Union Railways Limited

Channel Tunnel Rail Link

PURLEET, THURROCK, ESSEX

ARCHAEOLOGICAL EVALUATION REPORT

TIS No. 192/84 - 10411

OXFORD ARCHAEOLOGICAL UNIT

November 1995

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Prepared by: Date:
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ARCHAEOLOGICAL EVALUATION

SUMMARY

As part of a larger programme of archaeological investigation along the route of the Channel Tunnel Rail Link, Union Railways Ltd commissioned the Oxford Archaeological Unit to undertake a field evaluation of 0.5ha of land immediately to the south of the Purfleet By-pass, Purfleet, Thurrock, Essex in July to September 1995. Purfleet is of national, if not international, importance for palaeoloithic archaeology and pleistocene geology, as recognised from previous investigations of chalk and gravel pits in the locality. Quarrying has significantly depleted this resource. The deposits of interest represent the fill of an ancient river channel, aligned east to west, which is crossed obliquely by the CTRL route at a point where the railway runs in a cutting. In this evaluation, the sedimentary stratigraphy of the deposits has been recorded from a series of ten boreholes and four test pits. A considerable number of Palaeolithic flint artefacts were recovered, largely from a slope wash or solifluction deposit eroded from a chalk cliff forming the southern edge of a palaeochannel of the Thames. Lithic material was also recovered from fluvial sediments at the margin of the palaeochannel. In both cases the flint was in relatively good condition, indicating that it had undergone little post-depositional re-working. Pollen was recovered from fine-grained sediments, but molluscs and bones were all but absent from the deposits investigated.

In addition, some evidence of later prehistoric occupation was recorded, although the nature of the the evaluation precluded detailed interpretation of the features recorded.

1 BACKGROUND

1.1 Introduction

1.1.1 The Oxford Archaeological Unit undertook a two stage archaeological evaluation between 24th July and 4th August 1995 and between the 18th and 22nd September 1995, on behalf of Union Railways Ltd (URL) on land at the former Esso oil depot immediately to the south of the Purfleet By-pass, Purfleet, Thurrock, Essex (Figure 1). The evaluation forms part of a programme of archaeological investigation along the line of the Channel Tunnel Rail Link, the aim of which is to appraise the impact of the construction of the new railway upon the cultural heritage.

1.1.2 The work was carried out in accordance with a Written Scheme of Investigation (WSI), detailing the scope and method of the evaluation. Pleistocene deposits within the Purfleet area have been extensively quarried, allowing scientific and archaeological investigations to be carried out on them. The southern edge of a palaeochannel of the Thames crosses the evaluation site, and previous studies have shown that Palaeolithic artefacts are most densely distributed towards the southern edge of the pleistocene deposits.

1.2 Reason for the Project

1.2.1 HM Government has determined that a new railway should be built to connect London mainline railway stations and the Channel Tunnel. The project involves extensive construction work, including cuttings, tunnels and embankments.

Figure 1

1.2.2 An Environmental Statement has been prepared. This examines the impact of the project on the natural and built environment. The OAU has provided detailed archaeological input to this document (Assessment of Historic and Cultural Effects, Vols 1-4, OAU, 1994) and a number of sites have been identified where the proposedroute of the rail link will affect areas of particular known or potential archaeological sensitivity. Archaeological evaluation of these areas is necessary so that detailed mitigation strategies can be devised for the archaeology (references to these features in the Purfleet area are given here as OAU No.... and may be found in Volume 1 Route Corridor; Volume 2 Maps; Volume 3 Gazeteer; and Volume 4 Appendix B).

1.2.3 The CTRL Assessment of Historical and Cultural Effects (OAU 1994) identifies the Pleistocene channel deposits at Purfleet, with the co-occurrence of three distinct artefactual horizons in association with deposits containing molluscan, faunal and pollen evidence, as of at least national importance for Palaeolithic archaeology.

1.3 Construction Work on the Purfleet Site

1.3.1 The route crosses the Borough of Thurrock to approach the north portal of a new tunnel under the river Thames. Construction will involve cuttings, embankments and ground-level works. Some of the route through the area north of Purfleet crosses ground which has been subject to mineral extraction in the past, and is therefore of little or no archaeological sensitivity. The evaluation area, however, contains a significant extent of substantially intact land (although part of the site appears to have been affected by extraction). The railway will run through the site in cutting up to 8 m deep at the south-east end.

1.4 Geology, Landscape and Landuse

1.4.1 The Aveley Marshes end at Purfleet with the commencement of the chalk outcrop that extends through most of the ancient parish of West Thurrock. The Mar Dyke follows the line of a former, more sinuous course of the Thames. Extensive overlying gravels and other deposits on both the north and south sides of the Dyke provide evidence of the extent of the former valley. The CTRL affects the deposits on the south side.

1.4.2 The fluvial deposits at Purfleet are part of the Corbets Tey Gravel, the middle of three gravel terraces which have been recognised in the Lower Thames.

1.4.3 Elements of a composite stratigraphic sequence of pleistocene deposits determined by previous workers were expected in the area of study. The composite profile constructed by Bridgland (1994) and based on Hollin (1977) shows 5 major units are present above Chalk bedrock in the area. It is thought likely that these units will inter-digitate and change laterally. This is because the gravel and sand deposits exhibit bedding structures and sedimentological trends consistent with deposition in fluvial channels which are subject to rapid channel shifts, variable flow regimes and rapid shifts in the loci of sedimentation. The accepted model for the development of the Thames fluvial sequences (Bridgland 1994, 17-19) indicates that coarse sands and gravels are typically laid down in cold climate conditions while the finer grained interbedded sands, silts and clays overlying the gravels indicate temperate floodplain environments.

1.4.3 The analysis of oxygen isotopes in fossil plankton in deep ocean cores provides an indication of ice-cap size and therefore of climate. Warm and cold episodes are numbered backwards from the present interglacial - Oxygen Isotope Stage 1. The oldest of the Lower Thames interglacials, the Hoxnian, is correlated with Stage 11. Bridgland (1994, 13) has correlated the temperate deposits within the Corbets Tey Gravel to Oxygen Isotope Stage 9.

1.4.4 The pleiestocene sediments are banked against a chalk cliff line that exists towards the eastern end of the evaluation area.

1.4.5 Part of the north-western end of the site is designated as an Site of Special Scientific Interest (SSSI) known as Purfleet Chalk Pits.

1.4.6 The evaluation area mainly consists of rough pasture, scub and a few mature trees, with an area of hard-standing towards the centre.

1.5 Archaeological background

1.5.1 The Purfleet area is known to contain archaeological remains from the Palaeolithic up to the Roman periods.

1.5.2 Palaeolithic

1.5.2.1 The Palaeolithic evidence consists of flint artefacts and palaeo-environmental remains recovered from Pleistocene geological deposits. These deposits consist of a sequence of stratified clays, silts, sands and gravels lying in a channel cut into the north-facing chalk slope to the south of the Mar Dyke. This channel and its infilling Pleistocene deposits (the Mar Dyke channel) represent an early course of the Thames. A substantial part of these deposits has been removed by quarrying.

1.5.2.2 Palaeolithic flint artefacts were collected by Snelling from Botany Pit (TQ 556785) in 1961 (OAU 1994, OAU No. 1521). This flint industry has been attributed as "Proto-Levalloisian" and dates to between 200,000 and 300,000 years ago. Snelling recovered this assemblage from a deposit of gravel approx. 3.5 m thick resting on chalk bedrock at approx. 12 m OD (Wymer 1968, 312-313).

1.5.2.3 More detailed investigations of the Mar Dyke channel deposits (OAU No. 1516) were carried out less than 1 km to the east by Palmer in the late 1960s at Greenlands Quarry (TQ 566785) and Bluelands Quarry (TQ 570787). Palmer (1975, 1-13) recovered Palaeolithic artefacts from channel deposits in both quarries. These artefacts occurred in three distinct bands of gravel within the Pleistocene sequence. The artefacts from each gravel band have been attributed to, respectively: the Levalloisian industry (Gravel 1), the Clactonian and Acheulian industries (Gravel 2) and the Clactonian industry (Gravel 3). Palmer identified these gravel-bands within a deep sequence of Pleistocene deposits filling the middle of the Mar Dyke channel. At this point the base of the channel was cut into chalk bedrock at 6.7 m OD, and the top of the Pleistocene sequence occurred at 13.75 m OD. In between the gravel-bands 3 and 2, between 2 and 1, and over gravel-band 1, are complex sequences of clays, silts and sands. The lower clays and silts (between gravel-bands 3 and 2) have been shown to contain both mollusc

shells and pollen grains. The presence of molluscan remains suggests suitable conditions for the preservation of faunal remains, and in particular small mammals (voles, shrews and mice).

1.5.2.4 A recent re-examination of the Botany and Esso pits by David Bridgland as part of a geological study of the CTRL (Bridgland 1993) suggests that Palaeolithic artefacts are most strongly distributed towards the southern edge of the Pleistocene deposits where these are banked against the chalk anticline.

1.5.3 Mesolithic and Neolithic

1.5.3.1 Archaeological remains from these periods have been discovered at several locations in the area. At the west end of Greenlands Quarry (TQ 56407850) pottery (possibly Neolithic), flint artefacts (Mesolithic/Neolithic) and two possible post-holes (unattributed) were found in the top metre of the deposits exposed in the quarry section (OAU 1518). A prolific Mesolithic flint industry (OAU 1517) was also recovered from the topmost part of the section at the northeast corner of Greenlands Quarry (TQ 56857853). An assemblage of over 300 flint artefacts (OAU No. 1961), including flakes and a polished axe of likely Mesolithic and/or Neolithic age, was recovered from the topsoil at Beacon Hill (TQ 557782) during an archaeological salvage operation after the destruction of the hill-top by quarrying in 1969 (Caldwell 1971, 58).

1.5.4 Bronze Age

1.5.4.1 The only unambiguous location of Bronze Age archaeological remains is at the top of Beacon Hill (TQ 557782), where a Bronze Age cinerary urn (OAU No. 1961) was recovered during the 1969 archaeological salvage operation (Caldwell 1971, 58).

1.5.5 Iron Age and Roman

1.5.5.1 Isolated finds of pottery, bricks, tiles and loomweights attributed to the Roman and/or Iron Age periods (OAU No. 1522) have regularly been found in the upper parts of the old quarry faces around Botany Pit (TQ 556785). An inspection of "the old working face" in 1956 (Gilman 1956, 12-14) showed traces of pits and ditches containing pottery, bones and much charcoal (OAU No. 1523). These features can probably be linked with the isolated Roman/Iron Age finds common in the Botany Pit. No precise locations have been recorded for these archaeological remains, although they most likely came from the high west-facing side of the quarry.

2 AIMS

2.1 The Written Scheme of Investigation (URL/OAU 1995) outlined thirteen principal aims for the evaluation.

2.2 The evaluation aims were as follows:

2.2.1 To assess the sedimentological character, and horizontal and vertical extent, of affected Pleistocene/Palaeolithic deposits.

2.2.2 To assess the vertical and lateral distribution of palaeolithic artefacts within the Pleistocene levels.

2.2.3 To examine the Pleistocene/Palaeolithic levels to the depth of impact from construction works by means of boreholes and by test pits.

2.2.4 To assess the potential of the Pleistocene/Palaeolithic and other deposits for artefactual and environmental remains.

2.2.5 To assess the relationship of Palaeolithic archaeological deposits, including artefacts and ecofacts, to the Pleistocene lithostratigraphic and sedimentary sequence.

2.2.6 To determine the potential for post-Palaeolithic archaeological deposits and, if such deposits are defined, to assess their date, character, extent, quality and condition.

2.2.7 To relate all archaeological deposits found to other discoveries in the locality.

2.2.8 To critically review the local, regional, national and (where relevant) international significance of such archaeological deposits as are revealed.

2.2.9 To contribute towards proposals for mitigation of impact on such archaeological deposits as are revealed and/or can be predicted from the evaluation evidence.

2.2.10 To make a full graphic, photographic and written record of the evaluation.

2.2.11 To communicate the results of the evaluation to the client (and through them to the statutory consultees) in the form of a suitably illustrated report which shall be lodged with the County Sites and Monuments Record within one year of the end of fieldwork.

2.2.12 To prepare an archive of the evaluation project, to be deposited in an approved museum within a timescale to be agreed with the County Archaeologist, taking due account of the potential for further fieldwork.

2.2.13 To deposit the finds with the archive (subject to the agreement of the landowner and, where relevant, any decisions under Treasure Trove law).

3 METHODS

3.1 General

3.1.1 A detailed statement of the methods used in the evaluation is contained within Section 3 of the Written Scheme of Investigation (URL/OAU 1995), the accompanying Methods Statement (OAU 1995a) and the Site Safety Plan and COSHH Statement (OAU 1995b). The following is only intended to amplify certain aspects of the evaluation methodology.

3.1.2 In order to evaluate the thick and deeply buried pleistocene deposits, a staged approach to the evaluation was devised

3.1.3 The first stage of work took the form of a borehole investigation, carried out by the Geotechnical Service Facility (GSF) of the Institute of Archaeology, University College, London at the request of the Oxford Archaeological Unit. A series of shell

Figure 3

and auger core samples (see Figure 2) were taken in order to provide an assessment of the general profile and character of the lithographic and sedimentary depositional sequence and to inform the location of test-pits during the second stage of evaluation.

3.1.3 The second stage of work involved the excavation of a series of test-pits (see Figure 2), primarily for the recovery of artefacts and ecofacts, and to provide an oppurtunity for examination of the depositional sequence *in situ*.

3.2 Borehole investigation

3.2.1 A shell and auger percussion drill rig, capable of drilling and casing to depths of *c.*20m below ground surface through a variety of sediment types including sands and gravels, was used to drill an array of 10 boreholes along the proposed CTRL route corridor (Figure 2). This was carried out by Strata Investigation under sub-contract to GSF (see Plate 1).

3.2.2 In all cases, irrespective of apparent depth of Pleistocene sediments, boreholes were drilled to 10.0m depth from the surface to ensure that bedrock had been penetrated. As Pleistocene sediment thickness was typically shallower than anticipated, the Chalk was drilled to depths in excess of 5.5m in all cases.

3.2.3 Individual boreholes were recorded in detail during drilling. Where possible U4/U100 cores were requested and used. Recovery quality varied both down profile and across the site. Dense ground within the gravels precluded the use of U4/U100 cores in certain parts of the sequence. Elsewhere the extremely unconsolidated nature of the sands resulted in U4/U100 cores falling apart on extraction from the ground. Where sampling using U4/U100 cores was not possible open shelling of the hole was undertaken and sediments logged and taken as bulk samples.

3.2.4 All boreholes were logged in accordance with geological descriptive standards commonly in use by the GSF staff. These also accord with, or extend, the standards used by the Museum of London Archaeological Service.

3.2.5 The U4/U100 core samples were described using standard sedimentological terminology to describe colour, composition, bedding and grain sizes. In addition, other features such as the presence of clay coatings on clasts and sand grains, zones of reddening, blocky structure to the sediment and trace fossils indicative of plant rooting were actively sought (see Plate 2).

3.3 The Test Pit Investigation

3.3.1. Four test-pits were excavated using a mechanical excavator equipped with a 0.9m wide ditching bucket (see Plate 3). All the test pits were 4m long and 1.7m wide in order to accommodate a trench-box shoring system once a depth of 1.2m had been reached. The trench-box was lowered in stages as each test pit was excavated. This technique ensured that the short end-sections of each test pit were open to observation. None of the test pits exceeded 2.95m in depth.

3.3.2 A resident engineer was on site at all times to advise on and monitor the safety aspects

of the excavation. Test pit ARC2002 TP was resited after made ground was encountered in its initial position, and the final test pit was excavated through

Plate 1

Plate 2

unconsolidated sediments. A partial collapse occurred at a depth of 2.4m below ground surface and the test pit was abandoned and backfilled.

3.3.3 The location of test pits ARC2001TP, ARC2002TP, and ARC2003TP was determined in advance on the basis of the results of the coring operation (Figure 2). The location of ARC2004TP was determined on site after an initial review of the deposits recorded in ARC2001TP.

3.3.4 The test pits were excavated in spits, nominally of 0.25m depth. The spoil from each spit was stored separately to allow hand-sorting and sieving of the material for the recovery of artefacts. The topsoil was stored separately and an additional spoil heap was required for stratigraphically mixed material. In practice, the spit depth was generally greater than 0.25m due to the need to ensure a clean surface before the next spit was excavated. The excess spoil generated in this way was placed separately on a waste heap. Each spit was numbered separately.

3.3.5 Sediments were recorded by M Bates and C Pine of GSF in accordance with geological descriptive standards commonly in use by the GSF staff. These also accord with, or extend, the standards used by the Museum of London Archaeological Service.

3.3.6 One section in each test-pit was drawn at a scale of 1:20. In test pits ARC2001 TP, ARC2002TP, and ARC2003 TP, the end section of the test pit was felt to be representitive of the deposits as a whole; in ARC2004 TP, with more complex stratigraphy, the side face was drawn as a cumulative section as the trench-box was gradually lowered.

3.3.7 Approximately 100 litres of spoil from each spit was coarse sieved through 10mm and 4mm meshes. In addition, a variable proportion (generally about 300 litres) of the spoil was hand-sorted. M White of Cambridge University was present on site to supervise the recovery of the flint artefactual material and has produced a specialist assessment of the material recovered (Section 7.1).

3.3.8 Bulk samples for environmental analysis and recoverey of small artefacts were taken from each major stratigraphic unit. Forty litre samples were taken from *in situ* deposits where possible, or from the excavated spoil where safety considerations dictated. A ten litre sub-sample of each was processed by mechanical flotation to assess the potential for recovery of molluscs, bone and small artefacts such as flint chips. The non-floating residue was sieved through 10mm, 4mm and 0.5mm meshes and sorted for artefacts and bone. The flots were scanned under a binocular microscope by Dr M Robinson and the results are given in Section 7.4.

3.3.9 Column samples were taken from deposits to assess the potential for preservation of pollen, diatoms, and ostracods (monolith samples), as well as for micromorphological analysis (kubiena samples). Two of the monolith samples have been assessed for pollen preservation and the results are given in Section 7.2.

3.4 Survey

3.4.1 The borehole and test pit locations were surveyed by Simmons Survey Partnership for

URL. This data was supplied to the OAU.

Plate 3

4 RESULTS: BOREHOLE INVESTIGATION

4.1 General

4.1.1 The stratigraphic data and discussion presented here is included in a report produced by the GSF for the Oxford Archaeological Unit (Bates et al, 1995). The results for each borehole in turn are presented as a description of the stratigraphy; an assessment of geoarchaeological potential; and a summary of the results.

4.1.2 The integrated lithostratigraphic log is displayed as a stratigraphic column of constant width and scaled to a common depth scale (see Figure 3 for symbols used and Figures 4 to 13 for individual core descriptions). A second column adjacent to the lithological column indicates trends in grain sizes where increased coarseness of the sediment is represented by an increase from left to right across the horizontal axis. This column also portrays other stratigraphic data such as structural bedding features, contact types etc. A subsequent column logs the particle size of the largest clasts recorded within the gravel size fraction (an absence of record in this column indicates that no gravel sized clasts were present in the stratigraphy at this point). This form of data portrayal is useful as it rapidly indicates trends inherent in the stratigraphy and enables comparison with other sequences.

4.1.3 Further columns indicate the presence of rooting and bioturbation, the presence of clay coatings on the clasts and sand grains and the presence of biostratigraphic information (e.g. molluscs). The final columns contain information on facies interpretation and archaeological potential.

4.1.4 Figures 4 to 13 have been drawn to concentrate on the unconsolidated sediment above the Chalk bedrock (even though each borehole was drilled to a depth of at least 10.0m below ground surface). U4/U100 and bulk samples taken from within the Chalk bedrock are therefore not shown on the stratigraphic record sheets. The total number of U4/U100 core and bulk samples (from the unconsolidated sediments and from the Chalk), for each borehole, is given in the text. The U4 and bulk samples are referred to in the form $U4_1$, $U4_2$, $U4_3$; B_1, B_2, B_3 etc, for each borehole.

Figure 3

4.2 ARC 0006 SA (Figure 4)

4.2.1 Stratigraphy

4.2.1.1 This borehole (see Figure 2 for location) was drilled to a total depth of 10.0m below ground surface. Ground level at the top of the borehole was +18.812m O.D. and the base of the borehole was at +8.812m O.D. A total depth of *c.* 2.08m of unconsolidated sediments was found overlying rotted Chalk bedrock.

4.2.1.2 One U4/U100 core sample was taken and 8 bulk samples were recovered. Location of samples retrieved from the unconsolidated sediments relative to the stratigraphy is shown in Figure 4.

4.2.1.3 The Chalk bedrock lies at a depth of *c.* 2.08m (+16.732m O.D.) from the top of the borehole. The contact between the Chalk and the overlying sediment is sharp and was clearly seen during logging of the borehole in the field.

4.2.1.4 Immediately above the Chalk bedrock is the first of the three groups of sediments present within the borehole. The first is a thin bed (3.0cm) of coarse/medium sand with small flint fragments.

4.2.1.5 The second group of sediments present within the borehole is formed by a sequence of sands between core depths of 1.00m and 2.05m (+17.812m O.D. and +16.762m O.D.). The group is dominated by silty sand units with angular flint and sub-angular chalk gravel clasts up to a maximum of 5.0cm mean diameter.

4.2.1.6 The third of the groups present within the borehole is formed by silty sands, sands and a chalky gravel unit and is present between core depths of 1.00m (+17.812m O.D.) and the base of the fill at 0.30m (+18.512m O.D.). The upper part of this group of sediments contains charcoal and within the unit immediately below this there are probable infilled root channels between 0.40 and 0.60m (+18.412 and +18.212m O.D.).

4.2.1.7 The sediments within sample $U4_1$ (0.40-0.65m below ground surface, +18.412 to +18.162m O.D.) contained some $CaCO_3$ (reacted with dilute hydrochloric acid, see Appendix V). It is currently unknown whether $CaCO_3$ is present within the sediment below $U4_1$.

4.2.2 Interpretation

4.2.2.1 The lowest group of sediments (sand found directly over the Chalk), was thin and only observed during the field logging. It is possible that this deposit was laid down by running water. The second group of sediments present within the borehole is thought to be formed by colluvial slopewash processes. The upper part of the sequence appears to contain anthropogenic material (charcoal) and may represent stratified archaeological sediments.

4.2.3 Archaeological Potential

4.2.3.1 Archaeological material present within the three sedimentary groups represented within

this borehole is likely to have been reworked. There may, however, be locally *in situ* archaeological material on bed surfaces. The recent topsoil may also preserve features cut into the underlying units.

4.2.4 Summary

- 2.08m of Quaternary deposits were recovered.
- Three groups of sediments are present.
- A thin fluvial sand is present immediately above bedrock.
- Colluvial or solifluction sediments are present above the sands.
- Stratified archaeological material may occur at the top of the sequence.
- Archaeological potential is moderate and most material is likely to be reworked or in secondary context.

Figure 4

4.3 ARC 0007 SA (Figure 5)

4.3.1 Stratigraphy

4.3.1.1 This borehole (see Figure 2 for location) was drilled to a total depth of 10.0m below ground surface. Ground level at the top of the borehole was +18.514m O.D. and the base of the borehole lay at +8.514m O.D. A total depth of *c.* 1.84m of unconsolidated sediments were found overlying rotted Chalk bedrock. Chalk bedrock lies at a depth of *c.* 1.84m (*c.* +16.674m O.D.) from the top of the borehole. The contact between the Chalk and the overlying sediment was not clearly observed during field logging and was located immediately below bulk sample 4.

4.3.1.2 Three U4/U100 core samples were taken and 7 bulk samples recovered. Locations of samples retrieved from the unconsolidated sediments relative to the stratigraphy are shown in Figure 5. This borehole is dominated by two groups of sediments.

4.3.1.3 The first group consists of a thin silty sand unit containing chalk gravel clasts between core depths of 1.84 and 1.60m (+16.674m O.D. and +16.914m O.D.). The main group present within the borehole is seen between core depths of 1.60m and 0.34m (+16.914m O.D. and +18.174m O.D.), and consists of silty sands with sub-angular flint and chalk gravel clasts and a chalky gravel unit.

4.3.1.4 Modern roots and clay coatings are present within the upper units of the borehole between core depths of 0.40 to 1.16m (+18.114m O.D. to +17.354m O.D.). This part of the sequence may have been subjected to weathering and/or pedogenesis.

4.3.1.5 $U4_1$ and $U4_2$ both contain $CaCO_3$ (react with dilute hydrochloric acid), it is currently unknown whether $CaCO_3$ is present within the unconsolidated sediments below this point within the borehole.

4.3.2 Interpretation

4.3.2.1 The silty sandy unit containing gravel clasts (overlying the Chalk bedrock) may represent fluvial deposits. This deposit is overlain by silty sands and a gravel containing sub-angular clasts that may have been deposited by colluviation or solifluction.

4.3.3 Archaeological Potential

4.3.3.1 Any archaeological material present within the two sedimentary groups represented within this borehole is likely to have been reworked. There may be locally *in situ* material on bed surfaces. The recent topsoil may also preserve features cut into the underlying units.

4.3.4 Summary

- 1.84m of Quaternary deposits were recovered
- Two groups of sediments are present.

- A thin fluvial silty sand is present immediately above bedrock.
- Colluvial or solifluction sediments are present above the sands.
- Archaeological potential is moderate and most material will be reworked.

Figure 5

4.4 ARC 0008 SA (Figure 6)

4.4.1 Stratigraphy

4.4.1.1 This borehole (see Figure 2 for location) was drilled to a total depth of 10.0m below ground surface. Ground level at the top of the borehole was +18.302m O.D. and the base of the borehole lay at +8.302m O.D. A total depth of *c.* 3.85m of unconsolidated sediments were found over fractured Chalk bedrock.

4.4.1.2 Five U4/U100 core samples were taken and 3 bulk samples recovered. Locations of samples retrieved from the unconsolidated sediments relative to the stratigraphy are shown in Figure 6.

4.4.1.3 Chalk bedrock lies at a depth of 3.85m (+14.452m O.D.) from the top of the borehole. The contact between the Chalk and the overlying sediment is well preserved at the base of U4 $_5$ (3.40-3.85m). The contact is sharp and smooth.

4.4.1.4 Immediately overlying the Chalk bedrock are a series of predominantly massively bedded medium to coarse sands with occasional flint gravel clasts. Towards the top of this group there are indications of cross-stratification between core depths of 2.64 and 2.38m (+15.662m O.D. and +15.922m O.D.). Clay coatings on sand grains are noted at the base of this part of the sequence and between depths of *c.* 2.30m and 3.20m below the top of the borehole.

4.4.1.5 The second group of sediments consists of two depositional cycles. The first commences with a gravel at the base, passes through medium to coarse sands and ends with laminated sands and silts. The second of these cycles shows the gravel to be directly overlain by the laminated silts and sands. The first of these cycles is present between core depths of 2.38m and 1.60m (+15.922m O.D. and +16.702m O.D.). The second of these cycles is composed of finer grained sand units and interbedded silts, between core depths of 1.60 and 1.00m (+16.702m O.D. and +17.302m O.D.). Sands are present between 1.00m (+17.302m O.D.) and the base of the fill at 0.28m (+18.002m O.D.). These cycles contrast with the structureless sand unit below.

4.4.1.6 Modern roots and voids (probable root canals) are present within the upper 0.30m of the borehole (+18.302m O.D. to +18.002m O.D.). Clay coatings are present below 1.00m depth and are associated with the gravel at the base of the lowest cycle.

4.4.1.7 The sediments within U4 $_1$ (1.00-1.45m below ground surface, +17.302m to +16.852m O.D.), show a variable reaction with hydrochloric acid indicating a patchy distribution of $CaCO_3$. There is no reaction between the sediment and hydrochloric acid in any of the U4/U100 core samples below this depth.

4.4.2 Interpretation

4.4.2.1 The first of the sedimentary groups present within the borehole is thought to represent medium to coarse fluvial sands deposited in moderate energy conditions - probably rapidly. The second sedimentary group is formed by two sequences which show high energy conditions at the base of the sequence depositing gravels followed by

intermittent high and low energy events.

4.4.3 Archaeological Potential

4.4.3.1 The basal sedimentary group could contain reworked archaeological material or locally *in situ* material. The cyclical sequences, where gravels are associated with the base of the cycles, may contain *in situ* archaeology. Further evidence for clay coatings in association with the upper, laminated parts of the sequence suggests further weathering. The recent topsoil may contain archaeological material.

4.4.4 Summary

- 3.85m of Quaternary deposits were recovered.
- Two groups of sediments are present.
- A massively bedded sand with gravel clasts is present immediately above bedrock.
- The upper part of the profile is dominated by cyclical sequences of interbedded gravels, sands and silts.
- Archaeological material may exist *in situ* within the bedded sands and gravels. Reworked material may exist throughout the sequence.

Figure 6

4.5 ARC 0009 SA (Figure 7)

4.5.1 Stratigraphy

4.5.1.1 This borehole (see Figure 2 for location) was drilled to a total depth of 10.0m below ground surface. Ground level at the top of the borehole was +16.800m O.D. and the base of the borehole lay at +6.800m O.D. A total depth of *c.* 4.50m of unconsolidated sediments were found overlying rotted Chalk bedrock.

4.5.1.2 Six U4/U100 core samples were taken and 8 bulk samples recovered. Locations of samples retrieved from the unconsolidated sediments relative to the stratigraphy are shown in Figure 7.

4.5.1.3 This borehole is dominated by three groups of sediments. Considerable detail exists within each group.

4.5.1.4 Chalk bedrock lies at a depth of 4.50m (+12.300m O.D.) from the top of the borehole. The contact between the Chalk and the overlying sediment is not clearly seen and is present immediately below bulk sample 6 (B_6 on Figure 7).

4.5.1.5 Sediments directly overlying the Chalk bedrock consist of a series of bedded sands and gravels between core depths of 4.50 and 2.50m (+12.300m O.D. and +14.300m O.D.). The gravel at the base of the group is a sandy gravel with clasts of flint, quartz and sandstone, it is overlain by coarse sands with quartz and flint gravel clasts. Throughout this group of sediments there is a reduction in the maximum clast size present within the deposits up through the borehole to a depth of 2.50m.

4.5.1.6 The second of the sedimentary groups is found between core depths of 2.50m and 1.00m (+14.300m O.D. and +15.800m O.D.), and consists of laminated fine sands and silts overlying a coarse sandy gravel. A further sand overlain by bedded units occurs at the top of this part of the profile (see Plates 3 and 4). Clay coatings are found associated with the laminated parts of the sequence.

4.5.1.7 The third group consists of sands with gravel clasts and silty sands with sub-angular/sub-rounded gravel clasts and is present between core depths of 1.00m and 0.30m (+15.800m O.D. and +16.500m O.D.). This unit contains vertical channels that are possibly infilled root canals. Clay coatings are common throughout this part of the sequence (2.50-0.30m).

4.5.1.8 The borehole contains $CaCO_3$ (the sediment displays a patchy reaction with dilute hydrochloric acid), towards the base of U4 $_2$ (1.00-1.45m below ground surface, +15.800 and +15.350m O.D.). The top of U4 $_5$ (2.80-3.25m below ground surface, +14.000 and +13.550m O.D.), also reacts with hydrochloric acid. There is no reaction with hydrochloric acid within any of the other U4/U100 samples from this borehole.

4.5.2 Interpretation

4.5.2.1 The lowest group present (above the Chalk) is thought to have been deposited in a moderate to high energy fluvial environment. The reduction in the maximum clast size

up through the group may indicate that the strength of the current is decreasing or the channel is shallowing. The finer laminated deposits present within the second group indicates possible floodplain/overbank channel marginal deposits. The upper group is interpreted as of colluvial or solifluction origin.

4.5.3 Archaeological Potential

4.5.3.1 The basal sedimentary group could contain reworked archaeological material. The second group may contain reworked material with the possibility of *in situ* material. The third group could again contain reworked material and *in situ* material associated with bed surfaces. The recent topsoil may also preserve archaeological features cut into the underlying units.

4.5.4 Summary

- 4.50m of Quaternary deposits were recovered.
- Three groups of sediments are present.
- Sands and gravels are present immediately above bedrock.
- The middle part of the profile is dominated by cyclical sequences of interbedded gravels, sands and silts.
- An upper group exists which may have been deposited by colluvial or solifluction processes.
- Archaeological material could exist *in situ* within the bedded sands and gravels. Reworked material may exist throughout the sequence.

Figure 7

Plate 3

Plate 4

4.6 ARC 0010 SA (Figure 8)

4.6.1 Stratigraphy

4.6.1.1 This borehole (see Figure 2 for location) was drilled to a total depth of 10.2m below ground surface. Ground level at the top of the borehole was +18.752m O.D. A total depth of *c.* 2.05m of unconsolidated sediments were found overlying rotted Chalk bedrock.

4.6.1.2 One U4/U100 core sample was taken and 11 bulk samples recovered. Locations of samples retrieved from the unconsolidated sediments relative to the stratigraphy are shown in Figure 8.

4.6.1.3 This borehole contains two groups of sediments.

4.6.1.4 Chalk bedrock lies at a depth of 2.05m (+16.702m O.D.) from the top of the borehole. The contact between the Chalk and the overlying superficial sediments are sharp and were clearly seen during field logging.

4.6.1.5 Directly overlying the Chalk between core depths of 2.05m and 1.80m (+16.702m O.D. and +16.952m O.D.) is a sandy gravel with chalk and flint gravel clasts. This is overlain by the second sediment group present at depths of 1.80m to 0.26m (+16.952m O.D. and +18.492m O.D.). The group is dominated by a silty sandy with subangular to subrounded flint and chalk gravel clasts, some bedding is also present within the unit between core depths of 1.60m and 1.30m (+17.152 m O.D. and +17.452m O.D.).

4.6.1.6 Modern roots are present within the upper unit and this is seen between 0.60m and 0.40m (+18.152m O.D. and +18.352m O.D.) and there are no visible clay coatings within the profile.

4.6.1.7 The sediment shows a strong reaction with dilute hydrochloric acid within U4 $_1$ (0.25-0.45m below ground surface, +18.502 to +18.302m O.D.). It is currently not known whether $CaCO_3$ is present below this depth.

4.6.2 Interpretation

4.6.2.1 The basal sandy gravel is thought to have been deposited in a moderate to high energy fluvial environment. The overlying unit is considered to be a colluvial or solifluction deposit.

4.6.3 Archaeological Potential

4.6.3.1 The stratigraphy adjacent to this borehole is likely to predominantly contain reworked archaeological material with the possibility of *in situ* material on bedding surfaces. The recent topsoil may also preserve later prehistoric archaeological features cut into the underlying units.

4.6.4 Summary

- A 2.05m deep sequence of Quaternary deposits is present.
- Two groups of sediments are present.
- A thin sand and gravel unit is present immediately above bedrock.
- Colluvial sediments are present above the basal gravel.
- Archaeological material may exist *in situ* locally. Reworked archaeological material may exist throughout the sequence.

Figure 8

4.7 ARC 0011 SA (Figure 9)

4.7.1 Stratigraphy

4.7.1.1 This borehole (see Figure 2 for location) was drilled to a total depth of 10.0m below ground surface. Ground level at the top of the borehole was +16.648m O.D. and the base of the borehole lay at +6.648m O.D. A total depth of c. 4.75m of unconsolidated sediments were found overlying rotted Chalk bedrock.

4.7.1.2 Nine U4/U100 core samples were taken and 7 bulk samples recovered. Sample positions within the unconsolidated sediments are shown in Figure 9.

4.7.1.3 This borehole contains four groups of sediments. Considerable stratigraphic detail exists within each group.

4.7.1.4 Chalk bedrock lies at a depth of 4.72m (+11.928m O.D.) below surface. The contact between the Chalk and the overlying sediment is poorly preserved at the base of U4 9 (4.30-4.75m).

4.7.1.5 Immediately above the bedrock contact a poorly bedded coarse sandy gravel was present. This unit showed colour variation and contained flint, quartzite and sandstone clasts. This unit was overlain by a structureless moderately sorted medium sand with occasional gravel clasts (seen in U4 8). These two units constitute the basal group of sediments. The upper surface of this group lies at a depth of 3.64m below ground surface (+13.008m O.D.).

4.7.1.6 Overlying the basal sands and gravels are a complex of thinly bedded gravels, sands, silts and clays between a core depth of 1.70m (+14.948m O.D.) and 3.64m (+13.008m O.D.). Trends within these deposits can be noted. Towards the top of the group, two depositional cycles (2.66 to 2.36m and 2.36 to 1.70m depth) are present, showing fining upwards trends from gravels or sands to silts/silty-clays. The fine grained upper parts of these cycles are reddened and individual grains clay coated. Trends within the sequence below 2.66m depth are less clear but a shift from gravel to bedded silts is noted between core depths of 3.64 and 3.44m. A further fine grained horizon where clay coatings are recorded coincides with traces of rooting at a core depth of c. 2.66m. A single mollusc fragment (an apex of Pupilla muscorum) was found at a core depth of c. 2.50m.

4.7.1.7 The third of the sequences is present between core depths of 1.70 and 1.10m (+14.948m O.D. and +15.548m O.D.) and exhibits a slight coarsening upwards trend from a gravely sand to a sandy gravel.

4.7.1.8 The upper sequence is present between core depths of 1.10 and 0.10m (+15.548m O.D. and +16.548m O.D.) and consists of a silty sand with flint and chalk gravel clasts overlain by chalky gravels.

4.7.1.9 Rooting and bioturbation are present within the upper 1.70m of the borehole. Modern roots are present to depths of c. 1.00m below surface. Below 1.00m root canals are present that contain topsoil fills. Clay coatings on sand particles were

noted at intervals down through the borehole (see Figure 9).

4.7.1.10 The sediment within the upper three U4/U100 core samples (U4 1 to U4 3 (upper portion of the U4/U100 core only)) from borehole ARC 0011 SA shows a reaction with dilute hydrochloric acid. This shows that between 0.10 and 1.11m, below ground surface (+16.548 and +15.538m O.D.) there is CaCO3 present within the sediment. The sediment shows no reaction with dilute hydrochloric acid in any of the U4/U100 core samples below 1.11m below the ground surface (+15.538m O.D.).

4.7.2 Interpretation

4.7.2.1 It is likely that most of the sequence was deposited by moving water. The basal sediments between Chalk bedrock and a depth of 3.64m may have been deposited in a channel bar situation in moderate to high energy fluvial channel systems. The semi-cyclical sequences recorded between depths of 1.70m and 3.64m may represent deposition in a floodplain situation where repetitive shifts in channel location initiated progressive shifts to finer deposition, and subsequent exposure and weathering of the fine sediments. The third group within the sequence, between 1.70m and 1.10m, may represent a return to higher energy channel environments. The upper sequence from the borehole is dominated by coarse grained sediments containing sub-angular clasts, and may have been deposited by colluvial or solifluction processes. The recent topsoil may also preserve features cut into the underlying units.

4.7.2.2 Despite the presence of a single mollusc at a depth of c. 2.50m, it is unlikely that significant assemblages of vertebrate or molluscan fauna will be present in this stratigraphy.

4.7.3 Archaeological Potential

4.7.3.1 In situ archaeological material could occur locally in association with the thin gravel beds. Reworked material may occur in association with the remaining units.

4.7.4 Summary

- 4.75m of Quaternary deposits were present.
- Four groups of sediments were recorded.
- Poorly bedded sands and gravels are present immediately above bedrock.
- Rhythmic sequences of interbedded gravels, sands and silts overlie the basal sands and gravels.
- The upper parts of the sequence exhibit coarsening upwards trends and a flint/chalk rich gravel.

- Archaeological material may exist in situ within the bedded sands and gravels. Reworked material may exist throughout the sequence.

Figure 9

Plate 5
Plate 6

4.8 ARC 0012 SA (Figure 10)

4.8.1 Stratigraphy

4.8.1.1 This borehole (see Figure 2 for location) was drilled to a total depth of 10.0m below ground surface. Ground level at the top of the borehole was +14.769m O.D. and the base of the borehole lay at +4.769m O.D. A total depth of c. 2.00m of unconsolidated sediments were found overlying rotted Chalk bedrock.

4.8.1.2 Three U4/U100 core samples were taken and six bulk samples recovered. Sample positions within the unconsolidated sediments are shown in Figure 10. Chalk bedrock lies at a core depth of c. 2.00m (c. +12.769m O.D.) from the top of the borehole. The contact between Chalk and the overlying sediment was not clearly seen but is located at the base of bulk sample 3.

4.8.1.3 The basal group of sediments is dominated by a poorly bedded sandy gravel with flint, quartz and chalk clasts, between core depths of 2.00 and 0.85m (+12.769m O.D. and +13.919m O.D.) (see Plate 7). This contains a thin sandy unit at a core depth of 1.20m. Clay coatings are present on the surfaces of the quartz grains within this sand unit (1.12 to 1.20m). The flint gravel unit at core depths of 0.85-1.12m (+13.649m O.D.), contained a small percentage of exotic clasts (i.e. non - flint/chalk/quartz/quartzites). These included sandstones and other unidentified igneous and sedimentary rock clasts.

4.8.1.4 The second sediment group is present between core depths of 0.85m and 0.35m (base of the fill) (+13.649m O.D. and +14.419m O.D.), and is a sand with subangular flint, chalk and quartz gravel clasts. Rooting (modern) is also present within the upper group, between depths of 0.40 to 0.80m.

4.8.1.5 The matrix of the gravel within U4 3 (1.45-1.60m below the ground surface, +13.319 to +13.169m O.D.) shows a reaction with dilute hydrochloric acid. There is however no reaction within the two U4/100 samples from higher within the sequence.

4.8.2 Interpretation

4.8.2.1 The basal group of sediments is thought to represent deposition in a moderate to high energy fluvial channel. The upper group is also interpreted as fluvial in origin, with the finer grain size indicating a reduction in current energy.

4.8.3 Archaeological Potential

4.8.3.1 Both of the sediment groups within the borehole may contain reworked archaeological material. However, in situ archaeological material may occur in association with landsurfaces. The modern topsoil may also preserve later prehistoric or historic archaeological features cut into the underlying units.

4.8.4 Summary

- 2.00m of Quaternary deposits were recorded.
- Two main groups of sediments are present.
- Sands and gravels are present immediately above Chalk bedrock.
- The upper part of the profile contains a sand with sub-angular flint clasts.
- Archaeological material could exist within the sequence but is likely to be reworked. In situ archaeological material may occur in association with the zone of weathering/pedogenesis.

Figure 10

Plate 7

4.9 ARC 0013 SA (Figure 11)

4.9.1 Stratigraphy

4.9.1.1 This borehole (see Figure 2 for location) was drilled to a total depth of 10.0m below ground surface. Ground level at the top of the borehole was +14.159m O.D. and the base of the borehole lay at +4.159m O.D. A total depth of c. 3.30m of unconsolidated sediments were found overlying rotted Chalk bedrock.

4.9.1.2 One U4/U100 core sample was taken and five bulk samples were recovered. Sample positions relative to the unconsolidated sediments are shown in Figure 11.

4.9.1.3 Chalk bedrock lies at a depth of c. 3.30m (c. +10.859m O.D.) from the top of the borehole. The contact between the Chalk and the overlying sediment was not clearly seen and is present at the base of bulk sample 3.

4.9.1.4 Immediately above the bedrock contact a poorly sorted coarse sandy gravel was present. This unit contained flint and quartzite clasts and was present between core depths of 3.30 and 0.50m (+10.859m O.D. and +13.659m O.D.). This unit also contained some exotic clasts of sandstone and other unidentified igneous and sedimentary rock clasts.

4.9.1.5 The second unit is a thin bed of silty sand with rare flint gravel clasts, present between core depths of 0.50m and the base of the modern topsoil at 0.40m (+13.659m O.D. and +13.759m O.D.). No rooting or clay coatings were noted in this sequence.

4.9.1.6 No U4/U100 samples were taken from within the unconsolidated sediments of borehole ARC 0013 SA and therefore bulk samples B1 to B3 were tested for $CaCO_3$ (reaction with dilute hydrochloric acid). B1 and B2 showed no reaction with dilute hydrochloric acid. B3 (3.00 to 3.30m below ground surface, +11.159 to +10.859m O.D.) did react with hydrochloric acid. This may however be due to inclusions of the Chalk bedrock which is present immediately below the bulk sample at 3.30m below the ground surface (+10.859m O.D.).

4.9.2 Interpretation

4.9.2.1 The two sedimentary groups are thought to represent fluvially deposited sediments with some possible modification near to the surface by mass movement / re-working.

4.9.3 Archaeological Potential

4.9.3.1 The deposits could contain reworked and locally in situ archaeological material. The modern topsoil may preserve later prehistoric features cut into the underlying units.

4.9.4 Summary

- 3.30m of Quaternary deposits were recorded.

- Two groups of sediments are present.
- Sands and gravels are present immediately above bedrock.
- The upper part of the profile consists of a silty sand with occasional flint clasts.
- Archaeological material may exist within the sequence but is likely to be reworked.

Figure 11

4.10 ARC 0014 SA (Figure 12)

4.10.1 Stratigraphy

4.10.1.1 This borehole (see Figure 2 for location) was drilled to a total depth of 10.1m below ground surface. Ground level at the surface was +17.165m O.D. and the base of the borehole lay at +7.065m O.D. A total depth of c. 1.50m of unconsolidated sediments were found overlying rotted Chalk bedrock.

4.10.1.2 Three U4/U100 core samples were taken and four bulk samples recovered. Sample positions within the unconsolidated sediments are shown in Figure 12.

4.10.1.3 Chalk bedrock lies at a depth of 1.50m (+15.665m O.D.) from the top of the borehole. The contact between the Chalk and the overlying sediment is sharp and irregular and clearly seen in the base of U4 2 (1.10-1.55m) (see Plate 8).

4.10.1.4 The stratigraphy within this borehole consists of laminated and thinly bedded fine to medium sands (with flint gravel clasts up to 2.5cm mean diameter) and silts, between core depths of 1.50m and the base of the fill at 0.50m (+15.665m O.D. and +16.665m O.D.) (see Plates 8 and 9). Sand grains are clay-coated between 0.50m and 0.70m.

4.10.1.5 There was no reaction between the sediment contained within the two U4/U100 samples taken from within the unconsolidated sediments of borehole ARC 0014 SA.

4.10.2 Interpretation

4.10.2.1 These deposits are thought to represent bedded fluvial sands and silts. Weathering and incipient pedogenesis is present at the top of the group of sediments present within the borehole.

4.10.3 Archaeological Potential

4.10.3.1 These units may contain in situ archaeological material. The brick rubble at the top of the borehole 0.00-0.50m may contain anthropogenic material from historic periods.

4.10.4 Summary

- 1.50m of Quaternary deposits were recorded.
- A single sediment unit is present.
- Laminated sands and silts are present immediately above bedrock.
- The middle part of the profile is dominated by cyclical sequences of interbedded gravels, sands and silts.
- Only the upper part of the sequence is weathered.

- Archaeological material may exist in situ within the bedded sands and silts. Reworked material may exist throughout the sequence. Archaeological units (associated with brick rubble) may lie immediately below the ground surface in this area.

Figure 12

Plate 8

Plate 9

4.11 ARC 0015 SA (Figure 13)

4.11.1 Stratigraphy

4.11.1.1 This borehole (see Figure 2 for location) was drilled to a total depth of 10.0m below ground surface. Ground level at the top of the borehole was +12.787m O.D. and the base of the borehole lay at +2.787m O.D. A total depth of c. 2.40m of unconsolidated sediments were found overlying rotted Chalk bedrock.

4.11.1.2 Two U4/U100 core samples (of very poor quality) and six bulk samples were recovered. Sample positions relative to the unconsolidated sediments are shown in Figure 13.

4.11.1.3 Chalk bedrock lies at a depth of 2.40m (+10.387m O.D.) from the top of the borehole. The contact between the Chalk and the overlying sediment is poorly preserved at the base of bulk sample 3.

4.11.1.4 Immediately above the bedrock contact a poorly bedded coarse sandy gravel containing flint and quartzite clasts was present [between core depths of 2.40 to 1.30m (+10.387m O.D. and +11.487m O.D.)]. A small percentage of exotic clasts of sandstones, and other sedimentary and igneous rocks were noted in this unit. This unit was overlain by a structureless moderately sorted medium sand with flint and chalk gravel clasts. A second gravel unit is present at the top of the group between core depths of 0.70 to 0.26m (+12.087m O.D. and 12.527m O.D.). Modern roots penetrate through the upper 0.70m of the stratigraphy. No clay coatings were observed on any sands within the samples.

4.11.1.5 No U4/U100 samples were successfully recovered from the unconsolidated sediments of borehole ARC 0015 SA. The 3 bulk samples recovered from the unconsolidated sediments were tested for CaCO3 using dilute hydrochloric acid. There was no reaction with the hydrochloric acid from any of the bulk samples taken from within the unconsolidated sediments.

4.11.2 Interpretation

4.11.2.1 The sediments are thought to represent deposition in a moderate to high energy fluvial channel.

4.11.3 Archaeological Potential

4.11.3.1 Most archaeological material present within these units is likely to be reworked. Locally in situ finds may be present. The recent topsoil may preserve archaeological features cut into the underlying units.

4.11.4 Summary

- 2.40m of Quaternary deposits were observed.
- A single poorly bedded sandy gravel is present.

- Archaeological material is most likely to be reworked throughout the sequence.

Figure 13

Plate 10

5 LOCATION OF TEST PITS

5.1 On the basis of the information obtained during the borehole phase of the evaluation it was possible to determine the location of the test-pits to be excavated in the second stage of evaluation (Figure 2).

5.2 It was decided that three areas required visual examination by test-pitting. Table 1 summarises the key stratigraphic elements that were expected to be located.

	Test Pit ARC 2001 TP	Test Pit ARC 2002 TP	Test Pit ARC 2003 TP	Test Pit ARC 2004 TP
Location	Adjacent to chalk 'cliff' between ARC 0007 SA and ARC 0008 SA	In central area of site between ARC 0009 SA and ARC 0011 SA	At western end of site between ARC 0012 SA and ARC 0013 SA	To be determined
Nature of sequence	Gravels and bedded sands/gravels	Bedded sands and gravels over coarse basal gravels	Coarse sandy gravels	?
Depth to critical sediments	c.1.0m below ground surface	c.1.0m below ground surface	c.0.5m below ground surface	?
Archaeological Potential (for Pleistocene deposits)	In situ material may occur in association with clay-coated gravel units	In situ material may occur in association with clay-coated gravel units	Predominantly reworked material may exist within the gravels	?

Table 1 Summary of the key stratigraphic elements that were expected to be located during test-pitting, with depths to critical Pleistocene sediments and estimated Palaeolithic archaeological potential.

5.1.3 The Chalk 'cliff' was broadly located between boreholes ARC0007 SA and ARC0008 SA. This is the area that had been reported in previous studies as containing the majority of the artefacts. Therefore, test pit ARC 2001 TP was excavated between boreholes ARC 0007 SA and ARC 0008 SA.

5.1.4 The greatest sequence complexity had been noted in boreholes ARC 0009 SA and ARC 0011 SA. Test pit ARC2002 TP was therefore excavated between these boreholes.

5.1.5 Boreholes ARC 0012, 0013 and 0015 SA only produced evidence for a single thick gravel accumulation. As this unit differed from that recorded in the remaining boreholes, it was decided to locate test-pit ARC2003 TP between boreholes ARC0012 SA and ARC0013 SA to investigate it.

5.1.6 The position of the final test-pit, ARC2004 TP, was not pre-determined. It was to be located to examine any emergent areas of interest after the excavation of ARC 2001 -

2003 TP. In the event, it was located to the south-east of ARC2001 TP, to investigate further the line of the Chalk 'cliff' .

6 RESULTS: TEST PITS

6.1 Test-pit ARC2001TP (Figure 14)

6.1.1 This test-pit was excavated in order to confirm the nature of the stratigraphy in borehole ARC0008SA, to attempt to locate the 'cliff'line and to determine the presence or absence of archaeological deposits.

6.1.2 The test-pit was excavated with its long axis aligned from north-east to south-west and was 2.95m deep.

6.1.3 The south-west facing section was drawn (Figure 14) and the deposits recorded are detailed in Table 2.

6.1.4 Chalk bedrock was encountered at between 15.93 and 15.73m OD.

Depth below top of profile (metres)	Context number	Spit Number	Stratigraphic description
0.00 - 0.25	100	-	10YR 3/2 very dark greyish brown, sandy silt with modern roots. Structureless, loose and unconsolidated. Occasional angular to sub-angular flints (<5cm). Ocassional charcoal flecks and chalk clasts. Abrupt Contact
0.30 - 0.50	101	Spit 1	10YR 4/6 dark yellowish brown, silty sand to sandy silt. Loose, structureless and unconsolidated. Modern roots are present. Occasional small chalk clasts (<5cm). Diffuse Contact
0.50 - 0.90	101	Spit 2	As above but hard, firm and compact. Frequent sub-angular to sub-rounded flint clasts. Modern roots. Not observed
0.90 - 0.95	102	Spit 3	7.5YR 6/8 strong brown sand. Firm and compact. No apparent structure. Occasional sub-angular to sub-rounded flint clasts. Modern roots. Diffuse contact
0.95 - 1.20	102	Spit 3	As above, becoming more sandy with depth. Possibly fine bedded with alternating fine/coarse units. Modern roots still present. Sharp contact
1.20 - 1.45	103	Spit 4	10YR 5/6 yellowish brown, mid/coarse sand. Loose and unconsolidated. In places thin bedded with 7.5YR 5/8 strong brown sand (possibly with clay coatings?). Occasional small sub-rounded flint clasts (<2cm)

Depth below top of profile (metres)	Context number	Spit Number	Stratigraphic description
			Sharp contact
1.45 - 1.80	104	Spit 5	7.5YR 5/8 strong brown, moderately well-sorted flint gravel. Matrix supported - matrix sandy in places varying to clay silt. Clasts <1cm to >5cm. Clasts less than 3cm are well rounded. Clasts above 3cm are sub-rounded to sub-angular. Occasional chalk clasts. Moderately compact. Interbedded with 10YR 7/6 yellow medium/coarse clean sand. Occasional mottled clay silt clasts (7.5YR 5/8) - rounded. Bedding becomes more pronounced with depth. In places sandy beds are hard, possibly indurated/cemented. Bedding alternates between gravel with sand matrix and sand with some gravel clasts. Beds dip to west. Occasional clay-silt clasts with blocky structure and open root hole traces present Sharp contact
1.80 - 2.14	105, 106	Spit 6	10YR 5/6 yellowish brown coarse sand with fine gravel. Structureless, loose and unconsolidated. Sub-angular to well rounded flint clasts (<0.5cm to +3cm). Frequent clasts of clay-silt. Becomes coarser and more poorly sorted with depth. Sharp contact
2.14 - 2.30	107	Spit 7	10YR 5/2 greyish brown, clay-silt with black flecks. Occasional rounded flint clasts (2-4cm). Frequent clay-silt inclusions (2-3cm). Beds dip to east. Thin bedded and sub-parallel. Sharp contact
2.30 - 2.48	108	Spit 7	10YR 5/2 greyish brown, sandy silt with 10YR 6/6 yellowish brown, silt. Coarse bedded - dips to west. Occasional well rounded flint clasts (<2cm). Rare sub-rounded clay-silt clasts. Diffuse west dipping contact
2.48 - 2.69	109	Spit 8	10YR 6/6 yellowish brown, medium/coarse sand with 10YR 5/8 yellowish brown staining. No apparent structure. Occasional well rounded flint clasts (<2cm). Soft, loose and unconsolidated. Diffuse west dipping contact
2.69 - 2.73	110, 111	Spit 8	7.5YR 5/8 strong brown, medium/coarse sand. Possibly some clay silt present. Firm and compact. Frequent rounded flint clasts (<2cm). Thickens and becomes coarser with frequent gravel clasts to east

Depth below top of profile (metres)	Context number	Spit Number	Stratigraphic description
			(Context 110). Mixed with 10YR 5/3 brown clay-silt with some sand and clay-silt clasts. Sharp dipping contact
2.73- 2.95	112	Hand excavated	10YR 5/3 brown clay-silt interbedded with 2.5Y 7/4 pale yellow sand. Very thin bedded with sub-parallel, wavy and discontinuous laminae. No clasts. Infills hollow in chalk.
2.95-			Chalk bedrock

Table 2 Deposits recorded in ARC2001 TP

Figure 14

6.2 Test-pit ARC2002TP (Figure 15)

6.2.1 This test-pit was excavated in an area where the most complex, and deepest, stratigraphy had been recorded in an attempt to obtain the most complete profile possible.

6.2.2 The initial location (marked ARC2002a TP on Figure 2) of this test-pit was abandoned after excavation to a depth of 0.4m. A very mixed layer containing modern debris was encountered at this depth and, because of the danger of contamination and in consultation with a URL safety officer, it was decided to re-locate the test-pit 10m to the north-west.

6.2.3 The re-located test-pit was excavated with its long axis aligned from north-east to south-west and was 2.4m deep. At this depth, the side of the test pit collapsed due to the unconsolidated nature of the sediments and the test-pit was abandonned and back-filled. Below 1.2m, safety considerations precluded access and detailed recording of the stratigraphy in situ was not possible.

6.2.4 The south-west facing section was drawn (Figure 14) and the deposits recorded are detailed in Table 3.

Depth below top of profile (metres)	Context number	Spit Number	Stratigraphic description
0.00 - 0.30	200	-	Topsoil Sharp contact
0.30 - 0.55	201	Spit 1	10YR 3/4 dark yellowish brown medium coarse sand. Loose and soft with frequent angular to sub-rounded flint clasts (2-5cm). Occasional chalk fragments and modern roots. Occasional struck flints. Becomes darker towards base. Diffuse contact
0.55 - 075	202	Spit 1 Spit 2	10YR 4/4 dark yellowish brown medium sand with occasional flint/chalk clasts. Large rolled flints from base of unit. Infilled root channels present. Loose, structureless and unconsolidated. Diffuse undulating contact
0.75 - 1.16	204	Spit 3	7.5 YR 5/8 strong brown clay-silt and some sand. Firm and compact. Blocky structure. Infilled root channels. Sharp undulating contact
1.16 - 1.56	205	Spit 4 Spit 5	10YR 6/8 brownish yellow soft loose sand interbedded with 7.5YR 5/8 strong brown sand possibly with clay-silt coatings. This unit is thin

Depth below top of profile (metres)	Context number	Spit Number	Stratigraphic description
			bedded (beds 2-3cm thick), undulating and wavy. Possibly laminated in places. Not observed
1.56 - 1.61	205	Spit5	10YR 6/8 brownish yellow very soft well sorted sand. Thin discontinuous beds of 10YR 5/8 cemented sand with occasional root traces. Occasional rare chalk fragments (2mm). Not observed
1.61 - 1.90	205	Spit 5 Spit 6	10YR 6/6 brownish yellow soft sand. Occasional rounded flint clasts. Occasional clay-silt present. Not observed
1.90 - 2.40	205	Spit 6 Spit 7 Spit 8	Mid to brown grey clay silt with some sand. Possibly thin bedded or laminated in places. Occasional flint clasts. Test pit abandonned

Table 3 Deposits recorded in ARC2002 TP

6.2.5 In addition, a probable cut feature, Context 206, was observed in section. Its form and orientation are not known, but it may be a small ditch or gully. It was overlain by colluvial sand with occasional chalk fragments (Context 203, see Table 3). It was 0.3m deep and 0.84m wide, and contained a single fill, Context 203. This was a yellow (10YR 7/6) medium/fine sand with occasional rounded flint clasts (<5cm). A flint flake was recovered from the feature while cleaning the face of the test pit.

Figure 15

6.3 Test-pit ARC2003TP (Figure 16)

6.3.1 This test-pit was excavated in an area where predominantly coarse sand and gravel deposits had been recorded in the boreholes. One of the objectives had been to establish whether the coarse sediments are bedded, which had not been possible to establish from the boreholes as only bulk samples were retrieved.

6.3.2 The test-pit was excavated with its long axis aligned from north-east to south-west and was 2.8m deep.

6.3.3 The south-west facing section was drawn (Figure 15) and the deposits recorded are detailed in Table 3.

6.3.4 Chalk bedrock was encountered at 11.80m OD.

Depth below top of profile (metres)	Context number	Spit Number	Stratigraphic description
0.00 - 0.25	300	-	Topsoil Sharp contact
0.30 - 0.40/0.50	301	Spit 1	7.5YR 5/6 strong brown medium sand. Loose and structureless with frequent poorly sorted flint clasts (<2 to +5cm), sub-angular to rounded. Common chalk clasts (<0.5 to +3cm). Modern roots present. Sharp undulating contact
0.40/0.50 - 0.90	302	Spit 2	10YR 6/6 brownish yellow medium fine sand. Soft and loose and unconsolidated. Flints still present. Chalk clasts absent. Modern roots present. Occasional struck flakes. Flint clasts increase with depth. Clasts predominantly rounded flints. Not observed
0.90 - 1.54	303	Spit 3 Spit 4	7.5 YR 5/8 strong brown to 10YR 3/6 dark yellowish brown horizontally bedded, matrix supported flint gravel. Predominantly sub-rounded to rounded flint gravel clasts (2-5cm) interbedded with structureless coarse medium sand (10YR 6/8 brownish yellow). Thin beds of clay coated sand are present and occasional quartzite clasts. Occasional modern roots. Sharp sub-horizontal contact
1.54 -1.61	303	Spit 5	5YR 5/8 yellowish red coarse sand with well rounded flint clasts (<1 to +5cm). Possibly clay coated sand grains. Similar to thin beds in overlying units. Sharp sub-horizontal contact

Depth below top of profile (metres)	Context number	Spit Number	Stratigraphic description
1.61 - 1.75	304	Spit 5	10YR 6/6 brownish yellow coarse to medium sand. Thin bedded with bedding dipping to west. Some 5YR 5/8 yellowish red staining present. Bedding disappears towards base of unit. Possibly becoming coarser with depth. Diffuse undulating contact
1.75 - 2.81	305	Spit 6 Spit 7 Spit 8 Spit 9	Mixed 10YR 6/6 brownish yellow to 5YR 5/8 yellowish red bedded flint gravel. Poorly sorted with clasts <1cm to +10cm, rounded to angular. Occasional very large sub-angular to subrounded flint clasts (+20cm). Predominantly matrix supported. Individual beds may be present with higher sand content and clay coatings to sand grains. Firm and compact. Sharp contact
2.81 -			Chalk bedrock

Table 4 Deposits recorded in ARC2003 TP

Figure 16

6.4 Test-pit ARC2004TP (Figure 17)

6.4.1 This test-pit was excavated in order to further investigate the area adjacent to the chalk 'cliff'. The position of the pit was determined on the basis of the deposits observed in ARC2001 TP in relation to Boreholes ARC0007 SA and ARC0008 SA.

6.4.2 The test-pit was excavated with its long axis aligned from north-west to south-east, at right angles to ARC2001 TP, and was 2.35m deep.

6.4.3 The south-west facing section was drawn (Figure 17) and the deposits recorded are detailed in Table 5.

6.4.4 Chalk bedrock was encountered at 17.46m OD.

Depth below top of profile (metres)	Context number	Spit Number	Stratigraphic description
0.00 - 0.30	400	-	Topsoil sharp contact
0.30 - 0.45	401	Spit 1	7.5YR 4/2 brown sandy silt with occasional angular chalk fragments, angular flint clasts (<2 to +5cm). Modern roots, soft and loose. Occasional charcoal flecks and brick/tile fragments. Not observed
0.45 - 0.80	402	Spit 1	7.5YR 4/2 brown sandy silt with occasional angular chalk fragments, angular flint clasts (<2 to +5cm). Modern roots, soft and loose. Not observed
0.60 - 0.80	403	Spit 1 Spit 2	7.5YR 4/2 brown sandy silt with occasional angular chalk fragments, angular flint clasts (<2 to +5cm). Modern roots, soft and loose. Not observed
0.80 - 1.00	405	Spit 2 Spit 3	10YR 7/6 yellow silt with some sand. Becomes coarser and sandier with depth. Modern roots still present. Firm and structureless. Diffuse contact
1.00 - 1.04	406	Spit 3	As above becoming 7.5YR 4/6 strong brown. Sand content decreases. Occasional black patches Sharp undulating contact
1.04 - 1.80	407	Spit 3 Spit 4	10YR 7/3 chalk rich sand with fine silt matrix. Matrix supported with angular to subrounded chalk clasts (<1 to +3cm). Occasional flint clasts (rounded <2cm)

Depth below top of profile (metres)	Context number	Spit Number	Stratigraphic description
		Spit 5	Modern roots present. Becomes increasingly chalky with depth. This unit dips westwards as a body thinning to the west. Occasional flint clasts and cobbles present towards base of unit. Diffuse contact
1.80 -	409	Spit 6	Chalk bedrock

Table 5 Deposits recorded in ARC2004 TP

6.4.5 In addition, a cut feature, Context 410, was recorded at the north-west end of the test pit. It was cut from 0.80m below the modern ground surface, being overlain by colluvial sandy silt (see Table 5). Only the south-east side of the ditch, including its base, was encountered by the test pit. Judging by the profile of the side of ditch and the angle at which it was cut, it is probably 3 to 4m at the top, of which 1.7m was seen. It was 1.6m deep and contained two fills, Contexts 408 and 404. Context 408 was a strong brown (7.5YR 4/6), sandy silt with occasional angular to sub-angular flint clasts (<5 cm). Context 404 was a brown (7.5YR 4/2), sandy silt with frequent angular chalk fragments and angular flint clasts (<2 to +5cm).

Figure 17

6.5 Summary of Artefacts and Samples Recovered

6.5.1 Table 6 summarises the depth, below modern ground surface, of the spits excavated in each test-pit, along with the deposits associated with each spit. The number of flint artefacts and pottery sherds retrieved, and bulk samples taken, is also given. Two sherds were also recovered by hand excavation from Context 404.

6.5.2 In addition to the bulk samples shown in Table 6, three monolith samples (numbers 6, 7, and 8) and four Kubiena samples (numbers 9, 10, 11, and 12) were taken from ARC2001 TP (see Figure 16), and two Kubiena samples were taken from ARC2004 TP (see Figure 19).

Test Pit	Spit	Depth (m)	Context(s)	Flint Artefacts (no of pieces)	Pottery (No of sherds)	Bulk Sample Number
ARC2001 TP	1	0.27 - 0.56	101	8	2	-
	2	0.56 - 0.90	101	7	1	-
	3	0.90 - 1.15	102	3	1	1
	4	1.15 - 1.45	103	3		-
	5	1.45 - 1.70	104	2		2
	6	1.70 - 2.11	105, 106	3		3 (context 105 only)
	7	2.11 - 2.45	107, 108	1		4
	8	2.45 - 2.81	109, 110, 111	-		5 (context 109 only)
ARC2002 TP	1	0.25 - 0.55	201, 202	18	3	22
	2	0.55 - 0.90	202, 203, 204	1	1	23
	3	0.90 - 1.20	204, 205	3		-
	4	1.20 - 1.65	205	-		-
	5	1.65 - 1.90	205	1		-
	6	1.90 - 2.20	205	-		24
	7	2.20 - 2.40	205	-		-
ARC2003 TP	1	0.25 - 0.55	301, 302	8		-
	2	0.55 - 0.90	302	3		-
	3	0.90 - 1.20	303	-		16

Test Pit	Spit	Depth (m)	Context(s)	Flint Artefacts (no of pieces)	Pottery (No of sherds)	Bulk Sample Number
	4	1.20 - 1.50	303	1		-
	5	1.50 - 1.80	304, 305	3		17
	6	1.80 - 2.10	305	3		-
	7	2.10 - 2.35	305	-		18
	8	2.35 - 2.65	305	-		-
	9	2.65 - 2.78	305	-		-
ARC2004 TP	1	0.30 - 0.65	401, 402	4		-
	2	0.65 - 1.00	402 - 406	7	3	19
	3	1.00 - 1.32	404 - 407	3		-
	4	1.32 - 1.75	404, 406 - 408	27		20
	5	1.75 - 2.15	407 - 409	13		21
	6	2.15 - 2.37	408, 409	7		15 (context 408 only)

Table 6 Summary of excavated spits, artefact recovery, and bulk samples

7 SPECIALIST REPORTS

7.1 Flint Report by M. White

7.1.1 Introduction

7.1.1.1 A collection of 130 humanly worked flints and 10 pieces of unworked burnt flint were recovered during the course of the assessment. Two general series are evident, which can be separated primarily on the basis of stratigraphic position and the presence of burnt flint, and perhaps also by condition and size. However, it is not possible to give absolute numbers for each series, as the method of recovery often cross cut natural stratigraphic units, thus obliterating the main rationale behind the division. Whilst it may have been possible to use size and condition to provide absolute counts, this was considered inappropriate without greater stratigraphic, taphonomic and numeric control. The lower series is of greatest archaeological importance and therefore forms the main concern of this report. The total collection is summarised in Table 1 and outlined in greater detail in Table 2 following the main text. In addition, a large number of small flints were retrieved during sieving of the bulk samples. However, their small size made it impossible to determine whether they were humanly worked, machine struck, or produced by natural processes.

Trench	Flakes/Blades	Cores	Implements	Burnt Flint	Total
2001TP	27	1	0	2	30
2002TP	22	1	0	6	29
2003TP	16	2	0	0	18
2004TP	54	3	4	2	63
TOTALS	119	7	4	10	140

Table 7 Summary of flint collection

7.1.2 Methods

7.1.2.1 Each flake was measured using dial callipers to the nearest mm. Limited technological information was also taken from all lithic components. The material recovered from the wet-sieving of the soil sample was briefly examined, but excluded as it was considered to be of minimal value.

7.1.3 Flint Series One

7.1.3.1 This collection of flints was recovered from the upper sedimentary deposits at the site, mostly from Spits 1, 2 and 3 from all trenches, and from the feature (404) cutting through trench 2004TP. It consists of small flakes, cores and one retouched side-scraper. The collection is unstained, only mildly patinated and generally in a very fresh condition.

7.1.3.2 The collection exhibits mostly hard hammer flaking. There is evidence of lateral and

distal flake scars on the dorsal surfaces, although the most frequent scar pattern shows parallel removals from the proximal end. Few flakes exhibit wholly cortical dorsal surfaces. The cores associated with this series show parallel, single and alternate flaking techniques (cf. Ashton 1992), totally in concord with the evidence from the flakes. The cores show between 9 and 19 flake removals each. On the basis of the small size of the flakes and cores, the relatively high number of removals per core and the high incidence of flakes with two or more distal removals, I would suggest that this series has been fairly intensively reduced from small pieces of flint, mostly using a parallel flaking technique. In addition, the cortex evident on the bulk of this series is dissimilar to that seen on flint from the Chalk in the Purfleet area, which, therefore is unlikely to have formed the source of the raw material.

7.1.3.3 There are no technologically or typologically diagnostic features of this series which would allow an estimate of its age, although its stratigraphic position and association with burnt flint and pottery strongly indicates a later prehistoric date.

7.1.4 Flint Series Two

7.1.4.1 This collection was recovered from the lower stratigraphic units (spits 4-7) in test pits 2001 and 2004. Given the heavily rolled condition of the material recovered from the lower stratigraphic units in test pits 2002 and 2003, it is not possible to say whether it belongs to this series, although, from its stratigraphic position, it must be Palaeolithic. A proportion of this series was found within the bedded gravels and silts of 2001TP, although by far the greatest concentration was found in the chalky slope debris (?coombe rock) in 2004TP, and from small solution hollows in the underlying chalk. The collection is mildly patinated, generally in fairly sharp condition and is stained. The colour of the staining ranges from buff to dark red-brown. The series consists of cores, flakes and two bifaces, with one possible biface roughout.

7.1.4.2 Two bifaces and a possible biface rough-out were recovered during the course of the assessment, all from trench 2004. The bifaces have been manufactured using the soft hammer knapping technique and are in fairly sharp condition. The first biface is a complete, sub-cordiform type 120mm in length. Working is restricted to the tip of the piece and the butt is mostly unworked. The cortex remaining on the artefact reveals that the original nodule was thin and narrow, and that the shape of the biface may have simply followed the form of the original blank. A second biface is represented by a broken butt fragment. The tip is missing, and the nature of the break suggests that this may have been broken during manufacture. This feature, known as end-shocking, usually results from inadequate support of the biface during manufacture. A possible biface rough-out was also recovered. This shows evidence of some attempt at thinning the piece, but the poor angles and general shape seem to have defeated the knapper. This piece is more abraded than the other implements.

7.1.4.3 In addition to the bifaces themselves a small number of biface manufacturing flakes were recovered. These too are in relatively sharp condition, and are testament that the bifaces were manufactured at the site.

7.1.4.4 A significant assemblage of hard hammer flakes and three cores were also found. The cores show evidence of single, parallel and alternate flaking techniques. The dorsal

patterns on the flakes, ranging from 1 to 5 scars, show previous removals originating from the distal, proximal and lateral positions. A number exhibit relict core edges with removals from the proximal and lateral margins. The flakes, therefore, also indicate the use of several reduction techniques, and the frequent rotation of the cores in the pursuit of good flaking angles. The flakes are often fairly large (mean length from spits 4-6, 2004TP=57mm), and exhibit a range of residual dorsal cortex from 0-100%. The latter is evidence that all stages of core reduction from initial decortication are present at the site. Some of the flakes may represent the initial hard-hammer roughing out stage of biface production.

7.1.5 Dating and Industrial Affinities

7.1.5.1 The presence of bifaces allows the confident designation of the Purfleet material to the Acheulean techno-complex. Whilst this does give a general indication of the age of the site - it is definitely Lower Palaeolithic - it cannot be used to assign a specific date. Acheulean bifaces are found throughout south-eastern Britain in deposits ranging from 500 to 125kyr. Moreover, biface typology is of no value in assigning relative age. However, the nature of the industry is entirely consistent with Bridgland's proposed correlation with Oxygen Isotope Stage 9 (ca 300kyr).

7.1.5.2 Although the artefacts recovered would appear to fit Wymer's (1985) contention that a mixture of two industries - Clactonian (i.e. the flakes and cores) and Acheulean (the biface element) - are represented, there are no reasons at present for dividing the material in this manner. Core reduction of Clactonian character as present in this material is now widely recognised to be an integral part of the Acheulean.

7.1.6 Raw Materials

7.1.6.1 The raw material used in this collection exhibits a cortex entirely consistent with that seen on flint from the Chalk at Purfleet. This is a black flint with a thin white cortex. The material appears to be good quality, with fine flaking properties, although much of the flint present in the Chalk today is badly frost shattered. Two artefacts were noted to have been made on bull-head flint which forms bands at the base of the Thanet sands and is widespread in river deposits of the Lower Thames. These factors suggest that the raw materials used are those immediately available in the area.

7.1.7 Discussion

7.1.7.1 The condition of the Lower Palaeolithic artefacts indicate that whilst not in situ, they have not moved very far from their point of origin. The use of local raw materials, and the presence of all stages of both core reduction and biface manufacture also indicates that a fairly integral assemblage is represented.

7.1.7.2 It is clear that the density of artefacts greatly diminishes away from the chalk banks of the palaeo-channel towards the centre of the channel itself. This suggests that human activity was taking place on or near the edge of the channel, and that primary knapping scatters have been swept up into a mass movement deposit and simply carried downslope. This suggests that more or less primary scatters may survive to the

south of the current test trenches as well as in the margins of the fluvial deposits. The quantity of material recovered from 2004TP, in a very small volume of sediment, indicates the extreme richness of the site in the vicinity of the chalk 'cliff'. This is in line with previous observations.

Trench	Spit	Flakes/Blades	Cores	Implements	Burnt Flint	total
2001TP	1	8	1	-	1	10
	2	7	-	-	1	8
	3	3	-	-	-	3
	4	3	-	-	-	3
	5	2	-	-	-	2
	6	3	-	-	-	3
	7	1	-	-	-	1
2002TP	1	18	-	-	6	24
	2	1	-	-	-	1
	3	2	1	-	-	3
	4	-	-	-	-	0
	5	1	-	-	--	1
2003TP	1	7	1	-	-	8
	2	2	1	-	-	3
	3	-	-	-	-	0
	4	1	-	-	-	1
	5	3	-	-	-	3
	6	3	-	-	-	3
2004TP	1	4	-	-	-	4
	2	6	-	1	2	9
	3	3	-	-	-	3
	4	24	1	2	0	27
	5	11	2	-	0	13
	6	6	-	1	0	7
TOTAL	-	119	7	4	10	140

Table 8 Recovered flint collection divided according to individual spits

7.2 Pollen Analysis by R. Scaife

7.2.1 Introduction

7.2.2 Pollen analysis has been undertaken on two sub-samples from sediment monolith sections obtained from the middle-Quaternary sequence at Purfleet, Essex. The principal aims of this assessment are summarised as follows:

- To ascertain if sub-fossil pollen and spores are present in these sediments and if so, their state of preservation.

- If present, to provide preliminary information on the pollen taxonomic content and the possibility of correlating this sequence with other biostratigraphical assemblages.

- Does the site offer potential for more detailed and valid work in the future?

7.2.3 Methodology

7.2.3.1 Samples for pollen analysis were taken from the open section which had been cut back to expose a fresh face. This face was sampled in box monoliths for detailed laboratory examination and sampling. Two sub-samples were submitted by Dr M. Bates, University College, London for pollen analysis. These were from depths of 33-32cm and 14-13cm from the top of the monolith (ARC section 2001 TP, monolith Sample 8 and monolith Sample 7 respectively). the positions of these samples are given in Bates et al elsewhere in this report. However, it is noted here that monolith column 03 is the lower of the two samples.

7.2.3.2 Both sub-samples were from laminated/banded sandy silts of inorganic, minerogenic character resembling typical brickearth. Given this minerogenic character, rigorous pollen extraction procedures were required. These procedures followed those outlined by Moore et al. (1991) but with the addition of micromesh sieving (10u) for removal of the clay fraction. The samples of 7-8ml volume were decalcified with 10% HCL and deflocculated with 8% KOH. Coarse debris was removed through sieving at 150u and clay by micro-mesh (10u). Remaining silica (silt) was digested with boiling 40% hydrofluoric acid. Erdtman's acetolysis was also carried out although cellulose content was small. The concentrated pollen and spores were stained with safranin and mounted in glycerol jelly. This work was carried out in the Quaternary Environmental Change Research Centre of the Department of Geography, University of Southampton.

7.2.3.3 Pollen was found in only one of the two samples examined (32-33 cm). A preliminary pollen sum of 100 grains was identified and counted with an Olympus biological research microscope with phase contrast facility at magnifications of x400 and x1000. These data are presented in table 1. Taxonomy follows that of Stace (1991) and Moore et al. (1991).

7.2.4 Results

7.2.4.1 Of the two samples examined, only that from 32-33cm (monolith 8) contained pollen which was well preserved. These data are given in table 1 below. The sample from 13-14cm (monolith 7) was almost devoid with two badly degraded saccate pollen grains (cf. Pinus) recorded. In the former, pollen was sparse but generally well preserved which enabled a preliminary count to be made. Overall, the pollen

assemblage is not taxonomically diverse but is characterised by the dominance of temperate trees and shrubs. Betula (birch) and Quercus (oak) are dominant (33% and 31% of total pollen respectively). Corylus avellana type (which might include Myrica gale) is also relatively important (12%). Other taxa recorded include Fagus, Fraxinus and Tilia all of temperate woodland character. Poaceae (grasses) are the most important herb taxon. Other herbs by comparison are few with only single occurrences of Plantago lanceolate, Rosacea indet. and aquatic Myriophyllum alternifolium.

7.2.5 Discussion

7.2.5.1 Pollen has been previously found at Purfleet (Gibbard 1994). The pollen spectrum described here from monolith 8 clearly shows a temperate (interglacial) environment dominated by deciduous trees. Whilst Quercus, Corylus avellana and Betula are undoubtedly important, the small numbers of other thermophiles are nevertheless significant. Fagus, Fraxinus and Tilia are all known to be poor pollen producers and/or having limited pollen dispersion due to entomophily and in the case of Fagus large pollen grains. Thus, a mixed deciduous habitat is indicated. The absence of coniferous types is perhaps surprising when considered in relation to the many interglacial pollen (eg. Hoxnian) spectra from several other sites in eastern England. There is a possibility of contamination by recent (Holocene) pollen. This might, for example, come from tree root penetration or deep burrowing earthworms. Although this possibility is considered, it seems unlikely given the depth of the section, the fact that it was `cut back' to a great degree and also the presence of Myriophyllum alternifolium pollen (albeit one grain). These factors concur with the interpretation of Bates that the sediments were laid down in a fluvial environment.

7.2.6 Summary and conclusions

7.2.6.1 Two pollen samples were examined of which only one produced sufficient numbers of pollen grains to enable identification and pollen counting. The pollen spectrum obtained is clearly dominated by pollen of trees of mixed deciduous woodland. This is typical of temperate interglacial character. From a single sample it is not possible to correlate this assemblage with other interglacial sequences from the lower Thames of eastern England as a whole. The possibility of contamination has been considered but it seems likely that the pollen does in fact represent sub-fossil pollen preserved in fluvially laid sediments

7.2.6.2 Given the above data, it is suggested that a more detailed palynological investigation should be considered. This should produce a valuable vegetation record from what appears to be a middle Quaternary interglacial period. This is further enhanced by the Palaeolithic archaeology which is also present in this sequence.

Pinus	1
Betula	33
Quercus	31
Tilia	1
Fagus	2
Fraxinus	1
Corylus avellana type	12
Rosacea	1
Plantago lanceolata type	1
Poaceae	16
Myriophyllum alternifolium	1
Unidentified/degraded	5
cf Pteridium aquilinum	3

Table 9 Pollen data obtained from 32-33cm (ARC 2001 TP, monolith 8)

7.3 Prehistoric Pottery by A. Barclay

7.3.1 Introduction

7.3.1.1 The evaluation produced a small assemblage (14 sherds) of prehistoric pottery, which includes only one featured sherd. Twelve sherds were recovered by hand excavation and two by sieving. Analysis of the fabrics indicates a broad late Bronze Age to early Iron Age (800-600 cal BC) date range for the assemblage.

Quantification

Test pit	Context	No. of Sherds	Weight (g)	Comment
2001	spit 1	2	1	
	spit 2	1	6	
	spit 3	1	1	
2002	spit 1	3	7	
	spit 2	1	1	
2004	spit 2	3	33	Shoulder sherd
	404	2	14	
	408	1	<1	
Totals		14	64	

7.3.2 Fabrics and surface treatment

7.3.2.1 The majority of the sherds were manufactured from a range of flint tempered fabrics. Occasionally the flint temper has been mixed with sand. One sherd from context 404

was in a vesicular leached shell/organic and flint tempered fabric. With the exception of a fineware sherd (test pit 2002, spit 1) in a sandy fabric which is likely to be Iron Age, all of this material could be of late Bronze Age-early Iron Age date (cf. Barclay 1994; Brown 1988; Macpherson-Grant 1994). At least three sherds are from fineware vessels and these have been smoothed or burnished.

7.3.3 Forms

7.3.3.1 The small assemblage consists of 13 body sherds and one featured sherd (test pit 2004, spit 2) identified as a shoulder from a probable coarseware jar.

7.3.4 Discussion

7.3.4.1 The assemblage is characterised by relatively small (mean weight 4.6 g) body sherds from both coarse and fine ware vessels. The only featured sherd, a shoulder, is likely to come from an angular vessel of late Bronze Age-early Iron Age date. The overall range of fabrics is consistent with this date. Most of the material (11 sherds) came from the upper layers (colluvium) of test pits 2001-2 and 2004. Test pit 2001, spit 1 also produced a fragment of medieval/postmedieval tile indicating that at least some of this material is residual. Three sherds in flint tempered fabrics were recovered from ditch deposits 404 and 408 and it is possible that this feature is of a contemporary late Bronze Age-early Iron Age date.

7.4 Molluscs, Charred Plant Remains and Bones. Identifications and observations by M. Robinson

7.4.1 Molluscan remains were rare, although several of the samples produced specimens of Ceciloides acicula, a modern burrowing species. Sample 15 from Context 408, the lower fill of the later prehistoric feature in ARC2004 TP, produced a range of open country molluscs (Cepaea sp., Vallonia excentrica, V. costata, and Pupilla muscorum), one of shaded habitat (Discus rotundatus), and a single example of Cepaea nemoralis, a partially aquatic species. This range of species would not be incompatible with the environment pertaining in, for example, a deep, open ditch in unwooded countryside. A very small quantity of animal bone was also present, representing two species - mouse (Apedemus sp.) and an amphibian. The same context also contained two glume bases of spelt wheat (Tritium spelta), two indeterminate cereal grains, and a small quantity of oak charcoal (Quereus sp.).

8 SUMMARY OF RESULTS

8.1 Boreholes

8.1.1 The borehole stage of the evaluation indicated that the stratigraphic sequences observed fall into three separate spatial groups (Figure 18). Group 1 consists of the deposits observed in boreholes ARC0012 SA, ARC0013 SA, and ARC0015 SA. These boreholes were characterised by coarse sands and gravels, likely to have been deposited under medium to high energy environments of deposition. The sediments occur between 14.50m and 10.39m OD. The sedimentology indicates that they were deposited in fluvial conditions.

8.1.2 Group 2 consists of the deposits recorded in boreholes ARC0008 SA, ARC0009 SA, ARC0011 SA, and ARC0014 SA. A sequence of coarse fluvial sands and gravels was overlain by well bedded sands and silts with occasional thin gravel beds. These were interpreted as fluvial deposits grading vertically into channel margin or overbank floodplain deposits. There was some indication of episodes of pedogenesis and therefore of potential palaeo-landsurfaces. The upper part of the sequences in ARC0009 SA and ARC 0011 SA consisted of chalky silt or gravel. These are probably colluvial or soliflucted sediments.

8.1.3 Group 3 consists of the deposits recorded in boreholes ARC0006 SA, ARC0007 SA, and ARC0010 SA, at the eastern end of the site. Chalk bedrock overlaid a very thin bed of sand or gravel. This was overlain by a chalk-rich sediment, interpreted as colluvial or solifluction deposits.

8.2 Test Pits

8.2.1 ARC20001 TP did not locate the chalk 'cliff'. However, the rockhead was 1.5m higher than in the adjacent borehole ARC0008 SA (see Figure 19). The sediments present were well bedded and would be suitable for palaeo-current determinations. Flint artefacts were recovered from all the spits except Spit 7. Several flint flakes were present in the well bedded, pleistocene deposits in the lower part of the sequence. Their relatively sharp condition would indicate that they have not moved far from their point of origin. The upper deposits (Contexts 101 and 102) produced the majority of the flint artefacts, although this material is undiagnostic, it differs in character from the material in the lower levels of the sequence, and two small sherds pottery, recovered from Spits 1 and 2, indicate a late prehistoric date. The depth of Context 102 suggests that it may fill a cut feature, perhaps that seen in ARC20004 TP (Context 410), although it was not possible to be certain of this within the confines of the test pit.

8.2.2 It was difficult to record the deposits in ARC2002 TP due to the unconsolidated nature of the sediments and the depth of the sequence was not ascertained. However, the lower part of the recorded sequence (Context 205) seemed to confirm the nature of the sequence as recorded in ARC0011 SA. A single flint flake was recovered from the lower sequence (from Spit 5) but was in a rolled condition and undiagnostic. The upper deposits (Spits 1 to 3) produced a greater number of flint artefacts and a few small sherds of pottery. One flint flake was retrieved directly from Context 203,

which fills what is probably a late prehistoric feature. It was cut into a firm silty clay with a blocky structure, Context 204, which may represent the contemporary ground

Figure 18

surface. The overlying deposits, Contexts 201 and 202, are later, possibly colluvial deposits.

8.2.3 ARC2003 TP demonstrated that the coarse sands and gravels recorded in this area are in fact well-bedded and are suitable for palaeo-current determinations. A small number (7) of flint flakes were recovered from Spits 4, 5 and 6, all in a rolled condition. The upper part of the sequence (Spits 1 and 2) also produced a small quantity of flint, including two cores, which can probably be assigned to the late prehistoric period. Again, the later deposits may be colluvial in origin.

8.2.4 ARC2004 TP, immediately to the south-east of ARC20001 TP, revealed a chalky basal sediment (Context 407), possibly a colluvial or solifluction deposit. The lower part of 407 appeared to consist of mixed chalky rubble with pockets of sandy material filling hollows in the chalk bedrock. The majority of the Lower Palaeolithic artefacts came from this deposit and includes two bifaces, a possible biface rough-out, and a number of biface manufacturing flakes. They are generally in fairly sharp condition, suggesting that they have not moved far from their point of origin. The Pleistocene deposits were truncated by a large feature (Context 410) filled with brown sandy silt (Contexts 404 and 408). 404 produced two sherds of pottery of Late Bronze Age or Early Iron Age date. This feature may represent a substantial ditch but the small size of the test-pit precludes a more precise interpretation.

8.3 Biological and Artefactual Material

8.3.1 The assessment of the bulk soil samples produced little environmental material, except from the later prehistoric feature in ARC2004 TP which produced a small assemblage of molluscs, charred plant remains, small rodent and amphibian bones, and a fragment of pottery.

8.3.2 Examination of the sieved fraction of the non-floating residues of the bulk samples produced quantities of small flint flakes. These occurred in all of the samples except Sample 5 from Context 109.

8.3.3 Two of the column samples from the lower part of the sequence in ARC2001 TP (see Figure 14) were assessed by Dr R Scaife for pollen preservation. One of these, from the lowest, laminated unit (at 15.81m OD) produced a pollen spectrum dominated by pollen of trees of mixed deciduous woodland.

Figure 19

9 CONCLUSIONS

9.1 Pleistocene

9.1.1 The evaluation has produced a transect through the fluvial deposits and feather edge of the Corbets Tey Gravels, and has identified an artefact-rich, slope wash or solifluction deposit close to the line of the chalk 'cliff'. Unfortunately, it was not possible to relate this deposit to the fluvial deposits within the channel due to the presence of a large, later prehistoric feature.

9.1.2 The laminated and bedded silts, sand and clays seen in borehole group 1 and in ARC2001 TP have similarities with deposits recorded in Bluelands and Greenlands Quarries, where they produced mollusca, ostracods and pollen, and in the Botany and Esso Pits, where, like this sequence, the deposits were without fossils. The accepted model development of the Thames fluvial sequences (Bridgland 1994, 17-19) indicates that these deposits were laid down in interglacial, floodplain conditions. However, a discrepancy exists in that this sequence has previously been recorded at a height of about 10.6m OD, compared to between about 14.5m and 17.5m OD in the assessment area. However, since the silts, sands and clays observed in the nearby exposures are overlain unconformably by sands and gravels, it is possible that the deposits recorded during the present work represent a later part of the same interglacial sequence which has been eroded elsewhere.

9.1.3 Samples from the Pleistocene deposits did not produce faunal remains. However, the pollen spectrum recovered from the lower, interbedded silts in ARC2001 TP shows a temperate (interglacial) environment, dominated by trees of mixed deciduous woodland, consistent with the environment of deposition suggested by Bridgland (op cit).

9.1.4 The dating of interglacial deposits at Purfleet is uncertain - Bridgland (1994, 225-228) correlates this interglacial with Oxygen Isotope Stage 9, suggesting an age of about 300 000 BP (mid-Saalian Stage). However, Gibbard (1994) suggests that the interglacial sediments represent part of the later, Ipswichian stage. In the absence of molluscan material suitable for amino acid geochronological determinations, techniques such as Electron Spin Resonance, Thermoluminescence, and Chlorine-36 techniques would need to be used to provide age estimates for the sediments at Purfleet (Bates et al, 1995, 81).

9.1.5 The form of the chalk 'cliff' was not clearly revealed, but the fluvial sediments thin out against rising chalk bedrock in the south-eastern part of the site, suggesting that the 'cliff' is fairly low relief in character and complicated by solifluction or slope wash deposits (see Figure 19).

9.1.6 Archaeological material was recovered from all of the test pits but that recovered from the lower parts of ARC2002 TP and ARC 2003 TP was heavily rolled and re-worked. While not specifically diagnostic as palaeolithic material, the stratigraphic position makes this likely. In ARC2001 TP, a number of flint flakes, in fairly sharp condition, were recovered from the lower silt units. In ARC2004 TP, the majority of

the flint was recovered from the chalk-rich deposit overlying chalk bedrock, and from hollows within the bedrock, again in good condition. This deposit is probably a solifluction or slope wash deposit, eroded from the chalk 'cliff'. The condition of the artefacts suggests that they have not moved very far, indicating that in situ deposits may exist locally, either on the margin of the floodplain deposits, or to the south of the chalk 'cliff'. This association of archaeological material with the 'cliff' line is in accord with the situation recorded in other exposures at Purfleet. For example, archaeological material was recovered from sands and gravels banked against the chalk 'cliff' at Botany Pit (Wymer, 1968, 312-313 and 1985, 313) - some of this material was associated with chalky solifluction deposits.

9.1.7 The worked flint from ARC2004 TP is considered to belong to the Acheulian techno-complex, the most characteristic form of which is the bifacial hand-axe. Two bifaces, a possible rough-out, and a small number of biface manufacturing flakes were recovered from the chalk-rich deposit in ARC2004 TP. In addition, there were several cores and hard hammer flakes, of Clactonian character. This accords with material recovered from Bluelands and Greenlands Quarries from the basal gravel underlying the laminated silts, and from a gravel band overlying it. The possibility therefore exists that more than one Palaeolithic industry is represented by this material, as suggested by Wymer (1985). No material attributable to the Levalloisian industry was recovered during the present work.

9.1.8 This evaluation has confirmed that significant quantities of palaeolithic flint artefacts occur within the Pleistocene deposits affected by the CTRL at Purfleet. Their fresh condition, together with the evidence of flintworking and the range of implements and waste material present, reinforces the significance of the assemblage. Although there is no direct evidence for in situ from test pits 2001 and 2004, it has only travelled a short distance and the possibility of in situ deposits caanot be ruled out. The pollen confirms that there is at least some potential for palaeo-environmental reconstruction which can be coupled with the sedimentary analyses likely to shed light on the depositional conditions. The absence of molluscs and small bones and the very poor preservation of one of the pollen samples indicates that there is unlikely to be a continuous sequence of palaeoenvironmental evidence of all types. However, the absence of molluscs and bones in these test pits does not mean that there will not be pockets or more extensive localised sequences of rich deposits within the CTRL corridor in the vicinity of the chalk cliff.

9.1.9 The possibility that the basal sequence in ARC2001 TP may represent temperate interglacial deposits of later date than observed elsewhere at Purfleet gives this particular area a potential added significance which is not applicable to other parts of the Purfleet complex as currently understood. However, further investigations would be needed to confirm thia.

9.1.10 The areas of the gravels away from the area of the chalk 'cliff' appear to have less potential, as has been the pattern elsewhere within the complex.

9.1.11 Overall, the evaluation has reinforced the expectation that the Pleistocene deposits affected by the CTRL at Purfleet are of national importance, and more particularly has indicated a broad band of deposits, about 100m wide, along the line of the chalk

'cliff', obliquely crossed by the line of the CTRL, which have the highest potential. The geoarchaeological indications of weathering and incipient pedogenesis within the fluvial sands and gravels suggest some potential for other areas of archaeological interest, which (especially with the difficulties encountered in ARC2002 TP) have not been fully tested, though this is not indicated by the distribution and character of the flint work

9.1.12 While the recovery of in situ palaelithic flintwork and a fuller range and sequence of biological remains would have indicated the international interest of the deposits, this cannot be ruled out for the site on the basis of the limited extent of the boreholes and test pits excavated here.

9.2 Later Prehistoric

9.2.1 Although the investigation was specifically designed to assess the Pleistocene and associated Palaeolithic deposits, two later prehistoric features were recorded, in ARC2002 TP and ARC2004 TP. The large, ditch-like, feature in ARC2004 TP produced pottery of Late Bronze Age or Early Iron Age date and both features produced undiagnostic flint flakes. In both cases, the features were overlain by brown sand, or sandy silt, from 0.30 to 0.55m thick, underlying the topsoil. Similar deposits were also recorded in ARC2001 TP and ARC2003 TP. The spits corresponding to these deposits in each case produced a noticeable concentration of flint flakes, as well as a small quantity of pottery. These upper deposits have been interpreted as colluvial deposits and may correspond with similar deposits recorded at Greenlands Quarry (Gibbard, 1994, 74).

9.2.2 It is not known what the large ditch in ARC2004 TP may have been part of or how significant it may have been. However, it is a relatively substantial feature for this period, and compares closely with, for example, the size of the ditches of the North and South rings at Mucking (Clarke, 1993) and is much larger than, for example, the ditches of the enclosed settlement at Lofts Farm (Brown, 1988), though not dissimilar to linear later Bronze Age ditches at Gravesend (Mudd, 1994). If it were to belong to a large enclosure of the Mucking type, which it also parallels in topographical location on top of a low chalk hill overlooking the Thames, it would be of at least regional significance. Other examples of substantial late Bronze Age enclosures of this type occur at Springfield Lyons, Essex; Mill Hill, Deal and Highstead, Kent; and St Mary's Hospital, Carshalton, Surrey.

9.2.3 If in fact, it were later in date, the ditch might represent a smaller settlement enclosure of the more common Iron Age type, or might just be a large boundary ditch. The other small feature (Context 206) would be typical of a variety of gullies and ditches on later prehistoric sites, ranging from parts of whole field systems as at Mucking to minor lengths of gully of no obvious function.

10 IMPLICATIONS FOR CTRL

10.1 Palaeolithic Sequence

Significance

10.1.1 As indicated above, these deposits are of national importance, though areas of greater and lesser significance within this can be broadly defined.

Impact of CTRL

10.1.2 The CTRL will cut through the entire depth of Pleistocene deposits and the top of the underlying chalk throughout the evaluation area to a depth of about 8m. The northern side of the cutting will be partially retained to support the Purfleet by-pass, which will somewhat reduce the width of land take compared with an unretained cutting. The south side of the cutting will be unretained. A substantial volume of archaeologically significant deposits will therefore be removed.

Mitigation options and need for further work

10.1.3 Consideration should be given to detailed engineering design to reduce the width of the cutting, particularly on the south side, in the area of the most sensitive deposits on the line of the chalk 'cliff'. A programme of multi-disciplinary excavations to sample the deposits due to be removed should be undertaken prior to the construction of the railway. It may be necessary to carry this out in stages, either with some further evaluation to determine the strategy for sampling the deposits, or with a staged programme of excavation designed to have in-built flexibility to build on and adapt the strategy to take account of the results of each previous stage of the excavation. The later stages (if not all of them) might most effectively be dealt with as a closely controlled process of excavating the cutting itself. The programming of this, bringing it forward within the main construction programme to allow plenty of time for the archaeology, would be of paramount importance.

10.2 Later Prehistoric Features

Significance

10.2.1 The significance of the late prehistoric phase of activity on the site is extremely uncertain.

Impact of CTRL

10.2.2 While the extent of features associated with this phase of activity is unknown, it is clear that if extensive the CTRL could have a significant impact as it will be in a cutting.

Mitigation options

10.2.3 Further evaluation, by more extensive shallow trenching is needed to clarify the

character, extent and significance of the later prehistoric remains that would be affected by the CTRL. This would determine what need there might be for further mitigation.

10..2.4 The possible need to excavate a potentially significant later prehistoric site before the palaeolithic sequence was exposed will need to be fully considered in programming the work.

10.2.5 This further stage of evaluation could be combined with further test pitting of the Pleistocene sequence if this were desirable, or might, through sections excavated through the large ditch encountered in test pit ARC2004 TP, provide 'free sections' through much of the depth of the Pleistocene deposits in the vicinity of the chalk 'cliff'.

11 BIBLIOGRAPHY

Bates M. R., Barham A. J., Pine C. A., and Williamson V. D. 1995 Geological Borehole Investigation at Purfleet, Thurrock, Essex. Unpublished internal document

Bridgland D. R. 1994 Quaternary of the Thames (London)

Brown, N. 1988 'A Late Bronze Age enclosure at Lofts Farm, Essex' Preh. Proc. Soc. 54, 249-302

Caldwell A. 1971 'Beacon Hill, Purfleet' Panorama 14, 58

Clarke A. 1993 Excavations at Mucking EH Archaeological Report No 20

Gibbard P. G. 1994 Pleistocene History of the Lower Thames Valley (Cambridge)

Gilman P. J. 1956 'Purfleet: Botany' Panorama 2, 12-14

Hollin J. T. 1977 'Thames interglacial sites, Ipswichian sea levels and Antarctic ice surges' Boreas 6, 33-52

Moore P. D., Webb J. A. and Collinson M. E. 1991 Pollen analysis (Oxford)

Mudd A. 1994 'The excavation of a later Bronze Age Site at Coldharbour Road, Gravesend' Archaeologia Cantiana 114, 363-410

OAU 1994 Assessment of Historic and Cultural Effects of the Channel Tunnel Rail Link.

OAU 1995a Purfleet, Thurrock, Essex - Method Statement. Unpublished internal document

OAU 1995b Purfleet - Site Safety Plan and COSHH Statement. Unpublished internal document

OAU/URL 1995 Purfleet, Thurrock Essex - Written Scheme of Investigation. Unpublished internal document

Palmer S. 1975 'A Palaeolithic Site at North Road Purfleet Essex' Transactions of the Essex Archaeological Society 7, 1-13

Stace C. New flora of the British Isles (Cambridge)

Wymer J. J. 1968 Lower Palaeloithic Archaeology in Britain, as represented by the Thames Valley (London)

Wymer J. J. 1985 The Palaeolithic Sites of East Anglia (Norwich)