

**A Geoarchaeological Watching Brief at
Lansdowne Place and Wilbury Avenue, Hove
East Sussex**

NGR TQ 29615 04439 (Lansdowne Place)

And

NGR TQ 29088 05595 (Wilbury Avenue)

**Project No. 3157
Site Code: WCH 08**

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Abstract

A watching brief was undertaken to monitor the installation of new waste water infrastructure by 4-Delivery at two sites in Hove: Lansdowne Place and Wilbury Avenue. During the course of this watching brief the Quaternary geology of both localities was recorded and assessed for archaeological and palaeoenvironmental potential. At Lansdowne Place a sequence of Head Deposits derived from nearby Tertiary outcrops were recorded as covering a poorly preserved section of the 250kyr old Brighton-Norton raised beach. At Wilbury Avenue, Head Deposits were recorded as overlying Tertiary solid geology. At both localities decalcification and oxidation of the sediments was comprehensive and no palaeoenvironmental indicators were recovered. Additionally no macro or micro-artefacts were recovered from the Quaternary deposits despite an exhaustive sieving programme. The work has been useful in further aiding the mapping of deposits with archaeological potential through the city of Brighton and Hove and for the refinement of geological models delimiting the extent of the Quaternary resource.

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1.0 INTRODUCTION

1.1 Site Background

- 1.1.1 Archaeology South East was commissioned by 4 Delivery Limited to undertake geoarchaeological watching briefs at two locations in Hove, East Sussex during the summers of 2007 (Lansdowne Place, NGR TQ 29615 04439) and 2008 (Wilbury Avenue, NGR 29088 05595). These were undertaken to record geoarchaeological observations during improvement works associated with the installation of underground pumping stations, kiosks, new manholes and sewage pipes.

1.3 Planning Background

- 1.3.1 Planning permission has been granted by Brighton and Hove City Council (BHCC) for this scheme, subject to a geoarchaeological watching brief during construction groundworks at both sites.
- 1.3.2 In view of 4 Delivery's commitment to maintain a high regard to local heritage and environmental issues, a geoarchaeological watching brief was undertaken during specific groundworks associated with the improvement scheme in accordance with the advice of BHCC.

1.6 Geology and Topography

- 1.6.1 Both sites lie within areas previously delimited as an archaeologically sensitive area relating to the Brighton-Norton Raised Beach.

1.8 Aims and Objectives

- 1.8.1 The aim of the fieldwork was to conduct a watching brief throughout the improvement works, including subsampling and assessment of sediments for palaeoenvironmental and artefactual material.
- 1.8.2 This report presents the results of these investigations.

2.0 GEOLOGICAL BACKGROUND

2.1 Background to the wider Pleistocene resource

- 2.1.1 The sediments mapped in the Brighton and Hove area form part of a wider sequence of deposits spread across 30km of the Coastal Plain of Sussex (Figure 2) and eastern Hampshire. Together they provide a detailed record of environmental change and the activities of extinct human species during alternating periods of warm and cold climate. In West Sussex these deposits are currently being mapped and investigated through Mapping Surveys, funded directly by English Heritage (Roberts and Pope In Prep; Bates and Wenban-Smith In Prep).

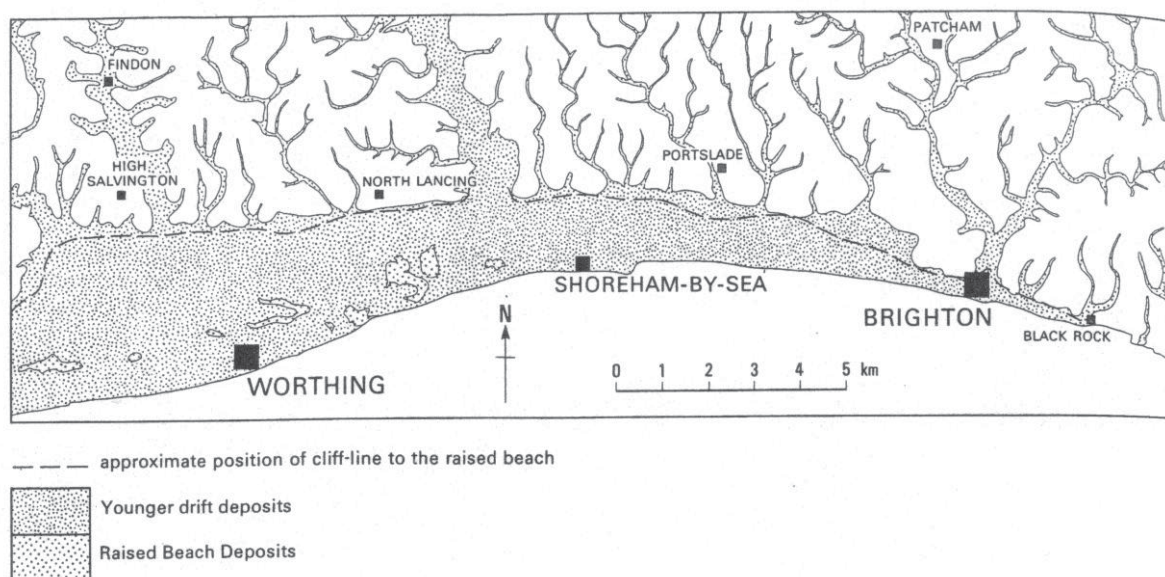


Figure 2: Distribution of the Brighton Raised Beach

2.2 Nature and extent of the resource

- 2.2.1 Brighton and Hove are situated on a low-lying coastal plain. This plain is an area of low relief, rising from sea level at the current channel coast to 50m OD where it meets the foot of the South Downs. The plain narrows substantially to the east, being less than 1km wide at Hove and terminates at the Black Rock cliffs behind the Brighton Marina. The plain is underlain by Upper Chalk and Tertiary bedrock, which forms a continuous platform covered by sediments deposited during the past 0.5 million years. These overlying deposits include sands and gravels relating to a series of raised beaches which formed during warm intervals between longer periods of sub-arctic conditions (glacial). The Brighton Raised Beach has been documented at a number of localities within West Sussex, and is represented by sands, silts and beach deposits overlying a platform at between c.8-12m above sea-level. The beach itself has been traced along the foot of the Downs at Sussex Pad, north of Shoreham (Bates *et al* 1998), through Worthing to the north of line of the east-west railway (Young and Lake 1988). New dating methods utilizing amino-acid ratios from shells preserved within the sediments have dated the Brighton-Norton formation to in excess of 0.2

million years ago (Davies 1985). Archaeological finds are rare from the Brighton-Norton formation, although flint tools have been found occasionally from these deposits in West Sussex and the Brighton and Hove area attesting to human (Neanderthal) occupation at this time (Woodcock 1981).

2.3 Distribution in City Council area

- 2.3.1 Within the Brighton and Hove area are a number of known localities demonstrated to preserve archaeologically sensitive deposits. Of these, the most important is the established SSSI (Site of Special Scientific Interest) at Black Rock, where the Brighton Raised Beach and overlying cold-stage deposits are preserved in an exposed section. This site is one of recognised national importance, being the best preserved natural exposure of a raised beach in the UK and preserving a sequence rich in faunal remains, environmental evidence and archaeology. The remaining section of cliff is now all that remains of an more extensive 4km section, originally stretching east to Rottingdean and west towards the Brighton Pier, where it has been built over as part of the esplanade (Ulliyott *et al* 2000). The site is today protected as an SSSI, overseen on behalf of English Nature by John Cooper of Brighton and Hove City Council. The standard sequence for Quaternary sedimentation associated with the Brighton-Norton Formation can be readily seen here and form a series of bedded Head Deposits comprising red to pinkish silts supporting consolidated beds of sub-angular chalk and flint gravel. Some of these beds are orientated in relation to the remnant chalk cliff of the Brighton Raised Beach and have bedding angles of up to 45 degrees orientated on a NE-SW axis. Others are of dry valley origin and have generally horizontal bedding angles and form the fill of north-south oriented valley profiles.
- 2.3.2 The section, which can be seen in Figure 3, preserves a flint cobble beach overlying a chalk platform at c. 8m above sea level. The beach deposits are overlain by 'coombe-rock' laid down in subsequent cold stages, this being a marly chalk rubble eroded from the Downs by thawing ice. These overlying deposits appear to preserve a rich assemblage of faunal remains including mammoth, horse and rhinoceros, yet they still await systematic scientific study (Parfitt *et-al.* 1998).
- 2.3.3 Another important exposure has been documented at Portslade (Prestwich 1887), where chalk and flint rubble was recorded overlying raised beach deposits at c. 4.5m above sea level. Exposures were also made during the laying of the main Brighton-Hove sewer in the late 19th century, where organic remains underlying cold-stage deposits (Prestwich 1887). At West Street deposits were exposed suggesting that the cliffline ran approximately along the line of the modern Western Road (Anthony Sutcliffe *pers. com.*). During the Nineteenth Century this beach line could still be traced as a 'low-cliff' through Portslade to Southwick and today presumably follows a line close to the Old Shoreham Road in the west of the City Council area.
- 2.3.4 The map in Figure 1 shows the likely extent of archaeologically sensitive Quaternary deposits in the city area. To the north, the chalk Downlands are mapped as being devoid of Quaternary deposits and form a clear limit to the distribution of these deposits. South of this line the whole area must be

considered sensitive although as continued investigation take place in the city the detail and extent of this area can be defined with more precision.

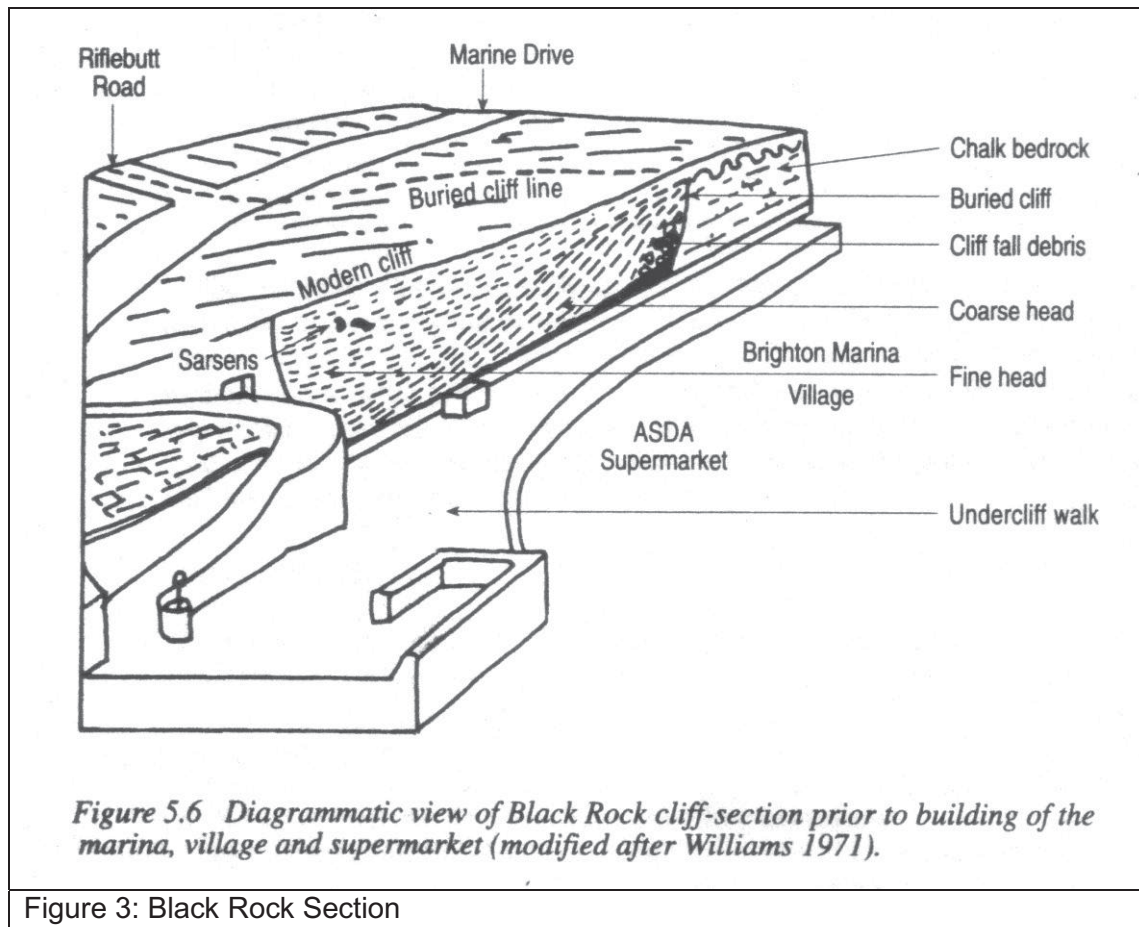


Figure 3: Black Rock Section

2.4 Threats to the resource

- 2.4.1 The Quaternary heritage of the Brighton and Hove area is under threat from two prime agents: development and weathering. The effects of weathering have been mitigated in the short term by remedial works at the Black Rock site. The effects of development are currently mitigated by the application of archaeological conditions set-out and enforced through the implementation of PPG16. This current study provides an example of this process at work.
- 2.4.2 Experience of management and planning strategies trialled by West Sussex County Council in the 1990's showed that the starting point for mitigation is the assuring the presence of a Geoarchaeologist during the initial Geotechnical ground investigations. Witnessing of trial trenching and borehole surveys is usually sufficient to characterise the sediments, allow the taking of basic samples and to provide suggestions for further work should it be required. In reality it is often the case that sensitive deposits are at a sufficient depth to avoid destruction from foundation laying but this must be demonstrated in each individual case, not assumed. The geo-technical investigation alone often provides valuable scientific data in its own right, even where it simply allows the absence of sensitive geology to be mapped, and thus distribution maps relating to the occurrence of sensitive deposits to

be mapped. Access to the site during geotechnical investigations is all that is required to assess the archaeological/scientific potential of the underlying geology in many cases. Desktop assessments can then be undertaken to anticipate the need for further work.

2.5 Development control

2.5.1 Currently planning policy on mitigation likely to impact upon Palaeolithic archaeology is under review, but draft planning policy has been drawn up. In the case of large redevelopment schemes and infrastructural projects affecting Pleistocene deposits, the following condition is attached to planning permissions:-

2.5.2 *“Provision shall be made for the presence of a qualified geoarchaeologist, with experience of Quaternary raised beach sediments, to be present during geotechnical site investigations. The geoarchaeologist shall be allowed access to log both boreholes and test pits undertaken at the site, have access to the results of previous geotechnical investigations where these results are public domain and witness the excavation of foundation trenches. The geoarchaeologist shall produce detailed geoarchaeological logs of witnessed excavations, take bulk samples of fine grained and marine sediments encountered and provide an assessment report with suggestions for further mitigation should it be deemed necessary. Geoarchaeologists employed shall liaise with active research Quaternary research teams including Dr Martin Bates (Lampeter) and the Boxgrove Project (UCL)*

From BHCC Draft Planning Conditions 2006).

3.0 METHODOLOGY

- 3.1 Ground works undertaken by the engineering contractors were monitored on a c.1 day per week basis by a geoarchaeologist until it became clear beyond reasonable doubt that no archaeological remains and/or significant geoarchaeological deposits were present (e.g. once excavation reached undisturbed natural Tertiary and Cretaceous geology).
- 3.2 Where new excavations did reveal significant archaeological material or palaeoarchaeological deposits, an opportunity was made for the collection of samples, which were hand-excavated and recorded to archaeological standards by the geoarchaeologist in attendance. Exposures where possible were hand-cleaned and recorded.
- 3.3 This approach allowed, where safety concerns were met, for any archaeological deposits or significant sedimentary facies, disturbed during the proposed works, to be adequately recorded in line with the advice given in PPG16 (the Government's advice on *Archaeology and Planning*) and City Council Planning Guidelines (BHCC 2006)
- 3.4 The spoil from the excavations was also be inspected by geoarchaeologists for the recovery any artefacts or ecofacts of archaeological interest. Sub-sampling of sediments often had to be undertaken directly from the excavator bucket due to the constraints imposed by safety on entering the pipe trenches and excavations.
- 3.5 Pleistocene Sediments were recorded in the following manner. Beneath the modern horizons, the running section was recorded at c. 5m horizontal intervals to allow the development of a series of detailed sediment logs. These comprised detailed sediment descriptions at 0.25m intervals or at the junction of major stratigraphic or lithological boundaries. The descriptions comprised matrix lithology, coarse components, sediment cohesion as well as characterisation of superficial structures and likelihood of decalcification. Given the presence of depositional contexts likely to preserve either artefactual or macrofaunal material at depths which are below the possibility of direct in-situ inspection, the arisings were placed in stratigraphical order to enable sieving, description and recording. During excavation dry sieving of such contexts, where possible, took place to look for lithic artefacts. In conjunction with the sieving, the spoil was constantly checked for artefacts as excavations continued.
- 3.6 Fine-grained deposits were sampled and assessed for vertebrate and invertebrate micro-fauna, micro-artefacts and palynological analysis.
- 3.7 Given the depth of stratigraphy, composite geological sections were drawn where possible at 1:20. Samples will be given a unique running number and marked on the section drawings. Sediment chromas and hues were recorded using a standard Munsell Soil Colour Chart. Section photography was undertaken where possible, however continuous shoring of the trench sides made this largely impossible.

- 3.8 Where deposits suitable for environmental sampling were encountered (buried soils, well-sealed slowly silting horizons) bulk soil samples (40 litres or 100% of smaller features) were taken for environmental analysis. In the case of sediments suitable for pollen, coleopteran or micropalaeontological analysis, these were closely sampled at <50mm intervals from vertical, closely recorded columns.

4.0 OBSERVATIONS AT LANSDOWNE PLACE

- 4.1 Lansdowne Place is a north-south aligned Regency Avenue with its southern end lying close to the modern coastline at its intersection with the contemporary east-west coastal route, Grand Parade, at c. 9m OD. From this intersection Lansdowne Place rises to the north until its intersection with Western Road at c. 18m OD.
- 4.2 Observations at the nearby site of Grand Avenue (NGR 529100 104223; demonstrated that there was potential for palaeoenvironmental remains to be preserved at depth at the proposed development location. On the basis of the earlier investigation it was likely that, underlying Pleistocene Head Gravels, a marine sequence comprising raised beach deposits and fine grained sands was present. Investigations during the 19th century indicated that a preserved landsurface may be encountered that might include organic and faunal remains.
- 4.3 The local topography forms part of the West Sussex Coastal Plain and is therefore low-lying and flat, with a gentle incline dipping seawards. The coastal plain is relatively narrow at this point being only c. 0.25km wide from north to south. The southern end of the site was thought to be situated c. 0.5km to the south of the inferred cliffline of the Brighton-Norton Raised Beach (Figure 2). Given the position and altitude of the site it was considered highly likely that deposits forming part of the terrestrial and marine facies of the Norton Formation (Bates *et al* 1998; 2000) would be present at the site.
- 4.4 In addition, the rapid narrowing of the coastal plain within the vicinity of the site is of interest. It is suspected that structural elements comprising a localised anticline within the Upper Chalk controlled coastal formation during the Pleistocene. This is suspected to have led to the formation of a headland, or partially enclosed marine bay in this area some 250,000 years B.P. The 'St Anne's Well Headland' hypothesis (Roberts and Pope, In Prep) suggests that, to the west of the site between Lancing and Hove, a minor embayment would have formed as sea action differentially eroded softer Tertiary Bed Rock remnants filling a superficial synclinal structure in preference to higher and more resistant topography of the chalk anticline which rises in east Hove and through Brighton. The Lansdowne Place investigations offered an opportunity to investigate this possibility further.
- 4.5 British Geological Survey (BGS) Sheet 318 (1984) shows the site to be underlain by Cretaceous Chalk and Quaternary Head deposits. Weathered remnants of the Reading Beds are shown to be present less than c. 300m to the north of the site. It is now known that these Tertiary beds do in fact extend as far south as Western Road and were present at the northern end of the site (Table 7).
- 4.6 In July 2007 work commenced on the renewal of sewer pipes, manholes and pumping stations along the length of Lansdowne Place. During these works the hole was monitored by Matthew Pope and Tania White of ASE. Exposures were monitored at c. 5m intervals and detailed logs made for deep exposures associated with manholes and the pumping stations sited at each end of the road. The recorded stratigraphic sequences are shown in tables 1 – 7 below.
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- 4.7 The logged sequences are shown in Figures 4, 5 and 6. These display a constant covering of variable Head Deposits along the N-S axis of the sequence, being comprised of decalcified silty-clay brickearths with varying quantities of angular flint gravel with indications of frost shattering. Stone free beds of pure brickearth were logged and may have a fluvial origin; none were indicative of in-situ loess. They most probably represent the downslope, fine-grained tail of Head Gravel lobes. However, the bulk of the material contained moderate amounts of unsorted gravel and can best be described as a diamicton deposit emplaced through gelifluction during mass movement caused by the partial thawing of permafrost. Processes associated with subsequent decalcification have led to the loss of structure within these deposits and micro-stratigraphy which may have preserved landsurfaces within the fine-grained, stone-free beds of the brickearth were not noted.
- 4.8 To the north of the site (Manhole 1) weathered Reading Beds were recorded as underlying the Head. These were suspected to be present within the region both on the basis of proximal mapping by the BGS and by the nature of the Head Deposits themselves, which appear ultimately derived from the Tertiary Reading Beds within the Hove area. The Head Deposits here are of a different character altogether to those preserved in the section at Black Rock, c. 5km to the east, in that they lack even modest amounts of chalk as coarse components, have far higher quantities of sand and clay within the matrix and contain varying quantities of small, exceptionally rounded pebbles characteristic of the Reading Beds. The recording of solid geology only at the northern end of the transect suggests that the cliff line lies close to the point and that it is in part a cliff cut into the Reading Beds. This has been seen before in the Westbourne-Arundel Raised Beach to the east of Slindon, where a composite cliff exposing both the Upper Chalk and unconformable contact with the overlying Reading Beds was formed. Cliffs of this nature can be currently seen at Newhaven where the less resistant Tertiary Beds are rapidly weathered at a faster rate than the underlying chalk, effectively sealing the chalk profile from further erosion and giving rise to loam-rich colluviums derived from the Reading Beds. It is thought that a similar process occurring more rapidly under peri-glacial conditions has given rise to the decalcified loamy Head Deposits seen within Hove.
- 4.9 At the extreme southern end of the site (Manhole 9) the base of the deep excavations associated with the pumping station exposed the surface of marine deposits comprising decalcified sand with occasional rounded flint cobbles. This deposit was encountered at c. 5m OD, an altitude entirely consistent with the Brighton-North Raised Beach. No overlying regressional or terrestrial deposits were associated with these sands, their upper surface appearing to be truncated through the deposition of the overlying Head. The possibility exists, however, for these deposits to thicken to the north, with possible preservation of regressional facies close to the cliff line just south of Western Road. At this point they would be expected to lie in excess of c. 8m below the modern ground surface. Further exposures associated with the Lansdowne Place works were not deep enough to test this possibility.
- 4.10 Samples were taken from the brickearth and marine sand for assessment of micropalaeontological, palynological and micro-artefact potential. 100 litres of sediment was sub-sampled and assessed for each context at each logged

section. It was hoped that surviving foraminifera, ostracods and other environmental indicators might provide some circumstantial evidence for the depositional context of these brickearth. Unfortunately the samples taken were barren, presumably due to decalcification and oxidisation, and no clear micro-artefacts were recovered.

Depth	Stratigraphy	Colour (Munsell)	Lithology	Clast Component	Notes
0-1.04	Made ground	-	Chalk sub-base	Flint nodules	Cuts into Head Gravels
1.04	Brickearth	10YR 4/4 Dark yellowish brown	Silty clay	30% angular flint shards (2-4mm) and 30% nodules of flint (50mm). Some mixing with Made Ground above.	Decalcified. Slightly friable. Sample 1.
1.74	Brickearth	10YR 4/6 Dark yellowish brown	Silty clay	70% flint specs (<3mm), 5% sub-angular flint inclusions (5mm).	Sample 2.
2.0	Brickearth	10YR 5/6 Yellowish brown	Silty clay	Few inclusions. 5% Mn mottling. 1% angular flint (>6mm).	Sample 3.
2.22	Brickearth	10YR 5/6 Yellowish brown	Silty clay	1% angular flint (>10mm)	Soft and slightly more adhesive than above. Sample 4.
2.36	Brickearth	10YR 5/6 Yellowish brown	Clay with silt	Mn flecking.	Sample 5.
3.47	Brickearth	10YR 5/6 Yellowish brown	Clay with silt	Mn deposits.	Crumbly, gritty clay with sand. Sample 6.
4.5	Lower Brickearth	10YR 5/8 Yellowish brown with 10YR 6/8 brownish yellow	Silt with clay	0.5% flint flecks (2mm) and 0.5% sub-rounded and sub-angular flint (10mm).	Sand with soft clay. Sample 7. Hole finished 4.97m.

Table 1: Manhole 9, located on Kingsway, TQ 29584 04302, top of excavations at c. 8.5m OD

Depth	Stratigraphy	Colour (Munsell)	Lithology	Clast Component	Notes
0-1.2	Made Ground	-		-	Chalk sub-base cuts into Brick Earth
1.2	Brickearth	10YR 5/6 Yellowish brown	Silt with clay	Mn and brown organic mottling. 1% chalk and occasional Fe deposits (<2mm). 10% Angular, sub-angular, sub-rounded flints and rounded beach pebbles (<20mm).	Junction of Made Ground and silty clay. Slightly darker brown and greyer than levels beneath. Sample 1.
2.0	Brickearth	10YR 5/6 Yellowish brown.	Silt with clay	Some Fe and Mn flecks. Fewer inclusions than sample at 1.2m above. More decalcified than above but some chalk flecks. Some rounded and sub-rounded flint specs (2-3mm.)	Sample 2.
2.2	Brickearth	10YR 5/6 Yellowish brown	Tearing (but softer than above) adhesive clay with silt.	Higher calcium content than layer at 2.0m. Chalk specs and sub-angular pieces 20mm. Mn 0.5% and other organic brown mottling.	Sample 3.
2.4	Brickearth	10YR 5/8 Yellowish brown	Clay with silt	Mn deposits. Almost no inclusions. Occasional angular flint (15-20mm).	Mixed junction with Marine Sand? 2m north of previous position within Manhole (15m north of Kingsway). Sample 5.
2.6	Brickearth	10YR 5/8 Yellowish brown.	Silty clay	Almost no inclusions with 1% Mn deposits. Flint as above.	Firm and adhesive. Sample 6. Hole finished @ 2.6m.

Table 2: Manholes 7 and 8 located 13m north of the junction of Kingsway and Lansdowne Place, TQ 29580 04302, top of excavations at c. 8.9m OD

Depth	Stratigraphy	Colour (Munsell)	Lithology	Clast Component	Notes
0-0.67	Made Ground		Chalk sub-base	-	-
0.67	Made Ground	10YR 4/3 brown	Silty clay	Occasional rounded flint pebbles (10mm). Occasional flint pebbles (80mm). Occasional glass and brick inclusions from mixing with made ground (2mm).	Mixed junction between made ground and brick earth. Soft, adhesive very silty clay. Sample 1.
1.3	Brickearth	10YR 4/6 dark yellowish brown with 10YR 5/6 yellowish brown	Silty clay	1% flint flecks (<5mm) and 5% Occasional angular and sub-angular flint nodules (70mm).	Soft, adhesive very silty clay. Sample 2.
1.53	Head Gravels	10YR 5/6 yellowish brown	Silty clay	Occasional flint cobbles (90mm). Dense angular, sub-angular, and sub-rounded flint nodules (<70mm). F	Horizontally bedded compacted flint. Clay sticky. Mottled with silt. Sample 3.
1.85	Lower Brickearth	10YR 5/6 yellowish brown.	Silty clay	Occasional sub-rounded flint (10mm). 10% Mn deposits. Granular quartz type mineral (1mm).	Mottled clay and silt. Sticky. Soft, adhesive. Sample 4.
2.95	Lower Brickearth	10YR 5/8 yellowish brown silt with 5Y 8/2 pale yellow clay.	Silty clay	No noticeable inclusions.	Soft, adhesive clay with finely bedded silt. Sample 5.

Table 3: Manhole 6, 150m to south of Western Road TQ 29599 04351, top of excavations at c. 9.5m OD

Depth	Stratigraphy	Colour (Munsell)	Lithology	Clast Component	Notes
0	Made Ground	-	Sub-base	-	Cuts into Brickearth
0.66	Made ground	10YR 4/6 dark yellowish brown	-	Oyster shell fragments. Pebbles. Mn flicking. Sub-angular flint (30mm)	Crumbly, friable. Possible contamination from above. Sample 1
0.76	Brickearth	10YR 3/4 dark yellowish brown	Clay silt	No inclusions.	Bedded flint. Sample 2.
1.0	Head gravel	10YR 3/4 dark yellowish brown	Clay silt	Sub-angular flint (40mm)	Sample 3
1.3-1.4	Head gravel	10YR 3/4 dark yellowish brown	Clay silt	60% Sub-angular flint (40mm)	Sample 5
1.6	Lower Brickearth	10YR 5/6 yellowish brown	Clay with silt	Clast free	Mottled. Sample 6
2.3	Lower Brickearth	10YR 5/6 yellowish brown	Clay with silt	Clast free	Mottled. Sample 6
2.95	Lower Brickearth	10YR 5/6 yellowish brown	Clay with silt	Clast free	Mottled. Sample 6

Table 4: Manhole 5, 100m to south of Western Road TQ 29605 04384, top of excavations a c. 11.6m OD

Depth	Stratigraphy	Colour (Munsell)	Lithology	Clast Component	Notes
0-0.55	Made Ground		Sub-base	-	Cuts into Brick Earth
0.55	Brickearth	10YR 4/6 dark yellowish brown	Silty Clay	Inclusions 1% sub-angular flint (~4mm).	Sample 1
1.04	Brickearth	10YR 4/6 dark yellowish brown	Silty clay	25% Mn deposits. 70% Dense sub-angular flint inclusions (>80mm).	Friable. Sample 2.
1.24	Lower Brickearth	10YR 4/6 dark yellowish brown	Silty clay	Mn deposits. Sub-angular flint (<45mm) and flint specs (3mm).	Mottled. Firmer clay than above. Sample 3
1.56	Lower Brickearth	10YR 6/2 light brownish grey and 10YR 5/6 yellowish brown	Silty clay	Clast free.	Mottled. Firmer clay than above. Sample 4.
2.22	Lower Brickearth	10YR 6/2 light brownish grey and 10YR 5/8 yellowish brown	Silty clay	Clast free.	Mottled. Sample 5.
3.5	Lower Brickearth	5Y 6/2 light olive and 10YR 5/8 yellowish brown	Silty clay	Clast free.	Mottled. Soft, adhesive. Sample 6. Hole finished @ 3.5m.

Table 5: Manhole 4. 75m to south of Western Road. TQ 29607 04405, top of excavations at c. 14.2m OD

Depth	Stratigraphy	Colour (Munsell)	Lithology	Clast Component	Notes
0-0.7	Made-ground	-	Chalk sub-base	-	Cuts into Brick Earth.
0.7	Brick Earth	10YR 4/6 dark yellowish brown	Silty clay	Few, if any inclusions. Fe ²⁺ and Mn mineral deposits.	Soft malleable adhesive silty clay. 0.2m layer remaining. Sample 1.
0.9	Head Gravels	10YR 4/6 dark yellowish brown with 10YR 5/8 yellowish brown (sand) and black gravels	Gravel and flint nodules	80% sub-angular flint gravel. Gravel 2mm and flint nodules 60mm from ice age solifluction	0.5m layer. Distinct. Sample 2.
1.55	Lower Brickearth	10YR 5/8 yellowish brown	Silty Clay	Fewer flint inclusions than above <7%	Soft adhesive clay-with silt. Sample 4 @ 1.65m.
1.75	Lower Brickearth	10YR 5/6 yellowish brown	Silty Clay	Fewer flint inclusions than above <5%	Soft adhesive clay-with increasing silt content. Non-tearing. Sample 5 @ 1.75m.
2.9	Tertiary Geology	10YR 5/6 yellowish brown	Fine to medium Fe stained sand with clay	Rounded black flint pebbles >10mm and smaller orange pebbles.	Sample 6.

Table 6: Manhole 3, 50m to south of Western Road. TQ 29615 04439, top of excavations at c. 17m OD

Depth	Stratigraphy	Colour (Munsell)	Lithology	Clast Component	Notes
1.7	Made ground	10YR 5/3 and 10YR 5/4 yellowish brown.	Clay with silt	Brick	Adhesive, soft. Adjacent Sample 1
1.9	Brickearth	10YR 5/4 yellowish brown silt and 10YR 6/2 light brownish clay		Clast free. Occasional Mn deposits and Fe ²⁺ .	Mottled. Very soft. Adhesive. Wetter – adjacent land drain. Sampled 2
2.0	Brickearth	10YR 5/2 grayish brown and 10YR 5/4 yellowish brown		Occasional rounded flint pebbles (10mm). Occasional Mn deposits	Mottled. Very soft. Adhesive. Sample 3.
2.2	Brickearth	10YR 6/8 brownish yellow silt with 10YR 6/2 light brownish grey clay	Clay with silt	Clast free.	Mottled. Very soft. Adhesive. Sample 4.
3.7	Clay	10YR 4/1 dark grey clay and 10YR 4/6 dark yellowish brown sand and 10YR 5/8 yellowish brown sand		Occasional rounded flint flecs (3mm).	Firm strong clay. Adjacent clay water pipe. Sample 5.
2.9	Lower Brickearth	GLE Y1 6/1 Greenish grey	Clay		Mottled. Sample 7
4.75	Lower Brickearth	10YR 4/4 dark yellowish brown	Sandy clay	Mn deposits	Sample 8

Table 7: Manhole 1, located on Western Road, TQ 29636 04303, top of excavations at c. 18.1m OD

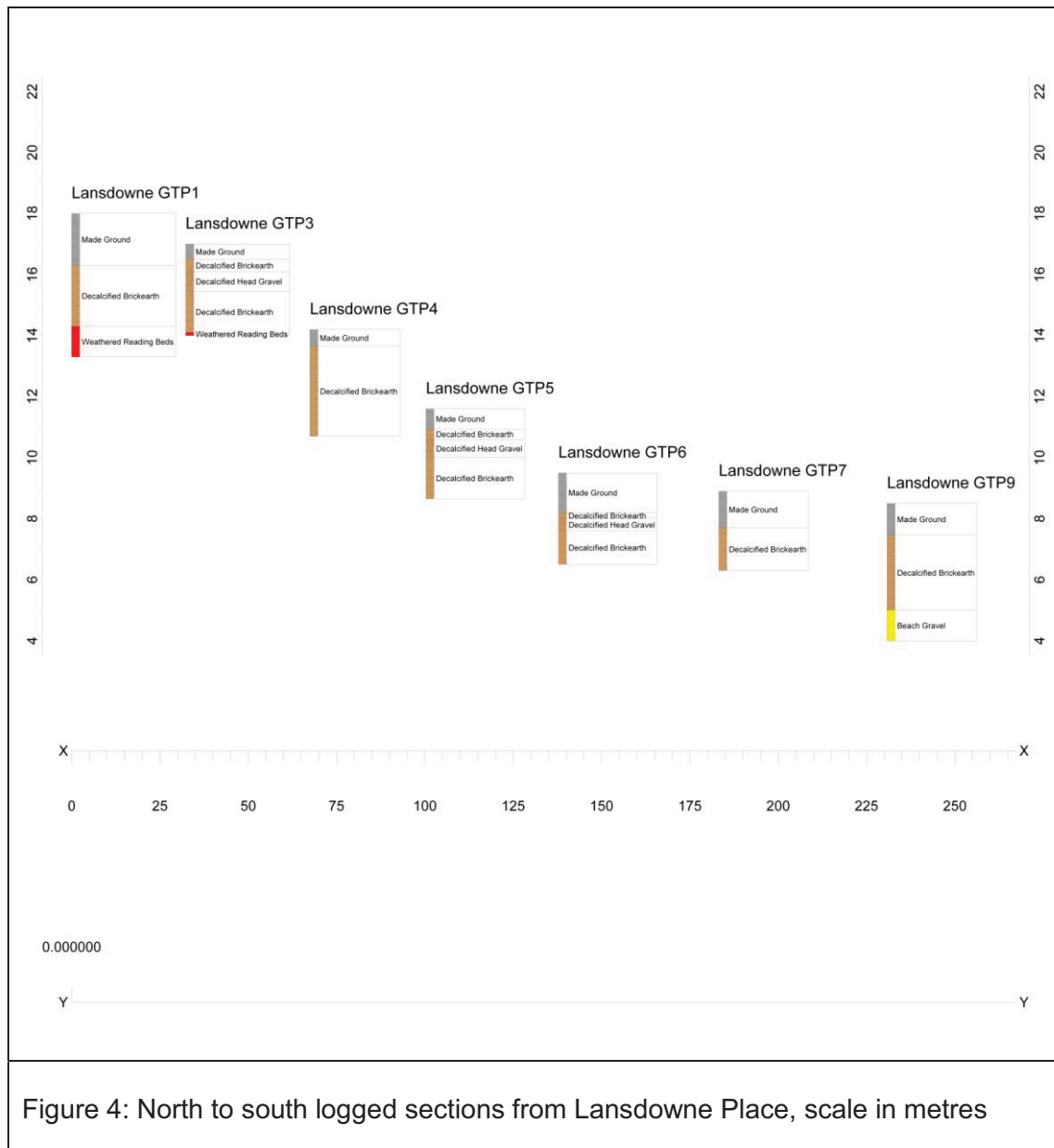


Figure 4: North to south logged sections from Lansdowne Place, scale in metres

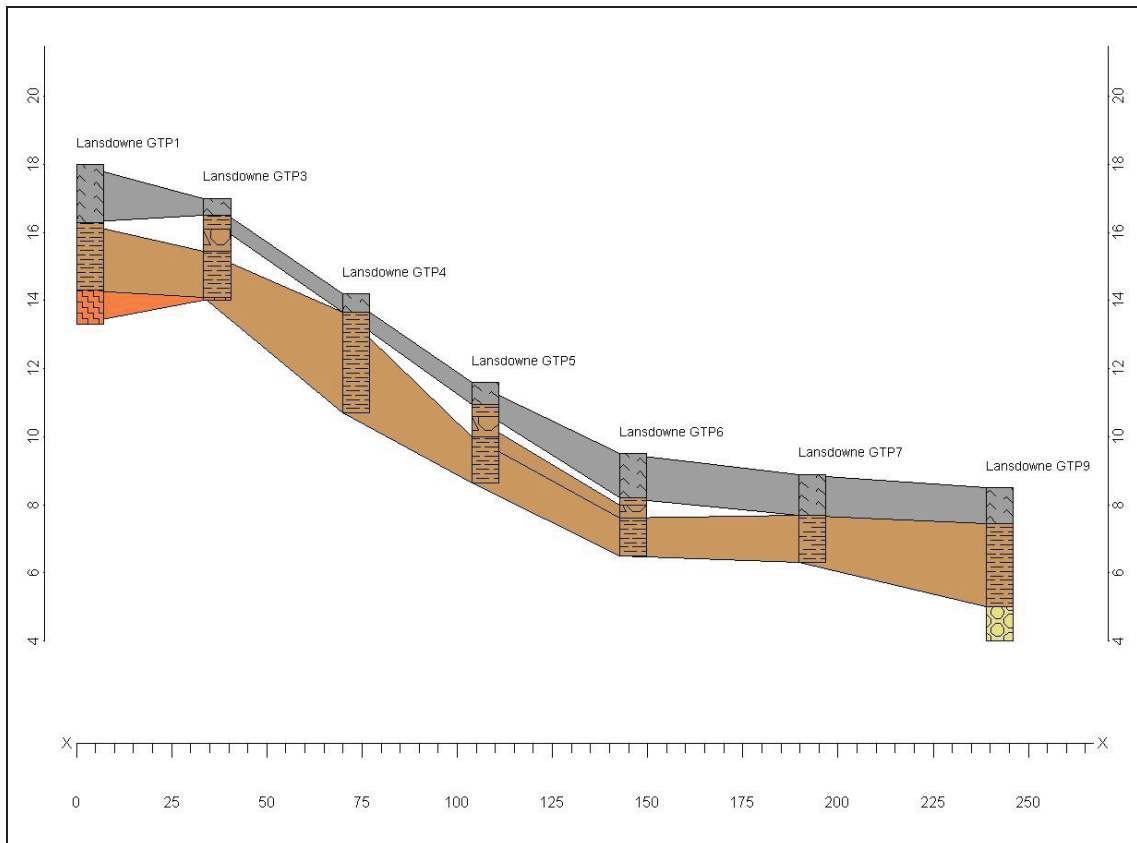


Figure 5: North to south correlated logged sections from Lansdowne Place, scale in metres

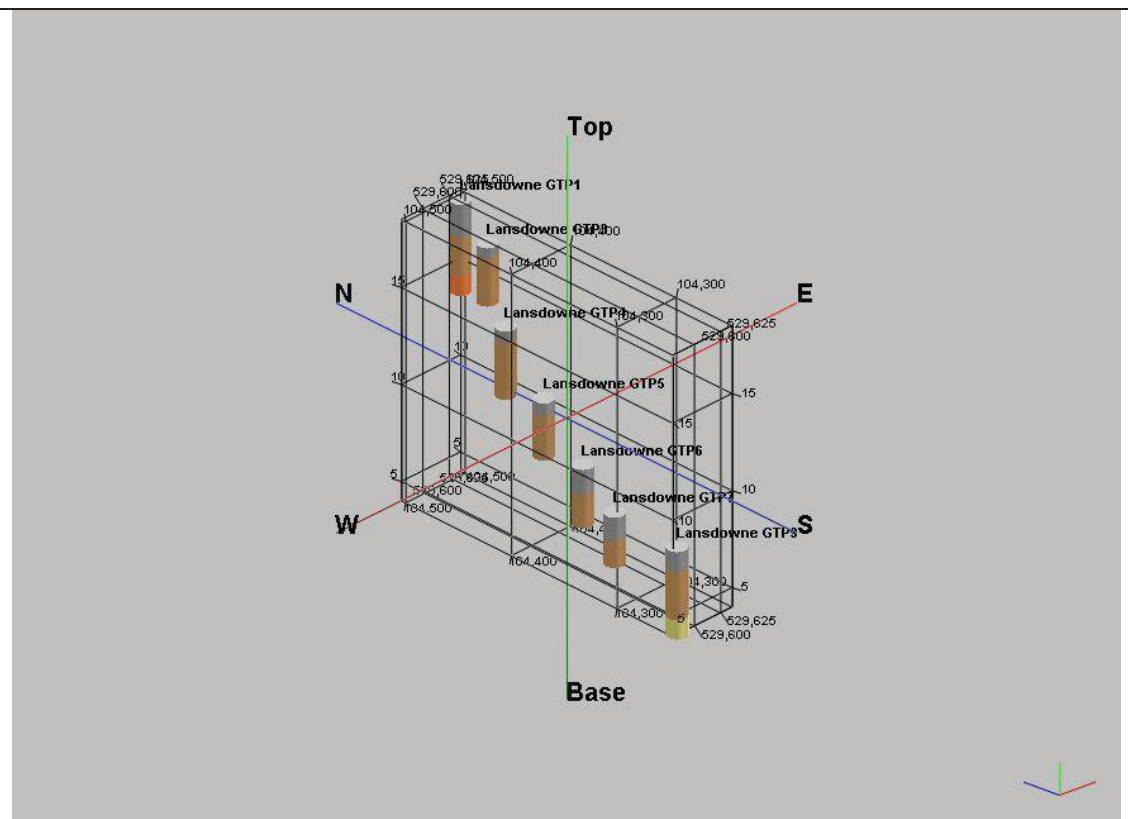


Figure 6: Three dimensional model of logged sections from Lansdowne Place, scale in metres



Figure 7: Exposure of Tertiary Beds underlying Head deposits in manhole 1, Lansdowne Road

5.0 OBSERVATIONS AT WILBURY AVENUE

- 5.1 Wilbury Avenue is an east west aligned road situated c. 1.5km to the north of the modern coastline and c. 1.25km to the north west of the Lansdowne Place site. The site sits at between c. 30 and 34m OD.
- 5.2 The local topography forms the lower elevation of the South Downs escarpment and the site sits just to the north of coastal plain which is thought to be up to c. 1.5km in width at this point. The site also sits close to the eastern flank of the north-south aligned Goldstone Dry Valley which formed a periglacially controlled axis of melt-water and surface drainage at points during the Pleistocene; it is also noted for the local occurrence of large Tertiary Sarsen stones. Given the position and altitude of the site it is was thought possible that head deposits and associated fine grained brickearths might be buried at depth on the site, and the work also provided an opportunity to determine whether any remnants of higher Raised Beach deposits were present in this area.
- 5.3 The BGS Sheet 318 (1984) shows the site to be underlain by Cretaceous Chalk and close to the margins of Quaternary Head deposits of the coastal plain which lie to the south. Weathered remnants of the Reading Beds are shown to be present less than c. 1000m to the north of the site. It is now known that these Tertiary Deposits are in fact present at Wilbury Avenue (see Table 9).
- 5.4 In August 2008 work commenced on the renewal of sewer pipes, manholes and pumping station along part of Wilbury Avenue as part of flood alleviation for Cromwell Road. During these works the excavations were monitored by Matthew Pope and Liane Peyre of ASE. Exposures were monitored at c. 5m intervals and detailed logs made for deep exposures associated with manholes, the kiosk and the pumping stations The recorded stratigraphic sequence is shown below in Tables 8 - 11.
- 5.5 Strip logs for the Wilbury Avenue site are shown in figures 8, 9 and 10. They show a sequence of Decalcified Head gravel overlying Weathered Reading Beds. To the east of the site a localised deposit of Calcareous Head was recorded, which might be expected to thicken eastwards as the ground rises onto a low ridge of Upper Chalk. This ridge may delimit the eastern margin of the opening of the Goldstone dry valley into the Coastal Plain to the south. The rapid fall in height of the Weathered Reading Beds surface between GTP2 and GTP3 may reflect this valley or might be the result of post-depositional solution of the underlying chalk which was itself exposed at the base of GTP3.
- 5.6 The recorded section show the deposition of sediments derived from both the Upper Chalk and Reading Beds, redeposited through periglacial gellifluction across the southern dip slope of the South Downs. No deposits associated with either Raised Beach formation or regression/terrestrial contexts were encountered, indicating low potential for the recovery of archaeological remains.
- 5.7 Samples were taken from brickearth seams of micropalaeontological, palynological and micro-artefact potential. One hundred litres of sediment

were subsampled and assessed from each context at each logged section. It was hoped that surviving forams, ostracods and/or other environmental indicators might provide circumstantial evidence for the depositional context of the brickearth. The samples were barren, presumably due to decalcification and oxidisation.

Depth	Stratigraphy	Colour (Munsell)	Lithology	Clast Component	Notes
0-1.04	Made ground	-	Chalk sub-base	Flint nodules, tarmac.	Cuts into Head Gravels
0.45	Decalcified Head	10YR 4/4 Dark yellowish brown	Silty clay	30% angular flint (20-40mm)	Decalcified. Slightly friable. Sample 1.
1.25	Calcareous Head	10YR 6/6 brownish yellow	Clay Silt	70% sub-angular chalk fragments 10-20mm 20% angular flint nodules 30-350mm (Av. 150mm)	Sample 2. Tabular Flint Noted.
2.5	Calcareous Head	10YR 6/6 brownish yellow	Clay Silt	60% sub-angular chalk fragments 10-20mm. 10% angular flint nodules 30-400mm (Av. 150mm)	Sample 3. To 3.1m depth.

Table 8: Manhole 1, GTP1, located outside no. 30 Wilbury Avenue TQ 29088 05595, top of excavations at c. 34m OD

Depth	Stratigraphy	Colour (Munsell)	Lithology	Clast Component	Notes
0-.04	Made ground	-	Chalk sub-base	Flint nodules, tarmac.	Cuts into Head Gravels
0.4	Decalcified Head	10YR 4/6 Dark yellowish brown	Silty clay	30% angular flint (20-40mm)	Decalcified. Slightly friable. Sample 1.
1.1	Brickearth (Decalcified)	10YR 4/6 Dark yellowish brown	Silty clay	Stone Free	Samples 2 and 3
1.3	Decalcified Head	10YR 4/6 Dark yellowish brown	Silty clay	60% angular flint (20-40mm)	Decalcified. Slightly friable. Sample 4.
2.4	Weathered Reading Beds	7.5YR 5/8 strong brown	Sandy Clay	10% rounded Tertiary Flint 10-30mm	Sample 5
2.8	Reading Beds	7.5YR 5/6 strong brown	Clay	5% rounded Tertiary flint 10-30mm	Sample 6

Table 9: Manhole 501, GTP2, located outside no. 28 Wilbury Avenue, TQ 29072 05606, top of excavations at c. 34m OD

Depth	Stratigraphy	Colour (Munsell)	Lithology	Clast Component	Notes
0.3	Made ground			Tarmac and chalk sub-base	Cuts into Head Gravels
0.8	Decalcified Head	10YR 4/6 Dark yellowish brown	Clay Silt	60% angular flint (20-40mm)	Decalcified. Slightly friable. Sample 1.
1.2	Decalcified Head	10YR 4/6 Dark yellowish brown	Clay Silt	60% angular flint (20-40mm)	Samples 2 and 3
3.2	Weathered Reading Beds	7.5YR 5/8 strong brown	Sandy Clay	10% rounded Tertiary Flint 10-30mm	Sample 4
4	Reading Beds	7.5YR 5/8 strong brown	Clay	5% rounded Tertiary flint 10-30mm	Sample 5
4.4	Reading Beds	7.5YR 5/8 strong brown	Clay	5% rounded Tertiary flint, Chalk fragments noted possibly indicating contact with chalk close to base	Sample 6

Table 10: GTP3, pumping station, located on Wilbury Avenue, TQ 29051 05610, top of excavations at c. 33m OD

Depth	Stratigraphy	Colour (Munsell)	Lithology	Clast Component	Notes
0.3	Made ground			Tarmac and chalk sub-base	Cuts into Head Gravels
0.4	Decalcified Head	10YR 4/6 Dark yellowish brown	Clay Silt	60% angular flint (20-40mm)	Decalcified. Sample 1. To 1m

Table 11: GTP4, cable pit, located on Wilbury Avenue, TQ 29053 05643, top of excavations at c. 34m OD

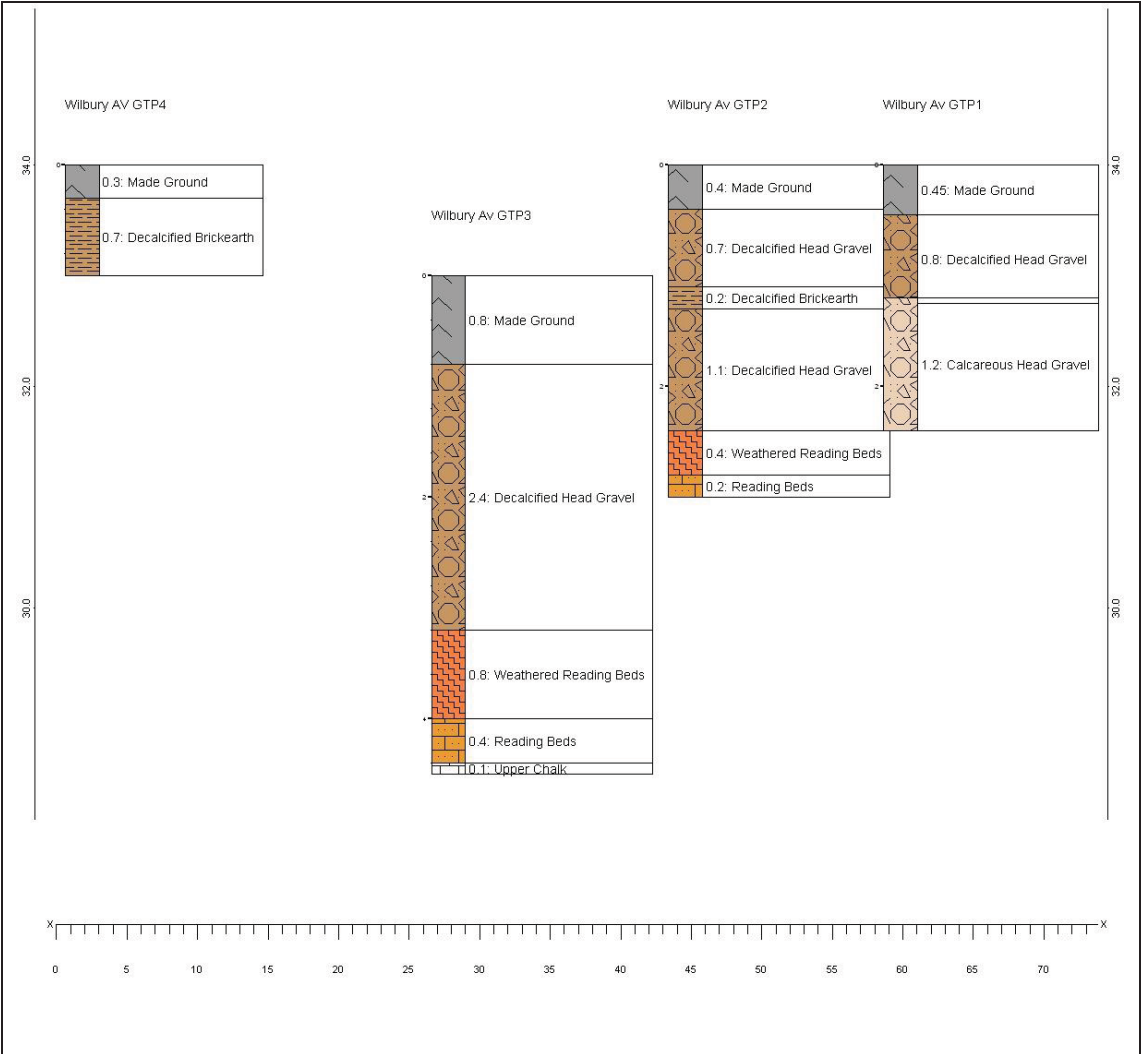


Figure 8: North to south logged sections from Wilbury Avenue, scale in metres

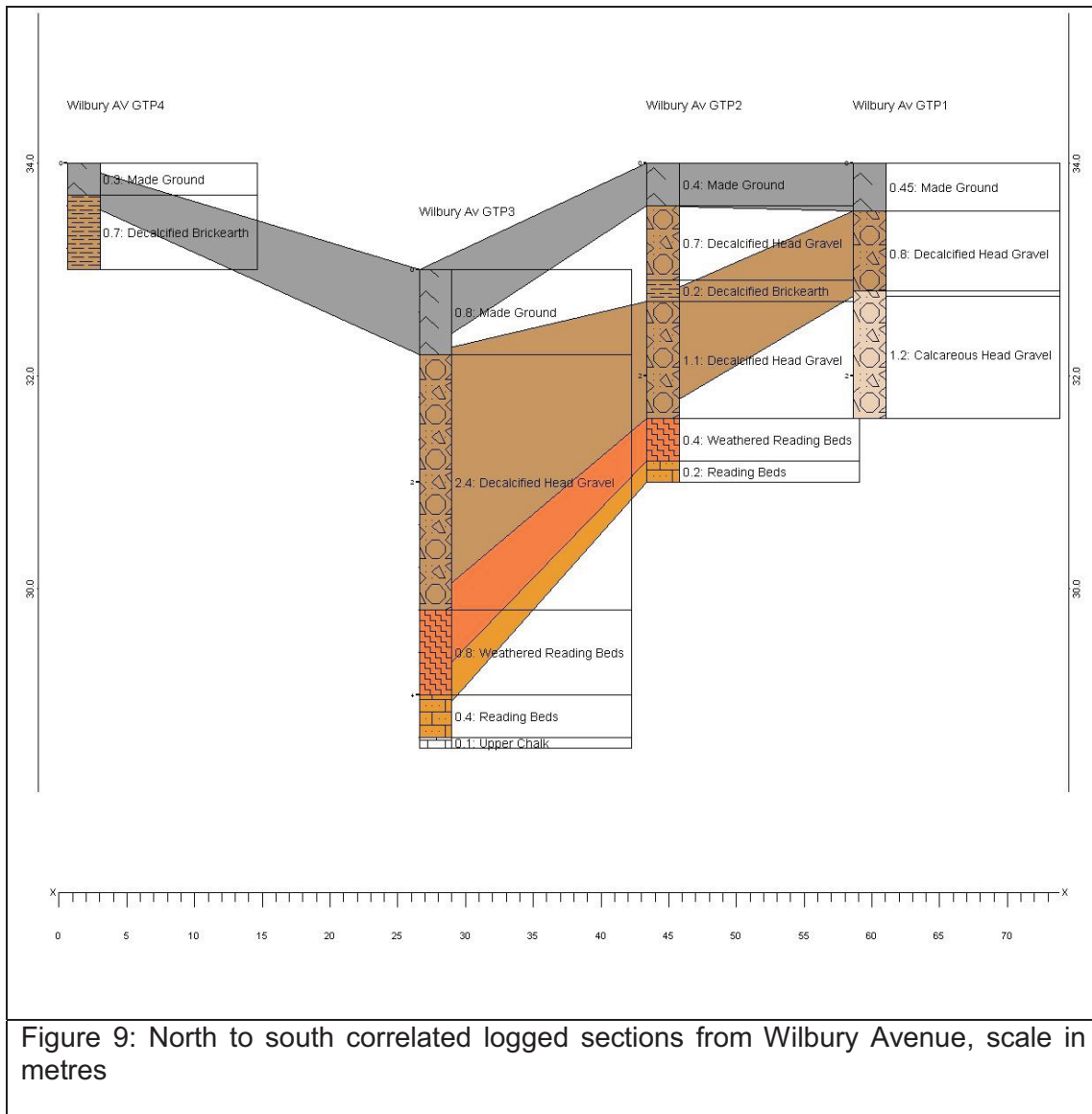




Figure 11: Exposure of Upper Chalk below Weathered Tertiary deposits at Wilbury Avenue, GTP3.

6.0 DISCUSSION

- 6.1 The investigations at Lansdowne Place and Wilbury Road offered the most extensive phase of geoarchaeological mapping within the Brighton and Hove area to date. As such it provided a unique opportunity to document geological variation in the surface Pleistocene geology within part of the city. On the whole the developments associated with sewer upgrade work were too superficial to record complete sequences through the Pleistocene geology to the surface of the underlying solid Geology. However, the deeper excavations associated with pumping stations at both sites did produce useful complete sequences.
- 6.2 Both sites allowed the characterisation the Head deposits associated with the southern slopes of the South Downs through Hove. Both could be characterised on the basis of containing large amounts of reworked Tertiary material and are therefore of a quite different character to the Calcareous Heads which cover the raised beach both at Black Rock and within the Steyne Valley area of Brighton. These Head deposits do not readily preserve either molluscan or mammal fauna but should not be written-off completely as having no potential for palaeoenvironmental remains. Similar Head deposits at Slindon, associated with large quantities of material derived from the Reading Beds contained well preserved pollen and macroscopic plant remains (Roberts and Pope In Prep). The original accounts of organic deposits associated with the Brighton-Norton Raised Beach within the area of Hove, do now make sense in that we can suggest that localised areas of anaerobic preservation may be associated with clay-rich facies of the Head.
- 6.3 The results of the fieldwork can be added to the evolving geological model for the Brighton and Hove area (Figure 12) which is, during small scale studies undertaken through both research and development led archaeology, starting to show the arrangement and physical limits of the Pleistocene geology within the city. The location of the fossil cliffline, previously unknown in Hove can now be approximated with more accuracy, refining our response to further development in the area and allowing more targeted research in the future. The identification of marine deposits at the base of the pumping station at the south of Lansdowne Road also provides a definitive indication of the presence of the Brighton-Norton raised Beach through eastern Hove. With a cliff line which swings south on its progression from the west in response to the St Ann's Well headland.
- 6.4 During further work of this nature it will be possible to implement methodological lessons learned from the approach developed at the Lansdowne Place and Wilbury Road sites. The nature of excavation, involving trenches too deep to safely enter and continuous shoring, do place limits on the degree to which samples can be taken under controlled conditions and sections adequately photographed and recorded. It is suggested that further projects of this nature involve some low-level purposive coring ahead of development. This can be achieved using low impact window sampling equipment, and can provide an initial characterisation of geology, an assessment of palaeoenvironmental potential and the ability to tie shallow excavations through Pleistocene sediments in with the surface of the underlying solid geology. The latter is particularly crucial as it allows surface

heights of wave cut platforms and the position of possible cliff lines to be determined.

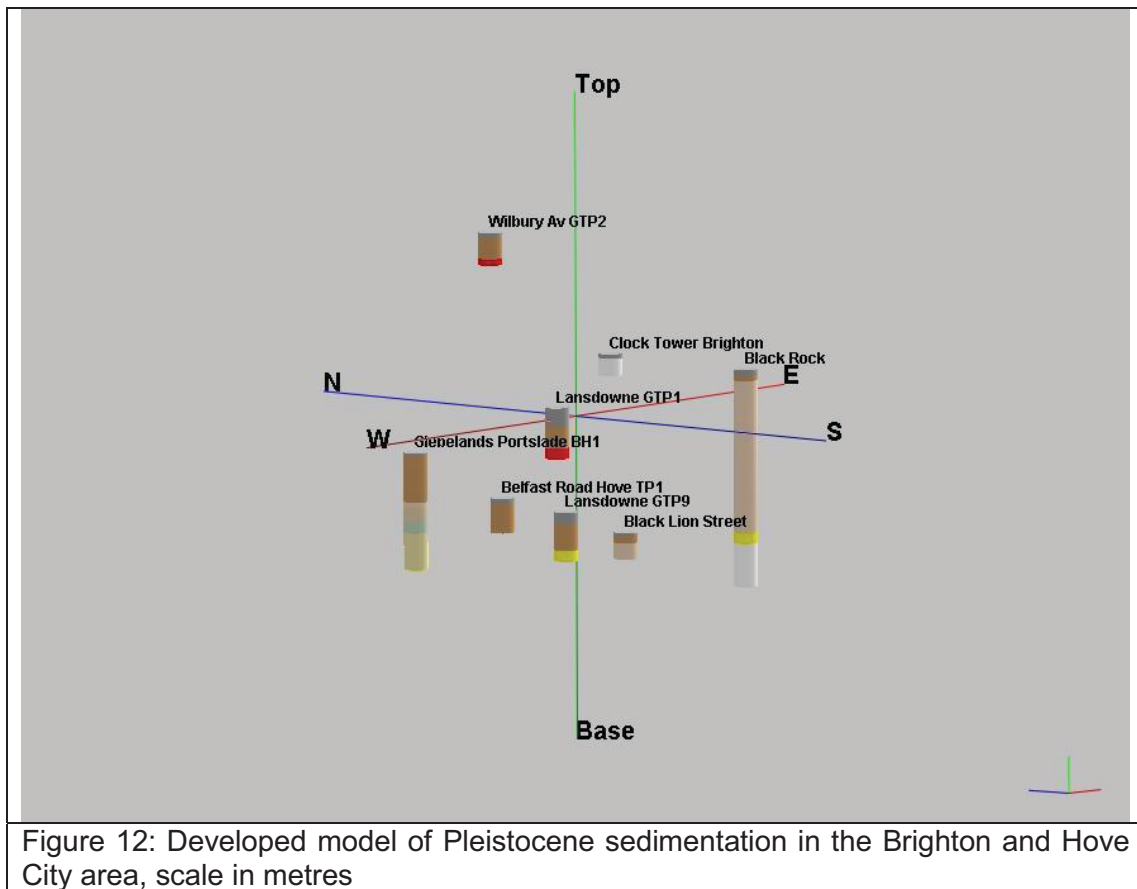


Figure 12: Developed model of Pleistocene sedimentation in the Brighton and Hove City area, scale in metres

Bibliography

Bates, M.R., Parfitt, S.A. and Roberts, M.B. 1998. The chronology, palaeoecology and archaeological significance of the marine Quaternary record of the West Sussex Coastal Plain, Southern England, UK. *Quaternary Science Reviews*. 16. 1227-1252.

Bates, M.R., Parfitt, S.A. and Roberts, M.B. 1998. *Palaeolithic Archaeology and Quaternary Stratigraphy of the West Sussex Coastal Plain* in Murton, J.B., C.A. Whiteman, M.R. Bates, D.R. Bridgeland, A.J. Long, M.B. Roberts, M.P. Waller (eds) *The Quaternary of Kent & Sussex*, Quaternary Research Association, London, 146-150.

Bates, M.R., Bates, C.R., Gibbard, P.L., Macphail, R.I., Owen, F.J., Parfitt, S.A., Preece, R.C., Roberts, M.B., Robinson, J.E., Whittaker, J.E. and Wilkinson, K.N. 2000. 'Late Middle Pleistocene Deposits at Norton Farm on the West Sussex Coastal Plain, Southern England'. *Journal of Quaternary Science*. 15 (1). 61-89.

Bates, M.R. and Wenban-Smith, F.F. In prep. *The Lower Coastal Plain in Sussex and Hampshire*.

Brighton and Hove City Council. 2006. Draft Planning Conditions

Parfitt, S.A., Owen, F. and Keen, D.H. 1998. *Pleistocene Stratigraphy, Vertebrates and Mollusca, Black Rock, Brighton* in Murton, J.B., C.A. Whiteman, M.R. Bates, D.R. Bridgeland, A.J. Long, M.B. Roberts, M.P. Waller (eds) *The Quaternary of Kent & Sussex*, Quaternary Research Association, London, 146-150.

Parfitt, S.A. and Sutcliffe, A.J. In press. 'Pleistocene channels of the Selsey Peninsula and Bracklesham Bay, West Sussex, UK'. *Journal of Quaternary Science*.

Prestwich, J. 1859. 'On the Westward Extension of the old Raised Beach of Brighton; and on the extent of the Sea-Bed of the same Period'. *Quarterly Journal of the Geological Society*. 15. 215-221.

Roberts, M.B. 1998. *Middle Pleistocene sediments and archaeology at ARC Eartham Quarry, Boxgrove, West Sussex* in J.B. Murton, C.A. Whiteman, M.R. Bates, D.R. Bridgeland, A.J. Long, M.B. Roberts and M.P. Waller (eds) *The Quaternary of Kent and Sussex Field Guide* London, Quaternary Research Association, 187-213.

Roberts, M.B. and Parfitt, S.A. 1999. *Boxgrove: A Middle Pleistocene Hominid Site at Eartham Quarry, Boxgrove, West Sussex*. London. English Heritage Monograph Series 17.

Roberts, M.B. and Pope, M.I. 2000, *Report on Geological Test Pits at Brooks' Field 2185 at Tangmere, West Sussex*, unpublished report for Chichester District Council.

Roberts, M.B. and Pope, M.I. in prep. *The Raised Beach Mapping Project* English Heritage Monograph Series.

Shephard-Thorn, E.R. 1995, *Portsdown-Arun Project*, unpublished report for English Heritage.

West, R.G. and Sparks, B.W. 1960. 'Coastal interglacial deposits of the English Channel'. *Philosophical Transactions of the Royal Society of London*. B 243. 95-133.

Woodcock, A. 1981. *The Lower and Middle Palaeolithic Periods in Sussex*. Oxford. British Archaeological Reports, British Series 94.

Young, B & Lake, RD 1988 *Geology of the Country Around Brighton and Worthing* Memoir of the British Geological Survey, sheets 318 & 333

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OASIS Form

Project name	Lansdowne Place and Wilbury Av Geoarchaeological Watching Brief
Short description of the project	A watching brief was undertaken to monitor the installation of new waste water infrastructure by 4-Delivery at two sites in Hove: Lansdowne Place and Wilbury Avenue. During the course of this watching brief the Quaternary geology of both localities was recorded and assessed for archaeological and palaeoenvironmental potential. At Both sites, Head Deposits were recorded as overlying Quaternary and Tertiary solid geology. At both localities decalcification and oxidisation of the sediments was comprehensive and no palaeoenvironmental indicators were recovered.
Project dates	Start: 08-08-2007 End: 10-09-2008
Previous/future work	No / No
Any associated project reference codes	WCH08 - Sitecode
Type of project	Field evaluation
Current Land use	Other 11 - Thoroughfare

Project location

Country	England
Site location	EAST SUSSEX BRIGHTON AND HOVE HOVE Lansdowne Place and Wilbury Road
Study area	2.00 Kilometres
Site coordinates	TQ 29615 04439 50.8243891772 -0.159529349689 50 49 27 N 000 09 34 W Point
Site coordinates	TQ 29088 05595 50.8348983496 -0.166601273189 50 50 05 N 000 09 59 W Point
Height OD / Depth	Min: 7.00m Max: 35.00m

Project creators

Name of Organisation	Archaeology South East
Project brief originator	East Sussex County Council
Project design originator	Archaeology South-East
Project director/manager	Neil Griffin
Project supervisor	Neil Griffin
Type of sponsor	Client
Name of sponsor/funding body	4- Delivery
Entered by	Matt Pope (m.pope@ucl.ac.uk)
Entered on	16 January 2009