

**CURATION OF THE SUSSEX/HAMPSHIRE COASTAL CORRIDOR
LOWER/MIDDLE PALAEOLITHIC RECORD**

ALSF, 3279 ANL

PROJECT REPORT

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EXECUTIVE SUMMARY

The unique Middle and Late Pleistocene sedimentary record preserved along the Sussex/Hampshire coastal corridor between Romsey and Brighton that formed over the last 500,000 years contains a wealth of Lower and Middle Palaeolithic archaeological remains. In this report we provide a summary of that work for curatorial staff to be used in conjunction with a set of ARC GIS Shape files defining differing Palaeolithic archaeological potential for the study region. The project has developed following consultation with archaeological curators for Hampshire and Sussex, where the project is located, in order to be tailored to their needs and integrated with the local minerals plans. This report summarises the background to the project (Section 2) and in particular the nature of the Palaeolithic resource, the project aims, objectives and methods. Section 3 summarises the current state of knowledge regarding the nature of the sequences within the West Sussex Coastal Plain and Solent area based on past work and the results of the recent field investigations. The Palaeolithic archaeological resource is described in Section 4. A geoarchaeological approach to the data and region is outlined in Section 5 that forms the rationale behind the structure of the GIS that is considered in Section 6; this is illustrated by two examples from the study area. In conclusion the data gathered through the project is considered within the structure of local research frameworks (Section 7) and finally within the field of development control (Section 8).

The current report draws on data and evidence drawn from previous phases of work on the project that included both data gathered from archaeological investigation of museum collections and fieldwork examining Pleistocene deposits and their associated palaeoenvironmental remains. These sources of evidence, along with age estimates provided by Optically Stimulated Luminescence dating and Amino Acid Geochronology form the basis for a palaeogeographic and landscape development model. This has provided the information to allow GIS zones to be constructed and the following statements regarding the spatial and temporal distribution and likely Palaeolithic importance of sequences within the study area have been made:

1. Areas associated with the Goodwood/Slindon Raised Beach are likely to contain high resolution in situ archaeological assemblage's representative of "snap-shot" time intervals.
2. Attribution of the Aldingbourne Raised Beach raised beach to the early stages of MIS 7 implies that sediments from the interglacials associated with MIS 9 and 11 are missing from the WSCP. It is likely that any that were once laid down have now been reworked and eradicated by the landward migration of the MIS 7 cliff line. Consequently we might anticipate some heavily rolled artefacts in this beach that span the temperate and cold phases between MIS 12 and 7, as well as fresher material contemporary with the formation of the deposit. This in fact corresponds with the known material (cf. Section 4.2.2.3), although the deposits have been subject to little formal archaeological investigation, which should perhaps be remedied at the earliest opportunity.

3. The majority of the lower coastal plain contains sediments associated with later MIS 7 and post-MIS 7 time. On the basis of evidence from elsewhere in the country it is anticipated that likely incidence of human activity would be low. However, evidence for activity in this time span is known in the UK and if present would be of considerable national importance.

4. The context or likely presence of any archaeological material associated with the other identified types of sequences in the WSCP is less easy to determine at present. Certainly in both channel fill sequences (such as those around Selsey Bill) and the cold climate deposits of the central plain area, sediments likely to preserve both in situ and reworked artefacts may occur. No such remains were found in the small investigation carried out for PASHCC, but this only impacted a miniscule proportion of the overall resource, so any further impacts should be evaluated, and perhaps a larger-scale investigative research programme initiated. Temporally these sequences also span time periods in which human occupation is known to have occurred in the UK.

4. Dating of Terrace 2 of the Eastern Solent to MIS 7 indicates considerable missing evidence covering MIS 2-6 in this part of the study region. The major change in dip of the long profile of Terrace 1, suggests a major palaeogeographic upheaval after MIS 7 that has had a major impact upon the Solent Basin drainage (perhaps as a function of changes in the Durlston Point and the Needles area. The presence of significant quantities of archaeological material associated with Terrace 2 suggests a very different pattern of human occupation (or preservation of record) between the Eastern Solent and the WSCP. Bearing in mind the sparse national record for MIS 7, this attribution makes all evidence from Terrace 2 of higher potential importance than previously recognised, requiring further investigation to assess the degree of derivation and the presence of less disturbed horizons within the gravel.

5. The long terrace sequence in the Solent system prior to the MIS 7 deposits of terrace 2 therefore presents a valuable complementary archive (to that from the West Sussex Coastal Plain) of human presence in the Sussex/Hampshire Coastal Corridor region, since, as explained above, it appears that there is a major absence of deposits spanning the period MIS 12 through to 8.

The PASHCC GIS is the prime medium through which the project currently presents its results to the 'end users' such as the HER and development control teams in the local authorities. The structure of the GIS was developed in conjunction with staff in relevant curatorial roles in both West Sussex and Hampshire as well as through experience developed in the course of other on-going or recently completed projects (Medway Valley Palaeolithic Project; Northern Tributaries Project); this data structure has necessarily evolved as the project results were generated. The ESRI GIS products, with the results of the project being presented as a series of individual shape files which could be used in versions of ArcView/ArcGIS v. 8.2 or later, were selected for use in the project. The core aim of these proposals were to ensure that the maximum and optimum Palaeolithic archaeological knowledge is recovered from deposits impacted by development.

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1. INTRODUCTION

The unique Middle and Late Pleistocene sedimentary record preserved along the Sussex/Hampshire coastal corridor between Romsey and Brighton (Figure 1) that formed over the last 500,000 years contains a wealth of Lower and Middle Palaeolithic archaeological remains (Bates *et al.*, 1997; Roberts and Parfitt, 1999; Bates, 2001; Wessex Archaeology, 1994). The importance of these deposits has been recognised by English Heritage by funding the various phases of excavation at the internationally renowned site at Boxgrove (Roberts and Parfitt, 1999), through mapping work on the upper coastal plain and the field and analysis work associated with the Palaeolithic Archaeology of the Sussex/Hampshire Coastal Corridor (PASHCC) (Bates *et al.*, 2004). These various works have now identified a range of sequences of different archaeological potential across the region and have produced information suitable for both curatorial purposes (evaluation/mitigation) as well as academic focused study. Here we provide a summary of that work for curatorial staff to be used in conjunction with a set of ARC GIS Shape files defining differing Palaeolithic archaeological potential for the study region which has previously been identified as the primary output of this project for curatorial use.

This report summarises the background to the project (Section 2) and in particular the nature of the Palaeolithic resource, the project aims, objectives and methods. Section 3 summarises the current state of knowledge regarding the nature of the sequences within the West Sussex Coastal Plain and Solent area based on past work and the results of the recent field investigations. The Palaeolithic archaeological resource is described in Section 4. A geoarchaeological approach to the data and region is outlined in Section 5 that forms the rationale behind the structure of the GIS that is considered in Section 6; this is illustrated by two examples from the study area. In conclusion the data gathered through the project is considered within the structure of local research frameworks (Section 7) and finally within the field of development control (Section 8).

1.1 Aggregate extraction and curation of the Palaeolithic resource

The project was developed following consultation with archaeological curators for Hampshire and Sussex, where the project is located, in order to be tailored to their needs and integrated with the local minerals plans.

This project included a review of Palaeolithic remains recovered from aggregate extraction sites in the area (Bates *et al.*, 2004). In the course of the project in order to make sense of these finds, and to improve the capability to manage the aggregate extraction landscape, it was also necessary to take account of remains recovered from other areas than merely those affected by extraction and to carry out a dating and correlation programme of aggregate deposits to place them in a synthesised chrono-stratigraphic framework. Therefore the project was conceived specifically to address these aims.

It was also deemed of particular importance to integrate the project within the context of other on-going project works within the area. Specifically these included the work at Boxgrove and the wider Upper Coastal Plain Mapping Project being undertaken by staff

at UCL and current project work being undertaken within the vicinity of Chichester Harbour by the Chichester Harbour Conservancy as part of the multi-stranded project 'The Rhythms of the Tide'.

Aggregate extraction within the study area has been intense during the past although current pressure is significantly reduced. Key areas of rich Palaeolithic resource potential such as the Warsash area of eastern Hampshire or the upper coastal plain between Chichester and Arundel have been particularly heavily impacted by resource extraction. At present only limited numbers of quarries are operational in the area and the focus of major extraction is now concentrated on the offshore zone of the Arun and Solent, however with major governmental initiatives on housing and development in the south east during the foreseeable future it may well be that terrestrial aggregate extraction becomes increasingly necessary.

Despite the reduction in the number of operational pits within the area considerable quantities of data are available both to inform predicative modelling and interpret past discoveries. There is a strong and unavoidable correspondence of interest between Palaeolithic archaeology and aggregate extraction. The great majority of sands and gravels used as aggregates were formed during the Pleistocene and so contain evidence of the Palaeolithic. In this context work through the ALSF is important not simply to demonstrate Palaeolithic archaeological presence, context and age but also to address those deposits without known Palaeolithic archaeology in order to clarify their status and potential. In the study region for this project, there has been substantial extraction since the second half of the 19th century focused on both the marine sands and gravels of the West Sussex Coastal Plain and the fluvial gravels of the Solent and to a lesser extent the Arun.

While previous extraction has inevitably impacted upon the Palaeolithic archaeological resource, it has also provided exposures of the sediments, and there is a long history of co-operation and tolerance between Palaeolithic investigators and commercial quarrying. Early hand-digging and screening of gravel provided ideal conditions for the recognition and recovery of artefacts, and quarry owners often cooperated with archaeological investigation on numerous occasions. Our current understanding of the Palaeolithic would be much reduced without the opportunities afforded by previous aggregate extraction. Far from being in conflict with the needs of Palaeolithic archaeology, ongoing and future aggregate extraction can be of benefit, so long as appropriate mitigating investigations are carried out.

The current planning legislation provides for mitigating the archaeological impact of all development, including aggregate extraction, under PPG 16 (DoE 1990). However, substantial unmitigated impact upon Palaeolithic evidence has taken place prior to PPG 16. This impact can to a large extent still be mitigated through study of surviving quarry faces and of material recovered from known sites, and this is one objective of this project.

Secondly, the piecemeal nature of mitigation work under PPG 16 — which is inevitably focused on areas chosen for development and hence can deliberately avoid key archaeological sites — means that it has been impossible to target key areas that can increase curatorial understanding of the region. Carrying out such targeted work under ALSF complements, and enhances the value of, other work carried out under PPG 16.

1.2 Relevance to ALSF priorities

The project produces a number of benefits corresponding to the priorities of the ALSF in (a) promoting environmentally friendly extraction and transport (ALSF Objective 2) and (b) reducing local effects of aggregate extraction (ALSF Objective 3). The project has/would:

- (a) Develop the capacity to manage the aggregate extraction landscape
- (b) Collate and assess baseline information on the Quaternary archaeology of the study
- (c) Help improve curatorial decision-making with regard to evaluation/mitigation of Quaternary archaeology of aggregate deposits
- (d) Develop improved/appropriate methods for field investigations of aggregate deposits
- (e) Develop an up-to-date research framework for Palaeolithic archaeology in the study area
- (f) Identify areas of aggregate of potentially higher Palaeolithic significance
- (g) Mitigate previous and ongoing aggregate extraction impact where not addressed under present planning conditions
- (h) Undertake community education and outreach to develop understanding and appreciation of Quaternary archaeology

The aims and objectives identified from Phase II work were specifically tailored to enhance our understanding of local and regional palaeogeography where clearer understanding will aid in ascribing the nature, distribution and age of sediments likely to contain Palaeolithic archaeological remains. This baseline information is clearly a prerequisite to refining the GIS required for curatorial purposes and to highlight areas where archaeological potential is high and where little is known about potential for human remains.

The core benefits of the project are in the areas of:

Promoting environmentally friendly extraction and transport (ALSF Objective 2) the project will:

- (a) Develop the capacity to manage the aggregate extraction landscape
- (b) Collate and assess baseline information on the Quaternary archaeology of the study

- (c) Help improve curatorial decision-making within evaluation/mitigation of Quaternary archaeology of aggregate deposits
- (d) Develop improved/appropriate methods for field investigations of aggregate deposits
- (e) Develop an up-to-date research framework for Palaeolithic archaeology in the study area
- (f) Identify areas of aggregate of potentially higher Palaeolithic significance
- (g) Mitigate previous and ongoing aggregate extraction impact where not addressed under present planning conditions

Reducing local effects of aggregate extraction (ALSF Objective 3) — the project will undertake dissemination to local users (curators) to develop understanding and appreciation of Quaternary archaeology

The project also contributes to a number of current objectives in the national Palaeolithic research framework (English Heritage/Prehistoric Society 1999).

2. BACKGROUND

2.1 The Pleistocene

The initial Palaeolithic occupation and subsequent settlement of Britain has taken place against the backdrop of the Quaternary period, characterised by the onset and recurrence of a series of alternating cold–warm/glacial–interglacial climatic cycles (Lowe and Walker, 1997). Over 60 cycles have been identified during the last 1.8 million years, corresponding with fluctuations in proportions of the Oxygen isotopes O^{16} and O^{18} in deep-sea sediment sequences. These marine isotope stages (MIS) have been numbered by counting back from the present-day interglacial or Holocene period (MI Stage 1), with (usually) interglacials having odd numbers and glacials even numbers, and dated by a combination of radiometric dating and tuning to the astronomical timescale of orbital variations, which have been a fundamental causative agent of the Quaternary climatic fluctuations. This is now the yard-stick by which Quaternary scientists (including Palaeolithic archaeologists) consider the evidence and contemplate correlations between sites. The Quaternary is divided into two epochs - the Holocene and the Pleistocene – where the Holocene represents the present-day interglacial and the Pleistocene represents the remainder of the Quaternary that is divided into Early, Middle and Late parts (Table 1). The Middle and Late Pleistocene are of most relevance to British Palaeolithic archaeology, with the first occupation of Britain occurring *c.* 700,000 BP in the Middle Pleistocene, and continuing thereafter, albeit with occasional gaps.

Middle and Late Pleistocene climatic oscillations were sufficiently marked to have a major impact on sea level and terrestrial sedimentation regimes. In the colder periods ice sheets grew across much of the country, and arboreal forests disappeared, to be replaced by steppe or tundra. Sea levels dropped across the globe due to the amount of water locked up as ice, exposing wide areas offshore as dry land, and enhancing river channel downcutting. In the warmer periods sea levels rose as ice melted, river channels tended to be stable and prone to silting up and the development of alluvial floodplains (Gibbard and Lewin, 2002), and forests regenerated. The range of faunal species inhabiting Britain changed in association with these climatic and environmental changes, with both evolution of species *in situ* to adapt to these changes and local extinction/recolonisation of species in response to changing environmental conditions.

Britain has been particularly sensitive to these changes, being i) situated at a latitude that has allowed the growth of ice sheets in cold periods and the development of temperate forests in warm periods, and ii) periodically isolated as an island by rising sea levels and then rejoined to the continent when sea level falls (White and Shreeve, 2000). This has led to different climatic stages having reasonably distinctive sets of associated fauna and flora. These both reflect in general terms the climate and environment, and may also identify in specific terms the MI Stage represented. The study of such evidence — such as large mammals, small vertebrates, molluscs, ostracods, insects and pollen — is an integral part of Pleistocene, and Palaeolithic, research for its role in dating early hominid occupation and recreating the associated palaeo-environment.

The evidence from different MI Stages is contained in terrestrial deposits formed during the stage. In contrast to the deep-sea bed, where there has been continuous sedimentation, terrestrial deposition only occurs in specific, limited parts of the landscape. It also takes place as a series of short-lived depositional events such as land-slips or river-floods interrupted by long periods of stability and erosion. Thus the terrestrial record is relatively piecemeal, and the challenge for both Pleistocene and Palaeolithic investigation is to integrate the terrestrial evidence into the global MIS framework, based on relatively few direct stratigraphic relationships, and making maximum use of biological evidence and inferences about the sequence of deposition in major systems such as river valleys (Bridgland *et al.*, 2004; Bridgland, 2006).

Present understanding is summarised in Table 1. The current interglacial began *c.* 10,000 BP (years before present) and it is generally agreed that MI Stages 2–5d, dating from *c.* 10,000–115,000 BP cover the last glaciation (Devensian), and that Stage 5e, dating from *c.* 115,000–125,000 BP, correlates with the short-lived peak warmth of the last interglacial (Ipswichian). Beyond that disagreement increases, although many British workers feel confident in accepting that MI Stage 12, which ended abruptly *c.* 425,000 BP, correlates with the major British Anglian glaciation when ice-sheets reached as far south as the northern outskirts of London (Bridgland 1994).

It is also important to remember that the MI Stage framework only reflects major climatic trends. Within each MI Stage there were also numerous climatic oscillations, represented by maybe only a few cm within sediment cores 10–20m long, that have not been recognised as distinct numbered stages. These still potentially correspond to a few thousand years of climatic change, with potential for associated changes in environment and sedimentary deposition. Some of the larger diversions have been recognised as distinct sub-stages with the MIS framework (such as Stage 5e), but many have not, and their presence has the potential to confound overly simplistic correlations of isolated terrestrial sequences with peaks or troughs on the continuous marine record. Colder diversions within predominantly warm stages are known as stadials, and warmer diversions within cold stages as interstadials.

2.2 Lower and Middle Palaeolithic archaeology

The Palaeolithic covers the time span from the initial colonisation of Britain in the Middle Pleistocene, at least 790,000 years ago (Parfitt *et al.*, 2005), to the end of the Late Pleistocene, corresponding with the end of the last ice age *c.* 10,000 years ago. Thus the Palaeolithic period occupies almost 700,000 years, and includes at least eight major glacial–interglacial cycles (Table 1), accompanied by dramatic changes in climate, landscape and environmental resources. At the cold peak of glacial periods, ice-sheets 100s of metres thick would have covered most of Britain, reaching on occasion as far south as London, and the country must have been uninhabitable. At the warm peak of interglacials, mollusc species that now inhabit the Nile were abundant in British rivers, and fauna such as hippopotamus and forest elephant were common in the landscape. For the majority of the time, however, the climate would have been somewhere between these extremes.

After the formation of the Channel probably some time in the later Middle Pleistocene (Gibbard, 1995) human access to Britain was only possible during periods of cold climate when sea levels were lower and consequently early hominids were only periodically present in Britain (White and Schreeve, 2000), which was at the northern margin of the inhabited world. The archaeological evidence of the period mostly comprises flint tools, and the waste flakes left from their manufacture. These are very robust and resistant to decay, and, once made and discarded, persist in the landscape, eventually becoming buried or transported by sedimentary processes related to climatic change and landscape evolution. Other forms of evidence include faunal dietary remains of large animals, sometimes cut-marked reflecting the stripping of flesh for food or broken open for marrow extraction and, very rarely, wooden artefacts. These forms of evidence are, however, more vulnerable to decay, and it is only very rarely that burial conditions were suitable for their preservation through to the present day. Hominid skeletal remains have also been found on occasion although, again, these are very rare and require exceptional conditions for their preservation.

The British Palaeolithic has been divided into three broad, chronologically successive stages — Lower, Middle and Upper — based primarily on changing types of stone tool. This framework was developed in the 19th century, before any knowledge of the types of human ancestor associated with the evidence of each period, and without much knowledge of the timescale. This tripartite division has nonetheless broadly stood the test of time, proving both to reflect a general chronological succession across Britain and northwest Europe, and to correspond with the evolution of different ancestral human species.

Evidence of very early occupation of Britain has recently been discovered on the Norfolk coast at Pakefield (Parfitt *et al.*, 2005), dating to possibly as old as MIS 21, *c.* 790,000 BP. The evidence consists of very simple cores and flakes, and was presumably made by a form of *Homo erectus/ergaster*, known to be present in Central/Eastern Europe from over 1,000,000 BP. Following this occurrence of very early hominid presence, there are a number of sites dating from MIS 13, *c.* 500,000 BP associated with the later western European *Homo heidelbergensis*, particularly at Boxgrove in Sussex, where an extensive area of undisturbed evidence is associated with abundant faunal remains and palaeo-environmental indicators (Roberts and Parfitt, 1999). It is worth noting here that the impact of the Anglian glacial advance in MI Stage 12 has had considerable impact on the geographical structure of the landscape associated with these early hominid sites in Britain. Major re-modelling of the major drainage basins such as the Thames (Gibbard, 1985) and the creation of the Severn and Fen basins (Rose, 1994) have resulted in the destruction of much of the landscape associated with the earliest phases of human activity (Wymer, 2001) while elsewhere, *e.g.* central East Anglia, the evidence remains deeply buried by the till deposits associated with the Anglian ice advance (*e.g.* Lewis, 1998).

From the Anglian onwards Palaeolithic occupation becomes more frequent in Britain, although probably not continuous. There was gradual evolution of an Archaic hominid lineage from *Homo heidelbergensis* into Neanderthals (*Homo neanderthalensis*) during the period from 500,000 BP up to the middle of the last glaciation (*c.* 35,000 BP). Very broadly speaking, the Lower Palaeolithic is associated with early Archaics and handaxe manufacture (Acheulian), and the Middle Palaeolithic with the development of Neanderthals and increasingly sophisticated flake-tool based lithic technology

(Levalloisian and Mousterian), alongside one distinctive form of handaxe, the *bout coupé*. It has, however, become clear with improved dating of several key sites, as well as the recent discovery of the Pakefield site, that the definition and distinction of Lower and Middle Palaeolithic are less clear-cut than was originally thought.

The Lower Palaeolithic embraces a variety of lithic technologies besides handaxe manufacture. At Pakefield, there is not a hint of handaxe manufacture, and the lithic industry consists entirely of small flint cores and flakes. Following this, most early sites are dominated by the manufacture of handaxes, although usually alongside a small component of core/flake production. However, there are also a number of contemporary early sites without handaxe manufacture that can be included as Lower Palaeolithic — particularly the manifestations of crude cores, flakes and notched flake-tools that occur at several sites in Kent and East Anglia and are labelled as Clactonian. It is also uncertain to what extent the manufacture of handaxes persisted alongside the uptake of "Middle Palaeolithic" Levalloisian and Mousterian technology, whether different human groups were involved, and whether a transition from Lower to Middle Palaeolithic took place contemporaneously across the whole of Britain. Handaxes are scarce, but present, at most of the few Levalloisian sites known in Britain. These may be derived from earlier deposits, or contemporary with the Levalloisian material. The problem is that our understanding of the Lower and Middle Palaeolithic archaeological record is restricted by:

- Poor provenance of most finds
- Difficulty of dating deposits of this age
- Uncertainties over the extent of earlier derived material in assemblages

After 35,000 BP, Neanderthals were suddenly replaced in Britain and northwest Europe by anatomically modern humans (*Homo sapiens sapiens*), who are associated with the later, Upper part of the Palaeolithic. The Upper Palaeolithic is also characterised by cultural changes such as the development of bone and antler tools and the representation of images of animals painted on cave walls or as small antler or bone carvings. The suddenness of this change and the physiological differences between Neanderthals and modern humans, as well as recent DNA studies, suggest that modern humans did not evolve from Neanderthals, but evolved elsewhere, probably in Africa or western Asia *c.* 125,000 BP, before colonising other parts of the world.

In contrast to the Lower and Middle Palaeolithic periods, the relatively recent age of the Upper Palaeolithic, and the fact that, at least in Britain, the period is within the range of radiocarbon dating, means that our understanding of the period is good. It is clear that, at least in Britain, there is a well-defined and clear break between the Middle and the Upper Palaeolithic. Upper Palaeolithic evidence is very sparse in Britain. The climate was in the second half of a major glacial episode, and human presence was probably limited to occasional parties venturing to the edge of their habitable range. Some material has been recovered from deposits accumulated in cave sites on the Welsh coast, in Devon, in Herefordshire and in the Peak District dating to the milder climatic phase before the Last Glacial Maximum of *c.* 20,000–15,000 BP (Barton and Collcutt, 1986).

There was no human presence in Britain during the LGM, and recolonisation did not take place until a short phase of climatic amelioration (Windermere Interstadial) from c. 13,000 to 12,000 BP towards the end of the last ice age. Again, the majority of the evidence comes from cave deposits. This short-lived episode of Upper Palaeolithic settlement/recolonisation, characterised by a blade-based technology with distinctive backed points — Creswell, Cheddar and Penknife points — was brought to an end by a renewed climatic deterioration (Loch Lomond re-advance), marking the final stage of the last glaciation. After this climate improved at the onset of the Holocene, and Britain was recolonised again, by people with a characteristic Long Blade technology, which rapidly developed into Mesolithic.

2.3 National Research framework for Palaeolithic archaeology

It was recognised in the 1980s that the present structure of archaeological curation and investigation in advance of development requires a framework of academic and research priorities against which to consider the significance of sites and to guide their investigation. The seminal English Heritage publication *Exploring our Past* (1991) identified three main themes — physical evolution, cultural development and global colonisation. More recently a working party of the Prehistoric Society has defined three main strands for a national Palaeolithic Research Framework (English Heritage/Prehistoric Society, 1999):

- Identification of research themes and priorities
- Development of specific projects of immediate relevance
- Education and dissemination initiatives

2.3.1 Research themes and priorities

While regularly under review, and subject to changing emphasis in light of new discoveries and research directions, a comprehensive list of core national research themes and priorities (NR) comprises:

- NR 1 Documentation and dating of regional sequences of material cultural change
- NR 2 Dating artefact-bearing deposits within regional, national and international Quaternary frameworks
- NR 3 Behaviour of Archaic (pre-anatomically modern) hominids (a) at specific sites, (b) across the wider landscape
- NR 4 Behaviour of anatomically modern hominids (a) at specific sites, (b) across the wider landscape
- NR 5 Extent of contrasts in Archaic and anatomically modern human behaviour and adaptations, and in fundamental cognitive capacities

- NR 6 Patterns of colonisation, settlement and abandonment through the Pleistocene
- NR 7 The climatic and environmental context of Archaic settlement, and the relationship between climate/environment and colonisation
- NR 8 The history of isolation/connection between Britain and the continental mainland, and the relationship/implications for Palaeolithic settlement and cultural development/expression
- NR 9 Improved documentation and understanding of hominid physiological evolution
- NR 10 Investigation of the relationship between evolutionary, behavioural and material cultural change
- NR 11 Social organisation, behaviour and belief systems

2.3.2 The resource

The main resource for addressing these themes is the lithic and faunal archaeological evidence contained in Middle and Late Pleistocene contexts. Undisturbed horizons have been rightly highlighted (Roe, 1980; English Heritage, 1991) as of particular significance for their stratigraphic and chronological integrity, and their fascinating glimpses into short-lived episodes of activity. Disturbed and transported material, such as predominates in fluvial contexts, has in contrast been widely downgraded in its potential significance, to the extent that some in the current curatorial environment would regard such material as being of insufficient significance to merit any protection or research in advance of destruction. However, besides avoiding the risk of writing off large quantities of the finite Palaeolithic resource just because we don't yet know what to do with it (Chippindale, 1989), it is becoming clear that the study of such material in fact *complements* the evidence from undisturbed sites by bringing a different chronological and spatial perspective to bear. Collections of transported artefacts represent a time and space-averaged sample, giving a more representative view of lithic production and diversity than the evidence from a few square metres representing one afternoon in the distant past. Such evidence may in fact be of more value in documenting and explaining general patterns of material cultural change, since it is less vulnerable to local heterogeneity caused by, for instance, specific tasks or raw material availability.

Besides the direct evidence of human activity, such as artefacts and cut-marked faunal remains, associated biological evidence also plays a central role. It can be used to:

- Reconstruct the palaeo-climate and local environmental context of early hominid activity
- Date the sedimentary context of any archaeological evidence, both through chronometric means such as Uranium series (for mammal bones) or Amino acid

dating (for molluscs) and by biostratigraphic comparison (particularly for mammalian assemblages)

- Identify the depositional and post-depositional processes of sedimentary contexts

Even at Middle and Late Pleistocene sites where direct archaeological evidence is absent, the study of any biological evidence has a major contribution to make to Palaeolithic research. As mapping and lithostratigraphic correlations of depositional units become more detailed in an area, accurate dating of even a few key units can provide foundations to tie in the whole sequence, and its contained archaeological horizons, with the wider national and international frameworks. This dating will most likely be achieved from the study of biological evidence — pollen, large vertebrates, molluscs or small vertebrates — from archaeologically sterile Pleistocene deposits. Thus a central aspect of the Palaeolithic archaeological agenda in any region has to be the discovery and study of such deposits.

In summary, the following key points can be made concerning how national Palaeolithic research goals can be addressed:

- The main evidence is lithic artefacts and dietary faunal remains
- It is essential to know the stratigraphic context of such material
- Evidence from *both* undisturbed primary context *and* disturbed secondary context sites is significant
- The interpretive potential of any archaeological material depends upon understanding of depositional and post-depositional processes that have affected it
- Dating is essential to document the degree and spatial scale of contemporary variability, and the trajectories of cultural stasis and change through the changing climatic framework of the Pleistocene
- Biological palaeo-environmental evidence plays a fundamental role in Palaeolithic research, even on sites without artefacts, by contributing to the construction of chrono- and climato-stratigraphic frameworks
- Geological evidence to form litho-stratigraphic frameworks

2.4 Regional research context and reasons for the project

Considerable attention has recently been focused on sediments from the higher areas of the West Sussex marine/terrestrial staircase because of the wealth of Lower Palaeolithic material that these sediments have furnished, particularly at Boxgrove (Roberts and Parfitt, 1999). One consequence of this heightened awareness of the Palaeolithic potential of Pleistocene deposits has been the readiness of the archaeological curators, in some situations, to include strategies for dealing with this type of archaeology during developer funded investigations. However at present,

despite the results of the Southern Rivers Palaeolithic Project (SRPP) initiative, the distribution of archaeologically sensitive sediments within our study area remains unclear and consequently responses to development threats are often based on partial and incomplete knowledge.

In order to address some of these issues for that part of the Sussex associated with the Boxgrove site a major, English Heritage funded, survey project is currently ongoing investigating the extent and Palaeolithic potential of high level marine/terrestrial deposits east and west of Boxgrove (Upper Coastal Plain Mapping Project, based at University College London). Other related projects have involved investigations of sediments from the lower West Sussex Coastal Plain (Bates *et al.*, 1997). For the Hampshire area of the coastal plain Terry and Wilkinson (St. Alfred's College, Winchester) have been undertaking a project for Hampshire County Council where the objective was to map and, if possible, delimit likely areas of *in situ* Palaeolithic archaeological potential (Wilkinson and Hennessy, 2004). This study is primarily based on investigation of a selection of British Geological Survey borehole records suitable for modelling the distribution of identified sediment bodies within ARC GIS software. Other studies in the East Hampshire area include that of Wenban-Smith *et al.* (2000), the Isle of Wight (Wenban-Smith, 2000) and within the offshore zone. However, despite these and other recent and ongoing projects, there remain several major unanswered questions concerning the age, nature, significance and potential of the Palaeolithic archaeological evidence contained in the aggregate resource in the Sussex/Hampshire Coastal Plain Corridor.

In particular:

- Knowledge of the distribution and nature of the depositional contexts of the main Pleistocene sedimentary units is inadequate and incomplete. Much of this is based upon the BGS mapping which typically reflects the near surface sediment characteristics and commonly fails to identify the precise nature of the often complex sub-surface stratigraphy. For example, at Norton Farm (Bates *et al.*, 2000) a complex sequence of beach gravels and sands, overlain by fine grained freshwater silts with an associated buried landsurface, exist at the site but BGS mapping simply reflects the occurrence of Head deposits near to the surface throughout the area.
- Dating and correlation of the main Pleistocene sedimentary units is uncertain both within the West Sussex Coastal Plain and the Eastern Solent Basin areas, and between these two major systems of Pleistocene sedimentation. This is a function of the preservational status of the deposits between the areas (i.e. large and small mammal remains preserve well within the higher parts of the West Sussex Coastal Plain and have been used for biostratigraphic correlation; the absence of similar material from the fluvial deposits of the Solent means that comparable correlations have not been possible in this area).
- No work has been done investigating/interpreting the Palaeolithic archaeological evidence documented in the SRPP, particular from the perspectives of: density/presence/distribution of material in specific units, and broad technological and typological characterisation of material within and between major sedimentary units. A pilot study into material from one site (Highfield Church Pit) in Terrace 4 at Southampton showed a large variety of handaxe forms, as well as several interesting

recurring typological quirks (Wenban-Smith, 2001). Such work needs to be supplemented by further studies from other sites in the same terrace, as well as material from other terraces in the Southampton area.

- There is currently a poor understanding of the distribution of aggregate deposits of higher Palaeolithic significance, particularly in areas of development sensitivity.

Regional studies investigating the Palaeolithic archaeological content of the Middle/Late Pleistocene aggregate sediments and examining, defining and correlating known and unknown sequences utilising both extant data and new field investigations have only been attempted in a piecemeal fashion in the West Sussex/Hampshire Coastal Corridor (with the major exceptions being the Upper Coastal Plain Mapping Project east and west of Boxgrove in the Goodwood–Slindon raised beach formation and Wilkinson’s project for Hampshire County Council (Wilkinson and Hennessey, 2004)). The current project has therefore taken as a starting point the SRPP, the Upper Coastal Plain and Hampshire County Council projects, and has built on these projects in order to increase knowledge of the distribution, and Palaeolithic significance, of Pleistocene sediments within the coastal corridor, to provide information relevant to planners, industry and academics. Additionally this project has provided a baseline dataset for comparison with information generated from the off-shore projects commissioned within the framework of the ALSF fund, e.g. the Arun Valley and Seabed Prehistory projects.

2.5 Project aims and objectives

Six project objectives were identified for this stage of the project. These were specifically focused on extracting information from the field, museum and laboratory studies for curatorial purposes:

1 — Palaeolithic resource characterisation

To characterise the Palaeolithic resource in the study region, and so provide baseline information for the curatorial community on the distribution, Palaeolithic archaeological content and significance of fluvial sands and gravels that are potentially vulnerable to aggregate extraction (Section 4).

2 — Pleistocene resource distribution and framework

To improve mapping of the distribution of Pleistocene deposits in the study region, and develop an integrated chronological and lithostratigraphic framework, supported where possible by interpretation of climate, environment and depositional processes/regimes (Section 3). This would provide a context for (a) future investigations in the region carried out in relation to aggregate extraction and other development and (b) archaeological material already recovered.

3 — Hominid settlement history and cultural development

To provide a framework for hominid settlement history and cultural change/patterning in the study region (Section 4).

4 — Predictive Palaeolithic modelling

To characterise the landscape of the study region into zones of different Palaeolithic potential, characterising the Pleistocene context and highlighting areas of high potential, with summaries of the expected nature of Palaeolithic evidence, its significance within the context of national and regional research frameworks, and signposting appropriate approaches to field investigation. This would be produced as a GIS layer with linked attribute tables suitable for integration with county SMRs and HERs (Section 6).

5 — Palaeolithic resource curation

To develop improved methodologies for the field evaluation, characterisation and interpretation of Palaeolithic evidence in Pleistocene sand and gravel bodies threatened by aggregate extraction.

6 — SMR enhancement

To contribute to enhancement of the quantity and quality of Palaeolithic SMR information available to aid curators (Section 4).

Specifically a set of revised aims and objectives for the project has been undertaken principally with the curatorial requirements foremost. Acceptance that sufficient palaeoenvironmental assessment has been undertaken to characterise, rather than provide detailed palaeoenvironmental reconstructions, units then the tasks required to complete the project have the following aims and objectives:

1. To characterise the environments of deposition for each of the major stratigraphic groups identified in the study area [this has been substantially completed through the interpretation of contained sediment sequences and the assessment of the microfossil (mainly foram/ostracod) content] AIM 1
2. To define key marker sites of particular regional importance and tie points in the regional stratigraphic sequences which are likely to benefit from additional investigation [key identified sites are Lepe, Warblington, Portfield Pit Westhampnett and West Street Selsey; only Lepe and Warblington remain to be analysed in detail] AIM 2
3. To date using OSL the major stratigraphic groups identified in the study area [this has been partially completed through the Phase 1 dating program and samples for the remaining sites now exist from the Phase 2 works] AIM 3
4. To characterise, for each of the main project regions investigated archaeologically (Eastern Solent and West Sussex Coastal Plain), (a) the broad pattern through time (as represented in the stratigraphic sequence of major sediment bodies) of human occupation, (b) broad chronological changes through time in material culture and (c) synchronic material cultural variations across the landscape. In this case of course "material culture" solely concerns lithic artefacts, and particularly handaxes, which constitute the main archaeological evidence of the Lower/Middle Palaeolithic, which is the focus of this study. AIM 4
5. To produce a detailed GIS layer for the region using known Palaeolithic archaeology, sediment mapping and palaeoenvironmental data to (a) characterise the landscape in terms of Lower/Middle Palaeolithic significance and potential and (b)

highlight areas of particular importance, identifying for such areas key research framework goals, and critical data/methods for addressing them. AIM 5

6. To disseminate the diverse project results as appropriate to a range of end users, namely: development control officers, curatorial staff, minerals planners, academic archaeologists and Quaternary scientists, schools and the general public in the project area. AIM 6

The output for this stage of the project was therefore a GIS system consisting of:

1. Shape files defining a series of polygons across the study area (these polygons define zones of similar geological (solid and drift) and Palaeolithic archaeological character within which approaches to the Palaeolithic archaeological record may be similar).
2. A series of characteristics defining the unique nature of each zone (in terms of archaeological, geological and chronological parameters).
3. Tabulated data containing lists of boreholes, sites investigated during the project and types of information stored in the project archive.

This report forms the accompanying written record for the GIS.

2.6 Project methodology and data collection

A diverse body of data relevant to the project was identified during the project lifespan that was held by a number of different organisations. Data sources used in this project include information on the sub-surface stratigraphy, known archaeology and information in museum collections and finally landuse histories. The main data sources included:

- Geological and soil maps compiled by the British Geological Survey and the Soil Survey and Land Research Centre (now the National Soils Resources Institute). This information formed the basis of the mapping component of the project, and was readily available, either in paper or digital form.
- Borehole, test-pit and site investigation data held by the British Geological Survey. Although far from complete, the coverage of records held by the BGS is extensive. Although there are problems of correlating borehole information, these data are potentially extremely important in assessing the nature and extent of alluvial deposits.
- Borehole records.
- Ordnance Survey maps. Information from successive editions of the local 1:50,000 and 1:25,000 and previous imperial editions supplied information on quarrying history in the region.

- County Historic Environment Records. The data held in these is obviously vital to any attempt to understand the Palaeolithic archaeology of the study area. All relevant records were examined and entered into the database as necessary.
- Data from the English Rivers Palaeolithic Survey included in the final reports of the English Heritage-funded project summarised by Wymer (1999).
- Unpublished information held by archaeological units. This included site watches, test-pit observations, borehole logs *etc.*, which were held by the units but may not necessarily have been included on the HERs.
- Academic palaeoecological studies carried out by non-archaeological bodies. A number of known palaeoecological and sedimentological studies have been carried out by students at various non-archaeological university departments on the sequences in the study area.
- Archaeological information held in museum collections.

3. PLEISTOCENE GEOLOGY OF THE STUDY AREA

The study area has been divided into a series of 5 geoarchaeological areas. Detailed study of the archaeological material has been undertaken in areas 1-3 and 5. Pleistocene deposits in the study areas fall into four discrete groups of sediments:

- Marine sands/gravels/silts associated with sea level high stands (interglacial, temperate stages) and fine-grained sediments capping the marine sequences associated with sea level regression phases occur within the West Sussex Coastal Plain area (Figure 3) (Areas 1 and 2, Figure 3).
- Coarse, poorly sorted angular flint gravels and silts associated with sea level low stands (periglacial, cold climate stages) typically overlying and burying the interglacial marine deposits in the West Sussex Coastal Plain area (Areas 1 and 2, Figure 3) and fluvial deposits of the Solent (Areas 3-5, Figure 3).
- Flint gravels deposited by fluvial (river) action in valleys such as the Solent (Figure 5) (Areas 3-5, Figure 3), Arun and Adur (Areas 1 and 2, Figure 3).
- Sediments preserved in abandoned/buried channels such as those between Selsey and West Wittering (Area 2, Figure 3) and around Stone Point (Area 4, Figure 3).

These groups of sediments formed as a direct result of the changes in climate regime during the Quaternary. As a consequence of global temperature changes the area of the Sussex/Hampshire coastal corridor will have seen phases of sea-level attaining, or exceeding, modern datums during interglacial periods (leading to the deposition of marine sediments ultimately becoming raised beaches) and phases when sea-level fall resulted in the retreat of the sea and exposure of the floor of the English Channel (leading to deposition of coarse river gravels in the main valleys and solifluction deposits across much of the coastal plain – see Bridgland, 2002). It should also be noted that in addition to sea-level changes the area appears to have been subjected to uplift as a result of tectonic processes (Preece *et al.*, 1990; Roberts and Parfitt, 1999; Bates, 2001). This uplift is responsible for elevating the marine and fluvial deposits above tidal datums for subsequent high sea-level events thereby preserving the deposits as raised beaches and terraces within the area (Bates *et al.*, 1997).

Today the study area contains unconsolidated Pleistocene deposits overlying bedrock geologies consisting of Cretaceous Chalk or Tertiary clays and silts (Gallois, 1965) (Figure 6). The distribution of these bedrock geologies has important implications for the nature of the overlying Pleistocene deposits and, in particular, the preservation within them of biological material. For example in the West Sussex Coastal Plain (Areas 1 and 2) the predominance of Chalk bedrock and the consequent formation of calcareous sediments has often led to the preservation of biological evidence such as molluscs, ostracods and mammalian remains, which have proved useful in dating and environmental/climatic reconstruction (Bates *et al.*, 1997, 2000, 2003; Roberts and Parfitt, 1999). In the Eastern Solent Basin, the relative absence of Chalk bedrock and calcareous Pleistocene sediments has led to a lack of such evidence, and a consequent lack of knowledge of dating, climate and environment.

During the time periods under discussion the regional palaeogeography differed considerably from that of the present day. To the east, beyond Brighton, the English Channel was closed prior to 450ka BP and the coastal plain lay at the eastern end of a large embayment connecting Britain with the continental mainland (Bates *et al.*, 1997, 2003). This link was severed shortly after 450ka BP and the subsequent history of the area was one of opening and closing of the English Channel (Gibbard, 1995; Preece 1995). To the west the presence of the former Solent River (Everard, 1954; Allen and Gibbard, 1993) and the landbridge between the Isle of Wight and the mainland presented a very different geography dominated by a large estuary occupying the area of the Eastern and Western Solent and Southampton Water (Figure 5) for much of the Pleistocene period.

On the West Sussex Coastal Plain the deposits containing Palaeolithic archaeological material consist of a staircase of marine and terrestrial deposits (Figure 4), with the highest set of deposits (associated with the Goodwood–Slindon raised beach at *c.* 40m OD) being of greatest age and containing, amongst other archaeological horizons (Woodcock, 1981), the internationally significant site of Boxgrove with its undisturbed Palaeolithic landsurfaces and hominid remains (Roberts and Parfitt 1999). Younger sets of deposits, examined mainly during extensive quarrying since the 19th century, occur at progressively lower altitudes across the coastal plain towards the present coastline (Bates *et al.*, 1997, 2003). These also contain Palaeolithic archaeological material and associated biological evidence.

In the Eastern Solent Basin, from east of the River Test to the Portsdown Anticline (Figure 5), the situation differs considerably from that in West Sussex. Within this zone marine/terrestrial deposits are restricted to a few locations in the vicinity of Portsdown and they are replaced by fluvial sediments laid down by the former Solent River. These gravels have been well mapped in Southampton and to the west of Southampton Water (Everard, 1954; Edwards and Freshney, 1987; Allen, 1990; Allen and Gibbard, 1993; Westaway *et al.*, 2006) however, deposits to the east of Southampton Water are less well understood and a relative dearth of information typifies the area between the Solent and the region of the West Sussex Coastal Plain. Here the Pleistocene sequences are typically decalcified and with a few exceptions they do not contain organic material. Consequently there is a lack of the fossil biological evidence commonly used for palaeoenvironmental analysis and dating. Many of the recent publications focused on this area also draw attention to the complexity of these deposits (e.g. Bates, 2001). Consequently much work remains to be undertaken mapping them more accurately and relating the distribution of sedimentary units to the occurrence of Palaeolithic archaeological remains.

Other deposits within the project area include the extensive sequences of soliflucted gravels that mantle the marine and terrestrial sequences across much of the area. These deposits may contain stratified, *in situ* Palaeolithic material (Roberts and Parfitt, 1999). Additionally fossiliferous sediments are noted in shallow channels around Selsey Bill where the clay-rich Tertiary substrates have often preserved the easily destroyed organic remains.

In summary, key aspects of the Pleistocene geological sequence in the study area are:

- At least 4 raised beaches are known to exist within the West Sussex Coastal Plain area (Table 2).
- The ages of the raised beaches are not fully understood, although collection and analysis of a substantial body of data has led to reasonably correlations with the marine isotopic framework being attempted (Bates *et al.*, 1997, 2003); however, where a number of different methods of determining the age of a sequence have been undertaken, for example at Boxgrove (Roberts and Parfitt, 1999), controversy exists regarding the interpretation of the data.
- The raised beaches are interpreted as have been deposited during high sea-level episodes under temperate conditions.
- Palaeo-landsurfaces are developed above some of the marine sequences (e.g. at Boxgrove, Norton Farm and Portfield Pit, Westhampnett (Figure 8)). These landsurfaces may be of considerable lateral extent and in places contain *in situ* Palaeolithic archaeological material.
- Periglacial conditions during subsequent cold periods resulted in the burial and preservation in some locations of these marine deposits and their overlying landsurface (Figure 3) under soliflucted sediments, and erosion and removal of the marine/landsurface deposits by the same processes elsewhere. Thus the remnant marine/landsurface deposits have a patchy distribution in the present day depending on a range of geomorphological factors.
- Fluvial activity has resulted in the deposition of extensive bodies of sand and gravel within the main river valleys of the area. At least 10 (and probably more) distinct morphological terraces, underlain by fluvial gravel, can be recognised in the Solent system. In many cases these gravel bodies contain extensive archaeological remains.
- The differentiation and dating of the different fluvial terraces in the Solent Basin remains problematic due to the generally urbanised nature of the region, the relative superficiality of the previous investigations and the general absence of suitable biological evidence.
- Interglacial channel deposits exist below marine sediments in places, particular in the vicinity of Selsey Bill, on the southern coastal edge of the West Sussex Coastal Plain.

In order to further investigate the nature of the sequences through the study area and number of sites have been selected for detailed investigation (Table 3). From some of these sites samples for dating and palaeoenvironmental assessment were obtained (Table 4).

3.1 West Sussex Coastal Plain

In order to understand both the limitations of our current understanding of the deposits and sequences of the area and to allow those areas of the study region that require

further investigation to be highlighted it is necessary to consider the range of deposits known to be present within the area and their likely presence within the study region.

In an early paper describing the Pleistocene deposits of the West Sussex Coastal Plain, Prestwich (1859) attributed sands and gravels at Waterbeach (SU 895985) to marine deposition. In a later paper, he presented further observations and correlated the deposits he interpreted as raised beach sequences in Sussex with similar deposits elsewhere in Southern Britain (Prestwich, 1892). At this time all marine sediments of the coastal plain (excluding the recent harbour fills) from the northern margin around Boxgrove southwards through the vicinity of the Chichester Harbour and south towards Selsey were considered to belong to a single high sea level event.

By the early 20th century it was recognised that more than one high sea-level event was preserved in the area and attempts to subdivide the coastal plain marine sediments were made by Palmer and Cooke (1923), Fowler (1932) and Calkin (1934). Fowler (1932) recognised that at least two, altitudinally (and, by implication, chronologically) discrete beaches were present in the area. The series of sands and gravels at heights above 30m (100 feet) O.D. (forming the upper coastal plain) were comparable with the sequences reported by Prestwich from Waterbeach and more recently those discovered at Amey's Eartham Pit, Boxgrove (Roberts, 1986; Roberts and Parfitt, 1999). These have often collectively been referred to as the Goodwood-Slindon or '100 foot' Raised Beach (Bates *et al.*, 1997). A lower series of sands and gravels at 4.5m (15 foot) O.D. on the lower coastal plain, typified by deposits at Selsey (Reid, 1892), also exists throughout the area. Elements of these younger sequences almost certainly exist within the Chichester Harbour area. Conventionally a Hoxnian age was ascribed to the highest 30m raised beach (Table 2) (Shephard-Thorn and Kellaway, 1978). However, the recent excavations at Amey's Eartham Pit, Boxgrove have suggested an age late within the Cromerian Complex for the raised beach that occurs between 30m and 43m O.D. (Roberts and Parfitt, 1999).

Key sites:

Boxgrove (Roberts and Parfitt, 1999)

Aldingbourne Park Pit (Woodcock, 1981)

Norton Farm (Bates *et al.*, 2000)

Portfield Pit (Bates, 1998)

More recently the sediments within the area of the lower coastal plain were remapped by the BGS (Berry and Shephard-Thorn, 1982; Shephard-Thorn *et al.*, 1982; Bristow and Wyatt, 1983; Lovell and Nancarrow, 1983). To the east, deposits at comparable elevations include the sands and gravels at Black Rock, Brighton (Mantell, 1822; Martin, 1929; Shephard-Thorn and Wymer, 1977; Young and Lake, 1988). Hodgson (1964) concluded that these low-lying aggradations (typically below the 15m contour) were deposited during a single high sea-level stand during the Ipswichian interglacial and the sequence at Black Rock was identified as the 'type sequence'. The beach/cliff-line is commonly known, therefore, as the Brighton/Norton Raised Beach. This situation is reflected by the BGS mapping throughout the area equating the majority of the marine sediments of the lower coastal plain with Raised Beach Deposit 1.

The recent work in the area (Bates *et al.*, 1997; Bates *et al.*, 2004) suggests that this sequence of events is too simplistic and that additional distinct high sea-level aggradations can now be recognised across the coastal plain.

The PASHCC investigation has identified the following additional elements within this sequence of deposits:

1. The Aldingbourne Raised Beach is more complex than previously recognised. At least 2 different sequences of sediments are now known to be preserved within the beach (Figure 9). These deposits have produced rare microfossil faunas (Foraminifera and Ostracoda) that support a complex history of deposition (Tables 5 and 6). OSL dating of the sediments (Table 7) suggests that contrary to previous expectations (Table 2) the earliest parts of this beach were laid down during the early parts of MIS 7.
2. The Brighton/Norton Raised Beach (Figure 10) represents an extensively preserved feature across the coastal plain from Havant in the west eastwards to Black Rock at Brighton in the east; to the south deposits have been mapped as far as Woodhorn Farm. Rich in microfossils (Tables 5 and 6) the OSL dating (Table 7) suggests probable correlation of this beach with the latter parts of MIS 7. Amino Acid Geochronology (Bates *et al.*, 2004) also suggest broad contemporaneity of these deposits. An important and extensive landsurface is developed on top of the marine sediments in places close to the fossil cliff line (Figure 8).
3. Marine deposits surrounding Pagham Harbour (Figures 10, 11 and 12) are now also known to contain microfossil assemblages although in many cases these are rather poorly preserved (Tables 5 and 6). The sediments have been dated (Table 7) to the last interglacial (MIS 5e). These assemblages of microfossils appear to be indicative of cool water conditions, contrary to the generally held perception of the last interglacial as a period in which temperatures may have been slightly above the present day average.
4. The Selsey (Figure 10) has also been dated to the last interglacial on the basis of the OSL age estimates (Table 7).

Another set of deposits known from the study area are the buried channel sediments that have been exposed on the foreshore between West Wittering and Selsey Bill. These channels and related fills have been linked to sea level highstand phases (Reid, 1903), and have been described by many authors including Reid (1892), Heron-Allen (1911), Palmer and Cooke (1923), West and Sparks (1960), West *et al.* (1984) and Bates *et al.* (2004). The channels, cut into Tertiary bedrock (Figure 13), sometimes contain brackish water faunas and are present in the area lying at or below current sea-level between Selsey and West Wittering. Today the channels are often buried by modern beach deposits and are only exposed after exceptional storms clear the beach of sand and shingle (Figure 11). Although it is

Key sites:

Early Channel (West *et al.*, 1984)

Lifeboat Station Channel (West and Sparks, 1960)

West Wittering Channel (Reid, 1892)

West Street, Selsey (Bates *et al.*, 2004)

difficult to demonstrate at the present time most authors would agree that the deposits are stratified below raised beach deposits (Reid, 1892; West and Sparks, 1960; West *et al.*, 1984; Stinton, 1985) and therefore must be older than the last interglacial because of the OSL date from the Selsey Ridge (Table 7). They have been ascribed ages varying from the early Middle Pleistocene (West *et al.*, 1984) to Ipswichian (West and Sparks, 1960).

Investigation of these deposits has been piecemeal and in certain instances conflicting evidence has been generated from different specialist works. For example study of the Lifeboat Station channel at Selsey (West and Sparks, 1960) indicated infilling of the channel under conditions associated with rising sea levels. However Whatley and Kaye (1971) suggest that foraminifera from the same sediment units implied infilling of the channel under conditions of falling sea level. PASHCC study of the channels at Selsey (Figure 12) and West Wittering indicate that sequence development in these channels are complex and that it is likely that a number of ages of deposits may be present within a single channel complex (Figure 15).

Although none of these channels have been positively traced on shore for more than a few 100m and it is probable that the inland extension of these channels (if preserved) cross parts of the coastal plain.

Comparing the size of these channels (typically less than three metres deep) with major river valley systems currently existing to the east and west of Selsey Bill (e.g. the Arun Valley and Solent where Holocene fills may exceed 20m in thickness) it is clear that all of the infilled channels around Selsey Bill are considerably smaller and shallower than those of the main Holocene infilled valleys. These channels may be similar, in part to some of the channels existing today within Chichester Harbour. They may have infilled under very different conditions to the deeper channels, such as that of the Arun, in which thicker sequence (of considerable time depth) recording a large part of the interglacial succession built up. The smaller Pleistocene channels are therefore likely to only contain short sequences within the interglacial and probably existed in ephemeral locations relative to the main contemporary channels recording the main transgressive/regressive signatures of the interglacial (perhaps akin to those sites in Langstone Harbour where peat accumulated in hollows in the topographic template at Baker's Rithe and Russell's Lake). The channels around the Bill could therefore be viewed as channels infilled, perhaps quite rapidly, when a threshold had been reached in sea level rise and main valley fills. Given the low gradient of these channels and the shifting nature of sedimentation patterns in the lower parts of such marine marginal situations changes in patterns of sedimentation at the mouth of the channels may easily have led to local transgressive/regressive trends superimposed on the longer term transgressive/regressive trends of the interglacial. Consequently the significance of the apparent trends in marine transgression/regression within these shallow channels should be treated with caution.

Archaeological material associated with these deposits is limited but a few fresh artefacts with Levallois affinities have been located within the vicinity of one of these channels at Selsey.

Cold climate periglacial sediments (Ballantyne and Harris, 1994), typically coarse angular flint gravels (Figure 16) or finer grained silts (brickearth) that may contain

chalk rich material, commonly occur as wedges of sediments overlying the marine interglacial sediments or resting directly on bedrock. The gravels are derived from degradation of the chalk bedrock of the downland block under cold climate conditions while the finer grained silts (brickearths) may derive from both fluvial and aeolian activity. The gravels have been extensively quarried for aggregate material across much of the coastal plain on both the upper and lower coastal plains. BGS mapping indicates that throughout much of the lower coastal plain brickearth appears to be the dominant periglacial sediment type although work elsewhere has shown that coarser gravels may be associated with channels draining the downlands and as wedges close to former cliff lines.

These deposits are well known as a source of aggregate and much attention, by both the British Geological Survey and sand and gravel extraction companies, have been exerted in mapping the distribution and nature of these deposits (e.g. Lovell and Nancarrow, 1983). However, until recently little has been known of their sedimentological and chronological properties. These deposits may also contain beds of finer grained silts suggesting different environments of deposition of the sediments. Elsewhere on the coastal plain extensive tracts of brickearth exist that may include elements of wind blown sediments or loess (Hodgson, 1964, 1967).

Key sites:

Boxgrove (Roberts and Parfitt, 1999)

Portfield Pit (Bates, 1998)

Cold climate deposits are now known to occur in two areas of the coastal plain to the east and west of Chichester. These deposits fall into two different groups:

1. Bedded chalky gravels and silts. These have been noted at a number of sites east of Chichester at Bersted (Figure 11) and Woodend Farm (Figure 17). These deposits appear to have accumulated under cold, wet conditions (Table 8) where abundance of earthworm granules in the sediments attest to intermittent soil formation. Age estimates from Woodend Farm place formation during MIS 5e however the nature of the sediments and associated faunas suggest that this is unlikely and a date immediately following the end of the last interglacial conditions were becoming cooler is more likely.
2. Fine grained carbonate rich silts beneath bedded chalky gravels. These deposits have been located at Warblington (Figures 17 and 18) and the ostracods attest to deposition in a substantial freshwater system (Table 8). Pollen indicates surrounding conditions of open grassland. Insects are also present in the deposits. Although no dates are available for these deposits their stratigraphic position below that of the marine deposits dated to MIS 5e at the site suggests a Devensian date for the sequence.

3.2 Solent system

Solent river deposits may be currently found in the following areas (Figure 5):

- West of Southampton Water, including the Avon and Stour Valleys (Western Solent - New Forest Gravel Formation (Area 4, Figure 3), Allen, 1991; Allen and Gibbard, 1993).

- East of Southampton Water (Area 3, Figure 3) and within the Test Valley (Area 5, Figure 3) (Eastern Solent - Edwards and Freshney, 1987; Booth, 2002).
- On the Isle of Wight (Hopson, 1999).

In addition, it has been thought that the Solent river also drained a significant area west of Bournemouth, although the associated deposits in the Frome and Piddle Valleys cannot be successfully correlated eastwards using traditional lithostratigraphic approaches (see Allen and Gibbard, 1993 and references therein).

The deposits to west and east of Southampton Water are usually mapped separately (Figure 5), largely because those of the Western Solent trend north-east to south-west and those of the eastern Solent north to south-east, making the two sedimentary sequences difficult to correlate, although they presumably meet offshore.

The sequences preserved within the broader Solent area typically consist of coarse gravels, often bedded, that may be up to 5m thick. Typically these gravels are indicative of deposition within high energy river channels flowing under cool to cold climate conditions when sea levels were lower than at present. In places these gravels may be capped by finer grained sediments representing floodplain conditions during temperate stages. More usually the gravels are capped by “Head”, poorly sorted sediments produced through solifluction (cold climate slope wash processes). Towards the seaward end of the river systems gravels are replaced by thick sequences of brackish water deposits (e.g. at Stone Point, Lepe) that represent former estuaries of the Solent. In our study we have attempted, where possible, to date the body of the gravel. Consequently we would expect our dates to reflect those parts of the isotope record correlated with cold stages, i.e. evenly numbered Marine Isotope Stages.

The Western Solent has been the subject of various successive mapping programmes, of which the most detailed was undertaken by Allen (1991; Allen and Gibbard, 1993). More recently, Westaway *et al.* (2006) have remapped this area, questioning some of the correlations previously made by Allen (Table 9). This remapping is complex and it should be noted that Westaway *et al.* (2006) present more than one correlation scheme for deposits in the lower parts of the sequence. In our study a single OSL date of 254 ± 18 ka (EX05-01, Table 7) from gravels at Exbury (SZ 4248 9997) suggests a date in MIS 8.

In contrast to the Eastern Solent, there is some biostratigraphic control on the Western Solent deposits between Bournemouth and Southampton. Organic deposits at Stone Point (Figure 19) and Pennington appear to belong to a former estuary of the Solent during the last interglacial. OSL dating within the Western Solent sequence (Table 6, Briant *et al.*, 2006) suggests minimum ages for the Stanswood Bay Gravel (Figure 20) of MIS 7b and the Tom’s Down Gravel of MIS 8. It should be noted that the date from the Tom’s Down Gravel is less reliable because not all the samples agree. BF03-02 and BF03-04 produce older ages with larger error bars because they appear to be approaching saturation and were rejected, whereas the other three samples from this site show good behaviour and were accepted. None of the OSL ages from the Old Milton Gravel are considered to be reliable.

Within the Eastern Solent a key challenge is correlating the different stratigraphic schemes used across the 4 different areas mapped on the 1:50,000 scale BGS maps. Gravels on the eastern side of Southampton Water and the lower part of the Test Valley (sheet 315) were mapped by Edwards and Freshney (1987), with continuation of this mapping in the Gosport area on sheets 316 and 331 (Hopson, 1999). They recognised up to 11 terrace levels at various heights trending north-west/south-east up the Test Valley between Romsey and Portsmouth and a further three submerged terrace levels offshore, the lowest of which is infilled with various Holocene sediments. North of Romsey, Booth (2002) has mapped 8 terrace aggradations in the Test Valley (sheet 299).

Westaway *et al.* (2006) have also attempted to re-map the deposits of this area and base their study only on sheet 315, although they consider the Portsmouth/Gosport area separately. They argue it is difficult to distinguish Terrace 4 from Terrace 3 immediately west of Warsash. However, detailed study of the paper shows a number of other changed correlations which combine to make the suggested revised stratigraphy significantly more complex than the original scheme on which it is based (Table 10); these conclusions are not supported by the PASHCC project investigation.

The borehole analysis undertaken during the PASHCC project is summarised in Figure 21, showing long profiles of the Test Valley / Eastern Solent terraces from north of Mottisfont to Gosport. These largely confirm the validity of the Edwards and Freshney (1987) mapping and their terrace numbering scheme. Thus, where there was no direct evidence available to challenge it, the Edwards and Freshney terrace scheme was applied to the whole of sheets 315, 316 and 331 within the study region, including within tributary valleys. The few changes made and implemented in the accompanying GIS are as follows:

- Terraces 10 and 11 as mapped were indistinguishable from each other using borehole records. Therefore for simplicity all Terrace 10 and 11 deposits have been reassigned to Terrace 10.
- Terraces 5 and 6 appeared to be wrongly assigned to Terrace 6 only to the north-east of Locks Heath. Therefore new areas of Terrace 5 deposits have been mapped at this location.
- Terrace attributions on sheet 299 south of Dunbridge correlate well with those on sheet 315 and the mapping of Booth (2002) was therefore retained here. However, north of Dunbridge the Booth (2002) mapping is less comparable. Figure 21 includes PASHCC field interventions within some of the higher terraces north of Dunbridge. Extrapolation of terrace gradients from areas to the south and east suggested that these should be correlated with higher terrace bodies than in the mapping of Booth (2002). The correlations made were then applied both at these locations and more broadly. These changed correlations were:
 - Terrace 2-3 on sheet 299 north of Dunbridge was reassigned to Terrace 5.
 - Terrace 4 on sheet 299 north of Dunbridge was reassigned to Terrace 7.
 - Terrace 5-6 on sheet 299 north of Dunbridge was reassigned to Terrace 8.

In addition it should be noted that:

- Boundaries between terrace levels are areas of uncertainty on the ground, especially since there is significant thickening of deposits in these areas (Dr Ian West, personal communication).
- The brickearth mapped in Gosport and Portsmouth appears to overlie Terrace 2 gravels throughout (implied by the mapping of Terrace 2 gravels at the edges). However, this is probably not the case. For example, gravels beneath brickearth north of Meon (SU 524 042) correlate more convincingly with Terrace 3 than Terrace 2. In addition, field interventions in Portsmouth during the PASHCC project recorded brickearth overlying solifluction deposits in the north (SU 662 035); and both silts and sands, but not gravels, within a patch of mapped Terrace 2 gravels at Milton Cemetery (SU 665 005).

With the exception of Terrace 1, the base of the lowest 5 terrace deposits show roughly uniform gradients, falling only very gently downstream (Figure 21). This change in gradient probably accounts for the extensive distribution of Terrace 1 deposits in the lower part of the Test, where it has largely replaced deposits of Terraces 2 and 3. Terrace 1 deposits are not observed onshore east of the Itchen, occurring instead beneath Southampton Water (Dyer, 1975; West, 1980).

Along Southampton Water, a full set of multiple terrace levels are well-preserved, dominated by deposits of Terrace 2 and 3. Deposits mapped as Terrace 2 become considerably more extensive towards the east, covering the entire area from Fareham to the coast and south of the Portsdown anticline, although as noted above these may not all actually be equivalent to Terrace 2. In contrast, Terraces 4 to 6 are more limited in their distribution and Terraces 7 to 10 much less extensive and found only on high ground (Edwards and Freshney, 1987). In these higher parts of the sequence, gradients are less clear, probably because there are fewer records at higher altitudes. Both Lake *et al.* (1985) and Edwards and Freshney (1987) note that the higher terrace deposits are more clay-rich and more likely to be overlain by solifluction deposits, and the lower frequently overlain by silts or clay-silts interpreted as ‘brickearth’ or ‘terrace loam’.

Determining the age of the Eastern Solent deposits is problematic, given the lack of biological evidence within the sequences. Lake *et al.* (1985) note that clays similar to those from Stone Point (Brown *et al.*, 1975) have been found underlying terrace gravels near Lee-on-Solent at SU 573 003 and SU 5630 0017 (in an area now covered entirely by housing). However, since neither the age of these deposits nor their relationship to the overlying gravels is clear, this adds little to our understanding of the age of this sequence. In addition, Westaway *et al.* (2006) use a mixture of archaeological tie-points and uplift modelling to suggest ages for the Eastern Solent/Test Valley terrace sequence. The single archaeological tie-point in their sequence is the reporting of abundant Levallois material in their ‘Belbin Gravel’ (Terrace 4 at Belbins Pit, near Romsey; Terrace 3 near Warsash). As noted above, the PASHCC investigations do not support this revised stratigraphy for the region. The only absolute age determination previously reported from the Eastern Solent is a TL date of 15.8 ± 1.5 ka from brickearth overlying Terrace 3 at Chilling Copse at SU 515 042 (Parks, 1990; Parks and Rendell, 1992), that cannot therefore date the deposition of the underlying fluvial gravels.

Field interventions during the PASHCC project have provided some further age control on the sequence in the form of OSL age determinations (Table 7). The discussion below explains the extent to which these age determinations are believed to be reliable:

- The date from Terrace 1 (HUF03-01) is believed to be reliable. Luminescence behaviour of this sample was good and scatter was fairly low, giving a precise age falling into the Early Devensian Stage (MIS4). It is possible, however, that the deposits forming Terrace 1 were laid down throughout the Devensian (i.e. MIS 5d – 2).
- The dates from Terrace 2 at Solent Breezes (SB03-03,-04,-05,-06) are also believed to be reliable, both because of good luminescence characteristics and because the multiple samples all agree within errors (Table 4). The midpoints of these dates place aggradation of this unit into MIS 7. This time period is usually associated with interglacial conditions, but considerable climatic fluctuations did occur. Therefore it is suggested that Terrace 2 may have been deposited during a colder phase within MIS 7. It is interesting to note the difference between this and the age for Terrace 1, which coincides with the change in gradient discussed above. Together, this suggests that there were phases of deposition between these two terrace levels that are not preserved onshore.
- The date from brickearth overlying Terrace 3 (CHILL03-01) is older than that previously recorded from TL-dating the same deposit (Parks, 1990; Parks and Rendell, 1992). This may reflect either multiple phases of deposition in the same deposit or differences in the thermoluminescence and optically-stimulated luminescence dating techniques. It does not provide an age constraint on the terrace gravels.
- Whilst both showing good luminescence behaviour, the two dates from Terrace 5 (HOOK03-05,-06) do not overlap. For this reason, it is difficult to say which is more reliable and thus to assign an age to this terrace deposit. No age is therefore suggested in the PASHCC interpretation.
- A similar situation is present for the samples from Terrace 6 (RIDGE03-01,-02). Both these samples also show good luminescence behaviour, but the two dates from do not overlap. In this case, the dates are significantly different and again, no age is suggested in the PASHCC interpretation.
- Neither of the dates from Terrace 8 is reliable. The sample from Yewtree Cottage (YTC03-01) was nearing saturation, with many measured natural doses failing to be reproduced in the laboratory. This suggests that the sample (and therefore the deposit) may be of considerable antiquity, but an age cannot be assigned to it. The sample from Spearywell Woods (SPW03-01) yields a surprisingly young age of c. 11 ka. However, this sample was taken from very close to the modern ground surface because suitable material was not present lower in the stratigraphic profile. For this reason, it is suggested that this date represents post-depositional reworking. This age places this event into the Younger Dryas cold event, in which aeolian reworking of sands was common (e.g. Bateman, 1995).

4. PALAEOLITHIC ARCHAEOLOGICAL SUMMARY OF THE STUDY AREA

4.1 Introduction

Archaeological data was gathered for four regions of the PASHCC study area:

- Region 1, Test Valley (vicinity of Romsey)
- Region 3, Southampton and eastern Solent
- Region 5, West Sussex Coastal Plain (west)
- Region 6, West Sussex Coastal Plain (east)

The archaeological data was grouped for analysis following the revised lithostratigraphical framework for the study region (cf. Sections 3, 5). Little of the material had detailed context provenance. However, the purpose of this aspect of the project was to investigate broad patterns in the Palaeolithic remains of the region. It was hoped that, if patterns were present, they would come through despite this uncertainty, and the project proceeded on this basis. The analysis focused primarily upon handaxe typology, since this was the main type of artefact for which there were sufficient numbers for meaningful comparison. However, attention was also paid to the presence of Levalloisian technology, since this is thought by some, based on research in the Thames Valley, to appear in England at a specific point in time (e.g. Bridgland, 1996), and, indeed, has already been used to attempt dating of terrace sequences in the Western Solent region (Bridgland, 2001). Full details of the methods of lithic analysis and criteria for nominative categories such as "degree of rolling" are given in the report on the first phase of work (Bates *et al.* 2004).

In the following sections, regional overviews are presented at the outset of each of the respective sections on the two main PASHCC study areas (West Sussex Coastal Plain; Eastern Solent), and more detailed information on the archaeological material from specific sites and lithostratigraphic units follows from the overviews.

An important caveat when considering the overall apparent distribution of occupation is that it is without doubt severely biased towards locales and periods where sedimentary processes have favoured (a) initial archaeological preservation and (b) survival of sediments through to the present day.

4.2 West Sussex Coastal Plain

4.2.1 West Sussex Coastal Plain overview

There is extensive and well-documented occupation very early in the Palaeolithic, in MIS 13 before the Anglian glaciation, along the foreshore of, and on the downland above, the Goodwood–Slindon cliff-line (Calkin 1934; Woodcock 1981; Wessex Archaeology 1994; Roberts 1986; Roberts *et al.* 1987; Roberts and Parfitt, 1999). Typologically, the handaxes of this period (in this region, at least) are dominated by

ovate and cordate handaxes, often very finely made and symmetrical with tranchet sharpening. Conventional thick-butted pointed handaxes (eg. as proliferate at Swanscombe and most other Lower/Middle Palaeolithic sites across the country) are absent although a few more-pointed ovates and sub-ovates are known. Following the Goodwood–Slindon raised beach phase, occupation must have ceased in the region at the climax of the Anglian glaciation, due to the intense cold, snow cover and the associated lack of plant and animal resources.

After this, there seem to be no deposits in the region from MIS 11, which is associated with abundant occupation in other parts of southeast England, and especially in the Lower Thames Valley at sites such as Swanscombe (Wymer, 1968; Roe, 1981). One site on the western fringe of the West Sussex Coastal Plain — Red Barns (Wenban-Smith *et al.*, 2000) — may date as old as MIS 11 but is now regarded on the basis of this project as being most likely dated to MIS 9 or 10. The evidence from Red Barns suggests patterns of behaviour very similar to those exhibited at Boxgrove, with routinised (ie. repeated and structured — cf. Gosden 1994; Gamble 1996) patterns of behaviour leading to concentrations of handaxes forming at certain key points in the landscape. As at Boxgrove, the handaxe assemblage is dominated by a clear typological form; but in contrast to the ovates and cordates of Boxgrove, the prevalent typology at Red Barns is thick-butted plano-convex sub-cordates.

Following this, the artefactual evidence becomes even sparser and poorly provenanced. The channel deposits at Selsey have been tentatively dated to MIS 9 in this project. No artefacts are reliably associated with any specific channel deposits, but it is possible that fresh condition proto-Levallois material reported from the vicinity is related to them. However, this could equally have come from the brickearth or Coombe Rock outcropping above the current beach.

The lack of Lower/Middle Palaeolithic evidence for the Period MIS 11 through to 9 is a direct result of the lack of survival of deposits of this period. This must reflect that the high sea-level stand of MIS 7, which we now equate with deposits of the Aldingbourne Raised Beach, must have reached at least the same level as those of MIS 9 and 11, and so must have wiped out deposits of this period. Whether this is because the MIS 7 high point was sustained over a longer period, and hence eroded further inland, or whether it just reached a higher level is uncertain without further research. As a direct result of PASHCC (cf. Section 5), we now have a model for the region's landscape development where the surviving deposits are integrated into a big picture of landscape evolution, and this incorporates a substantial gap in sediment survival between MIS 12 and MIS 7, with the possible exception of specific buried channels at Selsey; this makes the Selsey Bill area of prime importance in the region for addressing this gap in the evidential/depositional record.

A number of finds seem sufficient to indicate some human presence at the period of the Aldingbourne raised beach, dated to MIS 7 in this project. The artefacts are so sparse that it is not possible to characterise them typologically or technologically, although they do include a handaxe made on a large flake (from Pear Tree Knap) which seems, on the basis of Woodcock's description (1981: 262), to have similarities with some material from the Baker's Hole collection (Wenban-Smith, 1996). Other finds attributed to MIS 7 deposits are the sub-cordate and sub-ovate handaxe finds from Southsea, the Arun valley and the Brighton–Norton raised beach. These may

however be derived from older deposits. As a whole, if these dates and provenances are accepted, the evidence suggests the persistence of handaxe-dominated lithic technology through MIS 7 in the region, in contrast to the prolific Levalloisian technologies applied in northwest Kent, for instance as at Baker's Hole. Although this conclusion should be regarded as provisional, pending:

- Identification and investigation of more, and more reliably dated, deposits
- Recovery from same of more abundant, and more reliably provenanced, artefact assemblages

Following MIS 7, there are a number of pointed and sub-cordate handaxes present in later deposits, including a ficron from Terrace 1 of the Adur, and a couple of handaxes loosely associated with the Pagham/Merston raised beach. However, there remains great uncertainty over how old these are due to their lack of good provenance and the likelihood of derivation. In the absence of any evidence to the contrary, these are all regarded as derived specimens dating to pre-MIS 7.

Finally, there is a fine specimen of a *bout coupé* from Portfield Pit, Oving. Although there is no indication of its stratigraphic provenance, it probably originated from deposits overlying the younger part of the Chichester Fan Gravels. Typologically, based on the dates from Coygan Cave and Kents Cavern, this form of handaxe would be expected to occur in the mid-late Devensian, around MIS 3 (White and Jacobi, 2002), and reflects Neanderthal presence in southeast England.

4.2.2 West Sussex Coastal Plain (west)

In total over 400 artefacts were examined from this area (Table 13). The artefact assemblages from the region have been allocated into collections from eight different geo-chronological units (Table 14). Most of the material from the region comes from the Goodwood–Slindon raised beach. Besides the major excavations at Boxgrove, almost 250 waste flakes, 15 flake-tools and over 30 handaxes come from Woodcock's excavations at Slindon Bottom, and 60 handaxes from Manor Farm, Lavant (Shaw collection). Handaxes are very scarce, and evenly dispersed, across the remainder of the main geo-chronological sedimentary units in the study. A key point to consider, therefore, for each of the post- Goodwood–Slindon raised beach assemblages is whether they are genuinely associated with later deposits, or whether they are merely derived evidence from this early, and archaeologically prolific, phase of occupation.

The material from each geo-chronological collection is considered in turn below, in broadly decreasing age order; although, after the relative certainty of the great antiquity of the Goodwood–Slindon raised beach, the dating of the subsequent units is much more uncertain, and much of the material cannot be reliably provenanced.

4.2.2.1 Goodwood–Slindon raised beach

Work at Boxgrove and other nearby sites has led to the discovery and excavation of an extensive palaeo-landsurface, developed on the surface of the regressive lagoonal

phase of the Slindon Silts. This landsurface is rich in undisturbed lithic evidence of early human occupation, and also contains well-preserved faunal remains in areas where preservational conditions are suitable. Archaeological remains are also present near the base of the marine Slindon Sands, where they abut the palaeo-cliffline, indicating contemporary occupation of the adjacent landscape at the peak of high sea-level and climatic warmth. Archaeological remains continue to be present throughout the post-temperate phase of deposition, with further undisturbed horizons occurring within the cliff-collapse deposits that overlie the raised beach. The solifluction gravels that cap the sequence also contain abundant artefactual evidence, but in this case, it is most likely that the artefactual material is derived from the high ground to the north of the raised beach, and dates to the same period as the material from the underlying parts of the sequence. An assemblage of refitting handaxe manufacturing debitage in fresh condition was recovered from within the middle of the solifluction gravels, but this was most likely rafted in as a frozen mass, rather than indicating a palaeo-landsurface formed half way through the build-up of solifluction deposits.

Material from the Boxgrove project was not examined for this investigation, nor any from recent excavations at Slindon Bottom (Pope, 2001). However material from earlier collections from the Slindon area was examined, along with the numerous material from Woodcock's excavations in the 1970s (Woodcock, 1981). This aspect of the analysis formed, therefore, a useful case-study of how the typological characteristics of the historic collections from the Goodwood–Slindon raised beach compare with what we know from the intensive excavations of recent years (Roberts *et al.*, 1986 and 1997; Austin *et al.*, 1999).

The typological profile of the collection of handaxes studied from the Goodwood–Slindon raised beach is shown (Figure 23). A number of handaxes are not included in this analysis since they were broken or rough-outs, and so could not be reliably classified. Ovates and sub-ovates dominate, constituting almost 60% of the collection, with cordates forming the bulk (23%) of the remainder. There is a reasonable frequency of tranchet sharpening for these types of handaxe. There is a low number of pointed forms, and a moderately low number of sub-cordate forms. A small proportion 2–3% of the debitage is recognisable as from handaxe manufacture and the remainder is technologically undiagnostic waste debitage. All of the cores represent unstandardised approaches to reduction, generally leaving a small globular or bi-conical core. There is no sign of Levallois technique, either as cores or finished flakes, or as waste debitage from core preparation. The flake-tools are all of unstandardised form, being flakes that have been retouched (or backed) in various places, either to form an *ad hoc* scraping edge, or to blunt a part of the tool to facilitate handling and use of the opposing sharp edge for cutting.

When the condition of the handaxes is considered (Figure 24), it can be seen that the great majority are rolled or very rolled, regardless of typology. A higher proportion of the cordates are in fresh condition, primarily as a result of them coming from Woodcock's excavations, rather than having been collected from exposures or gravel deposits.

In general, the characteristics of the collection are not dissimilar to those from the excavated Boxgrove assemblage, where ovates and cordates, often tranchet-sharpened, dominate. There is a slightly higher incidence of ovates and cordates at

Boxgrove, and a much more reduced element of non-handaxe production. However, this may also be due to a different activity focus at the excavated Boxgrove sites, or their different role in the overall pattern of hominin activity in the local landscape, rather than reflecting different typological preferences at the period.

4.2.2.2 Red Barns

The site at Red Barns has long been thought most likely to fit into the regional geo-chronological sequence between the Goodwood–Slindon and the Aldingbourne raised beaches, although there has always been a question mark over how close it was in age to the Aldingbourne, and the possibility of it being younger could not be excluded. Litho-stratigraphically, it is not part of either a fluvial terrace sequence or a raised beach staircase. The site consists of a hollow in the south-facing Chalk bedrock slope of Ports Down Hill, where a dense accumulation of lithic artefacts on the surface of chalk-rich solifluction deposits has been gently buried by fine-grained colluvial/aeolian sediments that contain abundant molluscs, which were dated by AAR for this project. This unit has been buried by a chalk pellet-gravel, probably of colluvial/solifluction origin, the upper part of which has become cemented into a calcrete, probably by dissolution and re-precipitation of carbonates. The surface of the calcrete has then been buried by a deep sequence of colluvial silts and sands, and these latter deposits were the object of the OSL dating studies done for this project.

This dating has suggested that the Aldingbourne deposits may date as young as MIS 7, and that Red Barns is most likely to be MIS 9 or MIS 10. It seems increasingly likely, therefore, that Red Barns is indeed the next youngest site in the region to Boxgrove and other sites associated with the Goodwood–Slindon raised beach sequence. Unfortunately Red Barns is the only site from the region dated to this period, so it stands on its own to represent maybe 200,000 years of the Palaeolithic, between the onset of MIS 12, and the deposition of sediments associated with MIS 7. This is clearly not ideal, as we would like more, and a broader range of, sites to investigate how varied lithic material culture was across contemporary landscapes and how rapidly changes in material culture took place.

The material at Red Barns is dominated by the manufacture of distinctive plano-convex sub-cordate handaxes (Wenban-Smith *et al.*, 2000). Tranchet sharpening was occasionally applied, but there were no conventional pointed handaxes, and no ovates. There is also some proto-Levallois core reduction, and a few unstandardised flake-tools, similar to those in the Slindon bottom assemblage. The focus on handaxe manufacture at the site, together with the disproportionately high amount of handaxe manufacturing debitage present compared to the number of handaxes (Wenban-Smith 2004), suggest the site was used as a tooling up base before going on hunting/foraging trips, and support the idea that these early hominins were using the landscape in a proactive structured and organised way, rather than wandering around reactively encountering resources. The presence of some proto-Levallois material suggests that Levalloisian technology was incipient in handaxe-dominated industries (similar proto-Levallois material has been identified in MIS 11 deposits from Swanscombe in recent investigations by Wenban-Smith, in prep.), and that therefore the later development in MIS 8 of more fully-fledged Levalloisian industries (cf. Bridgland 1994) need not

reflect influx of a new population from the continent, but could just as easily represent in situ technological development of the native British population.

4.2.2.3 Aldingbourne raised beach

Archaeologically, the Aldingbourne raised beach has produced extremely little material, and none was able to be relocated and examined afresh for this project. Calkin (1934) reported the presence of very rolled flakes and cores in the exposures of the 1930s at Aldingbourne Park gravel pit, and Fowler (1932: 94) reports recovery of a handaxe from Coombe Rock derived from the pit, although it was not illustrated and its present whereabouts is unknown. Further material, comprising a heavily rolled handaxe, a core and a flake is reported by Woodcock (1981: 248) as having been said to have been found at Easthampnett, further to the west, and may have originated from the Aldingbourne raised beach. The most reliably provenanced artefact from the Aldingbourne raised beach is a handaxe from Pear Tree Knap, Tangmere, which was found *in situ*, sealed beneath Coombe Rock and 25cm into the surface of the raised beach gravels (Woodcock, 1981: 262). Finally, Woodcock (1981: 249) recovered one sharp and nine very abraded waste flakes from Aldingbourne raised beach deposits at Crockerhill, Boxgrove, during road works in the mid-1970s.

All of the flake and core material is technologically undiagnostic, and was at one time regarded as Clactonian. However, as pointed out by Woodcock, one would need much larger quantities, together with a more securely proven absence of handaxes, before any of these assemblages could be regarded as Clactonian. Although untraceable in the present day, Woodcock (1981: 262) provides a detailed description of the handaxe from Pear Tree Knap: "The implement was oval and made on a large flake, the platform of which was preserved as one of the longer sides. It has an irregular cutting edge, made by rough flaking on both faces". The edges were slightly abraded, but the artefact was generally sharp. Woodcock interpreted the sharpness as indicating that the artefact post-dated the beach, but it is also possible that it was contemporary, and discarded at a point when the sea-level had reduced enough for the beach to be no longer subject to littoral processes, but before it was buried by soliflucted chalk deposits. No description of the other handaxes survives, although one is reported as heavily rolled (Woodcock 1981: 248).

As it stands, this limited evidence is not incompatible with a MIS 7 date for the Aldingbourne raised beach, but it does not provide strong support either. If one was to find Levalloisian material at this horizon, one would feel much more confident in a MIS 7 attribution. Levalloisian material is relatively abundant (within the British context, where Levalloisian material is generally sparse) at a number of sites on outcrops of Chalk bedrock dated to MIS 7 or early MIS 8, for instance Baker's Hole in northwest Kent (Wenban-Smith, 1995). Sussex is not that far from Baker's Hole, so it would be quite surprising if prolific Levalloisian activity was happening in Kent, but not contemporarily at similar landscape contexts in Sussex. However, if the dating was secure, demonstrating such a contrast would add to our understanding of early human behaviour and territorial ranges.

4.2.2.4 Chichester fan gravel

There are three sites in the Chichester Fan Gravel, or in deposits that overlie the main fan gravel body, all of them single hand-axe find-spots (cf. Tables 13, 14). The stratigraphic provenance of all three is poorly known, and, even if found in the Chichester Fan Gravel, there is always the possibility of derivation from an older deposit such as the Goodwood–Slindon raised beach deposit. Two of the handaxes are pointed and abraded, but the other is a large *bout coupé* form in fresh condition, from Portfield Pit (north of the A27). On the basis of its typology, it seems most likely to have originated from a Devensian deposit overlying the Chichester Fan Gravel.

4.2.2.5 Selsey channel

A few flint artefacts, comprising flakes and a core with possible Levalloisian affinities, have been found on the Selsey foreshore in the vicinity of the buried channel that was investigated during this project. The core is apparently in fresh condition (N. Ashton and S. Parfitt pers. comm.), leading to the supposition that it may be related to the nearby channel, although this is clearly speculative. The channel itself has previously been thought to be most likely to date to MIS 7, probably encouraging the identification of Levalloisian tendencies in the artefact collection. However the work of this project has suggested that the channel fill deposits may be of MIS 9 date. In either case, the artefacts are too insecurely provenanced for use in constructing a regional framework.

4.2.2.6 Pagham/Merston raised beach

Two sites, both of them single handaxe find-spots, are known from the vicinity of the Pagham/Merston raised beach — Ford, Climping, and Large Acres gravel pit, Selsey (cf. Tables 13, 14) — which is associated with the high sea-level stand of MIS 5e. However, neither find is reliably provenanced, and, even if they were, one would have to consider the likelihood that they were reworked from an older deposit before incorporation in the beach. The handaxe from Ford was found on a field-surface near an outcrop of the buried Pagham/Merston raised beach. It is medium–large ovate, tranchet sharpened, identical to the typical form of many handaxes from Boxgrove. It is in moderately abraded condition, and strongly white-patinated, again similar to derived material if the colluvial/solifluction deposits that over-ran the Boxgrove raised beach and cliff-collapse sequence. It is tempting to regard it as being derived from the Goodwood–Slindon raised beach, although it is several km south of the cliff-line.

The handaxe from Large Acres pit was reported (Heron-Allen, 1911; Woodcock, 1981: 291) as having been found in Coombe Rock overlying the Pagham/Merston raised beach deposits, although the raised beach deposits themselves were also exposed in the quarry where it was found. The implement is strongly ochreous stained, and is a small–medium sub-cordate with an unworked butt. It is moderately abraded.

Woodcock (1981: 291) also reports discovery of a broken and heavily rolled handaxe, possibly originally of ovate form, from the Selsey foreshore. He regarded this as most

likely derived from the Pagham/Merston raised beach deposits. It could also have derived from other fluvial and solifluction deposits in the Selsey area, and, whatever its source, may have been originally derived from even older deposits.

4.2.2.7 Brickearths over Norton Sands and Pagham/Merston raised beach

Again, only two sites are known from this context, both single handaxe find-spots, and neither with good stratigraphic provenance — Appledram and Aldwick Road, Bognor (cf. Tables 13, 14). The handaxe from Appledram was a field surface find from close to the shore of Chichester Creek. It is of sub-cordate form, strongly ochreous stained and very abraded. The handaxe from Aldwick Road was thought to have come from deposits overlying the Pagham/Merston raised beach, although there is also the possibility that it came from the raised beach itself. It is of ovate shape and white patinated. It also shows two phases of working, with the tip end and one side re-trimmed after patina had developed, and some abrasion had affected the implement.

4.2.2.8 Eastern Solent Terrace 2

Two handaxes have been found at Southsea, Portsmouth (cf. Tables 13, 14), within Region 5, but related to terrace 2 of the Eastern Solent terrace sequence. One of these is a sub-ovate, and very abraded. The other is a sub-cordate, abraded and made on a flake. Terrace 2 of the Eastern Solent region has been shown with high confidence (cf. Section 5) to date to the second half of MIS 7.

4.2.2.9 Arun Terrace 3

One handaxe has been found at South Stoke, in deposits relating to Arun terrace 3. This would make it younger than the material from Eastern Solent T 2, since this latter has been correlated in this project with Arun T 4. The handaxe is pointed with a thick butt, and heavily abraded and ochreous patinated. There is some uncertainty (cf. Curwen and Curwen, 1922; Woodcock, 1981: 299) over which terrace it comes from, and it may have originated (or, if found lower, been derived) from a higher and older terrace.

4.2.2.10 Residual, miscellaneous derived/solifluction deposits

In addition to the sites that can be linked, albeit often speculatively, with a specific depositional unit, there are a number of sites without even this level of stratigraphic security. Two of these are from residual deposits capping Chalk downland — Madehurst (Slindon Pit) and Funtington (Stoke Clump). Such deposits are well-known as producing handaxe finds, occasionally in great abundance. However, they are essentially a stratigraphically uncontrolled palimpsest, and there is no way of dating the finds to any part of the Palaeolithic. At Madehurst two very contrasting handaxes, both in fresh condition, one sharply pointed and the other almost *bout coupé* in form, have been recovered from Coombe Rock overlying the Goodwood–Slindon raised beach. Both are strongly blue-white patinated and of uncertain date.

The latter may even date to the Neolithic. And at Funtington a pointed handaxe, moderately abraded was recovered from a patch of Clay-with-flints.

In addition to these, a number of artefacts have been recovered from such uncertain contexts that it is futile to even speculate on their most likely stratigraphic provenance. These comprise:

- Littlehampton (Atherington Beach) — Very abraded pointed handaxe from intertidal zone
- Hayling Island — Extremely abraded sub-ovate handaxe, and fresh condition flake from intertidal mudflat deposits
- Ports Down Hill — Very abraded pointed handaxe, probably from surface of colluvial/solifluction deposits
- Southsea Beach — Extremely abraded sub-cordate handaxe from present storm beach deposits

4.2.3 West Sussex Coastal Plain (east)

In total only 16 Palaeolithic finds, all handaxes, are known from this area (Table 15). Furthermore, all of these bar one are single find-spots, with High Salvington, Worthing being the exception, where three handaxes have been found. The assemblages from the region have been grouped into four geo-chronological units (based on our stratigraphic interpretation and associated radiometric dates), with a fifth representing derived material of uncertain provenance (Table 16). The typological distribution of the handaxes in each unit is summarised (Figure 25), and the breakdown of these assemblages by condition is also given (Figure 26). Condition is only known for 3 of the 4 artefacts in each of the last two assemblage groups, since the artefacts were not studied directly, but included from written records.

4.2.3.1 Residual, Clay-with-flints

There is no chronological control over the three handaxes in this assemblage, which come from Lancing College, Southwick Hill and West Blatchington. They are typologically diverse, although lacking any clearly pointed forms, with one each of ovate, cordate and sub-cordate. The cordate (from Southwick Hill) is in fresh condition, but the other handaxes are abraded.

4.2.3.2 Brighton–Norton raised beach

There are two handaxes from the Brighton–Norton raised beach — one from Goring and the other from the Black Rock cliff section. The handaxe from Goring is classified as *bout coupé*, and that from Brighton as sub-ovate. However, the *bout coupé* is reported as from the brickearth overlying the raised beach, and not from the raised beach itself (Wessex Archaeology, 1994). It is also not quite of the classic

Coygan Cave form, and could be a coincidentally similar cordate or sub-cordate, with a somewhat flattened base. Both handaxes are in very rolled condition. Chronologically, the Brighton–Norton raised beach is associated with MIS 7 on the basis of the stratigraphic position of the site linked to AAR results and mammal biostratigraphic dating.

4.2.3.3 Post- Aldingbourne raised beach and brickearth over Norton Sands

Handaxes from four separate sites, all individual find-spots, have been grouped together, since they all come from deposits overlying sediments attributed to MIS 7. Two of the handaxes are cordate, both of them from separate locations in the Broadwater area of Worthing; both of these are in fresh condition. For the other two handaxes, one is pointed and the other sub-cordate, and both of these are in very rolled condition. There is no chronological control on them, other than that they are thought to come from deposits younger than MIS 7.

4.2.3.4 Adur Terrace 1

A single handaxe has been found near Botolph's, Bramber. The location is accurately known and the handaxe was found at *c.* 23m OD, linking it to the first terrace of the Adur. The handaxe is a fine specimen of a ficron, and is in reasonably fresh condition, suggesting not too great a history of derivation. It is uncertain what age should be ascribed to Adur T 1, but current thinking places it unlikely to be older than MIS 7, which would make the site particularly important since it would be one of a small group of late MIS 8/early MIS 7 handaxe sites in Britain.

4.2.3.5 Miscellaneous, derived/solifluction

Six other handaxes come from uncertain context, probably mostly superficial solifluction deposits, and are of uncertain age (cf. Tables 15, 16). Three of them come from High Salvington, Worthing, although two of these are rough-outs and so could not be classified typologically. The third of the High Salvington group is a cordate. One of the others — from Fontwell Drive, not far from High Salvington — is also a cordate. Both cordates are moderately abraded. Of the other two handaxes, one — from Bramber — is sub-cordate, and the other — from Hangleton Down — is an ovate. The handaxe from Bramber is moderately abraded, but there is no information on the condition of the ovate from Hangleton Down, which is only known from published references (Grinsell, 1929; Woodcock, 1981: 328).

4.3 The Solent System (East)

4.3.1 Eastern Solent overview

The earliest occupation in the eastern Solent region is consistently represented by sparse remains sporadically associated with Terraces 7 and 8, dated here to the Anglian glaciation (MIS 12). Following that, there is a cluster of more abundant

material in the Test Valley (Romsey region) associated with T6, T5 and T4, equating with MIS 10 to MIS 8. Then there is another cluster of abundant material further downstream in the Southampton area associated with deposits of T4, T3 and T2 in the Warsash area. Activity in Southampton is most prolific in T4 and T3. Thus there is a consistent pattern in which Lower/Middle Palaeolithic remains seem to become progressively more abundant higher up the terrace sequence as one heads upstream. Whether this is a real aspect of the archaeological record or a factor resulting from urban expansion and patterns of quarrying, access and investigation remains to be considered further. When such factors are taken into account, Palaeolithic remains seem to be richest in Terraces 3 and 4, somewhat counter-intuitively considering the abundant sites in higher terraces in the Romsey area (notably Dunbridge, the material from which was not examined since it fell just outside the original study zone boundary).

The typological characteristics of the material are remarkably similar throughout the sequence T8 to T2, with a strong predominance of pointed and sub-cordate handaxes supplemented by a small number of cordate and ovate forms. Perhaps the most clear-cut aspect of the archaeological patterning is the fresh condition pointed assemblage from Pauncefoot Hill, which provides unequivocal evidence of the characteristics of an assemblage contemporary with the formation of T6. This pointed assemblage occurs in association with a low number of other handaxe shapes, all rolled. Following this, the assemblages from the lower terraces show the same patterning, although with the pointed element becoming increasingly rolled progressively lower down the terrace sequence.

There is a slight increase in the incidence of Levallois flake occurrence and of the diversity of non-pointed handaxe types down the sequence. The degree of rolling on the non-pointed handaxe types does not increase down the sequence, suggesting that these cannot be explained as a persistent derived element, but must have been continued to be made (albeit in much lower numbers), alongside the pointed forms that predominate. The earliest occurrence of Levallois is in terrace 5 (in the Test Road Material Pit), dated here to MIS 10. This is earlier than one would expect, although not impossible. However, good provenance is lacking, so this remains something for which further more scientific investigations are needed. Twisted cordates are absent in the terraces 6 and 5, but occur in very low quantities in terrace 4.

A notable feature of the handaxe typology, and one drawn attention to by Roe (2001) is the distinctive occurrence of the combination of cleavers and ficrons together in many assemblages from lower in the terrace sequence. These first appear in T5, again at the Test Road Materials Pit — which however has problems associated with the provenance of material. Otherwise, these co-occur at many sites in terraces 4 and 3, with cleavers becoming particularly abundant in terrace 3 in the Warsash area.

T1 has been dated to early in the Devensian (MIS 5–4), a period during which Britain is thought only to have been sporadically occupied by Neanderthal incursions in MIS 4 and 3 from the continent, associated with the occurrence of *bout coupé* handaxes. The *bout coupé* handaxe from Brambridge is reliably provenanced to marl overlying the T1 gravels, and so its stratigraphic position fits in well with this widely held presumption. There are also suggestions in the literature (Tyldesley, 1987) of *bout coupé* handaxe forms in collections from Millbrook and Redbridge, although none

were seen in the PASHCC study. Alongside the *bout coupé* material from Great Pan Farm (Isle of Wight) this suggests that the Solent basin might have been a centre of Neanderthal occupation in the Devensian, and this should be a focus for future investigations.

4.3.2 Test Valley (Romsey)

In addition to the material from the PASHCC fieldwork north of Mottisfont, exactly 400 artefacts were examined in museum collections from sites in Region 1 (Table 17). The Mottisfont material related to T8 and T7; and the museum material came from three distinct terrace units: T6, T5 and T4 (Table 18). For T6 and T5, only one site was examined for each terrace, Pauncefoot Hill and Test Road Materials Pit respectively. In contrast, four sites were attributed to T4, including the prolific sites of Minchin Hill, Luzborough Pit/Hill and Belbins Pit. There was also a small amount of material from Romsey generally, and from the Romsey Town Pit, which could not be related to a particular terrace and so was not included in the analysis. The typological distribution of the handaxes in each terrace is summarised (Figure 28a), and the breakdown of these assemblages by condition is also given (Figure 28b).

4.3.2.1 Terraces 8 and 7 (PASHCC fieldwork)

A single rolled flake was found in the T8 gravel at Spearywell Wood (SPW 03, test pit 3). This gravel is attributed to at least the Anglian and possibly earlier (MIS 12–14), indicating occupation of the region at this period, or even earlier if the flake is regarded as derived on the basis of its very rolled condition. Following this, there is good evidence of occupation in T7. Three flakes and a handaxe (Figure 27) were recovered from the T7 gravels at Great Copse (GTC 03, test pits 1, 2 and 3). Two of the flakes were fresh, and one rolled, and the handaxe was very rolled. This indicates occupation at least contemporary with T7, or possibly from earlier if the material is regarded as derived. The shape of the handaxe is a narrow sub-cordate, which may originally have had quite a sharp point, although this is broken off. The T7 gravel is attributed to the Anglian (MIS 12).

4.3.2.2 Terrace 6

The only site attributed to terrace 6 is Pauncefoot Hill. There is a clear predominance of pointed handaxes (65%), followed by sub-cordates (15%). There is a tiny amount of cordates and sub-ovates, and no true ovates. There is no presence of Levallois. The Pauncefoot Hill assemblage is notable for its fresh condition, with most (40%) of the pointed handaxes being in fresh condition, and progressively less material being rolled or very rolled. In contrast, all of the sub-cordate, cordate and sub-ovate material is rolled or very rolled, which could be taken to indicate that it is a derived element from earlier occupation, in contrast to the pointed assemblage, which can reliably be associated with the terrace formation in view of its freshness.

The dating and correlation work of this project has suggested that Terrace 6 is most likely associated with MIS 10.

4.3.2.3 Terrace 5

The only site attributed to terrace 5 is the Test Road Materials Pit. The general typological profile is very similar to that from Pauncefoot Hill, with 65% of the assemblage pointed and 21% sub-cordate. There is also a similarly tiny proportion of cordate and sub-ovate. However, there is also a small proportion of ovate handaxes. And there is also a single Levallois flake in the assemblage. This latter is reported as from the "River Test Pit", although has been linked to the Test Road Materials Pit, as the name of the collector (Benham) is the same as much of the Test Road material, and the River Test Pit has been given the same grid reference in some museum records — although of course this could also be a result of mis-correlation with the Test Road Pit.

However, in contrast to the pointed assemblage from terrace 6, that from terrace 5 is much more rolled, with most of it (55%) being very rolled, and a further 35% being rolled. Only 5% of the assemblage is in fresh condition. As for terrace 6, all of the other handaxe types are rolled or very rolled, as indeed is the Levallois flake. According to Roe (2001) the Test Road materials pit is one of a number of sites in the Solent region that produce both cleavers and ficrons together, although both elements were not seen in the material looked at for the project.

Overall, the collection from Terrace 5 is very restricted, being from only one site. The implications of the rolled pointed assemblage are that it is perhaps derived from the pre-existing Terrace 6, which produced numerous handaxes of the same type in much fresher condition. Therefore it may be that we have no good evidence from Terrace 5 in the region, which would be an interesting gap in the occupational record if it was confirmed by subsequent investigations — which, incidentally highlights the importance and value of carrying out investigations that produce "no results" (cf. Section 7.2.4).

The dating and correlation work of PASHCC has suggested that Terrace 5 is most likely also associated with the early part (MIS 10) of the "Wolstonian" (Saalian) complex, primarily on the basis of the OSL dating from Hook.

4.3.2.4 Terrace 4

Material from four sites — Minchin Hill, Luzborough Pit/Hill, Belbins Pit and Ashfield — has been attributed to terrace 4. Again, the typological profile is very similar to that for terraces 5 and 6. Almost the same proportion of handaxes is pointed, and there is a similar smattering of other types. However, for the first time in the area, deliberate profile-twisting is apparent on two of the cordates, and the assemblage includes some cleavers. There is also a higher incidence of Levallois, with five Levallois flakes, divided equally among the pits contributing to the terrace 4 assemblage.

None of the material is fresh. There is an even higher incidence of rolling within the pointed handaxe assemblage than for terrace 5, possibly indicating further derivation.

However, it is difficult to unravel the data in light of uncertainty over the depositional flow energies associated with the deposition of the artefact-bearing sediment for each terrace. The total absence of fresh or mint condition material perhaps suggests little contemporary deposition of pointed handaxes, although the concurrent absence of very rolled material suggests we are not simply dealing with a linear progression of degree of rolling as material is reworked from one terrace to another. This whole subject requires much more careful analysis, beyond the scope of this document, supplemented by consideration of the depositional energies of artefact-bearing contexts.

However, the degree of rolling in the other parts of the assemblage is similar to that of terraces 5 and 6, which refutes the possibility that these other elements of the assemblage have been progressively derived down through the terrace sequence — if this was the case, one would expect them to be more rolled in lower terraces.

The dating and correlation work of this project has suggested that Terrace 4 is most likely associated with the middle part of the "Wolstonian/Saalian" complex (MIS 8). No independent dating was obtained, but terraces 4 and 3 need to be fitted in between terrace 5 (dated to MIS 10) and terrace 2 (dated to MIS 7).

4.3.3 Eastern Solent (Southampton)

In addition to the material from the fieldwork — which comprised a single flake from Cams Hall — almost 600 artefacts were examined in museum collections from sites in this region (Table 19). The relative abundance relates to the large number of quarries in the Southampton area being extracted in the late 19th and early 20th centuries. These were easily accessible to collectors, and large collections were made in the region. This material came from terrace units from T8 to T1. However, material from terraces 5–8 was scarce, in contrast to material from terraces 2–4 which was extremely abundant. And a reasonable amount of material was present from T1 (Table 20). Due to the large numbers of pits, and the often imprecise records of exactly where pits were, and which parts of larger pits were being exploited at different periods, it has often not been possible to relate material to a specific terrace, particularly in the Shirley area of Southampton, around Southampton Common, and around Warsash. The analysis has focused upon exploring trends in the material provenanced to specific terraces, where a sufficient quantity is present. However, this has been supplemented by consideration of material that can be related to at least a pair of terraces, where this contributes to the overall picture. The material from Priory Bay is also considered, which has been related to terrace 5 on the basis of altitudinal correlation with the downstream profile of the terrace 5 formation — an attribution broadly supported by independent OSL dating of the site to MIS 10.

The collection from the region can be grouped into 7 main assemblages, getting progressively younger from terrace 8:

- Terrace 8
- Terrace 6–8
- Terrace 5, Priory Bay
- Terrace 4

- Terrace 3
- Terrace 2
- Terrace 1

The typological distribution of the handaxes in assemblages from terraces 1 to 4 is summarised (Figure 29), and the breakdown of these assemblages by condition is also given (Figure 30). Information is also given for material that could only be related to terraces 2/3 or 3/4.

4.3.3.1 Terrace 8

Only one site is known from terrace 8 in the region — a single handaxe find-spot at Midanbury Hill. This is a very rolled, crudely worked elongated pointed specimen. Terrace 8 is thought to date from the Anglian (MIS 12) or earlier on the basis of its location within the terrace staircase.

4.3.3.2 Terraces 6–8

Again, the only representation of this time period is a single handaxe find-spot, from the northwest corner of Southampton Common, at a point where near the boundary between a gravel patch attributed to T8 and a patch attributed to T6/7. A number of other handaxes are also known from "the Common", but there are so many possible terraces within the Common area that they could not be included in the overall framework review. The handaxe from the NW corner of the common is a small–medium sub-cordate, in rolled condition.

4.3.3.3 Terrace 5, Priory Bay

The sediments exposed in the 2001 fieldwork have been related in this project to Terrace 5 of the Eastern Solent system, based on extrapolation to the southeast of the terrace profile from the Test Valley and through Southampton. Whether or not this is correct — and there remains some debate over whether the deposits at Priory Bay are fluvial or associated with a raised beach — independent OSL dating of the archaeological horizons at Priory Bay have indicated a date in MIS 10, in the window where terrace 5 has been assigned by dating at Hook, and where it might be expected to occur when integrated with the rest of the terrace system.

The archaeological material from Priory Bay consists of abundant cordate and ovate handaxes, and debitage from their manufacture. These are present, in a rolled form, in the upper part of the basal fluvial gravels, and, in mint condition, on a possible landsurface developed on the surface of the fluvial gravels. This landsurface is buried by a thick sand-rich deposit, presumed to be of colluvial origin.

4.3.3.4 Terrace 4

Eight sites, mostly in the Southampton area, have been attributed to terrace 4, with a total of 159 handaxes (cf. Tables 19, 20). The dominant forms of handaxe are pointed (44%) and sub-cordate (20%) (Figure 29). Apart from these, there is a reasonable representation of other non-pointed forms, with quite a few ovate, cordate and sub-ovate forms, many of them with twisted profiles. There are five cleavers and at least one true ficron (from Luzborough). There is also one handaxe of *bout coupé* form (from the Ordnance Survey building, Rockstone Place), although most authorities do not accept it as a true *bout coupé* (Tyldesley, 1987; White and Jacobi, 2002).

The pointed handaxe collection is evenly divided between rolled and very rolled specimens (cf. Figure 30), but all other types of handaxe have a clear prevalence of very rolled condition. The "*bout coupé*" is also rolled.

Terrace 4 is here attributed to MIS 8.

4.3.3.5 Terrace 3

Twelve sites have been attributed to terrace 3, mostly in Southampton and along the east side of the Solent Water, with over 70 handaxes. The typological characteristics of the material from terrace 3 are very similar to terrace 4 (Figure 29), with almost half of the handaxes pointed, a quarter of them sub-cordate, and the remainder divided equally between the other types. The only difference is that there is some Levalloisian presence, in rolled or very rolled condition. There is also some Levalloisian presence from sites that can not be attributed more accurately than terrace 2/3 in the Warsash area. The conditional profile of the material is also very similar to terrace 4, with a higher proportion of the pointed handaxes in less rolled condition than for the other handaxe types.

Terrace 3 is here attributed to MIS 8.

4.3.3.6 Terrace 2

Eight sites from terrace 2 have produced material for the study, containing over 30 handaxes. Again, even at this low stage in the region's sequence, pointed handaxes are dominant, constituting almost 40% of the assemblage. However this pattern is less clear-cut than before, and despite the relatively low sample size compared to higher terraces, this level could be regarded as characterised by increasing diversification of handaxe typology (apart from any *bout coupé* specimens), as well as the concurrent presence of Levallois technology. Sieving for artefacts was carried out at test pits dug in terrace 2 deposits for the PASHCC project at Cams Hall. This produced a single very abraded flake that appeared to come from a laminar flaking strategy. Although such flakes can on occasion be produced accidentally from almost any knapping strategy, it seems a bit too coincidental that Cams is also one of the few sites to produce a good Levallois flake in the museum collections seen.

There was a slightly higher occurrence of very rolled material in terrace 2 than for the higher terraces, although, for each handaxe type, the intra-type distribution of

condition was similar to that of earlier terraces. Again, as for the earlier terraces, a higher proportion of the pointed group of handaxes were less rolled (Figure 30).

Terrace 2 has been securely dated to late MIS 7 by OSL at Solent Breezes.

4.3.3.7 Terrace 1

Five sites have been attributed to terrace 1, producing 11 handaxes between them, including one good *bout coupé* specimen reliably provenanced to marl overlying Itchen T1 at Highbridge (Brambridge). Apart from that, there is a similar distribution of types to the earlier terraces, with four of the handaxes pointed, two of them sub-cordate and the remainder divided between cordate, sub-ovate and cleaver (Figure 29). However, the condition of the assemblage contrasts with earlier terraces. All of the material from T 1 is very rolled or extremely rolled (apart from the *bout coupé*). This would suggest that it is mostly, if not all, derived from earlier terraces. There is no evidence of Levalloisian presence.

4.4 The Sussex/Hampshire Coastal Corridor as a whole

The earliest occupation of the region as a whole is consistently identified in Anglian or immediately pre-Anglian deposits. Frustratingly from the point of view of intra-regional comparisons, major phases of occupation evidence in the Sussex Coastal Plain do not seem to co-occur with those in the eastern Solent region (Table 21). From the meagre evidence available, the MIS 13 occupation at Boxgrove characterised by a massive predominance of ovate handaxes does not seem to be represented in the Anglian and pre-Anglian gravels of the eastern Solent, where there is only the sparsest hint of occupation represented in more pointed and sub-cordate forms. However, the provenance and dating of these is far too imprecise to be regarded as a contemporary cultural contrast with Boxgrove. At this stage, all that can be said is that the cultural preference at Boxgrove was for ovate forms, and just why this was in their heads rather than a pointed form remains a conundrum. One factor that can be ruled out is raw material, since the flint raw material at Boxgrove could have been made into whatever shape they wanted.

After the Anglian, there is very little evidence of Lower/Middle Palaeolithic presence from MIS 11 through to MIS 7 in the Sussex Coastal Plain (other than the isolated instance of Red Barns), a period represented by contrastingly abundant evidence in Test terraces 6 through to 2. Typologically, the Red Barns assemblage is consistent with the Test sequence in so far as it is dominated by handaxe manufacture. However the distinctive plano-convex form of the Red Barns handaxes has few equivalents in the Solent region, and certainly not associated with any particular terrace (cf. Wenban-Smith, 2001).

The lack of detailed provenance for most finds makes one wary of assigning too much importance to the rare occurrences of potentially significant items such as Levallois flakes. The earliest occurrence of Levallois is loosely associated with T5 in the Test Valley (MIS 10), and then there are a number of instances linked to T4 (MIS 8). Perhaps the most reliable instance of Levalloisian presence is the proto-Levallois core

from Red Barns (Wenban-Smith *et al.*, 2000) which probably dates to MIS 9, earlier than Bridgland and others would generally suggest for practice of Levalloisian technology in the UK. There is no evidence of Levallois in the West Sussex Coastal Plain — which is perhaps surprising in view of what we are now suggesting is the preponderance of MIS 8/7 deposits, and their proximity to rich fresh flint raw material sources from the Chalk, considering the prolific Levalloisian activity in this period in nearby regions such as the Lower Thames.

Perhaps the most interesting pattern to emerge is a steady increase in diversity in handaxe shapes through the relatively long sequence of terraces in the Test Valley, with increased incidence of cleavers, often accompanied by ficrons in the lower terraces (T4, T3 and T2). Finally, the presence of *bout coupé* handaxes in both the eastern Solent and the West Sussex Coastal Plain confirms a Neanderthal presence in the later Devensian, probably in the period MIS 4 and/or 3.

5. AN INTEGRATED GEOARCHAEOLOGICAL MODEL FOR THE STUDY AREA

Integrating diverse datasets to derive useful statements on the Palaeolithic resource distribution and potential is most effectively achieved using multi-disciplinary approaches within a geoarchaeological framework. Such an approach, as championed by Karl Butzer (1981), sees past hominid behaviour as inextricably engaged with an (ancient) landscape composed of geological and biological entities. Study of these past traces of human activity can only be achieved (according to Butzer) through a holistic approach embracing different lines of evidence as equal elements in the discipline of palaeogeography. Here we adopt such a holistic and inclusive approach to consider the nature of our archaeological resource.

5.1 Landscape development, palaeogeography and the timing of change in the study area

Landscape development in the study area has been influenced by a range of major factors associated with climate change, river history and sea-level change. These factors have acted independently at times, and at other times in combination, to produce a particular history of landscape development and patterns of palaeogeographic change. These changes through time and across space will have both influenced the day to day activity of our ancestors and also impacted on the archaeological record once its deposition had occurred. Integrating the evidence from the different areas of the study region, a number of major factors are immediately evident from the study:

1. Fluvial activity has characterised significant parts of the Solent study area. Within the Solent system at the western end of the study area fluvial activity has dominated sequence development upstream of Southampton during both warm and cold stages. Downstream of Southampton fluvial activity (primarily associated with cold stages) has alternated with phases of estuarine and marine activity associated with temperate interglacial periods. This fluvial activity has also been influenced by major palaeogeographic changes such as (a) the status of the land bridge connections between the Isle of Wight and the mainland, and (b) the presence or absence of a land bridge across the eastern end of the English Channel.
2. Fluvial activity has also characterised depositional history within the Arun and Adur catchments. Although both systems contain sequences (gravel terrace accumulation along the valley flanks) attesting to deposition during cold stages, little evidence for estuarine sediment sequences forming in association with the rivers terraces is presently forthcoming.
3. Marine activity has characterised much of the coastal plain region. Successive high stands of marine activity associated with a number of interglacial episodes can be inferred from marine and estuarine/intertidal sediments preserved as what is now dry land between Portsdown and Brighton. Sequence accumulation during both temperate and cold climatic episodes is attested to. Highly varied depositional environment characteristics have been

highlighted from the microfossil evidence collected as part of the PASHCC project, as well as that obtained from other English Heritage funded projects on the Upper Coastal Plain. The evidence is indicative of a changing local palaeogeography through time, from: (a) an initial phase of embayed coast line (Goodwood/Slindon Embayment) through (b) an open coast line phase (Brighton/Norton) to (c) a harboured coastline associated with the Pagham beach.

4. Cold stage activity is reflected in significant parts of the Pleistocene sedimentary archive forming large parts of the West Sussex Coastal Plain. As well as the major bodies of slope-derived solifluction deposits that are well known to cap both the Goodwood/Slindon beach and the Brighton/Norton beach, lacustrine and low angle solifluction deposits appear to characterise many of the large hollows across the coastal plain and two significant, and mappable such deposits are now known to the east and west of Chichester.

From these diverse bodies of information we can consider the palaeogeographic evolution of the region to have followed a number of distinct phases:

Embayed coast line phase. The deposits associated with the oldest events reflected in the sedimentary archive from the coastal plain are the marine sands and gravels of the Goodwood-Slindon Raised Beach/Slindon Formation. These deposits have recently been traced from Westbourne Common in the west to Tortington in the east during the Boxgrove Upper Coastal Plain Mapping Project (<http://matt.pope.users.btopenworld.com/boxgrove/raisedbeachhomep.htm>). This work suggests accumulation of the deposits within a large embayment. This bay opened southwards into the main English Channel at a time when the eastern end of the channel was likely to have been closed (cf. Bates *et al.*, 2003; Figure 7). Coastal cliffs would have extended further south both in the vicinity of Portsdown and east of Arundel. West of Portsdown a major estuary of the Solent River would probably have existed as the Isle of Wight would have been attached to the mainland at the western end between Durlston Point and the Needles. This embayed phase of coastal development appears to have been sustained through a subsequent phase of high sea level associated with the Aldingbourne Raised Beach, which appears to have very similar outcrop geometry to the older and higher deposits.

Age estimates from the PASHCC project and other works indicate formation of the Goodwood/Slindon Raised Beach during MIS 13 (Roberts and Parfitt, 1999). Dating from the PASHCC project (Table 7) suggests deposition of the Aldingbourne Raised Beach during the early part of MIS 7. Deposition of cold stage fluvial gravels in the Arun and Adur valleys is known for certain during this stage of the Middle Pleistocene, but the limited numbers of deposits preserved suggest that many of the older sequences have been reworked by subsequent fluvial activity. Towards the western end of the main Solent River valley, certain fluvial formations (e.g. Stanswood Bay Gravel and Taddiford Farm Gravel) have been dated to MIS 8, clearly indicating greater antiquity for other Western Solent system gravel bodies at higher elevations. Similarly, dating of the Solent Breezes site (Terrace 2) of the Eastern Solent to MIS 7 also suggests that nearly all the terraces in this region are associated with this early period dominated by embayed coast lines to the east.

Open coastline phase. All evidence for an embayed coastline appears to have disappeared with the final deposition of the Aldingbourne Raised Beach in the early part of MIS 7. Sediments associated with the Brighton-Norton cliff line have been demonstrated to extend from Brighton in the east to at least Havant in the west (Bates *et al.*, 2004). This suggests the presence of an open shoreline facing approximately south during this time period. Circumstantial evidence indicates that the Channel may have opened by this time (Bates *et al.*, 2003) but that westwards the Isle of Wight remained attached to the mainland and hence the presence of the large Solent estuary remained a feature of the landscape. Age estimates from mammal biostratigraphy as well as OSL and Amino Acid Geochronology suggests deposition the Brighton/Norton Beach in late MIS 7.

Deposition of sediments south of the Brighton-Norton Cliff line consisted of sands and gravels that can be traced at least 1km south of the cliff. On the basis of the contained microfaunas these are known to have accumulated in seas significantly cooler than those of the present day, perhaps close to the end of an interglacial phase.

Sea level fall during MIS 7 (as indicated by the height difference between the Aldingbourne and Brighton/Norton Raised Beaches) and the subsequent MIS 6 cold period would have left the coastal plain significantly above contemporary (in MIS 6) sea levels and significant downcutting of valley systems through these relatively soft sediments would have occurred during periods of water discharge (perhaps during periodic melt events). Infilling of the eroded systems that extend from dry or wet valleys in the chalk downlands is indicated where coarse flint- and chalk-rich sediments indicate high flow velocities during accumulation. This pattern of downcutting and infilling probably reflects a pattern that would have repeatedly occurred across the coastal plain area during cold episodes throughout the Middle and Upper Pleistocene periods. These channels may have been subject to repetitive re-modelling/reworking and infilling in successive warm and cold stages since their initial creation thereby resulting in complex sediment architectures. Significantly, age estimates for both Arun Terrace 4 as well as Terrace 2 of the Solent (Table 7) suggest accumulation during MIS 7 (perhaps during one of the colder oscillations within this multi-phase interglacial). This represents a key tie point in the marine/terrestrial record.

Harboured coastline phase. Sands and gravels across much of the Pagham/Selsey/Bognor area probably relate to an episode of marine sediment deposition broadly linked to the Selsey Ridge. The form of the ridge suggests that major changes in local and regional geographies appear to have accompanied the deposition of the Pagham Raised Beach. The form of the deposits suggests the development of harbours similar to those that exist in the present day behind barrier beaches or offshore bars. The data suggests that an offshore bar (the Selsey Ridge) may have formed a protected coastal plain behind which shallow 'harbours' developed in the low lying ground behind or adjacent to the bar. Evidence for this phase of activity is seen in the sands and gravels found in the southern part of the coastal plain (e.g. at Thorney Island and around West Itchenor). A range of dating results (Table 7) suggests that both the Selsey Ridge and the Pagham Raised Beach date to the last interglacial (MIS 5e).

Isolated by depositional process and geomorphological position from the marine deposits, are the sediments associated with cold climate activity (either fluvial deposition in major valleys or solifluction events in hollows in the coastal plain). In most cases these appear to fill hollows on the coastal plain; preliminary dating, as well as stratigraphic position, suggest they post-date the last interglacial and belong to the Devensian cold stage.

5.2 Sediments, sequences and archaeological potential

Attempting to define the archaeological potential of a region depends on a number of factors, particularly:

- those that relate to whether or not humans actually occupied an area in the first place
- those associated with locales in the landscape where sedimentary processes favour archaeological preservation through burial and where subsequent post-depositional processes lead to the preservation of that archaeological material.

Consequently for an adequate assessment of the archaeological potential both sets of factors require consideration. Here we attempt to link these factors and demonstrate the relatedness of these elements within a geoarchaeological framework for the area.

The nature of sediments within the study area is intimately linked to the processes responsible for transporting and depositing them, as well as the original source of the material. Thus high energy river channels with high flow velocities in the river water (e.g. Solent, Arun and Adur) can transport coarse particles of sand and gravel-sized clasts that require significant energy to move them. Conversely considerably less energy is required to move clay and silt sized particles. Thus there is a clear relationship between grain size of particles transported and the nature of the associated systems of deposition. In simple situations this means that artefacts within coarse gravel units are more likely to have been moved, rolled and reworked along with the gravel particles themselves while similar artefacts left in lower energy environments are less likely to have suffered movement and disruption.

On the basis of this type of information sequences and sediments can therefore be considered as more or less likely to preserve artefacts *in situ* or in reworked conditions. Similar lines of argument can also be made to interpret the likely contexts of any contained biological material. Consequently it is likely that:

1. Coarse fluvial deposits forming typical geomorphological terraces are more likely to contain artefacts in reworked condition (Figure a). These artefacts may be moved downstream in association with a depositing gravel body (i.e. dispersed contemporary with the deposit they are in) or be reworked from a pre-existing terrace through which a channel is downcutting (i.e. dispersed through time from one terrace to the next). Artefacts from such deposits are therefore likely to represent broad temporal phases and samples of material culture from general activity on a river floodplain.

2. Coarse marine deposits associated with raised beaches may also contain reworked artefacts (Figure b). These artefacts may be reworked during the lifespan of the beach contemporary with occupation or be reworked into younger beaches through landward erosion of younger beaches.
3. Finer grained floodplain situations and marine regressive phases may provide conditions suitable for *in situ* preservation of artefacts representing short episodes of activity on briefly exposed land surfaces (Figures a and b).

From the palaeogeographic and landscape development model presented above (Section 5.1) one can therefore derive the following statements regarding the spatial and temporal distribution and likely Palaeolithic importance of sequences within the study area:

1. Areas associated with the Goodwood/Slindon Raised Beach are likely to contain high resolution *in situ* archaeological assemblage's representative of "snap-shot" time intervals.
2. Attribution of the Aldingbourne Raised Beach raised beach to the early stages of MIS 7 implies that sediments from the interglacials associated with MIS 9 and 11 are missing from the WSCP. It is likely that any that were once laid down have now been reworked and eradicated by the landward migration of the MIS 7 cliff line. Consequently we might anticipate some heavily rolled artefacts in this beach that span the temperate and cold phases between MIS 12 and 7, as well as fresher material contemporary with the formation of the deposit. This in fact corresponds with the known material (cf. Section 4.2.2.3), although the deposits have been subject to little formal *archaeological* investigation, which should perhaps be remedied at the earliest opportunity.
3. The majority of the lower coastal plain contains sediments associated with later MIS 7 and post-MIS 7 time. On the basis of evidence from elsewhere in the country it is anticipated that likely incidence of human activity would be low. However, evidence for activity in this time span is known in the UK and if present would be of considerable national importance.
4. The context or likely presence of any archaeological material associated with the other identified types of sequences in the WSCP is less easy to determine at present. Certainly in both channel fill sequences (such as those around Selsey Bill) and the cold climate deposits of the central plain area, sediments likely to preserve both *in situ* and reworked artefacts may occur. No such remains were found in the small investigation carried out for PASHCC, but this only impacted a *miniscule* proportion of the overall resource, so any further impacts should be evaluated, and perhaps a larger-scale investigative research programme initiated. Temporally these sequences also span time periods in which human occupation is known to have occurred in the UK.
5. Dating of Terrace 2 of the Eastern Solent to MIS 7 indicates considerable missing evidence covering MIS 2-6 in this part of the study region. The major change in dip of the long profile of Terrace 1, suggests a major palaeogeographic upheaval after MIS 7

that has had a major impact upon the Solent Basin drainage (perhaps as a function of changes in the Durlston Point and the Needles area. The presence of significant quantities of archaeological material associated with Terrace 2 suggests a very different pattern of human occupation (or preservation of record) between the Eastern Solent and the WSCP. Bearing in mind the sparse national record for MIS 7, this attribution makes all evidence from Terrace 2 of higher potential importance than previously recognised, requiring further investigation to assess the degree of derivation and the presence of less disturbed horizons within the gravel.

6. The long terrace sequence in the Solent system prior to the MIS 7 deposits of terrace 2 therefore presents a valuable complementary archive (to that from the West Sussex Coastal Plain) of human presence in the Sussex/Hampshire Coastal Corridor region, since, as explained above, it appears that there is a major absence of deposits spanning the period MIS 12 through to 8.

6.0 GIS

6.1 Rationale of the GIS

The PASHCC GIS is the prime medium through which the project will present its results to the 'end users' such as the HER and development control teams in the local authorities. GIS has also been used to address specific project objectives and provide information for incorporation into the project as a whole.

The structure of the GIS was developed in conjunction with staff in relevant curatorial roles in both West Sussex and Hampshire as well as through experience developed in the course of other on-going or recently completed projects (Medway Valley Palaeolithic Project; Northern Tributaries Project); this data structure has necessarily evolved as the project results were generated. One of the key decisions in considering the GIS design was the software to be used. The project area includes three counties, each with their own HER; the results of the project had to be accessible to the respective HERs and development control teams.

It was decided to utilise ESRI GIS products, with the results of the project being presented as a series of individual shape files which could be used in versions of ArcView/ArcGIS v. 8.2 or later. Background data for each shape file and point data set were loaded into the Arc attribute field rather than as an external linked database in order to aid accessibility to information. Experience has shown that problems can arise when linking between GIS and external data, for example through the accidental re-location or deletion of one of the elements which results in the loss of links that subsequently need to be reconstructed or the software for one part of the work is upgraded (e.g. Access) resulting in compatibility problems.

6.2 Structure

The starting point for the system developed was the British Geological Survey mapping data in digital format. These have been used or modified to provide baseline information.

Borehole data, from the BGS archives has been obtained as part of the project. This was primarily used to examine the sub-surface areas in order to better understand the nature of the superficial mapping and to target areas for field investigation. Borehole data was entered into Rockworks 2002 (updated to 2006 recently). Information on position of the boreholes and basic lithological information was exported to the GIS via Excel files out put from the Rockworks 2006 software.

A range of tabulated data has been appended to the GIS that includes:

1. Borehole data. Location data as well as information on lithology of each borehole.
2. Archaeological archive data. Information gathered during the study of museum collections (see Appendix I).

3. PASHCC sites investigated. Information on the nature of the sequences and any associated palaeoenvironmental or dating material (see Table 4).

The borehole shape file has the following attributes:

- Borehole number
- Name
- Easting
- Northing
- Elevation
- Total Depth
- Top depth_1 (Depth of the top of the 1st unit)
- Basedep_1 (Depth of the base of the 1st unit)
- Lith_1 (Lithology of 1st unit)

Following the integration of geological and archaeological information (provided by the respective HERs) consideration was given to the development of a meaningful method of presenting the data. This process resulted in the creation of a number of zones within the study area (see Figures 33 and 34). These zones were digitised and attribute data appended. The listing of attribute data is presented in Table 22. A full listing of all information by zone is presented in Appendix II. It should be noted here that the boundaries between individual zones are by necessity shown as hard boundaries but these have been placed on the basis of the best knowledge available to the authors at the time of writing. Even in those areas of the West Sussex Coastal Plain that contain the densest concentration of borehole and test pit data such data points are only at 1km intervals. Consequently it is likely that boundary position will vary significantly and that sequences, deposits etc that exist in adjacent zones may well extend into other zones. Care should therefore be taken when considering the significance of individual zones and due attention should be taken of those adjacent zones when determining potential significance of sites.

Statistics for individual zones are presented in Table 11 and summarised in Figure 35. It should be noted that there is a clear imbalance between data collected in individual areas. For example zones tend to be smaller within the West Sussex Coastal Plain (Areas 1 and 2) than the Solent area (Areas 3-5). Conversely greater densities of borehole information is available for the West Sussex Coastal Plain (Areas 1 and 2) than the Solent area (Areas 3-5). A larger number of sites have been investigated by the PASHCC project in the West Sussex Coastal Plain area (a fact partially dictated by the density of development across the region). Finally numbers of archaeological archive sites appear relatively evenly distributed across the different areas with the single exception of zone 57 where 28 sites are listed.

In order to ensure that the above described elements of the GIS are straightforward to use a data catalogue has been prepared for each of the projects' shape files. The data catalogue contains a short summary explaining what the dataset represents, 'health warnings' (information on the limitations of the data or issues which need to be considered when using it), tables detailing fieldnames, an explanation and the source data.

Metadata for ESRI shape files has been created through ArcCatalog (part of the ArcGIS 8 package). This metadata can be stored alongside the data source as a XML file. The metadata profile is that of the FGDC (Federal Geographic Data Committee) standard established in the USA.

6.3 Case study 1: raised beaches of the West Sussex Coastal Plain

The central West Sussex Coastal Plain around Chichester has been targeted for aggregate extraction since the 19th century and represents an area intensively examined during the PASHCC project and from which a large number of boreholes are available (Figure 36). It serves as a good example of how the thinking about the regional geoarchaeology developed and the GIS has been formulated.

Significant quantities of borehole data were collected in the past across the region as part of the Mineral Assessment Surveys undertaken by the BGS (Lovell and Nancarrow, 1983). Individual borehole logs had previously been classified by Lovell and Nancarrow into defined stratigraphic units offering the possibility of defining discrete, mapable units that form the basis of the BGS mapping of the region (BGS, 1996). This information was examined by the authors and the lithological sequences logged within the Rockworks program. At first the BGS assigned stratigraphic format was adopted and used to inform the locations of key sites examined in the field by the PASHCC project (Figure 37). Investigation in the field consisted of geophysical survey, borehole drilling and test pitting (Figure 38). Following the investigation of the key sites a number of lithological transects were drawn up across key sectors of the coastal plain (e.g. Figures 10 and 16). At this juncture it was realised that the BGS mapping inadequately explained the range of deposits across the region and a new basis for establishing the stratigraphy developed. This newly adopted framework recognised significant new sediment bodies (e.g. the cold stage solifluction and lacustrine deposits around Woodend Farm and Warblington – see Figure 17). All sampled sediment bodies were examined for microfossil content (Foraminifera and Ostracoda) and those containing these elements were further diagnosed to environments of deposition (see Figure 39). Selected sites were then selected for OSL (Figure 40) and Amino Acid Geochronology. The results from the field and laboratory investigation subsequently informed a review of the original BGS data and a revised scheme identifying additional units was projected onto the data (Figure 41). This information (coupled to the archaeological site archive data) then enabled a series of zones to be defined. These zones are associated with unique combinations of factors integrating geological, geomorphological, biological and archaeological characteristics (Appendix II). The key finding of the investigation within this area was the extensive distribution of non-marine sediments associated with cold climate, low-sea level, events. These sequences had previously been misidentified within the BGS archive.

6.4 Case study 2: fluvial deposits of the eastern Solent

The situation in the Eastern Solent and Test Valley differed from that of the West Sussex Coastal Plain in that substantial investigation of the sub-surface did not occur in many regions. The widespread distribution of sites investigated in the West Sussex Coastal Plain was facilitated by the typically non-urban nature of much of the region. In contrast large areas of the eastern Solent drainage is occupied by Portsmouth, Gosport and the Southampton conurbation making access to sites difficult.

Within the Eastern Solent the key initial challenge was correlating the different stratigraphic schemes used across the 4 different areas mapped on the 1:50,000 scale BGS maps. This was achieved by examining the borehole records in conjunction with the BGS mapping. This exercise largely confirmed the validity of the Edwards and Freshney (1987) mapping and their terrace numbering scheme. Thus, where there was no direct evidence available to challenge it, the Edwards and Freshney terrace scheme was applied to the whole of sheets 315, 316 and 331 within the study region, including within tributary valleys. A few minor changes were made and have been previously discussed (see Section 3.2).

Here individual zones (Figure 43) have again been designated on the basis of the association and unique combinations of factors integrating geological, geomorphological, biological and archaeological characteristics (Appendix II).

7. PALAEOLITHIC ARCHAEOLOGY, DEVELOPMENT CONTROL AND A RESEARCH FRAMEWORK FOR THE SUSSEX/HAMPSHIRE COASTAL CORRIDOR

7.1 Development control, aggregate extraction and Palaeolithic archaeology

This section is relevant to all forms of development that have an impact upon the Palaeolithic resource. One major form of such development is, of course, aggregate extraction, and the PASHCC project has as one of its prime objectives to provide background information for curators and aggregate extractors alike on where Palaeolithic potential is likely to be highest, how to investigate if Palaeolithic remains are present and how to deal with them if they are. This objective has been primarily met (within this phase of PASHCC) through the GIS model prepared for, and given to, the county curators. It can also be made available by the county councils directly to other interested parties if they desire, such as archaeologists and consultants planning for mitigation in advance of development on behalf of aggregate extractors. This has broken down the PASHCC study area into a series of zones, and identified for each zone:

- The known Palaeolithic resource
- The importance of the known resource
- The likelihood of important remains
- Key research questions
- Suitable methods of investigation

The remainder of this section provides a more general discussion of the research and curatorial framework within which Palaeolithic mitigation can take place in advance of aggregate extraction and other development. The unique nature of the Palaeolithic resource requires some special knowledge and methods compared to more conventional archaeological remains, but, nonetheless, can be approached within the same framework. PPG 16 serves as a powerful tool to mitigate the impacts of development activity (including aggregate extraction) upon the archaeological resource. For this to take place it is, however, vital that those who carry out the curatorial functions of developing archaeological programmes and imposing archaeological planning conditions have a confident understanding of:

- The nature of the Palaeolithic resource
- Palaeolithic research priorities (both national and regional)
- Appropriate methods of investigation to realise the potential of the resource

The Palaeolithic poses particular problems since, unlike all other archaeological periods, the main evidence of human activity is not archaeological features or structures (as in the conventional archaeological resource) but artefacts, and occasionally other evidence (such as cut-marked faunal remains), contained within naturally deposited sediments. Thus it has been easy for those in the curatorial environment to overlook (and sometimes actively dismiss) Palaeolithic remains as "natural" rather than archaeologically relevant, particularly when, as is usually the case, they have been subject to some degree of disturbance by the natural burial processes that have led to their preservation. It has in the past often been easy,

therefore, for those in the curatorial environment to focus on artefacts from undisturbed occupation surfaces as the only type of Palaeolithic evidence worthy of mitigation, and disregard the evidence from a wide range of other contexts.

A second potential area of disagreement concerns the importance of various faunal and palaeoenvironmental remains. Despite the value of biological and palaeoenvironmental remains in enhancing understanding of the wider landscape, in other parts of which human activity may well be contemporarily occurring, some curators and consultants are reluctant to impose archaeological conditions under PPG 16 unless there is direct evidence of human activity. This is not solely a concern of the Palaeolithic/Pleistocene research community but has equal resonance for the wider archaeological community.

This section attempts to provide a curatorial introduction to the Palaeolithic resource, explaining how, alongside undisturbed remains, the significant Palaeolithic resource also embraces disturbed/transported artefacts, as well as faunal remains, palaeoenvironmental evidence and artefactually sterile deposits (cf. Section 7.2). All these types of evidence contribute to addressing national and regional research priorities (cf. Section 7.3). Even though the importance of a patch of Pleistocene river gravel may be less immediately apparent than a well-defined Roman villa, both have their role to play in studying the respective periods, and both are worthy of appropriate evaluation and mitigation under PPG 16.

It is not possible to provide a recipe book of methods for each and every situation. The Palaeolithic resource is too diverse. Nonetheless, we also present some guidelines on how the key investigative archaeological stages of desk-based assessment, field evaluation and mitigation should be approached.

7.2 The Palaeolithic Resource

7.2.1 Pleistocene deposits

The Palaeolithic resource comprises all material remains and deposits that contribute to investigating the Palaeolithic period, and addressing national and regional research priorities. Palaeolithic occupation has taken place through the Pleistocene period, thus the artefactual and faunal evidence of human behaviour and occupation is contained within Pleistocene deposits. These also contain biological, lithological and palaeoenvironmental evidence that help in dating the deposit, and providing information of the local climate and environment at any particular time. Such information is essential if we are to carry out core research objectives such as dating sites, constructing a framework of cultural change and development, and understanding human activity and behaviour in its environmental and landscape context.

The core resource for the Palaeolithic is, therefore, all Pleistocene deposits. All of these are not necessarily significant, but all have the potential to be so. It is then necessary to consider, for any preserved patch of Pleistocene deposits, what Palaeolithic remains are present, and what is the potential information available for addressing Palaeolithic research priorities.

7.2.2 Palaeolithic remains and relevant information

The most widely recognised type of Palaeolithic remains are lithic artefacts. Handaxes are the most commonly found and easily recognised type of lithic artefact, but the earliest lithic technology embraces simple core and flake strategies and attention should also be paid to their recognition. However, lithic artefacts are just one of a wide range of evidence relevant to Palaeolithic research. This can be divided into three main categories: human activity, biological/palaeoenvironmental evidence and intrinsic sedimentological data (Table 23).

7.2.2.1 Human activity

Besides lithic artefacts, which also include stones with batter marks used as percussors, there are several other ways in which the direct evidence of human activity can leave traces. Artefacts can be made from other material such as wood, bone and antler. These are much more perishable, and so rarely found. They are only preserved under certain combinations of swift burial, waterlogging and alkalinity of the sedimentary context. However, because of this rarity, one should be particularly aware of the possibility of their recovery from suitable contexts. Other forms of activity can also leave direct traces, such as cut-marks on dietary faunal remains or decoration of stones. Although no decorated/carved objects are yet known from the Lower/Middle Palaeolithic, there is some evidence of a capacity for ritual behaviour at this period (for instance the deposition of Neanderthal and *Homo erectus* skeletons in association with grave goods in Spain), so it is not out of the question that evidence of this type could be found.

Secondly, humans can move or re-arrange natural objects. Pieces of lithic raw material can be collected and transported, without any sign of knapping. And there is also the possibility of simple features and structures, such as stone pavements. Again, none are known from Britain as yet, and the claims for this type of evidence from Africa and southern France are questionable, but one should still be open to the possibility of such evidence.

Finally, there is the question of the earliest evidence of fire. On the continent and the Middle East, there is reliable evidence for the controlled use of fire for at least the last 100,000 years, i.e. coincident with the occupation of northwestern Europe by the Neanderthals in the last Ice Age. However there is little evidence of this period in Britain, and no evidence of the use of fire before the Upper Palaeolithic. Claims are regularly made for use of fire earlier than this but these are without exception highly problematic. There is no doubt that natural fires were a regular occurrence through the Pleistocene, probably often caused by lightning strikes. The evidence of these fires is preserved in deposits of the time, in the form of burnt out tree stumps, spreads of charcoal and then reworked charcoal fragments that enter fluvial sedimentary systems. There has never been any evidence that reliably links any of this evidence, which regularly crops up on Palaeolithic sites, with human control of fire. Nonetheless, one should still recognise the possibility of more satisfactory evidence occurring at some point.

7.2.2.2 Biological/palaeo-environmental

One of the key categories of evidence for researching the Palaeolithic is biological/palaeo-environmental evidence. This is often large mammalian, small vertebrate or molluscan, but there is a wide range of other evidence that may be present (cf. Table 23). This may be present at the same sites as artefactual remains, either in the same horizon or in stratigraphically related horizons. Or it may be present at sites where direct evidence is absent. In all these cases, the evidence has the same value and potential for Palaeolithic research, and should be recognised as significant. It can help in dating the deposit, and providing information of the local climate and environment at any particular time. Such information is essential if we are to carry out core research objectives such as dating sites, constructing a framework of cultural change and development, and understanding human activity and behaviour in its environmental and landscape context

7.2.2.3 Intrinsic sedimentological

Besides artefactual and environmental evidence, there is a range of other information associated with Pleistocene deposits that is relevant to Palaeolithic research objectives (Table 23). Information on their height above OD, their three-dimensional geometry, their position in the landscape and their sedimentary characteristics are all integral to interpreting their origin and date. Other factors such as the range of lithologies represented in the solid clasts, heavy mineral signatures and the occurrence of sand bodies suitable for OSL dating also have a role to play.

7.2.3 Disturbance and integrity

The burial and preservation of Palaeolithic remains is dependent upon where they have been deposited in the landscape, and which depositional processes have acted upon that part of the landscape. A wide range of processes are possible, ranging from total dispersal by glacial action, solifluction or high energy fluvial torrents, to gentle burial by fine-grained aeolian, colluvial or alluvial processes, leaving evidence essentially undisturbed. Thus Palaeolithic remains, and lithic artefacts in particular which are relatively indestructible, have the potential to be preserved and recognisable, although usually showing signs of wear-and-tear, after substantial transport and disturbance.

Consequently, understanding and interpretation of Palaeolithic remains is heavily dependent upon interpretation of the depositional and post-depositional processes that have affected them between their original deposition and their present context. Evidence from both disturbed and undisturbed sites has a role to play in addressing Palaeolithic research priorities. What is most important is, therefore, not necessarily to identify a lack of disturbance, but to be confident about the degree of disturbance. This knowledge then underpins the spatial/chronological scale at which the evidence can be interpreted.

Undisturbed horizons have been rightly highlighted (Roe, 1980; English Heritage, 1991) as of particular significance for their stratigraphic and chronological integrity, and their fascinating glimpses into short-lived episodes of activity. Disturbed and transported material, such as predominates in fluvial contexts, has in contrast been widely downgraded in its potential significance, to the extent that some in the current curatorial environment would regard such material as being of insufficient significance to merit any protection or research in advance of destruction. However, besides avoiding the risk of writing off large quantities of the finite Palaeolithic resource just because we don't yet know what to do with it (cf. Chippindale, 1989), it is becoming clear that the study of such material in fact *complements* the evidence from undisturbed sites by bringing a different chronological and spatial perspective to bear. Collections of transported artefacts represent a time and space-averaged sample, giving a more representative view of lithic production and diversity than the evidence from a few square metres representing one afternoon in the distant past. Such evidence may in fact be of more value in documenting and explaining general patterns of material cultural change, since it is less vulnerable to local heterogeneity caused by, for instance, specific tasks or raw material availability.

7.2.4 Significance

English Heritage (1998) have published eleven criteria, any of which are deemed sufficient to identify a Palaeolithic site as of national importance (Table 24). Assessment of significance depends upon the extent to which the evidence in a particular deposit can contribute to addressing national and regional research priorities. The English Heritage criteria successfully pinpoint a number of situations where there is particularly high potential to address a number of research priorities. It should be noted that remains in a primary undisturbed context represent just one of these criteria. Many sites without undisturbed remains may meet these criteria for national importance. Thus, by these guidelines, the absence of undisturbed primary context remains is not a basis for disregarding the potential of a Palaeolithic site, and failing to carry out mitigating archaeological works.

Furthermore, national importance should not serve as the bar for initiating mitigating works. It provides a useful means of measuring the relative significance of sites for, for instance, dispersing grant-aid funds, considering whether to preserve remains *in situ* or for attributing some form of statutory protection. Many sites that are not of national importance in themselves may contain good evidence that contributes to addressing national and regional research priorities, and impacts upon these should be mitigated.

Finally, significant knowledge — that contributes to both national and regional research priorities — can also be acquired, not only from single sites with high quality evidence, but also from repeated observations at sites with evidence that is in itself of little apparent potential. The incremental accumulation of information from, for instance, a single mapped fluvial terrace can lead, over time, to a reliable picture of the density, distribution and nature of Palaeolithic remains. This can not be achieved other than through a coherent strategy of investigation that recognises this from the outset, and sets in place a standardised methodology that leads to systematic small-scale data gathering exercises at every impact occasion. A single event may involve

excavation of a couple of test pits, sieving of eight 100 litre gravel samples and recovery of no evidence. This in itself fails to provide sufficient information to make a more general summary of the Palaeolithic remains in a body of gravel that may cover several hundred hectares. However, once this exercise has been repeated a hundred times over a period of maybe 20 years, *then* we will actually begin to learn something that can make a major contribution to core national and regional research objectives.

An important corollary is to recognise the significance of finding no Palaeolithic artefacts. When investigating patterns of human colonisation and settlement, identifying the absence of human presence at particular periods is just as important as identifying presence. Thus, as discussed above, it is necessary to focus upon Pleistocene deposits as the core resource for Palaeolithic investigation, and then one relevant fact for a body of sediment is the presence/prevalence of artefacts — a result of "no artefacts" would be just as significant an observation as "many pointed handaxes". The significance and potential of this data is tied in with the degree of spatial disturbance and chronological integrity of a deposit, which is why assessing this is such an important aspect of evaluation.

7.3 Research Framework for the Sussex/Hampshire Coastal Corridor

It was recognised in the 1980s that the present structure of archaeological curation and investigation in advance of development requires a framework of academic and research priorities against which to consider the significance of sites and to guide their investigation. The seminal English Heritage publication *Exploring our Past* (1991) identified three main themes — physical evolution, cultural development and global colonisation. More recently a working party of the Prehistoric Society has defined three main strands for a national Palaeolithic Research Framework (English Heritage/Prehistoric Society, 1999):

- Identification of research themes and priorities
- Development of specific projects of immediate relevance
- Education and dissemination initiatives

7.3.1 National Research themes and priorities

While regularly under review, and subject to changing emphasis in light of new discoveries and research directions, a comprehensive list of thirteen core national research themes and priorities (N 1–13) can be put forward (Table 25).

7.3.2 Regional Sussex/Hampshire Coastal Corridor themes

Developing a local research framework for Palaeolithic archaeology within the PASHCC study area involves consideration of both key questions and themes applicable to the record preserved within the area as well as practical problems related to the experience and familiarity of the workers required to implement the Palaeolithic

archaeological frameworks at a curatorial level. Furthermore there is also a need to consider the competence of the contractors to supply that information within a field most contracting field units are unfamiliar with.

Broad themes for a regional research framework encompass:

1. Human activity.
2. Spatial distribution of stratigraphic units.
3. Chronology.
4. Palaeogeography.
5. Environmental change.

Because of the inter-relatedness of the different strands within the discipline of Palaeolithic archaeology and in particular the need to treat Palaeolithic archaeology as a form of Pleistocene geography or palaeogeography these areas of the framework require equal consideration in both the development of a framework and subsequently its implementation through developer and research led projects. Key fields in the development of a palaeogeography for a particular region facilitate not only an understanding of the nature and significance of extant finds but also enables structured approaches to be made to future investigations and the prediction of locations in which archaeological material might be found. This form of Pleistocene geography is something that can only be practiced in a multi-disciplinary form utilising a large range of specialists in Palaeolithic and Quaternary studies.

Although considerable progress has been made through the course of this project to define the spatial distribution of stratigraphic units (that might contain Palaeolithic archaeology) our knowledge of the extent and lateral variability of sequences remains poor. It is probable that at present there is a better understanding of the spatial distribution of the sediments and sequences associated with the Solent fluvial deposits than those in the West Sussex Coastal Plain. This is primarily because of the scale at which sequences have been noted to vary in the West Sussex Coastal Plain is higher than that in the major fluvial systems. Consequently mapping and resource distribution has to be a key focus of local research frameworks in the future.

Chronology remains problematic and until reliable and replicable sets of age estimates become available then developing chronological frameworks remains a key goal in future projects. Chronological frameworks are, by necessity, going to be based on different elements in the two major regions of the West Sussex Coastal Plain and the Solent. However, approaches to dating and in particular the adoption of a multi-faceted approach to dating rather than the reliance on a single method must be a future goal.

Finally environmental change through the Palaeolithic and indeed during phases of particular warm or cold stage episodes in which we might have evidence for human activity is an important topic for consideration not only to elucidate human behaviour

in the past but also to predict likely changes in the future. Investigation of the range of palaeoenvironmental remains is and has been a distinctive feature of Palaeolithic investigations and should remain central to future studies.

7.3.3 Specific regional research priorities

1. Establishing evidence for Pre-Anglian occupation, (likely to be found in terraces T8 and above). In particular attention should be given to considering the dating of terrace T8 and above, sieving for artefacts and fieldwalking programmes.
2. Examining the spatial patterns associated with human occupation of the Boxgrove landsurface across the full width of the Upper Coastal Plain.
3. Establishing evidence of Devensian occupation during MIS 4 and 3. this would focus particularly on the investigations of terrace T1 and overlying deposits, especially at Brambridge. Within the West Sussex Coastal Plain this would focus on the newly discovered cold stage deposits of the Woodend and Warblington Silts.
4. The identification of zoological remains in Solent terraces. They must exist somewhere, and there are records. It is possible that unmapped outcrops of Chalk are close the surface in various places, for instance in Portswood as observed by one of the authors (FFWS) and investigations/monitoring should be targeted in these areas.
5. Investigation of spatial concentration of finds within terrace bodies — are they evenly scattered, or do they occur as distinct spatial concentrations; similarly, are finds evenly dispersed vertically through a gravel body, or are they associated with a specific horizon?
6. Establishing evidence for late Middle Palaeolithic occupation associated with the penultimate interglacial in the extensive terrestrial sequences associated with the Aldingbourne and Brighton-Norton Raised Beach and the landsurface associated with the latter.

7.3.4 Suggestions for strategic projects

A number of strategic projects can be identified that follow from these regional research priorities and landscape zone objectives. This list is not intended to be exhaustive or prescriptive. Many other worthy projects could be developed, and aspects from the different projects suggested could be extracted and woven together to form projects of different focus. All serve the multiple and complementary aims of:

- Improving the ability to curate the archaeological heritage in the Solent and West Sussex Coastal Plain regions

- Developing understanding of the character and distribution of the Pleistocene archaeological resource in these region
- Addressing national and regional research priorities

7.3.4.1 Palaeolithic/Pleistocene resource characterisation and Pleistocene chronostratigraphy

The project would entail a combination of: examination of all known artefacts from regions adjacent to those investigated in this study (i.e. the Weald sectors of the Arun/Adur, the Western Solent and Avon Valley) that are held in museum collections, geological data collection/modelling and new fieldwork. The geological data collection and modelling would collate all available information on the Pleistocene deposits of the region, leading to improved understanding of their nature and distribution. The fieldwork would be targeted at key deposits in the region to try and date them by OSL and/or biostratigraphic means, leading to improved correlation and dating of deposits (a) with each other and (b) with the wider national and international Pleistocene MIS framework. Once this framework had been developed the analysis of the artefacts would lead to construction of a new framework of cultural change and settlement history. It will then be possible to explore how it compares and contrasts with the pictures in other regions such as the Thames Valley, where studies of this nature have already been carried out and where our understanding is relatively good. The project would also lead to identification of key areas of potential for Palaeolithic archaeological remains. This represents a ‘roll-out’ of the present project across a wider area.

7.3.4.2 Systematic fieldwalking of Pleistocene terrace exposures

Most of our current understanding of the Palaeolithic of the region comes from stray finds and amateur collection from quarries. However this knowledge results from the unstructured research activities of a few individuals, mostly many decades ago. A few areas have been intensively searched on a regular basis, a few on a one-off basis but most have not been searched at all, particularly the extensive high terrace spreads in the Test Valley and lower terrace spreads up the Itchen Valley. The region is primarily agricultural with a significant quantity of arable fields that may regularly be available for fieldwalking. A project could be developed that applies a systematic and controlled fieldwalking survey of Pleistocene deposits through the Solent region. This may (a) pick up entirely new significant concentrations/sites [for instance the major new Wiltshire site of Harnham was found following identification of a concentration of handaxe finds in a ploughed field] and (b) would lead to a more balanced view of the distribution of Palaeolithic remains and settlement across the region. Such a project could also serve as a useful means of engaging with local archaeological groups and museums and promoting wider understanding of and interest in the Palaeolithic and Pleistocene.

7.3.4.3 Research excavations

There are a number of sites, for instance at Manor Farm (Lavant), in the vicinity of Warsash and Southampton Common or where we are already aware that Palaeolithic remains are present, but we lack information on their context and provenance. These would benefit from excavations and a machine-dug test pit programme aimed at (a) providing more controlled information on artefact context, presence, density and intra-site distribution, (b) better understanding of the nature, sequence and extent of Pleistocene deposits at the site, and (c) application of dating studies such OSL to date the deposits.

7.3.5 Dissemination, education and community involvement

The English Heritage/Prehistoric Society Palaeolithic Research Framework (1999) emphasised the importance of disseminating results to the wider community, and encouraged a more proactive role in this through education and outreach initiatives. Early prehistory, even more possibly than other areas of archaeology, is an area that stimulates the public imagination with its combination of Ice Age climate, exotic extinct animals and Early Man. However, general awareness is limited of the nature of the evidence, its presence all around and the potential for public contribution to advances in knowledge. In general, mechanisms are already in place, with an existing framework of professionals in the museum and education world whose remit already covers promoting wider appreciation and understanding of the archaeological heritage. There is, however, perhaps a need to get the Palaeolithic and Pleistocene higher on the agenda of those whose work already lies in this area. There are a number of avenues that could be developed.

7.3.5.1 Portable Antiquities Scheme

This scheme is already in place with officers based at regional centres around the country. While originally conceived in relation to metal-detecting, it can also serve as a first point of contact for reporting the recovery of lithic antiquities. This aspect can be flagged up in the outreach publicity material for the scheme and the antiquities officers can be given basic training in the identification of lithic artefacts. The *Lithic Studies Society* has held training days and developed a standardised recording proforma for lithic antiquities. Details are available from Elizabeth Walker at the National Museums & Galleries of Wales, Cardiff.

7.3.5.2 Popular dissemination and community/educational outreach

Perhaps greater efforts should be made, and resources applied, as part of the reporting requirements of both small and large projects, to working with museum and education officers in disseminating results in more publicly accessible form. This could include:

- Wider reporting of even small finds/projects in local media
- Visits to schools with artefacts and fossils to give short talks
- Teacher packs with visual resources and information summaries

- Public access open-days to sites (as held by the PASHCC at Lepe Country Park, Stone Point)
- Collaboration with museums over exhibitions and web resources
- Web-sites
- Production/distribution of leaflets, posters and CDs (already undertaken by the PASHCC project in conjunction with Southampton Museum)
- Public lectures, knapping demonstrations, artefact identification sessions

7.3.5.3 Specific recommendations for action

- Contact with Portable Antiquities Officer, training in lithics identification and development/application of a standardised proforma for recording lithic finds
- Increased emphasis in development control work for reporting requirements concerning public/community dissemination
- Increased emphasis in reporting objectives for larger strategic and development control projects of public/popular dissemination and museum/education liaison
- A specific strategic project whose prime objective is promoting understanding and appreciation of the Palaeolithic in the wider community

7.4 Strategy and methods

The core aim of these proposals is to ensure that the maximum and optimum Palaeolithic archaeological knowledge is recovered from deposits impacted by development. There is already a strong curatorial framework concerned with mitigating the archaeological impact of development, and involving the collaboration of three principal parties: developers and their consultants, the Local Planning Authority advised by the archaeological curators and commercial contractors. Custom and practice within this framework have, however, developed in relation to the needs of the post-Palaeolithic archaeological heritage. Nonetheless the current framework is also suitable for mitigating impact upon the Palaeolithic resource. Thus the overall strategy adopted is not for revolution in law or planning guidance, but for evolution of current practices and curatorial thinking. The potential of the existing curatorial and legislative framework for effective recognition and mitigation of the Palaeolithic can then be fully realised.

7.4.1 Curatorial awareness

Perhaps the most important issue is to raise awareness and understanding of the Palaeolithic amongst the key players in the curatorial system — namely local authority curators, consultants and contractors. Ultimately it is the local authority curators who have the role of advising on the extent of archaeological conditions on planning applications under PPG 16. However consultants often also have a major role in advance of planning applications in determining the amount and scope of archaeological work that accompanies planning applications, as well as in determining archaeological programmes that satisfy the requirements of local authority curators. In most regions good communications between those involved in these two functions are an integral part of delivering satisfactory archaeological mitigation. Therefore it is vital that those active in these functions, as well as archaeological contractors, recognise that the Palaeolithic is as much a part of the heritage as the Neolithic, the Roman or the Medieval, and have a good and shared understanding of (a) the nature of the resource, (b) the types of evidence that contribute to addressing national and regional research priorities and (c) appropriate methods of investigation.

Hopefully dissemination of documents such as this, alongside maximum engagement with bodies such as the Association of Local Government Archaeological Officers (ALGAO), English Heritage, the Council for British Archaeology and the Institute of Field Archaeologists, can play a role in developing awareness and evolving curatorial practice and thinking.

7.4.2 Desk-based assessment

From previous experience outside the study region, we are not confident that DBAs always correctly identify the potential Palaeolithic impact of developments or infrastructural projects. The scope and accuracy of DBAs are clearly heavily dependent upon initial baseline resource characterisation. They are also affected by (a) access and availability of the best possible information and (b) use made of this information.

There is one particularly fruitful source of information that should also be taken account of at the DBA stage. Most development projects, and particularly larger ones, have a range of geo-technical investigations that are carried out early in project cycle. These often involve excavation of test pits and bore-holes. Besides the point that these in themselves have archaeological impact, and perhaps should be monitored, they also provide an excellent opportunity for archaeological knowledge to be gathered on a site piggy-backing on the geo-technical investigations. These investigations provide exposures that reveal the presence and nature of any Pleistocene sediments present. All that is required is monitoring by a person with appropriate expertise, who can record the stratigraphic sequence, and observe and recover Palaeolithic remains if present.

We suggest that good practice for DBAs should include information from archaeological monitoring of geo-technical investigations. Implementation of this suggestion requires engagement with the consultancies and archaeological contractors who habitually carry out DBAs before large development projects. This is currently the case in Kent for instance, where consultancies such as CGMS Ltd now habitually organise monitoring of geo-technical investigations in sensitive Palaeolithic

landscapes. The results have in many cases obviated the need for a Palaeolithic aspect to conventional evaluation, and thus resulted in cost reductions rather than increases.

Access to the best information then needs to be complemented by appropriate interpretation. Again, in the future, this could substantially be addressed through a GIS model. Presently, this is probably most effectively carried out by specialists who can combine interpretation of geological mapping with understanding of the potential of the Palaeolithic remains found, or potentially likely to be present, to contribute to current research priorities. Hopefully those involved in DBA preparation can be encouraged to assimilate information in documents such as this, and take further account of the Palaeolithic resource. Key factors to identify and consider are:

- Presence/nature of Pleistocene deposits
- Presence/nature Palaeolithic remains
- Relevance to national/regional research priorities

7.4.3 Evaluation

It is necessary, in areas where there is potential for Pleistocene deposits and Palaeolithic remains, that special methods are applied to investigating their presence and potential. Identification of such areas depends in the first place on the quality of the baseline resource characterisation and the DBA. In these areas deeper test pits need to be dug. A detailed proforma method statement for Palaeolithic evaluation test pits is given in Appendix III. A key aspect of this is the application of standardised sedimentological recording and volume controlled sieving.

In areas where there is not thought to be even the possibility of Pleistocene deposits, there is no need to carry out a full Palaeolithic/Pleistocene evaluation. However, it would be good practice to at least ask the question as part of conventional evaluation: "Have Pleistocene deposits been encountered, and if so what is their nature and Palaeolithic potential?". Significant deposits may be found in unsuspected areas, and these may then require further evaluation specifically in relation to their Palaeolithic potential. This has been the case in a number of recent projects, which make useful case studies.

At Red Barns (Hants), an undisturbed floor of Palaeolithic artefacts was found 2.5m beneath the ground surface, in an area mapped as Chalk bedrock, but in fact covered by a thick layer of colluvial deposits (Wenban-Smith *et al.*, 2000). The remains were identified during monitoring of drainage works for later archaeological remains during construction of a housing development. At the Swan Valley Community School (Kent), the development was over half a km from the nearest mapped boundary of Pleistocene deposits, yet a handaxe and fluvial sands/gravels were found in the base of the conventional 30m evaluation trenches. Further deeper test pits identified artefact-bearing fluvial deposits across the site, and ultimately a full archaeological programme was requested by Kent County Council to mitigate the Palaeolithic impact the school construction (Wenban-Smith & Bridgland, 2001). Finally, at Harnham (Wilts), handaxes were found on a ploughed field surface

adjacent to a conventional trench, and varied Pleistocene deposits of uncertain origin were present in the base of the trenches. Subsequent deeper test pits then led to discovery of a complex suite of deposits in a restricted area, with abundant Palaeolithic artefacts, humanly modified faunal remains and undisturbed primary context material (Bates & Wenban-Smith, 2003; Whittaker *et al.*, 2004).

As discussed above, much relevant information can be gathered from monitoring of geo-technical investigations. If this has not been carried out for the DBA, then such monitoring should be carried out and the information fed into the evaluation stage of the archaeological curation cycle.

7.4.4 Mitigation

If Palaeolithic remains are present, it is advisable to take specialist advice on their potential and suitable methods for further study or mitigation of any impact. As discussed above significant contributions to Palaeolithic knowledge can be gained from both one-off studies of single high quality sites and the incremental long term accumulation of relevant data from sites that in themselves are of very little significance, and possibly lacking in evident remains altogether. The best example of this is fluvial terrace deposits. Although it is in fact uncertain (and a subject of current research) how long a time period is represented by their deposition, material within such deposits is generally thought to be datable to the level of the marine isotope stage, i.e. a period of *c.* 30,000 years. Far from being the disaster that some used to the more precise dating of later periods might think, these deposits thus represent relatively tightly defined time capsules within a period of 600,000 or 700,000 years of possible Palaeolithic occupation. There is a lot of knowledge to be gained from large-scale and long term sampling of such terrace deposits, leading to a full picture of the nature and prevalence of any contained Palaeolithic archaeological remains. This can easily be achieved through accumulated evaluation and mitigation test pit investigations. Urbanised regions, where they overlie Pleistocene terraces, are particularly suitable for development of such a programme, since there is likely to be regular development scattered over the terrace, and works such as foundations or services trenches will provide regular opportunities for sampling.

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Appendix I. Archaeological archive data collected in the PASHCC study.

Appendix II. Geoarchaeological zone descriptor information.

Appendix III. Proforma method statement for Palaeolithic/Pleistocene field evaluations.