Bexhill to Hastings Link Road

Geoarchaeological field assessment

Archaeological Investigation Report

Archaeological Investigation Report

oxfordarchaeology

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GEOARCHAEOLOGICAL FIELD ASSESSMENT REPORT

FOR

EAST SUSSEX COUNTY COUNCIL

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SUMMARY

Oxford Archaeology (OA) was commissioned by East Sussex County Council to undertake a geoarchaeological assessment for a proposed link road between Bexhill and Hastings, East Sussex (centred on NGR 756 108). The work was carried out between March 2006 and October 2007 prior to the determination of the planning application for the scheme.

The geoarchaeological assessment consisted of a staged approach in order to assess the archaeological potential of the proposed route that runs along the Battle-Hastings ridge. The route crosses an intricate pattern of river valleys and ridges. The proposed scheme skirts the edges of the Combe Haven Basin, which is a low-lying area that was once part of the Sussex Levels. The first phase of assessment, undertaken as part of the Environmental Impact Assessment, consisted of a desk based study of geotechnical and archaeological watching brief records, and placed these within their wider geoarchaeological context. This information provided baseline data on valley sequences along the route in order to identify deposits and sub-surface features that could be targeted for more detailed field investigation.

The second phase consisted of field investigation which comprised nine boreholes and eight test pits targeted on specific deposits within the four valley of the Combe Haven, Watermill Stream, Powdermill Stream and the Decoy Pond Stream, which are crossed by the proposed route. The field investigation was undertaken in order to provide more detailed sedimentary information and provide samples suitable to assess the palaeoenvironmental potential of the sequences.

The geoarchaeological assessment identified a high degree of consistency within the valleys sequence, which represented a typical tripartite system of sedimentation. Two main phases of rising sea level (marine transgression) and one phase of falling sea level (regression) were identified. Previous studies have noted that early prehistoric utilisation of the Levels was dependent on episodes of marine regression. The main period of regression was characterised by the accumulation of peats and organic deposits that represent a mosaic of different wetland environments. The formation of these deposits have been radiocarbon dated to between c 4390±60 BC (Late Mesolithic) to c 1790±100 BC (early Bronze Age). More detailed examination of the sequence revealed significant complexity within the main Combe Haven Peat Sequence. This sequence consisted of at least two phases of peat formation inter-dispersed with periods of minrogenic deposition, representing freshwater river flooding and shifting wetland environments.

During the field assessment boreholes were used to log valley sequences and collect environmental samples. Palaeoenvironmental assessment for pollen, waterlogged plant remains, insects and diatoms was undertaken for two valley sequences (Watermill Stream Valley and Powdermill Stream Valley). The assessment identified good potential for the preservation of environmental and organic remains. This allowed an interpretation of the vegetation history of the area from the Mesolithic onwards.

The first signs of direct human impact within the sequence were identified at -3.12 m depth (-0.80 m OD) associated with the peat accumulation. The pollen provides evidence of small clearings within the valley bottoms dated by radio carbon to c 3430±90 BC (Early-Mid

Neolithic). Such cleanings can occur naturally through fires or animal activity. However, in this sequence it coincided with an increase in charcoal and other anthropogenic indicators. Based on comparisons with other palaeoenviornmental studies the elevation and deposits are similar to those which have also been dated to the Neolithic / Bronze Age periods.

Test pits were positioned on the edges of the valley sequences to look for signs of human activity. Two of these test pits produced archaeological material. A Late Neolithic / Early Bronze Age flint scatter, burnt flint and charcoal, were recovered from a test pit (OATP4) at the edge of the Watermill Stream Valley which also produced the environmental evidence noted above. The stratigraphic location of these finds and their fresh condition, indicate that there is a good possibility that they have been recovered from an in-situ scatter. Such assemblages are exceptionally rare and present unique insights into the performance and structuring of activities in past. It is therefore possible that these flints provide an indication of a regionally, or nationally, important site.

A second test pit on the edge of the Combe Haven Stream Valley (OATP1) identified an archaeological deposit buried beneath the topsoil, which produced a quantity of fired clay. This appears to represent material derived from a domestic oven or pottery Kiln, potentially dating to the early historic periods. This assemblage may indicate an area of activity or occupation adjacent to the Combe Haven Stream, which may have been located at the edge of a large tidal inlet.

Combined archaeological and palaeoenvironmental research on the Levels are only now starting to reveal the full potential of these deposits. This is surprising considering the studies undertaken in Cambridge, London and Somerset on the Levels, where the early prehistoric period is known as a period of wetland exploitation. The Combe Haven and its tributary valleys are therefore important as an example of a low-lying area devoid of upstanding monuments, which has the potential to produce evidence of significant early prehistoric exploitation and occupation.

Bexhill to Hastings Link Road
East Sussex

GEOARCHAEOLOGICAL FIELD ASSESSMENT

NGR TQ 756 108

1 INTRODUCTION

1.1 Scope of the Study

1.1.1 Oxford Archaeology (OA) was commissioned by East Sussex County Council to produce a desk based Geoarchaeological Assessment as an addendum to the Environmental Impact Assessment (EIA) for the proposed Bexhill to Hastings Link Road (hereinafter referred to as the 'Scheme'). This field assessment aimed to ground truth the deposit model produced in the initial assessment report and provide more site specific information about the archaeological and palaeoenvironmental potential of the four valley sequences that cross the route.

1.1.2 The field investigation comprised 9 boreholes and 8 test pits targeted on specific areas of the four valley sequences in order to provide samples for detailed sediment descriptions and palaeoenvironmental assessment. The boreholes were targeted on the deepest representative sequences in order to recover palaeoenvironmental samples. The test pits were targeted on the valley edges and surface of the peat horizons in order to assess the archaeological potential and preservation of these deposits.

1.1.3 Based on the fieldwork results, two valley sequences were selected for palaeoenvironmental assessment which examined the preservation of pollen, plant remains, insects and diatoms. Material suitable for radiocarbon dating was also recovered from organic deposits in order to help correlated the sequences with previous palaeoenvironmental studies.

1.1.4 This report will bring together the different parts of the project in order to present an integrated assessment of the geoarchaeological potential of the valley sequences. This will provide an evidence-base for decision making about the nature and value of this resource and consideration of the possible impacts on these deposits.

1.2 Location, topography and geology

1.2.1 The Scheme follows a route between Bexhill and Hastings (centred on NGR 756108), crossing near to the village of Crowhurst. It follows the lower slopes of the Battle-Hastings ridge. The route skirts around the main Combe Haven basin crossing an intricate pattern of minor valleys and ridges, the river valleys of the Combe Haven, Watermill Stream, Powdermill Stream and Decoy Pond Stream.

1.2.2 The Combe Haven Valley itself is a low-lying, poorly drained, flat wetland, where much of the land lies just above sea level. The Combe Haven River runs through the main valley, towards Bulverhythe, from where it flows into the sea. The majority of the land is unimproved pasture with small farmsteads located on the higher ridges of the valleys. To the west and east are the major coastal urban areas of Bexhill and Hastings.

1.2.3 The British Geological Survey of Great Britain (BGS 320/321) maps the underlying geology of the area as predominantly floodplain valley deposits, surrounded by ridges of predominately Wadhurst Clay overlying Ashdown Sands. These are part of the Hasting Beds formation, that were former Cretaceous seabed deposits, uplifted through tectonic movement into what now forms part of South East England.

2 The Archaeological and Environmental Background

2.1 Introduction

2.1.1 The Scheme must be examined in its wider environmental context as part of a distinctive coastal environment. To be able to interpret and understand the area within its landscape setting it needs to be understood in terms of estuarine sedimentation and erosion processes, as a dynamic wetland environment with a specific plant succession that is confined to coastal edge environments.

2.2 Environmental background

2.2.1 In order to understand fully the character and distribution of archaeological sites in the Sussex Levels and the reasons behind major changes in settlement patterns in the past, it is necessary to understand the changing nature of the South Coast. Fluctuations in sea level throughout the Holocene have created an exceptionally full and complex sedimentary sequence.

2.2.2 The present day topography of the area 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 made-ground. The surface of the bedrock formed a "topographic template", depressions in which were filled with alluvial and estuarine sediments during the Holocene. The mapping of the underlying bedrock topography is therefore a key aim in understanding and interpreting the site sedimentary sequence.

2.2.3 The Holocene sediments in the area consist of a complex sequence of estuarine sandy clays, organic clays, and peats, deposited in a variety of environments representing alder carr, fen, reedswamp, intertidal saltmarsh and mudflats. The currently adopted stratigraphic sequence for the Combe Haven is based on work undertaken by Jennings and Symth (1987a, 1987b, and 1990). At least three discrete lithostratigraphic formations, predominantly of sands, organic deposits and silty clays, have been identified along the shores of the estuary in the intertidal zone to depths up to 10 metres.

2.2.4 The sediment sequence identified within the area of the Scheme is comparable to other sequences along the South East Coast and has been broadly divided into three main lithological units. The lower sequence consists of estuarine and marine sands that would have been deposited during the early Holocene. The middle part is characterised by silty clay alluvium and peat reflecting periods of changing sea-level and river flooding and the upper deposits consist of a return to estuarine silty clays that began to accumulate 2500-3000 years ago. The present landscape developed following the later reclamation of the area that began in the medieval period.

2.3 Archaeological background

2.3.1 The archaeological and historic background to the project has been extensively covered previously (OA, 2007), and only a brief summary is presented here to help place this work within a wider archaeological context:

2.3.2 Previously it has been assumed that the heavy soils of the Weald were less favoured for early prehistoric activity and settlement, compared to areas like the South Downs with its lighter soils (Armstrong, 1990). The lack of archaeological sites discovered within the area has tended to reinforce this view, with only isolated find spots hinting at low-levels of archaeological activity in the area. This is however in contrast to palaeoenvironmental studies (Jennings, 1987a, 1987b & 1990) that have identified potentially early prehistoric impacts on the vegetation history of the Combe Haven Valley. The absence of significant evidence is very likely therefore to reflect a lack of investigation rather than a true absence of activity and settlement in the area.

Prehistoric period

2.3.3 Early prehistoric activity within the area is likely to have been focused around the valley edges and wetlands, utilising areas of higher ground to exploit the wetland environment of the low-lying valleys. These environments would have offered rich resources for foraging, hunting and fishing. By the Iron Age, these environments were being inundated by estuarine conditions, creating natural inlets to act as harbours. This would have helped to facilitate development of transport and trade routes in the area.

2.3.4 At Upper Wilting Farm several possible hearths and pottery finds dated to the Bronze Age (and possibly the Early Iron Age) have been located on the valley edges and at the interface with the wetland zone. This suggests that there may have been a Bronze Age farming settlement located on the higher ground overlooking the Combe Haven river, possibly on land between Monkland Wood and Upper Wilting Farm (to the south of the Scheme).

2.3.5 Islands or promontories overlooking wetlands have previously produced evidence of extensive Bronze Age activity within the Sussex Levels. A peaty layer at Peacock Farm, in Eastbourne, produced significant quantities of Bronze Age pottery. Nationally important remains were also excavated at Shinewater, in Eastbourne, including a large wooden platform and trackway running east-west towards Willingdon. The platform, estimated to cover an area of *c* 2000 sqm, was associated with the upper peat surface and was overlain by marine silty clays. On the platform surface a 0.20 m thick accumulation of cultural material was identified dating to the late Bronze Age. Finds included several bronze axe heads and a sickle reaping hook with its wooden handle intact. Human remains were also recorded, deliberately placed on to the platform (Jennings et al, 2003).

2.3.6 The waterlogged conditions at the site provided excellent conditions for the preservation of wooden artefacts and ecofactal remains. The site was interpreted as a harbour or quay site, perhaps used by boats crossing the Channel. Excavation of the trackway in 1996, on the route of a new bypass, revealed a trackway surface and triple row alignment of vertical timbers. The trackway would have provided safe access across the wetland zone, connecting the platform to higher dry ground. Further evidence of trackways has been found at Ditton, to the northwest of Shinewater (Jennings et al, 2003)..

Late Iron Age and Roman Period

2.3.7 The Combe Haven Valley was inundated in the early Iron Age, with salt marsh and reed swamp environments replacing areas of former alder and willow woodland in the valley bottoms. These conditions then persisted until some point in the middle of the Medieval period, possibly the 11th century. Further forest clearance for agricultural use resulted in the deposition of colluvium, possibly including that recorded south-west of Upper Wilting Farm. Rising river water levels during this period could have facilitated the transportation of iron exports and enhanced trading over a wider area.

2.3.8 The remains of a thriving Iron Age economy have been identified in the Combe Haven Valley based on the establishment of an early iron smelting industry. The area contains the essential raw materials that are required for iron smelting, including a plentiful supply of fuel wood. During the Roman period, the iron extraction industry continued to be the main focus of economic activity in the area, and was likely to have expanded.

Medieval Period

2.3.9 In the Early Medieval period the lower-lying parts of the Combe Haven Valley were largely reclaimed from the sea, with only certain parts of the valley retaining any maritime links. There is a paucity of archaeological and historical evidence for this period.

Post-Medieval / Modern Period

2.3.10 The Combe Haven Valley appears to have remained relatively stable since the Medieval period, although some minor variation in sea-levels has been recorded.

3 AIMS

3.1 Research strategy

3.1.1 The main objective of the assessment was to identify the main sediment packages within the valley sequences, assess their archaeological significance and palaeoenvironmental potential.

3.1.2 The main aims of the assessment were to:

- Characterise the sequence of sediments and patterns of accumulation across the valley sequences, including the depth and lateral extent of major stratigraphic units, and the character of any basal land surface pre-dating these sediments;
- Identify significant variations in the deposit sequence indicative of localised features such as topographic highs or palaeochannels;
- Identify the location and extent of any waterlogged organic deposits and address the potential and likely location for the preservation of archaeological and palaeoenvironmental remains;
- Clarify the relationships between alluvial/fluvial sediment sequences and other deposit types, including periods of ‘soil’ development, peat growth and archaeological deposits;
- To identify any archaeological remains (if present) or deposits that the development may remove or impact during the construction of the scheme;

- Attempt to develop a comprehensive overview of these sequences that brings together the changing sedimentary, environmental and anthropogenic evidence of the proposed route;
- Establish a chronology framework for the sequence using radio-metric techniques;
- To assess the archaeological significance of the sequences and whether further work should be recommended;

4 METHODOLOGY

4.1 Introduction

The geoarchaeological assessment comprised a staged approach in order to fully characterize the Schemes archaeological and palaeoenvironmental potential. A desk based assessment of previous palaeoenvironmental and archaeological studies within the area was undertaken followed by a targeted field assessment in order to identify the more Scheme specific potential. This included a selection of samples for palaeoenvironmental assessment and integration of data.

4.2 Desk-based assessment and preliminary deposit modelling

4.2.1 An assessment of 31 boreholes and 63 test pit geotechnical records was undertaken by OA as part of the EIA to map the sedimentary sequence across the proposed Scheme and to highlight possible strata of archaeological and palaeoenvironmental potential. This data was entered into geological modelling software (Rockworks 2004©) and correlated and modelled into stratigraphic units across the Scheme. Specific emphasis was placed upon identifying variations in the character, elevation and thickness of organic or alluvial deposits, and the surface of the Pleistocene gravels.

4.2.2 The assessment identified that significant organic deposits were present within three of the four valley sequences crossed by the route. It identified significant archaeological and palaeoenvironmental potential within the valley sequences. Comparisons with other sites indicated that these deposits are likely to have a high archaeological and palaeoenvironmental potential.

4.2.3 No core or sample data was available during the desk-based assessment to verify any of the observations made in this report. All the data comprised paper copies of boreholes and test pit logs. Bates *et al* (2000) have drawn attention to the potential shortcomings of this form of data-set. The report identified the need for further field investigation in order to be able to fully characterise the archaeological and palaeoenvironmental potential of the sequence.

4.3 Targeted field Investigation

4.3.1 A program of 10 boreholes and 8 test pits was originally proposed across the valley sequence in order to ground truth the geotechnical data and assess the archaeological potential of these sequences. The boreholes were located within the four valley sequences (Figure 2) and were targeted on specific parts of the sequence where the thickest peat and the deepest sediment sequences were identified.

4.3.2 The boreholes were drilled using a Commachio MC300 drilling rig. Each borehole was drilled to the Pleistocene gravels or until bedrock was reached. A continuous sequence of core samples (0.125 m in diameter and 1.4 m in length) was retrieved from each location suitable for palaeoenvironmental assessment. The borehole samples were logged and the lithological data recorded using standard sedimentary recording procedures. This lithological information was then correlated into stratigraphic units and used to help revise the correlations presented within the preliminary deposit model.

4.3.3 The Trial pitting consisted of the excavation of eight 1.5 m wide by 5 m long by 5 m maximum depth trenches with a JCB excavator. The main aim of the trial pits was to assess the archaeological potential of the valley edge deposits, working on the assumption that these would have provided the best locations from which to exploit both the wet and dry land environments. Sample sections were photographed and recorded. All finds where assigned a unique number and bagged.

4.4 Reporting and palaeoenvironmental assessment

4.4.1 The geoarchaeological assessment report aimed to bring together the different strands of work in order to provide more detailed site specific and background information about the potential of the deposits. This field assessment will aim to bring together the changing sediment sequence, the vegetation history and identify anthropogenic impacts within the sequences.

4.4.2 A palaeoenvironmental assessment was undertaken on two borehole sequences (OABH 4 and 7) for pollen, waterlogged plant remains, insect and diatom and/or snails. Radio-carbon dates were selected from the main organic units to help correlate the sequence with previous palaeoenvironmental studies. Further sequences may be recommended for assessment and dating depending on the significance of the deposits and nature of any archaeology uncovered.

4.4.3 This assessment will form the basis for the selection of samples suitable for radiocarbon and thermo-luminescence dating.

5 RESULTS

5.1 Combe Haven Valley Sequence (Figure 3)

5.1.1 Two test pits (OATP1 and OATP2) and one borehole (OABH1) were originally proposed within the Combe Haven Valley Sequence. Due to initial problems of access the borehole was abandoned and only the test pits could be completed. The two test pits were excavated on opposing banks of the River Combe to a maximum depth of 3 m. The original positions were adjusted in the field to account for the missed borehole sample.

5.1.2 Test pit 1 was excavated to a depth of -2.50 m (+1.50m OD) onto a soft grey structureless clay (104) (Figure 6). This was overlain by a soft light reddish brown silty clay (103) with occasional sandy pockets between -1.80 m (+2.20m OD) and -0.58 m (+3.42 m OD). This was overlain by a loose light whitish sand (102) 0.24 m in thickness, possibly colluvial in origin. This was sealed by 0.34 m of soft mid brown silty clay topsoil (101).

5.1.3 The base of Test pit 2 came down onto the surface of a wood peat (207) at a depth of -2.20 m (+1.94 m OD). This was overlain by a loose grey sandy clay (206) between -

2.00 m and -1.20 m (+2.94 m OD). The upper surface of this deposit was iron stained with black deposits of manganese (205). This was overlain by soft grey silty clay (204) between -1.20 m and -0.72 m (+3.42 m OD). A loose light whitish yellow sand 0.16 m in thickness was located above this deposit. An organic archaeological horizon (202) was identified just underneath the topsoil and consisted of a brown silty clay containing frequent charcoal, bloom, and fired clay. This deposit appears to represent a spread of material associated with archaeological activity close to the river. This was overlain by 0.30 m of soft clay silt topsoil (201).

5.1.4 The fired clay consisted of 27 fragments weighing exactly 600g. The assemblage was quite small and there was very little in the way of preserved surfaces. Dating of the fired clay is problematic especially without supporting evidence, although an early historic date appears likely. It probably represents part of an oven or oven furniture such as a pedestal. Closer examination revealed that it is probably not derived from high temperature industrial processes (ie. metal / glass working), but more likely represents a domestic oven or pottery kiln.

5.2 Watermill Stream Valley Sequence (Figure 4)

5.2.1 Two test pits (OATP3 and OATP4) and four boreholes (OABH2, OABH3, OABH4 and OABH5) were excavated within the Watermill Stream Valley sequence. The boreholes and test pits to the east of the stream were excavated in their proposed positions. However, the ones to the west of the stream needed to be moved from their original locations because of the presence of standing water on the site, ecological constraints and areas of deep mud. This meant that the western edge of the valley could not be fully investigated and assessed during the field investigation.

5.2.2 Test pit 3 (Figure 6), towards the west of the stream, was excavated in order to assess the archaeological and waterlogged potential from the top of the peat deposits. It was excavated down to the top of a poorly humified reed peat (310) to a depth of -2.20 m (+0.69 m OD). This was overlain by a soft structureless light greyish blue silt clay (309) with occasional wood remains and root voids near its surface. A wood peat (308) was encountered between -1.20 m (+1.69m OD) and -0.90 m (+1.99 m OD), occasional macroscopic charcoal fragments were noted within the deposit. The upper surface of the peat showed signs of limited erosion. This was overlain by a thin deposit of whitish sandy clay (307) about 0.16 m in thickness, that could represent colluvial inputs overlying the peat. This was overlain by a soft yellowish brown silty clay (306). This was overlain by a thin soft organic yellowish brown silty clay band (305) possibly representing a period of bog or marsh vegetation. This was overlain by several phases of silty clay alluiviation (304-302) between -0.90 m (+1.99 m OD) and -0.24 m (+2.65 m OD). The deposition of 0.24 m of brown silty clay topsoil (301) was the last recorded period of sedimentation that continues to form today.

5.2.3 Test pit 4 encountered a firm reddish brown sandy clay (404) at a depth of just -1.0m (+1.35 m OD). This deposit extended down to a depth of -2.50 (-0.15 m OD) at the base of the test pit and represented the natural bedrock. The upper surface of the deposit was heavily mottled with reddish bands, indicating weathering. This was overlain by a compacted whitish yellow sand (403), possibly colluvial in origin, 0.28 m in thickness. This was overlain by 0.22 m of loose partially humified and dried out silt peat (402) between -0.72 m (+1.63 m OD) and -0.50 m (+1. 85 m OD) in depth. The sharp and undulating nature of the boundary between the two deposits clearly represents a break in sedimentation and a possible erosional contact. The upper horizon of the peat also exhibits signs of disturbance, and possibly indicates the proximity of a large active channel. This is overlain by a thin yellowish brown clayey silt topsoil (401).

5.2.4 Test pit 4 also produced a small assemblage of worked and burnt flints sealed within the upper interface between the peat (402) and underlying sand deposits (403). The flint assemblage consists of four flint flakes, a shallow minimally retouched flake (11 mm wide notch) and a simple edge-retouched flake. One flake was burnt and another was broken. The unretouched flakes exhibited micro-flaking typical of use-damage. Burnt flint weighing 150 g and macroscopic charcoal fragments were also recovered from the upper surface of the sand. The flints were all in exceptionally fresh condition and are unlikely to have moved far from their original place of deposition, indeed, it is possible the flints form part of an in-situ scatter. The small group includes both retouched artefacts and utilised flakes indicating that the assemblage probably results from the performance of various activities rather than representing a knapping scatter.

5.2.5 The dating of small flint assemblages, lacking diagnostic artefacts, is notoriously difficult and only broad date ranges may be suggested. The technological attributes of these flakes are most comparable to industries of later Neolithic or early Bronze Age date. However, the burnt flint material recovered may be suitable for thermoluminesence dating and could therefore provide an absolute date for this phase of activity.

5.3 Powdermill Stream Valley Sequence (Figure 5)

5.3.1 Two boreholes (OABH6 and OABH7) and two test pits (OATP5 and OATP6) were excavated within the Powdermill Valley Stream sequences. One of the proposed boreholes (OABH8) needed to be cancelled due to restrictions imposed because of an out break of foot and month. The location of all the boreholes and test pits within this area were therefore adjusted in order to compensate for the missing sample.

5.3.2 Test pit 5 was targeted on the lower slope of the valley at the interface with the wet deposits. The test pit was excavated to a stiff brownish yellow sandy clay (505) that was encountered at -0.92m (1.08 m OD) and continued to a depth of -2.50 m (-0.50 m OD) at the base of the test pit. This represented the underlying bedrock with signs of weathering of its upper surface. This was overlain by 0.12 m thick deposit of well humified and partially dried out silty peat (504) between -0.92 m (+1.08m OD) and -0.80 m (+1.20 m OD). It was overlain by two deposits of soft alluvial silty clay (503-502), the upper part of which exhibited signs of weathering and oxidation. It was sealed by 0.22 m of friable light brown silty clay topsoil (501).

5.3.3 Test pit 6 consisted of a similar sequence of weathered stiff greenish grey bedrock sand (607) at the base of the test pit between -2.30 m (-0.04 m OD) and -1.60 m (+0.66 m OD). This was overlain by 0.40 m of poorly humified wood peat (606). Two large tree branches were observed within the top of the peat, indicating good waterlogged preservation. Above this was soft light grey alluvial silty clay (605) between -1.20 m (+1.06 m OD) and -0.34 m (+1.92 m OD). A thin band of soft dark blackish brown peat clay (604) was identified at -0.78 m, possibly representing a return to a carr or reedswamp environment. This was overlain by two structureless grey silty clay deposits (603-602), the upper deposits becoming reddish brown due to the process of oxidation. This was sealed by 0.34 m of friable light yellowish brown silty clay topsoil (601).

5.3.4 No archaeological finds were recovered from these deposits and no material of colluvial origin was identified within the sequence. On a broad level, the sequence from the Powdermill Stream Valley was very similar to that identified within the Watermill Stream Valley.

5.4 Decoy Pond Valley Sequence (Figure 3)

5.4.1 Two test pits (OATP7 and OATP8) and three boreholes (OABH9, OABH10 and OABH11) were excavated within the Decoy Pond Valley Sequence. One of the boreholes was an additional borehole (OABH11) to those originally proposed within the geoarchaeological method statement. This was located within an area. of deepening sediment sequences. In addition, OATP8 needed to be moved slightly up slope from is original position due to the presence of dense clusters of trees.

5.4.2 Test pit 7 was excavated down to a sandy clay (704) at a depth of -2.80 m (+4.09 m OD). This was overlain at -0.80 m (+6.09m OD) by a thin 0.10 m band of loose light white sandy clay (703). A second loose light sandy clay (702) was also present between -0.70 m (+6.19m OD) and -0.25 m (6.64 m OD), possibly indicating two periods of colluviation. This was overlain by 0.25 m of friable mid yellowish brown silty / sandy clay topsoil (701).

5.4.3 Test pit 8 was excavated to a depth of -0.30 m straight onto sandy bedrock (802). This was only covered by 0.20 m of loose light yellowish sandy loam topsoil (801).

6 SEDIMENTARY SEQUENCE

6.1 Introduction

6.1.1 An interpretative cross-section of the four valleys stratigraphy initially presented within the appendix of the EIA (OA, 2007) has been updated (Figure 3) following the completion of the field investigation. The stratigraphic correlations have been revisited in the light of the more detailed geoarchaeological recording of the sequence within each valley from the borehole samples. In addition the more detailed lithological data is shown within the cross-section, in order to illustrate the complexity of the sediment sequences that exist along the route of the proposed Scheme.

6.2 Deposit model

6.2.1 The sedimentary sequence across the route of the proposed Scheme is associated with the Combe Haven River and its tributaries. The stratigraphy across the valleys is relatively consistent and comprises (in order of deposition):

- **Bedrock:** Very stiff blue grey laminated clays and light grey medium grained sandstone and siltstone;
- **Basal Gravel:** Very stiff grey sandy and clayey gravel;
- **Estuarine silts and sands:** Fine-grained silty/sandy clays/sands;
- **Combe Haven Peat Sequence:** Spongy dark blackish brown silty and fibrous peat;

- **Upper silts:** Soft light grey/greyish brown sandy clay and silty clay;
- **Subsoil:** Loose, light yellowish brown, silty sand / sandy silt
- **Topsoil:** Firm dark brown slightly sandy clay / sandy silt.

6.3 Pre-Holocene deposits and basement topography

Bedrock

6.3.1 The underlying bedrock across the site was recorded as being Wadhurst Clay overlying Ashdown Sands. The Wadhurst Clay was recovered as very stiff blue grey clay that in places was deeply fissured and fractured. The Ashdown Sands were recovered as hard, yellowish grey closely fissured silts with bands of sandy clay. In places the upper horizons of these deposits appeared weathered and mottled.

Basal gravel

6.3.2 The basal gravel unit consists of mixed deposits of fine to coarse weathered bedrock with well-sorted angular to rounded sandstone gravel. These deposits are confined to the valley bottoms and edges and vary in thickness from 1.30 m to 5.95 m. They accumulated during the last cold stage that occurred between 85,000 to 14,000 BP.

6.3.3 These gravels represent material deposited through glacial outwash streams by rivers swollen by spring and summer melting. These rivers formed the deeply incised valleys of the area when most of the water was trapped in glacial ice and sea level was much lower than present day. During the winter months the ground would have been frozen as permafrost and the valley edges would have been subject to solifluction processes.

6.3.4 Any finds recovered from the gravels will have undergone a high degree of transportation and are likely to be abraded. With the notable exception of the Sussex coastal plain, the area is not known for its Palaeolithic industries. This could be in part due to the lack of gravel extraction (Leslie and Short, 1999, 10) or to limited archaeological study in the area.. Any finds from this period would be exceptionally rare and likely to be of national importance.

6.4 Holocene sediments

Estuarine silts and sands

6.4.1 These deposits consist of fine-grained silty/sandy clay that occupy all of the valley bottoms and have been recorded as much as 3 km inland. They vary in thickness from 0.80 m to 4.60 m, accumulating at between -7 m OD to 0 m OD. These sediments can be finely laminated reflecting their tidal influence.

6.4.2 A brief period of peat accumulation between -3 m OD to -2.80 m OD, interrupted the main phase of marine transgression. This comprised a compacted wood peat, that represented a rapid cessation of marine conditions within the valley and the predominance of freshwater conditions. Marine conditions quickly re-established after -2.80 m OD with a return to the accumulation of silty / sandy clays.

6.4.3 The valley ridges and channel edges at this time would have provided an attractive location to Mesolithic hunter-gather communities, enabling them to exploit the rich resources and environments at the estuary edge. Any archaeological remains of this period are likely to be buried at depth under later accumulations of peat and estuarine silts.

Combe Haven Peat Sequence

6.4.4 The Combe Haven peat sequence can be broadly divided into three main organic units. A lower peat between -1.0 m OD and 0 m OD, consists of a compacted blackish brown wood peat with occasional clay lens. An upper peat, between +1 m OD and +2 m OD, consists of wood peat and clayey peats. A third deposit of humic silty clays and peaty clays then seperates the two. This sequence represents the main phase of marine regression, which is characterised by phases of peat accumulation and humic silty clays. This sequence of deposition indicates that a mosaic of different freshwater wetland environments would have existed at any one time in the bottom of the valleys.

6.4.5 Towards the edges of the valleys the peat is less easily divided into particular units and tends to be represented by a thick mass of peat. This is due to the fact that during periods of river flooding, peat would have continued to form within backwater environments at the valley edges while silty clays were still being deposited within the valley bottoms. These edge deposits are between 1.80 m and 5.60 m in thickness. They occur between -5 m OD to +2 m OD, with the most extensive deposits being located within the Watermill Stream Valley. Slightly older and thicker peat deposits appear to be located in the Powdermill Stream Valley (Geotechnical borehole 15). The thinnest and possibly the youngest deposits are recorded within the Decoy Pond Stream Valley. These are likely to have been eroded by shifting river channels, as suggested by the presence of sandy deposits (Geotechnical boreholes 23 and 25).

6.4.6 Any floodplain islands or promontories at the edges of the wetland zone would have been very attractive locations for Neolithic and Bronze Age communities to exploit the rich wetland and river resources present. However, settlement may have been confined to the top of the ridges or higher up on the slopes of the valleys. Any artefacts associated with these peat deposits are likely to have undergone only limited lateral transportation and would have been rapidly sealed by later flooding. At Upper Wilting Farm several possible hearth deposits dated to the Bronze Age have been previously located on the valley edges and at the interface with the wetland zone, suggesting that there may have been a Bronze Age (perhaps seasonal) settlement in this area. Any material recovered from this period is likely to be of significant value representing possible *in-situ* early prehistoric activity.

Upper silty clay

6.4.7 The upper silts mark a shift away from the deposition of organic sediments to minerogenic silty clays, represented by a second phase of marine incursion. These deposits consist of soft light-grey/greyish-brown, sandy clays and silty clays, occasionally with organic peat lens near to the base. They range in thickness from 0.40 m to 1.60 m, and are located at approximately 1 m OD to 6 m OD.

6.4.8 Previous studies of pollen and diatoms contained within this deposit record the establishment of salt marsh conditions on what had been previously alder woodland, including the seaward forest bed. Similar major incursions by the sea at this time are recorded in the Lower Thames Valley, and a number of other locations around the coast of England. It is often referred to as the 'Romano-British Trangression', with a number of potential causes cited for the increased sea level. It is widely believed that large-scale deforestation played a significant role in increased flooding and rising water levels of floodplain environments during this period.

6.4.9 Any artefacts identified within these silty clay deposits are likely to have undergone a moderate degree of lateral transportation and possible size sorting. Any human activity associated with these deposits is likely to be found towards the valley edges which could have acted as natural harbours. These may have been used for communications and trade, necessary for the growth of the iron industry in the area.

Subsoil

6.4.10 This unit consists of loose, light yellowish brown, silty sand/sandy silt. It varies in thickness from 0.40m to 1.60m, overlying the basal gravel and bedrock on the higher ground and over the alluvial deposits within the valley bottoms.

6.4.11 This unit represents a mixture of weathered bedrock, loess, colluvial and alluvial deposits. Towards the base of the valley much of this material is likely to be alluvium or colluvium. Archaeological features and deposits could potentially be dug into, contained within or sealed by these deposits. Any artefacts recovered from these deposits are likely to have been moved from their original contexts.

Topsoil

6.4.12 This consists of a mixture of firm, brown, sandy clay and clay with occasional to frequent partially sorted angular to sub-rounded gravel. It ranges in thickness from 0.35 m to 1.40 m, representing different sediment types and including ploughsoil and made-ground deposits.

6.5 Biostratigraphy

6.5.1 The base of the sequence consisted of bedrock overlain by deposits of sandy gravel and coarse sand. The upper surfaces of the deposits exhibit signs of weathering and oxidation indicating that they once formed part of the early Holocene land surface. The valley bottoms would have supported a dry forest bed within the early Holocene dissected by small freshwater streams. The sea would haven been further south of its current position and the Combe Haven would have been away from the coast.

6.5.2 The accumulation of clayey sands between -7.0 m OD and -3.0 m OD represents the inundation of the valley bottoms through a rise in sea levels. The pollen assemblages in all of the samples from Boreholes OA4 and OA7 were dominated by arboreal pollen, which represented a large proportion of the total pollen sum (TLP). Lime was the most dominant in the basal samples and is significant given its poor dispersal rate. The basal sample also contained high numbers of pine, with very abundant ferns. Areas of former forest bed would have gradually given way to salt marshes as the marine influence extended further up the valleys. Previous analysis of fossil remains and diatoms confirm that these deposits were lain down under estuarine conditions, radiocarbon dated to between 8000 and 5000 BP (Jennings et al, 2003).

6.5.3 At a depth of -5.51 m (-3.00 m OD) a major change in sedimentation from sandy clays to organic clays and peat is also marked by significant increases in oak. This represents a major slow down in sea level rise and the rate of sedimentation. This brief period of peat formation has been dated by radiocarbon to *c* 4*390*±60 BC, when estuarine conditions were confined to the present valley mouth and alder and willow carr appear to have become established on the floodplain of the valley. The causes of the marine regression are unknown but one suggestion is that the build-up of temporary beach sediment at the mouth of the valley may have been the likely cause (Jennings, 2005).

6.5.4 There is a return to estuarine conditions at -4.81 m (-2.40 m OD) with the replacement of carr deposits with salt marsh and mudflats. Alder replaces oak as the dominant woodland species, which represents at least half of the arboreal pollen assemblage in the remainder of the sequence. Other notable features in the arboreal pollen data are the disappearance of elm at -3.81 m (-1.90 m OD), that may represent the elm decline, dated to roughly 5000 BP.

6.5.5 Peat was re-established at -3.30 m (-0.80 m OD), reflecting a major withdrawal of the sea from the valleys, and a period when the shoreline extended out much further than the present day. Areas that were previously salt marsh appear to have been replaced by reed swamp initially and then carr deposits. This period represented a major regression and saw the main accumulation phase of the Combe Haven Peat Sequence. Evidence for this former shoreline comes from the remains of a submerged forest bed that can be seen at the low tide mark at the seaward mouth of the valley, *c* 2.5km south of the Scheme. The same forest bed can be found offshore near the Pevensey Levels, Rye Bay and Pett.

6.5.6 A change in the pollen recorded at -3.12 m depth (-0.80 m OD) within Borehole 4 is associated with accumulation of the lower wood peat, represented by a reduction in alder and corresponding rise in oak pollen grains. It is possible that this change represents an episode of clearance of local alder woodland, which subsequently permitted more oak pollen from the surrounding higher slopes to reach the site. Peaks in plantain/ribwort plantain and *Polypodium* (fern) spores are also recorded at this level and may also suggest some disturbance/opening up of the woodland in the immediate location. This period of disturbance was radiocarbon dated to c 6430±BC.

6.5.7 This peat appears to have been inundated at -2.90 m (m OD) in Borehole 4 with the accumulation of brown humic clays. The accumulation of these deposits represents a return to deeper water conditions and the development of reedswamp. The humic nature of the deposits suggest that the water depth was not sufficiently deep enough to prevent the growth of vegetation.

6.5.8 The upper peat accumulated from -1.80 m (0 m OD) to -0.70 m (+1.20m OD) within Borehole 7, produced a radiocarbon date of c 1790±100 BC. This deposit consists of a wood peat that represents a return to carr conditions. The same horizon within Borehole 4 consisted of humic silty clay more indicative of reed swamp conditions than a carr environment. This indicates that a range of different environments existed at any one time across the valley bottoms.

6.5.9 Charcoal fragments and colluvial inputs identified within Test pit 3 indicate possible early prehistoric activity within the Watermill Stream Valley associated with the upper peat. The distribution of any archaeological activity would have needed to be as dynamic as the shifting nature of the wetland that it was based on. This may explain why no evidence of disturbance was record within the pollen assessment of the upper organic horizon within Borehole 4, but signs of possible anthropogenic activity were identified within the test pit. It might also reflect the coarse pollen sampling resolution of the assessment, evidence of temporary disturbance may only be revealed by high resolution sampling.

6.5.10 The upper alluvial clays within the sequence represent a return of marine inundation between -2 m (3 m OD) and -0.20 m (5 m OD). This was likely to be caused by a period of transgression. Such a transgression has been observed at a number of coastal sites in South Eastern England. It is during this period of marine transgression that the wooden platform at Shinewater was rapidly submerged and protected by the deposition of the marine silty clays.

6.5.11 Increased human activity is evident in the uppermost levels in Borehole 4, represented by possible cereal cultivation and a very slight decline in woodland taxa. This is likely to reflect the growth of the iron industry within the valley through the Iron Age and into the Roman Period. In fact, the return of marine conditions to the valley is likely to have contributed to the development of these industries within the area. During the late prehistoric and earl medieval periods, the river valleys would have provided important trade and transport links.

6.5.12 By the 11th century the river inlets started to slowly silt up, with the last maritime connections being recorded at Bulverhythe in the 17th century. Pollen analysis from the upper deposits in the Combe Haven Valley has shown a decline in salt marsh plants and their replacement with grasses, sedges and cereals, consistent with the growth of modern agricultural activity. Secondary woodland regeneration has also been recorded in recent times, this is most likely to be due to the decline of the iron industry in the region.

7 DISCUSSION

7.1 Sediment sequence

7.1.1 The assessment has confirmed that the sediment sequence within the four valleys is consistent and represents a tripartite system of two main phases of marine transgression and one phase of regression. Within this sequence there are periods of complexity, with the main Combe Haven peat sequence consisting of at least two phases of peat formation representing fluctuating water levels and shifting wetland environments.

7.1.2 Comparisons with the previous palaeoenvironmental studies are complicated by differences in elevation of the main peat units with those recorded within the main low-lying Combe Haven Basin. This makes it difficult to correlate specific deposits between sequences without further confirmation with radio-carbon dating. There may have been a time lag between changes in sea level represented in the basin and when these effects extend further up the valley.

7.1.3 Pollen analysis of the sequence has previously suggested the first significant changes in the valley vegetation history may have been brought about by woodland clearance (Jennings and Smyth 1998), specifically the elm decline, either caused by the effects of disease or by the adoption of agriculture by Neolithic communities. The elm decline does appear to be present within the assessed borehole sequences, but does not coincide with any signs of arable cultivation. There was therefore no evidence within the sequences to indicate that the elm decline was caused directly by the adoption of agriculture within the area of the Combe Haven.

7.1.4 The assessment identified the first evidence of direct human impact within the valley sequences at -3.12 m depth (-0.80 m OD) associated with the accumulation of the lower Combe Haven wood peat. The pollen evidence indicates the first signs of disturbance / clearings within the valley bottoms. Such cleanings can occur naturally through natural fires or animal activity, in particular beavers *(Castor Fiber*) (Coles, 2001). However, closer pollen sampling intervals would help to confirm this . Based on the elevation these deposits are likely to date from the Neolithic/Bronze Age period.

7.1.5 The upper peat has been dated to the early Middle Bronze Age which is characterised at many sites across England as a period of extensive woodland clearance principally to make way for enclosed agricultural fields. No such evidence for extensive woodland clearance at this period is recorded within the assessed cores. Previous work looking at silt/sand deposits identified within the top of peat, have interpreted them as colluvial silts probably deposited as a result of woodland clearance of the surrounding valley edges, leading to erosion of the soils into the valley bottoms and rivers. Similar colluvial deposits overlaying the peat, and charcoal within the peat, were identified within the Watermill Stream Valley Sequence in Test pit 3. Identification of periods of short lived woodland disturbance may only be revealed by more detailed pollen sampling resolution than was undertaken in the assessment.

7.1.6 It has long been noted that Bronze Age utilisation of the area was dependent upon marine transgression episodes, which allowed the environment to shift from estuarine/saltmarsh to fen vegetation (Jennings *et al*, 2003). Early prehistoric activity (Mesolithic-Bronze Age) associated with the formation of the Combe Haven peat sequence is likely to be found buried between, sealed within or just above the peat. Along the route of the proposed Scheme between 1 m to 2 m of later fluvial sediments have been recorded overlying the upper peat deposits.

7.1.7 Comparison with the site at Shinewater, on the Willingdon Levels, provides a useful parallel as to the archaeological potential and significance of these sequences. At Shinewater, a substantial wooden platform and associated trackways, dated to the Late Bronze Age, was found buried by marine silts associated with peat deposits (Stevens, 1997). The elevation of the peat (+1 m OD) and topographical setting are very similar to the upper peat in the area of the Scheme and would have been prime locations for early prehistoric activity. The evidence from the Watermill Valley Sequence appears to be contemporary, if not slightly earlier, than the main phase of archaeology identified on the wooden platform at Shinewater.

7.1.8 However, it should also be noted that there is a noticeable difference in the vegetation succession of the Willingdon Levels, with its insignificant representation of alder, and this is in marked contrast to the Combe Haven sequence and other low-lying areas of the South East where alder is the dominant species. The development of a sedge fen environment at Willingdon, and the lack of alder carr development, was likely to be as a direct result of intense Bronze Age activity associated with the wooden platform. This anthropogenic succession is therefore in contrast to sites like Combe Haven where a natural hydrosphere succession from high salt marsh to alder carr occurred and was not arrested by anthropogenic activity. The activity identified within the area of the Scheme therefore does not appear to have been so extensive as represented at Shinewater.

7.2 Archaeological potential

7.2.1 The early prehistoric activity identified at the edge of the Watermill Stream Valley is likely to be associated with the exploitation of the area. The assemblage does not appear to represent a single phase of knapping activity, but rather the tools exhibit use ware, indicating more continuous exploitation of the valley bottoms. This phase of activity is therefore likely to be associated with the accumulation of the main Combe Haven peat sequence. In fact, it could be associated with the lower peat horizon that produced the environmental evidence of small clearings within the valley floor.

7.2.2 Comparisons of similar sites within the area have produced evidence of wooden track ways, platforms and placed deposits. The sites are considered of particular archaeological importance due to their excellent organic preservation and lack of later disturbance. The waterlogged nature of many of these sites has meant that organic material is preserved that is rarely recorded on dry land sites. Also many of these sites have indicated that much of the cultural material is located in approximately the same location as to when it was left or abandoned. These sites have therefore provided invaluable insights and information on different aspects of early prehistoric social, economic and ideological life. Many of these sites like the Sweet Track, in Somerset, Flag Fen in Cambridgeshire and Shinewater in Sussex, are classified as sites of national importance. The possibility of recovering similar archaeological features in the area of the Scheme can not be discounted.

7.2.3 The recovery of archaeological material from such a small sample is significant in itself and could indicate the location of a much larger area of early prehistoric activity. *In-situ* flint scatters are exceptionally rare and where recovered, for example on the floodplain of the Thames at Dorney or within alluvial deposits such as in the Ebbsfleet Valley they present unique insights into the performance and structuring of activities in the past. It is therefore possible that these flints may provide an indication of a regionally, or nationally, important site.

7.2.4 Parts of the Sussex Downs have been extensively studied and Bronze Age activity is well known from the low-lying dry valley sequences (Bell, 1992). This is in contrast to other areas of Sussex where there have been less concentrated studies on river valley sequences. However, combined archaeological and palaeoenvironmental research in the area is now starting to reveal the full potential of these deposits. The Sussex levels is therefore important as an example of a low-lying area devoid of upstanding monuments, producing evidence of significant early prehistoric exploitation and occupation.

7.2.5 The retrieval of fired clay from Test pit 2 in the Combe Haven Valley, although it cannot be precisely dated does indicate activity on the edge of this valley at a time when the area would have been subject to a marine transgression.

8 CONCLUSIONS

8.1.1 The geoarchaeological assessment has successfully characterised the nature of the sub-surface stratigraphy underlying the present ground surface and assessed the archaeological and palaeoenvironmental potential of these valley sequences. The following conclusions can be drawn:

- The assessment has confirmed that the sediment sequence within the four valleys is consistent and represents a tripartite system of two main phases of marine transgression and one phase of regression. The major stratigraphic sequences conform broadly to the regional model that has proposed by Jennings (1987 and 1990). The main peat deposits accumulated between the late Mesolithic period to the Bronze Age.

- Evidence of early prehistoric archaeology has been detected within the Watermill Stream Valley. The identification of possibly in-situ archaeological material and palaeoenvironmental evidence for woodland disturbance from the valley sequences from such a small sample is significant. The Combe Haven Peat Sequence has been shown to have the potential to contain regional, if not nationally, important archaeological and palaeoenvironmental deposits.

- There is potential for waterlogged remains to exist within the valley bottoms along the proposed route has been identified. Evidence could include deposits relating to the exploitation of the wetland environment and the use of the valleys for water transport (eg wooden structures, track ways or boats), as well as palaeoenvironmental material dating from the Mesolithic period onwards.

- There is potential for late prehistoric and early historical archaeological features and deposits to be recovered from the valley slopes and edges. Any activity identified is likely to be associated with the growth of the Iron industry within the area and the spread of tidal inlets within the valleys.

- The work provides a unique opportunity to expand our understanding of the Early prehistoric exploitation of this area.

9 ASSESSMENT OF FUTURE IMPACTS AND RECOMMENDATIONS FOR FURTHER WORK

9.1 Impacts

9.1.1 Details of the final design of the Scheme have currently not been confirmed. Therefore the impacts on potential significant archaeological deposits can only be broadly considered.

9.1.2 The more direct impacts on the valley ridges are more easily considered and mitigated using traditional archaeological methods and procedures. Impacts on the valley sequence are more difficult to determine without further information about the design.

9.1.3 Any proposed designs need to take into account that the Combe Haven Peat Sequence may contain deposits of regional, and possibly national, archaeological and palaeoenvironmental importance. Where possible every effort should be made to preserve the valley peat deposits in-situ and this should include the maintenance of hydrological and environmental conditions essential to their preservation. The design of the Scheme should try to minimise both the direct primary impacts (ground intrusion eg piling) and secondary impacts (*eg,* the compression of buried deposits through earthworks, or the de-watering of sensitive, waterlogged remains through digging drainage ditches and balancing ponds).

9.1.4 Without suitable mitigation, the valley sequences and any associated archaeological or organic remains will be vulnerable to both primary and secondary impacts. These impacts may occur during the construction and operational phases, and may also include residual effects from secondary impacts.

9.2 Recommendations for further work

9.2.1 Having identified the key horizons at which early prehistoric archaeology is likely to be located within the valley sequences a more targeted approach could now be adopted for any mitigation phase of the project. Traditional trench evaluation coverage of the lower valley sequence is likely to be complicated by issues of flooding, trench access, costs and safety.

9.2.2 An alternative method to improve the effectiveness of any subsequent work would be to undertake geophysical mapping of the valley bottoms which would help to identify areas of archaeological potential and disturbance (past channel activity). An EM31 magnetometer could be used to rapidly map the distribution of peat across the site and areas where it may have been truncated. This method consists of a transmitter and receiver coils mounted within a unit that is carried across the area. The position of the unit is recorded at all times by a GPS located within a backpack. The depth of the penetration is about 3-6 m depending on ground conditions and therefore suitable for mapping of near surface deposits rather than detailed detection of archaeological features or bedrock topography. The geophysical survey will provide rapid electromagnetic measurements of the electrical conductivity (the reverse of resistivity) of the floodplain sequence, which varies according to the different composition and moisture content of the sediment sequence. This could provide a cost efficient method of 3D mapping the peat deposits within the valleys and could identify sub-surface features and areas of different sediment deposition that may have been the focus for activity in the past.

9.2.3 This information could help to inform any Scheme design in order to minimise the impact to these important deposits. If required the information could also be used to inform evaluation or mitigation excavations which may need to be selective and targeted efficiently on areas of high potential.

9.2.4 Further work on the valley sequences is recommended. This should include selective, multi-disciplinary analysis of environmental indicators from Borehole 4, from the Watermill Stream Valley Sequence.

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APPENDIX 1 POLLEN ASSESSMENT

By Denise Druce (OA)

Introduction

Part of the component of the Environmental Impact Assessment required the identification of areas of geoarchaeological or palaeoenvironmental potential. Accordingly, a series of geoarchaeological investigations were carried out on the deposits to be impacted upon by the development, and two boreholes (OA4 and OA7) were chosen to be assessed for their pollen potential. Both cores were 9.00m long and 11 sub-samples were taken from Borehole OA4, and 10 from Borehole OA7. Both cores contain a sequence of basal sand/gravel, overlain by Holocene clays/silts and peats (the Combe Haven Peats).

Laboratory Procedure

The 21 sub-samples were processed for pollen using standard procedures (Faegri and Iverson 1989) and mounted in silicone oil. Two exotic (*Lycopodium*) spore tablets were added to each sample to provide a standard counting reference and to determine pollen concentrations. The pollen slides were examined with an Olympus BH-2 microscope using x400 magnification routinely. Counting was carried out over two cover slips and continued until a sum of at least one hundred land pollen grains, or until 10 traverses of the cover slip were reached, whichever was achieved first. Pollen identification was carried out using the standard keys of Faegri and Iverson (1989) and Moore *et al* (1991). Microscopic charcoal fragments and fungal spores were quantified where present, and plant nomenclature follows Stace (1997).

Results

The results of the pollen assessment are given in the Tables, where both actual counts and pollen percentages of the pollen sum of each taxon are given where appropriate. The pollen sum includes identified land pollen (TLP), and does not include unknown types, fern spores, aquatics/plants of wet soils, and indeterminate grains (corroded/crumpled etc).

Borehole OA4

All 11 samples from Borehole OA4 contained abundant pollen grains and a count of at least 100 was reached in all. The grains were well preserved in nine of the samples, however, some pollen grains were poorly preserved in both the basal (6.81m depth) and the top (1.21m depth) samples, with high values of determinate pollen grains.

The pollen assemblages in all of the samples from Borehole OA4 were dominated by arboreal pollen, which represented between 88.6%-98.9% of the total pollen sum (TLP). *Tilia* (lime) was the most dominant arboreal pollen in the basal sample and, represented 36.84% TLP, is significant given the poor dispersal rate of *Tilia* pollen. The basal sample also contained the highest number of *Pinus* (pine) grains, with very abundant *Pteropsida* (fern) spores, which, being robust, may indicate preferential preservation. The count for *Quercus* (oak) pollen increases significantly at 5.51m depth, but is replaced at 4.81m depth by *Alnus* (alder) pollen, which represents at least half of the arboreal pollen assemblage in the remainder of the sequence. Other notable features in the arboreal pollen data are the disappearance of *Ulmus* (elm) pollen at 3.81m depth, and a temporary increase in *Quercus* pollen at 3.12m depth. The presence of very corroded *Picea* (spruce) pollen in a number of the samples suggests that some of the sequence may contain some reworked sediment and/or pollen from long distance transfer.

Much of the sequence is dominated by *Alnus* (alder) pollen, with lesser amounts of *Corylus*-type (hazel/bog-myrtle), *Quercus* (oak), and *Tilia* (elm). Other recorded arboreal pollen types include *Betula* (birch), *Fraxinus* (ash), *Pinus* (pine), *Salix* (willow), and *Ulmus* (elm) however counts for these were relatively low.

Non-arboreal pollen is very poorly represented at all levels and is dominated by Poaceae (grass) grains with occasional ruderals such as *Aster*-type (daises), *Polygonum aviculare* (knotgrass), *Ranunculus*-type (buttercups), and *Rumex* sp. (docks). A few grains of *Plantago/Plantago lanceolata* (plantain/ribwort plantain) are recorded at 3.12m depth (which coincides with a change in the arboreal pollen assemblage highlighted above), plus *Cerealia* (cereal-type) pollen is recorded in the uppermost two samples (1.60m and 1.21m depth).

The counts for aquatics and plants of wet soils are low but consistent and include Cyperaceae (sedge), *Potamogeton* (pondweed), and *Sparganium*/*Typha angustifolia* (bur-reeds/lesser bulrush). However, apart from the higher count for *Cyperaceae* in the basal sample, like the herbaceous assemblage, the aquatics/damp loving plants are poorly represented.

Microscopic charcoal fragments were recorded in all but one of the samples, and was particularly abundant in the basal level. Fungal spores appear to be generally more abundant in the upper 3m of the core.

Borehole OA7

The uppermost fivesub-samples from Borehole OA7 (taken from 3.21m to 0.31m depth) contained abundant well-preserved pollen. Counts for indeterminate grains were slightly higher in the top sample (0.31m depth), however, a count of at least 100 grains was reached in this, and the other four. The lowermost five samples (taken from 3.41m to 7.11m depth) contained none or very few determinate pollen grains.

Like the pollen sequence from the majority of Borehole OA4, the four pollen-rich samples from Borehole OA7 are dominated by *Alnus* pollen, with lesser amounts of *Corylus*-type and *Quercus*. *Tilia*, *Ulmus*, *Betula* and *Pinus* pollen grains are also recorded, but are in low abundance. Similarly, relatively low counts for non-arboreal and aquatic pollen grains are recorded, and *Cerealia* pollen is particularly evident in the topmost sample (0.31m depth). Only occasional charcoal fragments were recorded in the pollen-rich samples from Borehole OA7.

Interpretation

Borehole OA4

The pollen recorded in Borehole OA4 suggests that the environment surrounding the sites during their infilling was, primarily, one of damp alder carr woodland. Hazel or bog myrtle also made up a large part of the flora. During the early stages of infilling at OA4 it appears that the drier slopes surrounding the slopes were dominated by lime, however oak becomes more dominant later on in the sequence. The very high values for alder in Borehole OA4 suggest that the deposits were laid down after the alder rise in Britain, dated to around 7000BP. The values of 61-90% alder pollen suggests it is over-represented in the pollen record and is masking the values of other tree species. This should be considered in any subsequent analysis and interpretation. It is also possible that the decline in elm pollen recorded at 4.81m depth represents the elm decline, dated to roughly 5000 BP, however this is speculative at this stage.

A change in the environment is recorded at 3.12m depth, represented by a reduction in alder and corresponding rise in oak pollen grains. It is possible that this change represents an episode of clearance of local alder woodland, which subsequently permitted more oak pollen from the surrounding higher slopes to reach the site. Peaks in plantain/ribwort plantain and *Polypodium* (fern) spores are also recorded at this level, which may also suggest some disturbance/opening up of the woodland in the immediate location. Increased human activity is evident in the uppermost levels in Borehole OA4, represented by possible cereal cultivation and a very slight decline in woodland. It has to be stressed that the above interpretations are very tentative at this stage.

Borehole OA7

The samples with abundant well-preserved pollen from Borehole OA7 were taken from a 2.55m layer of peat, recorded between 3.25m and 0.70m depth. Conversely, the lowermost five samples with low pollen counts were taken from an underlying layer of clay and silt, where pollen preservation/survival was limited.

Although the two stratigraphic sequences from the two boreholes are slightly different (i.e. the upper peat layer in Borehole OA4 is only 0.80m thick as opposed to the 2.55m of peat recorded in Borehole OA7), it is possible that there is some chronological overlap. The data are similar, with alder carr woodland dominating the landscape. Similarly, hazel/bog myrtle forms a large part of the surrounding flora, and oak, which was likely to have been growing on the drier slopes, is also well represented. The very high levels of alder pollen suggest that this part of the sequence accumulated after the alder rise in Britain. In addition, like Borehole OA4, possible cereal cultivation, and a very slight decline in woodland, is recorded in the uppermost sample in Borehole OA7 (0.31m depth).

Discussion

Although previous work has been carried out in the area (Smyth & Jennings 1990, 1998), and a general sequence of Holocene environmental changes have been formulated for the area (Jennings 2005). Detailed pollen work has been concentrated on deposits nearer to the coast. The estuarine conditions indicated in Jennings' work do not appear to be reflected in the deposits from this assessment, which suggests that changes in the stratigraphy recorded in Boreholes OA4 and OA7, though perhaps influenced by changes in the coastline and associated relative sea level, developed in a backwater, non-estuarine environment.

Conclusion and Recommendations

This assessment has shown that pollen preservation in the whole of Borehole OA4, and the top 3.21m of sediment in Borehole OA7 is generally good. It appears that although the two sediment sequences vary, with much deeper peat recorded in Borehole OA7, the two profiles are likely to overlap chronologically, which could be confirmed through radiocarbon dating. Further analysis of the pollen is recommended from the whole of Borehole OA4, and the deep peat in Borehole OA7. In doing so, a general picture of more regional vegetation changes, including those identified in previous work, should be reflected alongside more subtle changes in the immediate location at both sites. Of added importance would be the comparison of the data with palaeoenvironmental work carried out by Smyth & Jennings (1990, 1998) (also see Jennings, 2005). The information generated from further analysis of the boreholes from the Bexhill to Hastings Link Road would significantly add to our understanding of coastal processes within a backdrop of more regional trends.

In order to compare the data with previous work a number of radiocarbon dates should be taken from the base/top of a number of the stratigraphic boundaries.

Borehole OA4

The analysis of 81 pollen samples is recommended from Borehole OA4 where a standard sampling interval of every 0.08m should be taken in the uppermost 5.10m clay/organic clay and one of 0.16m taken in the basal 2.80m clayey sand/gravel. A closer sampling interval should also be considered at significant changes in the pollen record.

Borehole OA7

The analysis of 38 pollen samples is recommended from Borehole OA7 at a standard sampling interval of every 0.08m from 3.25m to 0.20m depth with a closer sampling interval at significant changes in the pollen record.

Costings
Subsampling of Cores: Sandra (Supervisor) 2 days
Pollen Preps (119 samples): Sandra 15 days
Plus Lab Fees: £450
Chemicals: £360
Pollen Counts (119 samples): Eliz/Denise 60 days
Report Production: Eliz/Denise 5 days

Bibliography

Faegri, K, and Iversen, J, 1989, *Textbook of modern pollen analysis*, 4th edn (Revised by K Faegri, P E Kaaland and K Krzywinski) Chichester

Moore, PD, Webb, JA, and Collinson, ME, 1991, *Pollen analysis*, 2nd edn. Oxford

Stace, C, 1997, *The New Flora of the British Isles*, Cambridge

Bexhill to Hastings Link Road: Borehole OA4																						
Preservation	Fair		Good		Good		Good		Fair		Good		Good		Good		Good		Good		Fair/Poor	
Potential	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Poss	
Depth (m)	1.21		1.60		1.71		2.31		2.51		3.12		3.81		4.81		5.31		5.51		6.81	
Monolith	1		3		5		8		10		15		20		22		24		28		30	
Microscopic charcoal fragments			+++		+++		++		+		+++		++		++		++		++		+++++	
Fungal remains																						
Fungal spores			5		3		4		4								1				4	
Trees/Shrubs/Climbers		**%**		**%**		**%**		**%**		**%**		**%**		**%**		**%**		**%**		**%**		**%**
Alnus	120	**71.9**	95	**66.0**	115	**60.2**	121	**73.8**	70	**61.9**	92	**56.8**	158	**90.3**	116	**64.1**	31	**23.5**	51	**34.0**	20	**17.54**
Betula		**0.0**	1	**0.7**	6	**3.1**	1	**0.6**		**0.0**		**0.0**		**0.0**	1	**0.6**		**0.0**		**0.0**		**0.00**
Corylus type	18	**10.8**	23	**16.0**	26	**13.6**	27	**16.5**	14	**12.4**	13	**8.0**	6	**3.4**	20	**11.0**	37	**28.0**	12	**8.0**	31	**27.19**
Fraxinus		**0.0**		**0.0**	2	**1.0**		**0.0**		**0.0**		**0.0**		**0.0**	1	**0.6**	2	**1.5**		**0.0**		**0.00**
Hedera helix		**0.0**		**0.0**	1	**0.5**	1	**0.6**		**0.0**		**0.0**		**0.0**		**0.0**	6	**4.5**		**0.0**	1	**0.88**
Ilex	1	**0.6**		**0.0**	2	**1.0**		**0.0**		**0.0**	1	**0.6**		**0.0**		**0.0**		**0.0**		**0.0**		**0.00**
cf *Picea*	1	**0.6**		**0.0**	1	**0.5**	1	**0.6**	1	**0.9**		**0.0**		**0.0**	2	**1.1**		**0.0**	2	**1.3**	4	**3.51**
Pinus	1	**0.6**		**0.0**		**0.0**	1	**0.6**	1	**0.9**		**0.0**		**0.0**	2	**1.1**		**0.0**		**0.0**	5	**4.39**
Quercus	7	**4.2**	16	**11.1**	20	**10.5**	4	**2.4**	15	**13.3**	34	**21.0**	9	**5.1**	18	**9.9**	25	**18.9**	68	**45.3**	4	**3.51**
Salix		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**	3	**1.7**		**0.0**		**0.0**		**0.00**
Tilia		**0.0**	3	**2.1**	10	**5.2**	3	**1.8**	10	**8.8**	11	**6.8**		**0.0**	12	**6.6**	20	**15.2**	8	**5.3**	42	**36.84**
Ulmus		**0.0**		**0.0**	1	**0.5**		**0.0**		**0.0**		**0.0**		**0.0**	1	**0.6**	4	**3.0**	4	**2.7**	2	**1.75**
Total %		**88.6**		**95.8**		**96.3**		**97.0**		**98.2**		**93.2**		**98.9**		**97.2**		**94.7**		**96.7**		**95.6**
Crop Plants																						
Cerealia	6	**3.6**	2	**1.4**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.00**
Herbs																						
Aster type		**0.0**		**0.0**		**0.0**	1	**0.6**		**0.0**		**0.0**		**0.0**	1	**0.6**		**0.0**		**0.0**	1	**0.88**
Caryophyllaceae (Silene type)		**0.0**		**0.0**		**0.0**	1	**0.6**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.00**
Plantago lanceolata		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**	2	**1.2**		**0.0**		**0.0**		**0.0**		**0.0**		**0.00**
Plantago sp	2	**1.2**		**0.0**	2	**1.0**		**0.0**		**0.0**	1	**0.6**		**0.0**		**0.0**		**0.0**		**0.0**		**0.00**
Poaceae	6	**3.6**	1	**0.7**	4	**2.1**	2	**1.2**	1	**0.9**	4	**2.5**		**0.0**	3	**1.7**	1	**0.8**	3	**2.0**	3	**2.63**
Polygonum aviculare type		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**	1	**0.6**	1	**0.6**		**0.0**		**0.0**		**0.00**
Potentilla type		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**	1	**0.6**		**0.0**		**0.0**		**0.0**		**0.00**
Ranunculus type	4	**2.4**	1	**0.7**		**0.0**		**0.0**	1	**0.9**		**0.0**		**0.0**		**0.0**	3	**2.3**	2	**1.3**		**0.00**

Rosaceae		**0.0**		**0.0**		**0.0**	1	**0.6**		**0.0**	2	**1.2**		**0.0**		**0.0**		**0.0**		**0.0**		**0.00**
Rubiaceae	1	**0.6**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.00**
Rumex sp		**0.0**	1	**0.7**		**0.0**		**0.0**		**0.0**	2	**1.2**		**0.0**		**0.0**	3	**2.3**		**0.0**		**0.00**
Solanum		**0.0**		**0.0**	1	**0.5**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**
Succisa pratensis		**0.0**	1	**0.7**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**	1	**0.88**
Total %		**11.4**		**4.2**		**3.7**		**3.0**		**1.8**		**6.8**		**1.1**		**2.8**		**5.3**		**3.3**		**4.4**
Ferns																						
Polypodium	3		3		3		2		3		11		2		3				5		3	
Pteridium	2		1		2														1		13	
Pteropsida (monolete)	2		5		13		9		8		9		3		10		11		11		130	
Pteropsida (trilete)					1		1										2		2		8	
Aquatics and Plants of Wet Soils																						
Cyperaceae	4		1		1		1		2		3				1		1		3		18	
Potamogeton	1		1																		1	
Sparganium/Typha angustifolia											1				3							
Typha latifolia					1																	
Unknown/indet. pollen																						
Broken grains	4		1								1				1		1				9	
Concealed grains	7				7		4		6								1		4		32	
Corroded	36		8		22		14		3		9		2		14		7		12		35	
Crumpled grains	15		10		17		5								7		3		22		20	
Unknown pollen	3		1		1												1				1	
Total pollen counted	167		144		191		164		113		162		175		181		132		150		114	

Actual counts are shown as standard text. Percentage calculations of total land pollen (TLP) are given in bold.
Charcoal fragments are quantified on a scale of + to +++++ where + = rare and +++++ = abundant.

Bexhill to Hastings Link road: Borehole OA7															
Preservation	Fair		Good		Good		Good		Good		Poor	Poor	Poor	Poor	Poor
Potential	Poss		Yes		Yes		Yes		Yes		No	No	No	No	No
Depth (m)	0.31		0.71		1.81		2.71		3.21		3.41	3.61	4.51	5.41	7.11
Core	2		5		9		12		14		18	20	22	24	27
Microscopic charcoal fragments	+		+		+		+				+++++	+++++	+++	++++	+++++
Fungal remains															
Fungal spores	2				3		4		4			4		4	
Other remains															
Dinoflagellate cysts									1						
Glomus					2						4				
Trees/Shrubs/Climbers		**%**		**%**		**%**		**%**		**%**					
Alnus	116	**70.7**	141	**76.6**	117	**72.7**	108	**74.0**	138	**77.5**	16			2	
Betula	1	**0.6**	1	**0.5**		**0.0**		**0.0**	2	**1.1**					
Corylus type	20	**12.2**	13	**7.1**	19	**11.8**	23	**15.8**	9	**5.1**					
Hedera helix		**0.0**		**0.0**	1	**0.6**		**0.0**	1	**0.6**					
Ilex	1	**0.6**		**0.0**		**0.0**		**0.0**		**0.0**					
cf *Picea*		**0.0**		**0.0**		**0.0**		**0.0**	1	**0.6**					2
Pinus		**0.0**		**0.0**	1	**0.6**		**0.0**		**0.0**					
Quercus	2	**1.2**	11	**6.0**	8	**5.0**	7	**4.8**	8	**4.5**					
Tilia		**0.0**	1	**0.5**	5	**3.1**	3	**2.1**	5	**2.8**	8				
Ulmus		**0.0**	3	**1.6**	1	**0.6**	1	**0.7**		**0.0**					
Total %		**85.4**		**92.4**		**94.4**		**97.3**		**92.1**					
Crop Plants															
Cerealia	3	**1.8**		**0.0**		**0.0**		**0.0**	1	**0.6**					
Herbs															
Caryophyllaceae (Silene type)		**0.0**		**0.0**	1	**0.6**		**0.0**		**0.0**					
Plantago lanceolata	2	**1.2**	1	**0.5**		**0.0**		**0.0**	1	**0.6**					
Plantago sp		**0.0**	1	**0.5**	2	**1.2**		**0.0**	2	**1.1**					
Poaceae	17	**10.4**	10	**5.4**	4	**2.5**	2	**1.4**	7	**3.9**					
Polygonum aviculare type	1	**0.6**		**0.0**		**0.0**		**0.0**		**0.0**					
Ranunculus type	1	**0.6**	1	**0.5**	2	**1.2**		**0.0**		**0.0**					
Rosaceae		**0.0**		**0.0**		**0.0**	2	**1.4**	2	**1.1**					
Urtica		**0.0**	1.0	**0.5**		**0.0**		**0.0**	1	**0.6**					
Total %		**14.6**		**7.6**		**5.6**		**2.7**		**7.9**					
Ferns															
Polypodium	1		2		3		3		1						
Pteridium	1														
Pteropsida (monolete)	83		6		5		5		6		20			4	
Pteropsida (trilete)															
Aquatics and Plants of Wet Soils															
Cyperaceae	24		1		1		2		2						
Filipendula	3		8		4										
Lemna	3														
Sparganium/Typha angustifolia	4								1						
Typha latifolia	1								1						
Unknown/indet. pollen															
Broken grains	6		2		2		1								
Concealed grains	8		1		1		1		6		4				2
Corroded	34		13		20		8		7		26				4
Crumpled grains	37		7		11		4		8						
Unknown pollen	2		5		2				1						

Actual counts are shown as standard text. Percentage calculations of total land pollen (TLP) are given in bold.

Charcoal fragments are quantified on a scale of + to +++++ where + = rare and +++++ = abundant.

APPENDIX 2 ASSESSMENT OF WATERLOGGED PLANT REMAINS

By Elizabeth Huckerby (OA)

Introduction

A series of boreholes were sunk along the route of the Bexhill to Hastings Link Road and as part of the geoarchaeology investigation Oxford Archaeology North was asked to assess the waterlogged plant remains from two of these boreholes (BH4 and BH7) and the potential for radiocarbon dating. Waterloggged plant remains are preserved in wet anaerobic conditions and unique in that they can provide information about the local environment. Both cores, which went down to a depth of 9 metres, contained a sequence of basal sand and gravel overlain by Holocene clays/silts and peats. A sample to be assessed was taken from each of the major sediment type.

Quantification

A total of twenty samples, ten from each borehole, were assessed. The wet samples weighed from 250g to 400g each. The depths, sediment type and weight of each sample are shown in Table *.

Borehole 4			
Sample number	**Depth metres**	**Sediment type**	**Weight grams**
2	1.20-1.25	Silty clay	370
4	1.55-1.60	Humic silty clay	310
6	1.70-1.75	Humic clay with ++ humified plant material	346
9	2.30-2.35	Humic clay with mod humified plant material	307
14	3.12-3.17	Compacted wood peat	252
18	3.80-3.85	Humic clay	240
21	4.81-4.86	Silty clay	296
23	5.30-5.55	Wood peat large wood fragments	255
27	5.50-5.55	Silty clay with occasional organic traces	261
29	6.80-6.85	Clayey sand	345
Borehole 7			
1	0.30-0.35	Silty clay	323
4	0.70-0.75	Organic silty clay with humified plant material	338
8	1.80-1.85	Clayey peat with wood fragments	245
11	2.70-2.75	Bedded peaty clay	234
13	3.10-3.15	Soft fibrous peat	245
17	3.40-3.45	Silty clay	245
19	3.60-3.65	Clayey peat	309
21	4.50-4.55	Silty clay	309
23	5.40-5.45	Sily clay	400
26	7.10-7.15	Sandy silt	400

Table * Bexhill to Hastings link road: samples assessed for waterlogged plant remains from Boreholes 4 and 7

Methodology

The samples were hand floated at Oxford Archaeology (South) and the flots were collected on a 250 micron mesh and retained in water. A representative from each sample was examined with a binocular microscope and all readily identified plant remains were recorded. Plant nomenclature follows Stace(1997) and the results are shown in the attached Tables.

Results

Borehole 4

Some waterlogged plant remains were recorded in all the samples although in the upper silty clay (1.20-1.25m) and the clay sand (6.80-6.85m) the quantities were very small. Wood fragments were abundant in the compacted peat and humic clay with humified plant. Amorphous plant remains were also present in most samples. The assemblage of waterlogged seeds recorded was small but did include alder (*Alnus glutinosa*) seeds and catkins, sedges (*Carex*), and buttercups (*Ranunculus repens*) with occasional seeds of mint species (*Mentha*), black bindweed (*Fallopia convolvulus*) and gipsywort (*Lycopus europaeus*).

Occasional charcoal fragments were recorded in some samples, although the outside of some of the wood was very black and initially appeared charred. Insect remains and moss fragments (bryophytes) were recorded in many of the samples.

Borehole 7

Some waterlogged plant remains were recorded in all the samples although in the silty clays (0.30-0.35m, 4.50-4.55m, 5.40-5.45m and 7.10-7.15m the quantities were very small. Wood fragments were abundant in the remaining samples together with amorphous plant remains. A small assemblage of waterlogged seeds, similar to that in Borehole 4, was recorded, although a few additional taxa were noted and included hazel (*Corylus avellana*) nutshell fragments, pale persicaria (*Persicaria lapathifolia*), meadowsweet (*Filipendula ulmaria*) and an unknown member of the cow-parsley family (Apiaceae). Insect remains and moss fragments (bryophytes) were recorded in many of the samples.

As in the borehole 4 occasional charcoal fragments were recorded in some samples, although the outside of some of the wood was very black and initially appeared charred. Insect remains and moss fragments (bryophytes) were recorded in many of the samples.

Discussion and conclusions

This assessment has demonstrated that plant remains were preserved in waterlogged conditions throughout the sediment sequence. The presence of alder (*Alnus glutinosa*) seeds and catkins in the peats, organic clays and humic clay is indicative of a fen carr woodland growing along the banks of the palaeochannel and the sedges, gipsywort, mint and meadowsweet may also have been growing in this damp woodland with blackberries and hazel. The soil conditions would have been very wet with a low potential for cultivation. Material suitable for radiocarbon dating was identified in most samples and this is shown in tables attached.

Potential and recommendations

The potential for further analysis of the waterlogged remains is low because of the low diversity in the assemblages. Therefore no further analysis is recommended. However the potential for radiocarbon dating is high.

Bibliography

Satce, C, 1997, *New Flora of the British Isles*, Cambridge

Sample number	**2**	**4**	**6**	**9**	**14**	**18**	**21**	**23**	**27**	**29**
Sample depth metres	**1.20-1.25**	**1.55-1.60**	**1.70-1.75**	**2.30-2.35**	**3.12-3.17**	**3.80-3.85**	**4.81-4.86**	**5.30-5.55**	**5.50-5.55**	**6.80-6.85**
Wood fragments		++	++	+++	++	++	+	++	+	
Amorphous plant remains	+	++	++	+	++	++	+	++	+	+
Roots	+					+				
Buds			+				+	+	+	
Leaf fragments								+		
Cone/catkin axis							+		+	
Carex stem/rhizome - sedge									+	
Thorn					+					
Charcoal fragments		+	+							
Bryophyte remains		++	++					+		
Insect remains		++	+	+	+	+	+			
Earthworm egg cases		+	+						+	
Fungal sclerotia										+
Sand	+									
Seeds										
Alnus glutinosa seeds - alder		+	+		+	+		+	+	
Alnus glutinosa catkins - alder			+							
Carex trigynous - sedges		+	+		+	+	+		+	+
Carex lenticular sedges							+		+	+
Mentha - mint						+				
Fallopia convovulus – black bindweed		+								
Juncus- reush seed capsule								+		
Lycopus europaeus - gipsywort			+							
Ranunculus repens-type buttercups		+	+		+	+	+	+		
Rubus fruticosus - blackberry							+			
Cf Sparganium – *bur-reed*					+					
Urtica dioica – common nettle							+			
Unknowns		+								
^{14}Carbon dating potential	**None**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes?**	**Yes**	**Yes**

Table ** Bexhill to Hastings link road: waterlogged plant remains from BH4. Present = +, abundant = ++

Sample number	**1**	**4**	**8**	**11**	**13**	**17**	**19**	**21**	**23**	**26**
Sample depth metres	**0.30-0.35**	**0.70-0.75**	**1.80-1.85**	**2.70-2.75**	**3.10-3.15**	**3.40-3.45**	**3.60-3.65**	**4.50-4.55**	**5.40-5.45**	**7.10-7.15**
Wood fragments	+	++	++	++	++	+	++	+		
Amorphous plant remains		++	++	++	++	++	++	+	+	+
Anthers							+			
Cone/catkin axis								+	+	
Leaf fragments				+					+	
Roots							+			
Charcoal fragments	+					+	+ (±)	+		
Bryophyte remains		+		+	+					
Insect remains		++	+		+			+		
Fly puparia					+	+				
Earthworm cases										
Fungal sclerotia						+				
Sand								+	+	+
Seeds										
Alnus glutinosa seeds				+	++	+	+			
Alnus glutinosa catkins				+	++					
Apiaceae undiff – cow parsley family		+								
Carex trigynous - sedges				+		+				
Carex lenticular sedges						+				
Corylus avellana – hazel nut fragments						+				
Filipendula ulmaria – meadowsweet		+								
Lycopus europaeus - gipsywort					+					
Mentha - mint		+								
Persicaria lapathifolia – pale persicaria								+		
Ranunculus repens-type buttercups		+			+					
Rubus fruticosus - blackberry		+	+		+					
Vaccinium sp – Bilberry/cranberry								+		
Unknowns				+	+					
^{14}Carbon dating potential	**None**	**Yes**	**Twigs**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**None**	**None**

Table *** Bexhill to Hastings link road: waterlogged plant remains from BH7. Present = +, abundant = ++

APPENDIX 3 ASSESSMENT OF DIATOMS

By Dr Philip Barker, Department of Geography, Lancaster Environment Centre, Lancaster University

Introduction
Seven samples were assessed for the presence of Diatoms from two borehole samples (BH4 and BH7). Diatoms are photosynthesising algae, they have a siliceous skeleton (frustule) and are found in almost every aquatic environment including fresh and marine waters and sediments. They are non-motile, or capable of only limited movement along a substrate by secretion of mucilaginous material along a slit-like groove or channel called a raphe. Diatom remains are preserved in wet anaerobic conditions and provide information about the local salinity and hydrology of a sediment sequence. Both cores, which went down to a depth of 9 metres, contained a sequence of basal sand and gravel overlain by Holocene clays/silts and peats. A sample to be assessed was taken from each of the major organic sediment types.

Preservation
Unfortunately, most have very few diatoms in them. Essentially there are just a few dissolved fragments amongst the silicate materials on the slide. Two slides had slightly more diatoms.

Results

Depth	Diatoms	Preservation	Concentration	Diversity	Environment	Potential
BH4						
6.80-6.82	Absent	N/A	N/A	N/A	Unknown	None
5.30-5.32	Absent	N/A	N/A	N/A	Unknown	None
3.80-3.82	Absent	N/A	N/A	N/A	Unknown	None
1.70-1.72	Present	Poor	Satisfactory	Very low	freshwater	Very low
BH7						
5.40-5.42	Absent	N/A	N/A	N/A	Unknown	None
3.20-3.22	Absent	N/A	N/A	N/A	Unknown	None
0.70-0.72	Present	Poor	Satisfactory	Very low	Freshwater	Very low

Borehole 4
I made a count of just 23 from BH4 1.70-1.71. Again this was quite diverse with *Pinnularia viridis* as the dominant taxon. The poor preservation might suggest that pore waters have been able to percolate through the pores and allow the diatoms to dissolve. The pore water could also have been neutral or even alkaline pH?

Borehole 7
A count of 74 from BH7 0.70-0.71. Dominant diatoms were *Pinnularia viridis* (38%) *and Amphora libyca* (16%), there were also 15 other taxa.

Environmental interpretation
This is a typical freshwater marsh/bog habitat with circumneutral pH.

Recommendations
Given the poor preservation it is not possible to do anything more quantitative with the data.

APPENDIX 4 ASSESSMENT OF WORKED FLINT

By Hugo Lamdin-Whymark

Assemblage

The excavation of a sandy deposit (403), situated beneath peat in Test Pit 4, located six flints. The flint assemblage consists of four flint flakes, a shallow minimally retouched 11 mm wide notch and a simple edge-retouched flake. One flake was burnt and another was broken; all of the unretouched flakes exhibited micro-flaking typical of use-damage. The flints were all in exceptionally fresh condition and are unlikely to have moved far from their original place of deposition, indeed, it is possible the flints form part of an *in situ* scatter. The small group includes both retouched artefacts and utilised flakes indicating that the assemblage probably results from the performance of various activities rather than representing a knapping scatter.

The flakes are of short and broad proportions, but are relatively thin. The bulb morphology indicates the flakes were detached using both hard and soft hammer percussors. The flakes all exhibit plain platforms and two of the platform-edges have been prepared by slight abrasion. The dating of small flint assemblages, lacking diagnostic artefacts, is notoriously difficult and only broad date ranges may be suggested. The technological attributes of these flakes are most comparable to industries of later Neolithic or early Bronze Age date.

Significance

The stratigraphic location of these flints and their fresh condition, indicate that there is a good possibility that they have been recovered from an *in situ* scatter. *In situ* flint scatters are exceptionally rare and where recovered, for example on the floodplain of the Thames at Dorney or within alluvial deposits the Ebbsfleet Valley, present unique insights into the performance and structuring of activities in past. It is therefore possible that these flints provide an indication of a regionally, or nationally, important site.

APPENDIX 5 ASSESSMENT OF FIRED CLAY

By Cynthia Poole (OA)

Introduction

27 fragments of fired clay, weighing exactly 600g, were recovered from a test pit excavated as part of a geoarchaeological assessment of the valley sequence along the proposed Bexhill to Hastings road scheme.

Assemblage

The fired clay assemblage was quite small and there was very little in the way of surfaces. The assemblage probably part of an oven or oven furniture such as pedestal. It does not look as though it is from high temperature industrial process (ie. metal / glass working). More likely domestic or crop processing or possibly a pottery kiln.

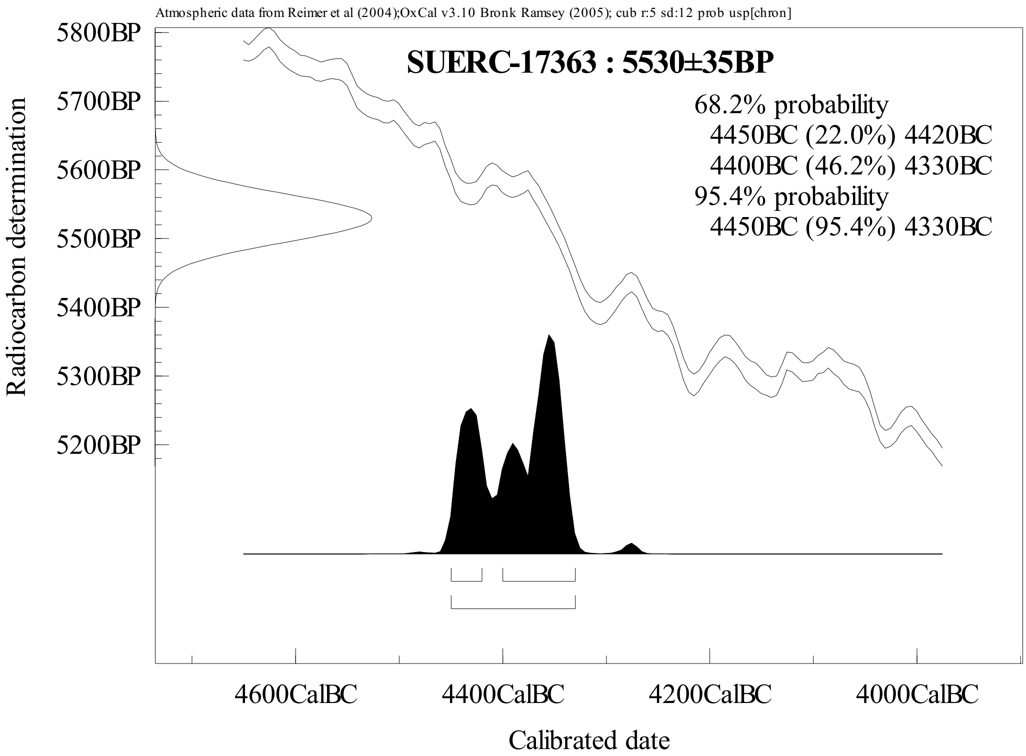
Recommendation

No further analysis is recommended.

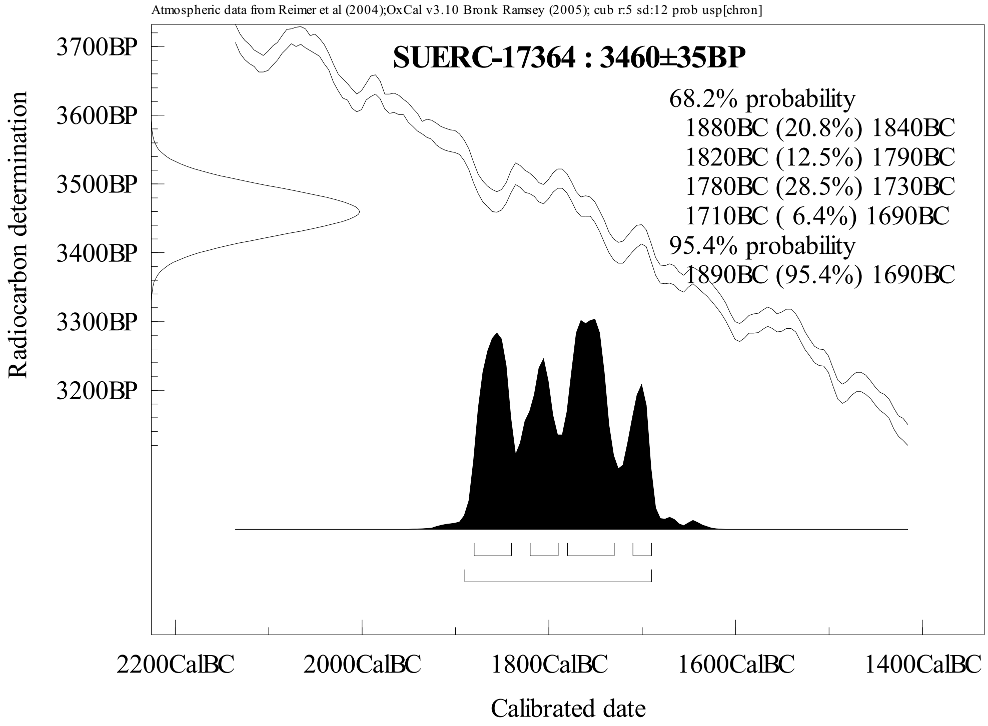
APPENDIX 6 RADIOCARBON DATES

BEXHM06 BH4 <23>, 5.40-5.45 m SUERC-17363 (GU-16384)

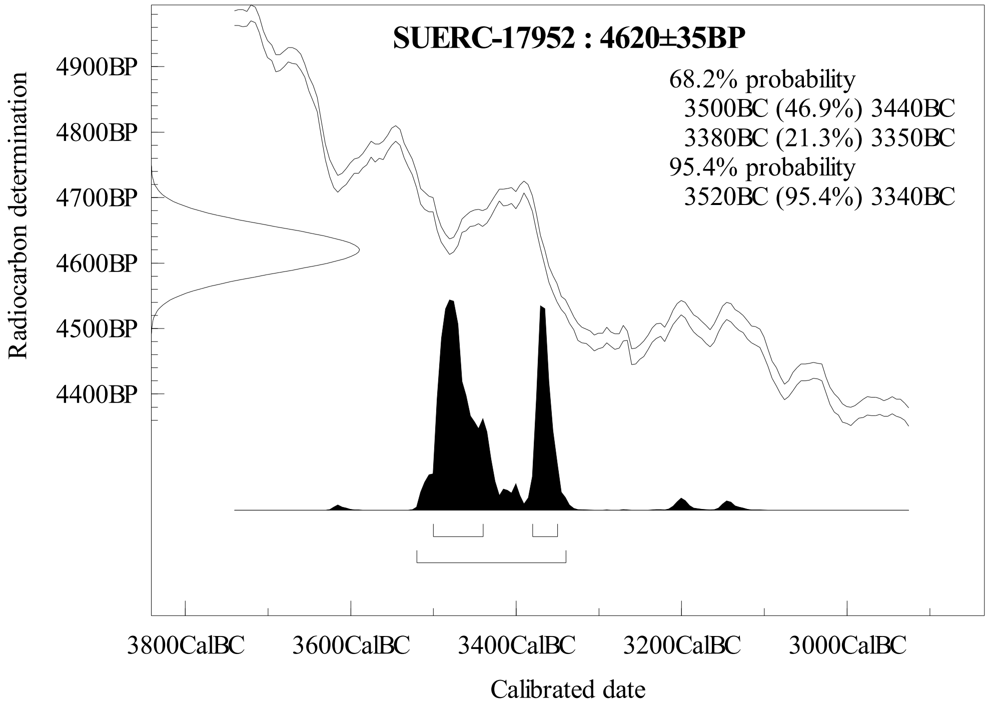
Calibration Plot



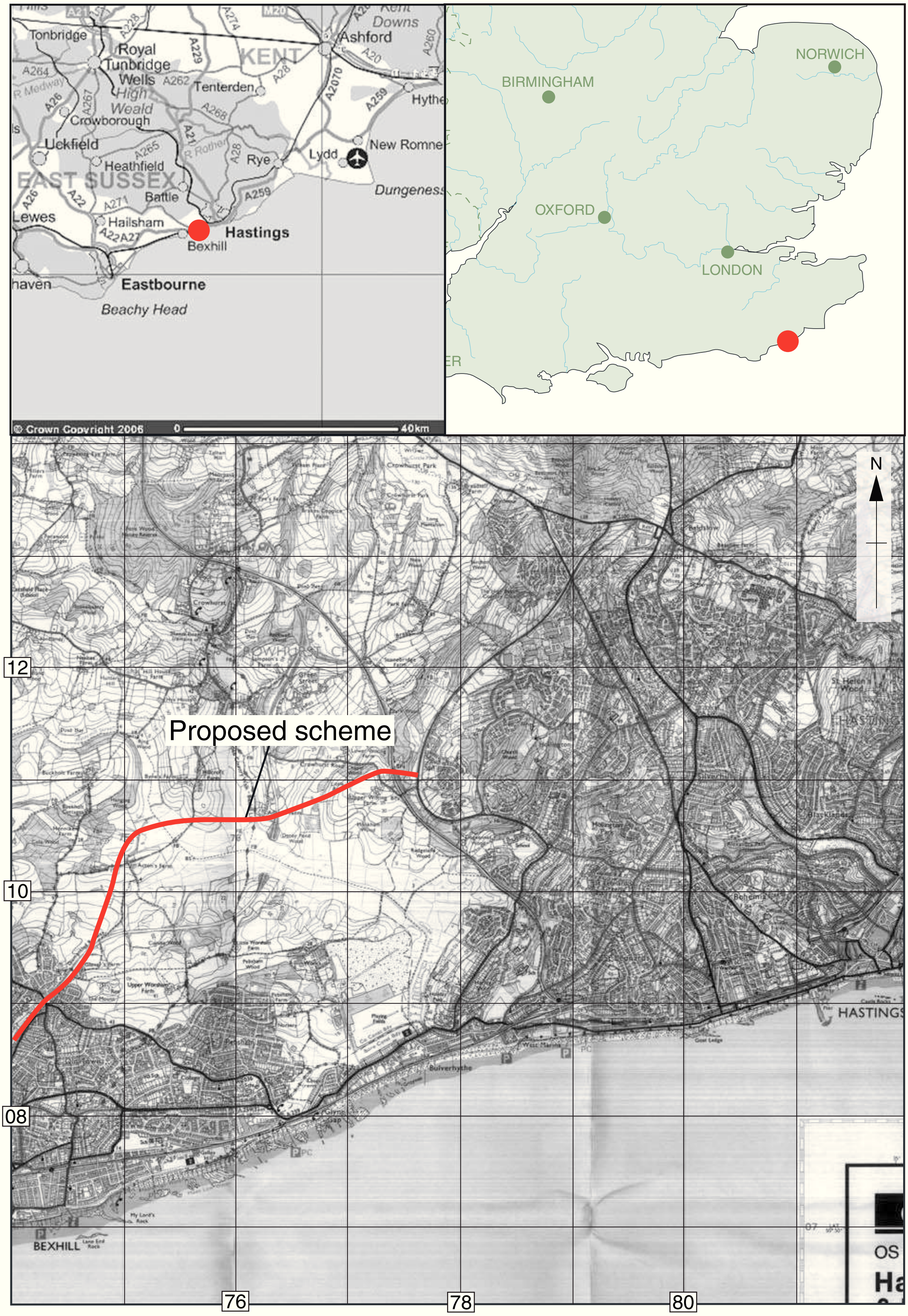
BEXHM06 BH7 <4>,0.70-0.75 m SUERC-17364 (GU-16386)



BEXHM06 BH4 <14>, 3.12-3.17 m SUERC-17952 (GU-16385)



Servergo:AthruH*BETHADBA*Bexhill to Hastings Link Road*GS*18.05.06



Scale 1:50,000

Figure 1: Site location

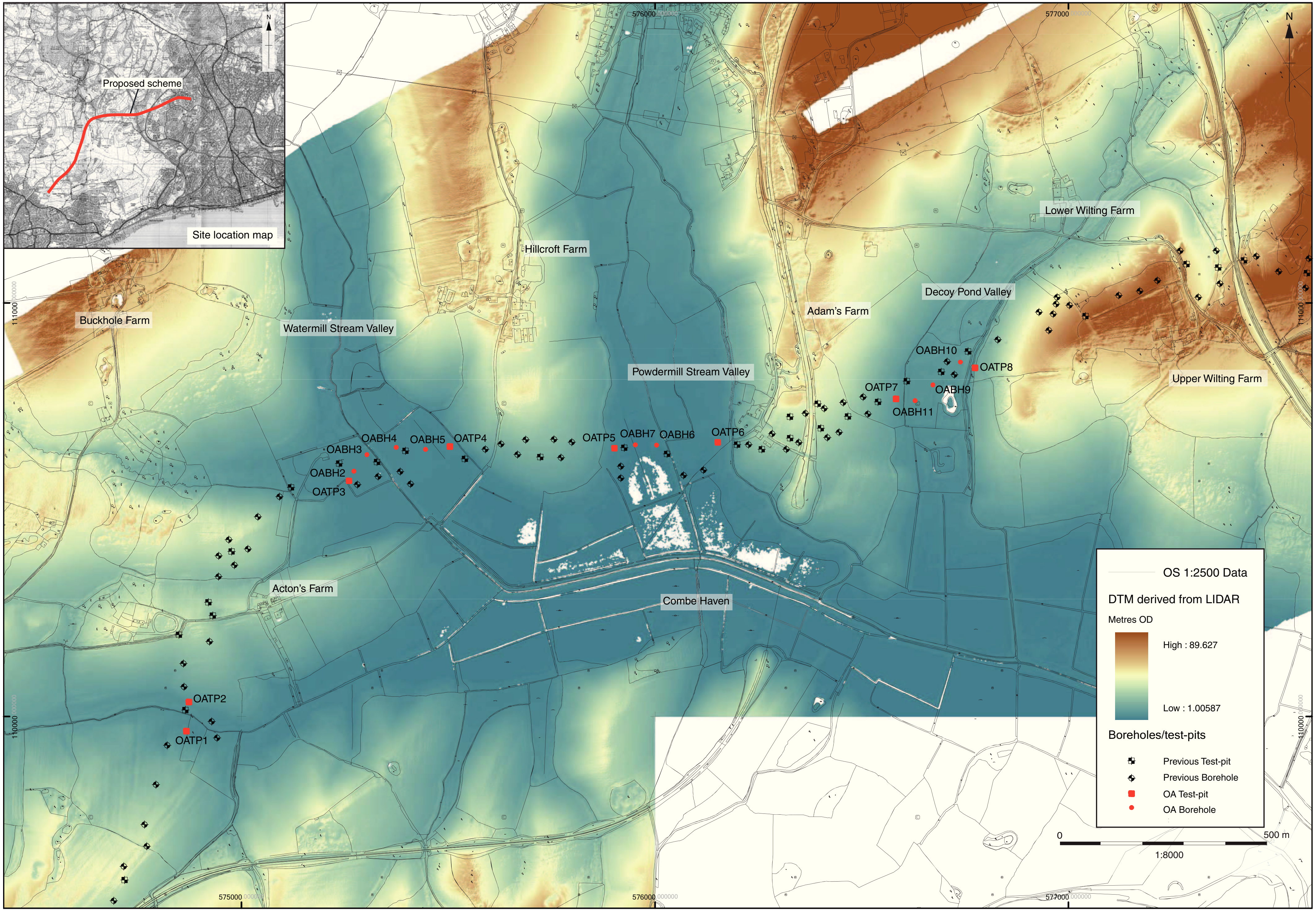


Figure 2: Borehole and Test-pit locations

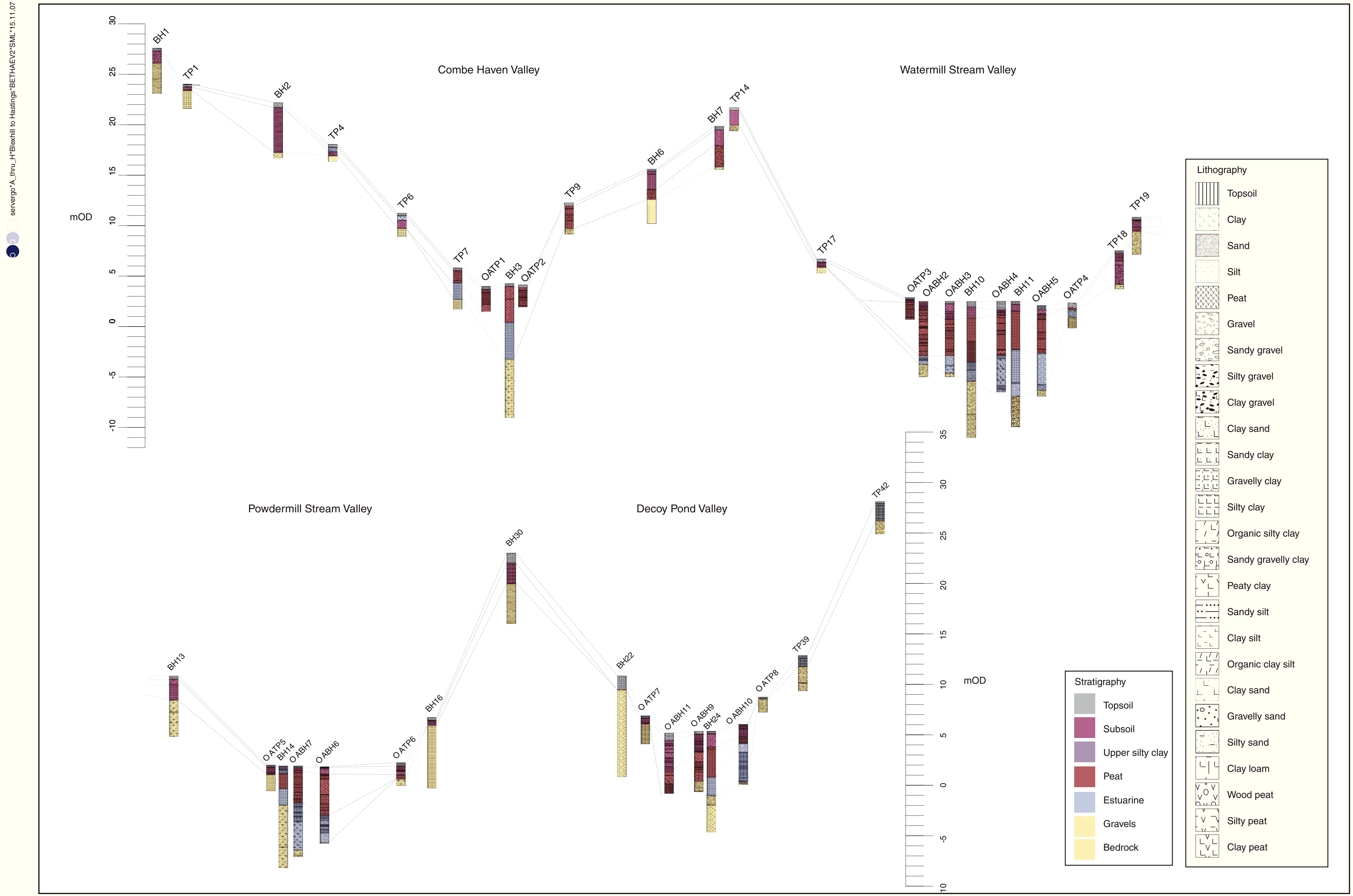


Figure 3: Overall route cross section

servergo*A_thru_H*Blexhill to Hastings*BETHAEV2*SML*15.11.07

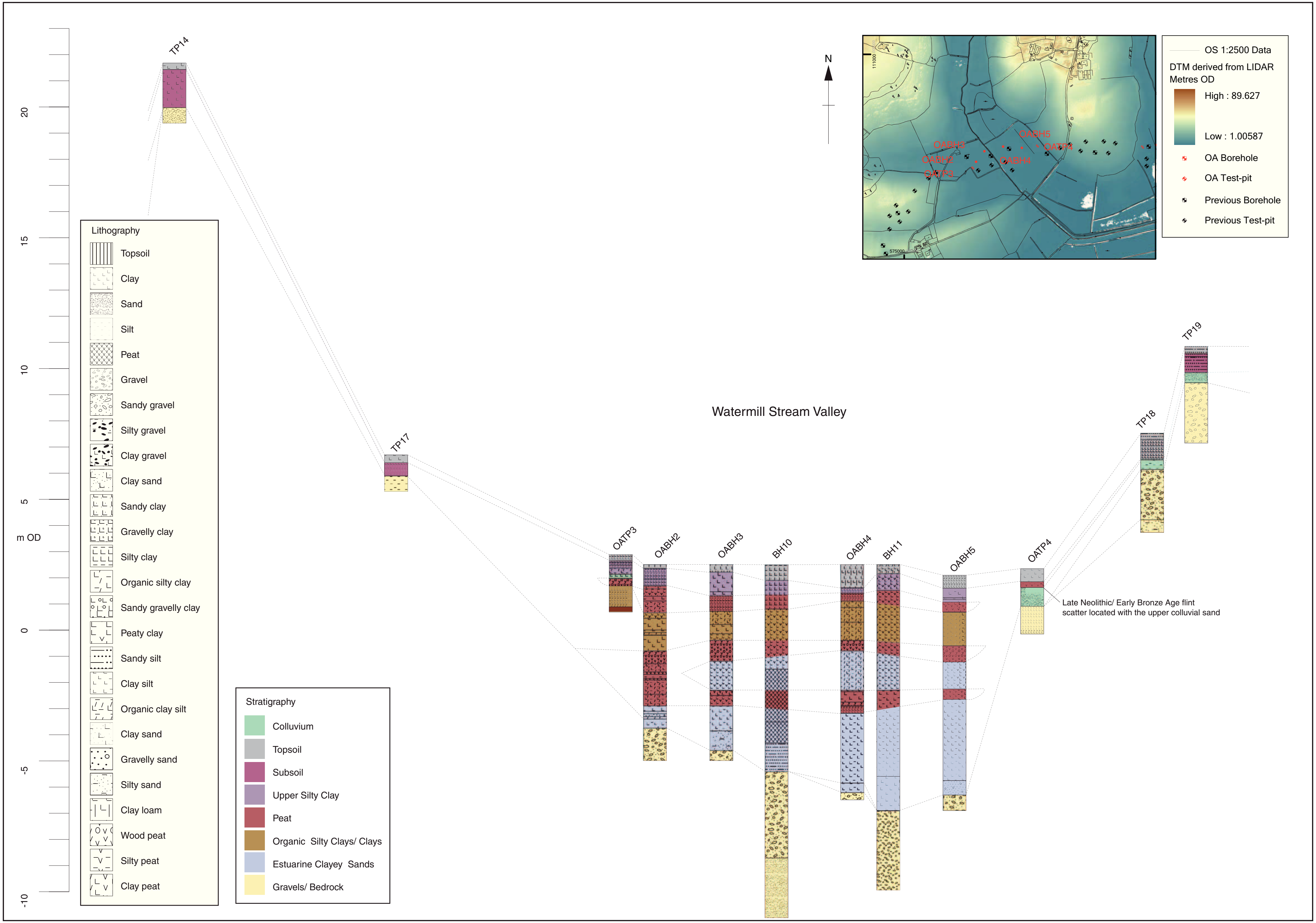


Figure 4: Watermill Stream Valley Sequence

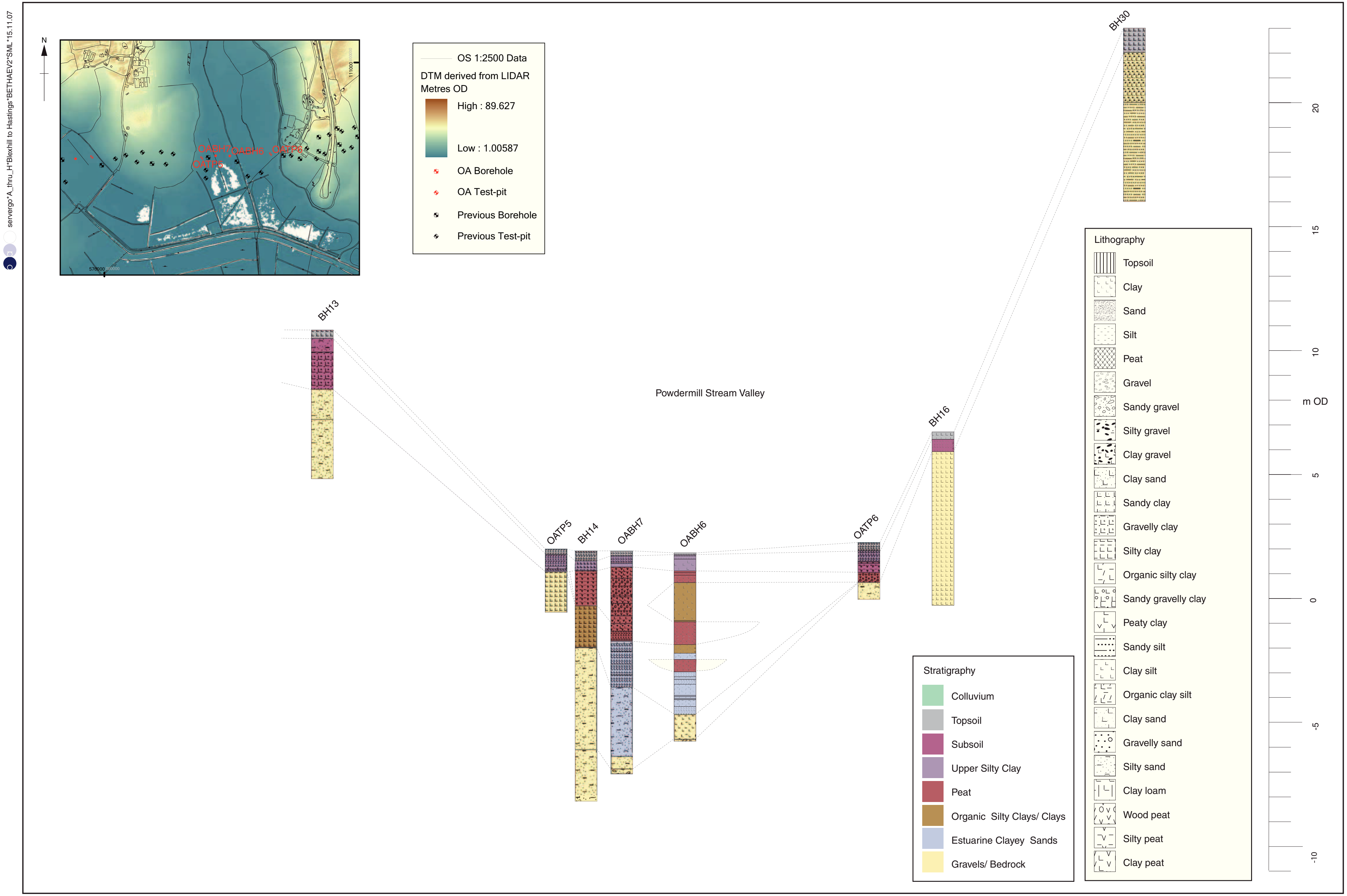


Figure 5: Powdermill Stream Valley Sequence

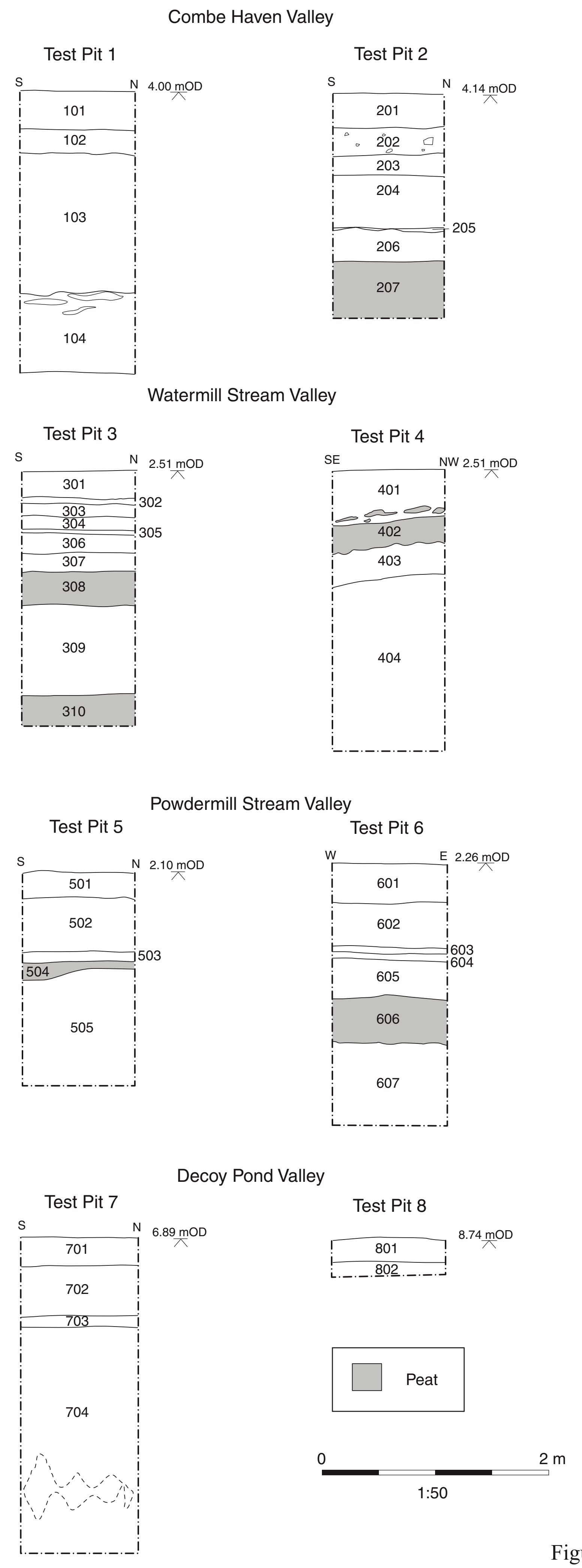


Figure 6: Test pit sections

Bexhill to Hasting borehole OA4 proposed subsample locations

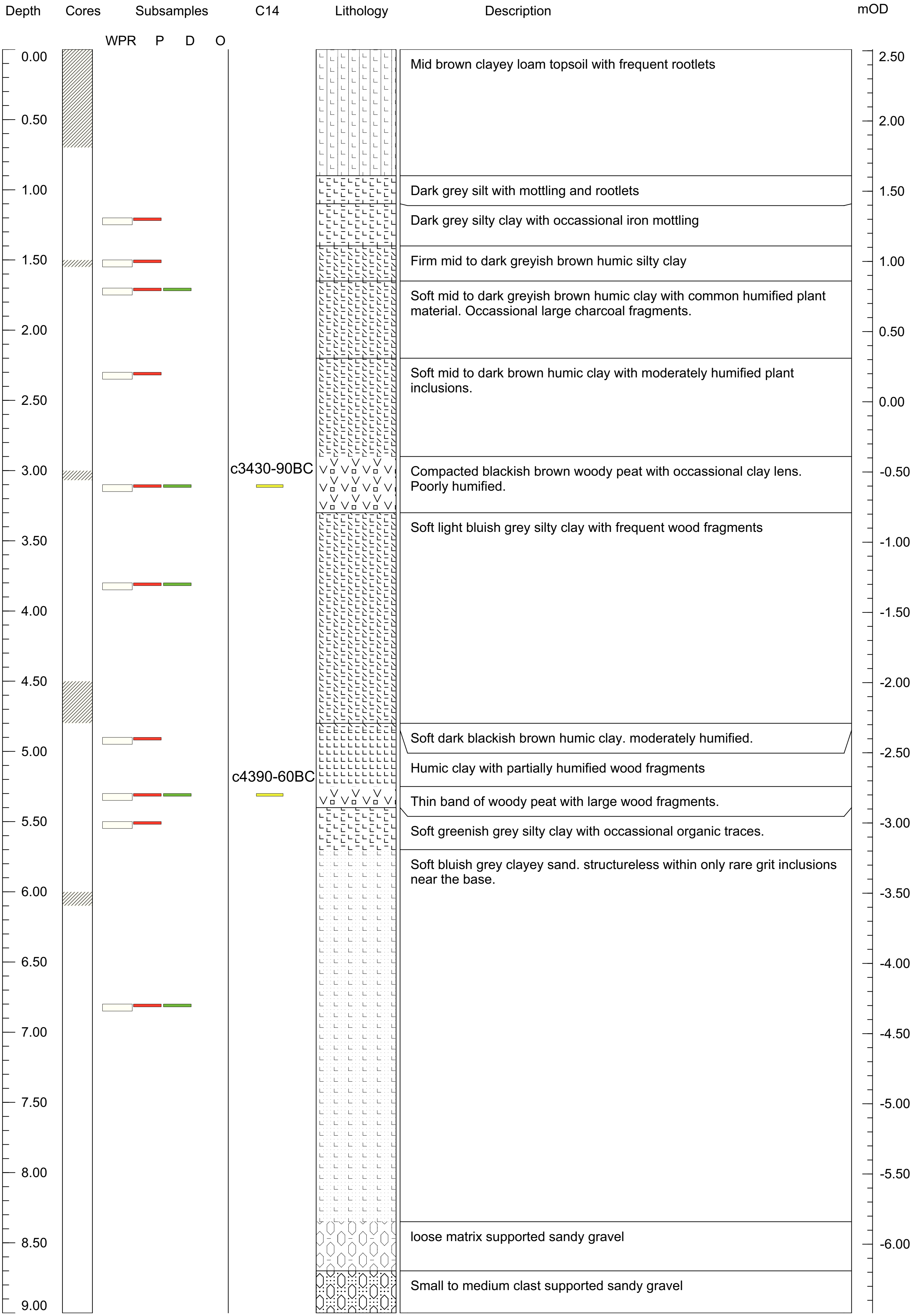


Figure 7: Sediment log of Borehole 4

Bexhill to Hasting borehole OA7 proposed subsample locations

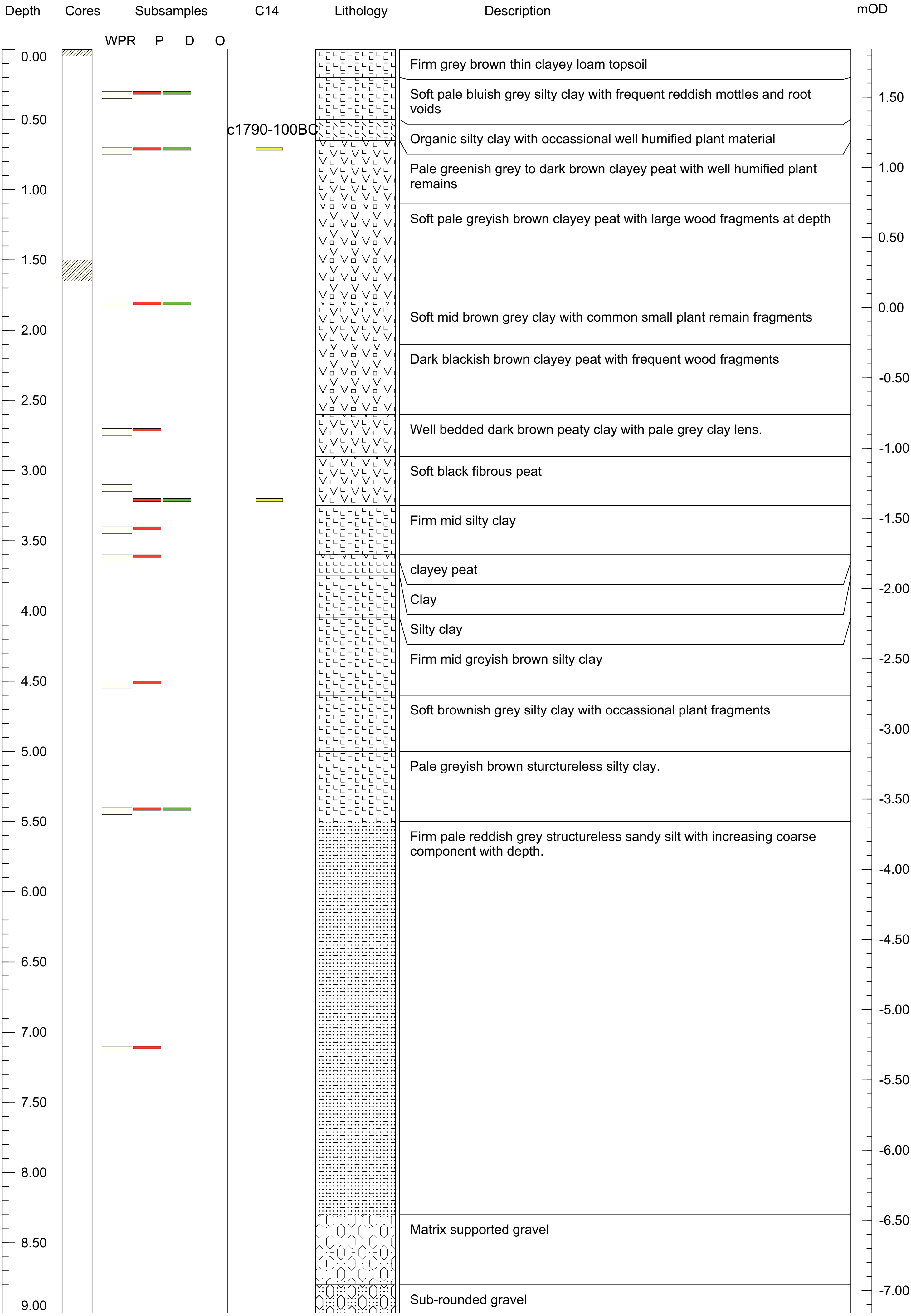


Figure 8: Sediment log of Borehole 7

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