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THE EBBSFLEET VALLEY, NORTHFLEET, KENT

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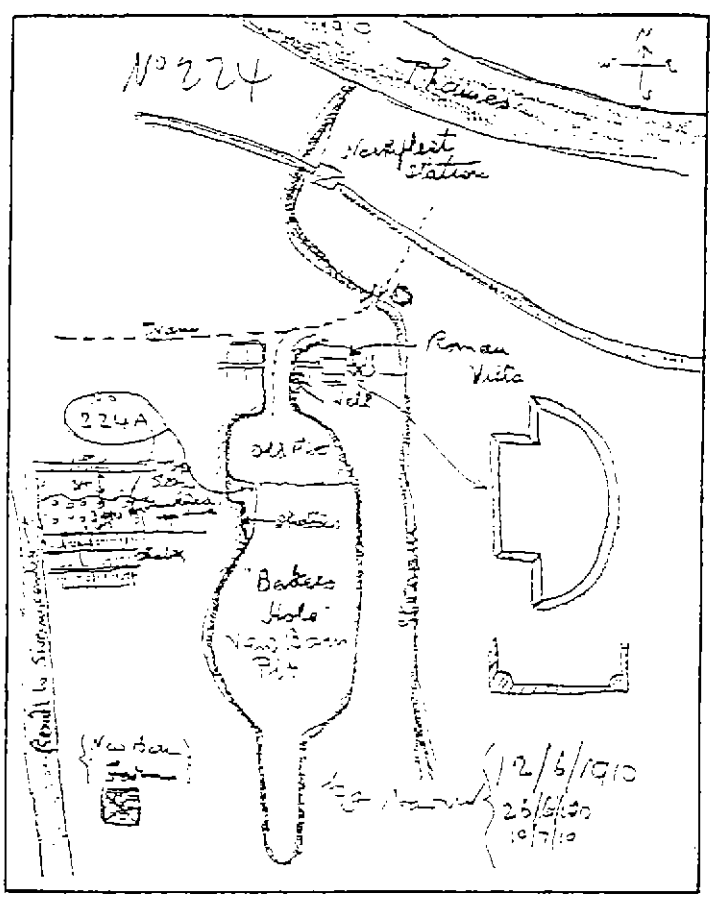
ARCHAEOLOGICAL EVALUATION

Contract No. 192/084-10507

Volume 2 Appendices



Hayward's 1910 sketch map of the Ebbsfleet Valley

OXFORD ARCHAEOLOGICAL UNIT
JULY 1997

UNION RAILWAYS LTD

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APPENDICES

Volume 2 of 3

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VOLUME 2

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APPENDIX 1

POTTERY

By Paul Booth, Oxford Archaeological Unit

1 Introduction

1.1 The evaluation produced a small, multiperiod pottery assemblage of some 110 sherds (1125 g), about 60% of which was of Roman date. The pottery was generally in moderate condition; some sherds, particularly the pre-Roman ones, had slightly abraded edges and eroded surfaces, and the average sherd weight, at just over 10 g, was not particularly large. The pottery was examined by context group and data recorded on standard record sheets. Sherds were assigned to major periods, although in some cases these identifications were tenuous owing to the small size of the fragments and the absence of diagnostic characteristics. They were then recorded in fairly broad fabric/ware groups, principally using the coding system employed in the Oxford Archaeological Unit's Roman pottery recording system, but with reference to well-defined local terminology where appropriate. Quantification of these fabric/ware groupings was by sherd count and weight. Notes were also made on vessel typology, though most of the surviving rims were small and relatively undiagnostic of specific form.

2 Quantification by period

2.1 The breakdown of the material by broad period was as follows.

Period	No. Sherds	Weight (g)
Later Bronze Age	6	21
?Prehistoric	3	5
Late Iron Age	5	108
Roman	64	658
?Saxon	17	186
?Medieval	1	1
Post-medieval	14	146

3 Fabrics

3.1 *General*

3.1.1 Fabrics/wares were divided into two broad groups. Pre-Roman and Anglo-Saxon fabrics were defined in terms of their principal inclusion types but were not, at this stage, divided into tightly-defined individual fabrics. The 'romanised' fabrics were assigned to established major ware groupings defined and coded on the basis of their principal common characteristic (eg R = reduced coarse wares). The single possible medieval (sandy, unglazed) fragment and the post-medieval material were not characterised in detail in terms of fabric and are not discussed further.

3.2 *Prehistoric fabrics*

3.2.1 The sherds dated to the later Bronze Age were all in flint-tempered fabrics. Flint was always the dominant inclusion type, but it was associated with quartz sand in two cases and with voids in one other. The attribution of these sherds to this period is not absolutely certain. All were small and there were no feature sherds. Three very small undiagnostic sherds were assigned to an unspecific 'prehistoric' category, although it is possible that they could have been of post-Roman date. Five sherds dated to the late Iron Age were in sand and grog-tempered 'Belgic type' fabrics, the date range of which could extend into the early Roman period.

3.3 *Roman fabrics*

3.3.1 The fabric groupings, with quantification, are given below:

S. Samian ware (all sources). 2 sherds, 4 g.
F45. ?Rhineland (white) colour-coated fabric. 2 sherds, 25 g.
F51. Oxford colour-coated ware. 1 sherd, 33 g.
A10. Fine buff ?amphora fabric. 2 sherds, 7 g.
M29. S.E. England buff mortarium fabric. 1 sherd, 55 g.
Q and Q10. White-slipped fine oxidised fabric. 3 sherds, 8 g.
O10. Fine oxidised fabrics. 7 sherds, 63 g.
R. General reduced (usually sandy) wares. 2 sherds, 4 g.
R10. Fine reduced fabrics. 6 sherds, 25 g.
R20. Coarse sandy reduced fabrics. 3 sherds, 12 g.
R30. Medium sandy reduced fabrics. 14 sherds, 153 g.
R39. Alice Holt sandy reduced ware. 1 sherd, 82 g.
B10. Black-burnished ware (BB1). 1 sherd, 8 g.
B20. Black-burnished ware (BB2). 7 sherds, 52 g.
C and C10. Coarse shell-tempered fabrics. 11 sherds, 105 g.
C11. Midlands late-Roman shell-tempered ware. 1 sherd, 13 g.

3.3.2 Relatively few of the fabrics could be assigned to specific sources with confidence, though most can be roughly located. The reduced coarse wares may have included probable Canterbury products (particularly in the R30 group), but oxidised fabrics from this source were not evident. None of the fine (R10) reduced sherds were clearly attributable to the North Kent Upchurch ware industry, but the BB2 sherds are most likely to have originated there. The C10 shell-tempered sherds are also likely to have been local North Kent products. The `fine and specialist wares' (samian, fine wares, mortaria etc) included typical regional products (such as mortarium fabric M29 and white-slipped (Q and Q10) fabrics). Imports included the samian ware fragments, possible amphora fragments (these were too small for confident identification) and two beaker sherds in fabric F45, attributed to the Rhineland. Other extra-regional imports included the few sherds specifically datable to the late Roman period, from Oxfordshire (F51), probably Harrold (Beds, C11) and Alice Holt (R39).

3.4 *Anglo-Saxon*

3.4.1 Seventeen sherds were assigned a Saxon date on fabric criteria. All were principally sand tempered, with organic and calcareous inclusions also present in a number of sherds. The dating of this material to the Saxon period is not absolutely certain, but as well as being based on the character of the sherds (and the occurrence of `rusticated' decoration on one of them), is supported by limited stratigraphic evidence, in that the sherds tended to occur in colluvial deposits, sometimes above Roman features.

4 Forms

4.1 Only ten vessels, all of Roman date, were represented by rim sherds. These included a late 2nd-3rd century beaker in F45 and a bowl (Young 1977 type C60?) in Oxford colour-coated ware. Coarse ware forms were a bead rim jar and two uncertain jars/bowls in R30, a flanged bowl in R39, a probable jar in C10 and a cooking pot and two bowls/dishes in BB2. The uncertainty of some of these identifications reflects the generally small size of the sherds in the assemblage.

5 Context and chronology

5.1 The flint-tempered sherds assigned to the later Bronze Age were widely distributed across the evaluated area, coming from Test Pit 2018 in the north, Trenches 1019 and 1020 west of the `villa' and from Trench 1291 to the south. The only sherds of this date possibly contemporary with the deposits in which they occurred are those in Spits 6 and 12 of Test Pit 2018. The remaining sherds occurred

residually, and their small size is consistent with this. Possible prehistoric sherds occurred in Trenches 1014, 1236 and 1287, but were so small that their dating is questionable and their significance quite uncertain.

5.2 Sherds dated to the late Iron Age were found in the upper deposits of Test Pit 2018 and in contexts in the villa area, where they were associated with Roman pottery. Together the late Iron Age and Roman material indicates activity here from the 1st-4th centuries, though the assemblage is far too small to be able to demonstrate gaps in the occupation sequence. The major coarse ware fabric groups present, however, hint at use of the site throughout, with C10 fabrics characteristic of the 1st-early 2nd centuries, supplemented by reduced coarse wares and then particularly by BB2 from the 2nd century onwards. The late Roman material identified above provides evidence for activity into the second half of the 4th century AD, particularly in the group from 1790 in Trench 1235, consisting of late shell-tempered and Oxfordshire colour-coated ware sherds, both likely to date after AD 350. In the absence of diagnostic forms, however, most of the small groups could only be dated late 1st/2nd century or later.

5.3 The 64 Roman sherds came from no fewer than 28 contexts in 11 different trenches, which indicates the tiny size of individual context groups (12 of which consisted of a single sherd), in turn emphasising the difficulty of using this material for dating. The Roman pottery inevitably concentrated in the vicinity of the villa, but sherds also occurred sporadically both to north and south. The assemblage was insufficiently large for meaningful patterns of distribution around the villa complex to be evident.

5.4 The small Anglo-Saxon assemblage was relatively widely spread, sherds perhaps occurring in seven separate trenches; 1015, 1016 and 1020 west of the Roman buildings, 1234, 1236 and 1237 adjacent and to the east of the buildings, and a possible sherd in Test Pit 2006 to the north. The general correspondence between these locations and those of the majority of the Roman material suggests that Saxon activity probably concentrated around the Roman building complex, if not within it. The nature of the colluvial deposits from which the Saxon sherds derive, however, cautions against pressing this association too closely. In any case, the material cannot be dated very precisely, though the presence of a probable rusticated sherd would support an early Saxon (perhaps 5th-6th century AD) date rather than anything later.

5.5 The single possible medieval sherd came from Trench 1023, to the west of the villa site, and post-medieval sherds were quite widely

distributed. None, however, came from the immediate vicinity of the Roman buildings.

6 General comments

6.1 The pottery assemblage was small, particularly when the number of excavated trenches and the known archaeological significance of parts of the site are considered. The relatively low level of examination of features in the vicinity of the Roman buildings, and the extent to which deposits here had already been disturbed by earlier excavation, were presumably both factors affecting the quantity of material recovered. This therefore adds relatively little to the broad understanding of the site at present. Limited low-level activity may be indicated in the later Bronze Age, but evidence for other prehistoric periods is exiguous. Activity throughout the Roman period seems to be indicated, but the material recovered does not at present allow the known Roman structures to be dated. There is evidence for late Roman use, and this may have continued into the period when Anglo-Saxon ceramics were widely adopted.

6.2 The Roman assemblage consists of local, regional and extra-regional components, all of which can be seen as consistent with known patterns of pottery supply in Kent. It contains nothing which augments or modifies the picture of these patterns currently available. Again, the assemblage is too small for analysis of differing proportions of fabrics and vessel types to be meaningful, nor does it permit inferences on specific aspects of site function and status to be drawn, though a larger collection would probably be of considerable value in these regards.

7 Assessment of potential and further work

7.1 The present assemblage is of very small size and its potential for further analysis is therefore limited. It is of some importance for understanding the chronology of the site, particularly in the post-Roman period. In its present form the assemblage has no potential for providing further data on trade and status and functional aspects of the site because of its small size. In the event of further work on the site the present material could be added to any resulting assemblage and recorded in line with it. If no further fieldwork is carried out the only component of the present assemblage requiring more detailed consideration would be the Anglo-Saxon material, the fabrics of which should be examined and recorded fully.

APPENDIX 2

CERAMIC BUILDING MATERIAL

By Paul Booth, Oxford Archaeological Unit

1 Introduction

1.1 A total of 391 fragments (42.421 kg) of ceramic building material was recovered in the evaluation. Of this total, 21 fragments (0.255 kg) were of uncertain date and 14 fragments (0.371 kg) were probably of post-medieval date. The remaining material (356 fragments, totalling 98.5% of the material by weight) was of Roman date. In addition, 18 fragments of fired clay (346 g), all but one small piece from probable Roman contexts in Trench 1235, were noted but were not examined further. The material was scanned briefly by context group and divided by period, principally on the basis of morphological characteristics but also using criteria of fabric type visible to the naked eye. Occasional pieces were examined under a binocular microscope at x20 magnification. The numbers of fragments assignable to principal tile types were noted and some thickness measurements were taken to support tile type identifications.

2 Fabrics/dating

2.1 There was considerable homogeneity of tile fabrics. The Roman material appeared for the most part to be in a single fabric with some variation in the amount of sand temper used. A very few fragments were isolated as being potentially in distinctly different fabrics. Post-medieval material was not readily distinguishable from that of Roman date on criteria of fabric, and the distinction was most easily made on the basis of tile types, with flat thin roof tiles being assigned to the post-medieval period. The latter material only appeared to be present in small quantities, as was also the case with post-medieval pottery, and there is reasonable confidence that the distinction between the two periods has been successfully drawn. Brick/tile fragments classified as uncertain were generally relatively small and had no obvious distinguishing characteristics. The uncertain and post-medieval brick/tile (only one small probable brick fragment was in fact observed) is not discussed further.

2.2 The principal Roman tile fabric was red to red-brown, quite fine, with sparse quartz sand grains and occasional iron ore and white calcareous inclusions. The amounts of sand and calcareous material were variable, but for the most part these variations appeared to be within a continuum within which dividing points could not be readily defined. The great majority of the material (346 fragments, 41.103 kg) was in this fabric. A few, otherwise similar fragments appeared distinctly more sandy, and these were noted separately (6 fragments,

391 g). It is possible that this fabric was under-represented in the preliminary examination. A very small number of fragments (4 fragments, 301 g) were in a slightly to moderately sandy buff fabric which was sufficiently different from the bulk of the material to suggest a distinctive product.

3 Types (Roman only)

3.1 Both roof and flat tiles were present on the site, together with a small number of pieces tentatively identified as from box-flue tiles, and a small number of pieces cut down for use as crude *tesserae*. One fragment was from an uncertain form. Many small fragments (44.9% of the assemblage, but only 8.4% of the total weight of Roman tile) were not assigned to type at this stage. The breakdown of tile types was as follows:

Type	No. Frags.	% Frags.	Weight	% Weight
Uncertain	160	44.9	3505	8.4
Tegula	83	23.3	16387	39.2
Imbrex	35	9.8	3790	9.1
Flat	64	18.0	17214	41.2
Box flue	6	1.7	545	1.3
Tesserae	7	2.0	157	0.4
Other	1	0.3	197	0.5

3.2 There were no complete tiles in the collection. Identification of some *tegulae* was based on the presence of a flange and that of *imbrices* on the characteristic curved shape. For other types, and for *tegulae* where the flange was not present, thickness was the principal criterion employed, though one box flue fragment had characteristic combing and others were identified on the basis of evidence for cutouts and scars where adjacent sides joined. Fairly consistent thickness ranges were noted however. In particular, *tegulae* were usually in a range from *c.* 18-25 mm thick, though thicker pieces (up to *c.* 29 mm) were noted occasionally. Box flue fragments always appeared to be thinner (ie less than *c.* 15 mm), but the sample was so small that this may not have been a reliable guide. Flat tiles ranged from 29-44 mm in thickness, but the great majority were in a range from 31-38 mm. In the absence of any complete dimensions there is no evidence for the precise types of flat tiles represented. The single large fragment of an unknown type was of a thin (10-12 mm thick) tile, curving in two dimensions, from context 161 in Trench 1013, close to the bath building. This might have been part of a hood, but insufficient survived for confident identification. The *tesserae*, roughly cut, were on average *c.* 30-35 mm square. Several had mortar on the four 'side' faces.

3.3 The approximate 2:1 ratio of *tegulae* to *imbrices* compares with that noted for the recent evaluation of the Thurnham villa site (URL 1997). At Northfleet, however, flat tiles (absent at Thurnham) formed a major component in the tile assemblage and were the most important type by weight. The range of tile types present is consistent with the recorded evidence for the structures, including a bathhouse, and the *tesserae* also confirm earlier records of this floor type. With the great majority of the material occurring in a single fabric evidence for fabric/type correlations was limited. It was noted, however, that the two minor fabric types both had a high representation of *imbrices*; four out of six fragments in the `sandy' fabric and three out of four fragments in the `buff' fabric were recorded as being of this type.

4 Context

4.1 The Roman tile derived from 40 contexts in 18 trenches, with the bulk of the material inevitably concentrated in trenches close to or within the Roman buildings. Trenches 1013, 1014 and 1234-1239, all within *c.* 20 m of structures, produced 91.4% (by weight) of all the Roman tile, and Trenches 1009, 1015, 1016, 1019 and 1020, all within 100 m, accounted for a further 5.3%. The only significant group of tile at any distance from the buildings was in Trench 1287 (Context 595), some 200 m south of the `villa' close to the Ebbsfleet river. The fragments here, however, totalling 1250 g, probably all derived from a single flat tile, the significance of which is therefore uncertain.

4.2 Twenty-four of the tile-bearing contexts also contained Roman pottery, though in most cases the quantities of pottery were very small. In three groups (1760, Trench 1015; 1837, Trench 1236; 1848, Trench 1234), this was supplemented with Saxon material and in a further two contexts (1809, Trench 1016; 1938, Trench 1020) tile was associated with Saxon pottery alone, though the latter group may also have contained a tile fragment of post-medieval date. The limitations of the pottery assemblage, however, mean that most pottery-dated tile-bearing contexts were only assignable to the late 1st-2nd century or later. Nevertheless, a number of groups were clearly post-Roman in terms of their formation and it is likely that most of the significant collections of tile, including a number which contained no other dating material at all, were from late Roman and later contexts. This serves only to indicate the post-Roman decay of the buildings, however.

5 Assessment of potential and further work

5.1 The material is of significance in indicating aspects of the character of Roman structures on the site. The total quantity of tile recovered to date is relatively small, and if no further work is undertaken on site the only additional examination of the present material likely to be required would involve more detailed characterisation and definition of the fabrics, looking at a limited sample of the material, to determine if the assemblage was as homogeneous as the initial examination would suggest. In the event of further excavation resulting in a larger assemblage being available for study, the present material should be incorporated within this for the purposes of detailed recording and analysis.

APPENDIX 3

WORKED FLINT

Dr. F.F. Wenban-Smith

1 Introduction

1.1 Lithic material was recovered from the Section 193 in Area 6, from all of the machine-excavated test-pits, except TT 1232, and from roughly a quarter of the other trial-trenches. The total number of lithic artefacts recovered was 169 from 23 trenches, test pits and sections. In addition, 887 pieces of burnt fire-cracked flint weighing 7.738 kg were also recovered. The density of lithic recovery varied widely across the evaluation site. Four trenches produced over 10 artefacts (TTs 1237 & 1240; TPs 2006 & 2018), six produced 5-9 artefacts (Section 193; TTs 1016, 1020, 1023, 1238 & 1287) and the remaining trenches produced 4 or less artefacts. Context 1725, which had no trench number, also produced 6 artefacts.

2 Quantification

2.1 The lithic material recovered was divided into major technological categories, and assessments of the period represented and its archaeological significance made on the basis of condition and technology/typology. Debitage less than 20 mm maximum dimension was categorised as a chip. The lithic collection is summarised by trench and context in Tables 1 and 2 below.

Table 1: Quantification of worked flint from Trial Trenches (TTs)

Trench	Total	Context	Cores	Tools	Debitage	Chips	Burnt (kg)
-	1	1720	-	1	-	-	-
-	6	1725	-	-	-	6	-
1009	1	137	-	-	1	-	-
1015	1	1760	-	-	1	-	-
1016	7	1734	-	-	2	-	-
		1809	1	1	2	-	1 (0.010)
		1945	-	-	1	-	-
1019	3	1765	-	1	2	-	-
1020	7	1938	-	1	6	-	3 (0.075)
1021	2	1780	-	1	1	-	1

Trench	Total	Context	Cores	Tools	Debitage	Chips	Burnt (kg)
							(0.002)
1023	5	1770	1	-	-	-	1 (0.040)
		1771	-	-	1	-	5 (0.100)
		1831	-	1	2	-	4 (0.007)
1234	1	1848	-	-	1	-	-
1235	1	1901	-	-	-	-	1 (0.055)
		1902	1	-	-	-	-
1236	1	1836	-	-	-	-	1 (0.002)
		1837	-	-	1	-	3 (0.090)
1237	13	1741	-	-	1	-	6 (0.075)
		1742	-	-	-	-	3 (0.090)
		1743	-	-	-	-	1 (0.002)
		1804	-	-	2	-	14 (0.140)
		1805	-	-	5	4	233 (2.102)
		1845	-	-	-	-	29 (0.140)
		1942	-	-	-	-	20 (0.800)
		1963	-	-	1	-	-
1238	9	1858	-	-	2	-	-
		1859	-	-	1	-	-
		1860	-	1	2	-	-
		1862	-	-	1	1	-
		1863	-	-	1	-	-
1240	15	1947	-	1	-	-	-
		1949	-	1	13	-	2 (0.206)
1276	-	42	-	-	-	-	1 (0.040)
1287	9	597	-	-	-	1	-
		619	-	2	6	-	4 (0.080)
1309	1	627	-	-	1	-	-

Table 2: Quantification of worked flint from Section 193 and Test-pits (TPs)

Trench	Total	Spit	Cores	Tools	Debitage	Chips	Burnt (kg)
Section 193	5	-	1	-	4	-	-
2005	4	1	-	1	3	-	-
2006	12	2	-	1	4	-	5 (0.072)
		3	-	-	2	-	-
		4	-	-	3	-	-
2018	59	NIS, 0	-	-	1	-	-
		1	-	-	4	-	1 (0.002)
		2	2	-	3	-	-
		3	-	-	1	1	-
		4	-	1	6	1	5 (0.127)
		5	1	-	1	-	4 (0.126)
		6	1	1	5	-	2 (0.014)
		7	-	-	1	-	-
		8	-	-	7	-	3 (0.090)
		9	-	-	8	-	3 (0.193)
		10	-	-	1	-	24 (0.153)
		C1500, 11	-	1	4	-	435 (2.365)
		12	-	-	5	1	65 (0.664)
		13	-	-	1	-	5 (0.005)
		21	-	-	1	-	-
2019	1	3	1	-	-	-	-
2020	1	NIS, -	-	-	1	-	-
2022	3	C47, -	1	-	2	-	2 (0.065)

Note: NIS = Not *in situ*

3 Raw material

3.1 The raw material was a mixture of flint gathered fresh from nearby chalk outcrops, and lumps of frost-fractured flint derived from exposures of Pleistocene colluvial or solifluction deposits prevalent in the area. The condition of the collection was as a whole good. Artefacts from some trenches, particularly TT 1240, were absolutely mint as well as unpatinated. Most artefacts were fresh rather than mint, and most were also unpatinated. Some artefacts had an opaque white-blue patina corresponding to the upper floor described by Burchell in 1938 to the south of the evaluation area, including one from TT 1240.

4 Flint from Trial trenches

4.1 The majority of lithics from Trial trenches are stray finds from colluvium or incorporated in late Prehistoric or Roman features. More significant assemblages were recovered from TTs 1020, 1238, 1240 and 1287. The large assemblage from TT 1237 merely reflects its more intensive sieve-sampling. Technologically there is no evidence in the collection as a whole of significant blade production, which would be expected for Mesolithic material. The cores are unintensively exploited pieces of local flint, reduced in a minimally structured way to leave a mis-shapen lump; the few blade-like pieces included in the debitage could easily be products of knapping strategies not specifically directed at blade-production. The range of tool-types in the collection includes edge-trimmed pieces and fairly large convex scrapers generally regarded as typically Neolithic. As a whole the collection seems to reflect Neolithic exploitation of the Ebbsfleet Valley area, with most finds being colluvially transported or derived. The more significant TTs are discussed below.

4.2 The assemblage from TT 1020 includes a mint condition convex end-scraper and several pieces of debitage in fresh condition. This suggests the potential presence of a concentration of minimally transported Neolithic material.

4.3 The assemblage from TT 1238 is entirely derived from Roman features. Nevertheless it is mostly in mint condition, suggesting that the Roman features have penetrated an undisturbed Neolithic horizon at the same location.

4.4 The assemblage from TT 1240 is both exceptionally large and in exceptionally mint condition. It includes pristine debitage and a well-made Neolithic convex scraper. The assemblage was recovered from machine-dug spoil from a sondage 2 x 2 m, and hence is an

incomplete sample of an even richer assemblage. The precise horizon of the artefacts within the peat (Layer 1949) is uncertain, although it was thought to come from the top, at the base of an organic, and possibly anthropogenic, silt. This trench was dug deeper than most others, and co-incidentally at a location specified by Burchell in 1939 as having a sealed Neolithic horizon. The assemblage supports Burchell's observations, and besides reflecting the presence at TT 1240 of an undisturbed Neolithic site, indicates the potential of undisturbed Neolithic horizons at deeper levels across the evaluation area.

4.5 The assemblage from TT 1287 is entirely derived from Roman features. However, it is mostly fresh and includes two scrapers, one of them a typical Neolithic convex form. As for TT 1238, this indicates the potential presence of a relatively rich Neolithic horizon under the Roman features.

5 Flint from Test-pits

5.1 The Test-pits were intended primarily to investigate Pleistocene deposits for Palaeolithic evidence. However, TPs 2005, 2006, 2018 and 2022 were dominated by Holocene colluvial deposits, and will be considered first.

5.2 Test-pits 2005, 2006 and 2022 contained similar material to most Trial trenches, namely low concentrations of debitage in fairly fresh condition with a few tools which are not culturally diagnostic, but which could well be Neolithic. This evidence mimics that from the Trial trenches and reflects general Neolithic occupation on the higher ground on the flanks of the Ebbsfleet Valley from where the colluvial deposits have originated.

5.3 Test-pit 2018 produced an exceptionally large assemblage of lithic artefacts, fairly evenly distributed throughout the top 3 m of the colluvium (Spits 1-13). Spit 11 contained a clear horizon of burnt fire-cracked flint, which also included a typically Neolithic convex scraper. The assemblage was mostly in fresh to slightly rolled condition, compatible with its colluvial transportation. The large TP 2018 assemblage probably does not reflect an undisturbed Neolithic site, rather a sump in the landscape where local Neolithic material has ended up. This makes it of significance for obtaining a sample of cultural material, though possibly not for any more detailed investigation. No artefacts were encountered below Spit 13, apart from a single flake in Spit 21, just above the Coombe Rock lining the base of the trench. This flake may have originated from the Coombe Rock, and hence be Palaeolithic, or it may have fallen in from a higher level. The latter is suggested by the condition of the flake and the fact that it is struck by a small pebble, unlike most Palaeolithic

flakes from the Coombe Rock in the Ebbsfleet Valley which are struck by much larger medium-hard percussors.

5.4 Pleistocene deposits of potential Palaeolithic significance were located in TT 1232, TPs 2019 and 2020, and the cleaned part of Section 193. These trenches and the section exposed a deposit of soliflucted chalk rubble containing derived Tertiary pebbles (Upper Coombe Rock), from which rich collections of Palaeolithic artefacts and fauna had been made in the previous 100 years, particularly by RA Smith, whose classic Baker's Hole Levalloisian site was near to the locations evaluated (Smith 1911; Wenban-Smith 1990). No artefacts were found in TT 1232, and only single, rolled artefacts were found in the Upper Coombe Rock at each of TPs 2019 and 2020. The artefact from 2019 was a Mousterian core, incomplete and broken into several pieces by frost-fracturing. The artefact from 2020 was a large flake, not of any identifiable knapping strategy, but typical of material collected from the Upper Coombe Rock.

5.5 A larger assemblage was recovered from the section-cleaning at Sections 185 and 193 in Area 6. Two large flakes were found in the Upper Coombe Rock in the part of the section cleaned south of the steps (Section 185); and two large flakes and a frost-damaged Mousterian/Levalloisian core were found in the larger part of the section cleaned north of the steps (Section 193). The core and one of the flakes were rolled, but one of the flakes, from a loamy lens within the Upper Coombe Rock at the northeastern end of the section was in mint condition and stained pale brown. The Area 6 section has also produced two other artefacts from the Upper Coombe Rock of Section 193: a Levalloisian core recovered in April 1992 (Wenban-Smith 1992) and a Levalloisian blade recovered in May 1996 (D. Bridgland, pers. comm.) from the cleaned section.

5.6 The Upper Coombe Rock at Area 6 has produced a reasonable assemblage of typical Middle Palaeolithic artefacts, considering the amount of deposit investigated. The mint condition and brown-stained flake is significant as much of RA Smith's collection is in similar condition, and it suggests minimal transportation despite the Upper Coombe Rock being primarily a solifluction deposit. This suggests that the remaining Upper Coombe Rock at Area 6 still contains what is left of RA Smith's site. The Upper Coombe Rock at Area 5 also contains artefacts, but at a lower density.

6 Conclusions

6.1 Most Trial trenches and Test-pits revealed a low density of residual Neolithic activity transported in colluvial deposits. However there was evidence of more significant Palaeolithic archaeological remains at Area 6, and more significant Neolithic archaeological remains at TTs 1240, 1238 and 1020.

APPENDIX 4

METAL OBJECTS AND SLAG

1 Introduction

1.1 A very small assemblage of two non-ferrous and eleven ferrous objects were recovered from the evaluation as tabulated below. In addition, a single small fragment of possible smithing slag was recovered from Layer 1859, the fill of the Romano-British Ditch 1885, in Trench 1238.

2 Quantification/Description

Context No.	Find No.	Trench No.	No. of Frags	Description	Date
1809	99	1016	1	Very thin copper alloy wire or pin fragment	R-B ?
1860	98	1238	1	White metal 'washer' - possibly part of a modern clothing stud	Modern ?
Spit 6	58	2018TP	1	Curved fragment of iron bar - possibly bent nail shank	R-B ?
1862	69	1238	1	Small iron nail shank	R-B
137/138	-	1009	2	Heavily corroded iron bolts	Modern
139	-	1009	1	Heavily corroded iron bolt	Modern
505	-	1292	1	Large iron nail	Modern
1825	-	1014	1	Bent iron nail shank or	R-B

Context No.	Find No.	Trench No.	No. of Frags	Description	Date
				possibly part of a hook	
1858	-	1238	1	Small iron nail with square-sectioned shank and flat rounded head	R-B
1859	-	1238	1	Small iron nail with square-sectioned shank and flat rounded head	R-B
1877	-	1239	1	Small iron nail with square-sectioned shank and flat rounded head	R-B
1886	-	1238	1	Iron nail shank	R-B

3 Assessment

3.1 The assemblage is too small to merit any further analysis. The only points worth noting are that iron objects, almost certainly all nails, survive in Romano-British contexts, notably the fills of Ditches 1879 and 1885 and Pit 1890 in Trenches 1238 and 1239 close to the site of the Northfleet villa. The white metal washer, although stratified in the fill of Ditch 1885, is very small and may be a modern intrusion. The single fragment of copper alloy is poorly preserved, but it would be unwise to base the quality of the preservation of non-ferrous metals on the site on a single object. The single slag fragment is also an unsurprising find on a Roman site of this type.

APPENDIX 5

WORKED WOOD

1 Introduction

1.1 Two upright timbers were retrieved from Layers 137 and 138 in the north-west end of Trench 1009.

2 Description

2.1 The timbers, measuring 400 x 50mm and 600 x 100mm, are both rotten on the outside while the heart of the wood is solid and not waterlogged. Both pieces are non-oak roundwood and neither are carefully trimmed as they both had branchlets protruding approximately 50mm. The piece from Layer 137 has three heavily corroded iron 'bolts' (140 x 20mm), of unknown profile, passing through it 300mm from the top. Neither timber was retrieved whole and their true length is unknown.

3 Assessment

3.1 The fragments are unlikely to be of archaeological significance as neither are waterlogged. Both may have been *in situ* when the land-fill deposits were dumped over them. Their original function is unclear, but they may have been part of a roughly constructed fence or gate post of post-medieval date.

APPENDIX 6

GLASS

1 Introduction

1.1 A total of 10 fragments of glass were recovered during the evaluation, of which 3 are window and 7 are bottle glass. All were of a 19th-20th century date from modern dump layers.

2 Quantification/Description

Context	Trench	No. of fragments	Description	Date
153	1011	3	Window fragment Bottle fragments	20th C
505	1292	4	Bottle fragments	19th & 20th C
520	1291	2	Window fragments	20th C
534	1300	1	Bottle fragment	20th C

3 Assessment

3.1 Since all of the glass fragment are of modern date, derived from dumped deposits, no further work is justifiable. The absence of Roman glass is not entirely surprising given the general small quantities of other Roman artefacts collected.

APPENDIX 7

WORKED STONE

By Fiona Roe

1 Introduction

1.1 A total of four fragments of worked stone were collected during the evaluation, two each from probable late Bronze Age contexts and Romano-British features.

2 Description

2.1 Two fragments of possible quern or rubbers of Upper Greensand were found in Spit 11 and Layer 1500 of Test-pit 2018, which are of probable late Bronze Age date

2.2 A fragment of beehive quern in Hertfordshire Puddingstone was found in Layer 1859 (Ditch 1885) of Trench 1238. A fragment of a possible quern/rubber of Greensand came from the peat deposit 1947 in Trench 1240. Two fragments of unworked ragstone, but almost certainly parts of building blocks, were also retained from Layer 1837 in Trench 1236.

3 Discussion

3.1 None of the fragments of worked stone are unexpected on the site. The fragments of worked stone are similar to fragments found during previous work at Springhead.

APPENDIX 8

MARINE SHELL

1 Introduction

1.1 A very small assemblage (17 pieces) of marine shell was recovered from the evaluation. Most of this material was hand-retrieved on site. Virtually all of the shell could be identified, and was dominated by oyster (*Ostrea*), most likely the common or edible oyster (*O. edulis*). Only two other types of shell were present: mussel (cf. *Myrtilus*) and edible cockle (*Cerastoderma edule*). These were recovered during sieving of a bulk soil sample, rather than by hand on site.

2 Dating

2.1 Predictably most of the shell can be dated to the Roman period, and was from rubbish from the villa complex dumped into pits or middens. Some was recovered in the undated, possibly aquatic, sediments 1837 and 1848 near the course of the Ebbsfleet river.

3 Assessment

3.1 The present assemblage is too small to merit any further analysis in its own right, but does indicate two main points, neither of which is unusual:

3.2 The marine shell is concentrated in Roman deposits, especially those associated with the villa.

3.3 If further excavation of the Northfleet villa is undertaken, useful quantities of marine shell and the full range of its types would be more reliably recovered by systematic sampling of large volumes of specific deposits, rather than by hand recovery.

APPENDIX 9

ANIMAL BONE

By A. Powell, Centre for Human Ecology, University of Southampton

1 Introduction

1.1 A total of 118 animal bones from hand collection were recorded from 13 different contexts, with the single largest group being 30 bones from Context 1858. An additional 18 fragments were recovered from four contexts as a result of sieving. The majority of the bones were recovered from Roman features, although a small number was recently redeposited material (4 fragments) and is not considered further.

2 Methods

2.1 All bones from all contexts were examined. The total number of bones for each context was recorded, as was the total of unidentifiable fragments. The presence of butchery marks and burnt or gnawed bone was also noted.

3 Condition of the bone

3.1 The condition of the bone was assessed and graded on a scale of 1 to 5. Bone graded as 1 was in excellent condition with little post-depositional damage, and that graded as 5 could not be identified to either species or element level. The condition of the bone is presented in Table 1. The majority was in good condition.

Table 1: Condition of the bone

Condition	2	3	4	5	Total
No. contexts	6	3	2	1	12

4 Species representation

4.1 Of the total of 118 recorded fragments, 47% could be identified to species (Table 2). Cattle bones predominated, with a few fragments each of sheep, pig and horse.

Table 2: Species representation

Species	Cattle	Sheep/goat	Pig	Horse	Unid.	Total
NISP	50	1	2	2	63	118

5 Sieved material

5.1 A total 18 fragments of animal bone was recovered from sieved contexts (Table 3), 6 of which could be identified to species (33%). Five of these fragments were of cattle bones and one of sheep/goat.

Table 3: Species representation from sieved contexts

Species	Cattle	Sheep/goat	Unidentified
NISP*	5	1	12

* = Number of Identified Specimens

5.2 The condition of the sieved bone can be seen in Table 4. Much of the material was in very poor condition and could not be identified to either species or element level.

Table 4: Condition of bone from sieved contexts

Condition	1	2	3	4	5
No. contexts	0	1	1	1	3

6 General comments

6.1 Fusion evidence for cattle was available and indicated the presence of young animals. A small number of mandibles was also present.

6.2 Butchery evidence was limited with only one incidence of knife marks being observed.

6.3 There were few measurable bones.

7 Discussion

7.1 There are few published animal bone assemblages from the Roman period in Kent. The Romano-British settlement at Monkton (Serjeantson, unpub.) on the North Downs consisted of houses and features and was dated mainly to the second century A.D. The hand retrieved material was dominated by fragments of sheep bone, followed by cattle, with fewer pig and horse bones. A similar dominance of sheep was recorded from the Roman defences at

Canterbury (King 1982). Although a predominance of cattle was identified at Kent Road, St. Mary Cray (Hart 1984), the bones were mainly recovered from a ditch which consisted of a large number of horn cores. An analysis of an assemblage recovered from further excavation at this site would therefore make a contribution in enlarging the data available from this area during the period.

APPENDIX 10

MACROSCOPIC PLANT AND INVERTEBRATE REMAINS

Dr M. Robinson and R. Pelling, Oxford University

1 Introduction

1.1 Fourteen samples were taken for the assessment of their charred plant content. Sample volumes ranged from 10 to 30 litres. Two samples were taken from the top of columns, above the water table, which were sampled for waterlogged material. These samples are undated. Of the remaining samples nine are derived from layers (1802, 1804, 1845, 1862, 1888, 1908, 1940, 1942 and 1963) within pits and ditches of Roman date. One sample was taken from a spread of sediment (1805) containing burnt flint and charcoal within Roman deposits. A final sample of Roman date was taken from a deposit (1725) underlying a Roman wall footing within trenches left open by the Thameside Archaeological Group after excavations in the 1970's and 1980's. One sample of possible pre-Roman date was taken from a deposit (1500) containing frequent burnt flint.

1.2 Samples were taken from waterlogged deposits from five trial trenches. A total of twelve samples were processed. Sample sizes ranged from 0.5 to 2 killogrammes.

1.3 The purpose of the assessment was to evaluate the quality of the preservation of the material and the potential for further sampling and analytical work.

2 Methods

2.1 Soil samples taken for the assessment of both charred and waterlogged remains were processed by bulk water separation and floated onto a 0.5mm mesh. Charred flots were then allowed to slowly air dry before being submitted for assessment. Waterlogged flots were submitted while still wet.

2.2 Each charred flot was put through a stack of sieves and scanned under a binocular microscope at x10 to x20 magnification. The quantity and quality of charred plant material was noted. Material was provisionally identified and estimates were made of the abundance of grain, chaff, weed seeds, charcoal and other charred items. Abundance of seeds and chaff was recorded on a four point scale, (+ = 1 - 10 items, ++ = 10 - 100, +++ = 101 - 1000, ++++ = >1000 items). Abundance of charcoal was recorded on a sliding scale (+ = present; ++ = common; +++ = frequent; ++++ = abundant). This information is recorded in the Tables 1 and 2 below.

2.3 Each waterlogged sample submitted for evaluation was examined. Samples were washed through a stack of sieves. Each fraction was scanned under water using a binocular microscope at magnification of x10 to x25. Any plant remains noted were provisionally identified and an estimation of abundance was made. Quantification is based on a four point scale (+ = present; ++ = common; +++ = frequent; ++++ = abundant). Insects fragments and molluscs were extracted and also identified. This information is recorded in Table 3 below.

2.4 Identification of waterlogged wood fragments was made by first examining broken fragments in transverse section under magnification of x40. Fragments were compressed slightly in order to identify vessels. Thin slices of wood taken in tangential section were examined under a high powered microscope at x100 and x400 in order to view spiral thickenings, pits, ray width and perforation plates where present.

3 Results: Charred Remains

3.1 The two samples taken from the top of sequences sampled for their waterlogged remains contained no charred remains. The samples are not included in the discussion or the table of charred remains.

3.2 Of the eleven samples of Roman date, ten contained seeds and chaff. Of those samples seven contain charred remains in large quantities. Three samples contain well in excess of 1000 items. Chaff dominates all the richer samples. *Triticum spelta* (spelt wheat) glume bases were most frequently identified. In addition large numbers of sprouted coleoptiles were noted in two of the rich samples, with occasional coleoptiles in other samples. Several germinated *Triticum* grains were noted. *Triticum spelta* is also the most frequently observed species amongst the grain. *Hordeum vulgare* (hulled, 6-row barley) is attested by both lateral grains and rachis internodes.

3.3 Preservation of the charred remains was generally good, with a large number of cereal grains identifiable to species. This would suggest both favourable conditions for charring and for post-depositional preservation.

3.4 Samples with useful quantities of material come from all trial trenches within the vicinity of the Roman villa. Charred remains were present in each class of feature. Trial trench 1287, which is some way removed from the villa site, produced no samples with useful material.

3.5 Small quantities of wood charcoal were recorded from several samples. *Quercus* (oak) is generally the most frequently noted

species, while occasional fragments of Pomoideae (hawthorn, apple, pear etc) and *Alnus/Corylus* (alder/hazel) were also noted.

4 Results: Waterlogged Remains

4.1 *Trench 1009*

4.1.1 Four samples were evaluated from Trench 1009. Sample 4 (Context 136) was taken from a depth of between 1.3 and 1.6m below the ground surface. The sample is characterised by pieces of *Salix* sp. wood (willow). The open structure suggests it to be root wood. Insects and molluscs are absent. Seeds are very rare, with very occasional *Rubus* sp. (bramble, blackberry etc.), *Juncus* sp. (rushes) and *Carex* sp. (sedges).

4.1.2 Samples 22 and 23 (Context 155 and 156) were taken from deposits extending to a depth of 3m below the ground surface. Both samples are characterised by very degraded peat and *Phragmites* (reed) type rhizomes. Seed remains are characteristic of wet marshy conditions, while a mineral rich water is suggested by *Ranunculus sceleratus* L. (celery leaved crowfoot). *Asphodius* sp., a dung beetle, identified in Sample 23 suggests some grazing land. Open, marshy reed swamp appears to be represented, with a background of grassland/grazing land.

4.1.3 Sample 24 was taken from a peaty deposit (Context 157) present at a depth of 3 to at least 3.5m. The character of this sample was very different to those above. *Phragmites* was completely absent. The sample instead was dominated by wood and twig fragments. The wood fragments were very poorly preserved with only occasional fragments greater than 2mm. Twigs and branch wood of *Alnus glutinosa* were identified. Flowing water molluscs were also identified.

4.2 *Trench 1240*

4.2.1 Two samples were taken from Trench 1240. Sample 30 (Context 1949) was taken from an organic rich silt at a depth of 3.6 to 3.9m below ground surface. Sample 29 (1948) was taken from a sandy deposit at a depth of 4.8 to 5m below ground surface. Both samples are dominated by twigs and branch wood of *Alnus glutinosa* (alder). Occasional seeds of woodland/scrub species are present in Sample 30 (*Ajuga repens, Corylus avellana, Rubus fruticosus* agg.). Reedswamp species are absent. Damp alder woodland appears to be represented. No insects remains were noted.

4.3 *Trench 1276*

4.3.1 Three samples were taken from this trench. Samples 1 and 5 were taken from a peaty deposit (Context 42) through which *Phragmites* type rhizomes were visible. Sample 6 was taken from a silty clay deposit (Context 78), which was seen to a depth of approximately 3m below the ground surface. *Phragmites* type rhizomes were again visible throughout this deposit.

4.3.2 All three samples were dominated by *Phragmites* type rhizomes, with very degraded peat also present in Samples 1 and 5. Plant species which grow in or beside ditches, streams and ponds or in marshy conditions are present in all three samples, such as *Apium nodiflorum* L. (fools watercress), *A. graveolens* L (wild celery), *Lycopus europeaus* L. (gipsywort), *Alisma plantago-aquatica* (water plantain), *Sparganium erectum* (branched bur-reed) and *Eleocharis palustris* (common spike rush). A mineral rich water is indicated by frequent seeds of *Ranunculus sceleratus* (celery leave crowfoot) in Sample 6. Sample 6, in addition to the wet ground/water side species, contains species suggestive of drier, open grassland, such as *Cirsium* sp. (thistles), *Picris hieraciodes* (hawkweed ox-tongue) and disturbed habitats, such as *Polygonum aviculare* agg., *Rumex* sp. and *Plantago major*. A maritime element is also present with frequent seeds of *Triglochin maritima* (sea arrowgrass) a plant which grows in salt-marsh turf. The occurrence of *Apium graveolens* with *Triglochin maritima* is interesting in that *A. graveolens* can also be a plant of brackish water. If cultivated it could survive in the salt marsh as an escapee. Three charred glume bases of *Triticum spelta* (spelt wheat) were also recovered from this sample, suggesting the deposit to be Iron Age/Roman.

4.3.3 The insect component of the three samples contain scarabaeid dung and phytophagus beetles further suggesting open conditions and grassland. Other insects, such as *Plateumaris* sp., are characteristic of marsh/reed swamp or emergent aquatic vegetation. The samples suggest wet and open conditions with some grassland and a coastal element.

4.4 *Trench 1013*

4.4.1 Sample 25, from Context 160, contains plant species characteristic of marshy conditions or stream/ditch bank, such as *Ranunculus sceleratus*, *Apium nodiflorum* and *Eleocharis palustris*. The insect assemblage is characteristic of a marshy reed bed or sedge fauna, with some open ground. *Plateumaris* sp. and *Donacia* sp., are found on marsh or reed swamp and emergent aquatic vegetation, while many species of *Bembidion* and *Pterostichus* like marshy conditions. *Odocantha melanura* is a ground beetle but climbs reed or sedge

stems and *Corylophus cassidiodes* lives in decaying vegetation, particulary reed or sedge. Some peaty ground near the surface is suggested by *Oodes* sp. and some pools of water are indicated by *Helophorus* sp. *Asphodius* sp., a dung beetle, again suggests some open grazing land.

4.5 *Trench 1310*

4.5.1 Samples 34 and 35, from Contexts 604 and 605, are dominated by remains of *Alnus glutinosa*, including twigs and branch wood, catkins and seeds. Sample 35 also contains a nut kernel and nut shell fragments of *Corylus avellana*. Further suggestions of a woodland environment are provided by *Rubus fruticosus* agg. (bramble), and *Potentilla sterilis* (barren strawberry), while *Urtica dioica* and *Sambucus nigra* suggest disturbed ground. A damp alder woodland is suggested by the assemblage.

5 Discussion

5.1 The samples fall into two main groups. One class of samples consists of *Phragmites* type rhizomes, with a wet, reed swamp type flora and fauna, with open conditions and grassland. Such samples appear to occur at depths of less than 3m below ground level, while the occurrence of charred cereal remains suggest these deposits to continue until quite recently. The rhizomes of *Phragmites* growing into the deposits, and the probable root wood of Salix in deposit 42, may be of recent origin. The second main group of samples is dominated by alder branchwood and twigs and contains a woodland/scrub element, suggestive of alder fen. This group of samples occurs at a depth of more than 3m below ground level. Taken together, the samples indicate that alder woodland has given way to an open reed swamp environment with grazing on drier ground.

6 Potential for further work

6.1 Samples assessed from within and immediately around the site of Northfleet Villa contain charred material of a quantity and quality sufficient to be of great potential for detailed analysis. The quantity of chaff suggests fairly substantial crop processing on the site. With more detailed analysis it would be possible to explore the nature of the processing, for example whether some malting waste is possible given the number of germinated grains and sprouted coleoptiles.

6.2 The cereal species noted are in keeping with the information regarding cereal cultivation known from elsewhere in Southern Britain during the Roman period. Spelt wheat appears to be the principle cereal type, while barley seems to be a secondary cereal

crop. There is very little archaeobotanical information published for Kent to date although recent evaluations by the Oxford Archaeological Unit and analysis of material form other sites suggest the potential of Roman sites in the region to be very high. Evidence seems to suggest that cultivated legumes were of more importance than elsewhere and also that emmer wheat may have continued in cultivation for a longer period of time. Further analysis of assemblages from the region should enable the development of a clearer picture regarding the cultivated crops. The good preservation of the material further suggests that future sampling of the site in the event of further excavation should also prove profitable.

6.3 The waterlogged samples have provided some useful information regarding the development of the local environment. It is unlikely that any further information will be gained from a more detailed analysis of the present samples given that the sampling intervals are very large. In the event of future excavations, however, there is the potential for more detailed analysis if a number of complete columns of samples are taken.

Table 1: Summary of Scanned Charred Remains

Total number of samples assessed for charred remains: 12. Number with seeds and chaff: 11.

Feature type		pit	ditch	other	other
Date		Roman	Roman	Roman	Pre-Roman?
Total number of samples		2	7	3	1
Samples with 1-10 items		-	2	1	1
11-100 items		-	-	-	-
101-1000 items		1	3	-	-
>1001 items		1	1	1	-
Triticum spelta	spelt wheat grain	+++	++	++	-
T. spelta	spelt wheat glume	++++	++++	+++	+
T. sp. hulled	spelt/emmer grain	+++	++	++	+
T. sp. hulled	spelt/emmer chaff	++++	++++	+++	+
T. sp.	wheat rachis	+++	-	+++	-
Hordeum sp.	barley grain	++	+	+	-
H. vulgare	6-row barley rachis	++	++	+	-
Cerealia indet	sprouted embryos	+++	+++	++	-
Weeds		++++	+++	++	-

Estimated quantities are of the richest sample from each feature type. Total number of samples includes those with no charred seeds or chaff.
+ 1-10 items; ++ 11-100 items; +++101-1000 items; ++++ >1000 items.

Table 2: Summary of Scanning Results of Waterlogged Samples: Plant Remains (Part 1)

Sample		1	5	6	25	34	35
Context		42	42	78	160	604	605
Trench		1276	1276	1276	101	1310	1310
Weight (kg)		0.5	0.5	1		0.5	1
Triticum spelta charred	spelt wheat glume base	-	-	+	-	-	-
Taxus baccata L.	Yew	-	-	-	-	+	-
Ranunculus acris/repens/bulbosus	Buttercup	-	+	-	-	-	+
Ranunculus sceleratus L.	Celery leaved crowfoot	-	-	++	++	-	-
Ranunculus subgen *Batrachium*	Crowfoot	-	-	-	-	-	-
cf. *Arenaria* sp.	Sandwort	-	-	+	-	-	-
Chenopodium sp.	Fat hen/Goosefoot	-	+	-	+	-	-
Rubus fruticosus agg.	Bramble/Blackberry	-	-	+	-	-	++
Rubus sp.		-	-	-	-	+	-
Potentilla sterilis (L.) Garcke	Barren strawberry	-	-	-	-	-	++
Apium nodiflorum (L.) Lag.	Fool's watercress	++	+	+	++	-	-
Apium graveolens L.	Wild celery	-	-	+	-	-	-
Polygonum aviculare agg.	Knotgrass	-	-	+	-	-	-
Rumex sp.	Docks	-	-	+	-	-	-
Urtica dioica L.	Common nettle	-	-	-	-	+	++
Alnus glutinosa (L.) Gaertner	Alder branch wood/twigs	-	-	-	-	++	++
A. glutinosa (L.) Gaertner	catkins, male	-	-	-	-	+	+
A. glutinosa (L.) Gaertner	catkins, female	-	-	-	-	-	+
A. glutinosa (L.) Gaertner	seed	-	-	-	-	-	++
Corylus avellana L.	Hazel nut kernel	-	-	-	-	-	+
Corylus avellana L.	Hazel nut shell frags	-	-	-	-	-	+
Salix sp.	Willow, root wood	-	-	-	-	-	-
Mentha sp.	Mint	-	-	+	-	-	-
Lycopus europaeus L.	Gipsywort	+	-	-	-	-	-
Ajuga reptans L.	Bugle	-	-	-	-	-	++
Plantago major L.	Plantain	-	-	++	-	-	-
Sambucus nigra L.	Elder	-	-	-	-	-	+
Cirsium sp.	Thistle	-	-	+	-	-	-
Picris hieracioides L.	Hawkweed ox-tongue	-	-	+	-	-	-
Alisma plantago-aquatica L.	Water plantain	-	+	-	-	-	-
Triglochin maritima L.	Sea arrowgrass	-	-	++	-	-	-
Juncus sp.	Rushes	-	-	+	-	-	-
Sparganium erectum L.	Branched bur-reed	-	+	-	-	-	-
Eleocharis palustris (L) Roemer &	Common spike-rush	-	+	-	+	-	-
Carex sp.	Sedge	+	-	-	-	-	+

Sample		1	5	6	25	34	35
Context		42	42	78	160	604	605
Trench		1276	1276	1276	101	1310	1310
Cyperaceae		-	-	+	+	-	-
Phragmites type	reed type rhizomes	++++	++	++	-	-	-

Table 2: Summary of Scanning Results of Waterlogged Samples: Plant Remains (Part 2)

Sample		4	22	23	24	30	29
Context		136	155	156	157	1949	1948
Trench		1009	1009	1009	1009	1240	1240
Weight (kg)		2	2	1	0.5	1	2
Triticum spelta charred	Spelt wheat glume base	-	-	-	-	-	-
Taxus baccata L.	Yew	-	-	-	-	-	-
Ranunculus acris/repens/bulbosus	Buttercup	-	-	-	-	+	-
Ranunculus sceleratus L.	Celery leaved crowfoot	-	+	+	-	-	-
Ranunculus subgen *Batrachium*	Crowfoot	-	-	-	-	-	-
cf. *Arenaria* sp.	Sandwort	-	-	-	-	-	-
Chenopodium sp.	Fat hen/Goosefoot	-	-	-	-	-	-
Rubus fruticosus agg.	Bramble/Blackberry	-	+	-	-	+	-
Rubus sp.		+	-	-	-	-	-
Potentilla sterilis (L.) Garcke	Barren strawberry	-	-	-	-	-	-
Apium nodiflorum (L.) Lag.	Fool's watercress	-	-	-	-	-	-
Apium graveolens L.	Wild celery	-	-	-	-	-	-
Polygonum aviculare agg.	Knotgrass	-	-	-	-	-	-
Rumex sp.	Docks	-	-	-	-	-	-
Urtica dioica L.	Common nettle	-	-	-	-	-	-
Alnus glutinosa (L.) Gaertner	Alder branch wood/twigs	-	-	-	+	+++	++
A. glutinosa (L.) Gaertner	catkins, male	-	-	-	-	-	-
A. glutinosa (L.) Gaertner	catkins, female	-	-	-	-	-	-
A. glutinosa (L.) Gaertner	seed	-	-	-	-	+	-
Corylus avellana L.	Hazel nut kernel	-	-	-	-	-	-
Corylus avellana L.	Hazel nut shell frags	-	-	-	-	+	-
Salix sp.	Willow, root wood	+++	-	-	-	-	-
Mentha sp.	Mint	-	-	-	-	-	-
Lycopus europaeus L.	Gipsywort	-	-	-	-	-	-
Ajuga replans L.	Bugle	-	-	-	-	+	-
Plantago major L.	Plantain	-	-	-	-	-	-
Sambucus nigra L.	Elder	-	-	-	-	-	-
Cirsium sp.	Thistle	-	-	-	-	-	-
Picris hieracioides L.	Hawkweed ox-tongue	-	-	-	-	-	-
Alisma plantago-aquatica L.	Water plantain	-	-	-	-	-	-

Sample		4	22	23	24	30	29
Context		136	155	156	157	1949	1948
Trench		1009	1009	1009	1009	1240	1240
Triglochin maritima L.	Sea arrowgrass	-	-	-	-	-	-
Juncus sp.	Rushes	+	-	-	-	-	-
Sparganium erectum L.	Branched bur-reed	-	-	+	-	-	-
Eleocharis palustris (L.) Roemer &	Common spike-rush	-	-	++	-	-	-
Carex sp.	Sedge	+	++	++	-	-	-
Cyperaceae		-	++	++	+	-	-
Phragmites type	reed type rhizomes	-	++	++	-	-	-

Table 3: Summary of Scanning Results of Waterlogged Samples: Insect Remains, showing minium number of individuals.

Sample	1	5	6	25	34	35	23	24
Context	42	42	78	160	604	605	156	157
Trench	1276	1276	1276	1013	1310	1310	1009	1009
Elaphrus cupreus Df.	-	-	-	1	-	-	-	-
Trechus obtusus Er. or *qadristriatus*	-	-	-	-	-	1	-	-
Bembidion sp.	-	1	-	2	-	-	-	-
Pterostichus sp.	-	-	-	1	-	-	-	-
Oodes sp.	-	-	-	1	-	-	-	-
Odacantha melanura	-	-	-	2	-	-	-	-
Helophorus aquaticus (L.) or *grandis* Ill.	-	-	-	-	-	-	1	-
Helophorus sp. (*brevipalpis* size)	-	-	-	1	-	-	-	-
Cercyon sp.	-	-	-	2	-	-	-	-
cf. *Megasternum obscurum* (Marsh.)	-	-	-	-	1	-	-	-
Chaetarthria seminulum (Hb.)	-	1	-	-	-	-	-	-
Ochthebius cf. *bicolon* Germ.	-	-	-	-	-	2	-	-
Anthobium unicolor	-	-	-	-	-	1	-	-
Stenus sp.	-	-	-	-	-	-	1	-
Paederus sp.	-	-	1	-	-	-	-	-
Geotrupes sp.	-	1	-	-	-	-	-	-
Aphodius sp.	1	1	-	1	-	-	1	-
Agrypnus murinus (L.)	-	-	1	-	-	-	-	-
Agriotes sp.	-	-	-	-	-	1	-	-
Brachypterus sp.	-	-	-	-	-	1	-	-
Corylophus cassidoides (Marsh.)	-	-	-	1	-	-	-	-
Donacia/Plateumaris sp.	-	1	-	1	-	-	-	1
Plateumaris sp.	1	-	-	2	-	-	-	-
Apion sp.	-	-	2	1	-	-	-	-

APPENDIX 11

MOLLUSCS FROM DRY FLOTS

Dr. M. Robinson, Oxford University

1 Introduction

1.1 Four flots, from samples which had been floated for charred plant remains from the Ebbsfleet evaluation trenches, were assessed for molluscs in order to determine the potential of the site for future molluscan analysis.

2 Methods and results

2.1 The samples which were processed for charred plant remains had been floated onto a 0.5 mm mesh and dried. They were sub-sampled to give the equivalent flot that would have been yielded by approximately 1 kg of sediment. The sub-samples were scanned under a binocular microscope and an estimate of the number of each species of mollusc was made. The results are given in Table 1 for Samples 61 and 62. Shells proved to be absent from Samples 27 (Context 1940) and 37 (Context 1963). The occurrence of the mollusc *Cecilioides acicula* has been ignored because this species burrows deeply.

3 Interpretation

3.1 Sample 61, from Context 619, was from a ditch regarded as Roman in date. The occurrence of *Helix aspersa* suggests the date of the context to be no earlier. The assemblage contains both dry ground open country species, such as *Pupilla muscorum* and *Vallonia excentrica,* and shade-loving species, such as *Discus rotundatus* and *Aegopinella nitidula.* Such a mixed fauna could have resulted from the ditch becoming very overgrown, scrub becoming established on the site or the presence of a hedge alongside the ditch.

3.2 Sample 62, from Context 597, was from another Roman ditch. In addition to dry ground open country species it also contains aquatic molluscs including the flowing water species *Valvata cristata* and *V. piscinalis.* This suggests that either the ditch carried flowing water or experienced episodes of freshwater flooding.

4 Potential for further work

4.1 Some of the archaeological features contain sufficiently high concentrations of mollusc shells for palaeoenvironmental interpretation. Archaeological considerations will determine the

degree to which the palaeoenvironmental evidence from individual contexts will be of significance.

4.2 In the event that further excavation takes place at the site, it is recommended that sequences of 2 kg samples be taken from suitable contexts especially buried soils, colluvial sediments and ditch fills. These should be analysed following conventional procedures (sieving down to 0.5 mm and full sorting of residues as well as any flots).

Table 1: Mollusca from dry flots

	Roman ditches	
Sample	61	62
Context	619	597
Valvata cristata	-	+
V. piscinalis	-	+
Carychium cf. *tridentatum*	+	-
Cochlicopa sp.	+	-
Lymnaea palustris	-	+
Planorbis planorbis	-	++
Vertigo pygmaea	+	-
Pupilla muscorum	+	+
Vallonia costata	-	+
V. excentrica	++	+
Vallonia sp.	+	++
Discus rotundatus	++	-
Aegopinella nitidula	++	-
Oxychilus cellarius	++	-
Clausilia bidentata	+	-
Helicella itala	+	+
Trichia hispida gp.	++	+++
Helicigona lapicida	+	-
Cepaea nemoralis	+	-
Helix aspersa	+	-

+ 1-2, ++ 3-10, +++ >102

APPENDIX 12

MOLLUSCS FROM DRILLED-CORE 0021SA, SECTION 193 AND PLEISTOCENE TEST-PITS

By Dr Richard Preece, Dept of Zoology Cambridge University

1 Introduction

1.1 Core samples from Borehole ARC 0021 SA were examined in detail in the laboratory for visiual evidence of mollusc preservation. This borehole was selected for assessment because observations made during drilling indicated that mollusc shells were preserved in some samples.

2 Method

2.1 Two samples were selected from each U4 core and air dried. Dried samples were broken down in water and sieved through a 500 micron sieve. Residues were air dried and sorted for molluscs. Samples were checked for relative abundance and to determine environmental implications.

3 Results

3.1 Species identifications (presence/absence) are presented in Table 1 below.

Table 1: Species identification (presence/absence) from Borehole 0021 SA

Species	2.15 - 2.20	2.20 - 2.30	5.30 - 5.40
Freshwater taxa			
Valvata cristata	-	+	+
Belgrandia marginata	-	-	+
Bithynia tentaculata	+	+	+
Physa fontinalis	-	-	+
Lymnaea truncatula	-	+	-
Lymnaea palustris	+	+	+
Planorbis (Planorbis) sp.	+	+	-
Anisus vortex	-	-	+
Armiger crista	-	+	-
Hippeutis complanatus	-	+	+
Segmentina nitida	-	-	+
Sphaerium corneum	-	-	+
Pisidium casertanum	-	+	+
Pisidium obtusale	+	-	-
Pisidium milium	-	+	+
Landsnails			
Carychium minimum	-	+	+
Carychium tridentatum	-	+	-
Oxyloma/Succinea	-	+	-
Cochlicopa lubrica	-	+	+
Discus rotundatus	-	+	+
Vitrea contracta	-	+	-
Nesovitrea hammonis	-	+	+

Species	2.15 - 2.20	2.20 - 2.30	5.30 - 5.40
Aegopinella nitidual	-	+	+
Euconulus fulvus	-	-	+
Helicodonta obvoluta	+	-	-
Cepaea spp.	-	+	+

3.2 Countable molluscs were only present in three samples from the following depths below the present ground surface:

2.15 - 2.20m
2.20 - 2.30m
5.30 - 5.40m

3.3 The totals recovered are generally low.

4 Conclusions

4.1 The species composition indicates that the sediments accumulated under fully temperate conditions. The presence of *Belgrandia marginata* (exclusively interglacial in Britian), *Segmentina nitida* and *Helicodonta obvoluta* are all strong indicators of warm conditions.

4.2 The assemblages include a mixture of aquatic and terrestrial elements and the depositional environment seems to have been a slow-flowing stream with a surrounding marshland.

4.3 There is no direct evidence from the species compositon for the age of the assemblage. It is, however, unlike most Holocene assemblages from Southern England and may represent a pre-Holocene interglacial.

5 Mollusca from Pleistocene sediments

5.1 A number of sample residues provided by the OAU were scanned for mollusc remains prior to selecting material for amino acid dating (Appendix 13). These are summarised below.

Sample Number	Test Pit	Context/Spit	Species
15	ARC 2005 TP	Spit 5	*Trichia hispida*
21	ARC 2006 TP	Spit 8	*Trichia hispida* *Nesovitrea hammonis*
33	Section 193	Context 1960	*Lymnaea* sp. *Planorbis (Planorbis)* sp. *Trichia hispida* *Pupilla muscorum*
63	Section 193	Context 1970	*Lymanea* sp.

Sample Number	Test Pit	Context/Spit	Species
			Planorbis (Planorbis) sp.
67	ARC 2063 TP	Spit 1	*Planorbis (Planorbis)* sp. *Trichia hispida*
68	ARC 2063 TP	Spit 2	*Bithynia tentaculata* *Lymnaea* sp. *Planorbis (Planorbis)* sp. *Pisidium* sp.

5.2 These samples indicate that molluscs are preserved within units associated with the Pleistocene sediments. However, the sample size in many cases was large and often few individuals were recovered from any given sample.

APPENDIX 13

AMINO ACID DATE

Three groups of molluscs, as described below, have been sent to the Amino Acid Laboratory, Dept of Geology, University of Bergen, Norway for amino acid dating. Unfortunately these dates were still outstanding at the time of report completion. The dates and their site significance will be made available as an addendum to this report at the earliest opportunity possible.

1. Borehole 0021SA - depth 5.3-5.4m (see back of report)

   Bithynia tentaculata
   Cepaea sp

2. Section 193 - Sample 33, Context 1960

   Trichia hispida

3. Test Pit 2006 - Sample 21, Spit 8

   Trichia hispida

All are terrestrial molluscs with the exception of *B. tentaculata* which is a freshwater mollusc.

APPENDIX 14

CARBON 14 DETERMINATIONS

One conventional C-14 date (Beta - 1905972), on a sample of small alder roundwood from Layer 1949 in Trench 1240, and two AMS dates (Beta - 105973 and Beta - 105974) from organic material at 2.88 - 2.95m and 3.60 - 3.70m below ground level in the additional borehole 0022SA, were undertaken by the Beta Analytic Radio Carbon Dating Laboratory, Florida, USA.

The results are presented on pages 45-49.

It should be noted that the two AMS dates of cal AD 655 and cal AD 680 must be dismissed as not dating the deposit from which they derive. Both samples were taken from waterlogged phragmites. Although it was realised that the roots of this reed can penetrate to depths of over 2m, it was believed at the time of sample submission that they derived from the depth at which they were found. The dates in comparison with that gained from the fragment of alder roundwood, recovered at a similar depth, clearly indicate that the earlier interpretation was incorrect.

BETA ANALYTIC INC.

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E-MAIL: beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

FOR: Dr. Anthony J. Barham
University College London

DATE RECEIVED: Auth. June 4, 1997
DATE REPORTED: June 24, 1997

Sample Data	Measured C14 Age	C13/C12 Ratio	Conventional C14 Age (*)
ta-105972	4380 +/- 40 BP	-29.2 o/oo	4320 +/- 40 BP

AMPLE #: ARC EFT/97, 1949, <30>
NALYSIS: radiometric-ADVANCE
TERIAL/PRETREATMENT:(wood): acid/alkali/acid

TE: It is important to read the calendar calibration information nd to use the calendar calibrated results (reported separately) when nterpreting these results in AD/BC terms.

TE: The two remaining samples, ARC EFT/97 ARC 0022 SA, 3.6-3.7m & RC EFT/97 ARC 0022 SA, 2.88-2.95m, are being analyzed by ADVANCE AMS nd will be reported separately.

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

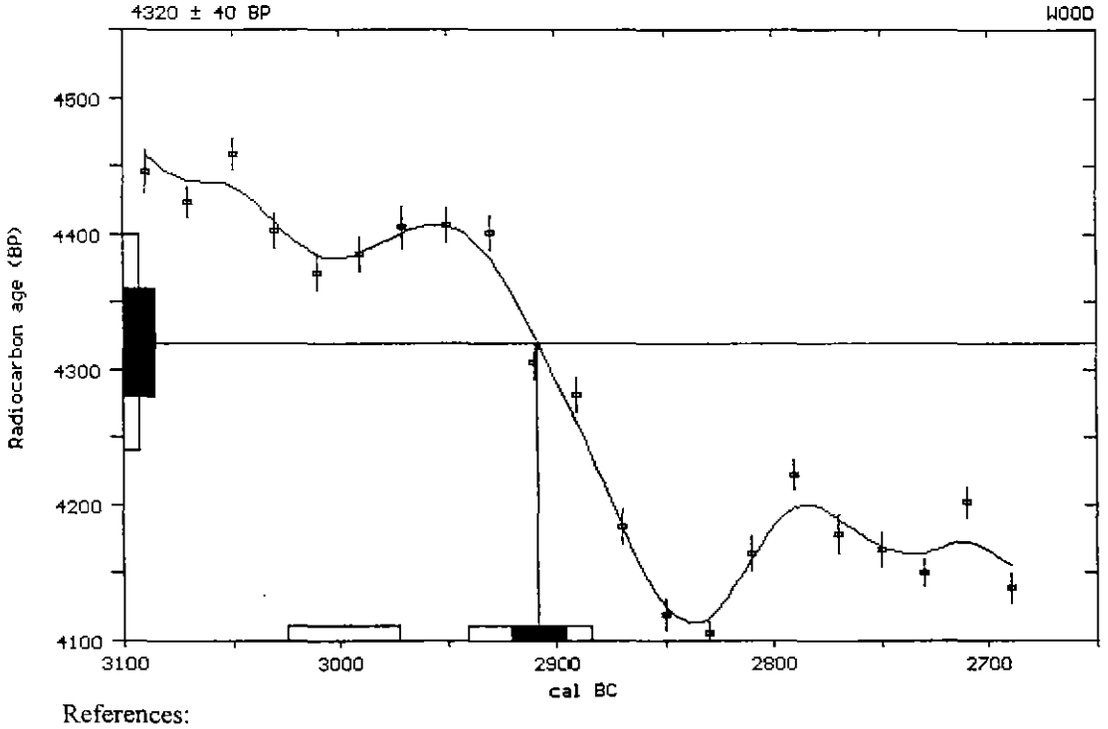
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-29.2:lab. mult=1)

Laboratory Number:	Beta-105972
Conventional radiocarbon age:	**4320 ± 40 BP**
Calibrated results: (2 sigma, 95% probability)	**cal BC 3025 to 2970 and cal BC 2940 to 2885**

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal BC 2910
1 sigma calibrated results: (68% probability)	cal BC 2920 to 2895



References:

Pretoria Calibration Curve for Short Lived Samples
Vogel, J. C., Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

Beta Analytic Radiocarbon Dating Laboratory

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E-MAIL: beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

FOR: Dr. Anthony J. Barham
University College London

DATE RECEIVED: Auth. June 4, 1997
DATE REPORTED: June 25, 1997

Sample Data	Measured C14 Age	C13/C12 Ratio	Conventional C14 Age (*)
Beta-105973	1450 +/- 50 BP	-28.5 o/oo	1390 +/- 50 BP

SAMPLE #: ARC EFT/97 ARC 0022 SA, 3.6-3.7 m
ANALYSIS: ADVANCE AMS (LLNL)
MATERIAL/PRETREATMENT:(plant material): acid/alkali/acid

Sample Data	Measured C14 Age	C13/C12 Ratio	Conventional C14 Age (*)
Beta-105974	1390 +/- 70 BP	-29.2 o/oo	1330 +/- 70 BP

SAMPLE #: ARC EFT/97 ARC 0022 SA, 2.88-2.95 m
ANALYSIS: ADVANCE AMS (LLNL)
MATERIAL/PRETREATMENT:(plant material): acid/alkali/acid

NOTE: It is important to read the calendar calibration information and to use the calendar calibrated results (reported separately) when interpreting these results in AD/BC terms.

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

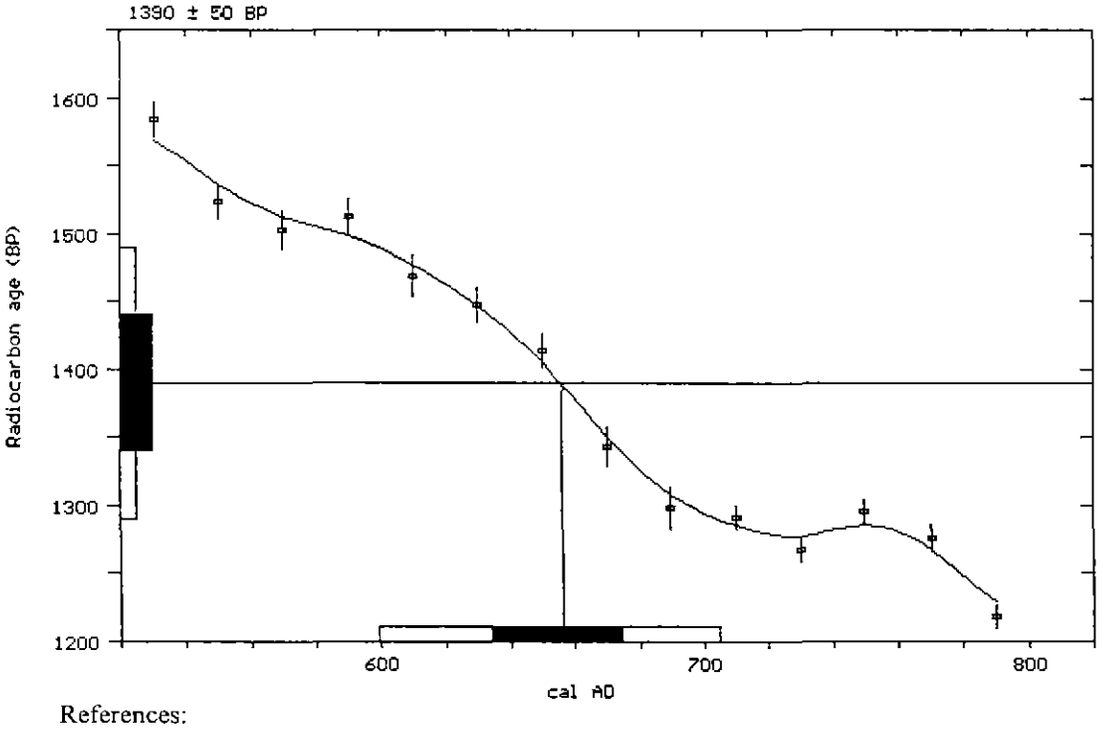
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables:C13/C12=-28.5:lab mult.=1)

Laboratory Number:	Beta-105973
Conventional radiocarbon age:	**1390 ± 50 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 600 to 705**

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 655
1 sigma calibrated results: (68% probability)	cal AD 635 to 675



References:

Pretoria Calibration Curve for Short Lived Samples
Vogel, J. C., Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

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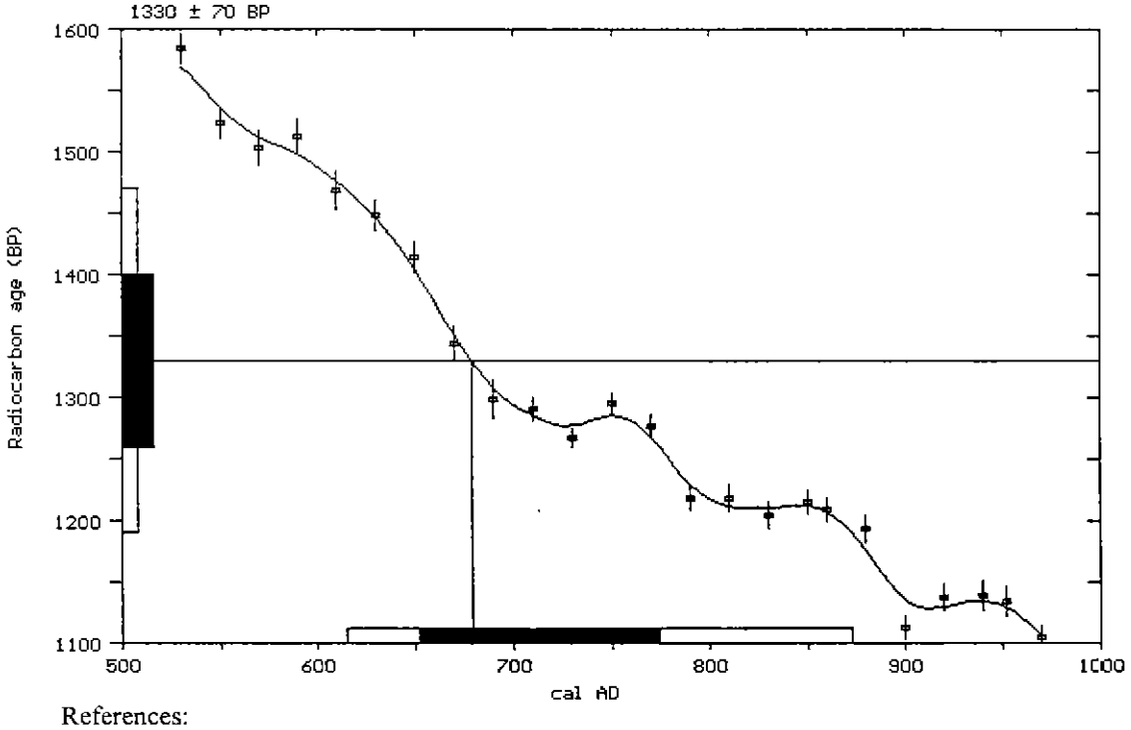
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables:C13/C12=-29.2:lab mult.=1)

Laboratory Number:	Beta-105974
Conventional radiocarbon age:	**1330 ± 70 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 615 to 875**

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 680
1 sigma calibrated results: (68% probability)	cal AD 650 to 775



References:

Pretoria Calibration Curve for Short Lived Samples
Vogel, J. C., Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

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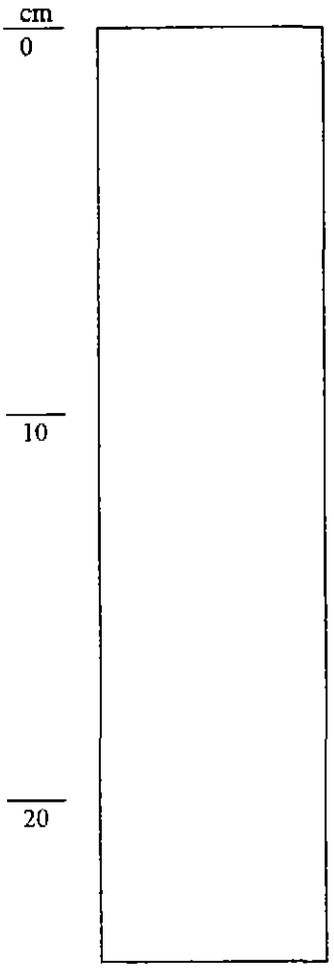
APPENDIX 15

CORE DESCRIPTIONS

GSF Cutting Shoe Sample Descriptions

Site Code: ARC EFT/97 **Sample Depth:** 9.00-9.20m
Borehole Number: 0022SA **Sample Number:** 22

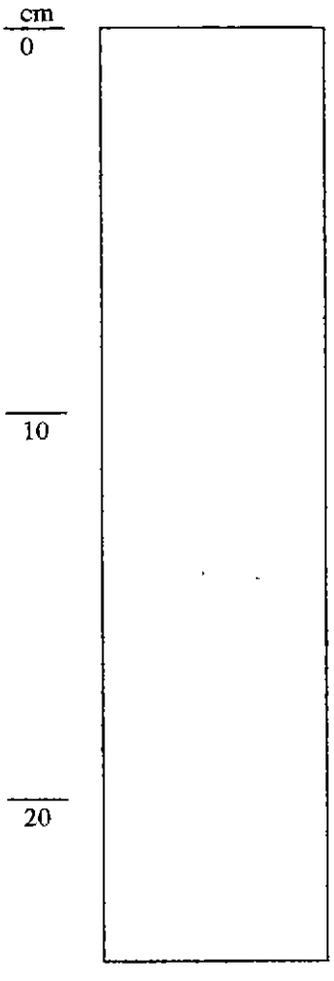


0-20cm 2.5Y 8/1 white chalk.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF Cutting Shoe Sample Descriptions

Site Code: ARC EFT/97 **Sample Depth:** 8.35-8.55m
Borehole Number: 0022SA **Sample Number:** 20

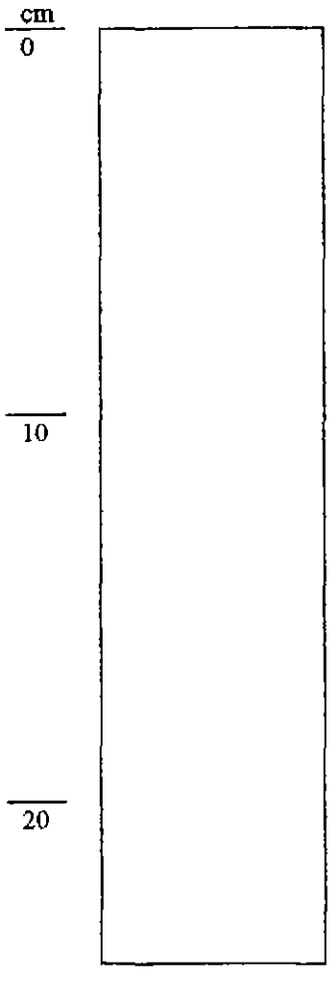


0-20cm Flint gravel with chalk clasts and a silty sand matrix. The flint clasts are sub-angular to angular. The unit varies from clast to matrix supported. Shell fragments are present in the unit and appear to be concentrated between 37-41cm.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF Cutting Shoe Sample Descriptions

Site Code: ARC EFT/97 **Sample Depth:** 7.80-7.90m
Borehole Number: 0022SA **Sample Number:** 18

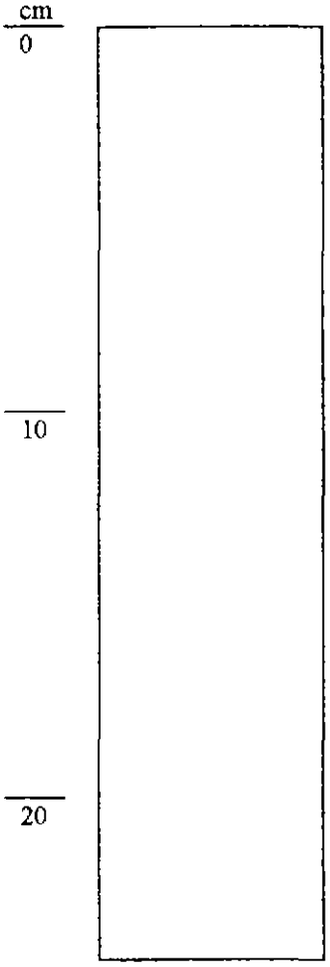


0-10cm 10YR 7/1 light grey clay silt supported chalk clasts up to 2.5cm mean diameter and sub-rounded chalk granules and pellets.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF Cutting Shoe Sample Descriptions

Site Code: ARC EFT/97 **Sample Depth:** 7.15-7.35m
Borehole Number: 0022SA **Sample Number:** 16

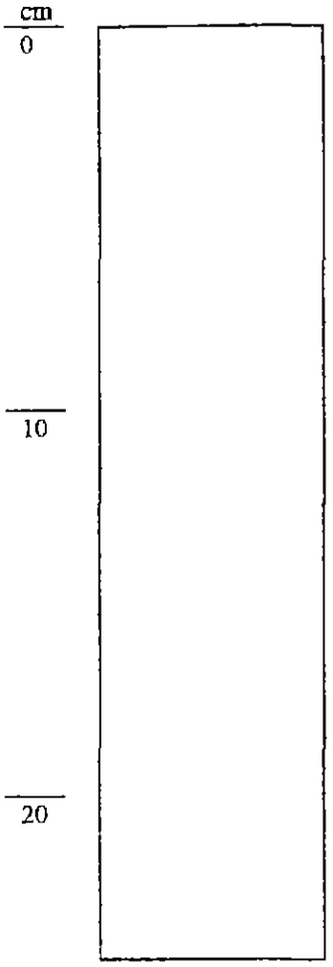


0-20cm Sandy flint gravel. The clasts are sub-angular to sub-rounded up to 6cm mean diameter. The sand fraction is a 10YR 5/3 brown coarse sand with shell fragments.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF Cutting Shoe Sample Descriptions

Site Code: ARC EFT/97 **Sample Depth:** 6.60-6.70m
Borehole Number: 0022SA **Sample Number:** 14

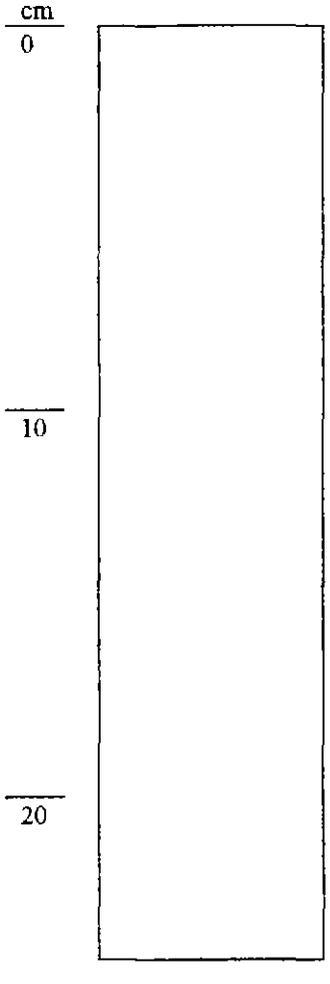


0-10cm 10YR 5/4 yellowish brown silty sandy gravel. The unit is predominantly composed of sub-angular flint clasts up to 4cm mean diameter. 10-40% cortex cover on the clasts and there are occasional well rounded clasts and shell fragments are also present.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF Cutting Shoe Sample Descriptions

Site Code: ARC EFT/97 **Sample Depth:** 6.10-6.15m
Borehole Number: 0022SA **Sample Number:** 12

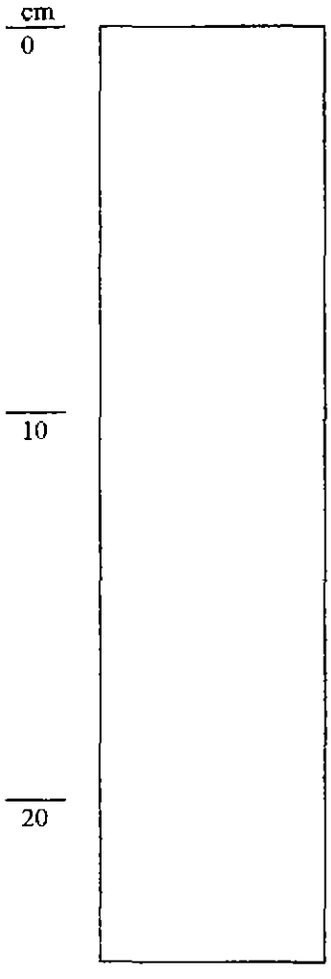


0-5cm 10YR 5/1 greyish brown sandy silt with pockets of 10YR 6/1 grey clayey silty. sand. Possibly disturbed.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF Cutting Shoe Sample Descriptions

Site Code: ARC EFT/97 **Sample Depth:** 5.55-5.75m
Borehole Number: 0022SA **Sample Number:** 10

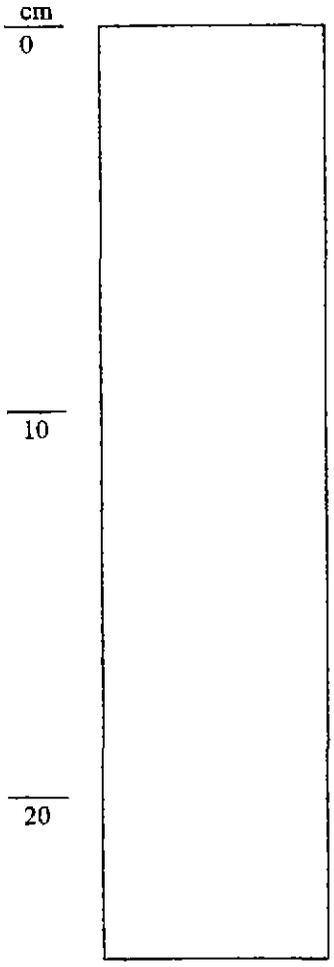


0-20cm 10YR 5/2 greyish brown sandy silt to silty sand. Possibly disturbed.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF Cutting Shoe Sample Descriptions

Site Code: ARC EFT/97 **Sample Depth:** 5.00-5.10/5.20m
Borehole Number: BH 0022SA **Sample Number:** 8

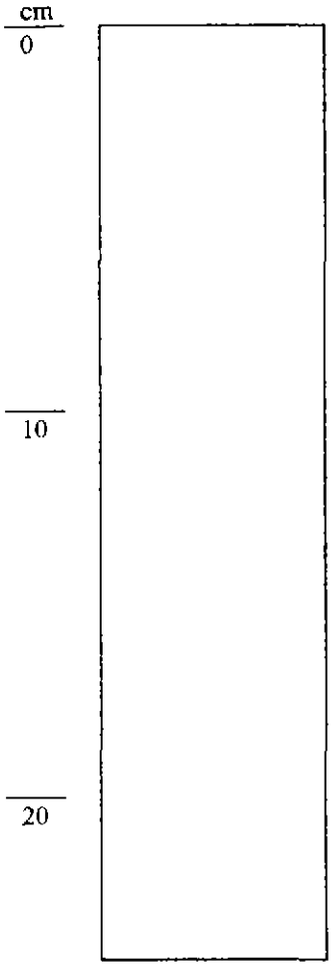


0-10/20cm 10YR 5/2 greyish brown clayey sandy silt. Possibly disturbed.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF Cutting Shoe Sample Descriptions

Site Code: ARC EFT/97 **Sample Depth:** 4.35-4.55m
Borehole Number: BH 0022SA **Sample Number:** 6



0-2cm 10YR 2/1 black fibrous peat with rare wood fragments. The peat is compact and fibrous.

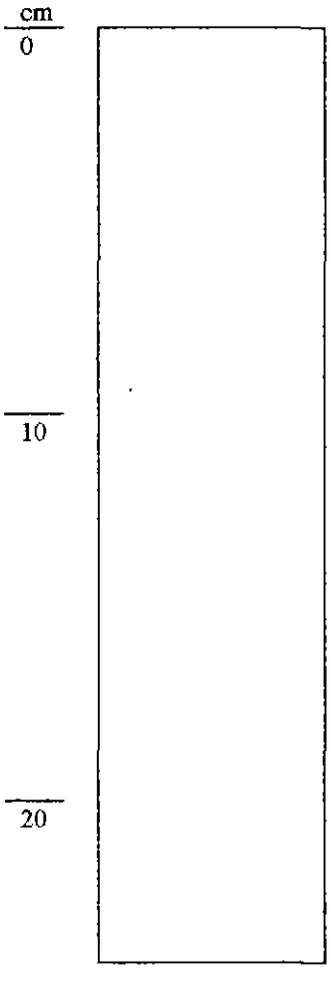
Sharp smooth

2-20cm 10YR 5/1 grey clayey sandy silt with rare sub-angular flint clasts and traces of organic material throughout the unit (*Phragmites sp.*?).

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF Cutting Shoe Sample Descriptions

Site Code: ARC EFT/97 **Sample Depth:** 3.70-3.90m
Borehole Number: BH 0022SA **Sample Number:** 4

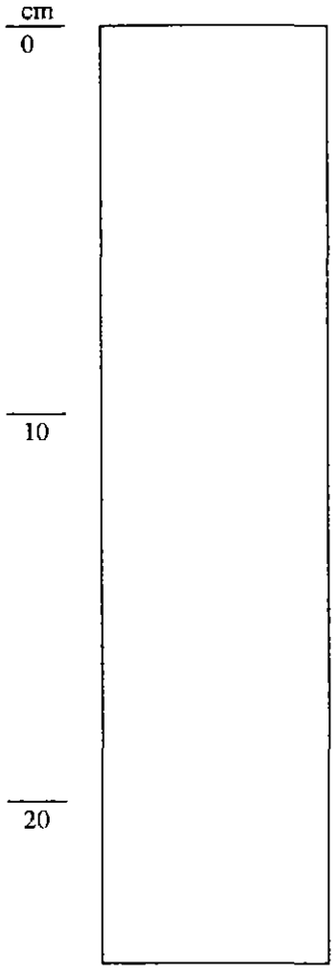


0-25cm 10YR 3/2 very dark greyish brown peaty silt. At 10-20cm the unit becomes at 10YR 3/2 very dark greyish brown to 10YR 2/1 black peat which is moderately humified and fibrous.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF Cutting Shoe Sample Descriptions

Site Code: ARC EFT/97 **Sample Depth:** 3.05-3.25m
Borehole Number: BH 0022SA **Sample Number:** 2

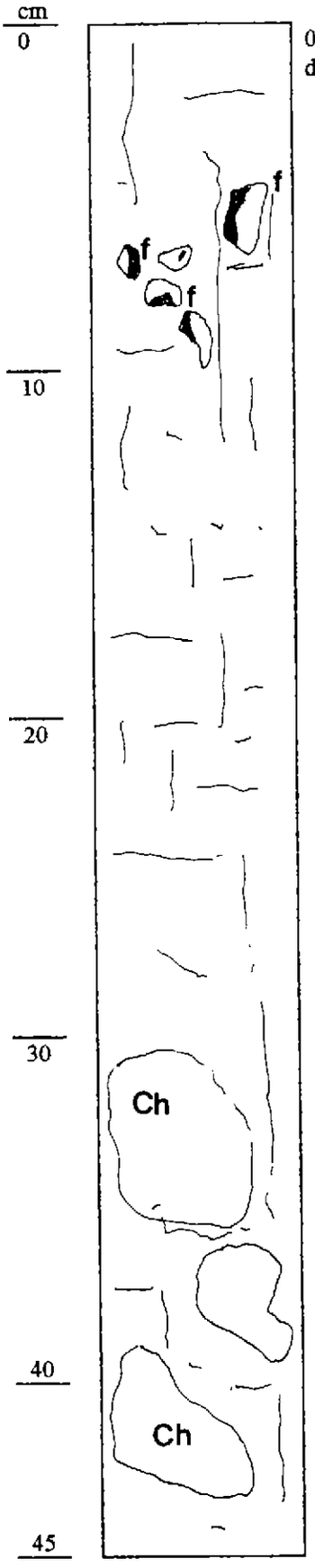


0-25cm 10YR 5/1 grey to 10YR 4/1 dark grey silty clay. At 10cm there are flecks of 10YR 3/1 very dark grey to 10YR 3/2 very dark greyish brown peaty silt. At 10-25cm 10YR 3/2 very dark greyish brown peaty silt with the peat fraction being fibrous and moderately compact.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF U4 / U100 Core Sample Descriptions

Site Code: ARC EFT/97 **Core Depth:** 9.10-9.55m
Borehole Number: 0022SA **Core Sample Number:** U4/23

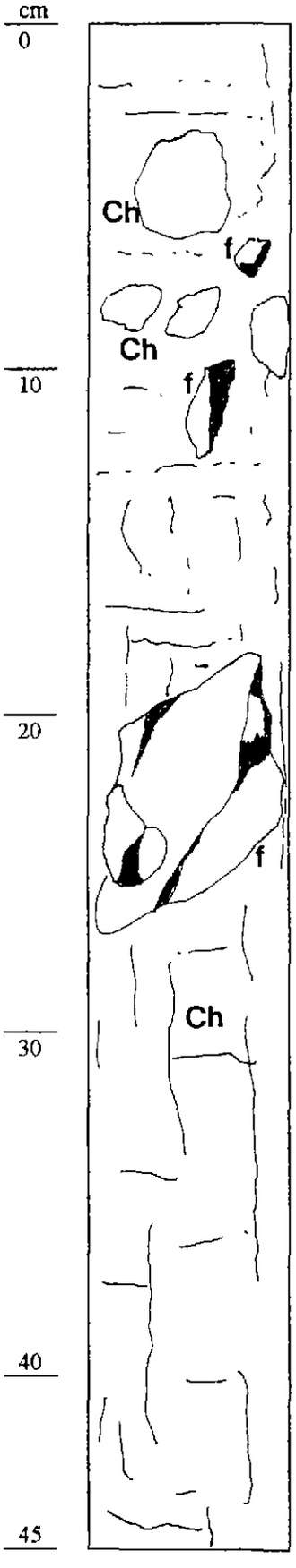


0-45cm 2.5Y 8/1 white chalk with sub-angular flint nodules up to 2cm mean diameter.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF U4 / U100 Core Sample Descriptions

Site Code: ARC EFT/97 **Core Depth:** 8.55-9.00m
Borehole Number: 0022SA **Core Sample Number:** U4/21



0-15cm 10YR 7/4 very pale brown clayey silty chalk.

----------Diffuse smooth----------

15-31cm 10YR 8/6 yellow clayey silty chalk

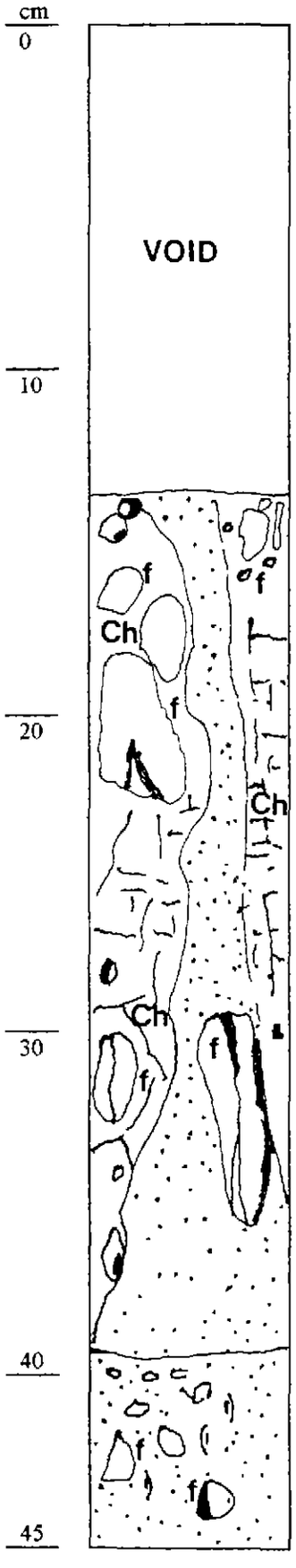
----------Diffuse smooth----------

31-45cm 2.5Y 8/1 white chalk with sub-rounded flint clasts up to 7.5cm mean diameter.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF U4 / U100 Core Sample Descriptions

Site Code: ARC EFT/97 **Core Depth:** 7.90-8.35m
Borehole Number: 0022SA **Core Sample Number:** U4/19



0-14cm VOID

14-37cm Flint chalk gravel with 10YR 5/3 brown medium moderately sorted sand. The flint clasts are up to 3.5cm mean diameter and are sub-angular and supported at the edges of the core by 10YR 8/2 very pale brown silty clayey chalk. In pockets the chalk is granular. There is a central area of 10YR 5/2 greyish brown moderately sorted medium sand. There are pockets of 10YR 5/2 greyish brown clayey silty sand at the transition form the central sand to the chalky matrix at the edges of the core.

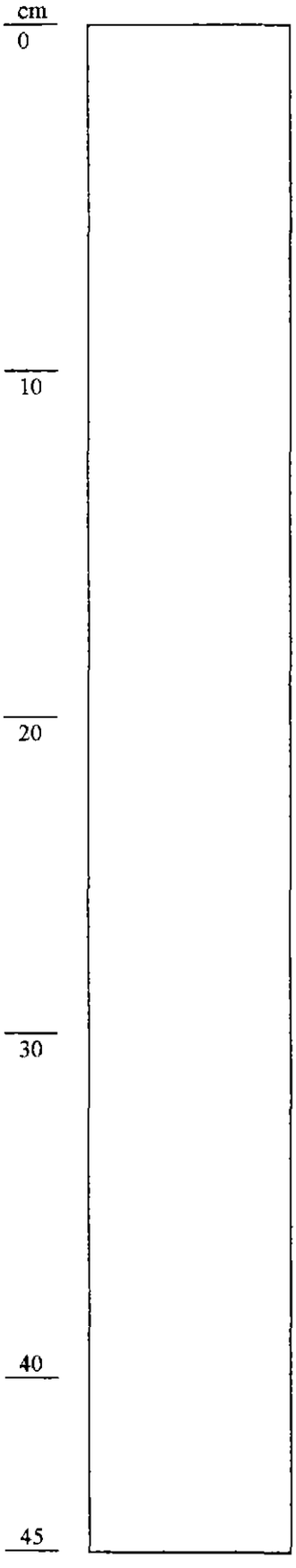
Sharp smooth

37-45cm Flint gravel with chalk clasts and a silty sand matrix. The flint clasts are sub-angular to angular. The unit varies from clast to matrix supported. Shell fragments are present in the unit and appear to be concentrated between 37-41cm.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF U4 / U100 Core Sample Descriptions

Site Code: ARC EFT/97 **Core Depth:** 7.35-7.65m
Borehole Number: 0022SA **Core Sample Number:** U4/17



No Core Recovery

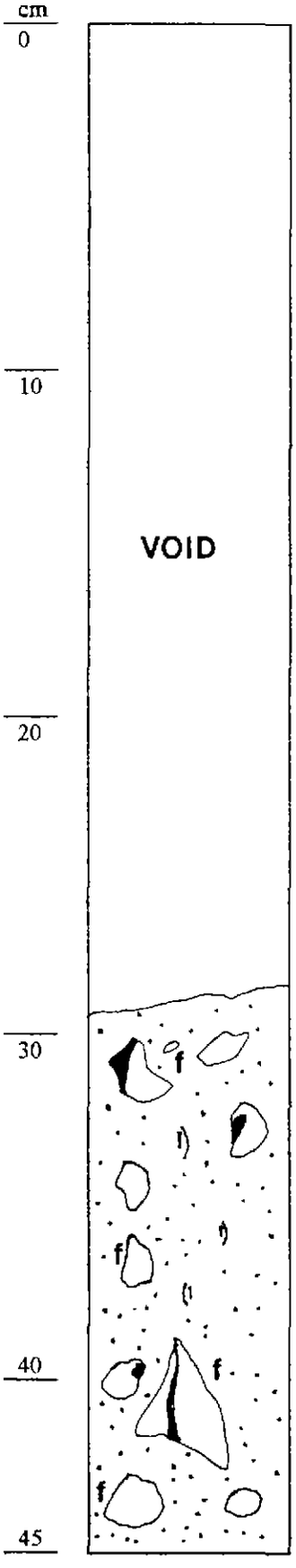
Disturbed Bulk Sample

Sandy flint gravel with clasts between 2.5 and 5.0cm mean diameter. The clasts are well rounded to sub-angular. The sand fraction is composed of 10YR 4/2 dark greyish brown moderately sorted coarse sand with chalk and rare shell fragments.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF U4 / U100 Core Sample Descriptions

Site Code: ARC EFT/97 **Core Depth:** 6.70-7.15m
Borehole Number: 0022SA **Core Sample Number:** U4/15



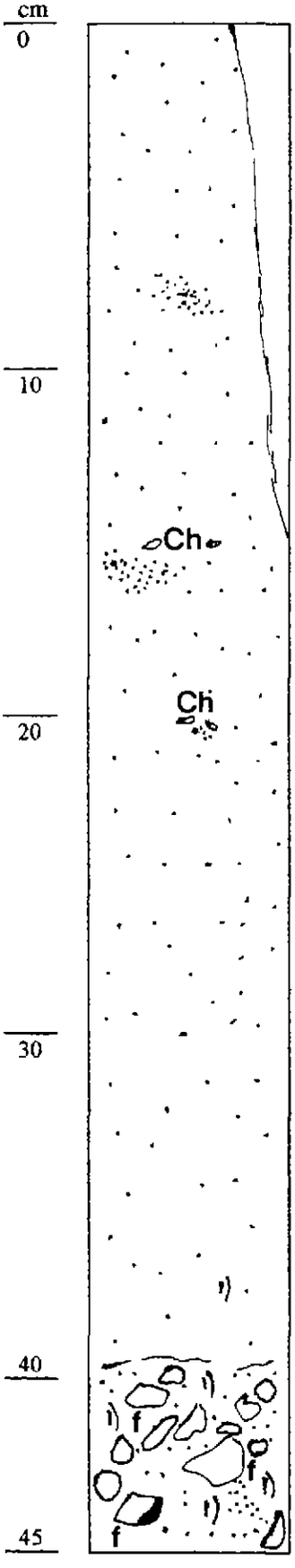
0-29cm VOID

29-45cm Sandy flint gravel. The clasts are sub-angular to sub-rounded up to 6cm mean diameter. The sand fraction is a 10YR 5/3 brown coarse sand with shell fragments.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF U4 / U100 Core Sample Descriptions

Site Code: ARC EFT/97 **Core Depth:** 6.15-6.60m
Borehole Number: 0022SA **Core Sample Number:** U4/13



0-39cm 10YR 5/3 brown silty sand with pockets/areas of 10YR 6/3 pale brown sand. There are rare flecks of calcium carbonate which appear to increase in number down through the unit. Between 35-40cm the sand fraction coarsens and there are matrix supported fragments of possible shell fragments.

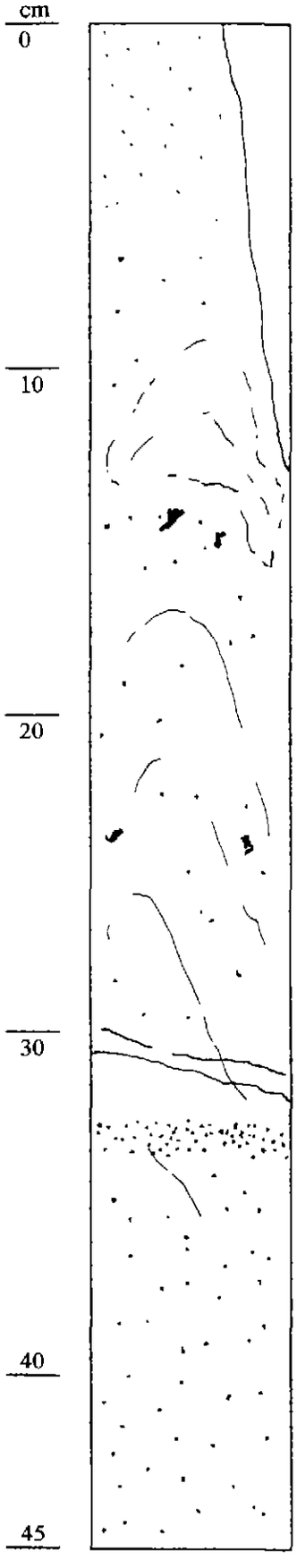
Sharp smooth

39-45cm The unit is a sandy gravel.The sand fraction is 10YR 5/4 yellowish brown coasre moderately sorted sand. The gravel fraction is composed of sub-angular to sub-rounded flint clasts <2cm mean diameter. The unit also contains abundant shell fragments.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF U4 / U100 Core Sample Descriptions

Site Code: ARC EFT/97 **Core Depth:** 5.55-6.10m
Borehole Number: 0022SA **Core Sample Number:** U4/11



0-30/31cm 10YR 5/4 yellowish brown medium moderatley well sorted silty sand. At 10-14cm there is an inclusion of 10YR 4/1 dark grey medium sand. The matrix is firm and compact with rare organic fragments.

Sharp smooth

30/31-31/33cm 10YR 7/3 yellowish brown thin bed of clayey sandy silt.

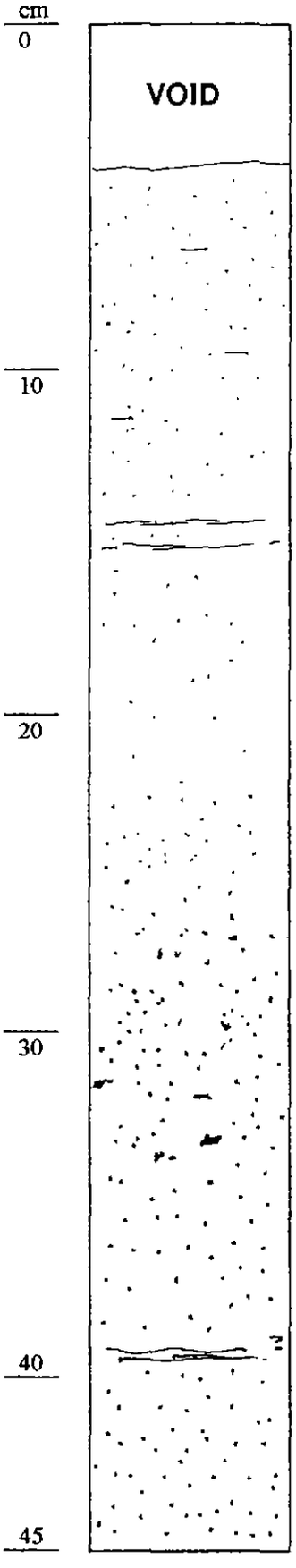
Sharp smooth

31/33-36cm 10YR 6/3 pale brown coarse sand changing to a 10YR 5/4 yellowish brown moderately sorted medium sand.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF U4 / U100 Core Sample Descriptions

Site Code: ARC EFT/97 **Core Depth:** 5.10-5.55m
Borehole Number: 0022SA **Core Sample Number:** U4/9



0-4cm VOID

4-18cm 10YR 5/2 greyiswh brown sandy silt unit which contains rare pockets of 10YR 7/3 very pale brown clayey silt and rare flecks of organic material. At 14-15cm the clayey silt forms faint discontinuous laminations.

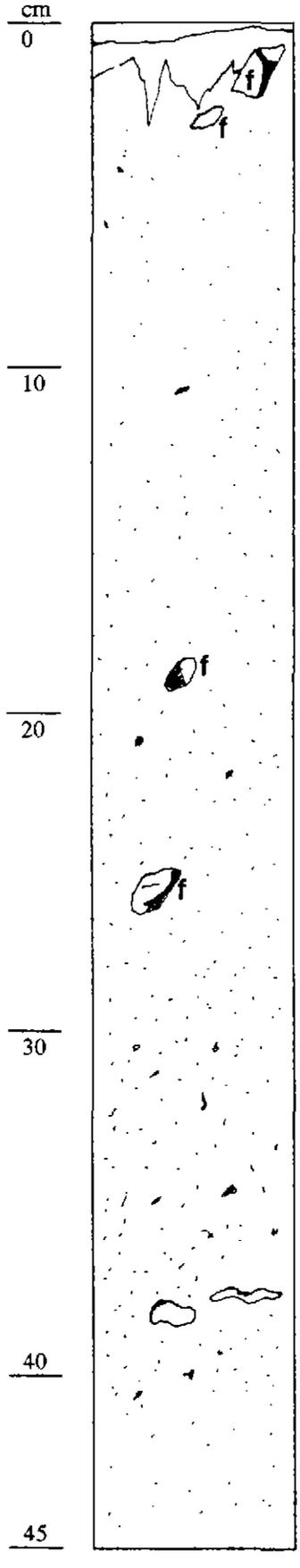
----------Diffuse smooth----------

18-45cm 10YR 5/2 greyish brown sandy silt to silty sand. The sand fraction is moderately sorted and consists of medium to coarse grains. There are rare pockets of organic material and at 39-40cm there are discontinuous clayey silt laminations.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF U4 / U100 Core Sample Descriptions

Site Code: ARC EFT/97 **Core Depth:** 4.55-5.00m
Borehole Number: 0022SA **Core Sample Number:** U4/7



0-1/2 VOID

1/2-2/4 10YR 3/1 very dark grey silty peat. The matrix contains rare sub-angular flint pebbles <2cm mean diameter.

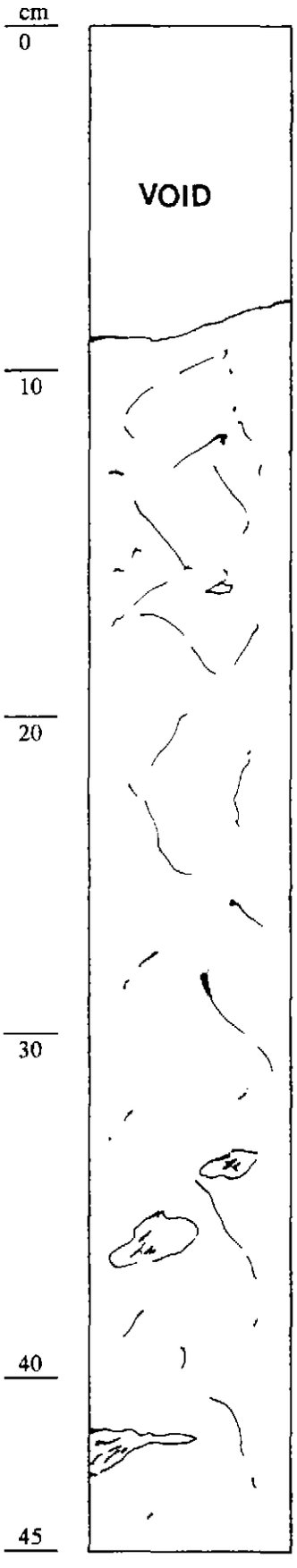
Sharp irregular

2/4-45cm 10YR 5/2 greyish brown clayey sandy silt with organic flecks and rare sub-rounded flint clays <0.5cm mean diameter. Between 20 and 45cm the sand fraction appears to coarsen and the matrix becomes a 10YR 5/2 greyish brown clayey silty sand below 0.30cm.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF U4 / U100 Core Sample Descriptions

Site Code: ARC EFT/97 **Core Depth:** 3.90-4.25m
Borehole Number: BH 0022SA **Core Sample Number:** U4/5



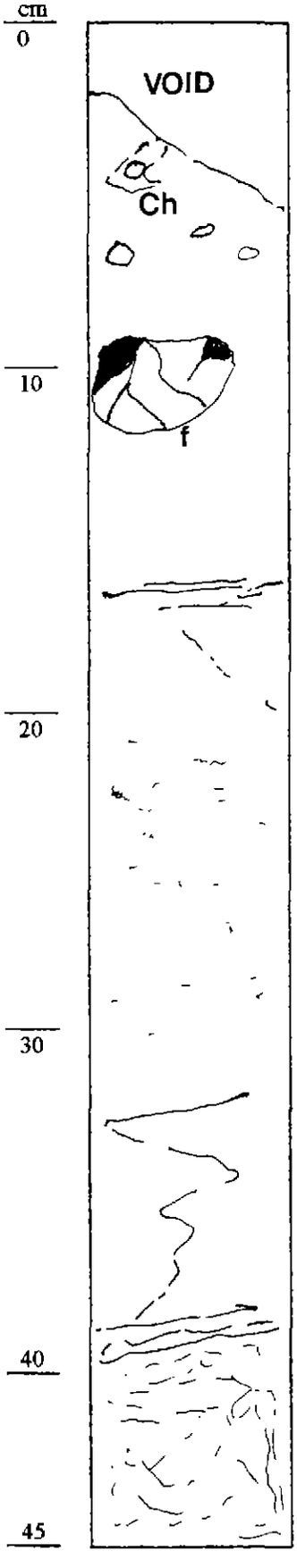
0-9/10cm VOID

9/10-45cm 10YR 2/1 black fibrous peat with rare wood fragments. The peat is compact and fibrous. Towards the base of the core (bottom 10cm) there are fragments of wood that appear to have been compressed.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF U4 / U100 Core Sample Descriptions

Site Code: ARC EFT/97 **Core Depth:** 3.25-3.70m
Borehole Number: BH 0022SA **Core Sample Number:** U4/3



0-2/4 VOID

2/4-15cm 10YR 5/1 grey silty clay. In the top of the unit there are traces of 10YR 4/2 dark greyish brown peaty silt. Rare inclusions of chalk pellets which are sub-rounded. At 10cm there is a large sub-rounded flint clast with approx 5% cortex cover.

----------Diffuse smooth----------

15-22cm 10YR 4/1 Dark grey to 10YR 4/2 dark greyish brown silty clay with rare organic fragments in the matrix.

----------Diffuse smooth----------

22-40cm 10YR 5/1 grey silty clay with rare organic flecking. Below 33cm the unit becomes a 10YR 3/2 very dark greyish brown as the peat/organic content increases down through the core.

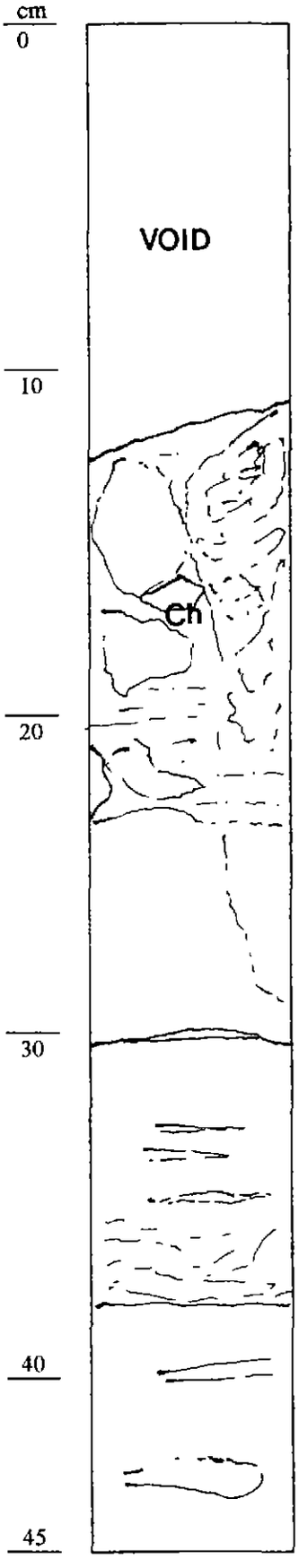
----------Diffuse smooth----------

40-45cm 10YR 3/2 very dark greyish brown peaty silt becoming a silty peat down through the core.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF U4 / U100 Core Sample Descriptions

Site Code: ARC EFT/97 **Core Depth:** 2.60-3.05m
Borehole Number: BH 0022SA **Core Sample Number:** U4/1



0-10/12cm VOID

11/12-20cm 7.5YR 2.5/1 black to 7.5YR 3/1 very dark grey fibrous unconsolidated peatysilt. The matrix is loose and non-cohesive. Pockets of 5Y 8/2 pale yellow chalk with 10YR 7/3 very pale brown silt clay contained within the chalk matrix.

20-24cm 7.5YR 2.5/1 black to 7.5YR 3/1 very dark grey fibrous firm and compact peatysilt. Pockets of 5Y 8/2 pale yellow chalk with 10YR 7/3 very pale brown silt clay contained within the chalk matrix.

Sharp smooth

24-30cm 10YR 5/1 grey silty clay to 10YR 4/1 dark grey silty clay. The unit also contains flecks and is mottled.

Sharp smooth

30-38cm 10YR 3/2 very dark greyish brown fibrous peaty silt. The peat becomes more fibrous towards the centre of the unit. The matrix contains flecks and pockets of 10YR 7/3 very pale brown coarse silt.

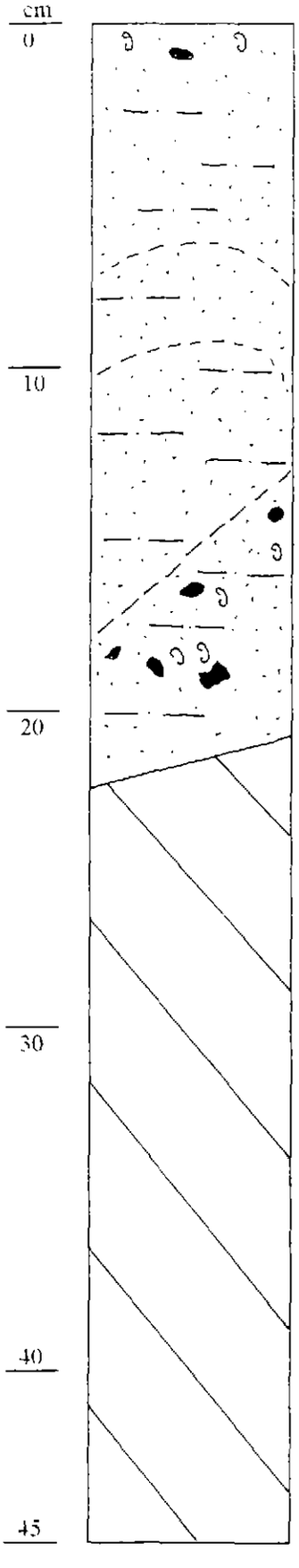
Sharp smooth

38-45cm 10YR 5/1 grey silty clay with pockets of 10YR 4/1 dark grey clay silt.

Scale:1:2 **Described by:CAP** **Date:01/06/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 5.20-5.50m
Borehole Number: 0021SA **Core Sample Number:** U4/19



0-16/13cm 10YR 4/6 dark yellowish brown well sorted silty sand. The unit contains flint gravel clasts in the top 3cm of the unit. These are sub-rounded matrix supported up to approximately 0.5cm mean diameter. There appears to be faint irregular bedding present within the unit which is picked out by variations in the silt content of the unit. The sand fraction is dominated by sub-angular to sub-rounded quartz grains forming approximately 90%. The remainder of the sand fraction is composed of glauconite, white opaque grains (chalk?) and dark opaque grains. There are abundant shell fragments present at the top of the unit. There is a strong reaction between the sediment and HCl and the lower boundary is sharp and smooth.

Sharp smooth

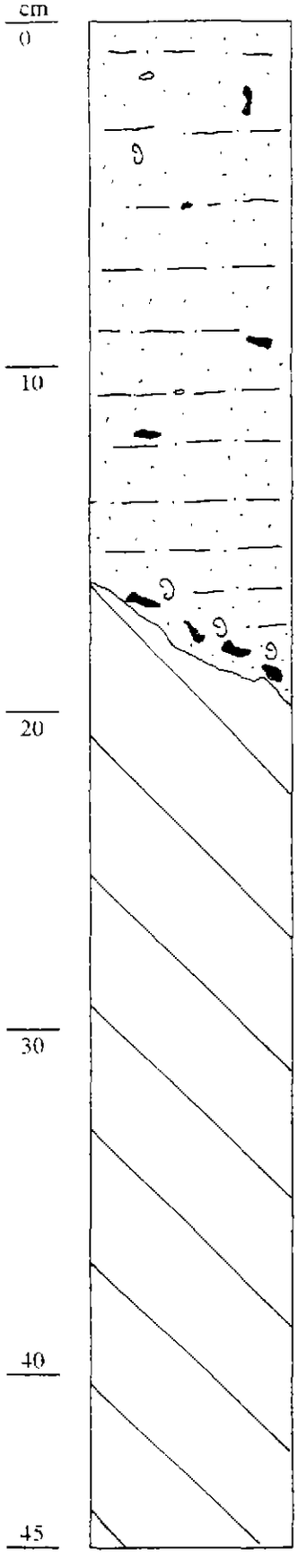
16/13-22/21cm 10YR 4/6 dark yellowish brown moderately sorted silty sand unit with flint gravel clasts and shell fragments. The flint clasts are matrix supported with sub-angular to rounded clasts up to approximately 1cm mean diameter. The sand fraction is dominated by sub-angular to sub-rounded quartz grains forming approximately 90%. The rest being formed form mica, dark and white opaque grains and glauconite. Shell fragments are present throughout the unit and there is a strong reaction between the sediment and HCl.

Scale: 1:2 **Described by: VW** **Date: 14/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 4.90-5.90m

Borehole Number: 0021SA **Core Sample Number:** Disturbed sample 18

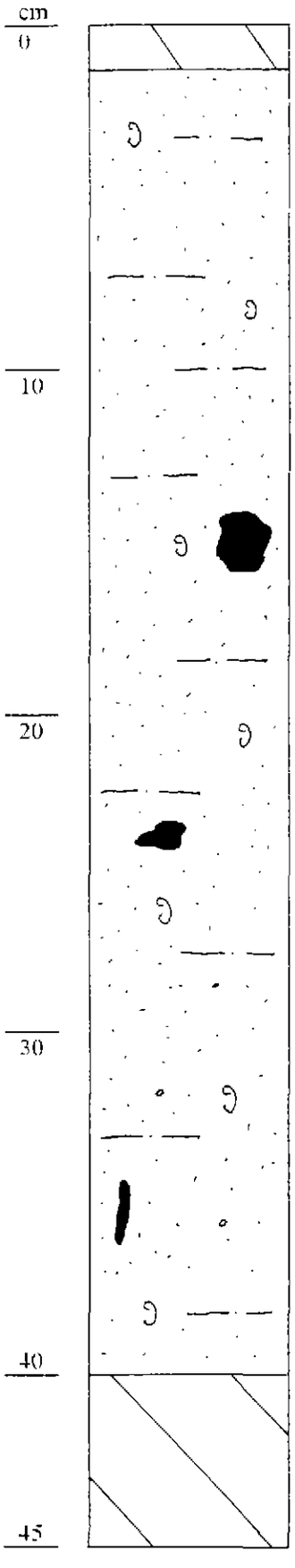


0-16/20cm 10YR 4/6 dark yellowish brown well sorted silty fine sand. The unit contains angular to sub-angular flint gravel clasts, matrix supported up to 0.5cm mean diameter. There is a concentration of these clasts at the base of the unit where they are clast supported. The sand fraction is dominated by sub-rounded quartz grains (95%) with some mica and white to cream opaque grains (chalk?). Shell fragments are present throughout the unit with the highest concentrations with the clasts at the base of the unit. There is a strong reaction between the sediment and HCl.

Scale: 1:2 **Described by: VW** **Date: 14/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 4.50-4.90m
Borehole Number: 0021SA **Core Sample Number:** U4/17



0-1cm VOID

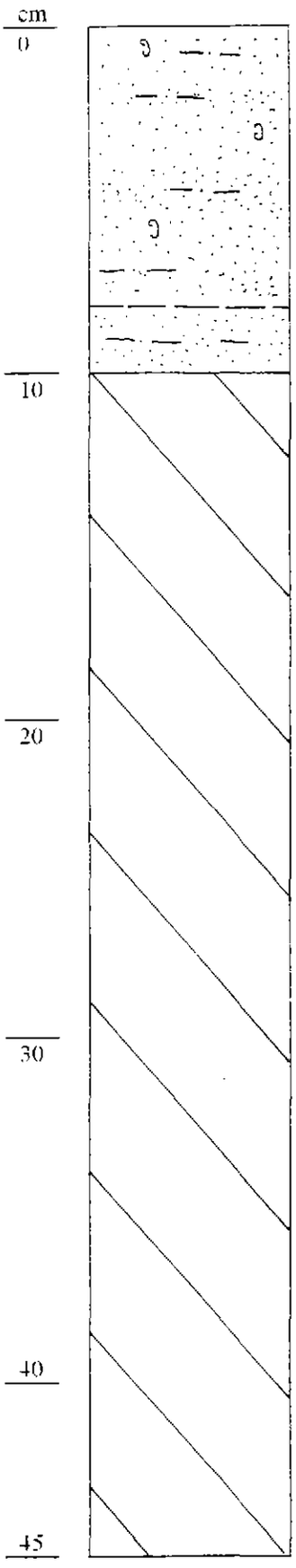
1-40cm 10YR 5/4 yellowish brown to 10YR 4/6 dark yellowish brown well sorted silty sand. There are matrix supported flint gravel clasts up to 1.5cm mean diameter and sub-rounded. The sand fraction is dominated by sub-rounded to rounded quartz grains forming >95%. The rest of the sand is formed from white mica and glauconite. There are fragments of shells spread throughout the unit and there is a strong reaction between the sediment and HCl.

Scale: 1:2 **Described by: VW** **Date: 12/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 4.40-4.50m

Borehole Number: 0021SA **Core Sample Number:** Disturbed sample 16



0-8cm The unit is slightly mottled with 10YR 4/6 dark yellowish brown with 7.5YR 4/6 strong brown patches There is a band between 6 and 7cm of 10YR 4/3 brown. The unit is a well sorted silty fine sand with faint bedding. The sand fraction is dominated by sub-angular to sub-rounded quartz grains. There are coarse sand sized chalk inclusions. There are shell fragments present throughout the unit. There is a strong reaction between the sediment and HCl and the lower boundary is sharp and smooth.

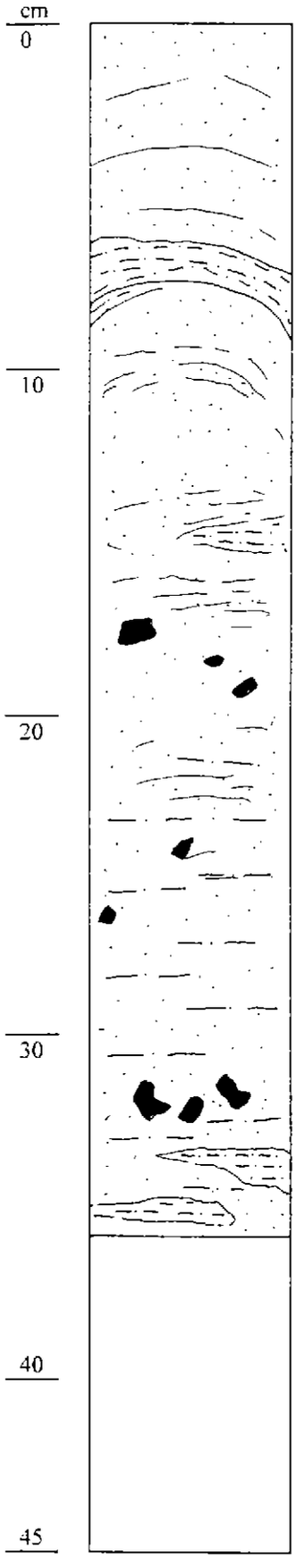
Sharp smooth

8-10cm 10YR 4/6 dark yellowish brown silty fine sand. The unit is well sorted and the sand fraction is dominated by sub-angular to sub-rounded quartz grains (>95%) with some mica grains. There is a strong reaction between the sediment and HCl.

Scale: 1:2 **Described by: VW** **Date: 14/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 4.00-4.40m
Borehole Number: 0021SA **Core Sample Number:** U4/13

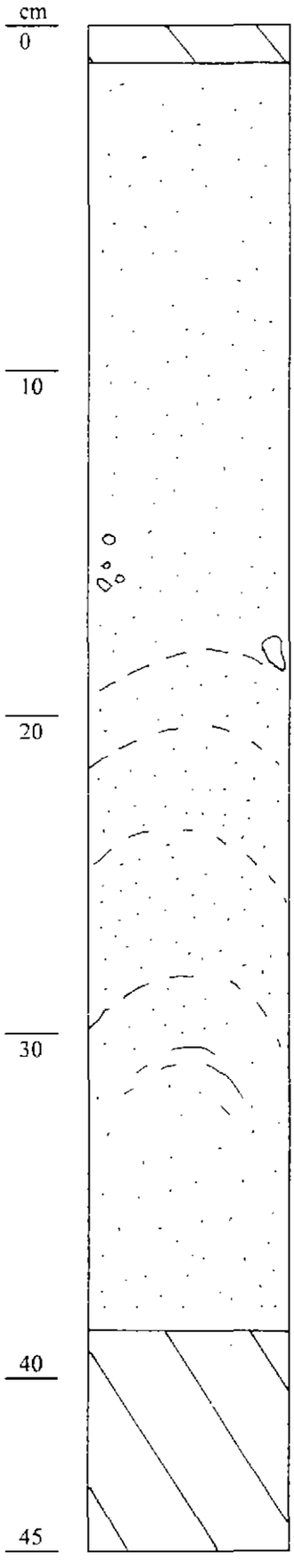


0-36cm The unit is a 10YR 4/6 dark yellowish brown with patches of 10YR 5/4 yellowish brown and 10YR 6/3 pale brown. The unit is a silty fine sand with clay silt laminae which become discontinuous and disturbed below 14cm. Flint gravel clasts are present throughout the unit. These are matrix supported sub-angular to sub-rounded up to approximately 1cm mean diameter. The sand fraction is dominated by sub-angular to sub-rounded quartz grains (approximately 95%). The remainder of the sand being composed of white opaque grains (chalk) and glauconite. The upper part of the unit above 14cm shows disruption during drilling. Much of the structure originally present may have been lost due to liquifaction below 14cm. There is a strong reaction between the sediment and HCl.

Scale: 1:2 **Described by: VW** **Date: 14/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 3.50-3.90m
Borehole Number: 0021SA **Core Sample Number:** U4/12



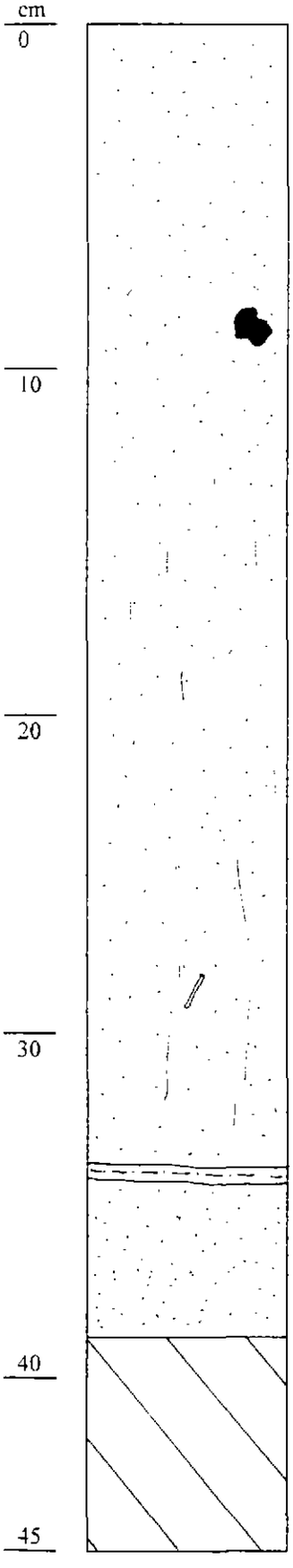
0-1cm VOID

1-39cm 10YR 4/6 dark yellowish brown well sorted silty fine sand. The unit contains laminae and discontinuous laminae of clay silt. There are rare sub-rounded matrix supported chalk gravel clasts up to 0.5cm mean diameter. Concretions of carbonate up to 1cm mean diameter, and sub-rounded are present. The sand fraction is dominated by approximately 94% quartz, 5% chalk and 1% glauconite. The grains are sub-rounded to rounded. The laminae present have been disturbed during drilling to give a concave down pattern seen in the core. There is a strong reaction between the sediment and HCl.

Scale: 1:2 **Described by: VW** **Date: 13/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 2.90-3.30m
Borehole Number: 0021SA **Core Sample Number:** U4/10

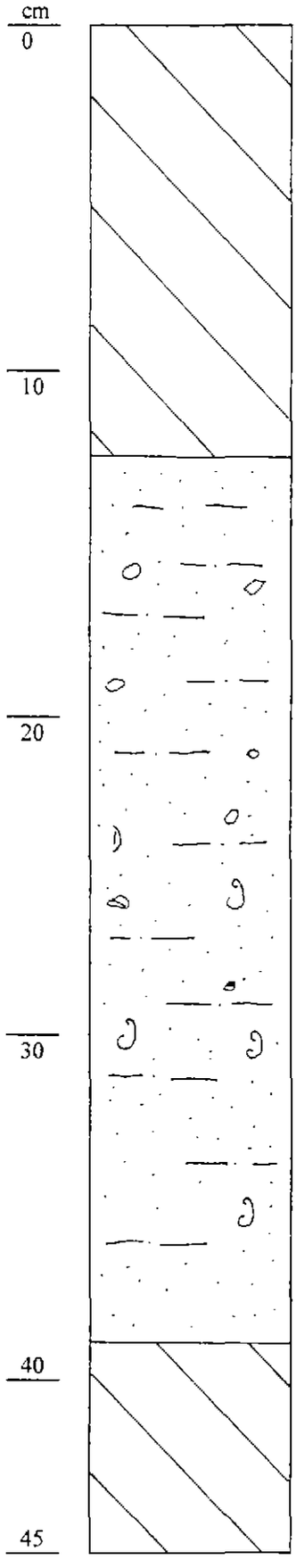


0-39cm The unit is mottled with 10YR 4/6 dark yellowish brown being dominant. There are patches and streaks of 10YR 5/3 brown. There is a single clast sub-angular flint clast, matrix supported approximately 1cm mean diameter. Concretions of carbonate material are also present. These vary in shape from rounded to elongated. The sand fraction is dominated by sub-angular to sub-rounded grains with approximately 90% quartz, with some white opaque grains (chalk or concretions), glauconite and dark opaque grains. Clay silt laminations are present near the base of the core (34cm). The elongated concretions have a sub vertical orientation and may represent the infilling of root canals. There are also vertically oriented 10YR 5/3 brown streaks which may represent the infilling of root canals. There is a strong reaction between the sediment and HCl.

Scale: 1:2 **Described by: VW** **Date: 14/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 2.00-2.40m
Borehole Number: 0021SA **Core Sample Number:** U4/7



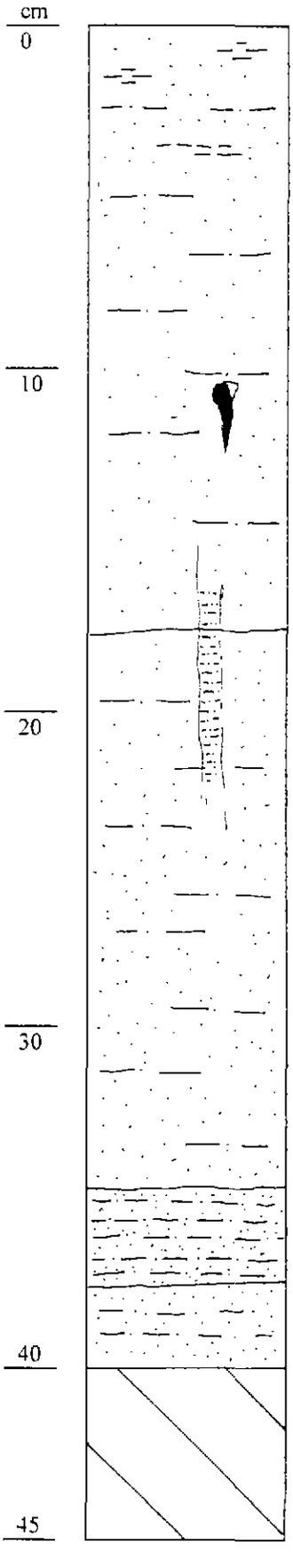
0-13cm VOID

13-39cm Mottled appearance with 2.5Y 5/3 light olive brown mottled by 5YR dark reddish brown sandy silt. The unit contains angular irregularly shaped clasts of carbonate material up to 1cm mean diameter and matrix supported. There is a small amount of fine sand present within the unit. The sand is composed of rounded quartz grains. The unit has a crumbly texture, molluscs are abundant and present through the entire core. The unit reacts strongly with HCl.

Scale: 1:2 **Described by: VW** **Date: 21/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 1.50-1.90m
Borehole Number: 0021SA **Core Sample Number:** U4/5



0-18cm 10YR 4/6 dark yellowish brown silty sand. Moderately sorted with gravel clasts towards the base of the unit. The clasts are composed of flint and carbonate concretions, both of which are matrix supported. The flint clasts are sub-angular up to 1cm mean diameter and the carbonate concretions are sub-rounded up to 0.5cm mean diameter. Also present are 10YR 2/2 very dark brown areas possibly infilled root canals. There is a decrease in the clay silt content down through the unit and an increase in the clast content. In the top 5cm of the core there are clay silt lenses/discontinuous thin beds. The sand fraction is composed of sub-angular to sub-rounded quartz grains. There is a strong reaction with HCl and the lower boundary is clear and smooth.

Clear smooth

18-35cm 10YR 4/6 dark yellowish brown slightly silty sand. The unit is well sorted with patches of 7.5YR 5/4 brown carbonate sand. The sand fraction is composed of sub-angular to sub-rounded quartz grains. There is a single vertical linear feature running from 16-22cm down through the core and it is filled with a sandy clay silt. There is a strong reaction with HCl and the lower boundary is sharp and irregular.

Sharp irregular

35-38cm 10YR 5/4 yellowish brown moderately sorted slightly sandy silt. There is a single flint gravel clast which is sub-angular approximately 1cm mean diameter. The sand fraction is composed of sub-angular to sub-rounded quartz grains and sand sized chalk grains. There is a strong reaction with HCl and the lower boundary is sharp and smooth.

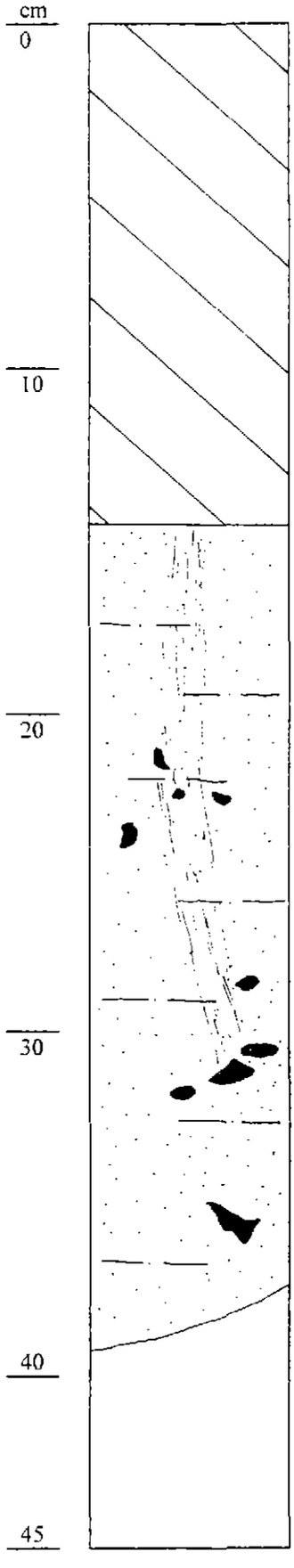
Sharp smooth

38-40cm 10YR 4/6 dark yellowish brown slightly silty sand. The unit is well sorted with patches of 7.5YR 5/4 brown carbonate sand. The sand fraction is composed of sub-angular to sub-rounded quartz grains. There is a strong reaction with HCl.

Scale: 1:2 **Described by: VW** **Date: 21/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 1.00-1.40m
Borehole Number: 0021SA **Core Sample Number:** U4/5



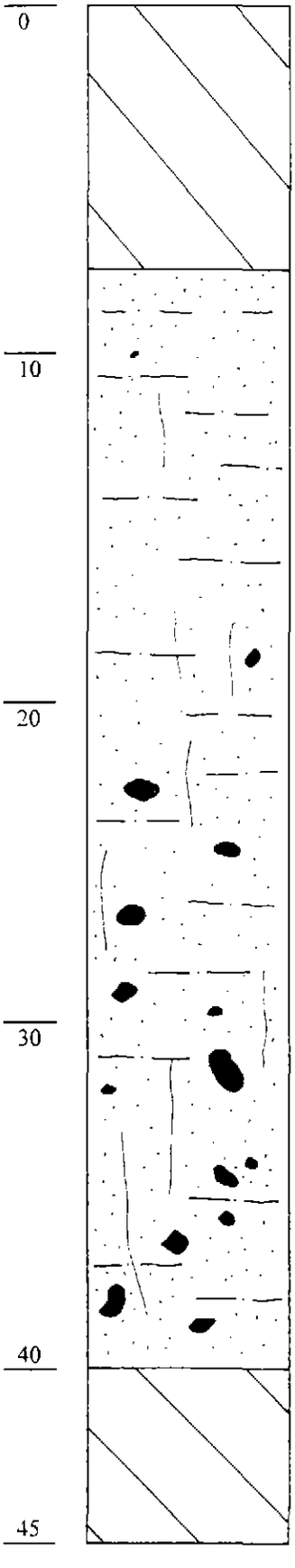
0-15cm VOID

15-40/38cm 10YR 4/4 dark yellowish brown silty sand. The unit is dry and hard, it is moderately sorted with flint and chalk clasts. The flint clasts are sub-angular to sub-rounded up to approximately 0.5cm mean diameter and matrix supported. The chalk clasts are sub-rounded and some are flattened and up to 0.5cm mean diameter. Much of the carbonate material appears to infill voids within the sand. The sand fraction is dominated by sub-rounded quartz grains. There are root traces in the centre of the core. There is an increase in the amount of carbonate material down through the core which is reflected in the reaction between the unit and HCl. There is no reaction with HCl at the top of the core and a slight reaction towards the base of the core.

Scale: 1:2 **Described by: VW** **Date: 17/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 0.50-0.95m
Borehole Number: 0021SA **Core Sample Number:** U4/1



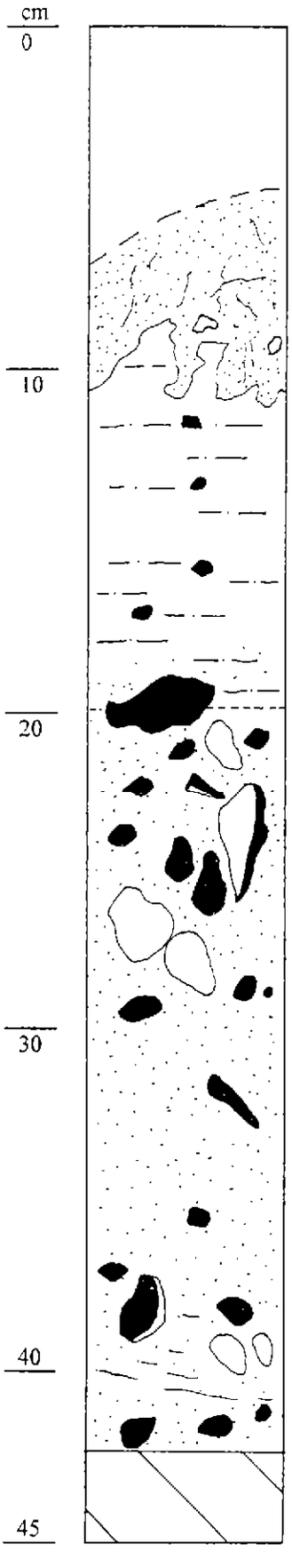
0-8cm VOID

8-40cm 10YR 4/4 brown silty sand. Well sorted sand with frequent flint gravel clasts. The clasts are rounded to sub-angular and up to approximately 1cm mean diameter and matrix supported. There are clasts of unknown material, which are up to 2.5cm mean diameter. The sand fraction is dominated by quartz with sub-angular to rounded grains. Modern roots are present throughout the unit and the sand shows no reaction with HCl.

Scale: 1:2 **Described by: VW** **Date: 21/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 1.50-1.95m
Borehole Number: 0020SA **Core Sample Number:** U4/2



0-8/6cm VOID

8/6-11/12cm 10YR 5/8 yellowish brown well sorted slightly silty fine sand. There is some 10YR 8/2 very pale brown streaking possibly infilling root canals. At the base of the unit there are 2 chalk gravel clasts, the largest being approximately 0.5cm mean diameter and sub-rounded. The sand is composed of sub-angular to sub-rounded quartz grains. There are fine roots present and there is a strong reaction with HCl. The lower boundary is sharp and irregular. The irregular nature of the boundary may show the presence of post-depositional flame structures.

Sharp irregular

11/12-20cm 10YR 8/3 very pale brown carbonate silt with coarse sand sized chalk clasts and flint gravel clasts. The number of flint clasts increases to the base of the unit. The chalk clasts are sub-rounded and the flint clasts are sub-angular to rounded. The clasts are matrix supported, there is a strong reaction with HCl and the lower boundary is clear with an increase in the sand content.

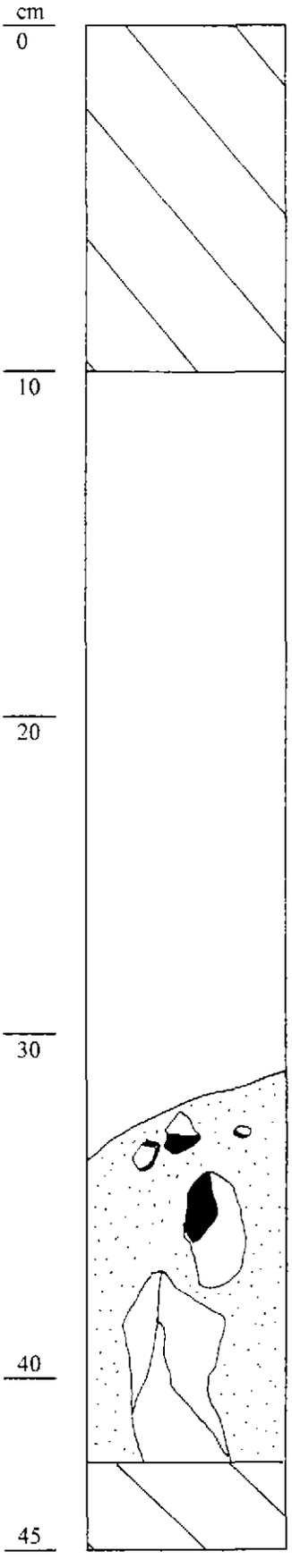
Clear smooth

20-42cm 10YR 5/6 yellowish brown sandy gravel. The gravel is poorly sorted and dominated by flint clasts up to 3.5cm mean diameter angular to sub-rounded, clast to matrix supported. A small percentage 1-2% chalk clasts up to 0.4cm mean diameter and sub-rounded. The sand fraction is composed of approximately 95% quartz, 4% chalk and 1% flint. All of the grains are subrounded to sub-angular. There is a strong reaction with HCl.

Scale: 1:2 **Described by: VW** **Date: 5/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 2.70-3.15m
Borehole Number: 0020SA **Core Sample Number:** U4/4



0-10cm VOID

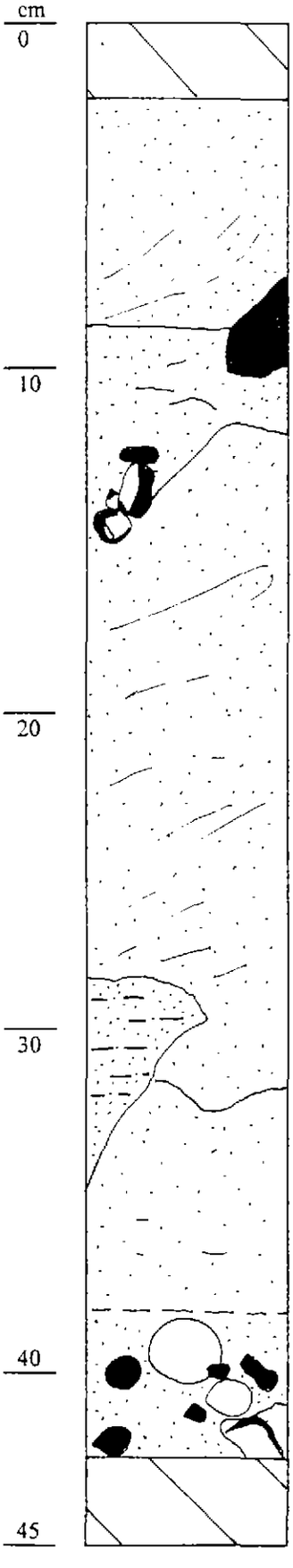
10-34/32cm Loose unconsolidated gravel with the same composition as below. This material probably represents part of the same unit which has been broken up and disturbed during drilling because of its dry and fragile state.

34/32-43cm 10YR 5/6 yellowish brown poorly sorted sand matrix in a poorly sorted gravel. The gravel is dominated by flint clasts with a small amount of chalk. The flint clasts are up to 5.5cm mean diameter, angular to sub-rounded and clast supported with 95% flint and 5% chalk. The sand fraction is composed of sub-rounded to sub-angular grains with 50% quartz, 40% chalk and 10% flint. There is a strong reaction with HCl.

Scale: 1:2 **Described by: VW** **Date: 6/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 2.10-2.55m
Borehole Number: 0020SA **Core Sample Number:** U4/3



0-2cm VOID

2-9cm 10YR 6/4 light yellowish brown and 10YR 5/8 yellowish brown fine sand. The two colours represent banding/bedding (thin beds). Both of the bands are composed of quartz, chalk and flint grains. However the lighter of the bands contains up to 50% chalk grains whereas there is approximately 10% in the darker bands. All of the grains are sub-rounded . The bedding is within the unit is inclined at approximately 30 degrees. There is a strong reaction with HCl.

——————————Sharp smooth——————————

9-12/16cm 10YR 6/6 brownish yellow medium to fine sand, poorly sorted with flint clasts and coarse sand sized chalk grains. The flint clasts are 2.5cm mean diameter and sub-rounded, (some of them have been broken during drilling), matrix supported. The sand fraction is dominated by quartz grains (>95%), chalk and flint are also present. All of the grains are sub-rounded. There is a strong reaction with HCl and the lower boundary is sharp and smooth.

——————————Sharp smooth——————————

12/16-28.5/33cm 10YR 5/6 yellowish brown changing to 10YR 4/6 dark yellowish brown down through the core. There is some thin bedding at the top of the unit and discontinuous thin beds and laminations lower in the unit. The unit consists of a fine sand with a small amount of silt which increases down through the unit as the colour of the unit darkens. The sand is dominated by >90% quartz, the rest being composed of chalk, flint and glauconite grains. All of the grains are sub-rounded, some with clay coatings. There is a strong reaction with HCl.

——————————Sharp irregular——————————

28.5-35cm Wedge of 10YR 5/3 brown silty fine sand. The sand fraction is well sorted and dominated by 95% quartz with some flint grains. The grains are sub-angular to sub-rounded and there is a moderate reaction with HCl. The boundary between it and the surrounding unit is sharp and irregular.

——————————Sharp irregular——————————

35/33-38cm 10YR 4/6 dark yellowish brown moderately sorted fine sand. The unit is dominated by quartz grains with coarse sand grains of flint and chalk (90% quartz, 9% flint and 1% chalk). There are some clay coatings on the grains. There is a strong reaction with HCl and the lower boundary is sharp and smooth.

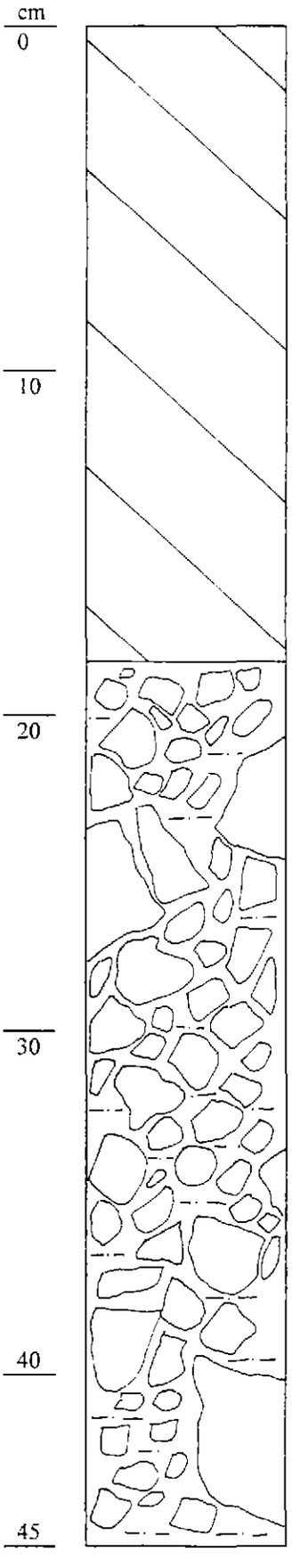
——————————Sharp smooth——————————

38-43cm Slightly mottled with 10YR 5/6 yellowish brown and 10YR 5/4 yellowish brown sandy matrix in a poorly sorted gravel. The clasts are dominated by flint with coarse sand to fine gravel chalk clasts. The flint clasts are rounded to sub-rounded (some clasts were broken during drilling). The sand fraction is dominated by 80% quartz, 15% flint and 5% chalk. The grains are angular (flint) to rounded (quartz). Some of the grains have clay coatings and there is a strong reaction with HCl.

Scale: 1:2 **Described by: VW** **Date: 6/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 4.30-4.75m
Borehole Number: 0019 SA **Core Sample Number:** U4/13



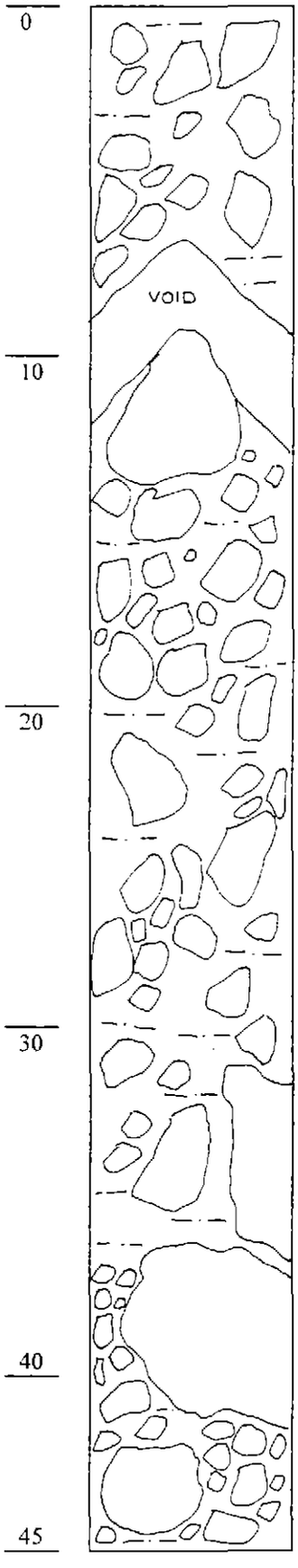
0-19cm VOID

19-45cm 10YR 8/3 very pale brown carbonate silt matrix in a chalk gravel. The gravel clasts are clast supported and poorly sorted, sub-angular to sub-rounded and up to approximately 6cm mean diameter.

Scale: 1:2 **Described by: VW** **Date: 10/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 3.80-4.25m
Borehole Number: 0019 SA **Core Sample Number:** U4/12

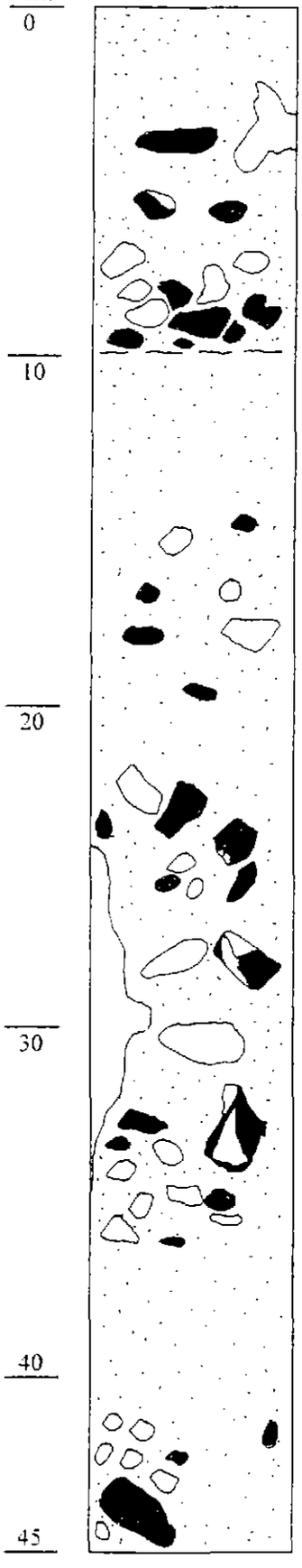


0-45cm 10YR 6/4 light yellowish brown silt matrix within a chalk gravel. The unit is poorly sorted with clast supported chalk gravel clasts. The chalk clasts are sub-angular to rounded and up to >6cm mean diameter. The silt is carbonate rich and reacts strongly with HCl.

Scale: 1:2 **Described by: VW** **Date: 10/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 2.80-3.25m
Borehole Number: 0019 SA **Core Sample Number:** U4/9



0-10cm 10YR 6/6 brownish yellow medium grained sand matrix in a clast to matrix supported poorly sorted gravel. The unit consists of approximately 60% flint and 40% chalk. The flint clasts are sub-angular to rounded up to approximately 2cm mean diameter. The chalk clasts are sub-angular to sub-rounded up to 1.5cm mean diameter. The sand fraction is composed 60% sub-rounded quartz, 30% chalk and 10% opaque grains. Glauconite is also present, the unit shows a strong reaction with HCl and the lower boundary is sharp and smooth.

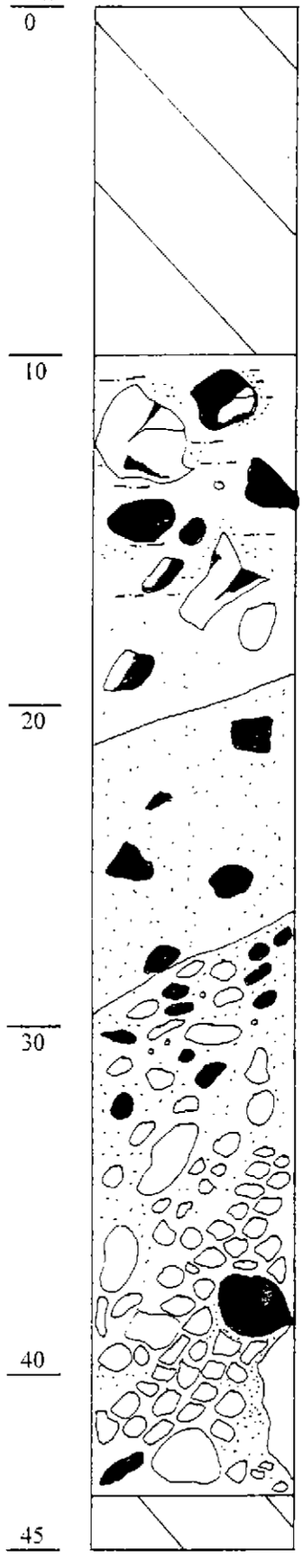
Sharp smooth

10-45cm 10YR 6/6 brownish yellow fine to medium sand matrix in a dominantly matrix supported gravel. Approximately 50:50 chalk and flint. The flint clasts are sub-angular to rounded (dominantly rounded). The chalk clasts are sub-angular to sub-rounded. Flint clasts are up to 3cm mean diameter and the chalk clasts are up to >3cm mean diameter. The sand fraction is composed of sub-angular to sub-rounded grains, 80% quartz and 20% opaque grains and chalk. There is a strong reaction between the unit and HCl.

Scale: 1:2 **Described by: VW** **Date: 10/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 2.30-2.75m
Borehole Number: 0019 SA **Core Sample Number:** U4/7



0-10cm VOID

10-20/22cm 10YR 7/4 very pale brown silty sandy matrix coating the loose gravel clasts. The unit is poorly sorted with angular to rounded flint clasts up to >7cm mean diameter. The matrix adheres to the surface of the flint clasts. The matrix consists of a silty sand with approximately 60% sub-rounded quartz grains, 20% opaque grains and 20% chalk. There is a strong reaction with HCl and the lower boundary is clear and smooth.

Clear smooth

20/22-29/27cm 10YR 6/4 light yellowish brown fine to medium sand with flint gravel clasts. The gravel clasts are matrix supported and sub-rounded to rounded up to 1cm mean diameter. There are also coarse sand sized chalk grains present. The sand fraction is formed from 80% sub-rounded quartz grains, 10% opaque grains and 10% chalk (all of the grains are sub-rounded). Glauconite is also present in small amounts. There is a strong reaction between the sediment and HCl and the lower boundary is sharp and smooth.

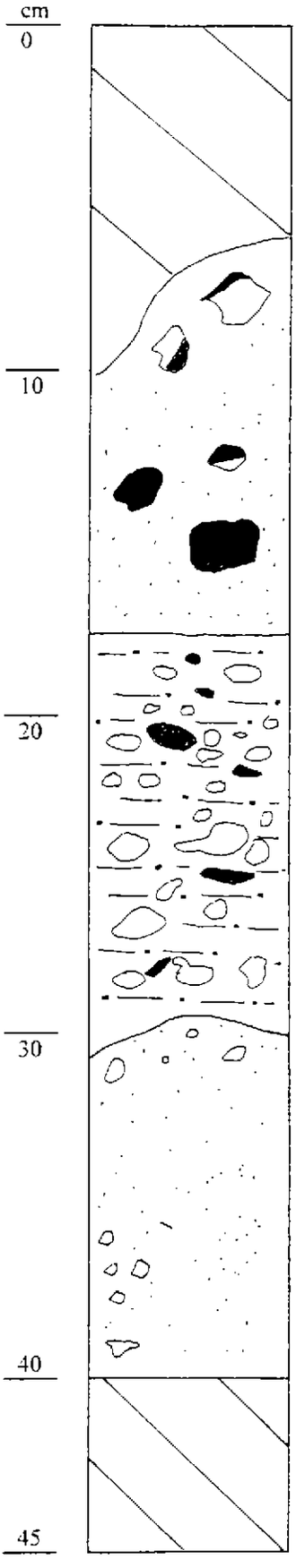
Sharp smooth

29/27-43cm 10YR 6/4 light yellowish brown sand matrix. The gravel fraction is poorly sorted, clast supported and consists of flint and chalk. The chalk clasts are sub-rounded up to 2.5cm mean diameter and the flint clasts are sub-angular to rounded up to 2.5cm mean diameter. There appears to be some preferred orientation with the long axes of some of the clasts being parallel to the upper boundary. There is an increase in the flint content up through the core. The sand fraction formed from 80% sub-rounded quartz grains, 10% opaque grains and 10% chalk Glauconite is also present in small amounts. There is a strong reaction between the sediment and HCl.

Scale: 1:2 **Described by: VW** **Date: 10/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 1.70-2.10m
Borehole Number: 0019 SA **Core Sample Number:** U4/5



0-10/7cm VOID

10/7-17cm 10YR 4/6 dark yellowish brown sandy gravel. The unit is poorly sorted, clast supported and composed of sub-angular to sub-rounded flint gravel clasts up to 2cm mean diameter. The matrix is composed of sub-angular to sub-rounded quartz grains, approximately 10% opaque grains and 1% chalk (possibly from the unit below). There is a strong reaction with HCl and the lower boundary is sharp and smooth.

Sharp smooth

17-31/30cm 10YR 8/2 very pale brown carbonate rich silt matrix in a poorly sorted gravel. The gravel consists of approximately 90% chalk and 10% flint. The clasts are sub-angular to rounded, matrix to clast supported and up to 1cm mean diameter. There is a strong reaction with HCl and the lower boundary is sharp and smooth.

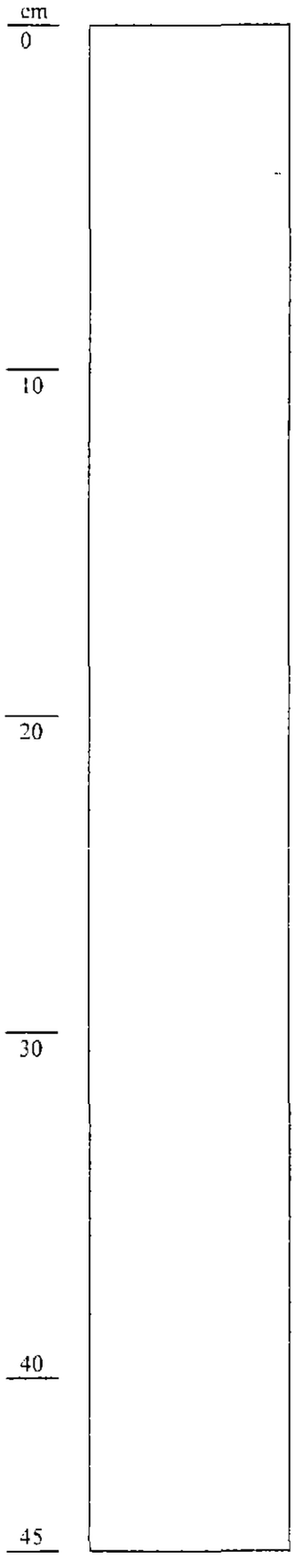
Sharp smooth

31/30-40cm 10YR 5/6 yellowish brown silty sand with chalk gravel clasts at the top of the unit. The unit is moderately sorted and the chalk clasts are sub-rounded matrix supported up to 0.5cm mean diameter. The sand fraction is composed of sub-angular to sub-rounded grains. Quartz forms approximately 90% of the sand the remaining 10% is composed of glauconite and opaque grains. There unit shows a moderate reaction with HCl.

Scale: 1:2 **Described by: VW** **Date: 10/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 1.10-1.50m
Borehole Number: 0019 SA **Core Sample Number:** U4/3

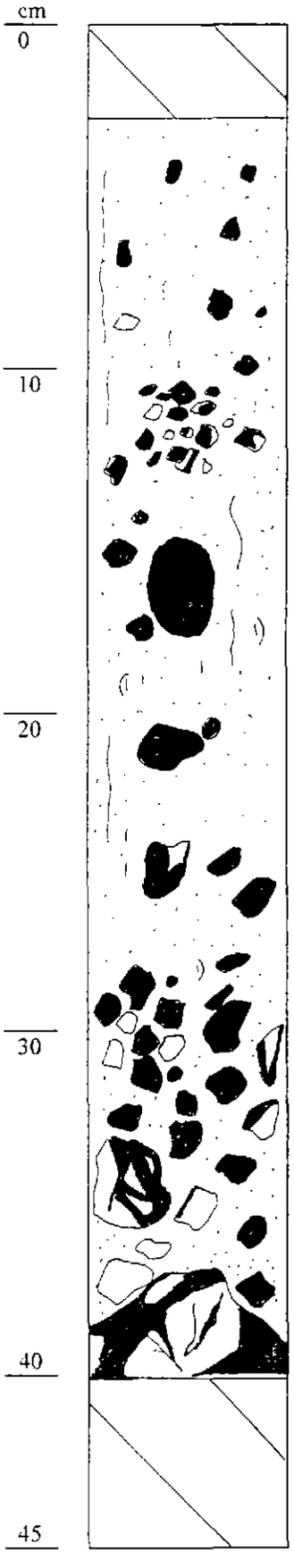


0–40cm The unit is variable in colour depending on the clast colour with a matrix of 10YR 5/4 yellowish brown. The unit is a very poorly sorted gravel with a sandy matrix. The unit is formed from flint gravel clasts which are clast supported and up to approximately 2.5cm mean diameter .The sand fraction is composed of sub-angular to sub-rounded quartz grains, 5% opaque grains, 5% cortex and 1% glauconite. Shell fragments are present and the matrix reacts with HCl.

Scale: 1:2 **Described by: VW** **Date: 10/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 0.50-0.95m
Borehole Number: 0019 SA **Core Sample Number:** U4/1



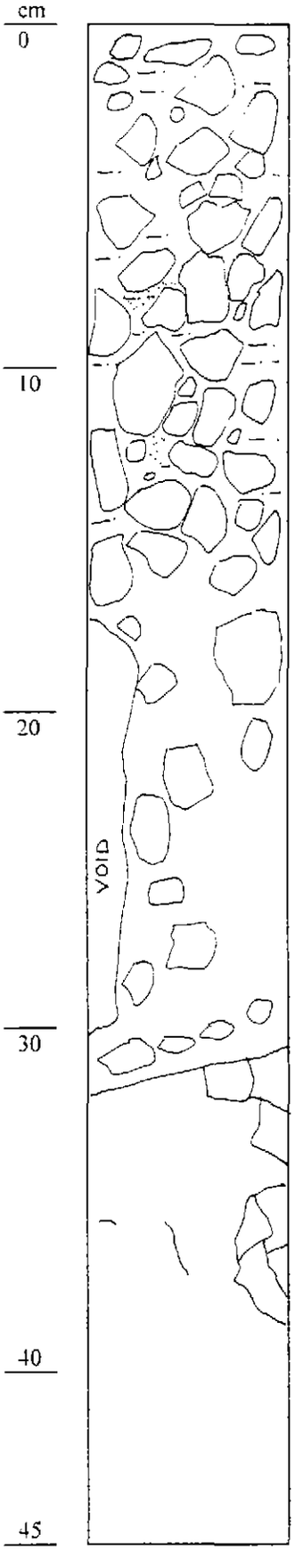
0-3cm VOID

3-40cm 10YR 4/6 dark yellowish brown poorly sorted sandy gravel. The gravel is dominantly clast supported with patches of matrix supported. The clasts are 100% flint sub-angular to rounded up to approximately 6cm mean diameter. The sand fraction is dominated by sub-angular to sub-rounded quartz grains(95%) with approximately5% chalk grains, glauconite and opaque grains. Roots and small shell fragments are present within the core and the sediment reacts with HCl.

Scale: 1:2 **Described by: VW** **Date: 10/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 4.30-4.75m
Borehole Number: 0018SA **Core Sample Number:** U4/12



0-32/31cm 10YR 8/1 white chalk gravel with 10YR 7/4 very pale brown clay silt matrix and staining on the chalk clasts. Two small pockets of 10YR 4/4 dark yellowish brown silty sand. The unit is a poorly sorted, matrix supported chalk gravel with a small amount of matrix. The clasts are sub-rounded up to 3cm mean diameter. There is a strong reaction with HCl and the lower boundary is sharp and smooth.

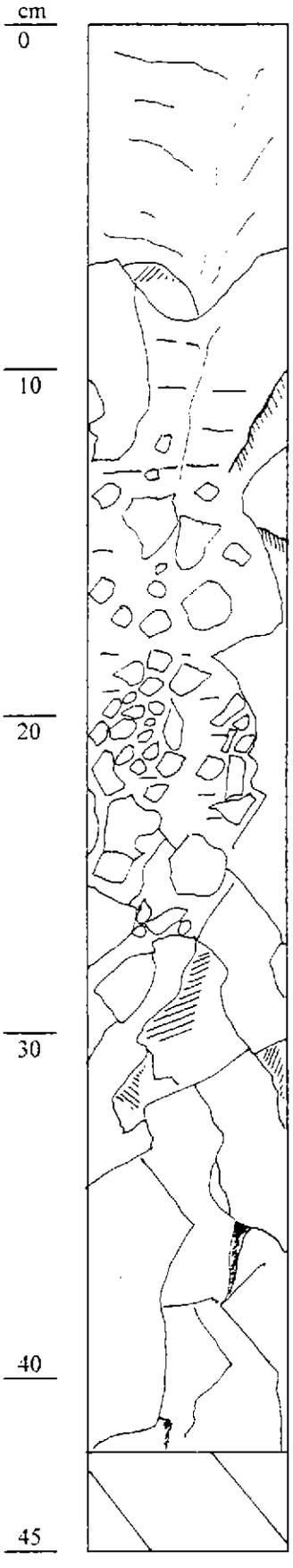
Sharp smooth

32/31-45cm 10YR 8/1 white chalk clasts. The unit is dominated by angular to sub-angular chalk clasts, clast supported. There is no matrix present.

Scale: 1:2 **Described by: VW** **Date: 25/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 3.80-4.25m
Borehole Number: 0018SA **Core Sample Number:** U4/11

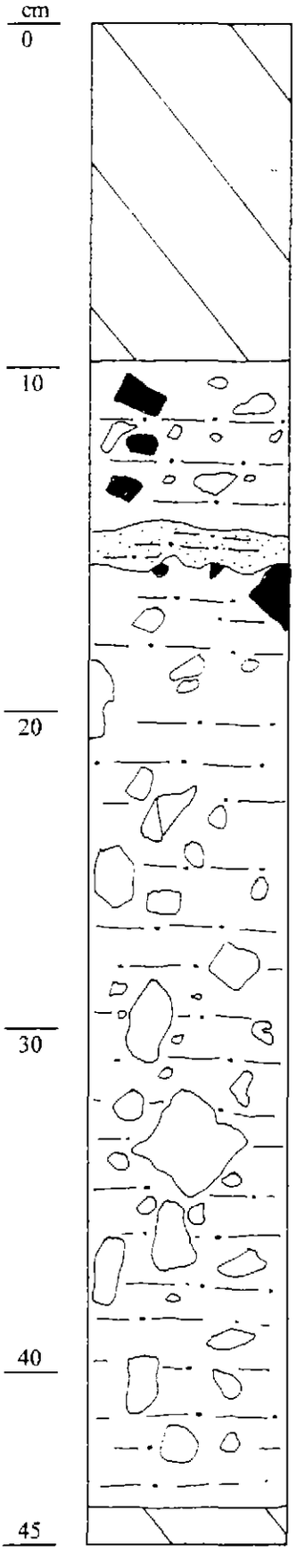


0-42cm White to 10YR 8/2 very pale brown chalk gravel. There is very little matrix present within the unit (dominantly between 10-22cm). The matrix is a 10YR 4/6 dark yellowish brown clay. The gravel is poorly sorted and 100% chalk. The clasts are angular to sub-angular up to >8.5cm mean diameter. It is possible that the material present below 20cm represents fractured bedrock.

Scale: 1:2 **Described by: VW** **Date: 25/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 3.30-3.75m
Borehole Number: 0018SA **Core Sample Number:** U4/10



0-10cm VOID

10-15cm 10YR 8/2 very pale brown chalky gravel. The unit is dense and compact with chalk and flint clasts present. The flint clasts are sub-angular to rounded and the chalk clasts are sub-angular. All of the clasts are clast supported, up to 1.5cm mean diameter and there is a small amount of chalky silt matrix. The silt shows a strong reaction with HCl and the lower boundary is smooth and sharp.

Sharp smooth

15-16cm 10YR 4/6 dark yellowish brown silty sand. Angular flint gravel clasts are present at the lower boundary. These clasts are up to 0.5cm mean diameter. The sand fraction is composed of approximately 95% quartz and 5% opaque grains with small amounts of glauconite and chalk. All of the grains are sub-angular to sub-rounded and the sediment reacts with HCl.

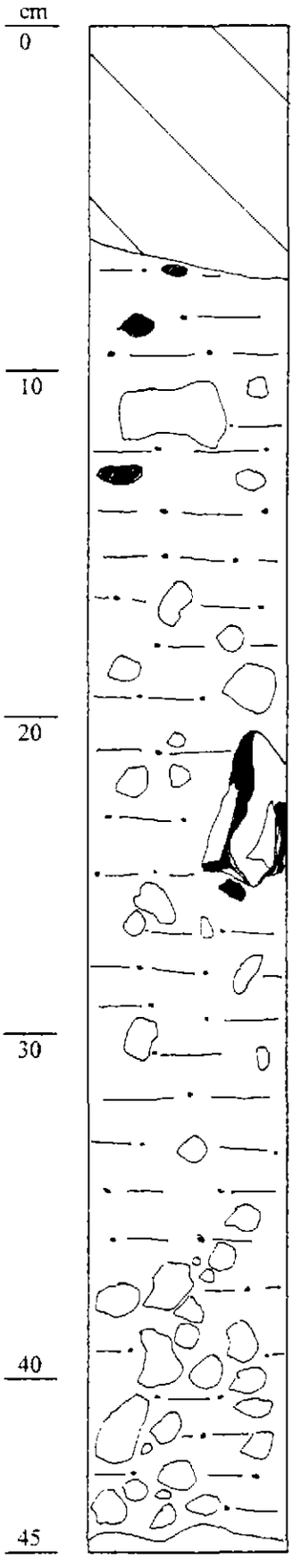
Sharp smooth

16-45cm 10YR 8/3 very pale brown chalk gravel. The gravel is almost all chalk with a single clast of flint at the top of the unit. This clast is sub-angular and approximately 2cm mean diameter. The chalk clasts are sub-angular to sub-rounded and up to 3.5cm mean diameter. The gravel is poorly sorted and matrix supported. The matrix is composed of a carbonate silt which reacts strongly with HCl.

Scale: 1:2 **Described by: VW** **Date: 9/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 2.80-3.25m
Borehole Number: 0018SA **Core Sample Number:** U4/9



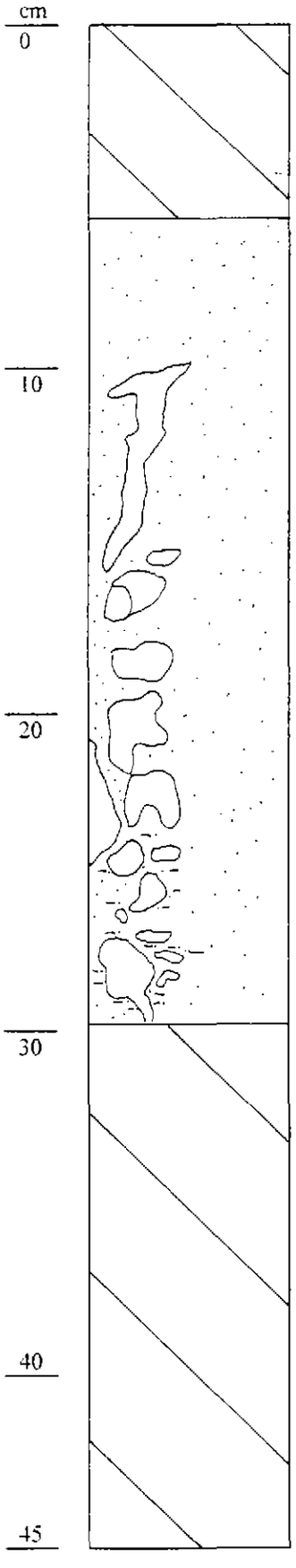
0-6cm VOID

6-45cm 10YR 7/4 very pale brown to 10YR 8/3 very pale brown carbonate silt matrix within a chalk gravel. The gravel is poorly sorted and dominated by sub-angular to sub-rounded chalk gravel clasts up to 3cm mean diameter. The unit changes from dominantly matrix supported at the top of the core to dominantly clasts supported at the base of the core. This reflects a slight increase in the number of clasts present within the core. There is a small percentage of flint clasts present within the core. The flint clasts are sub-rounded and up to 3cm mean diameter. The sediment shows a strong reaction with HCl.

Scale: 1:2 **Described by: VW** **Date: 8/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 2.30-2.60m
Borehole Number: 0018SA **Core Sample Number:** U4/7



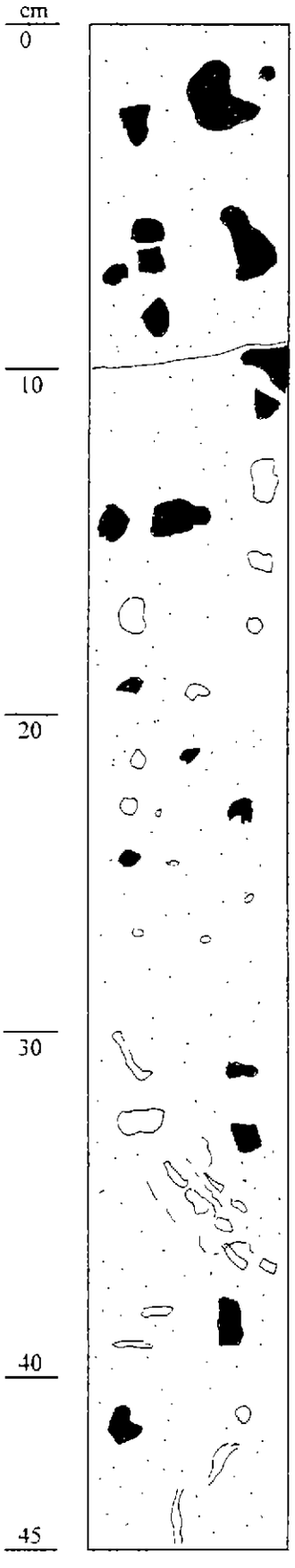
0-6cm VOID

6-30cm 10YR 5/6 yellowish brown well sorted fine sand. Chalk clasts are present down the side of the core. These clasts are sub-rounded matrix supported and up to 2cm mean diameter. The sand fraction is composed of approximately 90% quartz, 5% dark opaque grains, 5% chalk and <1% glauconite. All of the grains are sub-rounded. Towards the base of the core there appears to be carbonate silt which has formed around chalk clasts. There is a strong reaction with HCl.

Scale: 1:2 **Described by: VW** **Date: 8/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 1.70-2.15m
Borehole Number: 0018SA **Core Sample Number:** U4/5



0-10/9cm 7.5YR 4/6 strong brown gravely sand. The gravel clasts are 100% flint angular to sub-angular, matrix supported up to 2cm mean diameter. The sand fraction is well sorted and composed of >95% quartz grains, <1% glauconite and the rest is composed of opaque grains. All of the grains are sub-angular to sub-rounded. There is no reaction with HCl

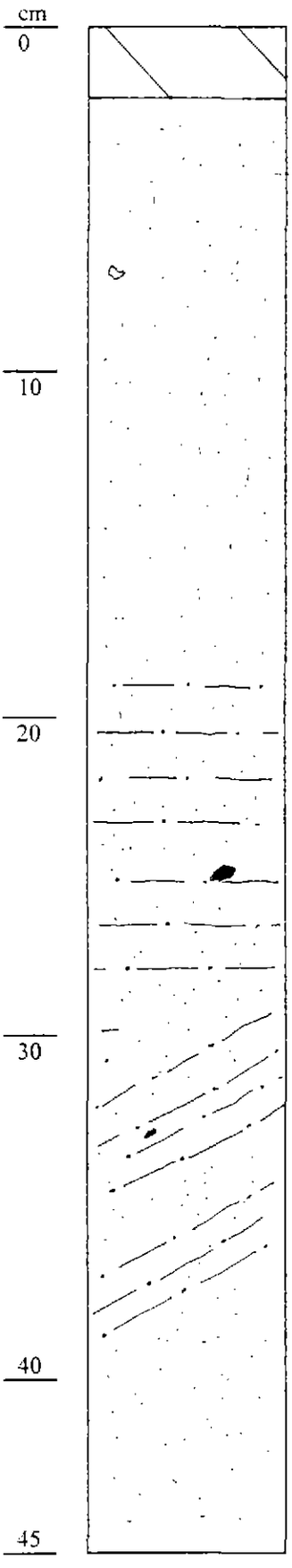
Sharp smooth

10/9-45cm 10YR 6/6 brownish yellow gravely sand. The gravel is composed of angular to sub-angular matrix supported flint clasts up to 2cm mean diameter and sub-rounded chalk clasts up to approximately 1.5cm mean diameter. The clasts are matrix supported. The sand fraction is well sorted with approximately 93% quartz grains, 5% chalk grains 1% glauconite and the rest is composed of opaque grains. Towards the base of the unit carbonate material forms a marbling affect through the sand. The sediment reacts with HCl.

Scale: 1:2 **Described by: VW** **Date: 8/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 1.10-1.55m
Borehole Number: 0018SA **Core Sample Number:** U4/3



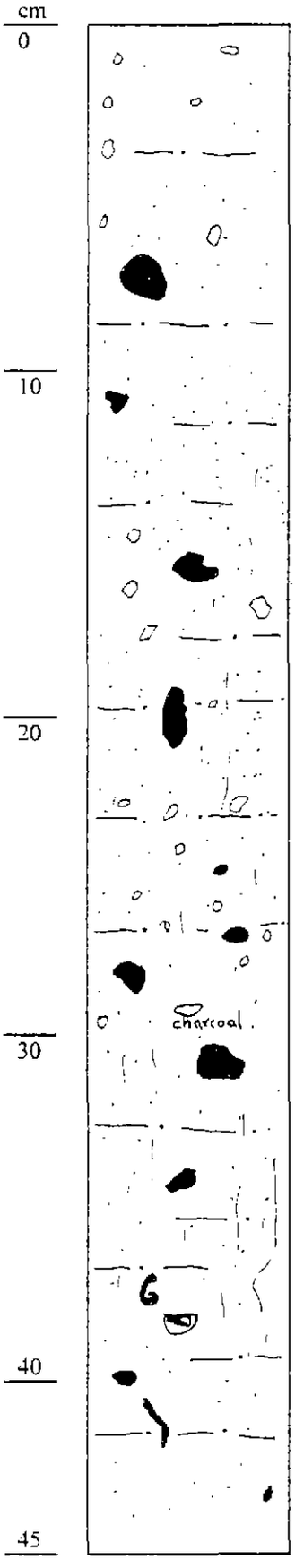
0-2cm VOID

2-45cm 10YR 5/6 yellowish brown to 7.5YR 4/6 strong brown. The change in colour within the well sorted sand reflects an increase in the silt content with a darkening in colour. Rare flint and chalk clasts are also present. These are sub-rounded to rounded up to 1cm mean diameter, matrix supported. The sand fraction is well sorted dominated by sub-rounded quartz grains approximately 97%, 1% glauconite, 1% opaque grains and 1% chalk. The darker bands within the unit show some cementation. There is no reaction with HCl. The bands have sharp smooth boundaries and roots are present in the top of the core.

Scale: 1:2 **Described by: VW** **Date: 8/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 0.50-0.95m
Borehole Number: 0018SA **Core Sample Number:** U4/1

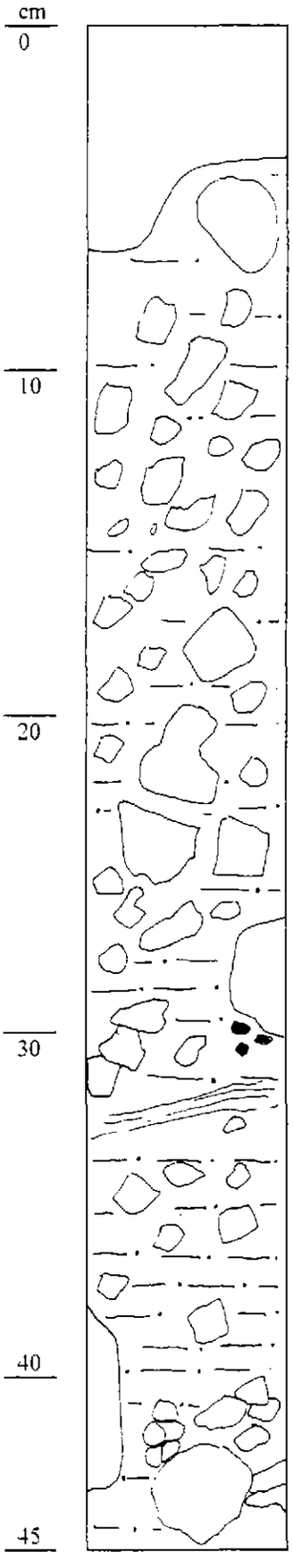


0-45cm The top of the unit is a 10YR 3/6 dark yellowish brown but this changes down through the core with a decrease in the silt content to a 10YR 4/6 dark yellowish brown. The whole unit is a silty sand which contains matrix supported flint and chalk gravel clasts. The chalk clasts become more frequent up through the core. They are sub-angular to sub-rounded and up to 0.5cm mean diameter. The sand fraction is composed of sub-angular to sub-rounded grains with approximately 90% quartz and 10% opaque grains. The unit also contains roots and root traces and a charcoal fragment. Below 30cm carbonate material has a marbling affect through the sand. The sediment throughout the core shows a strong reaction to HCl.

Scale: 1:2 **Described by: VW** **Date: 9/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 4.10-4.55m
Borehole Number: 0017 SA **Core Sample Number:** U4/14



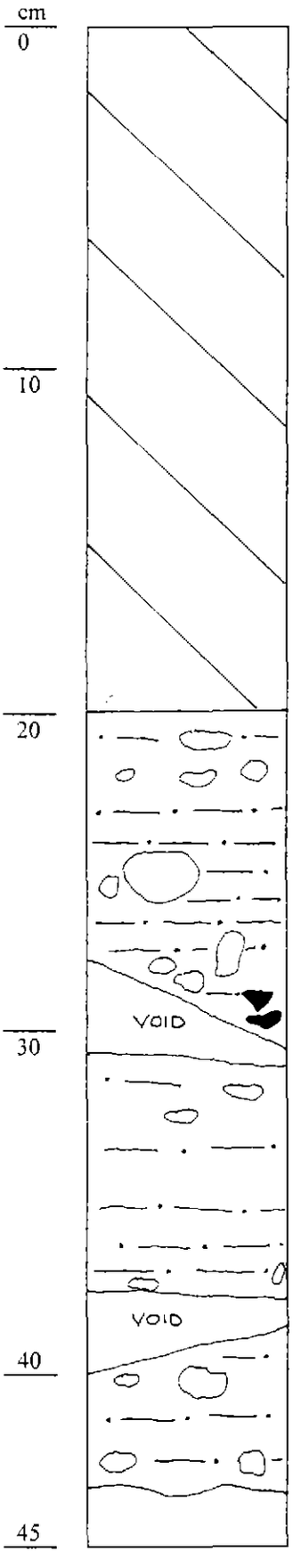
0-7/4cm VOID

7/4-45cm Variably stained chalk gravel. The staining ranges from 10YR 6/8 brownish yellow where it forms a strong band through the core at 31cm. 10YR 8/3 very pale brown at the top of the core. The gravel is poorly sorted and almost 100% chalk. The clasts are clast supported, sub-angular to sub-rounded up to approximately 4cm mean diameter. Flint clasts are present between 28 and 30cm where they are angular and up to 0.5cm mean diameter.

Scale: 1:2 **Described by: VW** **Date: 10/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 3.60-4.05m
Borehole Number: 0017 SA **Core Sample Number:** U4/12



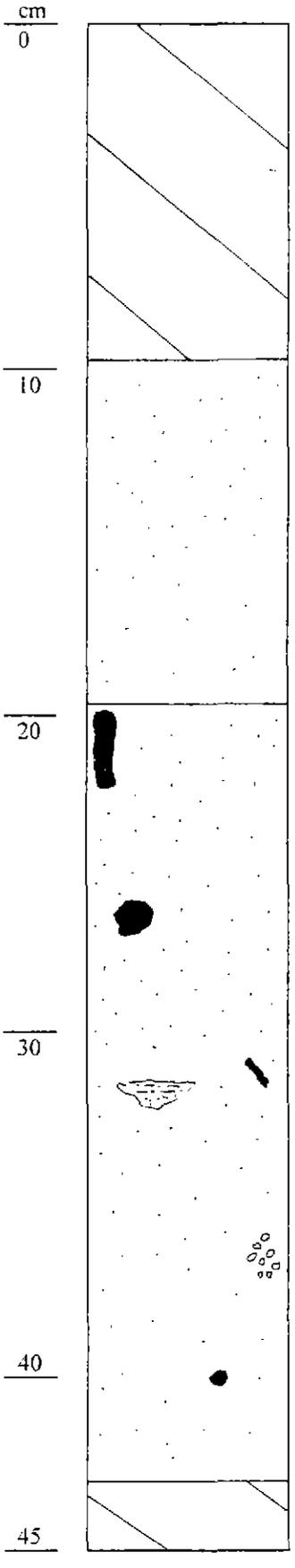
0-20/19cm VOID

20/19-43cm 10YR 6/4 light yellowish brown silt matrix in a chalky gravel. The unit is poorly sorted consisting of matrix supported gravel clasts. The chalk clasts are predominantly sub-angular to sub-rounded and up to 3cm mean diameter. The flint clasts are angular approximately 0.5cm mean diameter. The matrix is composed of carbonate silt with rare <1% quartz, <1% flint and opaque grains and up to 5% chalk grains. All of the grains are sub-rounded except the flint grains which are sub-angular to angular. The matrix reacts with HCl.
There are voids in the core created during the splitting of the core due to the hard, dry and clast rich nature of the sample.

Scale: 1:2 **Described by: VW** **Date: 9/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 3.10-3.55
Borehole Number: 0017 SA **Core Sample Number:** U4/10



0-10cm VOID

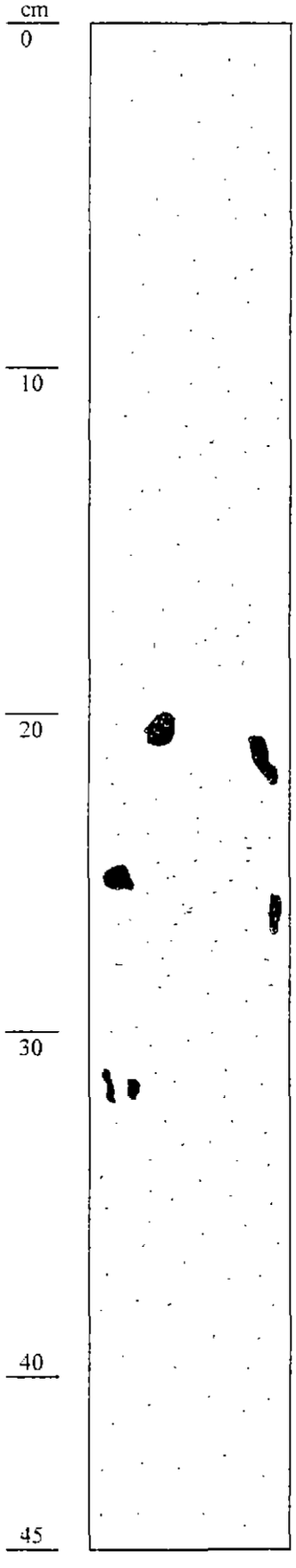
10-20cm 7.5YR 5/6 strong brown well sorted loose unconsolidated sand. The sand is formed from sub-angular to sub-rounded quartz grains with up to 5% glauconite and 5% dark opaque grains and the is no reaction with HCl.

20-45cm 7.5YR 5/6 strong brown well sorted sand with matrix supported gravel clasts. The clasts are sub-angular to sub-rounded and dominated by flint. The flint clasts are up to approximately 2cm mean diameter and present throughout the core. Chalk clasts are up to 0.5cm mean diameter and are present below 36cm. This sand unit has a higher silt content than the unit above and the sand has a similar composition being dominated by quartz with 5% glauconite and 5% dark opaque grains. There is a single intra clast of 7.5YR 3/4 dark brown silty sand at 32cm. There is a reaction between the sediment and HCl below 34cm.

Scale: 1:2 **Described by: VW** **Date: 9/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 2.60-3.05m
Borehole Number: 0017 SA **Core Sample Number:** U4/8

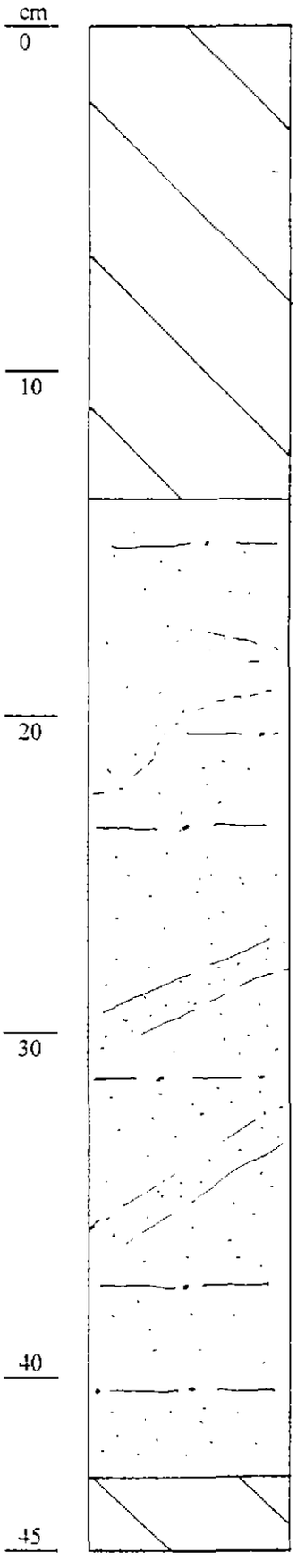


0-45cm 10YR 5/6 yellowish brown to 7.5YR 4/6 strong brown (with a higher silt content). The unit is a fine sand, well sorted with occasional flint gravel clasts. These are matrix supported sub-angular to rounded up to approximately 1.5cm mean diameter. The sand fraction is composed of approximately 94% quartz, 5% opaque grains and 1% glauconite. All of the grains are sub-angular to sub-rounded. An increase in the silt content is shown by a reddening of the unit which has an irregular banded distribution through the core. The sediment shows no reaction with HCl.

Scale: 1:2 **Described by: VW** **Date: 9/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 2.10-2.55m
Borehole Number: 0017 SA **Core Sample Number:** U4/7



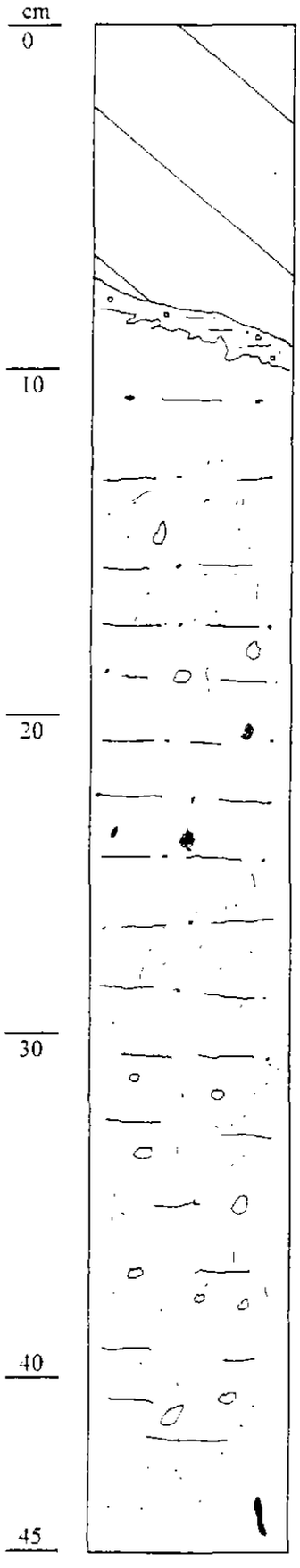
0-14cm VOID

14-42cm The colour of the unit varies with the silt content. A low silt content gives a 10YR 5/8 yellowish brown, this darkens to a 7.5YR 4/6 strong brown with an increase in the silt content. The unit is a well sorted silty sand to sand. The sand is composed of sub-angular to sub-rounded quartz grains. Less than 5% of the sand is formed of dark opaque grains and glauconite. There is no change in the composition within the silty areas. The unit is banded with some of the bands showing a low silt content. The sediment does not react with HCl.

Scale: 1:2 **Described by: VW** **Date: 9/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 1.60-2.05m
Borehole Number: 0017 SA **Core Sample Number:** U4/5



0-7/8cm VOID and contamination from higher in the sequence.

7/8-8/11cm 10YR 3/2 very dark greyish brown sandy silt with clasts of chalk, ceramic building material and slag? The clasts are coarse sand sized to fine gravel sized, sub-rounded to rounded and matrix supported. The unit is moderately sorted. The sand fraction is composed of sub-rounded quartz grains and finer opaque grains. The sediment reacts with HCl and the lower boundary is sharp and irregular.

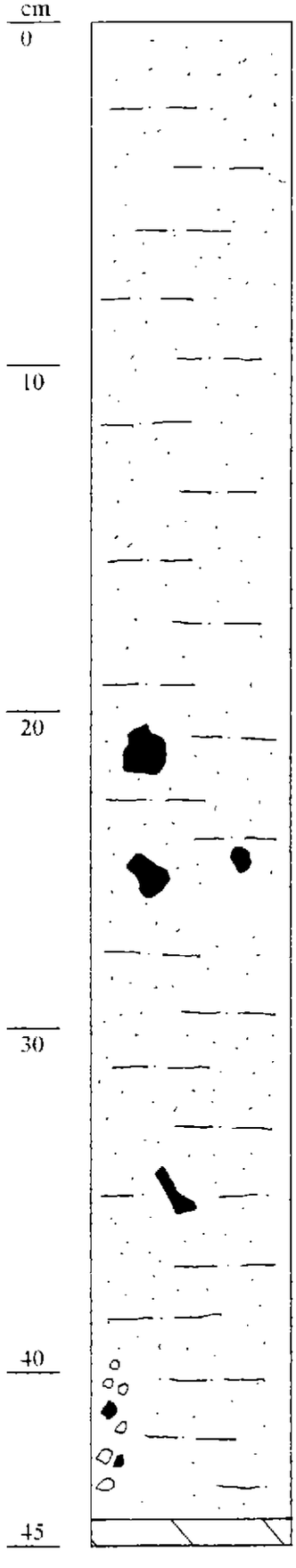
Sharp irregular

8/11-45cm 7.5YR 4/6 strong brown silty sand. Moderately sorted with rare flint and chalk clasts. The clasts are matrix supported sub-angular (flint) and sub-rounded (chalk) up to 0.5cm mean diameter. The sand fraction is composed of sub-rounded quartz grains and 5% opaque grains. Carbonate material is present and shows a marbling affect. There is a strong reaction between the sediment and HCl.

Scale: 1:2 **Described by: VW** **Date: 10/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 1.10-1.55
Borehole Number: 0017 SA **Core Sample Number:** U4/3

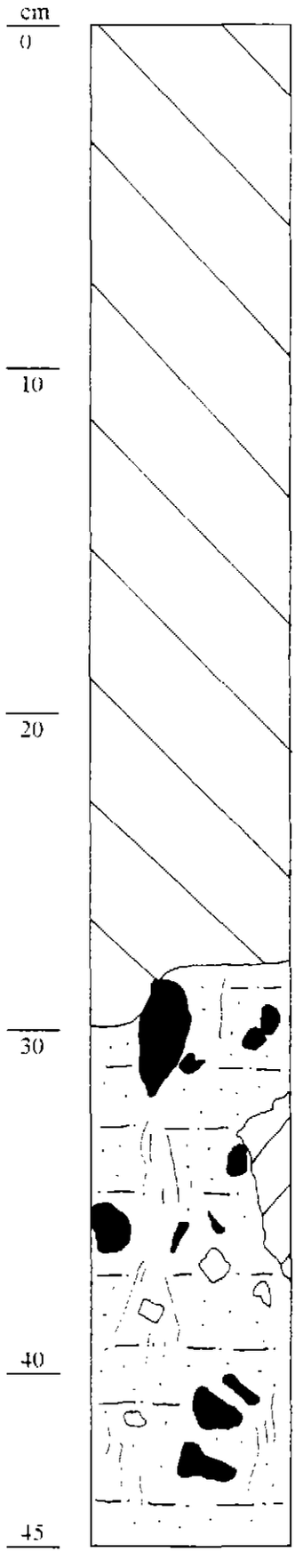


0-44cm 10YR 3/6 dark yellowish brown lightening to 7.5YR 4/4 brown silty fine sand. There is a decrease in the silt content down through the core. Matrix supported flint gravel clasts are found throughout the core. These are rounded to sub-angular up to 2cm mean diameter. Chalk clasts are also present below 38cm. These are sub-rounded, matrix to clast supported and up to 0.5cm mean diameter. The sand fraction is well sorted and composed of sub-angular to sub-rounded quartz grains with <5% opaque grains. Fine roots are present within the unit and the sediment reacts with HCl.

Scale: 1:2 **Described by: VW** **Date: 9/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 0.50-0.95
Borehole Number: 0017 SA **Core Sample Number:** U4/1



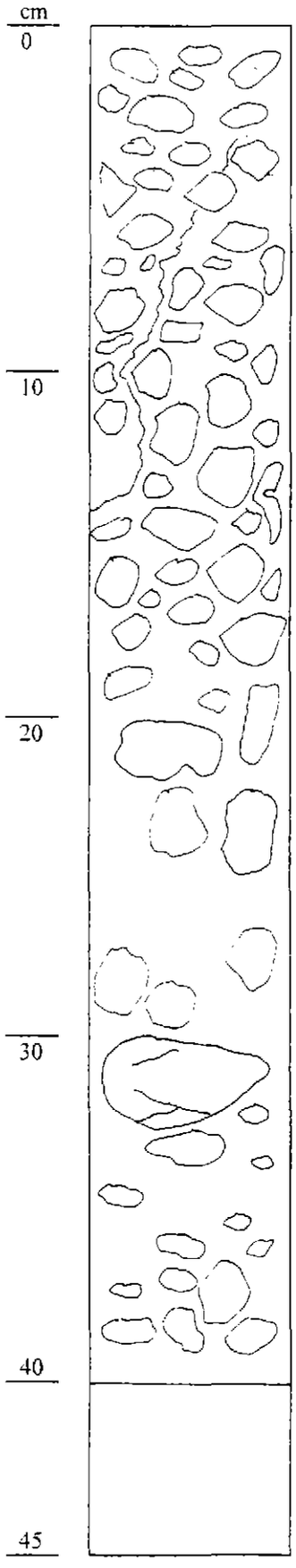
0-30/28cm VOID

30/28-45cm 10YR 3/4 dark yellowish brown silty sand with flint and chalk gravel . The clasts are matrix supported with a 60% flint : 40% chalk split. The clasts are sub-angular to rounded and up to 3cm mean diameter. The sand fraction is dominated by sub-angular to sub-rounded quartz grains with 5% opaque grains. There are inclusions of 10YR 2/2 very dark brown sandy silt at the edge of the core. Fine roots are present throughout the core and there is a strong reaction between the sediment and HCl.

Scale: 1:2 **Described by: VW** **Date: 9/4/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 4.10-4.50m
Borehole Number: 0016 SA **Core Sample Number:** U4/14

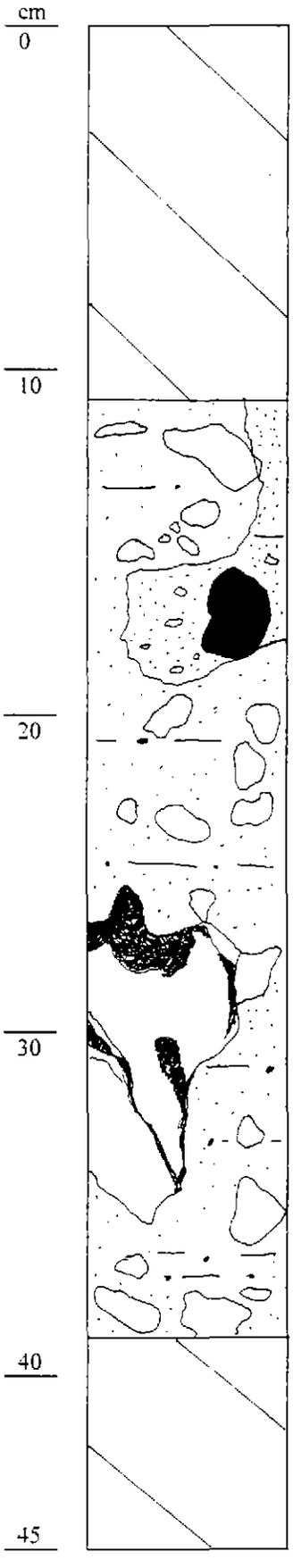


0-40cm 10YR 8/2 very pale brown silty chalk with a putty like matrix in a chalk gravel. There is some 10YR 7/4 very pale brown staining (iron?). The unit is moderately to poorly sorted with sub-rounded clast, matrix supported clasts up to 8cm mean diameter.

Scale:1:2 **Described by: VW** **Date: 7/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 3.40-3.80m
Borehole Number: 0016 SA **Core Sample Number:** U4/13



0-11cm VOID

11-39cm 10YR 7/3 very pale brown silty putty chalk matrix within a chalk gravel. The gravel is poorly sorted with chalk gravel clasts up to 2.5cm mean diameter and a single flint clast approximately 10cm mean diameter. The flint is a nodular angular shape. The chalk clasts are sub-angular to sub-rounded. The gravel is clast to matrix supported and the matrix shows a strong reaction with HCl.

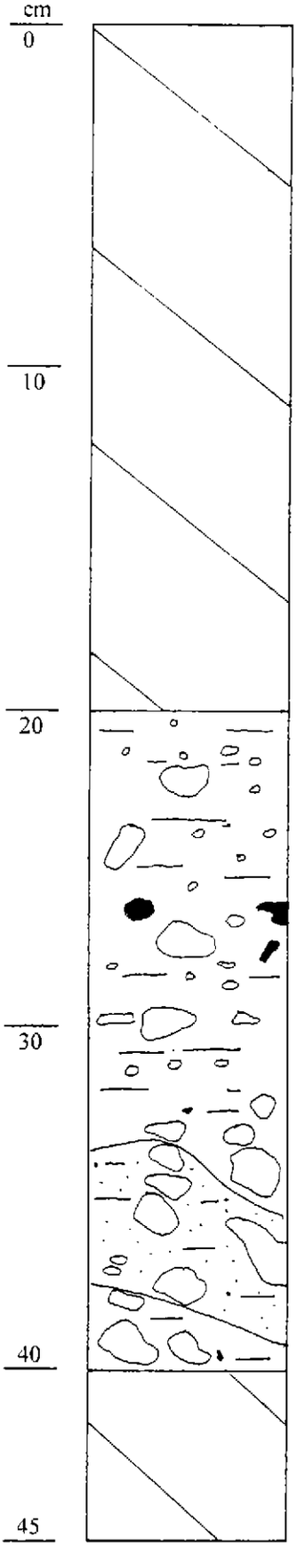
Sharp smooth

11-19cm This is a wedge of sediment towards the top of the core. 10YR 5/4 yellowish brown silty fine sand matrix in a gravel. The unit is poorly sorted and contains both flint and chalk clasts. The clasts are matrix supported and dominated by chalk clasts up to 0.5cm mean diameter. There is a single rounded flint clast approximately 2.5cm mean diameter. The chalk clasts are sub-rounded. The sand fraction is dominated by quartz (approximately 95%), 4% chalk and 1% flint. There is a very small amount of glauconite present. All of the grains are angular to sub-angular and there is a strong reaction with HCl.

Scale:1:2 **Described by: VW** **Date: 7/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 2.90-3.30m
Borehole Number: 0016 SA **Core Sample Number:** U4/11



0-20cm VOID

20-34/35.5cm 10YR 7/3 very pale brown silt matrix in a poorly sorted chalk gravel. There are also a small number of flint clasts. The chalk clasts are sub-rounded to rounded and up to 1cm mean diameter. The flint clasts are sub-angular to sub-rounded up to 1cm mean diameter. The gravel is matrix supported and composed of approximately 99% chalk. There is a strong reaction between the sediment and the HCl.

Sharp smooth

34/35.5-37.5/39cm 10YR 5/6 strong brown silty sand with matrix supported chalk gravel clasts. The unit is poorly sorted and only contains chalk clasts. These clasts are sub-angular to sub-rounded up to 3cm mean diameter. The sand fraction is dominated by 95% quartz, with 2% chalk, 3% flint and <1% glauconite. All of the grains are sub-rounded. There is a strong reaction with HCl and the lower boundary is sharp and smooth.

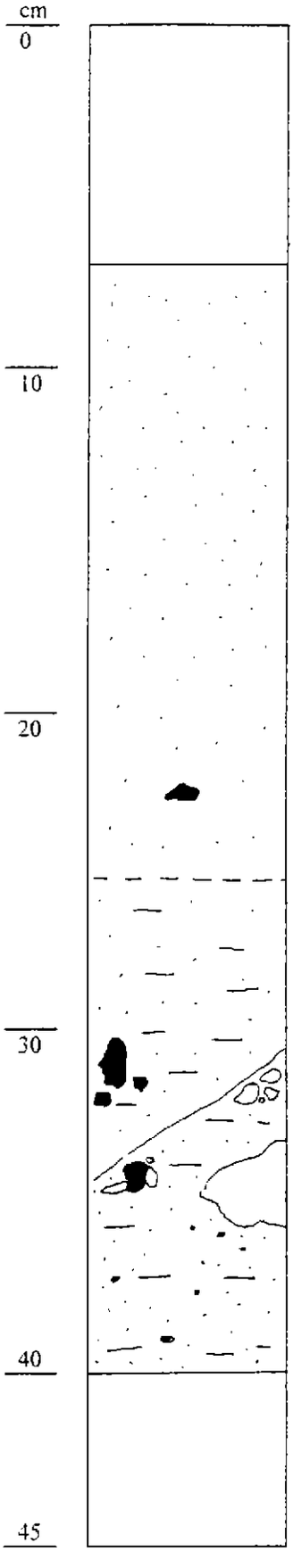
Sharp smooth

37.5/39-40cm 10YR 7/3 very pale brown silt matrix in a poorly sorted chalk gravel. There are also a small number of flint clasts. The chalk clasts are sub-rounded to rounded and up to 1cm mean diameter. The flint clasts are sub-angular to sub-rounded up to 1cm mean diameter. The gravel is matrix supported and composed of approximately 99% chalk. There is a strong reaction between the sediment and the HCl.

Scale:1:2 **Described by: VW** **Date: 7/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 2.40-2.80m
Borehole Number: 0016 SA **Core Sample Number:** U4/9



0-7cm VOID

7-26cm The unit is slightly mottled and contains bands of 5YR 4/4 reddish brown clayey sand and 10YR 4/6 strong brown fine sand. There are also patches of 10YR 5/4 brown fine sand. The banding is irregular. There is a single sub-rounded flint gravel clast 0.5cm mean diameter. The sand fraction is well sorted and dominated by 95% quartz. The colour of the sand unit reddens with an increase in the clay/silt content. There is no reaction with HCl and the lower boundary is sharp and smooth.

Sharp smooth

26-35/31cm 7.5YR 4/4 brown clayey sand. well sorted with 3 flint gravel clasts. The largest is approximately 1.5cm mean diameter, sub-angular. The sand fraction is well sorted, dominated by 95% sub-rounded quartz the rest formed from flint grains. The clay/silt content increases down through the unit. There is no reaction with HCl and the lower boundary is sharp and smooth.

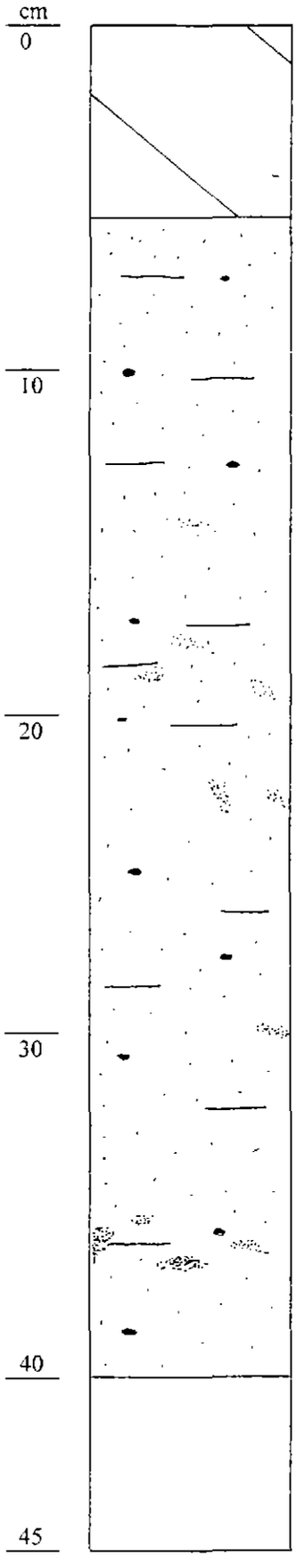
Sharp smooth

35/31-40cm 10YR 6/4 light yellowish brown slightly sandy silt matrix in a chalky gravel. The unit contains chalk clasts with rare flint clasts up to 2.5cm mean diameter, sub-rounded and matrix supported. The matrix contains a small amount of sand which is dominated by chalk grains with <1% quartz and some glauconite <1%. There is a strong reaction between the sediment and HCl and the lower boundary is sharp and smooth.

Scale:1:2 **Described by: VW** **Date: 7/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 1.95-2.35m
Borehole Number: 0016 SA **Core Sample Number:** U4/7



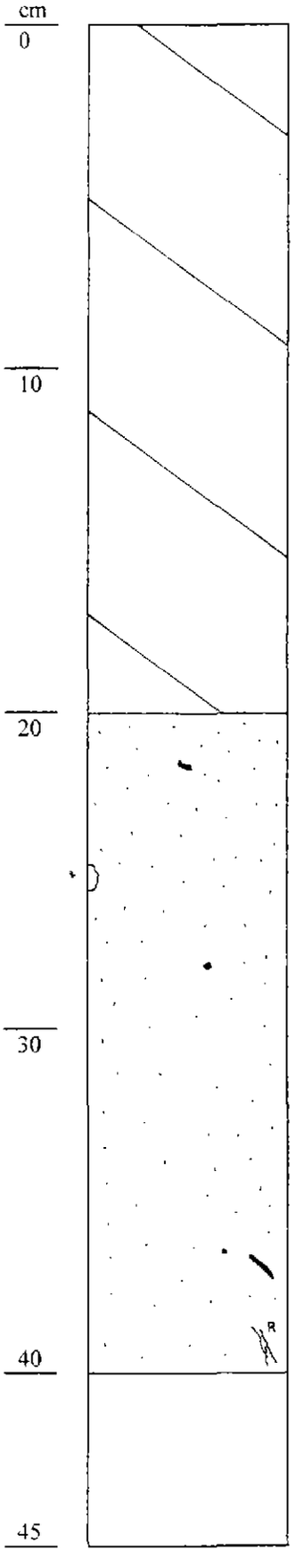
0-6cm VOID

6-40cm 5YR 4/4 reddish brown silty fine sand. There are patches of 7.5YR 5/6 strong brown sand. There is no clear bedding however there is a concentration of sand patches below 36cm. The sand fraction is almost 100% sub-rounded quartz grains. The sediment shows a slow reaction with HCl.

Scale:1:2 **Described by: VW** **Date: 10/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 1.50-1.90m
Borehole Number: 0016 SA **Core Sample Number:** U4/5



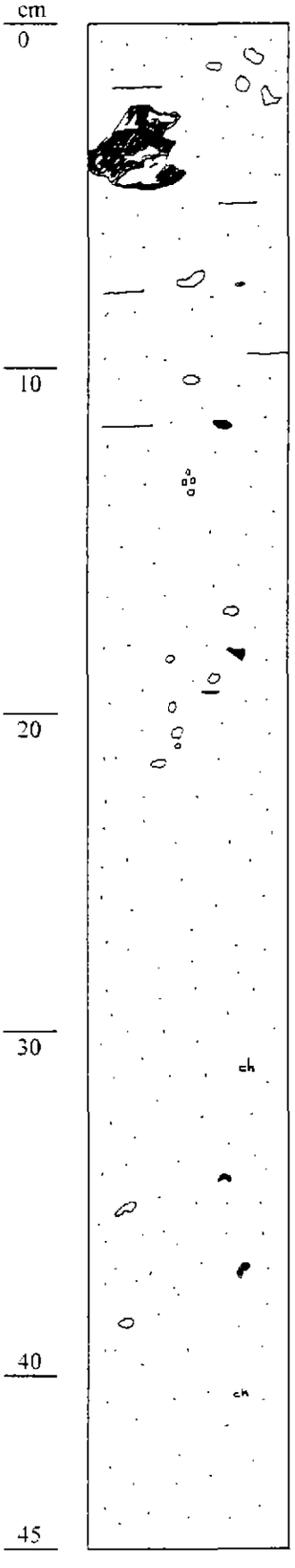
0-20cm The core is contaminated by material from higher in the sequence.

20-40cm 7.5YR 4/4 brown lightening to 7.5YR 5/6 strong brown down through the core due to a slight increase in the silt content within the fine sand. The unit is a very well sorted fine sand. There is a single sub-rounded chalk gravel clast 0.5cm mean diameter. There are coarse sand/fine gravel flint clasts present but rare. A single flint gravel clast, angular, 0.5cm mean diameter is present at 36cm. The sand fraction is composed of quartz. There are medium sand sized grains which appear to have clay coatings. The sand grains are sub-rounded. There is some rooting present within the unit and there is a strong reaction between the sediment and HCl.

Scale:1:2 **Described by: VW** **Date: 10/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 1.00-1.45m
Borehole Number: 0016 SA **Core Sample Number:** U4/3

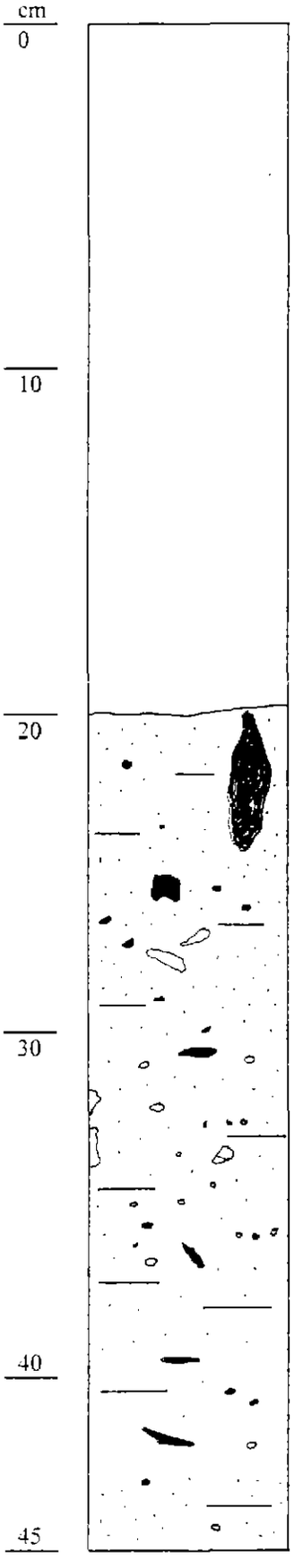


0-45cm The unit shows a slight colour variation depending on the silt content 7.5YR 3/4 dark brown with a higher silt content to 7.5YR 4/4 with a lower silt content. The unit is a fine sand with a silt fraction which increases up through the unit. Above 6cm there are two sub-angular flint clasts the largest of which is approximately 3cm mean diameter. These two clasts rest on each other. There are smaller flint and chalk clasts which are matrix supported up to 0.5cm mean diameter present throughout the unit. These are matrix supported, sub-angular to sub-rounded with 60% chalk and 40% flint. The unit appears to have a network of fine roots canals now infilled by carbonate material, charcoal flecks are present below 24cm and the unit reacts with HCl.

Scale:1:2 **Described by: VW** **Date: 10/3/97**

GSF U4 / U100 Core Sample Description

Site Code: EFT/97 **Core Depth:** 0.50-0.95m
Borehole Number: 0016 SA **Core Sample Number:** U4/1



0-20cm VOID

20-45cm 7.5YR 3/4 dark brown silty fine sand with gravel clasts. The clasts are matrix supported, composed of flint and chalk (approximately 50:50). The chalk clasts are smaller up to approximately 1cm mean diameter, sub-rounded. The flint clasts are sub-angular to rounded up to approximately 3cm mean diameter. The sand fraction is composed of quartz, with some medium sand sized grains. The unit appears to have a network of fine roots present through it and these have been infilled by carbonate material. The sediment shows a strong reaction with HCl.

Scale:1:2 **Described by: VW** **Date: 10/3/97**

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26 September 1997

Our Ref: 004-L97-LKKCC-00038-1347/CGP
Your Ref:

Kent County Council
Planning Department
Springfield
MAIDSTONE
ME14 2LQ

For the Attention of: Dr J. Williams

Dear Sir,

Subject : CTRL Archaeology Programme
Addendum to Ebbsfleet Evaluation Report

We are pleased to enclose the report on the Amino Acid dates prepared for the above evaluation.

We trust that you find this data informative.

Yours sincerely

Chris Place
Senior Archaeologist

cc Doc Con
L. Wilcox
M. Nay
R. Dio

APPENDIX 13 (ADDENDUM)

AMINO ACID GEOCHRONOLOGY

Amino acid geochronology is commonly used by Quaternary scientists to provide a framework of relative order to events recorded in the geological record. The use of amino acid geochronology in archaeological studies has recently been discussed by Johnson and Miller (1997) and further details by Miller and Brigham-Grette (1989). An amino acid geochronological framework is now well established for the Lower Thames area (Bowen *et al.* 1989; Bridgland 1994), however, in order to determine the significance of the ratios derived from the samples submitted in this study the following points need to be noted:

- amino acid epimerization studies do not directly provide age estimates in years before present. In this case ratios of D-alloisoleucine to L-isoleucine are investigated that show progressive increases through time towards equilibrium, hence comparative material from a number of sites is required in order to ascribe relative age to a site

- different species of molluscs epimerize at different rates, therefore ratios derived from one species cannot be directly compared with another species

- temperature plays an important role in determining how quickly epimerization occurs therefore all samples considered must have experienced similar diagenetic temperature histories.

Here comparative information has been selected from data published by Bowen (*et al.* 1989) from sites in southern England that are thought to have experienced similar diagenetic temperature histories (Table 2).

Results from borehole 0021SA, species *Cepaea* sp. (Table 1), compare well with ratios obtained from last interglacial sites such as Trafalgar Square (Table 2). However the ratios obtained from the freshwater species *Bithynia tentaculata*, from the same stratigraphical horizon, appear to contain two discrete groups of ratios including a group with higher, older ratios and a group of very low ratios. This evidence may indicate mixing of populations and contamination of sequences by younger sediments. The two groups of ratios indicate that both a Holocene component and a Pleistocene component exist in the sample. Ratios from the older, Pleistocene component are a little lower than expected for true last interglacial deposits (Oxygen Isotope Sub-Stage (OIS) 5e - c. 120,000 B.P.), although little comparative data is available for this species, and a later OIS sub-stage of 5 or OIS 4 age may be indicated.

The results from test pit ARC 2006TP produce very low ratios, that by comparison with those obtained from the site at Halling in Kent, indicate a post late-glacial age (Table 2). A Holocene age for these deposits is indicated.

The results from Section 193 are lower than those expected for a true last interglacial (OIS 5e) site and considerably smaller than those for a site of possible OIS 7 date. A later OIS sub-stage of 5 or OIS 4 age may be indicated.

DISCUSSION

These results indicate that some of the sediments existing at the eastern end of Section 193 are considerably younger than those recorded in previous excavations to the north within the area excavated by the British Museum (Area 1 the scheduled ancient monument). The sediments within this part of the section appear to be of last interglacial or even early Devensian in age.

The sediments within the area of borehole investigation to the east of Area 1 remains equivocal. Sediments from borehole 0021SA indicate that a strong component of probable last interglacial molluscs exist in the fauna. However, one mollusc was clearly of Holocene age and may indicate contamination of the sequence by more recent material or mixing of a Holocene sequence with reworked Pleistocene material.

The sediments from test pit 2006TP clearly contained a Holocene fauna that implies considerable reworking of the Pleistocene sediments in the area or contamination from overlying units through biological activity including rooting.

The ascription of any sediments in the route corridor to the last interglacial is of considerable archaeological significance as presently no *in situ* archaeological material recovered in southern England can be ascribed to this phase. The presence of recovered artefacts, within section 193 in sediments of possible last interglacial date, is of considerable potential importance to understanding later Pleistocene human activity in southern Britain. However, the stratigraphical relationship between the dated sediments and the artefact bearing sediments needs further investigation.

Refs.

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Bridgland, D.R. 1994 **Quaternary History of the Thames**. Geological Conservation Review Series. Chapman and Hall: London. 441pp.

Johnson, B.J. and Miller, G.H. 1997 Archaeological applications of amino acid racemization. **Archaeometry 39**, 265-287.

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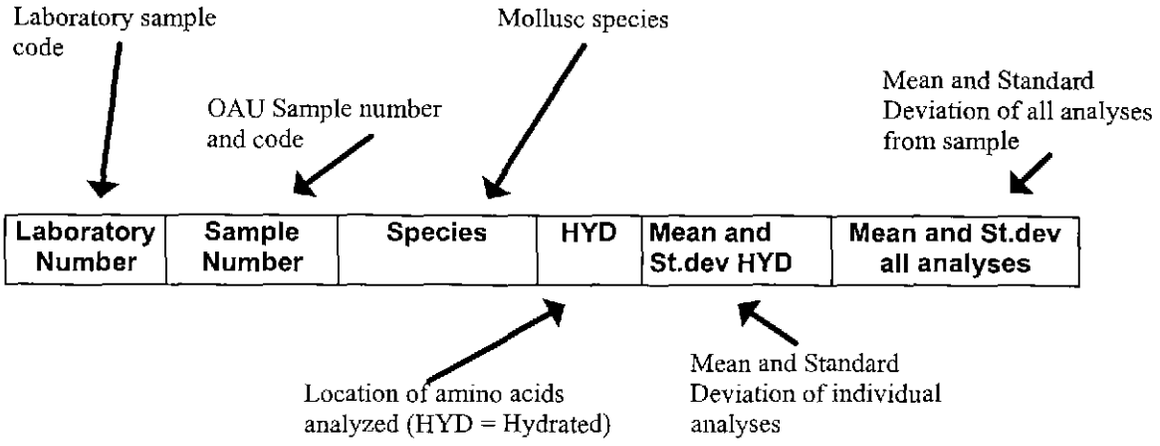
Laboratory Number	Sample Number	Species	HYD	Mean and St.dev HYD	Mean and St.dev all analyses
BAL 3355 A	ARC EFT97 Sec193. s33	*Trichia hispida*	0.066	0.056±0.014	
			0.046		
BAL 3355 B			0.055	0.056±0.001	
			0.057		
BAL 3355 C			0.086	0.084±0.003	
			0.085		
			0.081		
BAL 3355 D			0.064	0.065±0.006	
			0.071		
			0.060		
BAL 3355 E			0.096	0.096	0.070 ±0.015 (n=11)
BAL 3356 A	ARC EFT97 TP2006 s21 spit 8	*T.hispida*	0.016	0.016±0.000	
			0.015		
BAL 3356 B			0.039	0.034±0.011	
			0.021		
			0.042		
BAL 3356 C			0.019	0.018±0.002	
			0.016		
BAL 3356 D			0.045	0.033±0.018	0.026±0.012 (n=9)
			0.020		
BAL 3357 A	ARC EFT97 BH 0021 SA	*Bithynia tentaculata*	0.006	0.007±0.000	
			0.007		
			0.008		
BAL 3357 B			0.086	0.084±0.004	0.047±0.038 (n=7)
			0.081		
BAL 3357 C			0.064	0.070±0.008	0.077±0.009 (n=4)
			0.075		
BAL 3358 A	ARC EFT97 BH 0021 SA	*Cepaea* sp.	0.073	0.083±0.014	
			0.093		
BAL 3358 B			0.117	0.101±0.023	
			0.085		
BAL 3358 C			0.130	0.125±0.004	
			0.122		0.106±0.022
			0.123		(n=7)

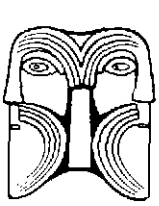
Table 1. Amino acid epimerization data from the Ebbsfleet evaluation samples.

KEY to Table 1 Headings



Site, unit	Age ascription	*Bithynia tentaculata*	*Trichia hispida*	*Cepaea* sp.
Halling, Layer G	Late-glacial		0.036±0.001	
Bobbitshole, Beds B and C	Last Interglacial (Ipswichian - OIS 5e)	0.09±0.014		
Trafalgar Square, Grey brickearth	Last Interglacial (Ipswichian - OIS 5e)	0.11±0.005	0.113±0.005	0.094±0.004
Crayford	Penultimate interglacial (OIS 7)	0.170±0.02		
Ebbsfleet, TP 2006, spit 8			0.026±0.012	
Ebbsfleet, BH 0021SA, 5.3-5.4m		0.077±0.009		0.106±0.022
Ebbsfleet, Section 193, sample 33			0.070±0.015	

Table 2. Comparative amino acid data for SE England (derived from Bowen *et al.* 1989)



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