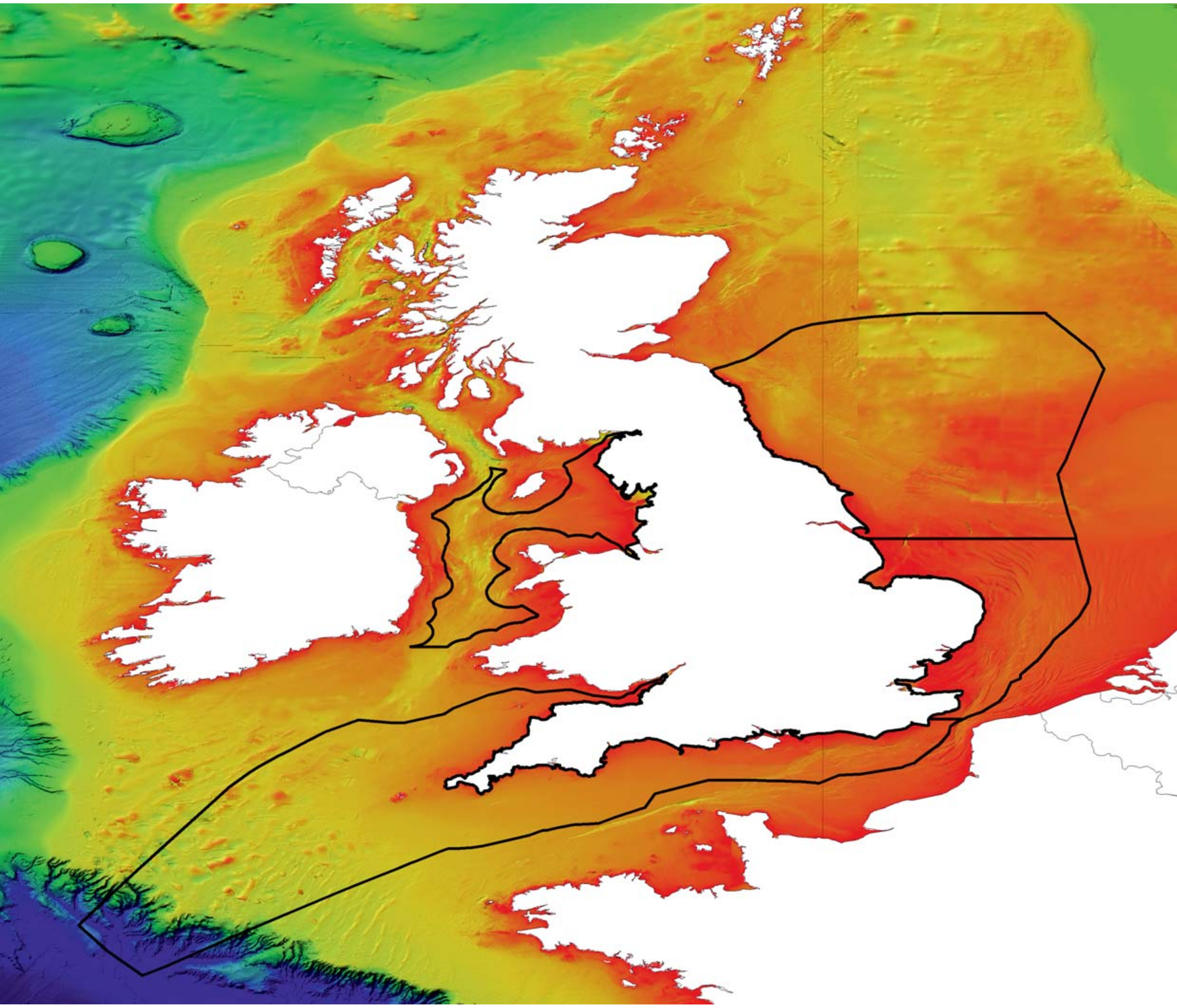
Wessex Archaeology

Audit of Current State of Knowledge of Submerged Palaeolandscapes and Sites

English Heritage Project no. 6231



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Wessex Archaeology

AUDIT OF CURRENT STATE OF KNOWLEDGE OF SUBMERGED PALAEOLANDSCAPES AND SITES

ENGLISH HERITAGE PROJECT NO. 6231

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AUDIT OF CURRENT STATE OF KNOWLEDGE OF SUBMERGED PALAEOLANDSCAPES AND SITES

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Summary

This project provides an audit of the current state of knowledge of submerged palaeolandscapes and sites within the confines of England's inshore and offshore region, as defined in the Marine and Coastal Access Act 2010. Intertidal sites are not specifically included in the audit unless directly part of an offshore project (e.g. cable routes, pipelines).

The aim of this project is to raise awareness and widen understanding of the results of offshore projects and surveys which have been undertaken for academic or commercial purposes through appropriate dissemination aimed at a professional, but not necessarily specialist, audience.

An assessment of available technical reports, research and other archived sources of palaeolandscape assessments has provided a total of **67 Projects** and **204 geophysical and geotechnical survey Events** within the audit database.

Within these Projects, this collection of Events has been used 240 times indicating a dataset reuse rate of around 17%.

Most of this dataset reuse is directly due to Marine Aggregates Levy Sustainability Fund (MALSF)-funded Regional Environmental Characterisations (RECs) and research projects, Marine Aggregates Regional Environmental Assessments (MAREAs) and aggregates licence renewal projects as well as the published MAREAs and RECs subsequently contributing to adjacent offshore renewables developments. The ALSF ethos of *collect once, uses many times* has occurred to some degree; certainly for the regions that have undergone these large-scale overview projects. These figures further highlight the significant contribution that aggregates-funded research has made to understanding archaeology offshore but also to other sectors of offshore industry. With the development of Round 3 offshore renewables schemes into regions without aggregates licences and associated regional research projects additional baseline datasets are currently being produced and assessed.

Regional distributions of known palaeolandscape features vary across archaeological periods especially during the Middle and Lower Palaeolithic. Distributions of palaeolandscapes of Mesolithic archaeological interest are extensive around all UK coasts and can in places be attributed to particular palaeochannels and other features. Substantial palaeolandscape areas of Upper Palaeolithic interest exist around all study areas, but particularly characterise the Irish Sea, with earlier Palaeolithic archaeology elusive in the region. Palaeolithic, including Lower and Middle Palaeolithic palaeolandscape evidence is prevalent across the central and especially southern North Sea and eastern English Channel and offers major opportunities for future research.

By investigating this large number of technical reports and research outputs several methodological themes are apparent from work carried out to date.

The typically coarse, but mostly absent, chronological control and mostly absent or low-resolution palaeoenvironmental analysis (usually restricted to peats), that typifies most

offshore archaeological investigations until recent years has clear temporal and spatial scale limitations that effectively precludes the identification of “archaeological-scale features” that are not ship or aircraft wrecks. The identification of a submerged prehistoric site is highly unlikely to be possible within this context.

Geophysical data quality is highly variable within and between projects which has limited the clarity of some palaeolandscapes projects. In some cases coverage of sub-bottom seismic survey lines is partial within a Project area allowing only sub-sets of a project to be assessed in any detail. Similarly geotechnical information is often partial across a Project area and was not targeted for archaeological purposes, i.e. within palaeochannels or other landforms of archaeological interest.

Where key archaeological findings are made whether it be artefactual, palaeoenvironmental or palaeogeographical, effective publication has not often occurred, partly due to the nature of the assessment source, i.e. contracted industry work. Whilst all ALSF research has been made freely-available on the internet, uptake of this invaluable resource has not always filtered fully into academic literature. This resource is clearly of paramount importance to the discussion made for human movement across the landscape and the resources and topography utilised by hominins during the last million years.

A clear theme that major south coast palaeolandscape projects have again highlighted is that the investigation of prehistoric archaeology must incorporate some form of palaeolandscape investigation, whether that is offshore, nearshore or the terrestrial environs of a particular location. Partly as a means of integrating the existing but partial and often poorly-contextualised offshore archaeological record, these data can be placed within an effective framework moving forward that allows the development of regional hypotheses for future prospection and testing.

Expanding the existing understanding of submerged prehistory and palaeolandscapes through new research, developing internationally-significant hypotheses, prospecting into new areas and linking up with similar research from mainland European coasts is entirely feasible at this point. Major priorities for the next generation of research would be to develop a fully source-to-sea approach to prehistoric archaeology completely integrated with palaeogeography; where modern coastlines are no boundary to methods, theories and concepts.

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Data Licences

The following data licences and notices apply:

- Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com
- Incorporating Lisiecki & Raymo, 2005 doi:10.1029/2004PA001071)
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1. INTRODUCTION

1.1. PROJECT BACKGROUND

1.1.1. Prior to the Marine Aggregate Levy Sustainability Fund (MALSF) the marine aggregate industry was making a substantial contribution to our understanding of submerged landscapes through licence specific Environmental Impact Assessments conducted as part of the licence application process. Each individual licence was focused on a relatively small area of seafloor, often related to fluvially deposited material, and so there was a strong correlation of interest between the deposits targeted for extraction and the extension of known fluvial systems into what is now offshore locations; which were expected to be interrelated with the potential presence of prehistoric artefactual and palaeoenvironmental material.

1.1.2. In 2003 Wessex Archaeology conducted the first MALSF project to investigate an area of seafloor for prehistoric material with the Seabed Prehistory project funded by the Mineral Industry Research Organisation (MIRO), which targeted a section of the Palaeo-Arun, in the English Channel (Wessex Archaeology 2008, 2009). This project helped establish geophysical and geotechnical methodologies best suited to providing data on these features and helped to establish a series of MALSF projects which ultimately led to the evaluation of the Middle Palaeolithic site found in aggregate extraction Area 240, situated off the coast of Great Yarmouth (English Heritage project number 5684).

1.1.3. The recovery of 88 Palaeolithic artefacts including 33 hand axes, and a large number of faunal remains from Area 240 has proved the potential for survival of Middle Palaeolithic material and sites offshore, despite repeated cycles of marine transgression and regression. This work, which was funded by EH, has subsequently informed the management of Area 240 and has wider implications for our knowledge of submerged landscapes. Our improved understanding of submerged palaeolandscapes has also led to Wessex Archaeology recently being commissioned by the aggregate industry to undertake an assessment of the Palaeo-Yare catchment area, namely to delineate, where possible, the regional extents and survival of specific sediment units from which a large number of flint artefacts and faunal remains were recovered within Area 240.

1.1.4. The MALSF also funded the acquisition of new, large data sets under the Regional Environmental Characterisation (REC) surveys off the South Coast, East Coast, Humber, Thames Estuary and Eastern English Channel. These data sets have been interpreted by geologists, archaeologists and ecologists to provide broad-scale understanding of these areas, which provide a context for the numerous small scale archaeological projects.

1.1.5. These RECs were then subsequently complemented by the Regional Environmental Assessment (REA) projects which were funded directly by the marine aggregate industry, where archaeological interpretations were again considered to be integral in understanding the marine environment across substantial areas.

1.1.6. Other archaeological projects such as North Sea Palaeolandscapes Project[1] (Gaffney et al. 2007) and West Coast Palaeolandscapes Project[2] (Fitch and Gaffney 2010) conducted by Birmingham University have used data from a variety of industry and public sources to further expand our knowledge of submerged landscapes in these two areas, particularly in respect of landsurfaces which were exposed during the early to mid-Holocene, contemporary with Mesolithic human activity.

1.1.7. This large volume of work, which has been conducted over the last nine years, has led to a substantial improvement in our understanding of the potential of prehistoric archaeological assets to survive offshore. This knowledge has been carried though into developer-led marine projects, in all sectors of offshore development. In particular, the influence can be seen in the integral role archaeologists are currently playing in the project teams for the development of the Round 3 Offshore Wind Farms, which are investigating areas of seafloor around the UK far larger than has previously been possible.

1.1.8. The ending of the MALSF has left us with a legacy of numerous projects which have explored the submerged landscapes off the English Coast. The majority of these projects have been summarised as a short monograph (Bicket 2011) and a longer publication discussing the results of the ALSF on our understanding of the Palaeolithic is currently in progress (*Lost Landscapes of the Palaeolithic*, English Heritage Project Number 5458).

1.1.9. There are relatively few examples of known submerged Palaeolithic and Mesolithic sites, and with the exception of the Area 240 site (Tizzard, Bicket, De Loecker 2013), they are confined to the coast, such as the Mesolithic submerged site at Bouldnor Cliff (Momber *et al.* 2011). However, a large number of apparently isolated artefacts have been retrieved in the North Sea through fishing and dredging activities. The finds reported through the Marine Aggregate Industry Protocol for Reporting Finds of Archaeological Interest, although without stratigraphic context, can provide relevant background information with regards to the audit of palaeolandscapes and the potential for associated archaeological sites.

1.2. AIMS & OBJECTIVES

1.2.1. The aim of this project is to raise awareness and widen understanding of the results of offshore projects and surveys which have been undertaken for academic or commercial purposes through appropriate dissemination aimed at a professional, but not necessarily specialist, audience.

1.2.2. The specific objectives of the project are defined as follows:

- To provide data highlighting the current state of knowledge of submerged palaeolandscapes to related projects in the NHPP specifically NHPP 3A1.101 (Historic Seascape Characterisation) and NHPP 4H1.1 (Assessment and protection of potentially significant submerged landscapes);

[1] doi:10.5284/1000397 (last accessed 26/02/2013).
[2] doi:10.5284/1000398 (last accessed 26/02/2013).

- To provide data to the Marine Management Organisation and other teams developing Marine Plans (arising from the Marine and Coastal Access Act 2010) from now until 2021;
- To provide knowledge gained to the wider archaeological and the scientific community and specifically to the 'People and the Sea: A Maritime Archaeological Research Agenda for England' (edited by Ransley *et al.* 2013);
- To inform relevant research activities as part of the NHPP through assessment and consideration of methodologies required to investigate submerged palaeolandscapes.

1.2.3. There are three formal Products resulting from this project to achieve the objectives above:

- An illustrated technical report outlining the data sets available and an interpretive account and discussion of survey results including an assessment of priority areas for future offshore survey, an evaluation of existing methodologies and recommendations for future projects;
- GIS layers to demonstrate the spatial extent of known survey events with MEDIN compatible metadata;
- A project archive suitable for updating in the future.

1.3. PROJECT SCOPE

1.3.1. The project has been confined to the consideration of prehistoric submerged landscapes, principally of Palaeolithic and Mesolithic date. As stated in the Design Brief the project does not include data on landscapes and sites submerged during the Late Holocene, such as Dunwich, Suffolk, and the numerous other lost villages along the East Anglian and Holderness coast.

1.3.2. This project provides an audit of the current state of knowledge of submerged palaeolandscapes and sites within the confines of England's inshore and offshore region, as defined in the Marine and Coastal Access Act 2010 (**Figure 1**). Intertidal sites are not specifically included in the audit unless directly part of an offshore project (e.g. cable routes, pipelines).

1.3.3. Based on Wessex Archaeology's experience assessing palaeolandscapes it is known that many of the surveys will have identified palaeolandscape features relating to multiple periods throughout the Pleistocene and Holocene. These issues have been considered during the development of the project GIS and associated interpretive data. Where measured chronology (usually radiocarbon dates or OSL dates) or a defined correlation is made in technical reports to particular palaeolandscape features and deposits of direct interest (such as peats) – or a defined geological unit or formation – corresponding archaeological periods have been assigned to specific projects. Where this evidence can be directly attributed to individual Events, e.g. particular vibrocore campaigns or sub-bottom profiler surveys, the corresponding archaeological period has also been assigned to the Event.

1.3.4. Wessex Archaeology is also aware of data management projects undertaken over the last year investigating the archiving of marine data and specifically that OASIS can be used to capture historic marine investigation events. In producing a GIS of Event data for this project we do not propose to duplicate existing OASIS-recorded events, but will ensure that the data recorded in the project GIS supplements the OASIS process and ensures compatibility with existing standards, for both OASIS and MEDIN.

1.4. PROJECT STRUCTURE

Execution Stages

1.4.1. The project comprises five Execution Stages (**Table 1**). This report represents Stage 4.

Execution Stage	Summary of process
1	Data acquisition and audit of Grey literature (research and commercial), published academic articles and raw data (primarily multibeam echosounder data).
2	Assessment and analysis of interpretations of data acquired and audited in Exclusion Stage 1 and interface with other Project Teams
3	Analysis of new data where necessary, re-interpretation of other data sets/report interpretations to provide consistent interpretations between different study areas and taking into account latest knowledge with respect to regional context.
4	Production of GIS layers (shapefiles) to show event survey extents, with MEDIN compatible metadata and interpretive accounts from each survey area. Production of draft report with discussion of high priority areas for possible future survey and evaluation of geophysical and geotechnical methodologies.
5	Production of project archive

Table 1: Summary of project stages.

2. EXECUTION STAGE 1

2.1. SOURCES

2.1.1. A wide variety of sources have been consulted for populating the database.

- Aggregates Levy Sustainability Fund (ALSF); archived with,
  - Archaeology Data Service (ADS),
  - Marine Environment Protection Fund (MEPF),
- ADS Grey Literature archive;
- Collaborative Offshore Wind Research Into the Environment (COWRIE);
- Renewables UK;
- Marine Management Organisation (MMO);
- Infrastructure Planning Commission (IPC);
- The Crown Estate (TCE);
- British Marine Aggregate Producers Association (BMAPA);
- Wessex Archaeology (WA) Project Database;
- United Kingdom Hydrographic Office (UKHO);
- Channel Coastal Observatory (CCO);
- HeritageGateway.org.uk
- Published academic sources;
- Other online grey literature.

2.1.2. A summary of the projects compiled during the initial audit of sources is presented in **Table 2**. Particular projects may appear in several of the sources reflecting the range of sources which include publication, archiving, planning and licensing functions. Several projects are not eligible for inclusion based on the criteria listed below (section 2.2.4).

Project Source	**Information held**	**Number of Records***
ALSF		
- MEPF	ALSF funded research projects (incl. RECs)	15
- ADS	ALSF funded research projects (incl. Seabed Prehistory, Area 240)	9
ADS Grey Literature	22 – “Maritime” 17 – “Marine” Keywords*	37
COWRIE	32 – “Archaeology” 22 – “Heritage” Keywords*	54
Renewables UK	Context for all rounds of renewable offshore development	46
MMO	Current and past planning applications (EIAs & ES documents) all sectors	32
IPC	Current and past planning applications across all sectors	25
TCE	General context	0
BMAPA	Contextual summaries of past aggregate dredging activity. Archive of all current and previous licences.	0
Wessex Archaeology Archives		
- Undertaken	Projects undertaken by WA	105
- Other Tenders	Projects known to have occurred but not undertaken by WA	56
HeritageGateway	Keywords ‘Maritime’ AND ‘Early Prehistory’. None in inshore or offshore locations. Records restricted to local HERs	35
Other Sources	Academic publications and online technical reports not included in other sources	2
TOTAL		**416***
*duplicates present (searches as of 03/05/2012), a proportion were not in the public domain at the time of writing.		

Table 2: Stage 1 audit of available sources.

2.2. PROJECT SELECTION CRITERIA

Project Methodology Development

2.2.1. Prior to the creation of the MALSF in 2002 our understanding of submerged prehistory was very limited and primarily based on highlighting which areas would have been exposed at times of lower sea-level based on models using modern bathymetry (e.g. Coles 1998). This was largely due to the available geophysical datasets at the time. This approach, while very effective in highlighting the large areas potentially available for exploitation during prehistory, was not able to take into account areas which had experienced post-transgression deposition or erosion, isostatic uplift or subsidence, or identify detailed palaeogeographic features of interest. One of the key elements of modelling where prehistoric material may be found offshore was to extrapolate from those settings where prehistoric sites are found in modern terrestrial environments, such as in association with major river systems and along coasts.

2.2.2. Due to these limitations many of the early marine archaeology assessments (across all sectors of offshore industry) were wholly based on the *potential* for submerged prehistory derived from adjacent coastal HER data and interpretation of seabed bathymetry (i.e. evidence for partially infilled palaeochannels or inundated river terraces).

2.2.3. Projects of this nature are not included in the database. This reflects the improvements in technological and archaeological working practices, post-MALSF. Typically the geophysical datasets for pre-MALSF projects were restricted to magnetometer, bathymetry and sidescan sonar surveys. As will be discussed below, these pre-MALSF development areas are clear candidates for future work to validate the existing assessments of palaeolandscape potential within a wider regional context.

2.2.4. On this basis, only Projects that are located in inshore or offshore English waters that have included an archaeological assessment of submerged palaeolandscapes, based upon one or more of the following Events types are included in the database:

- Seismic Sub-bottom Profiler surveys;
- Geotechnical boreholes or vibrocores;
- Grab-sampling of Holocene and Pleistocene sediments (beyond modern seabed sediments) obtaining clear stratigraphic context;
- Direct archaeological interventions (i.e. diver excavation at Bouldnor Cliff).

2.3. DATABASE STRUCTURE

Main Database Elements

2.3.1. The structure of the database is partitioned in two main areas:

- **Projects**; and,
- **Events**.

2.3.2. **Projects** consist of major schemes of work that may have several constituent project elements that may have been undertaken over several years such as Offshore Wind Farms, or aggregates dredging areas.

2.3.3. **Events** are specific interventions associated with **Projects**. These are typically sampling campaigns for geophysical surveys or geotechnical sample acquisition but also include data gathered in support of non-commercial research projects such as doctoral theses.

2.3.4. **Projects** are unique entities within the database; whereas **Events** datasets may be used more than once between different **Projects**, some utilising combinations and subsets of **Events** datasets. For example the MAREA projects typically utilise data from the ALSF-funded Regional Environmental Characterisation (REC) projects as well as industry survey data recorded as part of resource monitoring which has been used for archaeological assessments in support of Environmental Impact Assessment (EIA) at individual or clusters of aggregates licence areas.

Project Fields

2.3.5. Each Project has a Unique ID number which is the link between the database and GIS elements. There are twelve fields associated with **Projects** (**Table 3**, **Figure 2**):

Project Field	Description
ProjectUID	Project Unique ID number
ProjectRef	Shortened Project Name or Reference Number
ProjName	Project Name
ArchInterp	Text description of palaeolandscape interpretation
PublicationRef	Publication citation reference
PublicationDate	Date of Publication
Sector	Sector, e.g.: • Offshore Renewables, • Cables & Pipelines, • Aggregates, • Research
XMin	Project minimum X bounding coordinate
XMax	Project maximum X bounding coordinate
YMin	Project minimum Y bounding coordinate
YMax	Project maximum Y bounding coordinate
ProjectType	Type of Project, e.g.: • Desk-based Assessment, • Environmental Assessment, • Research Project.

Table 3: Description of Project Fields.

Associated Project Fields

2.3.6. In addition there are two associated fields to **Projects** (**Table 4**):

Associated Project Field	Description
ArchPeriods	English Heritage classification of archaeological periods
ICESRegion	International Council for the Exploration of the Sea (ICES) region ID number

Table 4: Description of Associated Project Fields.

Event Fields

2.3.7. There are ten fields associated with **Events** (**Table 5**):

Event Field	Description
EventUID	Event Unique ID (UID) number
EventClass	• Intrusive • Non-Intrusive
EventBroadTerm	Type of Event, e.g.: • Core Sampling • Geophysical Survey
EventNarrowTerm	Detail of Event, e.g.: • Vibro Core • Seismic Survey
XMin	Event minimum X bounding coordinate
XMax	Event maximum X bounding coordinate
YMin	Event minimum Y bounding coordinate
YMax	Event maximum Y bounding coordinate
EventSummary	Text description of Event
SurveyDate	Date of Survey

Table 5: Description of Event Fields

Associated Event Fields

2.3.8. In addition Archaeological Periods using the English Heritage scheme can also be assigned to an **Event** using the field:

- ArchPeriod.

2.4. GIS AND DATABASE MERGING

2.4.1. The database and GIS shapefiles for **Projects** and **Events** were merged using the corresponding UID fields: ProjectUID and EventUID, respectively.

2.4.2. Where accurate spatial data exists for **Events**; i.e. geophysical survey trackplots or borehole locations, Specific **Events** extents have been sourced and given their corresponding EventUID. In a minority of cases vibrocore logs were provided only in report format, or a derived form without specific, accurate or in some cases incorrect positional information. In these cases the Project extent or other definable survey extent has been used instead.

2.4.3. In this way, two polygon shapefiles have been produced. A **Project** extent layer containing details on the Project and the overall archaeological interpretation. This layer links to the second polygon shapefile containing all constituent **Events** extents that have been used to make that Project-specific archaeological interpretation.

2.4.4. All GIS elements are presented, unprojected in **WGS 84** coordinates.

2.4.5. Projects and Events fields can be queried by selecting a range of field-based filters (**Figure 2**). This permits the rapid characterisation of regional trends within the dataset at a scale and resolution appropriate to the range of data collated in offshore archaeological assessments to date.

2.4.6. By querying this merged database it is possible to examine and visualise the current knowledge of submerged palaeolandscapes using a range of properties based on the disparate **Projects** and **Events** fields during the last 1 million years (**Figure 3**).

3. EXECUTION STAGE 2

3.1. INVESTIGATING ADDITIONAL DATASETS

3.1.1. Complementary datasets were provided from the databases of the *Marine Aggregate Industry Protocol for the Reporting of Finds of Archaeological Interest* (TCE/EH/BMAPA 2005) and the English Heritage *Intertidal and Coastal Peat Database*[3] (Hazell 2008).

Reported Finds of Prehistoric Palaeolandscapes Interest

3.1.2. By the end of the reporting year 2011, 33 reports have been assigned a tentative prehistoric archaeological Period from around 400 reports of all types. There is a strong regional bias in the distribution with 31 out of the 33 deriving from the east coast aggregates licences, the vast majority from the East Anglian licences. Within the unclassified reports there is clearly a larger dataset of Quaternary-aged materials of archaeological interest representing a resource for future analysis and further research. In order to focus the discussion, only reports with an assigned period are examined here (**Table 6**) (**Figure 4**).

3.1.3. The reported finds are a mixture of artefacts and faunal and floral remains. Mammoth remains are particularly well represented, possibly due to their ease of identification; their distinctive appearance and relatively large size within dredged aggregates cargoes. Deer and possible Giant deer (*Megaloceros*) remains are also represented repeatedly.

Assigned Period	**Find types / Material**	**Number of reports**
Middle Palaeolithic	Hippopotamus bones	2
Middle Palaeolithic; Upper Palaeolithic	Mammoth bones	2
Palaeolithic	Mammal Bone, Mammoth bones, Mammoth teeth, Mammoth tusks, (Elephant / Mammoth bone), Antler, **Worked flint**,	20
Palaeolithic; Mesolithic	Mammal bone, Mammoth tooth, Deer bone, Peat	4
Early Mesolithic	Antler, Bone, Peat, **Worked Flint**, Wood	5
Total		**33**

Table 6: Summary of find types and materials and assigned periods. **Artefacts are in bold**.

3.1.4. Partly due to concentrated efforts to understand the East Anglian dredging regions and the great success of the reporting protocol, but also due to the richness of the Palaeo-Yare region as a whole, these licences have produced a considerable concentration of "Palaeolithic" artefacts or coeval skeletal remains possibly contemporary with Lower and Middle Palaeolithic periods.

3.1.5. Ipswichian dated material based on biostratigraphy (i.e. finds of Hippopotamus) has been reported from either Area 251 or 102 (East Anglia or Humber).

[3] http://www.english-heritage.org.uk/professional/research/heritage-science/environmental-archaeology/Environmental-Studies-Resources/intertidal-peat-database/ (last accessed 19/07/2012)

3.1.6. A mammoth tusk from Area 408, dated to c. 44 k BP also indicates late Devensian palaeolandscape potential in the heart of the North Sea (Allen *et al*. 2008).

3.1.7. In some cases finds are reported with relatively detailed location information such as the specific dredging lanes within a licence area. With the existing dataset of RECs, MAREAs and future archaeological assessments there is scope for more detailed spatial and temporal analysis of this resource.

Intertidal and Coastal Peats

3.1.8. The English Heritage Intertidal and Coastal Peat Database (Hazell 2008) contains twenty radiocarbon dates from the North Sea and English Channel elements of the database to illustrate the timing of peat formation which are now preserved within offshore locations (**Figure 5**). A range of peats are compiled within the database including basal peats and inundated terrestrial peats. Palynological dates from Jelgersma 1961 are not included in the following analysis (*cf*. Kiden *et al*. 2002).

3.1.9. All selected radiocarbon dates have been recalibrated against the IntCal09 Northern Hemisphere radiocarbon curve (Reimer *et al.* 2009) using the program OxCal 4.1 (Bronk Ramsey 1995; 2001). Calibrated dates are quoted as calibrated years BC using the 2σ calibrated range (95.4%). The mean of each calibrated date is also plotted on **Figure 6** (the white circles) and these data points have been used to construct the histogram in **Figure 7** showing the distribution of dated peats within consecutive 500-year class windows from 11,500 to 6,000 cal. BC.

3.1.10. The analysis highlights that a significant proportion of the dated offshore peats were formed between 9000 – 7000 cal. BC and are of direct relevance to the investigation of Early Mesolithic palaeolandscapes, particularly in the North Sea region although precise deposits and levels are not always recorded.

3.1.11. Of the 18 radiocarbon dated samples from the “North Sea” element of the *Peat Database* the vast majority of assays indicate an early Holocene / late Pleistocene age (prior to around 8000 – 12,000 cal. BC for *in situ* and rolled peat deposits coeval with the Early Mesolithic and Late Upper Palaeolithic periods. The broad distribution of named locations, many associated with seabed features such as *Brown Bank*, *Dogger Bank* or *between Leman and Ower Bank*, appears to agree well with existing assessments of Mesolithic palaeolandscape potential for these regions but without precise locations or specific sampled geomorphological features in all cases. Available dates from other offshore elements of the database are scarce but indicate a similar age range in the “English Channel” sector. Itemised descriptions were not published for samples offshore in the Irish Sea sector at the time of writing.

3.1.12. Significant numbers of dated cores exist within commercial and research projects publications, many from peats and intertidal sediments. A significant resource exists within the compiled projects for a future bespoke palaeoenvironmental and chronological analyses for palaeolandscapes and identification of Sea Level Index Points (SLIPs) and limiting points which would be directly complementary to the goals of the initial database (Hazell 2008). Regarding SLIPs and limiting points, offshore locations would represent farfield locations for testing and calibrating existing models (e.g. Shennan *et al.* 2006, Bradley *et al.* 2011) as well as valuable low-stand sea level context not provided by coastal samples but critical for submerged palaeolandscape research and reconstructions, particularly of Palaeolithic date.

4. EXECUTION STAGE 3

4.1. SPECIALISTS WORKSHOP

Workshop Summary

4.1.1. Following the initial audit of projects (Stage 1) and supplemental datasets (Stage 2) it was decided to undertake Stage 3 as a 1-day workshop involving key personnel from geophysical, geotechnical and archaeological elements of Wessex Archaeology Coastal & Marine. The workshop contributors were Dr Louise Tizzard, Dr Steph Arnott, Dr Paul Baggaley, David Howell (Geophysics) Jack Russell (Geoarchaeology), Dr Andrew Bicket and Victoria Cooper (Archaeology), and David Harrison (Data Management). The opportunity was taken to proceed through the GIS mapping and database entries to clarify archaeological interpretations, missing **Projects** or **Events**, and nominate projects that may benefit from reassessment.

4.1.2. The workshop was highly productive identifying an additional 5 projects, 9 additional survey events and 1 project candidate for reassessment. Minor clarifications were made to interpretations and some older, pre-MALSF methodology projects datasets were excluded on data quality issues. It was decided that riverine locations undertaken on reclaimed land would be included in the audit in order to incorporate preserved submerged terrestrial sediments beneath made ground. Therefore projects within the Severn Estuary and Thames region were reassessed for inclusion regardless of their location in the intertidal zone.

4.1.3. A key interpretive point was agreed that for aggregates assessments, where a regional assessment such as a MAREA or REC had been undertaken, the default palaeolandscape interpretation should be taken from these larger overviews; on the basis of wider regional context and improved dating control. This structure has been adopted for the regional interpretive summaries developed below.

4.1.4. Overall, the characterisation of palaeolandscape features and periods appeared to be coherent between projects and across regions, e.g. the distribution of Middle Palaeolithic and Mesolithic palaeolandscapes of the southern North Sea or the Upper Palaeolithic palaeolandscapes of the northeast Irish Sea basin are consistent between neighbouring project extents. Whilst extrapolating between nearby project areas with similar palaeolandscape features and dates is not possible, there is clear regionality to patterns of palaeolandscape distribution.

Reuse of datasets

4.1.5. Following Execution Stage 3 and subsequent assessment a total of **67 Projects** and **204 Events** exist within the audit database (as of 31/10/2012) (**Table 7**, **Figure 8**).

4.1.6. Within these **Projects**, this collection of **Events** has been used 240 times indicating a **dataset reuse rate of around 17%**. Most of this dataset reuse is directly due to MALSF-funded RECs and research projects, MAREAs and aggregates licence renewal projects. Subsequently the published MAREAs and RECs contribute to adjacent offshore renewables developments. The ALSF ethos of *collect once*, *use many times* rings true, certainly for the regions that have undergone these large-scale overview projects. These figures further highlight the significant contribution that aggregates-funded research has made to understanding archaeology offshore but also to other sectors of offshore industry.

4.2. Assessment of Bathymetry Datasets

Datasets

4.2.1. The Channel Coastal Observatory (CCO) is funded by DEFRA in partnership with maritime Local Authorities and acquires multibeam data for regional monitoring programmes around England. The multibeam data are acquired through survey contractors working for the Marine and Coastguard Agency on the Civil Hydrography Programme and made freely available through the CCO website. Although the data is acquired to a high resolution it normally only extends 1km below low water.

4.2.2. EMODnet (European Marine Observation and Data Network) was incepted in 2007 to support the Marine Strategy Framework Directive for the European Union which aims to achieve environmentally healthy marine waters by 2020. The program aims to consolidate hydrographic data from a consortium of marine science, survey, and industry partners in order to facilitate improved access to hydrographic data, especially digital bathymetry, and enable more cost-effective environmental impact assessment, scientific research and economic activity in general. Substantial coverage exists for European waters including the UK (**Figure 9**).

Methodology

4.2.3. Multibeam bathymetry data from the Channel Coastal Observatory (CCO) and European Marine Observation and Data Network (EMODnet) were assessed for their use in mapping submerged dendritic systems. Both datasets were provided as Fledermaus SD files and made into geotiffs for comparison with other spatial datasets.

4.2.4. The CCO data were provided at a cell size of 1m and cover survey areas extending approximately 2km offshore along sections of the coast over four regions. These regions cover the coast to the north of the Humber, the tip of Cornwall, the south coast of England from Exmouth to the Isle of Wight and Kentish coast from Folkestone to Herne Bay. In addition to the narrow coastal strip there are limited areas where the survey areas have been extended further offshore, particularly immediately south of Weymouth.

4.2.5. Although the CCO data quality and resolution are generally good its use for mapping submerged dendritic systems is limited. This is due to relatively limited areas covered by the surveys. Small sections of partially infilled channels can therefore be identified near the shore but their extents cannot be determined for any considerable distance.

4.2.6. The EMODnet SD files represent an aggregated bathymetric dataset sourced from public and private organisations in Europe. The data were provided at a 0.25 minute cell size and cover the Atlantic Ocean (Channel, Celtic Seas, Western Approaches) and the North Sea and Kattegat. Due to the aggregate nature of the dataset there is variation in the data resolution across the areas assessed. This means that some areas can be studied in greater detail than others, and for the most part it is the areas of deeper water further offshore that are at lower resolutions. Due to the 0.25 minute resolution of the data on the largest of partially infilled channels can be identified, such as those running the length of the Channel / Manche region. Smaller channels cannot be seen in this dataset making it of limited use for this project.

4.2.7. Based on this assessment the availability of multibeam bathymetry covering most areas of UK waters and European seas is of primary value for undertaking future palaeolandscape projects both research or industry-led. Of particular value for later prehistory where this corresponds to nearshore and inshore areas, access to this resource will be of particular use especially in areas of higher resolution survey. Coupling this to sub-bottom seismic surveys and geotechnical samples will in part, help to facilitate the uptake of MALSF methodology palaeolandscape assessments across new areas.

5. EXECUTION STAGE 4

5.1. INTRODUCTION

5.1.1. This report represents part of the project deliverables for Stage 4, the technical report.

5.2. INTERPRETIVE SUMMARIES

5.2.1. On geomorphological and archaeological grounds the study area (English territorial waters and EEZ) has been divided into four interpretive zones roughly following SEA and ICES zones. At a glance these zones also display regional variations in recorded periods of palaeolandscapes and archaeological material (**Figure 8**). The Interpretive Zones are:

- **Central North Sea** (including Humber Estuary)
- **Southern North Sea** (including Thames Estuary)
- **Channel & Celtic Sea** (including Severn Estuary)
- **Irish Sea** (including Liverpool Bay and Solway Firth)

5.2.2. Major landforms such as substantial submerged river systems are common to all regions with complex palaeochannel systems particularly dominating the palaeogeography of the southern North Sea and Channel/ Manche regions. The Loburg/Axial Channel, Thames-Medway system and the Fleuve Manche breaching of the Weald-Artois Ridge are major bathymetric features with long periods of development and significant ages. Most formed during the Quaternary, but enduring features such as the Loburg Channel reportedly formed during the Miocene (c. 10MA) (Liu *et al*. 1994, *cf*. Balson and D'Olier 1988) (**Figure 9**).

5.2.3. A brief palaeogeographic baseline is developed for each zone followed by a summary of the projects within the database which contribute palaeolandscape information to current knowledge. All projects have been assigned a Zone classification, based upon ICES sea regions (**Table 7**). In the case of the Rounds I and II of the Seabed Prehistory (**Project 6**) which encompasses several study areas from across English waters no zone has been assigned.

5.2.4. The distribution of compiled projects varies significantly across the zones generally reflecting licensing opportunities.

Interpretive Zone	Projects*	Events*	Events*	
			Geophysical	Geotechnical
Central North Sea	5	18	7	11
Southern North Sea	33	122	40	82
Channel & Celtic Sea	28	60	22	38
Irish Sea	9	13	10	3
National	1	-	-	-
Subtotal	67	-	72	132
Total	**67**	**-**	**204**	

Table 7: The regional distribution of **Projects** and **Events** in the database. *Due to Projects and Events crossing study area boundaries, duplicates exist in regional totals; Sub-totals and Totals do not include duplicates.

5.3. CENTRAL NORTH SEA

Regional Palaeogeographical Context

5.3.1. The sequence of Middle Pleistocene sediments preserved in the central North Sea is complex, with local variability (Gatcliff *et al*. 1994). A number of units have archaeological potential reflecting the changing palaeogeography of the region and the oscillation of glacial and inter-glacial periods during the last 1 million years (Tappin *et al*. 2011).

5.3.2. The Yarmouth Roads Formation is extensively preserved across the region representing the broad delta plain which incorporated the Bytham (relict), Thames, Rhine and Meuse systems and organic remains indicative of terrestrial and coastal environments (Cameron *et al*. 1992) deposited between 2.3 Ma and 480 kBP. Partly contemporary with the Cromerian Complex and Bytham river deposits (see **Section 5.4**); sediment sequences which are of particular importance to the Palaeolithic archaeology of the Southern North Sea and East Anglia (Pettitt and White 2012, Parfitt *et al*. 2005, Wessex Archaeology 2012a, b). There is potential for *in situ* and derived artefacts of Lower Palaeolithic age in the upper sediments of the Yarmouth Roads formation that have survived glacial reworking during the Middle Pleistocene (Tappin *et al*. 2011).

5.3.3. The upper portions of the Yarmouth Roads are cut by numerous channels which are infilled by a number of Middle Pleistocene formations; the Swarte Bank Formation (overlain by the Egmond Ground Formation), which are partially overlain by the Dogger Bank Formation. The Upper Pleistocene Botney Cut Formation is extensively preserved within channels across the region (**Figure 10**). These deposits were assessed to have some potential for containing derived artefacts reflecting the contemporary technology of the time, i.e. Lower, Middle and Upper Palaeolithic artefacts.

5.3.4. However, the potential for Lower and Middle Palaeolithic human activity in the region and the preservation of archaeological evidence is constrained during this period by several factors, reflected in the distribution of major Lower Palaeolithic sites to southern England, south of The Wash (Pettitt and White 2012). These factors include: the likelihood that the central North Sea was covered by more than one extensive ice advance during the Wolstonian Complex (c. 380 – 130 kBP) and Devensian Glaciation (110 – 10 kBP) (Tappin *et al.* 2011) and that Britain developed as an island during MIS 7 (after c.250 kBP) when, in conjunction with subsidence in the North Sea basin, the Weald-Artois ridge was fully breached creating a major and enduring barrier to human colonisation of Britain during inter-glacial periods. This appears to have led to a population crash of Neanderthals into MIS 6 (after c. 190 k BP) and abandonment until MIS 3 (Scott & Ashton 2011, Ashton, Lewis & Hosfield 2011).

5.3.5. Neanderthals returned to Britain with a new toolkit during MIS 3 between c. 60 and perhaps 42 kBP exploiting a tundra steppe environment populated by mammalian megafauna (Boismier *et al*. 2003); which is indicated from offshore contexts by a dated mammoth tusk recovered through dredging operations (Allen *et al*. 2008, see **Chapter 3**). A hiatus in human occupation seems to occur between the last Late Middle Palaeolithic Neanderthal activity and Earlier Upper Palaeolithic modern human activity. Aurignacian and Gravettian artefacts and sites indicate complex toolkits designed for hunting which is dated to around 35 kBP with human evidence absent by 24 kBP approaching the glacial maximum (Pettitt & White 2012, Tappin *et al*. 2011).

5.3.6. A further hiatus in human colonisation of Britain occurred around the Last Glacial Maximum. The well-documented, low-stand sea level of over -100m during the Late-Pleistocene / Early Holocene (13 – 6 kBP) (Fairbanks 1989, Shennan *et al*. 2006, Smith *et al*. 2011) defines the maximum extent of post-glacial palaeogeography which underpins our understanding of prehistoric palaeolandscapes during the Upper Palaeolithic and Mesolithic periods of northwest Europe; often referred to as Doggerland (Coles 1998, Gaffney 2007, 2009).

5.3.7. The Elbow formation, dating to this period, consists of intertidal fine-grained sediments and peat indicating palaeolandscape potential in areas where tidal erosion has not removed the deposits; towards the Dutch sector, and the vicinity of the Leman and Owers bank (Tappin *et al*. 2011, Rijsdijk *et al*. 2005, Godwin & Godwin 1933). The latter providing Maglemosian artefacts dating to around 12 kBP (Housely 1991) perhaps lost in a landscape of low-lying marshes, river valleys and lakes amongst rolling hills in a tundra landscape of shrubby trees; by the time Mesolithic hunter-gatherers could have been active in the region climatic amelioration had enabled the development of a familiar ecosystem of mixed deciduous woodland with oak, elm, alder and lime populated by deer and wide variety of other mammals (Tappin *et al*. 2011).

5.3.8. The final inundation of much of this palaeolandscape in the central North Sea occurred in the mid-Holocene beginning around 8000 BP, being largely completed by around 6000 BP (Tappin *et al*. 2011). Inundation was driven by rising, post-glacial eustatic sea level, slowing isostatic rebound and aided by meltwater pulses and high-magnitude tsunamis around 8000 BP (Weninger *et al*. 2008). Frequent examples of submerged forests both in the region and around much of the UK coastline record this process of inundation (Hazell 2008); dated peats from offshore locations in the North Sea appear to reflect this period, dating to between c.11.5 – 7.5 kBP (**Figure 6**).

Palaeolandscape Assessments

5.3.9. Preservation of the upper units of the Yarmouth Roads, which may be of most archaeological interest, is uncertain (Cameron *et al*. 1992) but has been identified within the Outer Humber REC (**Project 15**) and Humber MAREA (**Project 57**). The Yarmouth Roads formation indicates a palaeolandscape context for Lower Palaeolithic archaeology (Wessex Archaeology 2011, 2012) in deposits beneath the Mesolithic units of Doggerland but which has not been the focus of direct study to-date (**Figure 11**).

5.3.10. A range of palaeolandscape features and depositional environments have been identified through archaeological assessments of the region. Of uncertain archaeological significance, a series of glaciolacustrine units preserved within the area of the Inner Dowsing OWF (**Project 40**) contain pollen and Ostracods indicative of a cold steppe landscape during the Quaternary. Amino-acid racemisation dating indicates an date of deposition during MIS 7-6, during the end of the Wolstonian glacial complex providing context for regional palaeogeography reconstructions (e.g. Hijma *et al*. 2012) and palaeo-environments during the Middle Palaeolithic.

5.3.11. Recent high-profile MALSF research (Gaffney *et al.* 2007, 2009, **Project 10**), and the Humber MAREA (**Project 57**) and REC (**Project 15**) have provided an increasingly detailed picture of early-mid Holocene palaeolandscapes of direct relevance to Mesolithic archaeology in Doggerland. Networks of palaeochannels, lakes and marshes have been reconstructed geophysically and subsequently clarified by geotechnical sampling and analysis (**Figure 11**). Mesolithic palaeolandscape evidence from peats and estuarine sediments are known (Hazell 2008) in the Humber Estuary, indicating an extensive distribution of early Holocene palaeolandscape from shallow coastal to deeper offshore areas. These coastal areas are of particular interest as palaeolandscape work associated with the Humber REC elements of 'Doggerland' persisted around the Humber Estuary until the early Neolithic (Tappin *et al*. 2011).

5.3.12. Onshore there are significant Mesolithic archaeological remains preserved along the coast, and with substantial areas of Mesolithic period palaeolandscape features offshore (Gaffney *et al*. 2007, 2009). Between these areas nearer to the modern coast several projects have identified no palaeolandscape features. The Humber element of the Seabed Prehistory Project (**Project 6**) which sought to trial the integrated data collection of seismic survey and targeted geotechnical coring and subsequent industry assessments: Humber Gateway OWF (**Project 36**), Inner Dowsing OWF (**Project 40**), all highlight the impact of post-depositional erosion, reworking upon seabed locations. The lack of seabed sediments within some of these study areas appears due to erosion by alongshore coastal currents, with reworking and erosion by glacial activity prevalent within Quaternary units which obscures palaeolandscape features which are found preserved further offshore.

5.3.13. In addition to these early Holocene deposits the MAREA and REC also identified Upper Palaeolithic-aged material which is of critical importance for understanding the relationship between the palaeogeography and the distribution of *Homo sapiens* entering Britain between the LGM and Holocene. Major routeways into northern England and Scotland on the northern fringes of Doggerland, towards the Tweed valley, for example are associated with small but distinctive assemblages of Upper Palaeolithic lithic artefacts relating to several post-glacial traditions; some with clear origins in the western Europe mainland (Waddington & Passmore 2010, Ballin *et al.* 2010, Ballin & Saville 2003, Saville & Ballin 2010).

5.4. SOUTHERN NORTH SEA

Regional Palaeogeographical Context

5.4.1. The palaeogeographical context developed above for the Central North Sea zone is comparable to the southern North Sea. However, significant additional palaeolandscape elements are preserved within the southern North Sea. This is partly as a consequence of being located at the southern limits of the major Quaternary glaciations, rather than being overrun by them (Gibbard & Clark 2011), but also due to the proximity of: key palaeogeographical features such as the

Weald-Artois ridge (Toucanne *et al*. 2009); major fluvial systems of southern Britain and northwestern Europe (Hijma *et al*. 2012); and, main arteries of human colonisation during the last 1 million years (Cohen *et al*. 2011).

5.4.2. Around 1.7 Ma years ago, Britain was, even during highstand sea-level phases, connected to northwestern Europe across a wide front by the extensive Ur-Frisia delta fed by the Ancaster, Bytham, Thames, Rhine, Meuse and other northwest European rivers incorporating coastlines north of Aberdeen (Funnel 1995, Wessex Archaeology 2012). This enduring Pleistocene palaeogeography underpins the context for the earliest archaeological evidence in Britain (within the last 1 Ma years) from what is now East Anglia at Happisburgh and Pakefield (Parfitt *et al*. 2005, Parfitt *et al*. 2010).

5.4.3. The palaeogeography of the Southern North in the context of this earliest archaeology is dominated by two palaeo-rivers, the Bytham which drained the Midlands, and the Thames which had a northerly route through Essex into Norfolk and developed a complex fluvial system with the palaeo-Medway in what is now the outer Thames estuary (EMU 2009). At the mouths of these rivers, the earliest human activity in Britain is preserved in alluvial sediments of the palaeo-Thames at the Happisburgh 3 site dating to either MIS 25 (c. 970 kBP) or MIS 21 (c. 850 kBP) (Parfitt *et al*. 2010). A cool, coastal environment is recorded at Happisburgh 3, where boreal forest and estuarine marshland meet the sea. Lithic implements created by *Homo antecessor* indicate hominins surviving within a more northerly environment than previously thought (Stringer 2006).

5.4.4. The palaeo-Bytham, by 700 kBP, had altered its course and entered the North Sea through Pakefield where lithic artefacts probably produced by *H. antecessor* where created in a Mediterranean-type climate as evidenced by the palaeoenvironmental remains of beetles and pollen, the large mammal fauna recovered from Pakefield includes hippopotamus, straight-tusked elephant and giant deer. The artefacts are mainly simple flaked pebbles found within Cromer Forest-bed Formation fine-grained sediments. (Parfitt *et al*. 2005, Pettitt & White 2012).

5.4.5. Offshore, the delta-top Yarmouth Roads Formation (**Figure 13**, **14**), as discussed above, is partly contemporary with the deposits of the Bytham River and Cromer Forest-bed Formation indicating potential for early archaeological activity. Within the palaeo-Yare catchment there are two reported Lower Palaeolithic artefacts probably in secondary contexts that may be tentatively correlation with the Yarmouth Roads Formation (Wymer 1999, Wessex Archaeology 2012).

5.4.6. The North Sea as a whole experienced the Anglian Glaciation, the most pronounced glacial period in the Middle Pleistocene. The landscape was thoroughly remodelled; the course of the Thames was diverted south towards a position closer to that of the present day, with course of the Bytham being buried (Rose 2009). However, an important palaeolandscape feature of the Southern North Sea zone developed during the end of the Anglian glaciation in East Anglia – the palaeo-Yare valley.

5.4.7. A key finding from the Thames REC (EMU 2009) (**Project 13**) which was developed during the Relict Palaeo-landscapes of the Thames Estuary (Dix & Sturt 2011) (**Project 16**) was the mapping of tunnel valleys within the study area. These sub-glacial incised features indicate that the ice limits for the Anglian glacial, mapped further north (Ehlers & Gibbard 2004) could be revised to a more southerly position in the Outer Thames with significant connotations for the preservation of pre-Anglian Lower Palaeolithic deposits (*sensu* Happisburgh and Pakefield) and palaeolandscape features which are cut by Anglian features, and the development of post-Anglian submerged palaeolandscapes in the region, such as in the vicinity of Clacton (c. 400 kBP).

5.4.8. During the subsequent Hoxnian interglacial, significant lithic assemblages were being produced at a number of Lower Palaeolithic sites within the upper palaeo-Yare catchment; at Hoxne, Keswick Mill Pit and Whitlingham. Today, substantial numbers of Palaeolithic artefacts have been recovered, albeit out of context, from the Yare Valley (Wessex Archaeology 2012).

5.4.9. Further south at Clacton, Essex there is artefactual evidence preserved on the banks of the palaeo-Thames-Medway river system of a variety of lithic types; “Clactonian” pebble tools in the earlier warming phase, and Acheulean-type tools in the later cooling phase of the Hoxnian suggesting that at the same site two different groups of hominins were producing tools at two different times (Stringer 2006, 2011).

5.4.10. Following the Hoxnian interglacial (MIS 11), Lower Palaeolithic activity within the palaeo-Yare catchment is absent and during the subsequent glacial period, Britain became depopulated. Moving into MIS 9, the Purfleet interglacial, *H. neanderthalensis* colonised southern Britain hunting large mammals in a cold-steppe environment with Middle Palaeolithic technology of Levallois prepared-core artefacts from around 300 kBP (Roebroeks *et al*. 2011, Pettitt & White 2012). Access to southern Britain could be made across the Weald-Artois ridge.

5.4.11. Recent work by Wessex Archaeology (2009, 2012) has shed new light on Middle Palaeolithic palaeolandscapes in UK waters. The large collection of *in situ* Palaeolithic artefacts recovered from licence Area 240 have been attributed to deriving from a specific unit preserved across the relict-Yare valley which is exploited by the East Anglia aggregates licences (Wessex Archaeology 2012). OSL dates indicate the likely date of this unit’s deposition as c. 250 kBP indicating a Wolstonian (MIS 8) date. Palaeogeographical reconstructions show the area lay near the coast where the palaeo-Yare flowed into the Loburg Channel. These findings are significant, not only is this location the most northerly Palaeolithic sites of the period, but the detailed understanding of Pleistocene sediments gained from this work has connotations for other early archaeological sites within the entire palaeo-Yare catchment (on and offshore) but also across the region (see below).

5.4.12. The final breaching of the Weald-Artois ridge c. MIS 7, 6 is of central importance to understanding the Middle Palaeolithic archaeology of southern Britain at this time and for subsequent periods when the English Channel was an enduring feature (either as a large river or major seaway it was certainly a critical factor for the patterns of human colonisation in the later Pleistocene (Scott & Ashton2011).

5.4.13. The end of the major hiatus of human activity in Britain between MIS 6 to 4 is highlighted by finds from East Anglia at Lynford Quarry from the Neanderthal artefacts associated closely with evidence for mammoth butchery around 60 kBP (Boismier *et al*. 2003). However, archaeological remains from this time appear absent from the palaeo-Yare catchment; human activity being poorly defined until after the LGM (Wessex Archaeology 2012). White (2006) has speculated on the practical methods for how Neanderthals may have recolonised Britain during the colder conditions of MIS 3 (c. 60 kBP) after abandoning the region since MIS 7/6. Submerged palaeolandscapes provide critical context to this period of recolonisation. Sediments from the palaeo-Yare indicate MIS 3 dated coastal sediments suggesting palaeolandscape reconstructions could be targeted at this period (Wessex Archaeology 2012).

Palaeolandscape Assessments

5.4.14. Palaeo-river systems and the aggregates dredging areas that quarry their offshore deposits in addition to the substantial number of offshore windfarms already, and the emergent Round 3 schemes, provide significant opportunities for understanding not only the palaeo-Yare system but also the palaeo-Stour, Thames and Medway. Archaeological assessments in support of aggregates licences in the Outer Thames have located buried peats, estuarine deposits (**Figure 15**) and offer similar scope for investigating Palaeolithic and Mesolithic submerged prehistoric archaeology and palaeolandscapes.

5.4.15. The southern North Sea has undergone significant palaeolandscapes research through MALSF research projects, RECs and MAREAs, based upon many aggregates assessments the greatest concentration of Round 1, 2 and 3 offshore wind developments around the British Isles. For this reason the resolution and spatial coverage of analysed seabed and buried sediments is greatest in this region (**Figure 16**).

5.4.16. Considerable knowledge exists on many of the major palaeo-river systems off the East Anglian, Essex, and Kent coasts including the Yare, Stour, Thames and Medway. The considerable onshore knowledge base for these river systems is also substantial and with centuries of development permits detailed and accurate context for investigating offshore palaeolandscapes. The Middle Palaeolithic assemblage from Area 240 (**Projects 9**, **14**, **56**, and most recently **64**) is the only well-studied submerged Palaeolithic assemblage in the world (pers comm. N. Flemming 2012) dating to around 250,000 years ago. Older sedimentary deposits and Lower Palaeolithic assemblages exist such as from Table Bay, South Africa (Werz & Flemming 2001) but they have not received the same research focus as the Area 240 material. The MALSF Seabed Prehistory project of which the initial Area 240 investigations were a part also identified preserved, offshore extents of the sediments at Happisburgh and Pakefield (**Project 7**) indicating potential for future discoveries could be made extending into the Lower Palaeolithic in British waters (Wessex Archaeology 2009).

5.4.17. Palaeolandscape evidence for periods thought to be without hominin colonisation such as the Ipswichian (MIS 5) are suggested by megafaunal remains recovered from aggregates licences (see above).

5.4.18. Archaeological assessments in support of the Aggregates industry have often provided the first opportunities to examine palaeolandscapes potential in the North Sea (and English Waters as a whole). Aggregates assessments from Thames licences, in addition to the East Anglian licences, have repeatedly produced geophysical and/or geotechnical evidence which indicates the potential for Palaeolithic palaeolandscapes to be preserved within these offshore areas: Thames licences (e.g. **Project 71**) and, East Anglian licences (**Projects 62**, **67**, **69**), (**Figure 17**).

5.4.19. Archaeological assessments in support of Round 1 and 2 windfarms have repeatedly provided evidence and substantial spatial context for Palaeolithic palaeolandscapes: Galloper (**Project 18**), Thanet (**Project 24**), Gunfleet I, II (**Project 26**), London Array (**Project 45**), Triton Knoll (**Project 47**) in addition to the Outer Thames (**Project 13**) and East Coast (**Project 14**) RECs (EMU 2009, Limpenny *et al*. 2011), and Anglian MAREA (**Project 56**). Less defined palaeolandscape potential from schemes such as Lincs OWF (**Project 19**), Kentish Flats (**Project 29**) provide additional context. Considerable potential exists from the larger and further offshore area currently under investigation in support of Round 3 offshore renewables schemes, in particular Dogger Bank, East Anglia, Hornsea for North Sea context.

5.4.20. Considerable Mesolithic aged deposits have also been recorded from offshore development assessments as well as reported finds and dated offshore peats (see **Section 3.1**). In addition to the major aggregates related regional projects (RECs, MAREAs) archaeological assessments in support of individual licence areas and offshore renewables schemes have provided detailed evidence for Holocene palaeolandscapes. In addition to Area 240, Holocene landforms and peat deposits have been located in the east coast aggregates licences (e.g. **Project 67**, **69**).

5.4.21. Sheringham Shoal OWF (**Project 23**) has provided palaeolandscape evidence for early Holocene palaeochannels and terrestrial environments providing direct context for southerly preservation of similarly-aged landforms to those investigated in the Humber.

5.4.22. London Array OWF (**Project 45**) was found to contain several buried palaeo-channels, containing palaeo-sol and peat formations (with significant concentrations of charcoal) within the studied vibrocores date to the late Mesolithic. These terrestrial, and other identified intertidal, sediments were observed to extend to 6 and 10km offshore, respectively again highlighting the substantial areas of mid-Holocene palaeolandscapes that are preserved.

5.4.23. In addition aggregates and offshore renewables, the limited number of cable (not associated with offshore renewable schemes) and pipeline schemes that have received archaeological assessments indicate (across relatively narrow but very long cross-sections) significant palaeolandscape evidence. Peat deposits indicating palaeolandscape context have also been observed within the route of the Deborah Gas Storage Project (**Project 103**).

5.4.24. Offshore locations continue to provide significant palaeoenvironmental context that may not be (well-) preserved on land as highlighted by the Palaeo-Yare assessment (Tizzard *et al*. 2013), but for understanding the development of Holocene palaeoenvironments,

5.4.25. The importance of nearshore palaeolandscape features, particularly submerged forests and peat deposits for understanding coastal change during later prehistory, such as the Neolithic (Lewis & Aberg 2000, Sidell & Haughey 2007) or Bronze Age is discussed within the East Coast REC (**Project 14**) (Limpenny *et al*. 2011). Within the scope of the projects considered in this audit, this is of particular relevance to onshore extents of cable routes and pipelines, nearshore and estuarine dredging.

5.5. Channel & Celtic Sea

Regional Palaeogeographical Context

5.5.1. Whereas the North Sea palaeogeography is dominated by complex successions of glaciations the southern coast of the England has a more distal relationship to the major Quaternary glaciations (Gibbard & Clark. 2011). The effects of glaciation upon the palaeo-topography are however critical to the development of the Channel (Toucanne *et al*. 2009) and the regions importance for hominin colonisation during the Middle Pleistocene (Pettitt & White 2012). Major palaeochannel networks, characterise the bathymetry of the Channel region deriving both from onshore fluvial activity bisecting the coastal shelf but laterally, linked to the overtopping and breaching of the Weald-Artois Ridge during the Middle Pleistocene (Toucanne *et al*. 2009, Gupta *et al*. 2007, James *et al*. 2010, Arnott *et al*. 2011).

5.5.2. Prior to the breaching of the ridge during MIS 7/6, the known distribution of (pre-Anglian (MIS 12) Palaeolithic archaeology dates to the last 500,000 years from Lower Palaeolithic assemblages and hominin remains from important sites such as Boxgrove (Pettitt & White 2012). The site indicates human colonisation of southern England during colder transitional climates between fully-glacial and fully-interglacial conditions (Candy *et al*. 2011). With major ice fronts to the north and an enduring connection to the continent, colder environments were also no obstacle to *Homo heidelbergensis*, whose remains from Boxgrove (and Swanscombe, Kent) provide the first skeletal material from ancient hominins in the UK.

5.5.3. Major palaeolandscape assessments from the South Coast, the REC (James *et al*. 2010) and East English Channel reassessment (Arnott *et al*. 2011) portray several scenarios for coastal configurations from this period to later prehistory. Key Palaeolithic sites located at the base of the coastal cliff-line between Brighton and Portsmouth were, at the time of their use, at the margins of a wide, open coastal plain punctuated by rivers and lakes of the Solent and St. Catherine's Deep, smaller rivers and the mountains of the (Isle of) Wight (James *et al*. 2010). The area between northern France and Dungeness was an isthmus carved by meandering rivers facilitating access to southern Britain in a western route, in addition to the North Sea route through the Thames valley and East Anglia (Cohen *et al*. 2011, Scott & Ashton 2011).

5.5.4. During the Hoxnian interglacial (MIS 11, c. 400 kBP) south coast palaeolandscapes are more restricted towards nearshore areas due to highstand sea level, reconstructed at c. -10m RSL in the South Coast REC (James *et al*. 2010) and East English Channel assessments (Arnott *et al*. 2011). An array of palaeochannels from onshore river systems drained into the basin west of the Weald-Artois Ridge through relatively wide coastal plains several kilometres wide extending seaward of the current coastline indicating substantial areas exist where human activity may have occurred, but where relatively little archaeological and environmental material survives, compared to major centres at this time, East Anglia and the Thames Valley (Ashton *et al*. 2006, Ashton, Lewis, Hosfield 2011).

5.5.5. A clear theme that major south coast palaeolandscape projects have again highlighted is that the investigation of prehistoric archaeology must incorporate some form of palaeolandscape investigation, whether that is offshore, nearshore or the terrestrial environs of a particular location. Partly as a means of integrating the existing but partial and often poorly-contextualised offshore archaeological record; e.g. the substantial number of faunal remains and latterly lithic artefacts (particularly Mesolithic) recovered from the Solent (Wessex Archaeology 2004) and Isle of Wight aggregates licences. These data can be placed within an effective framework moving forward that allows the development of regional hypotheses for future prospection and testing.

5.5.6. Incorporating palaeochannels and buried peat deposits (**Figure 18**) existing palaeolandscape reconstructions post-glacial Upper Palaeolithic and later Mesolithic palaeolandscapes have markedly different extents and environmental conditions, with low-stand sea levels at 12,000 BP suggesting an extremely wide fluvial plain was an open connection to Europe for Upper Palaeolithic hunter-gatherers to enter southern England. By 5000 BP Eustatic sea level change had inundated much of the Channel inducing a complex array of islands and low-lying plains in the eastern channel near Dungeness (James *et al*. 2010) and wide coastal areas suggested south east of St Catherine's Deep / south of Selsey Bill (Arnott *et al*. 2011).

Palaeolandscape Assessments

5.5.7. Important methodological approaches were developed in this region during the initial stages of the MALSF program. Elements such as modelling from seismic survey datasets in the palaeo-Arun (**Projects 3** and **5**) and the integration of geotechnical and geophysical survey datasets within the expanded context of the Seabed Prehistory Project(s) (**Projects 6** and **8**) developed rapidly (**Figure 19**).

5.5.8. MAREAs and RECs in conjunction with the individual aggregates licence area assessments indicate a deeper chronology with potential for Lower Palaeolithic palaeolandscapes to be preserved around the Solent. Recent palaeoenvironmental assessments from the Round 3 renewables zones 6 (Southern Array) and 7 (West Isle of Wight) are likely to provide additional context for significant areas of the Channel region, especially Zone 7, outside of the MAREA / REC coverage.

5.5.9. The concentration of palaeo-channels offshore have been highlighted in the South Coast REC (James *et al*. 2010) (**Figure 20**). These palaeochannels to the west of the Isle of Wight are carved through a chalk plateau which is perhaps analogous to present day archaeologically-significant chalklands in the region, have been observed to be underfilled as sediment supply offshore is low. Holocene archaeological remains within and adjacent to these palaeo-fluvial systems are not likely to be deeply buried highlighting an area of potential for future projects.

5.5.10. Furthermore, evidence from the South Coast REC (**Project 12**) and East English Channel reinterpretation project (**Project 17**) indicates areas for future targeted offshore research that may be difficult to reconcile with the existing terrestrial evidence. Evidence for palaeolandscape features dating to the Ipswichian interglacial (MIS 5, c. 125 kBP) from the East English Channel indicate significant fringes of submerged palaeolandscapes which within the context of clear evidence from the numerous sites on the French side provides a major target for testing hypotheses on Neanderthal movement form France into now submerged landscapes and why the British evidence for habitation during the Ipswichian remains elusive.

5.5.11. Prior to regional overviews clear palaeolandscape context limited the interpretation possible for palaeolandscapes in particular aggregates licences. Following the publication of the MAREAs and RECs, it is clear that the major river terraces preserved offshore are major targets for aggregates extraction – the archaeological importance of which is now fully understood. Assessments in the region have variously returned no or chaotic features (e.g. **Projects 76**, **79**, **81**, **82**, **84-86**), or samples have been on superficial seabed sediments only (**Project 75**). Palaeochannels and fills are widespread across the region (e.g. **Project 82**) but attributing an archaeological context to them has been less often made than North Sea licences for example prior to the undertaking of regional assessments such as MAREAs or RECs, perhaps partly due to difficulties in reconciling existing BGS surveys of palaeochannels to newly identified features (e.g. **Projects 77**, **78**) but also due to the relative paucity of palaeolandscape context for the region prior to large-scale regional assessments.

5.5.12. Archaeological assessments in support of harbours and nearshore pipelines have variously recorded or not, palaeolandscape features of interest. Seismic and geotechnical samples from East Cowes have more specifically identified peats of Mesolithic archaeological interest from an inshore location dating to around 6000 cal. BC (**Project 109**) which is clearly of importance for contextualising the internationally-significant remains from Bouldnor cliff (**Project 134**), expanding regional Mesolithic palaeolandscape interpretations.

5.5.13. The archaeological assessment in support of capital dredging within the approaches to Southampton (**Project 127**) has indicated evidence for palaeolandscapes of early prehistoric interest including Lower and Middle Palaeolithic and Mesolithic archaeology. Overlying alluvial sediments also present opportunities for the preservation of later prehistoric material potentially of up to Bronze Age date.

5.5.14. This distribution of Mesolithic palaeolandscape evidence is relatively restricted to the coast and inlets but further offshore, relict coastal landforms have been investigated in detail with substantial effort applied to understanding the chronology of development and change (**Project 135**, **136**) (Mellett *et al*. 2012a, b). The potential indicated by the Regional Environmental Characterisations (James *et al*. 2010, Arnott *et al*. 2011) for post-glacial palaeolandscapes has yet to be realised.

5.5.15. A significant development within the practitioners undertaking palaeolandscape assessments is the uptake of University-based research projects in addition to the MALSF pathfinding work. Recent doctoral research in the East English Channel has incorporated industry-developed methodologies with detailed geomorphological interpretations and geochronology to examine the development of particular areas of seabed (**Projects 135**, **136**). In particular, improved chronological control and smaller-scale geomorphological interpretations are of particular importance to rationalising the scale of an archaeological site and human activity that until now has only been identified with two particular sites (Area 240 and Bouldnor Cliff).

5.5.16. The typically coarse, but mostly absent, chronological control and mostly absent or low-resolution palaeoenvironmental analysis (usually restricted to peats), that typifies most offshore archaeological investigations until recent years has clear temporal and spatial scale limitations that effectively precludes the identification of “archaeological scale features” that are not ship or aircraft wrecks. Where key archaeological findings are made whether it be artefactual, palaeoenvironmental or palaeogeographical, effective publication has not occurred, partly due to the nature of the assessment source, i.e. contracted industry work. This is quite clearly demonstrated in the recent Palaeolithic archaeological literature in which the open-access extensive online archives of submerged prehistory plays little direct role in (Pettit and White 2012, Hijma *et al*. 2012), but is clearly of paramount importance to, the discussion made for human movement across the landscape and the resources and topography utilised by hominins during the last million years.

5.5.17. West of the Solent, projects in the database become sparser. Across this region as a whole a major concentration of harbour-based projects dominate with relatively few offshore renewables developments (compared to the North Sea) Aggregates areas in the East English Channel and around the Isle of Wight have produced significant numbers of reported finds both through industry protocols and private collections (i.e. the Michael White collection, Wessex Archaeology 2007). The inshore nature of the harbour projects and reported fishing finds is reflected in the strong Mesolithic / Early Holocene artefactual and palaeoenvironmental evidence (indicated also by the reported peats, Hazell 2008).

5.5.18. The correlation between harbours and inshore locations to Mesolithic and younger archaeological material is further highlighted by assessments in Devon and Cornwall; Investigations in Penzance Harbour (**Project 110**) suggesting fen peat was in place around 5000 cal. BC.

5.5.19. However, not every harbour location has provided evidence for palaeo-cannels or other features of palaeogeographical interest, such as St. Mary’s, Scilly Isles (**Project 113**). Projects based on geophysical datasets only, have indicated palaeolandscape features of early prehistoric interest, but without geotechnical information classification has not been further developed (e.g. near Weymouth **Project 124**).

5.5.20. Moving towards the Celtic Sea and around the Cornish coast into the Severn Estuary relatively few projects have been compiled into the database.

5.5.21. Archaeological assessments in support of dredging activity at Culver Sands (**Project 80**) indicated no palaeolandscape features were observed in that study area.

5.6. IRISH SEA

Regional Palaeogeographical Context

5.6.1. Bathymetrically the Irish Sea is characterised by two regions – the Eastern Platform and the Western Trough. The platform is a broad shelf at around 50m depth. The trough, running parallel to the Irish coast is over 150m deep (Jackson *et al*. 1995). The basin is drained by large regional (infilled) palaeochannels visible in geophysical surveys with smaller palaeochannel features to the east possibly filled with Holocene sediments.

5.6.2. Quaternary geology as with the other Zones strongly reflects the glacial history of the region. Sequences of substantial till deposits are interspersed with glaciomarine and pro-glacial fluvial sediments, overlain by pro-deltaic and marine deposits. Glacial landforms such as patterned ground and pingo's are also preserved on the sea bed (*ibid*.).

5.6.3. Middle Palaeolithic activity is recorded in cave sites from North Wales but finds further north have not been made (Hodgson and Brennand 2006, Pettitt and White 2012). Existing distributions of Palaeolithic archaeology from northwest England in terrestrial contexts are limited to post-glacial, Late Upper Palaeolithic artefacts and environmental material (Hodgson and Brennand 2006).

5.6.4. During periods of lower sea-level such as the Wolstonian (MIS 8) and early MIS 7 when lithic assemblages at Pontnewydd are tentatively ascribed the coastal area associated with the Eastern Platform may have offered areas of palaeolandscape that could have been utilised by Neanderthals (Wessex Archaeology 2011b).

5.6.5. The post-glacial history of the region is contended by the presence of seabed features interpreted iceberg scour marks which have been interpreted as evidence that the Eastern Platform was always flooded and that little potential exists for post-glacial palaeolandscapes seaward of the current coastline. There is some debate on the post-glacial topography of the region with some authors arguing for a fully-flooded Irish Sea in the early Holocene, with others attributing a broad palaeolandscape fringe between southwest Scotland and North Wales, on the east of the Isle of Man (e.g. Van Landegham *et al*. 2009, Fitch *et al*. 2011).

5.6.6. Existing sea level reconstructions indicate the current coastline was inundated by around 7,000 BP (Shennan *et al*. 2006) with buried peat deposits preserved along the English, Welsh and Isle of Man coasts (Hazell 2008). Mesolithic archaeology remains from terrestrial contexts are substantial with important relationships with raised beaches noted in West Cumbria (Hodgson and Brennand 2006); reflecting highstand post-glacial sea level in the area (Shennan *et al*. 2006).

5.6.7. Current research is seeking to investigate the west coast use as an enduring seaway, reflecting the depth of the western trough and northerly deeps such as the

Minch (Garrow and Sturt 2011). The development and the use of boats to traverse coastal and riverine environments during the Holocene particularly for Mesolithic and Neolithic periods is a key theme for all regions but one where direct evidence will be extremely hard to encounter in submerged offshore contexts.

Palaeolandscape Assessments

5.6.8. A notable difference to palaeolandscape research in this zone is the lack of a MAREA and REC projects and also scarce academic research on the topic in submerged contexts. Aggregates licence areas do exist, in relatively small and discrete clusters near to Liverpool bay and the north coast of Wales. MALSF research projects are also relatively sparse, with the recently completed West Coast Palaeolandscapes Project (**Project 11**) providing some nearshore context to several study areas in the Irish Sea and also the Severn Estuary (Fitch *et al*. 2011). Palaeolandscape reconstruction has been most fully developed for a region of the Irish Sea abutting the Furness Peninsula at the mouth of Morecombe Bay. Palaeolandscape features of Upper Palaeolithic and Mesolithic interest were identified within this study area, reflecting palaeochannels and low-lying coastal geomorphology (**Figure 21**, **22**).

5.6.9. The major source of palaeolandscape assessments for the region derive from round 1 and 2 renewables schemes which have identified significant numbers of palaeochannel features from SBP surveys. There is a distinct Upper Palaeolithic character to Projects in the database from around the eastern Irish Sea suggesting inundated terrestrial landforms including river valleys and coastlines are preserved. These projects include: Walney OWF phase I (**Project 20**) and II (**Project 21**);

5.6.10. Assessments from Ormonde OWF (**Project 37**) provided geophysical evidence for palaeolandscapes of prehistoric interest perhaps Mesolithic and later in the form of numerous shallow palaeochannels encountered within the wind farm area but not the export cable route.

5.6.11. Data gathering issues from West of Duddon Sands OWF precluded an effective palaeolandscape assessment (**Project 25**). The assessment for Burbo Bank OWF was based upon pre-MALSF methodology and is desk-based (**Project 27**).

5.6.12. Cable and pipeline assessments have provided some palaeolandscape evidence. For example, the landfall sites of the HVDC Link along the west coast of the UK (**Project 106**) indicate palaeoenvironmental importance.

5.6.13. Substantial areas of the Solway Firth have been assessed from geotechnical and SBP datasets, but palaeolandscape features could not be identified within the chaotic SBP dataset (Wessex Archaeology 2002). With the cancellation of Round 3 activity in Scottish waters clarification of the palaeolandscape potential of the Solway Firth is still to be confirmed.

6. SUMMARY & RECOMMENDATIONS

6.1. SUMMARY

6.1.1. Following Execution Stage 3 and subsequent assessment a total of **67 Projects** and **204 geophysical and geotechnical survey Events** exist within the audit database.

6.1.2. Within these **Projects**, this collection of **Events** has been used 240 times indicating a dataset reuse rate of around 17%. Most of this dataset reuse is directly due to MALSF-funded RECs and research projects, MAREAs and aggregates licence renewal projects as well as the published MAREAs and RECs subsequently contributing to adjacent offshore renewables developments. The ALSF ethos of collect once, uses many times has occurred to some degree, certainly for the regions that have undergone these large-scale overview projects. These figures further highlight the significant contribution that aggregates-funded research has made to understanding archaeology offshore but also to other sectors of offshore industry. With the development of Round 3 offshore renewables schemes into regions without aggregates licences and associated regional research projects additional baseline datasets are currently being produced and assessed.

6.1.3. In conjunction, with all the other regions discussed below Britain's Mesolithic period palaeolandscape is extensive, notably well-preserved in places and produces significant numbers of lithic artefacts, and floral and faunal remains It is clear that huge areas of landscape have been inundated in the North Sea, South Coast and Irish Sea and around much of the European coastline with obvious connotations for interpreting the terrestrial distribution of Mesolithic sites and materials (Coles 1998, Bailey and Flemming 2008).

6.1.4. Prior to the Mesolithic, regions are characterised by differing palaeolandscape configurations corresponding to Palaeolithic archaeological periods. The Irish Sea appears especially characterised by post-glacial Upper Palaeolithic palaeolandscape features. The North Sea, especially the southern region has proven importance for Lower and Middle Palaeolithic palaeolandscapes during the last 1Ma and potential for Upper Palaeolithic palaeolandscapes across a wide area. During the last 500 kBP the south coast has important terrestrial Lower Palaeolithic archaeology with palaeolandscape reconstructions providing tools for developing and testing offshore potential for earlier hominin activity of similar age to East Anglia particularly in the eastern channel region in the vicinity of the Weald-Artois Ridge. Similarly palaeolandscape reconstructions associated with MIS 5 in the Channel hint at avenues for developing future research into human absence from Britain during the Ipswichian. MIS 3 dates from Area 240 suggest this important recolonisation period

6.1.5. Substantial evidence-based palaeolandscape reconstructions now exist especially for Lower Palaeolithic and Mesolithic periods in the Channel and North Sea regions enabling further hypotheses for the colonisation of Britain by *H. antecessor*, *H. heidelbergensis*, *H. neanderthalensis* and *H. sapiens* across several broad routes: a North Sea coastal route, an Atlantic coastal route, the Weald Artois ridge itself or a combination of them. For example if the artefacts at Happisburgh are made by *H. Antecessor* how did the diaspora develop through Europe to reach this position at the end of the world? Was this an Atlantic route from Northern Spain or through northwest Europe and across the North Sea coasts (Cohen *et al*. 2012)? Are differences in the type and distribution of lithic technology influenced by this palaeogeography and different cultural groups traversing the landscape through different routes (Scott & Ashton 2011)?

6.1.6. Similar questions for later periods can be framed within these palaeogeographic reconstructions, especially for sparsely represented periods in the Earlier and Later Upper Palaeolithic. The Middle Palaeolithic assemblage from the East Anglian aggregates licences clearly highlights the importance that submerged palaeolandscape research has for expanding the scope of known archaeological distributions and the contemporary environments in which they occurred. How was the region around Area 240 reached, exploited and abandoned?

6.2. RECOMMENDATIONS

Database Maintenance & Data Quality

6.2.1. Maintenance of the database is quick and straightforward requiring only the published data from finished technical reports and GIS metadata to complete. Where MEDIN-compliant GIS shapefiles are available they can be easily merged with the shapefiles or study areas and events can be digitised from illustrations and technical report text. However, due to the focussed nature of Environmental Statements it is likely that only full technical reports will incorporate the necessary information to populate the database. Where access cannot be granted due to client confidentiality or licencing issues it is likely that there will be projects that cannot be integrated in audits of this nature.

6.2.2. Generally itemised **Event** data *is* incorporated within technical reports however this is not universal, especially within some larger MALSF or academic research projects where similar datasets are merged then analysed; the individual industry surveys are not always listed as specific items or discussed in detail within methodology chapters. This is also an issue for tracking the quality of the data used to investigate palaeolandscapes.

Methodological Considerations

6.2.3. By investigating this large number of technical reports and research outputs several methodological themes are apparent.

6.2.4. The typically coarse, but mostly absent, chronological control and mostly absent or low-resolution palaeoenvironmental analysis (usually restricted to peats), that typifies most offshore archaeological investigations until recent years has clear temporal and spatial scale limitations that effectively precludes the identification of “archaeological-scale features” that are not ship or aircraft wrecks.

6.2.5. Geophysical data quality is highly variable within and between projects which has limited the clarity of some palaeolandscapes projects. In some cases coverage of sub-bottom seismic survey lines is partial within a Project area allowing only sub-sets of a project to be assessed in any detail. Similarly geotechnical information is often partial across a Project area and was not targeted for archaeological purposes, i.e. within palaeo-channels or other landforms of archaeological interest.

6.2.6. By expanding the frequency and scope of palaeoenvironmental sampling and especially dating to deposits stratigraphically above and below deposits of archaeological interest dating control can be substantially improved. Very few assessments from offshore contexts have proceeded to detailed palaeoenvironmental analysis and dating, most stopping at a general characterisation based upon published terrestrial sources or regional geological references. This largely precludes detailed correlation with existing knowledge except at local scales and certainly limits synthesis to very general regional overviews.

6.2.7. A major limitation, especially with older sedimentary bodies has been the integrity of OSL samples from vibrocores. Due to the potentially complex taphonomy of offshore sediments, in the rare occasions that OSL dating of sediments has been applied, the resultant dates have been of variable use (e.g. **Project 9**). Where radiocarbon dating cannot be used either due to age constraints (too old or too young) or lack of organic components, OSL dating must typically be applied. To improve the quality of dates improved sampling strategies must be adopted to identify unmixed or well-bleached sediments that will provide greater confidence in dates and a greater return rate of valid chronological control; especially to maximise the financial investment in establishing a chronology to a project. Tools exist for this specific purpose (Sanderson and Murphy 2010).

6.2.8. Where key archaeological findings are made whether it be artefactual, palaeoenvironmental or palaeogeographical, effective publication has not often occurred, partly due to the nature of the assessment source, i.e. contracted industry work. Whilst all ALSF research has been made freely-available on the internet, uptake of this invaluable resource has not always filtered fully into academic literature (Pettit and White 2012, Hijma *et al*. 2012). This resource is clearly of paramount importance to the discussion made for human movement across the landscape and the resources and topography utilised by hominins during the last million years.

6.2.9. A clear theme that major south coast palaeolandscape projects have again highlighted is that the investigation of prehistoric archaeology must incorporate some form of palaeolandscape investigation, whether that is offshore, nearshore or the terrestrial environs of a particular location. Partly as a means of integrating the existing but partial and often poorly-contextualised offshore archaeological record; e.g. the substantial number of faunal remains and latterly lithic artefacts (particularly Mesolithic) recovered from the Solent (Wessex Archaeology 2004b) and Isle of Wight aggregates licences. These data can be placed within an effective framework moving forward that allows the development of regional hypotheses for future prospection and testing.

Future Work

6.2.10. Sufficient information exists to undertake a detailed and extensive analysis of dated and environmentally investigated palaeolandscape features within the audits study area. This is especially true for the North Sea and Channel regions as they have received the highest concentrations of commercial projects and regional investigations (MAREAs, RECs). Dated peats and intertidal sediments are recorded from across much of the study area and represent important datasets for classifying limiting points and potentially sea-level index points (SLIPs) and improving relative sea level models and palaeogeographical reconstructions.

6.2.11. However, the scale of sampling, analysis and interpretation has to-date been relatively coarse and unlikely to locate sites or be at a spatial or temporal resolution appropriate for asking questions about patterns of human activity and behaviour except in general terms. Stored vibrocores and geophysical datasets that have been recorded but not archaeologically assessed provide a substantial existing resource for high-resolution palaeoenvironmental analysis and dating necessary to examine palaeolandscapes at a human-scale resolution.

6.2.12. Armed with this knowledge of Quaternary palaeogeography and in the context of major reappraisals and new work from terrestrial contexts the substantial gaps in the British prehistoric archaeological record have been identified in recent literature (AHOB 2011).

6.2.13. The potential of the Cromerian-aged deposits known to exist offshore from Happisburgh and Pakefield and preserved extensively as the Yarmouth Roads Formations may be forthcoming from on-going Round 3 renewables schemes such as Dogger Bank and Hornsea.

6.2.14. Furthermore, evidence from the South Coast REC (**Project 12**) and East English Channel reinterpretation project (**Project 17**) indicates offshore areas for future targeted research during periods when reconciling the existing terrestrial evidence has proven to be problematic; especially during the Ipswichian interglacial (Lewis, Ashton, Jacobi 2011) but also for other periods (Pettitt and White 2012). Evidence for palaeolandscape features dating to the Ipswichian interglacial (MIS 5, c. 125 kBP) from the East English Channel indicate significant fringes of submerged palaeolandscapes. Within the context of clear evidence from the numerous sites on the French side provides a major target for testing hypotheses on Neanderthal movement between France and now submerged landscapes in the English Channel Perhaps elucidating why the British evidence for habitation during the Ipswichian remains elusive; in addition to testing models on palaeogeographic and technological barriers to access (Ashton, Lewis, Hosfield 2011).

6.2.15. White (2009) has speculated on the practical methods for how Neanderthals may have recolonised Britain during the colder conditions of MIS 3 (c. 60 kBP) after abandoning the region since MIS 7/6. Submerged palaeolandscapes provide critical context to this period of recolonisation. Sediments from the palaeo-Yare indicate MIS 3 dated coastal sediments suggesting palaeolandscape reconstructions could be targeted at this period. Similarly the terrestrial evidence for Neanderthal and modern Human activity during this time is diagnostically complex and at the limits of radiocarbon dating techniques. Major research questions from offshore contexts can be readily assembled from the current knowledge base.

6.2.16. Conceptually, extending this palaeogeographic scenario of Neanderthal activity within colder environments from MIS 3 back to MIS8/7 and to the archaeological remains recovered from Area 240 provides another key area for understanding the distribution of Middle Palaeolithic archaeology.

6.2.17. Broadening the investigation of post-glacial Upper Palaeolithic submerged palaeolandscapes and the sparse terrestrial record of various hunter-gatherer cultures sporadically recorded from southern Scotland to southern England would be archaeologically important around all UK coasts.

6.2.18. Expanding the existing understanding of submerged prehistory and palaeolandscapes through new research, prospecting into new areas and linking up with similar research from mainland European coasts is entirely feasible at this point. To produce a fully source-to-sea approach to prehistoric archaeology, completely integrated with palaeogeography, where modern coastlines are no boundary to methods, theories and concepts should be a major priority for the next generation of research.

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APPENDIX I: LIST OF PROJECTS

Project UID	Project Ref	Proj Name	Publication Ref	Publication Date	Sector	Project Type
3	ALSF 3277	Submerged Palaeo-Arun River: Reconstruction Of Prehistoric Landscapes Pt 2	Submerged Palaeo-Arun And Solent Rivers: Reconstruction Of Prehistoric Landscapes, Sanjeev Gupta, Jenny Collier, Andy Palmer-Felgate, Julie Dickinson, Kerry Bushe, Stuart Humber, 2008, Doi:10.5284/1000025	01/01/2008	Aggregates	Research Project
5	ALSF 3543	Submerged Palaeo-Arun River: Reconstruction Of Prehistoric Landscapes Pt 1	Submerged Palaeo-Arun And Solent Rivers: Reconstruction Of Prehistoric Landscapes, Sanjeev Gupta, Jenny Collier, Andy Palmer-Felgate, Julie Dickinson, Kerry Bushe, Stuart Humber, 2008, Doi:10.5284/1000025	01/01/2008	Aggregates	Research Project
6	ALSF 3876	Seabed Prehistory (Rounds I & Ii)	Seabed Prehistory, Wessex Archaeology, 2009, Doi:10.5284/1000050	01/01/2009	Aggregates	Research Project
7	ALSF 4600	Happisburgh/Pakefield Exposures	Seabed Prehistory, Wessex Archaeology, 2009, Doi:10.5284/1000050	01/01/2009	Aggregates	Research Project
8	ALSF 5401	Seabed Grab Sampling	Seabed Prehistory, Wessex Archaeology, 2009, Doi:10.5284/1000050	01/02/2008	Aggregates	Research Project
9	ALSF 5684	Seabed Prehistory: Site Evaluation Techniques (Area 240)	Seabed Prehistory, Wessex Archaeology, 2009, Doi:10.5284/1000050	01/01/2009	Aggregates	Research Project
10	ALSF 4613	North Sea Palaeolandscape Project	North Sea Palaeolandscape Project, University Of Birmingham, 2011, Doi:10.5284/1000397	01/01/2007		Research Project
11	ALSF 5238	West Coast Palaeolandscape Project (Pilot Project)	West Coast Palaeolandscape Project (Pilot Project), University Of Birmingham, 2011, Doi:10.5284/1000398	01/01/2011	Aggregates	Research Project
12	MEPF 08/02	South Coast Regional Environmental Characterisation (Rec)	James, J W C, Pearce, B, Coggan, R A, Arnott, S H L, Clark, R, Plim, J F, Pinnion, J, Barrio Frójan, C,Gardiner, J P, Morando, A, Baggaley, P A, Scott, G, Bigourdan,N. 2010. The South Coast Regionalenvironmental Characterisation. British Geological Survey Open Report Or/09/51. 249 Pp.	01/01/2010	Aggregates	Research Project
13	MEPF 08/01	Outer Thames Regional Environmental Characterisation (Rec)	Emu Ltd, Outer Thames Estuary Regional Environmental Characterisation, Published By Marine Aggregate Levy Sustainability Fund	01/01/2009	Aggregates	Research Project

Project UID	Project Ref	Proj Name	Publication Ref	Publication Date	Sector	Project Type
14	MEPF 08/04	East Coast Regional Environmental Characterisation (Rec)	Limpenny, S.E., Barrio Froján, C., Cotterill, C., Foster-Smith, R.L., Pearce, B., Tizzard, L., Limpenny, D.L., Long, D., Walmsley, S., Kirby, S., Baker, K., Meadows, W.J., Rees, J., Hill, J., Wilson, C., Leivers, M., Churchley, S., Russell, J., Birchenough, A.C., Green, S.L., And Law, R.J. (2011). The East Coast Regional Environmental Characterisation. Cefas Open Report 08/04. 287pp.	01/01/2011	Aggregates	Research Project
15	MEPF 08/03	Outer Humber Regional Environmental Characterisation (Rec)	Tappin, D R, Pearce, B, Fitch, S, Dove, D, Geary, B, Hill, J M, Chambers, C, Bates, R, Pinnion, J, Diaz Doce, D, Green, M, Gallyot, J, Georgiou, L, Brutto, D, Marzialetti, S, Hopla, E, Ramsay, E, And Fielding, H. 2011. The Humber Regional Environmental Characterisation. British Geological Survey Open Report Or/10/54. 357pp.	01/01/2011	Aggregates	Research Project
16	MEPF 09/P126	The Relic Palaeo-Landscapes Of The Thames Estuary	Dix, J.K. And Sturt, F., 2011. The Relic Palaeo-Landscapes Of The Thames Estuary. Isbn 978-0-907545-67-5. Published By The Malsf. © Crown Copyright 2011	08/03/2011	Aggregates	Research Project
17	MEPF 09/P118	Use Many Times: Archaeological Interpretation Of Eastern English Channel Datasets	Arnott, S H L, Leivers, M, Pascoe, D, Davidson, S, And Baggaley, P A. 2011. Eecmhm Archaeological Characterisation. Use Many Times: Archaeological Interpretation Of Eastern English Channel Datasets. Wessex Archaeology Report 72640. 147 Pp.	01/02/2011	Aggregates	Research Project
18	Galloper Wind Farm (R2)	Galloper Wind Farm Project: Desk-Based Archaeological Assessment	Galloper Wind Farm Project: Desk-Based Archaeological Assessment, Wessex Archaeology, 2010, Unpublished Report Ref 66802.02	23/02/2010	Offshore Renewables	Desk Based Assessment
19	Lincs Offshore Wind Farm (R2)	Lincs Offshore Wind Farm: Archaeological Assessment	Lincs Offshore Wind Farm: Archaeological Assessment Technical Report, Wessex Archaeology, 2006, Unpublished Report Re 59100.06: Lincs Offshore Wind Farm: Stage 1 Geoarchaeological Assessment, Wessex Archaeology, 2009, Unpublished Report Ref 66031.02	01/05/2006	Offshore Renewables	Desk Based Assessment
20	Walney I Offshore Wind Farm (R2)	Walney I Offshore Wind Farm (R2)	Walney Offshore Windfarm And West Of Duddon Sands Offshore Windfarm: Environmental Assessment: Offshore Cultural Heritage Volume I: Text And Figures, Wessex Archaeology, 2006, Unpublished Report Ref 60990.08; Walney Offshore Windfarm, Irish Sea Stage 1 Archaeological Assessment Of Borehole Logs, Wessex Archaeology, 2008, Unpublished Report Ref 60991.01; Walney Offshore Windfarm Stage 2 Geoarchaeological Recording Of Borehole Samples, Wessex Archaeology, 2009, Unpublished Report Ref 60992.03; Walney Offshore Windfarm Stage 3 Sample Assessment, Wessex Archaeology, 2010, Unpublished Report Ref 60993.01	01/03/2006	Offshore Renewables	Desk Based Assessment

Project UID	Project Ref	Proj Name	Publication Ref	Publication Date	Sector	Project Type
21	Walney Ii Offshore Wind Farm (R2)	Walney Offshore Windfarm Phase 2, Irish Sea	Walney Offshore Windfarm And West Of Duddon Sands Offshore Windfarm: Environmental Assessment: Offshore Cultural Heritage Volume I: Text And Figures, Wessex Archaeology, 2006, Unpublished Report Ref 60990.08; Walney Offshore Windfarm. Phase 2 Stage 1 Archaeological Assessment Of Borehole Logs, Wessex Archaeology, 2009, Unpublished Report Ref 60994.01; Walney Offshore Windfarm Phase 2, Irish Sea: Stage 2 Geoarchaeological Recording, Wessex Archaeology, 2010, Unpublished Report Ref 60994.02	01/02/2006	Offshore Renewables	Desk Based Assessment
23	Sheringham Shoal Offshore Wind Farm (R2)	Sheringham Shoal Offshore Windfarm: Archaeological Desk-Based Assessment	Sheringham Shoal Offshore Windfarm Archaeological Desk-Based Assessment: Technical Report, Wessex Archaeology, 2006, Unpublished Report Ref 61031.02	02/01/2006	Offshore Renewables	Desk Based Assessment
24	Thanet Offshore Wind Farm (R2)	Thanet Offshore Wind Farm Project: Archaeological Assessment	Thanet Offshore Wind Farm Project Archaeological Assessment Of Marine Geophysical Data, Wessex Archaeology, 2006, Unpublished Report Ref 60070.05; Thanet Offshore Wind Farm Stage 1 Borehole Assessment, Wessex Archaeology, 2006, Unpublished Report Ref 60070.04; Thanet Offshore Wind Farm Stage 2 Archaeological Recording, Wessex Archaeology, 2007, Unpublished Report Ref 60070.06; Thanet Offshore Wind Farm Borehole Assessment: Stage 3 Sample Assessment, Wessex Archaeology, 2007, Unpublished Report Ref 60070.07	01/10/2005	Offshore Renewables	Desk Based Assessment
25	West Of Duddon Sands Offshore Wind Farm (R2)	West Of Duddon Sands Offshore Wind Farm (R2)	Walney Offshore Windfarm And West Of Duddon Sands Offshore Windfarm: Environmental Assessment: Offshore Cultural Heritage Volume I: Text And Figures, Wessex Archaeology, 2006, Unpublished Report Ref 60990.08	01/03/2006	Offshore Renewables	Desk Based Assessment
26	Gunfleet Sands I & Ii Offshore Wind Farm (R2)	Gunfleet Sands, South Essex Coast Offshore Wind Farm: Marine And Coastal Archaeological Assessment	Gunfleet Sands, South Essex Coast Offshore Wind Farm: Marine And Coastal Archaeological Assessment, Wessex Archaeology, 2002, Unpublished Report Ref 51167.01	01/05/2002	Offshore Renewables	Desk Based Assessment
27	Burbo Bank Offshore Wind Farm (R1)	Burbo Bank Offshore Wind Farm (R1)	Burbo Offshore Wind Farm: Archaeological Report, Liverpool Museum Field Archaeology Unit, 2002, Http://Www.Dongenergy.Com/Sitecollectiondocuments/New%20corporate/Burbo/Burboappvol4farchaelogy.Pdf	01/09/2002	Offshore Renewables	Desk Based Assessment
29	Kentish Flats Offshore Wind Farm (R1)	Kentish Flats Offshore Wind Farm Maritime And Coastal Archaeological Assessment	Kentish Flats Offshore Wind Farm Maritime And Coastal Archaeological Assessment, Wessex Archaeology, 2002, Unpublished Report Ref 51068.02	01/07/2002	Offshore Renewables	Desk Based Assessment

Project UID	Project Ref	Proj Name	Publication Ref	Publication Date	Sector	Project Type
36	Humber Gateway Offshore Wind Farm (R2)	Humber Gateway Offshore Wind Farm (R2)	Humber Gateway Offshore Windfarm: Seismic Assessment: Briefing Note, Unpublished Report Ref 60281.01	03/05/2006	Offshore Renewables	Desk Based Assessment
37	Ormonde Offshore Wind Farm (R1)	Ormonde Offshore Windfarm Project: Archaeological Assessment Of Marine Geophysical Data	Ormonde Offshore Windfarm Project: Archaeological Assessment Of Marine Geophysical Data, Wessex Archaeology, 2009, Unpublished Report Ref 72390.02	10/12/2009	Offshore Renewables	Desk Based Assessment
39	Lynn Offshore Wind Farm (R1)	Lynn And Inner Dowsing Offshore Wind Farms: Archaeological Assessment	Lynn And Inner Dowsing Offshore Wind Farms: Maritime Archaeological Assessment Technical Report, Wessex Archaeology, 2002, Unpublished Report Ref 51145.02; Lynn And Inner Dowsing Offshore Windfarms Geoarchaeological Assessment And Analysis Final Report (Stages 1-4), Wessex Archaeology, Unpublished Report Ref 59096.02	01/07/2002	Offshore Renewables	Desk Based Assessment
40	Inner Dowsing Offshore Wind Farm (R1)	Lynn And Inner Dowsing Offshore Wind Farms: Archaeological Assessment	Lynn And Inner Dowsing Offshore Wind Farms: Maritime Archaeological Assessment Technical Report, Wessex Archaeology, 2002, Unpublished Report Ref 51145.02; Lynn And Inner Dowsing Offshore Windfarms Geoarchaeological Assessment And Analysis Final Report (Stages 1-4), Wessex Archaeology, Unpublished Report Ref 59096.02; Lynn And Inner Dowsing Cable Routes Archaeological Assessment Of Geophysical Data, Wessex Archaeology, 2007, Unpublished Report Ref 59095.01	01/07/2002	Offshore Renewables	Desk Based Assessment
45	London Array Offshore Wind Farm I (R2)	London Array Offshore Wind Farm Project Phase I	London Array Offshore Wind Farm Project: Archaeological Assessment Technical Report, Wessex Archaeology, 2005, Unpublished Report Ref 57740.02; London Array Offshore Wind Farm - Phase 1: Archaeological Stage 2 Geoarchaeological Recording, Wessex Archaeology, 2009, Unpublished Report Ref 67111.05; London Array Offshore Wind Farm - Phase 1 Stage 3 Geotechnical Assessment, Wessex Archaeology, 2010, Unpublished Report Ref 67113.02	01/03/2005	Offshore Renewables	Desk Based Assessment
46	London Array Offshore Wind Farm Ii (R2)	London Array Offshore Wind Farm Project Phase Ii	London Array Offshore Wind Farm Project: Archaeological Assessment Technical Report, Wessex Archaeology, 2005, Unpublished Report Ref 57740.02	01/03/2005	Offshore Renewables	Desk Based Assessment
47	Triton Knoll Offshore Wind Farm (R2)	Triton Knoll Offshore Wind Farm Desk-Based Archaeological Assessment	Triton Knoll Offshore Wind Farm Desk-Based Archaeological Assessment, Wessex Archaeology, 2011, Unpublished Report Ref 70070.09	01/12/2011	Offshore Renewables	Desk Based Assessment
55	MAREA: TEDA	Marine Aggregate Regional Environmental Assessment Of The Outer Thames Estuary	Marine Aggregate Regional Environmental Assessment Of The Outer Thames Estuary, Erm Ltd	15/10/2010	Aggregates	Desk Based Assessment

Project UID	Project Ref	Proj Name	Publication Ref	Publication Date	Sector	Project Type
56	MAREA: AODA	AODA Marine Aggregate Regional Environmental Assessment: Archaeological Desk-Based Assessment	AODA Marine Aggregate Regional Environmental Assessment: Archaeological Desk-Based Assessment, Wessex Archaeology, 2010, Unpublished Report Ref 73330.02	01/11/2010	Aggregates	Desk Based Assessment
57	MAREA: HADA	Humber And Outer Wash Marine Aggregate Regional Environmental Assessment: Archaeological Desk-Based Assessment	Humber And Outer Wash Marine Aggregate Regional Environmental Assessment: Archaeological Desk-Based Assessment, Wessex Archaeology, 2012, Unpublished Report Ref 75710.05	31/01/2012	Aggregates	Desk Based Assessment
62	Aggregate Licence Area 228	Aggregate Dredging Licence Application Area 228: Archaeological Assessment	Aggregate Dredging Licence Application Area 228: Archaeological Assessment,Wessex Archaeology, 2011, Unpublished Report Ref 78670.03	01/12/2011	Aggregates	Desk Based Assessment
64	Aggregate Licence Area 240	Area 240	Tizzard, L., Bicket, A., De Loecker, D., 2013, Seabed Prehistory: Investigating The Palaeogeography And Early Middle Palaeolithic Archaeology In The Southern North Sea, Wessex Archaeology, Salisbury.	01/01/2013	Site	Research Project
65	Aggregate Licence Area 392	Hilbre Swash Aggregates Dredging Licence Area	Hilbre Swash Aggregates Dredging Licence Area: Desk-Based Assessment & Technical Report, Wessex Archaeology, 2011, Unpublished Report Ref 77200.02	20/08/2011	Aggregates	Desk Based Assessment
66	Aggregate Licence Area 393	Hilbre Swash Aggregates Dredging Licence Area	Hilbre Swash Aggregates Dredging Licence Area: Desk-Based Assessment & Technical Report, Wessex Archaeology, 2011, Unpublished Report Ref 77200.02	20/08/2011	Aggregates	Desk Based Assessment
67	Aggregates Licence Area 401/2	Yarmouth Dredging Area 401/2 Aggregate Dredging License	Yarmouth Dredging Area 401/2 Aggregate Dredging License Application Archaeological Assessment Technical Report, Wessex Archaeology, Unpublished Report Ref 56230.02	01/11/2004	Aggregates	Desk Based Assessment
69	Aggregates Licence Area 430	Southern North Sea Aggregate Licence Area 430: Marine Aggregate Extraction Archaeological Assessment	Southern North Sea Aggregate Licence Area 430: Marine Aggregate Extraction Archaeological Assessment, Wessex Archaeology, 2006, Unpublished Report Ref 62800.02	01/05/2006	Aggregates	Desk Based Assessment
71	Aggregates Licence Area 447	Cutline – Areas 446 And 447 Archaeological Assessment	Cutline – Areas 446 And 447 Archaeological Assessment: Technical Report, Wessex Archaeology, 2003, Unpublished Report Ref 52357.02	01/05/2003	Aggregates	Desk Based Assessment

Project UID	Project Ref	Proj Name	Publication Ref	Publication Date	Sector	Project Type
72	Aggregates Licence Area 447	Area 447 Cutline Pre-Dredge Monitoring Survey: Archaeological Assessment Of Geophysical Data	Area 447 Cutline Pre-Dredge Monitoring Survey: Archaeological Assessment Of Geophysical Data, Wessex Archaeology, 2008, Unpublished Report Ref 68100.01	01/02/2008	Aggregates	Desk Based Assessment
75	Aggregates Licence Area 451	St Catherine's, Isle Of Wight Marine Aggregate Extraction Area 451: Archaeological Assessment Of Grab Samples	St Catherine's, Isle Of Wight Marine Aggregate Extraction Area 451: Archaeological Assessment Of Grab Samples, Wessex Archaeology, 2006, Unpublished Report Ref 63650.02	01/08/2006	Aggregates	Environmental Assessment
76	Aggregates Licence Area 458	Marine Aggregate Extraction Licence, West Bassurelle Area 458/464: Archaeological Assessment Of Geophysical Data	Marine Aggregate Extraction Licence, West Bassurelle Area 458/464: Archaeological Assessment Of Geophysical Data, Wessex Archaeology, 2007, Unpublished Report Ref 65170.03	01/04/2007	Aggregates	Desk Based Assessment
77	Aggregates Licence Area 461	Median Deep: Area 461: Archaeological Assessment Of Geophysical Data	Median Deep: Area 461: Archaeological Assessment Of Geophysical Data, Wessex Archaeology, 2006, Unpublished Report Ref 60880.01	01/02/2006	Aggregates	Desk Based Assessment
78	Aggregates Licence Area 461	Median Deep: Area 461: Stage 2 Archaeological Recording Of Vibrocores	Median Deep: Area 461: Stage 2 Archaeological Recording Of Vibrocores, Wessex Archaeology, Unpublished Report Ref 60881.01	01/06/2007	Aggregates	Environmental Assessment
79	Aggregates Licence Area 464	Marine Aggregate Extraction Licence, West Bassurelle Area 458/464: Archaeological Assessment Of Geophysical Data	Marine Aggregate Extraction Licence, West Bassurelle Area 458/464: Archaeological Assessment Of Geophysical Data, Wessex Archaeology, 2007, Unpublished Report Ref 65170.03	01/04/2007	Aggregates	Desk Based Assessment

Project UID	Project Ref	Proj Name	Publication Ref	Publication Date	Sector	Project Type
80	Aggregates Licence Area 472	Area 472-Culver Sand Marine Aggregate Dredging: Environmental Assessment, Technical Report: Archaeology	Area 472-Culver Sand Marine Aggregate Dredging: Environmental Assessment, Technical Report: Archaeology, Wessex Archaeology, 2003, Unpublished Report Ref 48644.03	01/12/2003	Aggregates	Desk Based Assessment
81	Aggregates Licence Area 473 West	Eastern English Channel Areas 473 West, 474 East And West: Archaeologicla Assessment	Eastern English Channel Areas 473 West, 474 East And West: Archaeological Assessment, Wessex Archaeology, 2007, Unpublished Report Ref 64120.01	01/03/2007	Aggregates	Desk Based Assessment
82	Aggregates Licence Area 474 East	Eastern English Channel Areas 473 West, 474 East And West: Archaeologicla Assessment	Eastern English Channel Areas 473 West, 474 East And West: Archaeological Assessment, Wessex Archaeology, 2007, Unpublished Report Ref 64120.01	01/03/2007	Aggregates	Desk Based Assessment
83	Aggregates Licence Area 474 West	Eastern English Channel Areas 473 West, 474 East And West: Archaeologicla Assessment	Eastern English Channel Areas 473 West, 474 East And West: Archaeological Assessment, Wessex Archaeology, 2007, Unpublished Report Ref 64120.01	01/03/2007	Aggregates	Desk Based Assessment
84	Aggregates Licence Area 473	Eastern English Channel Areas 473, 474 And 475 Marine Aggregate Extraction: Archaeological Assessment	Eastern English Channel Areas 473, 474 And 475 Marine Aggregate Extraction: Archaeological Assessment, Wessex Archaeology, 2006, Unpublished Report Ref 58630.03	01/09/2006	Aggregates	Desk Based Assessment
85	Aggregates Licence Area 474	Eastern English Channel Areas 473, 474 And 475 Marine Aggregate Extraction: Archaeological Assessment	Eastern English Channel Areas 473, 474 And 475 Marine Aggregate Extraction: Archaeological Assessment, Wessex Archaeology, 2006, Unpublished Report Ref 58630.03	01/09/2006	Aggregates	Desk Based Assessment
86	Aggregates Licence Area 475	Eastern English Channel Areas 473, 474 And 475 Marine Aggregate Extraction: Archaeological Assessment	Eastern English Channel Areas 473, 474 And 475 Marine Aggregate Extraction: Archaeological Assessment, Wessex Archaeology, 2006, Unpublished Report Ref 58630.03	01/09/2006	Aggregates	Desk Based Assessment

Project UID	Project Ref	Proj Name	Publication Ref	Publication Date	Sector	Project Type
89	Aggregates Licence Area 480	Aggregate Dredging Licence Area 480: Archaeological Assessment Of Marine Geophysical Data, Pre-Dredging Monitoring Report	Aggregate Dredging Licence Area 480: Archaeological Assessment Of Marine Geophysical Data, Pre-Dredging Monitoring Report, Wessex Archaeology, 2008, Unpublished Report Ref 69890.02	01/09/2008	Aggregates	Desk Based Assessment
90	Aggregates Licence Area 481	Area 481 Aggregate Dredging Licence Application: Archaeological Assessment	Area 481 Aggregate Dredging Licence Application: Archaeological Assessment, Wessex Archaeology, 2007, Unpublished Report Ref 64690.02	01/02/2007	Aggregates	Desk Based Assessment
100	MAREA: SCDA	Emu / South Coast Dredging Association: Marine Aggregate Regional Environmental Assessment	Emu / South Coast Dredging Association: Marine Aggregate Regional Environmental Assessment, Wessex Archaeology, 2009, Unpublished Report Ref 65781.01	01/05/2009	Aggregates	Desk Based Assessment
103	Deborah Gas Storage Project	Deborah Gas Storage Project: Environmental Statement Chapter – Offshore Archaeology	Deborah Gas Storage Project: Environmental Statement Chapter – Offshore Archaeology, Wessex Archaeology, 2010, Unpublished Report Ref 73870	12/05/2010	Cables & Pipelines	Desk Based Assessment
106	Western HVDC Link	Western HVDC Link	Headland Archaeology. 2011b. Archaeological Assessment Of WHVDC Marine Geophysical Data, Headland Archaeology (Uk) Ltd.; Headland Archaeology. 2011c. Archaeological Assessment Of Marine Geotechnical Data, Headland Archaeology (Uk) Ltd; Headland Archaeology. 2011a. Offshore Maritime Cultural Heritage Desk Based Assessment, Headland Archaeology (Uk) Ltd.	30/09/2011	Cables & Pipelines	Desk Based Assessment
109	East Cowes Project, Isle Of Wight	East Cowes Project, Isle Of Wight: Archaeological Assessment	East Cowes Project – Phase 1 Archaeological Assessment Of Sidescan Sonar, Sub-Bottom Profile And Magnetic Surveys, Wessex Archaeology, 2006, Unpublished Report Ref 60220.04; East Cowes Project, Isle Of Wight Assessment Of Palaeoenvironmental Remains And Archaeological Recording Of Geotechnical Samples, Wessex Archaeology, 2006, Unpublished Report Ref 60221.03	01/09/2006		Desk Based Assessment
110	Penzance Harbour, Cornwall	Penzance Harbour, Cornwall: Palaeoenvironmental And Geotechnical Assessment	Penzance Harbour, Cornwall: Palaeoenvironmental And Geotechnical Assessment, Wessex Archaeology, 2006, Unpublished Report Ref 62490.02	01/10/2006	Harbours	Desk Based Assessment

Project UID	Project Ref	Proj Name	Publication Ref	Publication Date	Sector	Project Type
113	St Mary's Harbour	St Mary's Harbour Geophysical Survey Archaeological Assessment	St Mary's Harbour Geophysical Survey Archaeological Assessment: Archaeological Assessment Of Sidescan Sonar And Sub-Bottom Profiling Surveys, Wessex Archaeology, 2004, Unpublished Report Ref 58300.01	01/12/2004	Harbours	Desk Based Assessment
124	Blandford To Portland Gas Pipeline	Blandford To Portland Gas Pipeline Offshore Pipeline Route: Archaeological Assessment	Blandford To Portland Gas Pipeline Offshore Pipeline Route: Archaeological Assessment, Wessex Archaeology, 2007, Unpublished Report Ref 60712.01	01/03/2007	Cables & Pipelines	Desk Based Assessment
127	Southampton Approach Channel Dredge	Southampton Approach Channel Dredge: Archaeological Assessment	Southampton Approach Channel Dredge: Archaeological Assessment, Wessex Archaeology, 2008, Unpublished Report Ref 68530.03	01/12/2008	Capital Dredging	Desk Based Assessment
134	Bouldnor Cliff	Bouldnor Cliff	Mesolithic Occupation At Bouldnor Cliff And The Submerged Prehistoric Landscapes Of The Solent, Momber, G., Tomalin, D., Scaife, R., Satchell, J., Gillespie, J. 2011, Cba Research Report 164, Council For British Archaeology, York.	01/01/2001	Site	Research Project
135	Ne/F013388/1: Nerc Open Case Studentship	Preservation Of A Drowned Gravel Barrier Complex: A Landscape Evolution Study From The Northeastern English Channel	Mellett, C.L., Et Al., Preservation Of A Drowned Gravel Barrier Complex: A Landscape Evolution Study From The Northeastern English Channel, Mar. Geol. (2012a), Doi:10.1016/J.Margeo.2012.04.008	01/01/2012	Aggregates	Research Project
136	Ne/F013388/1: Nerc Open Case Studentship (Optical Dating)	Optical Dating Of Drowned Landscapes: A Case Study From The English Channel	Mellett, C.L., Et Al., (2012b) Optical Dating Of Drowned Landscapes: A Case Study From The English Channel, Quaternary Geochronology, 10: 201-208	01/01/2012	Aggregates	Research Project

APPENDIX II: RECONSTRUCTING THE GEODTABASE IN ARCGIS

Instructions for reconstructing in GIS:

- “84570_PaleolandscapesGeodatabase_v02-1_ArcGIS93.mdb"

2 Feature Classes in geodatabase:

- *Geo_ProjectPolygons*
- *Geo_EventPolygons*

Spatial and Chronological Attribute data held in the tables

- *GIS_Projects*
- *GIS_Events*
- *tbl_ProjectArchPeriods*
- *tbl_EventArchPeriods*

Method:

- Add Feature Classes to map
- Add tables to map
- Join based on **ProjectUID** for Projects and **EventUID** for Events

Interpretive Summary Zones

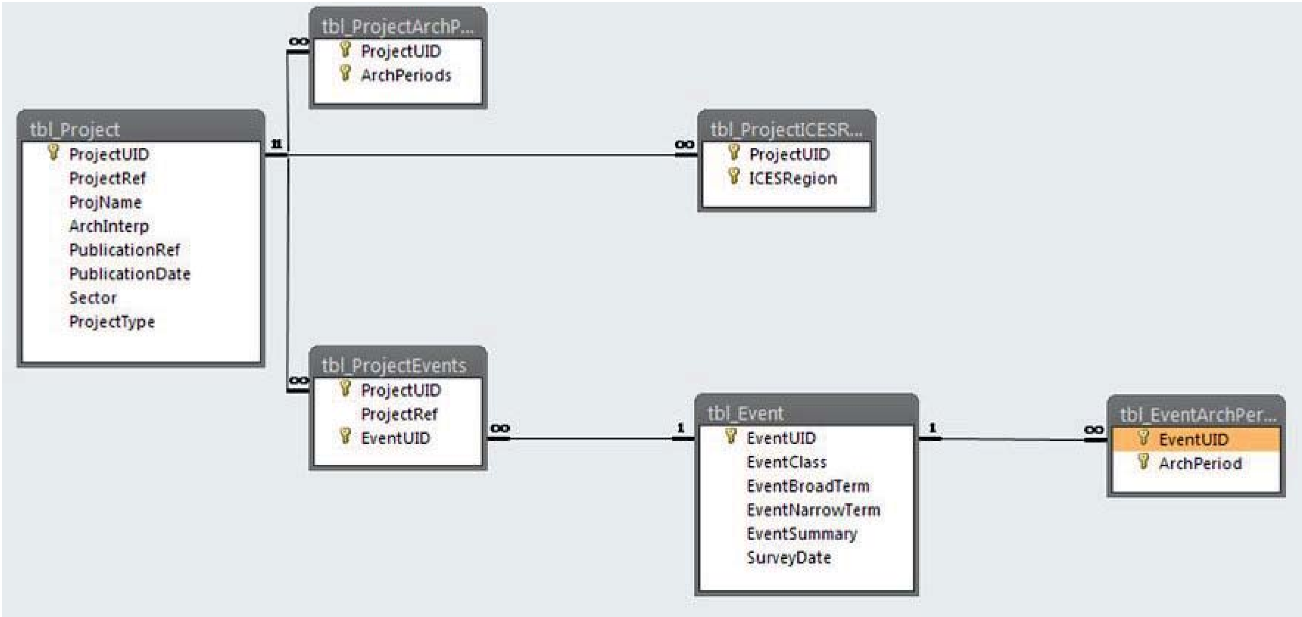
Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

Wessex Archaeology

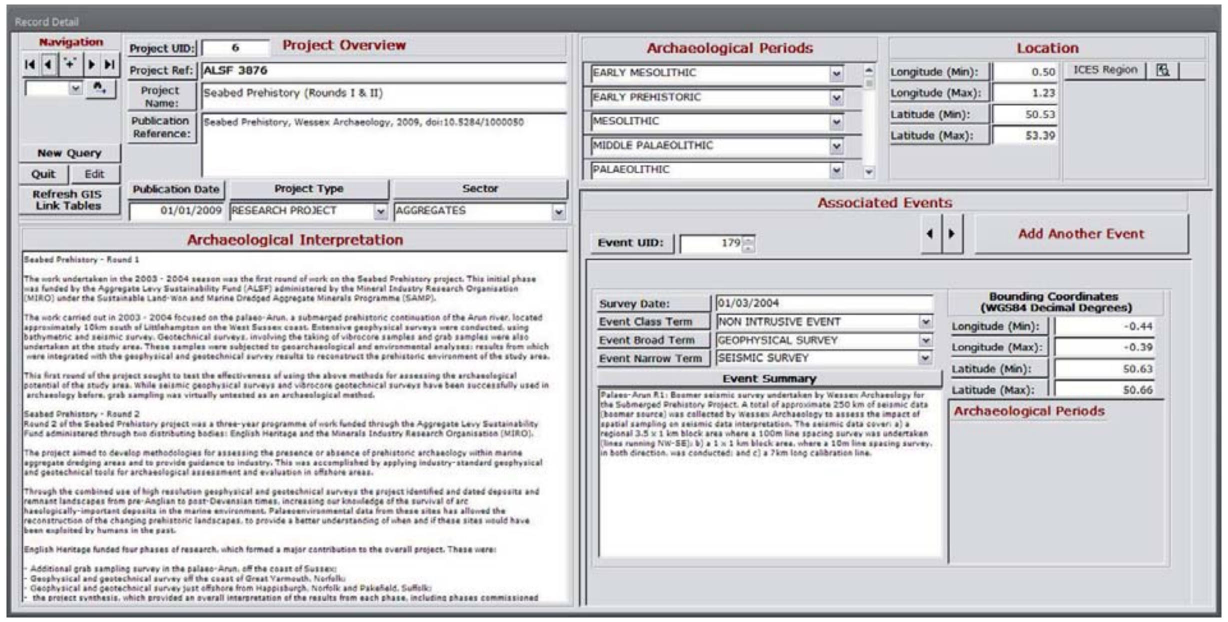
Date:	29/10/12	Revision Number:	0
Scale:	1:10,000,000 @ A4	Illustrator:	KJF
Path:	W:\Projects\84570\DrawingOffice\Report figs\Data Audit\12_10_26		

Location Map

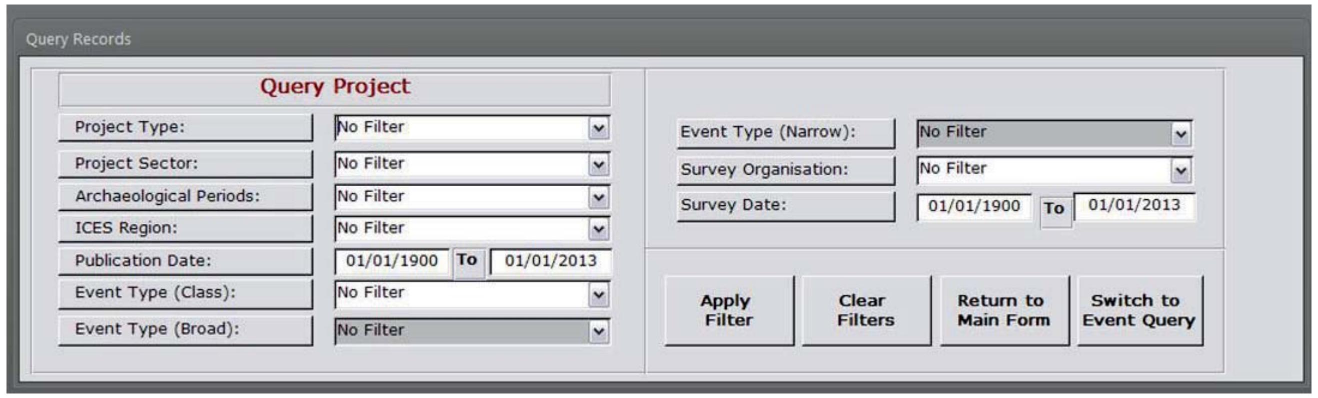
Figure 1



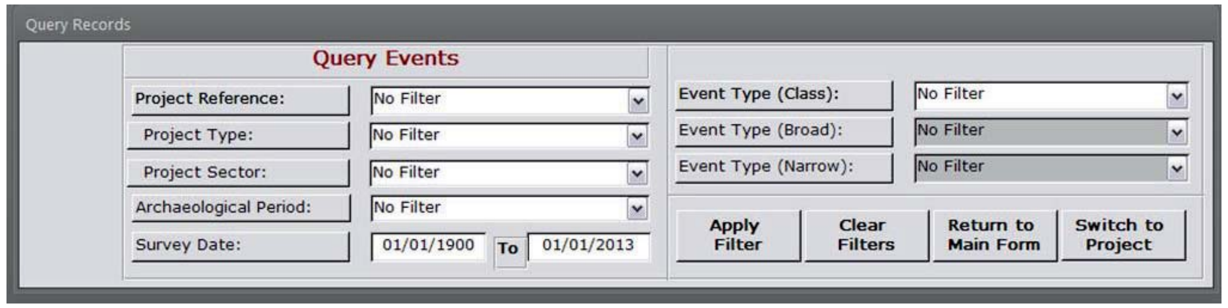
A. Database structure



B. Database entry form



Project database query form



Events database query form

Wessex Archaeology

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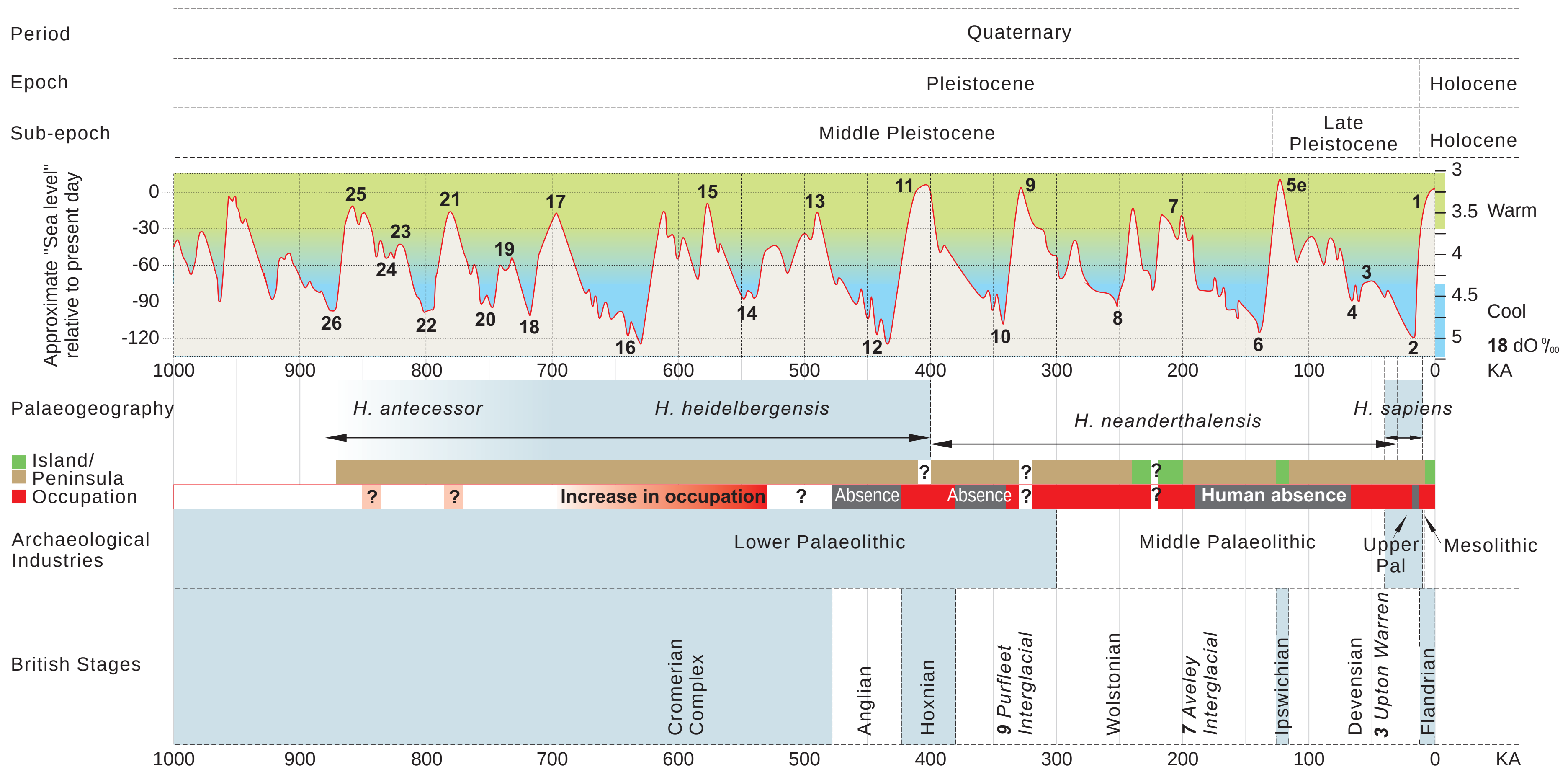
Database structure; Database entry form; Project (a) and Events (b) database query forms

Figure 2



Wessex Archaeology

(Incorporating Lisiecki & Raymo, 2005 doi:10.1029/2004PA001071)

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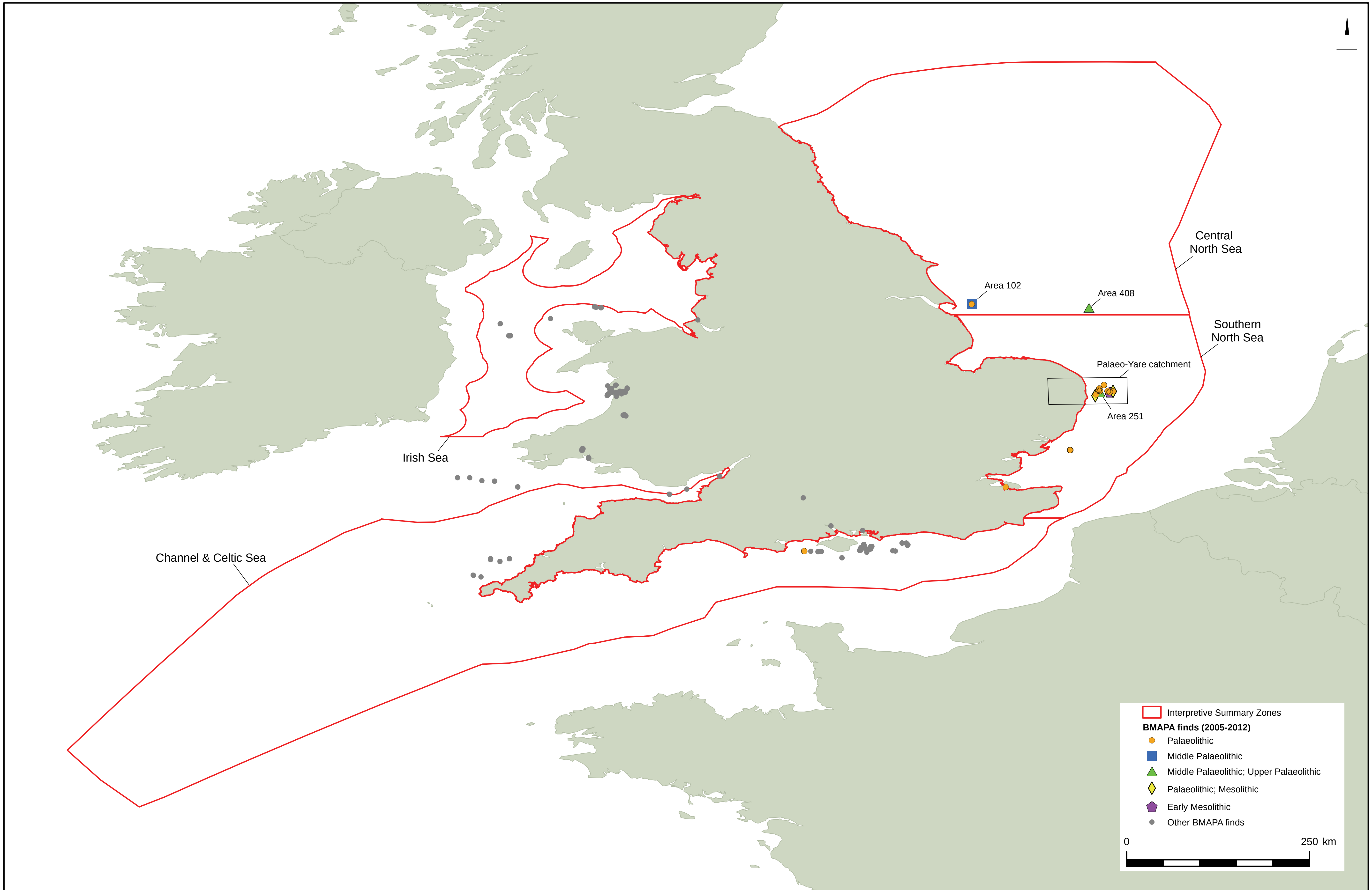
Quaternary Chronostratigraphy

Figure 3



Wessex Archaeology

Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

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Scale:	1:5,000,000 @A3	Illustrator:	KJF
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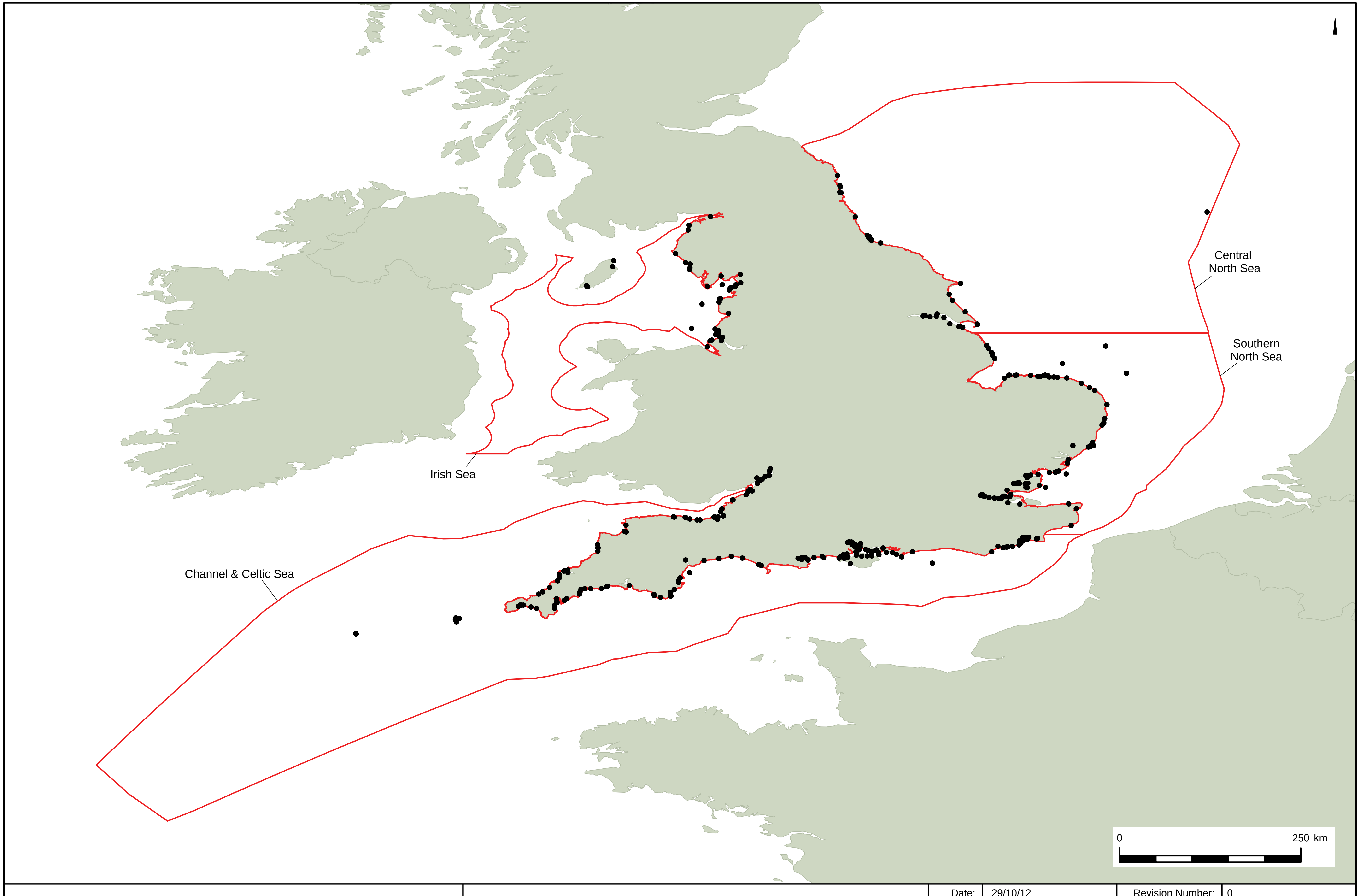
Distribution of BMAPA finds. Symbolised by Assigned Archaeological period

Figure 4



Wessex Archaeology

Interpretive Summary Zones

Peat database entry

Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

Date:	29/10/12	Revision Number:	0
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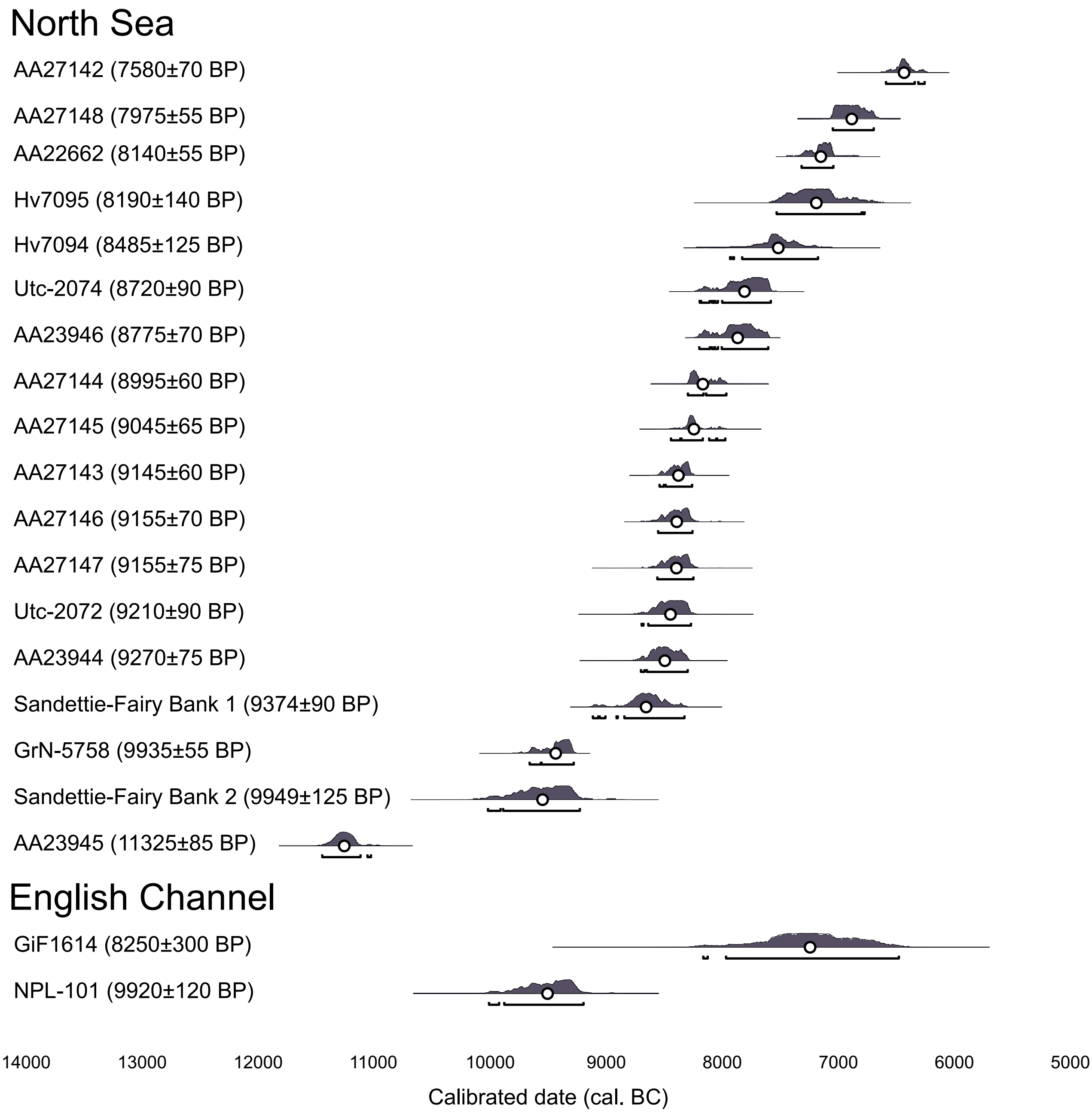
Distribution of offshore Peat Database entries

Figure 5



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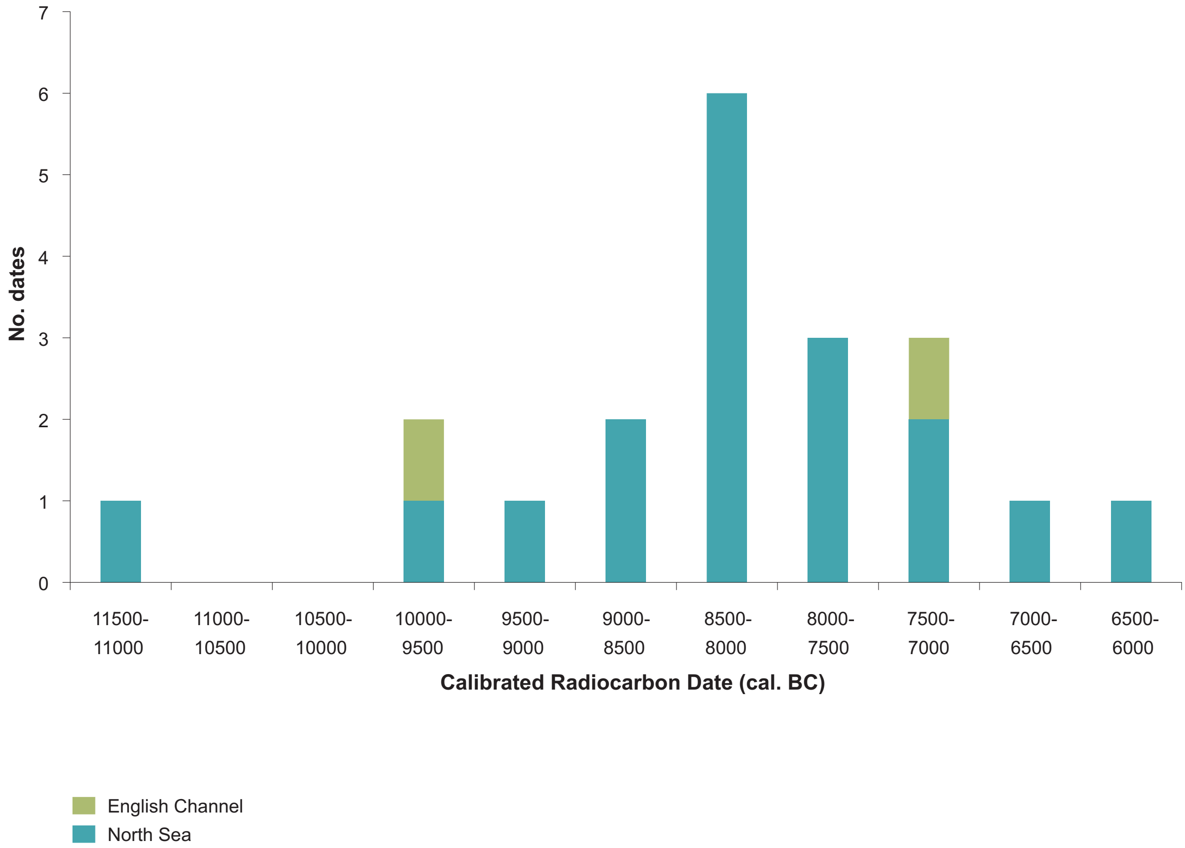
Wessex Archaeology

Age distribution of radiocarbon dates

Figure 6



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Scale:	N/A	Illustrator:	KJF
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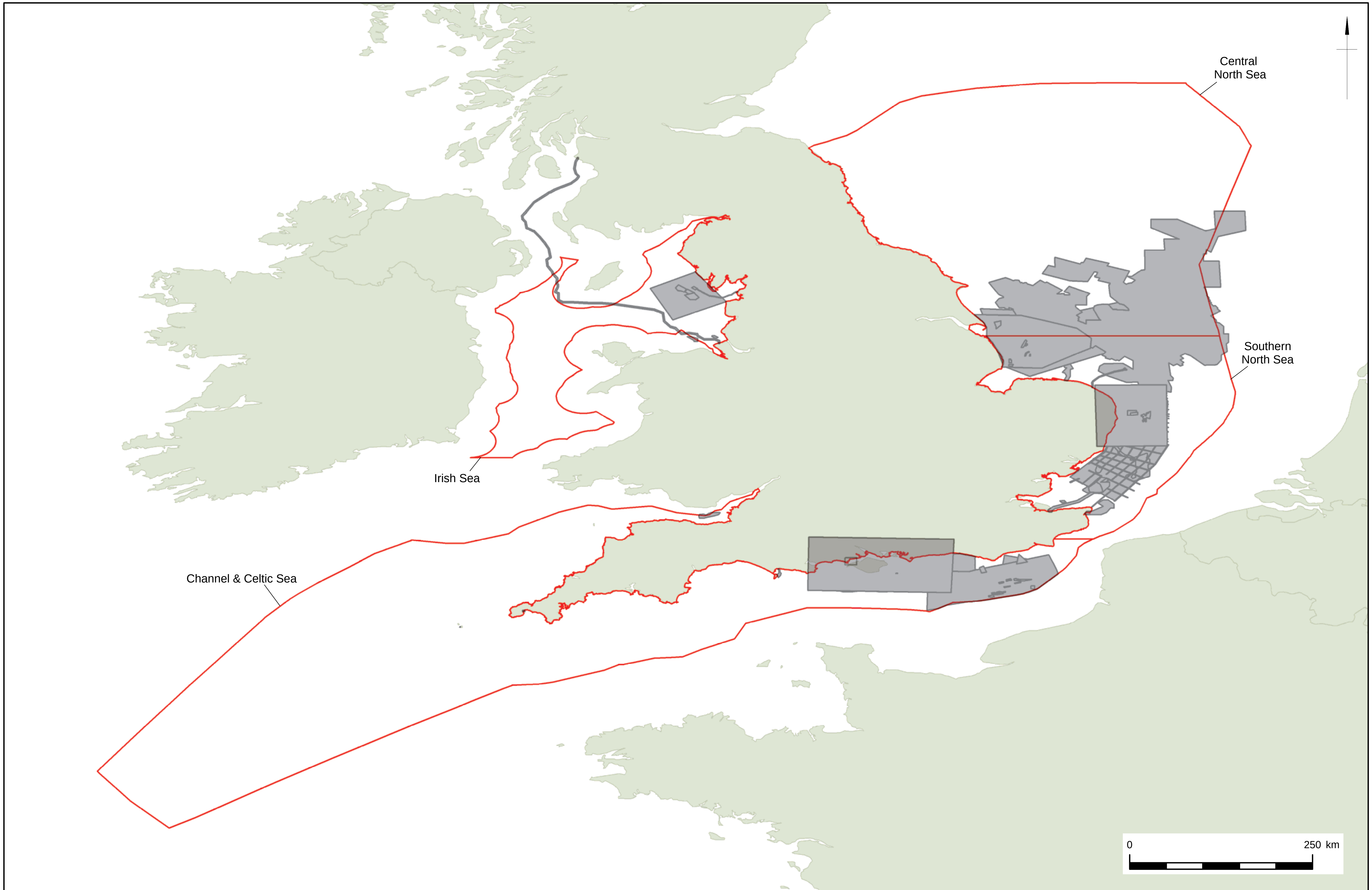
Wessex Archaeology

Histogram of radiocarbon dates

Figure 7



Wessex Archaeology

Interpretive Summary Zones

Palaeolandscapes projects

Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

Date:	01/11/13	Revision Number:	1
Scale:	1:5,000,000 @A3	Illustrator:	KJF
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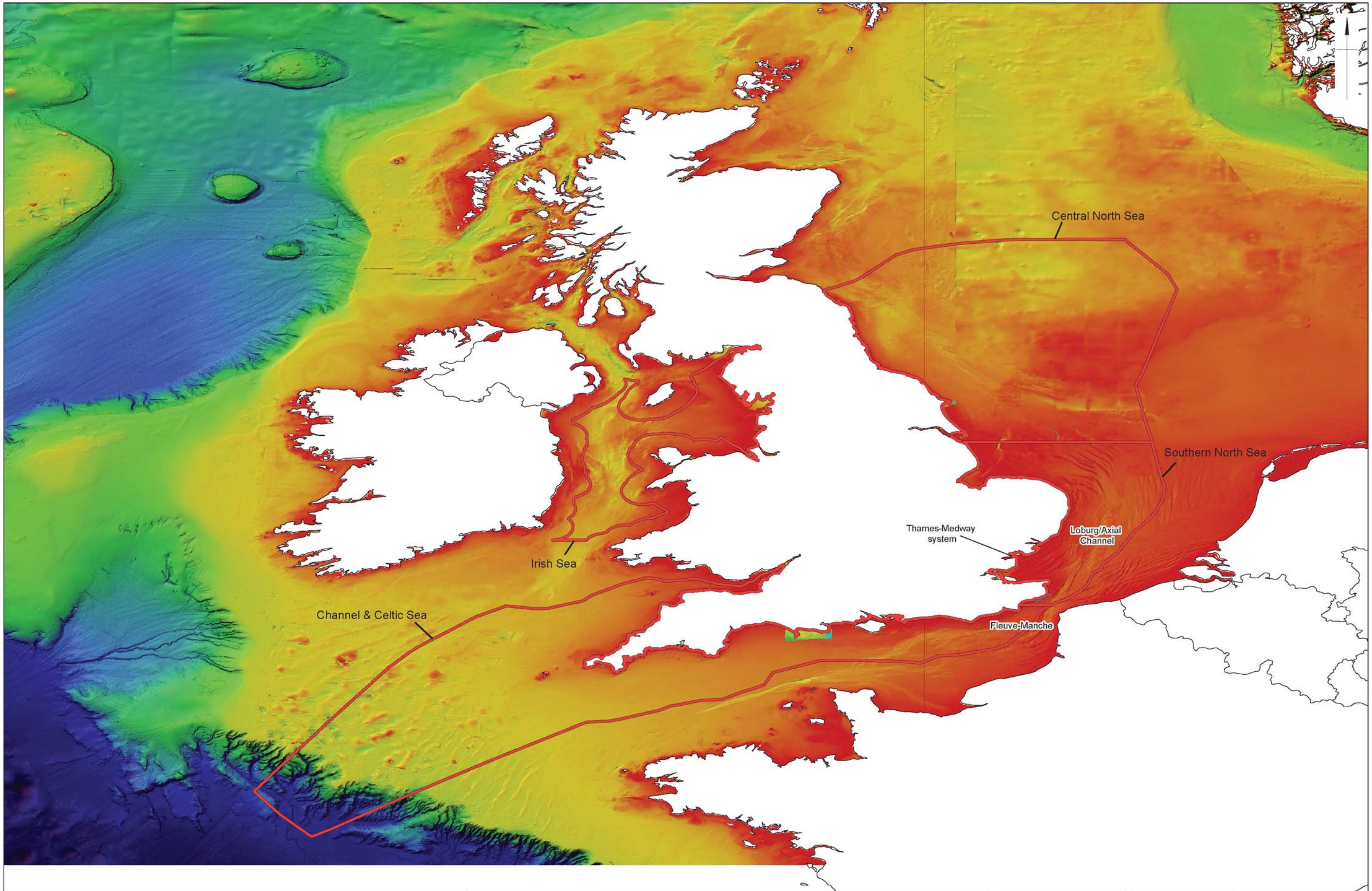
Overall distribution of Projects

Figure 8



Wessex Archaeology

Interpretive Summary Zones

Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

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Scale:	1:6,250,000 @A3	Illustrator:	KJF
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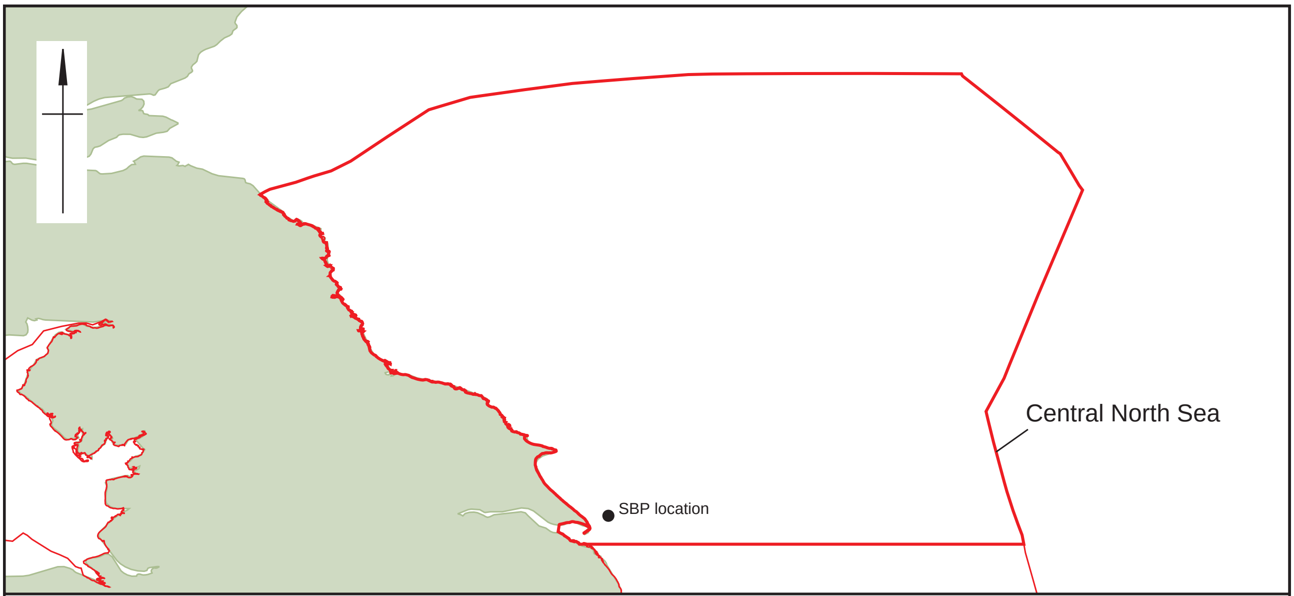
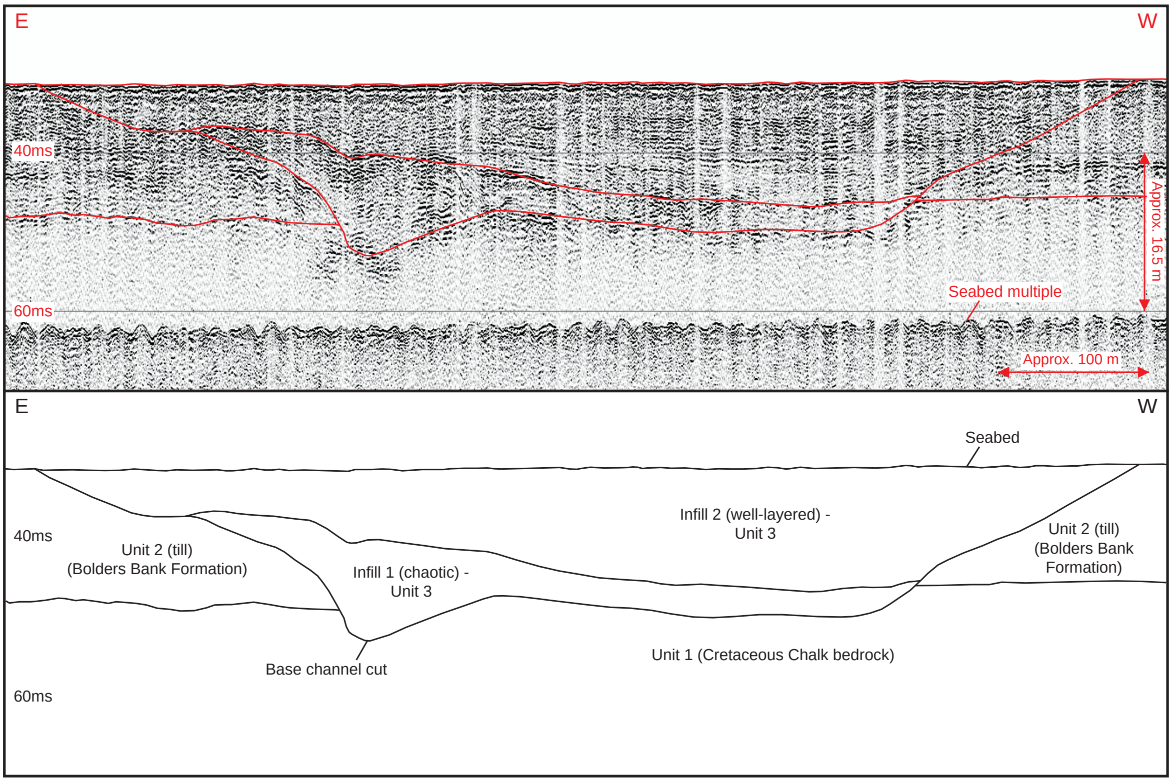
Bathymetry Data Coverage from EMODNET & CCO, with Interpretive Summary Zones

Figure 9





Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

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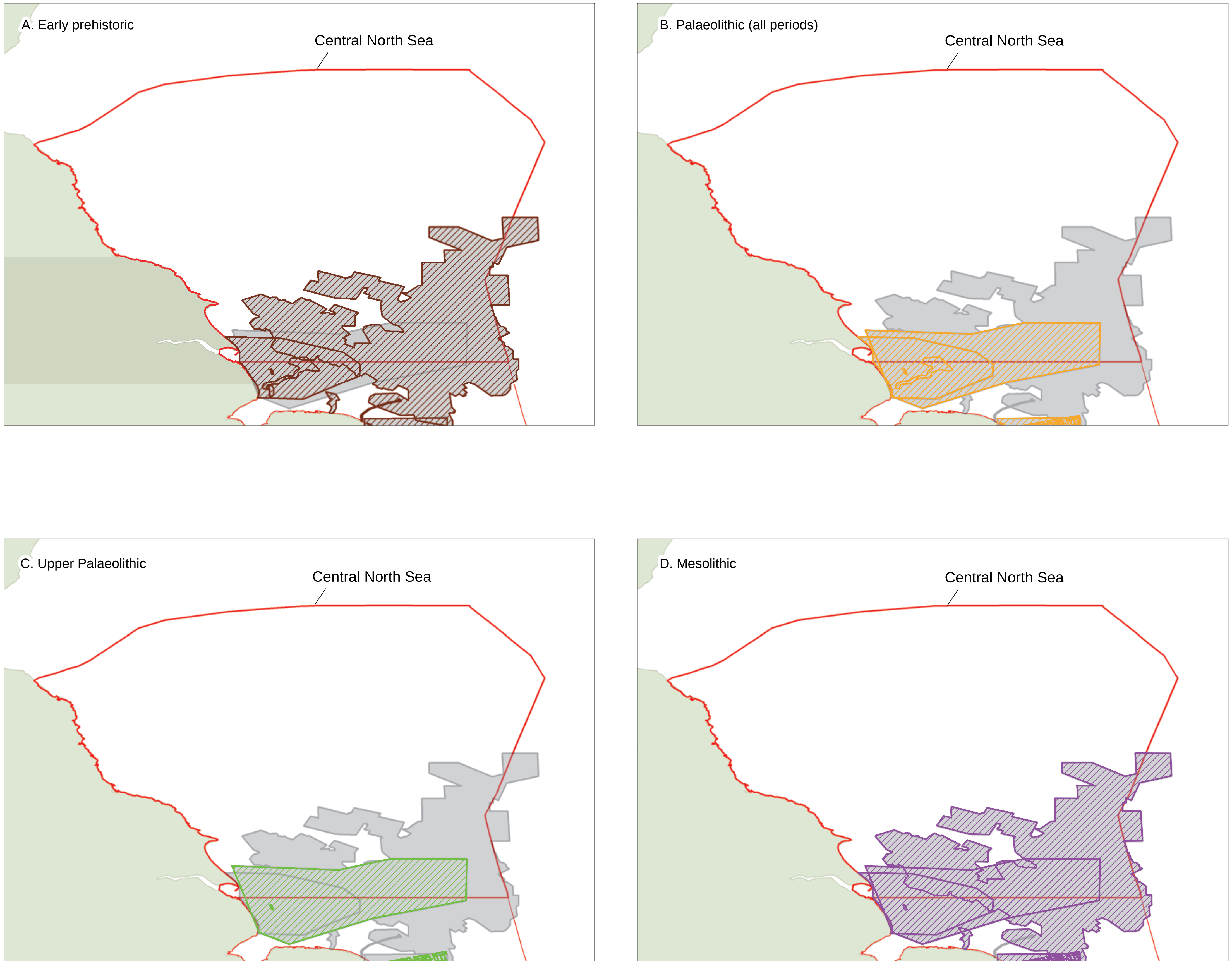
Wessex Archaeology

Central North Sea: data example

Figure 10



Wessex Archaeology

Interpretive Summary Zones
Early Prehistoric (> Mesolithic)
Palaeolithic
Upper_Palaeolithic
Mesolithic
All periods

0 250 km

Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

Revision Number:	1
Illustrator:	KJF
Date:	01/11/13
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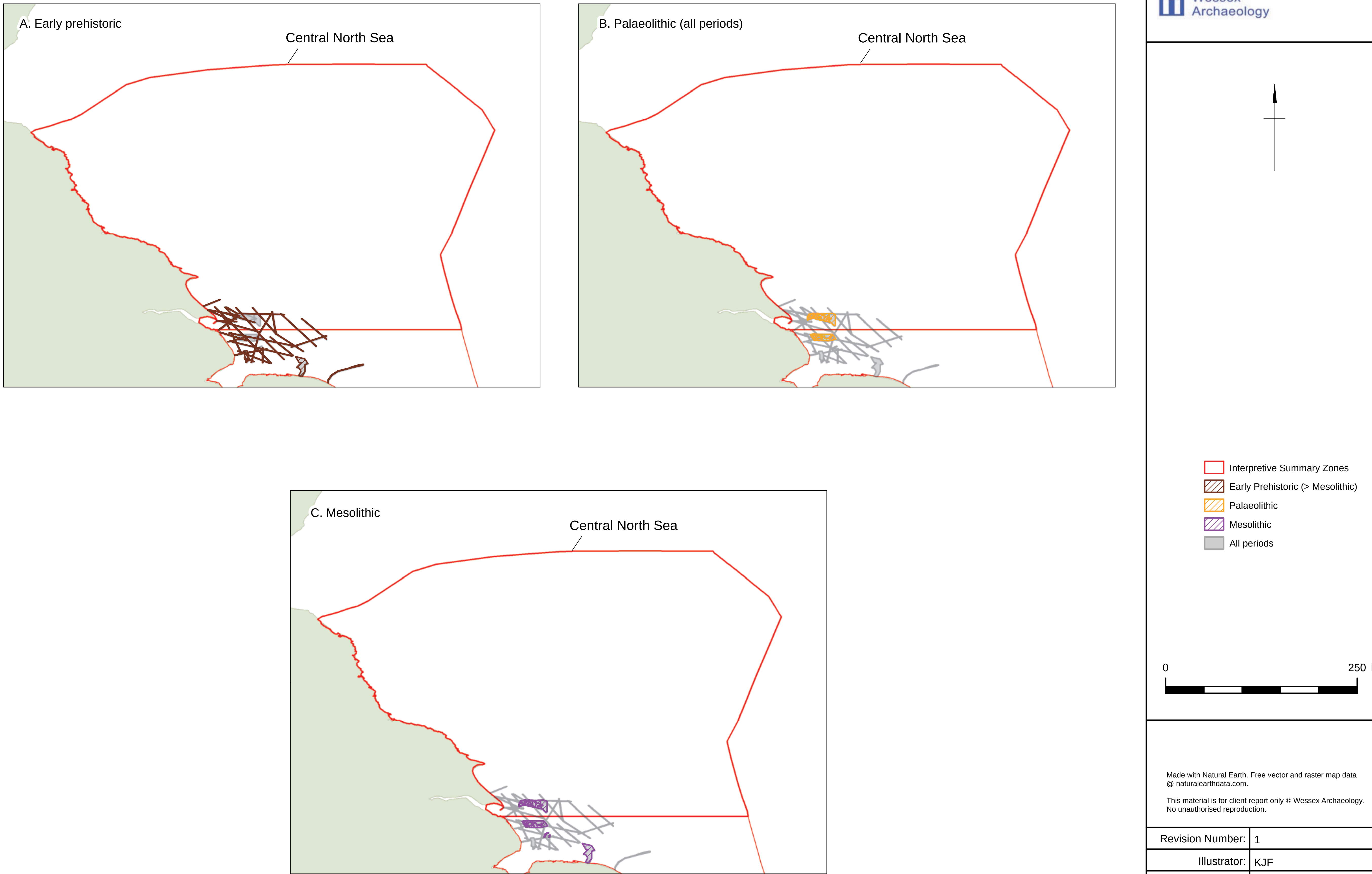
Central North Sea Zone: projects by archaeological period

Figure 11



Wessex Archaeology

Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

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Illustrator:	KJF
Date:	01/11/13
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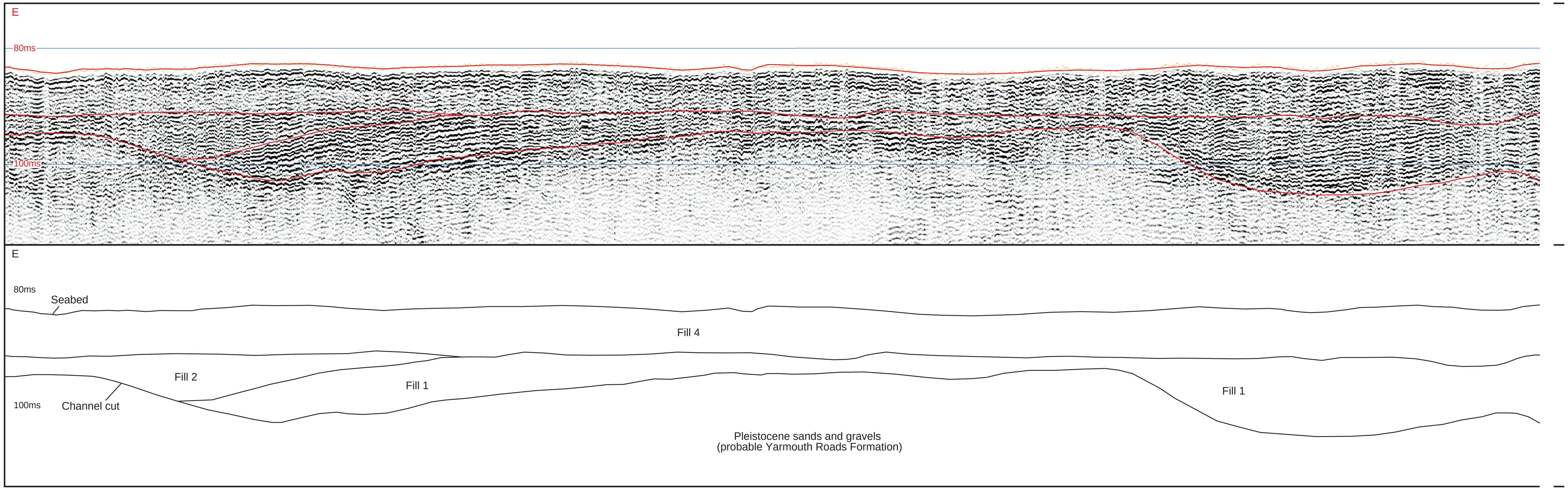
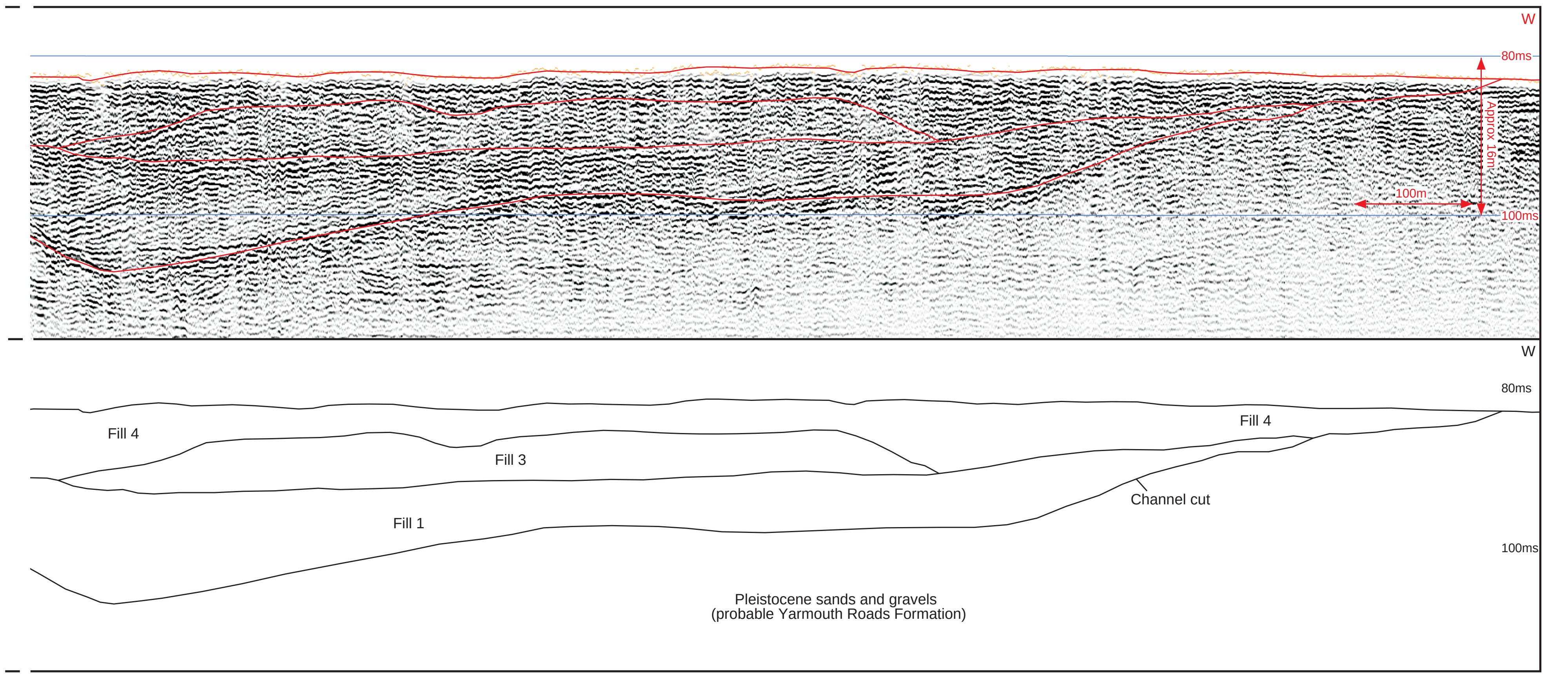
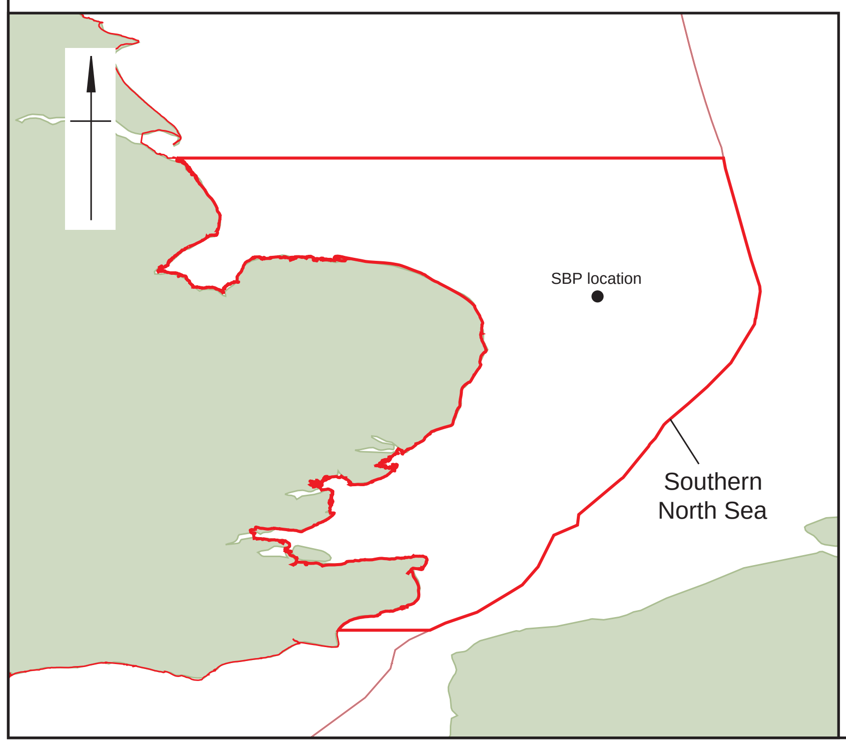
Central North Sea Zone: events by archaeological period

Figure 12







Wessex Archaeology

Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

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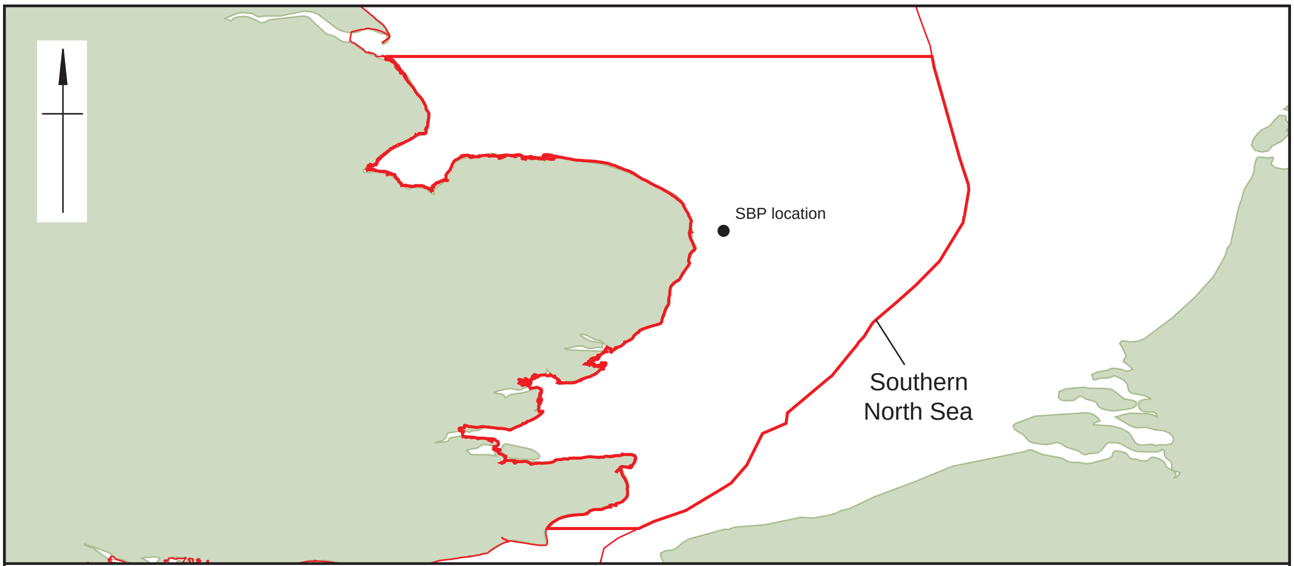
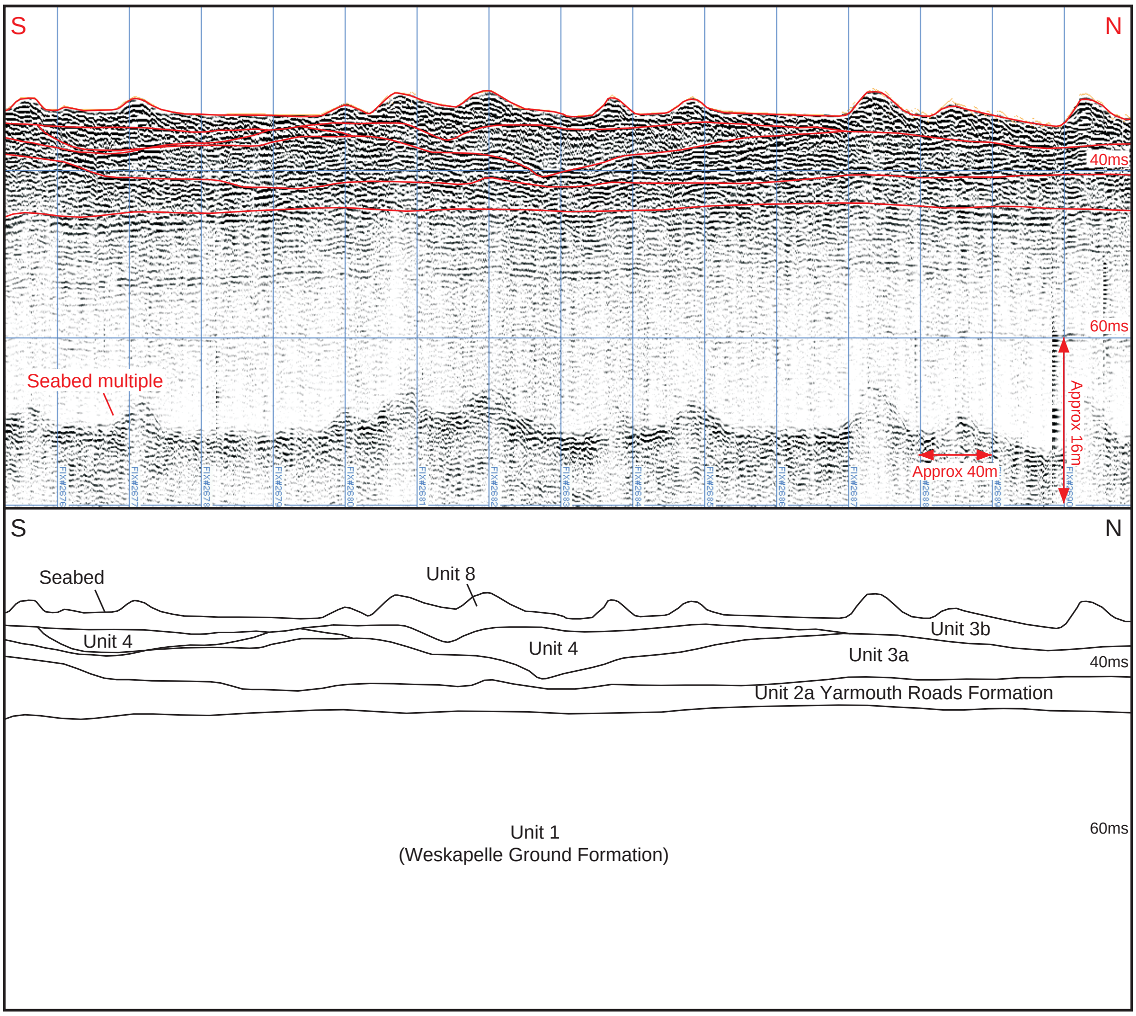
Scale:	1:5000 horizontal scale @A3	Illustrator:	KJF
Path:	W:\Projects\84570\DrawingOffice\Report figs\Data Audit\12_10_26		

Southern North Sea: data example

Figure 13





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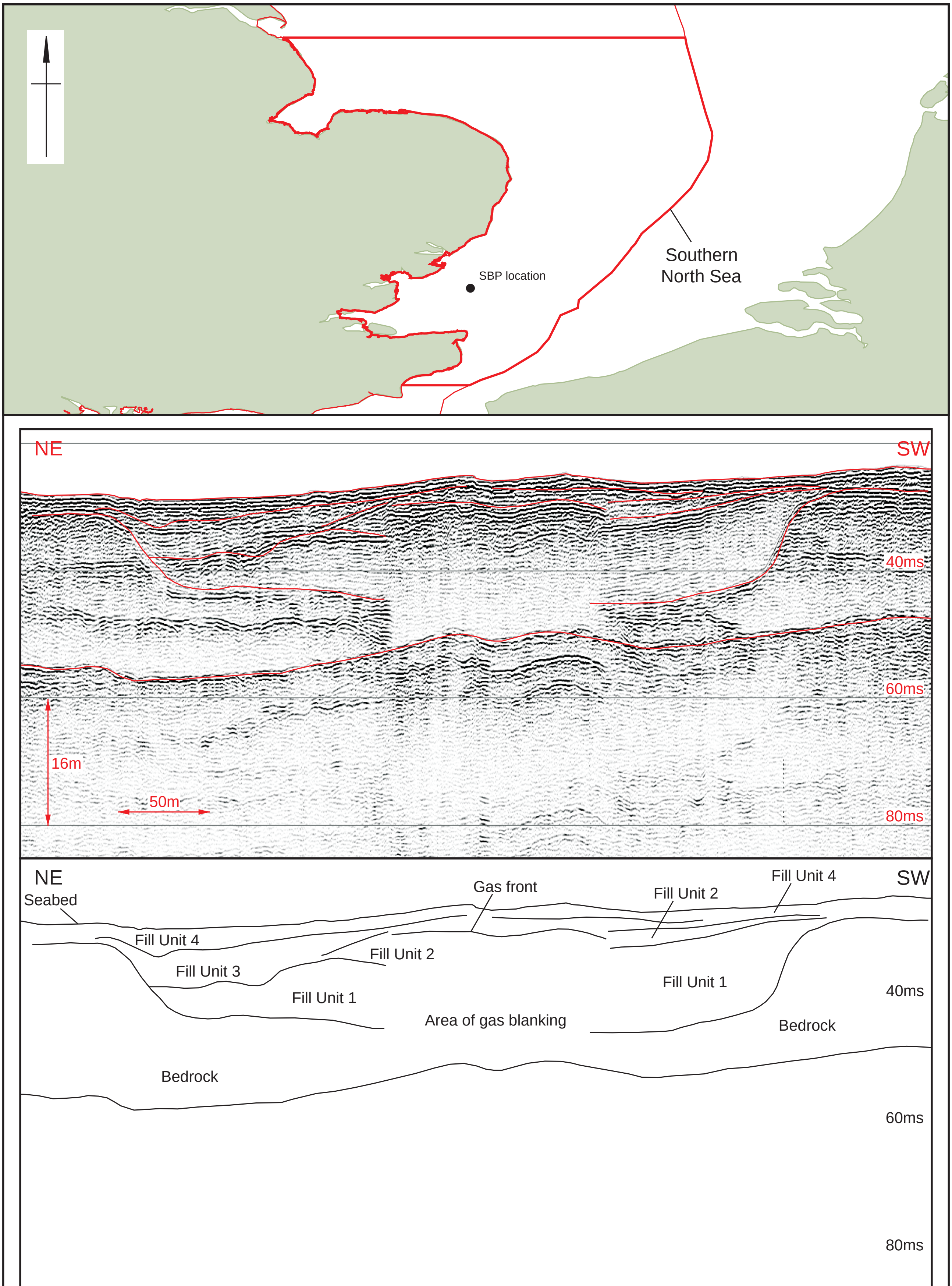
Wessex Archaeology

Southern North Sea: data example

Figure 14



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Wessex Archaeology

Southern North Sea: data example

Figure 15

Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

Date:	11/03/13	Revision Number:	1
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Wessex Archaeology

Southern North Sea Zone: projects by archaeological period

Figure 16

Interpretive Summary Zones
Early Prehistoric (> Mesolithic)
Palaeolithic
Lower Palaeolithic
Middle Palaeolithic
Mesolithic
All periods

0 150 km

Wessex Archaeology

Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

Date:	01/11/13	Revision Number:	2
Scale:	1:3,000,000 @A3	Illustrator:	KJF
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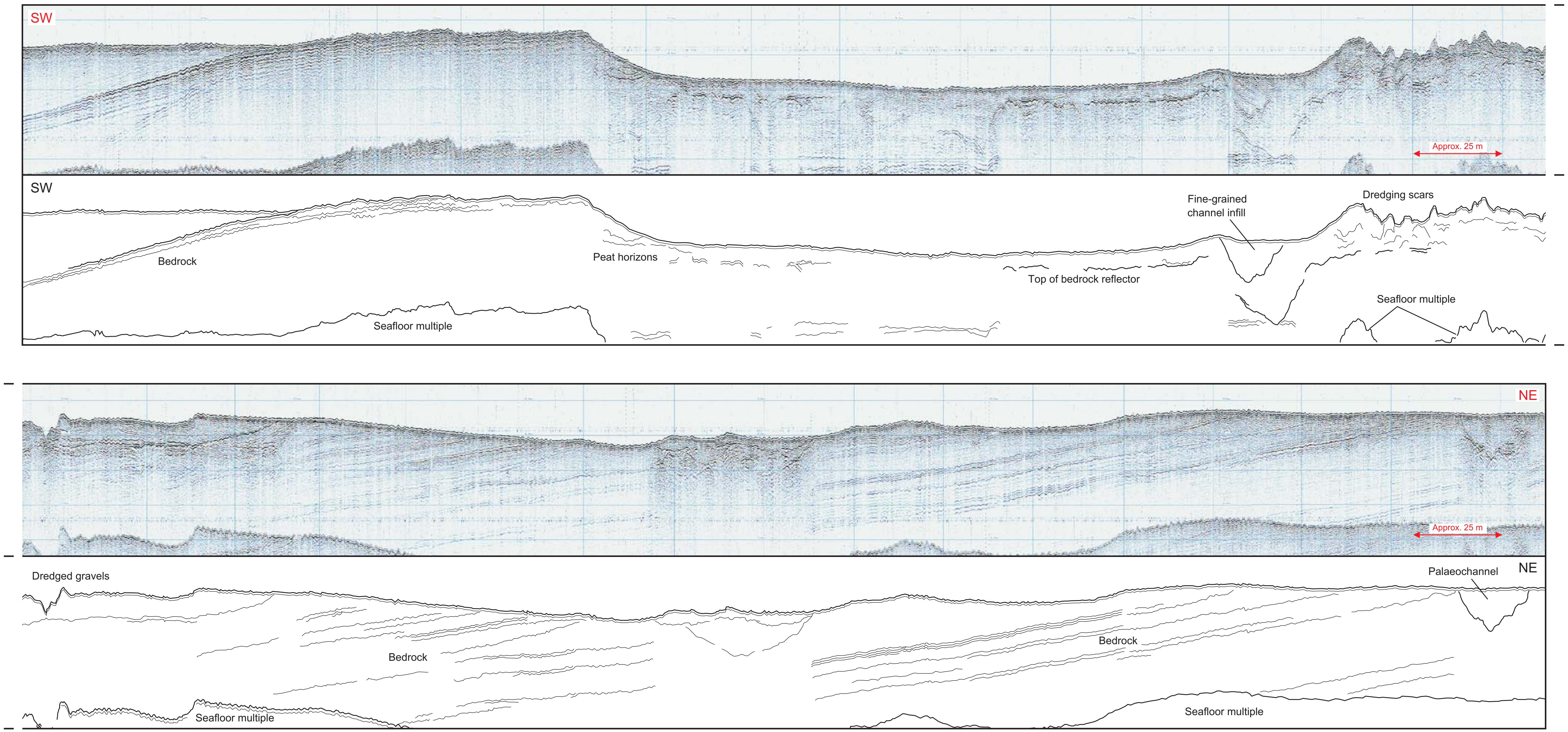
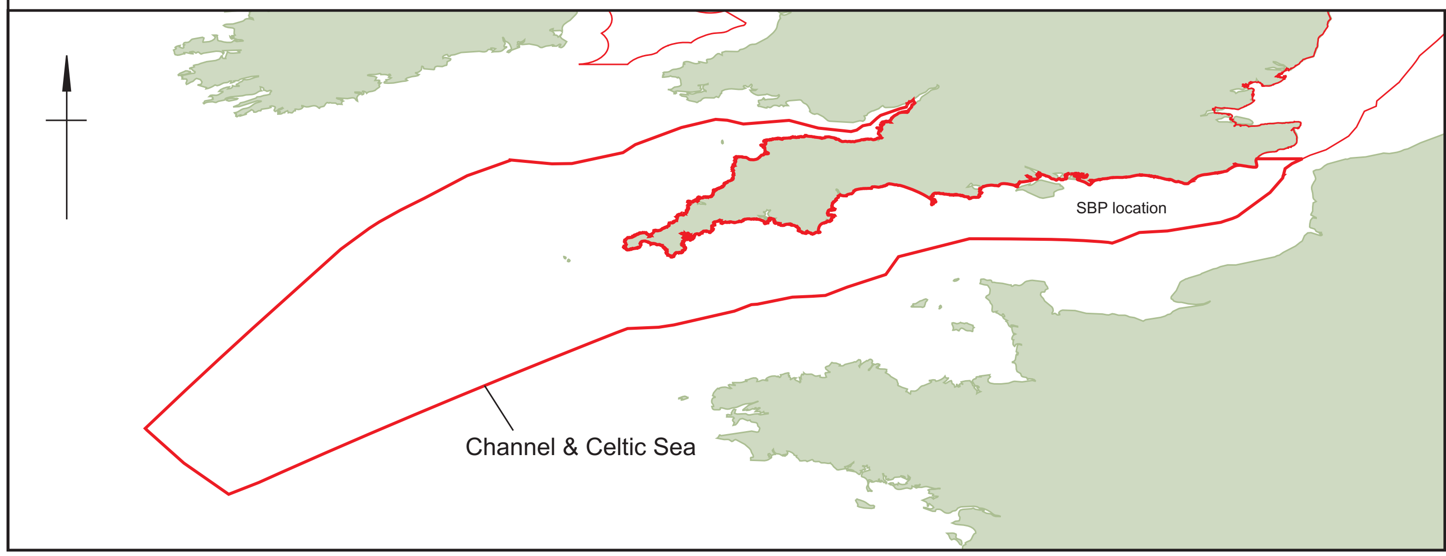
Southern North Sea Zone: events by archaeological period

Figure 17





Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

Wessex Archaeology

Date:	29/10/12	Revision Number:	0
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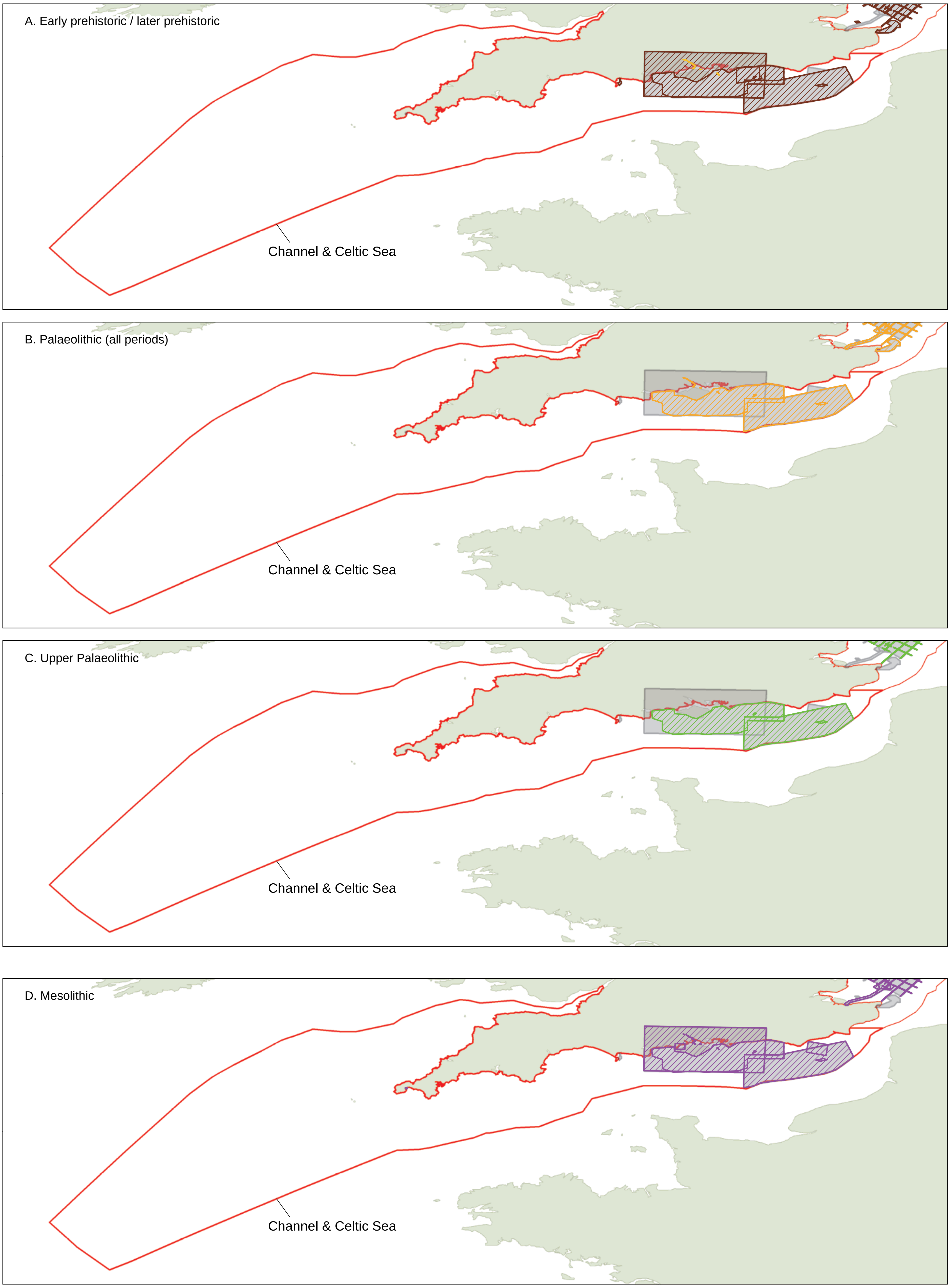

Interpretive Summary Zones
Early Prehistoric (> Mesolithic)
Later Prehistoric (≤ Neolithic)
Palaeolithic
Upper Palaeolithic
Mesolithic
All periods

0 250 km

Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

Date:	01/11/13	Revision Number:	2
Scale:	1:6,250,000 @A3	Illustrator:	KJF
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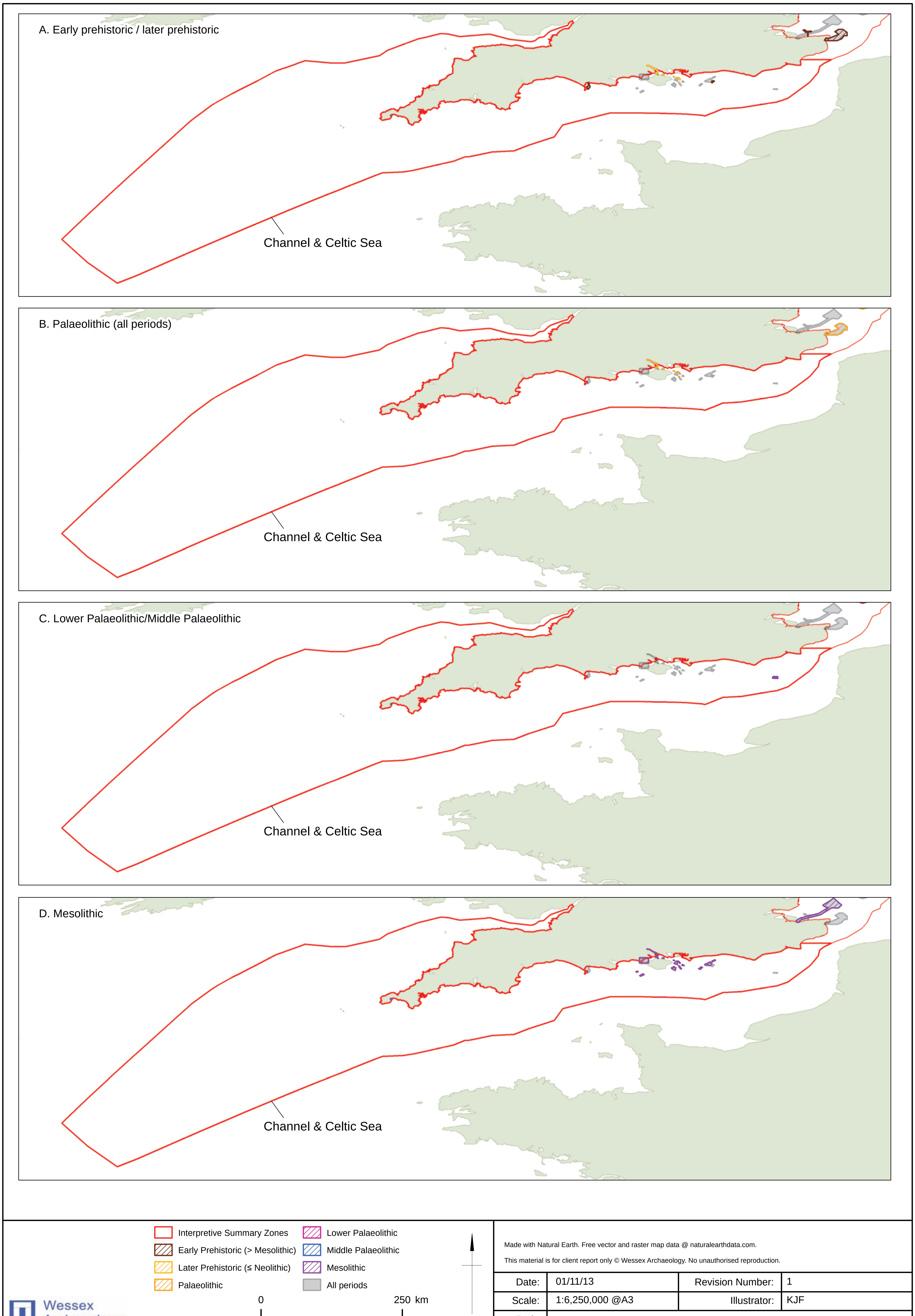
Wessex Archaeology

Channel & Celtic Sea Zone: projects by archaeological period

Figure 19



Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

Date:	01/11/13	Revision Number:	1
Scale:	1:6,250,000 @A3	Illustrator:	KJF
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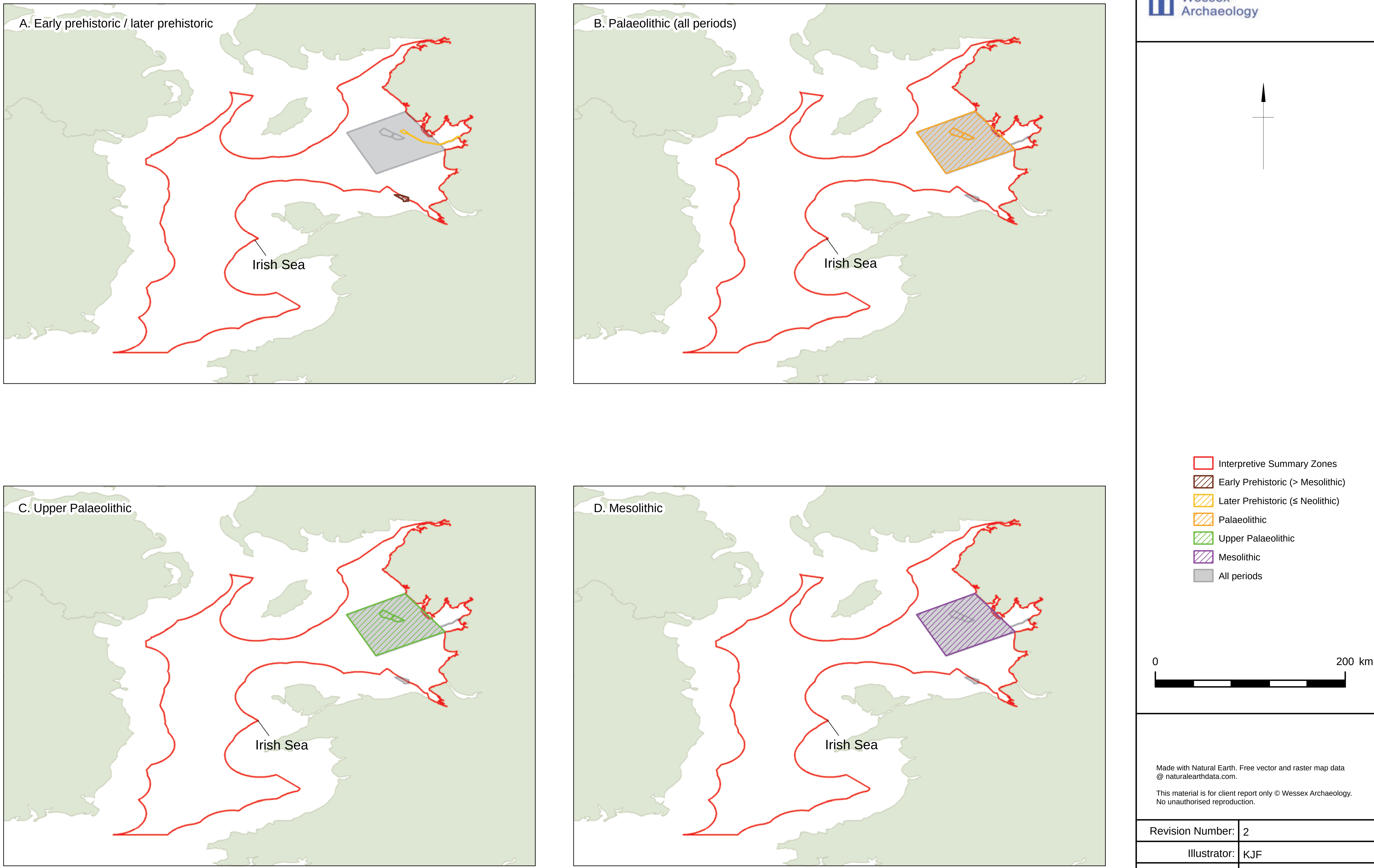
Wessex Archaeology

Channel & Celtic Sea Zone: events by archaeological period

Figure 20



Wessex Archaeology

Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

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Illustrator:	KJF
Date:	01/11/13
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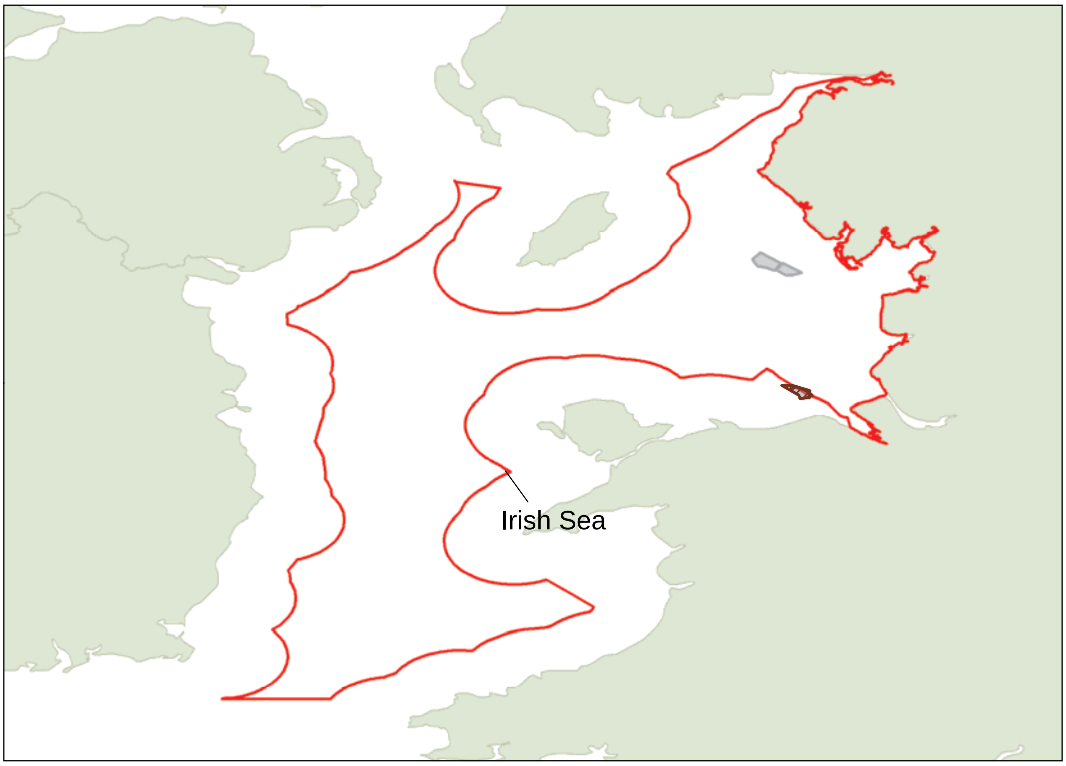
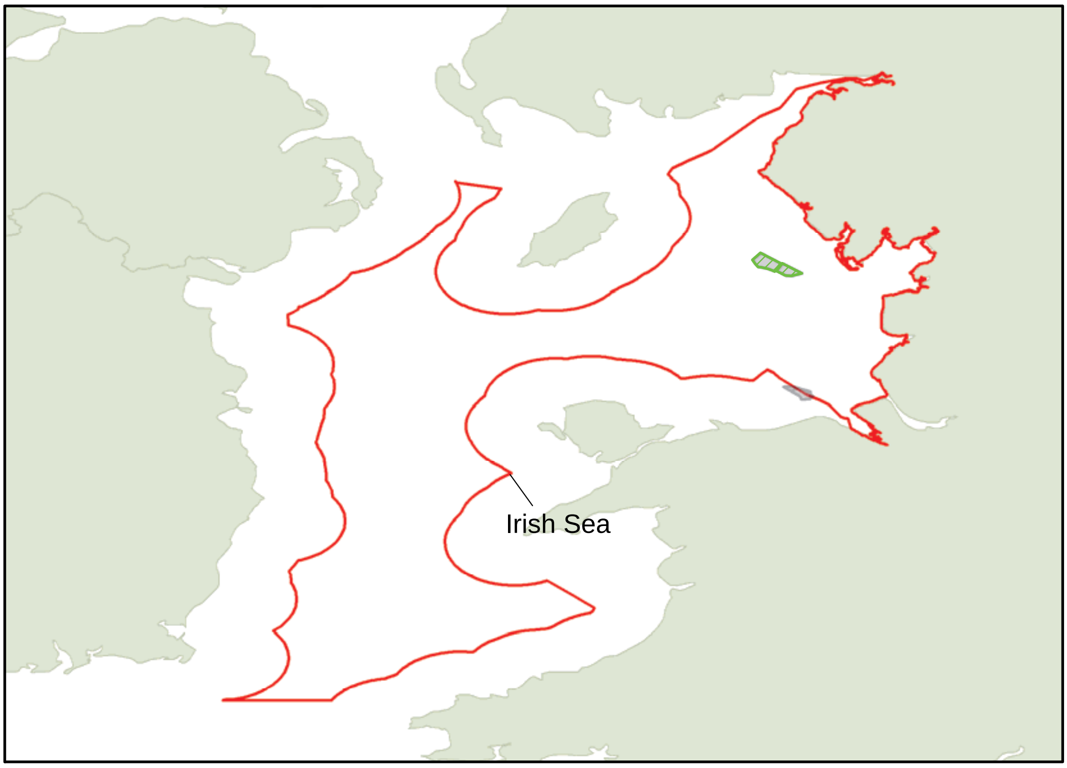
Irish Sea Zone: projects by archaeological period



A. Early prehistoric



B. Upper Palaeolithic

Interpretive Summary Zones
Early Prehistoric (> Mesolithic)
Upper Palaeolithic
All periods

Wessex Archaeology

Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

0 200 km

Date:	01/11/13	Revision Number:	1
Scale:	1:4,000,000 at A4	Illustrator:	KJF
Path:	W:\Projects\84570\DrawingOffice\Report figs\Data Audit\12_10_26		

Irish Sea Zone: events by archaeological period

Figure 22

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