FOREWIND

DOGGER BANK
TEESSIDE A & B

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Intertidal Benthic Survey

the INSTITUTE of ESTUARINE and COASTAL STUDIES

UNIVERSITY OF Hull
Institute of Estuarine and Coastal Studies

Teesside Landfall: Intertidal and Phase 1 biotope survey

Report to Forewind Ltd.

Institute of Estuarine and Coastal Studies
University of Hull

11th December 2012

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Forewind Ltd.

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For and on behalf of the Institute of Estuarine and Coastal Studies

Approved by:	Nick Cutts
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Date:	11th December 2012

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1. INTRODUCTION

1.1 Background

The Institute of Estuarine and Coastal Studies (IECS) was commissioned by Forewind Ltd to carry out a Phase 1 biotope survey of the intertidal zone located between the towns of Redcar and Marske-by-the-Sea, Tees estuary, Teesside. This area has been identified as a preferred landfall location for export cables, with the ultimate aim of connecting offshore wind farms off the Teesside coastline to the National Grid. The intertidal survey was completed as part of the development of the Environmental Impact Assessment (EIA) required from Forewind Ltd. to continue with the proposal to use this area as a landfall site.

The survey area as designated by the tender specification includes 0.63km^2 of intertidal area (Figure 1). There are currently no habitats or species with conservation interest within the survey site (Dogger Bank Teesside EIA Scoping report, Forewind. May 2012), however several have been identified within the Tees estuary. These include coastal saltmarsh[1], intertidal mudflats[2], intertidal underboulder communities[3] and saline lagoons[4].

1.2 Aims and objectives

The overall aim of this report, as set out by the tender provided by Forewind Ltd., is to carry out the necessary benthic ecological characterisation surveys and subsequent assessment required to inform the EIA process at the landfall site.

For the purposes of the EIA, the habitats and species assemblages present at the site will be characterised, and potential sensitivities to the impacts associated with the construction, operation and decommissioning of the project shall be assessed. This is a characterisation study based on qualitative data, rather than quantitative data and therefore sampling of the intertidal site aims to establish the communities present at the site, and identify any habitats or species of interest, such as those protected by UK BAP of the Habitats Directive.

[1] Annex 1 habitat under the Habitats Directive and UK Biodiversity Action Plan (BAP) priority habitat.

[2] Annex 1 habitat under the Habitats Directive, UK BAP priority habitat, on the OSPAR list of threatened and/or declining species and habitats.

[3] UK BAP priority habitat.

[4] Annex 1 habitat under the Habitats Directive and UK BAP priority habitat.

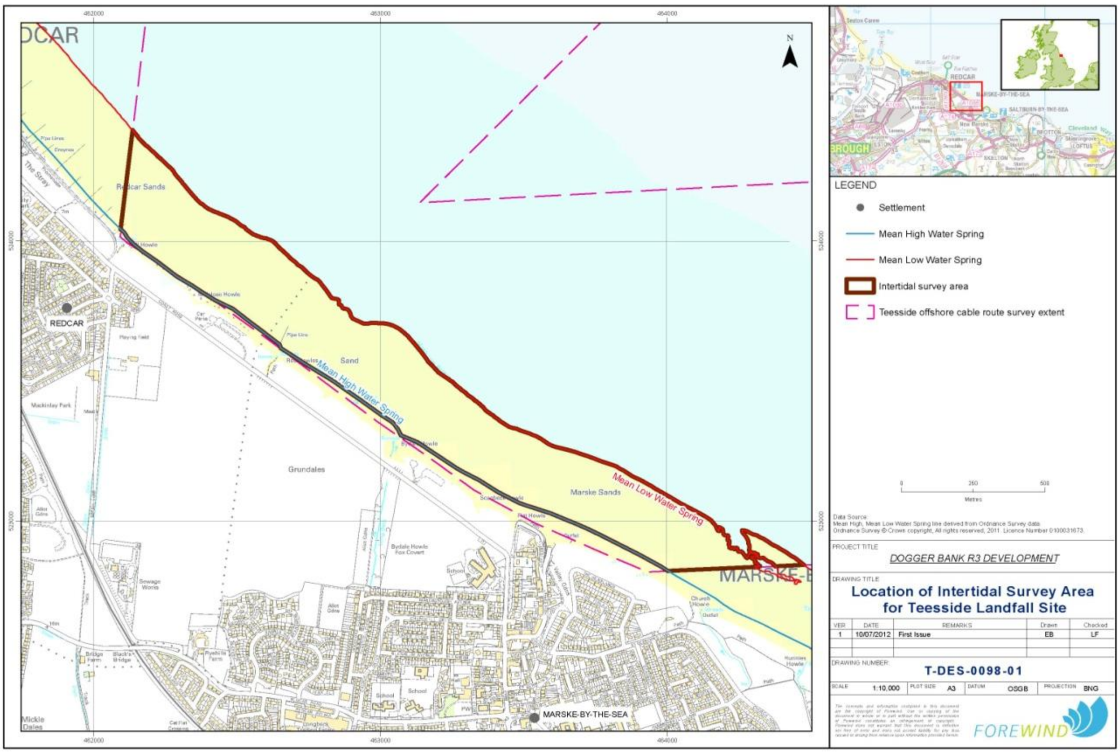

Figure 1. Location of intertidal survey area.

2. METHODOLOGY

2.1 Pre-survey analysis

Prior to undertaking the survey work, desk based analysis and preparation was carried out. This included an overview of any previous intertidal surveys conducted at the site, as well as analysis of OS based maps of the site in order to identify suitable sites to place the required number of transects for the survey.

The survey methodology specified that 6 transect lines should be placed approximately 500m apart for the entire length of the survey site, with a grid of sampling stations evenly distributed along the transect lines, at upper, middle and lower shore locations. Aerial photographs were not available for this study, therefore Google maps was used and Redcar and Cleveland Borough Council were consulted whilst analysing possible specific transect locations, in order to identify any areas of interest that would be useful to include in the survey. The information gained suggested that there were no specific areas that may prove of interest, and therefore transect lines were provisionally placed at equally spaced intervals, with a flexible methodology which meant that if an area of interest presented itself during the survey, the option to re-position the transect to include the area was available.

As the survey activities began approximately 2 hours before low water, tidal data for the area was derived from the UKHO TotalTide™ tide prediction software. As the survey's were to be conducted on foot, there were few weather restrictions, however biotope surveys were not conducted in or immediately after heavy rain as this may have resulted in the loss of surface features, and therefore inaccurate results.

2.2 Intertidal biotope survey

The survey was undertaken in a single deployment on 17th – 19th September 2012, during spring tides in order to maximise the extent of the intertidal area exposed at low tide. Two teams each comprising two IECS surveyors carried out the survey on foot, having each agreed upon the terms of the identification process and undertaking the first transect together, therefore eliminating any discrepancies in the survey approach and results.

Mapping was carried out according to the Common Standards Monitoring Guidance littoral sediment and Procedural Guideline 3.1 of the Marine Monitoring Handbook. Other procedural guidelines of relevance include 1.1 (intertidal resource mapping). At each distinct habitat along each transect, the nature of the substratum (including the depth of the redox potential discontinuity) was recorded together with the surface features and dominant species. These details were recorded using the standard MNCR forms (survey, habitat and site). Recording of such features took place where notable changes in the substratum (e.g. sediment type or surface features such as standing water, ripples etc.) occurred and where there was a notable change in biological surface features (e.g. tubes, casts, feeding pits, faecal mounds) which may indicate a change in species composition. The density of conspicuous organisms (e.g. *Arenicola marina*) was estimated by counting the number of surface features / m^2 (casts, surface siphon holes etc).

The density of less conspicuous characterising species such as bivalves was estimated by digging a 1 m^2 area (or 0.1 m^2 if densities are high). At each site, two spade loads of sediment (as indicated by Wyn & Brazier, 2001), dug to a depth 15-20 cm, were sieved through a 0.5 mm mesh and the infaunal organisms identified. All holes were back-filled after sampling. This resulted in 41 samples being collected, sorted in the field and the specimens inspected and then stored in 70% Industrial Methylated Spirits (IMS) for further analysis in the laboratory.

A rapid *in situ* analysis of the sediment particle size was undertaken within each distinct biotope. The sediment was visually compared to pre-sieved samples prepared in accordance with the Wentworth Scale.

The geographic position of all sample locations and biotope boundaries were recorded using a Magellan CX with dGPS, with a backup system of Magellan CE with dGPS to an accuracy of 1m. Target notes on any supplementary information (other than in MNCR forms) that could prove useful when interpreting maps of the area were taken in survey log books, and digital images were taken of the sediment surface, characteristic species and features to enable geo-referencing.

2.2.1 CONTAMINANT ANALYSIS

In addition to sediment and biotope analysis, samples were required to assess contaminant levels in the sediment. Three samples were taken from three different transects, one each from the upper shore, middle and lower shore locations. Sampling procedure for the contaminant analysis followed those outlined in the CSEMP Green Book. Surface sediment samples were collected using a clean plastic 6cm internal diameter corer, which was washed with clean seawater between each sample collection. Notes on sediment characteristics, presence or absence of anoxic layering, presence or absence of algae, and distinguishing surface features were made for each sample. Digital images were also taken, incorporating the location of sample and scale bar for future reference. All contaminant samples were stored in appropriate containers pre-provided by the National Laboratory Service (NLS). These were kept chilled during the survey, transferred to the IECS cold room at the earliest opportunity, and remained chilled until collected and analysed by the NLS.

2.3 Laboratory methods

A total of 41 samples were collected along the six transects. Once transported to the laboratory, the infaunal specimens were removed from the IMS, in accordance with H&S procedures, and processed. Macrofauna were identified to species level were possible using standard taxonomic keys, low and high power stereoscopic microscopes and dissection (where applicable).

All species taxonomic names were standardised to match those currently accepted on the World Register of Marine Species (WoRMS) website. It should be noted that the ephemeral green algae, *Enteromorpha intestinalis* has recently had its name updated to *Ulva intestinalis*.

A photographic reference collection was compiled, identifying the dominant species within each biotope, as well as those with importance to nature conservation (listed in UK BAP or Annexes of Habitats Directive).

3. RESULTS

3.1 Transect 1.

The location of Transect 1 within the sample area appears to be at a location of the beach designated for sea defence and limitation of coastal erosion (Figure 2). Concrete sea defences have been placed at the head of the transect, and at the base of the cliff at high shore, cobbles and boulders have been strategically placed directly above the strand line to help protect it from erosion. This section of the beach also contains several breakwaters to help prevent long shore drift. It is evident from the species found attached to the breakwater structures that they have been in their current position for several years. The breakwaters extend approximately 49 metres from the base of the concrete sea defence out into the sea, and are heavily encrusted with barnacles, several mollusc species such as limpets and mussels, and seaweed species *Enteromorpha*, *Fucus vesiculosus* and *Porphyra spp*. The cobble and boulder section at the base of the concrete sea defence was devoid of any invertebrates, however seaweed debris, branches and anthropogenic material were found, indicating the position of the strandline and start point for the transect (Figure 3).

Extending down shore from the strandline is an extensive area of smooth mobile sand, in between the breakwaters (Figure 4). From the cobble and boulder section, the sand continues past the breakwaters for a total distance of approximately 65.9 metres. Results from sample location S7 showed an area of sparsely scattered cobbles on the surface of the sand, presumably dislodged from the cobble and boulder section. A basic sediment analysis indicated a sediment composition of <5% gravel, with a high abundance of the amphipod *Bathyporeia pilosa.* Continuing further down shore, the smooth sand transitioned into rippled sand, characterised by <3cm ripples, which continue for approximately 45.4 metres (Figure 5). Sediment characteristics reported at S6 were of fine sand with a course sand/ gravel content of <10%, and presence of amphipod species such as *Bathyporeia spp*. and *Pontocrates arenarius*. As the <3cm rippled sand continued further down shore, it transitioned into sparser, shallower ripples of <1cm in height, which continued for approximately 116.8m (Figure 6). Basic sediment analysis at S5 showed a sediment content of predominantly medium to fine sand with <10% coarse sand and gravel, with *B. pelagica* the most abundant species identified. The area described from high shore extending to mid shore is identified as the biotope **LS.LSa.MoSa.AmSco.Pon**, characterised by the presence of *P. arenarius* in littoral mobile sand.

Adjacent to this biotope, an area of sand with <3cm ripples was once again identified, however this area had standing water in the troughs between the ripples. This smaller section was identified as **LS.LSa.MoSa.AmSco.Sco**, characterised by the presence of *Bathyporeia spp*. and *Scolelepsis spp*. in mobile sand. The sediment characteristics at S4 taken within this biotope were medium to fine sand, with <20% course sand and gravel.

As mid shore turns to lower shore, the ripples in the sand gradually reduce in height towards the sea, becoming flat sand at low water (Figure 7). The biotope at low water is identified as **LS.LSa.FiSa.Po.Ncir**, characterised by the presence of *Nephtys cirrosa* in medium fine sand. The sample taken from S2 also contained *B. elegans* and *Pontocrates altamarinus*.

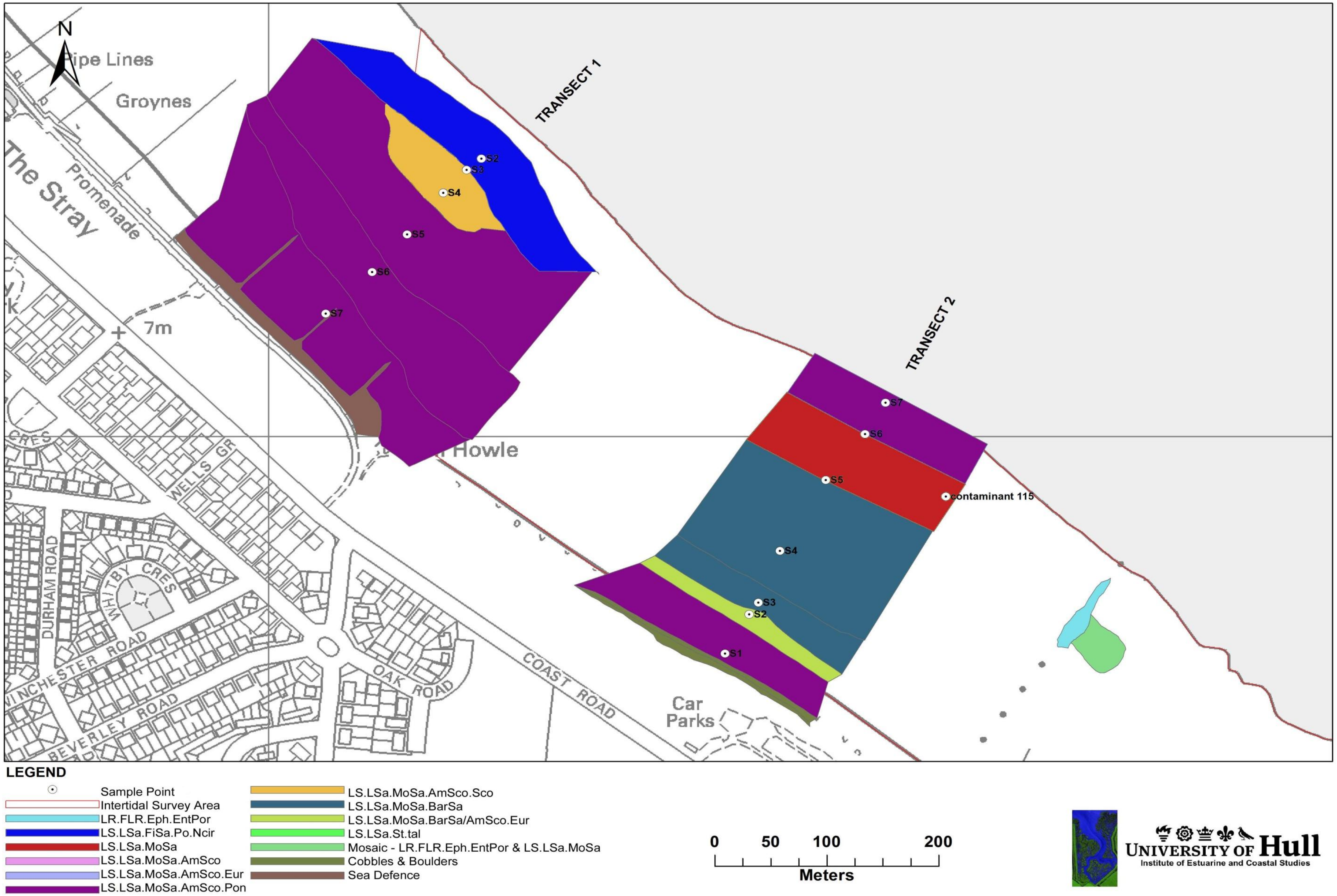

Figure 2. Map of Transects 1 and 2, including biotopes and sample numbers.

Figure 3. Cobble and pebble section. NW direction. High shore on Transect 1.

Figure 4. Smooth sand and breakwater. NW direction. Transect 1.

Figure 5. Rippled section. SE direction. Transect 1.

Figure 6. Sparse shallow rippled section. NE direction. Transect 1.

Figure 7. Shallow rippled section. SE direction. Transect 1.

3.2 Transect 2.

In a similar fashion to Transect 1 (Figure 2), there was a small section of boulders and cobbles at the high shore end of the transect placed in an attempt to prevent coastal erosion (Figure 8). The strandline is within the cobble and boulder section, indicated by seaweed debris, branches, wood and anthropogenic material found there. An invertebrate search of this small area was undertaken, but none were found.

A smooth sand section extended from the seaward edge of the boulder and cobble area, and was identified as **LS.LSa.MoSa.AmSco.Pon** (Figure 9). This biotope was assigned due to the presence of *Scolelepsis spp* and *P. arenarius* in mobile littoral sand. The sediment composition at S1 within this biotope was <5% gravel, with sporadic scattered pebbles present on the surface. Adjacent to this biotope further down shore, the smooth sand transitioned into a rippled sand section (<3cm) containing a runnel, indicated by standing water within the troughs of the ripples (Figure 10). Elsewhere, the sand was wet, but no standing water was present. Sample S2 revealed the presence of the isopod crustacean *Eurydice pulchra* as well as *B. pelagica* in course sand to fine gravel of <10%. Therefore this area of the transect was identified as the mosaic biotope **LS.LSa.MoSa.BarSa/LS.LSa.MoSa.AmSco.Eur**.

Immediately down shore of this section, a sandbar of damp, course, medium and fine sand with scattered pebbles on the surface is identified (Figure 11). Sample S3 showed the sediment composition to be course sand to fine gravel of <10%, and no invertebrates were found in this area. Therefore this area was identified as the biotope **LS.LSa.MoSa.BarSa**. This biotope extended down shore to the mid shore level, where an extensive area of <3cm rippled sand was identified. Sample S4 was included within this barren sand biotope, which was devoid of any invertebrates and had a sediment composition of <20% course sand and gravel (Figure 12). Due to the extent of this section, addition samples were taken from mid shore to low shore. The rippled sand continued to low water, with ripple heights transitioning from 3-4cm to 1-2cm, becoming almost flat at the water's edge. Sample S5 was identified as **LS.LSa.MoSa**, characterised by the presence of the amphipod *B. elegans* in mobile sand (Figure 13). This biotope was also identified further down shore for sample S6, as *B. elegans* were also present here (Figure 14). As the transect ended at low shore, the area was identified as **LS.LSa.MoSa.AmSco.Pon**, characterised as the presence of *Pontocrates spp*., with *B. elegans* also present.

Southwards from Transect 2, an area between mid and low shore was characterised as two small sections of **LR.FLR.Eph.EntPor**, and a mosaic of **LR.FLR.Eph.EntPor/LS.LSa.MoSa**. These two areas were characterised by the presence of the seaweed species *Enteromorpha spp*. and *Porphyra purpurea* on lower shore eulittoral rock (Figures 15 and 16).

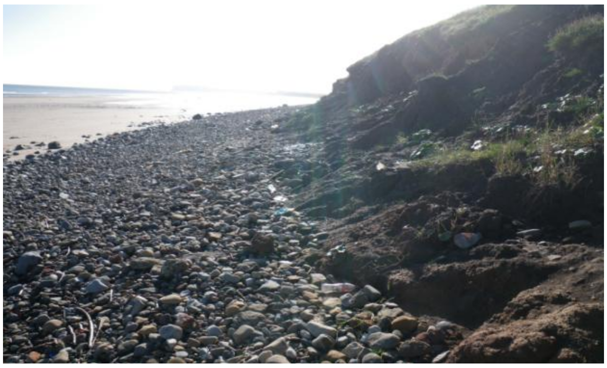

Figure 8. Cobble/ boulder section. SE direction. Transect 2.

Figure 9. Smooth sand section. NE direction. Transect 2.

Figure 10. Runnel/ rippled section. SE direction. Transect 2.

Figure 11. Smooth sandbar section. SE direction. Transect 2.

Figure 12. Rippled section at sample S4. NE direction. Transect 2.

Figure 13. Rippled section at sample S5. NE direction. Transect 2.

Figure 14. Rippled section at sample S6. NW direction. Transect 2.

Figure 15. Red and green algae on littoral rock.

Figure 16. *Enteromorpha spp*. on littoral rock.

3.3 Transect 3.

At the high shore top end of Transect 3 (Figure 17) was a steep boulder clay cliff approximately 6 metres high (Figure 18). The cliff was covered in vegetation, predominantly grasses and at the bottom of the cliff there was a narrow band of medium sand scattered with cobbles and saltmarsh plants. The area around the strandline at the base of the cliff was identified as **LS.LSa.St.tal**, characterised by a community of sandhoppers (talitrid amphipods) which generally occur at the strandline where debris and seaweed are found. Adjacent to this biotope was an area of cobbles and boulders, again strategically placed by Redcar and Cleveland Borough Council in order to diminish the effects of coastal erosion (Figure 19).

Directly down shore, an area of mobile sand identified as **LS.LSa.MoSa** was present. Basic sediment composition at sample S3 was classified as medium sand with patches of course gravel, pebbles and small cobbles (Figure 20). From sample S3 down shore towards S4 transitions from a prominent gradient with patches of water sheen on the surface of the sand to a very gentle gradient with small shallow pools of standing water (Figure 21). Sample S4 is also influenced by freshwater from a nearby surface water drain, which continues to influence the biotope further down shore, at sample S5 (Figure 22). The surface gradient as the transect moves further down shore decreases, and there was occasional standing water present, with shallow surface water which formed a small channel at the seaward end of the biotope. A small area of compacted clay was also identified within the biotope.

Adjacent to this area, the mid shore section of the transect was identified as **LS.LSa.MoSa.AmSco.Eur**, characterised as this biotope due to the high abundance of *Scolelepsis spp*. and the presence of *E. pulchra* in mobile sand. The sediment in this area consisted of compacted dry medium and course sand, including some gravel and shell fragments, with occasional attached strands of *Enteromorpha spp*. (Figure 23). The surface was also slightly elevated in relation to the previous higher shore area, but was beginning to descend again towards the seaward end of the biotope section.

As the transect moved further down shore, the sediment composition remained medium sand, but with a smaller amount of course sand than the higher shore locations. The surface of the water developed ripples approximately 3.5cm high, and contained standing water in the depressions (Figure 24). Sample S7 revealed the marine amphipod *P. arenarius* to be the most abundant species present, therefore categorising the biotope in this area as

LS.LSa.MoSa.AmSco.Pon. This biotope continued down shore until the transect sample ceased at low water. As the transect moved towards low water from S7, the sediment composition changed. At S8, it remained mainly consisting of medium sand with a small amount of coarser sand, gravel and shell (Figure 25). Although the ripples in the surface of the sand were still present, there was no standing water, and this sample also contained relatively abundant *B. pelagica*. Further down shore again, at S9, the sediment now comprised of fine and medium sand with a smaller amount of gravel than previously noted (Figure 24). The surface of the sand was also smooth rather than rippled, with no standing water but sporadic strands of *Enteromopha spp*. attached to the surface. As the transect reached low water, the sediment composition was solely fine sand, with courser sand fractions only found in the standing water contained by 2-4 cm ripples in the surface. Although there was a dedicated bivalve dig (approximately $1m^2$) at the low water sample (S10), no bivalves were found (Figure 26).

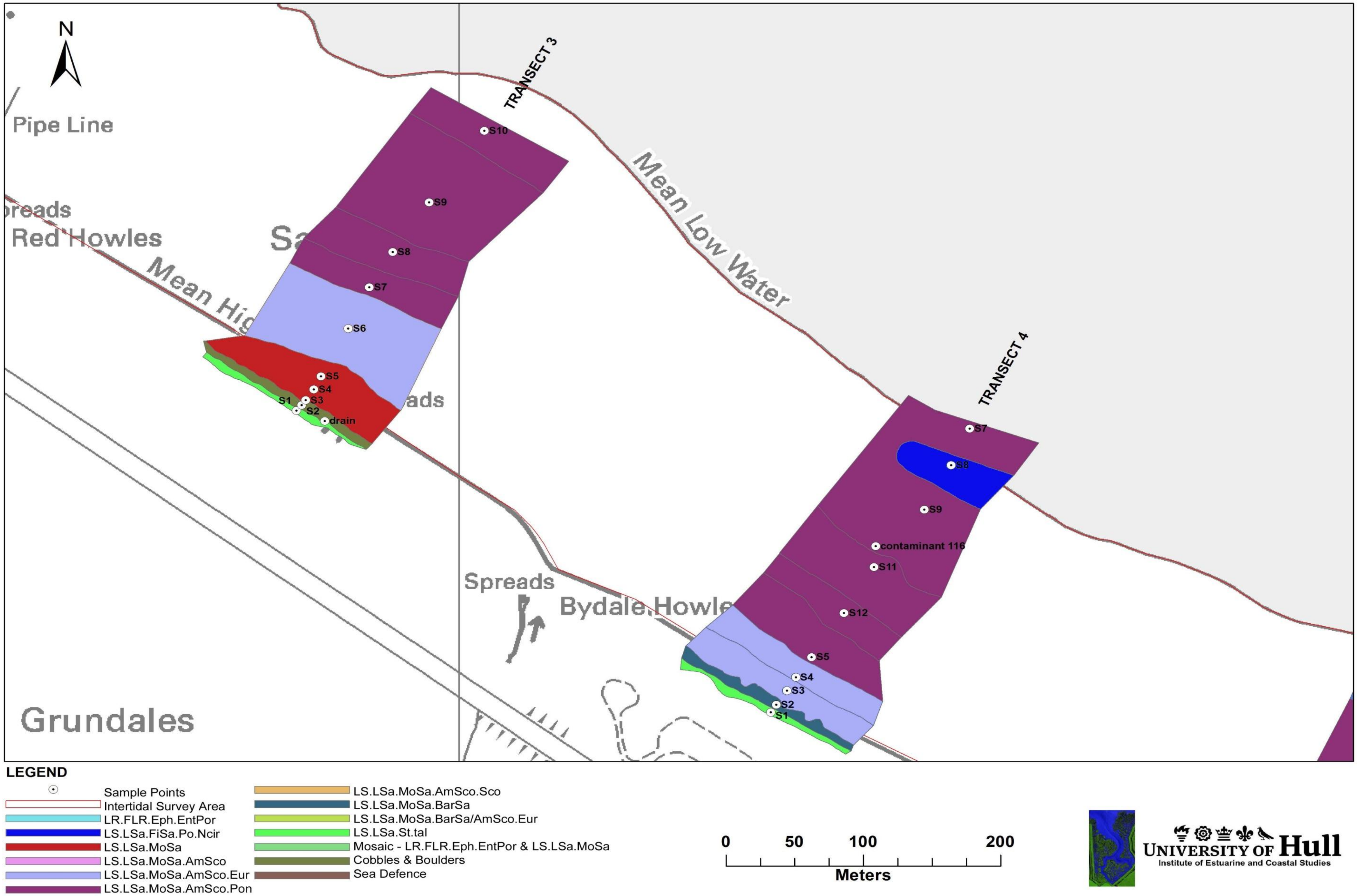

Figure 17. Map of Transects 3 and 4, with biotopes and sample numbers.

Figure 18. Cliff covered with vegetation. NW direction. Transect 3.

Figure 19. Cobble section. SE direction. Transect 3.

Figure 20. Course gravel and pebble section. SE direction. Transect 3.

Figure 21. Sediment composition for S4. Transect 3.

Figure 22. Channel of water near sample 5. SE direction. Transect 3.

Figure 23. *Enteromorpha* strands at sample 6. Transect 3.

Figure 24. Rippled sections with standing water. SE direction. Transect 3.

Figure 25. Rippled section. SE direction. Transect 3.

Figure 26. Dry smooth sand. NE direction. Transect 3.

Figure 27. Rippled sections. SE direction. Transect 3.

3.4 Transect 4.

The cliff top at the high shore end of Transect 4 (Figure 17) was covered in similar vegetation seen in Transect 3, predominantly grasses (Figure 28). At the base of the cliff there was a small band of course sand, including a small amount of gravel and occasional cobble on the surface of the sand (Figure 29). There was no clear strandline present, however talitrid amphipod holes in the sand were noted at sample S1, and the high shore band was assigned the biotope **LS.LSa.St.tal**. Adjacent to this, a small cobble section similar to the one found at the previous transects had been placed to reduce the effects of coastal erosion, which on the seaward side was followed by an area of **LS.LSa.MoSa.AmSco.Eur**, characterised by the presence of *E. pulchra* in mobile sand. Sediment characteristics noted at S3 (Figure 30) and S4 (Figure 31) in this section consisted of compacted dry medium sand with a small amount of gravel and shell fragments with several areas of scattered pebbles and cobbles on the surface. The gradient noted at S3 continued on to S4, but the incline decreased further down shore.

As high shore transitioned to mid shore, an extensive area of **LS.LSa.MoSa.AmSco.Pon** was identified. This biotope was characterised by the presence of *P. arenarius* in mobile sand. This biotope continued along the transect to low water, however sediment characteristics changed along the transect. The sample taken at the mid shore S5 revealed the sediment composition as wet medium sand including gravel and small pebbles. Further down shore, S12 had a smaller amount of courser sand, and was predominantly dry and compacted fine and medium sand with a gentle gradient (Figure 32). In addition, there were invertebrate tracks visible on the surface, and *Eteona spp.* were present in the sediment, as well as *Scolelepsis spp*. and *B. pelagica*. The sediment composition of fine and medium sand continued further down shore to sample S11, where small ripples had also formed (approximately 0.5cm high) (Figure 33). A dip in the beach profile meant standing water was contained in some of the ripple depressions, and again there were signs of invertebrate tracks on the surface of the sediment, with a high abundance of *Bathyporeia spp*. observed in the sample.

Down shore of S11, S9 had a higher percentage of dry, compacted, fine sand in comparison to the upper shore samples, although shell fragments, gravel and small pebbles were still present (Figure 34). The ripples in the surface were smaller in this area, approximately 10-20mm and the gentle gradient was still present. Sediment composition at sample S8 was similar to S9, however this small area was identified as the biotope **LS.LSa.FiSa.Po.Ncir**, characterised by the presence of *N. cirrosa* in fine sand. The surface ripples in this section where approximately 20- 30mm high towards the seawards edge of the area, containing standing water in the ripple depressions (Figure 35). In addition, *Arenicola spp*. casts were observed on the surface between S8 and S7 (Figure 36). At the low water end of the transect, the biotope returns to **LS.LSa.MoSa.AmSco.Pon**. The sediment is wet, but no standing water is present and is comprised of fine sand containing shell fragments, gravel, and small pebbles.

Figure 28. Cliff at the top of Transect 4. SW direction.

Figure 29. Sediment composition at sample 2, Transect 4.

Figure 30. Medium sand with dense cobble/pebble patches. NW direction, Transect 4.

Figure 31. Medium sand with scattered pebbles. SE direction, Transect 4.

Figure 32. Medium fine sand. SE direction. Transect 4.

Figure 33. Rippled section. NE direction. Transect 4.

Figure 34. Sediment composition for sample 9. Transect 4.

Figure 35. *Arenicola* casts, Transect 4

3.5 Transect 5.

The high shore end of Transect 5 was located in close proximity to a central access point and slip road off the High street near Marske-by-the-Sea (Figure 36). The easy access point onto the beach is well used by recreational users of the site, such as dog walkers, and there are several small boats moored here.

A vegetated cliff and sand dune system was identified at the high shore end of the transect, covering either side of the access point. A band of medium course sand was located at the bottom of the cliff, with several cobbles and occasional saltmarsh plants observed on the surface (Figure 37). This section was identified as **LS.LSa.St.tal**, characterised by the presence of the amphipod *T. saltator* observed at the sample point S1 and around the strandline located at the seaward boundary of the section. The strandline was characterised by the presence of seaweed, braches and driftwood, and anthropogenic material.

Directly down shore of this section an area of barren sand was identified. A sample taken at S2 was devoid of any invertebrates, and sediment composition consisted of dry, medium sand with a small amount of gravel and shell fragments. Dense patches of pebbles and small cobbles (10- 70mm diameter) were observed on the surface of the sand, and a prominent gradient sloping towards low shore was noted (Figure 38). This section of the transect was identified as **LS.LSa.MoSa.BarSa**.

Adjacent to this biotope followed an extensive area of **LS.LSa.Mosa.AmSco.Pon**. This biotope was characterised by the presence of *P. arenarius* at the upper mid shore sample stations S3, S4 and the lower mid shore S5. At the higher shore boundary to this biotope area, the steeper gradient observed at S2 declined into a gentle gradient. Basic sediment analysis showed medium sand with a small amount of shell fragments and gravel, and invertebrates present at S3 in addition to *P. arenarius* included *S. squamata* and *B. pelagica*. Shallow ripples in small sections <20mm high were observed on the surface, as well as patches of invertebrate tracks and occasional scattered pebbles (Figure 39). Towards mid shore on the boundary between sections 3 and 4, there were occasional attached strands of *Enteromorpha spp*. (Figure 40). At mid shore on the transect, sediments were recorded as wet and compacted fine and medium sand including small amounts of gravel and shell. The edges of the transect were elevated, creating a dip in the beach profile, and ripples in the sand approximately 30mm high contained standing water in the depressions (Figure 41). Towards the seawards boundary of this section, 100% of the sediment was covered in standing water. Species noted at S4 included *P. arenarium* and *B. pelagica*.

Further down shore, in the mid to lower shore area of the transect, sediments were characterised as dry, fine and medium sand containing fine gravel, shell fragments and occasional small pebbles. At the time of survey the surface of the sand was being blown by the wind (Figure 42). Ripples in this lower mid shore section transition from 10- 20mm high to smooth sand with no ripples towards the seawards boundary. Species observed in the sample taken at S5 included *P. arenarius*, *B. pelagica* and *S. squamata*.

At the lower shore end of the transect, the biotope transitions from **LS.LSa.MoSa.AmSco.Pon** to **LS.LSa.MoSa.AmSco.Sco**, characterised by the presence of *S. squamata* at sample S6. Sediment characteristics at low shore consisted of fine sand including courser material such as gravel and shell fragments. Ripples in the sand were observed to be approximately 10- 20mm high, and contained standing water and courser sand fractions in the ripple depressions (Figure 43). A gentle gradient sloped towards low water, but a slight dip and the transect profile at the landwards boundary of the biotope meant this small patch had 100% water coverage. Invertebrate tracks were visible on the sediment surface, and a sample taken at S6 revealed the presence of *B. elegans* in addition to *Scolelepsis spp*. A dedicated 1m^2 bivalve dig was undertaken at low water, however no bivalves were found.

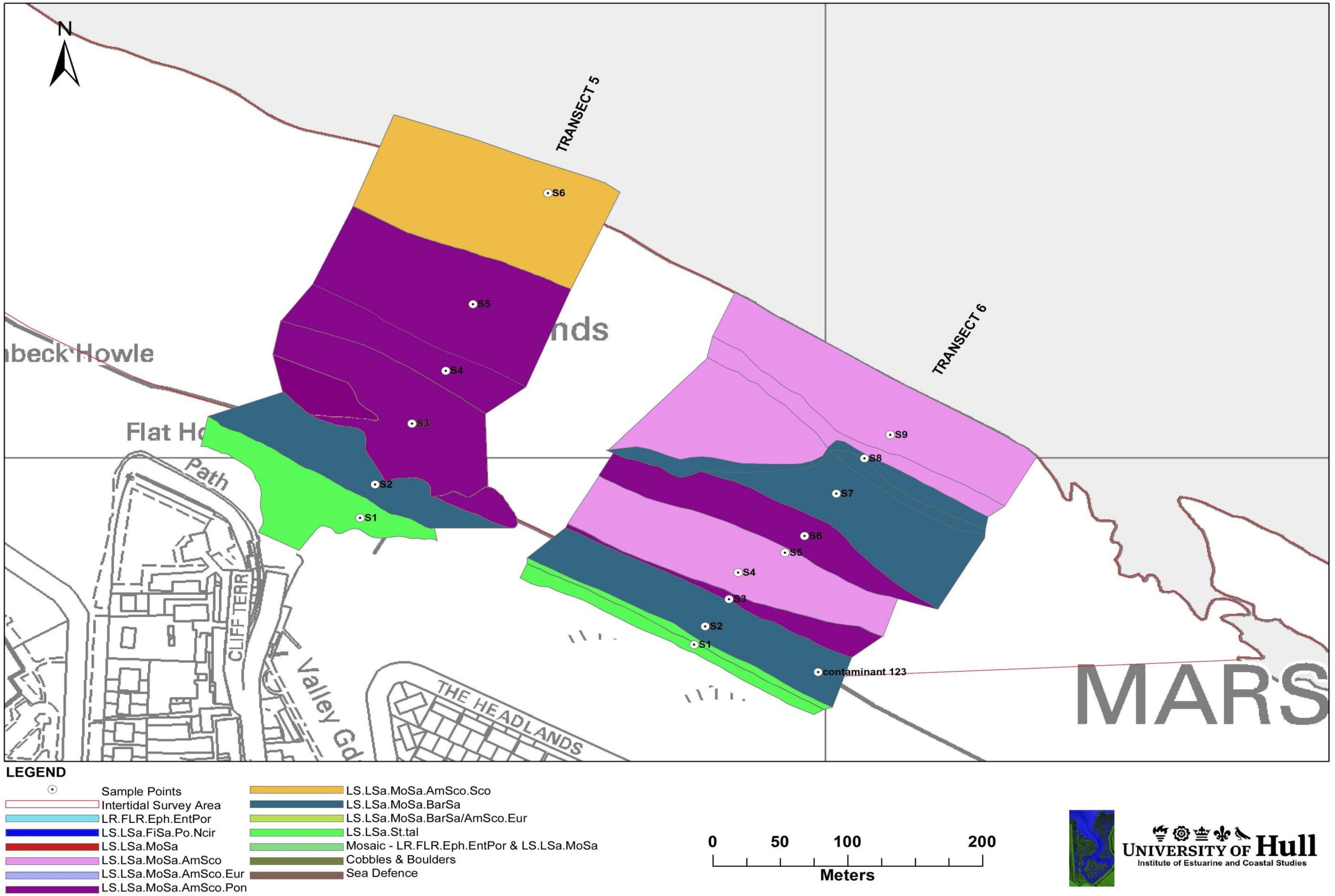

Figure 36. Map of Transects 5 and 6, including biotopes and sample numbers.

Figure 37. Bottom of cliff, NW direction. Transect 5.

Figure 38. Medium sand with gravel and shell fragments, NE direction, Transect 5.

Figure 39. Shallow ripples. SE direction. Transect 5.

Figure 40. *Enteromorpha* near S5. Transect 5.

Figure 41. Rippled section with standing water. NE direction, Transect 5.

Figure 42. Surface sand blowing. Transect 5.

Figure 43. Standing water in ripple depressions. NW direction, Transect 5.

3.6 Transect 6.

A small dune system was identified at the upper shore reaches of the sample area, which extended partly into the high shore boundary of Transect 6 (Figure 44). The high shore area of Transect 6 began with an area of flat medium to fine sand, again with scattered pebbles and cobbles as seen in the other transects, and some flowering plants identified as originating from the dune system also present. This section was identified as **LS.LSa.St.tal**, characterised by the presence of the sandhopper *Talitrus saltator* around the strandline approximately 8 metres into the section and characterised by seaweed debris and branches. The sample taken at S1 for infaunal analysis indicated a sediment composition of <20% course sand and fine gravel content (Figure 45).

Directly down shore of this area, an area identified as barren sand (**LS.LSa.MoSa.BarSa**) extended approximately 38.2 metres from the seaward boundary of the previous biotope. Sediment composition taken at S2 consisted of approximately 50% gravel content, and a high density of pebbles and cobbles were observed on the surface of the sand (Figure 46). Further down shore, adjacent to this biotope was a section classified as **LS.LSa.MoSa.AmSco.Pon**, characterised by the presence of *Scolelepsis spp*. and *P. arenarius* in mobile sand. Ripples of <3cm height were observed in this area, and formed a runnel where water drained from the beach as the tide retreated. Standing water was observed in the ripple depressions, with a small area in the centre of the biotope area where the level of standing water meant that ripples were fully submerged (Figure 47). The sediment composition of the sample taken at S3 indicated medium to fine sand with some coarse sand present. The sample was found to contain <20% fine to course gravel.

As the transect moved towards mid shore, a sandbar was found which extended approximately 54.9 metres down shore from the seaward boundary of the previous biotope (Figure 48). The sediment composition consisted of a mixture of course, medium and fine sand with <20% medium to fine gravel, and no observed ripples on the surface. The presence of *Scolelepsis spp.* at sample S4 informed the classification of the biotope **LS.LSa.MoSa.AmSco.Sco** for this area. Sample S5 further down shore was identified by the GPS as the mid shore point on the transect. Although the sediment composition of the sample was very similar to S4, the presence of the marine amphipod *P. arenarius* meant S5 was on the landward boundary of the biotope **LS.LSa.MoSa.AmSco.Pon**. This biotope continued down shore for approximately 33.4 metres, and included rippled sand <3cm high which contained standing water in the ripple depressions (Figure 49). The sediment composition of sample S6 revealed a course sand/ fine gravel content of <10%, which was less than the higher shore samples, and contained *P. arenarius*, *Scolelepsis squamata*, and *Bathyporeia spp*.

An area of barren sand was again identified as the transect moved from mid to lower shore, with no invertebrates found at sample S7 (Figure 50). This section was characterised by ripples <1cm high, and sediment comprising of medium to fine sand with <5% course sand/ fine gravel, and classified as **LS.LSa.MoSa.BarSa**. Further down shore, the ripples in the sand increased in height to <5cm, with standing water present in the depressions and completely covering them in the centre of the transect where the runnel was still draining (Figure 51). The sample taken at S8 had a sediment composition of medium to fine sand with <10% course sand and gravel, and contained 1 *Bathyporeia spp*. S8 indicated the boundary to the low shore biotope **LS.LSa.MoSa.AmSco**, characterised by the presence of amphipods and *Scolelepsis spp*. in medium fine sand. Sample S9 taken at the lower shore reaches of the transect contained 1 *S. squamata* and had a sediment composition of medium to fine sand, with a course sand/ fine gravel content of <10%. This biotope continued to low water (Figure 52).

Figure 44. Dune systems at the top of Transect 6. SE direction.

Figure 45. Sand slope at bottom of cliff. Transect 6.

Figure 46. Sediment with gravel, cobbles and pebbles. NW direction, Transect 6.

Figure 47. Runnel at S3. NW direction, Transect 6.

Figure 48. Sandbar section sediment. Transect 6.

Figure 49. Rippled section. NE direction. Transect 6.

Figure 50. Small ripples at mid- low shore. SW direction. Transect 6.

Figure 51. Ripples and runnel section. NW direction, Transect 6.

Figure 52. Smooth sand section at low shore. NE direction, Transect 6.

3.7 Contaminant results.

Three samples were taken from the survey area to analyse contaminant levels in the sediment. Sample 115 was taken from the **LS.LSa.MoSa** biotope at low shore on Transect 2, Sample 116 was taken from the **LS.LSa.MoSa.AmSco.Pon** biotope at mid shore on Transect 4, and Sample 123 was taken from high shore section of barren sand on Transect 6, identified as the biotope **LS.LSa.MoSa.BarSa**. All sediment samples were identified as marine fine sand, with small amounts of gravel and shell fragments. The full results from the report are given in Appendix III.

The contaminant concentrations found in the report were compared against several assessment criteria in order to ascertain whether the levels found at the Redcar and Cleveland site were an acceptable level in terms of their biological effects. Environmental Assessment Criteria (EACs) were used, as well as Effects Range (ER) values, Background Concentrations (BCs) and Background Assessment Concentrations (BACs) (OSPAR Commission, 2009). EACs refer to a primary assessment threshold, which identifies whether the contaminant concentration, in this case in sediment, is at a level where statutory targets or policy objectives are achieved or not achieved. Concentrations below EAC are unlikely to give rise to unacceptable biological effects, however some EACs are not used in OSPAR assessment, mainly because the proposed EACs are less than the OSPAR BACs. ER values were developed by the Environmental Protection Agency (EPA) to be used to assess the quality of coastal and estuarine environments and the ecological significance of the concentrations of hazardous substances found in sediments. The ER-Low (ERL) value is defined as the lower tenth percentile of the data set of concentrations in sediments which were associated with biological effects. Adverse effects on organisms are rarely observed when concentrations fall below the ERL value (OSPAR Commission, 2009). BCs are the concentration of a contaminant at a “pristine” or “remote” site based on contemporary or historical data (OSPAR agreement, 2005- 06). For naturally occurring substances, such as polycyclic aromatic hydrocarbons (PAHs) and trace metals, BCs are the typical concentrations found in uncontaminated locations in the OSPAR maritime area, the North-East Atlantic. For manmade synthetic substances such as chlorobiphenyls (CBs), OSPAR suggests a BC of zero. BACs were developed by OSPAR in order to facilitate precautionary assessments of data collected under the OSPAR Co-ordinated Environmental Monitoring Programme (CEMP) against BCs. Observed concentrations are suggested as ‘near background’ if the mean concentration is statistically significantly below the corresponding BAC.

All the above assessment criteria will be referred to, and contaminants with a higher concentration than the threshold are identified in Table 1. It should be recognised that natural processes such as geological variability or upwelling of oceanic waters at the coast can result in variations in BCs of contaminants, and the natural variability in BCs should be accounted for when assessing where concentrations are higher than expected. It is also important to note that the NLS follow the Green book guidelines, which state a <63µm sample fraction size. As the sediment samples taken included gravel and shell fragments, it may mean that only a small percentage of the sample was tested for contaminants. As different size particles react inconsistently to different contaminants, discrepancies in the results may be caused by the sample size. The OSPAR Commission (2009) table outlining the assessment criteria is given in Appendix II for reference.

The contaminant concentrations for all three samples were below the ERL values where ERL values are given.

Table 1. NLS analytical contaminant concentration results.

Analyte	Units	Sample 1	Sample 2	Sample 3
Arsenic, HF Digest : Dry Wt □	mg/kg	7.72	6.58	8.06
Cadmium, HF Digest : Dry Wt	mg/kg	<0.03	<0.03	<0.03
Chromium, HF Digest : Dry Wt □	mg/kg	6.94	4.99	5.97
Copper, HF Digest : Dry Wt □	mg/kg	9.54	3.12	2.84
Lead, HF Digest : Dry Wt	mg/kg	16.4	12	13.4
Lithium, HF Digest : Dry Wt □	mg/kg	10	8.48	9.06
Manganese, HF Digest : Dry Wt □	mg/kg	243	174	200
Nickel, HF Digest : Dry Wt □	mg/kg	3.82	2.04	2.78
Tin, HF Digest : Dry Wt □	mg/kg	0.83	0.66	0.64
Vanadium, HF Digest : Dry Wt □	mg/kg	17.3	12.7	14.5
Zinc : HF Digest : Dry Wt □	mg/kg	40.8	29.5	30.2
Acenaphthene : Dry Wt □	µg/kg	<2	4.12	5.6
Acenaphthylene : Dry Wt □	µg/kg	<2	<2	<2
Anthracene : Dry Wt	µg/kg	3.35 🟧	6.38 🟧 🟦	7.08 🟧 🟦
Benzo(a)anthracene : Dry Wt	µg/kg	5.18 🟩	16.4 🟧 🟦 🟩	8.83 🟩
Benzo(a)pyrene : Dry Wt	µg/kg	3.47	12.4	6.04
Benzo(b)fluoranthene : Dry Wt □	µg/kg	<10	13.1	<10
Benzo(ghi)perylene : Dry Wt	µg/kg	<10 🟩	<10 🟩	<10 🟩
Benzo(k)fluoranthene : Dry Wt □	µg/kg	<10	<10	<10
Chrysene : Dry Wt	µg/kg	6.11	13.4 🟧	11
Dibenzo(ah)anthracene : Dry Wt	µg/kg	<5	<5	<5
Fluoranthene : Dry Wt	µg/kg	11.4	39.1 🟧 🟦	28.2 🟧
Fluorene : Dry Wt	µg/kg	<10	<10	<10
Indeno(1,2,3-c,d)pyrene : Dry Wt	µg/kg	<10 🟩	<10 🟩	<10 🟩
Naphthalene : Dry Wt	µg/kg	<30	<30 🟧 🟦	<30 🟧 🟦
Phenanthrene : Dry Wt	µg/kg	15.9	34.8 🟦	38.7 🟦
Pyrene : Dry Wt	µg/kg	10.2	33.5 🟧 🟦	32.1 🟧 🟦
PCB- 028 : Dry Wt □	µg/kg	<0.1	<0.1	<0.1
PCB - 052 : Dry Wt □	µg/kg	<0.1	<0.1	<0.1
PCB - 101 : Dry Wt □	µg/kg	<0.1	<0.1	<0.1
PCB - 118 : Dry Wt □	µg/kg	<0.1	<0.1	<0.1
PCB - 138 : Dry Wt □	µg/kg	<0.1	<0.1	<0.1
PCB - 153 : Dry Wt □	µg/kg	<0.1	<0.1	<0.1

PCB - 180 : Dry Wt ☐	µg/kg	<0.1	<0.1	<0.1
Dibutyl Tin : Dry Wt as Cation ☐	µg/kg	<4	<3	<3
Dioctyl Tin : Dry Wt as Cation ☐	µg/kg	<3	<3	<3
Diphenyl Tin : Dry Wt as Cation ☐	µg/kg	<3	<2	<2
Tetrabutyl Tin : Dry Wt as Cation ☐	µg/kg	<3	<2	<2
Tributyl Tin : Dry Wt as Cation ☐	µg/kg	<3	<3	<3
Triphenyl Tin : Dry Wt as Cation ☐	µg/kg	<3	<2	<2
Dry Solids @ 30°C	%	78.1	83.3	87.6
Accreditation Assessment	No.	2	3	3

Where no key is given, all sample concentrations were lower than all assessment criteria's.
☐ No information given by OSPAR
■ Concentration exceeds BC
■ Concentration exceeds BAC
■ Concentration exceeds EAC

4. CONCLUSIONS.

Sediment composition of the study area in general predominantly consisted of coarse sand and gravel at high shore, transitioning into finer sand at low shore, containing small amounts of gravel and shell fragments. Dune systems were noted at high shore on some of the transects, and nearly all transects included cobbles and boulders at high shore, strategically placed by Redcar and Cleveland Borough Council in an attempt to diminish the effects of coastal erosion. Species compositions did not differ greatly between the transects, perhaps due to the small study area and similar sediment compositions. Evidence of Talitrids was found at the strandline of most transects, and the most abundant species throughout the survey were the amphipods *Scolelepsis spp.* and *Bathyporeia spp*., a full species abundance list is given in Appendix I.

As previously stated, the area of sand shore identified as the survey area is not currently included in any SAC, SPA, Ramsar or SSSI areas. However the Tees estuary is a Ramsar site and an SPA, and both designations extend southwards ending approximately 1km to the north of the survey area (Figure 53). Given the proximity to the survey site, any developments planned for the site should perhaps be considered in terms of the effects they may have on the integrity of the habitats included in the Ramsar and SPA designated areas located to the north.

None of the species found at any of the transect locations at the time of survey are currently included on the UK BAP or Habitats Directive Annex II species list. Neither are there any habitats found on any transect which fall within the UK BAP list of Habitats Directive Annex I habitat list. However, it is noted that the habitat type of subtidal sands and gravels were included in the UK BAP habitats list. Although the present study area only included the intertidal region, sediments were composed of sand and gravel along the entirety of the transects. Therefore, it is likely that this sediment composition continues into the subtidal region.

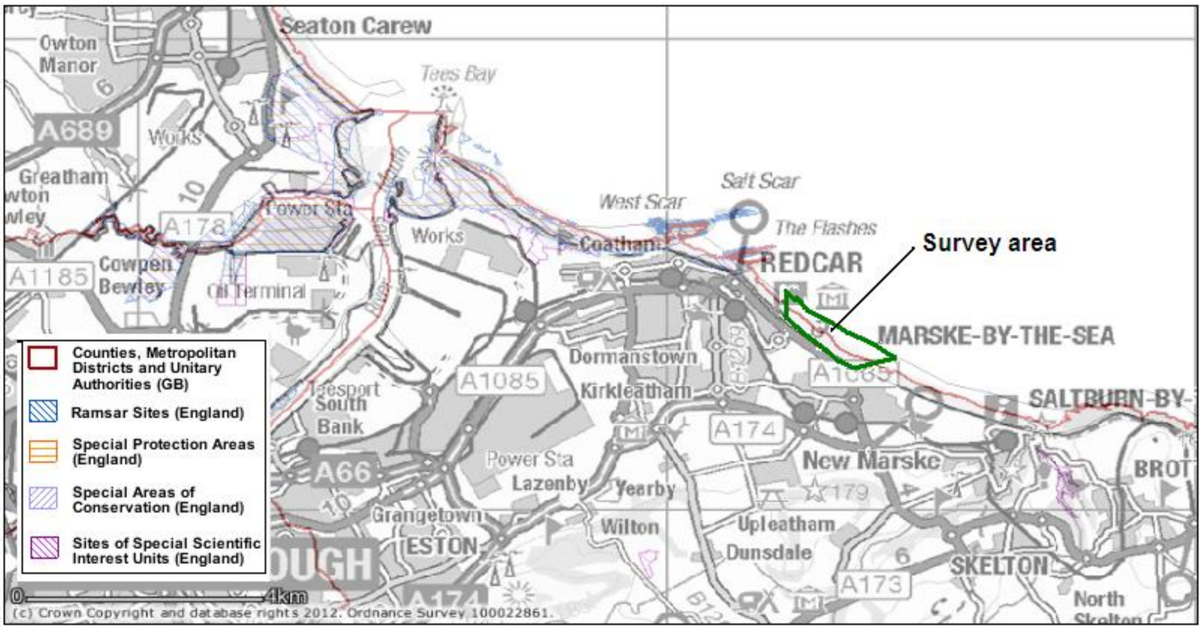

Figure 53. Map of survey area with SAC, SPA, SSSI and Ramsar designations.

APPENDIX I. SPECIES ABUNDANCES FOR EACH TRANSECT.

MCS Code		Taxon	Taxon qualifier	T1S1	T1S2	T1S3	T1S4	T1S5	T1S6	T1S7	T2S1	T2S2	T2S3	T2S4	T2S5	T2S6	T2S7	T3 S2	T3S6	T3S7	T3S8	T3S9	T3S10	T4S4	T4S5	T4S8	T4S9	T4S11	T4S12	T5S2	T5S3	T5S4	T5S5	T5S6	T6	T6S1	T6S2	T6S3	T6S4	T6S5	T6S6	T6S7	T6S8	T6S9
HD	1	NEMATODA																											22															
P	117/118	*Eteone flava/longa*								1									1												1													
P	498	*Nephtys cirrosa*		1	1			1												1	1	1	1			1		1				1												
P	704	*Paraonis fulgens*																			1							2			1													
P	722	*Aonides oxycephala*																													1													
P	778	*Scolelepis (Scolelepis)*	juv								4								202	1	2																							
P	783	*Scolelepis (Scolelepis) squamata*					1			15												6	13	2	3	9	12		4		115		7	5				36	26	6	2			1
P	791	*Spio martinensis*																			1		2																					
P	794	*Spiophanes bombyx*		1																																								
R	142	COPEPODA	spp																	1																								
S	132	*Pontocrates*	juv								1																																	
S	133	*Pontocrates altamarinus*			7												1						14																					
S	135	*Pontocrates arenarius*						1	2	25									2	54	7	7	1	1	10		8	16	47		9	3	2					12		20	2			
S	241	*Talitrus saltator*																																	p	4								
S	451	*Bathyporeia*	juv	1			3			1	13									4	4	3			4	1	9	8																
S	452	*Bathyporeia elegans*		1	5	13	8		2						3	1	6			3	1	3	2	1		15	4							5							1			
S	456	*Bathyporeia pelagica*					2	8	6	10		3							1	30	34	3	22	7	13		25	84	4		4	2	3					3			6		1	
S	457	*Bathyporeia pilosa*								175	7								8	1	16			10														2	1					
S	458	*Bathyporeia sarsi*						1		11																		5																
S	462	*Haustorius arenarius*																							2																			
S	854	*Eurydice pulchra*									3								1					2														1	1					
S	1385	*Crangon crangon*										1																																

APPENDIX II. OSPAR ASSESSMENT CRITERIA.

Assessment Criteria for PAHs, CBs and trace metals in *sediment*. BCs and BACs are normalised to 2.5% organic carbon for PAHs and CBs, and to 5% aluminium for trace metals. Grey shaded cells show where there are no data. Purple shaded cells show where the EACs are below the BACs.

PAHs (µg/kg dry weight)				
Compound	**BC normalised to 2.5% TOC**	**BAC normalised to 2.5% TOC (T_0)**	**EAC normalised to 2.5% TOC**	**Effects Range-Low (ERL) (T_1)**
Naphthalene	5	8	43	160
Phenanthrene	17	32	1250	240
Anthracene	3	5	78	85
Dibenzothiophene	0.6[b]	[a]		190
Fluoranthene	20	39	250	600
Pyrene	13	24	350	665
Benz[*a*]anthracene	9	16	1.5	261
Chrysene/ Triphenylene	11	20		384
Benzo[*a*]pyrene	15	30	625	430
Benzo[*ghi*]perylene	45	80	2.1	85
Indeno[*1,2,3-cd*]pyrene	50	103	1.5	240
C1-Naphthalene	2.7[b]	[a]		155
C2-Naphthalene	6.7[b]	[a]		150
C3-Naphthalene	3.3[b]	[a]		
C1-Phenanthrene/ Anthracene	2.7[b]	[a]		170
C2-Phenanthrene/ Anthracene	3.7[b]	[a]		200
C3-Phenanthrene/ Anthracene	2.2[b]	[a]		
C1-DBT	1.0[b]	[a]		
C2-DBT	0.7[b]	[a]		
C3-DBT	0.4[b]	[a]		
Total PAH (11 parent PAH (CEMP 9 + naphthalene and DBT)	188.6[c]	[a]		3340[c]
Total PAH (As for parent + alkylated PAHs)	212[d]			

CBs (µg/kg dry weight)				
Compound	**LC**	**BAC normalised to 2.5% TOC (T_0)**	**EAC normalised to 2.5% TOC (T_1)**	**Effects Range-Low (ERL)**
CB28	0.05[e]	0.22	1.7	
CB52	0.05[e]	0.12	2.7	
CB101	0.05[e]	0.14	3.0	
CB118	0.05[e]	0.17	0.6	
CB138	0.05[e]	0.15	7.9	
CB153	0.05[e]	0.19	40	
CB180	0.05[e]	0.10	12	
Total CB (Aroclor Equivalents ~ = 2 x ICES7CBs)				23 (ERL)
ΣICES7CBs	0.20[f]	0.46		11.5 (ERL)[g]
Trace metals (µg/kg dry weight)				
	BC normalised to 5% Al	**BAC normalised to 5% Al (T_0)**	**EAC Normalised to 1% TOC**	**Effects Range Low (ERL) (T_1)**
Hg	50[h]	70[h]	220[i]	150
Cd	200[h]	310[h]	60[i]	1,200
Pb	25,000[h]	38,000[h]	2,200[i]	47,000

[a] to be defined in relation to adopted BC assuming sufficient data in ICES database

[b] proposed at the ICES Working Group on Marine Sediments in Relation to Pollution (WGMS) in 2008

[c] sum of individual BCs or ERLs for 11 parent PAHs

[d] sum of individual BCs for specified parent and alkylated PAHs

[e] LC = 2 x QUASIMEME constant error

[f] LC = 8 x QUASIMEME constant error

[g] ER values for total CB concentration/2

[h] normalised to 5% aluminium

[i] normalised to 1%TOC

National Laboratory Service

Analytical Report

Final Report

Report ID - 20043995 - 1

UKAS TESTING 0754

Batch description: Marine Sediment Samples collected from the Intertid

Reported on: 14-Nov-2012

Ann Leighton
University of Hull
Institute of Estuarine & Coastal Studies
University of Hull
Hull
HU6 7RX

Dear Ann

Please find attached the results for the batch of 3 samples described below.

Samples Registered on:	21-Sep-2012
Analysis Started on:	21-Sep-2012
Analysis Completed on:	14-Nov-2012
Results for Batch Number	20043995
Your Purchase Order Number:	None supplied

You will be invoiced shortly by our accounts department.

If we can be of further assistance then please do not hesitate to contact us.

Yours sincerely

William Fardon
Customer Services Team Leader
Tel: (0113) 231 2177
nls@environment-agency.gov.uk

Client:	University of Hull	Project:	Marine seds analysis
Folder No:	002107115	Sampled on:	19-Sep-12 @ 13:30
Comments:	Marine fine sand with small amount of gravel and shell		
Quote No:	9101	Matrix:	Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Arsenic, HF Digest : Dry Wt	7.72	mg/kg		0.4	UKAS	LL	341
Cadmium, HF Digest : Dry Wt	<0.03	mg/kg		0.03	UKAS	LL	341
Chromium, HF Digest : Dry Wt	6.94	mg/kg		3	UKAS	LL	341
Copper, HF Digest : Dry Wt	9.54	mg/kg		1	UKAS	LL	341
Lead, HF Digest : Dry Wt	16.4	mg/kg		3	UKAS	LL	341
Lithium, HF Digest : Dry Wt	10.0	mg/kg		0.1	UKAS	LL	341
Manganese, HF Digest : Dry Wt	243	mg/kg		0.4	UKAS	LL	341
Nickel, HF Digest : Dry Wt	3.82	mg/kg		1	UKAS	LL	341
Tin, HF Digest : Dry Wt	0.830	mg/kg		0.5	None	LL	341
Vanadium, HF Digest : Dry Wt	17.3	mg/kg		1	UKAS	LL	341
Zinc : HF Digest : Dry Wt	40.8	mg/kg		5	UKAS	LL	341
Acenaphthene : Dry Wt	<2	ug/kg		2	UKAS	LL	1051
Acenaphthylene : Dry Wt	<2	ug/kg		2	None	LL	1051
Anthracene : Dry Wt	3.35	ug/kg		2	UKAS	LL	1051
Benzo(a)anthracene : Dry Wt	5.18	ug/kg		2	UKAS	LL	1051
Benzo(a)pyrene : Dry Wt	3.47	ug/kg		2	UKAS	LL	1051
Benzo(b)fluoranthene : Dry Wt	<10	ug/kg		10	UKAS	LL	1051
Benzo(ghi)perylene : Dry Wt	<10	ug/kg		10	UKAS	LL	1051
Benzo(k)fluoranthene : Dry Wt	<10	ug/kg		10	UKAS	LL	1051
Chrysene : Dry Wt	6.11	ug/kg		3	UKAS	LL	1051
Dibenzo(ah)anthracene : Dry Wt	<5	ug/kg		5	UKAS	LL	1051
Fluoranthene : Dry Wt	11.4	ug/kg		2	UKAS	LL	1051
Fluorene : Dry Wt	<10	ug/kg		10	UKAS	LL	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	<10	ug/kg		10	UKAS	LL	1051
Naphthalene : Dry Wt	<30	ug/kg		30	UKAS	LL	1051
Phenanthrene : Dry Wt	15.9	ug/kg		10	UKAS	LL	1051
Pyrene : Dry Wt	10.2	ug/kg		3	UKAS	LL	1051
PCB - 028 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 052 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 101 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 118 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 138 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 153 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 180 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
Dibutyl Tin : Dry Wt as Cation	<4	ug/kg		3	UKAS	LE	897
Dioctyl Tin : Dry Wt as Cation	<3	ug/kg		3	UKAS	LE	897
Diphenyl Tin : Dry Wt as Cation	<3	ug/kg		2	UKAS	LE	897
Tetrabutyl Tin : Dry Wt as Cation	<3	ug/kg		2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<3	ug/kg		3	UKAS	LE	897
Triphenyl Tin : Dry Wt as Cation	<3	ug/kg		2	UKAS	LE	897
Dry Solids @ 30°C	78.1	%		0.5	None	LE	1130

Accreditation Assessment	2	No.	None	LE	924
Sample Preparation	Report	Text	None	LE	924

The sample appeared to be a medium brown sandy sediment.

58.67g of the sample was taken for drying at <30degC which gave 46.31g of dried sample (weights include tray weight).
The sample was crushed using a jaw crusher.
The sample was then sieved until it passed through a 2mm sieve.
The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Analytical Report

National Laboratory Service

Final Report

Report ID - 20043995 - 1

UKAS TESTING 0754

Batch description: Marine Sediment Samples collected from the Intertid

Reported on: 14-Nov-2012

Client:	University of Hull	Project:	Marine seds analysis
Folder No:	002107116	Sampled on:	19-Sep-12 @ 13:55
Comments:	Marine fine sand with small amount of gravel and shell		
Quote No:	9101	Matrix:	Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Arsenic, HF Digest : Dry Wt	6.58	mg/kg		0.4	UKAS	LL	341
Cadmium, HF Digest : Dry Wt	<0.03	mg/kg		0.03	UKAS	LL	341
Chromium, HF Digest : Dry Wt	4.99	mg/kg		3	UKAS	LL	341
Copper, HF Digest : Dry Wt	3.12	mg/kg		1	UKAS	LL	341
Lead, HF Digest : Dry Wt	12.0	mg/kg		3	UKAS	LL	341
Lithium, HF Digest : Dry Wt	8.48	mg/kg		0.1	UKAS	LL	341
Manganese, HF Digest : Dry Wt	174	mg/kg		0.4	UKAS	LL	341
Nickel, HF Digest : Dry Wt	2.04	mg/kg		1	UKAS	LL	341
Tin, HF Digest : Dry Wt	0.660	mg/kg		0.5	None	LL	341
Vanadium, HF Digest : Dry Wt	12.7	mg/kg		1	UKAS	LL	341
Zinc : HF Digest : Dry Wt	29.5	mg/kg		5	UKAS	LL	341
Acenaphthene : Dry Wt	4.12	ug/kg		2	UKAS	LL	1051
Acenaphthylene : Dry Wt	<2	ug/kg		2	None	LL	1051
Anthracene : Dry Wt	6.38	ug/kg		2	UKAS	LL	1051
Benzo(a)anthracene : Dry Wt	16.4	ug/kg		2	UKAS	LL	1051
Benzo(a)pyrene : Dry Wt	12.4	ug/kg		2	UKAS	LL	1051
Benzo(b)fluoranthene : Dry Wt	13.1	ug/kg		10	UKAS	LL	1051
Benzo(ghi)perylene : Dry Wt	<10	ug/kg		10	UKAS	LL	1051
Benzo(k)fluoranthene : Dry Wt	<10	ug/kg		10	UKAS	LL	1051
Chrysene : Dry Wt	13.4	ug/kg		3	UKAS	LL	1051
Dibenzo(ah)anthracene : Dry Wt	<5	ug/kg		5	UKAS	LL	1051
Fluoranthene : Dry Wt	39.1	ug/kg		2	UKAS	LL	1051
Fluorene : Dry Wt	<10	ug/kg		10	UKAS	LL	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	<10	ug/kg		10	UKAS	LL	1051
Naphthalene : Dry Wt	<30	ug/kg		30	UKAS	LL	1051
Phenanthrene : Dry Wt	34.8	ug/kg		10	UKAS	LL	1051
Pyrene : Dry Wt	33.5	ug/kg		3	UKAS	LL	1051
PCB - 028 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 052 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 101 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 118 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 138 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 153 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 180 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
Dibutyl Tin : Dry Wt as Cation	<3	ug/kg		3	UKAS	LE	897
Dioctyl Tin : Dry Wt as Cation	<3	ug/kg		3	UKAS	LE	897
Diphenyl Tin : Dry Wt as Cation	<2	ug/kg		2	UKAS	LE	897
Tetrabutyl Tin : Dry Wt as Cation	<2	ug/kg		2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<3	ug/kg		3	UKAS	LE	897
Triphenyl Tin : Dry Wt as Cation	<2	ug/kg		2	UKAS	LE	897
Dry Solids @ 30°C	83.3	%		0.5	None	LE	1130

Accreditation Assessment	3	No.	None	LE	924
Sample Preparation	Report	Text	None	LE	924

The sample appeared to be a medium brown wet sand.

35.74g of the sample was taken for drying at <30degC which gave 30.13g of dried sample (weights include tray weight).
The sample was crushed using a jaw crusher.
The sample was then sieved until it passed through a 2mm sieve.
The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Analytical Report

Final Report

Report ID - 20043995 - 1

UKAS TESTING 0754

Batch description: Marine Sediment Samples collected from the Intertid

Reported on: 14-Nov-2012

Client: University of Hull
Project: Marine seds analysis
Folder No: 002110123
Sampled on: 19-Sep-12 @ 14:15
Comments: 2107117 (re-registered) - Marine sand with small amount of gravel and shell
Quote No: 9101
Matrix: Sediment

Analyte	Result	Units	Flag	MRV	Accred	Lab ID	Testcode
Arsenic, HF Digest : Dry Wt	8.06	mg/kg		0.4	UKAS	LL	341
Cadmium, HF Digest : Dry Wt	<0.03	mg/kg		0.03	UKAS	LL	341
Chromium, HF Digest : Dry Wt	5.97	mg/kg		3	UKAS	LL	341
Copper, HF Digest : Dry Wt	2.84	mg/kg		1	UKAS	LL	341
Lead, HF Digest : Dry Wt	13.4	mg/kg		3	UKAS	LL	341
Lithium, HF Digest : Dry Wt	9.06	mg/kg		0.1	UKAS	LL	341
Manganese, HF Digest : Dry Wt	200	mg/kg		0.4	UKAS	LL	341
Nickel, HF Digest : Dry Wt	2.78	mg/kg		1	UKAS	LL	341
Tin, HF Digest : Dry Wt	0.640	mg/kg		0.5	None	LL	341
Vanadium, HF Digest : Dry Wt	14.5	mg/kg		1	UKAS	LL	341
Zinc : HF Digest : Dry Wt	30.2	mg/kg		5	UKAS	LL	341
Acenaphthene : Dry Wt	5.60	ug/kg		2	UKAS	LL	1051
Acenaphthylene : Dry Wt	<2	ug/kg		2	None	LL	1051
Anthracene : Dry Wt	7.03	ug/kg		2	UKAS	LL	1051
Benzo(a)anthracene : Dry Wt	8.83	ug/kg		2	UKAS	LL	1051
Benzo(a)pyrene : Dry Wt	6.04	ug/kg		2	UKAS	LL	1051
Benzo(b)fluoranthene : Dry Wt	<10	ug/kg		10	UKAS	LL	1051
Benzo(ghi)perylene : Dry Wt	<10	ug/kg		10	UKAS	LL	1051
Benzo(k)fluoranthene : Dry Wt	<10	ug/kg		10	UKAS	LL	1051
Chrysene : Dry Wt	11.0	ug/kg		3	UKAS	LL	1051
Dibenzo(ah)anthracene : Dry Wt	<5	ug/kg		5	UKAS	LL	1051
Fluoranthene : Dry Wt	28.2	ug/kg		2	UKAS	LL	1051
Fluorene : Dry Wt	<10	ug/kg		10	UKAS	LL	1051
Indeno(1,2,3-c,d)pyrene : Dry Wt	<10	ug/kg		10	UKAS	LL	1051
Naphthalene : Dry Wt	<30	ug/kg		30	UKAS	LL	1051
Phenanthrene : Dry Wt	38.7	ug/kg		10	UKAS	LL	1051
Pyrene : Dry Wt	32.1	ug/kg		3	UKAS	LL	1051
PCB - 028 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 052 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 101 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 118 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 138 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 153 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
PCB - 180 : Dry Wt	<0.1	ug/kg	DC	0.1	UKAS	LL	685
Dibutyl Tin : Dry Wt as Cation	<3	ug/kg		3	UKAS	LE	897
Dioctyl Tin : Dry Wt as Cation	<3	ug/kg		3	UKAS	LE	897
Diphenyl Tin : Dry Wt as Cation	<2	ug/kg		2	UKAS	LE	897
Tetrabutyl Tin : Dry Wt as Cation	<2	ug/kg		2	UKAS	LE	897
Tributyl Tin : Dry Wt as Cation	<3	ug/kg		3	UKAS	LE	897
Triphenyl Tin : Dry Wt as Cation	<2	ug/kg		2	UKAS	LE	897
Dry Solids @ 30°C	87.6	%		0.5	None	LE	1130

Accreditation Assessment	3	No.	None	LE	924
Sample Preparation	Report	Text	None	LE	924

The sample appeared to be a medium brown sand with stones.

27.41g of the sample was taken for drying at <30degC which gave 24.28g of dried sample (weights include tray weight).
The sample was crushed using a jaw crusher.
The sample was then sieved until it passed through a 2mm sieve.
The sample was received unpreserved.

All parameters are determined on the air-dried (<30degC) portion except those requiring a wet sample fraction where as received (wet) sample was used.

Dry Weight (DW) results are reported as determined at <30degC.

Method Description Summary for all samples in batch Number 20043995

341	LL ME ICPMS 12.1 & 12.4 - Metals - HF Digest Open Vessel Hotplate Digest, determined by ICPMS, sieved to <63um
685	LL O PCBs - solvent extracted; determined by GCMS (SIM), larger particles manually removed prior to analysis.
897	LE O Organotins (GCMS) 01 - acetic acid/methanol extracted; derivatised; determined GCMS (SIM); from "as received" sample
924	Sample Preparation; Dry Solids (30°C); from "as received" sample
1051	LL O PAHs - solvent extracted; determined by GCMS (EI), larger particles manually removed prior to analysis.
1130	LE P Soil Preparation 01: The sample is air-dried at <30ºC in a controlled environment until a constant weight it achieved.

Chris Hunter
Laboratory Site Manager

All reporting limits quoted are those achievable for clean samples of the relevant matrix. No allowance is made for instances when dilutions are necessary owing to the nature of the sample or insufficient volume of the sample being available. In these cases higher reporting limits may be quoted and will be above the MRV.

Solid sample results are determined on a "dried" sample fraction except for parameters where the method description identifies that "as received" sample was used.

Key to Results Flags:

DC Analysis started outside of specified holding time. It is possible that the results may be compromised.

Please note all samples will be retained for 10 working days for aqueous samples and 30 working days for solid samples after reporting unless otherwise agreed with Customer Services

Key to Accreditation: UKAS = Methodology accredited to ISO/IEC 17025:2005, MCertS = Methodology accredited to MCertS Performance Standard for testing of soils, none = Methodology not accredited

Key to Lab ID: LE = Leeds, LL = Llanelli, NM = Nottingham, SX = Starcross, SC = Sub-Contracted outside NLS, FI = Field Data, NLS = Calculated

Any subsequent version of this report denoted with a higher version number will supersede this and any previous versions

END OF TEST REPORT