XLINKS' MOROCCO-UK POWER PROJECT

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Palaeolandscapes assessment of sub-bottom profiler data

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Summary

Wessex Archaeology was commissioned by WSP UK Limited to work on the United Kingdom elements of the Xlinks Morocco-UK Power Project development. The report consists of a palaeolandscape assessment of primarily sub-bottom profiler data, with multibeam echosounder data used for additional information where relevant. This report is in addition to the previously issued marine geoarchaeological assessment report and seabed features report and completes this stage of archaeological assessment of the proposed Xlinks route.

The assessment of the sub-bottom profiler data within the study area has indicated that the majority of the proposed route from United Kingdom landfall to the United Kingdom/France median line is characterised by pre-Quaternary bedrock overlain by modern seabed sediments. This is considered of low archaeological potential. However, features of archaeological potential were identified closer to the United Kingdom landfall.

A total of 19 features of palaeogeographic interest were identified within the study area. These are summarised as follows:

- a total of two channels were assigned a P1 archaeological rating;
- a total of three fine grained deposits were also assigned a P1 archaeological rating;
- a total of 13 simple cuts and fills were assigned a P2 archaeological rating;
- a single erosion surface was also assigned a P2 archaeological rating.

The deposits and features identified within Bideford Bay record the postglacial development of the environment within the bay from a low-lying area containing fluvial systems and flood plains, to a coastal environment with tidal/sand bar deposits, to a modern marine environment. The alluvial/fluvial sediments of Unit 5, potentially similar in date to the submerged forest at Westward Ho!, are of the highest archaeological potential.

No immediate mitigation action is recommended at this time. However, it is recommended that, should any further geotechnical sampling be carried out within any of the identified features, the logs be made available for Stage 1 geoarchaeological assessment by a suitable qualified archaeological contractor. This will help determine whether the identified features are of archaeological potential.

It is also recommended that, should any objects or deposits of possible archaeological interest be recovered during any groundwork operations, that they should be reported to a suitably qualified archaeological contractor using a pre-agreed reporting protocol. This will help to establish whether the recovered material is of archaeological interest and recommend appropriate mitigation measures.

Acknowledgements

This assessment was commissioned by WSP UK Limited, and their assistance throughout the project is acknowledged.

The survey data were acquired by GEOxyz and provided to Wessex Archaeology by WSP UK Limited and their assistance is acknowledged in this regard.

Xlinks Morocco-UK Power Project

Palaeolandscapes assessment of sub-bottom profiler data

1 INTRODUCTION

1.1 Project background

1.1.1 This report presents a palaeolandscapes assessment for the UK offshore elements of Xlinks' Morocco-UK Power Project (the 'Project'). For ease of reference, the UK elements of the Project are 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 peak (GWp) of renewable energy capacity that would cover an approximate area of 1,500 km2 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 UK waters that are the subject of this assessment will be undertaken within the Offshore Cable Corridor. The extent of the Offshore Cable Corridor 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. (Fig. 1).

1.1.4 The report consists of a palaeolandscape assessment of primarily sub-bottom profiler (SBP) data, with multibeam echosounder (MBES) data used for additional information where relevant. This report is in addition to the previously issued marine geoarchaeological assessment report (Wessex Archaeology 2024a) and seabed features report (Wessex Archaeology 2024b) and completes this stage of archaeological assessment of the Xlinks Proposed Development route.

1.1.5 The study area is defined by the client supplied shapefile (5260H-837-BB-01 Offshore Block Boundaries_Rev08) consisting of a varying corridor around the proposed route (Fig. 1).

1.2 Aims and objectives

1.2.1 The aims and objectives of this assessment are:

- identify any buried palaeolandscape features of possible archaeological potential;
- to cross-correlate the SBP interpretation results with the results of the marine geoarchaeological assessment (Wessex Archaeology 2024a);
- comment on the potential effects of development on identified deposits of interest; and

- provide recommendations for archaeological mitigation.

1.3 Co-ordinate system

1.3.1 The survey data were acquired in WGS84 UTM29N (survey blocks U1–U22) and WGS84 UTM30N (survey blocks U23–U39) and the results are presented in the same coordinate systems.

2 METHODOLOGY

2.1 Data sources

2.1.1 A number of data sources were consulted during this assessment, including:

- geophysical survey datasets acquired by GEOxyz;
- relevant background mapping from the area (admiralty charts received from MarineFIND, British Geological Survey (BGS) mapping (BGS 2024));
- client supplied survey reports (GEOxyz 2023a; b);
- previously issued Wessex Archaeology marine geoarchaeological assessment report for the Xlinks scheme (Wessex Archaeology 2024a);
- Previous relevant background work from the wider area (e.g. Wessex Archaeology 2012)

2.2 Geophysical data – technical specifications

2.2.1 The geophysical data were acquired by GEOxyz onboard survey vessels *Geo Surveyer XI* for the nearshore survey area between 27 August and 5 September 2022, and *Geo Ocean IV* for the offshore survey areas between 23 August and 08 September 2023. The route survey area was divided into approximately 10 km long blocks with block U01 located at the UK territorial waters border with France and U39 (nearshore) at the UK landfall (GEOxyz 2023a, b).

2.2.2 The nearshore survey line spacing was approximately 20 m with four crosslines run at maximum 625 m. The offshore survey line plans were developed to ensure the full Offshore Cable Corridor width was mapped, and line spacing varied between 50 m and 175 m. Crosslines were run in accordance with the Xlinks Proposed Development scope of works and acquired extending 500 m beyond the route corridor.

2.2.3 Further details on the equipment used is in Table 1.

Table 1 Summary of survey equipment

Survey Company	Survey Vessel	Data Type	Equipment	Data Format
GEOxyz	*Geo Surveyor XI*	SBP	Innomar SES 2000 Medium Parametric sonar	*.sgy*
		MBES	Kongsberg EM2040 (350 kHz)	*.xyz*
		Positioning	Trimble BD960 and Trimble BD982	
	Geo Ocean IV	SBP	Innomar SES 2000 Medium Parametric sonar	*.sgy*
		MBES	Kongsberg EM2040 (400 kHz) < 250 m water depth Reson 7160 (44 kHz) >250 m water depth	*.xyz*
		Positioning	Fugro SeaStar 9205	N/A

2.3 Geophysical data – processing

2.3.1 A number of datasets were assessed over the study area, each dataset was processed separately using the following software (Table 2):

Table 2 Software used for geophysical assessment

Dataset	Processing Software	Interpretation and rationalisation
SBP	CodaOctopus Survey Engine v8.6	ArcMap v10.8
MBES	QPS Fledermaus v8.5	

2.3.2 The SBP and MBES data were used as the primary datasets for the palaeographic assessment. The SBP data were processed using CodaOctopus Survey Engine Seismic+ software. This software allows the data to be visualised with user selected filters and gain settings in order to optimise the appearance of the data for interpretation. The software then allows an interpretation to be applied to the data by identifying and selecting sedimentary boundaries and shallow geological features that might be of archaeological interest.

2.3.3 The SBP data were interpreted with a two-way travel time (TWTT) along the z-axis. In order to convert from TWTT to depth, the velocity of the seismic waves was estimated to be 1,600 ms^{-1}. This is a standard estimate for shallow, unconsolidated sediments.

2.3.4 The SBP data can also be used to identify small reflectors, which may indicate buried material such as a wreck site covered by sediment. The position and dimensions of any such objects are noted in a gazetteer, and an image acquired of each anomaly for future reference. It should be noted that anomalies of this type are rare, as the sensors must pass directly over such an object in order to detect an anomaly.

2.3.5 For the SBP assessment, the centre line of the Offshore Cable Corridor was initially assessed. Where features of interest were identified, additional lines were then interpreted in order to more accurately map the extents of these features.

The MBES data were used as a seabed baseline for the palaeogeographic assessment, and to identify and under-filled palaeolandscape features still visible on the seabed where necessary. The data were gridded at 1 m and analysed using QPS Fledermaus software, which enables a 3-D visualisation of the acquired data and geo-picking of seabed anomalies.

2.4 Geophysical data – data quality

2.4.1 Once processed, the geophysical data sets were individually assessed for quality and their suitability for archaeological purposes, and rated using the following criteria (Table 3).

Table 3 Criteria for assigning data quality rating

Data quality	Description
Good	Data which are clear and unaffected or only slightly affected by weather conditions, sea state, background noise or data artefacts. Seabed datasets are suitable for the interpretation of upstanding and partially buried wrecks, debris fields, and small individual anomalies. The structure of wrecks is clear, allowing assessments on wreck condition to be made. Subtle reflectors are clear within SBP data. These data provide the highest probability that anomalies of archaeological potential will be identified.

Data quality	Description
Average	Data which are moderately affected by weather conditions, sea state and noise. Seabed datasets are suitable for the identification of upstanding and partially buried wrecks, the larger elements of debris fields and dispersed sites, and larger individual anomalies. Dispersed and/or partially buried wrecks may be difficult to identify. Interpretation of continuous reflectors in SBP data is problematic. These data are not considered to be detrimentally affected to a significant degree.
Below Average	Data which are affected by weather conditions, sea state and noise to a significant degree. Seabed datasets are suitable for the identification of relatively intact, upstanding wrecks and large individual anomalies. Dispersed and/or partially buried wrecks, or small isolated anomalies may not be clearly resolved. Small palaeogeographic features, or internal structure may not be resolved in SBP data.
Variable	This category contains datasets where the individual lines range in quality. Confidence of interpretation is subsequently likely to vary within the study area.

2.4.2 The quality of the SBP data has been rated as 'Good' using the above criteria, with shallow reflectors easily visible. Penetration was relatively limited, as is standard for parametric sonar data, but the very shallow depth of bedrock in the area meant this was a not a detriment to palaeolandscape assessment of the data.

2.4.3 The MBES data were rated as 'Good' for the purposes of palaeolandscapes assessment using the above criteria. The data quality and resolution may have caused some difficulty in the identification of small seabed objects, but this did not affect the ability to identify wider landscape-scale features.

2.5 Geophysical data – anomaly grouping and discrimination

2.5.1 The previous section describes the initial interpretation of all available geophysical datasets which were conducted independently of one another. This inevitably leads to the possibility of any one feature being the cause of numerous anomalies and apparently overstating the number of palaeolandscape features in the exploration area.

2.5.2 To address this fact the anomalies were grouped together; allowing one ID number to be assigned to a single object for which there may be multiple examples across many survey lines.

2.5.3 Once all the geophysical anomalies and desk-based information have been grouped, a discrimination flag is added to the record in order to discriminate against those which are not thought to be of an archaeological concern. For anomalies located on the seabed, these flags are ascribed as follows (Table 4).

Table 4 Criteria discriminating relevance of identified features to proposed scheme

Overview classification	Discrimination	Criteria	Data type
Archaeological	P1	Feature of probable archaeological interest, either because of its palaeogeography or likelihood for producing palaeoenvironmental material	SBP, MBES
Archaeological	P2	Feature of possible archaeological interest	SBP, MBES

2.5.4 The grouping and discrimination of information at this stage is based on all available information and is not definitive. It allows for all features of potential archaeological interest to be highlighted, while retaining all the information produced during the course of the geophysical interpretation and desk-based assessment for further evaluation should more information become available.

2.5.5 Any anomalies located outside of the defined study areas are deemed beyond the scope of the current assessment and are subsequently not included in this report.

3 PALAEOGEOGRAPHIC ASSESSMENT

3.1 Geological baseline and archaeological potential

3.1.1 The following is an overview of the geological and archaeological history of the wider region from the Pleistocene to the Holocene marine transgression. This is based on a range of secondary sources, including academic papers, monographs, geological information (e.g. BGS mapping), and previous work undertaken by Wessex Archaeology from the wider region. This serves as a baseline for the palaeogeographic assessment, and aids in producing a stratigraphy for the study area, assigning archaeological potential to identified units, and informing future sampling strategies.

3.1.2 A full baseline for the area has already been provided as part of the marine geoarchaeological assessment report (Wessex Archaeology 2024a) and will not be repeated in full here. This is a brief summary of the geological baseline of the area as background to the current report.

3.1.3 As a long, linear scheme, the study area crosses a number of different geological settings, both past and present, between landfall and the UK/France median line (Fig. 1). Starting within the relatively sheltered area of Bideford Bay, the route continues out into the Bristol Channel to the south of the island of Lundy, then continues approximately shore parallel along the north Cornish coast within the Celtic Sea. The route then passes north of the Isles of Scilly, where it turns south and terminates (for the purposes of this report) at the UK/France median line in the western approaches to the English Channel. The current environment is fully shallow marine, but this hasn't always been the case.

3.1.4 The Pleistocene geological history of the Celtic Sea, and the UK, 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 most recent 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; Marine Isotope Stage (MIS) 2; *c.* 26,000 years BP).

3.1.5 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. Further BRITICE-Chrono modelling of ice sheet advance and retreat indicate the study area will have been partially ice free and partially beneath the ISIS during the LGM (Clark *et al*. 2022).

3.1.6 The marine-terminating ISIS retreated rapidly, with no subaerial exposure between subglacial and submarine conditions throughout the main trough (Small *et al.* 2018), with a submerged proglacial environment forming across the study area. This resulted in the widespread deposition of glaciomarine sediments, followed by post-glacial tidal and marine deposits after full glacial retreat (Lockhart *et al.* 2018).

3.1.7 On the eastern margin of the ISIS, the ice was potentially land-terminating, with the Bristol Channel being subaerially exposed throughout the majority of the LGM, until marine inundation around 10,000 years ago (Clark *et al.* 2022). Evidence of subaerial exposure is observed in high-resolution geophysical and geotechnical data to the north of the study area

in Bideford Bay. Based on interpreted sub-bottom profiler data, cut and fill features were identified and tentatively interpreted as palaeochannels, possibly associated with the offshore extension of the palaeo-Taw river (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 Bideford 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), also supported by the presence of submerged forest deposits at the beach at Westward Ho! (Grant *et al.* 2021).

3.1.8 Within the wider region, buried fluvial features and other potential terrestrial deposits dating to after the LGM have been identified further north of landfall within the Bristol Channel as part of the West Coast Palaeolandscapes Survey (WCPS; Fitch *et al.* 2011).

3.1.9 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 project landfall (Rogers 1946; Balaam *et al.* 1987). Prehistoric findspots have also been reported near to the project landfall and provide additional evidence of occupation within the nearshore zone.

3.1.10 The lateral extent of these organic and fine-grained minerogenic sediments within the nearshore zone is unknown, however equivalent former land surfaces 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.

3.1.11 After the Holocene marine transgression, the archaeological potential of the study area changes to the maritime history of the UK, which is covered in the seabed features assessment report (Wessex Archaeology 2024b).

3.2 Palaeogeographic assessment results

3.2.1 A number of palaeogeographic features of archaeological potential have been identified within the study area. These features are discussed below, individually described in gazetteer format in Appendix 1, and their distribution is illustrated in Figure 2.

3.2.2 The shallow stratigraphy of the study area has been based on that presented in the marine geoarchaeological assessment report (Wessex Archaeology 2024a), but modified where necessary to include additional features visible in the geophysics but not within the previously assessed cores (Table 5). Similarly, some fine scale subdivisions are present within the core samples that are not resolvable within the SBP data. As such, a complete stratigraphy as outlined below will not be present in any one vibrocore sample or SBP data section.

Table 5 Shallow stratigraphy of the study area

Unit	Unit Name	Geophysical Characteristics [1]	Sediment Type [2]	Archaeological Potential
7	Seabed sediments (Holocene)	Generally observed as a thin veneer with occasional sand ripples, or thickening into large sand bank towards the nearshore. Boundary between surficial sediments and underlying Units 5 and 6 (where present) is not always discernible.	Gravelly sand and sandy gravel (Gravel lag)	Considered of low potential in itself, but possibly contains re-worked artefacts and can cover wreck sites and other cultural heritage.
6	Coastal to shallow marine (Early Holocene)	A relatively well defined, sub-horizontal reflector overlain by a relatively acoustically transparent unit that contains numerous faint internal reflectors, suggesting a complex structure.	Fine to medium sand with faint laminae and rare shells	Potential to contain derived archaeological and palaeoenvironmental material, and to protect underlying surfaces.
5	Alluvium (Early Holocene)	A relatively well defined, sub-horizontal basal reflector and a single phase of generally unstructured, acoustically transparent fill. Some internal reflectors are visible, but do not show a coherent structure. Occasionally punctuated by erosive features (channels) that often cut through the whole thickness of the unit.	Low strength sandy clay	Potential to contain *in situ* and derived archaeological and palaeoenvironmental material, and to protect underlying surfaces.
4	Head (Late Weichselian to Early Holocene)	Not definitively identified within the geophysical data.	Gravelly clay and clayey gravel.	Unlikely to contain archaeological material.
3	Glaciomarine (Late Weichselian)	Not definitively identified within the geophysical data.	Firm to stiff sandy clay with laminae of sand and shell fragments.	Unlikely to contain archaeological material.
2	Diamict (Late Weichselian)	Tentatively identified in the nearshore area as an acoustically transparent unit.	High strength gravelly sandy clay.	Unlikely to contain archaeological material.
1	Pre-Quaternary bedrock	Variable, but often with a strong upper reflector and irregular/dipping internal reflectors.	Variable.	Pre-Earliest occupation of the UK.

[1] Based on geophysical data

[2] Based on vibrocore data, Wessex Archaeology 2024a

3.2.3 Unit 1 is visible along most of the proposed route, and represents the pre-Quaternary bedrock in the region. The unit is characterised by a strong upper reflector, and variable internal structure, often comprising irregular and/or dipping reflectors. The upper surface is often irregular and eroded in nature, and the unit is often directly overlain by modern seabed sediment. The bedrock is likely to vary in composition, but is all interpreted to pre-date the earliest known hominin occupation of the UK. As such, Unit 1 is not considered to be of archaeological potential.

3.2.4 Ten small cut and fill features have been identified cutting directly into the surface of Unit 1, all located along a stretch of route approximately 30 km long approximately northwest of Padstow (Fig. 2). These features (ID numbers **7500** to **7509**) are similar in character, and are relatively shallow features characterised by well defined, often irregular, basal reflectors, and a single phase of acoustically transparent or unstructured fill (Fig. 3). In some cases the base is less distinct, but this is less common.

3.2.5 None of the previously acquired vibrocores sampled any of these features, and so their nature and fill composition is currently uncertain. Additionally, as they are cut into pre-Quaternary bedrock (Unit 1) and directly overlain by modern seabed sediment (Unit 7) there is little stratigraphic control with which to assign a potential age for the features. They are located within relatively deep water (approximately 70 m LAT), but modelling work by BRITICE-Chrono suggests they are in an area that was likely exposed as a terrestrial environment after the LGM (Clark *et al.* 2022). As such they could be small, remnant fluvial features, and could be of archaeological potential. Conversely, they could also represent deposits of glacial till (Unit 2) within hollows, potentially formed through glacial erosion or subglacial meltwater, in the irregular bedrock surface, and as such would be considered of low archaeological potential. Further work would be required to establish the exact nature of these features.

3.2.6 Unit 2 was only identified within three geotechnical samples (Wessex Archaeology 2024a) and was only tentatively identified within the nearshore area of the proposed route in the SBP data. As an interpreted glacial deposit/diamict, Unit 2 is not considered to be of archaeological potential.

3.2.7 Unit 3, a deposit of glaciomarine sediments, was identified within seven vibrocore logs during the Stage 1 geoarchaeological assessment (Wessex Archaeology 2024a), within which all deposits were visible in the upper 3 m of the stratigraphy. This unit was not definitively identified within the geophysical data, and so is likely to either be too thin in most places to be properly resolved in the SBP data or is acoustically indistinguishable from the overlying seabed sediment. However, as a glaciomarine deposit, Unit 2 is not considered to be of archaeological potential.

3.2.8 Unit 4 is a very thin (<1 m thick) unit identified in a single vibrocore sample (VC_60). This has not been resolved in the SBP data, presumably due to its thin nature and composition as reworked glacial till. It is not considered to be of archaeological potential.

3.2.9 Unit 5 is visible within the Bideford Bay area of the proposed route, close to the UK landfall (Fig. 2). It is characterised by a relatively well defined, sub-horizontal basal reflector and a single phase of generally acoustically transparent fill (Fig. 4). Some internal reflectors are visible, but do not show a coherent structure. There are potentially three separate deposits of this unit, **7510**, **7512**, and **7513**; although **7512** and **7513** are likely to be the same feature that is just separated in the data by an area of lower seismic penetration caused by a sand bar.

3.2.10 A number of cut and fill and channel features (**7514**, **7515**, **7516**, **7517**, and **7518**) have been observed cutting into Unit 5. These often cut through the whole thickness of the unit and into the underlying bedrock/till and are characterised by irregular basal reflectors and single phases of acoustically transparent/unstructured till (Fig. 4).

3.2.11 Unit 5 was found by vibrocore samples (VC_59 and VC_60, Wessex Archaeology 2024a) to comprise low strength sandy clay, and is potentially a deposit of Early Holocene alluvium deposited during a time of post-glacial sub-aerial exposure of Bideford Bay, with associated shallow fluvial features cut into the alluvial deposits. Unfortunately none of the channel features were directly sampled by the vibrocoring. As a terrestrial deposit, Unit 5 is considered of high archaeological potential, and could contain in-situ archaeological artefacts and/or palaeoenvironmental material.

3.2.12 Previous work in the area (Wessex Archaeology 2012) has identified acoustic blanking within the nearshore terrestrial sediments, potentially indicative of organic material. No such blanking or high amplitude horizons were identified within the current SBP data set, and no organic material was recovered from any of the nearshore vibrocores. One single survey line exhibited some high amplitude reflectors within the seabed sediments, but these were not corroborated by any adjacent or overlapping lines and so were regarded as a spurious result.

3.2.13 However, as a terrestrial deposit associated with a fluvial/floodplain system, the potential remains for thin layers of organic material to be present within Unit 5, particularly at its upper surface. The potential presence of these is corroborated by the known submerged forest remains on the beach at Westward Ho!, close to the proposed landfall (Grant *et al.* 2021). These would also be considered of high archaeological potential.

3.2.14 Unit 6 is represented by a single feature, **7511**, also located within Bideford Bay. This is characterised by a relatively well defined, sub-horizontal reflector overlain by a relatively acoustically transparent unit that contains numerous faint internal reflectors, suggesting a complex structure. The unit was found by vibrocore (VC_53, Wessex Archaeology 2024a) to comprise fine to medium sand with faint laminae and rare shells, but the potentially complex structure within the SBP data suggests it may be laterally variable. This unit is interpreted as a potential Early Holocene coastal deposit, probably dating from the period of the post-glacial marine transgression, and forms the core of a sand bar that crosses the proposed route at this location. As a potential coastal deposit, Unit 6 may contain reworked archaeological and palaeoenvironmental material, and is considered of medium archaeological potential.

3.2.15 A second deposit of possible Early Holocene coastal sediments have previously been recorded from vibrocores VC_59 and VC_60, close to the landfall. In the SBP data, these coastal sediments are indistinguishable from modern seabed sediment deposits, and so have not been mapped.

3.2.16 Unit 7 represents the modern marine sediment along the proposed route. For the majority of the route this comprises a thin veneer overlying bedrock, with some areas of slightly thicker accumulations and mobile bedforms. In the nearshore area, this thickens to a few metres over a possible sand bank, and then again towards the landfall. Vibrocores have found the sediment to generally comprise gravelly sand and sandy gravel, changing to fine to medium sand close to landfall (Wessex Archaeology 2024a).

3.2.17 As a modern deposit, Unit 7 is not considered to be of potential in itself, but could potentially contain re-worked artefacts and can cover wreck sites and other cultural heritage. This is

particularly the case in the nearshore area, where it could cover and protect sites close to landfall and contain material re-worked from the underlying alluvial material. However, in general, Unit 7 is considered of low archaeological potential.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Palaeogeographic features

4.1.1 The assessment of the SBP data within the study area has indicated that the majority of the proposed route from UK landfall to the UK/France median line is characterised by pre-Quaternary bedrock overlain by modern seabed sediments. This is considered of low archaeological potential. However, features of archaeological potential were identified closer to the UK landfall.

4.1.2 A total of 19 features of palaeogeographic interest were identified within the study area. These are summarised as follows:

- a total of two channels were assigned a P1 archaeological rating;
- a total of three fine grained deposits were also assigned a P1 archaeological rating;
- a total of 13 simple cuts and fills were assigned an P2 archaeological rating;
- a single erosion surface was also assigned a P2 archaeological rating.

4.1.3 The deposits and features identified within Bideford Bay record the glacial and postglacial development of the environment within the bay from a low-lying area containing fluvial systems and flood plains, to a coastal environment with tidal/sand bar deposits, to a modern marine environment. The alluvial/fluvial sediments of Unit 5, potentially similar in date to the submerged forest at Westward Ho!, are of the highest archaeological potential.

4.1.4 No immediate mitigation action is recommended at this time. However, it is recommended that, should any further geotechnical sampling be carried out within any of the identified features, the logs be made available for Stage 1 geoarchaeological assessment by a suitable qualified archaeological contractor. This will help determine whether the identified features are of archaeological potential.

4.1.5 It is also recommended that, should any objects or deposits of possible archaeological interest be recovered during any groundwork operations, that they should be reported to a suitably qualified archaeological contractor using a pre-agreed reporting protocol. This will establish whether the recovered material is of archaeological interest and recommend appropriate mitigation measures.

5 REFERENCES

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APPENDICES

Appendix I Palaeogeographic features of archaeological potential

ID	Classification	Archaeological Discrimination	Depth Range (mBSB)		Description
			From	To	
7500	Simple cut and fill	P2	0.5	3.5	Small, possible cut and fill feature cut into underlying bedrock and overlain by a thin deposit of modern sand, identified on multiple survey lines. Generally well defined irregular basal reflector with a single phase of acoustically transparent fill. Possible indications of a separate basal fill on one survey line, but this is unclear. Possible remnant of a fluvial feature, but located in relatively deep water and may be a subglacial meltwater channel or erosional feature containing glacial till.
7501	Simple cut and fill	P2	0.6	2.1	Small, possible cut and fill feature cut into underlying bedrock and overlain by a thin deposit of modern sand, identified on multiple survey lines. Generally well defined irregular basal reflector with a single phase of acoustically transparent fill. Possible remnant of a fluvial feature, but located in relatively deep water and may be a subglacial meltwater channel or erosional feature containing glacial till.
7502	Simple cut and fill	P2	0.7	2.6	Small, possible cut and fill feature cut into underlying bedrock, identified on multiple survey lines. Generally well defined irregular basal reflector with a single phase of acoustically transparent fill. Possible remnant of a fluvial feature, but located in relatively deep water and may be a subglacial meltwater channel or erosional feature containing glacial till. One of a number of similar features in this area.
7503	Simple cut and fill	P2	1	2.4	Small, possible cut and fill feature cut into underlying bedrock, identified on multiple survey lines. Generally well defined irregular basal reflector with a single phase of acoustically transparent fill. Possible remnant of a fluvial feature, but located in relatively deep water and may be a subglacial meltwater channel or erosional feature containing glacial till. One of a number of similar features in this area.
7504	Simple cut and fill	P2	1.1	5.8	Small, possible cut and fill feature cut into underlying bedrock and overlain by modern marine sediment, identified on multiple survey lines. Generally well defined irregular basal reflector with a single phase of acoustically transparent fill. Possible remnant of a fluvial feature, but located in relatively deep water and may be a subglacial meltwater channel or erosional feature containing glacial till. One of a number of similar features in this area.

ID	Classification	Archaeological Discrimination	Depth Range (mBSB)		Description
			From	To	
7505	Simple cut and fill	P2	1	4.5	Broad, distinct, possible cut and fill feature cut into underlying bedrock and overlain by modern marine sediment, identified on multiple survey lines. Generally well defined irregular basal reflector with a single phase of acoustically transparent fill. Possible remnant of a fluvial feature, but located in relatively deep water and may be a subglacial meltwater channel or erosional feature containing glacial till. One of a number of similar features in this area.
7506	Simple cut and fill	P2	0.8	3.6	Small, possible cut and fill feature cut into underlying bedrock and overlain by a thin deposit of modern sand, identified on multiple survey lines. Generally well defined irregular basal reflector with a single phase of acoustically transparent fill. Possible indications of a separate basal fill on one survey line, but this is unclear. Possible remnant of a fluvial feature, but located in relatively deep water and may be a subglacial meltwater channel or erosional feature containing glacial till.
7507	Simple cut and fill	P2	0.8	4	Small, relatively poorly defined, possible cut and fill feature cut into the underlying bedrock. Characterised by a poorly defined basal reflector, and a single phase of acoustically layered fill. Possible remnant of a fluvial feature, but located in relatively deep water and may be a subglacial meltwater channel or erosional feature containing glacial till.
7508	Simple cut and fill	P2	1.5	4.3	Small, relatively poorly defined, possible cut and fill feature cut into the underlying bedrock. Characterised by a poorly defined basal reflector, and a single phase of acoustically layered fill. Possible remnant of a fluvial feature, but located in relatively deep water and may be a subglacial meltwater channel or erosional feature containing glacial till.
7509	Simple cut and fill	P2	1.2	3	Small, relatively poorly defined, possible cut and fill feature cut into the underlying bedrock. Characterised by a poorly defined basal reflector, and a single phase of acoustically unstructured fill. Possible remnant of a fluvial feature, but located in relatively deep water and may be a subglacial meltwater channel or erosional feature containing glacial till.

ID	Classification	Archaeological Discrimination	Depth Range (mBSB)		Description
			From	To	
7510	Fine grained deposit	P1	2.7	7	A relatively thin unit between the underlying bedrock/glacial till and overlying seabed/coastal sediments. Characterised by a relatively well defined, sub-horizontal basal reflector and a single phase of generally acoustically transparent fill. Some internal reflectors are visible, but do not show a coherent structure. Potentially alluvium deposits as identified in vibrocores VC_59 and VC_60, but this is uncertain. Vibrocore VC_53 was acquired from within the boundaries of this feature, but did not penetrate deep enough to sample the sediments. The unit pinches out at seabed to the west, but the eastern boundary is overlain by a sand bar and the extent is unclear - however, it potentially continues beneath the sand bar and emerges on the eastern side as feature **7512**.
7511	Erosion surface	P2	0.7	8.6	A distinct, relatively strong, sub-horizontal reflector visible across multiple survey lines. Potentially marks the erosional surface between the underlying glacial till/bedrock/alluvium (**7510**) and the overlying post-glacial coastal/shallow marine deposits as identified in vibrocore VC_53. The unit pinches out at seabed to the west, but the eastern boundary is overlain by a sand bar and the extent is unclear.
7512	Fine grained deposit	P1	2.2	9	A unit between the underlying bedrock/glacial till and overlying seabed sediments. Characterised by a relatively well defined, sub-horizontal basal reflector and a single phase of generally acoustically transparent fill. Some internal reflectors are visible, but do not show a coherent structure. Potentially alluvium deposits as identified in vibrocores VC_59 and VC_60, but this is uncertain. The unit pinches out to the east, but the western boundary is overlain by a sand bar and the extent is unclear - however, it potentially continues beneath the sand bar and emerges on the western side as feature **7510**.
7513	Fine grained deposit	P1	0.4	7.4	A unit between the underlying bedrock/glacial till and overlying seabed sediments. Characterised by a relatively well defined, sub-horizontal basal reflector and a single phase of generally acoustically transparent fill. Some internal reflectors are visible, but do not show a coherent structure. Occasionally punctuated by erosive features (channels) that often cut through the whole thickness of the unit. Potentially alluvium deposits as identified in vibrocores VC_59 and VC_60.

ID	Classification	Archaeological Discrimination	Depth Range (mBSB)		Description
			From	To	
7514	Simple cut and fill	P2	0.8	3	A small, possible cut and fill feature identified cutting into the underlying possible alluvium deposits (**7513**) and overlain by a thin layer of seabed sediment. Characterised by a poorly defined basal reflector cutting through the base of **7513**, and a single phase of acoustically chaotic fill. Possible remnants of a fluvial feature, but only identified on two survey lines so this is uncertain.
7515	Channel	P1	1.6	4.9	A distinct cut and fill feature cut into the underlying possible alluvium deposit (**7513**) and overlain by a thin layer of seabed sediment, identified on multiple survey lines. Characterised by a generally well-defined basal reflector cutting through the base of **7513**, and a single phase of acoustically transparent/unstructured fill. Possible remnant fluvial channel.
7516	Simple cut and fill	P2	2.2	2.6	A small, shallow, but distinct cut and fill feature cut into the underlying possible alluvium deposit (**7513**), and overlain by modern seabed sediment. Characterised by a relatively poorly defined basal reflector and a single phase of acoustically chaotic fill. Only identified on one survey line and possibly the remnants of a fluvial system, potentially directly related to nearby channel feature **7517**.
7517	Channel	P1	1.4	5.2	A distinct cut and fill feature cut into the underlying possible alluvium deposit (**7513**) and overlain by a thin layer of seabed sediment, identified on multiple survey lines. Characterised by a generally well defined, irregular basal reflector, that at times cuts through the base of feature **7513**, and a single phase of acoustically transparent/unstructured fill. Possible remnant fluvial channel.
7518	Simple cut and fill	P2	1.5	3.2	A small but distinct cut and fill feature cut into the underlying possible alluvium deposit (**7513**), and overlain by modern seabed sediment. Characterised by a relatively well-defined basal reflector and a single phase of acoustically unstructured fill. Only identified on one survey line and possibly the remnants of a fluvial system, potentially directly related to nearby channel feature **7517**.

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UTM30N area

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U38A
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U39

Somerset County
Devon County
Cornwall
City Of Plymouth
Torbay
Isles Of Scilly

North West Bank
Jones Bank
Haddock Bank
ENGLISH CHANNEL

Study area
United Kingdom exclusive economic zone

0 50 km

Coordinate system: WGS 1984 UTM Zone 30N

Date: 06/09/2024 | Created by: KJF

Scale: 1:1,000,000 at A3 | Revision: 0

Figure 1: Location map

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Fig. 3

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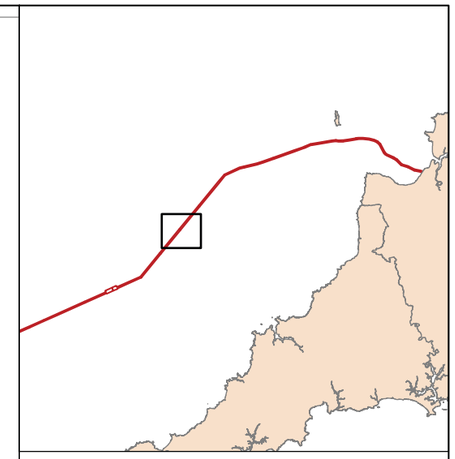
UK-GT-VC-39a



Study area

Vibrocore sample locations

Data example locations

Palaeolandscape features of archaeological potential

Simple cut and fill

0 1 km

Coordinate system: WGS 1984 UTM Zone 30N

Date: 06/09/2024	Created by: KJF
Scale: 1:40,000 at A3	Revision: 0

Figure 2a: Palaeolandscape features of archaeological potential

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7507

7506

UK-GT-VC-43

UK-GT-VC-41

Study area

Vibrocore sample locations

Palaeolandscape features of archaeological potential

Simple cut and fill

0 1 km

Date: 06/09/2024 | Created by: KJF

Scale: 1:40,000 at A3 | Revision: 0

Figure 2b: Palaeolandscape features of archaeological potential

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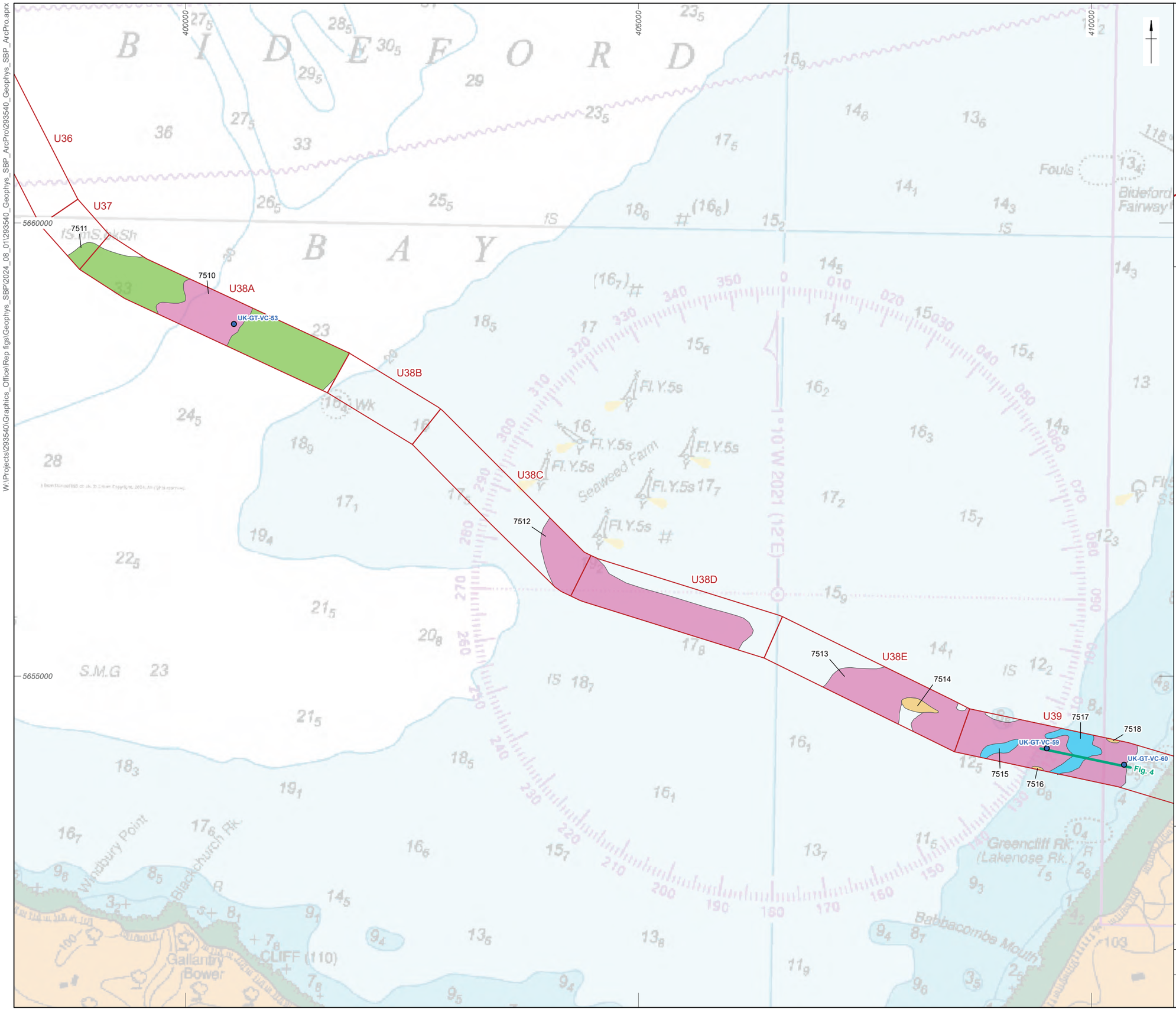
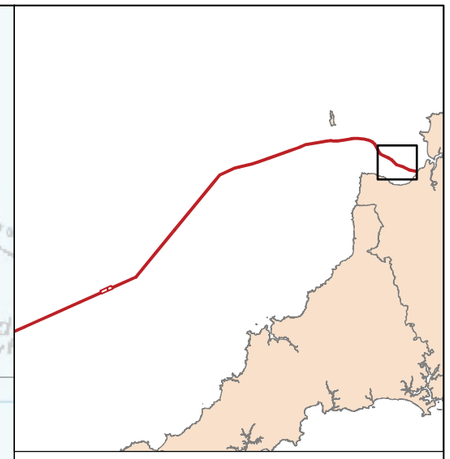




Study area
Vibrocore sample locations
Data example locations

Palaeolandscape features of archaeological potential

Channel
Simple cut and fill
Fine grained deposit
Erosion surface

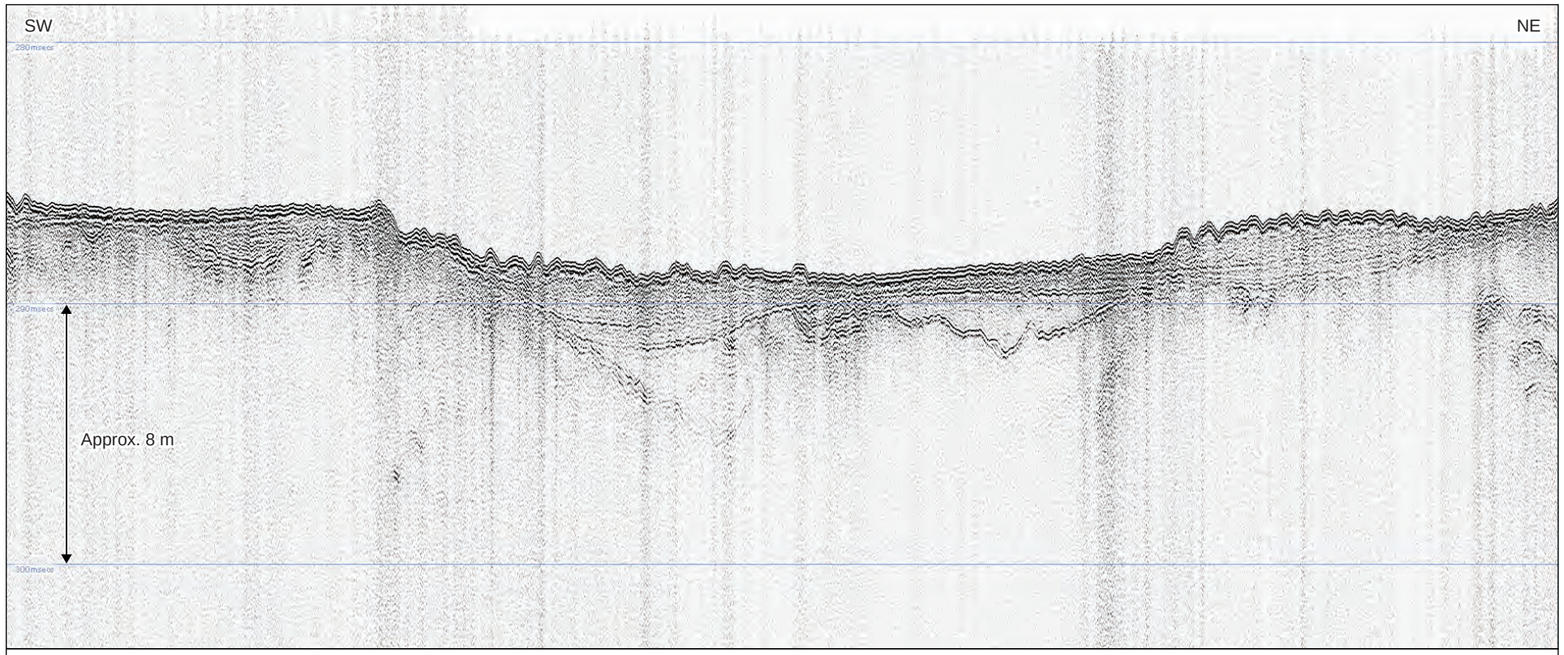
0 1 km

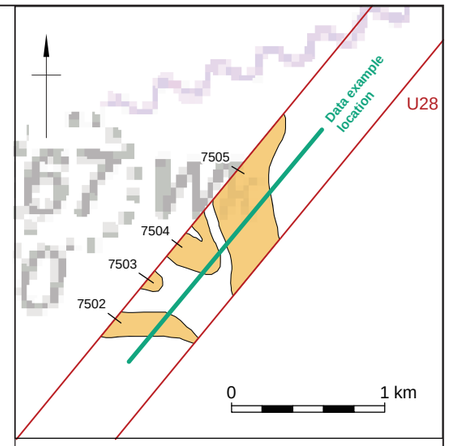
Coordinate system: WGS 1984 UTM Zone 30N

Date: 06/09/2024 | Created by: KJF

Scale: 1:40,000 at A3 | Revision: 0

Figure 2c: Palaeolandscape features of archaeological potential





Study area

Data example locations

Palaeolandscape features of archaeological potential

Simple cut and fill

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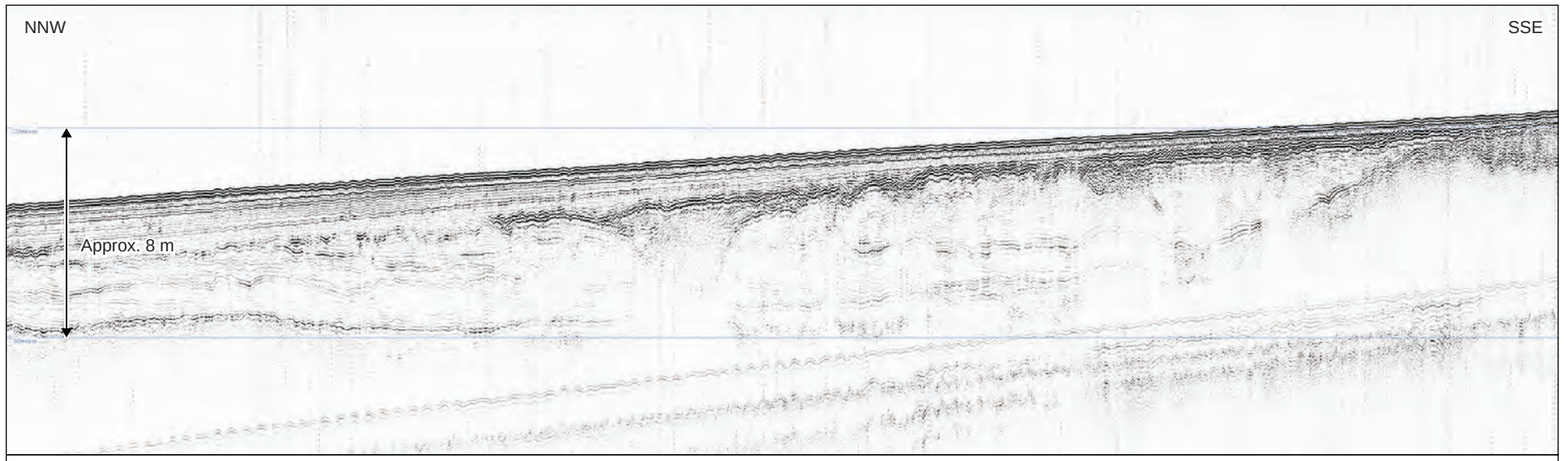
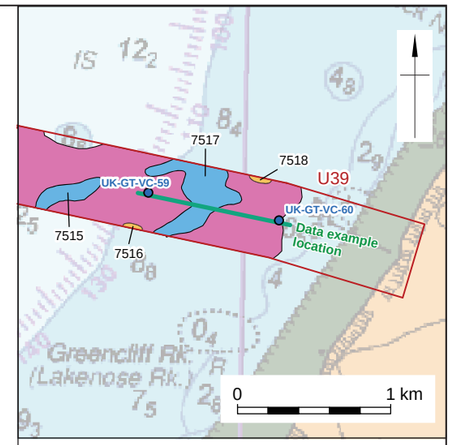
Figure 3: SBP data example – features 7502, 7504, and 7505





Study area
Vibrocore sample locations
Data example locations

Palaeolandscape features of archaeological potential

Channel
Simple cut and fill
Fine grained deposit

Created by: KJF	Date: 05/08/2024	
Scale: Inset 1:40,000 at A3	Revision: 0	

Figure 4: SBP data example – features 7513 and 7517

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