EMU / SOUTH COAST DREDGING ASSOCIATION

MARINE AGGREGATE REGIONAL ENVIRONMENTAL ASSESSMENT

FINAL REPORT

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Ref: 65781.10

June 2012

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65781.10

Title:	SCDA Marine Aggregate Environmental Assessment
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Managed by:	John Gribble
Origination date:	May 2009
Date of last revision:	June 2012
Version:	65781.10
Wessex Archaeology QA:	Euan McNeill
Status:	Final
Summary of changes:	-
Associated reports:	65780.01, 65781.01
Client Approval:	Kim Bridge

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Summary

Wessex Archaeology was commissioned by Emu on behalf of the South Coast Dredging Association (SCDA) to undertake a regional archaeological desk-based assessment for a large coastal and offshore Study Area in the English Channel, off the coast of Sussex, Hampshire, the Isle of Wight and Dorset.

The aim of this study was to identify known archaeology, highlight potential archaeology and consider the effects of all the existing and planned aggregate dredging operations on known and unknown archaeological sites within the Study Area as part of a Regional Environmental Assessment. This process, which is comparable to an Environmental Impact Assessment, has been developed to a regional scale in order to provide a background baseline for a wide area which will support future, more specific Environmental Impact Assessments associated with individual aggregate licence applications.

The Study Area extends from St Alban's Head, Dorset, in the west to Shoreham, West Sussex, in the east, and approximately 24km south from St Catherine's Point on the Isle of Wight. It includes the Solent and Southampton Water.

Within the Study Area the desk-based assessment has identified a total of 5760 records from the SeaZone database and 9573 records from the National Monuments Record. Because the majority of these sites fell within the terrestrial part of the Study Area, a buffer zone was created 5km inland of the coastline to reduce the terrestrial records, while at the same time retaining sufficient to provide context for the maritime sites.

The desk-based assessment also utilised the archaeological interpretations by Wessex Archaeology of primary geophysical and geotechnical data provided by Emu Limited and SCDA respectively. These data comprised 550 line kilometres of sub-bottom profiler data and 149 vibrocore logs.

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Acknowledgements

This Regional Environmental Assessment was commissioned by Emu Limited (Emu) on behalf of the South Coast Dredging Association. Wessex Archaeology would like to thank Justine Davies and Steven Freeman of Emu Limited for their assistance during the preparation of this report.

Data was provided by Emu and the members of the South Coast Dredging Association (SCDA), by the UKHO (United Kingdom Hydrographic Office) and by the NMR (National Monument Record). We are grateful to the staff of these organisations for their co-operation.

Nicolas Bigourdan compiled this report. Kitty Brandon prepared the illustrations. John Gribble managed the project for Wessex Archaeology and quality control was provided by Euan McNeill.

Data Licences

Archaeological site data in the Study Area was obtained the National Monuments Record (NMR), Swindon. Copyright restrictions apply to any data that may be obtained from the NMR.

A summary of available wreck data was obtained from the UK Hydrographic Office (UKHO) Wreck Index by Wessex Archaeology. In addition, Admiralty chart coverage has been assessed for the production of this report.

The material derived from the UKHO is subject to licence 820/020220/11 and the conditions on End-Users and Third Parties contained therein.

The following notice applies:

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1 INTRODUCTION

1.1.1 Wessex Archaeology (WA) has been commissioned by Emu Limited (Emu) on behalf of the South Coast Dredging Association (SCDA) to undertake a Regional Environmental Assessment (REA) for a large coastal and offshore Study Area in the English Channel, of the coast of Sussex, Hampshire, the Isle of Wight, and Dorset.

1.1.2 This report provides an assessment of the known and potential archaeological resource within the Study Area through reviewing primary data, records held by national inventories and secondary sources.

1.1.3 For the purposes of this report, the marine archaeological resource is considered to comprise:

- Prehistoric Archaeology;
- Maritime Archaeology;
- Aviation Archaeology.

2 AIMS AND OBJECTIVES

2.1.1 The general aims of the REA process as summarised in the Appendix 1 (Regional Environmental Assessment: The Perspectives of the Technical Regulatory Advisors) of the Marine Aggregate Regional Environmental Assessment (MAREA) Scoping Report (SCDA 2007) are as follows:

- To provide objective, evidence-based assessments of the distribution and importance of regional resources (living and non-living) and the potential impacts from the proposed activities on these resources, at a regional level.
- To provide a context for site-specific Environmental Impact Assessments (EIAs) within the relevant REA area and to identify site-specific issues that individual EIAs may need to focus on more specially.
- To provide an assessment of the impacts of different development scenarios of the aggregate extraction industry based on industry projections, and in relation to those due to other humans activities and natural variability.
- Provide a robust assessment of cumulative and in-combination impacts at the regional level, and thus contribute towards assessments of the magnitude and scale of such impacts in individuals EIAs.
- Make recommendations for monitoring to be addressed at the REA or individual EIA level and from R&D to address gaps in knowledge, understanding or assessment tools.

2.1.2 The aim of this study is to identify the range of effects of all the existing and planned future dredging operations on known and unknown archaeological sites within the Study Area.

2.1.3 This report will contribute towards the REA process which will consider the potential cumulative and in-combination effects of the existing and planned dredging operations on the marine environment.

3 STUDY AREA

3.1 STUDY AREA COORDINATES

3.1.1 The following co-ordinates (**Table 1**) were supplied by Emu to define the Study Area for the Scoping Study (Wessex Archaeology 2007c). The co-ordinates were supplied in WGS 84 decimal degrees and UTM Zone 30N co-ordinates:

ID	WGS84 (decimal degrees)		UTM Zone 30N	
	Longitude	Latitude	Easting	Northing
1	-2.03162	51.02783	567910	5653365
2	-0.24484	50.99935	693316	5653365
3	-0.28306	50.34223	693316	5580212
4	-2.04507	50.37005	567910	5580212

Table 1: Study Area Coordinates

3.1.2 For the MAREA WA refined this Study Area to reduce its landward extent to a line within 5km of the coastline. This was to facilitate data searches and minimise the volume of terrestrial archaeological data returned that is not relevant to the REA. The refined Study Area is shown in (**Figure 1**).

3.1.3 The Study Area (**Figure 1**) extends from St Alban's Head (Dorset) in the west to Shoreham (West Sussex) in the east. As stated above the Study Area extends 5km inland from the coast, while its marine element extends approximately 24km south from St Catherine's Point (Isle of Wight) and includes the Solent and Southampton Water.

3.2 CO-ORDINATE SYSTEM

3.2.1 Throughout the report, the Universal Transverse Mercator (UTM) co-ordinate system based on the WGS 84 spheroid is used to integrate the data supplied by the NMR, SeaZone and other sources. Where applicable, co-ordinates were translated using the Quest Geodetic calculator by Quest Geo Solutions Limited.

4 METHODOLOGY

4.1 LEGISLATION

4.1.1 The statutory, planning and policy context relating to the historic environment in the Study Area is set out in **Appendix I** below.

4.1.2 Recently, the government declared its intention to examine underwater heritage legislation as part of a wider review of heritage controls and to review the regulatory framework affecting development in the coastal area and improve co-ordination between government departments in relation to the granting of consents for activities that affect the seabed.

4.1.3 Although there is little in the way of cross-sectoral legislation at present a holistic approach is enshrined in the concept of Integrated Coastal Zone Management (ICZM), which will be central to coastal planning in the future. ICZM brings together everyone involved in the management and use of a particular stretch of coast within a framework that works to achieve common goals. Development control – such as

Planning and Policy Guidance and Environmental Impact Assessment – and non-statutory management plans – such as Coastal, Estuarine and Shoreline Management Plans and Heritage Coasts – have the potential to play a significant role in the investigation and conservation of the maritime historic environment within such a framework.

4.1.4 In summary, the legislation which relates specifically to the maritime historic environment in English territorial waters is the **Protection of Wrecks Act 1973**. The **Merchant Shipping Act 1995** is also relevant as it plays a significant role in the reporting of recovered marine archaeological material. Furthermore, the **Protection of Military Remains Act 1986** relates to the marine historic environment with regards to military ship and aircraft remains of historic interest. The introduction of the **National Heritage Act 2002** has given English Heritage (EH) responsibility for archaeology below the low watermark. This includes historic wrecks and historic landscapes in, or under the seabed, out to the 12 nautical mile territorial limit around England.

4.2 SOURCES

4.2.1 The Study Area has been used to define the searches for archaeological and related data for use in the desk based assessment. The principal sources consulted in the assessment are as follows:

- Records held in the maritime section of the National Monument Record (NMR);
- Records of wrecks and obstructions collated by SeaZone;
- Various secondary sources relating to the palaeo-environment and to the Palaeolithic and Mesolithic archaeology of Northern Europe with specific reference to the ALSF Seascapes and Seabed Prehistory projects, as well as those sources relating to known and potential wreck sites and casualties;
- Various secondary sources, with specific reference to the ALSF England's Shipping and Navigational Hazards projects with regard to historic shipping patterns;
- ALSF Air Crash Sites at Sea project and various secondary sources relating to historic aviation patterns;
- A range of previous archaeological assessment undertaken by WA that focused on the maritime archaeology of areas within the Study Area, ranging from large-scale strategic projects to small-scale assessments of individual wreck sites;
- The annual reports of BMAPA Protocol Implementation Service;
- Geophysical data collected by Emu, for the MAREA;
- Geotechnical data collected by United Marine Dredging Ltd (UMD), Hanson Marine Ltd and Cemex UK Marine Ltd (formerly Ready Mix Concrete Ltd (RMC) and South Coast Shipping Ltd (SCS)) and provided by SCDA.

4.2.2 Due to the large extent of the Study Area it was not feasible to consult the relevant Historic Environment Records (HER). In many cases, records held in the HERs are duplicates of those held by the NMR and it was agreed with English Heritage (EH) that it was not within the scope of this report to correlate the datasets from these organisations. EH has indicated that they will, however, expect that a consideration of HER data will take place as part of any future EIAs for specific aggregate dredging licences within the SCDA Study Area.

4.3 APPROACH

4.3.1 The sources outlined in above were consulted to provide a review of the known and potential archaeological resource within the Study Area. This review was considered with regards to three separate fields of enquiry:

- Prehistoric Archaeology (**Section 5**)
- Maritime Archaeology (**Section 6**)
- Aviation Archaeology (**Section 7**).

Prehistoric Archaeology

4.3.2 In order to assess the potential for prehistoric sites within the Study Area, various secondary sources were reviewed alongside the NMR datasets relating to the prehistoric terrestrial record within the onshore extent of the Study Area. The NMR terrestrial records were superimposed on a base map of the Study Area in the ArcView 9.2 Geographical Information System (GIS) software package and queried on the basis of their period classification to provide an understanding of the distribution and density of the known archaeological resource from the Palaeolithic to the Iron Age.

4.3.3 A first stage archaeological assessment of 149 vibrocore logs was undertaken in order to better understand the sedimentary sequence within the Study Area and evaluate the geoarchaeological and palaeoenvironmental potential of sediments within the region.

4.3.4 Geophysical data in the form of sub-bottom profiler data were also assessed in conjunction with the results of the geotechnical assessment, with the aim of identifying prehistoric features such as in-filled palaeochannels, evidence of cutting into the bedrock which has then been infilled, any potential land surfaces of archaeological significance and any peat or fine-grained sediment horizons. Any discernable patterns of these features which occur on a broad scale within the Study Area were also identified.

Maritime Archaeology

4.3.5 The maritime archaeological resource within the Study Area was assessed through a consideration of various secondary sources, alongside records of charted wreck sites, recorded shipping casualties and seabed features, collated from the NMR and SeaZone. These records were superimposed on a base map of the Study Area in the ArcView 9.2 GIS software package.

4.3.6 The SeaZone records relating to charted sites were queried based on their feature classification into wrecks and obstructions. Charted wreck sites are likely to be subject to mitigation following an EIA, at which stage the appropriate level of archaeological mitigation will be determined by an assessment of the importance and rarity of each individual site. Charted obstructions represent sites where the archaeological nature is not fully understood, and may also be subject to mitigation following EIA. Consequently, the entire wreck and obstruction data was queried by date and reviewed with regards to a composite timeline (Firth 2008) which sub-divides vessels into a date range based on generalisations regarding wreck sites which are likely to be of special interest.

4.3.7 In order to provide a statistical analysis of the charted wreck sites and to highlight any patterning in their distribution, a 10km² grid was placed over the Study Area within the GIS. The charted wreck sites were joined to the grid layer by spatial location, enabling the density of charted wreck sites within each grid square to be calculated across the Study Area. In order to present this data, the wreck density was sorted into eight distinct classifications ranging from grid squares with a nil or low density of wreck sites to those with a relatively high density of wreck sites. Each classification was colour-coded using graduated colours, with pale pink representing the lowest density of wreck sites and red representing the highest density of wreck sites within the grid squares (**Figure 11**).

4.3.8 Data for recorded shipping losses for which there are currently no known seabed remains is held by the NMR and were assessed to provide a review of the potential for unknown and uncharted shipwreck sites within the Study Area. The data relating to shipping losses was also queried by date with regards to the composite timeline (Firth 2008) discussed above. It is important to note that most of this data is drawn from documentary and secondary sources and will therefore be skewed towards more recent losses (i.e. within the last 200-300 years). Furthermore, the greater the distance offshore, the fewer reported losses are likely.

4.3.9 Records relating to known aircraft crash sites listed by SeaZone and those relating to aircraft losses listed by the NMR were considered alongside the records for WWII Air/Sea Rescue Operations. Along with an assessment of historic aviation patterns, this data was used to provide an understanding of the density and general distribution of aircraft activity thus highlighting the potential for the discovery of aircraft crash sites within the Study Area.

4.3.10 The review of the potential for unknown and uncharted archaeological sites within the Study Area was further supplemented by an assessment on site survival and visibility within the region. Through a consideration of the geology and seabed topography of the Study Area drawn from various secondary resources, it was possible to highlight the potential for unknown sites of archaeological interest to exist which may be impacted by existing or future dredging operations.

4.4 GEOTECHNICAL ASSESSMENT

4.4.1 A total of 149 vibrocore logs provided by SCDA were examined as part of this Stage 1 assessment. These logs were collected as part of geotechnical investigations by United Marine Dredging Ltd. (UMD), Hanson Marine Ltd. and Cemex UK Marine Ltd (formerly Ready Mix Concrete Ltd. (RMC) and South Coast Shipping Ltd. (SCS)) of aggregate resource areas across the area covered by the South Coast MAREA.

4.4.2 The logs provided were grouped according to the aggregate extraction area (e.g. Area 395) from which they were obtained, by geophysical survey line (e.g. Line 12) or according to seabed geographical name (e.g. Owers). The table below summarises the number of vibrocore logs and the aggregate areas, geophysical survey line or seabed area in which they were obtained, and by whom.

Aggregate extraction area/ Geophysical Survey Line/ Seabed geographical area	Number of logs	Company
Area 122/2	5	United Marine Dredging
Area 122/3	14	Alluvial Mining
Area 127	15	Andrews Survey
Area 340	14	RMC Marine

Area 351	12	Andrews Survey
Area 372/1	4	Alluvial Mining
Area 372-2	8	Hanson Aggregates Marine, Andrews Survey
Area 395	3	United Marine Dredging
SWIOW 396	3	Andrews Survey
Area 407	13	RMC Aggregates
Area 435	6	Hanson Aggregates Marine
Area 465-1	2	ARC Marine
Area 465/2	7	ARC Marine
Line 6	4	Alluvial Mining
Line 7	2	Andrews Survey
Line 12	15	Alluvial Mining, Volker Dredging, Andrews Survey
Line 14	4	RMC, South Coast Shipping
Line 17	1	Alluvial Mining
Line18	3	Coastal Geosciences
Owers	12	Andrews Survey, RMC Shipping
SWIOW	2	United Marine Dredging

Table 2: Vibrocore Log Provenance

4.4.3 The coordinates of the vibrocores were recorded in several co-ordinate systems on the core logs. WA compiled a digital list of the co-ordinates and converted all of them into WGS84 UTM Z30. Data from the logs was manually input into a database including coordinate, vibrocore identification number, recovery, water depth, date and time acquired, where given. The vibrocore identification number, locations and reference are given in **Appendix II** and their locations shown in **Figure 4**.

4.4.4 Results of the geotechnical assessment are addressed within the assessment of the archaeological baseline.

4.5 GEOPHYSICAL ASSESSMENT

Emu Geophysical Survey

4.5.1 Geophysical data were collected by Emu Limited between 22nd January 2008 and 12th February 2008 aboard the vessel *Discovery*. No survey report was provided and the details of the survey have been gleaned from the daily logs and sub-bottom profiler logs that were received. Datasets collected include sidescan sonar, sub-bottom profiler and swathe bathymetry. For the purposes of this report WA were commissioned to process and interpret only the sub-bottom profiler data.

4.5.2 Data were collected over an area around the Isle of Wight from as far west as Christchurch to Worthing in the east. Ten survey lines were run to the southwest of the Isle of Wight and 14 to the east with a total of 550 line kilometres run. The lines had various orientations and spacings (**Figure 3**) and were acquired to supplement data acquired during the South Coast REC survey in 2007 Wessex Archaeology 2007b).

4.5.3 The sub-bottom data were acquired using a surface-towed boomer system with an AA200 plate, towed with a layback of 30m. Power settings of 100J and 200J were used with a sweep duration of either 80ms or 100ms. An external hydrophone was used. Data were provided to WA digitally in Coda format. Daily logs and seismic logs were provided digitally in Excel format. No trackplot was provided but a csv file containing the easting and northing of each fix was received. This included the layback of the boomer

4.5.4 The geophysical assessment was limited to sub-bottom profiler data, because members of the South Coast Dredging Association (SCDA) emphasized that incorporating sidescan sonar data at this stage would be an unnecessary action since they would be specifically assessed for future individual EIA's. Furthermore, the REC data were not assessed for the purposes of this report. These propositions were agreed by EH during the Archaeological Methodology Meeting held at WA the 20th of August 2008.

4.5.5 Results of the geophysical assessment are incorporated into the baseline section below.

Geophysical Characterisation

4.5.6 The sub-bottom profiler data were studied in order to detect any cuts/fills, in-filled palaeo-channels, potential land surfaces of archaeological significance and peat/fine-grained sediment horizons that may have archaeological potential. Features within the survey area were mapped and digital images created for illustration purposes.

4.5.7 The sub-bottom profiler data were processed by WA using Coda GeoSurvey software. This software allows the data to be replayed with user selected filters and gain settings in order to optimise the appearance of the data for interpretation. The software then allows an interpretation to be applied to the data by identifying and selecting a sedimentary boundary that might be of archaeological interest.

4.5.8 The sub-bottom profiler data were interpreted with two-way travel time (TWTT) along the z-axis. In order to convert from TWTT to depth the velocity of the seismic waves was estimated to be 1,600 m/s. This is a standard estimate for shallow, unconsolidated marine sediments.

4.6 REVIEW OF PREVIOUS ASSESSMENTS CONDUCTED IN THE AREA

4.6.1 There are several previous investigations undertaken by WA that have been focused on the maritime archaeology of areas of the Study Area, ranging from large-scale strategic projects to small-scale assessments of individual wreck sites.

4.6.2 **Table 3** provides a summary of previous assessments undertaken in the area. The Study Areas for these reports are illustrated in **Figure 2.**

Project Name	Project Code	Reference (WA)	Contents
St Catherine IoW Area 451	44271	1998a	Environmental Assessment: Archaeology Technical report
East English Channel Areas 474 and 475	49897	2002	Archaeological Assessment
NAB Areas 372/1 and 372/2	50494	2003	Archaeological Desk Based Assessment
Hampshire Transit Harbour Tunnel	51057	2002	Marine Archaeological Investigation
OWERS Areas 396 and 435	52346	2005	Archaeological Interpretation of side-scan data
Portsmouth Regeneration Project	53668	2003	Archaeological Desk Based Assessment

Project Name	Project Code	Reference (WA)	Contents
Poole Harbour Deepening	55900	2004a	Archaeological Desk Based Assessment
Kendall's Wharf	56200	2005	Archaeological Desk Based Assessment
Seabed Prehistory (EEC)	57422.35	2008	Gauging the effects of Marine Aggregate Dredging: Final Report
Seabed Prehistory (Arun)	57422.32	2008	Gauging the effects of Marine Aggregate Dredging: Final Report
East English Channel Areas 473, 474 and 475	58630	2005	Archaeological Desk Based Assessment
Cross Solent Water Replacement	59180	2005	Archaeological Desk Based Assessment
South Coast REC	65770	In Production	In Production
SCDA Scoping REA	65780	2007c	Archaeological Data Scoping Study
AML	67030	2008b	Archaeological Pilot Study
SS Mendi	64440	2007	Archaeological Desk-Based Assessment
Lymington Harbour Protection	67130	2007	Archaeological Desk Based Assessment
East English Channel REA	68230	In Production	In Production
Southampton Approach Channel	68530	2008c	Archaeological Assessment

Table 3: Previous Assessments undertaken by WA in the area

4.6.3 These results of these assessments have been considered in drafting the SCDA MAREA.

5 PREHISTORIC ARCHAEOLOGY

5.1 INTRODUCTION

5.1.1 This section introduces the known archaeological and geological data from the English Channel to provide a context and identify specific issues within the Study Area. It also suggests archaeological and geo-archaeological sites that may be impacted by current or future dredging operations.

5.1.2 The term Before Present (BP) is used to describe the age of archaeological events which occurred from the Lower Palaeolithic to the Mesolithic period. The date of 1950 commonly forms the arbitrary origin for the BP age scale. From the Neolithic period onwards, the terms Before Christ (BC) and *Anno Domini* (AD) are used.

5.1.3 Submerged deposits are unique in two ways. Firstly the sediment modification processes involved in multiple episodes of transgression and regression having few terrestrial analogues (Dix and Westley 2004); and secondly the anaerobic depositional environment increases the potential for preservation of organic remains (Wessex Archaeology 2008a).

5.1.4 The way humans interact with the landscape helps to relocate hominin groups (as opposed to 'hominids', a term which includes African great apes (Stringer 2006, Klein 1999)) within reconstructed palaeo-geographies, in order to assess potential sites of activity with their consequent archaeological deposits. The crucial determining environmental factors used to shape settlement pattern models become more useful when the baseline information for assessing these areas is primarily geomorphological and environmental (Wessex Archaeology 2008a).

5.1.5 At the scale of marine aggregate areas, assessments are not definitive, they are used to illustrate probable activity rather than determine if particular groups utilised specific portions of a river floodplain (such as the palaeo-Solent), even if the reconstructed topography of areas can be distinctive enough to be useful (Wessex Archaeology 2008a). For example, both Upper Palaeolithic and Mesolithic hunting group seasonal migration and coastal-inland models of seasonal movement provide a practical template for potential activity (Jacobi 1979; Clutton-Brock and Noe-Nygaard 1990). Furthermore, routeways such as rivers were widely used for travelling through the landscape and for fishing; and valleys often provided primary hunting locations where game could be flushed out (Wessex Archaeology 2008a).

5.1.6 As described in Wessex Archaeology 2008a (25), 'aggregate areas are focused on river systems and their gravel deposits. These areas have potential for both primary and secondary context material, with fine-grained, fluvial sediments preserving any primary sites and the gravels potentially containing derived material. It is worth noting that the gravels themselves represented a useful resource to prehistoric groups and *in situ* material may, therefore, be found on surfaces within those gravels. However, the highest potential for deposits in primary contexts is within the fine-grained infill sediments.'

5.1.7 The portion of the seabed under investigation for the South Coast MAREA has been geologically shaped by climate change. Multiple glacial and interglacial phases caused relative sea level changes and drove a series of marine transgressions and regressions. As a consequence, vast portions of the English Channel Continental Shelf where human occupation and exploitation of the environment took place have been subject to repeated flooding and exposure.

5.1.8 In addition to human maritime activity which produced archaeological sites and artefacts dating to the historical period, the archaeological potential and sensitivity of the Study Area must also be considered with specific reference to submerged remains of human activity dated from the Palaeolithic and Mesolithic periods, deposited on exposed land surfaces at times of lower sea level. Although the south coast of Britain was not subject to cover by glacial ice sheets, the Study Area has been greatly influenced by the environmental changes caused by the presence of these ice sheets further north. Consequently, in order to properly evaluate the Study Area archaeologically, the nature and causes of these sea level changes need to be briefly discussed.

5.1.9 The prehistoric archaeological record for the British Isles covers the period from the earliest human occupation c.700,000 years BP to 2000 years BP. Within this time-span the present United Kingdom has been affected by three major glaciations (Anglian, Wolstonian, Devensian), which have affected, on a cyclical basis, hominin movements and occupations of the UK mainland and Continental Shelf according to the sea level fluctuations.

5.1.10 **Appendix III** gives an indication of relative sea level variations in the English Channel during the last c.800,000 years and illustrates these fluctuations in relation to the major archaeological periods. Since sea level fluctuations are the result of numerous factors, the projected sea level curves illustrated in **Appendix III** must be regarded as projections of general tendencies rather than representations of exact figures. A comprehensive account of these sea levels can be found in Shennan *et al.* (2000:278). The Oxygen Isotope Stages shown in **Appendix III** are from Wymer's projection in *The Lower Palaeolithic Occupation of Britain* (1999:4 Table 2), together with compilations by Dix and Westley (2004:95 Figure 64) and the *Ancient Human Occupation of Britain* (AHOB) project (AHOB 2006; e.g. Barton

2005:18 Table 2). The sea levels from the Pleistocene period are drawn from discussions by Funnel (1995:4 Figure 1), Dix and Westley (2004:67-80) and Lee *et al.* (2006:173-176).

5.1.11 For the purposes of this report, the prehistoric archaeological period has been divided into three phases:

- **Pre-Devensian**, c.700,000-110,000 BP, covering the period from the earliest evidence of hominin occupation of the UK to the onset of the Devensian glaiciation. This period corresponds to the Lower and Middle Palaeolithic;
- **Devensian**, c.110,000-13,500 BP, from the onset of the last glaciation up to and including the last glacial maximum. This period corresponds to the Early Upper Palaeolithic, the period which saw the transition from Homo Neanderthalensis (Neanderthals) as the dominant hominin, to modern humans;
- **Late Devensian and early Holocene**, c.13,500-6,000 BP, covering the period of human re-inhabitation of the British Isles following the last glacial maximum through to the last marine transgression and inundation of the Study Area during the Mesolithic.

5.2 PRE-QUATERNARY SHALLOW GEOLOGY OF THE STUDY AREA

5.2.1 Before going on to consider each of these periods in turn it is useful to sketch the pre-Quaternary geology of the Study Area. The Study Area lies in the Hampshire-Dieppe Basin, a wide and gently downward-sloping feature 280km in length which extends from Dorchester to the French Coastline.

5.2.2 The bedrock is largely Cretaceous chalk, which was folded and faulted across much of the UK during the Tertiary (Anderton *et al* 1979) In the North Sea the episode of uplift that caused this folding precipitated the process of subsidence which formed the North Sea basin.

5.2.3 Until the late Thanetian period (60-54 million years ago (Ma)) the English Channel seems to have been largely dry (BGS 1992). Subsequent Atlantic marine transgressions along the south coast during the early Eocene deposited a thick layer of London Clay over the bedrock. This phase was also marked by the beginning of the marine infiltration from the North Sea, which first created ‘swampy lowlands with lush vegetation draining into a semi-enclosed marine basin’ (BGS 1992:67).

5.2.4 It was during the early Ypresian transgression (54-52Ma), however, that the combination of rising sea level and tectonic relief lowering ‘opened a seaway through the English Channel area’ (BGS 1992:67), introducing deposits with rich concentrations of foraminifera (BGS 1992), which were first found in dredged samples (Dangeard 1923, 1929). These Tertiary sediments – mainly the Barton Clay Formation or the Bracklesham Group, depending on location – display an average thickness of 400 metres (Curry and Smith 1975) and a greatest proven thickness of 652m in the Sandhills borehole on the Isle of Wight (Edwards and Freshney 1987).

5.2.5 A small muddy and turbid embayment appeared during the Lutetian period (49-42Ma) in the present Solent region, where the level of marine salinity never stabilised during the Bartonian period (42-39Ma), because of frequent terrestrial runoff. However, during the last stage of the Eocene (Priabonian, 39-36Ma), although sediment deposition along the south coast of Britain was predominantly lacustrine; the east Solent inlet continued to experience marine deposits accumulation (BGS 1992:69).

5.2.6 Since at least the beginning of the Pleistocene (1.8 Ma) the UK was linked to Europe by a land bridge across the Straits of Dover. Although it shrank to a narrow isthmus during interglacial periods, this chalk ridge – the Weald-Artois anticline – formed the watershed between the North Sea basin and the proto-English Channel. The anticline was eventually breached, possibly during the Wolstonian glaciation (**Appendix III**) (Gupta *et al* 2007) as a result of overtopping by a large lake formed in the North Sea basin, and this breaching had a major effect on the development of the palaeo-landscape and topography of the English Channel.

5.2.7 The form and mechanisms of this overtopping and the creation of the Straits of Dover and the major palaeo-valley within the English Channel – the Northern Palaeo-valley – remain disputed. One view (Gupta *et al* 2007) argues for a catastrophic failure of the anticline, resulting in the sudden discharge of a huge body of water held within a lake built up against the southern edge of the glacial ice sheet. A counter argument is that the creation of the Northern Palaeo-valley was caused by more seasonal drainage, via overtopping from the same lake, of significant volumes of water from thawing ice sheets. Whatever the mechanism, water escaping from the North Sea basin caused massive erosion, cutting a deep gorge between Dover and Calais, scouring away much of the anticline and carving out a huge river valley through the English Channel.

5.2.8 The breaching of the Weald-Artois anticline ‘reorganised the palaeodrainages of north-west Europe by re-routing the combined Rhine-Thames river systems through the English Channel to form the Channel river, one of the largest palaeodrainages of Europe during late Quaternary low-sea level-stands’ (Gupta et all 2007). This large river is likely to have had a marked influence hominin and later human access to the UK.

5.3 PRE-DEVENSIAN (700,000-110,000 BP)

5.3.1 During the Pre-Devensian period (700,000-110,000 BP) the entire north European landscape was shaped by a series of marine transgressions and regressions, as well as two major glaciations and their interglacial stages.

5.3.2 The **Cromerian Complex** (787,000-478,000 BP) is the earliest recognised biozone in which evidence for hominin activity in the UK has been found.

5.3.3 Sea level changes within the Cromerian Complex occurred variously in both the colder and more temperate stages. For example, during OIS 16, recognised to be a cold phase of the Cromerian, sea level fell to approximately 90m below its current level. The topography and climate in Britain during the Pre-Devensian is thus difficult to reconstruct.

5.3.4 However, the Cromerian Complex (787,000-478,000 BP) is recognised as having at least six temperate phases (Preece 2001), and with the exception of OIS 16 and OIS 14, which are thought to represent colder phases (Wymer and Robins 2006:464-466), the period has been described as having a warm climate, similar to that of the present day Mediterranean. Just as other areas of the UK have been demonstrated to have been suitable for hominin occupation, so the Study Area may also have been largely favourable for such occupation during this period.

5.3.5 The **Anglian** glaciation (478,000-423-000 BP) was the most extensive of the glaciations, with ice sheets reaching as far south as the north Cornish coast and the Thames Valley (Wymer 1999:17). The trapping of water within the extensive Anglian ice sheets resulted in a fall in sea level thought to be the lowest recorded around the British Isles and estimated at 130m below the present level. As the ice sheet of the Anglian glacial (478,000-423-000 BP) pushed south and the climate became colder, the south of Britain was transformed into a predominantly periglacial landscape with ice covering much of the north of the UK. The glacial process during the Anglian largely reworked the pre-Anglian landscape, transporting sediments over large distances and changing the course of major rivers such as the Thames (Campbell and Bowen 1989:15).

5.3.6 During the temperate **Hoxnian interglacial** (423,000-380,000 BP) which followed the Anglian glaciation, the palaeo-Solent River was disrupted by the general transgression and the marine conditions were re-established in the English Channel. During this period Britain is likely to have been a peninsula of north-western Europe, connected by the Weald-Artois anticline.

5.3.7 The southern limit of the ice sheet during the **Wolstonian glaciation** (380,000-130,000 BP) is a point of ongoing discussion. It has been tentatively suggested that it ran across Lincolnshire and the Midlands (Wymer 1999:18). The Study Area would thus not have been covered by an ice sheet during this glacial phase. As a result, the post-Anglian, Hoxnian and Wolstonian deposits laid down by the Solent River were not subject to impact from ice sheets and are generally well-preserved. Sea levels are estimated to have been approximately 120m below their current level during the Wolstonian glaciation. This period shows the presence of discontinuous local permafrost as well as contortions and ice wedges in earlier gravels deposits.

5.3.8 During the Wolstonian complex, three cold stages (OIS 10, 8 and 6) interspersed with two temperate phases (OIS 9 and 7) are recognised. The analysis of deposits assigned to the first of these temperate phases, the Purfleet interglacial (339,000-303,000 BP), indicate a range of habitats including riparian, woodland and grassland environments with climatic conditions that are thought to be warmer than the present day (Bridgland *et al.* 1995:178). In the latter of these temperate phases, the Aveley interglacial (245,000-186,000 BP) Britain is thought to have become an island as sea level rose and the Weald-Artois anticline was breached. It is possible that the climatic conditions during the Wolstonian complex would have provided a landscape of bare ground and heath (Allen and Sturdy 1980:3) that was largely suitable for human activity within the Study Area.

5.3.9 The **Ipswichian interglacial (130,000-110,000 BP)** which followed the Wolstonian showed the first river terraces in the Study Area (BGS 1992) and the formation of raised beaches at Selsey (5m), Brighton (10m) and Portland (15m). Britain remained an island during the Ipswichian interglacial (130,000-110,000 BP). The climate during the Ipswichian Stage is thought to be for much of the time as warm as our current climate (Wymer 1999:33).

5.3.10 The lowering of sea level which occurred during the glaciations discussed above meant that for long periods of the Pre-Devensian period much of the English Channel would have been exposed as dry land. As such, it is probable that at various times in the past the Study Area was suitable for hominin exploitation. With reference to **Appendix III**, it is likely that portions of the Study Area were inhabitable for at least parts of OIS 19-6 (*c.*787,000-186,000 BP).

5.4 DEVENSIAN (110,000-13,500 BP)

5.4.1 The **Devensian glaciation** (110,000-13,500 BP) was the last glacial stage to occur before the current, Holocene climatic amelioration. The Devensian glacial maximum was reached *c.*18,000 BP and caused a lowering of sea level to approximately 120m below its current level.

5.4.2 Although the ice sheet came no further south than the Bristol Channel it proximity would have introduced periglacial conditions across the south of Britain, including the Study Area. As the ice sheet retreated northwards after 18,000 BP and sea level began to rise, marine waters started to enter former valleys and create estuaries, where silt accumulated over riverine gravel deposits (Wessex Archaeology 1998). Such evidence of a varying terrestrial environment within the region has been seen and recorded from a buried soil dating to 12,000 BP at Ventnor, Isle of Wight (Preece et al. 1995).

5.4.3 From the beginning of the Devensian glaciation (*c.*110,000 BP) through to the Late Mesolithic (*c.*8,500 BP), Britain would have been connected to the Continent as a result of the lower sea level. Within the Study Area, which would have been situated south of the ice front during the Devensian, a landscape of peri-glacial vegetation and tundra would have prevailed for much of this period.

5.5 LATE DEVENSIAN AND EARLY HOLOCENE (13,500-6000 BP)

5.5.1 This sea level retreat associated with the Devensian glaciation had the effect of exposing much of the current seabed of the English Channel. According to existing models of sea level change, the Study Area would initially have remained exposed as dry land following the retreat of the Devensian ice sheet. The present form of the now submerged Northern Palaeo-valley which crosses the southern portion of the Study Area was created by the combined course of the Rhine, Meuse and Thames, and the palaeo-Solent and -Arun rivers draining from over-deepened valleys which extended well inland of the present southern coastline of England (BGS 1992:77). The sediment contained in the palaeo-valleys on the seabed of the south coast dates largely from the Late Devensian and Early Flandrian periods, ‘when rising sea levels first laid down estuarine deposits, and then marine sediments as the transgression proceeded’ (BGS 1992:77).

5.5.2 During the Early Holocene period (*c.*8,900 BP) the rising sea level started to submerge gradually the southern half of the Study Area. The Solent River valley mouth drowned first, after which the river valley was gradually disrupted, eventually creating the West Solent, Christchurch Bay and Poole Harbour. At the start of this period, the sea level stood at approximately 65m below Ordnance Datum (OD), which allowed peat and submerged forest to be preserved below present sea level (BGS 1992). Geotechnical samples obtained from Fawley on the Solent showed the presence of Late Upper Palaeolithic and Early Mesolithic deposits respectively between 23 to 28m below OD and between 9m below to 3m above OD.

5.6 PREHISTORIC LANDSURFACES AND DEPOSITS

Introduction to Palaeogeographic Assessment

5.6.1 As part of the palaeogeographic assessment of the MAREA Study Area geotechnical and geophysical data were reviewed. A Stage 1 assessment of vibrocore logs was undertaken in order to better understand the sedimentary sequence within the Study Area and evaluate the geoarchaeological and palaeoenvironmental potential of sediments within the region.

5.6.2 The geophysical data referred to earlier were reviewed in conjunction with the geotechnical data with the aim of identifying features such as in-filled palaeochannels, evidence of cutting into the bedrock which has then been infilled, any potential land surfaces of archaeological significance and any peat or fine-grained sediment horizons. Any broad scale patterns of these features within the Study Area were also identified.

Geotechnical Assessment

5.6.3 This assessment of 149 vibrocores logs was carried out by WA with the objective of establishing for each log an interpretation of the sedimentary description, and a created a unitary system which grouped the sediment types recorded in the logs into four categories:

- Unit 1: Tertiary bedrock
- Unit 2: Pleistocene fluvial gravels
- Unit 3: Estuarine alluvium and peat
- Unit 4: Seabed sediments

5.6.4 Of these units it is considered possible that Units 2 and 3 have the potential to contain *in situ* prehistoric archaeological material. The results of the integrated geotechnical and geophysical assessments are discussed in detail below.

Unit 2

5.6.5 This unit comprised sand and gravel and was interpreted in cores **VC20** (Owers), **HPC15** (Area 122/3), **VC28\93**, **VC3A\93**, **VC39\93** (Line 14), **HPC13** (Area 122/3) and tentatively interpreted in **VC35** (Line 12) and **VC09** (Line 12). It is of note that from the vibrocore log descriptions the difference between this unit and **Unit 4** was not clear and it is likely that this unit is more widespread than the eight locations noted here.

5.6.6 The Unit 2 identified as Pleistocene fluvial deposits and comprised of sands and gravels is likely to be part of river terraces from the periods of lowered sea level. These deposits have the potential to contain Palaeolithic archaeological material since numerous Palaleolithic artefacts have already been recovered from similar context along the south coast and the Solent (Wymer 1999). However, it is equally possible that some of these sands and gravels may be relation to Pleistocene seabed lag deposits.

Unit 3

5.6.7 The Unit 3a comprised sandy silty clays and occurred in cores **VC35** (Line 12), **VC25** (Line 7), **VC56**, **VC67**, **VC68A** (Line 18), **VC20** (Owers), **HPC13**, **HPC15**, **HPC17A, HPC18**, **HPC23** (Area122/3), **VC16**, **VC36** (VC127), **VC1-95**, **VC15A-95**, **VCT25**, **VCT32** (Area 340), **VC25** (Area 351), **VCO** (Area 395), **VCC39**, **VC40**, **VC44** (Area 462/2), **VC28\93**, **VC30A\93**, **VC39\93** (Line 14). It was also tentatively interpreted in cores **VCS** (395), **VC1** (SWIOW396), **VC2** (SWIOW396), **VC9** (435) and **VC09** (Line12). The unit is interpreted as estuarine alluvium.

5.6.8 The Unit 3b is essentially composed silty sandy clay from oxidised estuarine and intertidal sediments. Within cores **VC09** (Line 12), **VC34**, **VC35** (Area 465-1) and **VC31\93** (Line 14) some red mottling was noted within the predominantly grey sediment. This is possibly due to oxidisation of the sediment and therefore indicative of periods of aerial exposure and the early stages of alluvial soil formation.

5.6.9 The Unit 3c was a black fibrous peat, 0.11m in thickness, recorded in one core, **VC4** (SWIOW).

5.6.10 The Unit 3 seems to have particular archaeological interest because it concerns coastal and estuarine sediments connected to the inundation of tributaries of the Channel river systems during the latest Holocene se level rise. Within the palaeo-Arun River valley, 12km south of Littlehampton (Sussex), similar sediments have been dated from the early Mesolithic period (Wessex Archaeology 2007b). Additionally, during the same assessment, oak charcoal was also recovered from peat deposits and dated to 8,893±30 BP (8,230-7960 cal. BC, NZA-26303). On the western side of the Isle of Wight at Bouldner Cliff a submerged Mesolithic archaeological site is being excavated from within Mesolithic alluvium and peat deposits (Momber 2000). Hence, it is likely that Unit 3 relates to the Mesolithic period (c.10,000 to 5,500BP).

Geophysical Assessment

5.6.11 For the purposes of the geophysical assessment the Study Area was divided into two zones based on the shallow geology and associated potential archaeology (**Figure 5**). The zone boundaries are indicative only. They do not represent boundaries of geological formations or features as they are based on the sub-bottom profiler data.

5.6.12 Zone 1 is located to the east of the Isle of Wight; Zone 2 is located to the south of the Isle of Wight. The nature of these zones and the features identified within these areas are discussed in detail below.

5.6.13 All features in both zones are located to the north of the Northern Palaeo-valley as this is the area covered by the survey lines. The Solent river system exited the coast at what is now Southampton Water and entered the Channel past the eastern end of the Isle of Wight. The river was in operation until at least the end of the last interglacial, creating a valley system during sea level high stands (Bates et al 2007).

5.6.14 It should be noted that it is not possible from the geophysical data to date the cuts and fills. Features close together spatially may or may not have formed at the same time. It is therefore not possible to determine which features are more likely to have a higher archaeological potential than others but all have some potential.

5.6.15 The features identified during the assessment are listed in **Appendix IV** and are illustrated in **Figure 4**.

Zone 1

5.6.16 The bedrock here is Tertiary bedrock, either the Barton Clay Formation or the Bracklesham Group depending on location. This is overlain by Pleistocene sands and gravels in places. Holocene seabed sediments of sand and gravelly sand overlie the whole area and are not possible to distinguish from the Pleistocene sediments in the sub-bottom profiler data. Cuts and fills are identified within this zone which may contain the Pleistocene fluvial deposits. It is these deposits and the edges of the fluvial channels that are of potential archaeological interest.

5.6.17 The river systems may have formed during the Cromerian Complex Stage or been initiated or resurrected during the Anglian interglacial (BGS 1992). The catastrophic flooding event that Gupta *et al* (2007) reports to have created many of the palaeochannels in the Channel occurred after the Solent River and palaeo-Arun were first formed.

5.6.18 There are 12 features of potential archaeological interest in this zone: **7000 – 7011** (**Figure 5**). All are cuts into the bedrock that have been filled by sediments, possibly of Pleistocene age. These sediments correspond to the Pleistocene fluvial gravels observed as Unit 2 in the geotechnical assessment.

5.6.19 Of the two features in this Zone located within dredging areas, **7007** is located in Area 435/2 with the north-eastern end only 20m from the nearest active dredging area. **7010** is located within the active dredging area of Area 122/1A, 123A and 124/1A.

5.6.20 Features **7000-7002, 7005** and **7011-7013** are all located in the old Solent river channel. **7000-7002, 7005** are in an area estimated by the BGS (1989) to have approximately 0.5-10m combined thickness of Pleistocene/Holocene palaeochannel infill sediments and of later Holocene seabed sediments; **7011** has rather more at 10-20m. Features **7003** and **7004** (see **Figure 6**) are in areas that have not been possible to map. Areas containing a larger combined thickness of Pleistocene and Holocene infill are more likely to contain thicker Pleistocene deposits and therefore have increased potential for archaeological material to be contained therein.

5.6.21 The dimensions of feature **7007** are consistent with it being the same palaeochannel observed in WA's survey over the palaeo-Arun (Wessex Archaeology 2008a) although this feature is located approximately 5.5km to the northwest of the palaeo-Arun survey area. This study observed the presence of peat in the vicinity through vibrocoring. No peat was observed in the sub-bottom profiler data during the current study. The estuarine alluvium and peat Unit 3 identified in the geotechnical data was not observed in any features of interest in the geophysical data. The peat was only observed in one vibrocore near the survey lines (**VC4**, SWIOW) and this vibrocore was over 3km from the nearest sub-bottom features, **7007** and **7008** (see **Figure 6**). In addition, the peat layer was only 0.1m in thickness and thus would not be resolved in the sub-bottom profiler data.

Zone 2

5.6.22 The bedrock here is Cretaceous, with different groups 'exposed' (i.e. present as the top layer of solid geology below the seabed Pleistocene and Holocene sediments) throughout the Zone. Of the 21 features observed in this Zone, the majority (14) are to be found in an area of Wealden Group bedrock. The Wealden Beds consist of two major units; an upper formation of muddy sediments termed the Weald Clay and a lower formation of mainly sandy sediments termed the Hastings Beds. However, no subdivisions of the Wealden Beds can be mapped offshore (BGS 1992). The Weald Clay corresponds to the Unit 1 identified in the geotechnical assessment. Being of Cretaceous age this unit is much too old to be of archaeological interest. The unit is observed in seismic profiles as containing numerous discontinuous and variably dipping reflectors (BGS 1992).

5.6.23 The Lower Greensand Group overlies the Wealden Beds and is 'exposed' in part of Zone 2. Being of Cretaceous age this unit is not of archaeological interest. Five features are observed that are cut into this unit (**7012, 7013, 7020, 7022** and **7023**) (**Figure 5**). The fills of two of these features (**7012** and **7013**) are fine grained while the fill of the other three is unknown, in part due to poor quality data.

5.6.24 Two observed features (**7019** and **7021**) are cuts into the Upper Chalk bedrock that overlies the Lower Greensand Group in places. They have been infilled with unknown sediments. The Upper Chalk comprises massively bedded white chalk with occasional nodular beds and hardgrounds. Up to 400m is preserved in the Isle of Wight (BGS 1992). Concave-up structures in the chalk have been interpreted as channel and scour features eroded on the Chalk Sea floor by currents during regressional phases and tectonic uplift during the Late Cretaceous (BGS 1992). The Tertiary bedrock seen in Zone 1 therefore lies uncomfortably upon the Chalk. These channel features are too old to be of archaeological interest; however the fill may be potentially of archaeological interest if it could be confirmed as Middle or Late Pleistocene in age.

5.6.25 Features **7014, 7015, 7027** (see **Figure 7**) and **7031** are located in Area 124/2 but outside the active dredging area (**Figure 4**). No other features are located within any licence or application areas to the west of the Isle of Wight. Only one feature is located within a prospecting area. **7023** is located in Area 500 – South Wight, approximately 350m southwest of the southwest point of Area 465/2. To the east of the Isle of Wight features **7012** and **7013** are located within Area 340 and **7021** in Area 407 although none of these are within active dredging zones.

5.6.26 Feature **7021** is located at the junction of the Solent river with the Northern Palaeo-valley. **7012, 7013** and **7021** in an area estimated by the BGS (1989) to have approximately 0.5-10m combined thickness of Pleistocene/Holocene palaeochannel infill sediments and of later Holocene seabed sediments.

5.6.27 Features **7014-7018** and **7023-7031** (see **Figure 7**), all the features in Zone 2 to the west of the Isle of Wight, are situated in an area where the estimated combined thickness of infill and surface sediments is 0-0.5m (BGS 1989). Features **7006**, **7008-7010** to the east of the Isle of Wight and the Solent river channel are also situated in an area of minimal sediment thickness. **7007** however appears to be situated in the palaeo-Arun palaeochannel in an area of 0.5-10m sediment thickness.

5.7 ARCHAEOLOGICAL POTENTIAL IN THE STUDY AREA

5.7.1 The following section provides a review of the archaeological potential in the Study Area. In order to provide such assessment for the Lower, Middle and Early Upper Palaeolithic periods, the general records of human occupation in Britain must be considered in conjunction with the local climatic and geological conditions discussed above.

5.7.2 In broad terms, archaeological sites can be found in either primary contexts, where the spatial relationship of finds have remained the same since they were deposited, or secondary contexts, where artefacts have been derived or moved from their original positions. Archaeological material discovered in secondary context may be associated with fluvial re-depositing, glacial processes and marine regressions and transgressions. Although discoveries from secondary contexts are by their very nature, derived artefacts, and have therefore lost come of the important spatial, relational information they would have carried when in primary context, recent work has shown that they do nevertheless have the potential to provide insights into patterns of past human land use and demography (Hotsfield and Chambers 2004).

Pre-Devensian (700,000-110,000 BP)

5.7.3 This section attempts to provide for the palaeo-topography of the Solent and the English Channel (within the Study Area) during the period between the end of the Middle Pleistocene and the first half of the Late Pleistocene. This will allow the development of a framework against which the potential for human activity may be discussed. Generally, in the English Channel area, the principal type of environment in which Quaternary deposits can be expected are palaeo-valleys with infill of

Pleistocene and early Holocene periods, as well as Holocene seabed sediments (BGS 1992).

5.7.4 Although glaciers never reached the south coast of Britain, the ice sheets affected sea level, drainage patterns and climate, changing drastically the previous morphology of the area around the Solent. However, areas in the vicinity of former rivers and coastlines are likely to be able to provide a range of hominin activity sites comparable to the important Lower Palaeolothic site at Boxgrove in West Sussex, where *in situ* artefacts have been found on a former wave-cut platform at the base of a cliff, indicating the presence of an active hominin population at the end of the Anglian interglacial (Wessex Archaeology 1998a; Robert and Parfitt 1999).

5.7.5 A large number of Lower Palaeolithic artefacts have been recovered from gravel terraces throughout the Hampshire Basin. These gravel deposits were created by fluvial action of glacial meltwater. Although these artefacts are rarely *in situ*, the typically low level of abrasion found on their surfaces suggests the location of a nearby source. However, no Palaeolithic remains have been recovered so far within the Solent river palaeo-channel and its associated submerged gravel terraces. It seems that the potential for finding *in situ* remains attributable to the Lower Palaeolithic period is (within Dredging Areas 451, 372/1, 372/2, 407) limited to deposits that have not been disturbed by any fluvial or marine action. This category can for instance includes deposits representing topographic highs which would contain datable stratified indications such as mineralized animal bones or plant remains (Wessex Archaeology 1998a, 1998b, 2003). In this regard, it is important to remember that onshore examples such as the Priory Bay beach deposits (Preece and Scourse 1987) or the gravel terraces above Bembridge on the Isle of Wight and along the north side of the Solent all contain palaeoliths from the Hampshire basin.

5.7.6 In the region of the Thames Estuary, where a long sedimentary sequence reveals records from which parallels can be drawn for the English Channel, recent investigations at Pakefield and Happisburgh in East Anglia (Parfitt *et al.* 2005) have exposed flint artefacts dated from 700,000 BP: the oldest hominin material recorded to date in Britain and Northern Europe. However, the artefact density found in fluvial gravel terraces in Britain implies that the peak of the Quaternary population appeared during the Anglian and Hoxnian periods (500,000 – 350,000 BP) (Wessex Archaeology 2008a). But Ashton and Lewis (2002:390-1) explained that the establishment of the English Channel 'changed the cycle of stability of human occupation, through the sensitive interplay of the sea level and climate change … [making Britain] … less attractive for colonisation, except in cool, open conditions'.

5.7.7 The Middle Palaeolithic period coincides principally with the last Devensian glaciation. At this time, *Homo Neanderthalensis* was the prevailing hominin species on the Continent, as is illustrated by sites such as Saccopastore, Italy, and Biache, France (Stringer 1996, Fig. 5.1). In Britain during this period, however, despite some dated material from sites like Pontnewydd in Wales, most studies conclude that there was only an intermittent, sporadic [human] occupation (Wessex Archaeology 1998:8). Ashton and Lewis (2002) argue that for most of the Middle Palaeolithic (180,000 – 60,000 BP), the British archaeological record shows a total absence of indication of the presence of hominins.

Devensian (110,000-13,500 BP)

5.7.8 The UK's terrestrial archaeological record suggests that Britain was uninhabited from *c.*180,000-60,000 BP. However, the possibility of a hominin presence throughout the Devensian prior to the glacial maximum (*c.*110,000-40,000 BP) should not be disregarded within the Study Area. Although the Late Middle

Palaeolithic period is marked by the onset of the Devensian glacial, it is unlikely that the initial cooling stages of the glaciation would immediately rule out a human presence within the Study Area.

5.7.9 Due to the presence of the Weald-Artois chalk ridge, between Handfast Point (Dorset) and the Needles (Isle of Wight), Poole Bay and Poole Harbour were part of the Hampshire drainage system during sea level regression (Dix 2001). This allowed the palaeo-rivers of the Piddle and Frome (which now enter Poole Harbour from the west) to be connected to the system of the palaeo-Solent, following a similar trajectory to the present-day Solent, along the northern coastline of the Isle of Wight (Bridgeland 1996). However, marine geophysical surveys in Poole Bay (Velagrakis, Dix and Collins 1999; 2000) and the mapping of the distribution of Palaeolithic artefacts from gravels to the west and east of Poole Harbour (Wessex Archaeology 1993), suggested that prior to the Late Pleistocene both rivers were separated from the palaeo-Solent, and flowed into the main Channel river (Bridgeland 1996). Additionally, it is important to note that around Bournemouth and the Stour valley, the rivers Avon and Stour showed a great accumulation of Lower Palaeolithic artefacts from the terrace gravels (Wymer 1999), which suggests some potential for the presence of derived artefacts or *in situ* remains.

5.7.10 Britain appears to have been occupied during the Early Upper Palaeolithic, but very little is known about this period, which is represented by isolated finds and a number of cave sites, but with very few significant assemblages. As one of the rare examples, the open air site of Beeding (north of Shoreham and east of the Study Area) was occupied from 28,000-24,000 BP. The increasing volume of archaeological finds from the wider Solent region suggests that the area was inhabited from the Late Upper Palaeolithic until rising sea levels led to the creation of the current shoreline (Wessex Archaeology 2008a).

5.7.11 This last period of human re-colonisation of the UK, which occurred between 18,000 and 13,000 BP) would have also included occupation of areas of the now submerged English Channel. This, according to Housley *et al* (1997:25) was ‘a dynamic process, integral to, and internally driven by, the social life of late glacial hunters’. This statement suggests that the human colonisation should be viewed more as a process rather than an event. Hence, the occupation was initiated by few small hunting groups as a exploration phase, before the establishment (maybe temporary) of ‘residential camps’ from 12,500 BP onwards (Housley *et al.* 1997:44-5).

Late Devensian and Early Holocene (13,500-6,000 BP)

5.7.12 As during previous periods, humans were for the duration of Late Upper Palaeolithic and Mesolithic essentially semi-nomadic hunter-gatherers. Archaeological evidence of their presence in the landscape consist primarily of worked flint assemblages, often as stray finds and sporadically as *in situ* finds. Their flint technology can be divided in Britain in two groups of artefacts used for butchery and/or tool manufacture: the Creswellian assemblages found in caves, and the Straight-backed Blade assemblages generally dominant in open air sites (Garrod 1926).

5.7.13 The area of the Arun palaeo-valley (located along the eastern limit of the Study Area) is dominated by the fluvial sands, estuarine silts and clays, and gravels dating from the Devensian periods, which may include Upper Palaeolithic and Mesolithic archaeological remains (Wessex Archaeology 2008a). Oak heartwood charcoal recovered by grab sampling and stratified within a peat deposit is a dated potential indication of human habitation in the Arun during the Mesolithic (Wessex Archaeology 2008a).

5.7.14 In terms of topography, aggregate Area 451 showed during the Late Upper Palaeolithic (and the early phase of the Mesolithic, but before the complete inundation) cliff tops and spurs to the east of the palaeo-Solent valley. They would have been a particularly advantageous location overlooking the palaeo-Solent estuary for a period of approximately 2,000 years, while the broad intertidal margin to the west of the valley would have become increasingly uninhabitable (Wessex Archaeology 1998a:10).

5.7.15 In dredging Areas 451, 372/1, 372/2, 407; much of the land remained above the mean high-water mark during the Late Upper Palaeolithic and would have provided immediate access for humans to a wide range of exploitable resources typical of marine, estuarine and freshwater environments, as well as the usual supply of animals and plants from further inland (Wessex Archaeology 1998a, 1998b, 2003).

5.7.16 The Mesolithic period is characterised in Britain by the continuous rise of sea level, together with river and tidal action depositing alluvial silt in intertidal marshes, creating the typical wet ground environment for woodlands. This landscape modification resulted in changes in lithic and other human technologies to suit the intensification of broader woodlands, such as ‘broad blades’ and obliquely-backed microlithic points (Wessex Archaeology 1998). Important Mesolithic sites such as Star Carr (Yorkshire), Thatcham IV (Berkshire) and Gough’s New Cave (Somerset) demonstrate the human responses to the changing landscape and environment.

5.7.17 Archaeological evidence for the Mesolithic within the Study Area includes stray finds and larger assemblages from along the east coast of the Isle of Wight, the north bank of the Solent, Portsmouth and Langstone Harbours and Selsey Bill. In addition, more than sixty stone tools have been dredged off the bed of the western Solent by local fisherman, Michael White and others (Wessex Archaeology 2004b, Momber *et al* 1994).

5.7.18 Apart from stray finds, a Mesolithic flint knapping site is located on the cliff between Sandown and the Culvers, for which palaeo-environmental indications support early tree clearance activities (Allen 1994, Wessex Archaeology 1998). Additionally, morphological similarities between aggregate Area 451 and Langstone Harbour and the presence at both locations of small Mesolithic finds clusters suggest the archaeological potential for similar occupational sites and land use patterns elsewhere in the Study Area.

5.7.19 The most fully investigated submerged prehistoric site present within the Study Area is located within the Solent, on the north-west coast of the Isle of Wight. The Bouldnor Cliff site lies in shallow coastal waters (9 to 11m depth), and is eroding out of a submerged cliff. Peat, a submerged forest, a hearth and more than 300 worked and burnt flints have been found at the site (Momber 2000; 2001; 2004; 2006, Momber and Campbell 2005). There are other instances elsewhere in the UK of Mesolithic/Neolithic sites in wet environments indicating the potential for further such sites, possibly in the Study Area. For example, the Brown’s Bay site, off Tynemouth in Devon contains flint artefacts underwater and onshore and dates from the Early and Late Mesolithic (Moran 2003). Additionally, numerous Mesolithic sites are known in the Severn Estuary (Bell *et al.* 2000), some skull depositions from the Neolithic have been recorded in coastal wetland contexts (King 2006), and a Neolithic skeleton was discovered in the peat in Hartlepool Bay in 1971 with flint flakes positioned nearby and evidence of birch branches and twigs covering the human remains (Waughman 2005).

5.7.20 The seasonal campsite at Hengistbury Head, south of Christchurch Harbour, dates to around 12,500 BP and is one of the best examples of an open air Mesolithic site in Britain (Barton 1992). From the 649 flint tools found at the site, almost all came from an exploitation area 12km away, towards Poole Harbour (which was dry land at that time), suggesting that the latter provided areas that were exploited by Mesolithic hunter-gatherers (Wessex Archaeology 2004a). This potential is enhanced by the two Mesolithic sites located to the west of Hengistbury (Powell and Southbourne) which have both produced large quantities of flint artefacts from a coastal and an offshore environment respectively, demonstrating that Hengistbury is not an unusual site, and that further Mesolithic sites or findspots are likely and should be expected in the Study Area area (Wessex Archaeology 2004a).

5.7.21 Mesolithic evidence in relation the dredging Areas 372/1 and 372/2 comprises 25 records concentrated on the north-east coast of the Isle of Wight, between East Cowes and Ryde, with a number of sites along the Medina River valley. These latter sites are significant in that they suggest the region's river valleys were a favoured Mesolithic activity area, which raises the likelihood of similar sites being present in similar and nearby and possibly drowned valleys within the Study Area (Wessex Archaeology 2003).

5.8 KNOWN PREHISTORIC SITES

5.8.1 With rare exceptions, evidence for submerged prehistoric archaeology in the offshore portions of the Study Area is sparse, but the NMR records of terrestrial prehistoric sites within the Study Area do help the assessment of the potential for prehistoric archaeology offshore. Due to the changes to the position of the coastline from the Pre-Devensian period to the present, it is legitimate to assume that the activity represented by terrestrial archaeological sites also occurred within the now-submerged extent of the Study Area when it was exposed as dry land.

5.8.2 A total of 9185 NMR Monuments were recorded for all periods within the Study Area. In order to obtain an overview of the prehistoric human activity within the Study Area, a number of queries were run against the NMR records, sub-dividing sites according to their period classification.

5.8.3 The NMR data contained a total of **2158** records of prehistoric and multi-period sites which contain references to the prehistoric period. The results of the period classification queries are presented in **Table 4** and illustrated in **Figure 8**. To avoid overcrowding, multi-period sites were excluded from the figure and sites presented by the NMR as lines and polygons were converted into points.

Period	Number of Records
Palaeolithic (700,000-10,500 BP)	419
Mesolithic (10,500-5,500 BP / 8,500-4,000 BC)	189
Neolithic (4,000-2,400 BC)	191
Bronze Age (2,400-700 BC)	361
Iron Age (700 BC – 43 AD)	139
Multi-Period referring to Prehistoric sites	859
	2158

Table 4: Prehistoric sites listed by the NMR and queried by period

5.8.4 A consideration of the known prehistoric sites is useful in highlighting the potential for prehistoric archaeological material to be present within the offshore extent of the Study Area. The distribution of these sites in coastal and estuarine zones is likely to have been favourable for hominin and later human exploitation and activity during the prehistoric period.

5.8.5 The figures displayed above in **Table 4** should not be viewed as directly representative of the volume of human activity within a given period. The survival of archaeological sites and artefacts is variable and depends on a complex array of interrelating factors that cannot be discussed here. Moreover, there are significant problems with the quality of data provided by national inventories such as the NMR, which provide often limited datasets dependent on recording biases.

6 MARITIME ARCHAEOLOGY

6.1 INTRODUCTION

6.1.1 Maritime archaeological sites broadly consist of either the remains of vessels and their contents or material which has been accidentally lost or deliberately thrown overboard from a vessel. Within the Study Area there is the potential for the presence of maritime archaeological sites of all periods from the Mesolithic to the modern day.

6.1.2 The evidence for coastal and maritime activity within the Study Area will be discussed with regards to a composite time line recently developed for shipwrecks around England (Firth 2008). The timeline takes into account the broad chronology of shipbuilding and employment and draws out a few generalisations regarding the age and special interest of vessels.

- **Pre-1508 AD**: The earliest category within the time line covers the period from the earliest Prehistoric evidence for human maritime activity to the medieval period, c.1508. This category was established on the basis that so little is known of watercraft or vessels from this period and archaeological evidence of them is so rare that all examples of craft are likely to be of special interest.
- **1509-1815**: The second category covers the period from 1509-1815, encompassing the Tudor and Stuart periods, the English Civil War, the Anglo-Dutch Wars and later the American Independence and French Revolutionary Wars. Wrecks and vessel remains from this date range are also quite rare, and can be expected to be of special interest.
- **1816-1913**: Category three falls into the period 1816-1913, a period which witnessed great changes in the way in which vessels were built and used, corresponding with the introduction of metal to shipbuilding and steam to propulsion technology. Examples of watercraft from this period are more numerous and as such it is those that specifically contribute to an understanding of these changes that should be regarded as having special interest.
- **1914-1945**: The fourth category on the time line extends from 1914-1945, encompassing the First World War (WWI), the inter-war years and the Second World War (WWII). This date range contains Britain's highest volume of recorded boat and ships losses. Those which might be regarded as having special interest are likely to relate to technological changes and to local and global activities during this period.

- **Post 1946**: The last category extends from 1946 through the post-war years to the present day. Vessels from this date range would have to present a rather strong case if they are to be considered of special interest.

6.1.3 Although in open waters the known records of wreck sites and losses are biased towards recent and predominantly Post-medieval and Modern periods, and even if the survival of stone-age boats is highly speculative in UK, Bronze- and Iron Age sea-going vessels are likely to have foundered in the Study Area, and some may have survived.

6.2 RECORDED WRECKS

6.2.1 Based on the charted sites listed by SeaZone and the recorded losses listed by the NMR, the baseline data has been used to provide a broad understanding of the nature and density of maritime activity within the Study Area. It is not within the scope of this report to discuss each record contained within the SeaZone and NMR data on an individual basis.

SeaZone

6.2.2 A total of 2,227 charted sites were listed in the SeaZone data within the Study Area. Using the 'Feature' attribute listed within the SeaZone data, these records were subdivided into those classified as wrecks and obstructions. A further query based on the type of site defined these records once more into categories of 'wrecks' 'aircraft' and 'unclassified' sites. The results of these queries are shown in **Table 5** below. A total of 17 aircraft sites were listed within the SeaZone data. These sites are considered in **Section 7** and are thus omitted from **Table 5** below.

SeaZone Feature	Type of Site		Total
	Wrecks	Unspecified	
Wrecks	490	679	1169
Obstructions	31	1027	1058
Total	**521**	**1706**	**2227**

Table 5: SeaZone charted vessels and unspecified sites

6.2.3 In order to provide a broad overview of the density and nature of maritime activity within the Study Area as implied by the SeaZone data, a number of queries were conducted based on the date of the charted wrecks and obstructions. The composite time line for shipwrecks around England, produced by Firth (2008), was used as a framework in which to sort the dates of these charted sites. **Table 6** below shows the results of the queries conducted on the SeaZone data based on these date ranges classified within this composite time line. These sites are illustrated in **Figure 9**.

Date	Wrecks	Unspecified	Total
<1508	1	0	1
1509-1815	12	0	13
1816-1913	34	1	35
1914-1945	202	4	206

Date	Wrecks	Unspecified	Total
>1946	138	1	139
Unknown	134	1700	1834
Total	**521**	**1706**	**2227**

Table 6: SeaZone wrecks and unspecified sites queried by date range

6.2.4 In order to identify any distribution patterns associated with vessel wrecking incidents, a 10km² grid was superimposed on the Study Area within ArcView GIS software. Shipwreck sites listed as both Wrecks and Obstruction features within the SeaZone data were joined to the grid by spatial location, ultimately enabling the calculation of the density of wreck sites within each grid square. The wreck site density was sorted into five distinct classifications ranging from grid squares with a nil or low density of wreck sites to those with a relatively high density of wreck sites. Each classification was colour coded using graduated colours, with pale pink representing the lowest density of wreck sites and red representing the highest density of wreck sites within the grid squares. The results of this statistical analysis are illustrated in **Figure 11**.

6.2.5 Overall, the wreck sites are dispersed fairly widely across the Study Area, although distinct areas of concentration have been noted. The highest density of wreck sites occurs at the north east side of the Isle of Wight and along the approach of Portsmouth Harbour as well as within the approach to Southampton. The remains of vessels within this area may have foundered on the associated bank along the coast of Hampshire and of the Isle of Wight. Further concentration of wreck sites has been noted along the whole eastern side and western tip of Isle of Wight and around the region of Poole Harbour.

Shipping Casualties

6.2.6 A total of 1839 recorded losses were listed in the NMR within the Study Area. It is important to note that the positions of recorded losses are often vague and inaccurate and also only represent those losses which were actually recorded.

6.2.7 The recorded losses were sorted into three categories entitled ‘wrecks’, ‘non-wrecks’ and ‘aircraft’. A total of 221 aircraft were listed in the NMR data and are considered in **Section 7**. ‘Non-wreck’ amounts to a single site representing Roman debris found in Yarmouth Roads.

6.2.8 A further query classified the wrecks into the date range discussed above (**Section 6.1**). The results of these queries are presented into **Table 7** below and illustrated in **Figure 10**.

Date	Shipping Casualties
<1508	55
1509-1815	609
1816-1913	787
1914-1945	155

Date	Shipping Casualties
>1946	7
Unknown	4
Total	**1617**

Table 7: NMR shipping casualties queried by date range

Discussion

6.2.9 The charted sites and shipping casualties should not be regarded as directly representative of the wreck sites that lie on the seabed within the Study Area. Prior to the advent of the Lloyds of London list of shipping casualties in 1741, there was no official record of ship losses and as such the record of shipping casualties is biased towards wrecking incidents which occurred from the mid 18th century onwards. Additionally, it must be taken into account that each NMR record holds only a nominal co-ordinate which does not relate to the physical location of the wreck, hence the shipping casualties refer to wrecking incidents for which there are no known positions other than a description of the general area and may consequently lie outside the Study Area.

6.2.10 In addition to the sites known to exist in the Study Area, the discussion of the maritime archaeological potential within the Study Area indicates that there is the potential for uncharted and unknown wrecks sites to lie within the Study Area. To demonstrate this potential the results of a number of previous archaeological assessments undertaken by WA within, and in the immediate vicinity of, the SCDA REA Study Area were reviewed (**Table 3**) and are illustrated in **Figure 2**.

6.3 COASTAL AND SEAFARING ACTIVITY IN THE STUDY AREA: PRE-1508

Early Prehistoric (Palaeolithic – Mesolithic)

6.3.1 The lack of evidence for Palaeolithic watercraft pre-dating the Devensian glacial maximum in the UK should not be taken to indicate a lack of maritime activity, The glacial events, marine transgressions and fluvial processes that are associated with the Palaeolithic in the UK suggests, however, that the potential for the survival of this type of artefact is low and there are currently no known archaeological remains of watercraft that pre-date the Mesolithic in Western Europe. This dearth of evidence for the Palaeolithic may be due more to the poor survival of organic remains in the archaeological record than to watercraft not existing, as the resources and simple technology required to construct small craft would certainly have been available to these human communities.

6.3.2 Watercraft from the Mesolithic period are currently represented exclusively by log boats, the oldest of which dates to 7,920-6,470 BC and was found in Pesse in the Netherlands (McGrail 2004). The various finds of Mesolithic watercraft in the UK and north-western Europe suggest that where conditions are favourable, the potential exists for similar finds from submerged alluvial deposits offshore.

6.3.3 As an example, the submerged Mesolithic site of Bouldnor Cliff on the north western side of the Isle of Wight where the remains of a forest have shown particularly good survival conditions which would be suitable for boat finds. It is generally thought that log boats were primarily used for transport and fishing in inland and sheltered waters during the Mesolithic period.

Neolithic and Bronze Age (4,000 – 700 BC)

6.3.4 Available archaeological evidence for the later Neolithic period suggests a fairly low-density of human occupation within coastal and estuarine areas of the Study Area. However this may be a factor of the poor survival of Neolithic sites rather than a real indicator of the level of human activity and population density.

6.3.5 By the end of the Neolithic sea level around the UK and within the Study Area was approaching roughly its current stand which suggests that from this period onwards archaeological remains in those areas currently offshore would only be associated with watercraft or vessels and not human occupation sites. Furthermore, this means that sea level would not have risen like during the Mesolithic to cover and potentially preserve any organic material such as wood deposited by humans within the intertidal zone (Wilkinson and Murphy 1995:71).

6.3.6 By the early Neolithic (c.5,500 BP) the coastal and outer estuarine areas within the Study Area would have provided a landscape rich in natural resources. A number of Neolithic logboats have been discovered around the British Isles and it is presumed they were used for fishing and were capable of journeying onto the open sea (Johnstone 1980). Specialised activities along the shore of the Study Area – fishing, shellfish collecting – are likely to have continued near to the coast and along the estuaries during the Neolithic (Wilkinson and Murphy 1995) together with an increase in the scale of fishing activities and the transportation of goods across water.

6.3.7 The oldest log boat discovered in Britain is the St Albans log boat dating to the 4th millennium BC, during the Neolithic. Found next to the River Colne at Old Parkbury in Hertfordshire, this is tangible evidence that Neolithic people possessed the tools and cognitive ability to construct such craft (McGrail 2004).

6.3.8 Within the MAREA Study Area there is a Neolithic findspot offshore from the mouth of Lymington River and a earthwork site on the northern edge of Lymington. In addition, the formation of large and extensive wetland areas (now submerged) from the northern shore of the Solent indicate direct evidence of Neolithic inhabitation, and potential for the discovery of Neolithic material along the mud flats of the area (Wessex Archaeology 2007).

6.3.9 In the Poole Harbour area, evidence for human activity during Neolithic is confirmed through the finds of an axe head and five polished flint axes from the north of the harbour (Wessex Archaeology 2004a). Nearby in Bournemouth the period is represented by the presence of isolated pits and flint artefacts, but more specifically by an occupation site on Hengistbury Head. However, further evidence might be found that is now submerged, since it has been shown that during the late Neolithic the sea level was 3m to 2m below OD, as suggested by submerged peat in Poole Harbour (Edwards 2001) or by an undated submerged forest previously visible on the foreshore at Bournemouth pier (Wessex Archaeology 2004a).

6.3.10 Like the Neolithic, there are relatively few indications of foreshore or maritime activity human activity during the Bronze Age within the Study Area. The Bronze Age does, however, show evidence for the increase in human activity and population movement from the Poole Harbour area into the Purbeck basin to exploit the chalk down-lands in the mid-2nd millennium BC (Cox and Hearne 1992). Among the crucial characteristics of the Bronze Age period is the role played by the coastline as a subsistence resource (Hinton and Hughes 1996) as can be attested by the variety of fish traps found on the Isle of Wight coast at Wotten Quar in the eastern Solent (Tomalin 1993).

6.3.11 Bronze Age communities also continued to exploit the resources along the coast and within estuarine zones. Marshes were used for grazing, and estuaries provided areas for hunting, fishing and shellfish gathering (Wilkinson and Murphy 1995:219). Also during this period specialised coastal activities such as salt production first appear in the archaeological record (Wilkinson and Murphy 1995:132).

6.3.12 During the Bronze Age, coastal margins' exploitation have been increased by the building of a variety of wooden structures commonly comprising fences, short trackways or brushwood masses to bridge creeks or areas of soft mud on the saltmarshes and mudflats, and short landing stages at the edge of the salt marshes to gain access to the channels (Wilkinson and Murphy 1995:164, 218).

6.3.13 Discoveries within the Humber Estuary, notably the Kilnsea fragment dating to 1,870-1,670 BC (Van de Noort *et al.* 1999) and the Ferriby boats 1, 2 and 3, built between *c.*2000-1,700 BC, suggest types of Bronze Age waterraft suitable for riverine, estuarine and possibly even sea-going use (Lillie 2005). Other Bronze Age maritime finds elsewhere around the British coast suggest that during this period people not only frequented coastal wetlands but were also capable of sea-borne transport (Wright 1990; Parfitt 1993; Muckelroy 1980; 1981). A Bronze Age vessel found at Dover is certainly thought to have been seaworthy (Clark 2004; Crumlin-Pedersen 2006) and a paddle discovered in the Crouch estuary in Essex may be broadly contemporary with the Dover Boat (Wilkinson and Murphy 1995:104) thus strongly suggesting Bronze Age seafaring.

Iron Age and Roman (700 BC – 500 AD)

6.3.14 Settlement evidence is limited along the coast during the Iron Age but the remains of wooden structures built to facilitate access to coastal salt marshes suggest a continued exploitation in the coastal pasture and other resources during this period (Wilkinson and Murphy 1995:165). Some coastal activity by semi-specialised communities focused on salt production, with possible sites within the Study Area at Poole, Hamworthy, Furzey Island, on the Fitzworth peninsula and on Biness and Baker Islands inside Portsmouth Harbour, where find spots (briquetage and pottery) are thought to be related to the Iron Age salt-making industry (Wessex Archaeology 2005). Other coastal sites which point to the exploitation of marine resources include shell midden on Furzey Island and at, Ower and Fitzworth (Cox and Hearne 1992, Wessex Archaeology 2004a)

6.3.15 By the Iron Age the south coast of England was involved in cross-Channel trade and communication as evidenced by archaeological finds such as a small Iron Age gold coin from Syracuse found on the Hampshire coast not far from Portsmouth (Wessex Archaeology 2002) and the top of a Spanish, Dressel 20 amphora reportedly recovered from the seabed in Southampton Water (Wessex Archaeology 2008d). Additionally, trading ports investigated at Mount Battern in Plymouth and Hengistbury in Dorset, and Roman accounts of the Veneti people based in Brittany suggest that England's Iron Age populations were using sea-going sailing ships. Despite this, evidence for Iron Age maritime archaeology is rare in the UK. A single vessel plank from Ferriby dated to *c.*775-700 or 530-375 BC suggests a planked boat-building tradition.

6.3.16 Maritime activity within the Poole Harbour area confirmed by the discovery of a logboat off Brownsea Island, radiocarbon dated to 295 +50 BC (Cullingford 2003) which according to McGrail (1978) could have carried passengers and bulky cargo, possibly in the harbour or the tributary rivers. Two jetties which connect to earlier landing sites have also been found near South Deep and date to 250-200 BC (Markey, Wilkes and Darvill 2002).

6.3.17 The use of the foreshore in the Poole Harbour area during the Roman period is demonstrated by a submerged site on the north-eastern side of Brownsea Island and a salt-working site on Poole waterfront (Wessex Archaeology 2004a). The Hamworthy Peninsula also played a maritime role within the harbour as finds suggested that the area was a supply base for the Romans trading continental goods such as wine from northern Italy and fine pottery from Armorica (Wessex Archaeology 2004a; Cullingford 2003; Cunliffe 1990). Although some mid-first century AD pottery is recorded from Portchester, the main Roman development of the area around Portsmouth Harbour as a shore fort did not take place until the late third century AD, when part of the promontory was enclosed by a massive masonry wall and ditch system (Cunliffe 1975). Cunliffe notes that the position of the Roman shoreline cannot be established, but clearly the fort had access to deep water at the head of Portchester Lake.

6.3.18 Roman ships in Britain have been found sporadically. Three vessels discovered in the Thames show the variety of vessel type which would have frequented Roman harbours such as Poole (Wessex Archaeology 2004a; Marsden 1994). However the potential for Roman ships to have been wrecked in the approach to Poole Harbour is illustrated by an encrusted amphora base found on Studland Beach (Wessex Archaeology 2004a). Another more direct evidence for Roman era shipwrecks within the Study Area comes from the recorded find in 1848 of a large ancient vessel, thought at the time to be a Roman galley, as well as some Roman amphora fragments dredged less than 100m from the recorded location of the vessel in 1893 in Southampton Water (Wessex Archaeology 2008d).

6.3.19 The coastal zone within the Study Area was also strengthened by coastal defences during the Roman period. As the perception of the vulnerable stretch of coast within the Study Area increased with the threat imposed by Germanic incursions, a series of defended land bases were constructed around the coast of south east Britain, extending from the Wash to the Solent (Rodwell 1972:46).

Early Medieval and Medieval (AD 500 – 1508)

6.3.20 Archaeological evidence for early medieval settlements in Britain is thin, but the Saxon migrations into Britain from the Continent imply continued and sustained maritime activity around the coast of the UK during this period. This influx of Saxon settlers introduced Scandinavian-style clinker-built vessels into the UK. Although located outside of the Study Area, the Sutton Hoo ship, an early Anglo-Saxon ship burial found on a promontory overlooking the River Deben in Suffolk, is an important example of this ship type. It not only represents the type of Northern European shipbuilding practices in use during this period, but provides evidence of the perceived social or cultural importance of ships and seafaring to the population of the UK at this time (Bruce-Mitford 1972; Evans 1994).

6.3.21 Although the exploitation of the coastal zone continued into the early medieval period, there is little evidence of the salt-production which had formed a significant element of the Roman economy in the Study Area. The coastal marshes continued to be valued and were principally used for sheep-pasturage in the early medieval period. Fisheries were also an important component of the maritime activity along the region's coastline during the Saxon period.

6.3.22 By the sixth century AD Portsmouth Harbour was clearly being used by cross-Channel vessels. The Anglo-Saxon Chronicle records that in AD 501 'Port and his two sons…came to Britain with two ships at the place which is called Portsmouth' (Cunliffe 1976). The Victoria County History records historic events associated with the harbour, such as the embarkation of Edward I in 1114 and 1123 (Doubleday and

Page 1920). The strategic advantages of the harbour were such that King John had a number of galleys permanently stationed at Portsmouth, for which an enclosed dock was ordered built in 1212, suggesting the large capacity of the harbour and hence the high volume of shipping traffic occurring within the Portsmouth approach area at this period.

6.3.23 A log boat, probably dating from the early medieval period was found in 2002 on the shore of Long Island inside the Portsmouth Harbour by the Hampshire and Wight Trust for Maritime Archaeology (Wessex Archaeology 2005). This find points to the longevity of the use of such vessels, probably mostly within sheltered coastal and inland waters.

6.3.24 The earliest medieval reference to a port in Poole Harbour appears in accounts dated to 1179 - 1183 AD (Wessex Archaeology 2004a). The Patent Rolls of 1224 AD and 1230 AD record the need for readiness and the availability of cargo space in ships required for the king’s service. Even though no remains of ships from the early medieval and medieval periods have been found in Poole Harbour, evidence from customs records, which records a great diversity in the range of goods coming in or out of the port by ship (Wessex Archaeology 2004a) suggests the expansion of the town of Poole during this period. In addition, a late medieval boatyard timber store has been reported from Poole, a site unique in Northern Europe (Hutchinson 1994).

6.3.25 By the late medieval period, purpose-built warships were constructed and the shipbuilding practices for both warships and merchant vessels were adapted to cope with an increase in tonnage. In order to facilitate the propulsion of these more substantial vessels, the single mast was replaced by three or four masts and extra rigging (Wessex Archaeology 2009:55). The introduction of the carvel technique of flush planking became a common shipbuilding practice for larger craft throughout Europe, although the clinker technique continued to be used on smaller vessels. The development of reliable navigation techniques had further implications on medieval maritime activity, enabling long oceanic voyages and greater distances to be travelled (Kemp 2002).

6.3.26 An important wreck from this period is located in a backwater of the River Hamble in the north of the Study Area. The 1400 ton *Grace Dieu*. was the largest of Henry V’s ‘great ships’ and probably one of the largest clinker vessels ever built. Work began on her in 1416 and by 1420 she was ready for sea. During her one voyage, to the Isle of Wight, the crew mutinied and she was laid up in the Hamble, firstly in the roads and then on a mud berth at Bursledon. Struck by lightning in 1439, she was sufficiently damaged by fire that work began on dismantling her and recovering useable materials before she was abandoned. There are no other known wrecks from this period within the Study Area. However, the survival of the remains of the *Grace Dieu,* and the level of maritime activity along the south coast of England suggests that the potential for finds of early medieval and medieval periods shipwrecks within the Study Area in the future is high.

6.4 COASTAL AND SEAFARING ACTIVITY IN THE STUDY AREA VICINITY: 1508 - 1815

6.4.1 Maritime activity in the Study Area and beyond expanded dramatically in the Tudor period. With the opening up of the New World and the founding of the East India Company in 1599, Southampton and Portsmouth became centres of large-scale global commercial shipping activities.

6.4.2 This period also saw the development of fortifications along the coastline of the Study Area. With a long and low-lying shore facing the Continent, the region was considered to be at risk from raiding and invasion during the post-medieval period and major defences were built from the reign of Henry VIII onwards (Gilman 1997:67). As goods were traded further afield from Britain the concept of sea power emerged and there was an corresponding expansion of military activity within the Study Area region. Naval warfare played a significant role in the development of the Study Area during the Napoleonic Wars which marked the early 19th century, and naval dockyards around the UK, including within the Study Area were either established or expanded.

6.4.3 The *England's Shipping* study (Wessex Archaeology 2004c) which provided an evaluation of the traffic recorded entering or leaving the ports demonstrated that during the period from the 15th century until 1730 Southampton and Portsmouth attracted the highest shipping traffic in the Study Area and were important maritime trading centres. The project also mapped nine pre-18th century naval battlegrounds within a 100km radius of Dunnose Head on the Isle of Wight. Both factors imply high potential for maritime archaeological sites and debris in the Study Area. This is borne out by the known and recorded losses for this period. The UKHO lists 12 charted wrecks between 1508 and 1815, whilst the NMR records 609 shipping casualties. Whilst the majority of these records probably relate to the later years of the 1508-1815 period, the figures nevertheless give an indication of the maritime archaeological potential of the Study Area.

6.4.4 The Yarmouth Road designated wreck site is an example of the type of late medieval maritime traffic that was passing through the Study Area during this period. The wreck which appears to be a late 16th century or early 17th century merchant carrack, is probably Spanish and possibly the *Santa Lucia*, lost in 1567. The wreck comprises four substantial and well preserved fragments lying in an area of undisturbed clay, overlain by mobile silts and sediments.

6.4.5 Within the Study Area is also located the well-known and important late medieval wreck of the *Mary Rose*, protected under the terms of the Protection of Wrecks Act 1973. Built in 1509, the *Mary Rose* was one of the bigger warships in Henry VIII's fleet. She was rebuilt in 1536 and sank in 1545 during an engagement with the French fleet in the Solent. The site was discovered by Alexander McKee in 1971, designated in 1974, and then excavated and partly raised. The main part of the hull is now being conserved in the Portsmouth Historic Dockyard, but the bow section was not raised during the main excavation and there is high potential for the survival of artefacts and features outside of the excavation area (Wessex Archaeology 2008b). Additionally, a 300m radius zone preserve *in situ* any material from the collapsed port side and upper works that may survive outside the excavated area.

6.4.6 From the post-medieval period there are several examples of designated wreck sites which illustrate the range of shipwreck types in the Study Area as well as the potential for the survival and future discovery of other shipwrecks from the same period.

6.4.7 The Studland Bay wreck is the earliest known example of a carvel built vessel in British waters (Hutchinson 1994), the wreck has been dated to between 1520 and 1530 AD by associated pottery and leather artefacts (Jarvis 1997). Within the Poole Harbour and Approach area and along the shore of Poole Bay, there are a further 226 records for the post-medieval and modern period shipwrecks and casualties (Wessex Archaeology 2004a), including the Swash Channel Wreck, an armed 17th century wooden vessel also protected under the Protection of Wreck Act (1973).

6.4.8 An example of a late 17ty/early 18th century wreck is that of the *Hazardous* in Bracklesham Bay, West Sussex. The *Hazardous* was built in Port Louis in 1698 as *Le Hazardeux*, a French 3rd rate with 50 guns. She was captured by the Royal Navy in

1703 and converted to an English 4th rate of 54 guns in Portsmouth. The ship was lost in November 1706, when she was run aground in Bracklesham Bay. The site was discovered by divers in 1977, and designated in 1986, after partial exposure caused by sediment changes in 1984 (Wessex Archaeology 2008b).

6.4.9 The wreck of the *Invincible* lies on Dean Sand, about 2.4 km south-east of Horse Sand Fort at the entrance to Spithead. The *Invincible* was a 74-gun ship-of-the-line, built in Rochefort in France in 1744. She was captured by Admiral Anson in the Battle of Finistere in 1747 and purchased by the Royal Navy where she was commissioned as a 3rd rate ship-of-the-line. Her lines were taken off, and two new 74-gun ships, the *Valiant* and the *Triumph* were built after her design in 1757. In 1758 a jammed rudder caused the *Invincible* to run aground on Dean Sand. Despite several efforts she could not be refloated. All guns and the crew were taken off, but the hull remained on Dean Sand. The wreck of the *Invincible* was discovered when a fisherman snagged his nets on it in 1979. The site was designated in 1980 (Wessex Archaeology 2008b).

6.4.10 The Needles wreck is an unusual designated wreck site. The site comprises what is thought to be the remains of two ships, the *Assurance*, a 44-gun 5th rate lost in 1738, and the *Pomone*, a 38-gun 5th rate lost in 1811. Dating evidence suggests that wreck material mostly comes from the *Pomone*. In addition, a collection of third century Roman coins has been raised from the site, most likely originating from the *Pomone*.

6.5 COASTAL AND SEAFARING ACTIVITY IN THE STUDY AREA VICINITY: 1815 - 1913

6.5.1 During 18th and early 19th centuries, merchant vessels and warships construction alike was dominated by wooden sailing vessels. However, the course of the Industrial Revolution had a profound impact on ship design. The technical innovation of the Industrial Revolution brought fundamental changes in naval technology, enabling the development of first steam propelled and later iron and steel vessels during the 19th century.

6.5.2 The use of iron and steel in the construction of vessels became widespread only after 1820. Initially, iron was used as a structural element in shipbuilding and only later to frame vessels and provide the covering of the hull. Although the combination of iron-hulled vessels with steam propulsion enabled long distance trade to be undertaken in a faster and more economical fashion, their widespread adoption took decades. Hence during this period there was still a substantial, often regional or local, shipping fleet dominated by wooden sailing vessels (Breen and Forsythe 2004:127-128).

6.5.3 The advent of the steamship brought a new type of traffic to the region. Steamships were quickly put to use for coastal voyages and shorter cross-Channel passages, and by the 1820s steamboat transport formed an extensive network around the British Isles (Pearsall 1985:195). This form of shipping activity soon became prevalent within South Coast region.

6.5.4 Navigation in and out of the ports through the channel between Portsmouth and Gosport by sailing craft has always been difficult. The approach, as reported in the 1857 *Sailing Directions for the English Channel*, was marked by a series of sand banks until the advent of regular maintenance dredging. The suggested best time to enter the harbour was near slack water to avoid the high volume of water flowing out of the harbour on an ebb tide, funnelled through the narrow harbour entrance. The *Directions* also suggest that the best precautions in entering the harbour are under a ‘judicious and moderate sail, a steady and attentive helmsman, with an anchor in constant readiness.’(King 1856). These environmental conditions, plus the congestion of the harbour noted in 1856 are hazards that can be expected to have caused maritime casualties in the past.

6.5.5 Although the archaeological importance of ports is not directly linked to aggregate dredging activity, as demonstrated in *England's Shipping* (Wessex Archaeology 2004c), they are the point of destination or departure for shipping, and suggest on the basis of their size, the level of shipping traffic using them. Hence, within the Study Area there are two major ports and a number of smaller harbours, all of which saw large amounts of shipping traffic during this period. The reach any of these ports historical shipping routes will have had to cross many of the existing and proposed aggregate areas within the Study Area, increasing the potential for maritime casualties, and for presence on the seabed of currently unknown wrecks.

6.5.6 A recent designated wreck site gives an insight into the type of wreck from the modern period and more specifically the early 20th century. The wreck of the *A1* submarine is situated southwest of Wittering on the south coast. The general depth on site is 10m (CD). HMS *A1* was the first British designed and built submarine. She was commissioned in 1903 and lost with all hands off the Nab light ship in 1904 in a collision. The submarine was raised in 1904 and then mainly used for training and experimental purposes. In 1911 she disappeared during an unmanned exercise, when the tow broke. Despite extensive searches the Royal Navy was unable to locate her, and she was only rediscovered by a fisherman in 1989 and designated as historic wreck in 1998 (Wessex Archaeology 2008b).

6.5.7 The 19th century witnessed an important increase in the volume of shipping traffic in the waters of the UK, and for overseas routes which were facilitated by steam propelled vessels. This technology also affected warfare, providing steam-powered ironclad warships which could operate regardless of the sea conditions (English Heritage 2000).

6.5.8 The recording of ship losses was more centralised during the late post-medieval period, and as such, the available record of shipping casualties is both more complete and accurate. The potential for discovering such vessels is further enhanced by the incorporation of metal elements within the vessel design which means that wrecks on the seabed dating to this period are often more evident than their predecessors through non-intrusive magnetometer surveys.

6.5.9 Known and recorded losses within the Study Area for this period amount to 34 charted wrecks, one unspecified charted obstruction and 787 recorded losses.

6.6 COASTAL AND SEAFARING ACTIVITY IN THE STUDY AREA VICINITY: 1914 - PRESENT

6.6.1 Within the Study Area, the maritime archaeological record of the First World War is dominated by both losses and known wrecks usually accompanied by massive loss of life. One example is the ss *Mendi* which was sunk south of the Isle of Wight after a collision on the 21st of February 1917, with the loss of 649 lives, the majority of whom were black South African labourers *en route* to the Western Front (Wessex Archaeology 2007a).

6.6.2 Of particular interest within the Study Area (dredging Area 451) is the German submarine U1195 sunk by HMS *Watchman* on 6th April 1945, together with an unidentified coastal motorboat and another unidentified wreck. Just beyond the area, the major identified remains are the French passenger liner *Cuba* sunk by the U1195 on 6th April 1945, and the HMS *Prince Leopold* lying to the east of Area 451 and to the west of Area 372/2 and which was sunk on 29th July 1944 by the German submarine U621. Additionally, located within the Study Area the SS *Fallodon* lies more specifically at the western edge of the Area 407. This 3,000 ton merchant ship, built in 1903, was torpedoed in 1917 by the German submarine UC-71 with the loss of one crewman.

6.6.3 Although some actions during both World Wars were directed at warships, submarines and U-boats, but by far the greatest shipping casualties were merchant vessels, some carrying cargos, others acting as troopships. The new technologies of the submarine, torpedo, mine and aircraft are mostly responsible for the huge number of shipping losses, 'as is the outright intention by all sides during both wars to destroy shipping (and anyone on board), a deviation from earlier centuries, where the emphasis during maritime conflict was on blockade or capture' (Wessex Archaeology 2009). As an island, Britain relied on the import of raw materials and manufactured goods to a huge extent, and the merchant convoys which traversed the Channel Sea during WWI, for example, were obvious targets for the German navy (Bowyer 2003:25; Maw 1999:1). From February 1917 to January 1918, an average of 46 German U-boats was at sea in any one month, sinking a total of 2,684 British merchant ships (Miller 2004:8).

6.6.4 The list of losses and known wrecks dating to both World Wars is immense within UK waters. The new technologies of submarine, torpedo and mine were largely responsible for the huge toll in shipping losses. This volume in shipping losses is further due to the outright intention by both the Allies and their Continental adversaries to intentionally destroy shipping, a derivation from earlier centuries where maritime conflict was primarily concerned with blockade or capture. The advent of air power brought another dimension to warfare in the 20th century, providing aircraft capable of destroying both military and merchant ships, a strategy which was amplified throughout WWII (Bowyer 2003:26).

6.6.5 Other sites in the Study Area include the first dedicated air station for seaplanes and flying boats, established by the Royal Navy during WWI on Calshot in Southampton Water.. The site still exists today but with a number of different uses (Ashworth 1982: 51). In 1942 it became evident that any successful invasion of the Continent needed artificial harbours, the construction of which would have to take place in number different locations. A third of these locations were in Hampshire (Doughty 1994: 39) and a number of 'wrecked' examples of these Mulberry harbours are located off the Sussex coast.

6.6.6 There are a total of 361 charted wrecks and recorded losses within the Study Area for the period covering the two World Wars. For the first time in the record there are more charted wrecks (202) than recorded losses, a factor of the greater visibility of the physical remains of wrecks of this period on the seabed.

6.6.7 Maritime activity within the Study Area region since 1945 has been multi-faceted. The area has seen continued and sustained military and commercial maritime traffic as well as a huge growth in leisure maritime activity. A diverse array of boats and ships has continued to enter the archaeological record. Although the number of casualties are less numerous than in preceding years – 139 charted wrecked and 7 recorded losses – the overall volume of seafaring activity continues to be very high (Wessex Archaeology 2009). Amongst the vessels which have foundered or wrecked within the Study Area dating to the modern post-war period, a number might be regarded to be of special archaeological interest.

6.7 MARITIME ARCHAEOLOGY SUMMARY

6.7.1 Based on the discussion above the Study Area can be considered to have been traversed or used by shipping for over 2000 years. However, it was the years between 1650 and 1800 that were of vital importance for the region as the ports of Portsmouth and Southampton grew and the Solent acquired an importance as a shipping hub that was both national and international. The volume of traffic and the congestion caused by the (relatively) narrow waterway that is the Solent are hazards that can be expected to have caused maritime casualties in the past (Wessex Archaeology 2005b).

6.7.2 In addition to the known and recorded maritime casualties in the Study Area it is also clear that there is the potential for the remains of unknown watercraft and vessels which date from at least the Mesolithic to the present day within the area. Given the density of marine traffic which has passed through the Study Area, particularly since the Iron Age the potential for the remains of unknown vessels within the Study Area is clearly very high.

6.7.3 In considering the potential for shipwrecks within the Study Area, it should be noted that such sites often extend beyond the confines of any remaining hull, depending on the circumstances of loss and the effects of post-depositional processes. The extended area may contain significant elements of structure, artefacts and stratified deposits and has to be considered as an integral part of the wreck site.

6.7.4 In addition to the potential for shipwrecks of many periods, consideration must also be given to the potential for stray finds of items lost or thrown overboard which may indicate preferred sea routes through the centuries. In this regard, the project named Protocol for Reporting finds of archaeological interest for British Marine Aggregate Producers Association (BMAPA) and English Heritage (EH) has led since 2005 to the discovery of nearly 200 finds among which some of them have the potential to be linked to either shipwreck sites or shipping routes such as a bone and wood fragment (UMA 0113a) found together and an admiralty telescope (Kendalls 0130a).

7 AVIATION ARCHAEOLOGY

7.1 INTRODUCTION

7.1.1 Since the advent of powered human flight in the early 20th century, thousands of military and civilian aircraft have been lost around the UK. Aircraft losses at sea span the entire period of aviation history, from the introduction of flight to the post-WWII period. However, although records of aircraft losses at sea are extensive, data regarding their location is limited.

7.1.2 A guidance note published by EH (2002) entitled *Military Aircraft Crash Sites* makes the case for recognising the importance of aircraft crash sites, specifically with regard to existing and planned development proposals which may have an impact on such sites. The guidance note argues that aircraft crash sites not only have significance for remembrance and commemoration, but that they also have a cultural value as historic artefacts, providing information on the aircraft itself and also the circumstances of its loss (English Heritage 2002).

7.1.3 There are over 10,000 thousand aircraft crash sites in UK waters, a high proportion of which are associated with military activity. Although this means the potential resource is very large, known sites recorded in the NMR are actually relatively few. There is therefore a reasonable potential for discovering previously unrecorded aircraft sites during any seabed development works especially off the east and south coasts of the UK.

7.1.4 Although the extent of our knowledge of aviation archaeology is limited, WA has proposed following three temporal divisions, broadly characterised by drawing out a few generalisations on importance and special interest (Wessex Archaeology 2009:62):

- **Pre-1939**: The period of intense and rapid development of a new technology, from the advent of powered flight to the outbreak of WWII. Although at least 119 different aircraft models were used by the military in the UK during this period, examples of only 24 survive today anywhere in the world. This, alongside the fragility of the airframes and the relative scarcity of flights over water deem any aircraft remains dating to this period of special interest;
- **1939-1945**: By the start of WWII, advances in technology had greatly extended the reliability and range of aircraft. Such technological innovation enabled aircraft to increasingly undertake long-range flights, many of which are likely to have taken place across the Study Area. This period also saw the highest number of aircraft and associated human casualties in the history of aviation and as such has special significance;
- **Post-1945**: A period characterised by the rapid development of jet propulsion technology and its use in both military and civilian aviation applications.

7.1.5 It is within these three broad chronological divisions that aviation archaeology shall be discussed below:

7.2 KNOWN AIRCRAFT CRASH SITES

7.2.1 Within the Study Area both the UKHO in SeaZone and the NMR list a number of known aircraft crash sites and recorded losses.

SeaZone

7.2.2 Of the 2,239 charted sites listed in the SeaZone data within the Study Area, only 12 contained references to aircraft crash sites. Of these three are pre-1946, four are post-1946 and the remaining five are of unknown date. The distribution of these sites is illustrated in **Figure 12**.

Recorded Losses

7.2.3 A total of 221 contained references to aircraft crash sites were returned in the NMR search for the Study Area. A total of 211 date to between 1914 and 1946, four post-date 1946 and the remaining six are undated. The distribution of these sites is also illustrated in **Figure 12**.

7.3 AVIATION ARCHAEOLOGY PRE-1939

7.3.1 Fixed wing aviation first began in the early 1900s in the United Kingdom, with the first flight across the English Channel in 1909 (Royal Air Force 2008). By the inter-war years, commercial civil aviation had significantly increased and various cross-channel services to a number of European and worldwide destinations had been established (Wessex Archaeology 2008c). The steady and rapid rise in commercial flights which followed WWII meant that by the end of the 20th century, flight was an accessible means of travel within and around the UK for most people (Wessex Archaeology 2008c).

7.3.2 The development of military and naval aviation began with the First World War (WWI). Initially, airpower was conceived as an adjunct of the army and navy, and it was the task of the Royal Naval Air Service (RNAS), founded in July 1914, to patrol the east coast of Britain and provide airborne defence and anti-submarine duties (Brown et al. 1995; English Heritage 2000). In response to the increasing threat posed by the Zeppelin airships and, from 1917, the Gotha bombing planes, aircraft were mass-produced in large numbers in Britain. This threat was further met by the establishment of 16 squadrons of fighter airfields, 480 anti-aircraft guns and 706 searchlights with a centralised control system around Britain (English Heritage 2000;

Lake and Francis 1998). However, despite this increase in the use of aircraft during WWI, there was comparatively little aviation activity over the sea (Wessex Archaeology 2008c).

7.3.3 Throughout the course of WWI, the potential of airpower as an independent sector of the armed forces became increasingly clear (Lake and Francis 1998). The patrols of the RNAS had pioneered the role of airpower from purely reconnaissance motives to an increasingly strategic role, and by April 1918 the Royal Air Force (RAF) had been established as an independent force (English Heritage 2000a; Lake and Francis 1998). Airpower had a profound impact on warfare during WWI, and by 1918 it had become apparent that increasing effort would have to be put into defending Britain's airspace at the expense of guarding the coastline (Brown *et al.* 1995). After the collapse of the Geneva disarmament talks in 1933, the British government engaged in a massive programme of rearmament and more than 100 permanent airbases were built throughout Britain during the inter-war years (English Heritage 2000; Lake and Francis 1998).

7.4 AVIATION ARCHAEOLOGY: 1939-1945

7.4.1 In WWII alone it has been estimated that an average of five aircraft crashed every day somewhere in the British Isles (Bédoyère 2001:8). With a few exceptions, aircraft predominantly come to be on the seabed as a result of an in-flight accident or enemy action. This cause of loss is vital in understanding the nature of aircraft remains on the seabed (Wessex Archaeology 2008c). For example, those aircraft which are on the seabed as a result of controlled ditching are likely to have a much greater preservation than those which exploded mid-air, which are likely to be highly fragmented and widely dispersed. This cause of loss has further implications on the impact of the aircraft. The force of the impact can have a key effect upon the damage sustained by the aircraft and consequently, the nature of its remains (Wessex Archaeology 2008c). There is a complex array of inter-related factors that determine the preservation of aircraft crash sites, and the ways in which they interact with one another are site specific. However, it is widely recognised that marine environments offer favourable conditions for the preservation of artefacts, enhancing the potential for the survival of aircraft crash sites on the seabed.

7.4.2 By the Second World War (WWII) an advance in aeroplane technology enabled overseas flights to take place with a much lower level of risk and air power became increasingly important at a strategic and operational level. Attacks on enemy territory by both the Allied forces and the Luftwaffe were facilitated by the mass-production of aircraft in vast quantities, and in Britain nearly 600 airfields were built between 1939 and 1945 (English Heritage 2000). The North Sea and English Channel formed a frontier between the Allies and Axis Europe during this period, becoming a significant focus for this high volume of aviation activity (Wessex Archaeology 2008c).

7.4.3 From the end of WWII until the early 1990s, military aviation activity was dominated by the Cold War. In addition to the pursuits undertaken by the RAF, a large number of American planes were based in the United Kingdom, and there was a high volume of aviation activity across the English Channel (Wessex Archaeology 2008c). The advent of the jet aircraft towards the end of WWII had significant connotations for aviation activity during the Cold War. These fast-flying jets had to be detected much earlier by radar defences in order to allow sufficient time enabling them to be intercepted before reaching the British coast (Brown *et al*. 1995). The establishment of the 'Rotor' radar stations facilitated this, enabling the Army and the RAF to operate an Air Defence Scheme directing aircraft and anti-aircraft artillery (English Heritage 2000).

7.4.4 One of the most complete sources of information received by WA during the scoping study for the WWII and post-war periods was provided by published aviation researcher Ross McNeill. McNeill has recorded 11,090 RAF aircraft losses in the North Atlantic, North Sea, English Channel, Irish Sea and Biscay areas between 1939 and 1990, the majority of which appear to have occurred during WWII (Wessex Archaeology 2008c). McNeill lists 540 losses in the English Channel and although WA cannot verify the accuracy of his data it was collated through a systematic study based on both primary and secondary sources and confirms the high volume of potential aircraft crash sites within the general vicinity of the Study Area suggested by the Seazone and NMR data.

7.4.5 Another survey of aircraft crash sites in England carried out by English Heritage in consultation with the Ministry of Defence (MoD) as part of the Monuments Protection Programme (MPP) revealed, perhaps predictably, that WWII losses tend to cluster along the southern and eastern margins of England. For example, some 1,000 losses were noted off the coast of Suffolk (English Heritage 2000; English Heritage 2002). Located beneath the flight paths of enemy bomber formations that were targeting London, Southampton and Portsmouth the Study Area would have been a focus for anti-aircraft defence and air combat during WWII.

7.4.6 Within the Study Area, a number of aircraft crash sites have been located in recent years. As part of investigations conducted by WA for assessing the construction of an outfall at Sandown on the Isle of Wight, WA identified a wreck found in the course of a hydrographic survey in 1989 as a C-47 Dakota (Wessex Archaeology 1997). During the ALSF-funded *Wrecks on the Seabed* project (Wessex Archaeology 2003b) a WWII inshore aircraft wreck of a B-17 bomber was discovered and in 2006, a second aircraft wreck was identified by the same project: this time a B-24 Liberator bomber lying in more than 50m of water off the Hampshire coast.

7.5 AVIATION ARCHAEOLOGY: 1945 - PRESENT

7.5.1 After WWII and until the early 1990s, military aviation activity was dominated by the Cold War. Accordingly, military aircraft research, design and development was further pushed forwards, much development of which was also applied to commercial aircraft (Wessex Archaeology 2009:67).

7.5.2 Throughout the periods prior to 1945, military activity provided the main context for aircraft design and development. Afterwards, there was a steady and rapid rise in commercial flights. Initially ex-military aircraft were used to transport people and cargo, with aircraft such as the American B-29 and the British Lancaster converted into commercial aircraft (Wessex Archaeology 2009:68). The first purpose-built commercial jet airliner was the de Havilland Comet, which first flew in 1949 and entered service for the British Overseas Airways Corporation (BOAC) in 1952, between London and Johannesburg. Flight soon became an available means of travel within and around the UK for most people, and the volume of airliner activity across the Study Area is likely to be high.

7.5.3 Despite the volume of aviation activity across the UK since WWII, there have been very few major losses. The AAIB (Air Accident Investigation Branch) lists 120 civil aircraft losses at sea around the UK between 1946 and 1994, most of which were light aircraft or in more recent years helicopters associated with the North Sea oil and gas industry (Wessex Archaeology 2009:68). Furthermore, unlike the preceding years the majority of military aircraft losses were due to training accidents rather than combat operations (Wessex Archaeology 2009:66). These include a Supermarine Attacker jet lost within the Study Area, off Worthing on the Sussex coast in the early

1950s, the remains of which were reported through the BMAPA Implementation Service in 2005 (Wessex Archaeology 2006c).

7.6 AVIATION ARCHAEOLOGY: SUMMARY

7.6.1 Within the last decade, the number of aircraft wrecks being found on the seabed is constantly increasing as a result of both seabed development activities and archaeological survey. These discoveries have raised the profile of aircraft crash sites as an archaeological resource with both the heritage and offshore development sectors (Wessex Archaeology 2009). In response to the clear discrepancies between the known and potential resource of aircraft crash sites, WA was therefore funded by EH through the Aggregates Levy Sustainability Fund to undertake a scoping study entitled *Aircraft Crash Sites at Sea* (Wessex Archaeology 2008c). The study aimed to identify current gaps in data and understanding relating to aircraft crash sites at sea.

7.6.2 While it is not possible to compile an exhaustive account of aircraft crash sites within United Kingdom territorial waters, the figures discussed above indicate the immense potential for such sites on the seabed. With regard to the Study Area, its position on the south coast, its close proximity to the Continent and the presence of strategic targets such as Southampton means that has been a significant focus for both military and commercial aviation activity throughout the 20th century.

7.6.3 In providing favourable preservation environment, the seabed can further enhance this potential, making the discovery of fairly intact aircraft far more likely than for those discovered on land. Despite this, due to the both the ephemeral nature of their remains and their low geophysical signature, aircraft crash sites are not easily distinguishable in standard geophysical survey.

7.6.4 There is thus a high potential for aircraft remains within the Study Area. It is important to note again that such sites are subject to automatic blanket protection from disturbance under the Protection of Military Remains Act 1986,

8 SITE SURVIVAL AND VISIBILITY

8.1 INTRODUCTION

8.1.1 In attempting to identify the impacts of existing and future aggregate extraction on the known and potential archaeological resource, the potential for the preservation of archaeological material and deposits within the Study Area is a key consideration.

8.1.2 Archaeological sites and material may be buried by sediment which serves to protect and preserve them. This preservation may be compromised by the removal of these protective sediments by both human and natural agents. Archaeological sites may be subject to erosion and scour resulting from natural hydrographic processes. Of relevance in the context of this study are the human agents which can cause disturbance as a result of marine and seabed activities such as aggregate dredging.

8.1.3 Aggregate extraction activities have the potential to adversely impact the archaeological resource within any of the licence, application and prospecting areas within the Study Area (**Figure 1**). The following sections attempt to assess site survival and visibility within the Study Area for each of the major archaeological themes.

8.2 PREHISTORIC ARCHAEOLOGY

8.2.1 The potential for prehistoric archaeological sites within the Study Area has already been discussed in this report (**Section 5.7**). However, the degree to which archaeological material can be expected to survive is important in the assessment of the submerged prehistoric archaeological potential of the Study Area. Since the earliest evidence for the occupation of the British mainland in *c.*700,000 BP, human and proto-human artefacts are likely to have been deposited on the Continental Shelf whenever the glacial sea level falls exposed the Solent and areas of the English Channel floor within the Study Area.

8.2.2 Along the south coast, where the glacial ice sheets will not have scoured away prehistoric archaeological deposits, or the sediments containing such material, the critical factor in the survival of prehistoric archaeological material is marine transgression: including the initial impacts of the encroaching surf zone on the sites or deposits and the ensuing period as the sea level rises over the site. Favourable factors for the survival of *in situ* prehistoric archaeological material include:

- Very low beach and offshore gradient so that wave action is attenuated and is constructional in the surf zone;
- Minimum fetch so that wave amplitude is minimum, wavelength is short and wave action on the seabed is low;
- Archaeological deposit embedded in peat or packed lagoonal deposits which give resistance and provide cohesion during marine transgression. Drowned forests and peat are good indicator environments;
- Where deposits are in a cave or rock shelter, roof falls, accumulated debris, concretions, breccia, conglomerate formation, indurated wind-blown sand, all help to secure archaeological strata;
- Local topography contains indentations, re-entrants, bays, rivers, estuaries, beach-bars, lagoons, near-shore islands, or other localised shelter from dominant wind fetch and currents at the time of transgression of the surf zone.

8.2.3 The visibility of the submerged prehistoric archaeological resource is determined by further factors, which include:

- Low net modern sediment accumulation rate so that the artefacts are not too deeply buried;
- No fields of sand waves or megaripples over the site;
- A slight change in oceanographic conditions so that the site is being gently eroded to expose deposits, permitting their discovery.

8.2.4 There are a number of prospective locations within the Study Area that may be considered to have favourable site survival and visibility for prehistoric archaeological material.

8.2.5 Prehistoric site survival is also expected to occur within the relict estuaries and river valleys of the Study Area. The resource rich palaeo-river valleys of the Solent and the Arun are likely to have been foci for past human activity and the gravel terraces laid down by these rivers and their tributaries would have provided favourable living sites for prehistoric human communities. Human occupation sites can be expected to survive in these palaeo-river valleys, although they are likely to be concealed within marine alluvium.

8.2.6 Although this report is primarily concerned with marine and offshore areas, the coastal areas adjacent to the Study Area have a high potential for the survival and visibility of the prehistoric archaeological resource. There is the potential for artefacts to erode out of modern coastlines. Coastal sediments adjacent to the Study Area, comprising mudflats, marshes and wetlands, also have a high potential for prehistoric site survival and visibility.

8.3 Maritime Archaeology

8.3.1 The ALSF *Navigational Hazards* project (Bournemouth University 2007) attempted to identify areas where a high potential for ship loss coincided with a high potential for preservation of archaeological materials. These areas were referred to as Areas of Maritime Archaeological Potential (AMAPs), and it is with reference to these that the survival and visibility of maritime sites within the Study Area will be considered.

8.3.2 The results of the *Navigational Hazards* project showed a general higher potential for the loss and preservation of vessels on approaches to estuaries inshore and shallow fine-grained sandbanks offshore (Bournemouth University 2007:33). The approaches to the Solent have been identified as an important AMAP in which these trends coincide.

8.3.3 The survival of a shipwrecks or maritime structures depends largely on whether they come to lie on or within the seabed sediments (Gregory 2006:8). Structures which lie exposed within the seawater are at risk of being deteriorated by wood boring or saprotophic organisms (Gregory 2006:8). Those which are engulfed or covered by sediments experience a much slower rate of deterioration due to the absence of dissolved oxygen (Gregory 2006:8).

8.3.4 The sediment types which contain a higher proportion of finer grained sediments and a lower proportion of coarser grains offer the best preservation for archaeological material on the seabed (Gregory 2006:14-15). This is partly due to the fact that such sediments tend to have lower bearing capabilities and thus engulf archaeological material more readily. Finer grained sediments are also quite mobile and will more easily cover archaeological material, although the obvious drawback of this is that such sediments may be more easily transported away from a site leaving it exposed. The penetration of oxygen is much lower in finer grained deposits such as sand which also contributes to the preservation of archaeological material (Riedl and Ott 1982).

8.4 Aviation Archaeology

8.4.1 With regards to aircraft crash sites within the Study Area, site survival and visibility is determined largely by the cause of loss of the aircraft. With a few exceptions, aircraft come to be on the seabed as a result of an in-flight accident or enemy action. Those aircraft which are on the seabed as a result of controlled ditching are likely to be much better preserved than those which exploded in mid-air or hit the water at speed, which are likely to be highly fragmented and widely dispersed.

8.4.2 The factors which determine the survival of an aircraft crash site are not yet fully understood. It is, however, recognised that marine environments generally offer favourable conditions for the preservation of artefacts, enhancing the potential for the survival of aircraft crash sites on the seabed.

8.4.3 (The seabed sediments within the Study Area as discussed in **Section 8.3** with regards to the survival of the maritime resource would similarly promote the survival of aircraft crash sites)

9 IMPACT ASSESSMENT

9.1 INTRODUCTION

9.1.1 This section considers the source and nature of the effects of aggregate dredging and the degree to which archaeological receptors are exposed to and affected by dredging practices within current dredging licence areas, application dredging areas and the prospecting areas (collectively termed potential areas of impact) and the MAREA Study Area as a whole.

9.1.2 For the purposes of this assessment, the archaeological resource is divided into the three broad themes discussed above: prehistoric archaeology, maritime archaeology and aviation archaeology. Within each of these themes, a number of receptors have been identified. These are:

Prehistoric Archaeology	Maritime Archaeology	Aviation Archaeology
Pleistocene fluvial gravels	Known, charted wreck sites	Known, charted aircraft crash sites
Estuarine alluvium	Shipping casualties / Recorded losses	Recorded aircraft losses
Peat	Unknown, uncharted wreck sites	Isolated aircraft finds
Isolated prehistoric finds	Isolated maritime finds	

Table 8: Archaeological Themes

9.1.3 The process of assessing the effects of dredging on these archaeological receptors involves identifying effects, predicting the magnitude of effect, identifying the sensitivity of each receptor to each effect and evaluating the significance of the likely impacts of that effect at a regional scale. Each stage of this process is detailed in turn below.

9.1.4 In the Impact Assessment Methodology compiled by Emu (2009) ‘effects’ are defined as the physical changes in the environment that result from a development activity. In the context of the MAREA effects are usually measurable, include marine and coastal effects and will be set in motion by a particular dredging activity.

9.1.5 ‘Impacts’ are changes in the baseline condition of potentially sensitive receptors. An impact may be significant in its own right or when added to existing impacts. Impacts may be negative or positive, resulting in adverse changes to or improvements in the baseline conditions respectively, or in the introduction of either new undesirable or desirable factors. The distinction between impacts and effects is made because effects do not necessarily impact the baseline conditions of all receptors.

9.2 DREDGING PRODUCTION, PROCESSING AND EFFECTS

Marine Aggregate Production and Processing

9.2.1 Deposits suitable for exploitation as marine aggregate comprise well-defined bodies, more than 0.5m thick, of well-sorted hard rock gravels in the size-range *c.* 2-40mm, without a covering of clay, silt or organic-rich sediments (Wenban-Smith 2002:1).

9.2.2 These gravel deposits represent submerged formerly terrestrial deposits which are of Pleistocene fluvial origin, generally preserved in terraces on the flanks of submerged river valley systems or filling palaeo-river channels (Wenban-Smith 2002:1).

9.2.3 Two types of dredging technique are employed to extract marine aggregate. The first is known as anchor dredging, and involves a vessel anchoring over a deposit. This technique is often employed when working in thick, localised reserves. The second technique, known as trailer dredging, is employed when working with more widely distributed deposits and trailer dredging is the technique most commonly used around the UK.

9.2.4 Dredging vessels locate the aggregate resource using a satellite navigation system. When in position, the dredge pipe is lowered to the seabed and as the vessel trails it slowly across the seabed powerful pumps are used to extract the aggregate. On large vessels, these pumps are capable of drawing up to 2,600 tonnes of material an hour from water depths of up to 50m (BMAPA 2006:6). The sand and gravel is discharged into the vessel's hold, displacing the seawater which was previously taken in as ballast.

9.2.5 Once fully loaded with aggregate, the vessel returns to a wharf to discharge the sand and gravel. The process of discharging involves bucket wheels, scrapers or wire-hoisted grabs which place the aggregate onto a conveyor system for delivery to the wharf or processing plant (BMAPA 2006:7).

9.2.6 Processing marine aggregate generally comprises screening, sieving by size and crushing, though the exact process varies from wharf to wharf. This precludes the scanning of the aggregate for archaeological material during processing, although a demonstrated potential exists for identifying and retrieving large artefacts from stockpiles of oversize stone and for retrieving ferrous artefacts picked up by magnet.

Dredging Effects

9.2.7 A number of real and potential effects of aggregate extraction are identifiable, including substrate removal, elevated turbidity and sediment transport, the mobilisation of contaminants, noise, water quality, changes to bathymetry, and constraints on vessel navigation.

9.2.8 Of these, substrate removal, elevated turbidity and sediment transport (together considered as sediment plume) and changes to bathymetry are most likely to have an impact on the archaeological record, although the degree of impact will vary according effect and from receptor to receptor.

9.2.9 Mobilization of contaminants, noise, water quality and vessel navigation will not affect the archaeological record and are therefore not considered further in this assessment.

9.3 INTERACTION BETWEEN RECEPTORS AND IMPACTS: PREHISTORIC ARCHAEOLOGY

9.3.1 The known archaeological record for submerged prehistoric archaeology and palaeo-landsurfaces in the Study Area is limited. In order to highlight areas of prehistoric archaeological potential in the Study Area deposits which have the potential to contain *in situ* prehistoric archaeological material have been identified from the results of the geotechnical and geophysical investigations (**Section 5.6**).

9.3.2 When assessing prehistoric archaeology in the context of aggregate dredging this report considers it more meaningful to concentrate on the deposit types in which the archaeological material may be found than to concentrate on archaeological periods to assess potential and impacts. For the purposes of this assessment, therefore, these deposits have been broadly categorised as Pleistocene fluvial gravels, estuarine alluvium and peat. It must be noted, however, that the available geophysical and geotechnical data are limited by their area of survey and cannot be regarded as providing a conclusive understanding of the full extents of these various deposits within the Study Area.

9.3.3 It must also be noted that this assessment has assumed that where alluvium and/or peat overlie a gravel deposit this gravel will not be targeted for extraction (see **9.2.1**. above). Should this assumption not be correct, the effects and impact on the overlying alluvium and/or peat must be assumed to be the same as those suggested below for Pleistocene fluvial gravel.

Pleistocene Fluvial Gravels

9.3.4 Pleistocene fluvial gravels were identified as sedimentary Unit 2 in the geotechnical assessment of the MAREA. These sediments comprise sands and gravels likely to represent river terraces from periods of lowered sea level, and based on finds of Palaeolithic artefacts from similar contexts along the south coast and in the Solent (Wymer 1999) they have the potential to contain Palaeolithic archaeological material.

9.3.5 The unit comprised sand and gravel and was clearly identifiable in three vibrocores within existing licence areas: **VC20** (Owers), **HPC15** and **HPC13** (Area 122/3). It was also tentatively interpreted in the logs for **VC35** (Line 12 / Area 451 Southern) and **VC09** (Line 12 / Area 451-Northern). The unit was noted outside existing licence areas in **VC28\93**, **VC3A\93**, and **VC39\93** (Line 14). No vibrocores containing Unit 2 were noted in application and prospecting areas (**Figure 4**).

9.3.6 These Pleistocene fluvial gravels are the primary target of aggregate dredging. However their full extent within the current south coast aggregate licence, application or prospecting areas and across the Study Area is not known. The degree to which the impacts of aggregate extraction overlap with the location and distribution of the receptor is thus unknown and on the basis of this uncertainty a precautionary approach has been adopted and a **high** uncertainty rating has been applied to this receptor.

9.3.7 Given this uncertainty, a precautionary approach has been adopted when considering this receptor and there is likely to be a **large degree of local and regional interaction** between impacts and receptor in this case.

Estuarine Alluvium

9.3.8 Estuarine alluvium, which overlies the Pleistocene gravels, was identified as sedimentary Units 3a/b in the MAREA Stage 1 geotechnical assessment. Twenty-six vibrocores containing Unit 3a/b deposits were observed within current aggregate licence areas and five within licence application areas. Seven core logs outside of current aggregate licence, application or prospecting areas contained Units 3a/b (**Figure 4**).

9.3.9 These sediments comprise sandy silty clays (Unit 3a) and silty sandy clay from oxidised estuarine and intertidal sediments (Unit 3b). This estuarine alluvium is of particular archaeological interest because it appears to relate to the inundation of tributaries of the Channel river systems during the latest, Holocene marine transgression. On the basis of similar, dated sediments from elsewhere in the Study Area and along the south coast (Momber 2000, Wessex Archaeology 2007b) it is likely that Unit 3 is Mesolithic in date: c.10,000 to 5,500BP.

9.3.10 Although estuarine alluvium has been identified within the current south coast aggregate licence, application or prospecting areas its full extent within potential areas of impact and across the Study Area is not known. The degree to which the impacts of aggregate extraction overlap with the location and distribution of the receptor is thus unknown and on the basis of this uncertainty a precautionary approach has been adopted and a **high** uncertainty rating has been applied to this receptor.

9.3.11 However, if the assumption that the aggregate industry will avoid areas in which estuarine alluvium is present or overlies gravels is correct, it is may be possible to reduce this uncertainty index to **medium**.

9.3.12 It is postulated that there is likely to be a **small degree of local or regional interaction** between the impact and receptor in this case.

Peat

9.3.13 Fluvial processes during the Late Devensian and Holocene resulted in the formation of peat deposits. These deposits are evidence of temporary minor falls in sea level and contain data that can help reconstruct past environments and provide a greater understanding of the geomorphology of the coastline during these periods. Peats may also contain *in situ* archaeological material. *Identifying and Protecting Palaeolithic Remains: Archaeological Guidance for Planning Authorities and Developers* (English Heritage 1998) notes that well-preserved indicators of the contemporary environment such as peat are of particular archaeological importance.

9.3.14 Peat was identified within sedimentary Unit 3 in the MAREA Stage 1 geotechnical assessment is described as Unit 3c, a black fibrous peat, recorded in one core, **VC4** (Area 396/1 SWIOW). No vibrocores containing Unit 3c were noted in application and prospecting areas (**Figure 4**).

9.3.15 The full extent of peat deposits within potential areas of impact and across the Study Area is not known. The degree to which the impacts of aggregate extraction overlap with the location and distribution of the receptor is thus unknown and on the basis of this uncertainty a precautionary approach has been adopted and a **high** uncertainty rating has been applied to this receptor.

9.3.16 As with estuarine alluvium above, however, if the assumption that the aggregate industry will avoid areas in which peat deposits are present or overlie gravels is correct, it is may be possible to reduce this uncertainty index to **medium**.

9.3.17 It is postulated that there is likely to be a **small degree of local or regional interaction** between the impact and receptor in this case.

Isolated Prehistoric Finds

9.3.18 Fluvial activity and a series of marine transgressions and regressions have shaped the sediments of the Study Area over time. These processes will also have resulted in the disturbance, movement and re-distribution of prehistoric artefacts and assemblages from their primary context.

9.3.19 There is thus a high potential for derived finds to be present within the potential areas of impact and the MAREA Study Area as a whole. However, whilst this potential exists, it is not possible to quantify or predict the volume or distribution of such artefacts. On the basis of this uncertainty a precautionary approach has, therefore, been adopted and a **high** uncertainty rating has been applied to this receptor.

9.3.20 A **moderate degree of local or regional interaction** between the impact and the receptor is suggested in this case.

9.4 INTERACTION BETWEEN RECEPTORS AND IMPACTS: MARITIME ARCHAEOLOGY

Known, Charted Wreck Sites

9.4.1 There are 2,227 known or charted maritime sites in the Study Area comprising shipwrecks and seabed obstructions. These sites have been charted, mainly by the UKHO, and their positions on the seabed are relatively secure. It is important to remember though that these recorded sites show a bias towards large iron or steel wrecks dating from within the last 150 years, due to the higher potential for structures of ferrous material to be identified on the seabed through geophysical survey.

9.4.2 The plot of charted wreck sites shown in **Figure 9** reveals areas with higher concentrations of wreck sites: for example, to the north-east of the Isle of Wight and along the approaches to Portsmouth and Southampton. For the rest there is a fairly widespread and general distribution of wrecks across the Study Area. Of the total number of charted maritime sites 34 are located in current aggregate licence areas. A further 11 sites are located within the dredging licence application areas and six (6) are located within prospecting areas (Area 499 Outer Owers and Area 500 South Wight).

9.4.3 Because the location and number of known, charted maritime sites within the potential areas of impact and the MAREA Study Area can be established, the interactions of this receptor with aggregate extraction impacts are well understood and documented. A **low** uncertainty rating has thus been applied to this receptor.

9.4.4 In addition, only 1.5% of the total number of charted sites within the Study Area lie within the current dredging licence, licence application areas or prospecting areas. On this basis, **no regional interaction** is likely between dredging impacts and the known, charted wreck sites receptor. At a licence area level, however, there is the potential for a **high degree of local interaction**.

Shipping Casualties / Recorded Losses

9.4.5 A total of 1,618 shipping losses are recorded in the NMR within the Study Area. As stated already it is important to remember that the positions of recorded losses are often vague and inaccurate and that these records only include those losses which were actually recorded.

9.4.6 Although the recorded losses are not tied to known positions on the seabed they should be expected to survive in some form within the Study Area. Similarly, the potential exists for the remains of shipping casualties listed at Named Locations located outside licence, application and prospecting areas to be present within these potential areas of impact.

9.4.7 Of the recorded losses within the Study Area only 3 are in any way proximate to a licence area, in this case Area 122/2. These records are associated with an NMR Named Location, the easternmost edge of which clips the western edge of Area 122/2.

9.4.8 The shipping casualties present within the potential areas of impact comprise approximately 0.2% of the total recorded losses listed for the Study Area. However, the large number of recorded losses and the lack of accurate positional data suggest that this receptor must be regarded with a degree of uncertainty. A precautionary approach has, therefore, been adopted and a **high** uncertainty rating has been applied to this receptor.

9.4.9 On this basis too, a **moderate degree of local or regional interaction** is suggested between the dredging impacts and shipping casualties as a receptor.

Unknown, Uncharted Wreck Sites

9.4.10 Unknown and uncharted wreck sites are those for which there is no record of loss or position, but whose existence is inferred or likely on the basis of the maritime history of the Study Area. It is not possible to quantify the extent of unknown and uncharted sites within the impact areas.

9.4.11 The Study Area contains a number of AMAPs (see **Section 8.3**) in which a high potential for ship loss coincides with a high potential for the preservation of archaeological materials (Bournemouth University 2007). However, it is important to note that sediment conditions favourable for preservation of archaeological shipwreck material are predominantly provided by finer-grained sediments rather than by the coarse gravel deposits targeted by the aggregate industry, and within the Study Area only a single aggregate licence area, Area 122/2, overlaps the AMAPs proposed by Bournemouth University.

9.4.12 There is a great deal of uncertainty regarding the distribution and extent of unknown, uncharted wreck sites within the potential impact areas and across the Study Area as a whole. A precautionary approach has, therefore, been adopted and a **high** uncertainty rating has been applied to this receptor and a **moderate to high degree of local or regional interaction** between the impact and the receptor is anticipated.

Isolated Maritime Finds

9.4.13 Maritime sites comprise not only wrecks of vessels, but also debris which is associated with maritime activities. This can include, for example, artefacts which were accidentally lost or material deliberately thrown overboard from a vessel.

9.4.14 While there is the potential for isolated finds of this nature within the potential impact areas and across the Study Area as a whole, it is not possible to quantify the volume or distribution of such artefacts. However, the number of known wrecks and documented losses and the inferred potential for unknown and uncharted wreck sites suggests a high potential for such finds to be present on the seabed.

9.4.15 Due to the uncertainty regarding their location, isolated maritime finds must be approached with caution. A **high** uncertainty rating has, therefore, been applied to this receptor and a **moderate degree of local or regional interaction** between the impact and this receptor is suggested.

9.5 INTERACTION BETWEEN RECEPTORS AND IMPACTS: AVIATION ARCHAEOLOGY

Known, Charted Aircraft Crash Sites

9.5.1 SeaZone lists 12 charted aircraft crash sites on the seabed within the Study Area, two of which lie within a licence, application or prospecting area. One is a modern loss, a Piper aircraft lost in 1975 which lies within Area 340, and the other is a Meteor which lies within Area 453.

9.5.2 Wessex Archaeology's *Wrecks on Seabed* project located and investigated the two aircraft wrecks, a B-17 and B-24 bomber, both of which lie within the study Area, but neither of which are associated with a licence, application or prospecting area.

9.5.3 Because the location of these wrecks is known the interactions of this receptor with aggregate extraction impacts are well understood and documented. A **low** uncertainty rating has thus been applied to this receptor.

9.5.4 On the basis of the known resource, therefore, **no regional interaction** is expected between the known, charted aircraft receptor and the aggregate extraction impacts. At a licence area level, however, there is the potential for a **high degree of local interaction**.

Recorded Aircraft Losses

9.5.5 In contrast to the small known resource, records of aircraft losses at sea are extensive. For the purpose of this report, recorded aircraft losses are those documented losses listed by the NMR at Named Locations and in the records of WWII Air/Sea Rescue Operations. There are a total of 221 recorded aircraft losses listed by the NMR within the Study Area. The total number of WWII Air/Sea Rescue Operations within the Study Area was extracted from contemporary maps which are sometimes ambiguous and unclear and thus must be considered with caution. The maps imply, however, that a substantial number of Air/Sea Rescue Operations took place within the Study Area.

9.5.6 Of the 221 recorded losses, only one (1) is proximate to a current aggregate licence area. This is a Mk1 Spitfire lost in 1940 linked to the Named Location adjacent to Area 122/2 described above.

9.5.7 Although the recorded losses are not currently tied to known aircraft remains on the seabed they should be expected to survive in some form within the Study Area. Similarly, the potential exists for the remains of aircraft losses listed in other Named Locations located outside licence, application and prospecting areas to be present within these potential areas of impact.

9.5.8 On the basis of available data, the recorded aircraft losses that lie within licence, application or prospecting areas comprise less than 0.5% of the total documented aircraft losses in the Study Area.

9.5.9 There is no single definitive list of aircraft losses in UK territorial waters and thus the numbers presented above must not be considered definitive. Additionally, the positional data for the NMR recorded aircraft losses and WWII Air/Sea Rescue Operations is poor. A precautionary approach has, therefore, been adopted and a **high** uncertainty rating has been applied to this receptor.

9.5.10 Given these factors, and the automatic protection afforded military aircraft under the Protection of Military Remains Act (1986), a **moderate degree of local or regional interaction** may be suggested between the impacts and the location and distribution of the receptor.

Isolated Aircraft Finds

9.5.11 Isolated finds relating to aviation activity may also be present within the potential areas of impact and the Study Area as a whole. Most aircraft came to be on the seabed as a result of in-flight accident or enemy action. The remains of aircraft that exploded in mid-air or hit the water at speed are likely to be represented by fragmented and widely dispersed wreckage and artefacts rather than a coherent aircraft wreck.

9.5.12 It is not possible to quantify the volume or distribution of such artefacts across the Study Area. However, the number of known aircraft crash sites and the documented aircraft losses suggests a high potential for such material to be present in or on the seabed.

9.5.13 Due to the uncertainty regarding their location, isolated aircraft finds must be approached with caution. A **high** uncertainty rating has, therefore, been applied to this receptor and a **moderate to high degree of local or regional interaction** between the impact and this receptor is suggested.

9.6 INTERACTION BETWEEN RECEPTORS AND IMPACTS: SUMMARY

9.6.1 **Table 9** presents a summary of the interaction between the various receptors and the potential areas of impact within the Study Area.

Theme	Receptor	Degree of Regional Interaction
Prehistoric Archaeology	Pleistocene Fluvial Gravel	Large
	Estuarine Alluvium	Small
	Peat	Small
	Isolated Prehistoric Finds	Moderate
Maritime Archaeology	Known Charted Wreck Sites	None
	Shipping Casualties	Moderate
	Unknown Uncharted Wreck Sites	Moderate / High
	Isolated Maritime Finds	Moderate
Aviation Archaeology	Known Charted Aircraft Crash Sites	None
	Recorded Aircraft Losses	Moderate
	Isolated Aircraft Finds	Moderate / High

Table 9: Summary of the interaction between the receptors and impacts at a regional scale

9.7 DREDGING IMPACTS

9.7.1 The process of marine aggregate extraction and the effects of substrate removal and sediment plume may result in the following impacts upon prehistoric, maritime and aviation archaeology:

- **Impact 1**: Direct damage to both *in situ* and derived archaeological material;
- **Impact 2**: Damage and dispersal of *in situ* material resulting in the disturbance of relationships between structures, artefacts and their surroundings or contexts;
- **Impact 3**: Loss of derived prehistoric artefacts and isolated wreck and aircraft artefacts and debris within the volume of aggregate;
- **Impact 4**: Destabilisation of sites through the removal of overlying or adjacent sediments prompting exposure and leading to instability, erosion or corrosion and decay;
- **Impact 5**: Burial of sites due to re-deposited sediment, potentially protecting and promoting the favourable preservation of sites.

Summary

9.7.2 **Table 10** below summarises the nature, type and order of impacts discussed above across all archaeological themes.

Impact	Effect	Nature of Impact	Type and Order of Impact
1	Substrate Removal / Changes to Bathymetry	Negative	Direct
2	Substrate Removal / Changes to Bathymetry	Negative	Direct
3	Substrate Removal	Negative	Direct
4	Substrate Removal / Changes to Bathymetry	Negative	Secondary/Indirect
5	Sediment Plume	Positive	Secondary/Indirect

Table 10: Summary of the nature, type and order of impacts

9.7.3 Impacts 1-3 arise from activities associated with marine aggregate extraction and are thus **direct** impacts. Impacts 4 and 5 occur as a consequence of the direct impacts and are **secondary** or **indirect**.

9.7.4 Impacts 1-4 result in adverse changes to the archaeological baseline conditions and are thus considered to be **negative** impacts. Due to the finite, non-renewable nature of the archaeological record, archaeological receptors affected by these impacts will by unable to return to their pre-impact state and as such there is no degree of reversibility to these impacts.

9.7.5 Impact 5 may result in the introduction of a potentially desirable factor for the archaeological receptor and is consequently regarded as a **positive** impact.

9.8 MAGNITUDE OF EFFECTS

9.8.1 In order to determine the magnitude of the effects of dredging on the archaeological receptors, the predicted effects are defined in terms of their elevation above background or baseline conditions and assessed against the following variables:

- Extent of effect;
- Duration of effect;
- Frequency of effect;
-

Elevation above Baseline

9.8.2 The effect of substrate removal upon the existing archaeological baseline will be adverse or negative. The archaeological record is non-renewable and any negative impacts will result in permanent and non-reversible changes to the existing baseline.

Extent of Effect

9.8.3 The direct and secondary/indirect impacts (Impacts 1-4) of substrate removal and changes to bathymetry arise as a direct result of the aggregate extraction process. It is therefore reasonable to propose that the extent of these effects is limited to aggregate licence areas. Their extent can therefore be considered to be confined to the **Primary Impact Zone** (PIZ), which encompasses only the footprint of each licence area.

9.8.4 The impact of the sediment plume (Impact 5) is also likely to be largely confined to the dredging licence areas, although the re-deposition of sediment may extend downstream, beyond the boundaries of the areas. The extent of this effect can therefore be considered to be **localised**, extending up to one tidal excursion (typically <10km) beyond the licence areas.

Duration of Effect

9.8.5 The direct impacts of substrate removal and changes in bathymetry (Impacts 1-3) on archaeological receptors occur as a result of dredging, are largely non-reversible and their effects upon the archaeological record can thus be described as **permanent**.

9.8.6 The effects of the secondary/indirect impacts of site destabilisation due to substrate removal and site burial due to sediment deposition (Impacts 4-5) on archaeological receptors are **short/medium-term** in duration. This is based on the exposure or concealment of archaeological material which results from the process of marine aggregate extraction. Any damage to archaeological material which is exposed on the seabed as a result of aggregate extraction, however, is non-reversible and **permanent**.

Frequency of Effect

9.8.7 Substrate removal, changes in bathymetry and sediment plume will occur during all normal dredging operations and are thus **routine**.

9.8.8 These effects will not, however, necessarily impact upon the archaeological resource each time they occur. The uncertainty about the extent, location and distribution of archaeological sites and material both within the PIZs and across the Study Area as a whole means that it is not possible to determine the frequency with which each receptor will be impacted by the effects of marine aggregate extraction.

9.8.9 It is therefore proposed that the frequency of the effects of substrate removal, changes to bathymetry and sediment plume on the archaeological record is **intermittent**; the effects occurring regularly but not at all times during dredging operations.

Summary

9.8.10 **Table 11** summarises the extent, duration, frequency and thus, the magnitude of the effects of substrate removal and sediment plume on archaeology.

Effect	Extent	Duration	Frequency
Substrate Removal	PIZ	Permanent	Routine
Changes to Bathymetry	PIZ	Permanent	Routine
Sediment Plume	Localised	Short-Term/ Medium-Term	Routine

Table 11: Magnitude of the effects of substrate removal and sediment plume on archaeology

9.8.11 Based on a combination of elevation above baseline and the extent, duration and frequency of the effects of marine aggregate extraction, it is proposed that the effects of substrate removal and sediment plume are of **low** to **medium magnitude**.

9.9 RECEPTOR SENSITIVITY

9.9.1 In order to asses the impacts of marine aggregate extraction at a regional scale, the sensitivity of each archaeological receptor must also be considered. The sensitivity of each receptor is assessed against the following three criteria:

- **Adaptability**: The ability of the receptor to avoid the effects of dredging.
- **Tolerance**: The ability of the receptor to be either unaffected or permanently changed by the effects of dredging.

- **Recoverability**: The ability of a receptor to return to a state close to that which existed before the effects of dredging caused a change.

9.9.2 The assessment of the sensitivity of all archaeological receptors must also take into account their value, which is based on the fact that they are finite and non-renewable in nature, and an assessment of whether the receptor in question is rare, protected or threatened.

9.10 RECEPTOR SENSITIVITY AND VALUE: PREHISTORIC ARCHAEOLOGY

Pleistocene Fluvial Gravels

9.10.1 In light of the archaeological potential of Pleistocene fluvial gravels any *in situ* deposits relating to the Lower and Middle Palaeolithic period within the region must be regarded to be of national and international importance in understanding Europe's earliest human populations. If present in the Study Area such deposits can be expected to found within or associated with Pleistocene gravels, which should therefore be regarded as a **high value** receptor.

9.10.2 Pleistocene fluvial gravels will be unable to adapt to, tolerate or recover from the effects of substrate removal and changes to bathymetry, resulting in a permanent change to the receptor. Due to its non-renewable and finite nature, and as the primary target of aggregate extraction, the receptor is thus **highly sensitive** to the effects of aggregate dredging.

9.10.3 With regard to the effects of sediment plume, Pleistocene fluvial gravels are likely to be unaffected or positively affected and are thus regarded as a receptor of **negligible** / **low sensitivity**.

9.10.4 On the basis of their age and the rarity of finds in a marine context, Palaeolithic and Mesolithic sites and material discovered within the Study Area would be of high national and possibly international archaeological importance. *Identifying and Protecting Palaeolithic Remains: Archaeological Guidance for Planning Authorities and Developers* (English Heritage 1998) notes that sites containing *in situ* Palaeolithic artefacts are so rare in Britain that they should be regarded as of national importance and whenever possible should remain undisturbed.

9.10.5 As described above, therefore, Pleistocene fluvial gravels should be considered to be a high value archaeological receptor

Estuarine Alluvium

9.10.6 The fluvial processes of the Holocene have resulted in the deposition of alluvial sediments within the Study Area. With the gradual rise in sea level which led to the inundation of the Study Area in the Late Mesolithic, some of these sediments will have sealed and buried deposits or landscape features in which Late Devensian and early Holocene *in situ* archaeological material may be present. Estuarine alluvium should thus be regarded as a **high value** receptor.

9.10.7 Estuarine alluvium will be unable to adapt to, tolerate or recover from the effects of substrate removal and changes to bathymetry, resulting in a permanent change to the receptor. However, on the assumption that alluvial deposits are not targeted by the marine aggregate industry they can be regarded as a receptor of **low sensitivity** to the effects of substrate removal.

9.10.8 With regard to the effects of sediment plume, alluvial deposits are likely to be unaffected or positively affected and are thus regarded as a receptor of **negligible / low sensitivity.**

Peat

9.10.9 As already discussed, fluvial processes during the Late Devensian and Holocene resulted in the formation of peat deposits within the estuarine alluvium. As evidence of past environments and changes to the geomorphology of the coastline during these periods, and because they may also contain *in situ* archaeological material, peat deposits should thus be regarded as a **high value** receptor.

9.10.10 Peat deposits will be unable to adapt to, tolerate or recover from the effects of substrate removal and changes to bathymetry, resulting in a permanent change to the receptor. However, on the assumption that peat deposits are not targeted by the marine aggregate industry they can be regarded as a receptor of **low sensitivity** to the effects of substrate removal.

9.10.11 With regard to the effects of sediment plume, peat deposits are likely to be unaffected or positively affected and are thus regarded as a receptor of **negligible / low sensitivity.**

Isolated Prehistoric Finds

9.10.12 Although archaeological material from secondary contexts is by its nature, derived, recent discoveries have shown that it nevertheless has the potential to provide valuable information on patterns of human land use and demography in a field of study which is still little understood and rapidly evolving (Hotsfield and Chambers 2004). Isolated prehistoric finds should thus be regarded as **moderate value** receptors.

9.10.13 The adaptability to, tolerance of and recoverability of isolated prehistoric finds from substrate removal and changes to bathymetry is **negligible**. This is because while derived material is still susceptible to direct damage and the potential for the loss of artefacts within the volume of aggregate remains, the damage and dispersal of archaeological material resulting in the loss of the relationship between the artefact and its archaeological context is not a principle concern when dealing with artefacts which are already within their secondary context.

9.10.14 For the same reasons, the exposure of derived material is not of the same degree of concern as *in situ*, primary context archaeological deposits. However, isolated archaeological material will be unable to tolerate the effects of substrate removal, resulting in a permanent change to the receptor.

9.10.15 The receptor’s ability to return to its pre-impact state after substrate removal is **zero**. Given their moderate archaeological value, however, isolated prehistoric finds can be regarded as receptors of **moderate sensitivity** to the effects of substrate removal.

9.10.16 With regards to the effects of sediment plume, isolated prehistoric finds are likely to be unaffected or positively affected, and are thus regarded as a receptor of **low sensitivity**.

Summary

9.10.17 **Table 12** summarises the value and sensitivity for each prehistoric receptor with regards to substrate removal and sediment plume.

Receptor	Value	Sensitivity	
		Substrate Removal	Sediment Plume
Pleistocene Fluvial Gravels	High	High	Low
Alluvium	High	Low	Low
Peat	High	Low	Low
Isolated Prehistoric Finds	Moderate	Moderate	Low

Table 12: Summary of the value and sensitivity for each prehistoric receptor

9.11 RECEPTOR VALUE AND SENSITIVITY: MARITIME ARCHAEOLOGY

9.11.1 The value assigned to a wreck site is to a large degree case specific. A vessel may have historical importance at a local, national or international level as a result of its association with a historical event or figure. Wartime losses or a vessel whose sinking was associated with a loss of life may have a level of importance directly associated with that loss of life. Vessels which are key to or representative of specific periods of maritime development may also be regarded as important. Alternatively a vessel may have a level of archaeological importance based on the rarity of its representation within the maritime archaeological record and/or its cargo. Wrecks which are regarded to be of special interest may be designated under the Protection of Wrecks Act 1973 or the Protection of Military Remains Act 1986.

9.11.2 The differing levels of importance assigned to wrecks are not necessarily dictated by age. However, in an attempt to provide a few generalisations regarding the age and special interest of vessels, a composite timeline (Wessex Archaeology 2008d) was consulted throughout this assessment which takes into account the broad chronology of shipbuilding and employment (**Section 6.1**). The known and potential maritime archaeological resource in the Study Area was queried by the periods presented in this timeline, the results of which were presented in **Section 6.7**.

Known, Charted Wrecks

9.11.3 The relative potential importance of the various periods into which the known, charted wrecks within the Study Area fall has been discussed already. Although this will vary from wreck to wreck, all of the known wrecks in the Study Area will have a greater or lesser degree have archaeological potential and value. Due to this variability at a regional scale known, charted wreck sites must be regarded as a **high value** receptor.

9.11.4 Particularly where substrate removal results in a direct impact to the archaeological record known, charted wreck sites will be unable to tolerate the effects, resulting in a permanent change in the receptor. The adaptability and tolerance of the receptor is **zero**.

9.11.5 However, because the extent and distribution of this receptor is fairly accurately known and the marine aggregate industry avoids seabed structures and obstructions such as wrecks, known charted wrecks can be regarded as a receptor of **low sensitivity**.

9.11.6 With regard to the effects of sediment plume, known charted wrecks are likely to be unaffected or positively affected and are thus regarded as a receptor of **low sensitivity**.

Shipping Casualties / Recorded Losses

9.11.7 The relative potential importance of the various periods into which the recorded shipping casualties within the Study Area fall has been discussed already. The recorded losses in the Study Area will each have a greater or lesser degree archaeological potential and value should they be located on the seabed. Due to this variability at a regional scale recorded shipping casualties must be regarded as a **high value** receptor.

9.11.8 Particularly where substrate removal results in a direct impact to the archaeological record the physical remains of recorded shipping casualties will be unable to tolerate the effects, resulting in a permanent change in the receptor. The adaptability, tolerance and the measure of the receptor's ability to return to its pre-impact state is zero.

9.11.9 Due to the uncertainty of their location and the potential, therefore, for impact from aggregate dredging recorded shipping casualties should be regarded as a receptor of **high sensitivity**.

9.11.10 With regard to the effects of sediment plume, the remains of shipping casualties are likely to be unaffected or positively affected and are thus regarded as a receptor of **low sensitivity**.

Unknown, Uncharted Wreck Sites

9.11.11 The biases in of the records of both charted wrecks and documented shipping casualties towards vessels lost from the mid-18th century onwards have already been discussed, as has the potential for the presence within the Study Area of unknown watercraft and vessels dating from the Mesolithic period to the modern day. A significant proportion of unknown, uncharted wreck sites will pre-date the consistent keeping of casualty records and on that basis (i.e. their age and rarity) unknown, uncharted wrecks as a group can be considered to be of special archaeological interest and should be regarded as a **high value** receptor.

9.11.12 Particularly where substrate removal results in a direct impact to the archaeological record the remains of unknown, uncharted wrecks would be unable to tolerate the effects, resulting in a permanent change in the receptor. As such, the adaptability, tolerance and the measure of the receptor's ability to return to its pre-impact state is **zero**.

9.11.13 Due to a lack of any certainty as to their numbers and location, and the consequent potential for them to be impacted by aggregate dredging unknown, uncharted wrecks should be regarded as a receptor of **high sensitivity**.

9.11.14 With regard to the effects of sediment plume, the remains of shipping casualties are likely to be unaffected or positively affected and are thus regarded as a receptor of **low sensitivity**.

Isolated Maritime Finds

9.11.15 Isolated maritime finds are isolated or derived artefacts which are likely to be of limited archaeological importance. However the occurrence of a number of seemingly isolated artefacts within a particular area can indicate historical shipping routes or maritime battlegrounds, for example, or may suggest the presence of a hitherto unknown wreck site. On this basis, isolated maritime finds are regarded as a **moderate value** receptor.

9.11.16 The adaptability and tolerance of isolated maritime finds to substrate removal is **low**. This assessment is based on the scattered and ephemeral nature of this receptor and the limited effect the impacts of aggregate dredging will thus have on it. However, if the receptor is adversely affected by substrate removal, it will be unable to recover, resulting in permanent change. As such the measure of the receptor's ability to return to its pre-impact state is **zero**. It is thus suggested that isolated maritime finds be regarded as a receptor of **moderate sensitivity**.

9.11.17 With regard to the effects of sediment plume, isolated maritime finds are likely to be unaffected or positively affected and are thus regarded as a receptor of **low sensitivity**.

Summary

9.11.18 **Table 13** summarises the value and sensitivity for each maritime receptor with regards to substrate removal and sediment plume.

Receptor	Value	Sensitivity	
		Substrate Removal	Sediment Plume
Known Charted Wreck Sites	High	Low	Low
Shipping Casualties / Recorded Losses	High	High	Low
Unknown Uncharted Wreck Sites	High	High	Low
Isolated Maritime Finds	Moderate	Moderate	Low

Table 13: Summary of the value and sensitivity for each maritime receptor

9.12 RECEPTOR VALUE AND SENSITIVITY: AVIATION ARCHAEOLOGY

9.12.1 The importance of aircraft crash sites is outlined in *Military Aircraft Crash Sites* (English Heritage 2002) as discussed above. They not only have significance for remembrance and commemoration, but also have an implicit heritage value as historic artefacts, providing information on the aircraft itself and also the circumstances of its use and loss (English Heritage 2002:2).

Known, Charted Aircraft Crash Sites

9.12.2 Within the Study Area there are 12 charted sites known to be aircraft wrecks, all of which are automatically protected by the Protection of Military Remains Act 1986. On this basis, known, charted aircraft crash sites are considered to be **high value** receptors.

9.12.3 Known, charted aircraft crash sites will be unable to tolerate the effects of substrate removal resulting in a permanent change in the receptor. As such, the adaptability, tolerance and the measure of the receptor's ability to return to its pre-impact state is **zero**. However, because the extent and distribution of this receptor is fairly accurately known and the marine aggregate industry avoids seabed structures and obstructions such as wrecks, known, charted aircraft crash sites can be regarded as a receptor of **low sensitivity**.

9.12.4 With regard to the effects of sediment plume, known aircraft crash sites are likely to be unaffected or positively affected, and are thus regarded as a receptor of **low sensitivity**.

Recorded Aircraft Losses

9.12.5 There are 221 recorded losses listed by the NMR within the Study Area. Of these 211 date to between 1914 and 1946, four (4) post-date 1946 and the remaining six (6) are undated. In addition, there are a large number of WWII Air/Sea Rescue Operations recorded to have taken place in the Study Area.

9.12.6 The location, distribution of the physical remains of these recorded aircraft losses on the seabed is poorly understood. However, these sites are likely to be of special archaeological interest, and will be automatically protected by the Protection of Military Remains Act 1986 should they be located. Consequently at a regional scale recorded aircraft losses must be considered as a **high value** receptor.

9.12.7 Particularly where substrate removal results in a direct impact to the archaeological record the physical remains of recorded aircraft losses would be unable to tolerate the effects, resulting in a permanent change in the receptor. As such, the adaptability, tolerance and the measure of the receptor's ability to return to its pre-impact state is **zero**. Although the positions of these sites are not known, the relatively short span of time since they were deposited on the seabed suggests that wreckage should be expected to survive in some form within the Study Area. Due to the uncertainty regarding their precise location and the potential, therefore, for impact from aggregate dredging recorded aircraft losses should be regarded as a receptor of **high sensitivity**.

9.12.8 With regard to the effects of sediment plume, the remains of recorded aircraft losses are likely to be unaffected or positively affected and are thus regarded as a receptor of **low sensitivity**.

Isolated Aircraft Finds

9.12.9 Isolated aircraft finds will consist of derived, aircraft-related artefacts which may be of limited archaeological importance as isolated objects. However the occurrence of a number of seemingly isolated artefacts within a particular area can give insights into patterns of historical aviation across the Study Area or may indicate the presence of a recorded but uncharted aircraft crash site. On this basis, isolated aircraft finds are regarded as a **moderate value** receptor.

9.12.10 The adaptability and tolerance of isolated aircraft finds to substrate removal is **low**. This assessment is based on the scattered and ephemeral nature of this receptor and the limited effect the impacts of aggregate dredging will thus have on it. However, if the receptor is adversely affected by substrate removal, it will be unable to recover, resulting in permanent change. As such the measure of the receptor's ability to return to its pre-impact state is **zero**. It is thus suggested that isolated maritime finds be regarded as a receptor of **moderate sensitivity**.

9.12.11 With regard to the effects of sediment plume, isolated aircraft finds are likely to be unaffected or positively affected and are thus regarded as a receptor of **low sensitivity**.

Summary

9.12.12 **Table 14** summarises the value and sensitivity for each maritime receptor with regards to substrate removal and sediment plume.

Receptor	Value	Sensitivity	
		Substrate Removal	Sediment Plume
Known Charted Aircraft Crash Sites	High	Low	Low
Recorded Aircraft Losses	High	High	Low
Isolated Aircraft Finds	Moderate	Moderate	Low

Table 14: Summary of the value and sensitivity for each aviation receptor

9.13 SIGNIFICANCE OF LIKELY IMPACTS

9.13.1 The significance of likely impacts arises from the combination of several variables, including the degree to which the receptor and the impact interact, the magnitude of the effect in terms of the extent, duration and frequency of the impact and the sensitivity of the receptor to the effect of impact. The significance of impacts are defined as 'not significant' or of 'minor', 'moderate' or 'high' significance.

9.14 SIGNIFICANCE OF LIKELY IMPACTS: PREHISTORIC ARCHAEOLOGY

9.14.1 **Tables 15** and **16** provide a summary of the results of the impact assessment for prehistoric archaeology receptors against the effects of substrate removal, changes to bathymetry and sediment plume carried out above.

Substrate Removal				
Impact Assessment Criteria	Prehistoric Archaeology Receptors			
	Pleistocene Fluvial Gravels	Estuarine Alluvium	Peat	Isolated Prehistoric Finds
Interaction between Effects and Receptors	Major	Minor	Minor	Moderate
Magnitude of Effect	Minor / Moderate	Minor / Moderate	Minor / Moderate	Minor / Moderate
Value of Receptor	Major	Major	Major	Moderate
Sensitivity of Receptor	Major	Minor	Minor	Moderate
Significance of Impact	**Major**	**Minor / Moderate**	**Minor / Moderate**	**Moderate**

Table 15: Summary of variables assessed with regards to substrate removal and prehistoric archaeology

Sediment Plume				
Impact Assessment Criteria	Prehistoric Archaeology Receptors			
	Pleistocene Fluvial Gravels	Estuarine Alluvium	Peat	Isolated Prehistoric Finds
Interaction between Effects and Receptors	Major	Minor	Minor	Moderate
Magnitude of Effect	Minor / Moderate	Minor / Moderate	Minor / Moderate	Minor / Moderate
Value of Receptor	Major	Major	Major	Moderate
Sensitivity of Receptor	Minor	Minor	Minor	Minor
Significance of Impact	**Moderate**	**Minor / Moderate**	**Minor / Moderate**	**Moderate / Minor**

Table 16: Summary of variables assessed with regards to sediment plume and prehistoric archaeology

9.15 SIGNIFICANCE OF LIKELY IMPACTS: MARITIME ARCHAEOLOGY

9.15.1 **Tables 17** and **18** provide a summary of the results of the impact assessment for maritime archaeology receptors against the effects of substrate removal and sediment plume accordingly carried out above.

Substrate Removal				
Impact Assessment Criteria	**Maritime Archaeology Receptors**			
	Known Charted Wreck Sites	**Shipping Casualties / Recorded Losses**	**Unknown Uncharted Wreck Sites**	**Isolated Maritime Finds**
Interaction between Effects and Receptors	Minor	Moderate	Moderate	Moderate
Magnitude of Effect	Minor / Moderate	Minor / Moderate	Minor / Moderate	Minor / Moderate
Value of Receptor	Major	Major	Major	Moderate
Sensitivity of Receptor	Minor	Major	Major	Moderate
Significance of Impact	**Minor / Moderate**	**Moderate / Major**	**Moderate / Major**	**Moderate**

Table 17: Summary of variables assessed with regards to substrate removal and maritime archaeology

Sediment Plume				
Impact Assessment Criteria	**Maritime Archaeology Receptors**			
	Known Charted Wreck Sites	**Shipping Casualties / Recorded Losses**	**Unknown Uncharted Wreck Sites**	**Isolated Maritime Finds**
Interaction between Effects and Receptors	Minor	Moderate	Moderate	Moderate
Magnitude of Effect	Minor / Moderate	Minor / Moderate	Minor / Moderate	Minor / Moderate
Value of Receptor	Major	Major	Major	Moderate
Sensitivity of Receptor	Minor	Minor	Minor	Minor
Significance of Impact	**Minor / Moderate**	**Moderate**	**Moderate**	**Moderate / Minor**

Table 18: Summary of variables assessed with regards to sediment plume and maritime archaeology

9.16 SIGNIFICANCE OF LIKELY IMPACTS: AVIATION ARCHAEOLOGY

9.16.1 **Tables 19** and **20** provide a summary of the results of the impact assessment for aviation archaeology receptors against the effects of substrate removal and sediment plume accordingly carried out above.

Substrate Removal			
Impact Assessment Criteria	**Aviation Archaeology Receptors**		
	Known Charted Aircraft Crash Sites	**Recorded Aircraft Losses**	**Isolated Aircraft Finds**
Interaction between Effects and Receptors	Minor	Moderate	Moderate
Magnitude of Effect	Minor / Moderate	Minor / Moderate	Minor / Moderate
Value of Receptor	Major	Major	Moderate
Sensitivity of Receptor	Minor	Major	Moderate
Significance of Impact	**Minor / Moderate**	**Moderate / Major**	**Moderate**

Table 19: Summary of variables assessed with regards to substrate removal and aviation archaeology

Sediment Plume			
Impact Assessment Criteria	Aviation Archaeology Receptors		
	Known Charted Aircraft Crash Sites	Recorded Aircraft Losses	Isolated Aircraft Finds
Interaction between Effects and Receptors	Minor	Moderate	Moderate
Magnitude of Effect	Minor / Moderate	Minor / Moderate	Minor / Moderate
Value of Receptor	Major	Major	Moderate
Sensitivity of Receptor	Minor	Minor	Minor
Significance of Impact	**Minor / Moderate**	**Moderate**	**Moderate / Minor**

Table 20: Summary of variables assessed with regards to sediment plume and aviation archaeology

9.17 SUMMARY OF SIGNIFICANCE

9.17.1 **Table 21** summarises the significance of likely impact for each group of maritime receptors with regards to substrate removal and sediment plume.

Receptor	Significance of Likely Impact		
	Substrate Removal	Changes to Bathymetry	Sediment Plume
Prehistoric Archaeology	**Moderate / Major**		**Moderate / Minor**
Maritime Archaeology	**Moderate / Major**		**Moderate**
Aviation Archaeology	**Moderate**		**Moderate**

Table 21: Summary of the significance of likely impact for each group of maritime receptors

9.18 CUMULATIVE AND IN-COMBINATION ASSESSMENT

9.18.1 In this Impact Assessment the main impacts of the marine aggregate extraction on archaeological receptors have been identified as the effects of substrate removal and sediment plume.

9.18.2 The following sections (**Sections 9.18**-**9.20**) present an assessment of the cumulative and in-combination impacts of these on each archaeological receptor.

9.19 CUMULATIVE AND IN-COMBINATION ASSESSMENT: PREHISTORIC ARCHAEOLOGY

Pleistocene Fluvial Gravels

9.19.1 Of the prehistoric receptors, Pleistocene fluvial gravels are likely to be impacted to the greatest degree by substrate removal and the effects of substrate removal upon this receptor have been assessed to be of **moderate** to **major significance**.

9.19.2 There is no way of confirming the presence and or quantifying the extent of archaeological material within Pleistocene fluvial gravel in advance of dredging activities within the Study Area. As a result, it would not be reasonable to consider the possible impact on such material as a constraint on extraction.

9.19.3 The effects of substrate removal upon Pleistocene fluvial gravels may be regulated to a degree by the implementation of the EH/BMAPA *Protocol for Reporting Finds of Archaeological Interest* during the course of marine aggregate extraction. The protocol enables finds of prehistoric archaeological interest to be reported and archaeologically researched. Should a number of finds be reported through the Protocol which imply an area of archaeological sensitivity on the seabed, archaeological consultation must take place a judgment will be made as to whether the area should be subject to a Temporary Exclusion Zone (TEZ). As the general practice of dredging is to remove aggregate in a series of shallow layers, there is an opportunity to investigate rapid measures such as exclusion zones should an area of archaeological sensitivity arise. A case in point is presented by the discovery of at least 28 hand axes in Area 240, approximately 13km off the coast of Great Yarmouth which may have been dredged up from a deposit in which they lay *in situ.* The location in which these finds were discovered has since been protected by a TEZ.

9.19.4 The effects of sediment plume upon Pleistocene fluvial gravel have the potential to bury and conceal archaeological material, thus promoting its preservation. The preferred means of mitigation with regards to the archaeological resource is to preserve archaeological material *in situ.* Consequently, such impacts are regarded as positive and do not compromise the existing baseline.

Estuarine Alluvium

9.19.5 Deposits suitable for exploitation as marine aggregate extraction comprise gravels without a covering of clay or silt. Consequently, the marine aggregate industry actively avoids areas in which estuarine alluvium is present. While there is the potential for *in situ* archaeological material to be concealed within and beneath estuarine alluvium, on this basis the effects of substrate removal upon this receptor is regarded to be of minor significance.

9.19.6 As an impact of minor significance, no action is required if impacts can be controlled by adopting normal good working practice. As with Pleistocene fluvial gravels, there is currently no way to quantify and qualify the presence of archaeological material within estuarine alluvium. In order to ensure good working practice in this case it is thus necessary for the EH/BMAPA Protocol to be adopted, enabling the reporting of archaeological material which may derive from such deposits. Areas of archaeological sensitivity may be subject to a TEZ.

9.19.7 The effects of sediment plume upon estuarine alluvium have the potential to bury and conceal archaeological material, thus promoting its preservation. The preferred means of mitigation with regards to the archaeological resource is to preserve archaeological material *in situ.* Consequently, such impacts are regarded as positive and do not compromise the existing baseline.

Peat

9.19.8 Deposits suitable for exploitation as marine aggregate extraction comprise gravels without a covering of organic-rich sediments. Consequently, the marine aggregate industry actively avoids areas in which peat deposits are present. While there is the potential for peat to both inform upon an understanding of past landscapes and to contain *in situ* archaeological material, on the basis that such deposits are actively avoided, the effects of substrate removal upon this receptor are regarded to be of minor significance.

9.19.9 As an impact of minor significance, no action is required if impacts can be controlled by adopting normal good working practice. In order to ensure good working practice in this case it is thus necessary for the EH/BMAPA Protocol to be adopted, enabling the reporting of archaeological material which may derive from such deposits. There have been two instances in which peat deposits were encountered during marine aggregate dredging and reported through the EH/BMAPA Protocol since it began in 2005. In one such instance, a peat deposit dredged approximately 20km east of Great Yarmouth was found to contain wood, mineralised bone, antler and a single piece of struck flint which are thought to have eroded out of a peat layer possibly more than 10,000 years old. If finds from a particular area suggest an area of archaeological sensitivity, a TEZ may be implemented.

9.19.10 The effects of sediment plume upon peat have the potential to bury and conceal archaeological material, thus promoting its preservation. The preferred means of mitigation with regards to the archaeological resource is to preserve archaeological material *in situ.* Consequently, such impacts are regarded as positive and do not compromise the existing baseline.

Isolated Prehistoric Finds

9.19.11 The extent, location and distribution of isolated prehistoric finds is unknown and thus it is not possible to qualify and quantify the potential for such material to be encountered during the course of dredging. As a response to this uncertainty, the effects of Substrate Removal are assigned as of moderate significance with regards to this receptor. As an impact of moderate significance, the effects of substrate removal upon isolated prehistoric finds must be recognised and addressed in consultation with an archaeologist.

9.19.12 The EH/BMAPA Protocol must be implemented to ensure good working practice with regards to isolated prehistoric finds. Should a number of seemingly isolated finds be reported from a particular area highlighting an area of archaeological sensitivity, a TEZ may be introduced.

9.19.13 The effects of sediment plume upon isolate prehistoric finds have the potential to bury and conceal archaeological material, thus promoting its preservation. The preferred means of mitigation with regards to the archaeological resource is to preserve archaeological material *in situ.* Consequently, such impacts are regarded as positive and do not compromise the existing baseline.

9.20 CUMULATIVE AND IN-COMBINATION ASSESSMENT: MARITIME ARCHAEOLOGY

Known Charted Wreck Sites

9.20.1 Based on their relatively secure positional data alongside the desire for the marine aggregate industry to avoid seabed structures which may damage dredging equipment, the effects of substrate removal upon known charted wreck sites is considered to be of minor significance.

9.20.2 As an impact of minor significance, while this impact should must be recognised, no action is required if its effects can be controlled by adopting normal good working practice. With regards to the known maritime resource, good working practice is outlined during the EIA, whereby charted wreck sites are invariably subject to archaeological Exclusion Zones (EZ) to protect them from being impacted by dredging activities within the region. The size of the EZs should be determined by the size of the vessel and any associated debris.

9.20.3 The effects of sediment plume upon known charted wreck sites have the potential to bury and conceal archaeological wreck sites, thus promoting their preservation. The preferred means of mitigation with regards to the archaeological resource is to preserve archaeological material *in situ.* Consequently, such impacts are regarded as positive and do not compromise the existing baseline.

Shipping Casualties

9.20.4 Due to their lack of secure positional data, shipping casualties are regarded with great uncertainty. While the remains of vessels recorded as documented losses are expected to be present in some form within the Study Area region, it is not possible to identify the location of each site prior to dredging. On this basis, the effects of substrate removal on shipping casualties are considered to be of moderate significance.

9.20.5 As an impact of moderate significance, the effects of substrate removal upon this receptor must be recognised and addressed in consultation with archaeologists. Should wreck material be discovered in the course of dredging, archaeological advice must be promptly sought. The recording of artefacts through the EH/BMAPA Protocol must further be adopted as good working practice. If a number of finds are discovered from a particular area, they may imply the presence of a wreck site. Such a discovery may be subject to a TEZ until further archaeological investigation can take place.

9.20.6 The effects of sediment plume upon this receptor have the potential to bury and conceal the remains of shipping casualties, thus promoting their preservation. The preferred means of mitigation with regards to the archaeological resource is to preserve archaeological material *in situ.* Consequently, such impacts are regarded as positive and do not compromise the existing baseline.

Unknown Uncharted Wreck Sites

9.20.7 It is expected that there is the presence of a significant number of wreck sites within the Study Area for which there is no record or positional data. Information relating to the extent and distribution of wreck sites which are not represented in archaeological inventories is poor and is often limited to broad generalisations of shipping patterns and maritime activity within the region. Consequently there is currently no way of quantify and qualifying the potential for which such sites are encountered during the course of dredging. As a result, the effects of substrate removal upon unknown uncharted wreck sites are considered to be of moderate significance.

9.20.8 As with shipping casualties, the effects of substrate removal upon this receptor must be recognised and addressed in consultation with archaeologists. Should wreck material be discovered in the course of dredging, archaeological advice must be promptly sought. The recording of artefacts through the EH/BMAPA Protocol must further be adopted as good working practice. Repeated discoveries of wreck related artefacts from a specific area may bring to light the presence of a hitherto unknown wreck site which may also be subject to a TEZ. In this case, the general practice of dredging aggregate in a series of strips will provide an interval during which mitigation measures can be employed.

9.20.9 The effects of sediment plume upon unknown uncharted wreck sites have the potential to bury and conceal archaeological wreck sites, thus promoting their preservation. The preferred means of mitigation with regards to the archaeological resource is to preserve archaeological material *in situ.* Consequently, such impacts are regarded as positive and do not compromise the existing baseline.

Isolated Maritime Finds

9.20.10 It is expected that there is a widespread distribution of isolated maritime finds within the Study Area. However, there is currently no way of identifying the location of such sites prior to dredging. On this basis, the effects of substrate removal on isolated maritime finds are considered to be of moderate significance.

9.20.11 In order to regulate the impacts of substrate removal on isolated maritime finds, the EH/BMAPA Protocol must be adopted as good working practice. If a number of finds discovered from a particular area imply the presence of a wreck site, the area may be subject to a TEZ until further archaeological investigation can take place.

9.20.12 The effects of sediment plume upon isolated maritime finds have the potential to bury and conceal archaeological material, thus promoting their preservation. The preferred means of mitigation with regards to the archaeological resource is to preserve archaeological material *in situ.* Consequently, such impacts are regarded as positive and do not compromise the existing baseline.

9.21 CUMULATIVE AND IN-COMBINATION ASSESSMENT: AVIATION ARCHAEOLOGY

Known Aircraft Crash Sites

9.21.1 Although known aircraft crash sites within the Study Area are extremely limited, those which are present have relatively secure positional data. Encounters of dredging equipment with aircraft material are likely to damage suction gear and/or contaminate dredged material and thus it is in the interest of the marine aggregate industry to avoid areas in which seabed structures are present. On this basis, the effects of substrate removal on known aircraft crash sites are considered to be of minor significance.

9.21.2 As an impact of minor significance, while this impact must be recognised, no action is required if its effects can be controlled by adopting normal good working practice. With regards to the known maritime resource, good working practice is outlined during the EIA, whereby charted aircraft crash sites are invariably subject to archaeological Exclusion Zones (EZ) to protect them from being impacted by dredging activities within the region. The size of the EZs should be determined by the size of the aircraft crash site and any associated debris.

9.21.3 The effects of sediment plume upon known charted aircraft crash sites have the potential to bury and conceal such sites, thus promoting their preservation. The preferred means of mitigation with regards to the archaeological resource is to preserve archaeological material *in situ.* Consequently, such impacts are regarded as positive and do not compromise the existing baseline.

Recorded Aircraft Losses

9.21.4 In comparison to the known aviation resource, the records relating to aircraft losses are extensive within the Study Area. However, due to their lack of secure positional data, aircraft losses are regarded with great uncertainty. While the remains of aircraft losses are expected to be present in some form within the Study Area region, it is not possible to identify the location of each site prior to dredging. On this basis, the effects of substrate removal on aircraft losses are considered to be of moderate significance.

9.21.5 As an impact of moderate significance, the effects of substrate removal upon this receptor must be recognised and addressed in consultation with archaeologists. Should material relating to an aircraft crash site be discovered in the course of dredging, dredging must cease immediately and archaeological advice must be promptly sought.

9.21.6 The recording of artefacts through the EH/BMAPA Protocol must further be adopted as good working practice. If a number of finds are discovered from a particular area, they may imply the presence of an uncharted aircraft crash site. Such a discovery is likely to be subject to a TEZ until further archaeological investigation can take place. A case in point is presented by the discovery of items relating to a WWII Hawker Hurricane aircraft, found in the Study Area in Area 447, approximately 19km east of

Walton-on-the-Naze in Essex. Following this discovery, an EZ was implemented around two seabed anomalies thought to represent the remains of the Hurricane. A further example is presented by the discovery of aircraft wreckage in Area 430, approximately 29km east of Southwold on the Suffolk coast. Following the discovery of the aircraft wreckage, a TEZ was instigated around the site to prevent further damage by marine aggregate extraction occurring.

9.21.7 The effects of sediment plume upon recorded aircraft losses have the potential to bury and conceal the remains of aircraft crash sites, thus promoting their preservation. The preferred means of mitigation with regards to the archaeological resource is to preserve archaeological material *in situ.* Consequently, such impacts are regarded as positive and do not compromise the existing baseline.

Isolated Aircraft Finds

9.21.8 While it is expected that there are a number of isolated aircraft finds within the Study Area, there is currently no way of identifying the location of such sites prior to dredging. On this basis, the effects of substrate removal on isolated aircraft finds are considered to be of moderate significance. In order to regulate the impacts of substrate removal on isolated aircraft finds, the EH/BMAPA Protocol must be adopted as good working practice. If a number of finds discovered from a particular area imply the presence of an aircraft crash site, dredging must cease and the area may be subject to a TEZ until further archaeological investigation can take place.

9.21.9 The effects of sediment plume upon isolated aircraft finds have the potential to bury and conceal archaeological material, thus promoting their preservation. The preferred means of mitigation with regards to the archaeological resource is to preserve archaeological material *in situ.* Consequently, such impacts are regarded as positive and do not compromise the existing baseline.

10 REFERENCES

AHOB 2006: Ancient Human Occupation of Britain 1 project, Summary Chart (http://www.nhm.ac.uk/hosted_sites/ahob/AHOBI/overview_time_chart.gif)

Allen, R.H., and Sturdy, R.G., 1980 'The Environmental Background' in Buckley, D.G (ed.) *Archaeology in Essex to AD150,* CBA Research Report No.34, London: Council for British Archaeology pp1-7.

Allen, M.J., 1994, 'The Land-Use History of the Southern English Chalklands with an Evaluation of the Beaker Period using Environmental Data: colluvial deposits as cultural indicators', Unpublished PhD Thesis, University of Southampton.

Anderton, R., Bridges, P.H., Leeder, M.R. and Sellwood, B.W., 1979, A Dynamic Stratigraphy of the British Isles, George Allen and Unwin, London.

Ashton, N. and Lewis, S., 2002, 'Deserted Britain: declining populations in the British Late Middle Pleistocene', in *Antiquity* 76: 388-396.

Barton, R.N.E., 1992, Hengistbury Head, Dorset. Volume 2: The Late Upper Palaeolithic & Early Mesolithic Sites. Oxford University Committee for Archaeology. Monograph No. 34.

Barton, N., 2005, *Ice Age Britain*, London: Batsford and English Heritage.

Bédoyère, G. de la, 2001, *Aviation Archaeology in Britain,* Buckinghamshire: Shire Publications Ltd.

Bell, M., Casldine, A. and Neumann, H., 2000, *Prehistoric Intertidal Archaeologyin the Welsh Severn Estuary*, CBA Research Report 120, York: CBA.

BMAPA & English Heritage, 2003, *Marine Aggregate Dredging and the Historic Environment: guidance note*. British Marine Aggregate Producers Association and English Heritage, London.

Bowyer, C. 2003. *Air War over Europe 1939-1945.* Yorkshire: Leo Coooper.

Breen, C. and Forsythe, W. 2004. *Boats and shipwrecks of Ireland.* Gloucestershire: Tempus Publishing Ltd.

Bridgland, D.R., 1996, 'Quaternary River Deposits as a Framework for the lower palaeolithic Record' in Gamble, C.S. and Lawson, A.J. (eds) *The English Palaeolithic Review,* Salisbury: Trust for Wessex Archaeology pp63-71.

Bridgland, D.R., 2001, 'The Pleistocene evolution and Palaeolothic occupation of the Solent River' in Wenban-Smith, F. and Hosfield, R. (eds.), *Palaeolithic Archaeology of the Solent,* Lithics Studies Society Occasional Paper 7.,London: Lithics Studies Society. 15-25.

British Geological Survey 1989, Wight Seabed Sediments and Quaternary Geology chart.

British Geological Survey (BGS), 1992, *The geology of the English Channel*, London: HSMO.

Brown, I., Burridge, D., Clarke, D., Guy, J., Hellis, J., Lowry, B., Ruckley, N. and Thomas, R., 1995, *Twentieth Century Defences in Britain: An introductory guide,* York: Council for British Archaeology.

Bruce-Mitford, R. 1972. *The Sutton Hoo Ship-Burial.* London: The Trustees of the British Museum.

Clutton-Brock, J. and Noe-Nygaars, N., 1990, 'New osteological and C-isotope evidence on Mesolithic dogs: companions to hunters and fishers at Staa Carr, Seamer Carr and Kongemose', in *Journal of Archaeological Science* 17:643-653.

Cowrie & Wessex Archaeology, 2007, Historic Environment Guidance for the Offshore Renewable Energy Sector, COWRIE 2007.

Cowrie & Oxford Archaeology with George Lambrick Archaeology and Heritage, 2008, Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy, COWRIE 2008.

Cox, P.W., and Hearne, C.M., 1991, *Redeemed from the Heath: The Archaeology of the Wytch Farm Oilfield (1987-90)*, Dorset Natural History and Archaeological Society Monograph Series 9.

Cullingford, C.N., 2003, *A History of Poole*, Christchurch: Philimore.

Cunliffe, B., 1975, Excavations at Portchester Castle Vol. I: Roman, Thames and Hudson.

Cunliffe, B., 1976, Excavations at Portchester Castle Vol. II: Saxon, Thames and Hudson.

Cunliffe, B., 1990, 'Hengistbury Head: a late prehistoric haven', in McGrail S. (ed.), *Maritime Celts, Frisians and Saxons*, CBA Research Report No. 71:27-31.

Department of the Environment, 1990. *Planning Policy Guidance: archaeology and planning*, (PPG 16). HMSO.

Department of the Environment, 1990. *Coastal Planning*, (PPG 20). HMSO.

Dix, J.K., 2001, ‘The Geology of the Solent River System’, in Wenban-Smith, F.F. and Hosfield, R.T. (eds.), *Palaeolithic Archaeology of the Solent River*, Lithic Studies Society Occasional Paper 7:7-14.

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

Doubleday, H. A. and Page, W., 1920, The Victoria County History of the Counties of England. A History of Hampshire and the Isle of Wight, London.

Edwards, R.J., 2001, ‘Mid to late Holocene realative sea-level change in Poole Harbour, southern England’, in *Journal of Quaternary Science* 16:221-235.

English Heritage 1996, *England's coastal heritage. A statement on the management of coastal archaeology.* English Heritage and The Royal Commission on the Historical Monuments of England.

English Heritage, 1998, Identifying and Protecting Palaeolithic Remains; archaeological guidance for planning authorities and developers, English Heritage.

English Heritage, 2000, *Twentieth Century Military Sites,* English Heritage Leaflet.

English Heritage, 2000a, *Survey of Military Aviation Sites and Structures: Summary Report,* English Heritage, Thematic Listing Programme.

English Heritage, 2002, *Military Aircraft Crash Sites: Archaeological guidance on their significance and future management,* English Heritage (www.english-heritage.org.uk/upload/pdf/Mil_Air_C_Sites.pdf).

Evans, A.C. 1994. *The Sutton Hoo Ship Burial.* London: British Museum Press.

Funnel, B.M., 1995, ‘Global sea-level and the (pen-)insularity of late Cenozoic Britain’ in Preece, R.C. (ed.), in *Island Britain: A quaternary Perspective*, London: The Geological Society. 3-13.

Garrod, D.A.E., 1926, The Upper Palaeolithic Age in Britain.

Gilman, P. 1997. ‘Fortifications’ in Glazebrook, J, (ed.) *Research and Archaeology: A Framework for the Eastern Counties, 1. Resource Assessment*. East Anglian Archaeology, Occasional Paper No.3:67-69.

Gupta, S., Collier, J.S., Palmer-Felgate, A. And Potter, A., 2007, Catastrophic flooding origin of shelf valley systems in the English Channel, in *Nature* 448:342-346.

Hinton, David and Hughes, Michael, 1996, *Archaeology in Hampshire: A Framework for the Future*, Hampshire County Council.

Housley, R.A., Gamble, C.S., Street, M. and Pettitt, P., 1997, ‘Radiocarbon evidence for Late-glacial human rec-colonisation of northern Europe’, in *Proceedings of the Prehistoric Society* 63:25-54.

Hutchinson, G., 1994, *Medieval Ships and Shipping*, London: Leicester University Press.

Jacobi, R.M., 1979, ‘Early Flandrian Hunters in the Southwest’, in *Proceedings of the Devon Archaeological Society* 13:48-93.

Jarvis, K., 1997, ‘Studland Bay Wreck’, in Delgado J.P. (ed.), *The British Museum Encyclopaedia of Underwater and Maritime Archaeology*, London: British Museum Press: 405-406.

Johnstone, P., 1980, *The Sea-craft of Prehistory*, London: Routledge.

JNAPC, 1995 (rev. 1998 and 2006), Code of Practice for Seabed Developers. Joint Nautical Archaeology Policy Committee.

Kemp, P. 2002. *The History of Ships.* Rochester: Grange Books

King, J. (ed.), 1856, *The Channel Pilot*, Hydrographic Office.

Klein, R.G., 1999, *The Human Career*, Chicago: University of Chicago Press.

Lake, J. and Francis, P., 1998, 'Thematic Reviews: Military aviation sites and structures' in English Heritage, 1998, in *Monuments of War: The evaluation, recording and management of 20th century military sites.* London: English Heritage pp13-17.

Lee, J.R., Rose, J., Candy, I, and Barendregt, R.W., 2006, 'Sea level changes, river activity, soil development and glaciation around the western margins of the southern North Sea Basin during the Early and early Middle Pleistocene: evidence from Pakefield, Suffolk, UK', in *Journal of Quaternary Science* 21: 155-179.

Markley, M., Wilkes, E., and Darvill, T., 2002, 'Poole Harbour: An Iron Age Port', in *Current Archaeology* 181:7-11.

Marsden, P., 1994, *Ships of the Port of London: 1st to 12th centuries AD.* London: English Heritage. Archaeological Report No. 3.

Maw, N. 1999. *World War One Channel Wrecks: Vessels lost in the English Channel 1914-1918.* Middlesex: Underwater World Publications Ltd.

McGrail, S., 1978, *Logboats of England and Wales*, BAR British Series 51.

McGrail, S., 2004, Boats of the World: From the Stone Age to Medieval Times, Oxford: University Press.

Miller, D. 2004. *Submarines of the World.* London: Greenwich Editions.

Momber, G., Rackley, A. and Draper, S., 1994, *New Forest Coastal Archaeological Resource*, Hampshire and Wight Trust for Maritime Archaeology.

Momber, G., and Campbell, C., 2005, 'Stone Age Stove under the Solent', in *The International Journal of Nautical Archaeologyl* 34(1):148-149.

Momber, G., 2000, 'Drowned and deserted: a submerged prehistoric landscape in the Solent, England' in *The International Journal of Nautical Archaeology* 29(1):86-99.

Momber, G., 2001, 'Six fathoms down off Bouldnor Cliff: A Mesolithic Site' in Sparks, B., Momber, G., and Satchell, J. (eds), *A Decade of Diving, Delving and Disseminating, Hampshire and Wight Trust for Maritime Archaeology 1991-2001*, Southampton: Oceanography Centre, 65-69.

Momber, G., 2004, 'The inundated landscape of the western Solent' in Flemming, N.C. (ed.), *Submarine prehistoric archaeology of the North Sea*, CBA Research Report 141, York: Council for British Archaeology, 37-42.

Momber, G., 2006, 'Mesolithic occupation: 11m below the waves' in Hafner, A., NIffeler, U. and Ruoff, U. (eds.), *The new view, Underwater Archaeology and the Historic Picture*, Proceeding of the 2nd International Congress on Underwater Archaeology, Ruschlikon bei Zurich, 21-24 Oktober 2004, Antiqua 40, Basel: Archaeologie Schweiz, 56-63.

Moran, L., 2003, 'Recent Discoveries off the Coast at Tynemouth', in *The School of Historical Studies Postgraduate Forum e-Journal* Edition Two (http://www.ncl.ac.uk/historical/postgrad_forum/ed_2/ed_2_moran.pdf)

Muckelroy, K., 1980, 'Two Bronze Age cargoes in British waters', in *Antiquity* 54: 100-109.

Muckelroy, K., 1981, 'Middle Bronze Age trade between Britain and Europe: a maritime perspective', in *Proceedings of the Prehistoric Society*, 47: 275-297.

Oxford Archaeology with George Lambrick Archaeology and Heritage, 2008, Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy, COWRIE 2008.

Parfitt K., 1993, 'The Dover Boat', in *Current Archaeology* 133, 4-8.

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

Pearsall, A. 1985. 'Steam enters the North Sea' in Bang-Andersen, A., Greenhill, B. and Grude, E.H. (eds.) *The North Sea: A highway of economic and cultural exchange'* Norway: Norwegian University Press pp195-216.

Preece, R.C., Kemp, R.A., and Hutchinson, J.N., 1995, 'A late glacial colluvial sequence at Watcombe Bottom, Ventnor, Isle of Wight, England', in *Journal of Quaternary Science* 10, 107-121.

Tomalin, D. J., 1993, 'Maritime Archaeology as a coastal management issue; a Solent case study from the SCOPAC coast', 93-112, in *Proceedings of the Standing Conference on Problems Associated with the Coastline seminar on regional coastal groups* – after the House of Commons report.

Rodwell, W. 1972. *Roman Essex.* Essex: Essex Archaeological Society.

RAF, 2008, Royal Air Force Museum, (http://www.rafmuseum.org.uk/milestones-of-flight/british_civil/1909.cfm)

Shennan, I, Lambeck, K, Flather, R, Horton, B, McArthur, J, Innes, J, Lloyd, J, Rutherford, M. and Kingfield, R. 2000. Modelling western North Sea palaeogeographics and tidal changes during the Holocene. In Shennan, I. and Andrews, J.E. (eds.) *Holocene land-ocean interaction and environmental change around the North Sea.* London: Geological Society Special Publication 166, pp299-319.

Stringer, C.B., 1996, 'The Boxgrove Tibia: Britain's Oldest Hominid and its placfe in the Middle Pleistocene Record', in Gamble, C. and Lawson, S.J. (eds.), *The English Palaeolithic Reviewed*, 52-56.

Stringer, C.B., 2006, 'The first humans north of the Alps', in Parfitt, S., Stuart, T., Stringer C. and Preece, R., 'First Britons', in *British Archaeology*, January-February: 18-27.

Sumbler, M. G., 1996, 'Introduction' in Sumbler, M.G. (ed.) *British Regional Geology: London and the Thames Valley,* (Fourth Edition) British Geological Survey, London HMSO pp1-7.

Velegrakis, A.F., Dix, J.K. and Collins, M.B., 1999, 'Late Quaternary evolution of the upper reaches of the Solent River, Southern England, based on marine geophysical evidence', in *Journal of the Geological Society of London*, 156:73-87.

Velegrakis, A.F., Dix, J.K. and Collins, M.B., 2000, 'Late Pleistocene/Holocene Evolution of the Upstream Section of the Solent River', in Collins, M. and Ansell, K. (eds.), *Solent Science – A Review*, Elsevier Science.

Waughman, M., 2005, *Archaeology and Environment of Submerged Landscapes in Hartlepool Bay, Hartlepool*: Tees Archaeology.

Wessex Archaeology, 1993, *The Southern Rivers Palaeolithic Project: Report No.1*, Unpublished Report 33645.

Wessex Archaeology, 1997, *Sandown Long Sea Outfall: Marine Archaeological Investigation*, Unpublished Report.

Wessex Archaeology, 1998a, *St Catherine's, Isle of Wight – Area 451, Environmental Assessment: Archaeology*, Unpublished Report 44271.03.

Wessex Archaeology, 1998b, *St Catherine's, Isle of Wight – Area 451, Environmental Assessment: Archaeology*, Unpublished Report 45200.02.

Wessex Archaeology, 2003, *Dredging Application Areas 372/1 North NAB and 372/2 South East NAB: Archaeological Assessment*, Unpublished Report 50494.02.

Wessex Archaeology, 2003b, *Aggregate Levy Sustainibility Fund, Wrecks on the Seabed Round 1, Assessment, Evaluation and Recording, Year 1 Report*, Unpublished Report 51536.04.

Wessex Archaeology, 2004a, *Poole Harbour Channel Deepening and Beneficial Use Scheme: Archaeological Assessment*, Unpublished Report 55900.01.

Wessex Archaeology, 2004b, *Seabed Prehistory: Gauging the effects of Marine Aggregate Dredging* , Unpublished Report 53146.02.

Wessex Archaeology, 2004c, *England's Shipping: Aggregates Levy Sustainability Fund, Year 2*, Unpublished Report 51522.05.

Wessex Archaeology, 2005, *Kendall's Wharf, Proposed Wharf Extension and Channel Deepening: Archaeological Assessmen*t, Unpublished Report 56200.01.

Wessex Archaeology, 2005a, *Strategic Environmental Assessment of SEA 6: Irish Sea Maritime Archaeology. Technial report to SEA, DTI.*

Wessex Archaeology, 2006, *Aggregate Levy Sustainibility Fund, Marine Aggegate and Historic Environment 'Wrecks on the Seabed': Geophysical Assessment*, Unpublished Report 57452.02.

Wessex Archaeology, 2006a, *Salcombe Cannon Site, Devon, Designated Site Assessment: Archaeological Report*, Unpublished Report 53111.03ff.

Wessex Archaeology, 2006b, *Aggregate Levy Sustainibility Fund, Wrecks on the Seabed R2, Assessment, Evaluation and Recording, Year 1 Report-Appendix C*, Unpublished Report 57453.04.

Wessex Archaeology, 2006c, *Protocol for Reporting finds of archaeological interest, Annual Report to BMAPA 2005-2006*. Unpublished report.

Wessex Archaeology, 2007a, *ss Mendi: Archaeological Desk-based Assessment*, Unpublished report.

Wessex Archaeology, 2007b, *Seabed Prehistory, Volume III - Arun Additional Grabbing*, Unpublished Report 57422.12

Wessex Archaeology, 2007c, *South Coast Dredging Association South Coast Regional Environmental Assessment: Archaeological Data Scoping Report*, Unpublishged Report 65780.01

Wessex Archaeology 2007d, *Regional Environmental Characterisation Survey: South Coast Region Geophysical Survey*, Unpublished report ref. 65770.01

Wessex Archaeology, 2007e, *Protocol for Reporting finds of archaeological interest, Annual Report to BMAPA 2006-2007*, Unpublished report.

Wessex Archaeology, 2008a, *Seabed Prehistory: Gauging the effects of Marine Aggregate Dredging, Round 2 Final Report, Volume 1: Introduction,* Unpublished Report 57422.31.

Wessex Archaeology, 2008b, *AML and the Historic Environment, Marine Data Information Partnership (MDIP) Pilot Project, Vol 2: Pilot Stud*y, Unpublished Report 67030.05.

Wessex Archaeology, 2008c, *Aircraft Crash Sites at Sea: A Scoping Study. Archaeological Desk-based Assessment*, Unpublished Report 66641.02.

Wessex Archaeology, 2008d, *Southampton Approach Channel Dredge: Archaeological Assessment*, Unpublished Report 68530.06.

Wessex Archaeology, 2008e, *Protocol for Reporting finds of archaeological interest, Annual Report to BMAPA 2007-2008*, Unpublished report.

Wessex Archaeology, 2009, *UKCS Offshore Oil and Gas and Wind Energy SEA: Archaeology*, Unpublished Report 68860.03

Wilkinson, T.J. and Murphy, P.L., 1995, *The Archaeology of the Essex Coast, Volume I: The Hullbridge Survey,* Chelmsford: Essex County Council Archaeology Section. East Anglian Archaeology Report No. 71.

Wright, E.V., 1990, *The Ferriby Boats: seacraft of the Bronze Age*, Routledge, London.

Wymer, J., 1999, *The Lower Palaeolithic Occupation of Britain,* England: Wessex Archaeology and English Heritage.

APPENDIX I: LEGISLATION AND POLICY

INTRODUCTION

This section outlines the legal framework that applies to the maritime heritage in the MAREA Study Area. The Study Area includes territorial waters administered by England and those beyond the 12 nautical mile limit which comprise the United Kingdom Continental Shelf. The maritime heritage within England's territorial waters is covered by legislation and guidance for England and the United Kingdom, whilst underwater heritage on the Continental Shelf is predominantly covered by international legislation and guidance, although in some cases policies from England and the United Kingdom apply.

PROTECTION OF WRECKS ACT (1973) (PWA)

Under the 1973 Act, wrecks and wreckage of historical, archaeological or artistic importance can be protected by way of designation. It is an offence to carry out certain activities in a defined area surrounding a wreck that has been designated, unless a licence for those activities has been obtained from the Government. Generally, the relevant Secretary of State must consult appropriate advisors prior to designation, though it is also possible to designate a wreck in an emergency without first seeking advice.

There are currently a total of 60 sites in UK waters protected the under Section 1 of the Act. These sites range in date and character from dispersed cargoes of Bronze Age metalwork to the largely intact remains of the submarine *A1*, lost in 1911. The following nine sites are located within the REA Study Area:

- Mary Rose
- Grace Dieu
- *HMS* Assurance / *HMS* Pomone
- *HMS* Invincible
- Yarmouth Road Wreck
- Studland Bay Wreck
- Hazardous
- Swash Channel Wreck
- HM Submarine A1

However, if any important wreck or ship borne artefact is discovered as a result of activities on the seabed, the designation of an area around the find remains a possibility.

MERCHANT SHIPPING ACT (1995) (MSA)

Within the context of the Merchant Shipping Act 1995, 'wreck' refers to flotsam, jetsam, derelict and lagan found in or on the shores of the sea or any tidal water. It includes a ship, aircraft or hovercraft, parts of these, their cargo or equipment. It may be of antique or archaeological value such as gold coins, or a yacht or dinghy abandoned at sea or items such as drums of chemicals or crates of foodstuffs (Definition from the Receiver of Wreck (RoW)).

The ownership of underwater finds that turn out to be 'wreck' is decided according to procedures set out in the Merchant Shipping Act 1995. If any such find is brought ashore the salvor is required to give notice to the RoW that he/she has found or taken possession of it and, as directed by the RoW, either hold it to the Receiver's order or deliver it to the Receiver. This applies whether material has been recovered from within or outside UK Territorial Waters, unless the salvor can prove that title to the property has been vested in him/her (e.g. by assignment to him/her of rights devolving from the owner of the vessel or its contents at the time of loss). Even if ownership can be proved the salvor is still required to notify the RoW.

The Crown makes no claim on a wreck found outside UK Territorial Waters which remains unclaimed at the end of the statutory one-year and the property is returned to the salvor. Ownership of unclaimed wreck from within Territorial Waters lies in the Crown or in a person to whom rights of wreck have been granted.

The RoW has a duty to ensure that finders who report their finds as required receive an appropriate salvage payment. In the case of material considered being of historic or archaeological importance, a suitable museum is asked to buy the material at the current valuation and the finder receives the net proceeds of the sale as a salvage payment. If the right to, or the amount of, salvage cannot be agreed, either between owner and finder or between competing salvors, the RoW will hold the wreck until the matter is settled, either through amicable agreement or by court judgement.

PROTECTION OF MILITARY REMAINS ACT (1986) (PMRA)

Under the Protection of Military Remains Act 1986, all aircraft that have crashed in military service are protected, and the Ministry of Defence (MoD) has powers to protect vessels that were in military service when they were wrecked. The MoD can designate named vessels as 'protected places' even if the position of the wreck is not known. In addition, the MoD can designate 'controlled sites' around wrecks whose position is known. In the case of 'protected places', the vessel must have been lost after 4 August 1914, whereas in the case of a wreck protected as a 'controlled site' no more than 200 years must have elapsed since loss.

For neither 'controlled sites' or 'protected places', is it necessary to demonstrate the presence of human remains. Diving is not prohibited at a 'protected place' but it is an offence to tamper with, damage, move or remove sensitive remains. However, diving, salvage and excavation are all prohibited on 'controlled sites', though licences for restricted activities can be sought from the MoD. Additionally, it is an offence to carry out unauthorised excavations for the purpose of discovering whether any place in UK waters comprises any remains of an aircraft or vessel which has crashed, sunk or been stranded while in military service.

In November 2001, the MoD reported on the Public Consultation on Military Maritime Graves and the Protection of Military Remains Act 1986. The report recommended that a rolling programme of identification and assessment of vessels against the criteria be established to designate all other British vessels in military service when lost, as Protected Places.

The records of vessels lost during both World Wars whilst on active service do not always give an exact location. Given the extent of German submarine activity within the Study Area there is high potential for finding previously poorly located losses.

Since 1986 the MoD has undertaken a rolling programme of identification and assessment that has resulted in several tranches of wrecks being designated under the PMRA. The most recent tranche came into effect on 1 May 2008 and there are now a total of 12 controlled sites and 46 protected places around the world.

There are currently a total of four wrecks designated under the by the PMRA within the Study Area: three vessels designated as 'Protected Places' and one designated as a 'Controlled Site'. These are:

- HMS Acheron part 1& 2 (Protected Place)
- HMS Loyalty (Protected Place)
- HMS Swordfish (Protected Place)
- UB 81 (Controlled Site)
-

It is anticipated that the wreck of the *Mendi*, a troopship carrying South African black labourers and lost south of the Isle of Wight after a collision in 1917 will be designated under the PMRA this year.

In addition, 228 reported aircraft losses are protected under the PMRA (see section **5.6** Aviation Archaeology). Any new finds of aircraft remains would enjoy the same automatic protection.

ANCIENT MONUMENTS AND ARCHAEOLOGICAL AREAS ACT (1979) (AMAA)

This act is primarily land based, but in recent years it has also been used to provide some level of protection for underwater sites.

The Act provides for the scheduling of monuments, which encompasses buildings, structures or work, cave or excavation, vehicle, vessel, aircraft or other moveable structure. In order to be eligible for scheduling, a monument must be of national importance. Sites range from standing stones to deserted medieval villages, and include more recent structures such as collieries and wartime pillboxes.

In relation to maritime scheduled monuments, once a wreck would have been scheduled, it would be an offence to demolish, destroy, alter or repair it without *scheduled monument consent*.

There are 491 designated monuments within the Study Area. However, since these sites are terrestrial they will not be affected or impacted by marine aggregates related activity. Consequently, no further focus will be putting on it for this assessment.

NATIONAL HERITAGE ACT (2002) (NHA)

This legal document modifies EH functions in order to take responsibilities for maritime archaeology within the limit of the United Kingdom territorial waters adjacent to England. It includes guaranteeing the protection of ancient monument, encouraging public access, and improving their understanding of ancient monuments in on, or under the seabed.

PLANNING POLICY GUIDANCE

The statutory planning and policy context relating to the historic environment in the Study Area is set out below.

Planning law only applies within the territory of local authorities which, as a general rule, extends only to the low water mark. However, English Heritage and RCHME included the following statement in *England's Coastal Heritage* (see below):

> *Although it remains government policy not to extend the Town and Country Planning system to the territorial sea, the principles set out in Planning policy guidance note 16: archaeology and planning should be applied to the treatment of sub-tidal archaeological remains in order to secure best practice.*

Additionally, the *Joint Nautical Archaeology Policy Committee JNAPC Code of Practice for Seabed Developers* recommends procedures for consultation and co-operation between seabed developers and archaeologists. This is consistent with the Government's policy on archaeology as stated in PPG 16, and should continue to be followed by the offshore industry.

Planning Policy Guidance: Archaeology and Planning (PPG 16) sets out the Secretary of State's policy on archaeological remains. It acknowledges the potentially fragile and finite or irreplaceable nature of such remains (para. 6), and states that the desirability of preservation of archaeological remains and their setting is a material consideration within the planning process (para. 18). PPG 16 provides that there is a presumption in favour of the physical preservation of nationally important archaeological remains (para. 8), and that where preservation *in situ* is not justified it is reasonable for planning authorities to require the developer to make appropriate and satisfactory provision for excavation and recording of remains (para. 25).

Paragraph 19 of PPG 16 suggests that it is in developers' own interests to include an initial assessment of whether the site is known or likely to contain archaeological remains as part of their research into the development potential of a site. Paragraph 22 adds: 'Local planning authorities can expect developers to provide the results of such assessments ... as part of their application for sites where there is good reason to believe there are remains of archaeological importance'. PPG 16 also notes that in spite of the best pre-planning application research, there may be occasions when the presence of archaeological remains only becomes apparent once development has commenced (para. 31).

Planning Policy Guidance 20: Coastal Planning (PPG 20) sets out the importance of the coast as a national resource. Paragraph 2.8 states that the coastal zone also has a rich heritage both above and below the low water mark. This includes buildings and areas of architectural or historic interest, industrial archaeology, scheduled and other ancient monuments and other archaeological sites. As a consequence, it is recommended that policies should encourage conserving and restoring structures of special historic, architectural or archaeological interest (para. 3.6).

IDENTIFYING AND PROTECTING PALAEOLITHIC REMAINS

Identifying and Protecting Palaeolithic Remains; Archaeological Guidance for Planning Authorities and Developers (English Heritage 1998) draws attention to the importance of Palaeolithic remains and states that they must be considered in line with PPG 16 when potentially affected by development proposals. Palaeolithic archaeological sites are defined as any land where artefacts or traces of a human presence of Pleistocene date have been found. The document notes that Palaeolithic remains have particular importance if:

- any human bone is present in relevant deposits;

- the remains are in an undisturbed, primary context;
- the remains belong to a period or geographic area where evidence of a human presence is particularly rare or was unknown;
- organic artefacts are present;
- well-preserved indicators of the contemporary environment (floral, faunal, sedimentological) can be directly related to the remains;
- there is evidence of lifestyle (such as interference with animal remains);
- one deposit containing Palaeolithic remains has a clear stratigraphic relationship with another;
- any artistic representation, no matter how simple, is present;
- any structure, such as a hearth, shelter, floor, securing device etc. survives;
- the site can be related to the exploitation of a resource, such as a raw material;
- artefacts are abundant.

The document goes on to note that sites containing any of these features are so rare in Britain that they should be regarded as of national importance and whenever possible should remain undisturbed.

The advice offered to developers and planning officers includes the following:

- It is advisable for prospective developers to research the archaeological potential of their sites (including that for Palaeolithic remains) at an early stage;
- It is the responsibility of developers to supply the relevant planning authority on the archaeology of their sites, with proposals for the way in which this will be accommodated within the development scheme, so that an informed planning decision can be reached. Information on the Palaeolithic remains or the potential for such remains within a certain site may be acquired from a desk-based assessment but when this is inadequate it may be necessary to obtain further information from a limited field evaluation by suitably qualified archaeologists;
- Planning authorities may apply a condition to a consent which prohibits the start of development until the applicant has ensured appropriate provision has been made for an adequate record of the site's archaeological remains.

CODE OF PRACTICE FOR SEABED DEVELOPMENT (JNAPC 2006)

The Code sets out archaeological principles applicable to seabed developments which are similar to those to be found in current policy and practice on land. Procedures for consultation and co-operation between seabed developers and marine archaeologists are outlined, as are their respective roles in the development process. The aim of the Code is to ensure a best practice model for seabed development both within and beyond the remit of the formal Environmental Impact Assessment (EIA) process.

COWRIE GUIDANCE (2007 AND 2008)

The *Historic Environment Guidance for the Offshore Renewable Energy Sector* (COWRIE / Wessex Archaeology 2007) is primarily aimed at the energy sector, although it has relevance to archaeological and environmental consultants, regulatory bodies and curators. It is also intended to promote an understanding of the conservation issues arising from the impacts of offshore renewable energy projects on the historic environment, and in this way develop capacity amongst developers, consultants and contractors.

The *Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable* (COWRIE / Oxford Archaeology & George Lambrick Archaeology and Heritage 2008) aimed at producing guidance on the assessment of cumulative impacts on the historic environment engendered by offshore renewable energy projects. It makes a distinction between cumulative (additive/changes) and synergistic (impact interactions) effects in order to provide sufficient guidance on general assessment and to implement a competent monitoring and reviewing system.

BMAPA/EH GUIDANCE (ENGLISH HERITAGE AND BRITISH MARINE AGGREGATE PRODUCERS ASSOCIATION 2003)

The *Marine Aggregate Dredging and the Historic Environment: guidance note* published by EH, in conjunction with the British Marine Aggregate Producers Association (BMAPA), provides guidance to the aggregate industry on assessing, evaluating, mitigating and monitoring the archaeological effects of marine aggregate dredging.

The guidance note sets out the character and importance of the marine historic environment and describes best practice in dealing with archaeological matters in the course of planning marine waters. This document emerged as a mitigation option for reporting archaeological finds, and became part of the conditions attached to dredging permissions. It is implemented in addition to measures to avoid areas of archaeological sensitivity through desk-based assessment and field evaluation.

Amongst the measures set out in the guidance note to mitigate the effect of marine aggregate dredging on the historic environment was the implementation of protocols to report and deal with finds made in the course of dredging. In August 2005 BMAPA and EH introduced a reporting protocol applicable to all BMAPA members, covering all wharves, vessels and production licence areas.

WA is currently managing the third year of an Implementation Service commissioned and supported by BMAPA, in terms of which finds made on vessels and at wharves are reported.

APPENDIX II: VIBROCORE LOCATIONS

Area	Vibrocore	UTM Zone 30N		Area	Vibrocore	UTM Zone 30N	
		Easting	Northing			Easting	Northing
Area 122/2	HV37A	640784	5621176	SWIOW 396	VC1	676020	5615887
Area 122/2	HV38	639776	5622243	SWIOW 396	VC2	675861	5615994
Area 122/2	HV40	639498	5623251	SWIOW 396	VC4	676255	5616401
Area 122/2	HV41	639147	5623781	Area 407	VCT1	637815	5592921
Area 122/2	HV43	640479	5621766	Area 407	VCT2	638195	5592567
Area 122/3	HPC6	639901	5615852	Area 407	VCT3	637888	5591973
Area 122/3	HPC10	640403	5616718	Area 407	VCT4	637447	5592389
Area 122/3	HPC13	640635	5617005	Area 407	VCT11	636389	5591302
Area 122/3	HPC14	641097	5618304	Area 407	VCT13A	635437	5590293
Area 122/3	HPC15	641128	5617393	Area 407	VCT14	636083	5590456
Area 122/3	HPC16	641143	5616614	Area 407	VCT15	635801	5590022
Area 122/3	HPC17A	641371	5617662	Area 407	VCT16	636129	5590090
Area 122/3	HPC18	641389	5616953	Area 407	VCT17	635358	5589606
Area 122/3	HPC19	641395	5616212	Area 407	SC04VC3	227071	5988020
Area 122/3	HPC21	641864	5615784	Area 407	SC04VC7	226516	5987741
Area 122/3	HPC22	641896	5615750	Area 407	SC04VC9a	227341	5988198
Area 122/3	HPC23	641644	5615348	Area 435	VC8	678380	5618084
Area 122/3	HPC24	641630	5616505	Area 435	VC9	678258	5617778
Area 122/3	HPC25	641922	5614906	Area 435	VC10	679245	5618808
Area 127	VC1	592087	5603603	Area 435	VC11A	679335	5618614
Area 127	VC3	592176	5604612	Area 435	VC13	679471	5618316
Area 127	VC4	592525	5604415	Area 435	VC16	680758	5618253
Area 127	VC10	591306	5605196	Area 465-1	VC34	597927	5600593
Area 127	VC11	590367	5604581	Area 465-1	VC35	597046	5600120
Area 127	VC12	590747	5604781	Area 465/2	VC29	604236	5595562
Area 127	VC13	590869	5604382	Area 465/2	VC37	603350	5594858
Area 127	VC16	591201	5603597	Area 465/2	VC39	602344	5594091
Area 127	VC17	591012	5603897	Area 465/2	VC40	602601	5594228
Area 127	VC30	589140	5606275	Area 465/2	VC41	602995	5594511
Area 127	VC31	589271	5605557	Area 465/2	VC44	601421	5593300
Area 127	VC33	590264	5605684	Area 465/2	VC55	603714	5595194
Area 127	VC34	589788	5605767	Line 6	BH10	640571	5600647
Area 127	VC35	589817	5605380	Line 6	BH7	642408	5599810
Area 127	VC36	589965	5604878	Line 6	BH13	639301	5602449
Area 340	VC1-95	636827	5607912	Line 6	VC39	639848	5601092
Area 340	VC2-95	637062	5607520	Line 7	VC25	645393	5609124
Area 340	VC3-95	637022	5607116	Line 7	VC15	646775	5606738
Area 340	VC8-95	639423	5607798	Line 12	ADDVC1	643373	5605231
Area 340	VC10-95	640648	5607663	Line 12	ADDCC4	645331	5607968
Area 340	VC11-95	640647	5607182	Line 12	VC31	641221	5603416
Area 340	VC15A-95	639200	5606340	Line 12	VC33	640730	5602547
Area 340	VC18-95	638673	5605170	Line 12	VC35	642311	5604175
Area 340	VC23-95	640064	5604565	Line 12	VC39	639848	5601092
Area 340	VC29-95	639845	5605334	Line 12	VC40	639260	5600235
Area 340	VCT25	640392	5607067	Line 12	BH19	642819	5604313
Area 340	VCT32	636931	5607246	Line 12	BH23A	645752	5607286
Area 340	VCT35	639140	5605450	Line 12	BH33	646341	5608237
Area 340	VCT36	639760	5606309	Line 12	VC09	646451	5608789
Area 351	VC3	648163	5611736	Line 12	VC22	647436	5609170
Area 351	VC5	649352	5611920	Line 12	VC20	647828	5609986
Area 351	VC6	648716	5611390	Line 12	VC15	648168	5610225
Area 351	VC7	647885	5611187	Line 12	VC5	649352	5611920
Area 351	VC9	648413	5611036	Line 14	VC28\93	681998	5620934
Area 351	VC12	648468	5610606	Line 14	VC30A\93	683167	5621687
Area 351	VC13	647840	5610553	Line 14	VC31\93	684368	5622780
Area 351	VC15	648168	5610225	Line 14	VC39\93	683642	5622212
Area 351	VC17	648475	5609791	Line 17	ADDVC2	644484	5606017
Area 351	VC18	648272	5609219	Line 18	VC56	637880	5610289
Area 351	VC20	647828	5609986	Line 18	VC67	638427	5608842
Area 351	VC25	645393	5609124	Line 18	VC68A	639378	5608853

Area 372/1	HPC06	640263	5611316
Area 372/1	HPC10	640124	5611017
Area 372/1	HPC12	639613	5610710
Area 372/1	HPC17	640713	5611633
Area 372-2	VC2	647939	5604034
Area 372-2	VC4	648234	5604261
Area 372-2	VC5	648245	5603544
Area 372-2	VC7	648858	5604644
Area 372-2	VC10	649737	5604593
Area 372-2	VC12	650051	5604147
Area 372-2	VC14	650962	5603459
Area 372-2	VC15A	650929	5604631
Area 395	VCZ	648185	5614404
Area 395	VCO	647940	5612660
Area 395	VCS	650236	5612690
Owers	VC8	680576	5617930
Owers	VC17A	674666	5615277
Owers	VC18A	674819	5615218
Owers	VC19	674921	5615278
Owers	VC20	674877	5615139
Owers	VC6/95	679953	5617346
Owers	VC7/95	680150	5617614
Owers	VC8/95	680486	5617596
Owers	VC36/95	679341	5614245
Owers	VC43/95	669691	5609184
Owers	VC44/95	668884	5608927
Owers	VC50/95	667683	5607684
SWIOW	WV163	599510	5603552
SWIOW	WV61	598776	5603785

APPENDIX III: THE RELATIONSHIP BETWEEN SIGNIFICANT ARCHAEOLOGICAL PERIODS AND RELATIVE SEA LEVEL STANDS

Relative Sea Level	Approximate Age	Oxygen Isotope Stage	Chronozone/ Biozone	Archaeology
0m+ to -10m+	5,500 BP 7,200 BP	-	Atlantic pollen zone	Late Mesolithic to Early Neolithic
-15m+	- 8,500 BP	-	Boreal pollen zone	Beginning of Late Mesolithic, land-bridge to the continent finally removed
-30m+	- 9,500 BP	-	Boreal pollen zone	Early Mesolithic
-40m+	- 10,000 BP	-	Preboreal pollen zone	Beginning of Early Mesolithic
-50m+	- 11,000 BP	1	Loch Lomond stadial	Final Upper Palaeolithic
-60m+	- 13,500 BP	2	Windermere interstadial/ Late glacial	Late to Final Upper Palaeolithic, Re-colonisation of Britain from *c.* 12,500 BP; Creswellian cave sites and 'straight-backed blade' open air sites at Brockhill and Hengistbury Head
-80 to -100m+	- 18,000 BP	2	Dimlington stadial/Late Devensian glaciation	Mid to Late Upper Palaeolithic, Britain probably not occupied
-120m+	- 40,000 BP	2	Devensian glacial maximum *c.* 18,000 BP	Early to Mid Upper Palaeolithic, appearance of modern humans in Europe *c.* 40-30,000 BP; Britain probably not occupied from *c.* 22,000 BP
-60 to -90m+	- 110,000 BP	3-5a-d	Devensian glaciation, Upton Warren/Chelford interstadials	Late Middle Palaeolithic; Kempton Park/East Tilbury gravel terraces deposited; Britain probably not occupied until 60,000 BP
0m+	- 130,000 BP	5e	Ipswichian interglacial	Early Middle Palaeolithic; Britain is an island and probably not occupied; raised beach deposits, e.g. Pagham
-120m+	- 186,000 BP	6	Wolstonian glaciation	Taplow/Mucking gravel terraces deposited; Britain probably not occupied from 180,000 BP
0m+	- 245,000 BP	7	(Aveley) interglacial	Pontnewydd (Homo neanderthalensis); Britain is an island; Norton raised beach

Relative Sea Level	Approximate Age	Oxygen Isotope Stage	Chronozone/ Biozone	Archaeology
-120m+	- 303,000 BP	8	Wolstonian glaciation	Lynch Hill/Corbets Tey gravel terraces deposited – possibly related to the particularly artefact rich Taddiford Farm Gravel in the Solent; Levallois technology appears
0m+	- 339,000 BP	9	(Purfleet) interglacial	Sparsity of sites; Britain probably an island for at least part of this stage
-120m+	- 380,000 BP	10	Wolstonian glaciation	Boyn Hill/Orset Heath gravel terraces deposited; many Lower Palaeolithic sites
0m+	- 423,000 BP	11	Hoxnian interglacial	Swanscombe (Homo heidelbergensis); Aldingbourne raised beach (possibly early OIS 7); Britain is an island during late Hoxnian
-130m+	- 478,000 BP	12	Anglian glaciation	Sea level probably at its lowest recorded level around the British Isles; first breach of continental land-bridge during late Anglian
+/-0m	- 528,000 BP	13	Cromerian complex, including Cromer Forest-bed formation (possibly confined to OIS 17-19) and Happisburgh glaciation (OIS 16?)	Boxgrove (Homo heidelbergensis); Slindon raised beach
-50m	- 568,000 BP	14		
+/-0m	- 621,000 BP	15		
-90m	- 659,000 BP	16		
-10m	- 712,000 BP	17		Happisburgh artefacts
-80m	- 760,000 BP	18		
-?m	- ?	19		Pakefield freshwater deposits and artefacts (OIS 17 or 19?)
+/-0m	- 787,000 BP			Pakefield estuarine deposits and artefacts (OIS 17 or 19?)

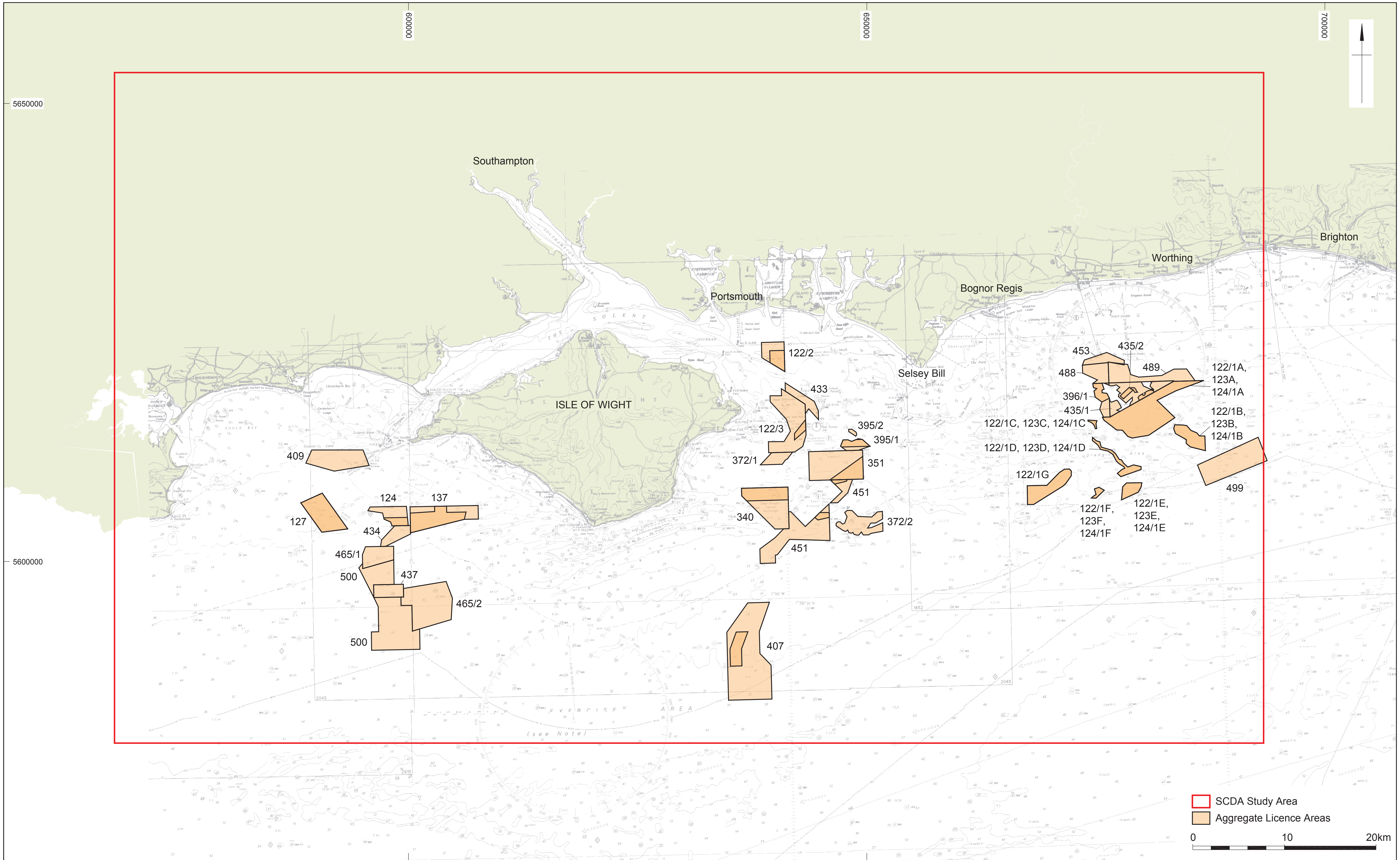
APPENDIX IV: GEOPHYSICAL ANOMALIES

WA_ID	Zone	Feature	Length (m)	Description	Sources
7000	**1**	Cut and fill	155	Cut into Barton Clay filled by sediments. Max depth of cut below seabed 7.8m; min depth below seabed 2.2m. Bright reflectors just below cut fade with depth. Fill has maximum thickness 5.4m. Depth below seabed approx 2.5m. Sub-parallel reflectors.	**6000**
7001	**1**	Cut and fill	234	Cut into Barton Clay, filled by sediments. Max depth of cut below seabed 6.0m, min depth below seabed 1.9m. Chaotic strong reflectors below cut. Fill has max thickness 4.0m. Approx depth below seabed 1.9m. Contains weak chaotic reflectors.	**6001**
7002	**1**	Cut and fill	349	Cut into Barton Clay with min depth below seabed 0.9m, max depth 6.5m. Fill to <1m below seabed.	**6002**
7003	**1**	Cut and fill	290	Cut into Barton Clay. Max depth below seabed 7.5m, min depth below seabed 3.2m. Sediment fill shows strong chaotic reflectors. Ave depth below seabed 1.9m, max thickness 5.6m.	**6018**
7004	**1**	Cut and fill	178	Cut into Barton Clay. Min depth below seabed 1.8m, max depth below seabed 6.1m. Strong chaotic reflectors in unit below cut. Fine grained fill with weak chaotic reflectors. Ave depth below seabed 1.9m, max thickness 4.3m. Overlying sediment has strong parallel reflectors	**6020**
7005	**1**	Cut and fill	112	Cut into Barton Clay. Min depth below seabed 2.0m, max depth below seabed 6.0m. Cuts across strong sub-horizontal reflectors of underlying unit. Fill has max thickness 3.4m, average depth below seabed 2.4m. Generally seismically transparent fill but poor data quality.	**6027**
7006	**1**	Cut and fill	54	Cut into Bracklesham Beds. Min depth below seabed 1.5m, max depth below seabed 4.2m.Fill contains weak chaotic reflectors. Ave depth below seabed 1.5m, max thickness 2.8m.	**6028**
7007	**1**	Cut and fill	271	Cut into Bracklesham Beds. Min depth below seabed 5.9m, max depth below seabed 15.8m. Fill contains faint reflectors dipping south-westwards. Max thickness 12.5m, average depth below seabed 3.1m. Overlying seabed sediments have strong, sub-parallel reflectors.	**6030**
7008	**1**	Cut and fill	158	Cut into Bracklesham Beds. Min depth below seabed 1.5m, max depth below seabed 6.7m. Fill contains faint sub-parallel reflectors. Max thickness 5.5m, average depth below seabed 1.4m.	**6031**
7009	**1**	Cut and fill	93	Cut into Barton Clay. Min depth below seabed 1.3m, max depth below seabed 5.7m. Fill has same seismic character as unit below cut. Max thickness 4.6m, average depth below seabed 1.3m.	**6032**
7010	**1**	Cut and fill	46	Small cut into Bracklesham Beds. Min depth below seabed 0.8m, max depth below seabed 3.7m. Fill contains weak reflectors. Max thickness 2.3m, average depth below seabed 1.7m.	**6034**

WA_ID	Zone	Feature	Length (m)	Description	Sources
7011	**1**	Cut and fill	68	Cut into Barton Clay. Min depth below seabed 3.7m, max depth below seabed 7.8m. SW side only visible, poor data. Fill has average depth below seabed 3.8m, max thickness 4.2m. Faint reflectors, almost structureless. Almost intersects 6056.	**6058**
7012	**2**	Cut and fill	242	Cut into Lower Greensand Group bedrock. Max depth below seabed of 10.3m, min depth below seabed 3.2m. Fill has max thickness 8.4m, average depth below seabed 2.5m. Generally seismically structureless except near centre where cut not discerned owing to poor quality data. Here appearance similar to that of unit below cut. Fine grained fill.	**6010**
7013	**2**	Cut and fill	212	Cut into Lower Greensand Group bedrock. Max depth below seabed 13.2m, min depth below seabed 2.1m. Fill contains chaotic indistinct reflectors with some hyperbolae. Fine grained, possibly mud. Max thickness 10.3m, average depth below seabed 3.4m. Poor quality data.	**6011**
7014	**2**	Cut and fill	101	Cut into Wealden Group bedrock. Max depth below seabed 5.6m, min depth below seabed 1.8m. Chaotic reflectors in fill. Max thickness 3.4m, average depth below seabed 2.2m.	**6012**
7015	**2**	Cut and fill	370	Cut into Wealden Group bedrock. Max depth below seabed 6.0m, min depth below seabed 2.5m. Fine grained fill with chaotic, faint reflectors. Max thickness 4.8m, average depth below seabed 1.4m. Appears slightly mounded.	**6013**
7016	**2**	Cut and fill	103	Cut into Wealden Group bedrock. Max depth below seabed 4.3m, min depth below seabed 1.2m. Fill appears to end at seabed, reflectors are bright and sub-parallel, roughly horizontal. Bedrock appears structureless below cut but shows structure either side of feature.	**6014**
7017	**2**	Cut and fill	119	Cut into Wealden Group bedrock. Max depth below seabed 5.6m, min depth 1.3m below seabed. Fill contains Faint chaotic reflectors. Max thickness 5.6m, average depth below seabed 1.5m. Poor quality data.	**6015**
7018	**2**	Cut and fill	119	Cut into Wealden Group bedrock. Max depth below seabed 4m, min depth below seabed 1.2m. Fill has max thickness 4.0m, average depth below seabed 1.6m. Faint chaotic reflectors. Poor quality data.	**6016**
7019	**2**	Cut and fill	213	Cut into Upper Chalk bedrock. Min depth below seabed 1.7m, max depth below seabed 6.6m. Hard to distinguish, especially in centre. Fine grained fill. Max thickness 3.7m, average depth below seabed 3.9m. Chaotic reflectors. Unit above approaches to within less than 1m of seabed.	**6022**
7020	**2**	Cut and fill	167	Cut into Lower Greensand Group bedrock. Min depth below seabed 1.5m, max depth below seabed 7.5m. Central part obscured by hyperbole. Fill contains weak reflectors partially obscured by hyperbole. Max thickness 6.3m, average depth below seabed 1.5m.	**6025**

WA_ID	Zone	Feature	Length (m)	Description	Sources
7021	**2**	Cut and fill	104	Cut into Upper Chalk bedrock. Hard to distinguish. Min depth below seabed 2.9m, max depth below seabed 7.5m. Fill has similar seismic character to unit below cut. Max thickness 5.4m, average depth below seabed 2m.	**6033**
7022	**2**	Cut and fill	83	Cut into Lower Greensand Group bedrock. Min depth below seabed 1.1m, max depth below seabed 3.9m. Fill approaches to <1m of seabed. Fill is strong horizontal reflectors, not fine grained.	**6036**
7023	**2**	Cut and fill	105	Cut into Lower Greensand Group bedrock. Min depth below seabed 3.1m, max depth below seabed 7.6m. Edges unclear. Generally dipping reflectors below, horizontal above.	**6038**
7024	**2**	Cuts and fills	332	Cut into Wealden Group bedrock. Min depth below seabed 2.0m, max depth below seabed 7.5m. Fill has a min depth below seabed 1.6m, max depth below seabed 6.7m. Onlapping reflectors, dipping northwest. This unit is also cut and filled with a fill containing horizontal reflectors. Max thickness 5.4m, average depth below seabed 1.6m. Poor quality data.	**6042**
7025	**2**	Cut and fill	107	Cut into Wealden Group bedrock. Min depth below seabed 1.4m, max depth below seabed 6.2m. Fill to <1m of seabed. Below cut seismically structureless, above cut approximately horizontal reflectors. Poor quality data.	**6043**
7026	**2**	Cut and fill	99	Cut into Wealden Group bedrock. Min depth below seabed 1.1m, max depth below seabed 4.9m. Fill is almost seismically structureless. Max thickness 4.9m, ave depth below seabed 1.6m. Poor quality data.	**6044**
7027	**2**	Cut and fill	86	Cut into Wealden Group bedrock. Min depth below seabed 1.6m, max depth below seabed 6.3m. Distinct strong reflector marks cut. Fill contains faint, approximately horizontal reflectors. Max thickness 4.6m, average depth below seabed 1.7m. Poor data quality.	**6045**
7028	**2**	Cut and fill	102	Cut into Wealden Group bedrock. Min depth below seabed 1.5m, max depth below seabed 6.3m. Distinct strong reflector marks cut. Some hyperbole. Fill contains weak chaotic reflectors. Max thickness 4.6m, average depth below seabed 1.4m. Poor quality data.	**6046**
7029	**2**	Cut and fill	146	Cut into Wealden Group bedrock. Min depth below seabed 1.0m, max depth below seabed 3.5m. Distinct strong reflector marks cut. Some hyperbole. Fill contains weak sub-horizontal reflectors. Max thickness 2.2m, average depth below seabed 1.4m. Poor data quality.	**6047**
7030	**2**	Cut and fill	76	Cut into Wealden Group bedrock. Min depth below seabed 1m, max depth below seabed 3.3m. Fill to <1m of seabed. Seismically structureless below cut, strong sub horizontal reflectors in fill, some hyperbole at base of cut. Poor quality data.	**6048**
7031	**2**	Cut and fill	433	Cut into Wealden Group bedrock. Min depth below seabed 1.1m, max depth below seabed 10.5m. Indistinct reflector marks cut. Poor data so not possible to describe fill.	**6052**

WA_ID	Zone	Feature	Length (m)	Description	Sources
7032	**2**	Cut	78	Cut into Wealden Group bedrock. Max depth below seabed 10.7m, min depth below seabed 1.3m. NE side only. Strong reflector. Poor data quality.	**6060**



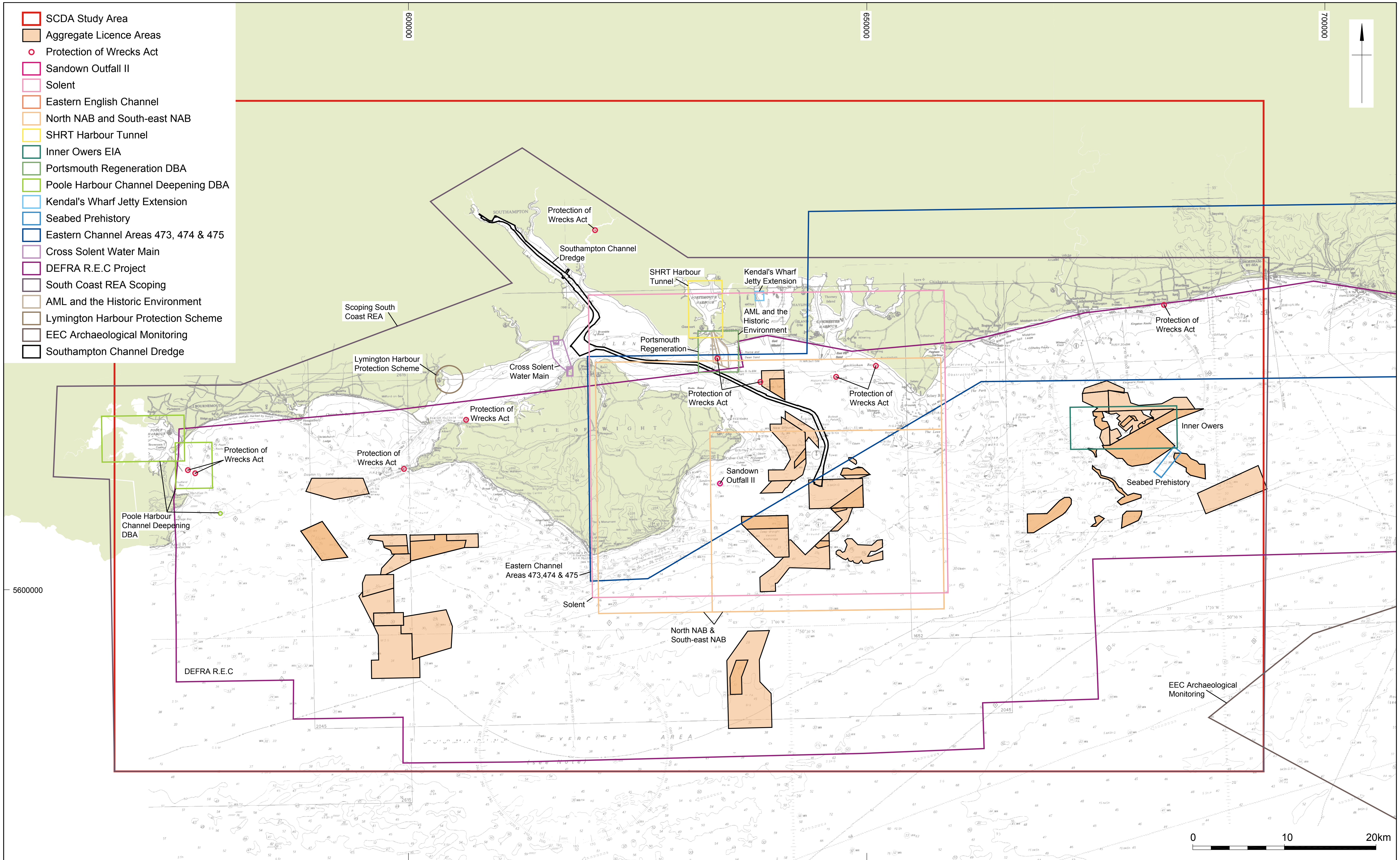
Wessex Archaeology

Drawing projection: UTM WGS84 zone 30N
Admiralty Chart 2450 (dated 2000)

Date:	30/03/09	Revision Number:	0
Scale:	1:400,000	Illustrator:	KJB
Path:	W:\Projects\65781\Drawing Office\Report Figures\...\09-03-30		

MAREA Study Area

Figure 1



Wessex Archaeology

Drawing projection: UTM WGS84 zone 30N
Admiralty Chart 2450 (dated 2000)

Date:	30/03/09	Revision Number:	0
Scale:	1:400,000	Illustrator:	KJB
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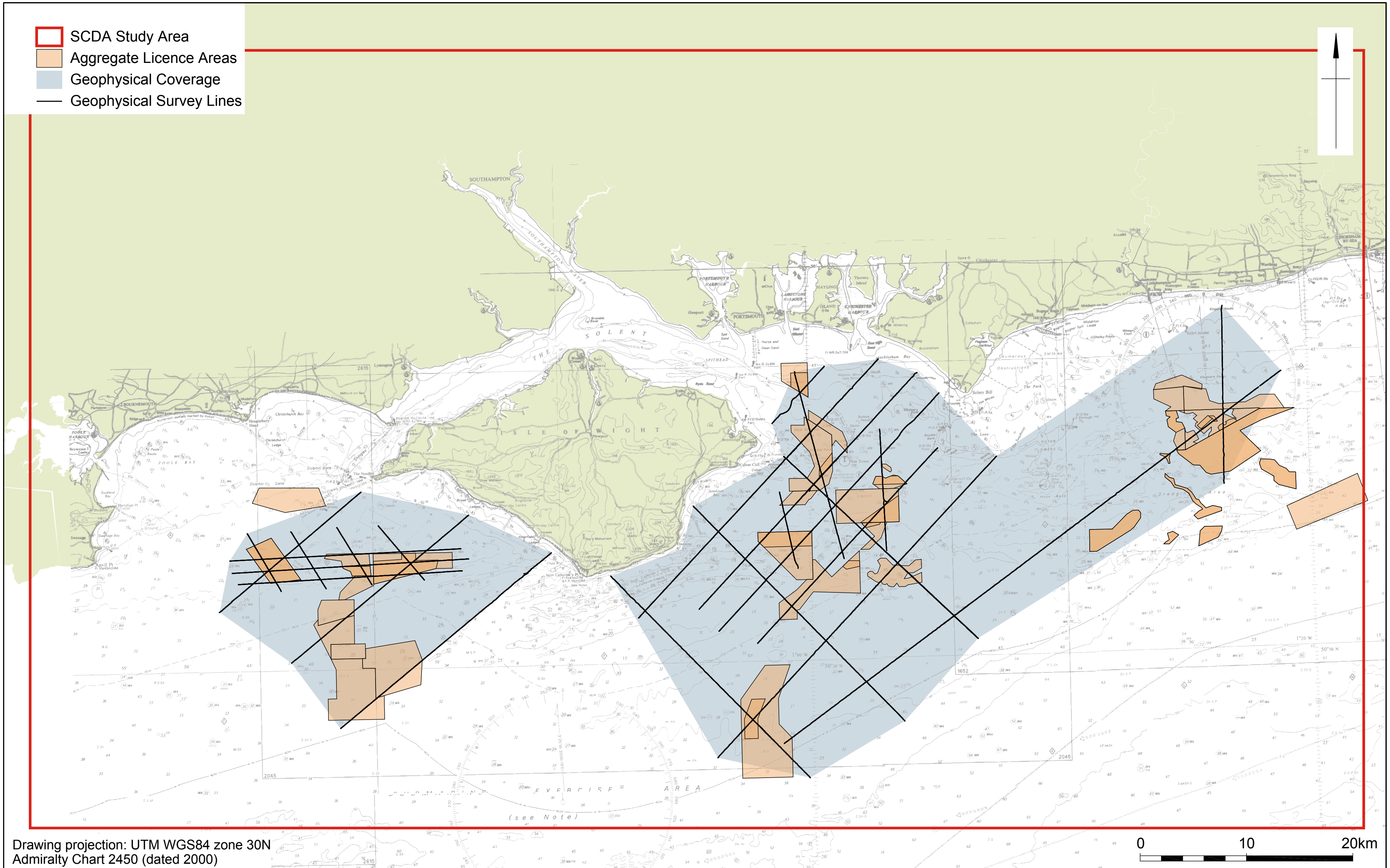
Previous selected Wessex Archaeology projects

Figure 2



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Admiralty Chart 2450 (dated 2000)

Wessex Archaeology

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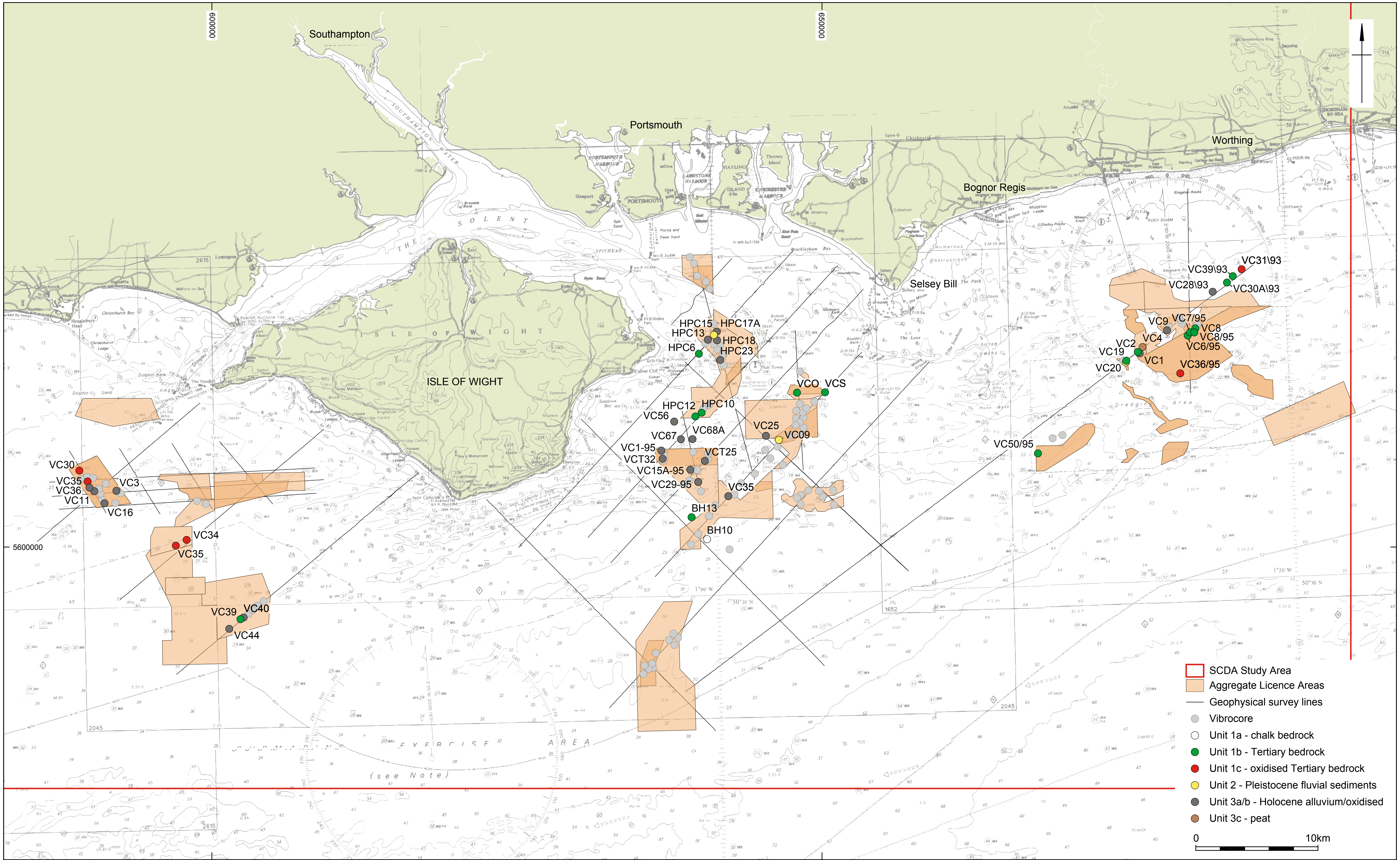
Reviewed REA Geophysical Data

Figure 3



Wessex Archaeology

Drawing projection: UTM WGS84 zone 30N
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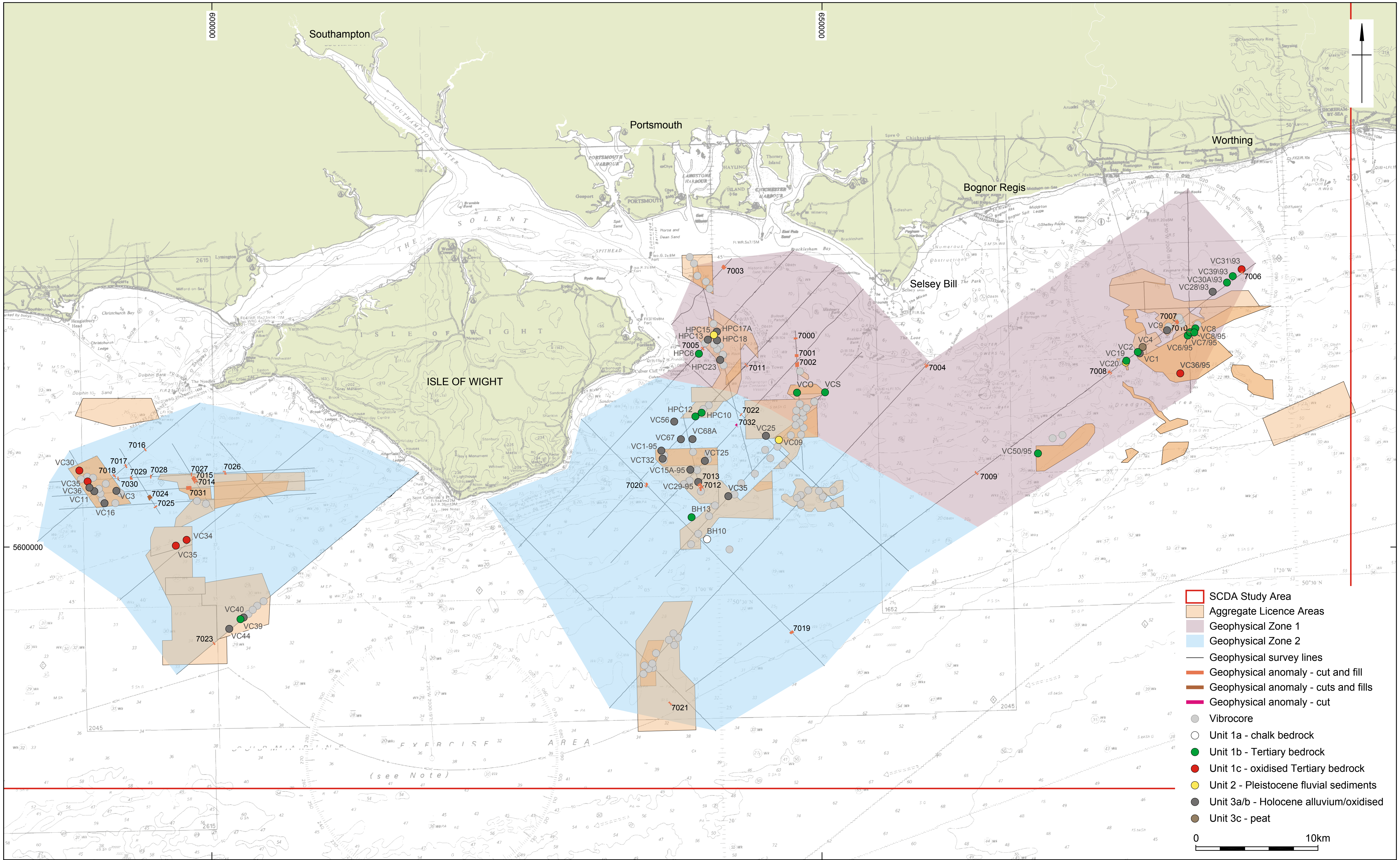
Vibrocore and dredging area

Figure 4



Wessex Archaeology

Drawing projection: UTM WGS84 zone 30N
Admiralty Chart 2450 (dated 2000)

Date:	20/04/09	Revision Number:	0
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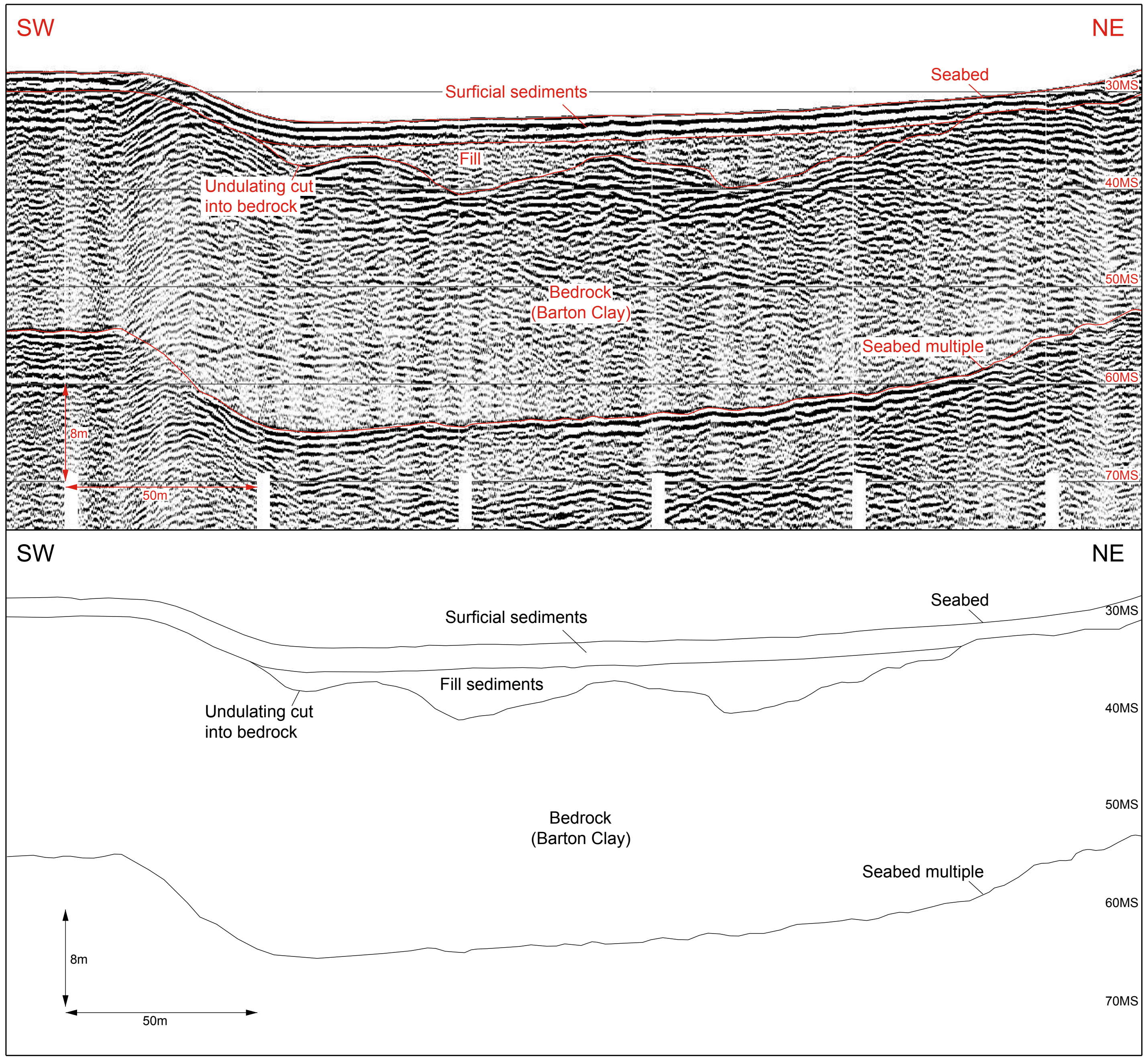
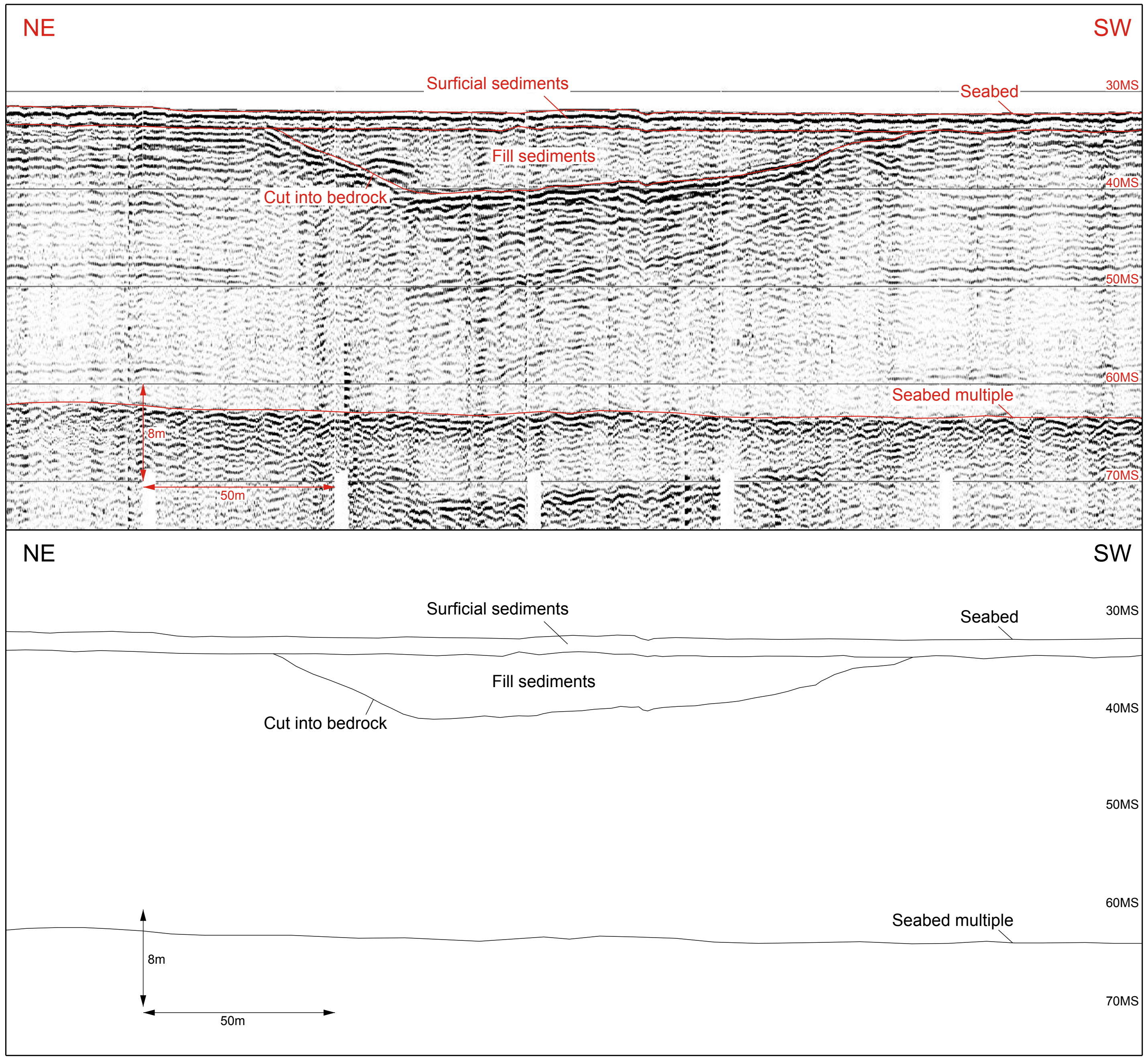
Geophysical anomalies

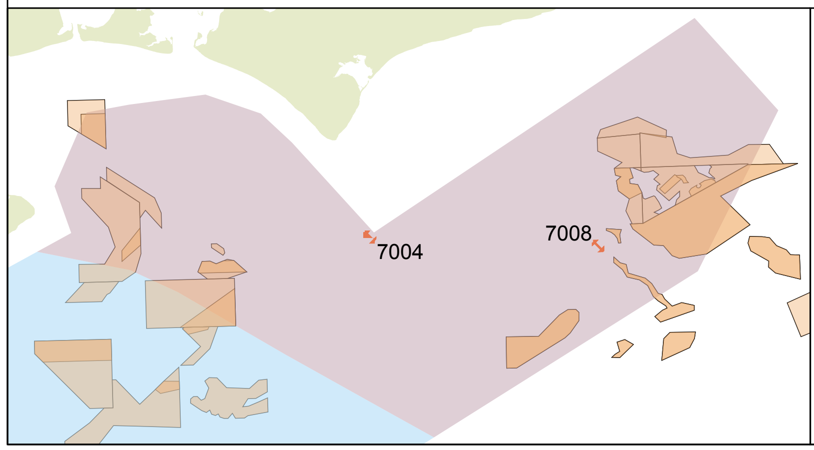
Figure 5

A. Sub-bottom profiler data example – Zone 1 cut and fill (7004)



B. Sub-bottom profiler data example – Zone 1 cut and fill (7008)





Aggregate Licence Areas
Geophysical Zone 1
Geophysical Zone 2

0 10 20km

Wessex Archaeology

Drawing projection: UTM WGS84 zone 30N

Date:	30/03/09	Revision Number:	0
Scale:	1:500 vertical (inset 1:500,000)	Illustrator:	KJB
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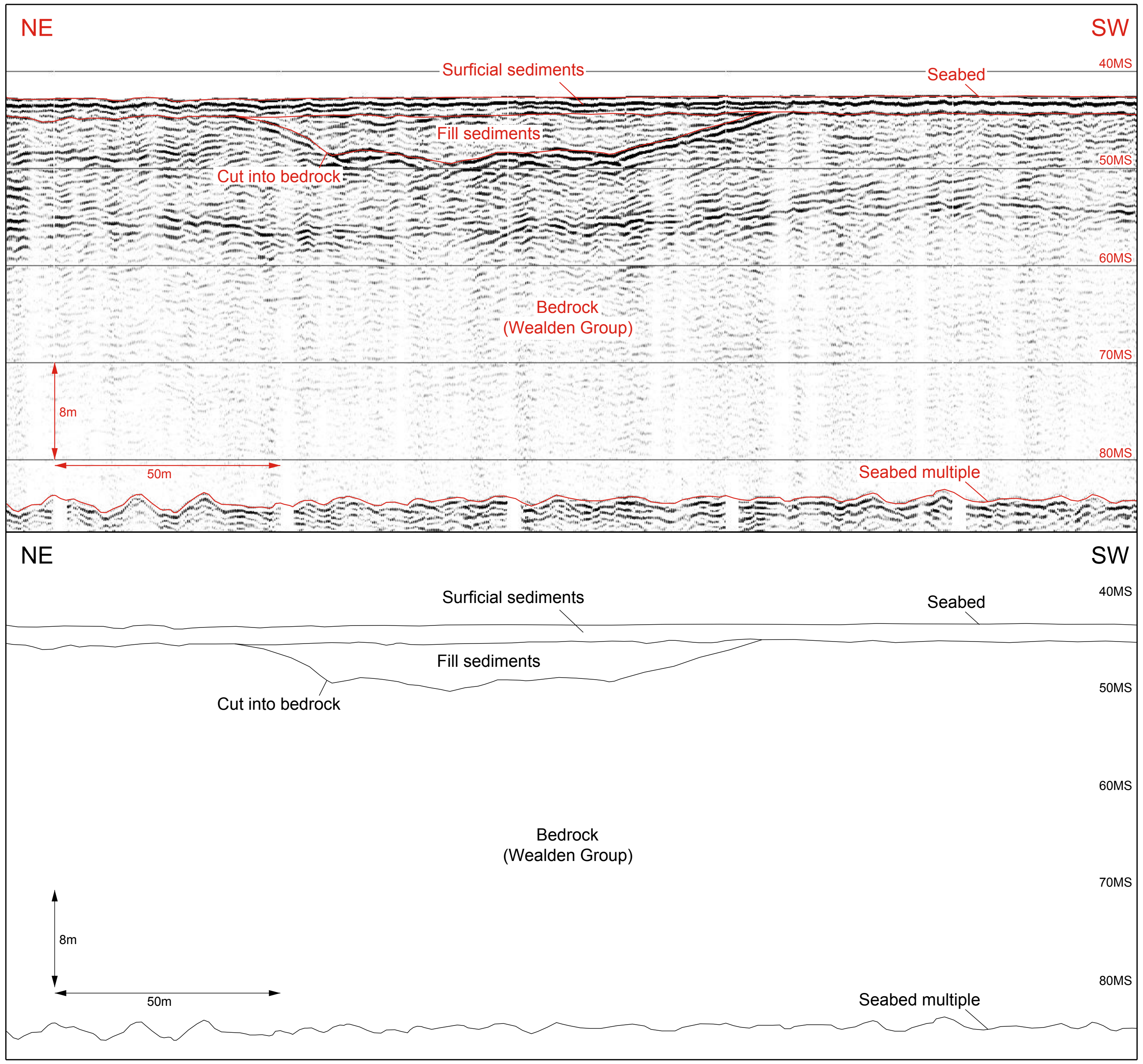
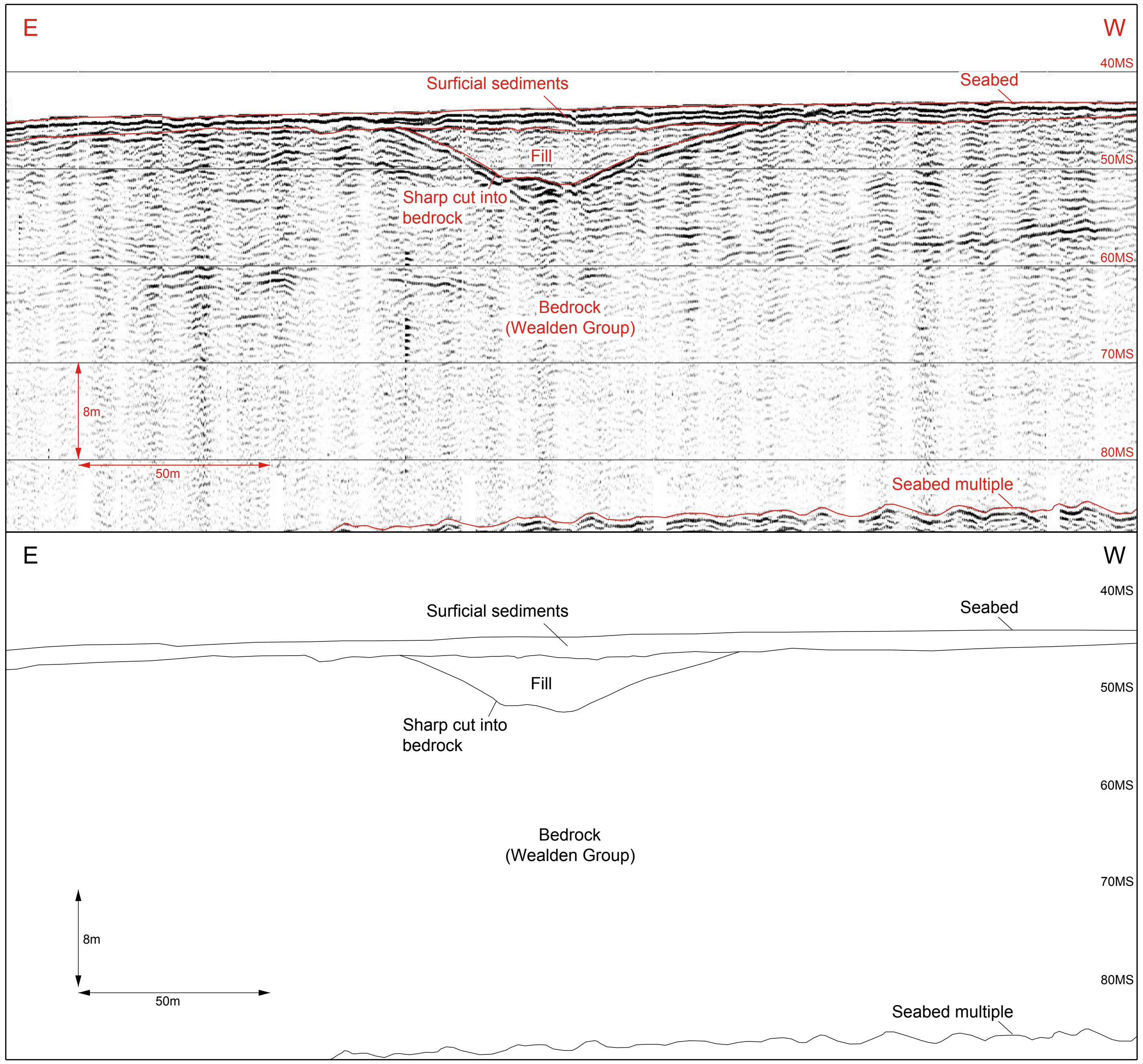
Sub-bottom profiler examples Zone 1

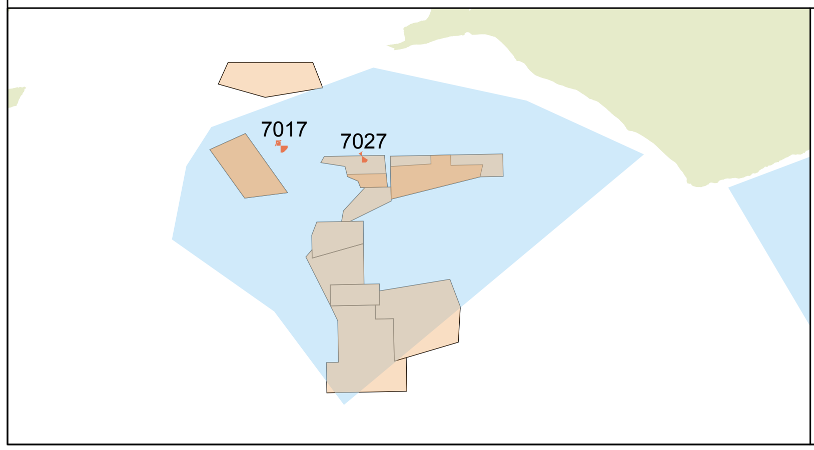
Figure 6

A. Sub-bottom profiler data example – Zone 2 cut and fill (7017)



B. Sub-bottom profiler data example – Zone 2 cut and fill (7027)





Aggregate Licence Areas
Geophysical Zone 2

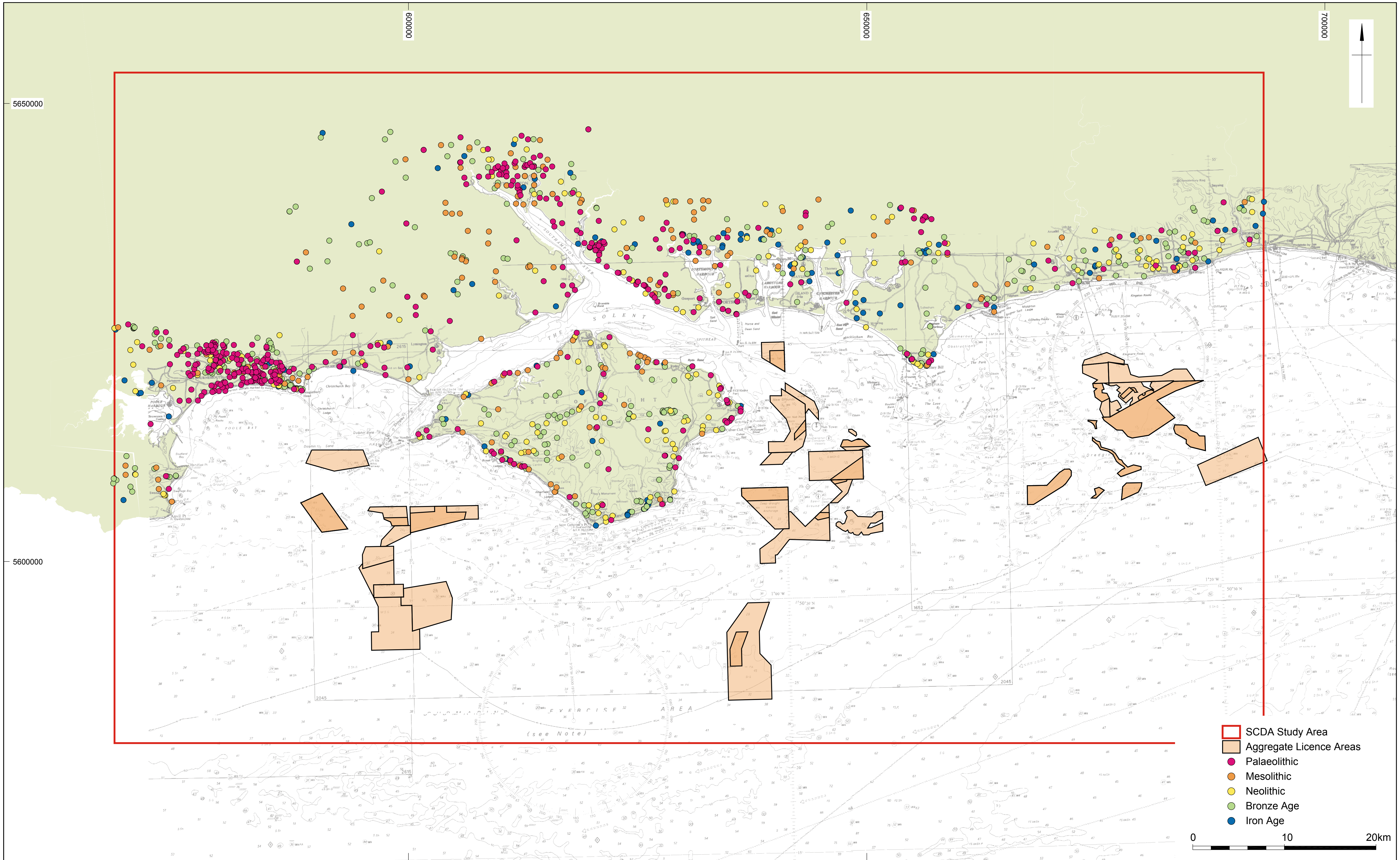
0 10 20km

Wessex Archaeology

Drawing projection: UTM WGS84 zone 30N

Date:	30/03/09	Revision Number:	0
Scale:	1:500 vertical (inset 1:500,000)	Illustrator:	KJB
Path:	W:\Projects\65781\Drawing Office\Report Figures\...\09-03-30		

Sub-bottom profiler examples Zone 2



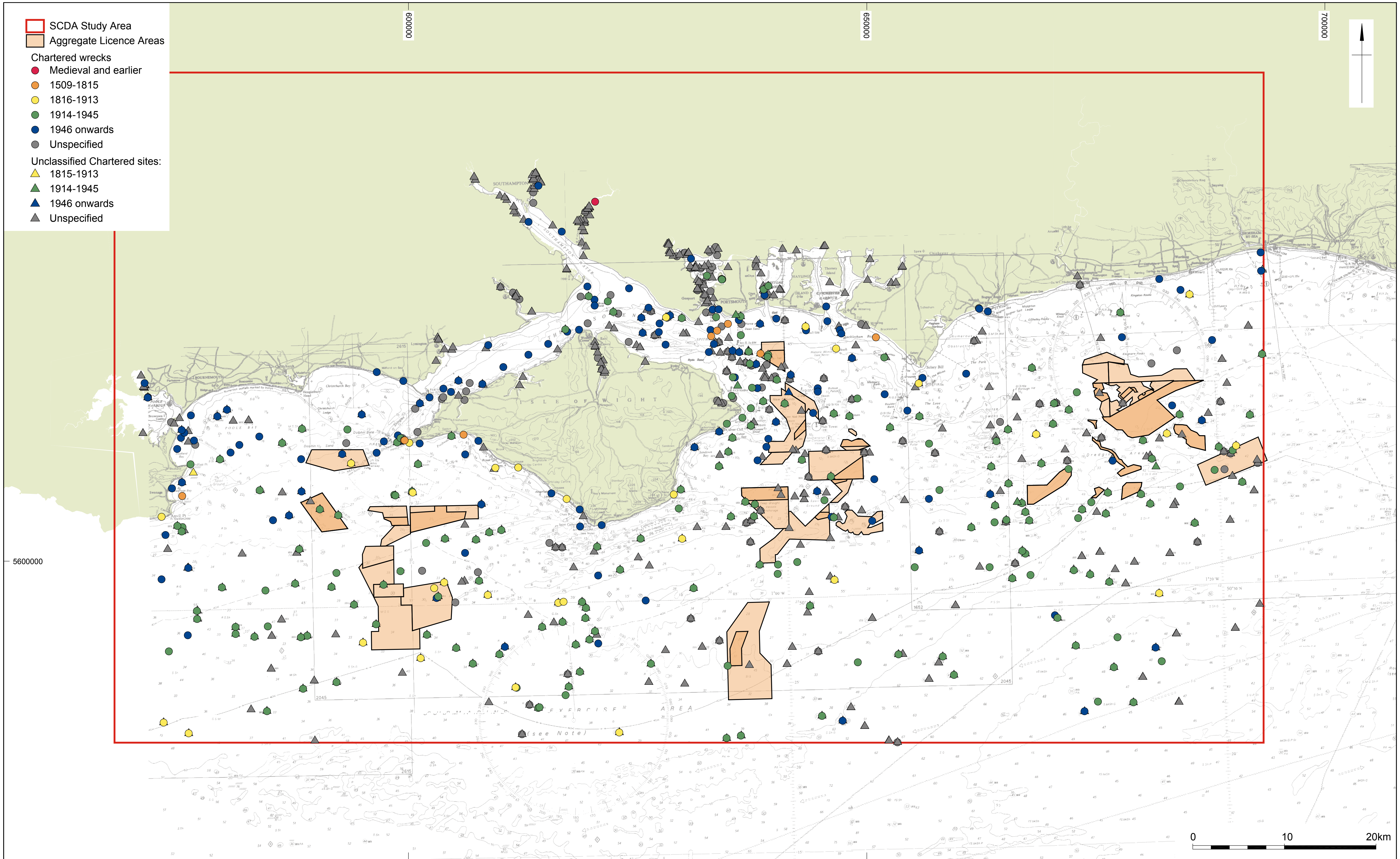
Wessex Archaeology

Drawing projection: UTM WGS84 zone 30N
Admiralty Chart 2450 (dated 2000)

Date:	30/03/09	Revision Number:	0
Scale:	1:400,000	Illustrator:	KJB
Path:	W:\Projects\65781\Drawing Office\Report Figures\...\09-03-30		

Known Prehistoric Sites in the Study Area

Figure 8



Wessex Archaeology

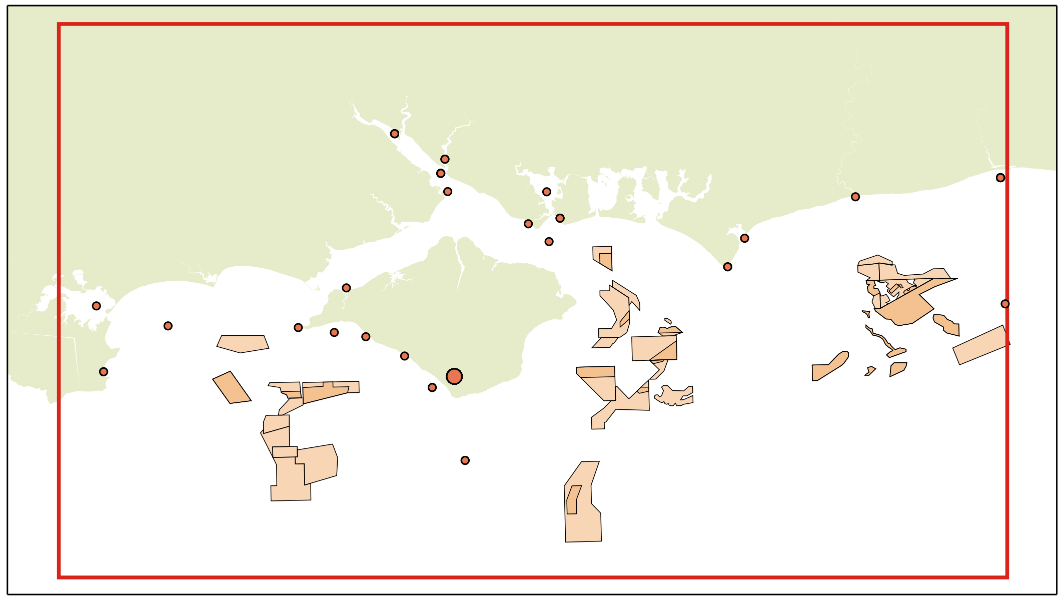
Drawing projection: UTM WGS84 zone 30N
Admiralty Chart 2450 (dated 2000)

Date:	30/03/09	Revision Number:	0
Scale:	1:400,000	Illustrator:	KJB
Path:	W:\Projects\65781\Drawing Office\Report Figures\...\09-03-30		

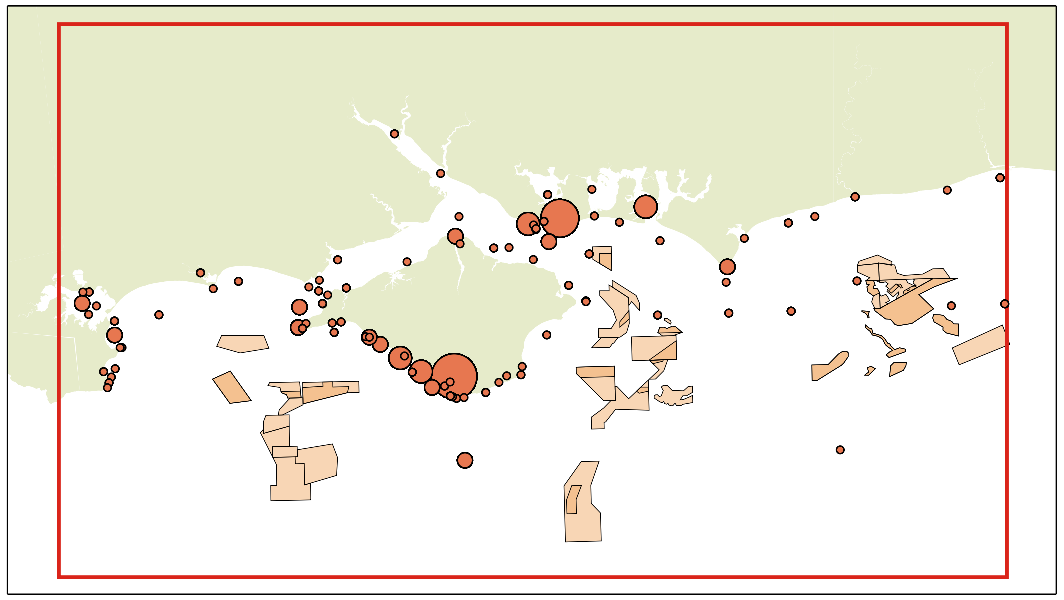
Chartered Wrecks and Unspecified Sites in the Study Area

Figure 9

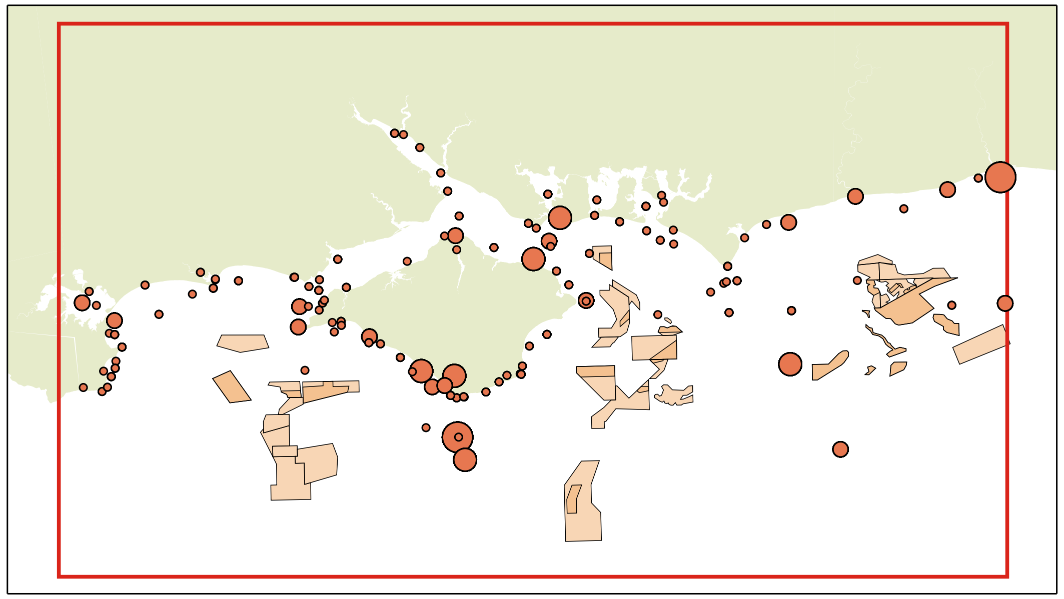
A. Up to 1508



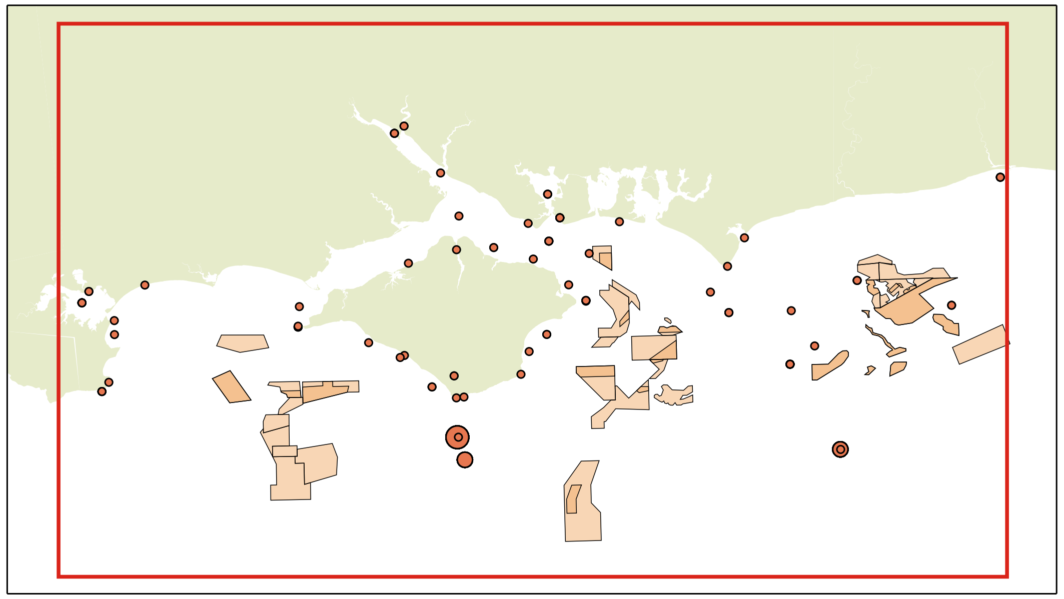
B. 1509-1815



C. 1816-1913



D. 1914-1945



E. 1945 onwards

SCDA Study Area
Aggregate Licence Areas
Number of casualties:
1-10
11-20
21-30
31-40
41-50
81-90

0 50km

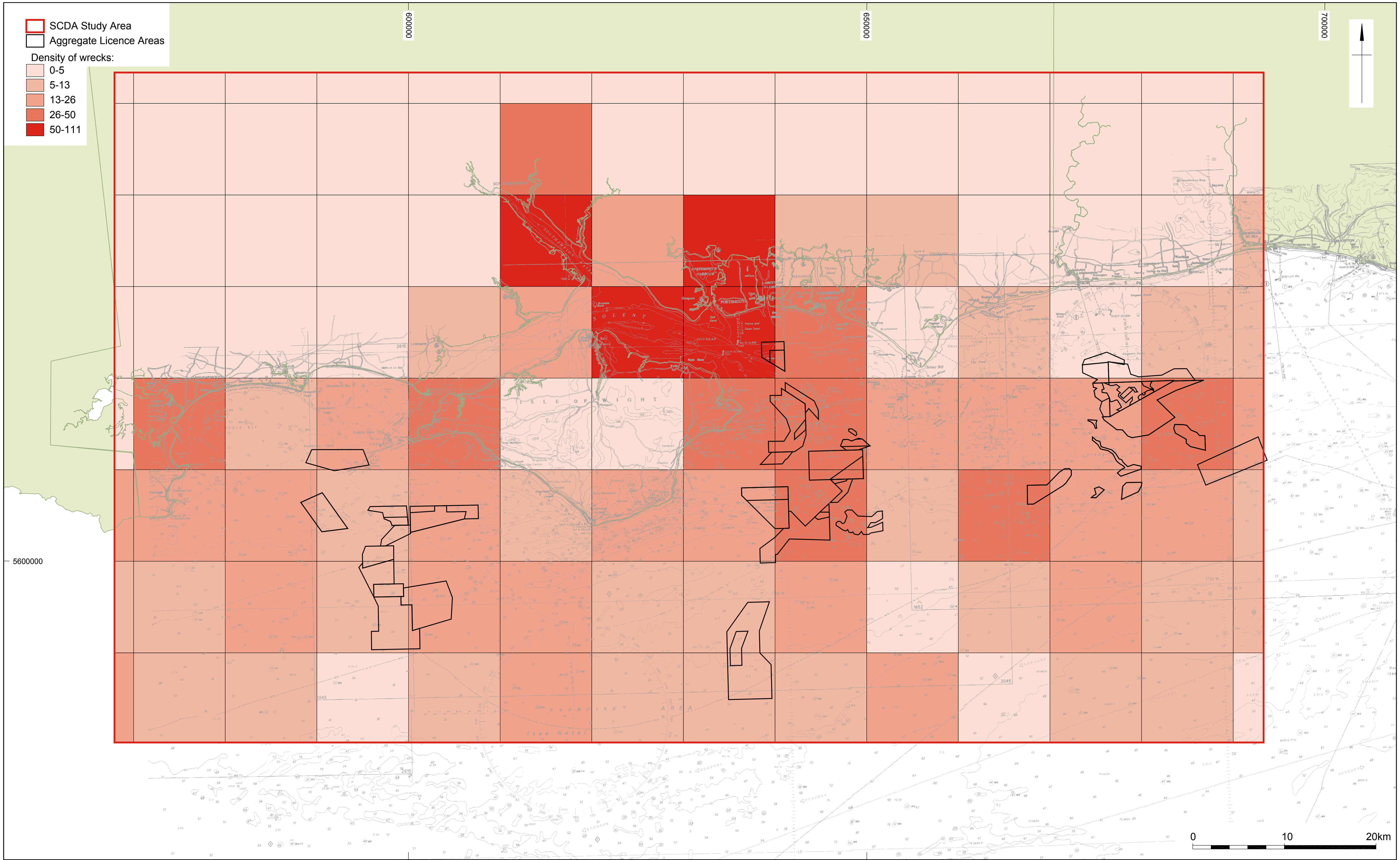
Wessex Archaeology

Drawing projection: UTM WGS84 zone 30N

Revision Number:	0
Illustrator:	KJB
Date:	30/04/09
Scale:	1:1,000,000
Path:	W:\Projects\65781\Drawing Office\ Report Figures\...\09-03-30

Proportion of Shipping Casualties in the Study Area

Figure 10



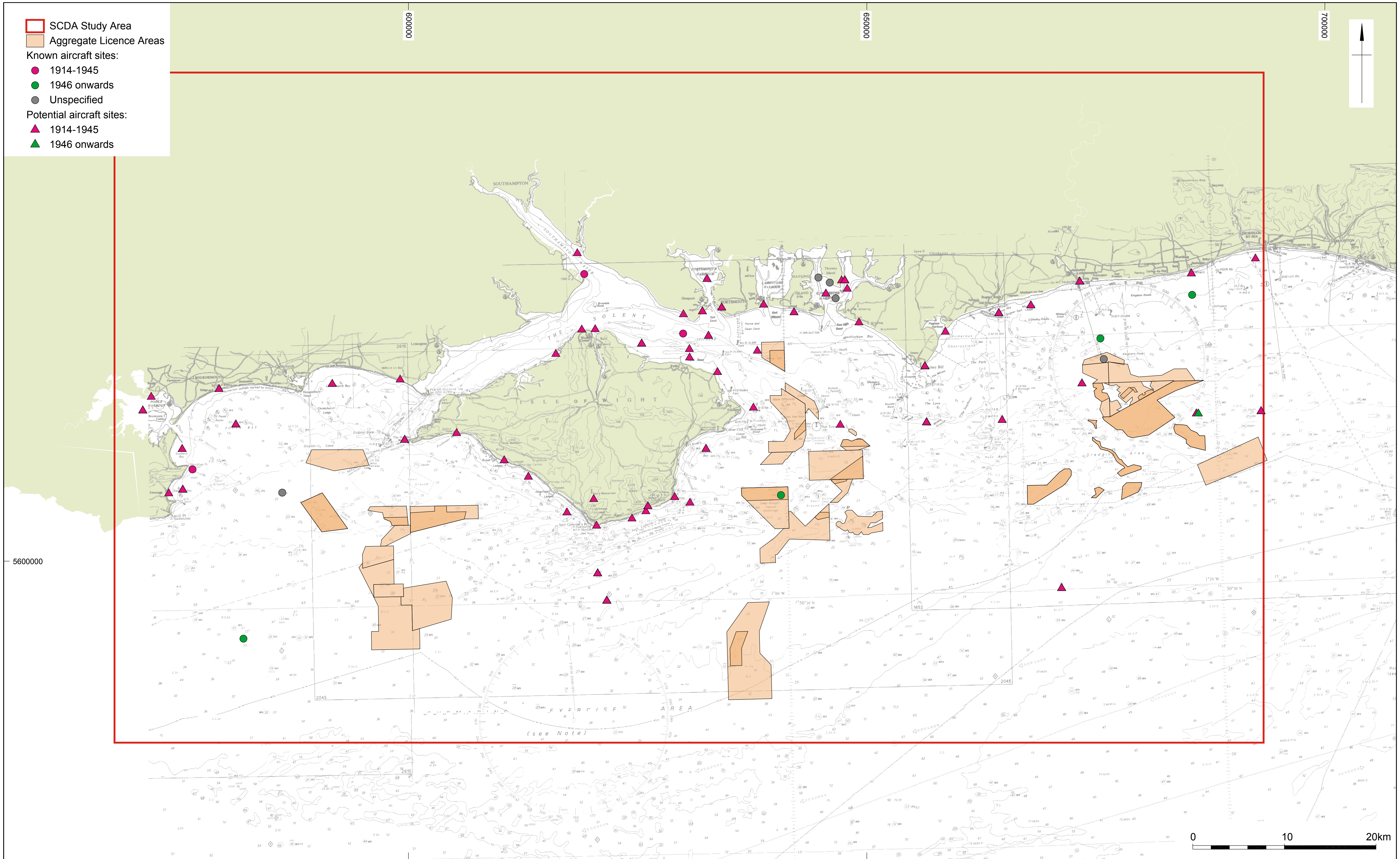
Wessex Archaeology

Drawing projection: UTM WGS84 zone 30N
Admiralty Chart 2450 (dated 2000)

Date:	30/03/09	Revision Number:	0
Scale:	1:400,000	Illustrator:	KJB
Path:	W:\Projects\65781\Drawing Office\Report Figures\...\09-03-30		

Density of Chartered Wrecks per 10km2 in the Study Area

Figure 11



Wessex Archaeology

Drawing projection: UTM WGS84 zone 30N
Admiralty Chart 2450 (dated 2000)

Date:	30/03/09	Revision Number:	0
Scale:	1:400,000	Illustrator:	KJB
Path:	W:\Projects\65781\Drawing Office\Report Figures\...\09-03-30		

Known and Potential Aircraft sites in the Study Area

Figure 12