Seabed Prehistory:

Gauging the Effects of Marine Aggregate Dredging

Final Report

Volume V
Eastern English Channel

Ref: 57422.35

February 2008

Wessex Archaeology

AGGREGATE LEVY SUSTAINABILITY FUND
MARINE AGGREGATE AND THE HISTORIC ENVIRONMENT

SEABED PREHISTORY:
GAUGING THE EFFECTS OF MARINE AGGREGATE DREDGING

ROUND 2
FINAL REPORT

VOLUME V: EASTERN ENGLISH CHANNEL

Prepared for:

English Heritage
1 Waterhouse Square
138-142 Holborn
London
EC1N 2ST

Prepared by:

Wessex Archaeology
Portway House
Old Sarum Park
Salisbury
SP4 6EB

Ref. 57422.35

February 2008

SEABED PREHISTORY R2

FINAL REPORT

VOLUME V: EASTERN ENGLISH CHANNEL

Ref. 57422.35

Summary

This study forms Volume V of the 'Seabed Prehistory: Gauging the Effects of Marine Aggregate Dredging - Final Report' commissioned by English Heritage (EH) and undertaken by Wessex Archaeology (WA). It was funded through Round 2 of the Aggregate Levy Sustainability Fund (ALSF) distributed by the Department for Environment, Food and Rural Affairs (DEFRA). The 'Final Report' comprises of eight volumes based on previous reports accomplished by WA for either EH or the Mineral Industry Research Organisation (MIRO), as part of Round 1 or Round 2 of the ALSF project 'Seabed Prehistory'.

In October 2004, WA was commissioned by MIRO to undertake the research project 'Seabed Prehistory Round 2 – Gauging the effects of marine aggregate dredging' under the financial support of the Sustainable Land Won and Marine Dredged Aggregate Minerals Programme (SAMP). This project extended the methodology of the 'Seabed Prehistory' Round 1 project into two additional aggregate dredging zones, namely Eastern English Channel and the Humber.

In Round 2 year 2 the project focussed on the Eastern English Channel dredging zone. The study area (36km^2) lies approximately 30km offshore south-west of Beachy Head, West Sussex, between the licensed aggregate areas 464 West and 464 East.

The analysis of the general pattern of prehistoric occupation of southern Britain and northern France showed that this part of Europe has been inhabited since the Lower Palaeolithic period. The distribution of the sites on the two coastlines suggested a link between the two areas. The number of archaeological sites on the coasts of southern Britain and northern France dating from the Lower Palaeolithic to the Mesolithic also suggested that, during times of lower sea levels, there was probably exploitation, and possibly inhabitation, of exposed land between the current coastlines defining the English Channel. The presence of palaeochannels within the study area is significant as much of the recovered prehistoric archaeological material, particularly in northern France, has been found within river valley deposits. These French rivers are known to have offshore extensions.

The survey methodologies comprised bathymetric, sidescan sonar and shallow seismic surveys as well as vibrocoring and grab sampling. All survey operations were conducted aboard the *MV Ocean Seeker* between 14th and 24th September 2005 by Gardline Environmental Ltd under the supervision of WA staff. A high quality dataset was acquired including approximately 498 line kilometres of geophysical data, 16 vibrocores and 100 grab samples.

The sediments observed within the geophysical and geotechnical data potentially contain prehistoric material. OSL dating suggests that the earliest *in situ* archaeology in the survey area would date from the Middle Palaeolithic although derived artefacts from the Lower Palaeolithic could be present. Gravel deposits within this early sequence are possibly of fluvial origin. They may represent river terraces and could therefore contain similar material recovered from terrace deposits on land.

There is the potential for the survival of prehistoric remains within or at the surface of the oldest identified unit (OIS 6/5e). This unit contains evidence of sub-aerial exposure and is located on the edge of the main valley. The terrestrial part of this deposit has survived *in situ*. Five other units comprise finer grained deposits, possibly from a floodplain environment. These types of landscapes and environments are obvious places for the survival of *in situ* archaeological remains.

Within the valley itself areas of terrestrial environments are inferred. The base of one unit marks a period of fluvial incision when large parts of the palaeovalley feature including the surface of another unit might have been exposed as land surfaces. Two channel infill units form part of a terrestrial environment when surrounding areas of the main valley feature were exposed.

The environmental history of the area during the Late Upper Palaeolithic and Mesolithic period are easier to elucidate from the data. If relative pollen dating is correct, one unit was deposited during the Godwin zone II, corresponding to the late Upper Palaeolithic period. Pollen and ostracod assessments point towards slow moving freshwater environments for this period within the wider context of a river valley.

The sedimentary record aided by radiocarbon analysis suggests that the three youngest units were deposited during the Early to Late Mesolithic period. They indicate that braided channels within a wide valley are submerged by sea level rise around 8,000 years ago. Thick sequences are preserved which probably include fluvial and estuarine alluvial sedimentation relating to the Early Mesolithic period.

These fluvial, estuarine and coastal environments are potential places where both *in situ* and derived archaeological material may survive.

The finds from the grab samples are of geological and modern origin. No prehistoric archaeological material was recovered. The deposit from which the samples derive is analogous to the youngest unit described in this report, radiocarbon dated to the Early to Late Mesolithic period. As mentioned above, it is likely that the deposit rapidly accumulated as a result of rising sea level during the early Mesolithic period. Any prehistoric material within this deposit is likely to have been reworked from its original context. The sieved grab samples represent a very small fraction of the total deposit within the grab study area and as such a lack of prehistoric archaeological material within the samples does not mean that it does not exist within this deposit.

This study demonstrated the survival of Middle and Upper Palaeolithic as well as Early Mesolithic landscapes that were exploitable by early humans within the Eastern English Channel area. This phase of the project further informed the development of archaeological assessment and evaluation strategies for marine aggregate extraction.

SEABED PREHISTORY R2

FINAL REPORT

VOLUME V: EASTERN ENGLISH CHANNEL

Ref. 57422.35

Acknowledgements

This project was commissioned by the Mineral Industry Research Organisation (MIRO) acting on behalf of the former Office of the Deputy Prime Minister (ODPM), now Department for Communities and Local Government (DCLG). The assistance provided by Kate Barton and Derren Creswell as project mangers for MIRO is gratefully acknowledged.

The geophysical and geotechnical surveys were conducted by Gardline Environmental Ltd. The assistance and the enthusiasm of the crew and survey team on board the survey vessel *MV Ocean Seeker,* particularly the party chief Bill Gibson, are gratefully acknowledged. We would also like to thank Phil Durrant, the Project Manager and head of Gardline Environmental, for his assistance.

The geophysical and geotechnical surveys were supervised for Wessex Archaeology (WA) by Dr Paul Baggaley and Cristina Serra. Dr Paul Baggaley, Cristina Serra and Dr Stephanie Arnott processed and interpreted the geophysical data. Jack Russell processed and interpreted the geotechnical data with help from Labhaoise McKenna.

Pollen and diatom assessment were conducted by Dr Robert Scaife of Southampton University. Foraminifera and ostracod assessments were conducted for WA by Jack Russell. Radiocarbon dating analysis was conducted by the Rafter Radiocarbon Laboratory, Institute of Geological & Nuclear Sciences, New Zealand. The Optical Stimulated Luminescence (OSL) dating was carried out by Richard Bailey at the Royal Holloway, University of London. Ceri James of the British Geological Survey provided data from the Eastern English Channel Seabed Habitat Map project.

We would also like to thank the WA ALSF steering group composed of Dr Ian Selby (Hanson Aggregates Marine), Dr Andrew Bellamy (United Marine Aggregates), Mark Russell (British Marine Aggregates Producers Association), Dr Gustav Milne (University College London), Dr Bryony Coles (University of Exeter), Simon Thorpe (Cornwall County Council), Veryan Heal (Cornwall County Council) and Matt Tanner (SS Great Britain) for their comments and guidance on this phase of the project.

Cristina Serra, Jack Russell and Dr Paul Baggaley compiled this report, and it was edited by Stuart Leather and Dr Dietlind Paddenberg. Illustrations were provided by Kitty Brandon. Dr Antony Firth, head of the Coastal and Marine Section of WA, initiated the research proposal. Quality Assurance was carried out by Steve Webster. The project was managed for WA by Stuart Leather.

SEABED PREHISTORY R2

FINAL REPORT

VOLUME V: EASTERN ENGLISH CHANNEL

Ref. 57422.35

Table of Contents

1. INTRODUCTION 1

1.1. Project Background 1
1.2. Study Area 2
1.3. Geoarchaeological Background 3

2. SURVEY METHODOLOGIES 5

2.1. Overview 5
2.2. Geophysical Survey 5
2.3. Geotechnical Survey 7

3. RESULTS 8

3.1. Geophysical Data 8
3.2. Geotechnical Data 15

4. DISCUSSION AND CONCLUSIONS 19

4.1. Grab Sample Survey Assessment 19
4.2. Geophysical and Vibrocore Data Assessment 20
4.3. Archaeological Potential 24
4.4. Recommendations for Future Work 25

5. REFERENCES 26

APPENDIX I: VIBROCORE LOGS 28

APPENDIX II: POLLEN AND DIATOM ASSESSMENT/ANALYSIS 33

APPENDIX III: FORAMINIFERA ASSESSMENT 37

APPENDIX IV: OSTRACOD ASSESSMENT 41

APPENDIX V: RADIOCARBON (^{14}C) DATING 44

APPENDIX VI: OPTICALLY STIMULATED LUMINESCENCE (OSL) DATING 46

APPENDIX VII: GRAB SAMPLES 47

Figures

Figure V.1	Presence of palaeochannels in the Eastern English Channel and locations of prehistoric findspots and sites
Figure V.2	Survey vessel: MV Ocean Seeker
Figure V.3	Boomer sub-bottom profiler and sidescan sonar
Figure V.4	Track-plot of study area
Figure V.5	Power vibrocore unit and Hamon grabbing unit
Figure V.6	Bathymetry of the study area with vibrocore and grab sample locations
Figure V.7	Bathymetry of study area
Figure V.8	Selected sidescan sonar images
Figure V.9	Schematic and composite section showing sedimentary units (1-10) and relative positions of vibrocores
Figure V.10	Seismic lines 35, 45 and 51 with interpretation
Figure V.11	Model of the base of primary channel surface
Figure V.12	Seismic lines 47 and 56 with interpretation
Figure V.13	Fledermaus model of the base of Unit 6 and Unit 7
Figure V.14	Seismic lines 02 and 45 with interpretation
Figure V.15	Fledermaus model of the base of Unit 8
Figure V.16	Seismic lines 02 and 39 with interpretation
Figure V.17	Vibrocore locations related to seismic data
Figure V.18	Vibrocore transect (projected)
Figure V.19	Photographic record of vibrocores
Figure V.20	Vibrocore VC3 with dating/interpreted environmental data

Tables

Table V.1	Overview of the volume structure of this report
Table V.2	Coordinates of the Eastern English Channel study area (WGS 84, UTM zone 31)
Table V.3	Coordinates of the Eastern English Channel grab sampling area (WGS 84, UTM zone 31).
Table V.4	Relationship between the sedimentary and seismic units observed in the data.
Table V.5	Optically stimulated luminescence (OSL) dating results.
Table V.6	Details of modern and fossil finds from the grab sampling survey.

SEABED PREHISTORY R2

FINAL REPORT

VOLUME V: EASTERN ENGLISH CHANNEL

Ref. 57422.35

1. INTRODUCTION

1.1. PROJECT BACKGROUND

1.1.1. In 2005, Wessex Archaeology (WA) was commissioned by English Heritage (EH) to compile the final synthesis of the research project 'Seabed Prehistory – Gauging the Effects of Marine Aggregate Dredging'. The project synthesis was funded through Round 2 of the Aggregate Levy Sustainability Fund (ALSF) distributed by the Department for Environment, Food and Rural Affairs (DEFRA) (see **Volume I**).

1.1.2. Round 1 of the 'Seabed Prehistory' project was undertaken between 2003 and 2004 as part of the Sustainable Land Won and Marine Dredged Aggregate Minerals Programme (SAMP), funded by Round 1 of the Aggregate Levy Sustainability Fund (ALSF) and administered by Mineral Industry Research Organisation (MIRO) on behalf of the former Office of the Deputy Prime Minister (ODPM), now Department for Communities and Local Government (DCLG).

1.1.3. The project was extended to Round 2 in order to assess the application of the Round 1 methodologies to aggregate dredging zones with different geoarchaeological characteristics. Round 2 comprised different components, each component funded through either EH or MIRO, under the ALSF funding for Round 2. Each component was an independent stand alone project, resulting in the eight volumes of this report. **Table V.1** provides an overview of all volumes of 'Seabed Prehistory: Gauging the Effects of Marine Aggregate Dredging - Final Report', **Volumes I-VIII** (Wessex Archaeology 2007).

Volume	Title
I	Introduction
II	Arun
III	Arun Additional Grabbing
IV	Great Yarmouth
V	**Eastern English Channel**
VI	Humber
VII	Happisburgh and Pakefield Exposures
VIII	Results and Conclusions

Table V.1: Overview of the volume structure of this report.

1.1.4. This report is **Volume V** in the series and sets out the Round 2 investigations into the Eastern English Channel area. It is an updated version of a previous 'Seabed Prehistory' project report for MIRO (Wessex Archaeology 2006).

1.1.5. The Eastern English Channel dredging zone is a new resource area that will provide between 8.5 and 17 million tonnes of marine aggregates per year over the next 15 years. This dredging zone was selected for study as part of this project as it will be one of the major sources of UK's marine aggregate, and its sedimentary architecture was formed under different processes than those of the Arun and the other study areas investigated in the 'Seabed Prehistory' project. While the river Arun constituted a tributary rather than a main watercourse, the rivers within the Eastern English Channel study area formed part of the trunk stream of this fluvial system.

1.1.6. These different formation processes are not fully understood, and this project has provided the opportunity to study a small area within this zone to a high resolution.

1.2. STUDY AREA

Offshore

1.2.1. The study area was chosen after reviewing data collected by the British Geological Survey (BGS) as part of their ALSF project 'Eastern English Channel Large-scale Seabed Habitat Map'. The BGS project included the acquisition of geophysical data over the Eastern English Channel region. After processing this data 14 palaeochannels were identified within the region. Following consultation with the BGS, WA selected an area over one of these channels for further investigation (**Figure V.1**).

1.2.2. The coordinates of the Eastern English Channel study area (WGS84, UTM zone 31) are given in **Table V.2**.

Easting	Northing
328483	5601950
333011	5600167
327032	5598568
322339	5600307

Table V.2: Coordinates of the Eastern English Channel study area (WGS 84, UTM zone 31).

1.2.3. The study area ($36km^2$) lies approximately 30km offshore south-west of Beachy Head, West Sussex, between the licensed aggregate areas 464 West and 464 East, both of which are held by United Marine Aggregates and CEMEX UK Marine Ltd (**Figure V.1**). The two areas are separated because material suitable for extraction does not cover the seabed where the palaeovalley resides beneath the seabed.

1.2.4. From the BGS data the palaeovalley feature measured approximately 2,800m wide and at least 30m deep. It was also evident that within the palaeovalley there were multiple phases of infill showing that this area was likely to have deposits relating to various stages of prehistory.

1.2.5. The study area has also been mapped as part of a larger palaeovalley system which originates from the area now occupied by northern France (Wright 2004; Hamblin *et al.* 1992:79 Figure 79).

Coastal

1.2.6. Two coastal study areas were selected to assess the distribution of prehistoric archaeological material that has been found on the coasts of France and the UK, adjacent to the study area. Records of Palaeolithic and Mesolithic sites and finds were obtained from the National Monuments Record (NMR) and local Sites and Monuments Records (ESSMR, WSSMR, IOWSMR), and from the French national archaeological database DRACAR.

1.2.7. The French coastal study area extends on its south-western margins from the Seine Estuary to Cap Gris Nez in the north-east and extends inland for approximately 75km. The UK coastal study area extends from St. Catherine's Point in the west to Shoreham in the east, and extends inland for approximately 25km. This difference in spatial extent is due to the difference in public access and availability of archaeological data in the two regions.

1.3. Geoarchaeological Background

Geology of the Eastern English Channel

1.3.1. The study area lies within the Hampshire-Dieppe basin. The underlying Cretaceous bedrock (Greensand, Gault Clay and Upper Chalk) is unconformably overlain by Tertiary sediments (Woolwich Beds, London Clay, Wittering, Earnley, Selsey and Barton Beds) of the Middle Eocene Barton (or Huntingbridge) Formation (Hamblin *et al.* 1992; Wright 2004).

1.3.2. The Pleistocene geology of the Eastern English Channel dredging zone is dominated by a series of palaeovalleys that were possibly formed as a result of lowered sea levels during the Cromerian Complex (OIS 19-13). These valleys are thought to be predecessors of French rivers including the Canche, the Authie and the Somme, and they probably predate the formation of the Dover Strait, which current research dates to the Anglian (OIS 12) (Hamblin *et al.* 1992:75-77, 80-81; OIS stages see **Volume I Section 2.2.10-11**).

1.3.3. However, a postulated catastrophic origin for the pattern of palaeovalleys and deeps in the Eastern English Channel dredging zone relating to the breach of the Dover Straight some time in the early Quaternary, probably during the Hoxnian or Anglian periods, or even later (Smith 1985). A recent study of the bathymetry of the English Channel is adding weight to this argument (Gupta pers. comm. 2005; Leake 2006). These theories are based upon the similarity of the palaeovalley system to the channelled scablands in north-west USA and the flood terrains of the planet Mars.

1.3.4. It appears that there is confusion relating to the formation and chronology of the palaeovalleys. This is due in part to the complexity of the anastomosing channels and the partially disturbed nature of the stratigraphy as a result of glacial/interglacial cycles. The lack of useful borehole data (as the deeper deposits are not of economic interest) means that the chronological sequence is largely conjectural.

1.3.5. Surface seabed sediments comprising sand and gravel in this area are thought to be 0-10m thick and not mobile, i.e. lag deposits. These are predominantly flint although contain (possibly ice rafted) erratics (Hamblin *et al.* 1992:82).

Archaeological Sites in Adjacent Coastal Areas

1.3.6. There are no known prehistoric archaeological sites within the Eastern English Channel study area.

1.3.7. Find spots of Palaeolithic worked flint are numerous in southern Britain (**Figure V.1**). The earliest recorded occupation of Britain (and north-western Europe) is represented by lithic artefacts from the Cromer Forest-bed Formation at Pakefield, Suffolk, dating to *c.* 700 ka (Parfitt *et al.* 2005). The site of Boxgrove on the Sussex coastal plain is a site containing the earliest recorded human remains in Britain (*c.* 500 ka). Boxgrove is of particular note as continuing occupation is recorded from a temperate period, which is thought to be a pre-Anglian interglacial, to at least the onset of glacial climate, and therefore lowered sea level, in the Anglian period (Roberts and Parfitt 1999).

1.3.8. In Britain, very few primary sites dating to the Early and Middle Upper Palaeolithic (*c.* 40,000 BP to 12,000 BP/11,900 cal. BC) are known. As most records obtained from the British Sites and Monuments Records are not subdivided by Palaeolithic period, a detailed characterisation of the Early and Middle Upper Palaeolithic in southern Britain is not possible. Sites classified as 'General Palaeolithic' are evenly spread over the area.

1.3.9. No sites from the Late Upper Palaeolithic (*c.* 12,000/11,900 cal. BC to 10,000 BP/9,600 cal. BC) can be identified from the British SMRs data as they are grouped as 'General Palaeolithic'. Wymer (1976) lists 474 finds and sites of Mesolithic date from Sussex. A submerged forest and cave containing flints of Mesolithic date are recorded at Pett Level, Fairlight, Hastings (Wymer 1977:317), whereas another 'submerged coastal site' is documented at Bognor (Wymer 1977:294). This list is not exhaustive but it does indicate the high proportion of Mesolithic archaeology occurring in southern Britain.

1.3.10. The majority of the Lower Palaeolithic sites and findspots in France are situated in the river valleys of the Seine, the Somme, the Canche and the Authie. One of the most famous sites is Amiens-Saint-Acheul, in the district of Pas de Calais, where lithic material discovered and recorded provides the type name of the European 'Acheulian' industry. This 'hand axe industry' appears in Britain around 300 ka (AHOB 2006).

1.3.11. The French site of Abbeville, in the Picardie district, is on the northern bank of the Somme and implementiferous deposits containing crudely made handaxes were discovered. The dating of these deposits is not secure but evidence from British stone axe finds would put them in a broadly contemporary period, in terms of typology, with the Acheulian industry (Champion *et al.* 1984).

1.3.12. Find spots of Upper Palaeolithic and Mesolithic flint material are numerous in the French coastal strip. The most notable concentration is visible along the course of the Somme. The site of Longpre-les-Corps-Saints on the northern edge of the Somme has produced lithic material in association with human remains of early Mesolithic date.

1.3.13. The archaeological find spots in northern France and southern Britain mostly represent derived rather than *in situ* material, thus only a broad area of human occupation can be inferred. Furthermore, all known sites are above or around present sea level. Most of the finds are of worked flint, which can only be very broadly dated unless found in a primary context. It can be assumed that some of the archaeological material discovered would have been deposited when the study area was submerged.

1.3.14. However, the more general pattern of prehistoric occupation of southern Britain and northern France is of note in that it shows that this part of Europe was inhabited since the Lower Palaeolithic period. The distribution of the sites on the two coastlines suggests a link between the two areas. The number of archaeological sites on the coasts of southern Britain and northern France dating from the Lower Palaeolithic to the Mesolithic also suggests that, during times of lower sea levels, there is likely to have been exploitation, and possible inhabitation, of exposed land between the current coast lines defining the English Channel.

1.3.15. The presence of palaeochannels within the study area is significant as much of the recovered prehistoric archaeological material, particularly in northern France, has been found within river valley deposits. For example, there are notable site concentrations along the French rivers Canche, Authie and Somme. These French rivers are known to have offshore extensions (Hamblin *et al.* 1992:79 Figure 62).

2. SURVEY METHODOLOGIES

2.1. OVERVIEW

2.1.1. The survey methodologies in the Eastern English Channel study area comprised bathymetric, sidescan sonar and shallow seismic surveys as well as vibrocoring and grab sampling.

2.1.2. The horizontal datum used throughout the survey was the WGS84 spheroid projected on to the Universal Transverse Mercator projection (UTM) zone 31. The vertical datum used for the survey was Lowest Astronomical Tide (LAT) Newhaven UK. LAT Newhaven is 3.4m below Mean Sea Level (MSL) and 0.13m below Ordnance Datum Newlyn (OD). All depth references for this report have been reduced to OD.

2.2. GEOPHYSICAL SURVEY

Survey Strategy

2.2.1. All survey operations were conducted aboard the MV *Ocean Seeker* (**Figure V.2**) by Gardline Environmental Ltd from 14^{th} to 24^{th} September 2005. WA staff were onboard the vessel supervising the survey work and undertaking initial data interpretation to inform the survey strategy in the field. WA mobilised two Coda Geosurvey processing systems on board the vessel for the duration of the survey.

2.2.2. The survey vessel had the capability to carry out both geophysical and geotechnical survey operations. The fieldwork was therefore carried out in one campaign, with the geotechnical evaluation following on from the geophysical data collection.

2.2.3. Survey operations were carried out on a 24 hour basis. On completion of the geophysical data collection the vessel returned to port to replace the Gardline Environmental geophysical survey crew for the geotechnical staff.

Technical Specification

2.2.4. Navigation for the survey was supplied via a C-Nav DGPS system, which used corrections from a satellite subscription service operated by C and C technologies. This system provided positioning for the vessel to an accuracy of less than 1m. Offsets from the DGPS position to the geophysical sensors were known enabling their positions to be logged in the raw data files.

2.2.5. The MV *Ocean Seeker* was fitted with a single beam echosounder which was used to acquire bathymetric data over the study area. This data was reduced to LAT using observed tidal elevations from Newhaven, which were extrapolated to the study area by reference to Admiralty Co-Tidal Chart 5058.

2.2.6. A shallow seismic (boomer) system was used to acquire the seismic data (**Figure V.3**). The data was recorded by a Coda Octopus 760 acquisition system with the data stored in *coda* format. This allowed the data to be replayed on the Coda Geosurvey processing systems used by WA onboard the vessel during the survey. In addition to this the data was printed to hardcopy during acquisition, which allowed numerous lines to be easily reviewed and compared.

2.2.7. Sidescan sonar data was acquired using a Klein 3000 sidescan sonar system (**Figure V.3**) operating at both 445 kHz and 125 kHz simultaneously on a 75m range setting. The data was recorded using SonarPro software with the data stored in xtf format suitable for processing using Coda Geosurvey software. The position of the towfish was recorded using a USBL tracking system in order to accurately monitor its position.

2.2.8. All three geophysical survey data sets were collected simultaneously. In total approximately 498 line km of geophysical data were acquired (**Figure V.4**).

Data Processing

2.2.9. The raw bathymetric data from the single beam echosounder were processed by Gardline Surveys Ltd in order to remove any spikes in the data and to apply tidal corrections. This data was then given to WA as an x, y, z text file which was reviewed using Fledermaus software. This allowed the bathymetric data to be converted into an interpolated surface model that was then used as a vertical reference plain for the geophysics data.

2.2.10. The sidescan sonar data were processed by WA using Coda Geosurvey software. This allowed the data to be replayed with various gain settings in order to optimise the quality of the images. The data were joined together to form a mosaic, giving a single georeferenced sidescan sonar image for the study area. This image could then be viewed in conjunction with other data sets.

2.2.11. The seismic data were processed by WA using Coda Geosurvey software. This software enabled the data to be replayed with user selected filters and gain settings in order to optimise the appearance of the data for interpretation. This interpretation was then applied to the data by identifying and selecting boundaries between layers.

Seismic Data Interpretation

2.2.12. The geophysical horizons within the seismic data are displayed in terms of two way travel time. This is the time from the discharge of acoustic energy from the seismic source, in this case a boomer, to the time that the hydrophone receives the reflected energy from the different seabed horizons. In this instance time is expressed in milliseconds. To calculate the depth of the geophysical horizons beneath the seabed a velocity of the seismic wave through the seabed geology has to be assumed. A velocity of 1600m/s was assumed throughout the processing of the data (Sheriff and Geldart 1983; Telford *et al.* 1990).

2.2.13. After the seismic data had all been interpreted, the position of the boundaries could be exported in the form of x, y, z text files where the z value was the calculated depth of the boundary below the seafloor.

2.2.14. The x, y, z text files were imported into Fledermaus software and gridded to surfaces which represented the boundaries interpreted from the seismic data.

2.3. Geotechnical Survey

Vibrocore Survey and Processing

2.3.1. The vibrocores were acquired using a power vibrocore unit (**Figure V.5**), which deployed a 6m core barrel. After recovery the cores were cut into 1m sections for storage and preliminary core logs recorded at this stage.

2.3.2. The actual locations of the vibrocores were selected during the survey and their x, y, z position recorded (**Figure V.6**).

2.3.3. The 16 vibrocores collected from eight sites (**Figure V.6**) were transferred to the environmental department at WA. One vibrocore from each site was split longitudinally and recorded, with the depth to each sediment horizon noted and the character, structure and form of the sediment described.

2.3.4. Basic sedimentary characteristics were recorded including depositional structure as well as texture, colour and stoniness (cf. Hodgson 1976). The descriptions are presented in **Appendix I**.

2.3.5. From the descriptions a log was plotted for each core. The logs were then compared in terms of their vertical distribution throughout the study area. This was achieved by plotting the cores in sections referenced to OD.

2.3.6. On the basis of the descriptions and the comparison of the core logs the major sedimentary units were ascribed principal phases. These were numbered and correlated with the sedimentary units described within the seismic interpretation. Profiles created by the phasing were integrated with the seismic data enabling comments on their palaeoenvironmental and geoarchaeological significance to be made.

2.3.7. Environmental and dating (^{14}C and OSL) samples were taken of relevant deposits in order to provide chronological and environmental information relating to their formation. Samples were taken for pollen, diatoms, foraminifera, ostracods and molluscs.

2.3.8. Stasis horizons containing vegetative organic matter suitable for radiocarbon dating were not present. Mollusc shells were common in many of the deposits and three unworn specimens were chosen as the next most suitable material for radiocarbon dating.

Grab Sampling Survey and Processing

2.3.9. The grab samples were acquired using a Hamon grab. On recovery the samples were washed onboard and the resulting residues put into plastic bags for storage and transportation (**Figure V.5**).

2.3.10. Each sample was transferred to the environmental department at WA and wet sieved through a nest of sieves in accordance with standard artefactual recovery procedures. The mesh sizes used were 10mm, 4mm and 1mm. The less than 1mm residues were discarded in conjunction with standard artefactual sieving procedures.

2.3.11. The greater than 10mm, 4-10mm and 1-4mm residues were scanned for archaeological material. Archaeological finds including flint, bone, slag, clinker, glass, burnt stone and ceramic building material (CBM) were retained for further analysis.

2.3.12. The locations of the grab samples were selected during the geophysical survey. A grid was defined with samples taken at 100 metre intervals, and the x, y, z position of each sample was recorded during the survey. The coordinates of the grab sampling area are given in **Table V.3** (**Figure V.6**).

Easting	Northing
328692	5600909
328915	5601242
330495	5600199
330279	5599870

Table V.3: Coordinates of the Eastern English Channel grab sampling area (WGS 84, UTM zone 31).

3. RESULTS

3.1. GEOPHYSICAL DATA

Overview

3.1.1. The survey covered an area of 36km^2 with approximately 498 line km of bathymetry, sidescan sonar and seismic data collected. A total of 59 lines were run south-west to north-east, and 20 cross lines were run north-west to south-east, to form a survey grid approximately one kilometre square.

3.1.2. All the data sets acquired were generally of high quality due to good weather and calm sea states during the survey period and good equipment configuration.

Bathymetric Data

3.1.3. The bathymetry of the study area ranged between 39 and 53m below OD (**Figure V.7**). On the eastern side of the study area the seafloor shoals to form a ridge running north-west to south-east throughout the entire area. To the west of this ridge the seafloor deepens to 53m below OD in the north and 43m below OD in the south. Moving further west the seafloor gradually shoals to 40m below OD.

3.1.4. The west-east bathymetric profile in **Figure V.7** shows that the seafloor gradually deepens towards the east before shoaling rapidly at approximately 5,000m along the profile. The general trend of features orientated north-west to south-east is for the bathymetry to deepen towards the north-west.

Sidescan Sonar Data

3.1.5. The review of the sidescan sonar data showed a seabed comprising sandy gravel with trawl scars caused by fishing activity. During the data interpretation, the presence of irregular objects with shadow that could possibly be anthropogenic debris was noted (**Figure V.8**). There are also sporadic anomalies that are believed to be ice-rafted erratic boulders as recorded by Hamblin *et al*. (1992).

Seismic Data

3.1.6. A palaeovalley feature was identified in the seismic data. It extended throughout the study area, over a distance of approximately four kilometres. The valley ranged in width between 1.5 and 2km, with a depth of 40 to 45m. This constitutes a long wide shallow palaeovalley feature with evidence of several phases of cut and fill events.

3.1.7. Horizons were also identified that have been truncated and cannot be traced in all the seismic profiles. These suggest that certain phases in the development of the valley are not fully represented. It is therefore difficult to reconstruct the continuous development of the valley.

3.1.8. The sequence of cut and fill events have been hypothesised by integrating all the data sets, and are discussed in **Section 4**.

3.1.9. The assessment of the seismic data included detailed descriptions of all the reflectors visible as geophysical boundaries. These are believed to be boundaries between sedimentary units representing phases of accretion and erosion from the first channel incision to the final marine transgression of the area.

3.1.10. The boundaries were interpreted by delineating reflectors in the Coda Geosurvey software. The boundaries were digitised and exported into the Fledermaus software package where they were interpolated to create surface models of the divisions between the units.

3.1.11. A total of five surfaces and ten sedimentary units were identified in the seismic data; these are described below and shown in **Figure V.9**. **Table V.4** below sets out the relationship between the sedimentary and the seismic units.

Seismic reflectors (geophysical boundaries)	**Description**	**Sedimentary Units**
Primary valley base	This is a strong linear reflector identified as a bedrock incision. This boundary could be traced almost for the complete length of the valley, from its truncated surface edges to the deepest valley form.	Base of **Units 1**, **2**, **3** and **4**
Primary central in-fill surface	This is a strong linear reflector corresponding to the deepest valley base in-fill. This boundary only occurred along the centre of the valley and could be traced throughout the entire study area.	Top of **Unit 4**
Eastern flank and western flank	These boundaries were identified as strong linear reflectors mostly truncated by current seafloor and shoaling towards the centre of the valley. These were identified as two separate events in the south of the study area and as a single merged boundary in the north. This layer was delineated as being the topmost, strong linear reflector.	Top of **Units 1**, **2** and **3**
Intermediate layers	These layers intermittently appear between the base of the primary valley and the upper eastern and upper western valley flanks. The reflectors were divided to reflect possible individual fluvial events. This layer could not be regularly mapped along the valley and so the interpretation of individual boundaries and units from the seismic profiles could not be tied in with certainty to the surfaces created in the modelling of this layer.	Base of **Units 6**, **7** and **8**
Braiding system	This was identified as a low amplitude linear reflector intermittently occurring in the upper centre valley fill. No consistency between braiding valleys could be observed.	Base of **Unit 9**

Table V.4: Relationship between the sedimentary and seismic units observed in the data.

3.1.12. The palaeovalley was orientated south-east to north-west and was approximately 1,450 to 2,000m wide. It had a maximum depth of 75m below OD. The central section of the palaeovalley contained a narrower, deeper channel (**Figure V.9)**.

3.1.13. **Unit 1** has been identified as consisting of two separate gravel deposits, **Unit 1a** and **Unit 1b**, which on-lap a truncated bedrock surface. **Unit 1a** is located on the western side and **Unit 1b** on the eastern side of the palaeovalley. Although the nature of the seismic reflectors in **Unit 1a** and **Unit 1b** is both similar it cannot be established whether they were once part of an extensive sheet of gravel or whether they are two separate units deposited at different times (**Figure V.10**).

3.1.14. A strong seismic reflector marks the top of **Unit 1**/base of **Unit 2**. The base of **Unit 2** shows small scale, low gradient incisions into **Unit 1**, however, they only occur on the western side of the study area. The seismic data suggest that the character of **Unit 2** is fine-grained, which indicates a low energy fluvial depositional environment.

3.1.15. **Unit 3** defines the base of the palaeovalley at a depth of approximately 60m below OD in the northern section of the study area, and up to a depth of approximately 62m below OD in the southern end of the study area. This reflector shoals on both sides of the palaeovalley with flanks on either side. These have been truncated at the level of current seafloor (**Figure V.10)**.

3.1.16. **Figure V.11** shows the base of the palaeovalley, which comprises the base of **Units 1, 2, 3 and 4**.The base of **Unit 4** is a surface created by the incision of the bedrock in the middle of the base of **Unit 3**.

3.1.17. The incision, which formed the deeper palaeovalley that was in-filled by **Unit 4,** has left a pair of bed-cut terraces, which comprise **Unit 3**. These vary in width between approximately 300 and 500m, although the eastern terrace is generally wider than the western terrace throughout the study area.

3.1.18. The incision that is in-filled by **Unit 4** gradually deepens towards the middle of the channel. In the south the depth of this palaeochannel increases by up to 5m (**Figure V.11**).

3.1.19. The base of **Unit 4** can be traced across 3.2km of the study area, in a north-south direction. The reflector cannot be traced on survey lines towards the south of the study area as the reflector deepens and insufficient seismic energy is reflected to trace the reflector further.

3.1.20. **Sub-Unit 4a** is composed of coarse material ranging in thickness with a maximum thickness of *c.* 8.5m. This material may comprise fluvial gravels that represent a period of high energy sedimentation. It accumulated in a prograding manner on the eastern slope of the palaeovalley and is approximately 600m wide.

3.1.21. A change in fluvial behaviour is apparent as **Sub-Unit 4b** overlays **Sub-Unit 4a**. **Sub-Unit 4b** is an on-lapping prograding fine-grained sediment deposit. The material accumulated from the western valley edge and expanded towards the centre of the palaeovalley. It extends to a width of approximately 900m with a thickness of up to 10m.

3.1.22. As **Unit 4** developed, the erosion and transportation of heavy coarse material gave way to the deposition of finer grained sediments. The infilling of **Unit 4** became complete when it reached the terraces at the base of **Unit 3** at approximately 63m below OD.

3.1.23. Once **Unit 4** had been deposited, only a relatively narrow valley shaped surface, approximately 200m wide and 4m deep, remained. This was detected predominantly across the southern third of the study area and marked a period of substantially diminished fluvial flow.

3.1.24. **Unit 5** is composed of low amplitude reflectors, which become acoustically transparent with depth. The thickness of the deposit ranges from 10 to 15m. The nature of the seismic signature suggests that this deposit is fine-grained sediment.

3.1.25. **Units 6** and **7** are channel infill deposits infilling channels cut into **Unit 5** (**Figure V.12**).

3.1.26. It is still difficult to ascertain the chronological deposition of these two units as the data does not show a clear stratigraphic relationship between them. However, both units show high amplitude reflectors displaying even sedimentation of coarse material possibly with organic material at the base, which would account for the intermittent appearance of the reflectors.

3.1.27. **Unit 6** developed on top of the western flank of **Unit 3**, after an incision through **Unit 5** and represents a palaeovalley approximately 900m wide and up to 8m deep (**Figure V.12**). The base of **Unit 6** is a deposit of coarse material, 3.5m deep and 235m wide (**Figure V.13**). This unit on-laps **Unit 3**, and is in turn overlain with finer grained material (**Figure V.9**).

3.1.28. **Unit 6** is best identified from the middle of the study area and gradually becomes more pronounced towards the south (**Figure V.12)**.

3.1.29. The base of **Unit 7** developed on the eastern flank of **Unit 3** as a set of multiple incisions, cutting through **Unit 5**. The creation of **Unit 7** has left a hanging surface, also known as a residual terrace delimiting the western extent of the base of **Unit 7** (**Figure V.12**).

3.1.30. The complexity of this sequence is more apparent in the southern profiles, widening and simplifying to the middle section and possibly continuing through to the north.

3.1.31. The base of **Unit 7** and its corresponding in-fill were formed in various stages. These were identified as four sub-events of boundaries and subsequent sediment in-fills or units. These are: **Sub-Units 7a, 7b, 7c** and **7d**.

3.1.32. The base of **Sub-Unit 7a** is the deepest reflector within **Unit 7** and is probably the first event of this channel incision which can be traced throughout the study area. This strong boundary reflector is best identified on seismic line 47 with an approximate width of 300m and a depth of 10m (**Figure V.12**).

3.1.33. **Sub-Unit 7a,** although mostly re-cut by later events, indicates a prograding structure, composed of relatively fine-grained material produced from a relatively low energy environment, and down-laps onto the top of **Unit 3** (**Figure V.12**). However, on the eastern side, this facies also on-laps the lens shaped residual deposit of **Unit 5**.

3.1.34. Underlying **Unit 7b** is a fluvial incision, approximately 7m deep and 200m wide. It has down-cut into **Sub-Unit 7a** with the sediments forming **Sub-Unit 7b** made of coarse material, with accreting surfaces building from its western side. The valley continued infilling producing gradual, oblique and tangential reflectors, which suggests a comparatively rapid aggradation (**Figure V.12**).

3.1.35. **Sub-Unit 7c** is also a fluvial incision, over 5m deep and approximately 300m wide and is down-cut through **Sub-Unit 7a** and **Sub-Unit 7b** (**Figure V.12**).

3.1.36. The bottom lens shaped deposit of **Sub-Unit 7c** illustrates a sigmoidal facies of coarser material, probably a sandy gravel composite. The aggradation continued with parallel and even filling of finer sediment up to mid-channel and possibly higher, but the top section was reworked by **Sub-Unit 7d** (**Figure V.12**).

3.1.37. **Sub-Unit 7d** is defined by a strong boundary reflector down-lapping on to the eastern flank of **Unit 3** and cutting into **Sub-Unit 7c**. The seismic data showed a chaotic to hummocky clinoform facies above **Sub-Unit 7d** indicative of mixed sediment types (**Figure V.12**).

3.1.38. The base of **Unit 8** is a strong linear reflector interpreted as a later palaeochannel. The boundary is identified as a continuous surface throughout the northern third of the study area, breaking into two separate surfaces towards the south. This discontinuity has been primarily assigned to later reworking of the valley's upper centre sections (**Unit 9**). Also, truncated at near-surface by the last transgression, the base of **Unit 8** down-laps onto earlier **Units 5, 6** and **7** as it runs towards the centre of the valley. The eastern and western flanks of **Unit 8** on-lap **Unit 1** showing that this unit is younger than **Unit 1** (**Figure V.9**). This strong reflector is indicative of the presence of organic material such as peat.

3.1.39. The base of **Unit 8** is discontinuous for the majority of the study area, but the study of the seismic profiles suggests that this surface formed over a valley at 51m below OD (**Figure V.14**). This valley shape can clearly be seen in the model of the surface produced in Fledermaus (**Figure V.15**).

3.1.40. Moving southwards through the study area, the base of **Unit 8** splits into two surfaces; the western flank deposit and the eastern flank, which is a substantial bank deposit of fairly fine sub-parallel material. However, the eastern flank was severely eroded and the reflector was broken into sections, and appears separated from the valley edge.

3.1.41. As the boundary of **Unit 8** reaches the northern section of the study area, the nature of the bank is clarified. This lens or slope front fill overlays a very course material that progrades down into the centre of the valley becoming a finer sub-parallel bank fill as it ends at the edge of **Unit 4**.

3.1.42. The base of **Unit 8** becomes a fairly continuous strong linear reflector for 500m at the northern end of the study area. The western side can be identified as a level surface seemingly unaffected by the marine transgression. The eastern half appears to have suffered greater marine disturbance resulting in an uneven surface. This valley edge has been truncated by a modern surface veneer.

3.1.43. The base of **Unit 8** was also associated with some of the residual terraces that have been identified. These were left out of context as earlier events truncated and/or reworked their surroundings. These features appear as strong reflectors in the seismic data, probably due to their rich silty clay formation and possible accumulation of organic material.

3.1.44. **Unit 9** is a sequence of faint channel shaped surfaces, probably a system of braiding channels, occurring in the upper centre sections of the study area. This unit has reworked parts of **Unit 8** and **Unit 5** as it has cut down through them. This set of events intermittently appears in the north of the study area, becoming more prominent towards the southern third of the study area.

3.1.45. Even though the detection of this boundary is intermittent along the palaeovalley, seismic line number 02 (**Figure V.16)** indicates a system of small braiding basins. Seismic lines number 39 and 43 illustrate deepened basins varying between 50 and 60m below OD.

3.1.46. **Unit 9** is characterised by a facies of sub-parallel, on-lapping reflectors, interpreted as being fine-grained sediment. The composite of **Unit 9** fluvial facies varies in thickness as the last marine transgression eroded, reworked and mixed-in marine sediments during the sub-littoral transformation. The marine reworking is suggested to have had a greater impact on the southern sections of the palaeovalley than on its northern counterparts with clear unit and boundary truncation. The thickness of this unit varies between 5m and 10m in the south and north, respectively.

3.1.47. **Unit 9** deepens towards the south and is characterised by two on-lapping events, **Sub-unit 9a** and **Sub-unit 9b**.

3.1.48. **Sub-unit 9a** is a bank of strong reflectors that on-lap on the eastern flank and dip towards the base of the valley. This facies is composed of coarse material.

3.1.49. **Sub-unit 9b** on-laps **Sub-unit 9a** indicating this to be a later stage of the valley infill. **Sub-unit 9b** is an even-lapping fine-grain deposit completely in-filling **Unit 9**.

3.1.50. The base of **Unit 10** was identified as a distinct interruption in the sedimentological sequence of the valley infill. This surface is mainly characterised by a change in deposition, indicating a change in sediment type (**Figure V.9**).

3.1.51. The base of **Unit 10** is mostly identified as a strong irregular linear reflector truncating earlier facies across the valley. In many instances, the eastern end of this boundary is no longer linear but rather chaotic. The high amplitude reflection is due to coarse material, and in particular gravels deriving from the valley flanks and having been deposited in a prograding manner from the western flank towards the east.

3.1.52. The main component of **Unit 10** formed a prograding shingled facies in a west-east direction. The shingled structure is similar to parallel oblique facies configurations mentioned in earlier stages but with greater thicknesses. Most importantly shingled deposits indicate progradation into shallow water.

3.1.53. All the fluvial events described can be observed in the majority of the seismic lines over the palaeovalley. However, there were also a number of features that could only be seen on selected seismic lines. These were residual terraces and isolated channel forms preserved from features of which all other evidence has been eroded.

3.1.54. Also, it was initially assumed that the palaeovalley flowed from south to north, from the eastern palaeovalley into the northern palaeovalley. However, the modelling of surfaces revealed a deepening of the sequence to the south, indicating a north-south flow. It is still possible that the north-south slope reflected the presence of fluvial pools due to localised over-deepening of the valley, rather than a true deepening of the valley.

3.2. Geotechnical Data

Vibrocores

3.2.1. The vibrocores were located at eight specified positions across the study area (**Figure V.6**). Six major sedimentary units were identified from eight vibrocores. These have been ascribed sedimentary units comparable to those observed within the seismic data. This correlation is shown in **Figures V.9** and **V.17.** These are shown in their relative vertical positions in **Figure V.18**.

Bedrock (57.70m to 56.17m below OD)

3.2.2. These were dark olive grey clays including occasional silt and sand and occurred in vibrocore **VC5** (**Figure V.18-19**). The deposit was 0.67m thick although its full extent was not penetrated. The deposit was interpreted as Tertiary bedrock.

Unit 1a Sandy gravel (41.26m to 43.10m below OD)

3.2.3. This unit was brown to grey compact sandy gravel with a high shell content. The unit was recorded in **VC7**. The top 0.2m (41.26m to 41.06m below OD) of this deposit were loose and disturbed either by coring or marine processes. The deposit from 41.06m to 42.69m below OD was brown, the colour being due to oxidation of ferrous material within the deposit. Below this level (42.69m to 43.10m below OD) the deposit was grey in colour and not oxidised.

Unit 3 Silty sandy gravel (49.02m to 49.53m below OD)

3.2.4. This unit was olive grey silty sandy gravel and occurred in **VC5**. Clasts of Tertiary bedrock (olive grey clay) were noted to be included. The deposit was interpreted as being indicative of a high energy fluvial or marine deposit.

Unit 7 Sand and clayey silts (55.34m to 57.30m below OD)

3.2.5. These were fine sands and clayey silts and occurred in vibrocore **VC3** (**Figures V.18** and **V.20)**. This unit was 1.98m thick. Its full extent was not penetrated. The deposits are indicative of both high and low energy environments possibly relating to fluvial/estuarine sedimentation.

3.2.6. This unit can be sedimentologically divided into three sub-units in vibrocore **VC3** (**Figure V.20**).

Sub-unit 7iii (VC3 55.34m to 56.41m below OD)

3.2.7. This sub-unit is possibly of estuarine/fluvial origin and comprises grey and greyish brown fine to medium sand.

Sub-unit 7ii (VC3 56.41m to 56.57m below OD)

3.2.8. This sub-unit is indicative of a lower energy possibly alluvial environment and comprises dark grey fine sands and clayey silts with dark possibly organic inclusions. The repeated layers of fine sands and silty clays are possibly flood couplets which are indicative of repeated, possibly seasonal, flooding.

Sub-unit 7i (VC3 56.57m to 57.30m below OD)

3.2.9. This sub-unit is possibly indicative of a fluvial/estuarine alluvial environment and comprises very dark grey fine sand with faintly visible laminae.

Unit 8 Sand and gravel (46.29m to 55.34m below OD)

3.2.10. This unit was between 1.82m and 3.46m thick and comprised predominantly of grey, yellow and brown fine sands, which occurred in vibrocores **VC1**, **VC5**, **VC6** and **VC8**. Its full extent was not reached in all of the vibrocores. The deposits were generally well sorted with little sedimentary architecture apparent. These sands were interpreted as possibly fluvial/estuarine or shallow marine in origin.

3.2.11. A brown sandy gravel with occasional mussel shell (*Mytilus edulis*) occurring in **VC3** from 54.99m to 55.34m below OD is stratigraphically analogous to **Unit 8** described in vibrocores **VC1**, **VC5**, **VC6** and **VC8** although coarser grained. This deposit is indicative of a high energy environment with a possible marine contact inferred from the molluscs. It is possible that this represents a transition including sediment mixing between **Unit 7** and **Unit 10**.

Unit 10 Gravelly sand (41.27m to 54.99m below OD)

3.2.12. This unit was between 0.63m and 4.9m thick and was made up of gravelly sands with very high concentrations of marine shell, and occurred in all of the vibrocores (**Figure V.18-19**). Its full extent was not penetrated in vibrocores **VC2** and **VC4**. These deposits are interpreted as rapidly accumulating shallow sub-littoral/marine sediments probably corresponding to the lag deposit relating to Holocene marine transgression described by Hamblin *et al.* (1992).

Environmental Data – Pollen, Diatoms, Foraminifera and Ostracods

3.2.13. Samples taken for pollen, diatoms, foraminifera and ostracods were assessed for presence and preservation with the full results given in **Appendices II-IV**. Many samples contained very low abundances or no environmental remains. This result is unremarkable given that very few fine-grained sediments suitable for preservation of microfossils were encountered in the vibrocores.

3.2.14. Pollen was rarely preserved within the sediments. Only one assessed sample (**VC3** at 4.35m, **Unit 7ii**) contained sufficient quantities of pollen suitable for analysis (**Figure V.20**). The sample was dominated by pine (*Pinus*) and birch (*Betula*) representing the extra-site vegetation of dry land, i.e. the vegetation adjacent to/surrounding the site in a close enough distance to allow deposition of wind-blown pollen on the site itself. There were herbs present including grasses (Poaceae) indicative of a wet herb fen as the on-site vegetation. No estuarine or brackish water species were found within the sample. Diatoms were not present in any of the assessed samples (**Appendix II**).

3.2.15. Foraminifera were preserved in low numbers in the assessed samples (**Appendix III**). Foraminifera present within **Unit 10** in vibrocores **VC1**, **VC3** and **VC5** are indicative of a marine inner shelf environment. Preservation was best in samples from **VC3** (**Figure V.20**) with estuary mouth taxa preserved within **Unit 7i** at the base of the core.

3.2.16. Ostracods were preserved in low numbers in the assessed samples (**Appendix IV**). However, one sample from **VC3**, **Unit 7ii** produced significant numbers of the freshwater taxa *Ilyocypris monstrifica* (**Figure V.20**).

Dating

3.2.17. Three bivalve molluscs were selected for radiocarbon dating (**Appendix V** and **Figure V.18)**. Two samples from **Unit 8** provided similar results: a sample taken from **VC3** at 55.13m below OD gave a date of 9,811±35 BP/ 9,160 – 8,350 cal. BC (NZA-23789); a sample taken from **VC1** at 48.86m below OD gave a date of 9,663±35 BP/ 9,160 – 8,150 cal. BC (NZA-23788); and one from the lowest part of **Unit 10** at 47.90m below OD gave a date of 8,442±35 BP/7,320 – 6,860 cal. BC (NZA-23787).

3.2.18. Dating of the sedimentary units is not secure. The use of mollusc shells for dating purposes is not ideal due to the possibility that they are not *in situ*. However, given the similarity in age ranges in date (**VC3**, 55.13m below OD 9,811±35 BP/ 9,160 – 8,350 cal. BC (NZA-23789) and **VC1**, 48.86m below OD 9,663±35 BP/9,160 – 8,150 cal. BC (NZA-23788)) from samples taken from two separate cores within **Unit 8** the results are considered to be useful and an indicative date for the final phase of sedimentation within **Unit 8**. The date taken from **Unit 10** (8,442±35 BP/7,320 – 6,860 cal. BC (NZA-23787)) is also considered to be within the expected range for a marine sediment in this area. Suitable organic material was not available for radiocarbon dating from other units recorded within the vibrocores.

3.2.19. Six samples were selected for OSL dating in order to confirm the initial radiocarbon dates (**Appendix V).** The results are presented in **Appendix VI, Table V.5** and are shown in **Figure V.18**.

Sample	Sedimentary Unit	Depth of sample (m below OD)	Age (ka)	Error (ka)
VC1	10	48.03	11.91	0.86
VC3	8	55.25	14.16	1.10
VC3	7iii	55.71	15.14	1.20
VC5	3	49.46	21.15	1.53
VC7	1b	43.01	176.55	19.98
VC7	1b	41.69	83.19	6.59

Table V.5: Optically stimulated luminescence (OSL) dating results.

3.2.20. Taking into account the length of time that the sampled sediments would have been within a metre or two of the seabed prior to inundation could improve these dates. However, this would only reduce the age range by up to 500 years (see **Appendix VI**).

3.2.21. There are some discrepancies between the OSL dates and the radiocarbon dates. In **VC1** samples for each dating technique were taken from the same stratigraphic layer (**Unit 10**) around 48.0m below OD. The radiocarbon dating gave a value of 8422±35 BP / 7,320 – 6,860 cal. BC (NZA-23787) and the OSL gave a date of 11.91±1.10 ka; a discrepancy of between 2,010 and 3,740 years (based on the calibrated ages). Also, in **VC3** samples were taken from **Unit 8** at 55.13m and 55.25m below OD for radiocarbon and OSL dating, respectively. The radiocarbon date was estimated at

9,811±35 BP/ 9,160 – 8,350 cal. BC (NZA-23789) compared to an OSL date of 14.16±1.10 ka, a discrepancy of between 2760 and 4150 years (based on the calibrated ages).

3.2.22. Based on these two sets of dates there appears to be a consistent error whereby the OSL dates are older than the radiocarbon dates. It is not possible to ascertain the reason for this error.

3.2.23. This error is further apparent when comparing the pollen assessment with the dates in **VC3**. The pollen assessed in **Unit 7ii** of **VC3** at 56.56m below OD is dominated by birch and pine pollen suggesting boreal type woodland which colonised this site during the late glacial interstadial (Allerød from *c.* 11,000 to 12,000 BP/10,900 to 11,900 cal. BC) or during the early Holocene (Pre-Boreal: Flandrian Chronozone Ia) at *c.* 10,000 to 9,800 BP/9,600 to 11,900 cal. BC) (Scaife 2006, see **Appendix II**). The OSL dating of **Unit 7iii** overlying **Unit 7ii** suggests an older date (15.14±1.2 ka) than suggested by the pollen analysis. This further suggests that the OSL dates of the sediments are older than the radiocarbon dates or environmental analysis suggest.

3.2.24. Based on the pollen analysis, stratigraphy and relative sea level it is considered likely that the radiocarbon dates are more accurate than the OSL dates. The OSL dates are still useful for chronological interpretation purposes, however, the inconsistency needs to be considered. It is not known whether this inconsistency applies to the dates from **Unit 3** and **Unit 1b** which were not radiocarbon dated, however, there is a possibility that this error is consistent throughout the samples.

Grab Samples

3.2.25. Wet sieving produced a range of finds including fossils, slag, clinker and coal. Amounts of finds per sample are given in **Appendix VII**. Positions of the grab samples are shown in **Figure V.6**. No prehistoric archaeological material was recovered. The total numbers of finds are given in **Table V.6**.

Finds		Total
Modern finds	Slag	77
	Clinker	63
	Coal	28
Fossils	Fish teeth	10
	Foraminifera	16
	Other	22

Table V.6: Details of modern and fossil finds from the grab sampling survey.

3.2.26. Most of the samples were dominated by high proportions of gravelly sand with a high shell content. The shells were all marine species. The gravel was usually subrounded to subangular flint with a yellowish brown patina and brown or black cortex. The largest flint recovered was 150mm diameter. Crustaceans, molluscs, bryozoans and annelids were noted adhering to some of the flint. The sand ranged in particle size although was predominantly medium to coarse. Low quantities of silt were also present in most of the samples.

3.2.27. Erratics were found in varying quantities. Igneous rocks including granite were present in samples 1, 7, 15, 27, 28, 29 and 69. They were usually subangular and ranged in size from 10 to 30mm diameter. Metamorphic rocks including quartz, schist and shale were recovered from samples 7, 26, 43, 44, 45, 53, 57 and 64. Sedimentary rocks including sandstone and mudstone were recovered from samples 7, 8, 21, 34, 38, 48, 50, 62, 64, 69, 78, 82, 85, 86, 94 and 95 (**Appendix VII**).

3.2.28. A total of 77 pieces and fragments of slag were recovered from the samples. These were generally small in size (less than 10mm diameter) and had an average weight of less than one gram.

3.2.29. A total of 63 pieces and fragments of clinker were recovered from the samples. These were generally small in size (less than 10mm diameter) and had an average weight of less than one gram.

3.2.30. A total of 28 pieces of coal were recovered from the samples. These were generally small in size (less than 10mm diameter) and had an average weight of less than one gram.

3.2.31. Fossil fish teeth and bone were recovered from the samples. A total of ten teeth were recovered ranging in size from 3 to 10mm. A total of 22 pieces of fossilised material including bone fragments were retrieved. A total of 16 fossil large benthic foraminifera were recovered.

4. DISCUSSION AND CONCLUSIONS

4.1. Grab Sample Survey Assessment

4.1.1. The finds from the grab samples are of geological and modern origin. No prehistoric archaeological material was recovered.

4.1.2. The sand and gravel within the grab samples are thought to constitute a lag deposit formed as a transgressive beach during rising sea levels probably during the Mesolithic period. Later winnowing has probably removed some of the finer sediments and encrusting by serpulids, bryozoans and crustaceans suggests a sediment that is not presently mobile (Hamblin *et al.* 1992). The erratic igneous and metamorphic rocks probably have a westerly origin and are most likely remnants of ice-rafted debris. Sedimentary rocks encountered may have a more local origin. The fossil fish teeth, bone and large benthic foraminifera (*Nummulites* sp.) probably originally derive from the (Eocene) Barton beds. Fish teeth and large benthic foraminifera (*Nummulites* sp.) are common in the Lower Barton or Highcliff Member (Melville and Freshney 1982).

4.1.3. The deposit from which the samples derive is analogous to **Unit 10** (described in this report). The deposit is homogenous ranging in thickness from 0.5 to 5m. Radiocarbon dating of this deposit (**Appendix V**) suggests that it formed during the early Mesolithic period. Foraminifera recovered (**Appendix III**) suggest a marine depositional environment. It is likely that the deposit rapidly accumulated as a result of rising sea level during the early Mesolithic period. Any prehistoric material within this deposit is likely to have been reworked from its original context. The sieved grab samples represent a very small fraction of the total deposit within the grab study area and as such a lack of prehistoric archaeological material within the samples does not mean that it does not exist within this deposit.

4.1.4. Modern material recovered including slag, clinker and coal are most likely to have occurred as a result of industrial or modern shipping activities. Similar amounts of modern material were recovered from the Round 1 grabbing survey 18km offshore of Littlehampton, West Sussex (**Volume II**). The coal is possibly reworked by natural processes, but is more likely to represent modern waste material dumped with the slag and clinker.

4.2. Geophysical and Vibrocore Data Assessment

4.2.1. Bedrock was recorded from the base of vibrocore **VC5** (**Figure V.18-19**) and is interpreted as a Tertiary bedrock. It is most likely to be part of the Barton or Huntingbridge Formation of Eocene date deposited within the Hampshire-Dieppe Basin.

4.2.2. A correlation of the sedimentary units with oxygen isotope stages is attempted here. The oxygen isotope stages present a climatic and environmental framework for the Pleistocene period to which the data can be compared.

4.2.3. **Unit 1** is a sheet of gravel on-lapping the truncated bedrock and is visible on either side of the valley forming two separate units (**Unit 1a** and **Unit 1b**) (**Figure V.9**).

4.2.4. **Unit 1a** was recorded in **VC7** (**Figures V.18-19**) and interpreted as being deposited in a high energy fluvial or more probably shallow marine environment. Its compaction indicated possible greater age than the other sedimentary units. The oxidisation of the upper part of this unit is indicative of sub-aerial exposure after its deposition. Sub-aerial exposure clearly demonstrates a terrestrial environment, suggesting that this deposit was at some point above sea level.

4.2.5. **Units 1a** and **1b** from the geophysical and geotechnical data appear stratigraphically to be the oldest units (other than Tertiary bedrock) identified within the study area and it is probable that they pre-date the formation of the palaeovalley. Molluscan material within this sediment is probably marine in origin. OSL dating of **Unit 1b** in vibrocore **VC7** at 42.88m below OD gave a result of 176.55±19.98 ka (**Appendix VI**, **Figure V.18**). The OSL date suggests Wolstonian (OIS 7 or 6) deposition. However, the OSL dates appear consistently older than radiocarbon dates and environmental evidence suggests, as such, this date is a probable overestimation. Based on relative sea levels proposed by Siddall *et al.* (2003) for the last 470,000 years and sedimentological evidence it is considered that the most likely interpretation of **Unit 1b** is a shallow sublittoral deposit formed as a result of transgressive or regressive systems in the Ipswichian (OIS 5e) or late Wolstonian (OIS 6).

4.2.6. A further OSL date was taken from the top of the sub-aerially exposed part of **Unit 1b** in **VC7** at 41.56m below OD which gave a result of 83.19±6.59 ka (**Appendix VI**, **Figure V.18**) indicating a Devensian (OIS 5d-4) date for sub-aerial exposure of this unit. This assumes that sunlight was able to penetrate the sediment when the sub-aerial exposure occurred.

4.2.7. The base of **Unit 2** represents small scale incisions of **Unit 1** present on the western side of the study area. These features are sporadic and represent short-lived events. These units must have formed subsequent to deposition of **Unit 1** and prior to **Unit 3.** Based on OSL dating (176.55±19.98 ka and 21.15±1.53 ka) their formation probably occurred between OIS 7-2.

4.2.8. **Unit 3** is a gravel deposit that has been incised by **Unit 4** and forms a terrace deposit. This deposit is stratigraphically the earliest deposit within the main palaeovalley feature. This unit was recorded in vibrocore **VC5**. The deposit itself is indicative of a high energy (fluvial) environment with evidence of reworking of bedrock material. OSL dating of this unit recorded in vibrocore **VC5** at 49.34m below OD gave a result of 21.15±1.53 ka (**Appendix VI**), indicating a Devensian (OIS 2) date. Even accounting for inconsistency in the OSL dates, it is considered that deposition in the Devensian period is likely.

4.2.9. These dates suggest that the formation of the paleovalley and fluvial systems recorded in this study area are younger than 176.55±19.98 ka (OIS 7/6). This is in agreement with the chronology inferred by the sequence stratigraphic model for the area proposed by Wright (2004) and correlates with the relative sea levels proposed by Siddall *et al.* (2003) for the last 470,000 years.

4.2.10. It should be noted that most theories on the formation of the Pleistocene palaeovalley system in the English Channel generally point towards a much older date. The main palaeovalley in this study post dates **Units 1a** and **1b**. The mapped palaeovalleys of the English Channel appear to demonstrate that the palaeovalley within this study is an offshore extension of one of the French rivers, probably the Canche or the Authie (Hamblin *et al.* 1992). It is suggested by Hamblin *et al.* (1992) that the formation of palaeovalleys within the East English Channel began during the Cromerian Complex period (*c.* 787 to 478 kyr). Onshore terrace deposits of the River Somme date to approximately 1,100 ka (Antoine *et al.* 2003) and the offshore formation of the Somme and Seine rivers may be earlier than Hamblin *et al.* (1992) suggest. The possibility that events relating to more glacial cycles are not represented in the sedimentary sequence observed cannot be ignored. However, these events might be preserved in the sedimentary record outside the study area within the long profile of the palaeovalley feature.

4.2.11. **Unit 4a** is interpreted from the geophysical data as a bank of fluvial gravels resting on the western terrace of **Unit 3** and sloping down into the channel basin of **Unit 4**. The implication of this is that **Unit 4** is a later cut. This cut was then filled to the base of the wider valley. If this deposition has occurred subsequent to the deposition of **Unit 3** (21.15±1.53 ka) then a Devensian date (OIS 2) is suggested. The incision of this part of the channel to *c.* 100m below OD would require significantly lower sea levels than that of today. The Devensian glacial maximum at *c.* 18,000 BP/ 19,300 cal. BC is a potential period when sea levels were low enough, up to 120m lower than today for this fluvial incision to have occurred (Siddall *et al.* 2003).

4.2.12. **Unit 5** is interpreted from the geophysical data as a fine-grained probably fluvial infill sediment of the main palaeovalley that is cut by later channels. These later channels are infilled by **Units 6** and **7**. **Unit 7iii** has been OSL dated to 15.14±1.20 ka. Deposition of **Unit 5** is therefore most likely to have occurred during the latter part of the Devensian period some time between deposition of between **Unit 3**, OSL dated to 21.15±1.53 ka, and **Unit 7iii** which has been OSL dated to 15.14±1.20 ka. **Units 4**, **5** and **6** represent cut and fill events potentially caused by short term fluctuations of climate and sea level during the Devensian (Hosfield and Chambers 2005).

4.2.13. The base of **Unit 6** and **Unit 7** could theoretically have formed at the same time as they have no direct stratigraphic relationship visible within the geophysical data. They are located on the western and eastern flanks of the valley, respectively. These two channels are interpreted as part of a braided fluvial system.

4.2.14. **Unit 7** is interpreted as palaeochannel infill and shallow marine/sublittoral deposit. In **VC3**, **Sub-unit 7ii,** at 56.41m below OD to 56.57m below OD, silty clay and fine sand laminae were observed and interpreted as part of a lower energy possibly alluvial environment (**Figure V.20**). This contrasted markedly with the sands and gravelly sands indicative of higher energy deposition within the other vibrocores.

4.2.15. Evidence from pollen, foraminifera and ostracod samples taken from vibrocore **VC3** (**Appendices II**, **III** and **IV**) are able to throw light on the depositional environments of **Unit 7**. The lowest part of **Sub-unit 7i** at 56.91m below OD produced a foraminiferal assemblage interpreted as an estuary mouth (**Appendix III**). Above this, the finer grained sequence (**Sub-unit 7ii**) produced non-marine ostracods including *Ilyocypris monstrifica* and *Candona candida* at 56.55m below OD and 56.51m below OD indicative of slow moving or still bodies of freshwater (**Appendix IV**). At 56.44m below OD pollen retrieved is indicative of a depositional environment of a wet herb fen (Scaife 2006, see **Appendix II**) with no indication of brackish water.

4.2.16. The pollen sample taken from **Unit 7ii** of **VC3** at 56.44m below OD is dominated by pine and birch. The presence of pine and birch suggests that this sequence is post-Devensian. Stratigraphically **Unit 7ii** was deposited prior to **Unit 8**. The radiocarbon date of the shell sample in **Unit 8**, at 55.13m below OD, suggests a maximum depositional date of 9,811±35 BP/9,160 – 8,350 cal. BC (NZA-23789).Considering the relative pollen dating and the overlying maximum age of **Unit 8** it is possible that **Unit 7** was deposited during late glacial interstadial (Windermere/Allerød; Zone II)' (Scaife 2006, see **Appendix II**).

4.2.17. If **Unit 7** was earlier in date, evidence of juniper would have been expected. However, if this unit was deposited after the late glacial interstadial the presence of oak would have been expected in the pollen sequence.

4.2.18. OSL dating of **Unit 7iii** at 55.58m below OD in **VC3** gave a result of 15.14±1.20 ka (**Appendix VI**, **Figure V.18**). This is older than the radiocarbon date 9,811±35 BP/ 9,160 – 8,350 cal. BC (NZA-23789) in **Unit 8**, at 55.13m below OD in the same core. Given the absolute radiocarbon date (**Unit 8**) and relative pollen date (**Unit 7ii**) above and below this sample (**Figure V.20**) it is suggested that the OSL date are consistently indicating older dates.

4.2.19. Vibrocore **VC3** shows a transition from estuarine (**Sub-unit 7i**) to freshwater (**Sub-unit 7ii**) and then to marine (**Unit 10**) environments of deposition (**Figure V.20**). This would suggest an overall trend of sea level rise with a lowered phase where the freshwater environments are interpreted (**Sub-unit 7ii** - from 56.41m below OD to 56.57m below OD). This is possibly due to a period of cooling temperatures.

4.2.20. The base of **Unit 8** represents a cut channel that extends across the valley. This channel was probably cut during a period of lower sea level, possibly during the Loch Lomond stadial. The geophysical signature of **Unit 8** suggests that it is a surface of sand and reworked gravel that has been deposited slowly. The depositional environment is difficult to ascertain from the character of the deposit recorded from **VC1** and **VC3**. The sediments might have been deposited in shallow marine, fluvial or estuarine conditions. No pollen, foraminifera or ostracods were preserved within this unit (**Appendices II-IV**). OSL dating of this **Unit 8** in **VC3** at 55.12m below OD gave a result of 14.16±1.11 BP (**Appendix VI**, **Figures V.18** and **V.20**). The radiocarbon date of a shell gave a result of 9,811±35 BP/9,160 – 8,350 cal. BC (NZA-23789) in **Unit 8**, at 55.13m below OD in the same core. It is suggested that the radiocarbon result is a more likely indication of time of deposition of this deposit, given the inconsistencies noted in the OSL dates. As it is the shell that is dated rather than the sediment, the shell may not provide an exact age of deposition. However, given the taphonomy it is likely that the shell represents the maximum age of the sediments.

4.2.21. **Unit 9** as interpreted from the geophysical data represents sedimentation within a braided channel system prior to the Holocene transgression. Its stratigraphic position between **Unit 8** and **Unit 10** which have maximum ages based on the calibrated C14 results of formed approximately between 9,663±35 BP/9,160 – 8,150 cal. BC (NZA-23788) and 8,442±35 BP/7,320 – 6,860 cal. BC (NZA-23787) respectively (**Figure V.9**).

4.2.22. The latest episode of sedimentation is represented by **Unit 10** comprising sands and gravelly sands which are thought likely to represent rapid sedimentation in a shallow marine/littoral environment. This unit was observed in the top of all of the vibrocores except **VC7** (**Figures V.18-19**). This deposit can be observed in the seismic data. Mollusc shell (*Mytilus edulis*) radiocarbon dated from the base of this unit (**VC1** 47.90m below OD) suggests that this deposit formed around 8,442±35 BP/7,320 – 6,860 cal. BC (NZA-23787) (**Appendix V**). OSL dating of **Unit 10** in **VC1** at 48.03m below OD gave a result of 11.91±8.6 ka (**Appendix VI**, **Figures V.18** and **V.20)**. This result is considered to be too old as the deposit is shallow marine and sea levels at this time would have been too low to produce a marine deposit at this date. The radiocarbon date is considered to be more accurate.

4.2.23. No pollen was preserved within this unit (**Appendix II**). Foraminifera were recovered including Miliolids are indicative of a marine inner shelf environment (**Appendix III**, **Figure V.20**).

4.2.24. Sea level index points (SLIPs) are specific sediment units with a known vertical reference that have been dated. They normally comprise *in situ* peat deposits. These points produce a curve of relative sea level against time. Before *c.* 8,000 BP (6,800 cal. BC) there are very few reliable SLIPs (Shennan and Horton 2002). Ongoing research into glacio-eustatic rebound and syntheses of known SLIPs for the Holocene period shows that the sea level curve produced by Jelgersma (1979) appears to be the most accurate for the Eastern English Channel and Southern North Sea (Dix and Westley 2004). If the depths of the radiocarbon samples are adjusted to Mean Sea Level in order to compare their vertical position with Jelgersma's sea level curve the radiocarbon dates for **Unit 8** are approximately 8 to 10m above Jelgersma's projected mean sea level for the period 9,811±35 BP/ 9,160 – 8,350 cal. BC (NZA-23789) to 9,663±35 BP/9,160 – 8,150 cal. BC (NZA-23788). The radiocarbon date 8,442±35 BP/ 7,320 – 6,860 cal. BC (NZA-23787) for **Unit 10** is approximately 10m below the projected mean sea level curve for this date. This comparison confirms the interpretation that **Unit 8** comprises fluvial/estuarine sedimentation above sea level and the interpretation of **Unit 10** as a marine inner shelf deposit.

4.3. ARCHAEOLOGICAL POTENTIAL

Lower, Middle and Early Upper Palaeolithic

4.3.1. The sediments observed within the geophysical and geotechnical data potentially contain prehistoric material. OSL dating suggests that the earliest *in situ* archaeology in the survey area would date from the Middle Palaeolithic although derived artefacts from the Lower Palaeolithic could be present. Much of the terrestrial archaeological record of the Palaeolithic in both northern France and southern Britain has been recovered from river terraces. Gravel deposits (**Unit 3** and **Unit 4a**) are possibly of fluvial origin and may represent river terraces and could therefore contain similar material recovered from terrace deposits on land.

4.3.2. There is the potential for the survival of prehistoric remains within or at the surface of **Unit 1**. This unit contains evidence of sub-aerial exposure and is located on the edge of the main valley. The indicatively terrestrial part of this deposit has survived *in situ*. **Units 2**, **4b**, **5**, **6** and **7** comprise finer grained deposits, possibly from a floodplain environment. These types of landscapes and environments are obvious places for the survival of *in situ* archaeological remains.

4.3.3. Within the valley itself areas of terrestrial environments are inferred. The base of **Unit 4** marks a period of fluvial incision when large parts of the palaeovalley feature including the surface of **Unit 3** might have been exposed as land surfaces. **Unit 6** and **7**, both channel infills, form part of a terrestrial environment when surrounding areas of the main valley feature were exposed.

Late Upper Palaeolithic and Mesolithic

4.3.4. The environmental history of the area during the Late Upper Palaeolithic and Mesolithic period are easier to elucidate from the data. **Unit 7,** if relative pollen dating is correct, was deposited during the Godwin zone II, *c.* 12,900 BP (13,200 cal. BC) to 11,600 BP (11,400 cal. BC), corresponding to the late Upper Palaeolithic period. Pollen and ostracod assessments point towards slow moving freshwater environments for this period within the wider context of a river valley.

4.3.5. The sedimentary record aided by radiocarbon dating suggests that **Unit 8** (9,811±35 BP to 9,663±35 BP/ 9,160 – 8,150 cal. BC), **Unit 9** and **Unit 10** (*c.* 8,442±35 BP/7,320 – 6,860 cal. BC) were deposited during the Mesolithic period (*c.* 10,000 to 8,600 BP/ 9,600 to 7,500 cal. BC). Braided channels within a wide valley (**Units 8** and **9**) are submerged by sea level rise indicated by **Unit 10**. Thick sequences of **Unit 8** and **9** are preserved which probably include fluvial and estuarine alluvial sedimentation relating to the Mesolithic period.

4.3.6. These fluvial, estuarine and coastal environments are potential places where both *in situ* and derived archaeological material may survive.

4.4. RECOMMENDATIONS FOR FUTURE WORK

4.4.1. An assessment of the molluscan content of **Unit 1** is suggested in order to obtain environmental and potential biostratigraphic data.

5. REFERENCES

AHOB 2006: Ancient Human Occupation of Britain 1 project, *Printable Summary Chart* (see Online-Resources).

Antoine, P., Coutard, J.-P., Gibbard, Ph., Hallegouet, B., Lautridou, J.-P. and Ozouf, J.-C., 2003, 'The Pleistocene rivers of the English Channel region', *Journal of Quaternary Science* 18:227-243.

Champion, T., Gamble, C., Shennan, S. and Whittle, A., 1984, *Prehistoric Europe*, London: Academic Press.

Coles, B.J., 1998, 'Doggerland: A Speculative Survey', *Proceedings of the Prehistoric Society* 64:45-81.

Dix, J.K. and Westley K., 2004, *A Re-Assessment of the Archaeological Potential of Continental Shelves*, University of Southampton (see Online-Resources).

Hamblin, R.J.O., Crosby, A., Balson, P.S., Jones, S.M., Chadwick, R.A., Penn, I.E., and Arthur, M.J., 1992, *The Geology of the English Channel, British Geological Survey UK Offshore Regional Report*, London: HMSO.

Hodgson, J.M. (ed.), 1976, *Soil Survey Field Handbook*, Harpenden, Soil Survey Technical Monograph No. 5. Cranfield University.

Hosfield, R.T. and Chambers, J.C., 2005, 'Pleistocene geochronologies for fluvial sedimentary sequences: an archaeological perspective', *Journal of Quaternary Science* 20:285-296.

Leake, J., 2006, 'The flood that made Britain', *The Sunday Times*, September 24, 2006.

Melville, R.V. and Freshney, E.C., 1982, *British Regional Geology: The Hampshire Basin and Adjoining Areas.* Fourth Edition, Institute of Geological Sciences, London: HSMO.

Parfitt, S. A., Barendregt, R.W., Breda, M., Candy, I., Collins, M.J., Coope, G.R., Durbidge, P., Field, M.H., Lee, J.R., Lister, A.M., Mutch, R., Penkman, K.E.H., Preece, R.C., Rose, J., Stringer, C.B., Symmons, R., Whittaker, J.E., Wymer, J.J. and Stuart, A.J., 2005, 'The earliest record of human activity in northern Europe', *Nature* 438:1008-1012.

Roberts, M., and Parfitt, S., 1999, *Boxgrove. A Middle Pleistocene hominid site at Eartham Quarry, Boxgrove, West Sussex*, London: English Heritage Archaeological Report 17.

Scaife, R., 2006, Pollen and Diatom Assessment/Analysis. Unpublished report, see **Appendix II**.

Shennan, I. and Horton, B., 2002, 'Holocene land- and sea-level changes in Great Britain', *Journal of Quaternary Science* 17:511-526.

Siddall, M., Rohling, E.J., Almogi-Labin, A., Hemleben, C., Meischner, D., Schmeizer, I. and Smeed, D.A., 2003, 'Sea-level fluctuations during the last glacial cycle', *Nature* 423:853-858.

Sheriff, R.E., and Geldart, L.P., 1983, *Exploration Seismology*, New York: Cambridge University Press.

Smith, A. J., 1985, ‘A Catastrophic Origin for the Palaeovalley System of the Eastern English Channel’, *Marine Geology* 64:65-75.

Telford, W.M., Geldart, L.P., Sheriff, R.E., 1990, *Applied Geophysics*, Cambridge: Cambridge University Press. pp 770.

Wessex Archaeology 2006, ‘Seabed Prehistory: Gauging the Effects of Marine Aggregate Dredging. Eastern English Channel’, Unpublished report ref. 58140.01.

Wessex Archaeology 2007, ‘Seabed Prehistory: Gauging the Effects of Marine Aggregate Dredging. Final Report, Volumes I-VIII’, Unpublished report ref. 57422.10-17.

Wright, M.R., 2004, ‘Late Quaternary Palaeovalley Systems of the Eastern English Channel’, Unpublished PhD thesis, Department of Geography, University of Durham.

Wymer, J.J., 1976, ‘The interpretation of Palaeolithic cultural and faunal material found in Pleistocene sediments’, in Davison, D.A. and Shackley, M. (eds.), *Geoarchaeology: Earth Sciences and the Past*, London: Duckworth. 327-334.

Wymer, J.J. (ed.), 1977, *Gazetteer of Mesolithic sites in England and Wales with a Gazetteer of Upper Palaeolithic sites in England and Wales*, CBA Research Report 22, London/Norwich: Council for British Archaeology and Geo Abstracts Ltd.

ONLINE-RESOURCES:

AHOB 2006:

http://www.nhm.ac.uk/hosted_sites/ahob/AHOBI/overview_time_chart.gif

Dix, J., and Westley, K., 2004:

http://www.arch.soton.ac.uk/Research/Aggregates//shelve-intro.htm

APPENDIX I: VIBROCORE LOGS

VC1

Depth below seabed (m)	Depth below OD (m)	Description
0.00-1.22	44.50-45.72	10YR5/4 Yellowish brown. Medium/coarse sand. Very frequent broken shell (occasionally whole including Venus, Scallop, Mussels, Oyster and Tellin). Fining upwards. Occasional sub-rounded (up to 40mm) flint. Occasional subrounded metamorphic stones (up to 40mm). Moderate worm tubes and sea mat throughout. Diffuse boundary.
1.22-3.85	45.72-48.35	10YR5/4 Yellowish brown. Fine/medium sand. Frequent broken shell (very occasionally whole including Scallops, Mussels, Oysters, Venus, Saddle oysters, Topshell, Little ear, Whelk). Occasional subrounded (up to 4mm) flint. Occasional (small 5mmm) sea urchins, sponges and tube worms. Massive. Whole scallops at 362 and 372. Clear boundary.
3.85-4.00	48.35-48.50	10YR5/4 Greyish brown. Fine sand. Moderate finely crushed shell. Sorted. Clear boundary.
4.00-4.70	48.50-49.20	10YR5/2 Greyish brown. Sandy gravel. Very frequent subrounded to subangular (up to 70mm) flint. Occasional ?erratics. Poorly sorted. Occasional roots.

VC2

Depth below seabed (m)	Depth below OD (m)	Description
0.00-0.48	43.73-44.21	10YR 5/4 Yellowish brown. Medium/coarse sand (with occasional grey silty clay). Frequent broken shell (occasionally intact including Venus, Saddle oyster and Oyster). Tube worms on shell. Moderate subrounded (up to 10mm) flint. Poorly sorted. Diffuse boundary.
0.48-1.62	44.21-45.35	10YR 5/4 Yellowish brown. Coarse sand. Very frequent broken shell (occasionally intact including Oysters Scallops, Little ear, Tellin, Saddle oyster). Tube worms on shell. Occasional subangular to subrounded (up to 40mm) flint. Very occasional fossil large benthic forams. Poorly sorted. Massive. Diffuse boundary.
1.62-2.44	45.35-46.17	10YR 5/4 Yellowish brown. Medium sand. Moderate broken shell (including Scallop, Topshell, Tellin, Oyster, Cockle -1). Very occasional rounded (up to 4mm) flint. Poorly sorted. Massive. Diffuse boundary.
2.44-3.30	46.17-47.03	10YR 5/4 Yellowish brown. Coarse sand. Very frequent broken shell (including Venus, Oyster, Tellin, Scallop, Mussels). Occasional subrounded to angular (up to 20mm) flint. Tube worms on shell. Poorly sorted. Massive. Diffuse boundary.
3.30-3.48	47.03-47.21	10YR 5/4 Yellowish brown. Medium sand. Frequent broken shell (including Scallops, Tellins, Venus none intact). Occasional subrounded (up to 2mm) flint. Massive. Poorly sorted. Diffuse boundary.
3.48-3.58	47.21-47.31	10YR 5/6 Yellowish brown. Coarse sand. Very frequent broken shell (including Oyster, Tellins, Mussels). Tube worms on shell. Occasional (up to 10mm) subrounded flint. Massive. Poorly sorted. Diffuse boundary.
3.58-4.40	47.31-48.13	10YR 5/6 Yellowish brown. Medium sand. Very frequent broken shell (including Mussels, Tellin, Venus occasionally intact). Occasional pockets of coarse sand. Massive. Poorly sorted. Diffuse boundary.

Depth below seabed (m)	Depth below OD (m)	Description
4.40-4.57	48.13-48.30	10YR 5/6 Yellowish brown. Coarse sand. Very frequent broken shell (including Scallop and Little Ear occasionally intact). Occasional subrounded (up to 35mm) flint. Massive. Poorly sorted. Diffuse boundary.
4.57-4.90	48.30-48.63	10YR 5/6 Yellowish brown. Medium sand. Frequent broken shell (including Tellin, Scallop, Little ear. Occasional; subrounded (up to 5mm) flint. Massive, poorly sorted.

VC 3

Depth below seabed (m)	Depth below OD (m)	Description
0.00-0.19	52.35-52.54	10YR4/4 Dark yellowish brown. Medium/coarse gravelly sand with occ. grey silty clay. Moderate subrounded to subangular (up to 10mm) flint. Moderate broken shell (inc. bivalves). Diffuse boundary.
0.19-0.36	52.54-52.71	10YR4/4 Dark yellowish brown. Coarse gravelly sand with occ. grey silty clay. Occasional subrounded to angular (up to 7mm) flint. Frequent broken shell (inc. bivalves, gastropods). Clear boundary.
0.36-2.16	52.71-54.51	10YR6/6 Brownish yellow. Medium/coarse sand. Occasional small (up to 10mm) subrounded to subangular flint. Very frequent broken shell (inc. Tellins, Saddle oyster, Scallops, Whelk, Oyster, Venus). Sorted. No sedimentary architecture. Diffuse boundary.
2.16-2.90	54.51-55.25	10YR6/6 Brownish yellow. Medium/coarse sand. Occasional small (up to 5mm) rounded to subangular flint. Very frequent broken shell (inc. Tellins, Saddle oyster, Oyster, Topshell. Scallop, Urchins). Sorted. Bands of fine/medium sand (up to 20mm thick). Diffuse boundary.
2.90-3.25	55.25-55.60	10YR6/3 Pale brown. Sandy gravel (flint subangular to rounded up to 45mm). Matrix - medium sand (?quartz 90%, brown/black 10%, occasional broken shell including *Mytilus edulis*).
3.25-3.33	55.60-55.68	10YR6/3 Pale brown. Medium sand (70-80% opaque ?quartz, 5% black, 10-15% red/brown). Very occasional (one) 25mm diameter rounded flint. Sharp (and angled) boundary.
3.33-3.44	55.68-55.79	2.5Y5/6 Light olive brown. Medium/fine sand (80% opaque ?quartz, 5%black, 10-15% red/brown). Well sorted. Sharp (angled) boundary.
3.33-3.39	55.68-55.74	10YR4/2 Inclusion of dark greyish brown, gravelly fine/medium sand. Frequent subrounded to rounded white ?pebbles? (up to 15mm). Occasional small subrounded ?metamorphic rocks (up to 7mm.) Occasional broken shell. Sharp (angled) boundary. This is a wedge shaped lens.
3.44-4.10	55.79-56.45	10YR4/1 Dark grey fine/medium sand (90% opaque ?quartz, 5%black, 5% yellow/brown). 400-410 loose. Diffuse boundary.
4.10-4.20	56.45-56.55	10YR4/1 Dark grey. Fine/medium sand (90% opaque ?quartz, 5%black, 5% yellow/brown). Massive. Occasional shell (Tellin). Occasional rounded (up to 7mm) flint. Very occasional lumps (up to 10mm) of grey clay.
4.20-4.26	56.55-56.61	10YR4/1 Dark grey. Clayey silty fine sand (90% opaque ?quartz, 10% black). Occasional subangular to rounded (up to 3mm) flint (concentrated towards base). Abrupt boundary.
4.26-4.32	56.61-56.67	10YR3/1 Very dark grey. Fine sand (90% opaque ?quartz, 10% black). Slightly visible bedding. Abrupt boundary.
4.32-4.48	56.67-56.83	10YR3/1 Very dark grey. Sand/ silty clay. Laminar (up to 40mm clay laminae interbedded with fine sand - ?flood couplets?). Black ?organic flecks within the silty clay. Darker ?organic bands. Abrupt boundary.
4.48-5.21	56.83-57.56	10YR3/1 Very dark grey. Fine sand (90% opaque ?quartz, 10%black. Occasional roots (to 5.02m). Faintly visible laminae.

VC4

Depth below seabed (m)	Depth below OD (m)	Description
0.00-0.34	44.56-44.90	10YR 5/4 Yellowish brown. Medium/coarse sand (very occasional grey silt). Very frequent broken shell (including Scallop and Venus occasionally intact). Occasional subrounded (up to 25mm) flint. Massive. Poorly sorted. Diffuse boundary.
0.34-1.50	44.90-46.06	10YR 6/4 Yellowish brown. Coarse sand. Very frequent broken shell (including Venus, Scallops, Mussels, Tellins, Gastropods) Moderate tube worms. Occasional (less than 10mm) subrounded flint, chalk and erratics (?igneous). Coarsening up. Poorly sorted. Diffuse boundary.
1.50-4.00	46.06-48.56	10YR 6/6 Brownish yellow. Medium sand. Very frequent broken shell (including Tellin, Mussel, Scallop, Oyster, Saddle oyster, gastropods very occasionally intact). Poorly sorted - sorted towards base.

VC5

Depth below seabed (m)	Depth below OD (m)	Description
0.00-0.31	46.46-46.77	10YR 6/4 Light yellowish brown. Medium/coarse (silty 1%) sand. 75% broken unidentifiable shell, 25% opaque ?quartz. Occasional rounded to subrounded (< 10mm) flint. Poorly sorted. Massive. Diffuse boundary.
0.31-0.63	46.77-47.09	10YR 6/4 Light yellowish brown. Medium/coarse (silty <1%) sand. 75% broken shell (including moderate intact Venus) 25% clear/opaque ?quartz. Moderate rounded to subrounded (< 70mm) flint. Poorly sorted. Large flints at base. Abrupt boundary.
0.63-1.55	47.09-48.01	10YR 4/4 Dark yellowish brown. Fine sand (95% clear/opaque ?quartz, 5% black). Well sorted. Darker wavy bedding ?FeO. Occasional subrounded to subangular (< 25mm) flint. Gradual boundary.
1.55-1.95	48.01-48.41	10YR 5/6 Yellowish brown. Fine/medium sand. (85% opaque ?quartz, 10%black, 5% broken shell). Banding of alternate fine/medium sand. Very occasional small (<5mm) rounded to subrounded flint. Clear boundary.
1.95-2.30	48.41-48.76	10YR 6/6 Brownish yellow/ 10YR 6/2 Light brownish grey. Fine/medium sand (80% opaque ?quartz, 20%black). Well sorted. Very occasional subrounded to rounded (<7mm) flint. Vertical-diagonal and slightly wavy (disturbed by coring?) banding of darker brown FeO? Clear (angled) boundary.
2.30-2.82	48.76-49.28	10YR 6/1 Grey. Fine sand. (90% opaque ?quartz, 10% black). Feintly visible horizontal bedding. Occasional broken shell (<3mm). Abrupt boundary.
2.82-3.33	49.28-49.79	5Y 4/2 Olive grey. Silty sandy gravel. Poorly sorted. Occasional small (<10mm) lumps of greenish/grey silty sandy clay. Very frequent rounded to angular (<80mm) flint. Matrix - silty sand with occasional broken shell. Abrupt boundary.
3.33-4.00	49.79-50.46	5Y 3/2 Dark olive grey. Silty clay. Very occasional sand. Massive. ?Tertiary bedrock.

VC6

Depth below seabed (m)	Depth below OD (m)	Description
0.00-0.45	46.19-46.64	10YR 5/4 Yellowish brown. Medium/Coarse (silty 1-2%) sand. Very frequent broken shell (including Venus, bivalves and gastropods occasionally intact). Occasional subrounded (<20mm) flint.
0.45-2.21	46.64-48.40	10YR 6/6 Brownish yellow. Coarse sand (90% shell, 10% mineral). Very frequent broken shell (including Venus, Tellin, Scallop, Topshell occasionally intact). Moderate subrounded (<10mm) flint. Very occasional subrounded (<10mm) erratics (?igneous). Pocket of fine/medium sand at 2.07-2.10m. Deposit disturbed (by coring?) at base. Abrupt (steeply angled) boundary.
1.88(2.21)-2.40	48.07 (48.40)-48.59	2.5Y 5/3 Light olive brown. Fine (silty <1%) sand (mineral). Banding (diagonal-vertical) visible (?FeO) 1-10mm. Very well sorted. Sand is mineral in content. Very occasional broken shell (?Scallops, mussels) at base. Abrupt angled boundary.
2.40-2.86	48.59-49.05	2.5Y 5/3 Light olive brown. Fine/medium sand (70% mineral, 30% shell). Moderate broken shell (including Cockles, mussels and scallops occasionally intact). Occasional subrounded (<10mm) chalk and flint. Poorly sorted. Diffuse boundary.
2.86-3.70	49.05-49.89	10YR 5/2 Greyish brown. Medium sand (70% mineral, 30% shell). Bands of coarse and fine sand (<50mm). Frequent broken shell (including Tellin, Mussels, Cockles, Scallops, Gastropods, Whelk). ?Organics at 3.35-3.37. ?bone at .337m.

VC7

Depth below seabed (m)	Depth below OD (m)	Description
0.00-0.20	41.52-41.72	10YR 5/4 Yellowish brown sandy gravel. Very frequent rounded to angular (<50mm) flint. Matrix - medium/coarse sand (90% shell). Poorly sorted. FeO staining. Abrupt boundary.
0.20-0.87	41.72-42.39	7.5YR 4/6 Strong brown. Silty sandy gravel. Frequent (<30mm) rounded to subangular flint. Matrix - medium/coarse sand (90% broken shell). Poorly sorted. FeO staining. Diffuse boundary.
0.87-1.32	42.39-42.84	7.5YR 5/8 Strong brown. Silty sandy gravel. Frequent rounded to subrounded (<50mm) flint. Matrix - silty (shelly) sand (medium/coarse). FeO staining. Clear boundary.
1.32-1.43	42.84-42.95	10YR 5/6 Yellowish brown. Gravelly silty sand. Moderate rounded to subrounded (<15mm) flint. Matrix - silty (shelly) sand (medium/coarse). Very frequent broken shell. Sorted. FeO staining Abrupt boundary.
1.43-1.79	42.95-43.31	10YR 6/1 Grey. Gravelly sand. Moderate to frequent rounded to subangular (<40m) flint. Matrix - silty sand (90% medium/coarse broken shell, 10% mineral). Poorly sorted. Clear boundary.
1.79-1.84	43.31-43.36	2.5YR 6/3 Light yellowish brown. Gravelly sand. Moderate to frequent rounded to subangular (<40mm) flint. Matrix - silty sand (90% medium/coarse broken shell). As above except light brown ?intrusive staining. Poorly sorted.

VC8

Depth below seabed (m)	Depth below OD (m)	Description
0.00-0.50	44.71-45.21	10YR 5/6 Yellowish brown. (Silty 1%) sand (medium/coarse).Very frequent broken shell (including Venus occasionally intact). Occasional subrounded (<10mm) flint. Poorly sorted. Diffuse boundary.
0.50-0.76	45.21-45.47	10YR 5/6 Yellowish brown. Sand (medium/coarse 80%shell, 20%mineral). Very frequent broken shell. Occasional subrounded (<10mm) flint. Poorly sorted. Diffuse boundary
0.76-1.00	45.47-45.71	10YR 5/4 Yellowish brown. Sand (coarse 85% shell, 15% mineral). Very frequent broken shell (including Scallops, Tellin). Occasional tube worms. Occasional subrounded (<5mm) flint. Occasional subrounded (<15mm) chalk. Coarsening up. Sorted. Abrupt boundary.
1.00-1.20	45.71-45.91	10YR 5/4 Yellowish brown. Sand (fine). Occasional broken shell. Occasional subrounded (<5mm) flint. Well sorted. Abrupt boundary.
1.20-1.84	45.91-46.55	10YR 6/4 Light yellowish brown. Sand (medium/coarse). Very frequent broken shell (including Mussels, Scallops). Sea urchins (<6mm) at 1.40m. Disturbed by coring. Gradual boundary.
1.84-2.21	46.55-46.92	2.5Y 5/3 Light olive brown. Sand (fine). Wavy ?FeO staining. Occasional ?organics.
2.21-4.42	46.92-49.13	5Y 5/2 Olive grey. Sand (fine). Feintly visible horizontal bedding. ?organics throughout particularly 2.74-2.84m. Well sorted.

APPENDIX II: POLLEN AND DIATOM ASSESSMENT/ANALYSIS

Dr Rob Scaife
School of Geography
University of Southampton
Highfield
Southampton SO17 1BJ

1.) Introduction

Pollen analysis has been carried out on ten samples selected from the principal lithostratigraphical units identified in vibro-cores 1, 3 and 5. The principal aim of the study was to ascertain if sub-fossil pollen and spores are present in the range of sediments encountered. If, present, diagnostic pollen assemblages can corroborate the general age of the material, provide a preliminary view of taxa present and the local vegetation environment. Of the ten samples examined, only one contained pollen in sufficient quantity to enable a pollen count to be made. However, this sample demonstrates the potential of at least some of the fine-grained sediments for further pollen analysis. This might prove important since data obtained can be used to study migration/arrival of trees during the early Holocene and thus, changing environment of the early Mesolithic human environment. Samples were also examined for diatoms which might provide evidence of salinity. These were, however, absent in all of the samples examined including the fine-grained units.

2.) Pollen techniques

Because of the coarseness and minimal humic content of this material, samples of 4-5 ml. were used, that is, except for the single fine-grained silty sample (VC3; 4.35m) where a standard 1.5ml sample was prepared. After deflocculation with Sodium hydroxide, decanting was used to remove the coarse sands. This was followed by treatment by Hydrofluoric acid for further removal of silica. Acetolysis was used, and although this would have been superfluous on those samples with extremely small humic content, the single sample which did contain pollen it proved useful for removal of organic debris and restoring pollen size after extended treatment using hydrofluoric acid.

3.) Results of Analysis

Pollen was only present in a fine-grained sample from unit 7ii at 4.35m in VC3. Other similar fine-grained material is, however, available in other cores. A pollen count of 297 grains was made from this sample. The taxa and counts made are listed in the table below. Pollen was, in general, well preserved with absolute pollen frequencies in the region of 30,000 grains/ml. Overall, trees are dominant with few shrubs and herbs. The pollen spectrum is described as follows.

3.i.) Trees and Shrubs; *Pinus* (pine) is dominant with *Betula* birch). The only other tree is a single grain of *Alnus* (alder). Shrubs comprise *Salix* (willow) with single occurrence of *Erica* (heather).

3.ii.) Herbs; Poaceae (grasses) and Cyperaceae (sedges) are most important with range of other taxa which occur sporadically. These are predominantly wet fen and wet grassland types such as *Thalictrum* (meadow rue) and *Sanguisorba officinalis* (greater burnet).

3.iii.) Spores: There are very few spores with only individual occurrences of monolete *Dryopteris* type (typical ferns) and *Osmunda regalis* (Royal Fern).

3.iv.) Miscellaneous: There are derived pre-Quaternary palynomorphs and small numbers of Hystrichospheres (possibly derived) and cysts of algal *Pediastrum*.

4.) Discussion

This pollen spectrum is dominated by pine and birch pollen. Although both of these are anemophilous and often over represented in pollen spectra, the substantial numbers recorded here do suggest local growth and dominance on drier ground. Absence of any other tree and shrub taxa is a clear indication that this material is either of very early Holocene, Flandrian Chronozone I or possibly late glacial interstadial (Windermere/Allerød; Zone II.) The latter is a possibility since a radiocarbon date of 9,811+/-35BP some 1.4m higher in the profile would place this pollen spectrum in the very earliest stages of the Devensian/Holocene transition. Allerød/Zone II date would be commensurate with development of pine and birch woodland although the very early Holocene colonisation by these taxa is also a strong possibility given that this site was on the early migration route for pine from its glacial refugeum (Birks 1998). Clearly, in any subsequent analyses of these cores, efforts should be made to date this lithostratigraphic unit. This would provide valuable information on the early migration of these trees into southern England after the close of the last cold stage.

There are few herbs in the spectrum, but where these do occur, they most probably reflect the on-site vegetation. That is, the evidence suggests a wet herb fen with fringing wet meadow taxa. There is no palynological evidence for any marine or brackish water influences in this sample although clearly, marine transgression occurred over the site by *ca.* 8,200 BP (6,800 cal. BC).

5.) Conclusions and suggestions for additional work

Pollen survives only in the more humic and finer grained sediments laid down in a lower energy environment than the coarser sands which are present throughout much of the sequence. At 4.35m in VC3, pine and birch are dominant suggesting boreal type woodland which colonised this site during the late glacial interstadial (Allerød from *ca.*11,000 to 12,000BP/ 10,900 – 11,800 cal. BC) or during the early part of the Holocene (Pre-Boreal: Flandrian chronozone Ia) at *ca.* 10,000 to 9,800 BP (9,600 – 9,200 cal. BC).

Any further work should concentrate on the humic, silty horizons in this and the other cores. Special effort should be made to date these horizons since, as noted above, they may provide valuable evidence for the history of woodland colonisation in southern Britain during the early Mesolithic period.

References

Birks, H.J.B., 1989, 'Holocene isochrone maps and patterns of tree spreading in the British Isles', *Journal of Biogeography* 16, 503-540.

Table: Pollen and spores recovered from Seabed - Offshore VC3 at 4.35m:

Trees	
Betula	46
Pinus	196
Alnus	1
Salix	3
Erica	1
Herbs	
Thalictrum	1
Ranunculus type	1
Sanguisorba officinalis	1
Artemisia	1
Lactucoideae	1
Poaceae	28
Cyperaceae	17
Spores	
Monolete (Dryopteris type*).*	1
Osmunda regalis	1
Misc.	
Pediastrum	3
Hystrichospheres	1
Pre-Quaternary *palynomorphs*	15
Total Pollen	297
Total Spores	2

APPENDIX III: FORAMINIFERA ASSESSMENT

Jack Russell
Wessex Archaeology

Introduction

Twelve sub-samples taken from vibrocores VC1, VC3 and VC5 have been assessed for the presence and environmental significance of foraminifera. The sediments are thought to comprise of palaeochannel infills and shallow marine sediments. Foraminifera were present in low numbers in ten of the 12 samples.

Method

Sediment was wet sieved through a 63µm sieve. The sediment was dried and sieved through 500µm, 250µm, 125µm sieves. Foraminifera were picked out under 10-60x magnification under transmitted and incident light using a Meiji EMT microscope. Where possible 50 specimens per sample were picked out and kept in card slides. Identification follows Murray (1979) and interpretation of their ecology follows Murray (1991) and Haslett *et al.* (1997).

Results

Assessment of the samples is summarised in **Table 1**. Abundance of foraminifera was generally low, with total counts ranging from 0 to 55. As the numbers of foraminifera recovered is low relative abundance of taxa has not been calculated.

VC1 (2 samples):

At 3.90m abundance of foraminifera was low to medium and the assemblage was dominated by reworked fossil taxa. These were mostly large benthic foraminifera. The rest of the assemblage contained marine taxa including *Elphidium gerthi* and Miliolids usually found in inner shelf environments.

At 4.62m abundance of foraminifera was very low with only seven foraminifera present, four of which were reworked fossil taxa. The remaining taxa *Cibicides lobalatus*, *Clavulina obscura* and *Glabratella milletti* are all marine taxa indicative of inner shelf environments.

VC3 (7 samples)

At 2.82m abundance of foraminifera was low to medium totalling 55. The assemblage is dominated by Miliolids indicative of marine inner shelf environments (*Massilina secans*, *Patellina corrugata*, *Quinqueloculina lata* and *Quinqueloculina seminulum*). *Elphidium gerthi* and *Glabratella millettii* both marine inner shelf taxa were also present in significant numbers. *Miliolinella subrotundata* was recovered which can be found in marine inner shelf environments and at estuary mouths. *Trochammina inflata* a salt marsh indicator and two marine planktonic taxa are probably transported. Reworked fossil taxa were also present.

At 3.04m abundance of foraminifera was very low. Seven reworked fossil taxa and one marine inner shelf foraminifera (*Brizalina sp.*) were present in the sample.

At 3.34m and 3.78m no foraminifera were recovered from the samples.

At 4.42m abundance of foraminifera was very low. Four fossil taxa, three *Elphidium sp.* (tolerant of brackish/marine environments) and one *Jadammina macrescens* (usually associated with salt marshes) were present.

At 4.46m abundance of foraminifera was very low with one reworked fossil Rotalid present.

At 4.82m abundance of foraminifera was low with 31 foraminifera present. The assemblage is dominated by *Lamarckina haliotidea* (a marine inner shelf taxa preferring muddy substrates and often transported into estuaries), *Elphidium incertum* (a marine inner shelf taxa), *Jadammina macrescens* (a salt marsh taxa). *Elphidium williamsoni* and *Elphidium incertum* were also present both indicative of brackish environments. Reworked fossil taxa were also present.

VC5 (3 samples)
At 0.88m abundance of foraminifera was low with 19 foraminifera recovered. The assemblage is dominated by Miliolids indicative of marine inner shelf environments (*Quinqueloculina cliavensis*, *Quinqueloculina lata* and *Quinqueloculina seminulum*). Reworked fossil taxa were also present in significant numbers.

At 2.16m abundance of foraminifera was very low with seven foraminifera recovered. The assemblage was dominated by *Elphidium sp.* (euryhaline) and *Elphidium macellum* (a marine inner shelf taxa). One reworked fossil taxon was recovered.

At 2.76m abundance of foraminifera was very low with five foraminifera recovered. The recovered foraminifera were all reworked fossil taxa.

Discussion
Abundance of foraminifera was low in all of the samples. The sediments processed were mostly sand and gravelly sand which indicate high energy deposition. This high energy causes reworking of robust taxa and can destroy taxa with more fragile tests. The preserved taxa within these sand deposits are therefore low in abundance and dominated by more robust and reworked taxa.

The two samples (3.90m and 4.62m) in **VC1** produced low numbers of marine inner shelf taxa. The sample at 3.90m is dominated by Miliolids and *Elphidium gerthi* marine inner shelf taxa and it is probable that this sample is analogous to foraminiferal Zone 1 described below. The sample at 4.62m produced very low numbers and as such cannot confidently be ascribed an environment or zone.

VC3 also had low numbers of foraminifera. A broad foraminiferal zonation can however be attempted from this core with a definitely marine inner shelf assemblage at the top (Zone 1) and with a more mixed marine/brackish assemblage (Zone 2) at the base of the core.

Zone 1. This zone is defined by sample 2.82m with the assemblage indicative of a marine inner shelf environment.

Samples at 3.04m, 3.34m 3.38m, 4.42m and 4.46m produced very low amounts or no foraminifera and are thus not ascribed a foraminiferal zone.

Zone 2. This zone is defined by the sample at 4.82m. This sample produced an assemblage containing foraminifera indicative of both marine inner shelf and brackish water environments. Murray (1971) suggests that the dominant taxa in this zone *Lamarckina haliotidea* although a marine inner shelf taxa, is often transported into estuary mouths. *Elphidium williamsoni* and *Elphidium incertum* present also point towards a brackish water environment. It is possible that the depositional environment of this sample is estuarine with a significant marine input (i.e. estuary mouth).

Of the three samples (0.88m, 2.16m and 2.76m) in **VC5** only the sample at 0.88m produced significant numbers of foraminifera. This sample was dominated by Miliolids (*Quinqueloculina cliavensis*, *Quinqueloculina lata* and *Quinqueloculina seminulum*) indicative of a marine inner shelf environment and is analogous to Zone 1 described in **VC3**.

The zonation described above is considered to be of low resolution although a useful indication of environmental change and probably sea level rise through **VC3**. The low abundance and lack of foraminifera in some samples from the middle of the sequence is not unusual for sand deposits.

Further Work

As abundance in the samples is very low further examination of gravels, gravelly sands and sand samples from these cores is not recommended.

References

Haslett, S.K., Davies, P. and Strawbridge F., 1997, 'Reconstructing Holocene Sea-level Change in the Severn Estuary and Somerset Levels: The Foraminifera Connection', *Archaeology in the Severn Estuary* 8:29-40.

Murray, J.W., 1979, *British Nearshore Foraminiferids,* London: Academic Press.

Murray, J.W., 1991, Ecology and Palaeoecology of Benthic Foraminifera, Harlow: Longman Scientific.

Table 1. Numbers of foraminifera per sample in **VC1**, **VC3** and **VC5**

Vibrocore	**VC1**		**VC3**							**VC5**		
Depth(m)	**3.9**	**4.62**	**2.82**	**3.04**	**3.34**	**3.78**	**4.42**	**4.46**	**4.82**	**0.88**	**2.16**	**2.76**
Ammonia sp.									1			
Brizalina sp.				1								
Brizalina variabilis		1										
Cibicides lobalatus	1								1			
Clavulina obscura		1										
Elphidium sp.							3				4	
Elphidium excavatum									2			
Elphidium gerthi	9		7									
Elphidium incertum									5			
Elphidium macellum											2	
Elphidium williamsoni									3			
Gavelinopsis sp.										1		
Glabratella millettii		1	4									
Jadammina macrescens							1		4			
?Lamarckina haliotidea			2						6			
Massilina secans			8									
Miliolinella subrotundata	5		5									
Patellia corrugata	1		1									
Quinqueloculina cliarensis										3		
Quinqueloculina lata	2		7							3		
Quinqueloculina seminulum	4		9							5		
Trifarina angulosa			1									
Trochammina inflata			2									
Planktonics			2						1			
Fossils	18	4	7	7			5	1	5	7	1	5
Zone	1		1						2	1		

APPENDIX IV: OSTRACOD ASSESSMENT

Jack Russell
Wessex Archaeology

Introduction
Twelve sub-samples taken from vibrocores **VC1**, **VC3** and **VC5** have been assessed for the presence and environmental significance of foraminifera. The sediments are thought to comprise of palaeochannel infills and shallow marine sediments. Ostracods were present in low numbers.

Method
Sediment was wet sieved through a 63µm sieve. The sediment was dried and sieved through 500µm, 250µm, 125µm sieves. Foraminifera were picked out under 10-60x magnification under transmitted and incident light using a Meiji EMT microscope. Where possible 50 specimens per sample were picked out and kept in card slides. Identification and environmental interpretation follows Athersuch *et al.* (1989) and Meisch (2000).

Results
Assessment and analysis of the samples are summarised in **Table 1**. Abundance of ostracods was generally low with total counts ranging from 0 to 52.

VC1 (2 samples):
At 3.90m abundance of ostracods was very low. Three broken and unidentifiable specimens and one *Celtia* sp. (a marine taxa) were recovered.

At 4.62m the sample contained no ostracods.

VC3 (7 samples)
At 2.82m abundance of ostracods was low. Of 11 taxa recovered nine were broken and unidentifiable. One example of *Paracytheridea cuneiformis* (marine/sublittoral) and one *Jonesia* sp. (marine) were recovered.

At 3.04m, 3.34m and 3.78m no ostracods were recovered from the samples.

At 4.42m abundance of ostracods was low to medium with a total of 34. Of these 14 were broken and unidentifiable. The sample was dominated by *Ilyocypris monstrifica* and *Candona candida,* both freshwater taxa. Other freshwater indicators were present including *Ilyocypris bradyi, Leptocythere pellucida, Limnocythere inopinata* and *Limnocytherina sanctipatricii*. One specimen of *Cythere lutea* (a marine/shallow sublittoral taxon) was also present.

At 4.46m the abundance of ostracods was medium with a total of 52. The assemblage is dominated by *Ilyocypris monstrifica* and *Candona candida,* both non-marine taxa. Additional freshwater indicators were present including *Fabaeformiscanodona levanderi Ilyocypris bradyi* and *Limnocythere inopinata*.

At 4.82m the abundance of ostracods was low with a total of 18. The assemblage included *Ilyocypris monstrifica, Ilyocypris bradyi* and *Candona candida* (non-marine taxa). *Aurila* sp., *Hemicythere* sp. and *Propontocypris* sp. (brackish/marine taxa) were present in low numbers.

VC5 (3 samples)
No ostracods were present in any of the samples at 0.88m, 2.16m and 2.76m.

Discussion
Abundance of ostracods was low in all of the samples. The sediments processed were mostly sand and gravelly sand which indicate high energy deposition. This high energy causes the destruction of the fragile valves particularly of the instar stages. In many of the samples this process was attested to by significant numbers of broken valves. The lack of instar stages in many of the samples is both indicative of reworking of sediment and destruction of these more fragile ostracods.

The two samples from **VC1** (3.90m and 4.62m) only produced one identifiable ostracod (*Celtia sp.* from sample 3.90m). Inference about the depositional environment cannot be attempted from the ostracod assemblage within these samples. Of the three samples (0.88m, 2.16m and 2.76m) in **VC5** no samples produced ostracods.

VC3 also had generally low numbers of ostracods. At 2.82m two identifiable ostracods were recovered, *Paracytheridea cuneiformis* (marine/sublittoral) and *Jonesia* sp., both indicative of marine and sublittoral environments, but their low number precludes informative environmental conclusions to be drawn. At 3.04m, 3.34m and 3.78m no ostracods were recovered from the samples.

The samples at 4.42m, 4.46m and 4.82m produced similar assemblages indicative of freshwater environments. At 4.42m ostracods were present in low numbers and the assemblage was dominated by *Ilyocypris monstrifica* and *Candona candida.* The taxa were represented by their adult forms and as such possibly represent a slightly reworked assemblage. At 4.46m the assemblage is similar dominated by *Ilyocypris monstrifica* and *Candona candida* with both adult and instar stages present. These ostracods are therefore most likely to represent the depositional environment. *Ilyocypris monstrifica* and *Ilyocypris bradyi* are known to prefer large slow moving or still waterbodies. *Candona candida* is known to prefer stagnant or slow flowing freshwaters with a muddy substrate (Meisch 2000). At 4.82m the abundance of ostracods is low however the assemblage is dominated by adult forms of non-marine taxa (including *Ilyocypris monstrifica*). A few brackish and marine taxa (*Aurila* sp., *Hemicythere* sp. and *Propontocypris* sp.) were recovered. The presence of these marine and brackish water taxa is interesting. They are rare within these samples and are probably redeposited. These might indicate proximity to coastal waters (within reach of tidal or storm surges) although these samples are overwhelmingly indicative of a predominantly freshwater body.

Further Work
As abundance in some of the samples is very low further examination of gravels, gravelly sands and sand samples from these cores is not recommended. The clays and silty clays within vibrocore VC3 are of interest and if dating of these sediments were achieved further analysis of their ostracod content might prove interesting.

References

Athersuch, J., Horne, D.J. and Whittaker, J.E., 1989, *Marine and Brackish Water Ostracods,* Synopses of the British Fauna (New Series) No. 43. Leiden/New York/København/Köln: E.J. Brill.

Meisch, C., 2000. *Freshwater Ostracoda of Western and Central Europe*, Süßwasserfauna von Mitteleuropa 8/3. Heidelberg/Berlin: Spektrum Akademischer Verlag.

Table 1. Ostracods presence/absence in **VC1** and **VC3**

Vibrocore	**VC1**		**VC3**						
Depth (m)	**3.9**	**4.62**	**2.82**	**3.04**	**3.34**	**3.78**	**4.42**	**4.46**	**4.48**
Aurila sp.									x
Candona candida							xx	x	x
Candona sp.							x	x	x
Celtia sp.	x								
Cythere lutea							x		
Eucypris sp.							x		
Eucythere sp.							x		
Fabaeformiscandona levanderi								x	
Hemicythere sp.									x
Ilyocypris bradyi							x	x	x
Ilyocypris monstrifica							xx	xx	x
Jonesia sp.			x						
Leptocythere sp.							x		
Leptocythere pellucida							x		
Limnocythere inopinata							x	x	x
Limnocytherina sanctipatricii							x		
Paracytheridea cuneiformis			x						
Propontocypris sp.									x

x – present (1-10 specimens)
xx – abundant (11-50 specimens)
xxx – very abundant (greater than 50 specimens)

APPENDIX V: RADIOCARBON (^{14}C) DATING

Dr Michael J. Allen
Wessex Archaeology

A series of three samples were submitted for AMS radiocarbon dating at Rafter Radiocarbon Laboratory, Institute of Geological & Nuclear Sciences, New Zealand and were funded by MIRO. In each case mollusc shell remains were extracted and dated. All radiocarbon results have been calibrated with the marine data presented by Stuiver *et al.* (1998) and performed on OxCal ver 4.0.1 (Bronk Ramsey 1995; 2001) and are expressed at the 95% confidence level with the end points rounded outwards to 10 years following the form recommended by Mook (1986).

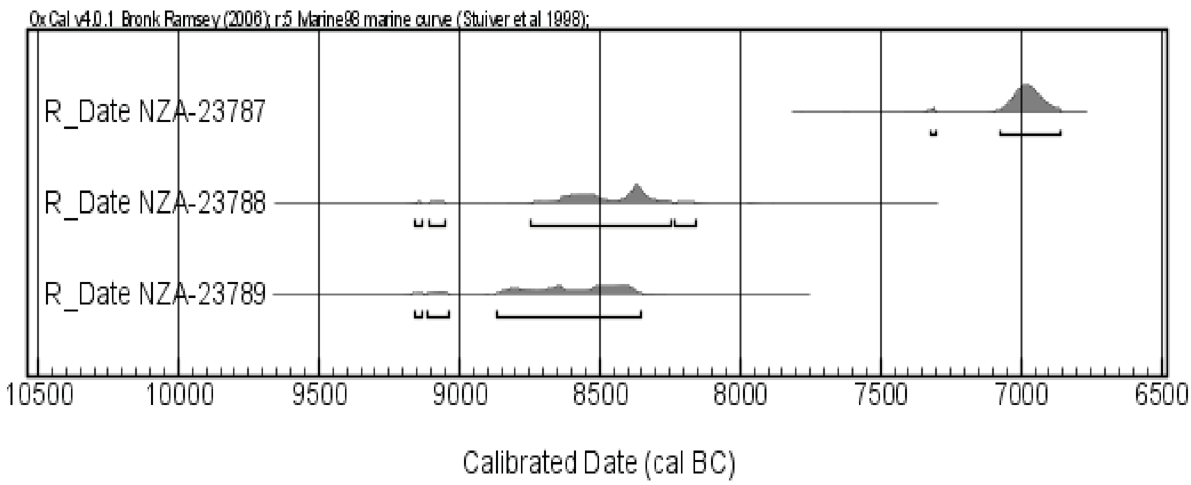


Figure 1. Calibrated radiocarbon results of shell dates from the Eastern English Channel survey area.

Core	*Unit*	*Depth (m)*	*Depth (m below OD)*	*Material*	*Lab no*	*Result no*	*δC^{13} ‰*	*Result BP*	*Cal. BC*
VC1	Unit 10	3.66	47.90	Shell: mussel	R29120/1	NZA-23787	1.4	8442±35	7320 - 6860
VC1	Unit 8	4.62	48.86	Shell: tellin	R29120/2	NZA-23788	-3.4	9663±35	9160 - 8150
VC3	Unit 8	3.04	55.13	Shell: tellin	R29120/3	NZA-23789	-4.9	9811±35	9160-8350

Table 1. Radiocarbon results of shell dates from the Eastern English Channel survey area.

References:

Bronk Ramsey, C., 1995, 'Radiocarbon Calibration and Analysis of Stratigraphy: The OxCal Program', *Radiocarbon* 37(2):425-430.

Bronk Ramsey, C., 2001, 'Development of the Radiocarbon Program OxCal', *Radiocarbon* 43(2A):355-363.
Mook, W.G., 1986, 'Business meeting: recommendations/resolutions adopted by the twelfth International Radiocarbon Conference', *Radiocarbon* 28:799.
Stuiver M., P.J. Reimer and T.F.Braziunas 1998 High-precision radiocarbon age calibration for terrestrial and marine samples, Radiocarbon, 40(3), 1127-1151

APPENDIX VI: OPTICALLY STIMULATED LUMINESCENCE (OSL) DATING

Dr Richard Bailey
then:
Department of Geography
Royal Holloway
University of London
Egham
Surrey TW20 0EX

now:
Oxford Luminescence Dating Laboratory
Oxford University Centre for the Environment
South Parks Road
Oxford OX1 3QY

An assumed 20+/-5% water content for all of the samples results in the following dates:

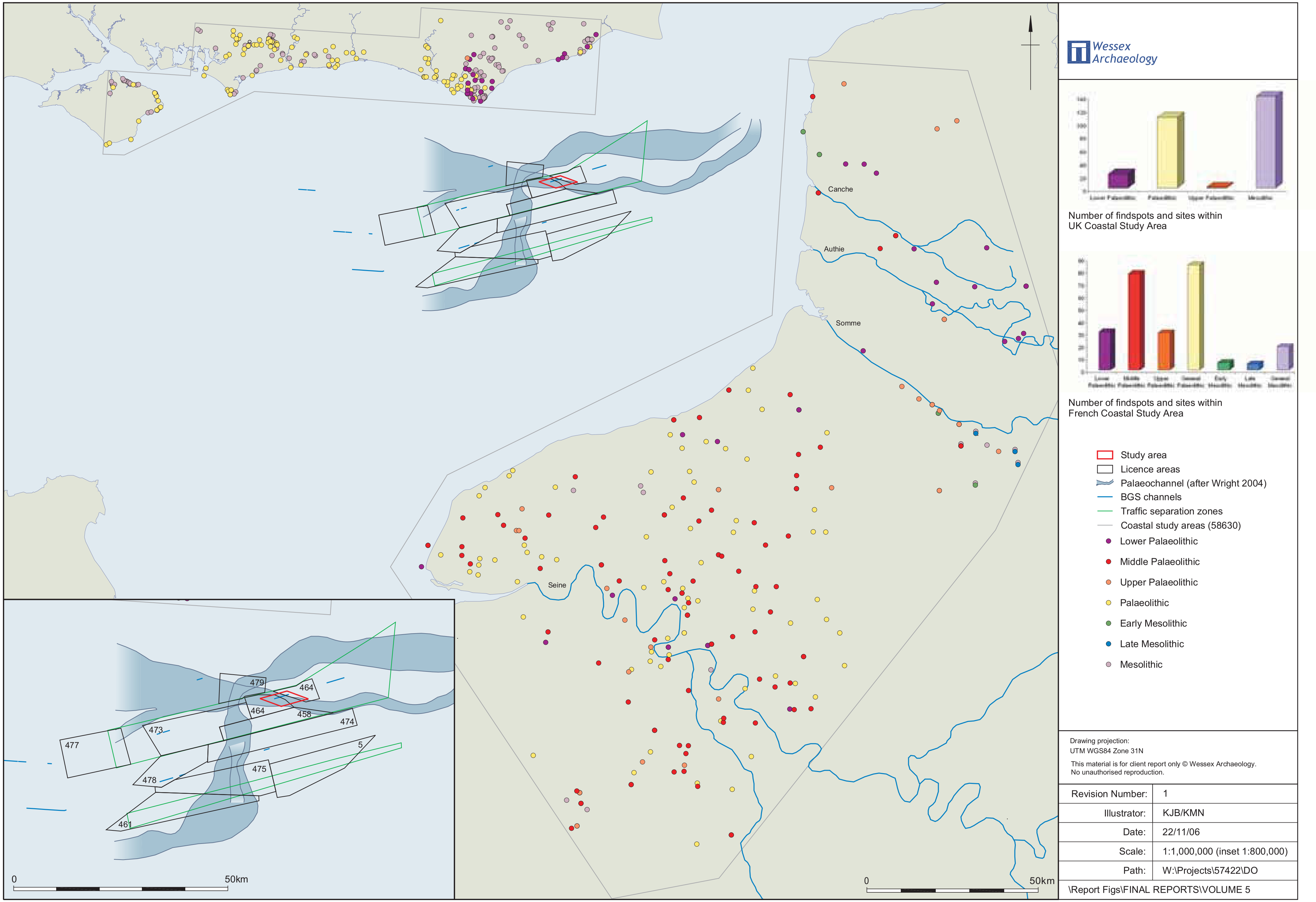
Core	Sediment unit	Depth (m below OD)	Age (ka)	Error (ka)
VC1	Unit 10	48.03	11.91	0.86
VC3	Unit 8	55.12	14.16	1.11
VC3	Unit 7iii	55.58	15.14	1.20
VC5	Unit 3	49.34	21.15	1.53
VC7	Unit 1b	42.88	176.55	19.98
VC7	Unit 1b	41.56	83.19	6.59

A correction needs to be applied to these results. These samples will have been within a metre or two of the surface (i.e. before the sea covered them) for some amount of time.This will make a slight difference to the ages (the difference will be to reduce the age estimates, but by no more than 500 years).

APPENDIX VII: GRAB SAMPLES

Grab	Coordinates		Water depth (m)				Fossils			Erratics		
	Easting	Northing		Slag	Clinker	Coal	Teeth	Forams	Other	Sedimentary	Metamorphic	Igneous
1	328695.9	5600907.1	53.8				1					1
2	328779.1	5600856.2	54.2	1	6	1						
3	328861.3	5600793.2	54.7									
4	328944.3	5600737.2	55		1							
5	329026.8	5600683.5	54.8	1								
6	329110.9	5600629.3	54.7					4				
7	329190.7	5600575	54.8							1	1	1
8	329270.8	5600517	54.8	2						1		
9	329361.2	5600464.1	54.4									
10	329445.9	5600412.6	53.9									
11	329527.8	5600356.4	53.5		1							
12	329614.6	5600298.3	53.2									
13	329700.8	5600241.8	53									
14	329776	5600188.8	52.7	2							1	
15	329862	5600134.1	52.5									1
16	329943.4	5600074	52.1	1			2		1			
17	330031.8	5600024.1	51.3		1							
18	330118	5599968.6	50.5									
19	330198.1	5599909.6	50.1	1	3			1				
20	330283.8	5599860.6	49.6	3		1		1				
21	330340.4	5599960.5	50.2	1					2	1		
22	330249.9	5599994	50.4	1	4							
23	330159.9	5600048.3	50.6	4			1					
24	330081.3	5600108.7	51.2	4	1			3		1		
25	329995.2	5600165.4	48.8	2								
26	329913.9	5600241.1	49.1	1	1	1			1		1	
27	329833.7	5600270.5	49.1	3				2				1
28	329745.6	5600326.9	49.5	2		1						2
29	329662.3	5600381.6	49.8	1	1		1					1
30	329580.6	5600437.8	50									
31	329498.6	5600493.4	50.5									
32	329414.3	5600546.9	50.7	1						1		
33	329328.5	5600603.9	50.7	1					1			
34	329246.1	5600657.7	50.8	1	2	2				2		
35	329163.1	5600708.2	50.6	1	2							
36	329077.8	5600770.3	50.9	3	1	2	1					
37	329000.4	5600819.8	50.9		1							
38	328920.4	5600884	50.3							1		
39	328832.5	5600932.6	50.4		2	1						
40	328748.2	5600982.9	50.5		2	1	1		1			
41	328800.63	5601078.21	45.57	1					1			
42	328885.53	5601020.62	45.22									
43	328972.71	5600963.06	45.3	5	1	2			1		1	
44	329059.33	5600910.07	46.69	3							1	
45	329133.77	5600857.5	48.31	2	1	1		1	1		1	
46	329220.14	5600797.93	49.3									
47	329306.35	5600743.48	49.54									
48	329389.78	5600687.35	49.78	4	9				1	1		
49	329469.07	5600632.28	49.85						1			

Grab	Coordinates		Water depth (m)				Fossils			Erratics		
	Easting	Northing		Slag	Clinker	Coal	Teeth	Forams	Other	Sedimentary	Metamorphic	Igneous
50	329555.56	5600575.48	49.7	1						1		
51	329635.53	5600522.53	49.6									
52	329718.66	5600468.5	49.25		1							
53	329803.63	5600413.33	49.06			1		1			1	
54	329884.69	5600357.86	48.79		4	1						
55	329960.68	5600304.05	48.63		2	2			1			
56	330053.8	5600246.04	48.45	1								
57	330134.64	5600191.86	48.33								1	
58	330223.21	5600136.55	48.06	1								
59	330303.8	5600080.94	47.23	1								
60	330388.17	5600027.58	46.83						1			
61	330443.57	5600110.82	49.47			2						
62	330361.9	5600164.1	51.2	1				1		1		
63	330268.9	5600214.6	51.8									
64	330196.9	5600281.5	52.8	1	1					1	1	
65	330109.2	5600326.1	53	3	1							
66	330031.4	5600380.3	53.2								1	
67	329944	5600438.5	53.7			3		2			2	
68	329866.4	5600493.8	53.8		5	1			1			
69	329780.3	5600549.9	54.7	1						1		1
70	329694.4	5600604.8	54.9		1				1			
71	329612.9	5600659.2	54.9	1	1							
72	329528.6	5600714.1	54.9	2								
73	329441.2	5600769.2	54.1									
74	329362.7	5600827.8	53.5	2	1				2			
75	329274.1	5600882.8	52.3		1				5			
76	329196.2	5600940.8	50.8									
77	329109.6	5600990	50.2	1								
78	329030.1	5601051.6	49.4	1						1		
79	328941.2	5601103	49.1									
80	328858.7	5601160.67	44.38									
81	328919.3	5601239.3	49.9						2			
82	328998.3	5601176.4	49.4							1		
83	329076	5601132.9	49.6									
84	329160.7	5601068.3	50.3									
85	329251.6	5601021.5	51.1		1	1			1	1		
86	329330.7	5600957.1	50.7		1	1	1			1	1	
87	329412.4	5600913.7	51.6	1					1			
88	329494	5600847.8	52.8	1		1					1	
89	329583.4	5600805.1	53.4	2	1		1		1			
90	329675	5600731.3	54.4									
91	329749.47	5600695.62	54.6									
92	329832.2	5600640.7	54.6			1			1			
93	329916.2	5600580.9	54.4		1							
94	330000.8	5600526.2	54.1	1						1		
95	330086.4	5600477.9	54.1							1		
96	330170.5	5600419.9	53.8									
97	330265.6	5600360.6	53.7				1					
98	330327.5	5600305.1	53.5	1								
99	330418.3	5600243.6	53						1			
100	330499.2	5600192.3	52.7	2	1	1					1	



Drawing projection:
UTM WGS84 Zone 31N

Revision Number:	1
Illustrator:	KJB/KMN
Date:	22/11/06
Scale:	1:1,000,000 (inset 1:800,000)
Path:	W:\Projects\57422\DO

\Report Figs\FINAL REPORTS\VOLUME 5

Presence of palaeochannels in the Eastern English Channel and locations of prehistoric findspots and sites

Figure V.1

a) Survey vessel: MV *Ocean Seeker*

b) Survey vessel: MV *Ocean Seeker*

Wessex Archaeology	Date:	27/11/06	Illustrator:	KJB/KMN
	Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

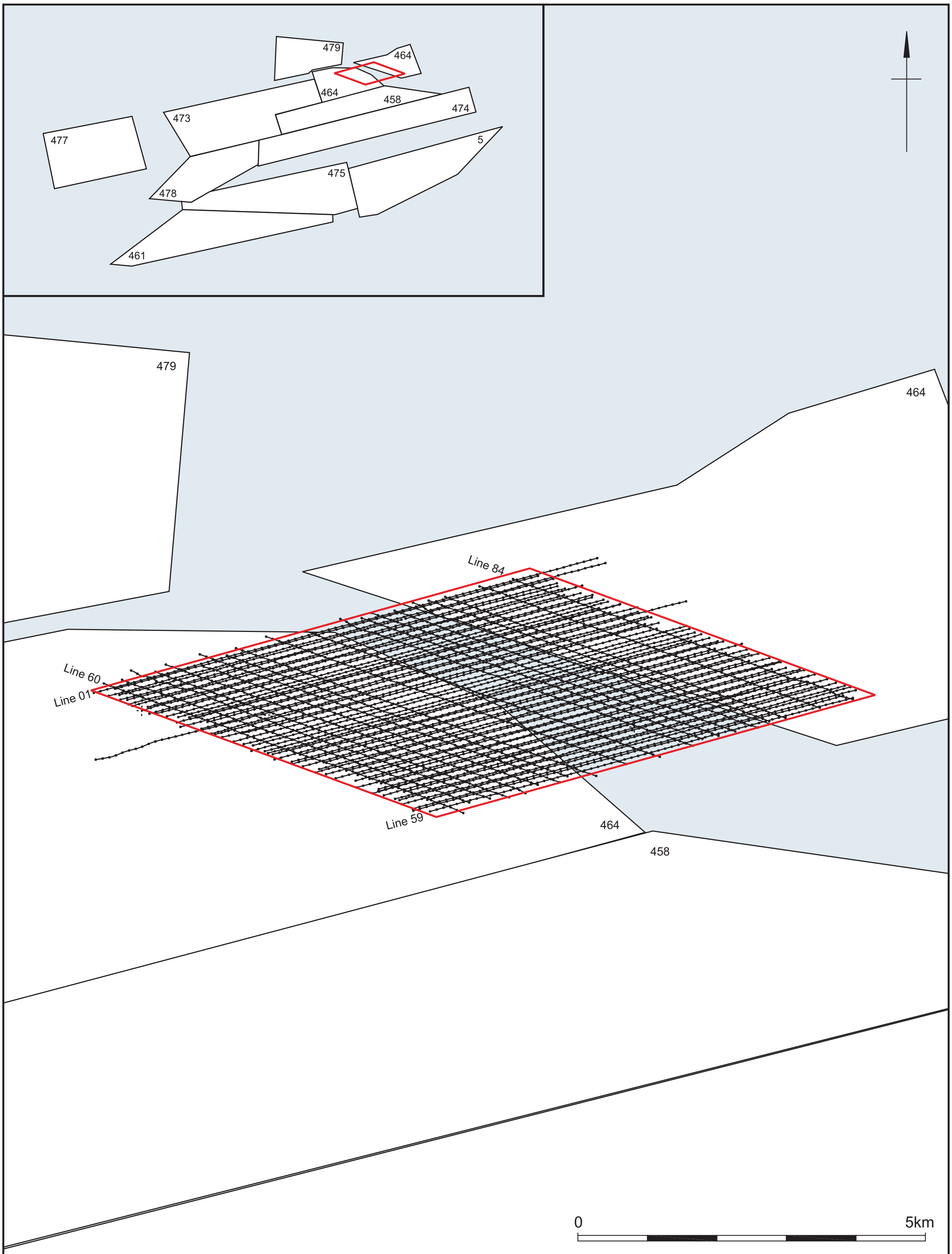
a) Boomer sub-bottom profiler

b) Sidescan sonar (Klein 3000)

Wessex Archaeology	Date:	27/11/06	Illustrator:	KJB/KMN
	Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Boomer sub-bottom profiler and sidescan sonar

Figure V.3



Study area Licence Areas Trackplot	This material is for client report only © Wessex Archaeology. No unauthorised reproduction.		
	Date: 22/11/06	Revision Number:	1
Wessex Archaeology	Scale: 1:80,000	Illustrator:	KJB/KMN
	Path: W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Trackplot of study area

Figure V.4

a) Power vibrocore unit

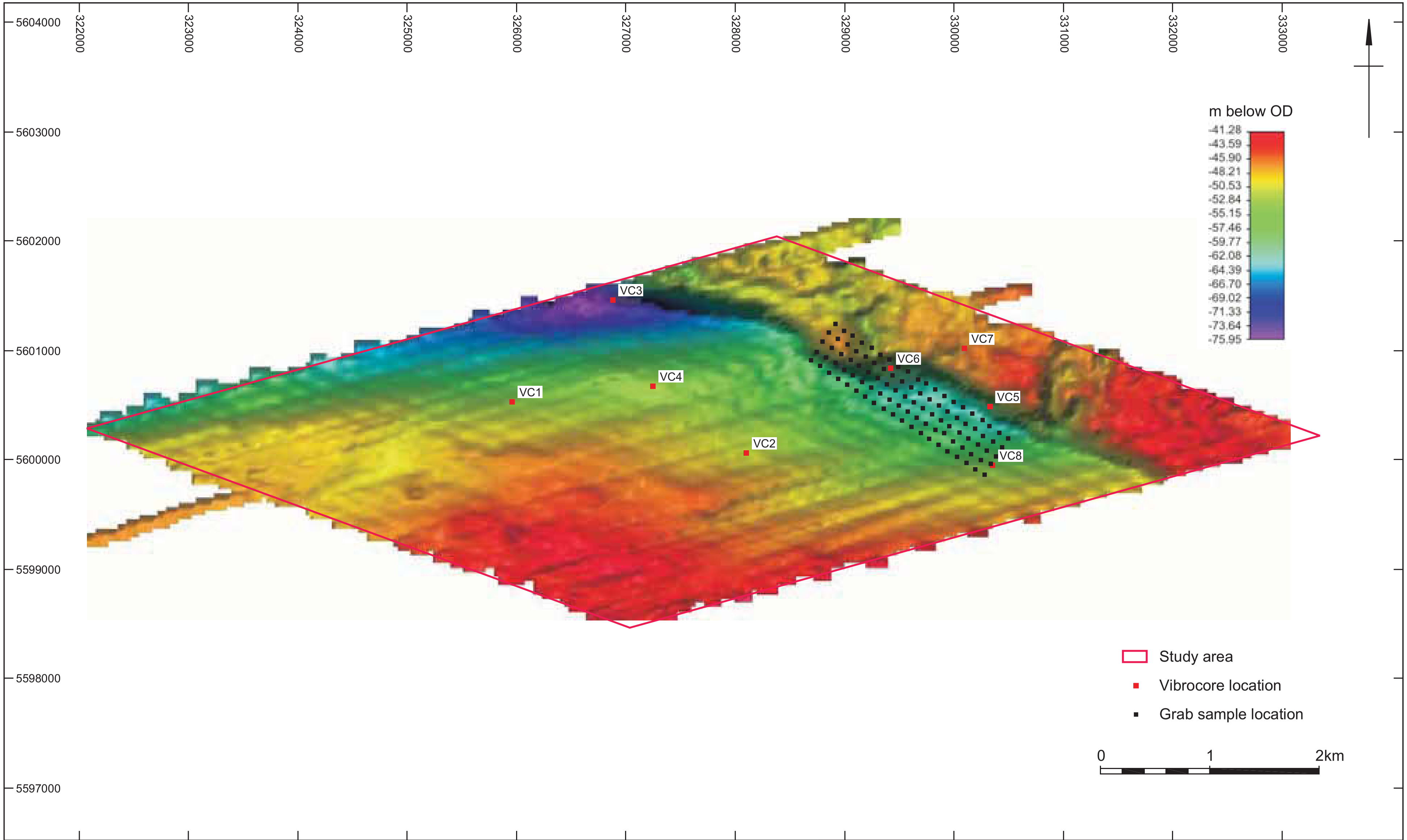
b) Hamon grabbing unit

c) Sieve / washing unit

Wessex Archaeology	Date:	27/11/06	Illustrator:	KJB/KMN
	Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Power vibrocore unit and Hamon grabbing unit

Figure V.5



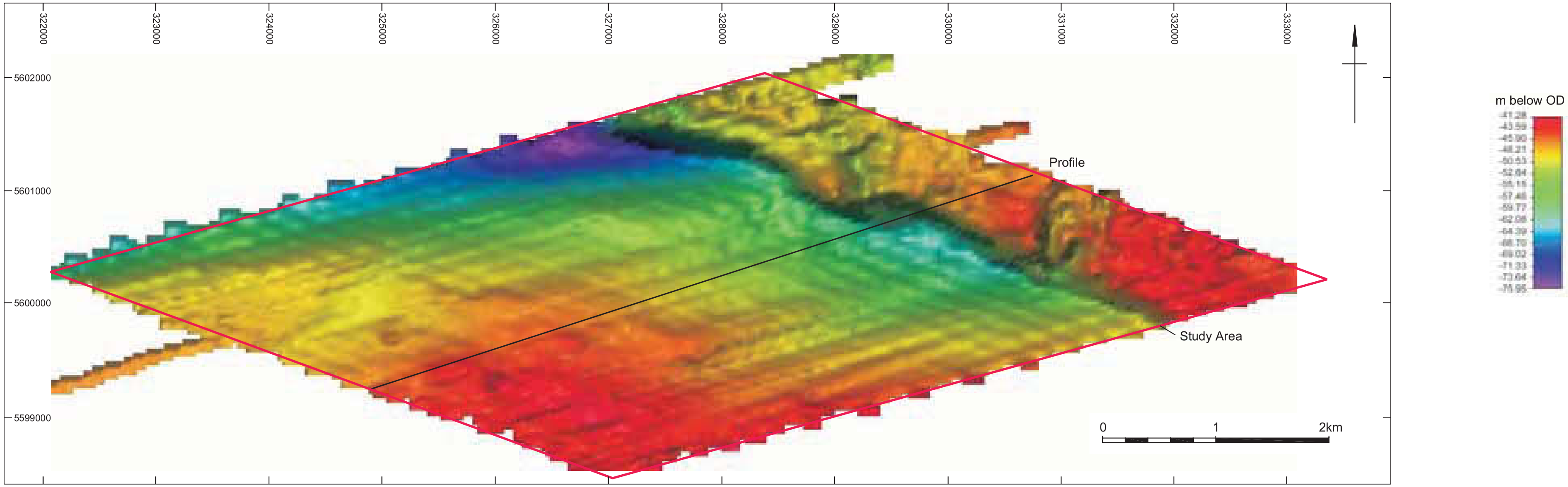
Wessex Archaeology

Drawing projection: UTM WGS84 z31N

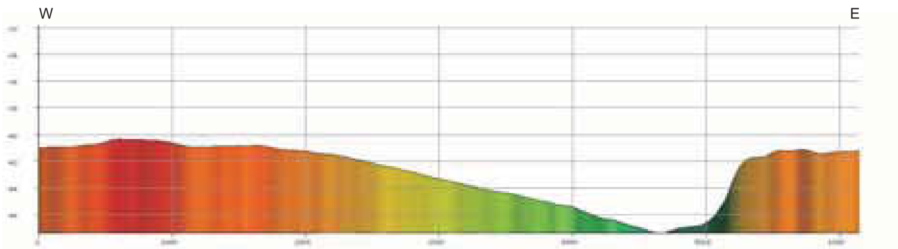
Date:	24/11/06	Revision Number:	1
Scale:	1:50,000	Illustrator:	KJB/KMN
Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Bathymetry of the study area with vibrocore and grab sample locations

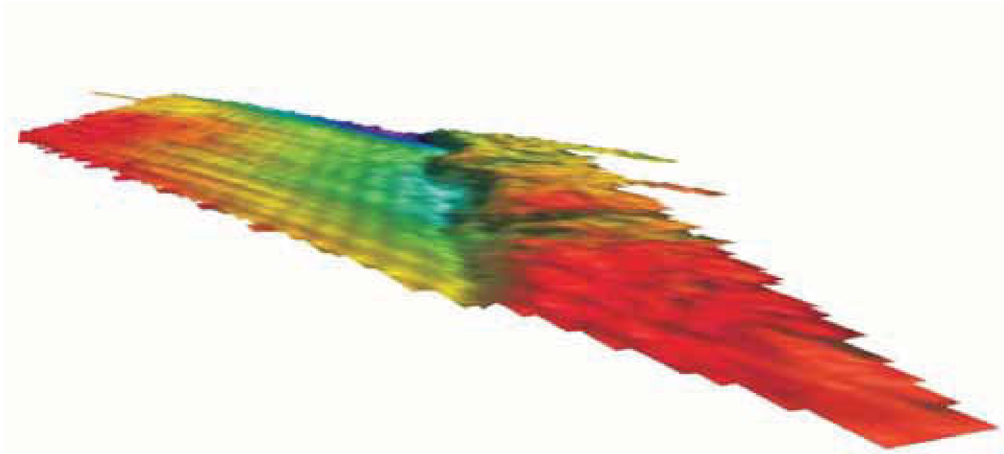
Figure V.6



a) Bathymetry of the study area



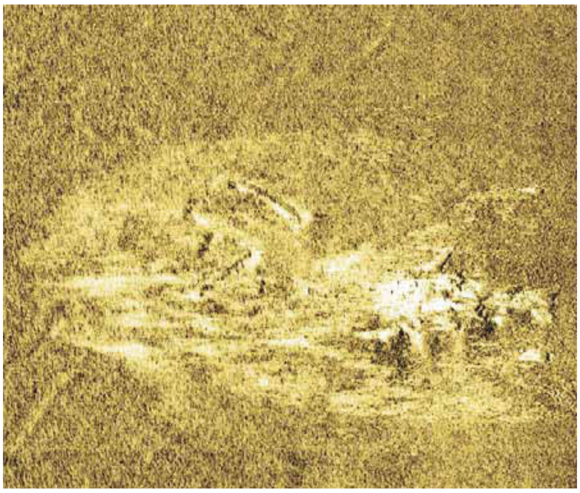
b) Profile

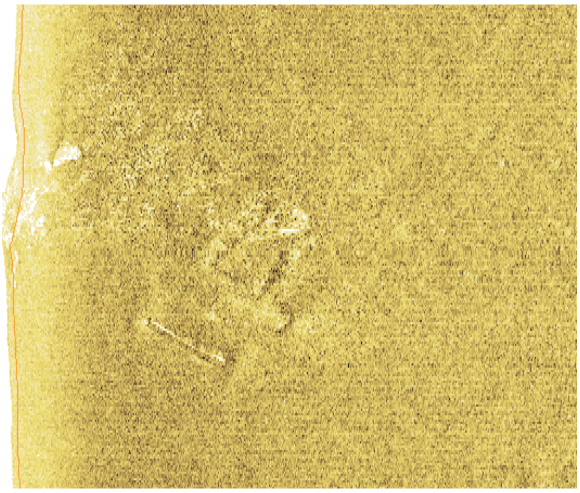


c) View from the south east

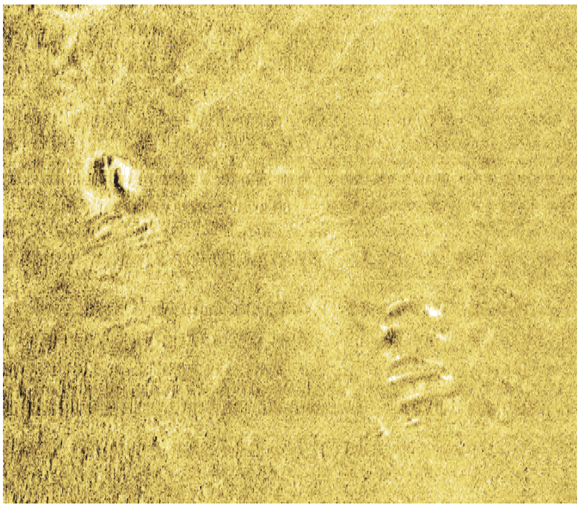
Drawing projection: UTM WGS84 z31N

Date:	24/11/06	Revision Number:	1
Scale:	Plan 1:40,000 Profile 1:40,000 horizontal, 1:400 vertical	Illustrator:	KJB/KMN
Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		


a) Debris partially obscured by shoal of fish


b) 3005. Debris 7m x 5m

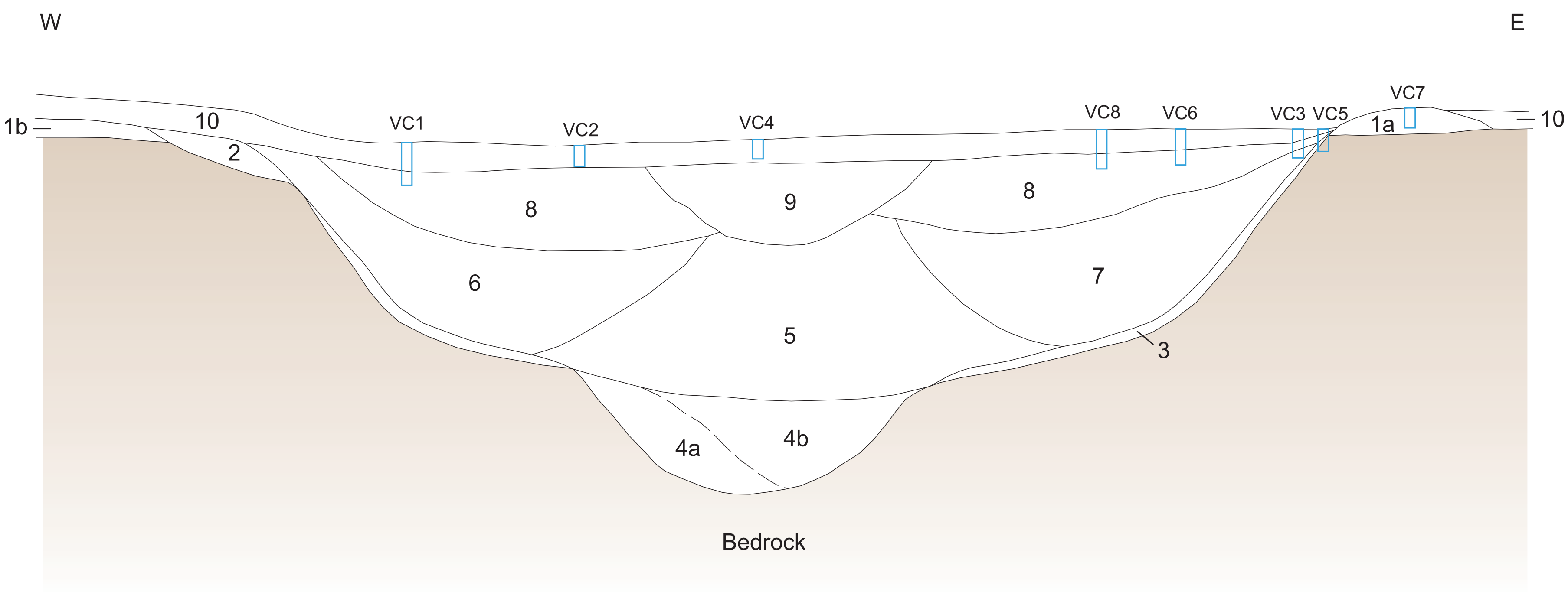

c) 3006. Debris 4m x 0.6m x 1.5m


d) Debris 0.7m x 5m (left), 3m x 5m (right)

Wessex Archaeology	Date:	22/11/06	Illustrator:	KJB/KMN
	Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Selected sidescan sonar images

Figure V.8



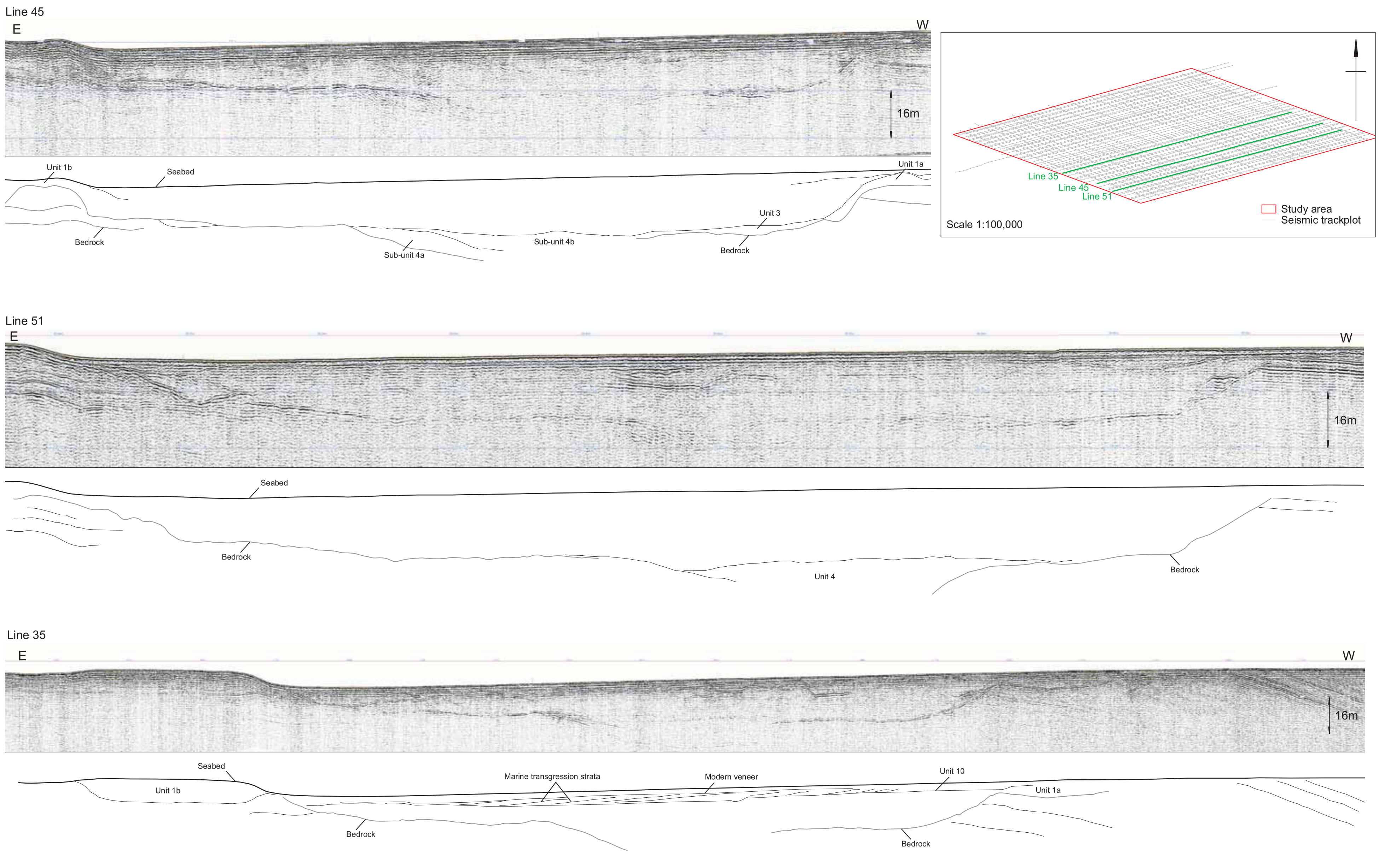
Schematic no vertical scale

Date:	24/11/06	Revision Number:	1
Scale:	Horizontal sacle approx 1:1250	Illustrator:	KJB/KMN
Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Wessex Archaeology

Schematic and composite section showing sedimentary units (1-10) and relative positions of vibrocores

Figure V.9

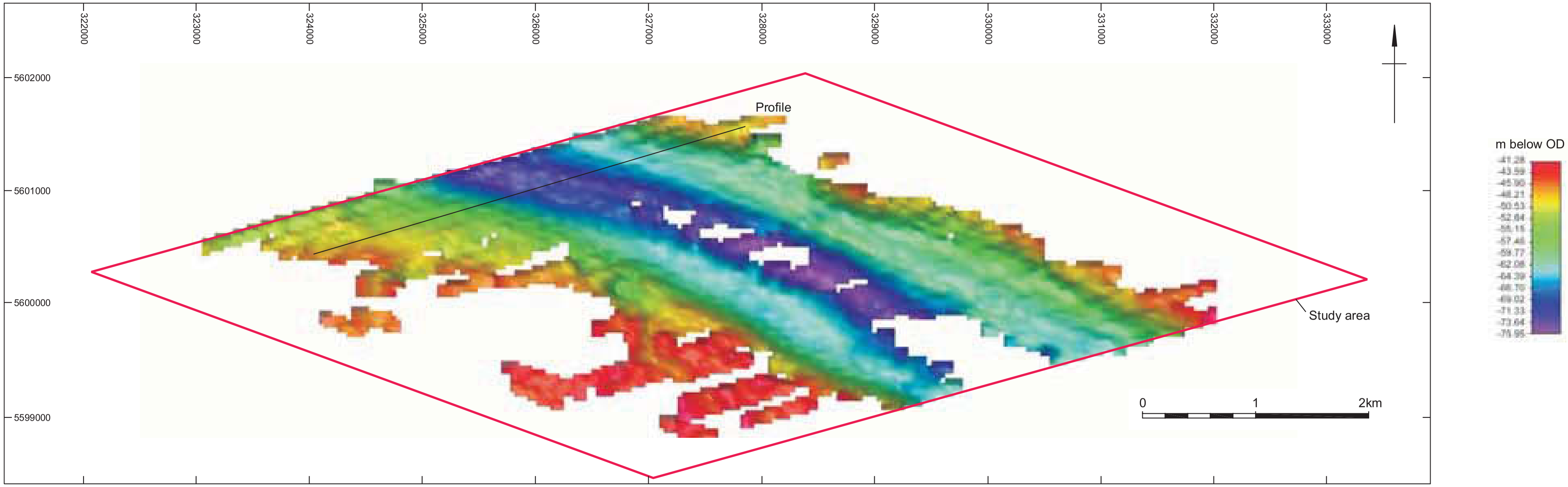


Date:	27/11/06	Revision Number:	1
Scale:	Not to scale (inset 1:100,000)	Illustrator:	KJB/KMN
Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

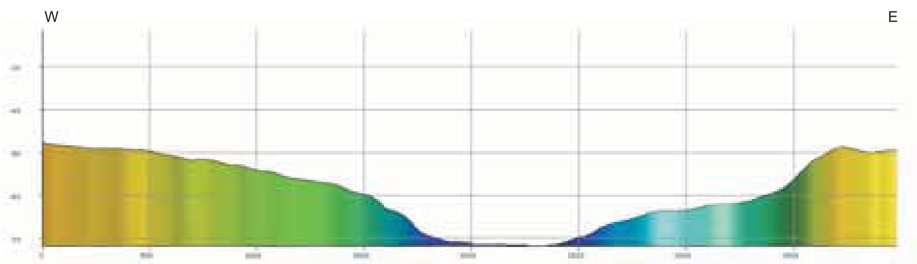
Wessex Archaeology

Seismic lines 35, 45 and 51 with interpretation

Figure V.10



a) Model of the base of primary channel surface



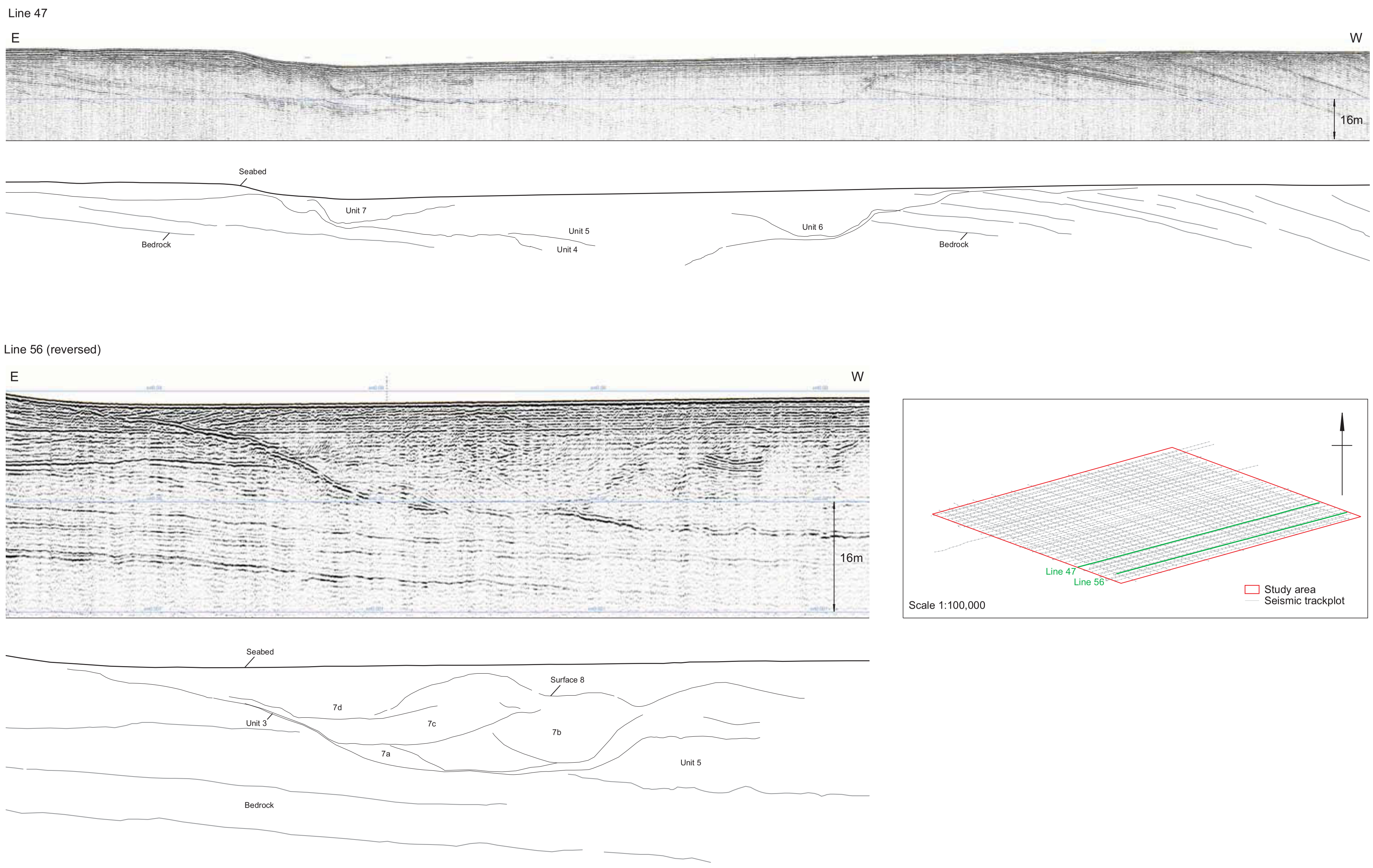
b) Profile

c) View from south east

Wessex Archaeology	Drawing projection: UTM WGS84 z31N This material is for client report only © Wessex Archaeology. No unauthorised reproduction.	Date:	27/11/06	Revision Number:	1
		Scale:	Plan 1:40,000 Profile 1:25,000 horizontal, 1:625 vertical	Illustrator:	KJB/KMN
		Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Model of the base of primary channel surface

Figure V.11

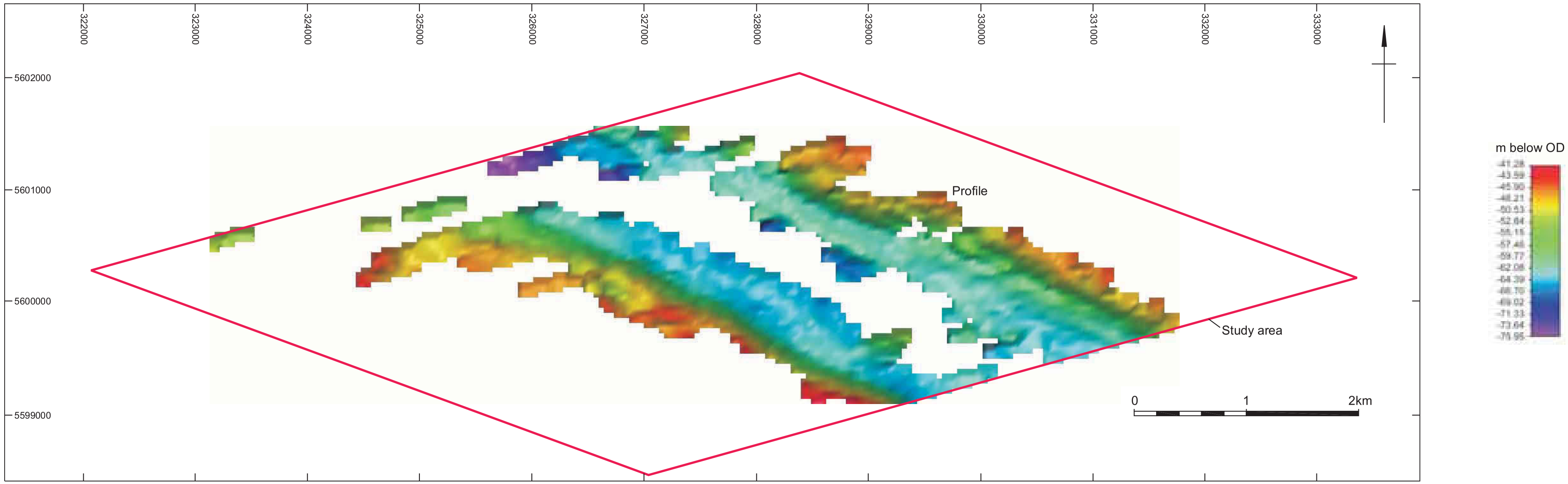


Date:	27/11/06	Revision Number:	1
Scale:	Not to scale (Inset 1:100,000)	Illustrator:	KJB/KMN
Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

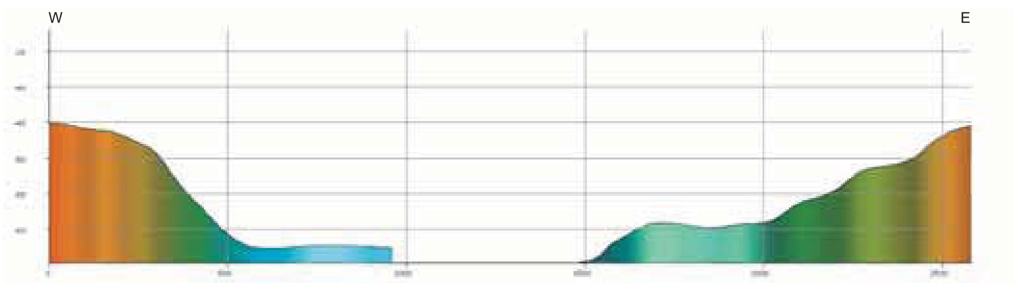
Wessex Archaeology

Seismic lines 47 and 56 with interpretation

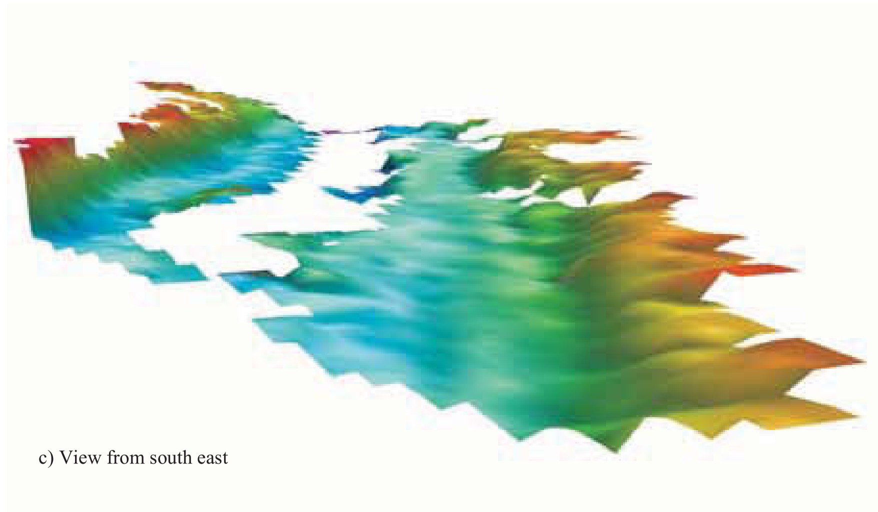
Figure V.12



a) Fledermaus model of the base of Unit 6 and Unit 7



b) Profile



c) View from south east

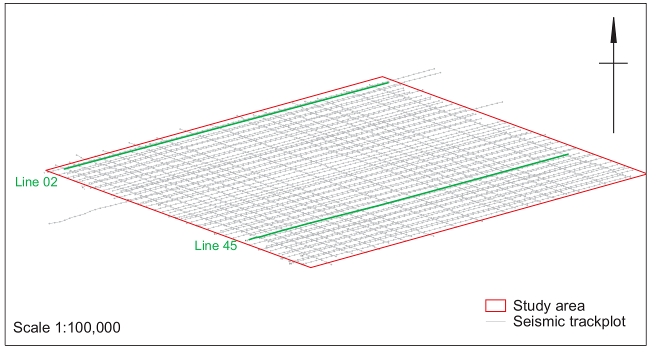
Wessex Archaeology

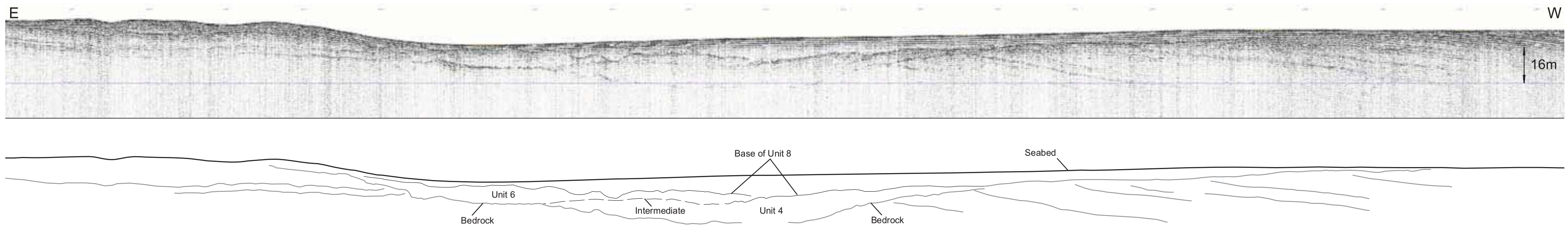
Drawing projection: UTM WGS84 z31N

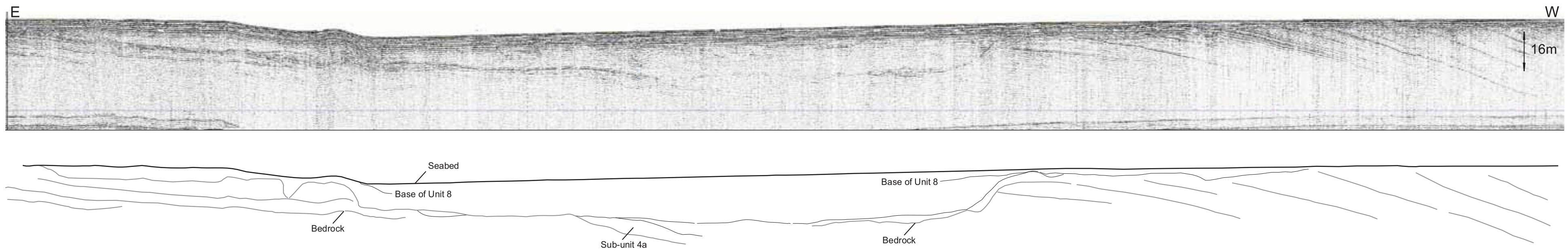
Date:	27/11/06	Revision Number:	1
Scale:	Plan 1:40,000 Profile 1:150,000 horizontal 1:750 vertical	Illustrator:	KJB/KMN
Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Fledermaus model of the base of Unit 6 and Unit 7

Figure V.13





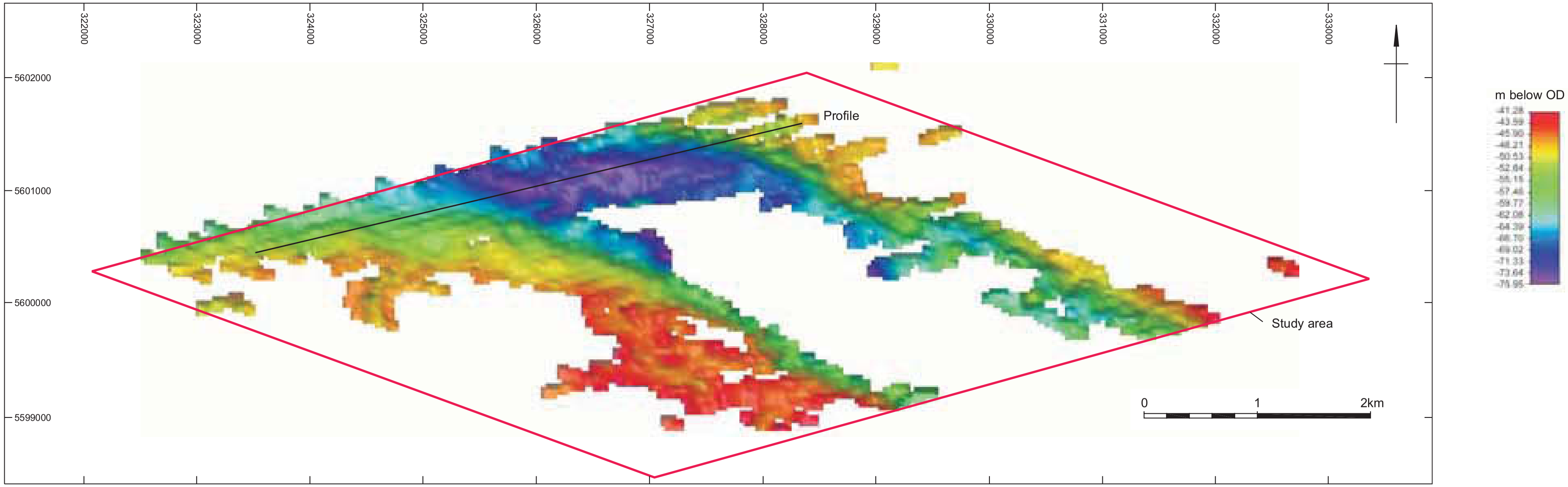


Wessex Archaeology

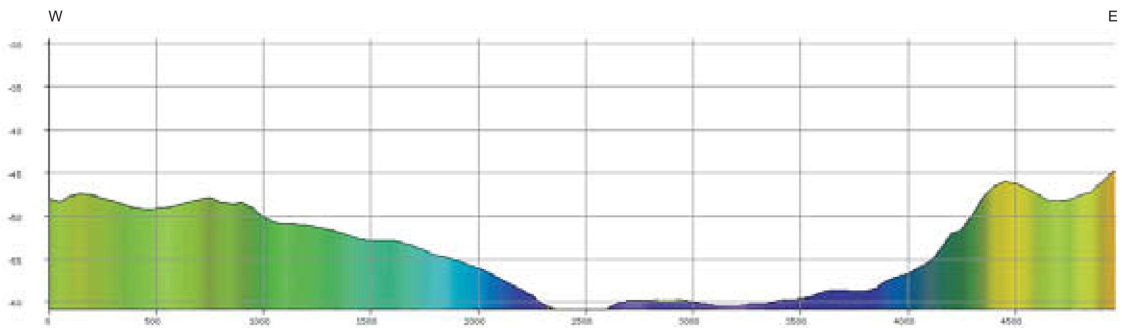
Date:	27/11/06	Revision Number:	1
Scale:	Not to scale (inset 1:100,000)	Illustrator:	KJB/KMN
Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Seismic lines 02 and 45 with interpretation

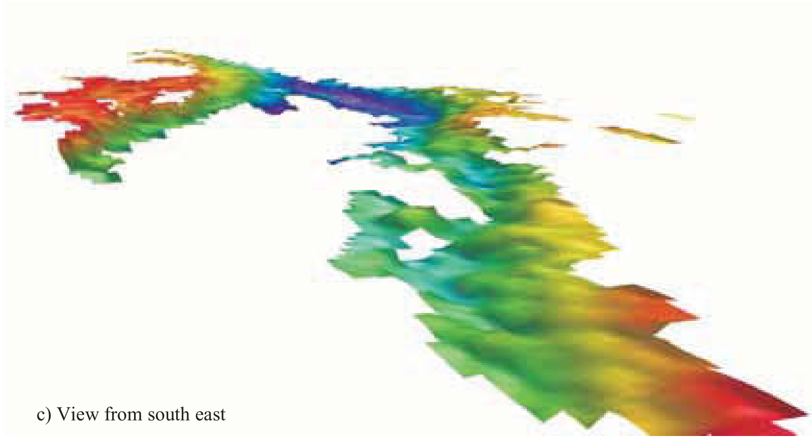
Figure V.14



a) Fledermaus model of the base of Unit 8



b) Profile



c) View from south east

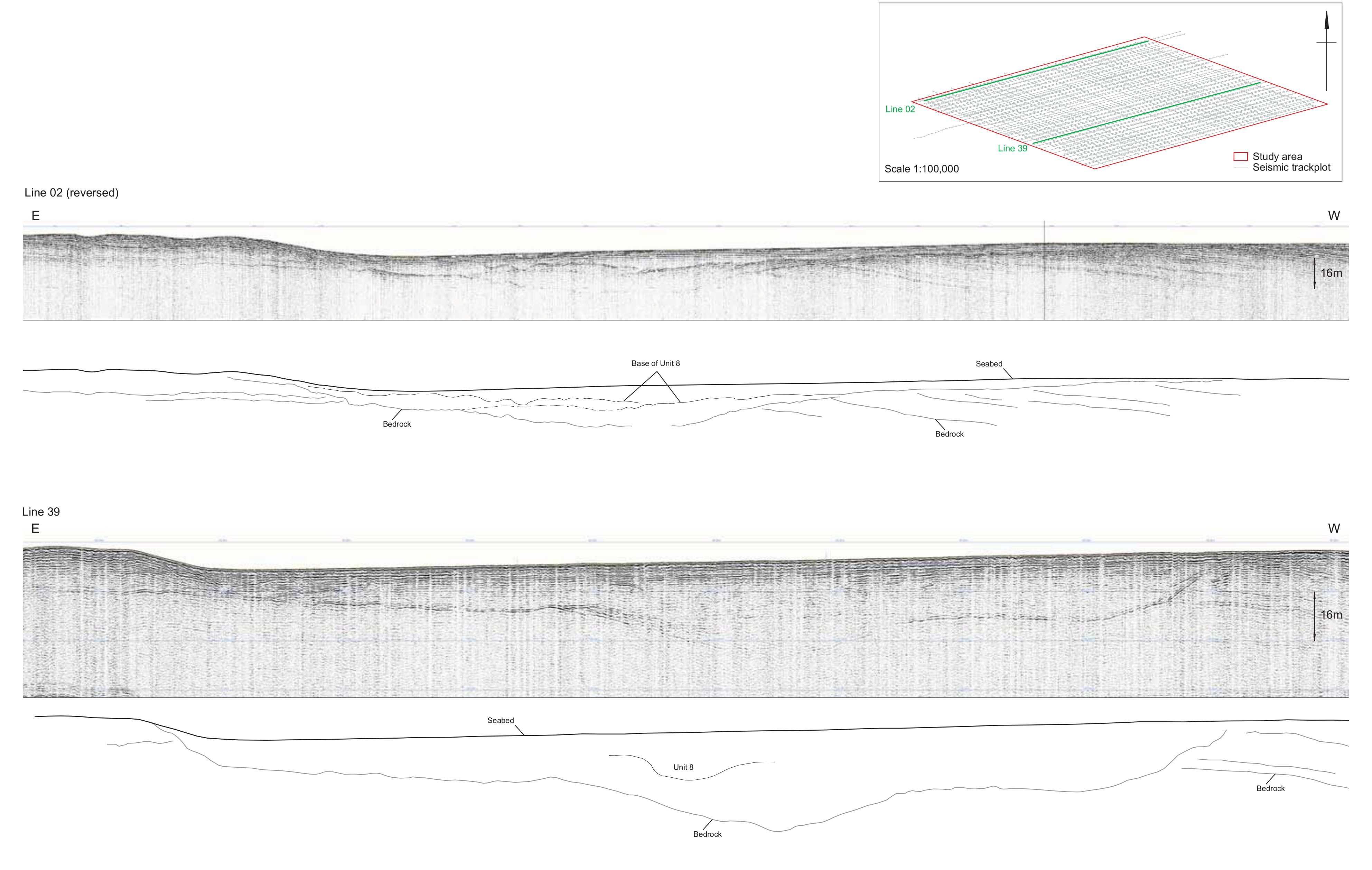
Wessex Archaeology

Drawing projection: UTM WGS84 z31N

Date:	27/11/06	Revision Number:	1
Scale:	Plan 1:40,000 Profile 1:25,000 horizontal, 1:625 vertical	Illustrator:	KJB/KMN
Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Fledermaus model of the base of Unit 8

Figure V.15

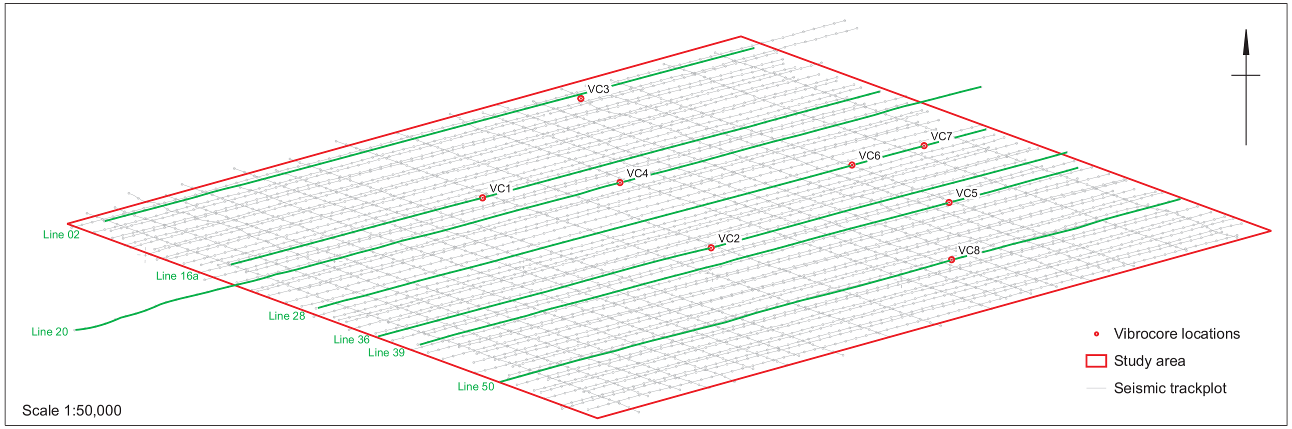


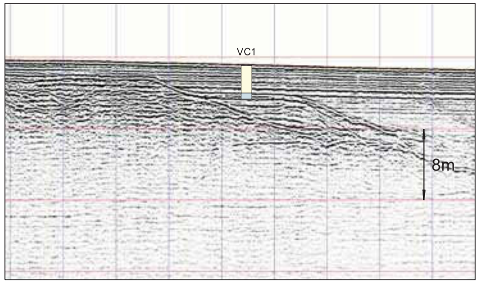
Date:	27/11/06	Revision Number:	1
Scale:	Not to scale (inset 1:100,000)	Illustrator:	KJB/KMN
Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Wessex Archaeology

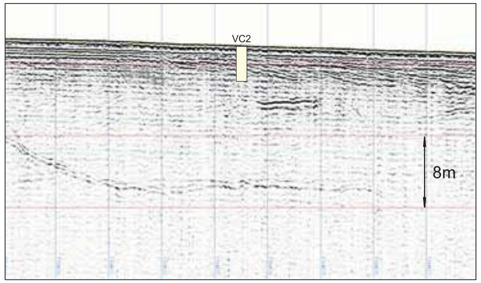
Seismic lines 02 and 39 with interpretation

Figure V.16

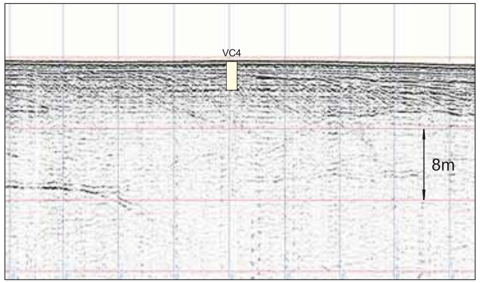




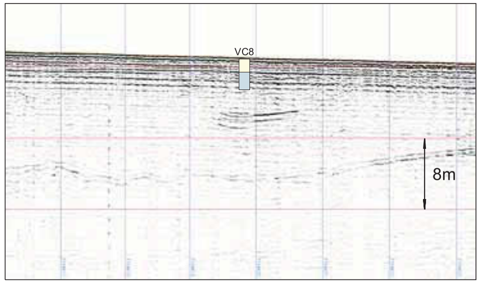
VC1, line 16a



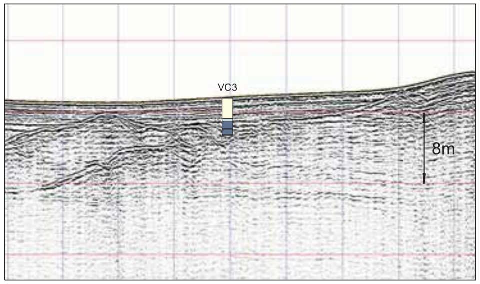
VC2, line 36



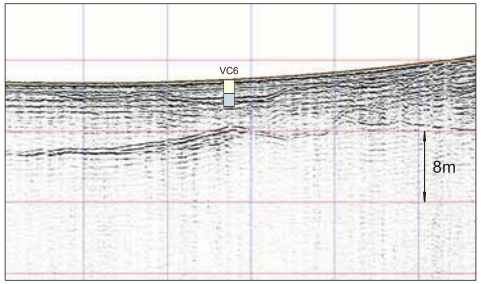
VC4, line 20



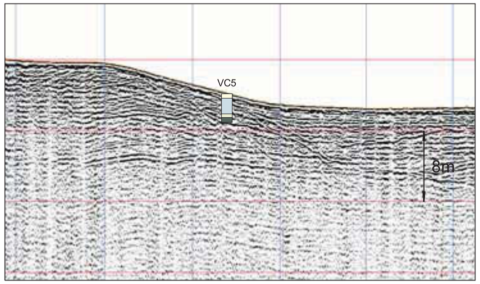
VC8, line 50



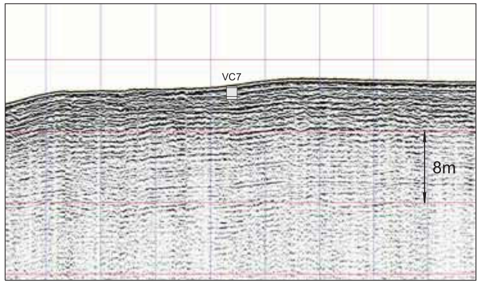
VC3, line 28a



VC6, line 02



VC5, line 39



VC7, line 28a

Wessex Archaeology

10m
0

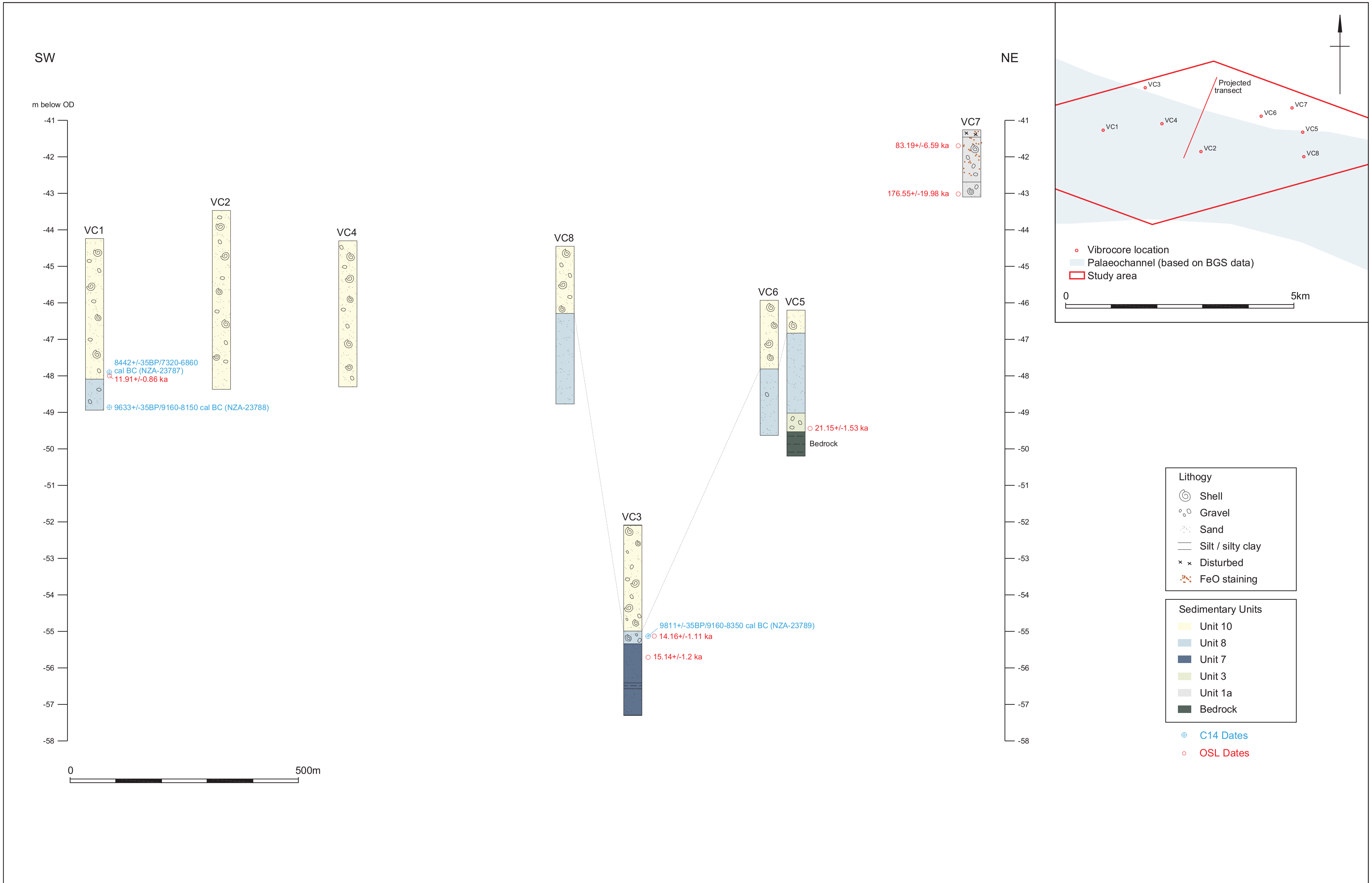
Sedimentary units

Unit 10 | Unit 3
Unit 8 | Unit 1a
Unit 7 | Bedrock

Date:	27/11/06	Revision Number:	1
Scale:	1:750 vertical (inset 1:50,000)	Illustrator:	KJB/KMN
Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Vibrocore locations related to seismic data

Figure V.17

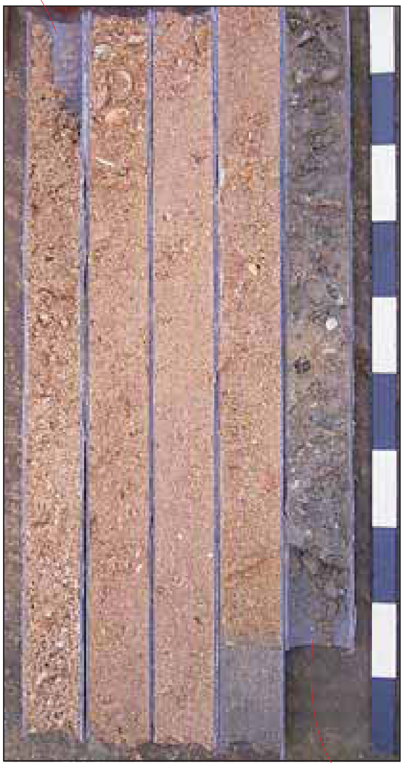


Date:	23/05/07	Revision Number:	2
Scale:	Horizontal 1:8000, vertical 1:100 (inset 1:80,000)	Illustrator:	KJB/KMN
Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Wessex Archaeology

Vibrocore transect (projected)

Figure V.18



a) VC1

b) VC3

c) VC5

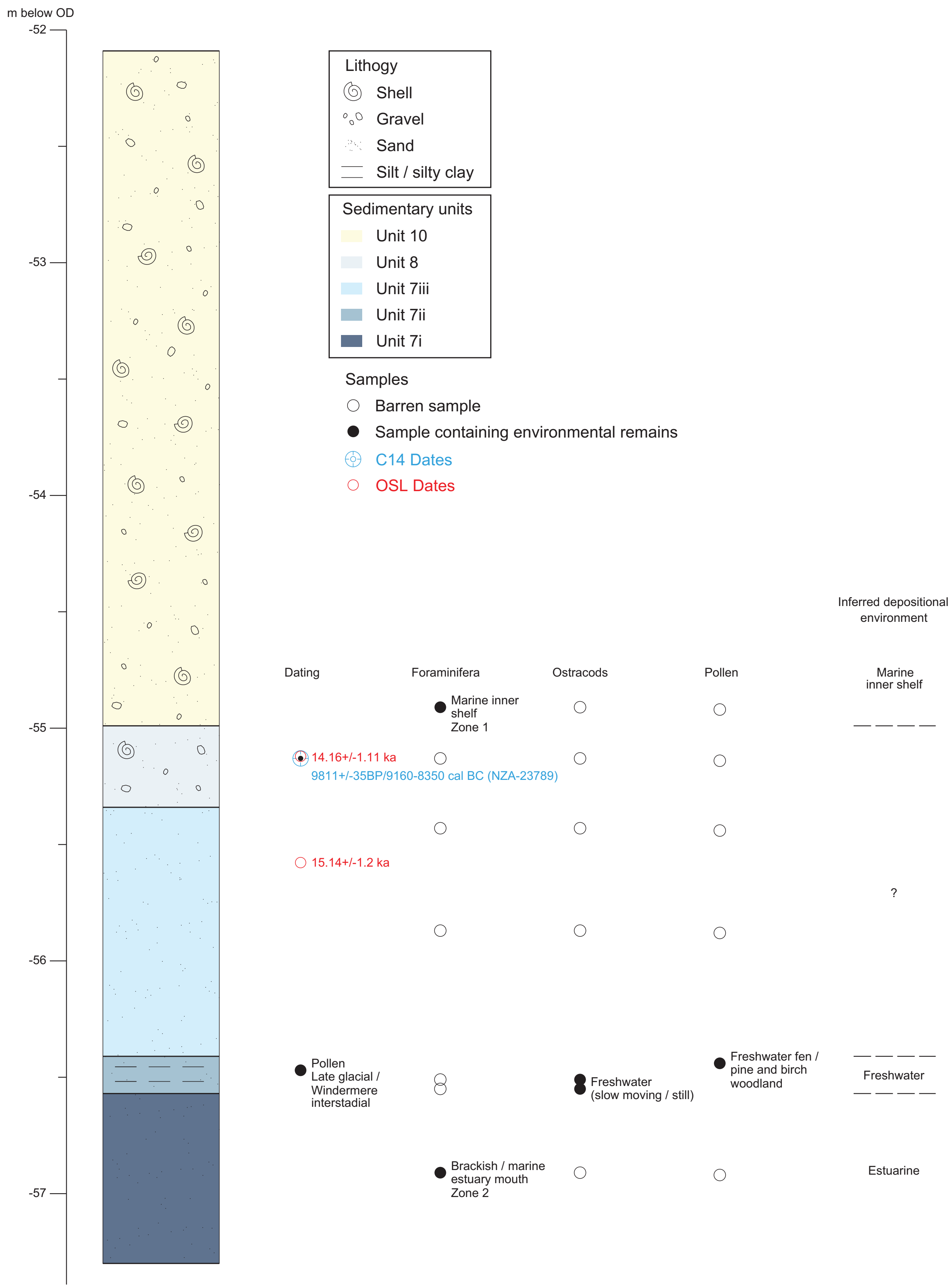
d) VC7

Scale bar = 1 metre

Wessex Archaeology	Date:	27/11/06	Illustrator:	KJB/KMN
	Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Photographic record of vibrocores

Figure V.19

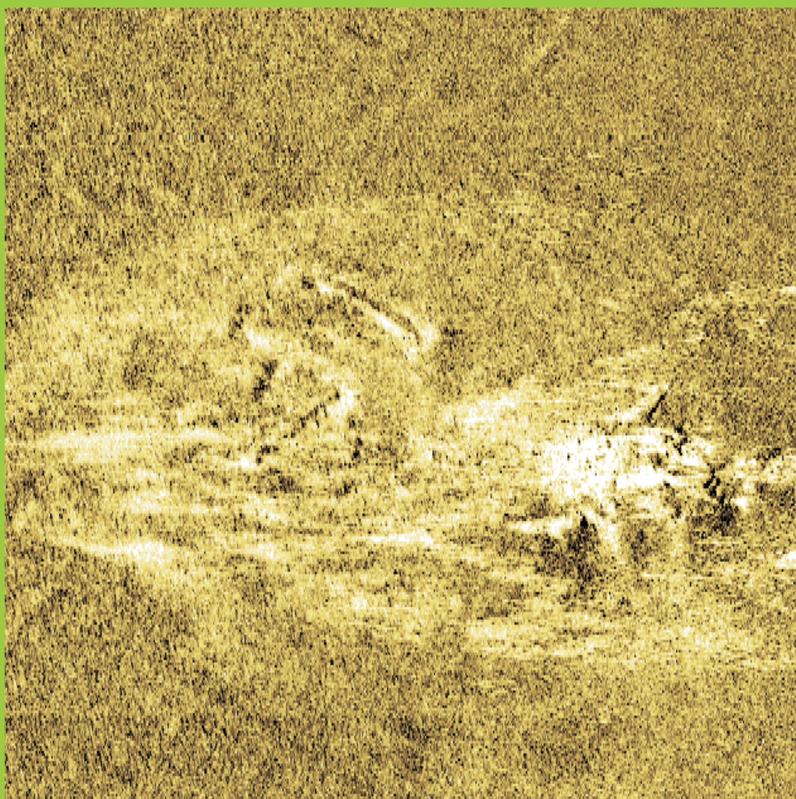


Date:	23/05/07	Revision Number:	2
Scale:	1:25 vertical	Illustrator:	KJB/KMN
Path:	W:\Projects\57422\Drawing Office\Report Figs\FINAL REPORTS\VOLUME 5		

Wessex Archaeology

Vibrocore VC3 with dating / interpreted environmental data

Figure V.20



WESSEX ARCHAEOLOGY LIMITED.
Head Office: Portway House, Old Sarum Park, Salisbury, Wiltshire SP4 6EB.
Tel: 01722 326867 Fax: 01722 337562 info@wessexarch.co.uk www.wessexarch.co.uk
London Office: Unit 113, The Chandlery, 50 Westminster Bridge Road, London SE1 7QY.
Tel: 020 7953 7494 Fax: 020 7953 7499 london-info@wessexarch.co.uk www.wessexarch.co.uk

Registered Charity No. 287786. A company with limited liability registered in England No. 1712772.