RPS Planning, Transport and Environment

INDEX DATA	RPS INFORMATION
Scheme Title Dover A20 Road and Sewer scheme	Details Environmental Archaeological and palaeoenvironmental field and laboratory assessment report
Road Number A20	Date
Contractor	
County	
OS Reference (CB?) 34	
Single sided ✓ Double sided A3 0 Colour 0	

93/36

FOR THE ATTENTION OF CANTERBURY ARCHAEOLOGICAL TRUST

DOVER A20 ROAD AND SEWER SCHEME ENVIRONMENTAL ARCHAEOLOGICAL AND PALAEOENVIRONMENTAL FIELD AND LABORATORY ASSESSMENT REPORT.

MARTIN R BATES AND ANTHONY J. BARHAM

DEPARTMENT OF HUMAN ENVIRONMENT
INSTITUTE OF ARCHAEOLOGY
UNIVERSITY COLLEGE LONDON
31-34 GORDON SQUARE
LONDON WC1H 0PY, U.K.

WITH CONTRIBUTIONS FROM:
C. BLOOMFIELD, N. BRANCH, N.CAMERON, E.CROSS, A.FAIRBAIRN, J.HATHER, P.HUNTER, B.IRVING, J.STEWART, C.WARD, K.WILKINSON, V.WILLIAMSON.

GEOARCHAEOLOGICAL SERVICE FACILITY
TECHNICAL REPORT 93/03

Appendices

APPENDIX I	Sites observed by GSF listed by GSF field codes
APPENDIX II	Sites observed by GSF listed by CAT codes
APPENDIX III	List of all bulk samples held by GSF
APPENDIX IV	Samples assessed for pollen analysis
APPENDIX V	Sample data from plant macrofossil assessment
APPENDIX VI	Sample data from diatom assessment
APPENDIX VII	Sample data from mammal, reptile and bird assessment
APPENDIX VIII	Sample data from fish assessment
APPENDIX IX	Sample data from molluscan assessment
APPENDIX X	Sample data from insect assessment

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

1.0 INTRODUCTION

This Report forms the Assessment (to Phase 3 of MAP II) of the environmental archaeological and palaeoenvironmental material recorded and recovered during monitoring of the construction of the A20 Road and Sewer Scheme. The assessment was conducted throughout both field and laboratory-based stages in line with MAP II principles (English Heritage, 1991) and guidelines set out by Macphail et al. (1992).

This Assessment Report summarises results of the Fieldwork and Assessment Programme approved by English Heritage from September 1st 1991 - May 15th 1993. Fieldwork in fact commenced in August 1991, ahead of a project design agreement, as engineering works by Mott MacDonald were already impacting on stratigraphy in Dover.

Fieldwork was originally scheduled for 9 months duration, but this was extended to 14 months (a guillotine imposed of September 30th 1992) when the complex nature of the engineering works became clear. Discovery of the Bronze Age Boat on 28th September 1992 therefore necessitated further revision of fieldwork schedules, leading to a separate budget and project design for that work. The Environmental Archaeological works conducted by GSF on the two coffer dammed excavations at the Boat site are therefore not included in this report and will be submitted as a separate Assessment Report in the Autumn of 1993. Provision for A20 Road and Sewer Scheme fieldwork monitoring ceased under the agreed schedules in February 1993, although engineering works are still on-going in July 1993 (time of writing) and are now not expected to end before October 1993.

Samples generated by the fieldwork were assessed through a three-stage process. Bulk sample processing was completed over 10 months from May 1992 to March 1993 inclusive, and phased so that processing commenced once preliminary estimates of sample processing targets could be set. Bulk processing of 25% of a projected total of 1000 contexts was targeted (Phase I). Processed samples were then passed through assessment by a full range of specialists after sample residue extraction and sorting was completed (Phase II). Finally, specialists assessed the research significance and potential of a sub-set of samples to set targets for the analysis stage of MAP II (Phase III).

The fieldwork and three Phases of sample assessment were resourced, and timetabled as shown in Table I, and the structure of the Assessment follows four separate but integrated phases.

Table 1 **GSF time cascade, resources and Report structure for the A20 Road and Sewer Scheme Project**

	ASSESSMENT PHASE	RESOURCE	ASSESSMENT REPORT SECTIONS
	FIELDWORK MONITORING (August 1991 - February 1993)	19 months at 2 person days/week	3.0 - 3.4
PHASE I	BULK SAMPLE PROCESSING AND SORTING (May 1992 - March 1993)	10 person months	4.0 - 4.2.2
PHASE II	BULK SAMPLE RESIDUES PRELIMINARY ASSESSMENT (25% all samples)	20 person days within December 1992 (specialists and processing staff)	4.2.3
PHASE III	SPECIALIST ASSESSMENT OF SELECTED SAMPLE RESIDUES, SEDIMENTOLOGY STRATIGRAPHIC INTERPRETATION	219 person days by 12 specialists (December 1992 - March 1993)	4.3 - 7.2
	INTEGRATION OF ALL DATA AND REPORT	36 person days (February - May 15th 1993)	8.0 - 11.0

The project is unusual due, in part, to the nature of the distribution of archaeology and palaeoenvironmental remains and secondly, and of equal importance, the nature and limitations imposed on the project by the engineering construction methods and design. Problems arose frequently during the project and in many cases decisions regarding strategy, techniques and methods used by GSF (and CAT) were taken on the basis of engineering, health and safety and time schedules imposed by the contractors rather than on optimal palaeoenvironmental and archaeological design strategies.

The route-corridor represents a ribbon-like site of 2.6km length and only minimal (<10m) width (Figure 1). In reality this allowed sections, sites and profiles to be observed along this transect but only infrequently were observations in plan involving controlled excavation made. Consequently the project provided a two-dimensional view of a transect from upland chalk areas into the lower coastal strip and across the mouth of the modern Dour Valley, through the urban centre of the modern town.

This two-dimensional approach has important limitations for the development and interpretation of stratigraphic sequences in the area. It is difficult to assess lateral variability in stratigraphic succession and in places, e.g. the valley bottom, lithostratigraphic and archaeological context variation across space is likely to be considerable over short distances. Hence it was important to assess the relationship of the sediments within the transect area to those adjacent to this transect, in other words to

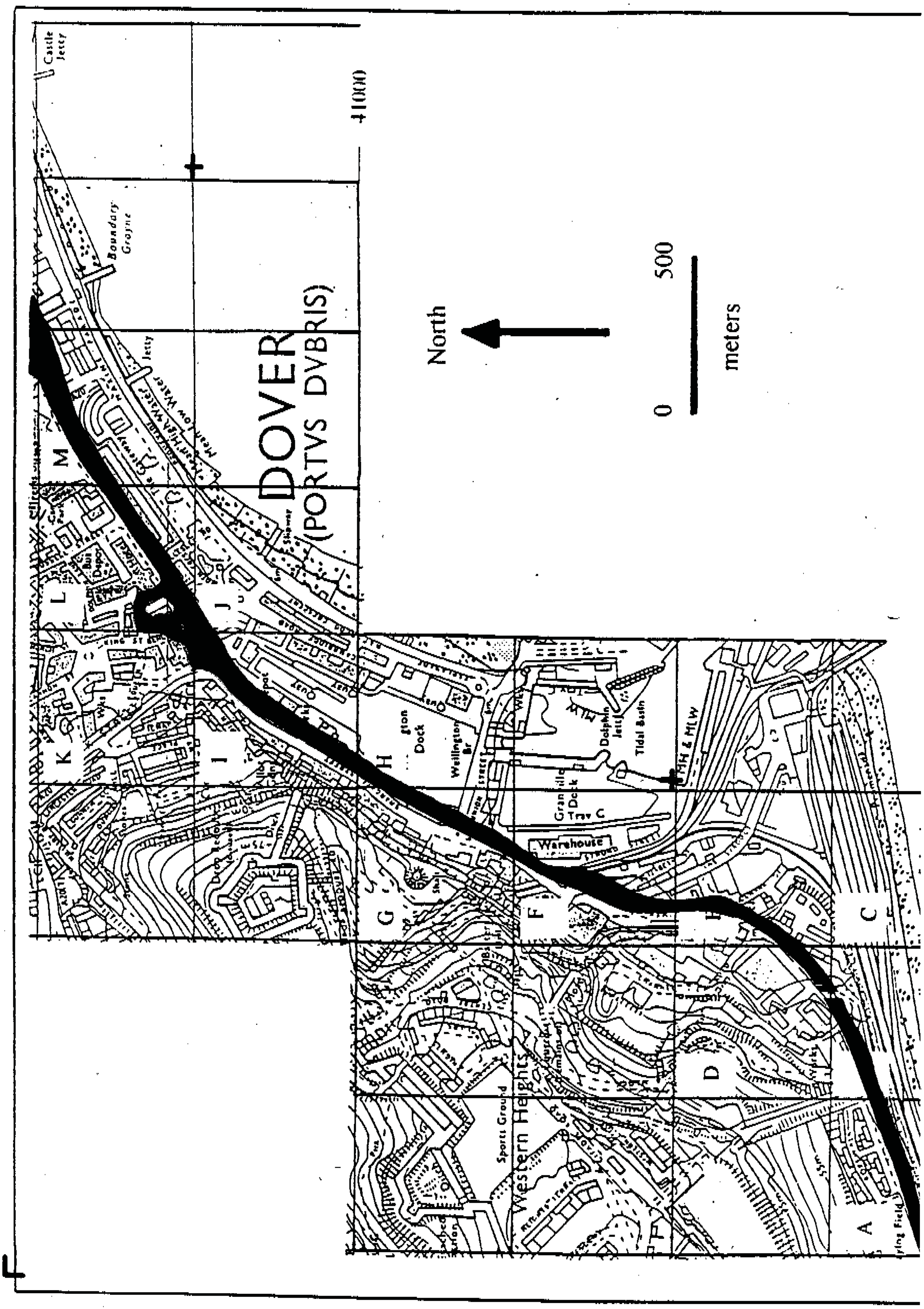


FIGURE 1 The route corridor for the A20 Road and Sewer Scheme showing the grid system adopted for site classification

assess how representative the recorded transect was of the remaining sediments in the area. This was achieved, to a limited degree, in the town centre area where a loop in the sewer trench allowed 3-dimensional space to be examined (Figure 1 areas K and L). From this work it may be possible to produce a 3-D picture of the sediment distribution in this area, at the Analysis Stage.

It is necessary to outline, at this stage, the rationale for sampling and sequence recording and the methodology adopted by GSF. A detailed discussion of recording, sampling and sample processing/assessment strategies is provided in Sections 2.2 and 4.0 of this report. Given the linear nature of the route corridor an attempt was made to sample, at as many locations as possible, to provide a record of the nature of the sequences at all points along the transect. In places these sediments were directly associated with archaeological material. Elsewhere direct links with archaeological material as observed in the field were more tenuous. Critically it is argued that off-site stratigraphies, perhaps with well preserved palaeoenvironmental records, may be encountered and correlated with sites elsewhere on the transect or indeed with past excavations reported in the area. The methodology adopted assumes that sequences at any point on the transect, whether directly associated with archaeology or not, form part of a coherent body of data that relates to a sequence of landscape development within which evidence is present for past human activities (from c.14 ka B.P. (thousands of years before present) to the present day).

The justification for this methodology was exemplified late in the project by the location of the Bronze Age boat in stratigraphic units of tufa and peat which had been located previously during purposive borehole sampling, but hitherto had not yielded in situ archaeological material. The integrated geoarchaeological recording and sampling will allow the archaeo-stratigraphic contexts of the boat to be placed within a broader lithostratigraphic and facies[1] model of the palaeo-Dour catchment morphology as a result of the methods adopted: a result which could not have been achieved from recording of the boat trench in isolation.

This approach was adopted due to difficulties in attempting to delimit archaeological "site" boundaries and stratigraphies in conventional archaeological fashion due to the nature of the section observed. The transect allowed a large number of sites/stratigraphies to be observed and recorded. In isolation these individual observations would be of local significance. In the approach adopted by GSF and CAT these observations are placed into a stratigraphic framework for the subsurface archaeo-stratigraphic resource preserved beneath the modern town. Thus, "snap-shot" frames of detailed archaeological contexts attain greater significance by placement within the framework of the 2.6km length of the route corridor.

---

[1]A facies approach places emphasis on defining the depositional environment by which deposits form. This involves integration of all properties of the sediment unit including bedding, size of sediment particles and critically, both large and microscopic faunal and floral remains. In a geoarchaeological project this information is further integrated with all archaeological remains in the sediment unit.

1.1. STRUCTURE OF THE ASSESSMENT REPORT

An adequate evaluation of the archaeological results obtained from the Assessment Stage of the project involves both evaluation of the data in terms of its intrinsic quality and archaeological significance but also its significance within a contextual approach based (i) on the stratigraphic context within which finds are located (e.g. in situ or derived) (ii) on the facies (environment of deposition) of the finds and therefore the interpretative potential of the data and (iii) the theoretical/methodological context of the information gathered viewed from a perspective of previous known archaeology in the area of investigation (e.g. see Barham and Bates 1990, Philp 1981 and Wilkinson 1990) and the significance of the new information from both local, regional and national archaeological perspectives.

This report is therefore structured to enable easy consultation of data from individual areas investigated, and also to assess the data from all these perspectives. It is further subdivided physically for ease of reference following the four phases adopted for Assessment viz. Fieldwork, Bulk Sample Processing, Preliminary Assessment and Specialists Assessment.

Sections 1.2 and 1.3 present a brief summary of past work in the area. Section 2.0 discusses the methodology used during the field project, the nature of the archive and the aims and objectives of the assessment. Section 3.0 discusses the nature of the stratigraphic sequences recorded along the route corridor. Bulk sample selection and processing methods are discussed in Section 4.0. Section 5.0 discusses the sedimentology of samples selected for assessment. Specialist assessments are summarised in Sections 6.1. to 6.7.

Radiocarbon results from samples submitted for the assessment are discussed in Section 7.1. Section 8.0 outlines the development of a stratigraphic framework based on data recovered during the project and the ability to construct detailed palaeoenvironmental histories illustrated with reference to sequences studied in the town centre area. Section 9.0 addresses the potential of the samples to investigate (i) research themes outlined before commencement of the project and (ii) new goals formulated during the project. In a project of this nature and scale the long-term curation and storage of large sample volumes is important and this is discussed in Section 10.0. Final conclusions are made in Section 11.0.

The GSF Project team responsible for generating the data discussed in this report, and particularly the full body of archival material through the final duration of the project are listed in Table 2.

Table 2 **GSF Project Team responsible for production of report and archive to Phase III (MAP II)**

MAP II PHASE	ASSESSMENT PHASE	PERSONNEL	ARCHIVE	SECTIONS IN REPORT
PHASE I	PROJECT PLANNING AND DESIGN	MR A J BARHAM (GSF, DIRECTOR) and DR M R BATES (GSF, Project Manager)		2
PHASE II	FIELDWORK MONITORING AND SAMPLING	DR M R BATES WITH MR A J BARHAM, MR P HUNTER, MS C WARD AND MR V WILLIAMSON	ARCHIVE A ARCHIVE C	3.0 - 3.4
PHASE III	ASSESSMENT OF POTENTIAL FOR ANALYSIS			
	I. BULK SAMPLE PROCESSING AND RESIDUE EXTRACTION/ SORTING	MR J STEWART WITH MR P HUNTER AND MR J CZATSKA	ARCHIVE D	4.0 - 4.2.3
	II. BULK SAMPLE RESIDUES AND PRELIMINARY ASSESSMENT	MR A FAIRBAIRN, DR J HATHER, MR B IRVING MR J STEWART AND DR K WILKINSON	ARCHIVE E	4.3
	III. SPECIALIST ASSESSMENT OF SELECTED SAMPLE RESIDUES, SEDIMENTOLOGY AND STRATIGRAPHIC INTERPRETATION			
	- SEDIMENTOLOGY	MR A J BARHAM, DR C BLOOMFIELD AND MR V WILLIAMSON	ARCHIVE B AND F	5.0 - 5.2
	- STRATIGRAPHY	DR M R BATES	ARCHIVE A	3.0 - 3.4
	- PALYNOLOGY	MR N BRANCH	ARCHIVE G	6.1
	- PLANT MACROFOSSILS	DR J HATHER AND MR A FAIRBAIRN	ARCHIVE H	6.2
	- DIATOMS	DR N G CAMERON	ARCHIVE I	6.3
	- LARGE AND SMALL MAMMALS/ BIRDS/ REPTILES + AMPHIBIANS	MR J STEWART	ARCHIVE J	6.4.1
	- FISH	MR B IRVING	ARCHIVE K	6.4.2
	- MOLLUSCS	DR K WILKINSON	ARCHIVE L	6.5
	- INSECTS	MS E CROSS	ARCHIVE M	6.6
	FACTUAL SUMMARY, STATEMENT OF ARCHAEOLOGICAL POTENTIAL AND RECOMMENDATIONS FOR STORAGE AND CURATION	DR M R BATES (GSF PROJECT MANAGER)		8.0 - 10.0
	PLANNING AND RECOMMENDATIONS FOR ANALYSIS STAGE	DR M R BATES AND MR A J BARHAM		

N.B. UPDATED PROJECT DESIGN AND COSTS FOR ANALYSIS STAGE TO BE JOINTLY FORMULATED BY GSF/CAT IN AUGUST/SEPTEMBER 1993 FOR SUBMISSION TO ENGLISH HERITAGE OCTOBER 1ST 1993 — MR A J BARHAM AND DR M R BATES (GSF) WITH MR P CLARK AND MR K PARFITT (CAT)

This assessment is report supported by a series of specialist assessment studies of selected samples that have been summarised and condensed into this report. These specialist studies were of sub-samples from a small percentage of the total number of contexts sampled, and form the basis for defining the potential for investigation of the full set of samples at the analysis stage. All detailed information from these studies are held in the project archive and are available for consultation, bound separately, and listed below.

The assessment project archive has been arranged in the following fashion:-

ARCHIVE A. Site stratigraphic archive including stratigraphic descriptions and sample data, from all points monitored.

ARCHIVE B. Detailed core and monolith descriptions.

ARCHIVE C. Site and sample photographs.

ARCHIVE D. Bulk sample sieving sheets.

ARCHIVE E. Preliminary sample assessment sheets (based on a 25% sample of the total sample archive).

ARCHIVE F. Sedimentology of selected samples.

ARCHIVE G. Palynology of selected samples.

ARCHIVE H. Plant macrofossil assessment of selected samples.

ARCHIVE I. Diatom assessment of selected samples.

ARCHIVE J. Large and small mammal, birds and reptiles/amphibians assessment of selected samples.

ARCHIVE K. Fish assessment of selected samples.

ARCHIVE L. Mollusc assessment of selected samples.

ARCHIVE M. Insect assessment of selected samples.

In order to accommodate a wide variety of data sources (i.e. GSF records, CAT records, construction engineers records) a new system for classifying sites has been developed. All sites observed and integrated in the GSF archive have been assigned a code based on geographic location. The route corridor has been subdivided into 250m grid squares tied to the Ordnance Survey 1:25000 grid, commencing at the southwest end of the corridor and ending at the northeast end of the route. Within each grid square (designated A, B, C etc.) individual sites are assigned a number (hence A1, B4, K23). This system, based on the Ordnance Survey grid system also assigned all sites to a 5 figure grid reference. A full list of all monitored sites is given in Table 3 and additional tables in Appendix I and II enable conversion of this system to GSF and CAT field codes.

Finally it should be noted that this project is one of the first large scale archaeological assessment projects to be conceived, implemented, and completed under MAP II guidelines. It also represents an archaeological monitoring and assessment project of unusual complexity in relation to the engineering works and project design of the A20 Road and Sewer Scheme (but likely to represent a project type frequently undertaken in urban environments as Victorian sewer systems are replaced). The feasibility, and limitations, of such studies require consideration and assessment, and these points will be considered for inclusion in the design of the Analysis Stage (Phase IV, MAP II). The success of the project, and hence the methodology of MAP II guidelines, can therefore be considered, and is likely to be an important research theme at the analysis stage, viewed from a national archaeological resource management perspective.

Table 3 **Sites and grid locations of sections observed by GSF during the A20 Road and Sewer Scheme Project**

SITE INDEX NUMBER	SITE LOCATION NUMBER	CAT SITE/SECTION CODE	GRID REFERENCE		DATUMS
A1			31076 40136	OB	40/39m
A2			31154 40168	OB	37.5/36.5m
A3			31051 40128	OB	40/39.7m
A4			31132 40163	OB	37.5/35.0m
A5			31235 40197	OB	35/32m
B1	GSF7		31456 40236	SO	27.92/25.92m
B2	GSF7		31326 40223	SO	29.57/26.62m
B3	GSF30,P1		31880 40228	SO	22.42/19/61m
B4	GSF30,P3		31379 40212	SO	22.42/19.24m
B5	GSF30,P2		31390 40221	SO	21.37/19.41m
B6	GSF30,P4		31391 40218	SO	21.64/19.34m
B7	GSF30,P5		31392 40219	SO	21.64/19.44m
B8	GSF30,PLA		31390 40221	SO	21.27/18.77m
D1	GSF10		31494 40320	SO	18.265/15.415m
D2	GSF10		31498 40324	SO	18.265/14.865m
D3	GSF 28A		31494 40298	SO	16.90/13.50m
D4	GSF 31		31480 40288	SO	18.62/12.52m
D5	GSF 32		31993 40319	SO	18.50/12.50m
D6	DAF/93		31498 40331	SO	15.50/13.50m
D7	DAF/93		31490 40331	SO	14.50/12.00m
D8	DAF/93		31496 40336	SO	14.50/11.50m
E1	GSF 2		31640 40335	SO	4.596/4.036m
E2	GSF 4		31577 40343	SO	5.127/3.907m
E3	GSF 9		31522 40397	SO	8.00/-2.50m
E4	GSF 11		31502 40363	SO	19.06/13.56m
E5	GSF 16	DS/B-92	31581 40433	SO	5.395/0.195m
E6	GSF 26	,s13		SO	7.00/6.00m
E7	GSF 25		31561 40349	SO	7.50/6.50m
E8	GSF 22	DS/B-92,s62	31556 40396	SO	3.94/2.54m
E9	GSF 27	DS/B-92,s62	31564 40408	SO	5.94/2.40m
F1	GSF 5		31606 40660	SO	7.43/4.637m
F2	GSF 5		31660 40650	SO	7.307/4.347m
F3	GSF 5		31612 40645	SO	7.50/4.447m
F4	GSF 13		31614 40630	SO	8.785/4.285m
F5	GSF 35	DS/R-92,s121	31588 40686	SO	9.97/4.77m
F6	GSF 36		31584 40442	SO	9.55/4.63m
G1	GSF 1	T1	31718 40880	SO	4.555/1.485m
G2	GSF 6		31708 40849	SO	4.863/1.565m
I1	GSF 3		31832 41072	SO	5.022/2.172m
I2	GSF 12		31946 41229	SO	6.00/1.90m
I3	GSF 14		31948 41231	SO	6.00/2.40m
I4	GSF 15	DS/Y-92,s38	31960 41245	SO	3.26/1.60m
I5	GSF 15	DS/Y-92,s38	31960 41247	SO	2.50/1.50m
I6	GSF 18		31963 412252	SO	6.147/1.447m

SITE INDEX NUMBER	SITE LOCATION NUMBER	CAT SITE/SECTION CODE	GRID REFERENCE		DATUMS
I7	GSF 17		31967 41246	SO	6.177/2.77m
I8	GSF 19		31967 41247	SO	6.177/1.927m
I9	GSF 20		31968 41249	SO	6.177/1.657m
J1	DSE-2		32066 41248	SO	6.72/-2.28m
J2	TWS-7		31986 41233		Not known
K1	GSF 21		31996 41278	SO	3.40/1.30m
K2	GSF 23		31996 41283	SO	6.04/1.87m
K3	GSF 29	DS/P-92,s87	31982 41314	SO	5.60/1.90m
K4	GSF 33	DS/B-92,S108	31992 41277	SO	5.99/4.29m
K5	GSF 24	DS/P-92,s73	31996 41283	SO	6.04/3.24m
K6	GSF 39		3199 41275	SO	3.95/2.25m
K7	QS-1		31942 41400	BH	6.79/-4.11m
K8	QS-2		31956 41400	BH	6.76/-0.74m
K9	DBS-2		31998 41255	BH	6.01/-1.99m
K10	DBS-3		31993 41300	BH	5.81/-9.19m
K11	DBS-4		31980 41370	BH	5.64/-1.86m
K12	DSC-1		31974 41257	BH	4.81/-0.95m
K13	DSC-2		31964 41250	BH	3.50/-6.50m
K14	DSC-3		31990 41265	BH	3.40/-0.10m
K15	DSC-4		31985 41265	BH	3.40/-0.50m
K16	DSC-5		31975 41255	BH	5.91/-1.69m
K17	TWS-1		31998 41255	BH	6.10/0.85m
K18	TWS-2		31998 41255	BH	6.10/1.00m
K19	TWS-3		31998 41255	BH	6.12/2.13m
K20	DSC, s1		31974 41257	SO	5.31/4.64m
K21	DSC, s2		31974 41257	SO	6.52/5.30m
K22	DSC, s3		31974 41257	SO	6.23/4.78m
L1	GSF 37	DS/T-92, s119	32012 42266	SO	Not known
L2	GSF 38		32018 42267	SO	3.55/2.75m
L3	GSF 38A		32017 42265	SO	3.40/3.20m
L4	GSF 40		32005 42265	SO	Not known
L5	GSF 41		32019 42268	SO	2.70/2.00m
L6	GSF 43		32018 42267	SO	2.15/1.20m
L7	GSF 44		32018 42267	SO	1.00/0.40m
L8	GSF 45		32018 42268	SO	0.50/-0.20m
L9	GSF 54		32012 42269	SO	1.93/1.23m
L10	DSI-1		32222 41280	BH	4.26/-2.64m
L11	DSI-2		32012 41445	BH	4.74/-1.26m
L12	DBS-1		32005 41265	BH	6.02/-2.33m
L13	TWS-5		32017 41265	BH	5.83/-2.58m
L14	TWS-4		32050 41327	BH	5.03/-2.72m
L15	DSE-1		32075 41278	BH	5.42/-6.18m
L16	TWS-6		32030 42256	BH	6.00/-2.30m
M1	TWS-8		32354145	BH	6.67/-4.83m
M2	TWS-9		32304145	BH	7.39/-2.60m

1.2 PAST WORK

Previous archaeological work in the Dover Town area has focused on the excavation and interpretation of large structures located to the north east of Market Square. The two large masonry constructions identified in the area have been interpreted as the Classis Britannica (Roman Naval Fort) and the later Saxon Shore Fort (Philp, 1981). In addition to those two major structures evidence of Roman settlement has been located and excavated (Rhatz, 1958; Rigold, 1969; Philp, 1989) and include the Painted House with the Bacchic Murals (Philp, 1989) and a bath house complex (Parfitt pers.comm.). Additionally a rich post-Roman record also exists for the town centre area (Philp, 1981) although this largely remains unpublished. Little is known of the pre-Roman occupation of the area. Neolithic or Bronze age flint-work has been found beneath the Roman forts in addition to a possible Iron Age structure (Parfitt pers.comm.). Mesolithic artefacts have been located at River (Parfitt, 1982). However, no precise provenance has been assigned to these artefacts. A single flake tentatively ascribed to the earlier Holocene has been located <u>in situ</u> at Crabble Paper Mill (Barham and Bates, 1990). Palaeolithic material has been located in abundance on the clay-with-flints in the Whitfield area and elsewhere on the chalk uplands (Parfitt, pers.comm.).

Topographic reconstruction of the area has been based primarily on archaeological evidence with limited examination of the sedimentological and geomorphological data. Reconstruction of the Roman harbour by Rigold (1969) and the estuary by Philp (1981) was based on such data. More recently sedimentological and geomorphological data has been examined and a revised model for landscape development formulated (Barham and Bates, 1990). This model still requires verification and probably considerable modification and refinement.

The previous work, while of considerable importance, focused on the standard archaeological data with very limited attention to non-artefactual/non-structural evidence from archaeological contexts. To date no examination of palaeoenvironmental data has been undertaken in the area adjacent to, and within archaeological contexts. This is despite the presence of a rich palaeoenvironmental record that has in many places been sampled for faunal, floral and sedimentological analysis, and the clear evidence for waterlogged archaeological levels preserved beneath the modern town.

This deficiency in the data sets has been previously highlighted by Barham and Bates (1990) and Wilkinson (1990). Critically, in the absence of previous data studies undertaken as part of this project represent information from areas about which nothing is known and where assumptions have been made on the basis of data gathered elsewhere. This has a number of implications for the work discussed in this report:-

1. No depositional context model (with the exception of a lower Dour catchment sedimentological model proposed by Barham and Bates, 1990) is present to aid in the interpretation of the archaeological results from this project.

2. Nothing was known of the types of biostratigraphic data (or faunal assemblage data from archaeological contexts) that were likely to be encountered.

3. No set of reference materials from the region existed for comparison with the A20 data, prior to project commencement.

4. Assessments of the significance of environmental archaeological material recovered during the A20 project have to be made from a "ground zero" position, and in terms of being the first attempt to assess the resource (i) being impacted upon by the engineering scheme and (ii) likely to remain adjacent to groundworks after scheme completion.

The work undertaken both at assessment level and at post-assessment level will therefore:-

1. Provide a set of data that will provide the basis for a reference collection.

2. Provide the data for development of models and hypotheses which may be tested during future investigations, at the analysis stage of MAP II.

3. Represent an important set of information to aid in the interpretation of sequence development and unit interpretation in the area, and plan archaeological responses to future urban, industrial and engineering programmes impacting on the archaeological resource in Dover.

Clearly past work in the Dour Valley has indicated the presence of archaeological structures of regional and international importance (e.g. Classis Britannica Fort). Work elsewhere (e.g. Holywell Coombe - Preece, 1992; the Cuckmere Valley - Scaife and Burrin, 1992) has suggested that, in places, the Dour Valley may also contain extensive palaeoenvironmental data of regional and international scientific significance. Perhaps critically in an area considered to be the "Gateway to Britain" and certainly an important route-way for colonisation into the U.K. during periods of lowered sea level, this area represents a key region to investigate and test models of human and biological migrations and cultural transfers during the last 15ka B.P. Some of this data has already been discussed during the A20 project, and much of the archived data and samples recovered and assessed from the project forms a research base from which these issues can be further developed during the Analysis stage of the MAP II programme.

1.3 A GEOARCHAEOLOGICAL PREDICTIVE MODEL OF THE ROUTE CORRIDOR

The route corridor lies on Middle Chalk that forms the northern limb of the Wealden Anticline (Jones, 1977). Superficial sediments (i.e. of Quaternary age - the last 2 million years) vary along the route way and reflect, in part, the nature of the geomorphology and, perhaps more locally (i.e. within the town centre), human activity.

The basic geomorphology of the area and the nature of the sediments has been recently examined in detail and will only be summarised here (see Barham and Bates, 1990 for further details). Critically this work has linked the nature and age of the expected sediments to the archaeological potential and hence forms a model that can be tested against the data obtained in this study.

The route corridor (Figure 1) can be split into 3 geomorphological zones (Figure 2):-

1. The Western Heights from Aycliffe to Archcliffe Fort (Grid Squares A - D).

2. Bulwark Street to York Street Roundabout (Grid Squares E - I).

3. York Street Roundabout through the town centre to the Eastern Docks (Grid Squares I - M).

These zones of engineering impact can be related to the zones of predicted archaeological significance (by Barham and Bates 1990; Wilkinson 1990), and from this, the results of the A20 Road and Sewer Scheme regarded as a partial test of those predictions. It should be noted that the depth and extent of engineering impact, in terms of ground excavated/removed both as a direct result of the Road and Sewer Scheme, and by associated groundworks for services varied in magnitude both across short distances and from original design during the course of works.

1. The Western Heights (see Figures 1 and 2, Grid Squares A-D).

   This area is dominated by undulating topography where the chalk is usually close (<2m) to the surface. Thin clay-with-flints and occasional thicker sequences of fine grained sandy silts with chalk gravel are present in this area.

2. Bulwark Street to York Street Roundabout (see Figures 1 and 2, Grid Square E-I).

   The route corridor runs along the edge of the town at the base of the chalk cliffs into the main Dour Valley. Sediments present in this area ranged from sands to coarse, well rounded beach gravels.

3. York Street Roundabout to the Eastern Docks (see Figures 1 and 2, Grid Squares E-I).

   This area was identified in previous work (Barham and Bates, 1990; Wilkinson, 1990) as of great potential archaeological significance where deep, well stratified and well preserved sedimentary sequences were likely to occur. The spatial

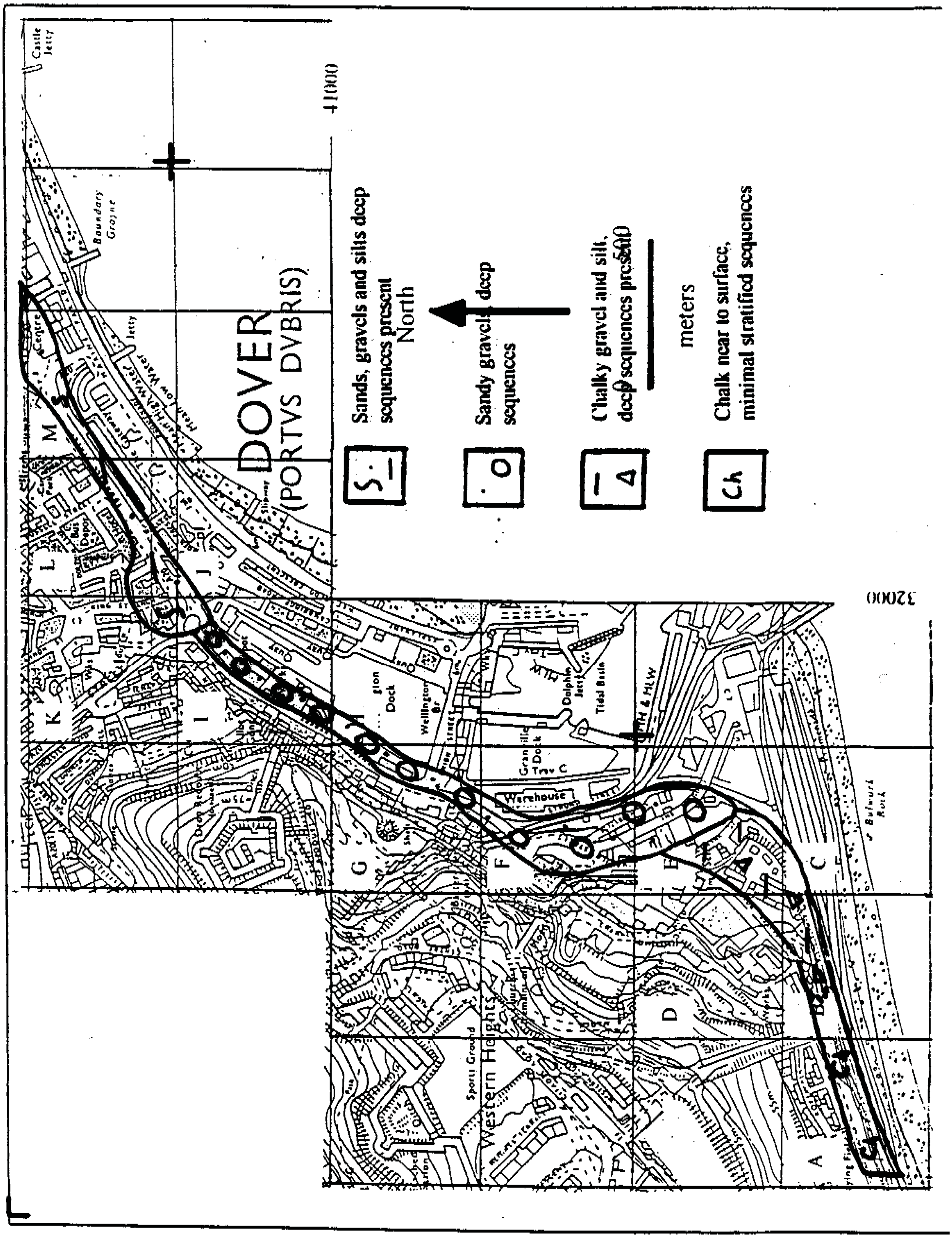


FIGURE 2 A geoarchaeological predictive map of the route corridor

distribution of sites eventually recorded in the assessment is shown in Archive A and discussed in Section 3.

2.0 DESIGN STRATEGY ADOPTED FOR FIELD MONITORING AND SAMPLING

The engineering route corridor extended a distance of approximately 2.6km from the Western Heights (at Aycliffe) to the Eastern Docks below Dover Castle (Figure 1). This route way traversed a range of geomorphological situations and superficial sediments (see Section 1.3 above). Engineering tasks, problems and the solutions adopted varied considerably along the route corridor and played an important role in determining the nature of the sections/areas open for inspection/sampling and hence the degree to which useful information was collected during the project. These constraints, and the adjustments to the archaeological brief which were necessitated are discussed below in detail (see 2.3).

The route corridor delimited the construction area for the installations of 2 main services. A sewer, of variable dimensions, was constructed in advance of road construction/alteration and provided deep sections through the underlying sediments (see Plate 1). After completion of the sewer system road construction began for the new A20 extension from Folkestone to Dover. With the exception of two deep underpasses (and associated infrastructure), a number of deep road cutting and alterations to bridges, road construction only caused minimal deep disturbance (>2m depth) of sediments and observations were restricted to chance observations during service realignment.

The methodology adopted was therefore opportunistic to a large degree and was modified during the course of the 19 month monitoring programme. As discussed in the CAT Assessment Report a number of factors contributed to this less than ideal situation. In particular:-

* The Dover A20 Road and Sewer Scheme Archaeological Assessment was conceived (and funded by English Heritage) as a rapid response to the late official recognition of the considerable threat posed to the archaeological resource of the area. A phased and thoroughly considered programme of archaeological works ahead of development was therefore impossible.

* Engineering works had commenced by the time English Heritage had been able to respond to an outline assessment of the threat posed submitted by Canterbury Archaeological Trust (see Parfitt 1991) by making funds available. Archaeological considerations were inadequately addressed both in the early public planning/consultation stages and in drawing up the engineering cascades once the scheme was approved by the Department of Transport.

* Although the initial archaeological response was planned and funded to address the impact of Sewer Scheme separate from the A20 Road Scheme this division was soon rendered academic by the complex phasing of engineering works.

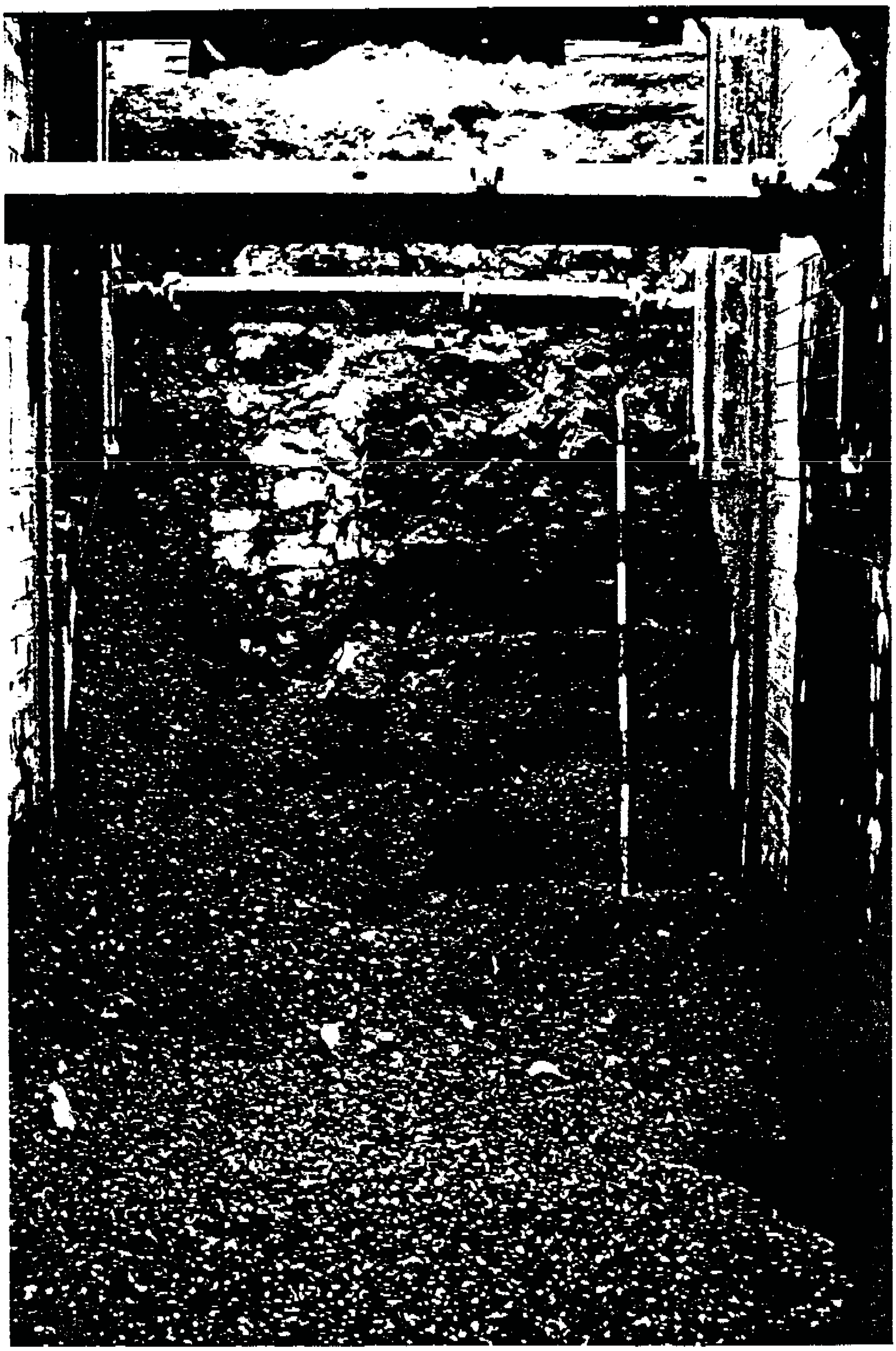


Plate 1. Sewer Trench section along Snargate Street, Dover showing hydraulic shoring and exposed terminal section

* The engineering design made no concessions to known/expected archaeological structures along the route. Therefore, although important areas were identified (Parfitt 1991) (e.g. Archcliffe Fort, the Crypt) site set-piece excavation was only achievable where "windows" existed in the engineering time cascades (e.g. at the Crypt Site, DS-C/91).

* Mitigating measures, other than attempting to record the nature of archaeological sequences impacted upon were almost always impossible. Within the remit of PPG 16 preservation through archive was the only option available, and this had to be achieved without recourse to structured and phased archaeological excavation except at the Crypt Site, DS-C/91, where this was possible within pre-defined engineering schedules. Where significant archaeological contexts and structures were unexpectedly identified (e.g. the Dover Boat Trench), mitigating measures involving modifications to the engineering design, allowing preservation in situ were never an option, and recording and recovery of archaeological information were conducted to very tight time and resource constraints.

While impacts on archaeological evidence of international significance such as the Dover Bronze Age Boat were clearly unpredictable in a specific locational sense, archaeological work completed prior to the engineering works commencing clearly identified the potential of the deep, predominantly waterlogged and well-stratified sequences likely to be encountered (Barham and Bates 1990; Philp 1981; Rhatz 1958; Wilkinson 1990). Accordingly, the field methodology, and associated sampling and recording, took this anticipated high archaeological resource potential into account together with the problems inherent in (i) a substantial part of the previous data from archaeological investigation remaining unavailable and unpublished (ii) minimal environmental archaeological data being available from previous investigations and (iii) the logistical/financial constraints impaired by failures in the consultation/planning procedures preventing a considered response at an early stage in the engineering scheme design.

2.1 AIMS AND OBJECTIVES OF THE FIELD METHODOLOGY

Given the constraints imposed a reactive and responsive design was adopted for the field methodology and associated sampling and recording strategies. Key elements, following the guidelines outlined in MAP II (English Heritage 1991), were as follows:-

2.1.1 To monitor, as fully as possible, all exposures/sections impacted on by engineering groundworks (subject to Health and Safety constraints), given the probability that most areas of the route could be of archaeological significance.

2.1.2 To sample the stratigraphic sequences as fully as possible given (i) the archaeological content of the stratigraphy could not be assessed adequately in the field by conventional means in short-duration exposures (ii) a stratigraphic model of the area impacted on was an interpretative objective of the assessment (iii) no estimates could be made of the medium and longer-term effects of dewatering on waterlogged stratigraphies either side and beneath the areas of direct impact (iv) the need to produce for the first time an assessment of the palaeoenvironmental significance of the deposits preserved beneath modern Dover and (v) the sample requirements necessitated by the palaeotopographic and facies research themes identified as critical for advancing archaeological understanding in the Dover area (Barham and Bates 1990; Wilkinson 1990).

2.1.3 To maximise the resources available (field personnel/time/funding) so as to give priority of sampling/recording time to areas of the route corridor known or expected to have higher archaeological potential, based on the assessment of CAT (Parfitt 1991).

2.1.4 To assess, and process in a manner suitable for archive, all stratigraphic observations and samples, within a phased programme which would follow through to yield research themes and prioritised targets for work at the (post-assessment) analysis stage of MAP II (Macphail *et al.*, 1992). Specifically this meant that for environmental archaeological objectives (i) a 25% target for preliminary processing had to operate in tandem with the field sampling programme (ii) high quality undisturbed monoliths of key stratigraphic sequences had to be retrieved and assessed, but also curated in a manner suitable for later detailed research objectives (e.g. full pollen analysis) (iii) bulk samples retrieved in the field had to be of individual size/sampling density adequate to be assessed and also adequate for research priorities when defined at the end of the assessment phase.

2.1.5 To store samples in a manner which would not prejudice their use for subsequent analysis, or as materials for radiocarbon dating.

2.1.6 To record all sections in terms of sedimentological/stratigraphic properties to a standard set of criteria, and in a manner which could be integrated with standard archaeological recording at sections/set-piece excavations where time permitted, and archaeological criteria justified, the use of these more standard approaches.

2.2 SAMPLING AND RECORDING STRATEGIES

The objectives outlined above (Section 2.1) were met through a three-tier methodology which could be vertically integrated at key locations where significant archaeological horizons were encountered:-

[A] Stratigraphic and sedimentological recording (see Section 2.3) at all exposures on the route corridor, with O.S. grid co-ordinates and datums recorded for all exposures. Limited bulk sampling of contexts undertaken of either (i) key stratigraphic units (for facies modelling) (ii) stratigraphic units where archaeological/palaeoenvironmental content of units required systematic evaluation [such sampling points carry a GSF Site Index Code only e.g. A1, L15].

[B] Stratigraphic and sedimentological recording as under [A], supplemented by recovery of undisturbed monoliths and/or Kubiena tins where later X-radiography and/or micromorphology was anticipated as likely to be needed at the analysis stage.

[C] Recording as at [A] and [B], supplemented by section drawing/recording and trial excavation by CAT staff. At such locations extensive bulk sampling was undertaken, both to recover artefactual materials subsequently (time-constraints precluded any on-site sample processing), and for palaeoenvironmental/environmental archaeological residues associated with artefact-rich levels or archaeological features (e.g. floors/pit-fills).

Recording levels [A] and [B] were achieved through a nominal average 2-3 person day/week attendance by GSF staff on-site, often acting with support from CAT personnel, and level [C] recording by a combined team of GSF and CAT personnel (normally 1 and 2 or 1 and 3 staff respectively).

A fourth, and ultimately critical, level of monitoring/recording was adopted mid-way through the assessment, when it was clear that concern over de-watering effects necessitated monitoring/recording of stratigraphic levels at the base-levels of the sewer trench, but where safety factors made it impossible to observe sediments directly. Instead purposive boreholes were drilled within the route corridor and marginal to the pipe alignment using wire-line percussive techniques and sediment context recovery either as disturbed bulk samples or U4/U100 diameter undisturbed core (Plate 2).

To our knowledge, this method was a novel archaeological sampling technique on projects of this type, and its success was exemplified (i) by demonstrating a potential prehistoric context by chance recovery of a "Thames pick" flint artefact at BH DSE-1 Grid Sector L15 and also in successfully identifying peat/tufa facies as of likely prehistoric significance in advance of the change discovery of the Dover Boat within this unit 8 months later.

2.3 THE NATURE OF ENGINEERING WORKS AND CONSEQUENCES ON ARCHAEOLOGICAL MONITORING

The route-corridor, and hence the area of monitoring, was 2.6km in length. The width of the area to be monitored varied from less than 3m at the narrowest point to over 300m in the area of Bulwark Street. An average width of 10 to 20m was more typical. The nature of the route-corridor varied considerably along its length, dependant primarily on the nature of construction activity.

Plate 2. Shell and auger drilling at the Crypt site (DS-C), Dover

The sewer trench, usually dug in advance of road construction, provided a continuous profile through the sediments from the Western Heights at Aycliffe to Fishmongers Lane in central Dover. All three geomorphological zones (see Section 1.3) were traversed and sampled. Sewer trench width never exceeded 3m and was usually 1.5 to 2.5m in width. Depth varied from less than 0.5m on the Western Heights to nearly 4m in the town centre area. Consequently the ability to observe continuous sections corresponded to trench depth and nature of the shoring. Observations were often difficult where trench depth was deepest. Construction of the sewer trench was piecemeal, digging commencing at a number of points along the route hence a progressive movement from one end to the other was not possible. This further affected the intensity of recording strategies (see 2.1 above which could be achieved.

Sewer trenching was undertaken by mechanical excavation to maximum depths of 4m. Shoring with hydraulically operated sheet steel (drag boxes) was used to stabilise trenches in excess of 1.5m depth. The drag boxes were emplaced at shallow depths and lowered gradually as sediment was removed from the trench base. This resulted in both sides of the trench being obscured from view at all times and only the digging face at the trench end open for recording. Upon completion of digging the laid pipe was covered with gravel and the drag boxes removed. Thus opportunities for section recording was limited.

Road construction usually commenced after sewer trench construction and with the exception of a few deep cuts primarily affected the upper 2m of stratigraphy. The upper 2m (predominantly post-Medieval in age) was usually recorded by CAT in conjunction with GSF (level C monitoring see 2.1 above) particularly where archaeological structures were encountered e.g. in the vicinity of Bench Street.

Elsewhere along the route corridor shallow to deep exposures were available for recording in areas of cutting for road emplacement. In these situations it was usual for longer exposures to be open for examination for sufficient periods to allow detailed recording.

Deep road cuttings in the vicinity of Archcliffe Fort (D1-D8, Table 3) revealed extensive open sections suitable for recording. Two deep underpasses, one on the Western Heights (B3-B8) and the second in Townwall Street (L2, L4-L8), provided further opportunities to observe and sample deeply stratified sequences. Finally rebuilding of the culvert for the river Dour beneath Townwall Street, and the realignment of the railway bridge in Snargate Street (F1-F6) also provided deep sequences.

Road construction activity therefore provided useful additional keyholes to sequences observed during sewer trench digging but these were limited in areal extent. This activity also provided cleared areas for drilling adopted by GSF as a alternative to section recording.

A number of difficulties were encountered during the project that stem directly/or indirectly from non-archaeological problems linked directly to the nature of the construction project:-

1. Only limited observations were possible in the deep sewer trench sections. This was because of (i) shored trench sides prevented easy observations and prevented sampling, (ii) the unshored end of the trench was often loose and therefore in a semi-collapsed state, (iii) cleaning unshored sections was dangerous due to the excessive height of the sections (usually between 2 and 4m in depth). Health and safety regulations often prevented access to the trench (see Plate 1).

2. Where observations were possible inadequate time was often available to record sequences prior to further excavation or trench infilling by the contractors.

3. Due to inadequate arrangements prior to commencement of construction activity (see Section 2.0 above) it was often impossible to explore stratigraphies in advance of construction activity (with the exception of sections in Bench Street (K4, K5) and the Crypt site (K1, K20, K21, K22)).

4. Much of the construction activity involved the implementation of temporary works, not marked on plans and drawings supplied by the contractors. Therefore it was often difficult to predict where temporary exposures would occur, and plan time/staff resources for the monitoring of these areas.

5. It was not possible to excavate and observe sequences immediately beneath construction base levels (due to the likelihood of later subsidence). However it was often essential to sample and record these sequences as it was not possible to discount the long term, possibly detrimental, effects of construction activity on these sequences (i.e. de-watering, pressure release, aeration etc.).

These difficulties stem directly from inadequate provision being made for archaeological and palaeoenvironmental work being made at an early stage in timetabling of the A20 construction project. No facility had been agreed in advance to halt engineering works should temporary exposure merit further attention (with the noted exception of the discovery of the Bronze Age Boat[2]). Additionally little or no trial assessment work was to be undertaken in advance of contractors arriving on site. The project therefore had to rely on the goodwill of the contractors, the ability of the excavation team to be in the right place at the right time, completion of recording exercises during breaks in construction activity (lunch breaks etc.) and finally good luck. As a result a number of important sections have certainly been lost or inadequately recorded.

2.4 THE INTEGRATION OF THE PALAEOENVIRONMENTAL DATA SET WITH THE ARCHAEOLOGICAL DATA SET.

---

[2]Only the immediate field recognition of the exceptional significance of the Dover Boat by on-site staff prevented major loss and even then exceptional co-operation from the contractors, and emergency funding provision from English Heritage was required to retrieve the wooden structure.

From the beginning of the project integration between archaeological and palaeoenvironmental goals was both desirable and necessary. From a practical perspective many of the stratigraphic observations made by CAT could usefully aid GSF investigations and conversely GSF observations proved useful in identifying areas of potential interest prior to the commencement of engineering work in that area (e.g. the predictions made by GSF on the basis of borehole data from K13, K16 and L13 that terrestrial deposits of pre-Roman age were present at depths of c.6m below ground level in the location at which the Bronze Age Boat was found later in the project). Clearly integration at the practical field level was advantageous to both groups.

More specifically data exchange between GSF and CAT has involved:-

1. Cross referencing spot-dated horizons of archaeological and palaeoenvironmental significance. A series of spot dates were undertaken on CAT samples from the Crypt Site, Bench Street and Fishmongers Lane where GSF personnel were processing bulk samples from contexts at these sites. Additionally spot-dating of GSF bulk sample residues was undertaken on a number of occasions allowing crude age estimates and residuality to be calculated from a range of samples.

2. Stratigraphic data recorded by GSF or CAT personnel has been integrated into the database. Furthermore CAT stratigraphic data is fully compatible with GSF archive system. Tables are provided to cross reference database systems with GSF and CAT field codes (Appendices 1 and 2).

3. Finds data has been transferred both to and from GSF. Artefact recovery from bulk samples has enabled material both for spot-dating and archiving to be transferred to CAT. In addition large quantities of hand retrieved ecofacts (predominantly large mammal bone) has been passed to GSF from CAT excavations.

4. Documentary data, located during CAT investigation of data sets, has been integrated into GSF archive and should prove useful (e.g. newspaper cuttings on the frequencies and nature of chalk cliff falls in the area).

5. Finally, and perhaps most importantly, goals and themes for research (see Section 11.0) first outlined in the English Heritage project proposal of August 1992 have been examined and redefined and a further set of research objectives outlined on the basis of the fieldwork. Careful integration has been necessary to enable both archaeological and palaeoenvironmental data to be considered in the evaluation of these themes (e.g. palaeoeconomies of Dover 850-1450 A.D. and the ability to map archaeologically significant landscapes such as the 2nd A.D. land surface).

3.0. SITES AND SECTIONS OBSERVED DURING FIELDWORK.

Fieldwork commenced in August 1991 and continued on an intermittent basis until April 1993. Sewer trench digging was largely complete by summer 1992 while road construction activity has continued beyond April 1993 with a projected completion date of late summer/autumn 1993.

Fieldwork has been undertaken on a flexible basis by a team from GSF, usually monitoring progress on a weekly basis. At times a field presence of 2-3 people for periods 2-5 days was required. Often observations and recording was undertaken in conjunction with CAT personnel.

These vary in the nature and type of sediments and associated archaeological significance and require assessment from different perspectives.

Observations made during the course of the project produced a series of carefully recorded sedimentological stacked sequences representing key profiles and sections observed along the line of the route corridor. In places these control sections were observed and recorded in controlled archaeological contexts. These sequences are listed in Table 3 by Site Index Number, Site Location Number (field codes given during the project to areas of the route corridor by GSF), CAT site or section code (where GSF recording complemented CAT excavation procedures), Ordnance Survey Grid Reference, height datums and zone of archaeological potential.

3.1 METHODS OF RECORDING AND SAMPLING AT SECTIONS

All sequences observed in the sewer trench, road cuttings and archaeological excavations have been described to a standard format used by GSF. Section description is usually undertaken along a vertical profile through the sequence where all stratigraphic units are preserved. Where sections are noted to be highly variable multiple descriptions are used to provide a detailed profile recording. This is usually undertaken in conjunction with detailed drawing of the profile. Profile description usually includes the following:-

i) Colour as measured using the Munsell Soil Color chart (Munsell, 1975).

ii) Grain size to give an approximation of the main grain sizes present in a unit, the nature of the sorting of grain size distribution through the unit.

iii) The nature, orientation and composition of the sediment particles (clast lithology).

iv) Shape of included particles.

v) Nature of included biological material.

vi) The nature of any archaeological material.

vii) The nature of the contacts between units.

viii) Unit and profile thickness and geometry.

For each profile recorded an individual record sheet (see Figure 3) is presented in Archive A. Section photographs, present in Archive C are listed on record sheets as illustrated in Figure 4.

Where time and safety considerations permitted, sampling of the sequences was undertaken. Sample location, type, size etc varied with the nature of the sediment profile and the questions likely to be asked of the included data. Sample data is presented in Archive A on sheets (Figure 5).

Disturbed bulk samples of 2 to 20kg+ were commonly taken through profiles. Where stratigraphic recording indicated conformability and potential high resolution sample intervals were commonly 10cm. Sampling for molluscs usually produced samples of 2-3 kg. Sediment samples also varied depending on grain size properties (i.e. coarse gravel units required large bulk samples (20kg+) to be statistically valid). Clearly rigid guidelines for sampling techniques were not applicable to this project and individual sequences were sampled on the basis of assumed sediment and biological properties in line with suggestions made by Macphail et al. (1992).

Bulk samples were taken and stored in heavy-duty plastic bags or 10 litre plastic tubs and clearly labelled with indelible ink or coded labels. All samples taken are listed in Archive A by Site Index Number and in Appendix III. Organic-rich samples, potentially useful for ^{14}C dating or biostratigraphic analysis were stored in a fridge at the Institute of Archaeology to retard sample degradation. Less sensitive samples (e.g. gravels) are stored systematically in Dover District Council facilities in Deal.

In addition to disturbed samples a series of samples were taken to maintain stratigraphic integrity, provide detailed evidence of stratigraphic succession and to provide a repository of material suitable for sampling at high resolution suitable for pollen, microstratigraphic and diatom analysis. This was undertaken by:-

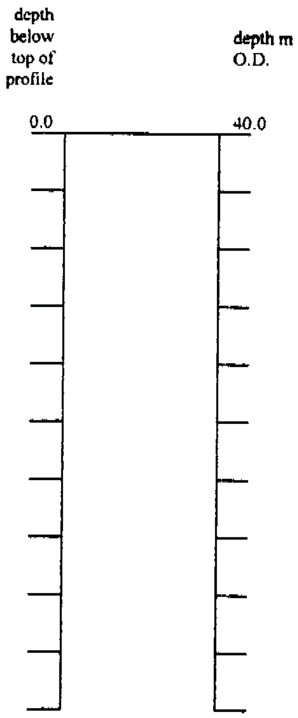
i) Hammering 500 x 50 x 50mm metal monolith tins, with plastic inserts, into profiles. If monoliths were placed to overlap a complete, continuous sequence could be recorded. These tins were subsequently cut out of the profile, wrapped in cling film and stored under refrigerated conditions.

ii) Small 80 x 50 x 40 tins (Kubiena tins) were hammered into the section to provide undisturbed sediment samples suitable for soil micromorphological investigation.

RECORD NUMBER	003

GEOARCHAEOLOGICAL SERVICE FACILITY - *STRATIGRAPHIC DATA SHEET*

		Site Index Number	A1
G.S.F. Site Location Number	GSF 1	Grid Reference	31076 40136
C.A.T Site/Section Code		Sheet	
Location	100m west of Gloucester Road	Notes	
Top of Profile	40.0m O.D.		
Base of Profile	39.4m O.D.		
Stratigraphic Profile		Section Drawing	
Orientation	WSW-ENE	Type of Observation	OP/RC
		Observed By	GSF



0.00 - 0.60 5YR 5/0 yellowish red slightly sandy silt with frequent angular - sub-angular flints (1- >8cm). Heavily rooted.

Sharp contact

0.60 - 0.65 Shattered chalk blocks

FIGURE 3 Stratigraphic data sheet used for the archive

RECORD NUMBER	001

GEOARCHAEOLOGICAL SERVICE FACILITY - ***PHOTOGRAPHIC RECORD SHEET***

		Site Index Number	A1
G.S.F. Site Location Number	GSF 1	Grid Reference	31076 40136
C.A.T Site/Section Code		Sheet	
Location	100m west of Gloucester Road	Notes	

Photographs taken:

1. Red-brown silts overlying weathered chalk to west of Gloucester Road.

2. Detail of red-brown silts overlying weathered chalk west of Gloucester Road.

FIGURE 4 Photographic data sheet used for the archive

RECORD NUMBER	003

GEOARCHAEOLOGICAL SERVICE FACILITY - ***SAMPLE DATA SHEET***

		Site Index Number	A1
G.S.F. Site Location Number	GSF 1	Grid Reference	31076 40136
C.A.T Site/Section Code		Sheet	
Location	100m west of Gloucester Road	Notes	

Samples taken:

Bulk samples **BS 1 (0.0-0.10m)**
BS 2 (0.10-0.20m)

FIGURE 5 Sample data sheet used for the archive

A further strategy, using drilled sediment cores was also adopted. A wire-line percussion drill rig, drilling 100mm cores, was used in areas of engineering difficulties to record stratigraphies and recover samples. Drilling involved the recovery of disturbed bulk samples, at c. 0.20m intervals, and undisturbed U4/U100 sediment cores of 0.45m length. Recording of sequences (see Archive A) was undertaken by observation of disturbed samples and U4/U100 core extremities augmented by detailed recording of extruded cores in the laboratory (see Archive B).

3.2. DISTRIBUTION OF SITES ALONG THE ROUTE CORRIDOR

A total of 90 stratigraphic profile observations have been made along the route corridor during the Field Work Programme by GSF. These comprise observations made on single profiles either from test-pits, engineering temporary sections or purposive boreholes.

Three main concentrations of sites are noted:-

1. In the immediate vicinity of Archcliffe Fort (B1-B8, D1-D5).

2. In the area around Bulwark Street toward the bridge over the railway in Snargate Street (E1-E9, F1-F6).

3. The town centre area from York Street Roundabout to Fishmongers Lane (I2-I9, K1-K19, L1-L16).

Table 4 lists the grid squares (see Figures 1and 2) and the numbers of sites observed and recorded in each square. It is clear that a large number of observations were made in the town centre squares (I-M = 50 profiles of the total of 89 [56%]). This is a function of (i) a number of set piece excavations/trial trenches being dug in this area, (ii) the slower speed of trenching due to the presence of large buried masonry structures allowing increased levels of recording, (iii) the greater internal cohesion of the sediments (clay-silts as opposed to gravels) leading to greater section stability and enhanced ease of observation and (iv) more complex nature of the sequences necessitating the additional use of boreholes.

In the remaining two areas, the Western Heights (Squares A-D) and the undercliff area (Squares E-I) sites cluster around deep construction activity, e.g. the underpass on the Western Heights (B3-B8).

It is clear that the data set is clustered and unevenly distributed along the route corridor and that certain areas in the Western Heights and the undercliff area have only received cursory examination. This is not perceived as a particular constraint on interpretation of project results as stratigraphic sequences in these areas appear relatively constant and predictable allowing extrapolation between observation points. This is not the case in the town centre where stratigraphic variability, even over short distances, makes correlation of adjacent stratigraphies difficult.

It was fortunate that engineering problems slowed construction of the pipe trench in areas of the central town spatially coincident with zones of higher archaeological potential, deeper and complex stratigraphy and high preservation through waterlogging. This was not planned into either the archaeological brief which only provided for opportunistic recording (sampling) in the engineering works cascade. The archaeological brief precluded any delay to engineering works on archaeological criteria. In future projects of this type much greater consideration should be given to planned access within safety factors to ensure adequate archaeological monitoring. If unplanned engineering delays had not occurred in the Dover Town area adequate monitoring/recording/sampling would not have been achievable.

5.3 A SUMMARY OF THE STRATIGRAPHIC SEQUENCE ALONG THE ROUTE CORRIDOR TRANSECT

It has previously been suggested (Section 1.3) that sites observed during the project fall naturally into 3 groups, 1) Western Heights (Grid Squares A-D), 2) Bulwark Street to York Street, undercliff area (Grid Squares E-I) and 3) York Street Roundabout to the Eastern Docks town centre area (Grid Square I-M). The subdivisions are a result of a number of factors that include geomorphological and topographic position, depth to rock-head, sedimentation patterns and to a limited extent human activity patterns. These subdivisions are a convenient way to discuss the data set.

5.3.1 The Western Heights (Grid Squares A - D)

Twenty-one stratigraphic profiles were recorded in detail (see Table 3 for Site Index Numbers) in the area between Aycliffe and Archcliffe Fort (Table 3). This represents 24% of the total profiles recorded by GSF for the Route corridor as part of the Assessment. The stratigraphic profiles indicate a range of stratigraphies and sediment types that increase in thickness and complexity from west to east along the route corridor.

The area occupied by grid square A (Site Index Numbers A1-A5) is a low angle valley interfluve and contains 5 profile observations that typically record a thin veneer (<1m) of superficial sediment, usually clay-with-flints, lying on shattered, in situ chalk bedrock. The palaeoenvironmental potential of these sequences is low and the deposits indicate that, with the possible exception of a few features cut into these sediments little or no stratified archaeology is likely in these areas.

Grid squares B and D (a total of 16 profiles described) contain thicker sequences (up to 4m) of sediments that lie on the edge of or fill a small, now dry valley trending NW to SE. No observations were made in Grid Square C. The sediment sequences thicken to the east and become more complex in the vicinity of Archcliffe Fort (e.g. D6-D8) (Plate 3). Typically the sequences contain a simplified profile with three main stratigraphic units:-

1. A basal chalk and flint rich gravel.

2. A series of predominantly fine grained silts with occasional thin beds of fine-medium chalk or flint gravel.

3. An upper coarse chalk/flint gravel.

This tripartite sequence is clearly seen at profile D3 in the section exposed in the old moat at Archcliffe Fort. The fine grained sediments stratified between the two gravel units locally show considerable complexity (e.g. D6-D8, B8) and include small gravel units, beds or bands of increased reddening and rooting (B8), and extensive molluscan material (D6-D8).

AREA	NUMBER OF SITES	GEOMORPHOLOGICAL ZONES	NUMBER OF PROFILES	% TOTAL
A	5	THE WESTERN HEIGHTS (Aycliffe to Archcliffe Fort)	21	24
B	8			
C	0			
D	8			
E	9	THE UNDERCLIFF AREA (Bulwark Street to York Street Roundabout)	18	20
F	6			
G	2			
H	0			
I	9	THE DOVER TOWN CENTRE AREA	50	56
J	2			
K	22			
L	16			
M	2			
TOTAL	89			

Table 4 **List of grid squares and sites along route corridor**

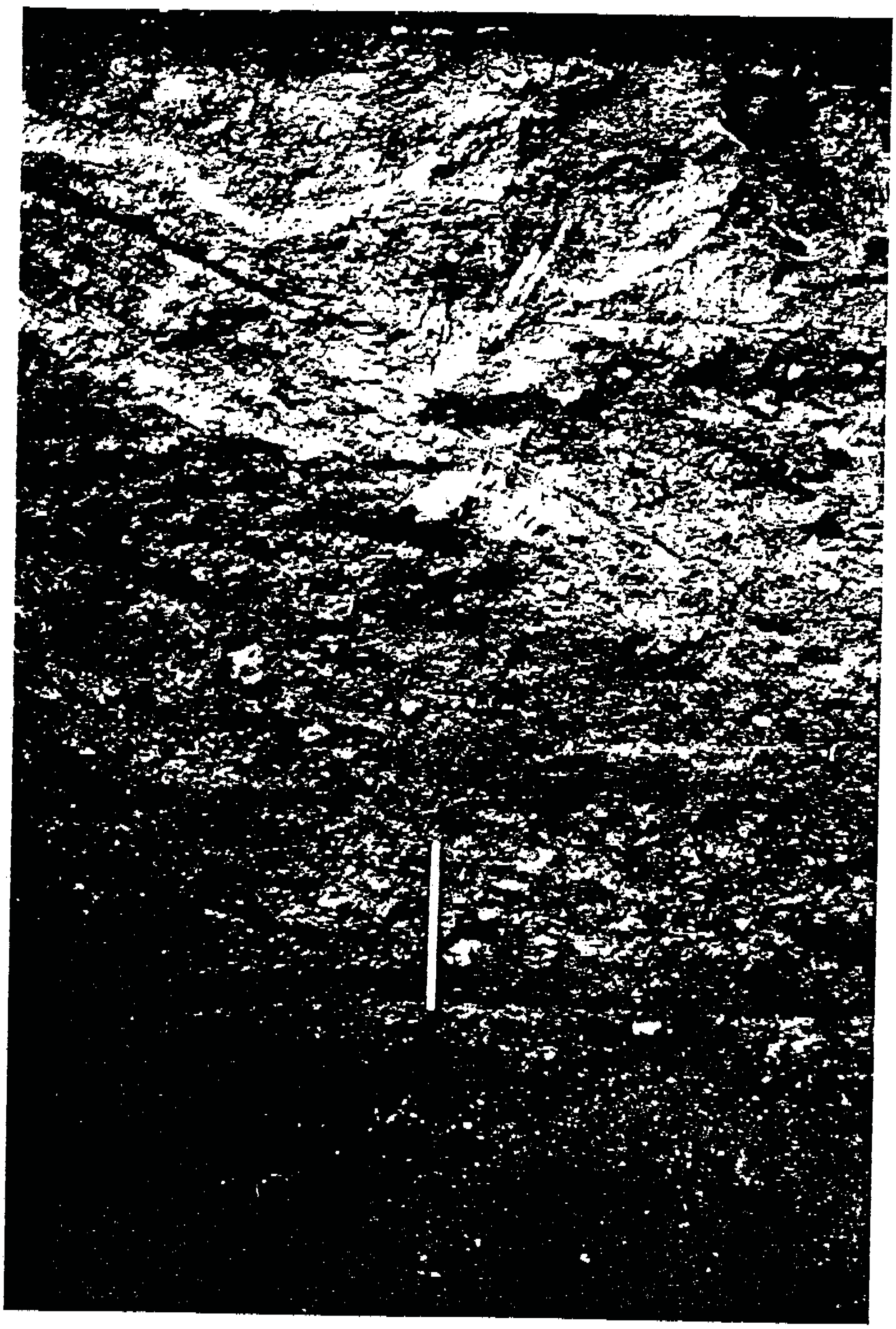


Plate 3. Late-glacial solifluction deposits at Archcliffe Fort

These sequences are not directly associated with archaeological material in the area but may correlate, in part, with the valley bottom gravels samples in L15 from which a flint core axe was recovered.

These sediments are significant because they contain molluscan (see Section 6.5) and sediment micromorphological evidence that may be used as a proxy record to log climatic change. Typically sequences of the type exposed in the vicinity of Archcliffe Fort are thought to have been deposited in the Late-glacial period (10-13ka B.P.) during a phase of rapid environmental change. Sites of comparable age occur at Holywell Coombe, Folkestone (Preece, 1992), Pegwell Bay, Isle of Thanet (Kerney, 1965) and Halling in the Medway Valley (Kerney, 1971).

3.3.2 Bulwark Street to York Street Roundabout (the undercliff area) (Grid Squares E - I)

Eighteen stratigraphic profile observations were made in this area (18% of the total for the project) that includes the historical Paradise Basin and the undercliff area along Snargate Street (E1 - E9; F1 - F6; G1 - G2 and I3). Typically the sediment types observed in the area fall into one of two categories, (i) sands with occasional silt horizons and (ii) gravels with some sand.

The observations made suggest a relatively simple distribution of sediments consisting of coarse, well rounded flint gravels adjacent and banked up against the chalk bedrock cliff (e.g. F6 and F7) (Plate 4) and secondly away from the bedrock cliff a deep sequence of sands (Plate 5) with thin gravel deposits at the base of the sequence immediately above the chalk (e.g. E5 and E8). Typically the sequences were truncated by recent activity and were only partially complete.

The sequences observed conform to expected stratigraphies predicted by earlier work (Barham and Bates 1990). Sediment types (sand and gravels) indicate moderate to high energy depositional regimes expected of beach environments at the base of exposed chalk cliffs as predicted along Snargate Street (Barham and Bates, 1990). Stratigraphically these sequences usefully complete the superficial geology map for the area but offer little (with the exception of the stratified sand sequences infilling the old Paradise Basin - Site Index Numbers E5 E8 E9) prospect of detailed palaeoenvironmental reconstructions. Dating beach deposits is likely to be difficult as the majority of cultural debris and molluscs within the sediments are likely to be reworked and thus not indicative of time of deposition of the units.

The sands infilling the old Paradise Basin area (Site Index Numbers E5, E8, E9) are well stratified in places and represent a partially complete history of infilling of the area. These sediments are likely to contain foraminiferal and ostracoda remains that will indicate the nature of infill of the area.

Plate 4. Beach deposits resting against a chalk cliff below Archcliffe Fort

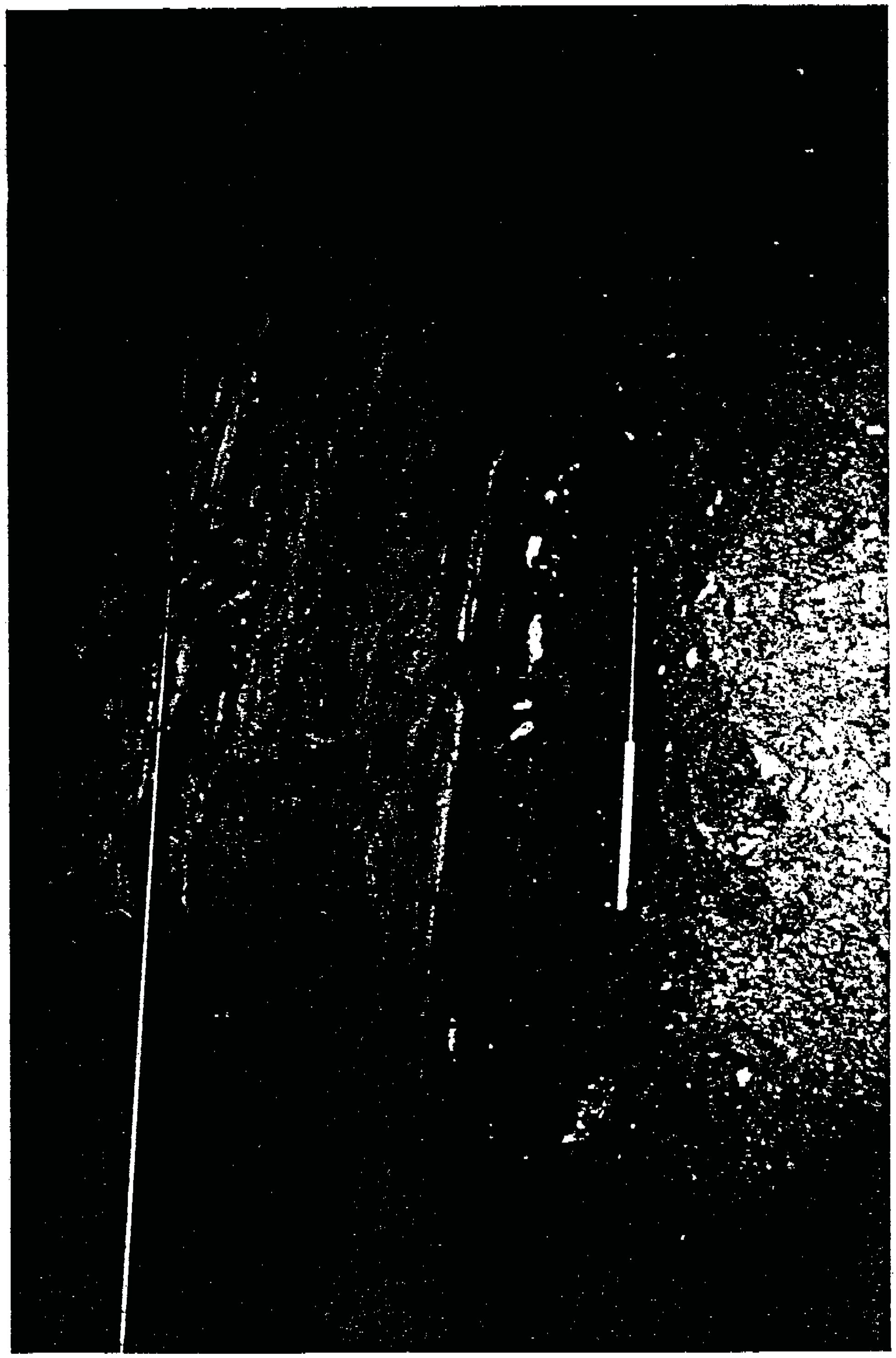


Plate 5. Bedded sands and gravels at Bulwark Hill infilling the old Paradise Basin

Of considerable interest in the Dover area, partially due to the life threatening nature of the events, is the history of cliff falls from the cliffs behind Snargate Street. Abundant documentary evidence is available in the histories of Dover and, within the last 100 years, the Dover newspapers. For the first time in archaeological contexts evidence of a major cliff collapse is revealed. The sequences recorded in the vicinity of the bridge over the railway in Snargate Street (F1-F6) show well sorted beach gravel overlain by coarse chalk rubble with occasional levels of water worn beach material. This has been interpreted from field observations as evidence of successive cliff collapses. Documentary evidence may resolve the dating of these events, and sedimentary analysis will be required to confirm the facies designations ascribed from field stratigraphic observation.

3.3.3 The Dover town centre area (Grid Squares I - M)

A total of 50 stratigraphic observations of sequences (56% of all observations made during the project) were examined in this area. Geologically and geomorphologically this area was likely to contain a complex stratigraphic sequence with terrestrial, fluvial and marine sediments being deposited in different locations at different times. Additionally, as the focus of human occupation and activity since at least the Roman period, anthropogenic influences on sedimentation patterns (i.e. harbour defence constructions) and post-depositional activity (i.e. dredging, spoil disposal during construction activity) may alter and locally modify the sedimentary sequence. As a consequence of the stratigraphic complexities and the historical importance (in addition to a denser pattern of engineering construction activities) greater resources were focused in this area than elsewhere along the route corridor.

The basic stratigraphic framework has been sampled, and subsequently constructed, from a grid of boreholes along lines of major disturbance (Figure 6, Table 5). Recovery of undisturbed core samples in fine grained sedimentary units has allowed sequences, towards the base and immediately below the effective depth of trenching (but not of piling activities) to be observed. Additionally sufficient observations have been made at various locations along the sewer trench and in areas of deep construction activity (e.g. the Bench Street Underpass) to examine, in detail, many of the sedimentary units recovered from drill cores. These observations can then easily be placed in the stratigraphic framework constructed from the drill core data.

The sequences recovered in all cases exhibited a high degree of stratification and conformability indicating that high resolution lithostratigraphic and biostratigraphic sequences were present. No single core or section sampled all units described in the area and therefore a complete stratigraphic profile shown in Figure 6 records the sequence beneath Bench Street toward the old Dover Stage Hotel. Table 6 lists the main stratigraphic units and the locations where these units are unequivocally exposed (N.B. Other exposures may well contain sediments time equivalent with those shown in Table 5 but remain to be assigned to specific sedimentological or chronological units).

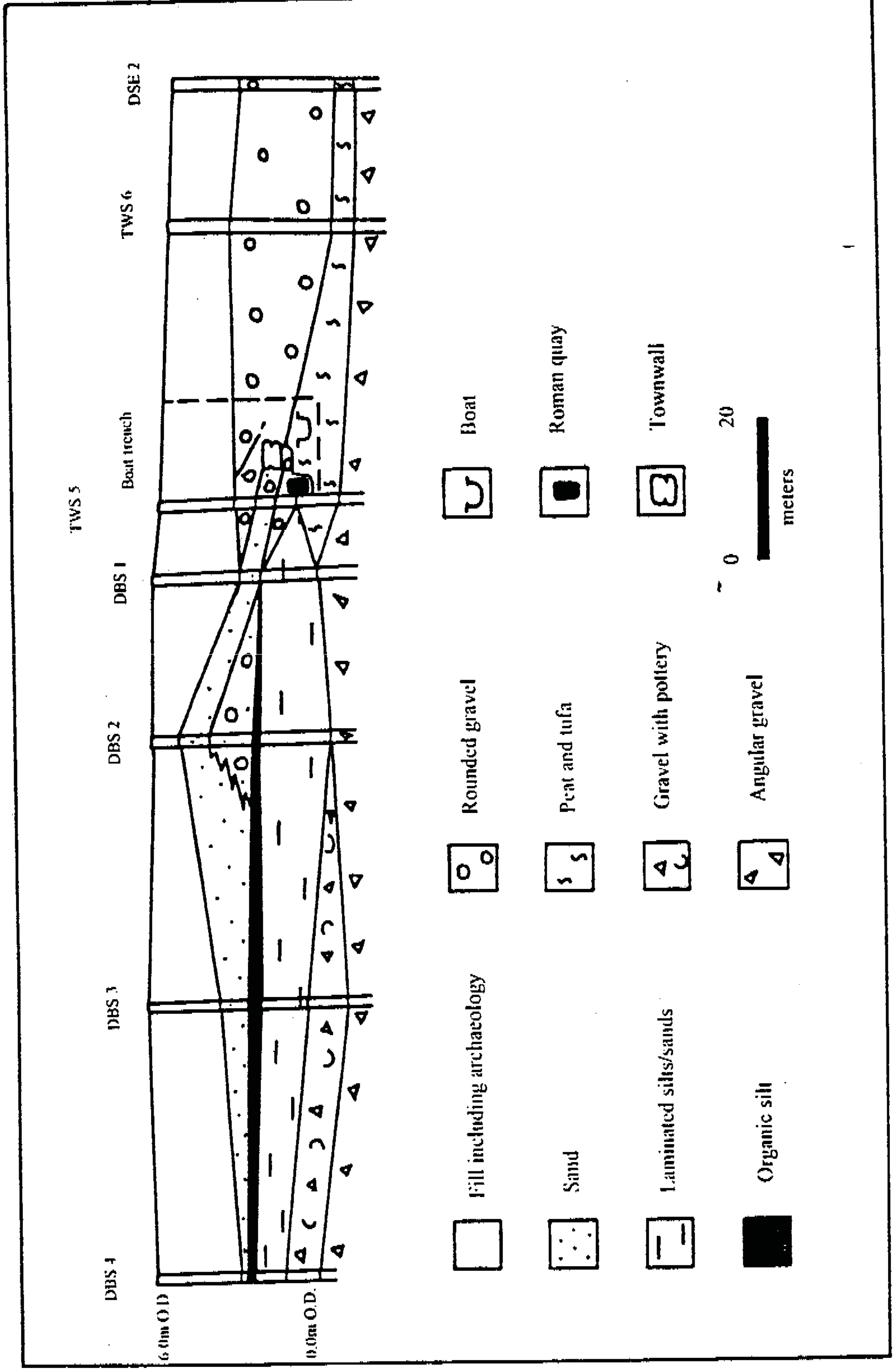


FIGURE 6 Stratigraphic profile along bench street from Townwall Street to the junction of Queens Street and Fishmongers Lane constructed from borehole and trench sequences

The initial processing of the field data and the integration with the core data extruded during the laboratory processing suggested a complex history of sedimentation. The basal flint gravels have been sampled down to chalk rockhead at locations K10 and L15. Immediately above the gravels are a series of tufas, peats and organic silts. These were well sampled at a number of profiles e.g. locations K7, K13, K16, L13 and L16. Tufa present ranged from hard, compact tufa (K7) similar to the building stone used in the construction of the Classis Britannica Fort and the Pharos, to soft friable tufa pellet gravels (L13). These deposits have also been observed and sampled in open sections at L7 (and more extensively during the excavation to recover the Bronze Age Boat). The variability in these sequences and the association of tufa, peats and organic silts (Plate 6) suggests that a complex, well preserved land surface is present throughout much of central Dover at depths of circa 0.0m O.D. to -1.0m O.D. The sediments are locally rich in plant macrofossils and molluscs and likely to produce a high resolution palaeoenvironmental picture.

Overlying these deposits, or in places the basal flint gravels, are a series of gravels rich in building debris, pot, bone, etc. and subsequently a series of sometimes laminated clay-silts and sands with variable organic content. These deposits are interpreted as the primary fill of the old harbour basin. Well stratified in places (see Plate 6), e.g. K9, K10, L12, they are likely to furnish a detailed picture of environmental change during harbour infilling. This sequences is overlain by a widespread sequence of sands and silts containing freshwater molluscs (see Section 6.5.) and reeds (see Section 6.2.). These deposits were well exposed in the Crypt Site area and sampled from open sections at location K1. In addition boreholes K9, K10, K11, K12, K13, K14, and K15 have produced organic sediments at similar depths that correlated with this event. Plate 7 illustrates this stratigraphy.

This sequence is unconformably overlain by a thick series of sands and gravels, clearly consisting of well rounded flint gravels of probable marine origin. these sediments are well exposed beneath Bench Street (K9, K10, K11, L12, L13) and in the Crypt Site area (K11, K12, K13, K14). Finally these sequences are overlain by a sequence of organic silts in the inland part of Bench Street (K11) and into Fishmongers Lane (L11). These deposits are poorly stratified and mixed with substantial quantities of building rubble, wood, bone etc. They are unlikely to produce high quality palaeoenvironmental sequences, although processing and analysis of the archaeological residues may provide useful data on the type of archaeological contexts still preserved in situ in areas marginal to the A20 route corridor.

This sequence forms the basic stratigraphic framework against which other borehole sequences and trench excavated data can be compared. It is likely that this sequences, while correct in succession, will require modification after further laboratory analyses have been completed.

SEDIMENT TYPE	ESTIMATED AGE	INFERRED ENVIRONMENT OF DEPOSITION
ORGANIC SILTS	NORMAN-EARLY MEDIEVAL	FRESHWATER/TIDAL
SAND AND GRAVELS	POST-ROMAN/PRE-NORMAN	MARINE
CALCAREOUS SILTS AND PEATS WITH FRESHWATER MOLLUSCS AND PLANT MACROFOSSILS	POST-ROMAN/PRE-NORMAN	FLUVIAL/STANDING WATER WITH OCCASIONAL SALINE INFLUXES
FINE GRAINED, SOMETIMES LAMINATED, SAND AND ORGANIC SILTS	LATE TO POST-ROMAN	TIDAL TO FLUVIAL
ANGULAR GRAVELS WITH ROMAN POT, TILE AND BUILDING MATERIAL	LATE TO POST-ROMAN	SUB-TIDAL TO FLUVIAL
TUFA, TUFA PELLET GRAVELS, PEATS AND ORGANIC SILTS	EARLY TO MIDDLE HOLOCENE	FRESHWATER/TERRESTRIAL
ANGULAR FLINT GRAVEL	LATE-GLACIAL	FLUVIAL

Table 5 Major sediment units, estimated ages and inferred environments of deposition beneath dover Town Centre (Grid Squares I-M)

SEDIMENT TYPE	LOCATIONS
ORGANIC SILTS	K3, K8, K11, L11
SAND AND GRAVELS	I9, K1, K7, K9, K10, K11, K12, K13, K14, K15, K16, K19, L2, L11, L12, L13, L14, M1, M2
CALCAREOUS SILT	K1, K2, K9, K10, K11, K12, K13, K14, K15
LAMINATED ORGANIC SANDS AND SILTS	K8, K9, K10, K11, K12, K13, K14, K15, K16, L11, L12
ANGULAR GRAVELS	K10, K11, L10, L11, L14
TUFA AND PEATS	J2, K8, K13, K16, K19, L7, L13, L14, L16

Table 6 Major sediment types and locations in Dover Town Centre

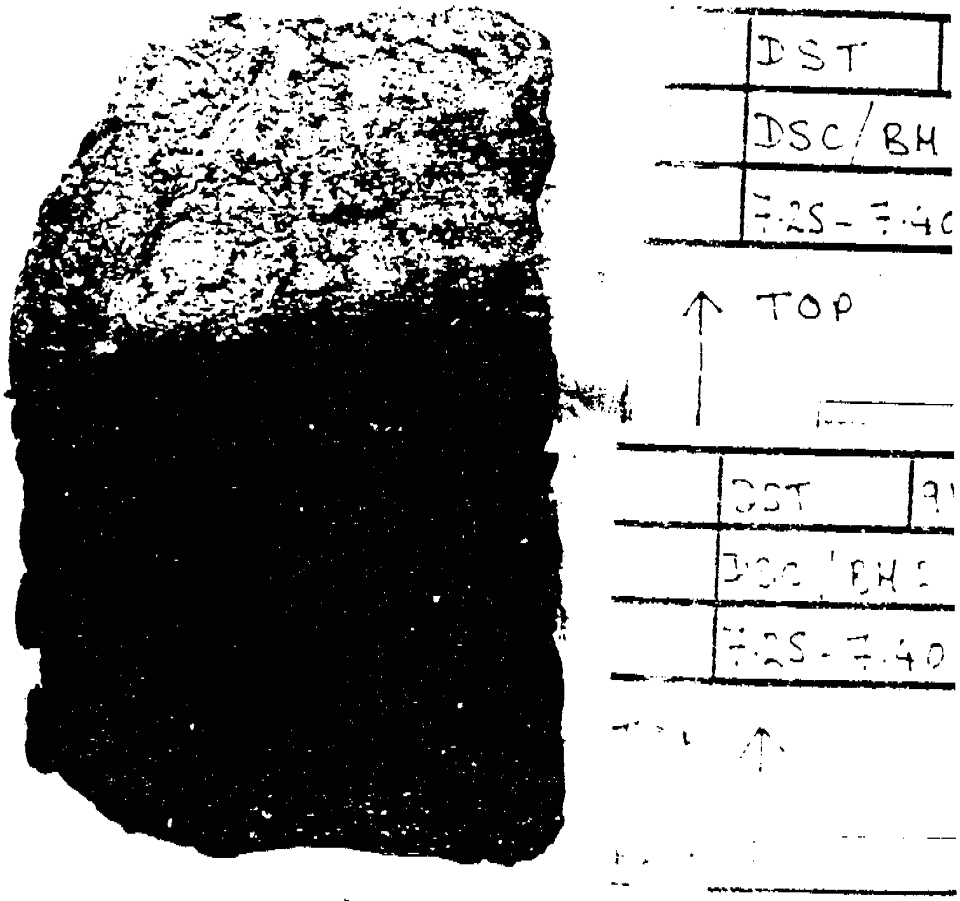


Plate 6. Tufa, peat and organic silts as seen in an extruded U4/U100 core from borehole DSC-2 (7.25-7.40m below ground surface).

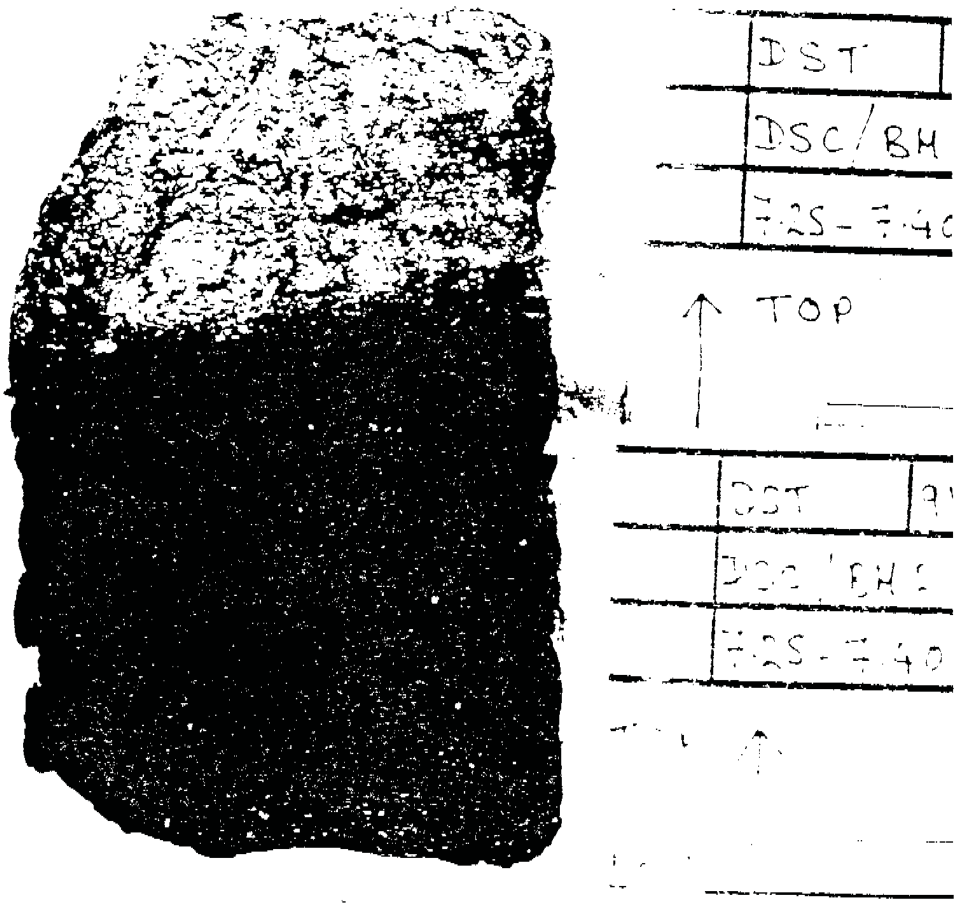


Plate 6. Tufa, peat and organic silts as seen in an extruded U4/U100 core from borehole DSC-2 (7.25-7.40m below ground surface).

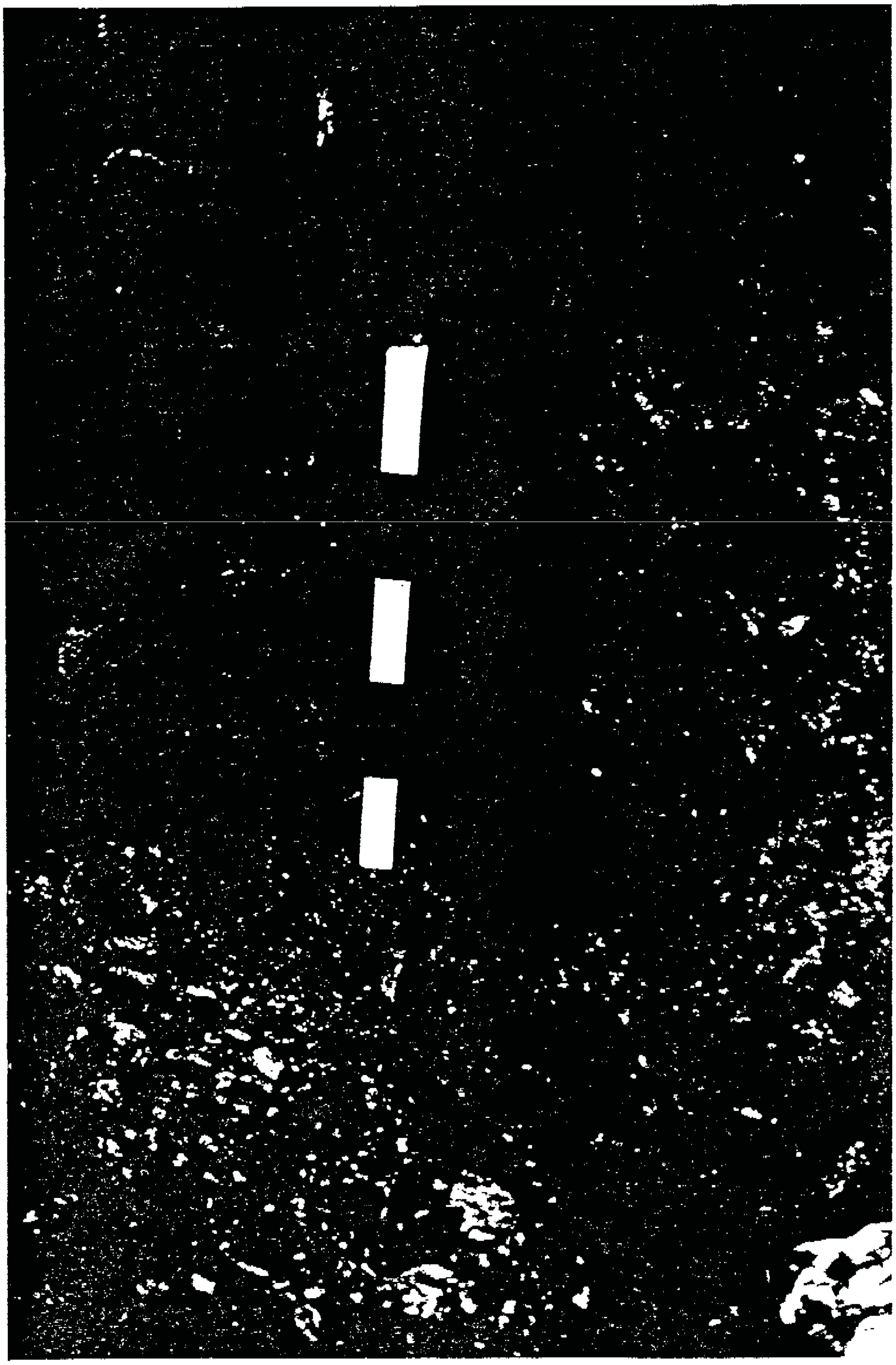


Plate 7. Freshwater organic silts underlying marine sands and gravels at the Crypt Site

3.4 ENVIRONMENTAL ARCHAEOLOGICAL AND PALAEOENVIRONMENTAL SAMPLE ARCHIVE RECOVERED DURING FIELDWORK

A total of 840 disturbed samples were taken during the project (see Tables 7 and 8, Appendix III). These came from a variety of sources (see Table 8). Twenty two percent of these samples were from excavated contexts recorded during CAT excavations and trial pits, forty-four percent from boreholes and thirty three percent from GSF trench profiles. There was a clear bias towards large numbers of samples from the Town Centre area (III) where, incidentally the stratigraphy was highly complex, laterally highly variable and where the deepest sections were present. This bias in sample number, towards the Town Centre area (III) is also reflected in the distribution of profiles revealed (see Table 4).

A total of 46 monoliths were recorded from the route corridor and 93% were recorded from open sections. 78% of the monoliths came from area I while only 17% came from the Town Centre area. This reflects the nature of the sequences present in the trench and open sections. Sediments in areas II and III were predominantly medium to coarse grained and not suitable for sampling with monoliths. One hundred percent of all U4's came from this area (III) and reflect the methodological difficulties encountered when sampling and recording sequences in the Town Centre.

The sampling exercise provided approximately 23m of monolith material and 22.05m of U4 undisturbed core material. This represents a considerable quantity of material upon which high resolution sedimentology and biostratigraphic investigation may be undertaken. This distribution of monoliths and U4 samples also produces a bias in sedimentary focus towards finer grained fluvial and harbour fills in the Town Centre area and fine grained silt at Archcliffe. Coarse grained fluvial and marine sequences are not recorded through this method of sampling.

The samples taken cover a wide range of sediment types from coarse grains to fine sands, silts and peats. The samples were taken from outcrop varying in elements from >20m O.D. to c. -4m O.D.. Samples ranged in potential age from sequences considered to be of late Pleistocene age (c. 14ka B.P.) to post-Norman contexts. Thus a considerable diversity exits in potential archaeological and paleoenvironmental significance of this material. In addition the resolution of the sequences from which the samples derive is likely to vary and hence individual samples may vary in importance. Preliminary age estimates indicate (see Section 7.1) that the samples derive from sequences that accreted at varying rates and hence sample size and significance will vary depending on estimated duration of sequence development.

Where possible large samples were taken as the samples represent the only material likely to be recorded from the sequences prior to destruction. If sample size is proven to be inadequate for statistically valid interpretations, further sampling is not possible. This may have considerable implications for future sampling strategies on similar projects.

		Number
	Processed	258 (30.7%)
Bulk samples	Unprocessed	582 (69.3%)
	Total	840
	Part processed	2
Monoliths 1	Unprocessed	44
	Total	46
	Part Processed	13
U4/U100 2	Unprocessed	36
	Total	49

TABLE 9. Summary sample data for Dover A20 Road and Sewer Scheme.

N.B.

1. All monoliths cleaned, photographed and recorded. Part processing includes, X-radiography, loss-on-ignition, details, particle size analysis and magnetic susceptibility determinations

2. All cores extruded, cleaned, photographed and recorded. Part processing includes X-radiography, loss-on-ignition, pH analysis, particle size determinations and magnetic susceptibility determinations.

	CAT site	Boreholes	Sections	Areas		
				I	II	III
Bulk samples	185 (22%)	372 (44.3%)	283 (33.7%)	89 (10.6%)	95 (11.3%)	656 (78.1%)
Monoliths	3 (65.2%)	0 -	43 (93.5%)	36 (78.3%)	2 (4.3%)	8 (17.4%)
U4's	0 -	49 (100%)	0 -	0 -	0 -	49 (100%)

TABLE 7. Total sample statistics for Dover A20 Road and Sewer Scheme.

TABLE 8. Sample statistics by site code for Dover A20 Road and Sewer Scheme.

	BULK SAMPLES			U4/U100	MONOLITH	KUBIENA TINS
	Processed	Unprocessed	Total			
DS-C	30	84	114		3	
DS-I	5	7	12			
DS-P	22	22	44			
DS-B	2	3	5			
DS-E		3	3			
DS-J		2	2			
DS-Y		2	3			
DS-S	2		2			
DBS-1				2		
DBS-2	16		16	3		
DBS-3	19		19	4		
DBS-4				6		
QS-1	21	8	29	6		
QS-2	12	7	19	3		
DSE-1	10	14	24			
DSE-2		10	10			
DSC-1		44	44			
DSC-2	22	17	41	7		
DSC-3		20	20			
DSC-4		25	25			
DSC-5	6	8	14	4		
TWS-1	7		7			
TWS-2						
TWS-3		18	18	2		
TWS-4		12	12	1		
TWS-5	17		17	2		
TWS-6	1	8	9	1		
TWS-7	5		5			
TWS-8	7	9	16			
TWS-9						
DSI-1		14	14	4		
DSI-2		13	13			
GSF 1		7	7			
GSF 2	1	1	2			
GSF 3	4	7	11			
GSF 4		14	14			
GSF 5	10	10	20		2	
GSF 6	1		1			
GSF 10		18	18		4	
GSF 11		1	1			
GSF 13		6	6			
GSF 14		2	2			
GSF 15		7	7		1	
GSF 16	2	2	4			
GSF 17		2	2			
GSF 18	3	1	4		1	
GSF 19		3	3			
GSF 20	1	3	4			
GSF 21	5	19	24		1	

GSF 22		10	10			
GSF 25	1	1	2			
GSF 26		1	1			
GSF 27		2	2			
GSF 28					2	
GSF 28A	8		8			
GSF 29		5	5		2	
GSF 30		40	40		10	
GSF 31		13	13		8	
GSF 33					3	
GSF 35	2		2			
GSF 36	2		2			
GSF 37	3		3			
GSF 39	1	20	3			
GSF 40		3	3			
GSF 41	2	3	5			
GSF 43	3		3			
GSF 44	1	11	12			
GSF 45		3	3			
DAF	4	14	18		10	
MEGGA					2	
TOTALS	258 (30.7%)	582 (69.3%)	840	49	46	

TABLE 8. Sample statistics by site code for Dover A20 Road and Sewer Scheme.

4.0 DESIGN STRATEGY ADOPTED FOR SAMPLE PROCESSING AND ASSESSMENT

As discussed in Section 3.0 the Fieldwork programme was designed to retrieve both undisturbed sedimentological samples (U4/U100 cores, monoliths and Kubiena tins) adequate for detailed palaeoenvironmental analysis, together with large bulk samples for calibrating, and ultimately studying, the archaeological, faunal and floral characteristics of sedimentary units destroyed by the engineering works. Of necessity, for logistical reasons, sampling was frequently opportunistic. Purposive sampling at pre-defined critical locations was primarily restricted to wire-line percussive borehole and rare set-piece excavation methods.

Key objectives, and factors considered to constrain the method of sample assessment, were considered (a) at the design stage of fieldwork, and (b) once fieldwork had commenced and the full limitations of access to engineering sections realised. Key elements in the design were as follows:-

i) Sample variability. It was predicted from previous work (Barham and Bates 1990) that an extremely wide range of context types (e.g. from fine colluvial sits, through peats to marine gravels) would be encountered. The design for assessment would need to be sufficiently flexible to deal with very different particle sizes, different context ages (from late-glacial to modern), varying states of organic preservation, disaggregation requirements, and equipment.

ii) Finite sample sizes. Although field sampling procedures were adjusted to sample context type (see Section 3.1) e.g. large bulk samples for contexts with visibly high preservation of organics or archaeological content; monoliths for thinly bedded well-stratified (high resolution) fine-grained sediments, sampling was highly constrained by access. The A20 Road and Sewer Scheme was de facto a 2.6km long fast-track "rescue" excavation where neither archaeological or palaeoenvironmental significance was specifiable prior to section exposure. Most section recording and sampling had to be frequently completed in 2-3 hour "windows" of opportunity. Re-sampling, or duplicate sampling by alternative procedures to assess optimum strategies was impossible. Therefore, all samples retrieved formed the basis for assessment, but also had to be stored and retained in part, for detailed study at the analysis stage (Phase 4 of MAP II). Sample processing should therefore be partial.

iii) Environmental Archaeological significance. As no published data was available prior to commencement of the project on the preservation states, concentrations or stratigraphic integrity of contexts from central Dover, all samples processed had potentially unknown (either high or low) significance prior to processing, even if adjacent spatially to known or expected, previously recorded archaeological sites.

iv) MAP II design criteria. The nature of the MAP II model required a design that permitted assessment processing methods to be either modified, repeated or re-targeted once research targets were agreed for the analysis stage. Thus, modification to processing methods had to be anticipated for the analysis stage.

v) Interaction between Field team and processing strategy. A "responsive" model was desirable, where the field team could receive information back quickly on-site, so as to adjust sampling strategies as concentrations/states of preservation became know, even at very preliminary levels.

4.0.1 Design criteria for sample processing

Given these factors the processing strategy adopted for the MAP II assessment included the following design criteria:-

* The widest possible array of sample context types (in terms of both age, sediment type and archaeological context) should be assessed.

* The samples processed should be spatially representative of a wide range of locations along the route corridor.

* No samples taken should be processed to destruction, or processed in a manner preventing re-assessment/analysis by other methods or techniques at a later stage.

* Processing should assess the potential of the recovered samples across a wide range of criteria/possible research themes. This would be achieved through investigation of (i) diversity of included ecofacts/artefacts (ii) states of preservation and (iii) abundance.

* Sample processing techniques should be as standardised as possible (within limits imposed by sediment properties e.g. grain size).

* Where sampling was spatially/chronologically more intensive (i.e. skewed to areas of high archaeological significance) processing should track this inherent bias.

* Archaeological significance, ascribed in the field, would not influence either selection of samples for processing, or methods of processing. This criterion was based on the fact that sample content (in archaeological residue terms) could only be assessed visually across a narrow band of large particle sizes in the field.

These general tenets were applied to form targets for processing. As processing commenced mid-way through the field programme, targets were set as percentages of (unknown) final sample totals. In fact, the final totals processed exceeded the 25% target (see 4.2 below). The methodology for processing (i) bulk samples (ii) undisturbed core/monoliths and (iii) all samples from the Project is shown schematically in Figures 7, 8 and 9).

4.1 THE RATIONALE FOR SAMPLE SELECTION

A total of 840 samples were taken during the project (Appendix III, Table 9). These ranged from large (>20kg) bulk sediment samples to small (<1kg) samples from fine grained units for particle size analysis. In addition to these bulk samples undisturbed samples were taken as a series of 46 monoliths, 49cores and Kubiena tins were also taken (Table 9). Monoliths and U4/U100 cores have been cleaned, photographed and described, and then in some cases split with half retained for archive and the other sub-sampled at 1cm intervals (total sample lists do not include these sub-samples produced in the laboratory phase of the assessment). The samples from cores and monoliths are predominantly to be used for detailed particle size analysis, pollen, ostracod, diatom and other sedimentological techniques (e.g. total P values, Loss-on-Ignition).

Decisions taken selecting samples for processing, sieving and assessing were difficult for the following reasons:-

1. Bulk sample processing needed to commence prior to the end of the project. Hence a complete sample set was not available when processing began.

2. As a result of (1) above estimates of the final nature and quantity of samples to be obtained later in the project had to be made.

3. Samples had to be selected before a full data set was available so priorities were difficult to formulate.

It was therefore decided that the bulk sample processing strategy should aim to:-

* Examine a range of contexts from a number of locations along the route-corridor.

* That the selected samples should cover a range of depths from near surface to the lowest contexts examined (i.e. c. 13m below ground surface).

* That sample matrix should include all sediment types (i.e. gravel-sand-clay, waterlogged/desiccated, acid/alkaline).

These problems were outlined above (Section 4.0.1). The primary objectives were to (i) provide the broadest possible overview of the potential of all samples recovered and (ii) evaluate and specify both techniques and samples most likely to form a cost-effective approach to research theme definition at the analysis stage (Phase IV of MAP II).

A two-phase approach to the Assessment was adopted. Preliminary assessment was conducted on a c. 25% target all bulk samples and c. 10% target of all undisturbed core/monolith material. These procedures were shown schematically in Figures 7, 8 and 9. Specific processing methods are outlined in Sections 4.2.1 and 4.2.2 as applied to the preliminary assessment of samples. In summary these procedures were applied to:-

1. Bulk samples, sieved to (usually) 0.5mm produced extract samples for the main vertebrate, plant macro, mollusc, insect assemblages and some sedimentological data.

2. Monolith and U4/U100 core samples (split usually at 1cm intervals) provided pollen, diatom samples in addition to limited quantities of vertebrate, plant macrofossil and mollusc material.

The preliminary assessment involved sieving, sorting, and examination of residues from a total of 258 bulk samples. This involved processing over a 10 person month period. A good spatial coverage of contexts from along the route corridor was achieved with 10.6% of samples from Area I, 11.3% from Area II and 78.1% from Area III. This distribution broadly follows the distribution of total samples by Area, i.e. the strong skewness to sampling from the central Town area is reflected in the 78.1% of samples from Area III.

The results of the preliminary assessment of the samples are held in part E of the archive. As a result of the preliminary assessment a series of samples were targeted for detailed analysis by specialists. This "specialist assessment" phase specifically aimed to address questions such as:-

* What range of environmental residues were present and what level of taxonomic identification/palaeoenvironmental interpretation could be reasonably gained from (i) individual sample extracts (ii) the sample set?

* Were the bulk samples producing sufficiently abundant extracts of particular residues (e.g. molluscs) to justify detailed research at the Analysis Stage?

* What were the preliminary indications regarding potential for local palaeoenvironmental/palaeoeconomic reconstructions (e.g. from pollen/plant macrofossil/bone assemblages)?

* Were the samples producing high residue recovery scattered in location/depth along the route corridor, or were particular spatial patterns emergent when 25% of all samples were processed?

* What taphonomic/facies patterns were discernible when assemblage type/composition was matched against context/stratigraphic data?

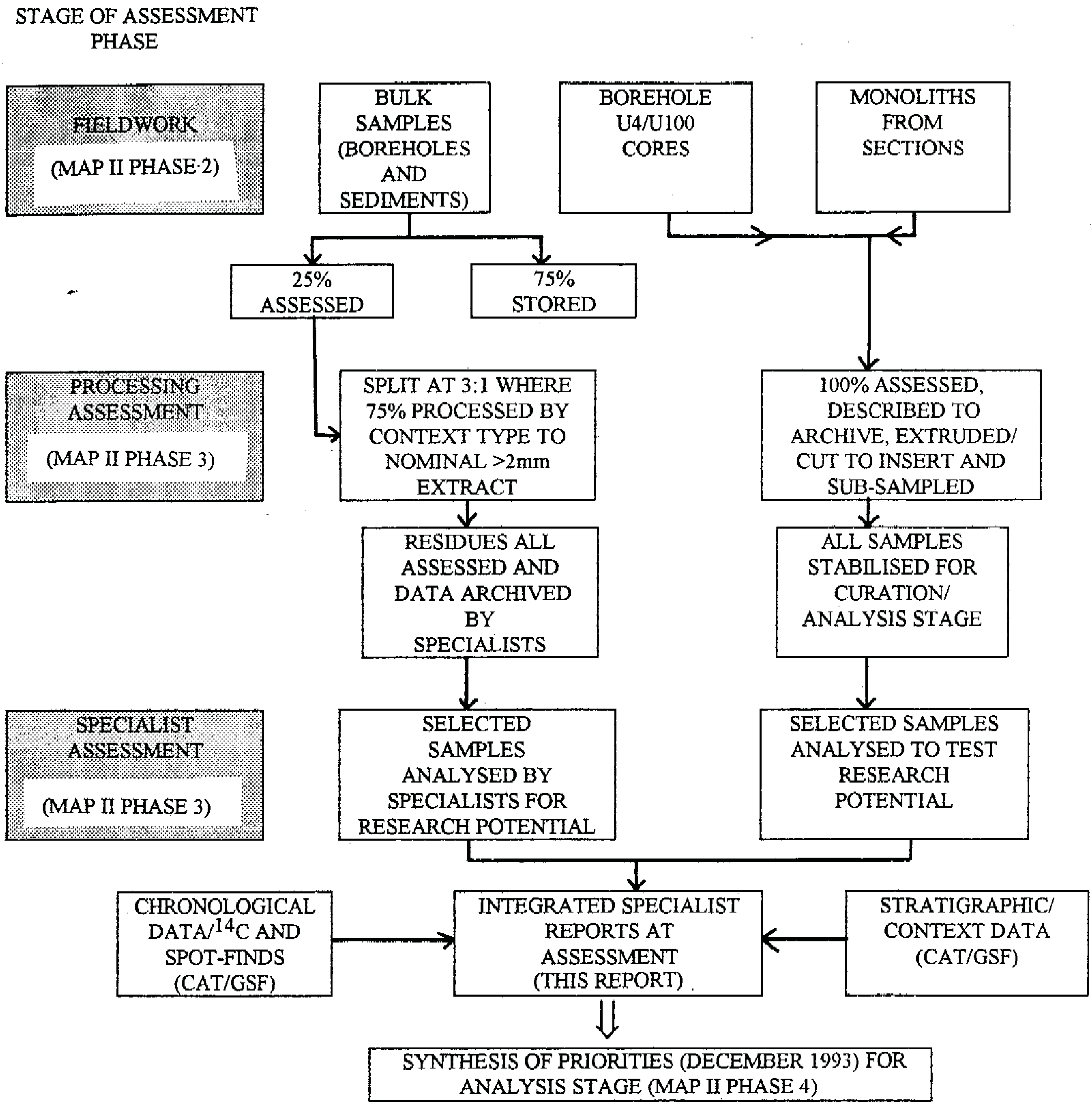


Figure 7. Summary of all decision making/processing of all samples from Dover A20 Road and Sewer Scheme.

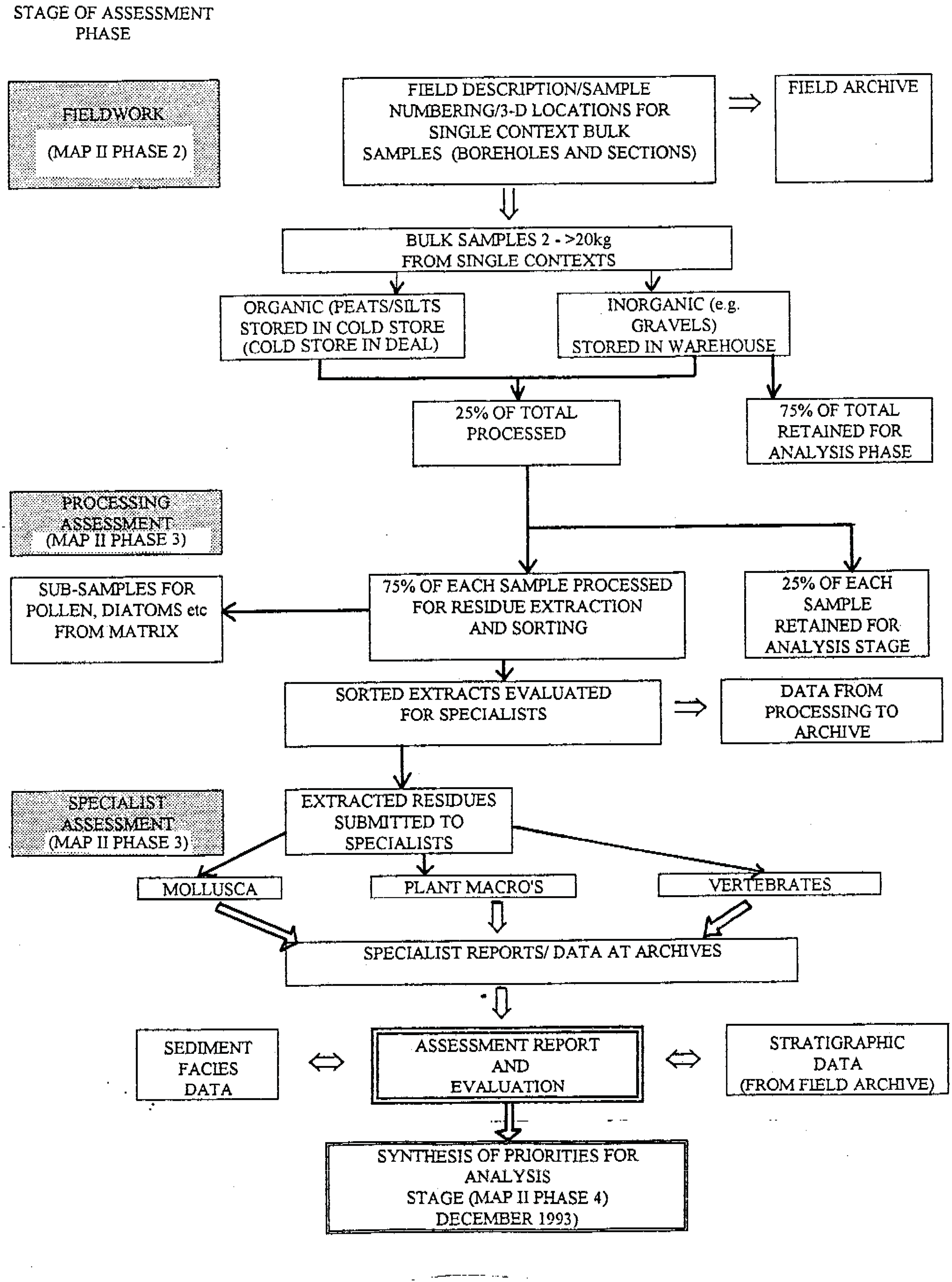


Figure 8. Bulk sample processing decision making used in Dover A20 Road and Sewer Scheme.

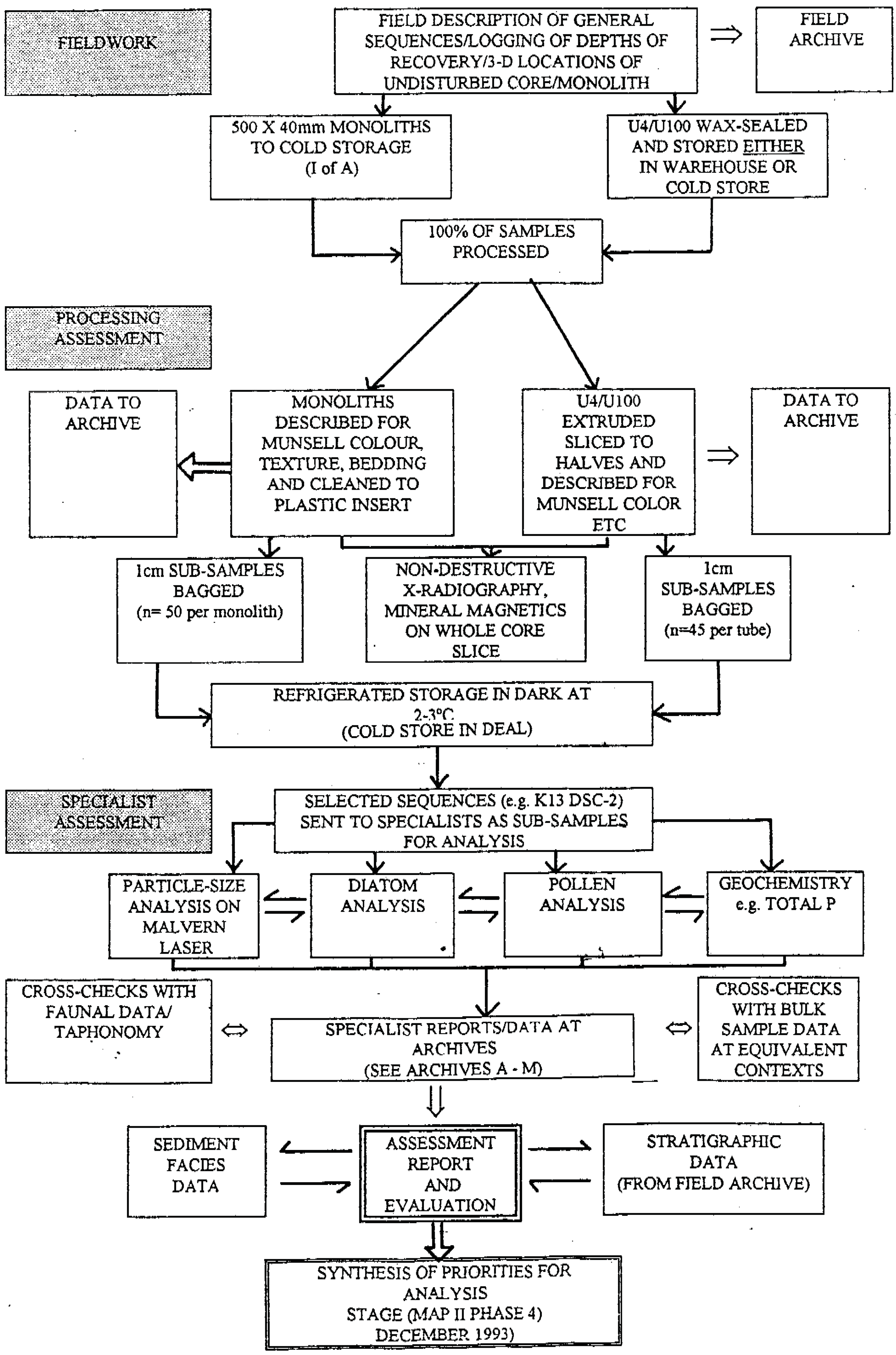


Figure 9. Monolith and core processing decision making used in Dover A20 Road and Sewer Scheme.

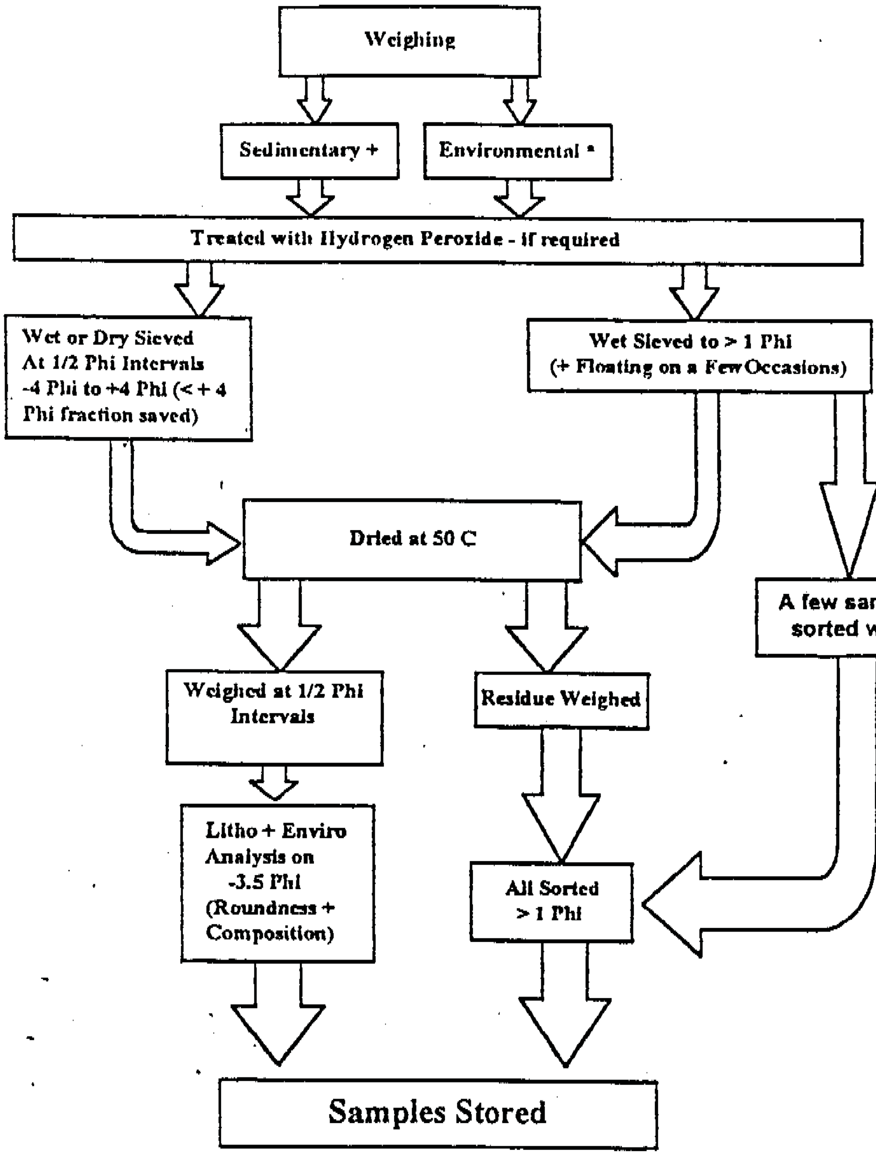


Figure 10. Flow chart to illustrate sample processing methodology

The samples selected for detailed analysis are presented in Appendix III.

4.2 SAMPLE PROCESSING METHODS AND PRELIMINARY ASSESSMENT STAGE RESULTS

Samples were taken from boreholes, set-piece excavations and trench sections. These samples varied in volume. Borehole samples fell into two categories (i) undisturbed U4 core sediments and (ii)disturbed samples between U4 tubes. The vertical resolution of the disturbed samples was usually poorer than resolution within the U4 samples. Those taken from sewer trench sections varied both in quantity and vertical resolution.

The flow chart in Figure 10 outlines the processing procedure for targeted samples depending on the nature of the deposits and the questions under consideration. All processing procedures were recorded on standardised sample record sheets (Figure 11). These records are archived in Section D of the archive. Two techniques were used to process samples, (i)a sample is sieved through a series of sieves with different mesh sizes from >16mm to 63 microns (this technique was used for samples for which particle size data was required) and (ii) a sample is sieved to 0.5 mm and the residue retrieved (i.e. the fraction smaller than 0.5mm is lost). The latter technique has been frequently adopted due to time constraints. In addition experiments have shown that the recovery of size fractions below 0.5mm (i.e. 0.25mm) add little additional data not already recovered from the >0.5mm size fractions (clearly this depends on the nature of the sample being examined, i.e. diatoms would be lost if this method were adopted for their recovery). This methodology immediately creates a problem, it is always possible to access the environmental remains in a sedimentological sample, however it is not possible to obtain a full sedimentological description of a sample which has been subject to environmental processing, and where the sediment below 0.5mm is lost.

Sub-sampling of all bulk samples was routinely undertaken to allow further processing to be undertaken if necessary. These varied in size between 1 and 2kg.

It was also appreciated that sedimentological and environmental processing techniques that involved drying residues were likely to destroy, and distort, much of the waterlogged material, e.g. plant and insect material. Additionally it is noted that the 0.5mm mesh size used during environmental processing would allow certain plant macroscopic remains to pass through the mesh.

4.2.1 Sedimentological Processing Technique

GEOARCHAEOLOGICAL SERVICE FACILITY — *SAMPLE RECORD SHEET*

Record Number: 060

To be filled out by sampler:

Project code: DST / 91 Bulk sample No. GSF 3 0.70-0.90

Section code:

Profile data:

Strat. logs:

Sample depth: 0.7 - 0.9

Type of sample: Sedimentological Yes No

Environmental (Yes) No

No of bags:

Taken by: Date:

To be filled out by processor

Processed on: ? Processed by: J Stewart

Sediment description: Dark brown silt + charcoal, flint pebbles + some building mat., bone, shell + clay pipe.

Contamination: /

Size of Sample: Whole: ___Kg___ No of bags: ___

sub sample processed: 11.5 Kg No of bags: 1

pH of sample matrix: / Date: /

Of the sub sample processed:-

sediment sample: (Y)/N 3.5 Kg

W/L sample: Y/(N) ___Kg

Rest wet sieved to 0.5mm 9 Kg Time taken 60 mins

Reagent used for disaggregating Calgon Peroxide Hot water

When sieving - any 0.5mm Flot Y/N (Charred/waterlogged)

W/L sample:-
Weight processed ___kg
Weight left ___Kg (For specialist to process)

Process: Parafin flotation (0.25mm) Y/N
Wet sieved to 0.25mm Y/N

…ted on: ? Sorted by: Chas + Pat

1 mm Residue: Weight: Sorting time: ?

0.5 mm Flot: / Weight: / Sorting time: /

Waterlogged 0.25 mm residue: / Weight: / Sorting time: /

Parafin Flot: / Weight: / Sorting time: /

Material Present	0.5mm Flot	1 mm Residue	0.25mm Par. Flot	0.25mm Residue	Comments
Pottery					
Metal					
Glass					
Brick/tile					
Building stone					
Coal					
Slag					
Wood					
Charcoal					
Carbonised grain					
Seeds					
Nutshell					
Fruitstone					
Moss					
Reeds					
Mammal bone		1			1 frag of ?
Small mammal bone					
Fish remains					
Bird bone					
Leather					
Insects					
Freshwater/ terrestrial molluscs					
Marine molluscs					
Eggshell					
Anything else					

Sample available for ^{14}C:
Sample submitted for ^{14}C:

Abundance 0 = 0
1 = 1-10
2 = 11-100
3 = >100

Pollen assessment YES/NO........................

Diatom assessment YES/NO........................

Phosphate determination YES/NO........................

Sedimentological analysis to be conducted..

FIGURE 11 Bulk processing sample record sheet

The sample was weighed and a water-logged sample of approximately 1kg taken for future processing. All processing details were recorded on a standard bulk sample record sheet (Figure 11). Sample record sheets for all samples processed appear in Archive D. In some cases the samples were dried prior to sieving to aid disaggregation of the sediment matrix. The samples were then sieved. If the matrix consisted predominantly of sand samples were dry sieved. If they contained substantial quantities of clay and organic materials they were disaggregated using Hydrogen peroxide and wet sieved. All sieving, used a stack of sieves with mesh sizes from 16 mm to 63 microns with sieve intervals of half Phi, the sediment finer than 63 microns was also retained. All size fractions recovered were then weighed when dry (wet sieved samples were oven dried at 50°C). The palaeoenvironmental material from the two largest size fractions (i.e. 16mm and 11.2mm). were extracted for specialist observation. Palaeoenvironmental material from finer sieve sizes remains unsorted although it has been visually examined by the various specialists.

4.2.2 Environmental Processing Technique

Sub-samples were taken for sedimentological and water-logged investigations. The remaining sample was weighed and recorded on a standard record sheet (Figure 11). The sediment was then disaggregated with water and Hydrogen Peroxide (H_2O_2) if necessary. The sediment was then decanted into a sieve with a mesh size of 0.5 mm and gently washed. This was undertaken with care to ensure that plant matter, molluscs and other material were not lost due to floatation. Some residues were mixed in a bucket with water to enable the charred plant macroscopic remains to be floated off and decanted into a 0.5 mm mesh to aid separation. This is not a standard method employed to recover charred plant matter (Kenward et.al., 1980) but the method was considered adequate for the purpose of the assessment. The residues were then oven dried at approximately 50°C and bagged. In all cases 50-75% of the initial sample is retained and stored for future alternative pre-treatments at the analysis stage.

During sorting bone, mollusc shell, egg shell, insects, plant macros, and finds were purposively extracted. In addition a series of unusual ecofacts were also recovered. These included a number of remains not usually recovered on archaeological sites and include barnacle plates (Cirrepeds), brittle star (Ophiuroid) skeletal elements (see Figure 12) and small spheroid concretions derived from earthworms (Oligichaets) and/or slugs (Limacids). Additionally rarely preserved skeletal elements were also recovered, these may have considerable taphonomic significance, e.g. dermal denticles (skin elements) of cartilaginous fish such as sharks and rays. These may be identifiable to specific level, although it is thought that intra-specific variability exceeds inter-specific variability (Ward, D., pers. comm.).

Sorting was undertaken in two stages. The residue greater than 2 mm was completely sorted, while that between 2 mm and 0.5 mm was sorted until it was felt that a representative proportion of that size fraction had been observed. This was normally 25% of the total extract. Initial processing involved sorting all residues to 0.5mm although this

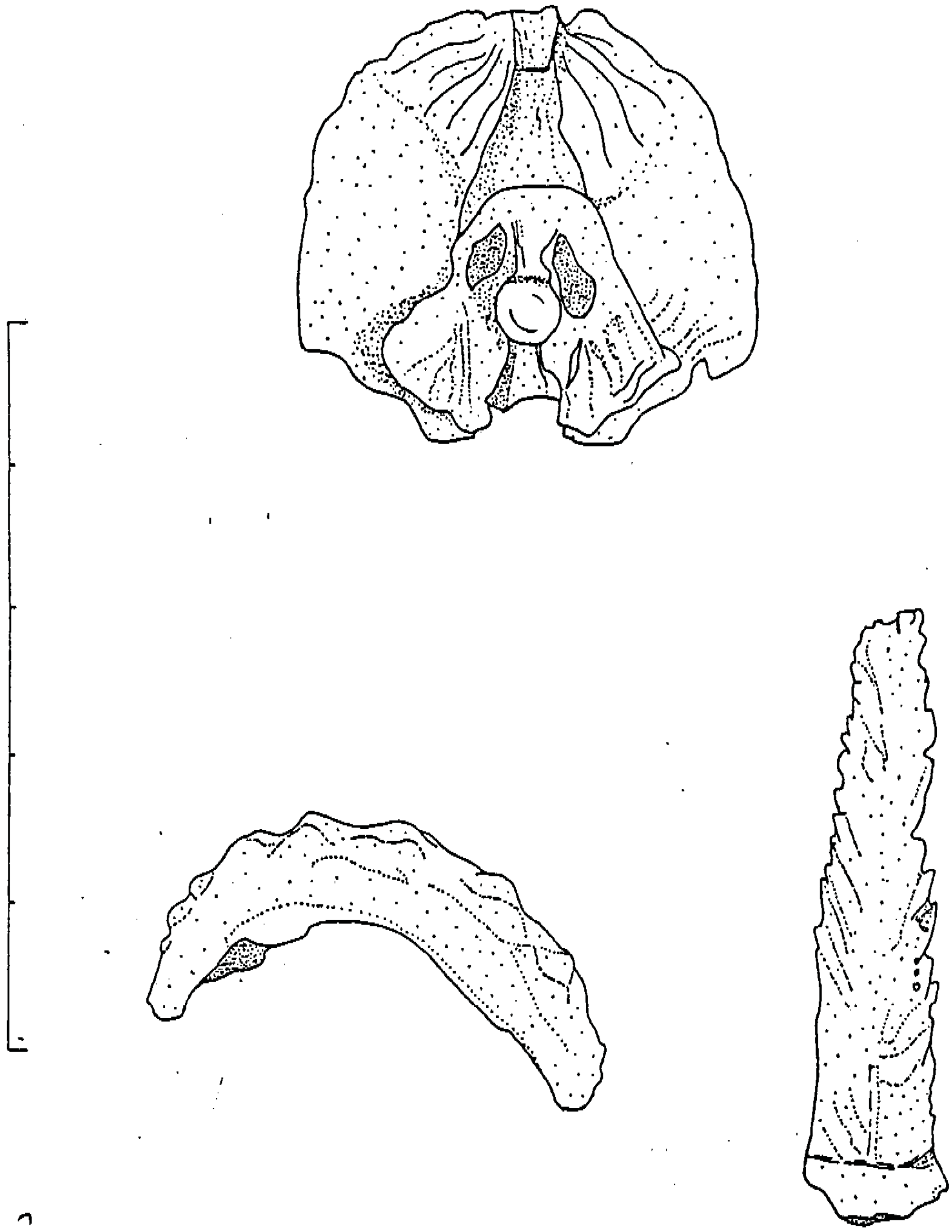


FIGURE 12 Ophiuroid arm ossicles from sample DSP-92, 106

A. Face of vertebra
B. Lateral shield
C. Lateral arm spine

was exceedingly time consuming and was abandoned later. A few small samples formed the exception to this rule. The subjective nature of this process is preferable to one based solely on volumes. The quantitative data in each Section should thus be viewed within these constraints.

In order to determine mesh sizes applicable to the assessment strategy an experiment was conducted on two relatively large samples (DSP 92, 340 and 391). The samples were sieved, their residues split into different clast sizes and sorted material recorded in the different size classes. The results are presented in tables 10 and 11.

>2mm residue.	1-2mm residue.	1mm - 0.5mm residue.
Pottery Ceramic building material Amber bead Charcoal Charred grain Seeds Large mammal bone Fish bone Marine mollusca Freshwater and terrestrial mollusca	Slag Charcoal Charred grain Seeds Small mammal bone Fish bone Egg shell Marine mollusca F.W./ Terrestrial mollusca Barnacle plates Crab shell Ophiuroid elements Worm/slug pellets	Slag Seeds Fish bone Egg shell Barnacle Fragments Ophiuroid elements Freshwater and terrestrial mollusca

Table 10 DS/P 92 340. Remains in each size category

>2mm residue.	1-2mm residue.	1mm - 0.5mm residue.
Pottery Slag Charcoal Charred Grain Seeds Nut shell Large mammal bone Fish bone Bird bone Egg shell Marine mollusca Crab shell Reworked fossils	Slag Charcoal Charred grain Seeds Small mammal bone Fish bone Marine mollusca Barnacle plates Ophiuroid elements	Slag Fish bone Egg shell Ophiuroid elements

Table 11 DS/P 92 391. Remains in each size category

TABLE 12. List of all samples selected for specialist assessment.

SITE LOCATION NUMBER. CAT SITE CODE. (SITE INDEX CODE)	POLLEN	PLANT MACROS	DIATOMS FORAMS ETC	MAMMALS	FISH	MOLLUSCS	INSECTS
CRYPT				165			
(AREA k)		170		170	170	170	
		221		221	221	221	
	222	222		222	222	222	
	255	255		255	255	255	255
	331	331		331	331	331	331
		333		333	333	333	
					340		
		361		261	361	361	
	391	391		391	391	391	
	393	393		393	393	393	
	394	394					
DSI (AREA K/L)	24	24		24	24	24	24
		25		25	25	25	25
DSP				107			
(AREA K/L)		340		340		340	
				390			
	391	391		391		391	
D3						282	
(GSF 28A)						283	
						294	
						296	
						287	
D7				1		1	
(DAF -93)				2		2	
				3		3	
				4		4	
K13	3.20 - 3.25						
(DSC-2)	3.60 - 3.65						
		4.30 - 4.50		4.30 - 4.50		4.30 - 4.50	4.30 - 4.50
		4.70 - 4.90		4.70 - 4.90		4.70 - 4.90	
	4.98 - 4.99						
	5.055 - 5.07						
	5.13 - 5.14						
	5.30 - 5.31	5.50 - 5.70				5.50 - 5.70	
	5.57 - 5.58						
	5.69 - 5.70	5.70 - 6.00		5.70 - 6.00		5.70 - 6.00	
	6.15 - 6.16						
	6.45 - 6.46						
	6.82 - 6.83						
	6.91 - 6.92						
	7.04 - 7.05						
	7.10 - 7.11	7.40 - 7.65				7.40 - 7.65	
	7.50 - 7.51						
	7.59 - 7.60					8.00	
L13		6.48 - 6.60				6.48 - 6.60	
(TWS-5)		6.60 - 7.05				6.60 - 7.05	
		7.05 - 7.13				7.05 - 7.13	
		7.13 - 7.20				7.13 - 7.20	

K1 (GSF 21)				**0.00 - 0.30** **0.30 - 0.40**			**0.00 - 0.30**
J2 (TWS-7)				**6.95 - 7.00**			
NUMBER OF SAMPLES	**24**	**23**	**8**	**26**	**12**	**32**	**6**

TABLE 12. List of all samples selected for specialist assessment.

Finds.

The >2mm size range produced the largest quantities of finds. Ceramics (pottery and building materials) were seen in the other size classes, but were of insufficient size for identification. Slag was present in all size classes and the slag found in the smaller size classes appears to be of a different morphology to the larger fractions and suggests the different size categories may indicate different varieties. Confirmation of this observation would justify the use of the smaller mesh sizes. The amber bead recorded in the >2mm fraction illustrates the potential of bulk sieving for the retrieval of small finds in addition to a more complete retrieval of finds such as pottery. A corollary of this is that the restricted field sampling, necessitated by engineering constraints, requires review if applied to similar schemes in future. Field processing on-site should also be considered, even if samples are not retrieved through conventional set-piece excavation.

Plant Macroscopic Remains. (see section 6.2)

Charcoal was found in all size fractions. However it is not practical to identify large quantities of charcoal and it is difficult or impossible to resolve taxonomic status from smaller fragments. Thus only the >2mm fraction was collected. The grain and seeds were most prolific in the smaller size fractions. 0.5mm is not the traditional mesh size used for the retrieval of plant macroscopic remains as it eliminates many plant remains due to their small size, although it does allow for a certain range of species to be assessed. The use of mesh sizes finer than 0.5mm was rejected as this would have slowed down both the sieving and the sorting. As already mentioned water-logged samples were taken with the aim of allowing the smaller remains to be examined if necessary. Further work, at the analysis stage, should therefore use either 0.125 or 0.25mm mesh for full retrieval.

Vertebrate Remains. (see section 6.4)

The 2mm size fraction was the most productive size interval although certain skeletal elements only appear in the smaller size categories. Large mammals and bird bones are usually only useful in the >2mm category. The icthyofaunal report (Appendix XII) demonstrates the futility of sieving to less than 2mm in most cases. Tables 10 and 11 illustrate that small mammals and herpetofaunas only regularly appear when a mesh size of 1mm or less is employed and although they do occur in larger sized residues it is often the smaller fractions which produce the identifiable elements such as teeth. Egg shell appears in all size fractions although if a large sample is required for taxonomic investigation the smaller size fractions must be examined.

Molluscan Remains. (see section 6.5)

Marine molluscs appear in all size fractions as small fragments and can be used to establish presence or absence of species. Molluscs traditionally require the use of a 0.5mm mesh size particularly when quantification of the remains is to be achieved.

Other Remains.

The two samples processed revealed that ophiuroids would not have been found had the mesh size been over 1mm and certain skeletal elements would not have been found had a mesh size of 0.5mm not been used. Specifically the ophiuroid vertebrae appear in the 1mm mesh size while the lateral shields and the lateral arms only appear once a 0.5mm mesh is employed. Similarly barnacles were only recovered if mesh size of 1mm or less is used. Remains such as crab shell are, however, best retrieved from the 2mm size. Reworked fossils, while, not strictly of archaeological interest were retrieved when found as they may aid sediment provenancing.

The remains which have therefore dictated the mesh size used were the molluscs and vertebrates in as much as the mesh used was the ideal for their retrieval. The plant and insect remains (not discussed above) were also important in dictating the mesh used as they usually require smaller mesh sizes (Kenward et al. ,1980) although due to time constraints and the nature of the assessment objectives under the MAP II approach the 0.5mm was considered to be an adequate compromise and as such represents an optimum when all remains are to be considered. The use of completely separate samples for initial plant and insect remain retrieval was rejected as it would have been impractical and time consuming. The water-logged samples were therefore taken to allow further analysis if the initial residues proved particularly fruitful.

4.2.3. Discussion of results.

The preliminary assessment of all samples was undertaken by a panel of specialists examining each sample in turn. Visual assessment were made of each sample residue (see record sheets Figures 13, 14 and 15). Comments were made regarding the abundance, degree of preservation, broad nature of the assemblage and potential for future work. This task was undertaken for plant macrofossil, mollusc and vertebrates. Screening for other material such as insects, pollen and diatoms was not possible at this preliminary stage due to the specialised nature of the processing techniques and size of material.

The data obtained from this assessment was then utilised to select samples for detailed analysis. A series of points were noted from this exercise:-

Molluscan Remains. (see section 6.5)

Marine molluscs appear in all size fractions as small fragments and can be used to establish presence of absence of species. Molluscs traditionally require the use of a 0.5mm mesh size particularly when quantification of the remains is to be achieved.

Other Remains.

The two samples processed revealed that ophiuroids would not have been found had the mesh size been over 1mm and certain skeletal elements would not have been found had a mesh size of 0.5mm not been used. Specifically the ophiuroid vertebrae appear in the 1mm mesh size while the lateral shields and the lateral arms only appear once a 0.5mm mesh is employed. Similarly barnacles were only recovered if mesh size of 1mm or less is used. Remains such as crab shell are, however, best retrieved from the 2mm size. Reworked fossils, while, not strictly of archaeological interest were retrieved when found as they may aid sediment provenancing.

The remains which have therefore dictated the mesh size used were the molluscs and vertebrates in as much as the mesh used was the ideal for their retrieval. The plant and insect remains (not discussed above) were also important in dictating the mesh used as they usually require smaller mesh sizes (Kenward et al. ,1980) although due to time constraints and the nature of the assessment objectives under the MAP II approach the 0.5mm was considered to be an adequate compromise and as such represents an optimum when all remains are to be considered. The use of completely separate samples for initial plant and insect remain retrieval was rejected as it would have been impractical and time consuming. The water-logged samples were therefore taken to allow further analysis if the initial residues proved particularly fruitful.

4.2.3. Discussion of results.

The preliminary assessment of all samples was undertaken by a panel of specialists examining each sample in turn. Visual assessment were made of each sample residue (see record sheets Figures 13, 14 and 15). Comments were made regarding the abundance, degree of preservation, broad nature of the assemblage and potential for future work. This task was undertaken for plant macrofossil, mollusc and vertebrates. Screening for other material such as insects, pollen and diatoms was not possible due to the specialised nature of the processing techniques and size of material.

The data obtained from this assessment was then utilised to select samples for detailed analysis. A series of points were noted from this exercise:-

G.S.F. **Qualitative archaeobotanical assessment** — **Ref. Number** 28

Area code GSF2 — **National Grid Reference** — **Sample No.** 87-051

Dating — **Context Number** — **Weight Kg's**

Volume of botanical material
☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Overall degree of preservation
☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Context Type

Pit fill	☐	Valley colluvium	☐	Palaeosol	☐
Ditch fill	☐	Solifluction	☐	Peat	☐
Other fill	☐	Alluvium	☐	Bore Hole	☐
Other	☐......	Specify			

Cultural Material

Volume ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Mode of preservation ☐ Charred ☐ Waterlogged ☐ Desicated ☐ Mineralised

Degree of preservation ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Presence of:

☐ Wood ☐ Weed seeds ☐ Cereal grains

☐ Other .... Specify

Palaeoenvironmental Material

Volume ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Mode of preservation ☐ Charred ☐ Waterlogged ☐ Desicated ☐ Mineralised

Degree of preservation ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Presence of:

☐ Wood ☐ Moss ☐ Seeds ☐ Monocot stems / leaves

☐ Other .... Specify

Processing Recommendations for sub-samples

Potential for chronological determination	☐ Good	☐ Possible	☐ Poor
Potential for habitat reconstruction	☐ Good	☐ Possible	☐ Poor
Potential for economic reconstruction	☐ Good	☐ Possible	☐ Poor

Further comments

Operator JCH

Date 21.12.92.

FIGURE 13 Plant macrofossil assessment record sheet

G.S.F. **Qualitative archaeological assessment of Mollusc shells** — **Ref. Number** 28

Area code GSF 2 **National Grid Reference** ☐ **Sample No.** 0·4-05

Dating ☐ | **Context Number** ☐ **Weight Kg's** ☐

Presence of:
- Marine species ☐
- Fresh water species ☐
- Terrestrial species ☐

Context Type

Pit fill	☐	Valley colluvium	☐	Palaeosol	☐
Ditch fill	☐	Solifluction	☐	Peat	☐
Other fill	☐	Alluvium	☐	Bore Hole	☐
Other	☐	Specify	☐		

Quantity of shells recovered ☑ <10 ☐ 10-50 ☐ 50-100 ☐ 100-500 ☐ >500

Marine Shells:
- Approximate quantity ☑ <10 ☐ 10-50 ☐ 50-100 ☐ 100-500 ☐ >500
- Presence of durable shelled species eg. oysters ☐ Yes ☐ Complete ☐ Incomplete ☑ No
- Presence of gastropods ☐ Yes ☑ No ☐ Uncertain
- Presence of bivalves ☐ Yes ☑ No ☐ Uncertain
- Presence of non-durable shells, eg. Mussels ☐ Yes ☐ Complete ☐ Incomplete ☑ No

Fresh water shells:
- Approximate quantity ☑ <10 (NONE) ☐ 10-50 ☐ 50-100 ☐ 100-500 ☐ >500
- Presence of large durable shelled species eg. Theodoxus ☐ Yes ☑ No ☐ Uncertain
- Presence of gastropods other than Lymnaea ☐ Yes ☑ No ☐ Uncertain
- Presence of Lymnaea ☐ Yes ☑ No ☐ Uncertain
- Presence of bivalves ☐ Yes ☑ No ☐ Uncertain
- Presence of Bithynia ☐ Yes ☐ Apices ☐ Operculae ☑ No

Terrestrial shells:
- Approximate quantity ☑ <10 (NONE) ☐ 10-50 ☐ 50-100 ☐ 100-500 ☐ >500
- Presence of durable shells eg. Pomatias, Clausiliidae ☐ Yes ☑ No ☐ Uncertain
- Presence of Helicidae ☐ Yes ☑ No ☐ Uncertain
- Presence of delicate shells eg. Carychium, Zonitidae ☐ Yes ☑ No ☐ Uncertain
- Groups present ☐ Marsh ☐ Shade ☐ catholic ☐ Open country

Potential for chronological determination ☐ Good ☐ Possible ☑ Poor

Potential for habitat reconstruction ☐ Good ☐ Possible ☑ Poor

Potential for economic reconstruction ☐ Good ☐ Possible ☑ Poor

Further comments 11·2mmT
1 x LIMPET
NOT WORTH DOING MORE WITHOUT SMALLER FRACTION.

Operator KNW.

Date 21/12/92.

FIGURE 14 Mollusc assessment record sheet

G.S.F.	**Qualitative archaeological assessment of Vertebrates**	**Ref. Number** 28

Area code GJF2 **National Grid Reference** ☐ **Sample No.** 0·4-0·5

Dating ☐ **Context Number** ☐ **Weight Kg's** ☐

Presence of:	**Quantity**	<10	10-50	50-100	>100
Large mammal	☐ Yes				
Small mammal	☐ Yes				
Avifauna	☐ Yes				
Herpetofauna	☐ Yes				
Icthyofauna	☐ Yes				

Context Type

Pit fill	☐	Valley colluvium	☐	Palaeosol	☐
Ditch fill	☐	Solifluction	☐	Peat	☐
Other fill	☐	Alluvium	☐	Bore Hole	☐
Other	☐	Specify			

Icthyofauna

Cranium				*Post-cranium*			
Neurocranium	☐ Yes	☐ No	☐ Uncertain	Vertebrae	☐ Yes	☐ No	☐ Uncertain
Dentary	☐ Yes	☐ No	☐ Uncertain	Ribs	☐ Yes	☐ No	☐ Uncertain
Opercular	☐ Yes	☐ No	☐ Uncertain	Fin rays	☐ Yes	☐ No	☐ Uncertain
Pelvic	☐ Yes	☐ No	☐ Uncertain	Spines	☐ Yes	☐ No	☐ Uncertain
Others Teeth	☐ Yes	☐ No	☐ Uncertain	Scales	☐ Yes	☐ No	☐ Uncertain
Scutes	☐ Yes	☐ No	☐ Uncertain	Otoliths	☐ Yes	☐ No	☐ Uncertain

Herpetofauna

Cranium				*Post cranium*			
Neurocranium	☐ Yes	☐ No	☐ Uncertain	Vertebrae	☐ Yes	☐ No	☐ Uncertain
Dentary	☐ Yes	☐ No	☐ Uncertain	Ribs	☐ Yes	☐ No	☐ Uncertain
Other	☐ Yes	☐ No	☐ Uncertain	Pelvis Shoulder	☐ Yes	☐ No	☐ Uncertain
Limbs Fore limb	☐ Yes	☐ No	☐ Uncertain	Hind limb	☐ Yes	☐ No	☐ Uncertain
Phalanges	☐ Yes	☐ No	☐ Uncertain				

Avifauna

Cranium				*Post-cranium*			
Neurocranium	☐ Yes	☐ No	☐ Uncertain	Vertebrae	☐ Yes	☐ No	☐ Uncertain
Bill	☐ Yes	☐ No	☐ Uncertain	Ribs	☐ Yes	☐ No	☐ Uncertain
Limbs				Sternum / Fercula	☐ Yes	☐ No	☐ Uncertain
Wings	☐ Yes	☐ No	☐ Uncertain	Pelvis	☐ Yes	☐ No	☐ Uncertain
Legs	☐ Yes	☐ No	☐ Uncertain	Phalanges	☐ Yes	☐ No	☐ Uncertain

Small mammal fauna

Cranium				*Post-cranium*			
Neurocranium	☐ Yes	☐ No	☐ Uncertain	Vertebrae	☐ Yes	☐ No	☐ Uncertain
Maxilla	☐ Yes	☐ No	☐ Uncertain	Ribs	☐ Yes	☐ No	☐ Uncertain
Mandible	☐ Yes	☐ No	☐ Uncertain	Shoulder	☐ Yes	☐ No	☐ Uncertain
Teeth	☐ Yes	☐ No	☐ Uncertain	Pelvis	☐ Yes	☐ No	☐ Uncertain
Limbs Fore limb	☐ Yes	☐ No	☐ Uncertain	Hind limb	☐ Yes	☐ No	☐ Uncertain
Phalanges	☐ Yes	☐ No	☐ Uncertain				

Large mammal fauna

Cranium				*Post cranium*			
Neurocranium	☐ Yes	☐ No	☐ Uncertain	Vertebrae	☐ Yes	☐ No	☐ Uncertain
Maxilla	☐ Yes	☐ No	☐ Uncertain	Ribs	☐ Yes	☐ No	☐ Uncertain
Mandible	☐ Yes	☐ No	☐ Uncertain	Shoulder	☐ Yes	☐ No	☐ Uncertain
Teeth	☐ Yes	☐ No	☐ Uncertain	Pelvis	☐ Yes	☐ No	☐ Uncertain
Limbs Fore limb	☐ Yes	☐ No	☐ Uncertain	Hind limb	☐ Yes	☐ No	☐ Uncertain
Phalanges	☐ Yes	☐ No	☐ Uncertain				

Digested	I ☐	H ☐	A ☐	SM ☐	LM ☐	Chopped	I ☐	H ☐	A ☐	SM ☐ LM ☐
Gnawed	I ☐	H ☐	A ☐	SM ☐	LM ☐	Cut mark	I ☐	H ☐	A ☐	SM ☐ LM ☐
Cooked	I ☐	H ☐	A ☐	SM ☐	LM ☐	Rolled	I ☐	H ☐	A ☐	SM ☐ LM ☐
Burned	I ☐	H ☐	A ☐	SM ☐	LM ☐	New Break	I ☐	H ☐	A ☐	SM ☐ LM ☐

Potential for chronological determination	☐ Good	☐ Possible	☐ Poor
Potential for habitat reconstruction	☐ Good	☐ Possible	☑ Poor
Potential for economic reconstruction	☐ Good	☐ Possible	☑ Poor

Further comments NOTHING

Operator B Irving

Date 21/12/92.

FIGURE 15 Vertebrate assessment record sheet

1. Silt deposits in the vicinity of Archcliffe Fort and the Western Heights (e.g. D6-D8, B8) contained abundant, well preserved molluscan faunas of clear palaeoenvironmental significance. Other types of palaeoenvironmental material were absent from these samples.

Recommendation: detailed analysis of selected samples for molluscan analysis.

2. Sands and gravels in the vicinity of Bulwark Street and Snargate Street produced only low quantities of often heavily rolled vertebrate and marine mollusc material. Sample sizes were of insufficient size, despite large primary sample size, for statistically valid samples to be recovered. In addition the rolled nature of the material suggests deposition in a secondary context.

Recommendation: little potential for palaeoenvironmental and palaeoeconomic reconstruction therefore no further analysis. As sedimentary particles indicative of facies further work may be required in the future.

3. Sands, gravels and silts of the town centre area recovered from boreholes produced variable quantities of material ranging form vertebrates, molluscs and plant macrofossil to insects. Clearly the material was well stratified in places with a high palaeoenvironmental potential.

Recommendation: further analysis of key samples to assess and formulate palaeoenvironmental and biostratigraphic sequences.

4. Sands and silts of the town centre area directly associated with archaeological features (e.g. the Crypt site). High frequencies of bone, plant macrofossils and in places molluscs and insects were encountered.

Recommendation: further analysis of key samples to produce a detailed assessment of the palaeoeconomic potential of the samples.

On the basis of the recommendations made in this preliminary assessment a selection of samples were targeted for further work (see section 4.3).

4.3. DETAILED ASSESSMENT OF SELECTED SAMPLES.

A list of all samples selected for further assessment is presented in Table 12. These samples were all assessed at a preliminary stage deemed to be of significance, and justifying further analysis. Where possible samples were identified that contained a wide range of material (e.g. DS-C/91, contexts 170 and 332) so that inter-disciplinary comparisons between data were possible. Total numbers of samples examined are also given. All details of this work are presented in sections 6.1 to 6.7.

Table 13 lists all samples processed for sedimentological analysis. Samples examined for sedimentological criteria did not pass through the two-fold assessment model as this was inappropriate to this type of material. Samples were selected on the basis of observations made in the field and during monolith and core cleaning. Samples were selected to illustrate and clarify trends in sequences associated with well stratified sequences in association with archaeological or biologically important sections.

DSC 2	TWS 5	DAF-93	DBS 2	DSEx1		
K13	**L13**	**D7, MONO. 03**	**K9**	**L15**	**MISCELLANEOUS**	
3.20 - 3.25	3.90 - 4.10	2 - 3	2.50 - 2.80	5.00 - 5.20	E1, 0.40 - 0.51	GSF 2
3.44 - 3.48	5.00 - 5.40	3 - 4	3.30 - 4.30	5.60 - 6.00	F2, 515	GSF 5
3.60 - 3.65	5.40 - 5.70	4 - 5	4.85	6.20 - 6.40	G2, 603	GSF 6
4.98 - 4.99	6.30 - 6.31	5 - 6	5.30	7.00 - 7.40	I6, A	GSF 18
5.01 - 5.02	6.35 - 6.36	6 - 7	6.05	8.50 - 8.60	I6, C	GSF 18
5.12 - 5.14	6.62 - 6.64	9 - 10	7.10 - 7.55		K1, M1	GSF 21
5.19 - 5.20	6.98 - 7.00	19 - 20			K1, 0.50 - 0.72	GSF 21
5.29 - 5.30	7.20 - 7.50	30 - 31			L5, 4103	GSF 41
5.56 - 5.57		43 - 44			L6, 4302	GSF 43
5.60 - 5.61					L7, 4401	GSF 44
5.69 - 5.70						
5.80 - 5.81						
5.90 - 5.91						
6.15 - 6.16						
6.25 - 6.26						
6.35 - 6.36						
6.45 - 6.46						
6.53 - 6.54						
6.82 - 6.83						
6.87 - 6.88						
6.91 - 6.92						
6.99 - 7.00						
7.50 - 7.51						
7.55 - 7.56						
7.59 - 7.60						
7.72 - 7.73						

Table 13 Samples selected for sedimentological assessment

5.0 SEDIMENTOLOGY OF SELECTED SAMPLES

Sedimentological work has focused on a number of tasks:-

1. Core extrusion, recording of borehole samples and monolith descriptions (see Archive B, Tables 14 and 15 this report).

2. Analysis of selected samples from boreholes and open sections to determine sedimentary properties (see Table 12 this report and Archive part F).

3. Bulk samples

5.1 CORE EXTRUSION FROM U4/U100 TUBES AND MONOLITH PROCESSING

Methodology and decision making used in core and monolith assessment is shown graphically in Figure 16.

All monoliths taken have also been cleaned, recorded and photographed and in some cases sub-sampled to the level of the insert (see parts B and C , Archive, Table 14).

All core material has been extruded from the U4 tubes and in all cases described (part B, Archive) and photographed (part C, Archive). In some cases the core material has been sub-sampled into 1 or 2cm sub-samples. This has not been undertaken on all samples as this may prejudice sample interval selection for future analysis (Table 15).

This material is now in a stable condition in refrigerated conditions and can be used for further processing and targeted examination at the Analysis Stage of MAP II or as archive material.

Cleaning and recording of the core and monolith material has allowed a full assessment of the data to be undertaken. The degree of stratification, presence of bioturbation and the nature of the included organic matter as been observed and noted during this process. Core material of high potential has been noted and two borehole sequences selected for further analysis. Boreholes K13 and L13 were selected as generally representative of the range of sedimentological units identified within the central Dover route corridor and available for further examination at the Analysis Stage of the project. They may not however represent all time periods preserved in the stratigraphic sequences).

MONOLITH	DESCRIBED	SUB-SAMPLED	PHOTOGRAPH	X-RAYED	LOSS ON IGNITION	PARTICLE SIZE ANALYSIS	MAGNETIC SUSEPTIBILITY
DSC/91							
M1 S1	-		-				
M2 S2	-		-				
M3 S3	-		-				
DAF/93							
M1	-		-				
M2	-		-				
M3	-		-	-	-	-	-
M4	-		-				
M5	-		-				
M6	-		-				
M7	-		-				
M8	-		-				
W.PROF M1	-		-				
W.PROF M2	-		-				
GSF 5							
M1	-		-				
M2	-		-				
GSF 10							
M1	-		-				
M2	-		-				
M3	-		-				
M4	-		-				
GSF 15							
LOC[n] B M1	-		-				
GSF 18							
M1	-		-				
GSF 21							
M1	-		-	-			-
GSF 28							
M1	-		-				
M2	-		-				
GSF 29							
M1	-		-				
M2	-		-				

TABLE 14. LIST OF ALL MONOLITH SAMPLES TAKEN DURING A20 PROJECT AND STATEMENT ON THE NATURE OF PROCESSING UNDERTAKEN.

MONOLITH	DESCRIBED	SAMPLED	PHOTOGRAPH	X-RAYED	LOSS ON IGNITION	PARTICLE SIZE ANALYSIS	MAGNETIC SUSEPTIBILITY
GSF 30							
P1 M1	-		-				
P1 M2	-		-				
P1 M3	-		-				
P1 M4	-		-				
P1 M5	-		-				
P1 M6	-		-				
P2A M7	-		-				
P2A M8	-		-				
P2A M9	-		-				
P2A M10	-		-				
GSF 31							
M1	-		-				
M2	-		-				
M3	-		-				
M4	-		-				
GSF 31							
M1	-		-				
M2	-		-				
M3	-		-				
M4	-		-				
GSF 33							
M1	-		-				
M2	-		-				
M3	-		-				
GSF Megga Inst							
M1	-		-				
M2	-		-				

TABLE 14. LIST OF ALL MONOLITH SAMPLES TAKEN DURING A20 PROJECT AND STATEMENTS ON THE NATURE OF PROCESSING UNDERTAKEN.

CORE	EXTRUDED	DESCRIBED	SUB-SAMPLED	PHOTOGRAPH	X-RAYED	LOSS ON IGNITION	PHOSPHATE ANALYSIS	pH ANALYSIS	PARTICLE SIZE ANALYSIS	MAGNETIC SUSCEPTIBILITY
DSC-2										
3.20-3.65	-	-	-			-	-	-	-	
4.90-5.35	-	-	-	-	-	-	-	-	-	
5.50-5.95	-	-	-	-	-	-	-	-	-	-
6.10-6.55	-	-	-	-	-	-	-	-	-	-
6.80-7.25	-	-	-	-	-	-	-	-	-	
7.25-7.40		-		-						
7.40-7.85	-	-	-	-	-	-	-	-	-	-
DSC-5										
4.70-5.15	-	-		-						
5.95-6.35	-	-		-						
6.50-6.75	-	-		-						
6.80-7.25	-	-		-						
DBS-1										
5.50-5.95	-	-		-						
5.95-6.40	-	-		-						
DBS-2										
4.40-4.85	-	-	-	-	-					
4.85-5.30	-	-	-	-	-					
5.60-6.05	-	-	-	-	-					
DBS-3										
4.70-5.15	-	-		-						
5.25-5.70	-	-		-						
5.85-6.30	-	-		-						
6.45-6.90	-	-		-						

TABLE 15. LIST OF ALL U4/U100 CORE SAMPLE TAKEN DURING A20 PROJECT AND STATEMENTS ON THE NATURE OF PROCESSING UNDERTAKEN.

CORE	EXTRUDED	DESCRIBED	SUB-SAMPLED	PHOTOGRAGH	X-RAYED	LOSS ON IGNITION	PHOSPHATE ANALYSIS	pH ANALYSIS	PARTICLE SIZE ANALYSIS	MAGNETIC SUSEPTIBILITY
DBS-4										
2.85-3.25	-	-		-						
3.40-3.85	-	-		-						
4.30-4.75	-	-		-						
4.90-5.35	-	-		-						
5.50-5.95	-	-		-						
6.10-6.55	-	-		-						
TWS-3										
5.90-6.35	-	-		-						
6.50-6.95	-	-		-						
TWS-4										
6.10-6.55	-	-		-						
TWS-5										
6.00-6.45	-	-	-	-		-	-	-	-	
6.60-7.05	-	-	-	-		-	-	-	-	
TWS-6										
7.05-7.50	-	-		-						

TABLE 15. LIST OF ALL U4/U100 CORE SAMPLE TAKEN DURING A20 PROJECT AND STATEMENTS ON THE NATURE OF PROCESSING UNDERTAKEN.

CORE	EXTRUDED	DESCRIBED	SUB-SAMPLED	PHOTOGRAPH	X-RAYED	LOSS ON IGNITION	PHOSPHATE ANALYSIS	pH ANALYSIS	PARTICLE SIZE ANALYSIS	MAGNETIC SUSCEPTIBILITY
QS 1										
4.55-5.00	-	-		-	-					
5.15-5.60	-	-		-						
5.75-6.20	-	-		-	-					
6.35-6.80	-	-		-						
6.95-7.40	-	-		-						
9.50-9.95	-	-		-						
QS 2										
4.40-4.85	-	-		-						
4.90-5.35	-	-		-						
5.50-5.95	-	-		-						
PCG-2										
2.35-2.80	-	-		-						
3.80-4.25	-	-		-						
PCG-3										
3.20-3.65	-	-		-						
3.80-4.25	-	-		-						
DS I -2										
2.90-3.35	-	-		-						
3.50-3.95	-	-		-						
4.10-4.55	-	-		-						
4.70-5.15	-	-		-						

TABLE 15. LIST OF ALL U4/U100 CORE SAMPLE TAKEN DURING A20 PROJECT AND STATEMENTS ON THE NATURE OF PROCESSING UNDERTAKEN.

5.2 SPECIALIST ASSESSMENT OF SELECTED SAMPLES

The study of selected samples has been sub-divided into two:-

1. A study of selected samples from core material taken from boreholes in the town centre.

2. A study of bulk samples taken from open trenches and boreholes along the route corridor.

CORE K13 (DSC-2).

Extruded core samples have been analysed by a number of techniques (Figure 16, see section 4.0) including particle size analysis, magnetic susceptibility analysis, X-radiography, total Phosphate analysis, loss-on-ignition, calcium carbonate content. Detailed methodologies and results of these techniques are presented in detail in part F of the Archive. Only summarised results are presented here, as exemplification of the methods used, results achieved, and potential for further work.

Borehole K13 is discussed more fully in Section 8.1. However comments will be made here to illustrate the sedimentological results.

The particles size data (Figure 17) clearly indicates a general trend in particle size from a poorly sorted silt with some sand and clay at the base of the sequence (7.50-7.60m) through a series of slightly better sorted clayey-silts (6.53-6.54m to 5.19-5.20m) to an initially sandy silt (5.01-5.02/4.98-4.99m) to a well sorted medium sand (3.20-3.25m).

Percentage organic content (based on loss-on-ignition) and calcium carbonate content results are presented in Figure 18 and display an inverse relationship. Organic content (LOI %) is low with the exception of parts of core 6.8-7.25m and 4.9-5.35m. These high values are a result of the presence of peat in the sequence. Conversely calcium carbonate levels are generally high and only decrease towards the areas of higher organic content.

Total P concentrations follow the organic content signatures with the exception of an anomalous peak in total P values in the middle of core 6.1-6.55m (Figure 19). Variation in mass specific mineral magnetic susceptibility levels does occur. This is seen in core 6.1-6.55m.

Sedimentological Analysis Stage:1

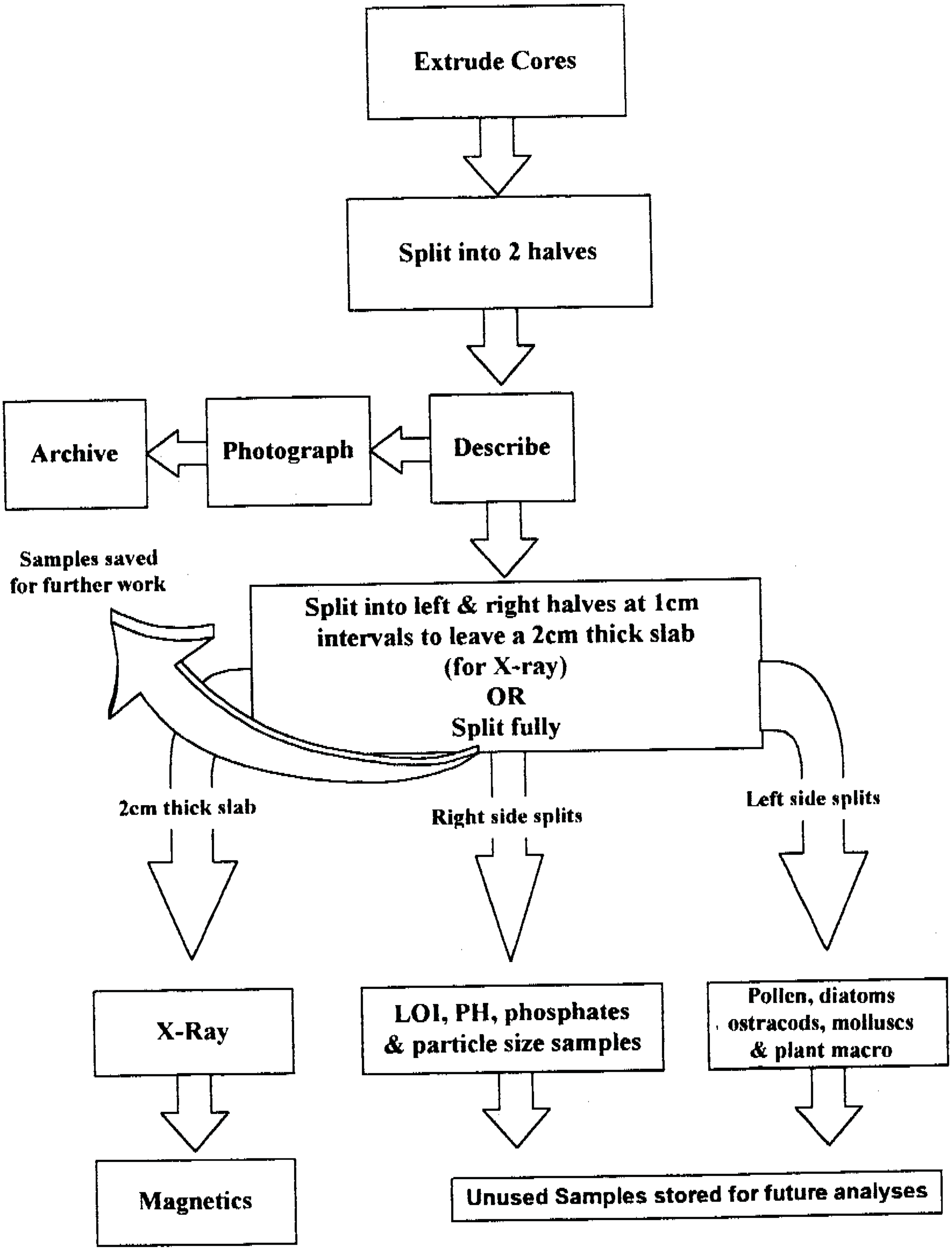
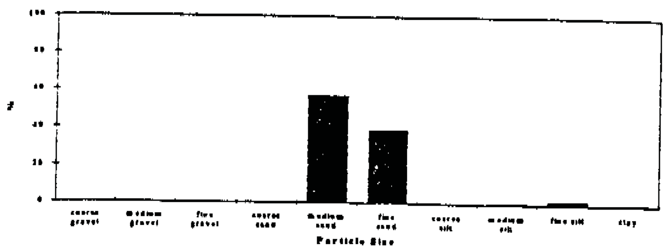
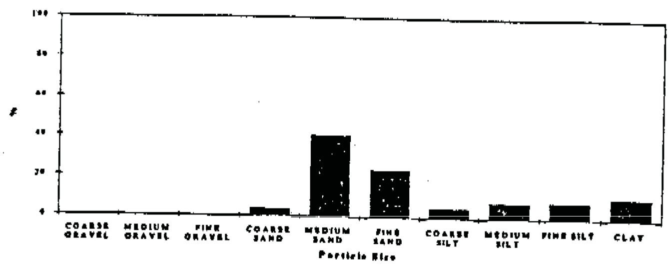


FIGURE 16 Sedimentological samples flow chart

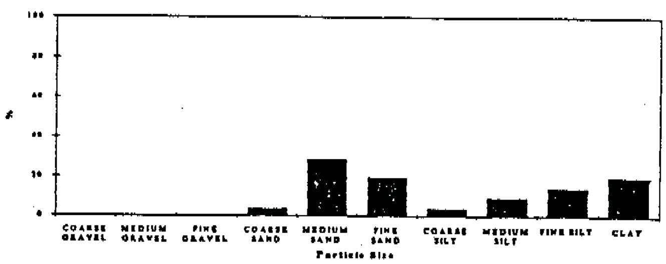
20-3.25m



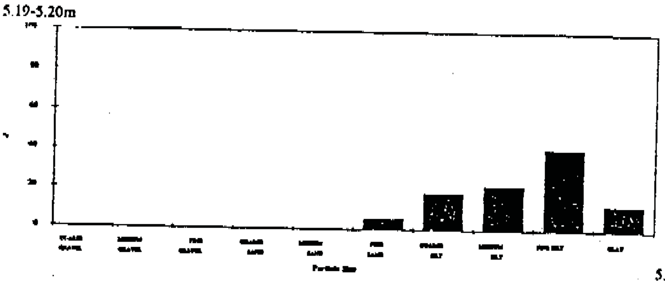
98-4.99m



01-5.02m

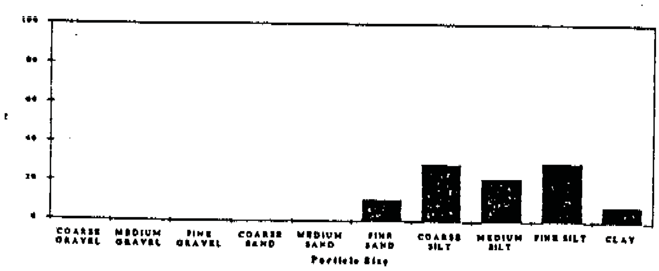


5.19-5.20m

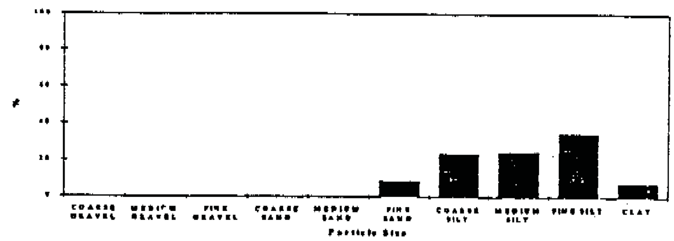


5.2

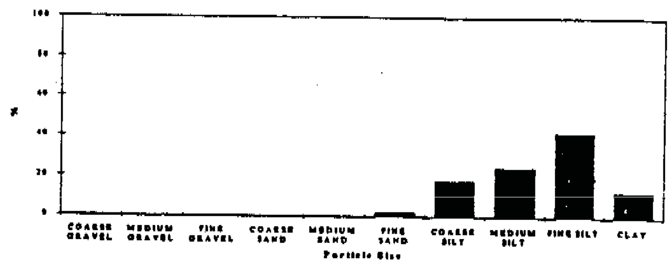
-5.70m



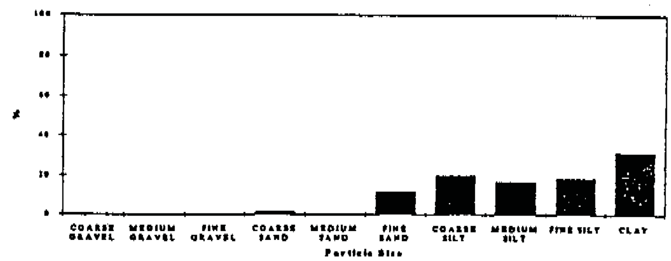
6.15-6.16m



6.53-6.54m



6.87-6.88m



7.59-7.60m

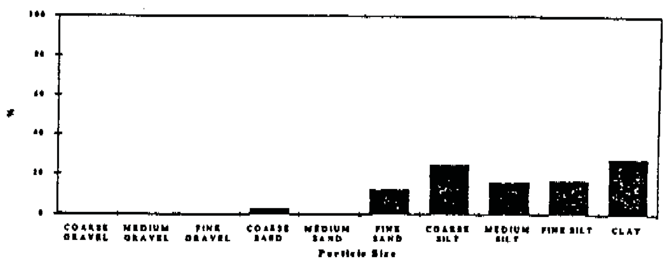


FIGURE 17 Particle size data from selected samples from borehole K13

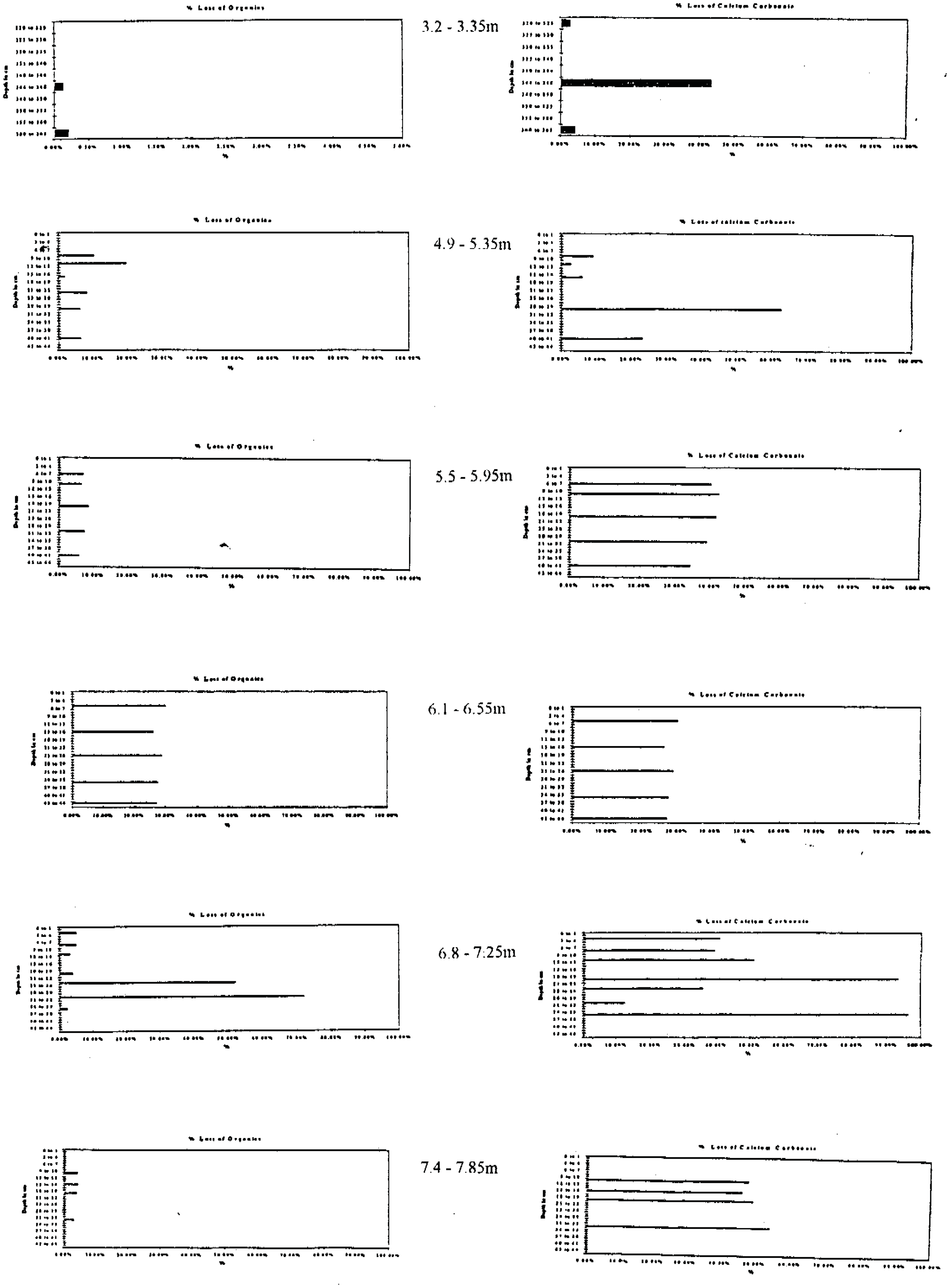


FIGURE 18 Organic and calcium carbonate content from selected samples from borehole K13

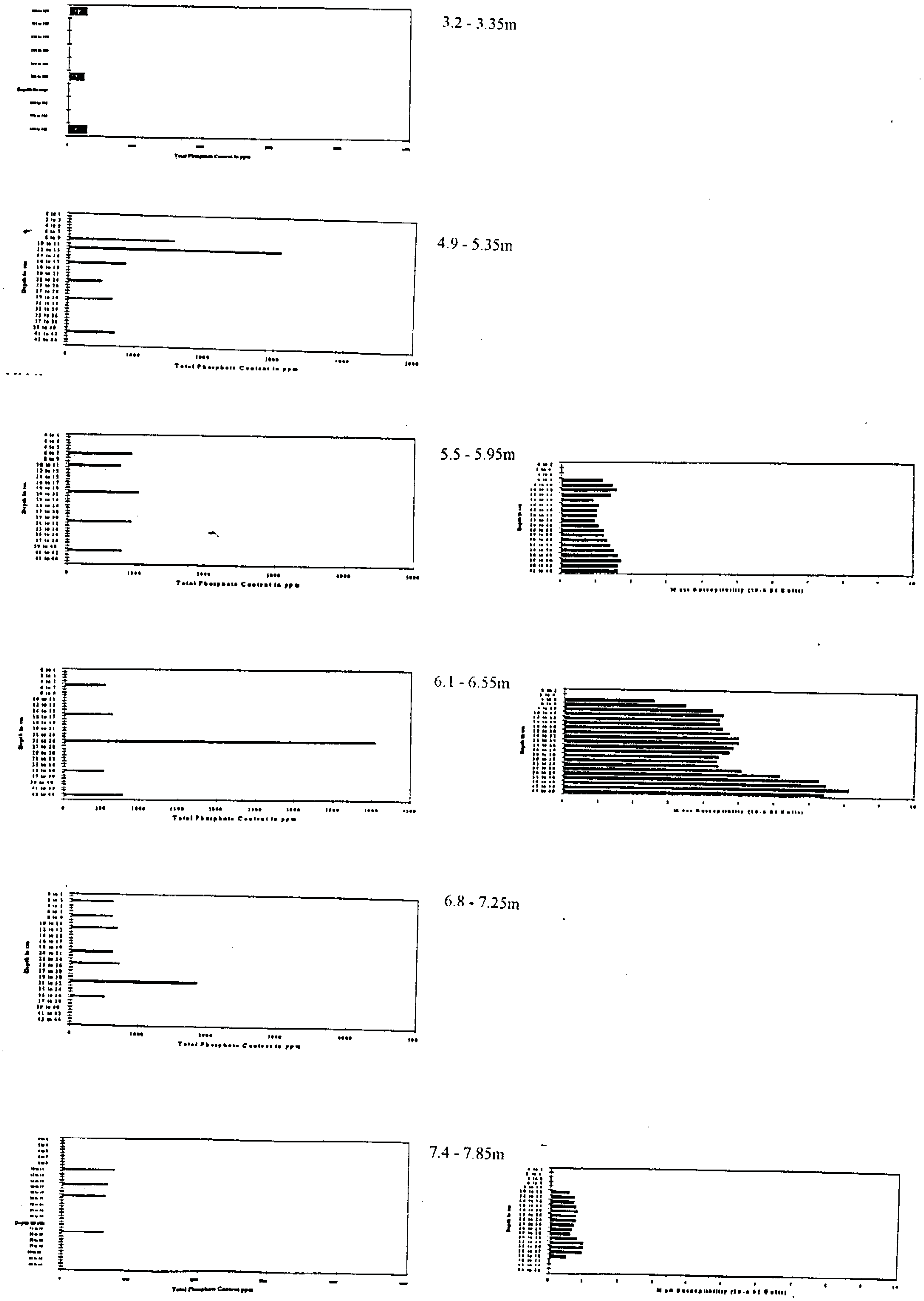


FIGURE 19 Total P and mass-specific magnetic susceptibility measurements from borehole K13

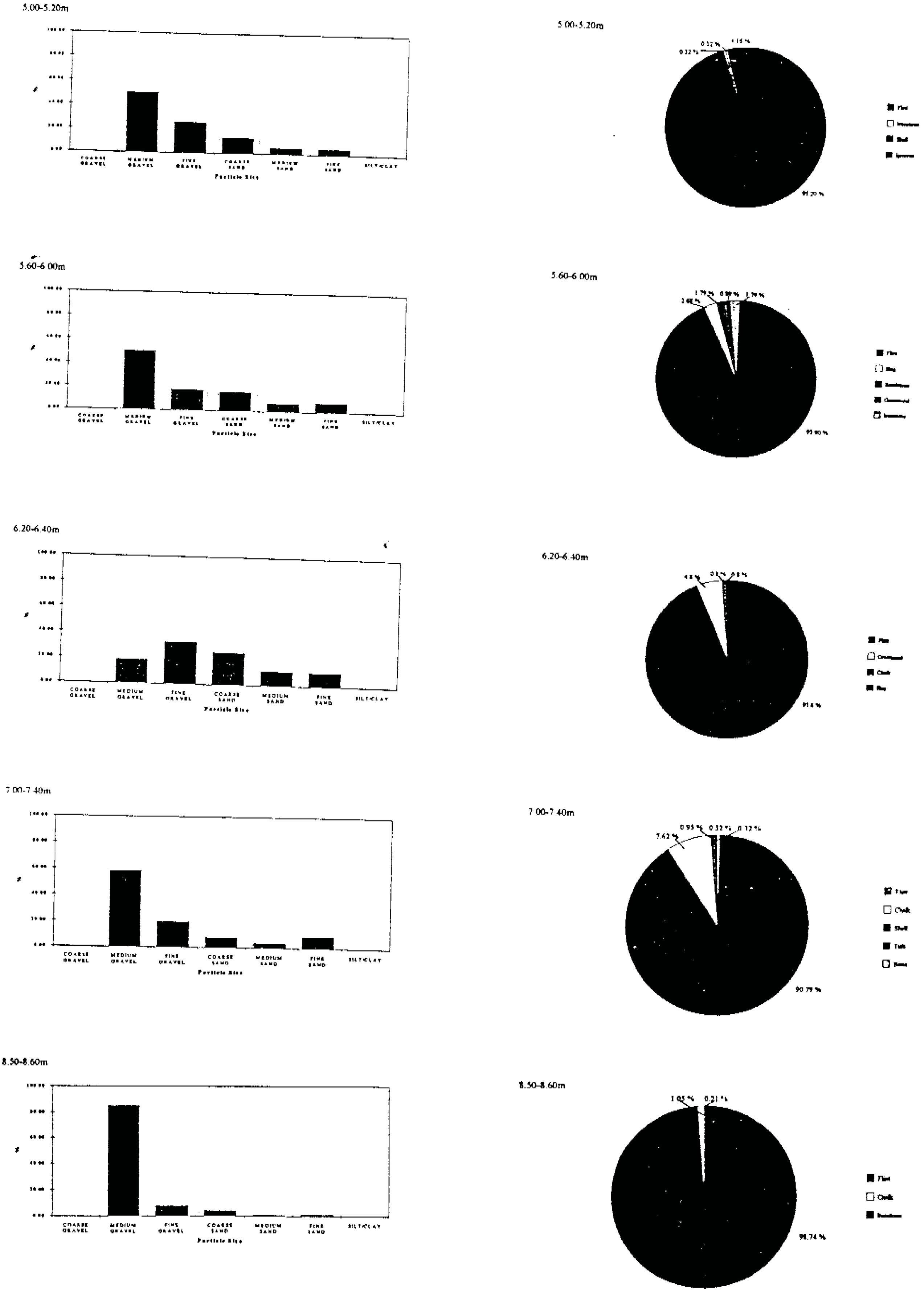


FIGURE 20 Particle size distributions and clast composition for selected samples from the Route Corridor

Clearly this information suggests that detailed sedimentological analysis of the sequences can produce results indicating trends in data that require explanation. This remains to be achieved and will require additional analyses.

BULK SAMPLES FROM CORE L15 (DSE-1).

Disturbed bulk samples were selected for particle size analysis and composition. This was undertaken to assess the feasibility of characterisation of gravel units on the basis of sedimentological properties.

Grain size distributions down profile clearly shows variation from a moderately sorted medium gravel (5.00-6.00m) through a poorly sorted gravel (6.20-6.40m) towards a better sorted, coarser gravel (8.50-8.60m) (Figure 20).

Clast composition varied down profile. Both the upper and lower samples showed little incorporation of material other than flint in the assemblage. The remaining samples however indicate a variety of material including slag, greensand, chalk, bone and tufa.

It is not possible to determine the significance of this data from this borehole alone. However clearly this suggests that mappable units (based on particle size and clast lithological data and probably particle shape) occur within these sequences.

The sedimentological analysis has been able to show that detailed sedimentological examination can provide useful information that will be required for a complete understanding of the sequences and taphonomic history of the samples.

The work undertaken on borehole K13 requires further analysis in order to complete the sequence analysis. This borehole does not contain all lithological units recorded in the area (see Section 2.2.3.) hence additional boreholes require analysis in order to fully sample all stratigraphic units. Additionally if a facies based approach is adopted for sequence analysis (see Section 8.0) other boreholes will require analysis to examine lateral variability in sedimentary units.

6.0 BIOLOGICAL DATA

All information in this Section has been summarised from the detailed specialist reports archived in parts G to M of the Archive. Interested readers should consult these documents for detailed information on methods and results. These reports are not intended as statements relating to palaeoecological reconstructions but statements of potential sources of data that may be exploited during post excavation analysis.

6.1 POLLEN

It is clear from the preliminary analysis of samples that pollen concentration and preservation varies considerably among the samples chosen for assessment. A range of samples from archaeological and borehole samples were chosen (Appendix IV) and subjected to standard pollen preparation techniques (see methods outlined in Moore, Webb and Collinson, 1991). The results are divided into two groups for ease of discussion:-

1. Archaeological contexts.
2. Borehole contexts.

1. Archaeological contexts.

Eight samples were chosen from a series of sites in Bench Street, Fishmongers Lane and the Crypt Site. Of those analysed only context 255 from the Crypt site and context 24 from Fishmongers Lane produced countable pollen concentrations. This information suggests that pollen exists in archaeological contexts. However predicting the presence of pollen without undertaking time consuming and costly preparations would be difficult. Equally the stratigraphic context and taphonomic history of the contexts, within pit fills and layers is complex and other studies (e.g. vertebrate assessment) suggests residuality within many of these deposits. With the exception of isolated occurrences, e.g. context 24 from Fishmongers Lane, it is thought that the complex taphonomic history of the contexts coupled with the unlikely presence of pollen in many of these contexts does not warrant further pollen analytical investigation. Pollen analysis from archaeological contexts should therefore only be attempted at the analysis stage if clear archaeological justifications exist for "snap-shot" interpretations of the complex assemblages likely to be present e.g. local habitat definition coupled to plant macrofossil assessment.

2. Borehole contexts

16 samples from borehole K13 (DSC-2) were analysed and 9 samples produced pollen in sufficient concentrations to allow counting of pollen grains (Appendix IV). Pollen concentration varied down profile from c.15000 grains/ml at the top to less than 5000 grains/ml at the base. Corroded, amorphous, folded and broken grains were also noted throughout the profile suggesting variable taphonomic processes operating on the samples. A simplified pollen diagram is presented in Figure 21.

The data suggested that variation in the pollen assemblage down profile may be a reflection of vegetation patterns and sedimentation history. The pollen diagram can be split into three main parts:-

1. The basal part between 690 and 710cm with high values of arboreal pollen dominated by *Tilia* and *Corylus* types.

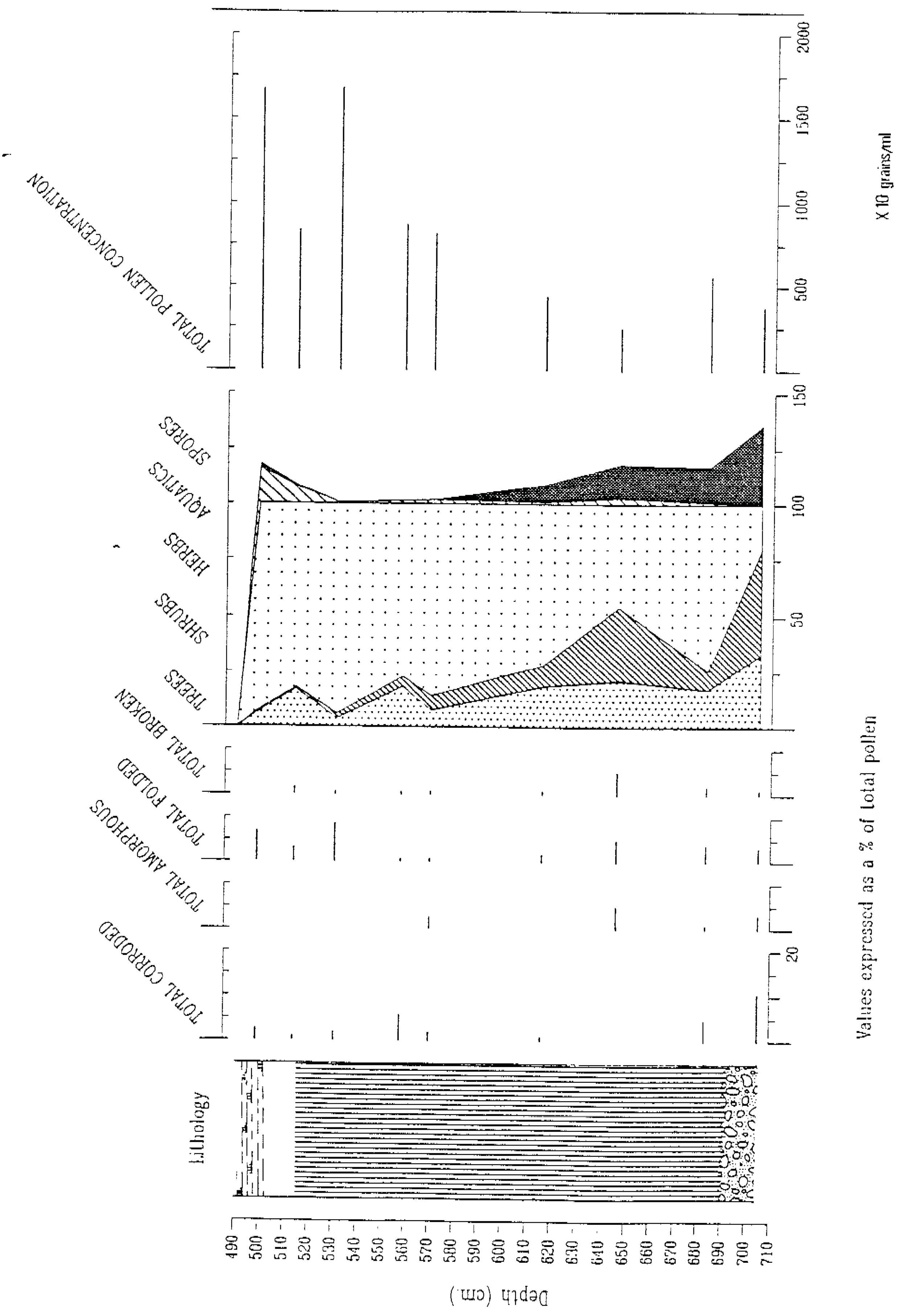


FIGURE 21 Simplified pollen diagram from borehole K13

2. A sequence of silts and sandy silts between 514 and 690cm with a wide diversity of pollen types including coastal vegetation (e.g. *Aster* type and *Suaeda maritima*), calcareous grassland types, wetland, woodland and arable species. This assemblage suggests wetland areas with standing water possibly occasionally inundated with saline water.

3. The upper part between 490 and 514cm containing significant levels of aquatic vegetation.

This, pilot assessment, indicates that sufficient levels of countable pollen can be extracted from borehole sequences. Additionally, variation in pollen concentration and preservational status of individual grains suggest significant complexity in vegetation and taphonomic history of the samples.

The work undertaken clearly indicates further, more detailed analysis, should be undertaken from additional locations. Archaeological contexts, e.g. the Crypt Site, Bench Street and Fishmongers Lane have only produced pollen in low concentrations and taphonomic history is complex in these locations. Borehole sequences are more likely to provide interpretable pollen spectra from the conformable, well-stratified and waterlogged sequences recovered as undisturbed U4/U100 samples. Radiocarbon dating will be feasible from these samples, and necessary for age-calibration of the pollen assemblage data. In order to fully comprehend these sequences variation in pollen spectra both vertically and horizontally across space needs assessment. This would require the analysis of a number of sequences from a selection of boreholes. Additionally to comprehend taphonomic history the pollen data must be integrated with the sedimentology, diatom, ostracod and plant macrofossil data.

6.2 PLANT MACROFOSSILS

A total of 24 samples were assessed in detail from a range of archaeological and borehole sequences. These samples were selected as a result of the preliminary assessment of all samples (see Section 4.2.3 and part E in the Archive). These samples are listed in Appendix V, table 1. A complete list of all identified material, presented by site is given in Appendix V, Tables 2-6.

A wide variety of plant remains were recovered from the Dover A20 Road & Sewer Scheme and although identification of the plant remains was limited, preliminary interpretation has demonstrated that the assemblages can produce information concerning the plant economy and environment in Dover. The plant remains include waterlogged seeds, fruits, stems and moss fragments and a variety of charred and mineralised remains from a range of very different sampling areas and contexts covering a wide time range from pre-Bronze-Age levels to the Post Medieval period. The potential of these materials to address questions relating to ancient economy and palaeoenvironmental reconstruction will now be discussed.

Ancient economy

Plant remains linked to human activities at specific points in time were limited to those recovered from bulk samples during the excavations of the Medieval deposits in Dover town centre at The Crypt Site (DSC) and Bench Street (DSP). Ranging in age from the tenth to fifteenth centuries A.D. these samples were recovered from a series of intercut pits and occupation layers dug into a natural sand deposit. Most of the remains were of charred wood, cereals and wild seeds and fruits from a wide taxonomic range. The cultivated taxa and the wood charcoals contain the expected range of plant resources used in the medieval period, and the large numbers of unidentified remains (especially charcoals) suggests many other taxa may be present. Mineralised remains were also identified in two samples from the eastern garderobe in DSC (**331** & **333**). Although many samples contained little material several contained rich assemblages which are of considerable importance. Sample DSI **24** contained some charred cereal remains, however, the complex taphonomic history of these samples makes interpretation difficult.

Most of the samples were recovered from 'pit-fills' and 'occupation layers' and, with the exception of the latrine samples and two samples from DSC (**221** & **222**), the sample composition and preservational context suggested that the taphonomic history was too complex to allow easy conclusions to be drawn. This limited the scope of any interpretation to establishing the presence or absence of particular resources at the site at specific points in time, as the sample composition and weed floras could not be used to suggest aspects of subsistence activities and crop husbandry practice. The samples DSC **221** and **222** had a similar, almost pure composition containing rich assemblages of

Oat grains and spikelets in contrast to the other samples This suggest that they represented single or related events and that the remains could be used in more detailed interpretation. The samples from the latrine fill confirmed its use as a toilet being of a typical 'cess-pit' assemblages and produced a clear link to the plants which were actually consumed by the contemporary community.

While many of the samples from DSC and DSP can only confirm the presence or absence of resources at certain points in time, the potential of some samples to answer more detailed questions about plant economy and activities has been demonstrated. There is, however, no clear relationship between context type and samples (i.e. samples with high quality, useful plant remains cannot be determined prior to processing). This will cause difficulties when in selecting samples for further analysis.

The analysis of variation and distribution in sample composition may provide information regarding rubbish disposal patterns through the site and could link the samples to specific dumping activities (although most of the deposits represent secondary rubbish accumulations and would therefore not allow activity areas to be directly identified). While detailed information for a specific feature or at a site level may be of low resolution the value of the plant remain assemblages relates to with the thorough nature of sampling within the well controlled and documented stratigraphy of the site. Even at an elementary interpretative level, establishing the presence or absence of certain economic taxa at points in time may provide a sequence showing fluctuations and changes in resource use over time. A major problem with the assemblages is the possibility of contamination and residuality due to the intercut nature of many of the deposits. Analysis of the distribution of other artefacts may indicate the degree to which the assemblages have been reworked. It is possible that many of the plant remains from some very poor assemblages, and many of the fresh looking seeds from others (especially of Elder (Sambucus nigra L.) could be intrusive or residual in origin.

Ancient Environment

Naturally accumulated plant remains, all preserved by waterlogging, were recovered in the borehole samples, from DSI and a single sample from DSC. A wide variety of taxa and plant components were recovered and there was considerable variation in the quality of assemblages and information. The samples cover a wide time-span from pre-Roman contexts (core TWS-5) through to those contemporary with the medieval occupation deposits (DSI). The most productive samples were the disturbed bulk samples from trench sections and between core sections in the boreholes, with the samples from the core sections themselves providing very limited plant remain assemblages, probably due to the small sample size.

Most of these samples have only been subject to limited investigation, however, some information has been obtained on the source habitats which produced the seeds and soft plant tissues, including the depositional environment and the nature of the groundwater conditions contemporary with the assemblage formation. The samples from DSI have indicated large scale human disturbance in the environment. It is certain that further identification will improve the identification of source habitats and allow further interpretation to establish the soil and water conditions under which the source plant communities grew. Comparison of samples from throughout the sequence could be used, indirectly to suggest the changes and relative scale of human disturbance of the environment and to indicate the importance of human activity as factors in the formation of 'natural' deposits. The well preserved and rich plant assemblages from the samples have a clear role to play in the identification of ancient habitats and as part of an inter-disciplinary study to reconstruct past environments and development of the Dover area.

Development of the Archaeo-stratigraphic sequence

The considerable potential of the waterlogged plant remains to provide information concerning local plant communities and environmental conditions suggests that as part of an inter-disciplinary study they could provide data to help understand the environmental history and development of the stratigraphic sequence of the Dover area. As well as habitat reconstruction, the sampling and stratigraphic recording allows the distribution of different categories of plant remains to be plotted in relation to the stratigraphy, providing information concerning aspects of the formation processes of the archaeo-stratigraphic record. In this area the plant remains will provide a useful source of information.

Methodological development of borehole investigations

The plant remain assemblages from the borehole samples varied considerably in quality and provided environmental data only. The core sections produced few identifiable plant remains probably due to their small size, e.g. sample TWS-5 **6.46-6.60.** When well preserved layers are included in the cores there is potential to provide useful information. The bulk disturbed samples from cores produced considerable quantities of material and provided a useful basis for environmental interpretation. Much richer assemblages were recovered from the trench section bulk samples, however, the boreholes produced plant remains and are invaluable where the conditions do not allow the opening of trenches.

GSF processing procedures

During the analysis the sample processing procedures were assessed for efficiency, to examine the representation of plant remains recovered and to observe scope for improvement. All processing procedures were adequate, however, some of the borehole bulk samples did not have wet sub-samples retained before drying and sieving which may have reduced the range and value of the plant remain data. It is also possible that many smaller seeds are being missed during sample sorting and that samples identified for specialist analysis should be sorted by the specialist involved.

The plant remains from Dover have been shown to have considerable potential to address a range of problems concerning the economic and environmental history and development of Dover and contribute to the wider research aims of this project. The basis of sample selection in any future analytical work would be based on the brief preliminary assessments of the samples carried out in advance of the detailed assessment. It should be noted that many of the samples included in this assessment would require further work to fully interpret them.

The work on samples from DSC and DSP should focus on analysing rich comparative samples, from each phase of the site, to examine the development of the medieval economy, changes in function of the site structures. This work should incorporate more detailed analysis of the charcoals and any weed floras firmly associated with cereal assemblages. This analysis has shown the limited nature of the charred samples and the main focus of any study would be samples potentially representing one or related activities (i.e. DSC **221**). A study of the possible contamination from residual and intrusive material would be an important project goal for understanding the material from this site and also as an independent theoretical research topic. All information concerning the plant economy of the site would be compared and contrasted to known historical and archaeological data to provide a more thorough and view the site development.

Environmental plant material has been most productive in the bulk samples from trench sections and boreholes. Such samples would be the focus of environmental work, where available, with the soft plant tissues as well as the seeds and fruits coming under full analysis. The core section samples themselves would be used where rich samples were identified (from preliminary assessment) and where bulk samples had not or could not be taken. Interest would focus on identifying the finer characteristics of the habitats from which the remains were derived and looking for any evidence of fluctuations in environmental disturbance by human communities as reflected in the sample contents.

Summary and conclusion

The plant remains from twenty four environmental samples from the Dover A20 Road & Sewer Scheme have been subject to a basic interpretative analysis. The analysis suggests that it should be possible to address a number of research topics outlined in the project aims. Charred and mineralised plant remain assemblages may answer questions concerning the development of the plant economy in Dover from the tenth to fifteenth centuries A.D. Rich waterlogged assemblages have been recovered covering a longer time span and have the potential to aid in understanding the changes in plant habitats and the environment as a whole when interpreted within the inter-disciplinary environmental project. Future research areas have been identified and while individual samples have not necessarily produced the highest level of information possible, the thorough sampling and the detailed knowledge of the stratigraphic relationships of the samples suggests that the much more detailed information may be available by considering the composition and distribution of analysed samples as a whole. The plant remains from Dover have shown a considerable potential to help answer archaeological and environmental questions and their analysis should form a part of any future research project.

6.3 DIATOMS, FORAMINIFERA AND OSTRACODA

Diatom preparation followed standard techniques (Batterbee 1986, 1988). Slide preparations were scanned for each sample and a species list produced. Where necessary dominant species were noted (see Appendix VI). Diatom diagrams have not been produced due to the limited number of samples examined. Eight samples were examined from borehole DSC - 2.

Diatoms are well preserved in 50% of the samples examined, poorly preserved in one and absent for 3. The samples from the lower part of the sequences (tufa and peats) did not produce any diatoms. Diatoms were absent or badly preserved from the upper parts of the sequence. The well preserved assemblages derived from laminated sands and silts and produced faunal assemblages indicative of marine and brackish water communities with occasional occurrences of freshwater types.

The limited data set examined suggested that trends are present in both species composition and preservation through the sequences and that further work is necessary. Percentage counts would provide further useful information for reconstruction of salinity changes (Juggins, 1992: Denys, 1992, 1993). Variations in freshwater species composition may reflect both variation in water quality and source. Further work should involve detailed sampling at close intervals throughout the sequence and should include detailed taxonomic study of species present and the taphonomic implications of the structure of the data set.

6.4.1 VERTEBRATES (INCLUDING LARGE AND SMALL MAMMALS, REPTILES, AMPHIBIANS AND BIRDS)

A total of 19 samples were assessed for the vertebrate analysis (see Table 12). A total of 10 produced useful assemblages. Material was selected from a range of contexts including bulk samples recovered during archaeological excavation, sewer trench excavation and boreholes. All samples were sieved and in some cases these samples were augmented by assessment of the hand retrieved material collected during excavation (it is however recognised that hand collected material has an inherent bias and must be treated with caution). A full list of all material assessed is presented in Appendix VII. During the assessment careful consideration was given to the state of preservation of the bone material and the likely taphonomic implications of this data for the interpretations of the assemblages. All primary data is presented in Section J of the Archive.

A wide range of species were noted, mainly from contexts associated with archaeological features in the Crypt-Bench Street-Fishmongers Lane area (see Table 16). Very little useful material has been recovered from the borehole contexts. Much of the recorded bone is from domestic species with variable quantities of bird (40% in context 331 from the Crypt Site) and fish (see Section 6.4.2). Hand retrieved material has been assessed due to the limited sample size available from bulk samples but this material may be inherently difficult to interpret.

During the study a set of stratigraphically linked samples were assessed from the Crypt Site to examine the question of residuality in the assemblages. Results were inconclusive although some evidence suggested that significant mixing of assemblages had occurred.

The samples from the Crypt site potentially contain the highest quality information to address questions regarding economic and palaeoenvironmental questions. The Bench Street material, present in greater abundance, derived from contexts which have to be treated with caution as they may well include much residual bone and thus have no contemporaneity with the timing of the depositionary process responsible for unit formation. The Crypt Site contexts also included bone which may have been residual although a few contexts were considered to be more reliable. The Fishmongers Lane material gave indications to suggest that there was a mixture of residual and primary waste bone. The borehole bone remains were of very little use in explaining the deposits examined.

The palaeoeconomic conclusions of this investigation are hampered by (i) residuality, (ii) sample size and (iii) dating of the contexts containing bone. Commonly there is insufficient contexts from any give time frame to allow adequate comparisons to be made however a range of samples from pre-Norman to the early 14th century are present.

SPECIES	170	221	222	255	331	333	361	391	393
Sus sp.	1								
Ovicaprid					6				
Canis sp.				?>1					
Indet. large mammal	63	34	41		58	14	26	?	1
Rattus rattus					1				
Mus musculus	1				?>1				
Indet. murid			1		?>1				1
Microtus agrestis									
Indet. rodent	2			1	?>1				
Indet. small mammal	1	1	1		?>1	1	1		3
Anuron					2	3			
Gallus sp.									
Indet. large bird	?	?		1	18	10			
Indet. passeriform	?				4	6			
Avian egg shell	6	10		1	13		11	7	16

Table 16. Bulk sample taxa for selected species: Crypt site.

General remarks can be made regarding the economy of 11th to 12th century. For instance, ovicaprids are the commonest species group being exploited, followed by cattle and then pigs. This does not mean that ovicaprids were the most important food resource as different species provide different quantities of meat and other products. No attempt was made here to resolve this problem as it was felt that given the small size of assemblages may yield meaningless statistics. Domestic fowl were present and the egg shell found probably means that they were being kept for that purpose. This again is based on a small sample and may be subject to revision. There is no significant wild element to the diet during this period and apart from the few birds may have been unimportant to the economy. The palaeoenvironmental story told by the remains is impeded by the same problems as is the palaeoeconomic one. Those vertebrates that were found were not useful at indicating palaeoenvironments. The remains have shown however, that when found, small mammals can give information regarding geographical range changes and are therefore of use in that respect (O' Connor 1987). It is reasonable given their scarcity, however, to suggest that they should not be targeted in their own right, although when found during sieving exercises they should be investigated.

Recommendations

This study represent the first specialist bone assessment from a Dover site. The work has highlighted the importance of integrating the bones with the contextual information to establish their relationship. It is recommended that if more large mammal bone is to be studied in the immediate future that they be done in conjunction with bulk samples emanating from the same contexts. This being such that some control on residuality may be achieved. Therefore it is suggested that future work be focused on the taphonomy of these deposits rather than on traditional palaeoeconomic interpretations.

If more bulk samples are to taken to a higher assessment level our knowledge of those preliminary assessed will be important. From this it would seem that there is much variation between deposits examined and that many samples, particularly those from boreholes, yield little useful material due to their size and facies. However, if samples are to be investigated for other environmental remains, vertebrates will inevitably be found and if they should prove interesting they should be analysed. This does therefore necessitate a degree of specialist knowledge at the retrieval stage of any such project.

The final recommendation is that deposits yielding bone should be recorded more fully in future excavations. Particularly in terms of details of bedding and other sedimentological structures which may shed light on the deposit's mode of formation and therefore on the taphonomy of the vertebrate remains they contain.

Summary

In the light of the present assessment it would be useful to consider the vertebrate bones in terms of the research objectives outlined at the start of the project (Barham et.al., 1992). The first theme was that of investigating the palaeoeconomic history of the Dover town centre. This, it would seem, is possible given the data assessed, the material not yet assessed and the techniques that have been evolved by zooarchaeologists to do so. However it is unclear whether even when enough data from a single context or group of associated contexts is available, that the relationship between bone data and palaeoeconomies is close enough to make reliable detailed interpretations. The reasoning being that the vagaries of taphonomy are almost certain to produce apparent patterns which will vary according to the statistical tools used. So anything more elaborate than working out the frequencies with which species occur, such as recommended by O'Connor (1985), will in this authors view be too ambitious.

The use of vertebrates in shedding light on topographic change will always be fairly limited due to fact that vertebrates are fairly mobile and turn up in relatively small numbers as fossils. However, in certain circumstances where the numbers are large enough small vertebrates and particularly mammals can be useful. Unfortunately, the bones dealt with in this assessment have not been very enlightening.

Due to the limited use of the vertebrate remains in elucidating the first two research themes it is not envisaged that they will be of great value in the final three. As illustrated above there are some interesting questions which have arisen as a result of this assessment despite there being little useful information supplied to answer those questions specifically asked at the start of the project. These are of course the questions concerning the recognition of residuality and whether or not vertebrate assemblages are of paleoeconomic/palaeoenvironmental interpretative value or simply useful in helping explain the origins of specific deposits.

6.4.2 ICTHYOFAUNAL REPORT

A total of 13 context have been assessed in detail and these contexts have produced a wide range of material. A total of 16 species and remains of Salomid, sharks and wrasses have been located (Appendix VIII). Without exception these species are marine or migratory species and none are obligate freshwater taxa. The full report is presented in Section K of the Archive.

Skeletal element composition varies as does degree of preservation. Some evidence of butchery is present (e.g. DSP/92, context 340) and some evidence for heat damage (cooking?) is present (e.g. DCS/92, context 170).

In all cases material has been assessed from archaeological contexts, e.g. pits or layers. Naturally deposited sequences have produced little or no fish bone. Clearly there is a relationship between occurrence of fish material and human activity. Fish species present derived from a range of environments from sandy estuarine conditions (Thornback Ray) to deep water North Sea environments (Haddock). It follows that little can be inferred regarding the natural environment of the area from this material. Conversely however the range of environmental preferences may indicate the area over which fishermen were ranging to catch material, e.g. haddock is currently a deep water North Sea fish that does not occur in the Straits of Dover or the Channel.

Potentially the material may be of greater significance in indicating the palaeoeconomy of the period. Unfortunately there are considerable difficulties in the interpretation of the contexts from which this material derives. Residuality in large mammal bone and ceramic assemblages clearly represents a problem that is likely to apply to the fish material. Additionally it is difficult to make precise age determination of these contexts (beyond 10-13th centuries A.D.). In many cases skeletal elements consist predominantly of teeth and the more resistant skeletal elements clearly indicating taphonomic influences on the assemblage.

To summarise while the data is in some cases well preserved and in quantity the residuality factor and the unknown taphonomic biases make the interpretation of this material difficult. Additionally it is difficult to date much of this material. Further analysis of contexts would be useful to obtain a more complete range of species utilised in early Medieval Dover. It is unlikely that detailed studies, based on a complete understanding of the taphonomy of the assemblages, can be made. An alternative view, that regards the fish material as particles within the context, and seeks to study the nature of the sequence and variability with the sequences (i.e. a facies approach), could usefully examine further contexts for the included fish remains. This data would also be necessary in considering the statistical validity of sample sizes in relation to the nature of the context in the ground and trench size from a methodological perspective.

6.5 MOLLUSCS

A series of samples were selected for analysis from a range of contexts and locations. The results are located Appendix IX. A full description of methods and results is located in Section L of the Archive.

The results from the 3 areas in the town centre (see Tables 1-3, Appendix IX) indicate a restricted number of species are encountered in the samples. The number of individuals in samples is frequently low and shell preservation is poor. The nature of the samples does not allow palaeoeconomic inferences to be made beyond a documentation of the range of potential food species available.

Extensive terrestrial and freshwater molluscan remains have been located in two sets of samples. Fine grained silts from the area adjacent to Archcliffe Fort (B2-B8, D6-D8) (Tables 4 and 5, Appendix IX) have produced large numbers of individuals from a restricted range of species. Shell preservation and the number of individuals per sample varies between the two locations assessed, suggesting variable taphonomic influences. Critically the deposits at D6-D8 contain sufficient material, in well preserved state, to enable detailed palaeoenvironmental reconstructions to be made. Interestingly preliminary observations suggest the assemblage indicate cold, periglacial environments. Comparison with work published elsewhere (e.g. Folkestone, Preece, 1992) suggests these deposits may be pre-Allerod in age (but younger than 20ka B.P.) and of considerable palaeoenvironmental significance. Such a sequence would be of regional and international significance.

Molluscs have also been recorded and assessed from boreholes drilled in the town centre (Tables 6-8, Appendix IX). Of the samples assessed many contained poorly preserved molluscan assemblages, with low total number of individuals. Those with shell preserved are often highly fragmented. In contrast a few samples (K3, 8m) contained large, well preserved assemblages. In some cases the assemblage did appear mixed, with elements of Late glacial age mixed into later Holocene sequences. The assemblages suggest however that where shell preservation and numbers are high important palaeoecological and taphonomic data can be derived from the samples.

Analysis of mollusc shells recovered from samples from Dover have demonstrated the vast complexity of palaeoenvironments under which sediment deposition has occurred. This has ranged from sites deposited under a steppe/tundra environment in the Late Devensian period, through tufas with associated marsh assemblages and alluvial silts containing fresh water assemblages, to fully marine sands containing fragments of mussel and periwinkle. Significantly the assemblages vary considerably in composition and preservational status and rarely occur in abundance (unlike assemblages recovered from the foot of the Chalk Downs at Folkestone (Kerney 1963; Kerney et.al. 1980, Preece, 1991, 1992)). Within a single bore hole shell preservation varied such that in consecutive samples total shell counts ranged from over 500 to less than 20. It is likely that this variation is probably caused by differing sediment geochemistry, itself possibly a result of percolation of acidic ground water and other taphonomic factors. However, it is also possible that differing mechanical erosive processes have affected shells in different sedimentological units.

The assessment of marine mollusca suggest that it is unlikely that substantial inferences regarding palaeoeconomy will be derived from the samples. Marine molluscs are infrequently preserved, usually highly fragmentary and in low quantities. This is true of most contexts from the Crypt site and Fishmongers Lane. Only in Bench Street was preservation good, and a palaeoeconomic link could be postulated. Even here the remains of shellfish were not present in large enough quantities to suggest which species were playing the most important role in the subsistence economy, although periwinkles predominates. The main conclusions that can be drawn from samples containing shellfish remains are qualitative, i.e. that periwinkle, mussel, oyster and to a lesser degree cockle played a part in the Saxon and Medieval diet. The value of examining further bulk samples from pit fill contexts from the three above sites is probably minimal unless several hundred shells were found in each samples the results would only be qualitative and would therefore probably contribute little further information.

Two areas have, however proved further study would be profitable:

1. Analysis of material from sequences adjacent to Archcliffe Fort (D6-D8, D3, B3-B8). These sequences have been shown to contain a rich biostratigraphic sequence, in association with a complex sedimentary sequences. The deposits represent the earliest sequences in the area (almost certainly pre-Allerod) and therefore may provide detailed information on a period during which Britain was being recolonised after the glacial maximum at 18ka B.P. Critically the sequences should enable previous models (e.g. Kerney *et.al.*, 1980, Preece, 1992) to be tested. While not directly associated with archaeological material sediments of probable late-glacial age have been recorded in the valley bottom in association with flint gravels that produced a crude, bifacially flaked core tool. Additionally the nature of these assemblages requires clarification in order to assess the extent of reworking in valley bottom sediments in situations associated with the Prehistoric sediments below the Roman harbour. In order to pursue these studies it is necessary to attempt age calibration of the sequences either through AMS dating of key mollusc species or Optical Luminescence Dating of quartz grains in the sequence.

2. Analysis of material from the boreholes. The data assessed clearly shows that useful data can be obtained from a study of the molluscs. Two avenues of investigation need to be considered (i) use of samples for reconstruction of `snap-shot' environments (the patchy distribution and uneven preservation of molluscs in the sequences make it unlikely that good, continuous mollusc profile can be developed), (ii) the data can be used to aid construction of a facies model for sequence development (e.g. the identification of reworking of Late-glacial sequences into more recent ones).

6.6 INSECTS

Six samples were processed and analysed for insects (see Section M in the Archive). Full lists of insects recorded are listed in Appendix X. Preservational status and context varied between samples and those from the Crypt Site produced poor assemblages not amenable to investigation. Three interesting samples were observed that indicate the nature of the data that may be obtained by further study.

A single sample from K1 produced a range of insects compatible with a freshwater interpretation for this context. It was noted that certain elements in the fauna may have been reworked. Two samples from Fishmongers Lane produced a wide diversity of insect types indicative of many niches and included types typical of household environments to those fond of foul water conditions.

Clearly these observations have indicated the high potential of further studies provided that useful assemblages can be relatively easily identified. These are likely to be locally present and difficult to predict. The example presented (K1) indicates the usefulness of this class of data (compare interpretations with pollen, plant macrofossil, molluscs and diatoms).

6.7. MISCELLANEOUS.

During the bulk sieving program a series of other classes of data were recovered due largely to the large number of samples sieved, the careful sorting of the samples and the fine mesh used during sieving (0.5mm). These classes included barnacle plates and Ophiuroid ossicles (figure 12). Although at the present unexplained their occurence may well have some taphonomic significance. Finally it is worth noting that this is probably the first record of ophiuroid remains on an archaeological site.

7.0 CALIBRATION OF THE SEQUENCES

The nature of the sequences recorded varied from those directly associated with archaeology (usually Medieval and post-Medieval contexts) to stratigraphies indirectly dated by correlation with known events to events with no direct or indirect method of dating. It has become apparent that in order to calibrate the sequences present in the area it is necessary to consider the ways in which this calibration may be achieved.

7.1 RADIOCARBON (^{14}C) DATING

A number of samples have already been submitted for radiocarbon dating (see Table 17). The samples were, with the exception of GSF 21, all extracted from borehole material and were of restricted size and had to be dated using the Oxford Radiocarbon Laboratory Accelerator Mass Spectrometer. The age-estimates will calibrate the age of the sequences lying at depth in the town centre area and the final infilling of the Roman harbour area (GSF 21). Clearly a range of dates exist for the peat units lying below 4.99m depth below ground surface and this data has implications for the speed of unit development and the age of the contexts associated with the Bronze Age Boat. Age estimates from GSF 21 date the final infilling of the old Roman harbour. The dates obtained to date conform to the expected stratigraphic order of events. However the order of magnitude of the ages from DSC-2 exceed those expected. Age estimation of sequences in the area may be compromised and perhaps altered by a number of factors:-

1. The area bedrock is chalk ($CaC0_3$) and the potential exists for hard-water contamination of samples. Additionally tufa growth may also add to this hard-water effect.

2. The area of interest contains variable quantities of autochthonous and allochthonous material that must be identified.

Consideration should be given to refining and calibrating the stratigraphic framework in the area and further ^{14}C determinations will be required:-

1. Further age estimates of the tufa/peat sequences below Roman levels are required to calibrate landscape changes that occurred in the area.

2. No estimates of initiation, speed and duration of infilling of the Roman harbour are presently available. This data is critical for defining later Roman/early Saxon locations of likely foci of activity.

3. Consideration should be given to dating the late-glacial mollusc faunas found in the vicinity of Archcliffe Fort due to the international significance and likely importance in determining landscape change during a period of recolonisation of the area after climatic amelioration subsequent to the late Devensian ice advance.

A range of potentially datable material has been identified from the samples processed during the assessment phase. These materials include bone, shell, plant tissue (including wood, stem and leaf material), peat and tufa. The usefulness of these materials varies depending on context of the material, state of preservation etc.

LABORATORY NUMBER	**SAMPLE REFERENCE CODE**	**MATERIAL**	**RADIOCARBON AGE B.P.**
OxA - 4183	GSF 21, 0.00-0.30m	Wood	1545±65
OxA - 4184	GSF 21, 0.30-0.40m	*Equisetum* sp. stem	1670±65
OxA - 4185	DSC-2, 4.99-5.01m	humic acid from peat	1740±70
OxA - 4186	DSC-2, 7.09-7.11m	peat	4810±95
OxA - 4187	TWS-5, 6.72-6.74m	peat	4340±85
OxA - 4188	TWS-5, 6.80-6.82m	peat	6315±85
OxA - 4189	TWS-5, 6.90-6.92m	peat	8380±110

TABLE 17. AMS Radiocarbon age estimates from Dover A20 Road and Sewer Scheme Assessment Phase.

7.2 ARCHAEOLOGICAL SPOT DATING

A series of samples have been submitted from GSF contexts and samples for spot dating by CAT (see Table 18). Due to the nature of the material (pot sherds, coins etc.) and the context of discovery it is often difficult to determine precise age estimates of the sedimentary matrix within which the objects were encountered.

Pottery and other ceramic material usually only provide broad age estimates. As a particulate material within sedimentary contexts (e.g. beach gravels, laminated sandy-silts) they are not always in primary context and may have been incorporated into these units from pre-existing sequences and are often reworked and rolled. The relationship between the finds and the sediment matrix is often unknown and the time gap difficult to estimate. A further problem is caused by the low quantities of material usually recovered in the samples.

Spot-dating of recovered material is useful. However it is unlikely that precise age-estimates will be obtained from such studies.

SITE INDEX NUMBER	DEPTH / CODE	AGE
F1/F3	SAND	?Post Medieval
I1	1.10-1.20m	16/17th century A.D.
I6	C	1600-1750 A.D.
K1	0.00-0.30m	? Post Roman
K6	3901	1850-1900 A.D.
K7	1.5m	1900-1950 A.D.
	2.5-2.7m	1900-1950 A.D.
	3.2-3.3m	? Post Medieval
	3.3-3.5m	Post Medieval
	3.55-3.60m	Post Medieval
	3.6-3.7m	Post Medieval
	7.55-7.77m	Roman
	7.8-8.0m	Roman
K8	2.3-2.5m	1175/1200-1250 A.D.
	3.2-3.4m	1150-1250 A.D.
	3.4-3.6m	Early Medieval
K13	3.8-4.0m	Post Medieval
	4.7-4.9m	Post Roman
K22	0.37-0.67m	?850-1000 A.D.
M1	3.1-3.6m	1600-1750 A.D.

TABLE 18. Spot dates from processed bulk samples.

8.0 THE DEVELOPMENT OF A FRAMEWORK FOR STRATIGRAPHIC PALAEOENVIRONMENTAL AND ARCHAEOLOGICAL INTERPRETATION BASED ON A FACIES ANALYSIS

The data recovered from the area of investigation is both diverse in age and in sediment type. Figure 6 and Table 5 presented a simplified stratigraphic sequence constructed from borehole data and trench observations in the vicinity of Bench Street. Further transects may be constructed along lines defined between observation points for any area along the route corridor.

Construction of stratigraphic sequences and correlations between sequences on the Western Heights is likely to be relatively straight-forward and unlikely to cause difficulties in interpretation. Correlations within the town centre area is however potentially complex with highly variable sequences present that require careful study and integration into a 3-dimensional model of sediment accumulation, e.g. the nature of the Roman harbour and its subsequent infilling will have been a complex event in which sediments of different types will have been deposited at the same time in different areas. In order to fully integrate and understand this data it is necessary to adopt a `facies based' approach to the sequences. The facies of a sedimentary rock unit is the sum of all its inherent properties including lithology, internal structure, bed base, grain size variation, three dimensional structure, fossil content etc. (Scott, 1979; Walker, 1984). This enables lateral modification in the lithological and fossil aspects of sedimentary rocks (dependant on varying environments of deposition) to be included within a theoretical framework. For example a modern storm beach may consists of coarse gravel close to and above high water marks however this can be traced below the low water levels through fine gravel and sand to sub-tidal silts. The sediments are linked through process and are time equivalent but vary in the nature sediment fabric.

The development of a facies model allows the observed sediment facies to be integrated into a process model. This is achieved by analogy with modern geological processes. Facies models link modern and ancient observations into coherent synthesis. A well developed facies model must fulfil a number of functions (Walker, 1984):-

1. It must act as a norm, for purposes of comparison.

2. It must act as a framework and guide for future observations.

3. It must act as a predictor in new geological situations.

4. It must act as an integrated basis for interpretation of the environment or system that it represents.

Thus the approach has, in addition to aiding palaeoenvironmental reconstructions, important implications as it will provide data of a predictive nature for areas remaining to be examined and as a framework to guide future work. Hence the approach has many advantages for future archaeological and palaeoenvironmental work in the area. The approach can be shown to be applicable to the study area and, indeed perhaps the only way of usefully integrating the data being produced by specialists working on the project.

Figure 6 illustrates a provisional, and simplified, interpretative cross-section from the old Dover Stage Hotel towards the town centre along Bench Street. It is noted that both the Medieval town wall and the remains of a probable Roman timber structure both rest on a high of tufa, peat and organic silts. This high is probably a remnant of a once more extensive sequence of tufa and peats extending over much of the valley floor area. Processes of erosion, possibly linked to rising sea-level, changes in coastal configuration and changing base levels for streams and rivers may have initiated incision of these deposits and as a product influenced the deposition of the gravel with Roman artefacts found in boreholes K10 and K11. Clearly the nature of the sediments present and their age calibration requires careful study before integration into a model (a facies model) that examines cause and effect. This will only be possible following careful evaluation of a number of borehole sequences and detailed investigation of micro and macro floral and faunal sequences. This data has been shown to be present in the area (see Sections 5 and 6). The extant information available for borehole K13 is used (Section 8.1) to illustrate this potential.

8.1 A DETAILED STUDY OF BOREHOLE K13

This borehole can be lithologically divided into 5 main sections (Figure 22):-

1. Sands and gravels.
2. Sandy peats.
3. (Laminated) sands and silts with variable quantities of organic material.
4. Calcareous silts, peats and tufa.
5. Angular flint gravel.

The sedimentology has been discussed in detail in Section 5.2. Initial results suggest field stratigraphic observations are confirmed by the laboratory results. Variation in total P levels appears to follow changes in organic content and the sediments become less carbonate rich towards the top of the profile. Elements of the stratigraphy appear laminated with high organic content.

Pollen analysis (Section 6.1., Figure 21) suggests major changes in vegetation from a largely woodland dominated top of the tufas into a sequence of aquatic and mixed pollen assemblages through to a fully aquatic assemblage in the overlying silts and sands. Diatom assemblages from these units clearly indicate an environment dominated by marine/brackish elements with occasional influxes of freshwater species. This pattern is broadly mirrored in the plant macrofossil data for the upper part of the sequence (see Section 6.2.). Insufficient data is available from the vertebrate assessment to comment however the molluscs indicate a similar trend from terrestrial assemblages in the tufas to more aquatic assemblages in the overlying units. The tufa/peat sequence has been dated by AMS Radiocarbon dating and an age range of 4810±95 B.P. (DSC-2, 7.09-7.11m) to 4340±85 B.P. (TWS-5, 6.72-6.74m) for the upper peat has been suggested. Dates of 6315±85 B.P. and 8380±110 B.P. have been obtained for the lower and middle peats at TWS-5.

Currently the sandy peats have produced the widest variety of data and this suggest that the environment of deposition for this unit was an aquatic one with perhaps channel edge vegetation and arable ground assemblages nearby. Plants tolerant of saline conditions are present in small quantities suggesting proximity to the coast but no direct maritime influence in the area. This unit can be traced through a number of boreholes and trenches (see Table 6) and clearly represents a major deposit indicating the establishment of freshwater wet ground conditions over large parts of the old Roman harbour in a pre-Norman time period. Radiocarbon age estimates of 1545±65 B.P. and 1670±65 B.P. (GSF 21) and 1740±70 B.P. (DSC-2, 4.99-5.01m) have been obtained from this unit.

STRATIGRAPHIC SEQUENCE	AGE ESTIMATES	SEDIMENTOLOGY	POLLEN	PLANT MACROFOSSILS	DIATOMS
Fill Well bedded sands to sandy gravels Coarse gravel at base Major u/c	Late 10th-early 12th century				
Humified peat	1740±70B.P.	High Total P peak/moderate organic content	Aquatic pollen increase with Sphagnum, Chenopodium and Cyperaceae	Aquatic river edge and disturbed ground taxa	
u/c					
Laminated sandy silts Becomes sandier with depth	(2nd century Pot)	Increase in calcium carbonate up profile, two fining upwards cycles	Mixed assemblage including aquatics, woodland, open ground		Mixed brackish water and marine types
Major u/c					
Tufa and peat	4810±95B.P.	High organic and peak in Total P content	High arboreal content including Tilia and Corylus		
Silt Major u/c Gravel					

Figure 22. Summarised specialist data from borehole K13 (DSC 2).

The evidence available from this borehole clearly indicates that for any given sediment unit a wide range of data sources are available to enable the sequence to be characterised and the facies described. Correct correlation, based on radiometric dating, will be required to integrate this data into a facies model.

9.0 STATEMENT OF ARCHAEOLOGICAL POTENTIAL AND REVISED THEMES FOR STUDY AND RESEARCH FOR THE ANALYSIS STAGE

The fieldwork and assessment of samples collected during the project have addressed a series of topics and it is clear from this work that considerable potential exist for a wide range of post-assessment analyses on a range of data sources. The following areas have been noted to have significant potential:-

1. The Western Heights sites B3-B8 and D3-D8 have been shown to contain an important stratigraphic sequence containing rich molluscan assemblages that relate to an unknown time span probably within the Late-glacial period. Stratigraphic resolution is sufficient to enable detailed palaeoenvironmental analysis capable of examinating climatic fluctuations during a time period when Britain was being recolonised by humans after the last glacial maximum.

2. The town centre area (area I4-I9, J, K, L and M) where extensive well preserved sequences occur. These sequences are rich in palaeoenvironmental material, are in places well stratified, and will enable detailed palaeoenvironmental investigation. The nature of the pre-Roman landscape, the shape and infilling of the Roman harbour and the development of the typography on which the town was constructed are all areas which can be investigated.

3. The town centre area also contains archaeological sites (DSC, DSP, DSI) where large quantities of palaeoenvironmental material has been recovered from archaeological contexts which may allow palaeoeconomies to be examined. This material is worthy of further work although continual reference to contextual details with regard to contemporaneity should be undertaken.

Five proposed research themes will now be examined in detail.

THEME A PALAEOECONOMIC HISTORY IN THE DOVER TOWN CENTRE (YORK STREET ROUNDABOUT / BENCH STREET / FISHMONGERS LANE AREA)

Here a combination of boreholes, set-piece excavation and opportunistic sampling of engineering sections has yielded stratigraphically well-controlled sequences. Archaeological stratigraphy has yielded (i) very well preserved material, (ii) controlled context phasing and (iii) a high chronological potential. These data both calibrate/confirm and extend the historical/documentary archive. Fish bone, large mammal bone and plant macrofossils are abundant, particularly for c. 9th-12th century levels in the Crypt site, similar aged deposits in Bench Street and at the western end of Fishmongers Lane. Previous work (Wilkinson, 1990) has highlighted this area as critical in the socio-economic/structural development of the Medieval Town, but the environmental samples now recovered will permit:-

- Environmental archaeological/socioeconomic reconstruction of the urban environments/activity areas which have not been studied at any previous excavation in Dover.

- Specific descriptions of the fauna being exploited in specific time periods.

- Re-interpretation of data available/partially available from previous KARU excavations in environmental archaeological terms.

- A study of the formative periods of the Medieval town, and the evolution of the Town in the more recent periods.

- A calibration, development and testing of the data generated by the desk-top evaluations conducted previously by the OAU (Wilkinson, 1990), CAT (Parfitt, 1991) and GSF (Barham and Bates, 1990) of the likely locations, nature and age of both structural archaeology and other archaeological deposits in Central Dover.

These goals must be tempered with the knowledge that the taphonomic history of the samples is not clearly understood. Evidence exists that suggests residuality and reworking of assemblages may be common and that it is difficult to ascertain fully the extent of this problem. Temporal control on the samples is problematic and it is difficult to determine precisely the age of the sequences. However, broader temporal statements are likely to be possible even if great detail on palaeoeconomies appears over ambitious.

It is not envisaged that further large scale processing of samples to address these questions is warranted. Limited bulk sample processing of a small number of samples will however be required to complete a basic data set.

THEME B TOPOGRAPHIC CHANGE FROM THE LATE-GLACIAL TO POST-MEDIEVAL PERIODS

The integration of borehole stratigraphy and visible excavated stratigraphic units permits incremental reconstruction of the time/space sequence of depositional units from pre-Holocene/Late-glacial morphometry to the present day.

In archaeological terms this allows examination of the relationships between changes in topography e.g. Dour valley floor/valley sides/proto-harbour to foci of human activity/settlement patterns. Changes involve both natural sedimentation (valley in-filling/beach accretion), human purposive 'landscaping' (cuts/made ground) and interactions between human activity and natural process (re-location/re-construction of town walls/gates in relation to coastal change/hydrological changes in the Dour Valley).

Specifically this important research theme involves:-

- the relationship between documentary sources/archaeological SMR data from previous studies and this project which is patchy in spatial coverage, and the functional relationships between sites and local palaeoenvironments, e.g. relationships to flood datums/drained land/tidal limits.

- The construction of models of occupied sites/landsurfaces at specific time periods and the landsurface morphometry and deposits with which they were contemporary.

- Extension of data from the known archaeological record to predictive statements about archaeological stratigraphy/sites/structures lying at depth and as yet undisturbed/unrecorded beneath Dover, using 3-D modelling calibrated against the stratigraphic data base compiled from trench excavation/boreholes. This is relevant (i) to answering questions set out at the start of the project, e.g. relationships between shifts in location of the harbour/the mole, (ii) calibration of 17th to 19th century historical evidence where precise statements can now be made about the local landscape change e.g. cliff collapses in the vicinity of the railway bridge in Snargate Street, and (iii) future use of the data/archive as a predictive geoarchaeological management tool in relation to future urban development/engineering work/conservation of the archaeological resource.

- Integration of laboratory analysis of sediments with both stratigraphic observations/documentary evidence to specify local ground conditions for precise time periods e.g. the construction/abandonment/infilling of the Paradise Basin; local site conditions prior to the construction of Archcliffe Fort.

- This theme will produce a series of maps illustrating sediment units and inferred palaeogeographies for various time periods.

THEME C THE DEVELOPMENT OF THE ARCHAEO-STRATIGRAPHIC SEQUENCE AND ITS IMPORTANCE AS A RESOURCE

Here the assessment programme already illustrates considerable potential both in relation to the development of Dover and the development of the urban settlement in a region/national/international context.

It is clear from the assessments completed to date that:-

- Detailed 'snap-shots' of local environments for specific time-frames can be reconstructed e.g. freshwater deposits developed between estuarine and wind-blown sand facies at the eastern end of the Crypt site; detailed reconstruction of the harbour tidal regime over time with implications for harbour access/boat size/westward shifts in the harbour location from the post Roman period until the sixteenth century.

- Longer sequences - calibrated by both archaeological and radiocarbon dating -will permit reconstruction of the rates of infilling of the harbour; rates/timing of changes in ground elevation within the Roman - Medieval town layouts; specification of palaeoenvironments in the prehistoric period.

- Relationships between the nature of the events leading to deposit formation e.g. storm surges/aeolian activity/flooding, and the preservational quality/taphonomy/archaeological interpretation of deposits produced as a result.

- The data gathered will permit testing of published models for local tectonic subsidence/relative sea-level changes in southern England against specific local evidence (peats/estuarine facies/archaeological features) with specifiable relationships to tidal limits identified and sampled during the field programme.

- Likewise, many of the stratigraphic events record the role/effects of surges/storm climatic events e.g. storm surges/storm damage/overwash etc.. on the built town which can be researched both at a site-specific scale and in more general terms as observations of human/environmental interaction and social response to climatic events. Here close coupling of palaeoenvironmental/sedimentological data with archaeological and historical/documentary evidence will permit detailed reconstruction of individual events and their visibility/resolution in the archaeological record (e.g. the project has identified a previously unknown two phase chronology to the south-west section of the town wall). Here the project methodology allows direct connection between (i) records from excavation of the built structure, (ii) identifiable wear/abrasion damage to the lower level of the wall by storm deposits, (iii) sedimentological characterisation of the storm gravel unit and (iv) the mapped spatial distribution of the storm gravels relating to the archaeological features).

THEME D METHODOLOGICAL DEVELOPMENT OF BOREHOLE STRATIGRAPHIC INVESTIGATIONS ASSOCIATED WITH ENGINEERING WORKS IN DEEPLY-STRATIFIED URBAN ARCHAEOLOGICAL ENVIRONMENTS WITHIN MAP II GUIDE-LINES

The assessment programme has involved the deployment of novel methods/techniques involving integration of commercial borehole data/purposive borehole drilling alongside more conventional sampling, archaeological excavation and site-recording.

These methods have not been used hitherto in projects of this type, where the archaeological response to engineering work is logistically tightly constrained. For the Assessment Report and in the subsequent analytical stage targets will be to:-

- Assess the effectiveness of close interval borehole sampling/analysis in terms of cost/time efficiency, archaeological recovery as compared to results available only from set-piece excavation/opportunistic sampling.

- To compare the cost-effectiveness of these methods for assessing deeply-stratified urban deposits, particularly where water-logged. A significant proportion of the results from the boreholes could not have been replicated from lower levels of the engineering works without very high costs if conducted by excavation involving coffer-dams/pumping etc..

- To test the predictive potential of 3-D subsurface modelling of archaeostratigraphic units from boreholes beneath urban centres like Dover, against the archaeological data as known.

- To assess the methodology, and improve upon it so that the experience gained in Dover can form the basis for structured archaeological responses to similar problems elsewhere in the U.K. and Europe in the future.

THEME E DEVELOPMENT OF A GEOGRAPHICAL INFORMATION SYSTEM (GIS) COMPUTER DATA-BASE TO ALLOW ALL STRATIGRAPHIC/FIND/FAUNAL DATA TO BE INTEGRATED, INTERPRETED AND MODELLED IN THREE-DIMENSIONS (2.5D)

The nature of the project fieldwork and evolving palaeoenvironmental data set (stratigraphic/biological) is spatially and temporally discontinuous and difficult to accommodate in conventional archaeo-stratigraphic frameworks (e.g. Harris matrix). A more flexible data-base is required within which this information may be integrated with previous work in the Dover area. The data-base should be fully relational and capable of operating in 3 dimensions to allow stratigraphic modelling of sub-surface sequences. Critically the data needs to be able to be manipulated to produce:-

- 2-dimensional maps of given litho-stratigraphic or chronostratigraphic units.
- 3-dimensional representation of stratigraphic units and time surfaces.
- These categories should be relatable to finds/biological data etc.
- "What if" models should be possible using this data to investigate likely causative factors for unit/palaeogeographic formation.

Some of these themes are necessarily interlinked and do not form stand-alone elements in a post-excavation project. Data gathered in Theme B (3-dimensional modelling of deposits) is critical if objectives listed under Theme C are to be achieved. Clearly many of the goals related to the use/interpretation of the borehole data will best be used (and may only be interpreted) in an electronic data-base (Theme E). Rapid integration of the data and on-screen illustration of results will considerably reduce time taken for data interpretation. This is of particular relevance to the 3-dimensional modelling.

Theme A is considered to be perhaps the area of research where great difficulties are likely to be encountered. Further processing of additional samples is thought to be of limited value. This area of research will however provide data for theme D and should be given consideration.

Themes B and C require extensive additional work on borehole and trench samples specifically to examine pollen, diatom, ostracod, foraminifera and sedimentological samples from the cores. Smaller quantities of molluscan and insect analyses are necessary on samples to refine these interpretations. At least 3 boreholes need to be studied in detail. This information will be interpreted within the facies model approach that can usefully be developed within theme E.

10.0 STORAGE AND CURATION OF SAMPLES

All sample material is now in store and fully archived. Full stratigraphic descriptions including samples are presented in part A of the Archive. Complete descriptions of all core and monolith samples in Section B and a full photographic archive in Section C. A complete list of all bulk samples held has also been presented (Appendix III).

Samples are held:-

1. In refrigerated conditions in the Wolfson Archaeological Science Laboratories at University College London Institute of Archaeology.

2. In store in Dover District Council stores at Deal.

All cores and monoliths and sub-samples are held in refrigerated conditions to prevent decay of samples. In addition fragile bulk samples with high organic content and from which sub-samples may be required for ^{14}C determinations are also held here. These samples are stable at the present time but likely to be subject to long term decay. Much of this material constitutes the primary archive for the project and unused core material should be stored for future examination. Consideration should be given to the long term curation and location of these samples. Sample storage should be undertaken in refrigerated conditions with the main project archive.

Bulk samples are held in store at Deal. This store represents temporary accommodation. Further bulk processing of samples will still leave a large quantity of material. The future of these samples requires consideration and clarification.

11.0 CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK.

The fieldwork and project assessment has been successful and achieved many of the goals and targets set out in the project research design. Because of the relative sparsity of previously published data available along much of the route corridor it was difficult to formulate precise themes for study prior to the commencement of the project. However the following broad categories were noted:-

1. To map topographic change in the area through a combination of borehole, trench and section observations coupled with CAT excavations and previously available excavated data.

2. To trace archaeologically important horizons through a combination of the techniques listed in 1 above, e.g. to trace the extent of the Roman harbour.

3. To provide a data base of information from the area to be used as the basis for project design and formulation of project designs in future strategies of investigation.

The project has been able to address all three aspects and as information has become available to the project teams specific questions have been formulated relating to areas of the route corridor for which no previous data was available or the extant information sources were insufficiently known to enable direct formulation of hypothesis. These questions and themes for research have been listed in section 9.0 above.

Future work on the recovered material should focus on the investigation and interrogation of these information sources. The research themes listed (A-E) form separate themes for investigation but information sources needed for theme investigation is likely to be mutual and hence individual themes cannot be seen as alternative strategies but parts of a whole for which fully understanding of any one theme relies, at least to some extent, on an understanding or at least investigation of, the other themes. Three types of themes can be identified:-

1. Palaeoeconomy (Theme A). This theme, investigating the nature of the faunal material in the Crypt site and Bench Street areas and the implication for the economy of Dover during the later Saxon and early Medieval periods represents an element that requires only minimal data from other areas. The nature of the data sets, where residuality and reworking has been identified, suggests that sequence resolution is likely to be low and that this option must be considered medium to low priority.

RECOMMENDATIONS. Further work will be necessary on the samples already processed but not studied. This will include further species identifications, study of age structure of the assemblages where appropriate and investigation of cut marks etc. on the surface of the bones. In addition a limited number of additional samples will require processing.

11.0 CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK.

The fieldwork and project assessment has been successful and achieved many of the goals and targets set out in the project research design. Because of the relative sparsety of previously published data available along much of the route corridor it was difficult to formulate precise themes for study prior to the commencement of the project however the following broad categories were noted:-

1. To map topographic change in the area through a combination of borehole, trench and section observations coupled with CAT excavations are previously available excavated data.

2. To trace archaeologically important horizons through a combination of the techniques listed in 1 above, e.g. to trace the extent of the Roman harbour.

3. To provide a data base of information from the area to be used as the basis for project design and formulation of project designs in future strategies of investigation.

The project has been able to address all three aspects and as information has become available to the project teams specific questions have been formulated relating to areas of the route corridor for which no previous data was available or the extant information sources were insufficiently known to enable direct formulation of hypothesis. These questions and themes for research have been listed in section 9.0 above.

Future work on the recovered material should focus on the investigation and interrogation of these information sources. The research themes listed (A-E) form separate themes for investigation but information sources needed for theme investigation is likely to be mutual and hence individual themes cannot be seen as alternative strategies but parts of a whole for which fully understanding of any one theme relies, at least to some extent, on an understanding or at least investigation of, the other themes. Three types of themes can be identified:-

1. Palaeoeconomy (Theme A). This theme, investigating the nature of the faunal material in the Crypt site and Bench Street areas and the implication for the economy of Dover during the later Saxon and early Medieval periods represents an element that requires only minimal data from other areas. The nature of the data sets, where residuality and reworking has been identified, suggests that sequence resolution is likely to be low and that this option must be considered medium to low priority.

RECOMMENDATIONS. Further work will be necessary on the samples already processed but not studied. This will include further species identifications, study of age structure of the assemblages where appropriate and investigation of cut marks etc. on the surface of the bones. In addition a limited number of additional samples will require processing.

2. Topographic change and the archaeostratigraphic sequence as a resource (Themes B and C). These themes require consideration together as they require similar data sources. Examination of these themes will provide detailed information on the nature of the environment during human occupation of the area, the nature of topographic change during that time period, provide predictive models of human/landscape interactions useful for future project design in the area and provide information of use to planning bodies, developers in the area regarding archaeological potential/depths of archaeology etc. prior to construction activities. Considerable further work on boreholes and trench sequences will be required to provide detailed information necessary for the formulation of such models. Given the nature of the material recovered during the project these themes provide detailed and exciting data sources. These themes are considered of very high potential.

RECOMMENDATIONS. This work will require the analysis in detail of 3 boreholes. In addition in order to complete the sequence and study lateral variability in sediment sequence (facies) parts of a probable further 3 boreholes and 5 open trench sections will require study. This includes material from the town centre area and the Western Heights. This work will need to include detailed analysis of the sediments, molluscs, insects, pollen, plant macrofossils, pollen, diatoms and ostracods. In addtion a further series of ^{14}C AMS dates will be required to calibrate and correlate the sequences. This is likely to be time consuming.

3. Methodology (Theme D). The use of boreholes to map sub-surface stratigraphies and predict likely location of stratified archaeology is novel and fully justified in this project (the discovery of the Dover Boat was dependent on the identification (through boreholes) of sediments of likely prehistoric data in the area). Further work is required to fully asses the use of this methodology through 3-dimensional plotting of the data and sequence modelling. Much of the data required for this task is already available. Further information will be forthcoming from (2) above. Given the novelty of the approach used in this project and its worth as a tool in future projects involving linear trenches in urban environments it is important that this theme is investigated and evaluated.

RECOMMENDATIONS. This theme will require the plotting and integration of the data now avaliable in archive form with the data to be produced during the analysis stage of the project. Assimilation and plotting of the data will be required during the final stages of completion of the project.

4. Development of the GIS system for urban archaeology and landscape mapping (Theme E). This theme is the logical development and a useful way in which much of the data produced in the A20 project can be stored, organised and questioned in the future. Clearly where such a large and spatially disparate body of data has been recorded it will be impossible to fully assimilate it with all other data sources without a rapid method of data interrogation. Using a GIS system will allow the data to be interrogated by future

generations, added to after excavations and refined after detailed study. The development of such a system is considered of high importance in this project.

RECOMMENDATIONS. This needs to be fully integrated with CAT proposals regarding software types etc. Work will primarily involve data input into the data base. Any adopted database should be able to output into 3-dimensional space suitable for topographic modelling.

BIBLIOGRAPHY.

Barham, A.J. and Bates, M.R. 1990 The Holocene Prehistory and palaeoenvironments of the Dour Valley catchment. A geoarchaeological assessment for Dover District Council. Geoarchaeological Service Facility Technical Report 90/04. 122pp.

Barham, A.J., Bates, M.R., and Stewart, J. 1992 Dover A20 Road and Sewer Scheme environmental archaeological and palaeoenvironmental assessement - final assessment plan. Geoarchaeological Service Facility Site Assessment Report 92/04. 13pp.

Batterbee, R.W. 1986 Diatom analysis. 527-570. In: Berglund, B.E. (ed.) Handbook of Holocene Palaeoecology and Palaeohydrology. Wiley.

Batterbee, R.W. 1988 The use of diatom analysis in archaeology: a review. Journal of Archaeological Science 15, 621-644.

Clapham, A.R., Tutin, T.G. and Moore, D.M. 1987 Flora of the British Isles. 3rd edition. Cambridge University Press.

Denys, L. 1992 A check-list of the diatoms in the Holocene deposits of the Western Belgian Coastal Plain with a survey of their apparent ecological requirements I. Introduction, ecological code and complete list. Professional Paper No.246, Belgian Geological Service, Brechem. 41pp.

Denys, L. 1993 A check-list of the diatoms in the Holocene deposits of the Western Belgian Coastal Plain with a survey of their apparent ecological requirements II. Centrales. Professional Paper No.247, Belgian Geological Service, Brechem. 92pp.

English Heritage 1991 Management of Archaeological Projects. Historic Buildings and Monuments Commission for England, London. 41pp.

Gale, S.J. and Hoare, P.G. 1991 Quaternary Sediments: Petrographic methods for the study of unlithified rocks. Belhaven Press:London.

Juggins, S. 1992 Diatoms in the Thames Estuary, England: Ecology, Palaeoecology and salinity transfer function. Bibliotheca Diatomologica 25. Cramer. Berlin. 216pp.

Kennard, H.K., Hall, A.R., and Jones, M.K.G. 1980 A tested set of techniques for the extraction of plant and animal macrofossils from water-logged archaeological deposits. Science and Archaeology 22, 3-15.

Kerney, M.P. 1963 Late-Glacial deposits on the Chalk of South-East England. Philosophical Transactions of the Royal Society of London Bulletin. 246 203-254.

Kerney, M.P. 1965 Weichselian deposits in the Isle of Thanet, East Kent. Proc.Geol.Ass. 76, 269-274.

Kerney, M.P. 1971 A Middle Weichselian deposit at Halling, Kent. Proc.Geol.Ass. 82, 1-12.

Kerney, M.P. , Brown, E.H. and Chandler, T.J. 1964 The Late-Glacial and Post-Glacial history of the Chalk escarpment near Brook, Kent. Phil. Trans. Roy. Soc Of London. B.291, 1-43.

Kerney, M.P., Preece, R.C. and Turner, C. 1980 Molluscan and plant biostratigraphy of some Late Devensian and Flandrian deposits in Kent. Phil.Trans.R.Soc. B 291, 1-43.

Macphail, R., Canti, M., and McHugh, M. 1992 Assessment of soils and sediments in "Management of Archaeological Projects". Ancient Monuments Laboratory Report 28/92. Historic Buildings and Monuments Commission for England. London.3pp.

Moore, P.D., Webb, J.A. and Collinson, M.E. 1991 Pollen Analysis. Blackwell Scientific Publications.

Munsell 1975 Munsell Soil Color Charts. Munsell Color, Macbeth: Baltimore.

O'Connor, T. 1985 On quantifying vertebrates - some sceptical observations. Circaea 3 (1), 27-30.

O'Connor, T. 1987 Why bother looking at archaeological wild mammal assemblages? Circaea 4, 107-114.

Parfitt, K. 1982 A trail excavation at River, near Dover. Kent Archaeological Reviews 69, 218 - 219.

Parfitt, K. 1991 The New Dour Sewers Scheme: the Archaeological Implications. CAT: Canterbury.

Philp, B.J. 1981 The Excavation of the Roman Forts of the Classis Britannica at Dover. 1979-1977. KARU Monograph Series 3; Dover.

Philp, B.J. 1989 The Roman Painted House with Bacchic murals at Dover. Karu Monograph Series 5; Dover.

Preece, R.C. 1991 Accelerator and radiometric radiocarbon dates on a range of materials from Colluvial Deposits at Holywell Coombe, Folkstone. Pp 45-53. In: Lowe, J.J. (Ed) Radiocarbon Dating: Recent Applications and Future Potential. Quaternary Proceedings No 1. Quaternary Research Assoc: Cambridge.

Preece, R.C. 1992 Episodes of Erosion and stability since the Late-Glacial: the evidence from Dry Valleys in Kent. Pp 175-184 In: Bell, M. and Boardman, J. (Eds). Past and Present Soil Erosion: archaeological and geographical perspectives. Oxbow Monograph 22: Oxford.

Rhatz, P.A. 1958 Dover: Stembrook and St.Martin-le-Grand. Archaeologia Cantiana LXXII, 117-119.

Rigold, S.E. 1969 The Roman Haven of Dover. Archaeological Journal 126, 78-100.

Scaife, R.G. and Burrin, P.J. 1992 Archaeological inferences from alluvial sediments: some findings from southern England. Pp 75-91 In: Needham, S. and Macklin, M. (eds). Alluvial Archaeology in Britain. Oxbow Books: Oxford.

Scott, A.C. 1979 The ecology of Coal Measure floras from Northern Britain. Proc.Geeol.Ass. 90(3), 97-116.

Walker, R.G. 1984 General introduction: Facies, facies sequences and facies models. 1-10. In Walker, R.G. (ed.) Facies Models, 2nd edition. Geoscience Canada Reprint Series 1.

Wilkinson, D.R.P.1990 Historic Dover. An Archaeological Implications Survey of the Town. Dover District Council: Dover.48pp.