17	2.20	2.37	1.45	2.22	3.83	1.13	2.57	1.47	-	-

Appendix B – Raw Benthic Invertebrate Data

Not included in this interim survey report as data not yet available

Appendix C – Station Descriptions

A brief description of each station is provided here, including photographs. Biotopes are classified to Level 4, with a possible Level 5 suggested from the Marine Habitat Classification for Britain and Ireland Version 04.05 (Connor *et al*., 2004; JNCC, 2022). The biotope descriptions for each station will be confirmed once the benthic infauna analysis is returned.

Upper North (UN)

The strandline is right at cliff base and the cliff base relatively dry; the strandline is standard flotsam and drift algae and litter. Further north the cliff base is wet from recent high water. Sediment description as per UC. Some cliff deposits visible in sediments, clay material.

Biotope classification: **LS.LSa.MoSa** (Barren or amphipod-dominated mobile sand shores), probably **LS.LSa.MoSa.BarSa** (Barren littoral coarse sand)

Middle North (MN)

An old steel sheet piled groyne is located to the south. Lower shore starts to expose clay platform.

Biotope classification: **LS.LCS.Sh** (Shingle (pebble) and gravel shores), possibly **LS.LCS.Sh.BarSh** (Barren littoral shingle)

Lower North (LN)

Biotope classification: **LS.LSa.MoSa** (Barren or amhipod dominated mobile sand shores), possibly **LS.LSa.MoSa.BarSa** (Barren littoral coarse sand)

Upper Centre (UC)

The recent wet strandline is of pebbles, algae and other drift material approx. 10 m from cliff base. Sediment is medium sand; shingly, sandy and stony below 10 cm. There are talitrid burrows evident but no obvious RPD layer.

Biotope classification: **LS.LSa.St** (strandline), possibly **LS.LSa.St.Tal** (Talitrids on the upper shore and strandline)

Middle Centre (MC)

Metal groyne to south.

Biotope classification: **LS.LCS.Sh** (Shingle (pebble) and gravel shores), possibly **LS.LCS.Sh.BarSh** (Barren littoral shingle)

Lower Centre (LC)

Situated on the clay platform. Sediments are sand plus some shingle. Very wet with running water back down the shore.

Biotope classification: **LS.LSa.MoSa** (Barren or amhipod dominated mobile sand shores), possibly **LS.LSa.MoSa.BarSa** (Barren littoral coarse sand)

Upper South (US)

Strandline 10-15 m from cliff base. Medium sand covering shingle.

The upper shore is relatively flat; mid shore sloping onto flat lower shore.

Biotope classification: **LS.LSa.MoSa** (Barren or amphipod-dominated mobile sand shores), probably **LS.LSa.MoSa.BarSa** (Barren littoral coarse sand)

Middle South (MS)

Station was just above the transition onto lower flat intertidal, on sloping wet mid shore. Sediments are a mix (matrix) of shingle, pebbles and sand. To the north is the groyne. This station is directly online with mobile phone tower.

Biotope classification: **LS.LCS.Sh** (Shingle (pebble) and gravel shores), possibly **LS.LCS.Sh.BarSh** (Barren littoral shingle)

Lower South (LS)

Even medium sand – wet on flatter lower intertidal. Lower shore is sand, leading onto exposed clay platform. Steel groyne to north.

Biotope classification: **LS.LSa.MoSa** (Barren or amhipod dominated mobile sand shores), possibly **LS.LSa.MoSa.BarSa** (Barren littoral coarse sand)

Upper Extra North (UXN)

Finer sand on upper shore

Biotope classification: **LS.LSa.FiSa** (Polychaete/amphipod-dominated fine sand shores)

Middle Extra North (MXN)

Biotope classification: LS.LCS.Sh (Shingle (pebble) and gravel shores), possibly LS.LCS.Sh.BarSh (Barren littoral shingle)Lower Extra North (LXN)

Shoreline narrows with increased distance north, clay and shingle at lower shore are closer to the cliffs, no high tide strandline at all. Beach more shelving possibly.

Biotope classification: **LS.LSa.MoSa** (Barren or amhipod dominated mobile sand shores), possibly **LS.LSa.MoSa.BarSa** (Barren littoral coarse sand)