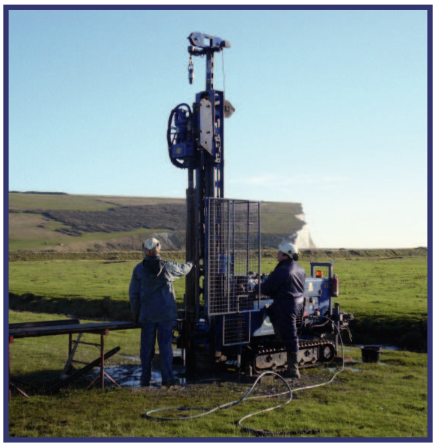
Cuckmere Haven



Geoarchaeological Borehole Survey

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Geoarchaeological Borehole Survey and Geophysical Ground Truthing

Field Assessment Report

East Sussex County Council

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Summary

At the end of December 2010, Oxford Archaeology undertook a borehole survey within the Cuckmere Haven, East Sussex, on behalf of East Sussex County Council, to help ground truth two recent phases of geophysical sediment mapping (Bates 2010a and 2010b). The fieldwork aimed to identify the base of the bedrock surface and provide samples for lithological and palaeoenvironmental assessment. This work was part of a wider heritage study of the Haven that was designed to help inform local communities about the heritage resources of the valley and the potential impacts of future coastal change.

The fieldwork successfully sampled one sequence to a depth of 30m within the valley to help ground truth the geo-electric sections. Unfortunately ground conditions prevented a second sample from reaching full depth and this was abandoned in order to concentrate on further assessment of the borehole samples. The base of the alluvium was encountered at a depth of 24m below ground surface and solid chalk was encountered at 27.5m in depth. The Holocene sequence comprised basal silty clays and peats overlain by thick laminated clayey sands. Inter-stratified sand and clay deposits were identified between 11.40m and 5.60m in depth, and these were sealed by overlying homogeneous clays and silty clays.

Preliminary assessment of the ostracod and foraminifera assemblages suggest a transition from freshwater to brackish conditions at the base of the sequence. The marine incursion of the valley is dated to 8030±30 yr BP. Thick deposits of overlying laminated sands appear to represent brackish conditions within tidal mudflats. There is a gradual transition into mid/high salt marsh conditions further up the sequence, with an increasing marine influence around 8.50m, possibly reflecting tidal surges. Brackish tidal mudflat conditions return with the deposition of the upper silty clays. The present-day predominantly freshwater environment of the Haven is therefore a relatively recent development.

A similar sand dominated sequence has been recorded within the Lower Ouse, but this sequence appears to lack the thick freshwater organic and peat deposits present within the valleys recorded to the east, such as those found in the Combe Haven. However further dating and palaeoenvironmental assessment is required before more comprehensive comparisons between sequences can be made.

Only a single tie point for ground truthing the geophysics currently exists, but when considered with the other available data, the work was able to identify the base of the bedrock and pick-up subsurface features within the geo-electric sections. The relationship between the geophysical profile and the drill log at the site indicates that the base of the Holocene alluvial surface coincides with the 6.38ohm/m contour (light to dark green) and consequently we have used this to infer the shape of the topographical template along all four transects. The revealed valley profile shows abrupt steep valley sides on to a moderately smooth slightly concave base, possible as the result of erosion by continuous migrating channels.

The works has confirmed the presence of significant lateral and vertical variation within the sedimentary sequence and palaeotopography across the valley. The true significance of this is currently unclear and highlights the need for further detailed study and sampling.

Geoarchaeological Borehole Survey and Geophysical Ground Truthing

Field Assessment Report

1 INTRODUCTION

1.1 Scope of work

1.1.1 In December 2010 Oxford Archaeology was commissioned by East Sussex County Council (ESCC) to undertake a borehole survey within the Cuckmere Haven to help ground-truth two recent geophysical investigations (Bates 2010a and 2010b). Up until recently only limited data was available about the historic environment of the valley, its geomorphology and its archaeological interest. Two sampling locations were selected in order to identify the base of the valley sequence to help map and understand the evolution of the sequence and its buried archaeological potential.

1.1.2 The County Archaeologist for East Sussex, Casper Johnson, provided the brief for the investigation (ESCC 2010). The work is part of a wider study of the Cuckmere Valley funded by the Department for Environment, Foods and Rural Affairs (Defra) as part of the Pathfinder programme, designed to help local communities develop an enhanced understanding of the potential effects of coastal change.

1.2 Location

1.2.1 The Cuckmere Haven (also known as the Cuckmere Estuary) occupies the mouth of a small valley in East Sussex, where the River Cuckmere meets the English Channel between Eastbourne and Seaford (NGR 551400 098500; Figure 1). The Haven comprises a series of reclaimed coastal marshes, relict tidal creeks surrounded by rolling valley hills (Plate 1). The beach at the mouth of the Haven is next to the famous chalk cliffs named the Seven Sisters (Plate 2).

1.3 Previous work

1.3.1 Very little data is currently available for the Cuckmere Haven and previous sampling of the valley sequence has been extremely limited. In September 2010 a conductivity survey was undertaken to help map the subsurface geomorphological features and deposit sequences (Bates 2010a). The results of survey indicated that the sediment architecture varies significantly across the valley floor. Topographic features (now buried) have been inferred in places and potential landscape differences associated with changing lateral and temporal sequences may well exist relatively close to the surface across the site. This has allowed the upper valley sequence to be divided into four key sedimentary zones (Bates 2010a).

1.3.2 The conductivity survey was followed up by a geophysical resistivity survey (Bates 2010b), which was designed to examine the deeper floodplain sequence and help map the buried palaeotopography. This work was able to penetrate to depths greater than the 6m achieved in the conductivity survey. The results clearly show the profile of subsurface features, with good contrast identified within the geo-electric sections between the Holocene sediment sequence and Chalk bedrock. As well as identifying the basic geometry of the buried valley system, the survey also identified the potential position of a number of subsurface features, including several buried channels, and helped define the profile of the submerged valley sides. A series of basal shelves/steps were also identified along the length of the valley, which indicates areas that may have been submerged at different times during the Holocene by rising sea-level.

1.3.3 The plot of the conductivity survey is reproduced in Figure 2, along with the location of the resistivity transects. Ground truthing of the geophysical survey results was the next step in the study and a targeted borehole survey was recommended (Bates 2010b).

1.4 Background

1.4.1 The present day topography of Cuckmere Haven has undergone significant modification and bears little resemblance to the landscape of the prehistoric past. Evidence of early prehistoric surfaces and sites can be deeply buried below later accumulations of alluvium and colluvium.

1.4.2 In order to fully understand the character, distribution and archaeological potential within the Cuckmere Haven, it is necessary first to understand the changing nature of sediment patterns and palaeotopography within the buried valley sequence. Fluctuations in sea-level rise throughout the Holocene have created an exceptionally full and complex sequence of sedimentary units. The basal surface of the valley formed a "topographic template"; depressions in which were filled with alluvial and estuarine sediments during the onset of flooding during the Holocene. Areas of higher elevations (now buried) may have developed into floodplain islands. This template would have had a significant influence over the development of vegetation and hydrological patterns within the valley sequence, that would have been a major influence on archaeological activity within the area.

1.4.3 There is little published information regarding the development of the sedimentary sequences within the Cuckmere Valley, although Burrin (1983) describes boreholes from Cuckmere Haven where basal gravels are replaced by silty clays at 28m below ground surface. These in turn are replaced at a depth of 20m by sands and at 3m by silty clays. Previous work within the study area (Hunter and Pine, 2004) have indicated that the uppermost 3m of stratigraphy beneath the western part of the floodplain are variable and a number of discrete sedimentary units were identified. Presently only a single borehole is recorded in the alluvial area of the floodplain in the British Geological Survey Geoscience archive (TV59NW6, depth 17.98m at grid reference TV 51780 99360).

1.4.4 There has been much debate about the degree of stratigraphic uniformity between sites along the South Coast and how much these can be compared to other coastal sequences. Jennings and Smyth (1982a; 1982b) emphasis the differences between sequences and highlight the importance of local factors like the breaching of gravel bars, while Burrin (1983; 1991) considers the similarities between sequences and advocates a more uniform stratigraphic model. Waller and Long (2010) have recently reviewed all of the available river valley data for Sussex and concludes that no one model explains the development of all these sequences. This debate is further complicated by the current limited level of detailed sampling of many of these valley sequences and the lateral sediment variation that can exist within such fluvially active environments.

1.4.5 Long *et al* (2000) have proposed a more general tri-partite model of estuarine development, based on regional sea-level changes that is often applied to southern England. This provides at least a baseline model that a sequence can be compared to. This model suggests that the lower sequence consists of estuarine and marine sands that would have been deposited during estuarine expansion during the early Holocene. This lower sequence consists of sand deposits overlying freshwater silty clays and peats. The middle part is characterized by silty clay alluvium and wetland peats/organic silts reflecting a phase of estuarine contraction. The upper minerogenic deposits represent a return to estuarine expansion in the late Holocene.

2 Aims and Methodology

2.1 Aims

2.1.1 The broad aim of this survey was to contribute to an understanding of the sedimentological and palaeo-environmental history of the Cuckmere Valley in order to assess the archaeological potential.

2.1.2 More specifically, the objective was to ground truth the geo-electrical surveys to allow refinements in interpretation and the opportunity to consider in detail future mitigation options including, for example, site-specific archaeological and palaeo-environmental evaluation.

2.1.3 The project was designed to:

(i) Establish a permanent record of the stratigraphy in two selected locations through the Holocene alluvium and proving bedrock

(ii) Collect samples to assess the potential for off-site analysis/assessment

(iii) Create preliminary interpretations of the valley-wide geo-electrical surveys to understand archaeological potential and site formation processes

(iv) Establish the potential for the survival of archaeological remains

2.2 Methodology

2.2.1 Two boreholes were originally proposed at selected locations in the valley where major changes were noted in the geophysical survey. The locations; along the line of transect LN131 at 0m and 620m, were identified after careful examination of all four transects. The aim was to drill through the alluvium to bedrock, and to record the depth of alluvium, the depth of any gravel or solifluction deposits at the base of the alluvium and the depth at which bedrock was encountered. Unfortunately due to very difficult ground conditions encountered on site, it was only possible to drill one borehole to the full 30m depth to bedrock (see Sec. 3.2 below). The location also needed to be adjusted in the field and the borehole was taken at 200m along transect LN131.

2.2.2 Drilling was carried by a specialist sub-contractor using a tracked Commachio MC300 percussion rig (Plate 3). This rig is capable of drilling to significant depths and generally recovers better quality cores for archaeological purposes than a traditional shell and auger rig. The drilling was monitored on site by a qualified geoarchaeologist. A continuous sequence of undisturbed core samples was retrieved (Plate 4) and the position of sample location tied in with a GPS relative to National Grid coordinates and Ordnance Datum.

2.2.3 The cores were returned to Oxford, where they were extruded and the deposits described in detail according to Jones *et al* 1999. This included information on depth, texture, composition, colour, clast orientation, structure (bedding, ped characteristics etc) and contacts between deposits. Provision was also made for the recording of any visible ecofactual, or artefactual inclusions e.g. pottery, daub or charcoal fragments.

3 Results

3.1 Introduction and presentation of results

3.1.1 The results presented in this report provide an overview of the findings of the fieldwork and interpretation of the geo-electric sections. The lithological descriptions can be found in Appendix A, the assessment of ostracods and foraminifera in Appendix B and the AMS radiocarbon dating result in Appendix C.

3.2 General soils and ground conditions

3.2.1 The fieldwork encountered a number of problems from the outset due to a period of unprecedented heavy snow and frozen ground the previous week. At the time of the fieldwork the snow had mostly melted away leaving the upper ground surface highly saturated and the surrounding hillsides still partly frozen.

3.2.2 The frozen ground meant that alternative means of site access needed to be found due to the weight of the borehole trailer. This caused considerable delays and further access issues in reaching the proposed sampling locations. The wet ground conditions of the valley base also meant that the trailer kept getting stuck and sinking (Plate 5). Some of the field access points were too soft to use with the sampling equipment (Plate 6) and many areas were cut off by relict creeks and drainage ditches swollen by melting snow water (Plate 7).

3.2.3 Unfortunately as a result of the conditions only one borehole sequence was completed to the full 30m depth to bedrock. It was not possible to complete the second borehole to full depth in the time available and there was also a real danger that the equipment would get permanently stuck in the soft ground. Consequently in consultation with the County Archaeologist and Martin Bates the second location was abandoned and resources transferred to undertaking more detailed assessment on the borehole sequence that was recovered.

3.3 Borehole sequence

3.3.1 The borehole sampling identified the base of Holocene sequences at approximately 24.0m bgl in depth (-23m OD) where a thin deposit of sandy gravels was identified. Chalk bedrock was encountered at a depth of 27.0m bgl (-26.1m OD) overlain by chalk-rich deposits thought to be solifluction deposits, sandy gravel and a thin sand deposit. A bluish grey silty clay with a few shells and inter-bedded peats were identified above this basal set of deposits and they represent the base of the Holocene sequence. These deposits may represent 'dryland' deposition during a period of lower sea-level, before the English Channel was flooded through the Straits of Dover as a consequence of sea-level rise. This sequence was overlain by a homogeneous sequence of laminated sands, silts and clays with occasional shell inclusions between depths of 21.00m bgl (-20m OD) and 13.20m bgl (-12.3m OD). These deposits represent brackish inundation in the early Holocene due to rising sea-level. At a depth of 13.20m bgl a bluish (greenish) grey clay was encountered with occasional redeposited peats and some shells were identified representing lower energy deposits. This was overlain by an upper sequence of alternating brownish grey silty clays and medium orange sand deposits. These deposits represent marine inundation and tidal surges. Laterally the sediments inter-digitate with colluvial slope wash deposits from the valley sides. The upper 1.10m bgl of the sequence is represented by oxidized brownish yellow slightly organic silty clay that may represent a period of reclamation/embankment.

3.3.2 Within the broader context of East Sussex the sequence is similar to those in the Ouse to the west, according to Waller and Long (2010). However, the sequences described in detail by Burrin and Jones (1991) from the lower parts of the Ouse are some 5km up stream of the mouth of the river and consequently not in a similar geomorphological position to that of the recently drilled borehole. However, of relevance to the present study are the following points that are extracted from Burrin and Jones' work:

(i) Lateral variation across the floodplain is noted in sequence stratigraphic architecture

(ii) The Holocene sequences bottom onto coarse gravels at approximately -23m O.D.

(iii) The sequence is similar to the those described by Burrin (1983) and Burrin and Jones (1991) within the Ouse

(iv) The Cuckmere sequence does not conform with the general sediment models

3.3.3 Comparison with other valley systems, should, however, be treated with caution. The Holocene history of sedimentation in the Sussex river systems has recently been reviewed by Waller and Long (2010) who came to the conclusion that by comparing sites across the region there does not appear to be a single stratigraphic model for the region that explains the development of all sequences.

3.3.4 Finally it should be noted that onset of sedimentation onto the Late Pleistocene gravel surface will have probably been controlled by sea-level rise. Flooding of the surface was caused by either marine/brackish waters moving up-system relative with sea- level or by fluvial systems backing up in advance of the rise.

3.4 Ground-truthing of the geophysical results

3.4.1 In the event, as described above, only a single borehole was drilled at the site and consequently only a single tie point for ground truthing the geophysics currently exists. The electrical sections have been interpreted based on this single tie point. The base of the Holocene template and the surface of the underlying bedrock are shown within Figure 3. This also identified the position of the topographic steps and solifluction deposits.

3.4.2 The relationship between the geophysical profile and the drill log at the site indicates that the base of the Holocene alluvium coincides with the 6.38ohm/m contour (light to dark green) and surface of the bedrock coincides with the 10.20ohm/m contour (bright green). This data has been used to infer the shape of the topographical template along all four transects (Figure 4). With the one exception of transect LN135 which, due to instrumentation problems, did not produce an interpretative section.

3.4.3 The valley profile indicate steep valley edges with an abrupt transition into a moderately smooth concave base. Some undulations near to the valley edges may indicate areas of minor erosional scallops. This profile is similar with sequences recorded in the Ouse, where the smooth valley floors were interpreted as evidence of erosion by continually migrating channels (Castleden 1980).

3.5 Preliminary palaeoenvironmental assessment

Ostracod and foraminifera assessment (by John Whittaker)

3.5.1 In total 36 samples were taken throughout the borehole samples to assess for the preservation of ostracods and foraminifera. The results of the assessment shown in Appendix B, confirm that they are sufficiently well-preserved within the sequence to offer meaningful interpretations about the types of sedimentary environments present. These can be particularly good indicators of changing water salinity and coastal environments over time.

3.5.2 The assemblage appears to be dominated by brackish and marine species, with only a limited freshwater assemblage identified at the base of the borehole. The samples between 22.78m - 24m bgl contain a predominantly freshwater assemblage, possibly representing ponding on the pre-inundation surface. A brackish component is present with a sample from 24.00m bgl, that appears to be the result of contamination at the top of the core.

3.5.3 The likely environment through the bottom and middle part of the core between 14.5m – 22.0m is brackish; possibly tidal mudflats giving way up-profile to mid/high salt marsh. On the basis of the current data it appears the onset of tidal access may have been at c. 22.00m (-21.10m OD). There is some possible evidence of marine conditions at around 8.5m, possibly brought in by storm surges, associated with inter-digitating sand and clay deposits.

3.5.4 There is a return to brackish tidal flats and saltmarsh right up to the top of the sequence (to 0.50-0.52m at least). The almost complete estuarine signal in this borehole is quite surprising and shows that this sedimentation (which was not river alluvium) was substantial and kept up with sea-level throughout. The approximately 20 metres of estuarine deposits poses a number of key questions, including where the Cuckmere river was throughout all this time, where the coast was situated and what sort of coastal barrier was present.

Radiocarbon dating

3.5.5 A sample for radiocarbon dating was submitted from the basal organic deposit from 23.18m bgl in depth. A waterlogged hazelnut shell (*Corylus avellana*) from the buried land surface helped date the first effects of marine inundation to 8030±30 BP (7070-6820 cal. BC at 95.4%: SUERC-33111) (Appendix C). This is consistent with other south coast sequences which indicate that marine inundation occurred relatively early in the Holocene.

4 Discussion

4.1 Reliability of field investigation

4.1.1 The single borehole was able to prove bedrock and obtain a continuous sequence of sample cores at 240m along transect LN131. Core recovery was excellent and compaction was kept to a minimum. The sequence is broadly consistent with the previous sequences identified within the area by Hunter and Pine 2004 and Burrin 1983. However, it is difficult to ascertain how representative this sample is of the valley sequence based on only one sample location.

4.1.2 At this point it is difficult to provide any degree of reliability to the geophysical interpretation based on a single tie point. This is because the interpretation of the geophysical data needs to be treated with caution. The sharpness of the transition (e.g. as seen on LN132) certainly supports this scenario, however it should be remembered that the geophysics is not mapping lithology but resistivity/conductivity. For example, a single lithological unit may vary laterally in grain size, water content and (if close to the sea) conductivity due to the presence of salt water. This may cause electrical resistance/conductivity to vary laterally within a unit. Furthermore where lithological boundaries are not sharp transitions but graded ones then the electrical gradient across the boundaries will also change.

4.2 Evaluation objectives and results

4.2.1 The borehole survey was able to successfully identify the base of the Holocene alluvial surface and prove the upper surface of the bedrock. However, the survey failed to provide a second tie-in point for the geophysics.

4.2.2 Accepting these difficulties it can, however, be suggested that the ground-truthing using the borehole has confirmed the preliminary conclusions of the survey:

- The geo-electric sections clearly discriminate subsurface features
- The bedrock surface and topographic template can be identified along the profiles
- That the sequence thickness attains depths of at least 27.5m in places

4.2.3 At present other factors still remain to be explained. For example, the surface of the bedrock undulates greatly and the significance of this cannot yet be fully determined. Preliminary interpretations about the archaeological potential of the buried topography and deposits must be made cautiously and if anything this emphasise the need for further work to better define these sub-surface features.

4.3 Interpretation and Significance

4.3.1 Although the origin of the Cuckmere Valley is currently obscure major modifications to the valley would have taken place at the end of the last cold stage when significant discharge, down-valley, of spring meltwaters would have resulted in erosion and downcutting in the valley floor. The valley edges would also have been subjected to erosion through periglacial processes, leading to the accumulation of the solifluction deposits identified at the base and edges of the valley.

4.3.2 With the onset of warming during the Holocene, soils would have started to form within the Cuckmere Haven and its surrounding valleys. A remnant of this earlier Holocene soil may be potentially represented at the base of borehole OABH1 at a depth of 23.00m bgl (-22.10m OD). The valley bottoms may have supported a dry forest bed of pine and birch at this time dissected by small freshwater streams. The sea would have been further south than present and the Cuckmere Haven would have been a predominantly wooded environment, rich in food resources and supporting abundant animal populations. This would have provided an attractive environment for Upper Palaeolithic and early Mesolithic hunter-gather communities to exploit.

4.3.3 The preliminary mapping of the topographic template within the Haven has identified a number of subsurface features that include possible palaeochannels and buried islands. A series of topographic steps was identified within geo-electric section LN131 that may indicate basal valley shelves that may have been inundated at different times during the Holocene (Figure 5). The steps may have a variety of causes and additional ground-truthed data is required. Further geophysical sampling is also necessary in order to laterally define these subsurface features and map them spatially across the valley. This undulating template would have had a significant influence on sedimentation and vegetation patterns within the Haven.

4.3.4 A summary of the borehole sedimentary sequence and results of the preliminary palaeoenvironmental assessment are presented in Figure 6 and discussed below:

4.3.5 At Langney Point the transgressive contact was recorded by Jennings (1985) at a depth of -24.7m O.D. at c.9850 cal. BP. This consistent with the lower Cuckmere Valley date of 8030±30 BP (SUERC-33111), where similar deeply buried organic rich silts are present in OABH1. The organic silty clay deposits identified at a depth of 22.00m (-21.10m OD) may represent one such drowned floodplain surface that was caused by the backing-up of these partially freshwater river systems. Rising water-levels within the valley would have helped to create a mosaic of different wetland environments, providing a range of resources for exploitation by local communities.

4.3.6 A major phase of clayey silt/sand deposition is recorded above 21.50m, potentially associated with brackish water incursion. These deposits may have been deposited in low saltmarsh or tidal mudflat environments. The ostracods indicate that this environment was protected from a wholly marine influence, possibly due to the presence of a shingle barrier. Mesolithic communities would have had to adjust to the changing floodplain conditions. More permanent activity may have moved away from the valley floor to the edges and islands that surrounded the tidal flats. Exploitation of the tidal environment would have probably been on a more seasonal basis, although the flats may have provided easy access to the Weald.

4.3.7 No thick units of freshwater organic deposits were identified in OABH1, or in the previous borehole work (Hunter and Pine 2004). Burrin (1983) records the basal gravels at Cuckmere overlain at c. 28m by silty clays to c. 20m, then sands up to 3m, overlain by an upper silty clay. A similar estuarine sand dominated lower sequence is recorded within the Lower Ouse and Adur Valleys (Waller and Long 2010). In contrast freshwater peat formation is extensively recorded from the valley sequence to the east of Beachy Head, and from the middle Ouse valley during the mid Holocene which began at Lewes c. 7200 cal. BP in the Glynde valley (Waller and Hamilton 2000). Other sequences also record a phase of peat accumulation during the mid Holocene associated with a phase of estuarine contraction. These peats are consistently described as comprising a basal woody peat and an upper detrital peat, overlain by brackish/marine silts. The upper surface of these mid Holocene peat sequences have previously produced evidence of Bronze Age activity, most notably at the site of Shinewater, in the Willingdon Levels, East Sussex (Greatorex 2003) and evidence of woodland clearance within Combe Haven (Jennings 1985; OA 2008).

4.3.8 The absence of any thick peat deposits within the sequence may simply reflect the currently limited scope of the sampling within the valley, highlighting the need for further deep sampling. Certainly the evidence of redeposited peat lumps recorded between 13.20m (-12.3m OD) and 11.40m (-10.5m OD) within OABH1, hint that peat deposits may be preserved around the edges of valley. However, if the absence of peat or freshwater deposits is found to be a true reflection of the lower Cuckmere Valley sequence than this may limit its archaeological potential. Certainly very local factors, such as the presence of gravel bars as suggested by Jennings and Smyth (1982a; 1982b) at sites such as the Combe Haven, may be one of many determining factors. Waller *et al* (2010) also attributes the absence of mid Holocene peats to more exposed marine conditions and limited gravel supply to the west of Beachy Head.

4.3.9 The thick upper deposits of inter-digitating silts and sands mark a major phase of marine incursion and channel migration. Preliminary studies of the ostracods contained within the upper sequence suggests the establishment of mid to upper saltmarsh followed by tidal mudflats conditions on the valley floor. Similar major incursions by the sea at this time are recorded at Combe Haven and Romney Marsh, and at a number of other locations along the coast of England. It is often referred to as the 'Romano-British Transgression', with a number of potential causes cited for the rapid rise in sea level. It is widely believed that large-scale deforestation and sediment availability may have also played a significant role in the increased flooding and rising water-levels in valleys during this period.

4.3.10 Later prehistoric to early medieval activity associated with these saltmarsh environments are likely to be found towards the valley edges and coastal islands which could have acted as natural harbours and staging points. These may have also been used for communication, necessary for the growth of settlement and trade in the area.

4.3.11 Reclamation on parts of the Cuckmere Haven is likely to have occurred following the storms of the 13th century AD. This may have reduced the tidal influence in the area and increased sedimentation within the valley, which may have facilitated this process.

4.4 Recommendations for further work

4.4.1 The study area would benefit from a detailed geomorphological field study that would focus on mapping key geomorphic landscape and sedimentary features on the valley edges and exposed sections. This would include an examination of the thick colluvial exposures identified on the valley slopes, cliff sections and other valley features. This may also include more detailed assessment of the environmental and sedimentary evidence, including the land snail and artefactual material preserved within the colluvial deposits.

4.4.2 Further integrated modelling of the valley sequence and buried palaeotopography would also help to provide a more comprehensive understanding of the evolution of Cuckmere Haven and its buried archaeological potential.

4.4.3 Further field sampling and mapping of the buried valley sequence is required in order to provide a clearer understanding of the sedimentary sequence and help to better define subsurface features. This work should also search for preserved organic deposits around the edges of the valley and further upstream that may have greater archaeological and palaeoenvironmental potential. This should be combined with a programme of palaeoenvironmental and dating work in order to provide a chronological framework to the sequence and allow it to be compared with other regional sequences.

4.5 Acknowledgements

4.5.1 OA would like to thank Casper Johnson and Adrian Davies for their help and advice in setting up the project. The fieldwork was undertaken by Carl Champness and Christof Heistermann. The geophysical interpolation was carried by Martin Bates who provided advice and guidance throughout the project. The report was produced by Martin Bates and Carl Champness.

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APPENDIX A. BOREHOLE LOG

GEOARCHAEOLOGICAL SERVICES

FIELD SEDIMENT LOGGING SHEET

SITE CODE: SECH10

NG EASTING: 551409.95

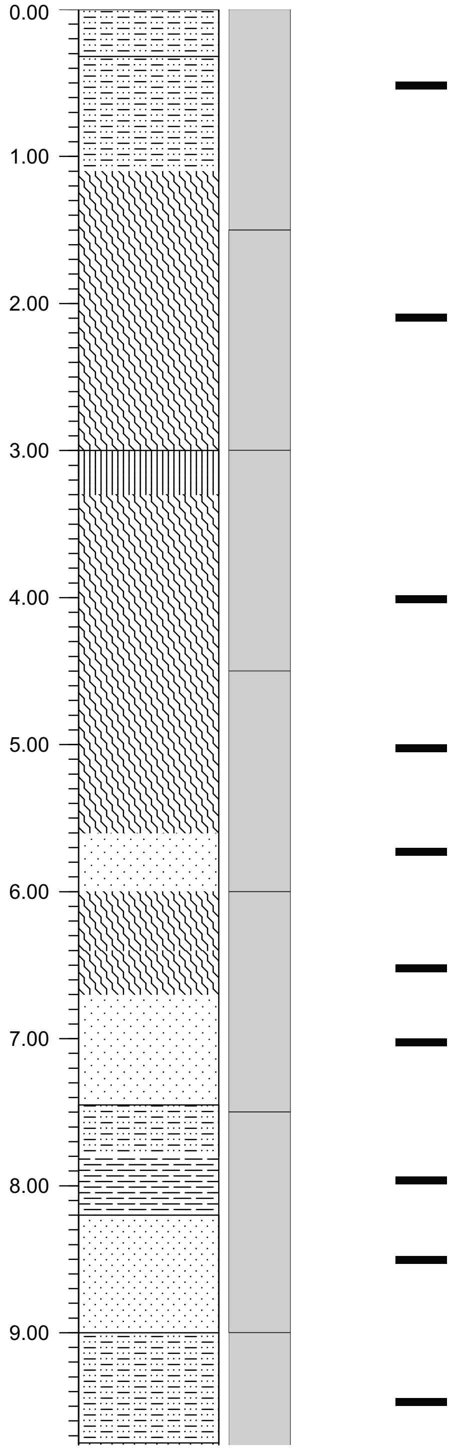
OABH1

ELEVATION: 0.907

NG NORTHING: 98028.807

Depth | Lithology | Cores | Sub-samples | Description

C14 | Ostracod



silty clay: Friable to soft mid brown organic silty clay with frequent rootlets and no coarse inclusions.

silty clay: Firm to soft brownish yellow structureless silty clay with occassional manganese staining. Distinct upper boundary with the topsoil.

clay: Very soft grey structureless clay with no coarse inculsions. Diffuse upper boundary.

Void: Compaction void

clay: Soft light greyish yellow structureless clay with no coarse inclusions.

clay: Soft structureless light grey clay with no coarse inclusions

silty sand: Loose light grey fine to medium silty sand

clay: Soft light brownish yellow structureless clay. Diffuse lower boundary with the underlying grey clay.

clay: Soft light grey structureless clay with no coarse inclusions.

silty sand: Loose light to mid fine grey silty sand.

silty clay: Soft light yellow structureless silty clay / clay.

clayey silt: Soft mid grey structureless clayey silt.

sand: Loose mid grey medium silty sand with no coarse inclusions.

silty clay: Soft yellowish grey structureless clay.

NOTES:

GEOARCHAEOLOGICAL SERVICES

Oxford Archaeology

FIELD SEDIMENT LOGGING SHEET

SITE CODE: SECH10

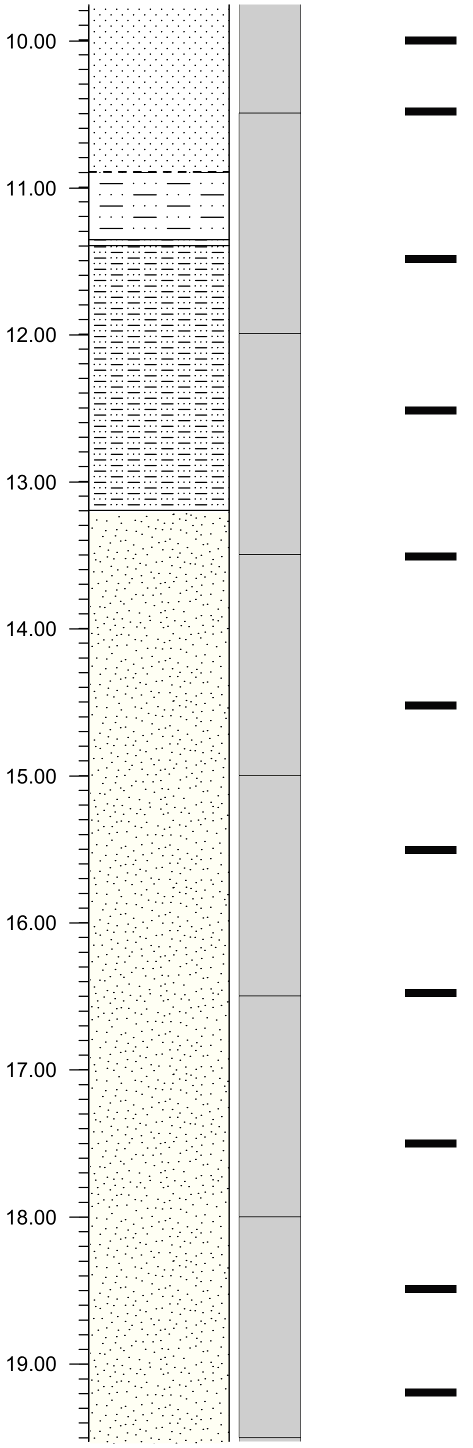
NG EASTING: 551409.95

OABH1

ELEVATION: 0.907

NG NORTHING: 98028.807

Depth | Lithology | Cores | Sub-samples (C14, Ostracod) | Description



sand: Loose mid grey medium sand. Becoming increasing clayey sand near to the base.

clayey sand : Soft mid grey structureless silty clay / clayey sand. Very diffuse upper transition.

silty clay: Soft mid-dark brown organic silty clay with very distinct boundaries.

silty/sandy clay:Soft light grey structureless silty clay with pockets of redeposited fibrous peat.

clayey sand: Soft light laminated greenish grey clayey sand.

NOTES:

GEOARCHAEOLOGICAL SERVICES

Oxford Archaeology

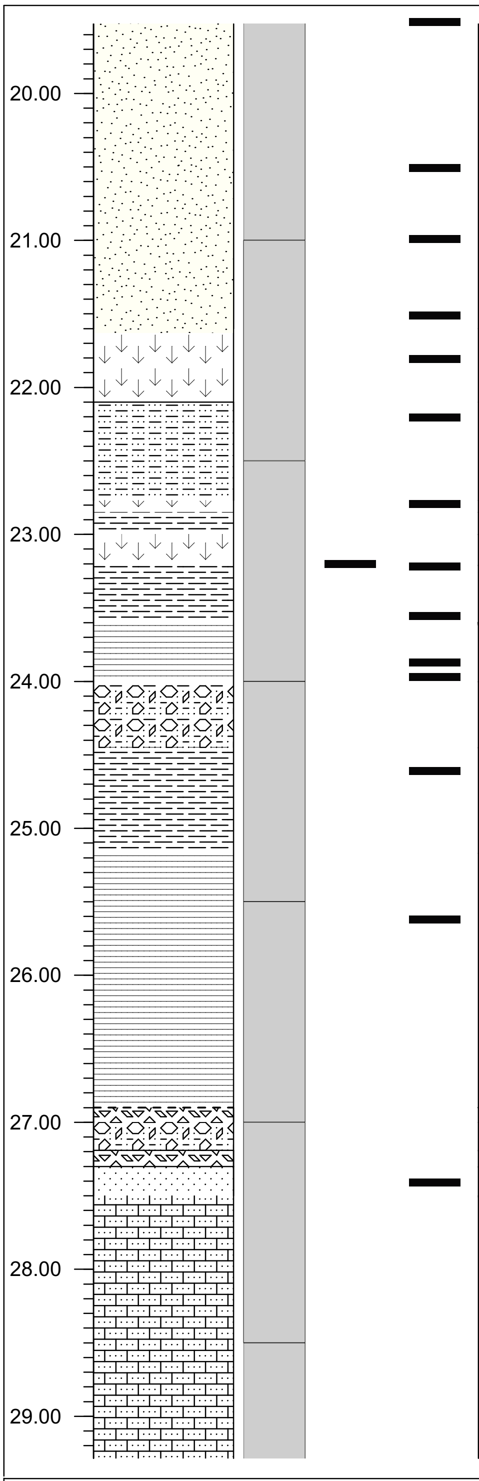
FIELD SEDIMENT LOGGING SHEET

SITE CODE: SECH10 NG EASTING: 551409.95

OABH1 ELEVATION: 0.907 NG NORTHING: 98028.807

Depth | Lithology | Cores | Sub-samples | Description

C14 | Ostracod



organic clayey silt: Soft dark greyish brown organic silty clay with occassional wood inclusions. Diffuse upper boundary.

silty clay: Soft grey structureless silty clay with no coarse inclusions.

organic clayey silt: Soft dark greyish brown organic clayey silt.

clayey silt: Soft light grey minerogenic structureless clayey silt.

organic clayey silt: Soft dark greyish brown organic clayey silt.

clayey silt: Soft structureless slightly greenish grey clayey silt.

silty clayey gravel: Soft light/mid grey silty clay with sub-rounded pebble and cobble gravel (40%).

gravel: Loose clast supported sub-angular to sub-rounded cobble gravel clasts. Becoming clayey near to the upper boundary.

clayey silt: Firm to soft yellowish white calcareous clayey silt.

clayey silty gravel: Firm yellowish white calcareous gritty clayey silt with angular pebble gravel and chalk lumps.

Soliflucted chalk: Large fragments of blocky sub-angular to angular chalk.

gravel: Loose clast supported sub-angular cobble gravel and chalk lumps (5-9cm).

Soliflucted chalk: Large fragments of blocky sub-angular to angular chalk.

sand: Loose light yellowish white calcareous medium to coarse sand. Sharp contacts

chalk: Chalk bedrock

NOTES:

GEOARCHAEOLOGICAL SERVICES

FIELD SEDIMENT LOGGING SHEET

Oxford Archaeology

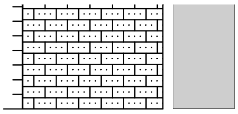
SITE CODE: SECH10

NG EASTING: 551409.95

OABH1

ELEVATION: 0.907

NG NORTHING: 98028.807

Depth	Lithology	Cores	Sub-samples		Description
			C14	Ostracod	
30.00					

NOTES:

Appendix B. ostracod and Foraminifera Assessment

CUCKMERE VALLEY, EAST SUSSEX

SECH/10 OA B1

storm surge ▼ (at 8.50-8.52m)

onset of tidal access? ▼ (at 22.78-22.80m)

ORGANIC REMAINS

	0.50-0.52m	2.00-2.02m	4.00-4.02m	5.00-5.02m	5.70-5.72m	6.50-6.52m	7.00-7.02m	8.00-8.02m	8.50-8.52m	9.50-9.52m	10.00-10.02m	10.50-10.52m	11.50-11.52m	12.50-12.52m	13.50-13.52m	14.50-14.52m	15.50-15.52m	16.48-16.50m	17.50-17.52m	18.50-18.52m	19.20-19.22m	19.50-19.52m	20.50-20.52m	21.00-21.02m	21.50-21.52m	21.80-21.82m	22.20-22.22m	22.78-22.80m	23.20-23.22m	23.60-23.62m	23.90-23.92m	24.00-24.02m	24.20-24.22m	24.61-24.63m	25.65-26.67m	27.45-27.47m
plant debris + seeds	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	
brackish foraminifera	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x			
brackish ostracods	x	x	x			x		x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x		x		x	x			
charophyte oogonia		x			x		x		x		x																									
earthworm granules		x	x			x						x																								
molluscs		x	x						x		x	x			x	x	x		x		x	x	x		x	x										
insect remains		x									x													x				x	x	x		x	x			
marine foraminifera		x					x	x	x		x																									
freshwater ostracods							x		x		x																	x		x	x	x	x			
marine ostracods									x			x																								
fish remains												x																								
cladoceran ephippia																											x									
	mud				silty/sand					mud																				pebbles + mud		mud	gravel + mud	chalk debris		
Ecology	tidal mudflats and creeks, some fringing saltmarsh			high salt-marsh	tidal sandflats				creek (marine event)	mid-high saltmarsh bordering on mudflat						tidal mudflats and creeks, some fringing saltmarsh												both freshwater and a few brackish components in mud (contamination); basal gravels						solifluction		
	tidal access																											Freshwater								

BRACKISH FORAMINIFERA

	0.50-0.52m	2.00-2.02m	4.00-4.02m	5.00-5.02m	5.70-5.72m	6.50-6.52m	7.00-7.02m	8.00-8.02m	8.50-8.52m	9.50-9.52m	10.00-10.02m	10.50-10.52m	11.50-11.52m	12.50-12.52m	13.50-13.52m	14.50-14.52m	15.50-15.52m	16.48-16.50m	17.50-17.52m	18.50-18.52m	19.20-19.22m	19.50-19.52m	20.50-20.52m	21.00-21.02m	21.50-21.52m	21.80-21.82m	22.20-22.22m	22.78-22.80m	23.20-23.22m	23.60-23.62m	23.90-23.92m	24.00-24.02m	24.20-24.22m	24.61-24.63m	25.65-26.67m	27.45-27.47m
Jadammina macrescens	x	x	x	xx							x		xx	xx	xx			x				x		x	x	x	x					x	x			
Trochammina inflata		x		xx		o				o	xx	xx	xx	xx	xx							x		x	x											
Haynesina germanica	xx	xxx	xxx		xx	x	xx	x	xx	x	xx	xx	o	x	x	xxx	xxx	xx	xx	xx	xx	xx	xx	x	xx	x	x	x			o		x			
Ammonia sp. (brackish)	x	xx	xxx		xx	x	x	x	xx	x	xx	xx		x	x	x	x	x	x		x	x	x	x	xx	x	xx									
Elphidium williamsoni	x	xx	xx				x	x	xx		x	x	o	o		x	x	x	o	x	xx	x	x	o		o	o									
Elphidium waddense		x	xx													x	xx		x			x	xx	x		o										

Agglutinating foraminifera of mid-high saltmarsh

Calcareous foraminifera of low-mid saltmarsh a

MARINE FORAMINIFERA

	0.50-0.52m	2.00-2.02m	4.00-4.02m	5.00-5.02m	5.70-5.72m	6.50-6.52m	7.00-7.02m	8.00-8.02m	8.50-8.52m	9.50-9.52m	10.00-10.02m	10.50-10.52m	11.50-11.52m	12.50-12.52m	13.50-13.52m	14.50-14.52m	15.50-15.52m	16.48-16.50m	17.50-17.52m	18.50-18.52m	19.20-19.22m	19.50-19.52m	20.50-20.52m	21.00-21.02m	21.50-21.52m	21.80-21.82m	22.20-22.22m	22.78-22.80m	23.20-23.22m	23.60-23.62m	23.90-23.92m	24.00-24.02m	24.20-24.22m	24.61-24.63m	25.65-26.67m	27.45-27.47m
miliolids		x						x			x																									
Ammonia batavus							x	x	x		x																									
Elphidium excavatum									x		o																									
Cyclogyra involvens									o																											

Essentially marine foraminifera, but can penetrate outer estuaries

BRACKISH OSTRACODS

	0.50-0.52m	2.00-2.02m	4.00-4.02m	5.00-5.02m	5.70-5.72m	6.50-6.52m	7.00-7.02m	8.00-8.02m	8.50-8.52m	9.50-9.52m	10.00-10.02m	10.50-10.52m	11.50-11.52m	12.50-12.52m	13.50-13.52m	14.50-14.52m	15.50-15.52m	16.48-16.50m	17.50-17.52m	18.50-18.52m	19.20-19.22m	19.50-19.52m	20.50-20.52m	21.00-21.02m	21.50-21.52m	21.80-21.82m	22.20-22.22m	22.78-22.80m	23.20-23.22m	23.60-23.62m	23.90-23.92m	24.00-24.02m	24.20-24.22m	24.61-24.63m	25.65-26.67m	27.45-27.47m
Cyprideis torosa	o	x	xx			o		x	xx	o	x	x		o							x			x	x											
Leptocythere porcellanea			x						x												x		x	xx	x							x	xx			
Loxoconcha elliptica								x	xx		xx	x									x		x													
Cytherura gibba									o																											
Leptocythere psammophila												o																								
Leptocythere castanea																xx	xx		xx	x	x	x	x	x		x										
Leptocythere lacertosa																xx	xx	x	xx	x	x	x	xx	x	xx	x	x	x		x		xx	x			

Brackish ostracods of estuarine mudflats and creeks

MARINE OSTRACODS

	0.50-0.52m	2.00-2.02m	4.00-4.02m	5.00-5.02m	5.70-5.72m	6.50-6.52m	7.00-7.02m	8.00-8.02m	8.50-8.52m	9.50-9.52m	10.00-10.02m	10.50-10.52m	11.50-11.52m	12.50-12.52m	13.50-13.52m	14.50-14.52m	15.50-15.52m	16.48-16.50m	17.50-17.52m	18.50-18.52m	19.20-19.22m	19.50-19.52m	20.50-20.52m	21.00-21.02m	21.50-21.52m	21.80-21.82m	22.20-22.22m	22.78-22.80m	23.20-23.22m	23.60-23.62m	23.90-23.92m	24.00-24.02m	24.20-24.22m	24.61-24.63m	25.65-26.67m	27.45-27.47m
Pontocythere elongata									x			o																								
Cythere lutea									x																											
Hemicythere villosa									x			o																								
Leptocythere pellucida									o			o																								
Hirschmannia viridis									o																											

Essentially marine ostracods, but can penetrate outer estuaries

FRESHWATER OSTRACODS

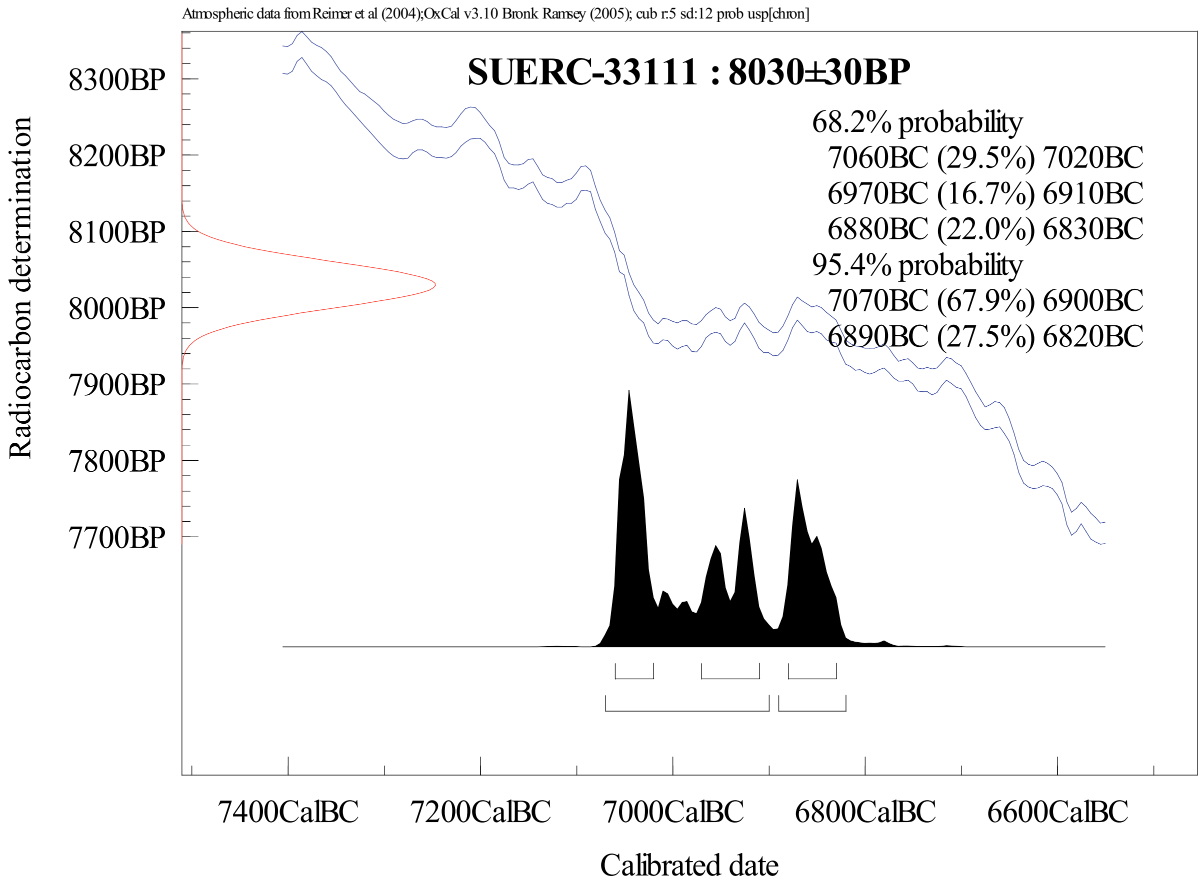
	0.50-0.52m	2.00-2.02m	4.00-4.02m	5.00-5.02m	5.70-5.72m	6.50-6.52m	7.00-7.02m	8.00-8.02m	8.50-8.52m	9.50-9.52m	10.00-10.02m	10.50-10.52m	11.50-11.52m	12.50-12.52m	13.50-13.52m	14.50-14.52m	15.50-15.52m	16.48-16.50m	17.50-17.52m	18.50-18.52m	19.20-19.22m	19.50-19.52m	20.50-20.52m	21.00-21.02m	21.50-21.52m	21.80-21.82m	22.20-22.22m	22.78-22.80m	23.20-23.22m	23.60-23.62m	23.90-23.92m	24.00-24.02m	24.20-24.22m	24.61-24.63m	25.65-26.67m	27.45-27.47m
Prionocypris zenkeri							o																													
Heterocypris salina									o		o																									
Sarscypridopsis aculeata											o																									
Candona neglecta																												xx		x	o		x			
Candona candida																												x								
Ilyocypris spp.																												x		xx		x				
Cypris ophtalmica																												x								
Cyclocypris sp.																														x						

Non-marine ostracods

Organic remains are recorded on a presence (x)/absence basis only

Foraminifera and ostracods are recorded: o – one specimen; x – several specimens; xx – common; xxx – abundant

Appendix C. Radiocarbon Dating


Atmospheric data from Reimer et al (2004);OxCal v3.10 Bronk Ramsey (2005); cub r:5 sd:12 prob usp[chron]
SUERC-33111 : 8030±30BP
68.2% probability
7060BC (29.5%) 7020BC
6970BC (16.7%) 6910BC
6880BC (22.0%) 6830BC
95.4% probability
7070BC (67.9%) 6900BC
6890BC (27.5%) 6820BC
Radiocarbon determination
8300BP
8200BP
8100BP
8000BP
7900BP
7800BP
7700BP
7400CalBC
7200CalBC
7000CalBC
6800CalBC
6600CalBC
Calibrated date

Appendix D. Summary of Site Details

Site name:	Cuckmere Haven, East Sussex
Site code:	SECH10
Grid reference:	NGR 551400 098500
Type:	Field sampling
Date and duration:	December 2010
Area of site:	130 ha
Summary of results:	In late December a borehole survey was undertaken in order to ground-truth two previous geophysical surveys. The fieldwork successfully sampled one sequence to a depth of 30m within the Cuckmere Valley revealing a 24m deep estuarine sequence overlying chalk solifluctions deposits and Chalk bedrock at 27.5m in depth. This data was used to identify the base of the Holocene template along the geophysical transects and provide a sequence of environmental change.
Location of archive:	The archive is currently held at OA, Janus House, Osney Mead, Oxford, OX2 0ES, and will be deposited with the Sussex Past County Museum in due course, under the following accession number: TBC

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