XLINKS' MOROCCO-UK POWER PROJECT

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Stage 1 and 2 Marine Geoarchaeological Assessment

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Summary

Wessex Archaeology (WA) were commissioned by WSP UK Ltd, on behalf of Xlinks 1 Limited, to undertake a Stage 1 and 2 Marine Geoarchaeological Assessment of geotechnical vibrocores acquired during a geotechnical survey undertaken in September 2023 for the UK offshore elements of Xlink' Morocco-UK Power Project (the 'Project'). This Stage 1 and 2 Marine Geoarchaeological Assessment follows a preliminary Stage 1 Geoarchaeological Review undertaken by WSP in March 2024, following which a series of nearshore vibrocores (VC53, VC59 and VC60) were identified as containing deposits of possible geoarchaeological potential and therefore were recommended for Stage 2 recording.

A total of 44 geotechnical vibrocores were reviewed as part of the Stage 1 geoarchaeological assessment undertaken in this study. A sequence of Quaternary deposits was identified and comprised glaciogenic sediments including Diamict and laminated sands and clays interpreted as Glaciomarine sediments, overlain by transgressional sands and gravels containing fragmented shells. In the nearshore area of Barnstaple Bay, a sequence of Late Glacial to Early Holocene deposits was identified, comprising fine-grained laminated Alluvium, Coastal to Shallow Marine sands and gravels and sediments assigned as 'Undifferentiated'.

During the Stage 1 review, two vibrocores (VC59 and VC60) were identified as containing deposits interpreted as Alluvium and assigned a medium priority status. In all three vibrocores reviewed as part of the Stage 2 assessment (VC53, VC59 and VC60) sands interpreted as Coastal and Shallow Marine were also identified and assigned a medium priority status. No vibrocores were identified as containing deposits of high geoarchaeological potential (e.g. Peat). A unit of very gravelly clay identified in VC60 was defined as 'Undifferentiated' as the depositional history of the deposit was unclear based on the vibrocore log alone. However, following the Stage 2 recording this deposit was interpreted as 'Head' based on the clast angularity and high gravel content.

A total of four transects were created to show the stratigraphic relationship between deposits within the Xlinks' Offshore Cable Corridor. The stratigraphic units presented within these transects included Bedrock (including Reworked Bedrock), Diamict, Glaciomarine sediments, Head, Alluvium, Coastal to Shallow Marine and Seabed Sediments. Palaeogeographic reconstructions of Late Glacial to Holocene sea level change in Barnstaple Bay have shown that during the Late Weichselian, this area was subaerially exposed, but was rapidly inundated during the Early Holocene. These model projections indicate that VC53 was located on the palaeoshoreline between c. 12 ka and 11 ka, with a shallow marine environment forming at c. 10 ka. The timing of submergence in the area adjacent to the modern coastline is unclear, however based on palaeogeographic reconstructions it is possible that both VC59 and VC60 were fully submerged by approximately 6 ka.

The identification of palaeolandscape features through seismic interpretations further supports a former terrestrial landscape suitable for hominin occupation. Considering the location of both vibrocores (VC59 and VC60), it is possible that the Alluvium is associated with the submerged palaeo-Taw, although this is unclear based on available geophysical and geotechnical datasets.

Based on the Stage 1 review of geotechnical logs, three vibrocores (VC53, VC59, and VC60) were recommended for Stage 2 geoarchaeological recording. Although deposits interpreted as Coastal to Shallow Marine and Alluvium indicate that a former terrestrial landscape developed in Barnstaple Bay during the Late Glacial to Early Holocene, collectively these sediments are considered to have low potential for palaeoenvironmental assessment and scientific dating. As such, no further works (i.e. a Stage 3 palaeoenvironmental assessment) are recommended. However, geoarchaeological recording of the possible ice-marginal deposits in VC28 should be undertaken if core samples are available from this sequence.

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Wessex Archaeology would like to thank Toby Gane at WSP UK Ltd for commissioning this report and providing support throughout. The Stage 1 review and reporting was undertaken by Hayley Hawkins and the Stage 2 geoarchaeological recording was undertaken by Miriam Weinbren. The figures were produced by Nancy Dixon. The report was quality controlled and managed on behalf of Wessex Archaeology by Daniel Young.

Xlinks' Morocco-UK Power Project

Stage 1 and 2 Marine Geoarchaeological Assessment

1 INTRODUCTION

1.1 Project and planning background

1.1.1 This report presents a Stage 1 and 2 Marine Geoarchaeological Assessment (MGA) of geotechnical data acquired during a geotechnical survey undertaken in September 2023 for the UK offshore elements of Xlinks' Morocco-UK Power Project (the 'Project') (**Figure 1**). For ease of reference, the UK elements of the Project area referred to in this report as the 'Proposed Development'. The report accompanies the application to the Planning Inspectorate for development consent for the Proposed Development.

1.1.2 The Proposed Development forms part of the wider Project proposed by the Applicant to develop a sub-sea electricity supply project from Morocco to the UK. The Project includes an electricity generation facility entirely powered by solar and wind energy combined with a battery storage facility. Located in Morocco's renewable energy rich region of Guelmim Oued Noun, the Applicant proposes to install approximately 11.5 Gigawatts peat (GWp) of renewable energy capacity that would cover an approximate area of 1,500 km^2 and connect exclusively to Great Britain (GB) via four HVDC sub-sea cables, with a total offshore route between Morocco and the UK of approximately 4,000 km.

1.1.3 The offshore elements of the Proposed Development in the UK waters that are subject of this assessment will be undertaken within the Offshore Cable Corridor (OCC). The extent of the OCC is from the UK exclusive economic zone (EEZ) boundary to the landfall site at Cornborough Range on the north Devon coast. The total length of the Offshore Cable Corridor in UK waters is approximately 370 km.

1.1.4 GEOxyz were commissioned by Xlinks to undertake a reconnaissance survey which includes a geotechnical investigation of the offshore route and associated nearshore areas at each landfall location. This Stage 1 and 2 Marine Geoarchaeological Assessment follows a preliminary Stage 1 Geoarchaeological Review undertaken by WSP in March (WSP 2024).

1.2 Summary of previous work

Preliminary Stage 1 Geoarchaeological Review (WSP 2024)

1.2.1 A preliminary Stage 1 review of geotechnical vibrocores recovered from the UK OCC was undertaken by WSP in March 2024. A total of five Geoarchaeological Classifications (GCs) were identified following the review and comprised of seabed sediments c. 1.0 m in thickness in the nearshore zone (GC1), recorded overlying clays with fragments of organics (GC2) and laminated clays between c. -17.0 m and -15.0 m relative to Mean Sea Level (MSL) (GC3). The vibrocores containing thick sequences of sands and gravels at the southern extent of the UK OCC in the Celtic Sea were interpreted as glacio-outwash deposits, laid down following the retreat of ice from the area during the Last Glacial Maximum (GC4). Shale gravels were assigned a low geoarchaeological priority status as these deposits were interpreted as Devonian and Carboniferous bedrock (GC5).

1.2.2 The laminated clays in the nearshore zone were considered to have the highest geoarchaeological and palaeoenvironmental potential, possibly representing tidal mudflat sediments. The age of these fine-grained deposits is unclear, however the elevation of these deposits relative to local sea level reconstructions indicate that deposition may have occurred during the Mesolithic or Early Neolithic periods. As such, VC53 and VC59 were recommended for Stage 2 geoarchaeological recording to determine the depositional history of deposits and suitability of deposits to contain material suitable for palaeoenvironmental assessment.

1.3 Scope of works

1.3.1 To help frame geoarchaeological investigations of this nature, WA has developed a five-stage approach, encompassing different levels of investigation appropriate to the results obtained, accompanied by formal reporting of the results. The stages are summarised below (**Table 1**).

1.3.2 This report outlines the results of a Stage 1 and 2 assessment of geotechnical logs from the Xlinks' UK OCC acquired during a survey undertaken in September 2023, as detailed in **Section 1.1**. The report will include a geoarchaeological review of geotechnical vibrocores alongside the recording and deposit modelling of selected sequences, with recommendations made for further geoarchaeological work if deemed necessary.

Table 1 Staged approach to geoarchaeological investigations

Stage	Description
Stage 1: Geoarchaeological review	Desk-based review of geotechnical and geological data. Establish likely presence/ absence/ distribution of archaeologically relevant deposits. Identify deposits or samples for Stage 2 works.
Stage 2: Geoarchaeological recording/monitoring	Target deposits or samples identified in Stage 1. Describe the sequences recovered and undertake deposit modelling (if suitable). Interpret depositional environment (if possible). Identify if suitable deposits are present for Stage 3 works.
Stage 3: Palaeoenvironmental assessment	Sub-sample deposits of archaeological interest for paleoenvironmental assessment (e.g. pollen, plant macrofossils, foraminifera, ostracod and diatoms) and associated scientific dating. Provide an outline interpretation of the archaeological and palaeoenvironmental context. Any recommendations for Stage 4 works will depend on the potential for further analysis and the project research objectives.
Stage 4: Palaeoenvironmental analysis	Full analysis of samples and additional scientific dating as specified in Stage 3, together with a detailed synthesis of the results, in their local, regional or wider archaeological and palaeoenvironmental context. Publication would usually follow from a Stage 4 report.
Stage 5: Publication	Publication of the results of Stage 1-4 works for submission in a peer reviewed journal, book or monograph, depending on the archaeological significance of the work. The scope and location of the final publication will be agreed in consultation with the client and regulatory bodies where appropriate.

2 GEOARCHAEOLOGICAL BACKGROUND

2.1.1 Geoarchaeological assessments are typically undertaken with reference to geological periods (e.g. Quaternary), epochs (e.g. Pleistocene) and sub-epochs (e.g. Weichselian) that

reflect major climate sea-level and/or environmental changes. Here we adopt European nomenclature correlated to the Marine Isotope Stage (MIS) record to distinguish between different climatic periods, with dates given in ka (thousands of years before present). Marine Isotope Stages are deduced from marine palaeoclimatic records and reflect alternating warm (interglacial and interstadial) and cold (glacial and stadial) periods throughout the Quaternary.

2.1.2 The Xlinks' UK OCC is located on bedrock predominantly comprising Devonian to Carboniferous mudstone and sandstone to the north and Upper Cretaceous to Miocene limestone, siltstone, mudstone and chalk to the south (BGS Geoindex Offshore). Both Permian to Triassic mudstone and halite-stone and Lower Cretaceous limestone and sandstone are also mapped sporadically throughout the UK OCC and may be encountered in geotechnical vibrocores where deposits outcrop or subcrop beneath seabed sediments. The bedrock is overlain by considerable thicknesses of Quaternary sediments dominated by glacially-derived deposits including subglacial diamicts (tills) and periglacial sediments (Evans 1990). These Quaternary deposits are often capped by post-transgression (marine) sands and gravels.

2.1.3 The Pleistocene geological history of the Celtic Sea is dominated by repeated glacial/interglacial cycles, resulting in rising and falling sea levels. Recent studies investigating the glacial geomorphology of the southern Celtic Sea through geotechnical and geophysical techniques have demonstrated the expansion of ice into this region during the Late Devensian (Roberts, et al. 2007), terminating in the outer shelf waters during the Last Glacial Maximum (LGM; MIS 2; c. 26,000 years BP). It is unclear if the Elsterian (478,000–424,000 years BP; MIS 12) and Saalian (185,000–135,000 years BP; MIS 6) glaciations extended into the Celtic Sea and outer Bristol Channel (Mitchell and Orme 1967), however subglacial and ice-marginal deposits (including glaciolacustrine clays and glaciofluvial gravels) likely to be of either Saalian or potentially Elsterian age, have been recorded c. 12 km to the northeast of the UK OCC in Barnstaple Bay (Grant et al. 2019; Wessex Archaeology 2022). Nonetheless, indirect affects resulting from changing sea levels and cold periglacial conditions will have influenced the region.

2.1.4 During the LGM, a marine-terminating ice stream of the British-Irish Ice Sheet (BIIS) referred to as the Irish Sea Ice Stream (ISIS) covered the southwest and southern Celtic Sea (Roberts, et al. 2007). The results of the BRITICE chrono mapping of glaciogenic landforms indicated that ice advanced into the Celtic Sea around 27 ka (Clark et al. 2012) before reaching its maximum extent on the shelf break at c. 26 ka (see **Figure 3**). The maximum extent of the eastern flank of the ISIS was recorded to the north of the Isles of Scilly, where boulders overlying glacial till produced a terrestrial cosmogenic nuclide (TNC) age of 25.9 ± 1.5 ka (Smedley et al. 2017).

2.1.5 The Quaternary stratigraphy for the Celtic Sea has more recently been redefined by Lockhart et al. (2018), with the lowermost facies typically comprised of stiff, matrix-supported diamict interpreted as the Upper Little Sole Formation. Microfauna in glaciomarine sediments directly overlying this diamict have produced radiocarbon ages of 25.6 ± 0.5 ka on the shelf break, constraining the timing for the maximum extension of ice into the Celtic Sea.

2.1.6 Following the rapid retreat of ice from the Celtic Sea (Small et al. 2018), a submerged proglacial environment formed recorded by an extensive sequence of glaciomarine sediments. These deposits are however highly complex, with deformation structures highlighting the oscillatory nature of ice retreat across the shelf (Giglio et al. 2021). Glaciomarine deposits across this area vary considerably in lithology with both distal

laminated clays to highly reworked clays and sands with coarse-grained units likely representing more proximal deposition (Scourse et al. 2019).

2.1.7 Overlying these glaciogenic sediments are medium to coarse gravelly sands with shell fragments, interpreted as post-glacial tidal deposits of the Melville Formation (Lockhart et al. 2018). No direct dating has been undertaken on such deposits, however the Melville Formation has an inferred age of 24-13 ka based on dates from the underlying Upper Little Sole Formation (Praeg et al. 2015; Scourse et al. 2019) and overlying modern superficial units (Scourse et al. 2002). These tidal deposits have been widely recorded across the Celtic Sea, including in the central to outer shelf where they form part of extensive megaridges. These submerged structures are suggested to represent post-glacial tidal ridges which formed on an irregular topography of partially eroded glacial sediments of the Upper Little Sole Formation (Lockhart et al. 2018).

2.1.8 Post-transgression marine sediments form the uppermost unit of the Celtic Sea stratigraphy. Intertidal molluscs preserved in these sands and gravels have been radiocarbon dated to between 13.9–4 ka BP (Furze, et al. 2014) and therefore record continued rising sea levels from the Late Glacial through to the Late Holocene.

2.1.9 The Quaternary stratigraphy comprising glacial diamict, glaciomarine sediments and postglacial marine sands and gravels demonstrates that most of the Celtic Sea was likely submerged following the retreat of the ISIS post-LGM. However, evidence of sub-aerial exposure has been demonstrated through high-resolution geophysical and geotechnical data to the north of the UK OCC in Barnstaple Bay. Based on interpreted sub-bottom profiler data, simple cut and fill features were identified and tentatively interpreted as palaeochannels, possibly associated with the offshore extension of the palaeo-Taw (Wessex Archaeology 2012). Isolated areas of acoustic blanking were also identified and may represent the preservation of peat or organic-rich deposits. Palaeogeographic reconstructions for Barnstaple Bay further support this interpretation with a period of exposure during the Late Glacial before rapid inundation during the Early Holocene (c. 8 ka; Grant et al. 2019).

2.1.10 Estuarine to intertidal sediments and organic deposits in the wider area have recovered nationally significant prehistoric archaeology, notably at Westward Ho! located c. 3 km northeast of the UK OCC (Rogers 1946; Balaam et al. 1987). Significantly, a Mesolithic 'kitchen midden' was found between fossiliferous sandy clays and peat/peaty clays at levels of c. -2.0m OD (Rogers 1908; 1946). The midden, containing charcoal, wood, bone, flint, stone, and shellfish fragments accumulated between 6810 ± 140 BP (Q-1212: 5840-5560 cal BC) and 6320 ± 90 BP (HAR-5645: 5380-5200 cal BC (Balaam et al. 1987). The assemblage as a whole was taken to suggest the attractiveness of the coastal-intertidal zone for the exploitation of a range of resource types (Balaam et al. 1987).

2.1.11 The lateral extent of these organic and fine-grained minerogenic sediments within the nearshore zone is unknown, however equivalent former landsurfaces may be preserved. If recovered, such deposits may have the potential to contain or partially mask Late Glacial to Early Holocene archaeological features, and/or layers (including peat/organic units of high geoarchaeological potential) and preserve a range of palaeoenvironmental remains informing on past landscape, environment and land-use.

2.1.12 Prehistoric findspots have also been reported near to the UK OCC landfall and provide additional evidence of occupation within the nearshore zone. Such finds include an assemblage of c. 550 flints, including some Mesolithic material, located along a small stream valley at Cornbrough, Abbotsham, c. 0.80 km southwest of the UK OCC landfall

(NRHE 33121) and four Mesolithic scrapers located in the area of Rock Nose, c. 1.5 km to the northeast of the landfall (NRHE 33120).

3 AIMS AND OBJECTIVES

3.1.1 The principal aim of this combined Stage 1 and 2 report is to determine the geoarchaeological potential of deposits within the UK OCC of the Xlinks' Project.

3.1.2 This will be achieved by addressing the following objectives:

- Review geotechnical vibrocore and borehole logs to identify deposits of potential archaeological interest, assigning high, medium and low priority status;
- Describe vibrocore and borehole sequences assigned medium and high priority status;
- Model the character, extent and depth of deposits;
- Interpret the probable environments represented;
- Determine the importance of the deposits, with regard to their archaeological and palaeoenvironmental potential, and;
- Make recommendations for dating and palaeoenvironmental assessment as appropriate, with reference to key research questions and regional/national period specific and maritime research agendas.

4 METHODOLOGY

4.1 Coordinate system

4.1.1 The location information for the geotechnical vibrocores was initially presented in two different coordinate projections, WGS UTM Zone 29N for VC01 to VC31a and WGS UTM Zone 30N for VC32 to VC60. However, to support the import of data into Rockworks, coordinates were normalised and converted in ArcPro to WGS UTM Zone 30N Eastings and Northings.

4.1.2 The vertical reference level is given as metres below sea floor (mbsf) which assumes the top of the vibrocore is equal to the level of the seafloor. Water depths are given as metres relative to Mean Sea Level (MSL). The location and elevation data for geotechnical vibrocores is presented in **Appendix 1**.

4.2 Geotechnical coring strategy

4.2.1 A total of 44 vibrocores, including four grab samples (VC01, VC02, VC06 and VC19), alongside 44 Cone Penetration Tests (CPTs) were acquired during a geotechnical survey undertaken in September 2023. A full list of the vibrocores recovered from the UK OCC is presented in **Appendix 1** with the locations shown in **Figure 2**.

4.2.2 Vibrocores were acquired using a high-performance corer along the UK OCC. The target depth of the geotechnical vibrocores was c. 5.0 mbsf, however this was only achieved at six locations. All geotechnical vibrocores were acquired in clear liners and were split into 1.0 m sections offshore. The vibrocores were split open lengthways, photographed and described in detail by the geotechnical engineer on the vessel and subsequently wrapped in clear plastic liners. The vibrocores selected for Stage 2 recording were delivered to Wessex Archaeology.

4.3 Stage 1 review of geotechnical data

4.3.1 The geotechnical survey comprised vibrocores and CPTs locations which were evenly distributed across the UK OCC. Following the initial geotechnical survey, core logs and photographs were delivered to WSP UK who undertook a preliminary Stage 1 geoarchaeological review, the results of which are summarised in **Section 1.2**. Wessex Archaeology were later commissioned by WSP UK to undertake a combined Stage 1 and 2 Marine Geoarchaeological Assessment for the UK OCC.

4.3.2 Each of the geotechnical vibrocore logs were reviewed by a trained geoarchaeologist in order to determine their potential for further geoarchaeological works. In many instances the recovery of deposits was limited due to the high strength of sediments beneath the seabed. As such, CPT logs were utilised to support interpretations, particularly for vibrocores which only recovered <1.0 m of sediment. However, it should be noted that descriptions provided through CPTs are often limited to lithology and do not include information on structure or inclusions (e.g. laminations) only evident in the geotechnical vibrocores.

4.3.3 Deposits recovered were assigned either a high, medium or low priority status based on their perceived geoarchaeological significance as itemised in **Appendix 2** and shown on **Figure 3**. Core photographs were also provided for each vibrocore.

4.4 Stage 2 geoarchaeological recording

4.4.1 The preliminary Stage 1 review undertaken by WSP UK Ltd identified three geotechnical vibrocores with the potential to contain deposits of geoarchaeological significance within the UK OCC (VC53, VC59 and VC60). All core samples acquired from these locations were requested for Stage 2 geoarchaeological recording and subsequently delivered to Wessex Archaeology.

4.4.2 Stage 2 geoarchaeological recording was undertaken by a geoarchaeologist at Wessex Archaeology in June 2024. As the core samples were not required for luminescence dating, the liners were split under normal UV light conditions.

4.4.3 All core sections subject to Stage 2 geoarchaeological recording were photographed and described by a suitably trained geoarchaeologist following Hodgson (1997) and COWRIE (2007), to include information such as:

- Depth;
- Texture;
- Composition;
- Colour;
- Inclusions;
- Structure (bedding etc.); and,
- Contacts between deposits (where visible).

4.4.4 Interpretations were made regarding the probable depositional environments and formation processes of the sampled deposits. This data is presented in **Appendix 3**.

4.4.5 Deposits recovered in vibrocores were interpreted in terms of their geoarchaeological potential. Of greatest geoarchaeological potential are sediments from former terrestrial depositional environments, as well as certain features or inclusions of possible archaeological and palaeoenvironmental interest, specifically:

- Peat layers;
- Deposits containing other organic material such as wood fragments, roots, dark organic staining etc.;
- Clay or silt deposits, especially those containing laminated features such as lacustrine varves or tidal rhythmites;
- Inorganic fossils (such as molluscs);
- Concentrations of charcoal;
- Individual artefacts such as pieces of flint or pottery (though finding these within core samples is rare), and;
- Any other feature thought to indicate a terrestrial depositional environment.

4.5 Deposit modelling

4.5.1 The results from the Stage 1 review of geotechnical logs and photographs and Stage 2 geoarchaeological recording were used to produce a deposit model. Deposit modelling identifies the range of Quaternary deposits that may be present in a defined area and maps their lateral extent and depth.

4.5.2 Only lithostratigraphic records with sufficiently detailed descriptive terminology and location data (including surface elevation) were included in the model. Given the UK OCC extends away from the nearshore zone and into the offshore UK waters, the surface elevation of some vibrocore exceeds -128 m MSL. Palaeogeographic modelling and reconstructions of Relative Sea Level (RSL) in the Celtic Sea during the LGM are scarce, however for the south coast region in the English Channel RSL was approximately 20 m higher than the Global Mean Sea Level (GMSL) curve, at around -100 m (Shennan et al. 2018; Wessex Archaeology 2023). Although this estimated sea-level minimum will have some degree of error, it assumes that those vibrocores recovered at -100 m or below remained submerged during the Late Weichselian. As such, a total of 20 vibrocores acquired to the south of the UK OCC (VC01-VC20a; between -128.9 m MSL and -102.5 m MSL), have been excluded from the deposit models.

4.5.3 In total 25 deposit records were used in the deposit modelling.

4.5.4 All available data points were entered into industry standard geological utilities software (Rockworks™). Each stratigraphic unit was given a colour and pattern allowing cross correlation and grouping of the different sedimentary units. The grouping of these deposits is based on lithological descriptions, which define distinct depositional environments referred to as 'stratigraphic units' (e.g., Bedrock, Alluvium and Made Ground).

4.5.5 Outputs include two-dimensional stratigraphic profiles ('transects') of selected interventions, generated using RockWorks™. The locations of the transects are presented alongside the deposit models in **Figures 4** to **7**.

5 RESULTS

5.1 Stage 1 review of geotechnical data

5.1.1 A total of 44 vibrocores were reviewed as part of the Stage 1 works, with the aim of identifying deposits of potential geoarchaeological significance. Outline descriptions based on geotechnical logs are presented in **Appendix 2**, accompanied by an interpretation of deposits.

Bedrock

5.1.2 Bedrock was recovered in a total of 15 vibrocores and comprised of structureless chalk further to the south and shale gravel to the north of the UK OCC. In two vibrocores (VC17 and VC18) sandy chalk gravel with shell fragments was recorded overlying structureless chalk and is interpreted as disturbed bedrock reworked by later marine processes.

Diamict

5.1.3 The lithostratigraphy of deposits encountered during the monitoring is listed and summarised below. The specific lithologies and lithostratigraphic succession encountered in each intervention are outlined in **Appendix 2**.

5.1.4 Dark grey firm to very stiff heterogeneous gravelly sandy clay was recovered in three vibrocores from the UK OCC (VC19grab, VC20a and VC60). The vertical extent of this deposit is unclear given the shallow depth of the vibrocores. However, where recovered, this deposit is typically at depths of between 0.54 mbsf and 1.25 mbsf. The surface of this deposit was recovered at seabed in grab sample VC19, although terminates at a shallower depth of 0.14 mbsf. Rare shell fragments were also recorded and may suggest some degree of post-depositional reworking. The high shear strength and heterogeneous nature of this clay suggests it was deposited in a glacial environment and is interpreted as glacial till (Diamict). Diamict is assigned a low priority status.

5.1.5 In VC60, a thin unit of dense slightly sandy very clayey gravel was recorded at depths of between 0.68 mbsf and 1.00 mbsf. The gravel-dominated unit is stratigraphically constrained between glacial diamict and is therefore also glacial in origin, most likely representing subglacial outwash.

Glaciomarine

5.1.6 In seven vibrocores (VC04, VC07a, VC24, VC25, VC30, VC37a and VC39a) very dark grey firm to very stiff slightly to very sandy clay and dense sand with lenses of clay were recorded at depths of between 0.08 mbsf and 3.30 mbsf. Thin laminations are frequently observed within these deposits and they occasionally display a convex structure possibly representing post-depositional alteration through glaciotectonic deformation. Gravel clasts are occasionally recorded within these deposits, interpreted as representing dropstones. Shell fragments are also observed within this unit and suggest deposition within a subaqueous low-energy environment. This combined with the high strength nature of these sediments suggests that deposition likely occurred within a glaciomarine environment.

Coastal to shallow marine

5.1.7 In a single vibrocore (VC53) a lithologically variable sequence of gravelly sands and fine to medium sands with rare sand and clay laminae and shell fragments was recorded between seabed and 4.73 mbsf. The laminations suggest deposition in a rhythmic low energy setting with sharp contacts to gravelly sands indicative of a rapid change of depositional energy. Fine to coarse shell fragments are also observed throughout and they are therefore

tentatively interpreted to represent deposition in a highly active coastal to shallow marine setting. Coastal sediments are assigned a medium priority status.

Alluvium

5.1.8 In two vibrocores (VC59 and VC60) dark grey fine sand with occasional clay laminae and shell fragments are recorded overlying firm clay with laminae of sand and fragments of organic clay. The clay unit in VC60 (0.10 m) is thinner relative to that recorded in VC59 (1.28 m) and stratigraphically overlies a unit of gravelly clay, tentatively interpreted as periglacial sediments (i.e. Head). The presence of organic inclusions and fine-grained laminated sediments indicative of low-energy rhythmic deposition may suggest that deposits were formed in a shallow water alluvial environment. Alluvium is assigned a medium priority status.

Seabed sediments

5.1.9 A total of 38 vibrocores were recorded as comprising a transgressive sequence of sandy gravels overlain by occasionally gravelly medium to coarse sands. Both fragmented and whole shells are observed and suggest deposition in a marine setting. This unit is stratigraphically recorded at seabed and typically overlies glacial sediments where present. These deposits are interpreted as post-transgressional seabed sediments and are considered to have low geoarchaeological potential.

Undifferentiated

5.1.10 Determining the depositional environment of the deposits from the Celtic Sea based on lithology alone is often complex and given the shallow recovery of vibrocores, resolving these complexities though stratigraphy is also challenging.

5.1.11 In VC28, a heterogeneous sequence of firm clay, sandy gravels and sands with thin laminations are recorded to a maximum depth of VC28. This sequence is lithologically unique with the majority of vibrocores in the vicinity comprising seabed sediments and in few instances, are underlain by glaciogenic deposits. Fragments of peat and woody plant remains are also observed and are detrital in nature. The depositional history of this sequence is unclear, however given the context of the area and the deposits recovered nearby, it may represent an ice-proximal sequence.

5.1.12 A firm very gravelly clay is recorded in VC60 between 0.54 mbsf and 1.55 mbsf. The lithology of the gravel is described as sandstone and shale and based on the core photograph, appears to be angular to subangular throughout. The depositional history of this deposit is unclear, although it has characteristics similar to deposits associated with Diamict and Head.

5.2 Stage 2

5.2.1 Stage 2 geoarchaeological recording was undertaken on a total of three vibrocores (VC53, VC59 and VC60) that were requested following a preliminary Stage 1 geoarchaeological review of geotechnical logs undertaken by WSP (see **Section 1.2**).

5.2.2 Two vibrocores (VC59 and VC60) contained deposits interpreted as Alluvium assigned a medium priority status. In all three vibrocores, sands interpreted as coastal and shallow marine sediments were also assigned a medium priority status. No vibrocores were identified as containing deposits of high geoarchaeological potential (e.g. Peat).

5.2.3 A full list of vibrocores retained for Stage 2 geoarchaeological recording, along with sediment descriptions and an interpretation of depositional environment is presented in **Appendix 3**.

Alluvium

5.2.4 Both VC59 and VC60 were assigned medium priority status as they comprised deposits interpreted as Alluvium.

5.2.5 VC59 recovered a dark grey slightly sandy clay with frequent becoming rare fine (<2mm) laminae of fine to medium sand. Frequent fine to coarse (<5mm) pockets of organic fragments are observed between 1.88 mbsf and 2.47 mbsf and become rare and fine (<1mm) to 2.70 mbsf. Rare shell fragments are recorded throughout the deposit and combined with the presence of fine laminations, suggest that deposition likely occurred within an estuarine setting. Black fragments of organic matter are detrital in nature and indicate a degree of reworking, with fragments likely redeposited from a semi-terrestrial environment in the local area.

5.2.6 VC60 comprised a thin (0.10 m) unit of Alluvium stratigraphically overlying very clayey gravels. The Alluvium in VC60 is described as dark brown slightly silty sandy clay with occasional black flecks of organics. The deposit is lithologically similar to the Alluvium identified in VC59, however no bedding is observed and both the upper and lower boundaries appear to be reworked. Rare black organic flecks are observed which are detrital in nature. The depositional history of this silty sandy clay is unclear given the maximum vertical extent of the unit, although it is possible that it captures the edge of an estuarine, or possibly floodplain, environment.

Shallow marine to coastal

5.2.7 In VC53, a sequence of bedded coarse sands and gravels and fine to medium sands with faint silt and clay laminations is recorded stratigraphically underlying modern seabed sediments.

5.2.8 The beds of sands and gravels are moderately well sorted with the gravel lithology described as predominantly fine subrounded flint and quartz clasts with rare medium (<32 mm) subrounded clasts between 4.35 mbsf and 4.70 mbsf. Marine bivalves and tusk mollusc shells were identified within these coarse-grained units and are indicative of deposition in a partially, or fully, marine environment. The upper boundaries of these beds are sharp and are followed by thick units of fine to medium sands with silt and clay laminations. This sequence is characteristic of a transgressive sequence, with an abrupt change in depositional regime from high-energy marine inundation to low-energy sands associated with rhythmic, likely tidal, processes. The sediments recorded in VC53 are therefore interpreted as forming part of a transient coastal to shallow marine sequence.

5.2.9 The alluvial sediments in both VC59 and VC60 are overlain by predominantly fine to medium, occasionally coarse, sands with faint laminae, occasional fine to medium shell fragments and dark grey mottling throughout. The fine-grained nature of these sands, presence of fragmented shells and laminae are collectively characteristic of rhythmic deposition in either a coastal or shallow marine environment.

Undifferentiated

5.2.10 During the Stage 1 review, a very gravelly clay was defined as 'Undifferentiated' as the depositional history of the deposit was unclear based on the vibrocore log alone. During Stage 2 recording, frequent orange sands were observed and have been interpreted as

oxidised slate bedrock. The gravel comprised angular to subangular slate and subangular flint clasts and the clay was recorded as high strength. During the initial review, this unit was assumed to likely represent Diamict, however both the high gravel content and angularity of clasts suggests that this deposit was laid down by slope processes in a periglacial environment (i.e. Head), reworking into the upper surface of the underlying Devonian to Carboniferous bedrock.

5.3 Deposit modelling

5.3.1 A total of four transects were created to show the stratigraphic relationship between deposits within the UK OCC (**Figures 4** to **7**). The stratigraphic units presented within these transects include Bedrock (including Reworked Bedrock), Diamict, Glaciomarine sediments, Head, Alluvium, and Coastal to Shallow Marine and Seabed Sediments.

5.3.2 Cross section 1 is located in the central Celtic Sea and comprises eight geotechnical vibrocores (**Figure 4**). Bedrock subcrops beneath a thin veneer of seabed sediments to the southwest, whereas in the northeast thick glaciomarine deposits are recorded and are overlain by transgressive sands and gravels. The lower boundary of these glaciomarine sediments was not reached due to the shallow recovery of vibrocores.

5.3.3 Quaternary deposits are present in two vibrocores in Transect 2 (**Figure 5**) and are entirely absent, with the exception of seabed sediments in Transect 3 (**Figure 6**). It should be noted that many vibrocores included in these cross sections recovered <1.00 m of material and therefore the true extent of Quaternary deposits is unknown based on geotechnical information alone. The upper surface of the glaciomarine units identified in VC37a and VC39a were both recorded at a similar elevation of c. 76.2 m RSL. To the northwest in Transect 3, the surface of VC46 is recovered at -60.70 m RSL and shows a shallowing of the seabed as the cable route reaches landfall.

5.3.4 Cross section 4 comprises three vibrocores located in the nearshore area of Barnstaple Bay (**Figure 7**). The upper surface of the Coastal to Shallow Marine sequence recorded in VC53 is recorded at c. -31.0 m RSL and would have been submerged earlier than both VC59 and VC60, recorded at -13.50 m RSL and -10.0 m RSL, respectively (**Figure 7**). Although Alluvium is absent in VC53, it may stratigraphically underly the transgressive sediments, however this is unclear given the shallow penetration of vibrocores. The Alluvium stratigraphically underlies a unit of Coastal to Shallow Marine sediments in VC59 and possibly represents the infill of a palaeochannel, the edge of which may be identified in VC60. The Alluvium in VC60 overlies a Head sequence indicating a degree of subaerial reworking in a periglacial environment. Equivalent cold-stage deposits are recorded onshore (Wessex Archaeology 2023).

6 DISCUSSION

6.1 Introduction

6.1.1 The Quaternary stratigraphy of deposits recovered in vibrocores from the Xlinks' UK OCC is summarised in **Table 2**, with deposits assigned to stratigraphic units defined by Lockhart et al. (2018). However, due to uncertainty around taphonomy, along with the large distance between sampling locations, it was not always possible to assign a single Formation with confidence; such deposits are grouped together as Undifferentiated. The Melville Formation (see **Section 2.1.7**) was not identified in vibrocores reviewed in this study.

Table 2 Stratigraphy of deposits within the Xlinks' UK OCC

WA Unit Name	Description	Epoch	Formation
Seabed Sediments	Medium to coarse sand with shell (Modern seabed)	Late Weichselian to Modern	Layer A
	Gravelly sand and sandy gravel (Gravel lag)	Late Weichselian to Late Holocene	Layer B
Coastal to Shallow Marine	Fine to medium sand with faint laminae and rare shells	Early Holocene	N/A
Alluvium	Low strength sandy clay	Early Holocene	N/A
Head	Gravelly clay and clayey gravel	Late Weichselian to Early Holocene	N/A
Glaciomarine	Firm to stiff sandy clay with laminae of sand and shell fragments	Late Weichselian	Upper Little Sole
Diamict	High strength gravelly sandy clay	Late Weichselian	

6.2 Diamict

6.2.1 The oldest sediments recovered in two vibrocores (VC19grab and VC20a) comprise high strength heterogeneous clays interpreted to have formed in a subglacial environment (Diamict). Diamict recorded across the UK OCC correlates to the Upper Little Sole Formation, which is associated with the expansion of the Irish Sea Ice Stream (ISIS), a southern lobe of the British Irish Ice Sheet (BIIS) into the Celtic Sea during the Late Weichselian, at approximately 26 ka (Clark et al. 2022; **Figure 3**).

6.2.2 Diamict associated with the Upper Little Sole Formation (Lockhart et al. 2018) has low geoarchaeological potential as it was deposited by ice during the Late Weichselian, during which period the Celtic Sea would have been unsuitable for hominin occupation.

6.3 Glaciomarine

6.3.1 High strength sandy clay with occasional to rare laminae of sand and organic clay and fragments of shell was recorded in seven vibrocores from the UK OCC. These structured clays indicate deposition in a quiet water environment, whilst the high shear strength and presence of shell fragments suggests that formation occurred in a glaciomarine environment. This unit is assigned to the Late Weichselian glaciogenic sequence of the Upper Little Sole Formation (**Table 2**).

6.3.2 Recent studies assessing the deglacial sequences in the Celtic Sea show that the extension of the marine-terminating ISIS in the region was relatively short-lived, with ice reaching its maximum near the continental shelf break at c. 25.6 ± 0.5 ka before rapidly retreating between 25.3 ± 0.2 ka and 24.7 ±0.2 ka (Scourse et al. 2021). This evidence suggests that there is low potential for the formation of exposed palaeolandscapes such as palaeochannels in the outer Celtic Sea where the southern extent of the UK OCC is located. Dropstones which are typically characteristic of glaciomarine sediments are also recorded in these deposits. Glaciomarine deposits are considered to have low geoarchaeological potential.

6.4 Head

6.4.1 To the north of the UK OCC in Barnstaple Bay, a single vibrocore (VC60) recorded very gravelly clays stratigraphically overlying bedrock. Based on the Stage 2 recording, this deposit was interpreted as 'Head'. Deposits grouped as Head can form through a wide range of depositional processes, including aeolian (windblown), colluvial/solifluction and

alluvial and are typically characterised as Pleistocene in date, although may include Holocene colluvial sediments. Given the angularity of gravel clasts recorded, this unit is likely to represent soliflucted material deposited in a periglacial environment.

6.4.2 Head deposits are mapped by BGS across the Taw valley and more significantly, have been found to stratigraphically underly a sequence of beach gravels, unfossiliferous and fossiliferous clays and peats/organic clays at Westward Ho!, where nationally significant Mesolithic archaeology has been recovered (Rogers 1946; Balaam et al. 1987). The offshore extent of equivalent deposits is hitherto unknown given that the sub-shallow stratigraphy of Barnstaple Bay remains relatively understudied. Despite this, it is possible to suggest that the sequence recorded in VC60, comprising a thin (0.10 m) deposit of Alluvium overlying Head, may correlate to the sequence onshore at Westward Ho! However, this remains unclear given the absence of geotechnical vibrocores from the nearshore zone and the thin nature of the Alluvium recovered in VC60.

6.4.3 Although Head deposits can bury stable horizons/landsurfaces preserving Palaeolithic artefacts, the sediments recovered in VC60 are highly reworked and are assigned a low priority status.

6.5 Shallow marine to coastal

6.5.1 In three vibrocores (VC53, VC59 and VC60), gravelly sands and sands with faint laminations are recorded in the nearshore zone of Barnstaple Bay.

6.5.2 Fragments of shell within this deposit suggest deposition in a marine setting, however a bedded structure is frequently observed and is indicative of low-energy periodic deposition. Comparatively coarser deposits of gravelly sands are also recorded and are indicative of higher energy conditions, and combined with the presence of shell, likely represent deposition within a coastal plain, or possibly littoral, environment. Given the changes in energy resulting in more laminated and comparatively coarser sand units, it is difficult to determine the depositional environment. However, based on the presence of shell, indicative of marine conditions and organic fragments which indicate a more marginal environment that would allow vegetation to establish, these deposits are interpreted as representing deposition in a shallow marine to coastal setting.

6.5.3 Palaeogeographic reconstructions of Late Glacial to Holocene sea level change in Barnstaple Bay have shown that during the during the Late Weichselian, this area was subaerially exposed but was rapidly inundated during the Early Holocene (Grant et al. 2019). These model projections indicate that VC53 was located on the palaeoshoreline between c. 12 ka and 11 ka, with a shallow marine environment forming at c. 10 ka. The timing of submergence in the area adjacent to the modern coastline is more unclear, however based on palaeogeographic reconstructions it is possible that both VC59 and VC60 were fully submerged by approximately 6 ka (Grant et al. 2019).

6.5.4 Coastlines are key landscape elements in the submerged prehistoric environment, as demonstrated at the Mesolithic site of Westward Ho! c. 2 km to the east of the UK OCC landfall. However, no such equivalent deposits of *in situ* organic material have been recovered from within these sediments, with the presence of organic fragments indicating a degree of reworking within this migratory and transient coastal to shallow marine landscape. This unit is therefore considered to have low potential for both palaeoenvironmental assessment and scientific dating.

6.6 Alluvium

6.6.1 Alluvium characterised as sandy clay was identified in two vibrocores (VC59 and VC60) located within Barnstaple Bay. Given the presence of shell fragments and fine sand laminations, these deposits were tentatively interpreted to represent deposition in an estuarine environment.

6.6.2 Based on interpreted SBP data from the Atlantic Array Offshore Wind Farm (Wessex Archaeology 2012), a series of palaeolandscape features were identified in the landfall extension in Barnstaple Bay, including acoustic blanking possibly indicating the preservation of organic deposits and/or peats, and simple cut and complex fill features tentatively interpreted as representing an offshore continuation of the palaeo-Taw. Other isolated cut and fill features were also identified (Wessex Archaeology 2012), however could not be definitively attributed to the palaeo-Taw. Considering the location of both vibrocores (VC59 and VC60), it is possible that the Alluvium is associated with the submerged palaeo-Taw, although this is unclear based on available geophysical and geotechnical datasets.

6.6.3 The identification of submerged features supports palaeogeographic reconstructions presented by Grant et al. (2019) which show that a subaerial landscape developed in Barnstaple Bay prior to final marine transgression at c. 5 ka. The attractiveness of this landscape to prehistoric communities is demonstrated at both Westward Ho! and in the nearshore area where Mesolithic findspots including flint scatters have been recovered (NRHE ID 33120 and 33121).

6.6.4 The Alluvium recorded in nearshore vibrocores supports previous geophysical assessments that Barnstaple Bay was once subaerially exposed forming a terrestrial landscape between the Late Glacial and Early Holocene period (Wessex Archaeology 2012). Despite this, the Alluvium is minerogenic with only reworked organics recorded, therefore, the potential to obtain secure dates and develop a robust chronology is considered low. In addition, whilst alluvial sediments deposited in an estuarine setting are likely to contain microfossils that may inform on changes in salinity, most palaeoenvironmental material preserved will be of uncertain source area (i.e. pollen and plant macrofossils).

6.7 Seabed sediments

6.7.1 The Quaternary lithostratigraphy for the Celtic Sea records a sequence of marine transgressional sediments overlying older, glaciogenic deposits (Lockhart et al. 2018). These deposits comprise shelly coarse-grained sands and gravels (Layer B) representing an erosional boundary deposited by transient marine conditions during the Late Glacial to Holocene (13.9 to 4 ka BP; Furze et al. 2014), overlain by sands with shell fragments associated with the present-day seabed (~13 ka BP; Scourse et al. 2002). This transgressive sequence is frequently observed in the vibrocores with a lag gravel deposit fining upwards to well sorted shelly sands. Although defined by BGS as distinct lithostratigraphic units, these deposits have been collectively interpreted as seabed sediments and are assigned a low geoarchaeological potential.

7 CONCLUSION AND RECOMMENDATIONS

7.1.1 A sequence of Quaternary deposits comprising glaciogenic sediments (Diamict and Glaciomarine deposits) of the Upper Little Sole Formation and transgressional seabed sediments was identified in the offshore extent of the Xlinks' UK OCC. Collectively, these deposits were considered to have low geoarchaeological and archaeological potential. To

the north of the UK OCC in Barnstaple Bay, a sequence of Quaternary deposits was identified, comprising Coastal to Shallow Marine sands and gravels, Head and fine-grained Alluvium.

7.1.2 Based on the Stage 1 review of geotechnical logs, three vibrocores (VC53, VC59, and VC60) were recommended for Stage 2 geoarchaeological recording. Although deposits interpreted as Coastal to Shallow Marine and Alluvium indicate that a former terrestrial landscape developed in Barnstaple Bay during the Late Glacial to Early Holocene, collectively these sediments are considered to have low chronological and palaeoenvironmental potential. As such, no further works (i.e. a Stage 3 palaeoenvironmental assessment) are recommended.

7.1.3 In VC28, a heterogeneous sequence of firm clay, sandy gravels and sands with thin laminations were recorded, with fragments of detrital peat and woody plant remains. This sequence is lithologically unique with the majority of vibrocores in the vicinity comprising seabed sediments. The depositional history of this sequence is unclear, but it may represent an ice-proximal sequence; geoarchaeological recording of this sequence is recommended at an appropriate stage of the project, if core samples from this sequence are available.

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WSP 2024 Xlinks Devon Preliminary Environmental Information Report. Volume X, Appendix 7.1: Stage 1 Geoarchaeological Review of Ground Investigation. Ref OXF11809

APPENDICES

Appendix 1 – Vibrocore location and elevation data

Name	Total depth	Easting	Northing	Elevation (m RSL)
UK-GT-VC-01	0.15	230533	5434698	-128.9
UK-GT-VC-01grab	0.15	230538	5434696	-128.9
UK-GT-VC-02grab	0.14	226966	5443649	-127
UK-GT-VC-03a	0.46	223252	5452953	-121.5
UK-GT-VC-04	1.75	219550	5462248	-122.9
UK-GT-VC-05	4.87	215854	5471528	-113.9
UK-GT-VC-06grab	0.14	212148	5480827	-121.3
UK-GT-VC-07a	5.66	208563	5490159	-120.7
UK-GT-VC-08	5	208502	5490674	-120.8
UK-GT-VC-10a	0.61	207537	5509509	-120.3
UK-GT-VC-11	0.48	209984	5519680	-115.6
UK-GT-VC-12	2.75	210532	5521956	-111.5
UK-GT-VC-13	0.47	210613	5522272	-112.3
UK-GT-VC-15	0.55	212329	5529418	-114.5
UK-GT-VC-16	0.5	214677	5539140	-111.4
UK-GT-VC-17	1.24	218157	5548056	-110.8
UK-GT-VC-18	0.98	222565	5557473	-106.7
UK-GT-VC-19	0.02	226386	5565642	-104
UK-GT-VC-19grab	0.14	226381	5565643	-104
UK-GT-VC-20a	1.15	231731	5575027	-102.5
UK-GT-VC-21	3.4	239883	5580835	-100.5
UK-GT-VC-22	3.88	245456	5584796	-99.9
UK-GT-VC-23	1.5	248024	5586638	-99.8
UK-GT-VC-24	2.15	250209	5588166	-99.7
UK-GT-VC-25	1.4	255775	5591080	-98.2
UK-GT-VC-26	0.84	255939	5591155	-98.4
UK-GT-VC-28	3.3	258331	5592213	-97.8
UK-GT-VC-29	1.43	269520	5597223	-93
UK-GT-VC-30	2.32	274972	5599666	-92.8
UK-GT-VC-31a	0.02	284324	5603846	-88.1
UK-GT-VC-32	0.3	293231	5607833	-85.2
UK-GT-VC-33	0.25	307103	5614028	-79.58
UK-GT-VC-34	0.64	313308	5616798	-77.72
UK-GT-VC-35	1.22	320273	5620693	-74.25
UK-GT-VC-37a	0.8	326559	5628343	-76
UK-GT-VC-39a	1.35	332744	5635863	-74.9
UK-GT-VC-41	0.76	339264	5643801	-75
UK-GT-VC-43	0.48	345612	5651526	-73.5
UK-GT-VC-44	0.95	354382	5655713	-68.9

Name	Total depth	Easting	Northing	Elevation (m RSL)
UK-GT-VC-45	0.6	363974	5658704	-65.51
UK-GT-VC-46	0.93	373362	5662114	-60.7
UK-GT-VC-51	0.5	393055	5664559	-52.3
UK-GT-VC-53	4.73	400535	5658885	-30.7
UK-GT-VC-59	3.25	409506	5654204	-13.5
UK-GT-VC-60	1.55	410359	5654023	-10.6

Appendix 2 – Stage 1 geotechnical review

VC id	Depth from (m)	Depth to (m)	Description	Interpretation	Priority/ Potential
UK-GT-VC-01	0.00	0.15	Light yellowish brown slightly gravelly SAND with occasional fine to coarse shell	Seabed sediments	Low
UK-GT-VC-01grab	0.00	0.15	Light olive brown slightly gravelly SAND with shell fragments	Seabed sediments	Low
UK-GT-VC-02grab	0.00	0.14	Light olive brown fine SAND with occasional shell fragments	Seabed sediments	Low
UK-GT-VC-03a	0.00	0.46	Olive grey slightly gravelly medium SAND with occasional shell fragments	Seabed sediments	Low
UK-GT-VC-04	0.00	0.55	Light yellowish brown slightly gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-04	0.55	1.48	Light yellowish brown medium SAND with rare fine gravel and occasional fine shell fragments	Seabed sediments	Low
UK-GT-VC-04	1.48	1.75	Very dark grey stiff very fine sandy SILT with rare organic lenses and calcareous	Glaciomarine	Low
UK-GT-VC-05	0.00	4.87	Pale yellowish brown gravelly medium to coarse SAND with occasional fine to coarse shells	Seabed sediments	Low
UK-GT-VC-06grab	0.00	0.14	Greyish brown slightly gravelly medium SAND with occasional fine shell material and slightly organic	Seabed sediments	Low
UK-GT-VC-07a	0.00	0.08	Dark greyish brown gravelly coarse SAND with shell fragments	Seabed sediments	Low
UK-GT-VC-07a	0.08	0.18	Dark grey firm very sandy CLAY with sub-horizontal laminae and rare fine medium gravel and shell fragments	Glaciomarine	Low
UK-GT-VC-07a	0.18	5.66	Structureless CHALK	Bedrock	Low
UK-GT-VC-08	0.00	2.58	Pale yellowish brown gravelly medium SAND with occasional coarse shell fragments	Seabed sediments	Low
UK-GT-VC-08	2.58	4.02	Grey slightly gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-08	4.02	5.00	Grey very gravelly medium SAND with occasional fine to coarse shell fragments. Gravel is limestone and chalk	Seabed sediments	Low
UK-GT-VC-10a	0.00	0.32	Grey slightly gravelly medium SAND with occasional fine to coarse SAND and chalk	Seabed sediments	Low
UK-GT-VC-10a	0.32	0.44	Grey very gravelly medium SAND with occasional fine to coarse shell fragments and chalk	Seabed sediments	Low
UK-GT-VC-10a	0.44	0.61	Structureless CHALK	Bedrock	Low
UK-GT-VC-11	0.00	0.42	Olive grey slightly gravelly fine becoming medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-11	0.42	0.48	Structureless CHALK	Bedrock	Low

VC id	Depth from (m)	Depth to (m)	Description	Interpretation	Priority/ Potential
UK-GT-VC-12	0.00	2.35	Light yellowish brown medium SAND with rare fine gravel and occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-12	2.35	2.56	Light yellowish brown very fine to coarse gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-12	2.56	2.75	Yellowish brown slightly sandy medium to coarse subrounded GRAVEL with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-13	0.00	0.47	Greyish brown slightly gravelly medium SAND with occasional fine shell fragments	Seabed sediments	Low
UK-GT-VC-15	0.00	0.20	Grey silty fine SAND with rare shell fragments	Seabed sediments	Low
UK-GT-VC-15	0.20	0.42	Pale olive very gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-15	0.42	0.55	Structureless CHALK	Bedrock	Low
UK-GT-VC-16	0.00	0.26	Light brownish grey slightly gravelly coarse SAND with occasional shell fragments	Seabed sediments	Low
UK-GT-VC-16	0.26	0.50	Light brownish grey very sandy medium to coarse subrounded GRAVEL with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-17	0.00	0.24	Light olive brown medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-17	0.24	0.74	Light grey very sandy medium subangular chalk GRAVEL with occasional fine to coarse shell fragments	Reworked bedrock	Low
UK-GT-VC-17	0.74	1.24	Structureless CHALK	Bedrock	Low
UK-GT-VC-18	0.00	0.26	Light brownish grey medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-18	0.26	0.76	Greyish brown very gravelly medium SAND with occasional fine shell fragments	Reworked bedrock	Low
UK-GT-VC-18	0.76	0.98	White slightly sandy subangular coarse chalk GRAVEL with occasional fine to coarse shell fragments	Reworked bedrock	Low
UK-GT-VC-19	0.00	0.02	Pale brown gravelly coarse SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-19grab	0.00	0.14	Dark grey slightly gravelly sandy firm CLAY with rare chunks of organic clay and occasional fine to coarse shell fragments	Diamict	Low
UK-GT-VC-20a	0.00	0.38	Greyish brown gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-20a	0.38	0.90	Light olive brown slightly sandy fine to coarse subrounded GRAVEL with rare clay chunks	Seabed sediments	Low
UK-GT-VC-20a	0.90	1.15	Dark greyish brown slightly sandy CLAY with rare fine to medium gravel	Diamict	Low
UK-GT-VC-21	0.00	0.40	Light olive brown slightly gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low

VC id	Depth from (m)	Depth to (m)	Description	Interpretation	Priority/ Potential
UK-GT-VC-21	0.40	0.63	Light yellowish brown very gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-21	0.63	3.40	Structureless CHALK	Bedrock	Low
UK-GT-VC-22	0.00	3.88	Structureless CHALK	Bedrock	Low
UK-GT-VC-23	0.00	0.47	Light olive brown medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-23	0.47	0.94	Light olive brown very gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-23	0.94	1.50	Structureless CHALK	Bedrock	Low
UK-GT-VC-24	0.00	1.05	Light olive brown very gravelly medium SAND with occasional fine shell fragments	Seabed sediments	Low
UK-GT-VC-24	1.05	2.15	Very stiff sandy CLAY with rare fine to coarse gravel and shell fragments and occasional convex laminae	Glaciomarine	Low
UK-GT-VC-25	0.00	0.50	Light yellowish brown medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-25	0.50	0.87	Dark grey very gravelly medium to coarse SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-25	0.87	1.40	Dark grey fine SAND with rare chunks and lenses of clay and fine shell fragments	Glaciomarine	Low
UK-GT-VC-26	0.00	0.57	Light yellowish brown medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-26	0.57	0.84	Greyish brown very gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-28	0.00	0.12	Greyish brown medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-28	0.12	0.50	Greyish brown gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-28	0.50	0.76	Dark greenish grey medium SAND with rare fine to medium glauconite gravel and occasional fine to coarse shell fragments	Glaciomarine	Low
UK-GT-VC-28	0.76	0.92	Dark greenish grey slightly sandy firm CLAY with rare lenses of sand and occasional glauconite and fine shell fragments	Glaciomarine	Low
UK-GT-VC-28	0.92	1.57	Greenish grey medium SAND with rare clay lenses and occasional woody plant remains and fine to coarse shell fragments	Glaciomarine	Low
UK-GT-VC-28	1.57	1.84	Greenish grey slightly gravelly medium SAND with occasional glauconite and occasional woody plant remains and fine to coarse shell fragments	Glaciomarine	Low
UK-GT-VC-28	1.84	2.00	Greenish grey gravelly fine SAND with rare chunks of clay and occasional fine to coarse shell fragments	Glaciomarine	Low
UK-GT-VC-28	2.00	2.22	Dark greenish grey very sandy subrounded medium GRAVEL with rare chunks of clay and peat and occasional glauconite and	Glaciomarine	Low

VC id	Depth from (m)	Depth to (m)	Description	Interpretation	Priority/ Potential
			occasional woody plant remains and fine to coarse shell fragments		
UK-GT-VC-28	2.22	2.84	Dark greenish grey firm CLAY with rare sand lenses and occasional glauconite and rare gravel and occasional fine to coarse shell fragments	Glaciomarine	Low
UK-GT-VC-28	2.84	3.18	Dark greenish grey medium SAND with rare chunks of clay and occasional fine to coarse shell fragments	Glaciomarine	Low
UK-GT-VC-28	3.18	3.30	Dark greenish grey very sandy soft CLAY with rare fine gravel and occasional fine to coarse shell fragments	Glaciomarine	Low
UK-GT-VC-29	0.00	0.25	Light olive brown medium SAND with occasional fine shell fragments	Seabed sediments	Low
UK-GT-VC-29	0.25	1.25	Light yellowish brown very gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-29	1.25	1.43	Dark greyish brown very sandy subrounded GRAVEL	Seabed sediments	Low
UK-GT-VC-30	0.00	1.00	Light olive brown medium SAND with rare medium to coarse gravel and frequent shell fragments	Seabed sediments	Low
UK-GT-VC-30	1.00	1.20	Greyish brown very gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-30	1.20	2.32	Very dark grey stiff to very stiff slightly sandy CLAY with rare fine chalk gravel and rare lenses of organic clay	Glaciomarine	Low
UK-GT-VC-31a	0.00	0.02	Very dark grey GRAVEL with shell fragments	Seabed sediments	Low
UK-GT-VC-32	0.00	0.30	Light brownish grey sandy coarse subrounded GRAVEL with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-33	0.00	0.25	Light greyish brown sandy coarse subrounded GRAVEL with frequent fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-34	0.00	0.14	Greyish brown gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-34	0.14	0.38	Dark greyish brown sandy medium subrounded GRAVEL with rare chunks of clay and occasional fine shell fragments	Seabed sediments	Low
UK-GT-VC-34	0.38	0.64	White to light grey very stiff CLAY with claystone cobbles	Bedrock	Low
UK-GT-VC-35	0.00	1.22	Light greyish brown medium SAND with frequent fine and occasional shell fragments	Seabed sediments	Low
UK-GT-VC-37a	0.00	0.40	Dark greyish brown very gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-37a	0.40	0.80	Dark brownish grey firm CLAY with rare fine to medium gravel and thin layers of sand	Glaciomarine	Low

VC id	Depth from (m)	Depth to (m)	Description	Interpretation	Priority/ Potential
UK-GT-VC-39a	0.00	1.00	Light yellowish brown medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-39a	1.00	1.19	Light yellowish brown gravelly medium SAND with frequent fine shell and occasional coarse shell fragments	Seabed sediments	Low
UK-GT-VC-39a	1.19	1.35	Very dark grey slightly sandy firm CLAY with rare lenses of sand	Glaciomarine	Low
UK-GT-VC-41	0.00	0.21	Light olive brown fine SAND with occasional shell fragments	Seabed sediments	Low
UK-GT-VC-41	0.21	0.76	Greyish brown very gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-43	0.00	0.09	Light olive brown fine SAND with occasional fine shell fragments	Seabed sediments	Low
UK-GT-VC-43	0.09	0.33	Light olive brown very gravelly medium SAND with occasional chunks of white silt and shell fragments	Seabed sediments	Low
UK-GT-VC-43	0.33	0.48	White very sandy SILT with rare fine gravel	Bedrock	Low
UK-GT-VC-44	0.00	0.21	Light yellowish brown medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-44	0.21	0.95	Light olive brown sandy fine becoming coarse GRAVEL with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-45	0.00	0.30	Brown very gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-45	0.30	0.60	Dark reddish brown gravelly SAND with rare cobbles and occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-46	0.00	0.78	Yellowish brown very gravelly medium SAND with occasional fine to coarse shell fragments	Seabed sediments	Low
UK-GT-VC-46	0.78	0.93	Very dark grey shale GRAVEL	Bedrock	Low
UK-GT-VC-51	0.00	0.50	Very dark grey shale GRAVEL	Bedrock	Low
UK-GT-VC-53	0.00	1.75	Dark greyish brown medium SAND with rare sand lenses and fine to coarse shell fragments	Coastal to shallow marine	Medium
UK-GT-VC-53	1.75	2.00	Greyish brown sandy fine subrounded GRAVEL with occasional coarse shell fragments	Coastal to shallow marine	Medium
UK-GT-VC-53	2.00	2.22	Greyish brown slightly gravelly medium SAND with rare lenses of clay and fine to coarse shell fragments	Coastal to shallow marine	Medium
UK-GT-VC-53	2.22	3.36	Greyish brown fine SAND with rare clay lenses and occasional silt beds and occasional fine to coarse shell fragments	Coastal to shallow marine	Medium
UK-GT-VC-53	3.36	3.70	Dark greyish brown fine gravelly coarse SAND with fine to coarse shell fragments	Coastal to shallow marine	Medium
UK-GT-VC-53	3.70	3.78	Greyish brown fine to medium SAND with occasional fine to coarse shell fragments	Coastal to shallow marine	Medium

VC id	Depth from (m)	Depth to (m)	Description	Interpretation	Priority/ Potential
UK-GT-VC-53	3.78	4.00	Greyish brown very fine gravelly medium SAND with rare chunks and lenses of clay and occasional fine to coarse shell fragments	Coastal to shallow marine	Medium
UK-GT-VC-53	4.00	4.33	Light brownish grey medium SAND with occasional fine to coarse shell fragments	Coastal to shallow marine	Medium
UK-GT-VC-53	4.33	4.73	Greyish brown very gravelly medium SAND with occasional fine to coarse shell fragments	Coastal to shallow marine	Medium
UK-GT-VC-59	0.00	1.77	Dark grey fine SAND with clay laminae and occasional fine shell fragments	Coastal to shallow marine	Medium
UK-GT-VC-59	1.77	3.05	Very dark grey firm CLAY with frequent laminae of sand and rare chunks of organic clay and occasional fine shell fragments	Estuarine alluvium	Medium
UK-GT-VC-59	3.05	3.25	Dark brown very silty medium shale GRAVEL	Bedrock	Low
UK-GT-VC-60	0.00	0.44	Dark grey silty very fine SAND with occasional fine to coarse shell fragments	Coastal to shallow marine	Medium
UK-GT-VC-60	0.44	0.54	Dark grey firm CLAY with black chunks of organic clay and rare fine gravel	Estuarine alluvium	Medium
UK-GT-VC-60	0.54	0.68	Dark grey very sandy firm CLAY with medium gravel	Head	Low
UK-GT-VC-60	0.68	1.00	Dark grey dense slightly sandy clayey fine GRAVEL	Head	Low
UK-GT-VC-60	1.00	1.10	Dark grey very gravelly sandy firm CLAY	Head	Low
UK-GT-VC-60	1.10	1.25	Dark grey very sandy gravelly soft CLAY	Head	Low
UK-GT-VC-60	1.25	1.55	Slightly sandy angular shale GRAVEL	Bedrock	Low

Appendix 3 – Stage 2 geoarchaeological recording

VC id	Depth from (m)	Depth to (m)	Description	Interpretation	Context
VC53	0.00	0.16	Void	N/A	5301
VC53	0.16	0.95	Mid orangish brown fine to medium SAND. Dense and structureless	Seabed sediments	5302
VC53	0.95	1.09	Void	N/A	5303
VC53	1.09	1.50	Dark greyish slightly orangish brown medium SAND with fine (<2mm) rare shell fragments. Diffuse lower contact	Seabed sediments	5304
VC53	1.50	1.72	Dark orangish slightly greyish brown medium to coarse SAND with very rare shell inclusions	Seabed sediments	5305
VC53	1.72	1.90	Dark slightly orangish brown medium to coarse SAND and fine to medium subrounded (90%) to subangular (10%) flint and quartz GRAVEL with mollusc tusk shell fragments and marine bivalves	Seabed sediments	5306
VC53	1.90	2.06	Void	N/A	5307
VC53	2.06	2.21	Greyish brown fine to coarse SAND and fine flint subrounded (70%) to subangular (30%) flint and quartz GRAVEL with occasional shell fragments. Sharp lower boundary	Coastal to shallow marine	5308
VC53	2.21	3.35	Dense light grey medium to coarse silty SAND with faint bedding and rare laminae of clayey sand from 2.33-2.37 m. Sharp lower boundary	Coastal to shallow marine	5309
VC53	3.35	3.70	Greyish brown fine to coarse SAND and fine flint subrounded (70%) to subangular (30%) flint and quartz GRAVEL with occasional shell fragments. Sharp lower boundary	Coastal to shallow marine	5310
VC53	3.70	3.79	Dense light greyish brown fine to medium SAND with band of clay at lower boundary. Sharp lower boundary	Coastal to shallow marine	5311
VC53	3.79	3.99	Light greyish brown medium to coarse SAND and fine subrounded flint and quartz GRAVEL with rare fine shell fragments	Coastal to shallow marine	5312
VC53	3.99	4.05	Void	N/A	5313
VC53	4.05	4.35	Light grey medium to coarse SAND. Sharp lower boundary	Coastal to shallow marine	5314
VC53	4.35	4.70	Greyish brown medium to coarse SAND and fine to coarse subrounded with few subangular flint and quartz GRAVEL with few fine shell fragments	Coastal to shallow marine	5315
VC59	0.00	0.15	Void	N/A	5901
VC59	0.15	1.00	Firm dark grey fine to medium SAND with frequent fine (<1mm) shell fragments becoming rare with depth. Common mottles of very dark grey sand	Coastal to shallow marine	5902
VC59	1.00	1.07	Void	N/A	5903
VC59	1.07	1.88	Firm dark grey fine to medium SAND with frequent fine (<1mm) shell fragments becoming rare with depth. Common mottles of very dark grey sand becoming frequent from 1.07 mbsf. Very sharp lower contact.	Coastal to shallow marine	5904

VC id	Depth from (m)	Depth to (m)	Description	Interpretation	Context
VC59	1.88	2.70	Firm dark grey brown slightly sandy CLAY with frequent fine (<2mm) laminations of fine to medium sand and rare fine (<1mm) shell fragments. Frequent fine to medium pockets (<5mm) of black fragments of organic matter becoming rare from 2.70 mbsf. Laminations becoming rare from 2.50 mbsf.	Alluvium	5905
VC60	0.00	0.06	Void	N/A	6001
VC60	0.06	0.44	Dark grey brown slightly clayey fine to medium grained SAND with rare shell fragments (<5mm) in size. Clear lower contact.	Alluvium	6002
VC60	0.44	0.54	Dark brown firm silty slightly sandy CLAY with frequent black specks. Irregular lower boundary	Head	6003
VC60	0.54	1.15	Dark grey brown coarse grained sandy very gravelly CLAY. Gravel is fine to coarse (10-30mm) subangular to angular sandstone and flint GRAVEL. Frequent mottles of orange sand and red sand.	Head	6004
VC60	1.15	1.25	Dark greyish brown slightly clayey fine to coarse slate and sandstone subangular to angular GRAVEL with rare mottles of red sand	Head	6005

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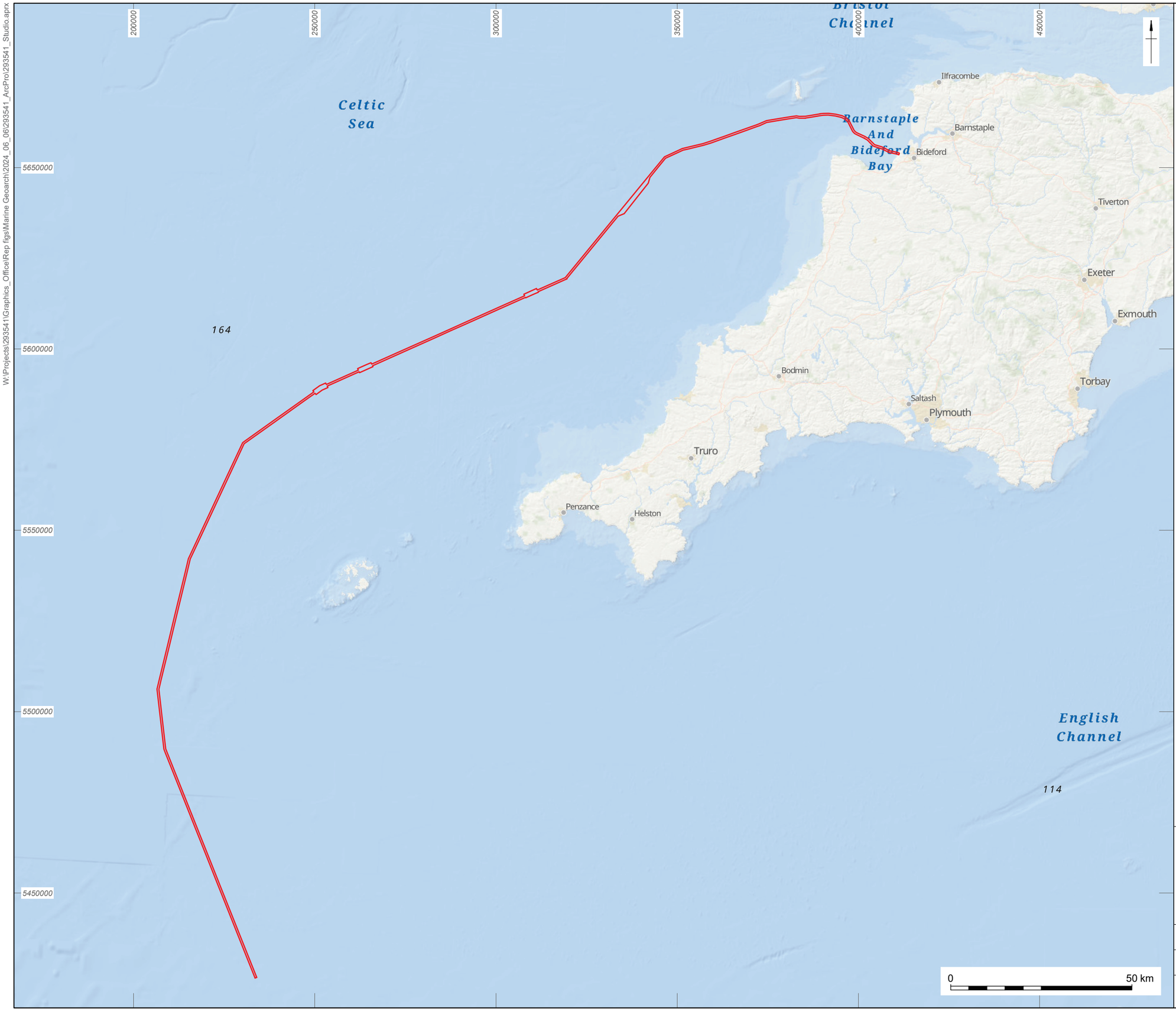

Site boundary

Coordinate system: WGS 1984 WGS 1984 UTM Zone 30N
Esri UK, Esri, TomTom, Garmin, Foursquare, FAO, METI/NASA, USGS, OceanWise, Esri, GEBCO, Garmin, NaturalVue

Date: 10/06/2024	Created by: ND
Scale: 1:1,000,000 at A3	Revision: 0

Figure 1: Location of Xlinks' Proposed Development

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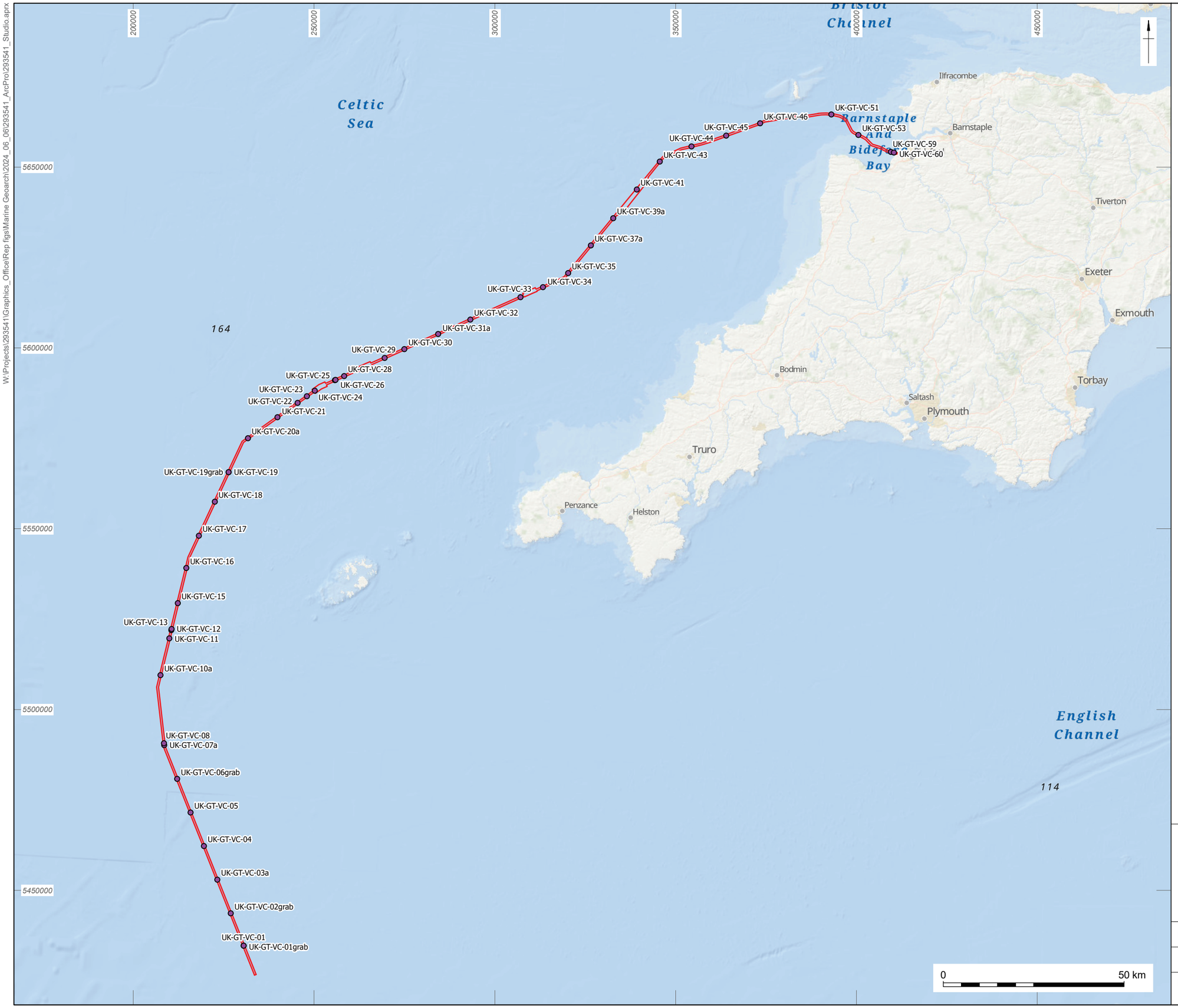

Site boundary
Vibrocore locations

Date: 10/06/2024	Created by: ND	
Scale: 1:1,000,000 at A3	Revision: 0	

Figure 2: Location of vibrocores

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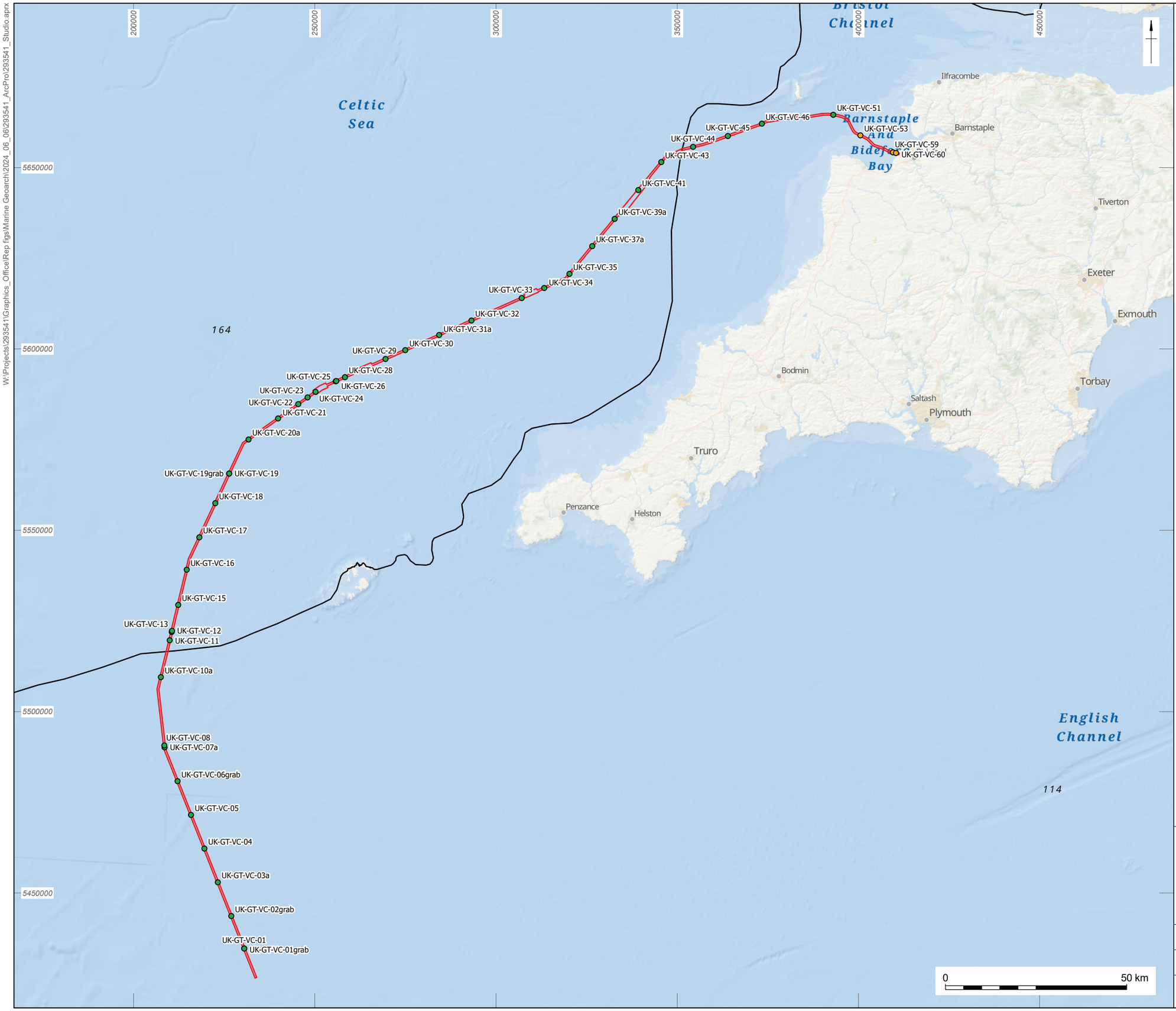

Site boundary

Maximum ice extent (c. 26 ka; Clarke et al. 2022)

Vibracore locations

- Low priority
- Medium priority

Date: 10/06/2024	Created by: ND
Scale: 1:1,000,000 at A3	Revision: 0

Figure 3: Geoarchaeological priority status and maximum extent of the British Irish Ice Sheet in the Celtic Sea at 26 ka (after Clark et al. 2022).

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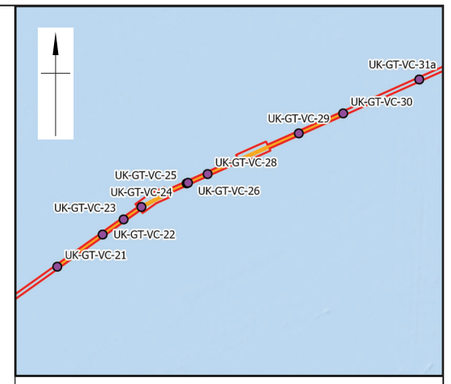
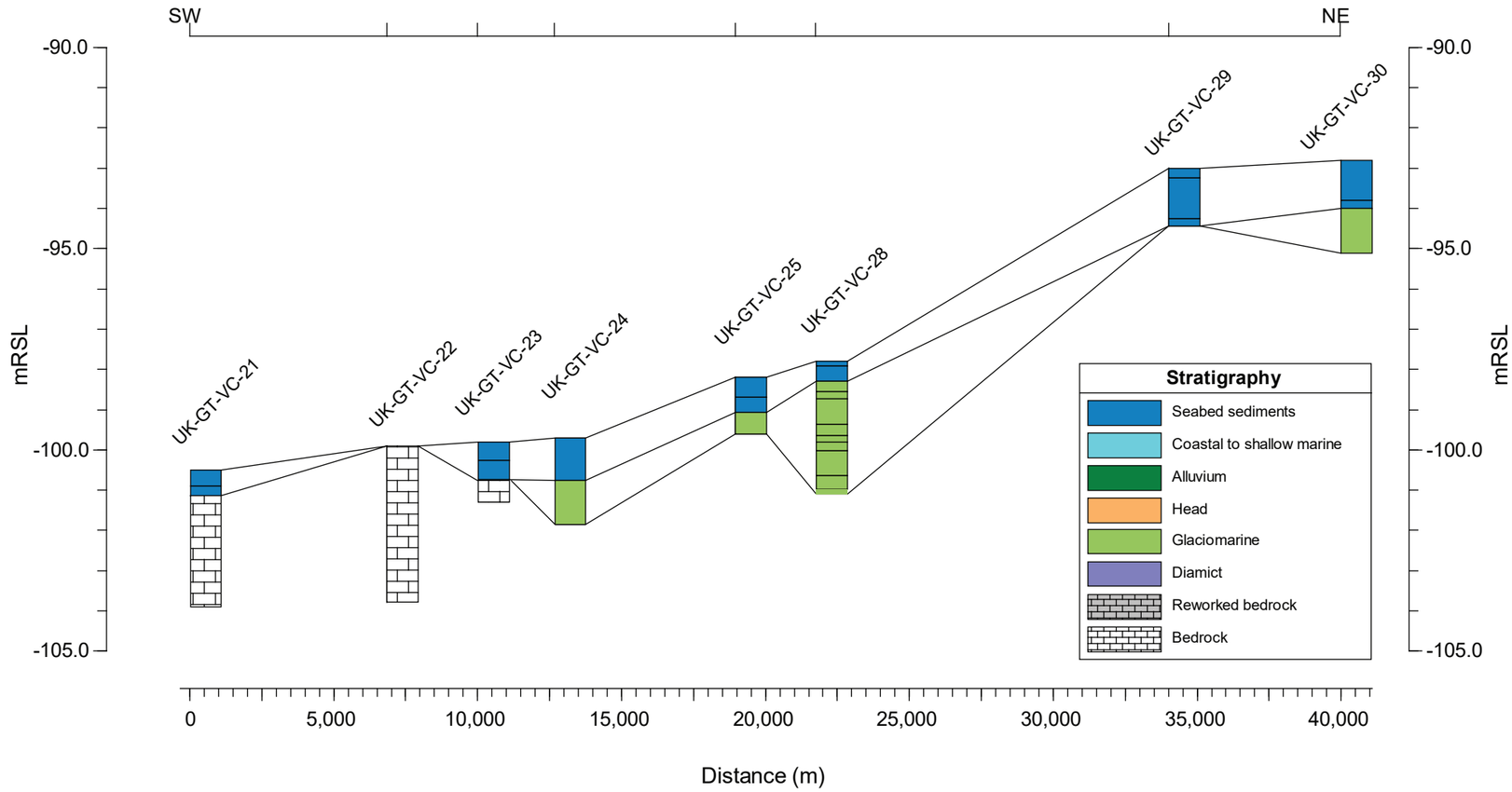


Site boundary
Vibracore location
Transect



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Scale: N/A	Revision: 0

Figure 4: Transect 1

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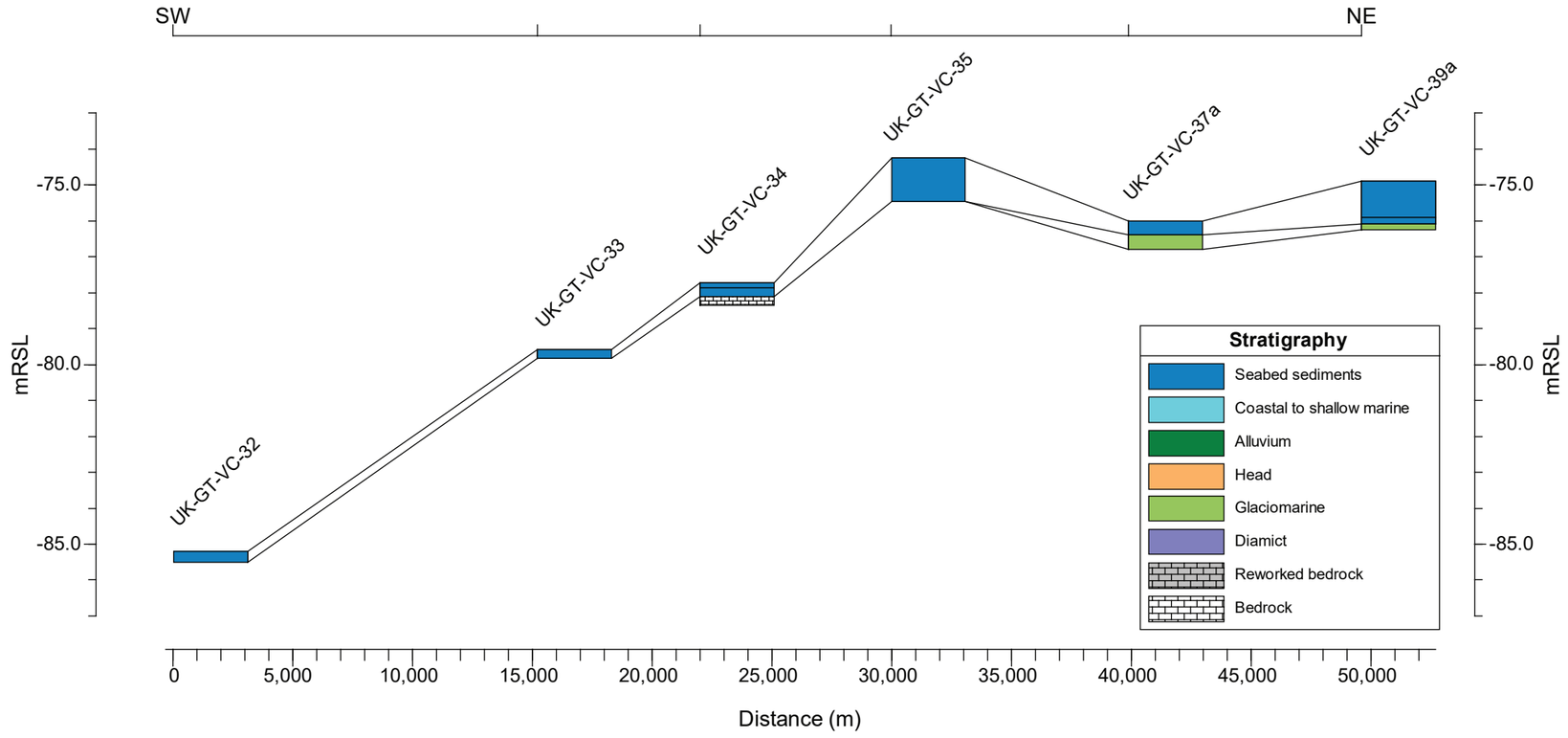

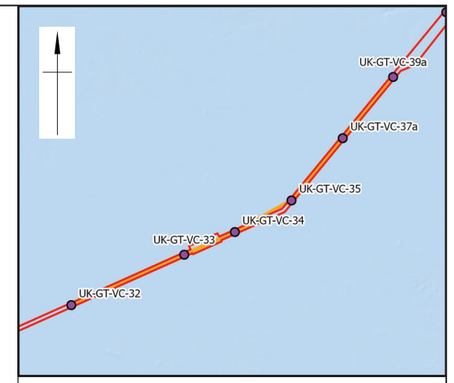

Site boundary
Vibracore location
Transect

Created by: ND/KJF | Date: 24/06/2024

Scale: N/A | Revision: 0

Figure 5: Transect 2

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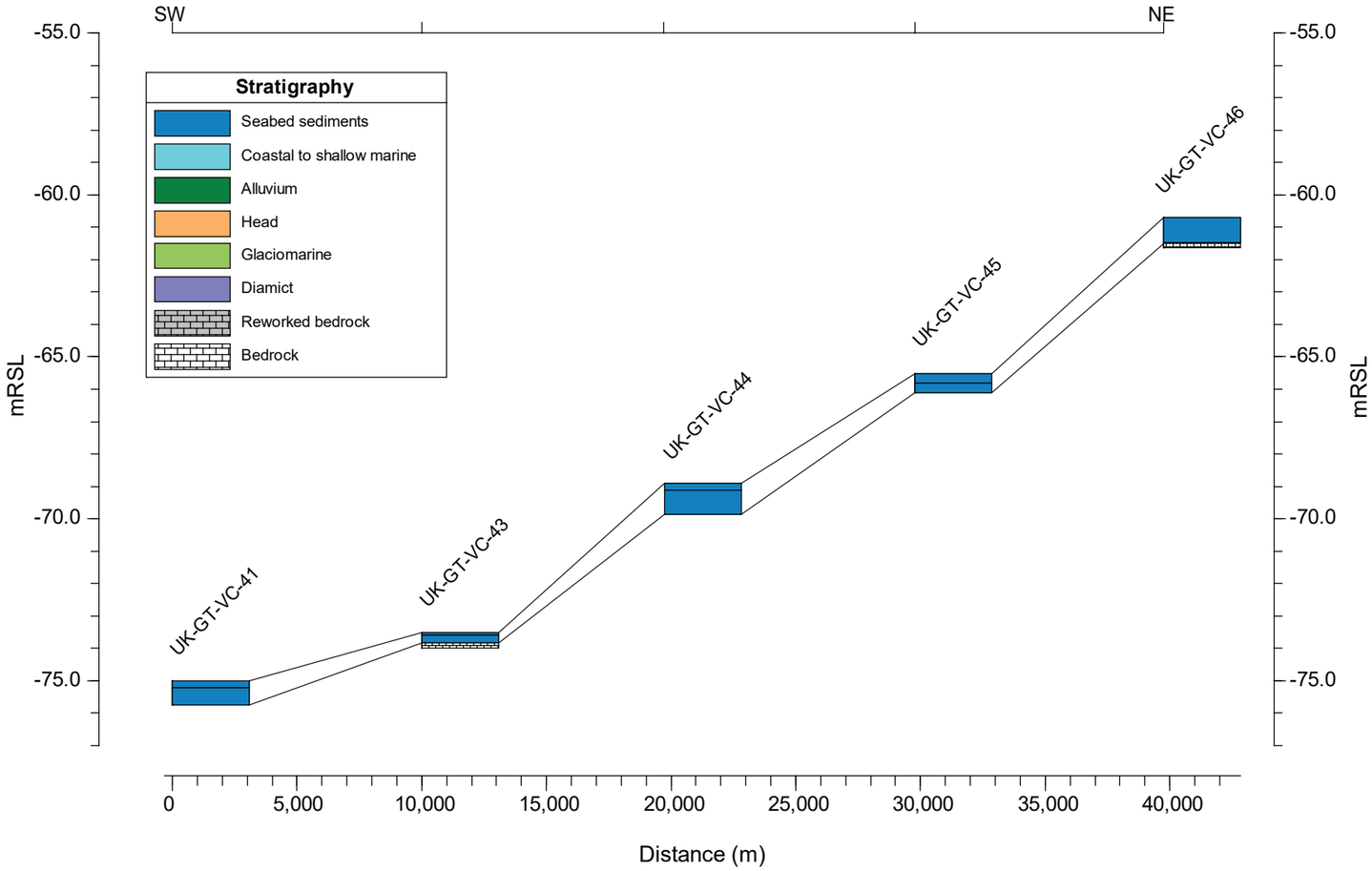

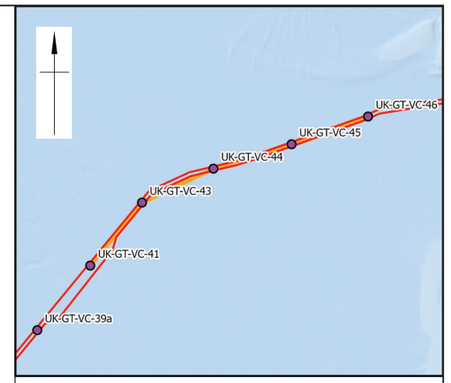

Site boundary
Vibracore location
Transect

Created by: ND/KJF	Date: 24/06/2024	
Scale: N/A	Revision: 0	

Figure 6: Transect 3

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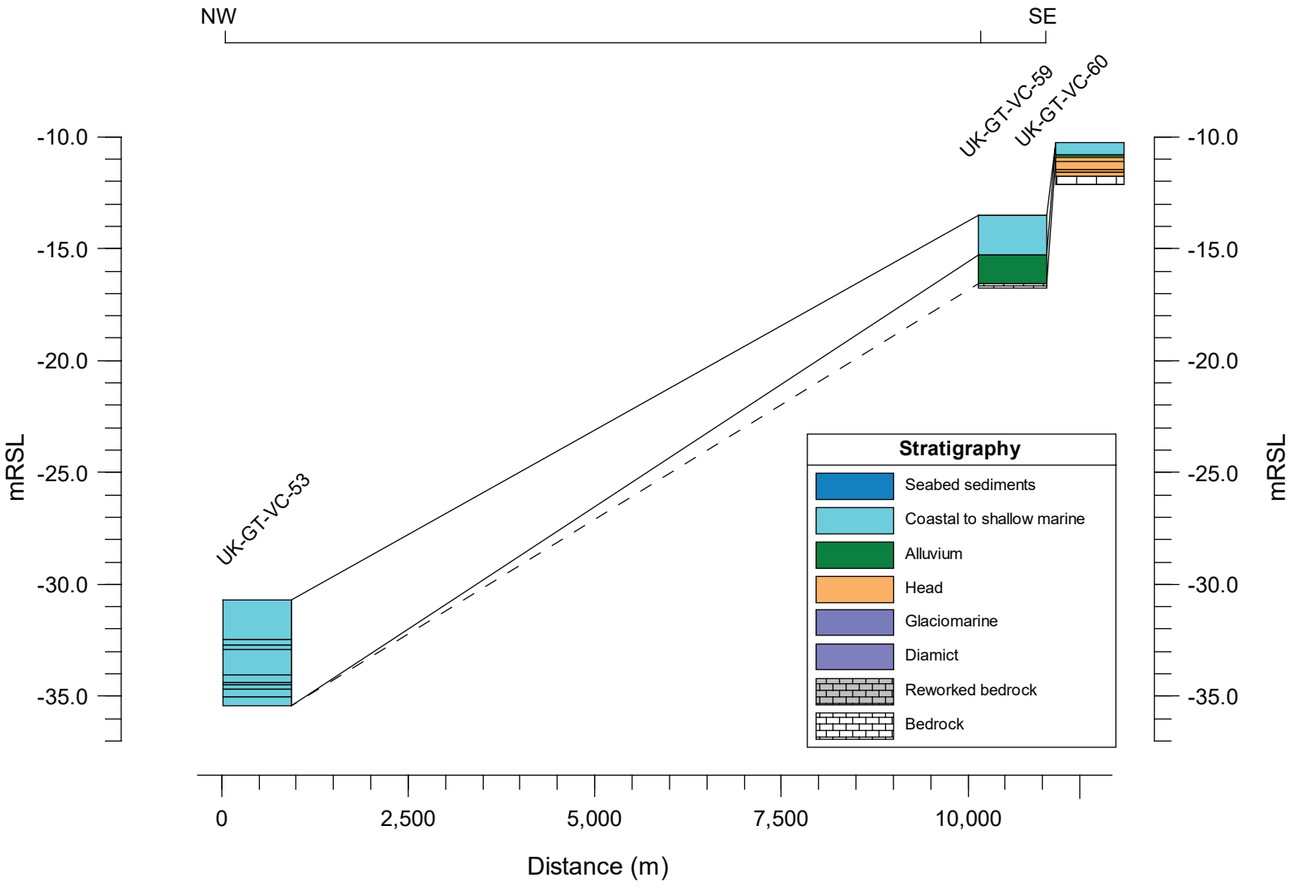

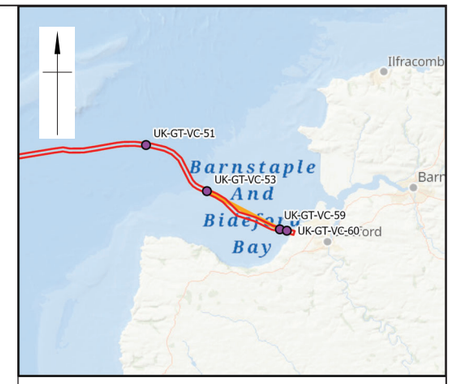

Site boundary
Vibracore location
Transect

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Scale: N/A | Revision: 0

Figure 7: Transect 4

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