Appendix 7.3

Proposed Brine Outfall Pipe, Fleetwood, Marine Archaeological Assessment Final Technical Report
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PROPOSED BRINE OUTFALL PIPE, FLEETWOOD MARINE ARCHAEOLOGICAL ASSESSMENT

FINAL Technical Report

Summary

Wessex Archaeology was commissioned by Hyder Consulting (UK) Ltd to carry out a desk based Marine Archaeological Assessment to accompany proposals for a brine outfall at Fleetwood, Lancashire.

The Archaeological Assessment has assessed information from National and Regional archaeological databases and primary and secondary sources pertaining to prehistoric, maritime and aviation archaeological sites within the Study Area and the immediate vicinity. In addition, marine geophysical data has been assessed to identify known archaeological sites and sites of archaeological potential within the study area.

Previous archaeological finds from the close vicinity of the Study Area demonstrate the presence of early Holocene communities on the Fleetwood peninsula, and highlight the potential for previously unknown archaeological remains within the Study Area. A potential early Holocene terrestrial palaeo-channel was identified during the geophysical assessment, which has a high potential for the preservation of prehistoric archaeological remains.

A Roman vase was discovered by fishermen in 1949 in the vicinity of the Study Area, although the position appears to be the corner of the British National Grid square and is not thought to be precise. Along with a number of other Roman finds from the Fleetwood peninsula, the find does indicate the potential for further finds from this period either associated with terrestrial structures which have been eroded by the sea, or relating to shipping activity in the area. Four shipwrecks have been located in the vicinity of the Study Area. A further 84 recorded shipwreck incidents occurred in the vicinity of the Study Area for which no remains have been located and there is the potential for the remains of these sites to lie within the Study Area.

No aviation wrecks have been located within the Study Area, however two aircraft wreck incidents are reported in the vicinity and a number of Air/Sea rescue operations occurred off the Fleetwood peninsula during the Second World War. As no remains of these crashed aircraft have yet been located there is the potential that some may lie within the Study Area.

Thirteen geophysical anomalies of uncertain origin but possible archaeological interest were identified on the seabed of the Study Area. There is the potential that these anomalies could be remains of shipwrecks or aircraft wrecks reported within the vicinity of the Study Area.

Mitigation measures relating to the potential for submerged prehistoric remains are likely to include detailed sub-bottom profile survey of the possible valley feature and archaeological assessment of geotechnical samples. This will provide an understanding of the nature of sediments within the feature and the potential for survival of palaeo-environmental sediments or archaeological remains. Details of mitigation measures will be set out in later stages of the project.
Mitigation measures relating to the seabed anomalies could include further high resolution geophysical survey, ROV or diver investigations to clarify the nature of the anomalies. Avoidance of all anomalies should be considered from both an engineering and archaeological perspective, however if this is not possible, further investigation and recording of anomalies of an anthropogenic origin is likely to be required. Details of proposed mitigation measures will be included in the WSI once development proposals have been finalised.
Acknowledgements

This project was commissioned by Hyder Consulting (UK) Ltd. Thanks are extended to Hyder Consulting (UK) Ltd, Peter Iles and Ken Davies at Lancashire County Council, Claire Sutton at Fleetwood Community History Library, and Lynn Asghar at Fleetwood Museum for their assistance with local history research.

Dave Howell undertook the archaeological assessment of geophysical data, whilst Hanna Steyne undertook the desk based research. Hanna Steyne compiled this report with contributions by Dave Howell. The illustrations were prepared by Kitty Foster and the project was managed by Caroline Budd for Wessex Archaeology.
PROPOSED BRINE OUTFALL PIPE, FLEETWOOD
MARINE ARCHAEOLOGICAL ASSESSMENT

FINAL Technical Report

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1. INTRODUCTION

1.1. Project Background

1.1.1. Wessex Archaeology has been commissioned by Hyder Consulting (UK) Ltd to undertake a desk based Marine Archaeological Assessment to accompany proposals for a brine outfall at Fleetwood, Lancashire.

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

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

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

1.2. Aims and Objectives

1.2.1. The purpose of this Marine Archaeological Assessment is to identify known and potential archaeological remains within the Study Area, identify potential impacts of the project on such archaeological remains and outline a mitigation strategy based on the potential impacts. The Marine Archaeological Assessment will inform the impact assessment and mitigation strategy for the project.

1.3. Legislative Background

1.3.1. The Study Area lies within England’s territorial waters. Within this area the UK has jurisdiction with regard to heritage. An outline of legislation, policy and guidance relevant to the marine historic environment can be found in Appendix I. This includes reference to:

- Protection of Wrecks Act 1973;
- Protection of Military Remains Act 1986;
- Ancient Monuments and Archaeological Areas Act 1979;
- Merchant Shipping Act 1995;
- Marine and Coastal Access Act 2009;
- Policy Statement 5: Planning for the Historic Environment 2010;
- Relevant codes of practice and guidance for seabed developers and the offshore renewable energy sector;
- Relevant guidance for coastal and seabed archaeology; and
- Relevant international conventions and treaties.

2. METHODOLOGY

2.1.1. This assessment was carried out in a manner consistent with available guidance, including the Joint Nautical Archaeology Policy Committee (JNAPC) and the Institute for Archaeologists (IfA) Standard and Guidance for Desk Based Assessment (Institute for Archaeologists 2008).

2.2. Site Location and Study Area

2.2.1. The Study Area is located off the beach between Rossall School and Fleetwood. The Study Area for this assessment is limited to the offshore section of the outfall pipe (Figure 1) plus a 50m buffer. Sources outside the Study Area were drawn upon where they were relevant to either the historic environment of the Study Area or the potential impacts on the historic environment outside the Study Area. Locations mentioned in the text outside the study area are also presented in Figure 1.

<table>
<thead>
<tr>
<th>Point location (including buffer)</th>
<th>Easting</th>
<th>Northing</th>
</tr>
</thead>
<tbody>
<tr>
<td>West end of outfall</td>
<td>494470</td>
<td>5972445</td>
</tr>
<tr>
<td>East end of outfall (at foreshore)</td>
<td>496520</td>
<td>5972480</td>
</tr>
</tbody>
</table>

Table 1: Study Area Co-ordinates (WGS 84, UTM Zone 30N)

2.3. Sources

2.3.1. The Study Area has been used to define the search areas for archaeological and related data. The principal sources consulted to inform this assessment comprise both third party data and secondary sources, outlined as follows:

- English Heritage’s National Monument Record database which includes designated historic assets; non-designated heritage assets; shipwreck casualties (recorded ship losses).
- Lancashire County Council Historic Environment Record, incorporating the Friends of Lancaster Maritime Museum Shipwreck database.
- UK Hydrographic Office (UKHO) Shipwreck Index.
- Maritime and Coastguard Agency database of reported wreck material.
- Lancashire County Council’s interactive mapping website – MARIO.
- Fleetwood Museum and Local History Library archives.
- Archaeological discoveries reported through the Marine Aggregate Industry Protocol.
- Online Portable Antiquities Scheme database.
• British Geological Society data.
• ALSF Reports and publications.
• Published documentary sources and relevant previous investigations by Wessex Archaeology.
• Marine geophysical data as supplied by the client including sidescan sonar, magnetometer and sub-bottom profiler (pinger) data.

2.3.2. The sources outlined above were consulted to provide a review of the known and potential marine archaeological resource within the Study Area. This review was considered with regards to three separate fields of enquiry, comprising prehistoric archaeology, maritime archaeology and aviation archaeology. The baseline characterisation data with respect to marine archaeology is considered to provide a clearer picture of the presence and location of sites within and around the Study Area.

2.3.3. In order to assess the potential for prehistoric sites within the Study Area, various secondary sources were reviewed, alongside geophysical data.

2.3.4. A review of the maritime archaeological resource within the Study Area was obtained through a consideration of secondary sources alongside records of known wrecks and shipping casualties collated from the UKHO, NMR and Lancashire HER. These records were superimposed on a base map of the Study Area in ArcView 9.3 GIS software package.

2.3.5. UKHO records include charted wrecks and obstructions, the latter being sites where the exact nature is not fully known. Records for shipping casualties held by the NMR and Lancashire HER represent wrecking incidents for which there are currently no known seabed remains. Shipping casualties are typically considered in marine archaeological assessments in order to provide a review of the potential for unknown and uncharted shipwreck sites within a study area.

2.3.6. Records relating to aircraft crash sites listed by UKHO and those relating to aircraft losses listed by the NMR and HER were considered alongside records for World War Two Air/Sea Rescue Operations. Along with an assessment of historic aviation patterns, this data was used to provide an understanding of the density and distribution of aircraft activity in order to highlight the potential for the discovery of aircraft remains within the Study Area.

2.4. Marine Geophysical Assessment

2.4.1. As part of the Environmental Impact Assessment (EIA) for the proposed scheme, Wessex Archaeology carried out an archaeological assessment of marine geophysical data collected by Osiris Projects in 2011. Further background information was obtained from the Osiris survey report (Osiris 2011).

2.4.2. The geophysical data used for this report were assessed regarding their quality for archaeological purposes and each system rated using the following criteria:
<table>
<thead>
<tr>
<th>Data Quality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Data which are clear and unaffected by weather conditions or sea state. The dataset is suitable for the interpretation of standing and partially buried metal wrecks and their character and associated debris field. These data also provide the highest chance of identifying wooden wrecks and debris.</td>
</tr>
<tr>
<td>Average</td>
<td>Data which are affected by weather conditions and sea state to a slight or moderate degree. The dataset is suitable for the identification and partial interpretation of standing and partially buried metal wrecks, and the larger elements of their debris fields. Wooden wrecks may be visible in the data, but their identification as such is likely to be difficult.</td>
</tr>
<tr>
<td>Variable</td>
<td>This category contains datasets with the quality of individual lines ranging from good to average to below average. The dataset is suitable for the identification of standing and some partially buried metal wrecks. Detailed interpretation of the wrecks and debris field is likely to be problematic. Wooden wrecks are unlikely to be identified.</td>
</tr>
</tbody>
</table>

Table 2: Criteria for assigning data quality rating

2.4.3. The sidescan sonar data have been rated as "Variable" using the above criteria. The main problem affecting the data appears to be clipping of the signal during acquisition, meaning some of the data range from the sonar pulses is missing. This makes equalisation of gains for display and interpretation difficult, though the data were deemed fit for purpose in this case.

2.4.4. The sub-bottom profiler data have been rated as "Variable" using the above criteria. The data appear affected by both the shallow water depths and by weather conditions, though they were deemed fit for purpose after processing by WA.

2.4.5. Similarly, the marine magnetometer data were also rated as “Variable” using the above criteria. The raw magnetic data is very noisy, with regular data spiking (presumed to be electrical interference) of 0.5nT or less, though some spikes are larger than 1nT. This makes identification of smaller anomalies problematic.

2.4.6. The multibeam bathymetry data were rated as “Good” using the above criteria. High resolution data of the entire survey area were acquired, though a degree of noise is visible in the shallowest section of the site.

Marine Geophysical Assessment – Technical Specifications

2.4.7. The data assessed were obtained by Osiris between the 28th June and the 4th July 2011 on the MV Eagle. The dataset consisted of sidescan sonar, sub-bottom profiler (pinger), multibeam bathymetry and marine magnetometer data.

2.4.8. The survey was conducted over a corridor 200m wide and approximately 2km long, and comprised five E – W main lines at a spacing of 40m and four N – S cross lines at a spacing of 500m.
2.4.9. Osiris used a GeoAcoustics 159D dual frequency towfish operated at 410kHz and 50m range, with towfish positioning provided by fixed layback. The data were recorded digitally using a Coda DA2000 system and provided to WA as .cod files.

2.4.10. The sub-bottom profiler data were collected using a GeoAcoustics GeoPulse pinger system operated at 3.5kHz and a firing rate of 250ms. The data were recorded digitally using a Coda DA2000 system and provided to WA as .cod files.

2.4.11. A Geometrics G882 Caesium vapour magnetometer was used to collect the marine magnetic data. The data were provided to WA in two formats: as raw data in individual .txt files, and as processed data as a single .csv file.

2.4.12. A GeoAcoustics GeoSwath interferometric multi-beam echo sounder system was used to collect the multibeam bathymetry data during the survey. The data were provided to WA as a single processed .PTS file.

2.4.13. Primary positioning for the survey was provided by an RTK GPS receiver utilising the Leica SmartNet RTK network, with secondary positioning logged using a dGPS system. All coordinates for the survey were recorded in WGS84 UTM 30N.

Marine Geophysical Assessment – Processing

2.4.14. The sidescan sonar data were processed by WA using Coda Geosurvey software. This allowed the data to be replayed with various gain settings in order to optimise the quality of the images. The data were initially scanned to give an understanding of the geological nature of the area and were then interpreted for any objects of possible anthropogenic origin. This involves creating a database of anomalies within Coda by tagging individual features of possible archaeological potential, recording their positions and dimensions, and acquiring an image of each anomaly for future reference.

2.4.15. A mosaic of the sidescan sonar data is produced during this process to assess the quality of the sonar towfish positioning. The survey lines are smoothed, and the navigation corrected either with CNV files provided by the survey company who acquired the data or individual fixed laybacks as recorded in the survey logs. This allows the position of anomalies to be checked between different survey lines and for the layback values to be further refined if necessary.

2.4.16. The form, size, and/or extent of an anomaly is a guide to its potential to be an anthropogenic feature, and therefore of its potential archaeological interest. A single, small, but prominent anomaly may be part of a much more extensive feature that is largely buried. Similarly, a scatter of minor anomalies may define the edges of a buried but intact feature, or it may be all that remains of a feature as a result of past impacts from, for example, dredging or fishing. The application of a ratings system is therefore a means of prioritising sites in order to inform further stages of the interpretation process, and on its own is not definitive.

2.4.17. The shallow seismic data were studied in order to detect any in-filled palaeochannels, ravinement surfaces and peat/fine-grained sediment horizons that may have archaeological potential.
2.4.18. The shallow seismic data were processed by WA using Coda Seismic+ software. This software allows the data to be visualised with user selected filters and gain settings in order to optimise the appearance of the data for interpretation. The software then allows an interpretation to be applied to the data by identifying and selecting a sedimentary boundary that might be of archaeological interest.

2.4.19. The shallow seismic data were interpreted with a two-way travel time (TWTT) along the z-axis. In order to convert from TWTT to depth, the velocity of the seismic waves was estimated to be $1,600\text{ms}^{-1}$. This is a standard estimate for shallow, unconsolidated sediments.

2.4.20. Any small reflectors which appear to be buried material such as a wreck site covered by sediment were also recorded, the position and dimensions of any such objects noted in a gazetteer, and an image of each anomaly acquired. It should be noted that anomalies of this type are rare, as the sensors must pass directly over such an object in order to produce an anomaly.

2.4.21. The magnetometer data were interpreted by WA using Geometrics MagPick software in order to identify any discrete magnetic contacts which could represent buried metallic debris or structures such as wrecks. The pre-processed data set provided by Osiris was used and no further processing was deemed necessary. The data were gridded using the MagPick software to create a map of magnetic anomalies, and was interpreted using a combination of this and the individual profiles.

2.4.22. The multibeam bathymetry data were used to provide a vertical reference for the sub-bottom profiler data, and were fully analysed to identify any unusual seabed structures that could be shipwrecks or other anthropogenic debris. The data were gridded and analysed using Fledermaus software, which enables 3-D visualisation of the acquired data and geo-picking of seabed anomalies.

**Marine Geophysical Assessment – Anomaly Grouping and Discrimination**

2.4.23. The previous section describes the initial interpretation of all available geophysical data sets, which were conducted independently of each other. This inevitably leads to the possibility of any one object being the cause of numerous anomalies in different data sets, apparently overstating the number of archaeological features in the study area.

2.4.24. To address this issue, the anomalies were grouped together in conjunction with results of the desk based assessment of known archaeological sites. This allows for one ID number to be assigned to a single object for which there may be, for example, a UKHO record, a magnetic anomaly, and multiple sidescan sonar anomalies. In this case there was no correlation between known archaeological sites and the marine geophysical data.
2.4.25. Once all the geophysical anomalies had been grouped, a discrimination flag is added to the record in order to discriminate against those which are not thought to be of an archaeological concern. These flags are ascribed as follows:

<table>
<thead>
<tr>
<th>Non-Archaeological</th>
<th>U1</th>
<th>Not of anthropogenic origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>U2</td>
<td>Known non-archaeological feature</td>
<td></td>
</tr>
<tr>
<td>U3</td>
<td>Non-archaeological hazard</td>
<td></td>
</tr>
<tr>
<td>Archaeological</td>
<td>A1</td>
<td>Anthropogenic origin of archaeological interest</td>
</tr>
<tr>
<td>A2</td>
<td>Uncertain origin of possible archaeological interest</td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>Historic record of possible archaeological interest with no corresponding geophysical anomaly</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Criteria discriminating relevance of feature to proposed scheme.

2.4.26. All surface anomalies identified within the Study Area are presented in Appendix II and discussed in this report (Section 4.3). All sub-surface features identified within the Study Area are presented in Appendix III and discussed in Section 3.3.

2.4.27. The grouping and discrimination of information at this stage is based on all available information and is not definitive. It allows for all features of potential archaeological interest to be highlighted, while retaining all the information produced during the course of the geophysical interpretation and desk based assessment. This process enables further evaluation should more information become available.

2.5. **Chronology**

2.5.1. The term Before Present (BP) is used throughout this report when describing the age of archaeological events which occurred from the Lower Palaeolithic to the Mesolithic period. The BP timescale is predominantly used to report raw radiocarbon ages which cannot be directly correlated with a calendar date due to the inconsistency of $^{14}$C levels within the atmosphere. The exception to this is the Mesolithic period, the radiocarbon ages for which can be correlated with a calendar date (9,500-5,500 BP, 8,500-4,000 BC). BP dates are commonly calculated in years before 1950. From the Neolithic period onwards, the time scales Before Christ (BC) and Anno Domini (AD) are used.

2.5.2. Geological time, prior to periods of archaeological interest, is expressed in millions of years (Ma). Major glacial and interglacial stages are also referred to in terms of Marine Isotope Stages (MIS) to facilitate correlation with other sources.

3. **RESULTS: PREHISTORY**

3.1.1. Research undertaken by the Ancient Human Occupation of Britain (AHOB) project reveals that the earliest evidence for hominin (humans and their early ancestors) settlement in Britain dates to some 970,000 years ago, currently the earliest evidence for hominins in northern Europe (Parfitt *et al.*
Evidence for this settlement was discovered at Happisburgh, Norfolk and comprises over 70 flint tools and flakes unearthed on the foreshore. In the absence of associated fossil hominin remains, the species which made the Happisburgh tools remains unknown. Human lineage in Lower and Middle Palaeolithic Europe can be traced through the fossil remains of *Homo heidelbergensis* (the earliest remains in Britain of which were discovered in Boxgrove, Sussex dating c. 500,000 BP), thought to have evolved into *Homo neanderthalensis* (Neanderthals) by c. 300,000 BP. Around 30,000 BP, evidence suggests that Neanderthal populations died out across Europe, coinciding with the dispersal of anatomically modern humans (*Homo sapiens*) in Britain. This period corresponds to a change in the archaeological record in Europe, termed the Upper Palaeolithic.

3.1.2. Over the past 970,000 years, the entire north-west European landscape has been shaped by a series of marine transgressions and regressions that are associated with fluctuating glacial and interglacial conditions arising from changes in global climate (Figure 2). During this period, the Study Area was subject to oscillating periods of seafloor exposure, ice coverage or marine inundation, making it suitable for hominin exploitation at various times in the past.

3.1.3. For the purposes of this report, the discussion of archaeological potential in relation to prehistoric archaeology has been divided into three phases:

- Pre-Devensian c. 970,000-110,000 BP (MIS 18 – MIS 4), encompassing the period from the earliest evidence of hominid occupation of the UK. This period corresponds to the Lower and Middle Palaeolithic;

- Devensian to Late Glacial Maximum (LGM) c. 110,000-18,000 (MIS 4 to MIS 2), encompassing the onset of the last glaciation up to and including the LGM. This period includes the Middle and Early Upper Palaeolithic which saw the transition from Neanderthals to modern humans;

- Post-LGM and early Holocene c. 18,000-6,000 BP (MIS 1), encompassing the period of human re-inhabitation of the British Isles following the last glacial maximum through to the final inundation of the SA during the Mesolithic.

3.1.4. Broadly speaking, archaeological sites can be found in either primary or secondary contexts. Archaeological sites discovered in a primary context can be defined as those in which the spatial relationship of finds has not altered since they were deposited. Artefacts found in their primary context are not necessarily exactly at their point of deposition, but the overall artefact movement is considered small on a regional scale. Artefacts discovered within a secondary context are those which have been moved from their original positions by natural processes. Archaeological material discovered in secondary contexts may be associated with fluvial re-depositing, glacial processes and marine regressions and transgressions. Although discoveries from secondary contexts are by their very nature, derived artefacts, recent work has shown that they have the potential to
provide information on patterns of human land use and demography (Ashton and Lewis 2002; Hosfield and Chambers 2004).

3.1.5. Most archaeological finds of terrestrial nature from the Study Area will be of Palaeolithic, Mesolithic or potentially Neolithic date. Recovery of terrestrial material of later periods will be less likely as they post-date the principle episode of Holocene transgression and the establishment of fully marine conditions, which are thought to have occurred in the area around 3,500BP (Tooley 1978: 131).

3.2. Known Prehistoric Archaeology

Pre-Devensian c. 970,000-110,000 BP

3.2.1. One possible Clactonian scraper is recorded in the Portable Antiquities Scheme near Chorley (PAS ID LANCUM-EEB756). The artefact was found with five other flint flakes and two pieces of ochre. No other sites or finds from this period are recorded within Lancashire.

3.2.2. No sites of this date are known within the Study Area.

Devensian to Late Glacial Maximum (LGM) c. 110,000-18,000 (MIS 4 to MIS 2)

3.2.3. No sites of this date are known within Lancashire or the Study Area.

Post-LGM and early Holocene c. 18,000-6,000 BP

3.2.4. No archaeological sites of this date are known within the Study Area, however the following overview indicates the presence of early communities in the vicinity, with places close to the Study Area illustrated in Figure 1.

3.2.5. Flint artefacts of Upper Palaeolithic type have been found at three caves in Cumbria to the north of Morecambe Bay and provide the most north-westerly evidence for Upper Palaeolithic occupation in Britain. At this time the area would have been on the edge of the permanent snowfields covering the Lake District Hills (http://www.lancashire.gov.uk/environment/landscape/landscapecharacass/chap2.2.asp).

3.2.6. The Poulton Elk (NMR Monument Number 887049), discovered at Carleton approximately 7km to the south-east of the Study Area (Figure 1) represents one of the earliest examples of human occupation in Lancashire. The elk was found to have two barbed bone points lodged within the skeleton indicating it had been hunted by people, but had escaped only to die in a marsh. The elk has been radiocarbon dated to around 12,000BP (Hallam et al. 1973).

3.2.7. A number of Mesolithic flint working sites and isolated finds have been located in Lancashire, however very few have been ascribed to the early Mesolithic period, and those that have tend to be located on the higher ground rather than coastal areas. It is possible that this is a result of subsequent sea level rises and sedimentation which has buried coastal, estuarine and riverine settlements, or peat development over inland wetland sites (Middleton et al. 1995: 201).

3.2.8. A number of late Mesolithic sites are known across lowland Lancashire, which suggest patterns of behaviour and preferences for particular environments. The sites tend to be adjacent to wetlands, rivers and the
coast, on well drained soils with a range of good quality raw materials. The flint scatters are confined to small areas and are suggestive of larger long stay sites with a wider range of lithic tools (Middleton 1995: 202). The location of sites between rivers and the coast could indicate that the region of the Study Area would have been an attractive location for Mesolithic communities.

3.2.9. Two exposures of peat thought to date to this period have been identified on the Cleveleys foreshore (2001) 1.5km and 2km south of the Study Area, which could provide good preservation environments for archaeological remains.

3.3. Geology and Palaeo-geographic Assessment

General Geological Setting

3.3.1. The Study Area lies beyond the high water mark in shallow water which is neither covered by the onshore British Geological Survey geology maps nor the Offshore Series. An overview based on the BGS publications, secondary sources and the marine geophysical assessment is provided below.

3.3.2. Since the first recorded hominin activity in Britain, around 970,000 BP (Parfitt et al. 2010), the area has experienced successive glaciations and marine transgressions. At around 12-13,000 years BP glacio-isostatic adjustment resulted in the retreat of the ice sheets and a process of sea-level rise ensued, which removed the land-bridge between Britain and Ireland.

3.3.3. The three major glaciations which have taken place in the last 900,000 years are the Anglian (c. 478,000 BP - 423,000 BP), the Wolstonian (c. 380,000 BP - 130,000BP) and the Devensian (c. 100,000 BP - 13,000 BP). At the peak of all three glacial maximums ice sheets would have covered the Study Area (Wymer 1999: 17). These ice sheets affected the landscape through glacial erosion, erosion from glacial outwash, deposition of sediment from glacial outwash and topographical changes caused by the effects of the mass of the ice sheet upon the landmass.

3.3.4. Sea level during the Devensian glacial maximum would have been as much as 60m lower than present, with sea levels gradually rising as temperatures increased. At the beginning of the Mesolithic, sea level would have been around 35m lower than present and by the Neolithic would have reached a level similar to the present day (Tooley 1978: 130).

3.3.5. Using adjacent areas as a baseline in combination with the marine geophysical data, the stratigraphy of the Study Area is expected to be as follows:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Recent Seabed Sediments (Surface Sands Formation SL1 Member)</td>
</tr>
<tr>
<td>3</td>
<td>Early Holocene deposits (Unknown Formation, possible SL2 Member of Surface Sands Formation)</td>
</tr>
<tr>
<td>2</td>
<td>Devensian Till (Cardigan Bay Formation Upper Till Member)</td>
</tr>
<tr>
<td>1</td>
<td>Permo-Triassic Bedrock (Mercia Mudstone)</td>
</tr>
</tbody>
</table>

Table 4: General geological sequence from the survey area
3.3.6. Not all of the sequence described above is present across the entire survey area, with some of the units being absent in places. The geological units are individually described below, and features of archaeological interest are described in Appendix III and incorporated into Figure 3.

3.3.7. Due to the gravelly nature of the seabed sediments and the generally hard nature of the shallow sub-seabed geology (Osiris 2011), the penetration of the sub-bottom profiler system (pinger) was reduced and only generally obtained a maximum of approximately 10m below seabed (BSB). Because of this, Unit 1 was not definitively identified in the sub-bottom profiler data, but is interpreted to be present from BGS information (BGS 1984; Jackson et al. 1995).

3.3.8. The bedrock here is probably the Permo-Triassic Mercia Mudstone group, and is considered too old to be of archaeological potential. It is possible that the upper surface of the unit could have once been a land surface upon which archaeological material could have been deposited, though it is likely that any land surfaces which were once present have been subsequently removed by erosion during the Devensian glaciation.

3.3.9. Unit 2 directly overlies Unit 1 across all of the survey area, and is present just below the superficial seabed sediments in the east and the west. The unit is acoustically chaotic in nature, and is interpreted as being the Upper Till Member of the Cardigan Bay Formation, which is Devensian in age. Due to the glacial nature of this unit, it is not considered to be of archaeological potential. However, the upper surface of the unit could have once been a land surface, upon which archaeological material could have been deposited.

3.3.10. Unit 3 is present as a poorly defined possible channel feature cut into Unit 2 (7500). Due to the equipment penetration and general data quality the feature was only well-defined on a few survey lines, though it appears to trend roughly N-S and is approximately 1.1km wide and up to 8.2m deep (Figure 3). The feature is defined by an undulating basal reflector and a single, generally acoustically chaotic fill. This is possibly a Holocene terrestrial channel feature cut before the recent marine transgression. The nature of the fill is uncertain but it is possibly part of the SL2 Member of the Surface Sands Formation, although ground truthing would need to be undertaken to confirm this.

3.3.11. Unit 4 is present as a thin veneer over the whole site, and is interpreted as comprising Holocene sandy gravels across most of the site, with an area of fine to medium sand at the eastern end. These are interpreted as recent marine sediments. Although they are not considered of a high archaeological potential in themselves, it is possible that these sediments can cover archaeological sites (e.g. wrecks) if they are worked into large sand waves. No evidence for this has been identified on the multibeam bathymetry data.

**Palaeo-geographical Assessment**

3.3.12. The palaeo-geographic assessment comprises a review of the geophysical data in conjunction with the known geology with the aim of identifying features with archaeological potential within the Study Area, namely indicators of past land surfaces (Wessex Archaeology 2008).
3.3.13. The Study Area has witnessed repeated episodes of glaciation and marine transgression. The potential for remains related to the Lower, Middle and Upper Palaeolithic period is low, as glacial activity is likely to have disturbed sediments containing archaeological material.

3.3.14. During the Late Upper Palaeolithic the Study Area would have been free of ice and above mean sea level, remaining so through the Mesolithic. By this time sea levels were approximately 35m lower than today (Murphy 2002: 46) and the Study Area would have been suitable for human activity, as indicated by the Poulton Elk. Furthermore, there is a correlation between known terrestrial Mesolithic sites and access to water. Rivers and streams, such as the Lune and Wyre would have provided access routes inland and would have been a focus for wildlife and game hunting, whilst coastal sites provided access to marine resources (Maritime Archaeology Ltd. 2007: 63). These former sites would now be submerged.

3.3.15. From 7,000 BC to 5,000 BC, sea levels rose rapidly and the landscape would have changed significantly (Norman 1982). River valleys and coastal plains would have flooded, with freshwater marshes, woodlands and low lying vegetation would have becoming brackish before dying off with rising water levels. The build up of dead vegetation would have created thick organic deposits which were then buried by water borne clays, sands, gravels eventually forming a peat layer.

3.3.16. The process of inundation is complex and varied but in low energy environments the deposition of alluvial and marine sediments can protect archaeological remains. In higher energy environments the process can be highly erosive and the discovery of in situ archaeological material is unlikely, although artefacts could be discovered in secondary contexts.

Pre-Devensian (970,000-110,000 BP)

3.3.17. During the Pre-Devensian period (970,000-110,000 BP) the entire north-west European landscape was shaped by a series of marine transgressions and regressions that are associated with fluctuating glacial and interglacial conditions arising from changes in global climate. The lower sea levels that occurred during glacial periods meant that for long periods during the last c. 970,000 years, areas of the southern North Sea have been exposed as dry land.

3.3.18. The pre-Anglian landscape of the Study Area is thought to have been extensively modified by the later Anglian glaciation, suggested by the absence of sediments dating to this period in the area.

Anglian

3.3.19. The Anglian glacial was the most extensive of the glaciations, with ice sheets reaching as far south as the north Cornwall coast and the Thames Valley (Wymer 1999: 17). During this glacial episode, sea level is thought to have been the lowest recorded around the British Isles at an estimated 130m below the present level and it is thought that the ice sheet would have extended onto the floor of the Irish Sea, covering the Study Area (Brenchley and Rawson 2006: 446). Caernarfon Bay Formations date to this period and are found elsewhere in the Irish Sea, but have not been located within the vicinity of the Study Area.
Wolstonian

3.3.20. The Wolstonian (380,000-130,000 BP; MIS 10-16) comprised three cold stages (MIS 10, 8 and 6) interspersed with two temperate phases. The extents of the ice sheets during the cold stages is uncertain, although it has been tentatively suggested that the ice margin ran across Lincolnshire and the Midlands (Wymer 1999: 18) covering the Study Area. Sediments dating to this glaciation have been found in the Irish Sea, however not within the vicinity of the Study Area.

Ipswichian

3.3.21. The Wolstonian period was followed by a very rapid climatic amelioration with sea level rising to more than 5m above OD on the English coasts. Britain was an island during the Ipswichian with a climate thought to be for much of the time as warm as our current climate (Wymer 1999: 33). Despite the favourable climatic conditions and the availability of large mammal fauna, it is suggested that Middle Palaeolithic hominins were absent during this period in Britain (Wymer 1999: 33; Ashton and Lewis 2002).

3.3.22. Some members of the Cardigan Bay formation in the Irish Sea are thought to date to the start of the Ipswichian interglacial, however none have been located within the vicinity of the Study Area.

3.3.23. One possible Clactonian flint scraper found near Chorley is the only artefact ascribed to pre-Devensian period in Lancashire. No material of this date has been found in the close vicinity of the Study Area.

Devensian to LGM (110,000 BP – 18,000 BP)

3.3.24. The Devensian glaciation (110,000-13,500 BP) was the last glacial stage to occur before the present climatic amelioration. The greatest extent of the Devensian ice sheet occurred c. 18,000 BP and caused a lowering in sea level to around 120m below its current level connecting Britain with to the Continent. The southern edge of the Devensian ice sheet is thought to have extended in a line from the Severn to the Wash (Flemming 2002: 7) and would have covered the Study Area, making the area uninhabitable for much of the period. Britain’s terrestrial archaeological record suggests that Britain was largely uninhabited from c. 180,000-60,000 BP. The first evidence for re-occupation dates to the Early Upper Palaeolithic (c. 40,000-30,000 BP, MIS 3).

3.3.25. Offshore sediments of Devensian age within the Irish Sea region are represented by the upper till sediments of the Cardigan Bay Formation, deposited when the area was covered by glacier. Upper Till deposits have been found outcropping immediately offshore from the study area (Jackson et al. 1995: 89) and were identified within the marine geophysical data assessment as Unit 2.

3.3.26. Sediments located immediately offshore from the Study Area have been interpreted as forming during the last glaciation in glacial lacustrine and marine conditions dating to the Devensian period. In some areas this is overlain by sediments which indicate the gradual retreat of the ice sheets from the area (Jackson et al. 1995: 93).

Post LGM and Early Holocene (18,000-6,000 BP)

3.3.27. According to existing models of sea-level change, the Study Area would have remained dry land following the retreat of the Devensian ice for
thousands of years. Peaty-silt deposits identified within Surface Sands Formation around Morecambe Bay have been interpreted as reed swamps adjacent to open water before 9,200BP (Jackson et al. 1995: 96). The area of peat and tree stumps on the Cleveleys foreshore to the south of the Study Area is thought to date to the Mesolithic period (2001).

3.3.28. At approximately 12,000 BP Britain was re-colonised by humans for the last time. The period saw a change to a warmer and wetter climate with development of pine forests across the region, suitable for human exploitation. As the climate warmed, the cold-climate mammals migrated north moving with the retreat of open steppe vegetation that they habitually grazed. Vegetation is likely to have been sparse at the beginning of the period, but rising temperatures resulted in a diversification of both the flora and the fauna. Horses, aurochs, red deer and elk became increasingly more common, and a low scrub of juniper and willow followed by pine and birch forest began to develop (Chiverall et al. 2004).

3.3.29. Evidence for late Upper Palaeolithic material within the wider area is scarce, with the only evidence from north-west England coming from cave sites, of which there are none in the vicinity of the Study Area. The presence of major rivers such as the Wyre and Lune suggest a landscape with plentiful food and fresh water resources and it is possible that late Upper Palaeolithic communities may have been active within the region at this time. The natural erosion processes associated with glacial tundra environments and subsequent marine inundation suggest that it is unlikely that archaeological material from the late Upper Palaeolithic date will survive within the Study Area in situ.

3.3.30. The climate finally ameliorated during the Early Mesolithic period (10,000-9,500 BP) marking the onset of the Holocene epoch. Sharp rises in temperature were accompanied by an equally rapid rise in sea level, with Britain once again becoming an island. By around c. 8,500BP the pine forests had been replaced by denser, deciduous woodland. Oak and elm occupied slightly better drained slopes, whilst exclusively oak woodland was predominant on poorly drained low-lying ground (http://www.lancashire.gov.uk/environment/landscape/landscapecharacteristics/chap2.2.asp). There is evidence for small scale woodland clearance in the region, thought to be for the management of animals (Middleton et al. 1995: 203).

3.3.31. The Poulton Elk, with its embedded barbed antler points (Hallam et al. 1973, Middleton et al. 1995: 201), indicates the presence of hunting groups in the close vicinity of the Study Area, and it is likely that the wooded plains would have covered the Study Area creating an area suitable for hunting.

3.3.32. As sea levels rose through the Mesolithic period, coastal communities would have been displaced, moving inland to avoid coastal flooding. Archaeological sites testify to an organised and diverse lifestyle with groups exploiting large territories and a range of landscapes. Early Mesolithic sites and find spots in terrestrial contexts are often found adjacent to wetlands and estuaries (Oxford Archaeology 2007: 11), in bluff locations overlooking rivers with locally available flint sources and locations close to springs, indicating a preference by these Mesolithic communities for areas in which they had access to freshwater and could exploit marine resources. The low lying plateau around the Study Area between the Lune and Wyre Rivers
would have been some distance from the sea, but may have been within range of communities living in the area.

3.3.3. Sub-surface geophysical feature **7500** is identified as a wide, poorly defined possible channel feature (Figure 3). The feature is interpreted as a possible terrestrial channel feature of early Holocene date, cut before the recent marine transgression. If the feature is a terrestrial palaeochannel, it has the potential to contain *in situ* and derived archaeological artefacts and palaeoenvironmental evidence.

3.3.34. Bathymetric data and sea level curves for the area (Tooley 1978: Figure 38) indicate that the Study Area is likely to have been dry land until the Late Mesolithic period and possible into the Neolithic. The coastline is thought to have assumed an approximation of its current appearance by the Bronze Age, although historic records indicate coastal erosion through the post-Medieval period.

4. **RESULTS: MARITIME ARCHAEOLOGY**

4.1.1. Maritime archaeological sites can be broadly defined for the purposes of this study as comprising either wrecked or abandoned vessels on the seabed or intertidal zone, or debris which has been accidentally or deliberately lost overboard from a vessel. As an island nation, the UK has a long maritime history and there is potential for the archaeological evidence of maritime sites of all periods dating from the Mesolithic period to the present within the Study Area.

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

- **Class A: Pre-1508 AD**: The earliest category within the time line covers the period from the earliest Prehistoric evidence for human maritime activity to the end of the medieval period, c. 1508. Very little is known of watercraft or vessels from this period and archaeological evidence of them is so rare that any archaeological remains of vessels will be of special interest.

- **Class B: 1509-1815**: The second category encompasses the Tudor and Stuart periods, the English Civil War, the Anglo-Dutch Wars and later the American Independence and French Revolutionary Wars. Remains of boats and ships dating to this period are also rare; the majority of boats and ships dating from this period can be expected to be of special interest.

- **Class C: 1816-1913**: Category three covers a period during which there were great changes in the way in which vessels were built and used, corresponding with the introduction of metal to shipbuilding and steam to propulsion technology. There are more examples of boats and ships from this period.
so greater discrimination is warranted in determining which ones are of special interest, however boats and ships that make a distinct contribution to understanding and appreciating this century should readily be regarded as having special interest.

- **Class D: 1914-1945**: The fourth category on the time line encompasses the First World War (WWI), the inter-war years and the Second World War (WWII). The highest volumes of known boats and ships lost in UK waters were casualties of WWI and WWII, with lesser numbers lost in the inter-war years. Greater discrimination will be required. Nonetheless, technological changes, the magnitude of events and the consequences locally and globally of activities in these years will clearly give rise to some boats and ships having special interest.

- **Class E: Post 1946**: The last category extends through the post-war years to the present day. The volume of boats and ships lost to archaeological contexts falls dramatically. A strong case will need to be made for boats and ships lost after 1945 to have special interest.

### 4.2. Known Maritime Archaeological Sites

4.2.1. A search of the Lancaster HER, incorporating the Friends of Lancaster Maritime Museum Shipwreck Database, returned no known shipwrecks within the Study Area, but three within the wider vicinity (2006, 2007 and 2008). These sites are illustrated in Figure 3 and details are summarised in Appendix IV. In addition Admiralty Chart 2010 marks an unidentified shipwreck in Lune Deep, which is not in the HER or NMR databases (2009).

4.2.2. Lancashire HER had one non-shipwreck record lying just outside the Study Area (2002). The record is the findspot of a Roman red terracotta vase netted by fishermen in 1949. The co-ordinates of the findspot are on the corner of a British National Grid square, indicating the precise location of the find is not known. Details are presented in Appendix IV and its location illustrated in Figure 3.

4.2.3. A number of shipwreck events occurred within the vicinity of the Study Area, the remains of which have not yet been located. These sites are summarised below and in Appendix V.

<table>
<thead>
<tr>
<th>CLASS</th>
<th>DATE</th>
<th>SHIPPING CASUALTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>PRE 1508</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>1509-1815</td>
<td>8</td>
</tr>
<tr>
<td>C</td>
<td>1816-1913</td>
<td>69</td>
</tr>
<tr>
<td>D</td>
<td>1914-1945</td>
<td>5</td>
</tr>
<tr>
<td>E</td>
<td>POST 1946</td>
<td>2</td>
</tr>
</tbody>
</table>
### Table 5: Recorded shipwreck events within the vicinity of the Study Area by WA period class.

<table>
<thead>
<tr>
<th>CLASS</th>
<th>DATE</th>
<th>SHIPPING CASUALTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNKNOWN</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>84</td>
<td></td>
</tr>
</tbody>
</table>

4.2.4. The significantly higher numbers of shipwrecks dating from the period 1816 to 1913 most likely reflects the construction and growth of the town and port of Fleetwood in the 1830’s. Prior to this, shipping in the area was heading for Morecambe Bay and Lancaster via Lune Deep, and would most likely have avoided the shallow flats that surround the study area.

4.2.5. The relatively low numbers of ships lost, and not located, during the war years might be explained by the shallow location of the study area, and is not a reflection of overall losses in the Liverpool Bay or Irish Sea region, which are known to have been high.

4.2.6. A search of the UKHO wrecks and obstruction databases returned no results within the Study Area.

4.2.7. A search of the NMR returned no known shipwreck sites or casualty records within the Study Area.

4.2.8. A search of the MCA Receiver of Wrecks database returned no records of reported wreck from within the Study Area.

4.2.9. No archaeological finds have been reported through the BMAPA Finds Protocol in the vicinity of the Study Area.

### 4.3. Marine Geophysical Assessment: Seabed Features Assessment

4.3.1. A total of nine sidescan sonar anomalies and five magnetometer anomalies were identified within the Study Area. These were grouped to produce a list of thirteen anomalies of potential archaeological interest; no previously recorded wrecks or obstructions were present in the area to inform the groupings. The anomalies and record were characterised as follows:

<table>
<thead>
<tr>
<th>Archaeological Discrimination</th>
<th>Number of Anomalies</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>0</td>
<td>Anthropogenic origin of archaeological interest</td>
</tr>
<tr>
<td>A2</td>
<td>13</td>
<td>Uncertain origin of possible archaeological interest</td>
</tr>
<tr>
<td>A3</td>
<td>0</td>
<td>Historic record of possible archaeological interest with no corresponding geophysical anomaly</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

**Table 6: Geophysical anomalies of archaeological potential**

4.3.2. The individual anomalies identified in the geophysical survey are discussed below, and are summarised in Appendix II and Figure 3.
4.3.3. Anomaly 7013 is the only example of a grouped sidescan sonar contact and magnetic anomaly. The sidescan sonar data shows a dark reflector 0.8m wide with a height of 0.4m, the length value is erroneous due to distortion caused by snatching in the data. The magnetic amplitude is 3nT and a broad anomaly is implied. This anomaly is interpreted as a possible small piece of ferrous debris and is classed as an A2, but is considered to be of greater potential archaeological interest than the other individual anomalies.

4.3.4. In total, seven sidescan sonar contacts visible as dark reflectors were recorded from the data (7003, 7004, 7005, 7006, 7009, 7010 and 7012). Of these, six had height and one had no visible shadow (7010). Most of these anomalies were small (<2m in length and <0.9m in width) and rounded, though some were also somewhat elongated (7009, 7010 and 7012). These could represent small pieces of non-ferrous anthropogenic debris, or possibly natural features.

4.3.5. Only one bright reflector was noted from the sidescan data, anomaly 7007. This appeared as a distinct elongated oval shape with a length of 1.7m and a width of 1.2m. This may be a piece of non-ferrous anthropogenic debris composed of material that absorbs acoustic waves rather than reflects them (such as wood), or possibly a natural feature.

4.3.6. Of the thirteen anomalies seen on the geophysical data, four anomalies were derived purely from the magnetometer data. These included two small anomalies (7001 and 7002), both 2nT, which may represent small pieces of buried ferrous debris. Also noted was a small, but distinct 5nT anomaly (7011) which is likely to represent a small piece of buried ferrous debris. This anomaly may be related to anomaly 7013, as they lie 41m apart. Anomaly 7008 is a small, but broad anomaly of 2nT; however it is possible that this represents a natural feature.

4.3.7. No geophysical anomalies were identified within close proximity to the findspot of the Roman terracotta vase (2002).

4.4. Coastal and Seafaring Activity: Prehistoric – Romano British Period

4.4.1. As discussed above (Section 3), the rise in sea level during the Mesolithic period cut off Britain’s dry-land connections with the Continent and Ireland. Evidence for settlement on the Isle of Man dating to around 8,000 BP indicates the use of vessels for open sea voyages in the Irish Sea during this period.

4.4.2. A logboat from Lough Neagh in the north of Ireland dating to c. 5300 BC (Breen and Forsythe 2004) indicates the type of vessels which Mesolithic communities were constructing in the region. It is generally thought that logboats were used for transport and fishing in inland and sheltered waters during the Mesolithic period, however, ethnographic evidence suggests that logboats can be modified making them suitable for sea journeys, for example with the addition of out-riggers. Whilst the addition of out-riggers may not be appropriate for northern European timber, a possible example of this modification for sea voyages was found 1km offshore from Gormanstown, Co. Meath (Forsythe and Gregory 2007) and could be an example of a type used for coastal journeys and open sea voyages in the Irish Sea region.
4.4.3. Other simple craft seen in later contexts, such as hide boats, may also have been used by Mesolithic communities, although their light construction would make them much less likely to survive in the archaeological record.

4.4.4. Potential evidence for maritime activity within Mesolithic Lancashire is currently limited to indirect evidence, namely the consistent location of Mesolithic sites in coastal and riverine environments (Middleton 1995: 202).

4.4.5. At the start of the Neolithic period (c. 4000 BC) the Study Area would have been on the coastal fringe, potentially at risk of flooding at high tides. Continuity of settlements in coastal and riverine areas is seen North Lancashire suggesting continued use of marine resources, however no sites of pre-Romano-British date have been reported on the Fleetwood peninsula in the vicinity of the Study Area. The following summarises the evidence for coastal, riverine and maritime activity in the period.

4.4.6. Logboats provide the only archaeological evidence in the UK directly relating to watercraft during the Neolithic period (Niblett 2001), which may have been used to transport goods along and across inland waterways such as the River Wyre and within Morecambe Bay. The discovery of porcellanite stone axes from Ireland on the UK mainland and the Western Isles of Scotland, also indicates trade and transport of goods over sea was taking place during this period (Breen and Forsythe 2004: 32).

4.4.7. Developing technologies and complexity of social organisation in the later prehistoric period brought an increase in the volume of seafaring. Whilst examples of logboats from this period indicate they were still used, finds of sewn plank boats from the Humber region demonstrate that more complex boat building technologies were also in use in the north of England (McGrail 2004: 184).

4.4.8. Large quantities of Neolithic stone axes quarried in the southern Lake District have been found in the Humber Basin (Cummins 1979) and in Europe illustrating extensive trading networks and cross channel trade (Shotter 1997: 4) that communities in the north-west were involved in.

4.4.9. A substantial level of maritime traffic is suggested between the west coast of Lancashire and the Isle of Man from the Bronze Age onwards based on archaeological material on the island (Bowen 1970: 25) and it is thought that this may have been an important trade route between England, the Isle of Man and Ireland (Goodwins 2011: 15).

4.4.10. Evidence indicates continued woodland clearance in north-west Lancashire from the Iron Age through the Romano-British period suggesting permanent settlements and more intensive use of the landscape (Middleton 1995: 206). When the Romans arrived in the area, however, the landscape was still heavily wooded and described by Tacitus as dominated by woodland and estuaries (Shotter 1997: 4). Whilst major trading ports dating to the Iron Age have been identified in southern England no similar sites have yet been identified in the north-west.

4.4.11. Ptolemy, writing in the second century AD, names a number of tribes living in the north-west of England, including the Setantii who are thought to have lived in the Fylde area, or possibly southern Cumbria (Shotter 1997: 4). Ptolemy also talks of a place called ‘Portus Setantiorum’ (The harbour of the...
4.4.12. The site of Portus Setantiorum has not been confirmed, but for many years has been suggested to have been located somewhere off the Fleetwood peninsula (Porter 1876: 3). No Iron Age or Romano-British settlement sites has been located in the area, as might be expected for such a major indigenous port, however a number of significant Roman finds have been made, including perhaps four major hoards of silver coins and casual finds of Roman coins including some unusually early examples for the north-west (Shotter and White 1995: 86).

4.4.13. Further evidence for Roman presence on the Fleetwood peninsula comes from the ‘abrupt and broken termination of a Roman road’ which was visible in the 1830’s (Porter 1876: 7) at the coast near Rossall Point (2003), near to where one of the Roman coin hoards was discovered (2004). A second section of road thought to have been of Roman date was recorded as running from Ribchester to Kirkham heading towards Poulton-le-Fylde and Fleetwood (Shotter and White 1995: 86). Porter (1876: 8) reports that many Roman objects including pottery, spears, horse shoes, battle axe, swords and coins had been found along the line of the road, however it seems that most of these have now been lost.

4.4.14. Shotter and White (1995: 87) raise the possibility that the Port could have been located at the confluence of the Wyre and Lune rivers, some 2 miles north of Fleetwood. Reports of submerged masonry off the Fleetwood coast suggest that remains of settlements, of as yet unknown date, do survive underwater. One description records a wall 40 yards long, approximately two feet below the low water mark. To landward there is little depth, but on the seaward side is a drop of 15ft, and the seabed is strewn with masonry (Shotter and White 1995: 87). The recovery of a red terracotta Roman vase (2002) by fishermen in 1949 in the vicinity of the Study Area could be an indication of Roman shipping in the area, or of a submerged terrestrial site. The position given for the find is just outside the Study Area, however it is also the corner point of a British National Grid square, suggesting the precise coordinates of the findspot are not known.

4.4.15. The excavators of the Roman fort at Kirkham, located on the River Ribble to the south of the Study Area, suggest that it was located to act as an entrepôt for ships travelling inland to Preston and potentially further by barge or road (Howard-Davis & Buxton 2000: 77). Howard-Davis & Buxton (2000: 77) also suggest that the Roman forts in the north west, located at Chester on the River Dee, Kirkham on the River Ribble, Lancaster on the River Lune and Carlisle on the Solway Firth are all about one days sailing apart, and in combination provide trading and military access to otherwise topographically difficult territory.

4.4.16. In addition to the likely continued use of logboats and sewn plank boats, there is documentary and representational evidence for the use of hide boats in Britain from about 500 BC. The 3rd century BC historian Timaeus describes the British using seagoing boats made from ‘osiers covered with stitched hides’. Roman authors, including Caesar, describe British and Irish hide boats built on a woven willow framework with prominent keels, which would have made them stronger and more seaworthy than the currachs and
coracles currently being built in western Ireland and Wales (McGrail 2004: 182).

4.4.17. Direct archaeological evidence for Romano-British shipbuilding has been found in the Thames, Severn Estuary and in Guernsey, representing both a ‘Romano-Celtic’ shipbuilding type and also Mediterranean shipbuilding techniques. No boats or ships of Roman date have been found in the north of England.

4.4.18. By the 4th century AD, the Roman Empire was in decline as weaknesses in the empire caused by political instability were exploited by raids from frontier tribes. The reconstruction of the fort at Lancaster around AD 330-340 is thought to have been to defend against sea-borne raiders from the Irish Sea. The economic disruption and continued raids on towns stopped the growth of Romanised civilian settlements such as Lancaster, or caused their abandonment. After AD 400 the region would have returned to an almost entirely rural, agricultural economy and lifestyle, which, for the majority of the population, would have meant little change. By the middle of the 5th century direct Roman rule had been replaced by local governance and the Roman legions had returned to the continent (http://www.lancashire.gov.uk/environment/landscape/landscapecharacass/chant2.2.asp).

4.5. Coastal and Seafaring Activity: 500 – 1508 AD

4.5.1. After the end of Roman occupation, much of the Roman infrastructure ceased to be used. By the 6th century the tribal kingdoms of north Lancashire were absorbed into Anglian Northumbria. Place name evidence suggests that Lancashire continued to be populated by British speaking people into the 7th and 8th centuries, with many examples of combined British and Anglo Saxon words.

4.5.2. The Northumbrian kingdom was one of the strongest and most influential of the Saxon kingdoms, ruling the area around the Study Area. The flourishing culture of the 7th century Northumbrians is highlighted by the Lindisfarne gospels, but place name evidence suggests that the church was also important in the region of the Study Area. Place names ending with the suffixes of hamm (as at Bispham) and tun (as at Poulton) indicate places where early churches governed large areas of the surrounding countryside. Place names containing ecles, which in Celtic languages is derived from the Latin ecclesia meaning a place of worship, are evidence of early places of Christian worship within British settlements. Such settlements include Great Eccleston to the south east of the Study Area (http://www.lancashire.gov.uk/environment/landscape/landscapecharacass/chant2.2.asp). It is around this time that the first historical reference to the Hundred of Amounderness is entered, in the Ripon Grant of AD 705 as ‘Hacmunderness’ (Porter 1876: 16).

4.5.3. The 9th century saw the beginning of Viking raids to Ireland, Scotland and north-west England, with serious attempts at permanent land grabs in Lancashire and Cumbria in the 10th century. The Viking settlements on the Isle of Man, north-west England and Dublin maintained close alliances, and it is likely that the coastline of the Study Area was on the sailing route between settlements. Archaeological and place name evidence records the migration of Vikings into north-west England, including the region around the
Study Area. Place names with Scandinavian endings such as by meaning farm and further north other suffixes such as fell, force, gill, thwaite, beck and dale all indicate Scandinavian influences. It can be expected that in addition to the River Ribble, the River Wyre would have been used as a relatively safe haven and the shallow sands around the Fleetwood peninsula offering suitable beaches on which to pull up the flat bottomed boats of the time.

4.5.4. In the year 936 the Hundred of Amounderness was granted by King Athelstan to the See of York (Porter 1876: 16), who relinquished ownership sometime before 1066, probably as a result of frequent battles and raids in the area, which dramatically reduced the population and profitability of the area (Porter 1876: 21).

4.5.5. During the Viking period, there would have been continued trade and travel between communities based in England, Isle of Man, Ireland, Denmark and Norway. No examples of the boats used by the Vikings have been found within the north-west England, however small boats were found in two Viking burials on the Isle of Man (Goodwins 2011: 32), examples have been found in Ireland (http://www.droghedaport.ie/cms/publish/printer_988.shtml) and an Irish built ship was excavated in Denmark (http://vikingeskibsmuseet.dk/en/the-sea-stallion-past-and-present/).

4.5.6. In 1069 Swein, King of Denmark, sent an invasion fleet of 240 ships up the Humber. The Danes were joined by a large English force and were able to capture the castles at York. William quickly took back the stronghold at York, but he went on to systematically destroy the villages, crops, animals and people across the North of England. This action resulted in widespread famine and became known as the ‘Harrying of the North’. The ongoing result of this action can be seen in the Domesday Book entries for the Hundred of Amounderness, where only 16 of 62 named manors are inhabited, and the rest referred to as ‘waste’ (Marshall 2009: 27). The Domesday book also mentions a navigation structure at Rossall, thought to have been used to aid ships entering Lune Deep and possibly also the River Wyre (http://lanternimages.lancashire.gov.uk/index.php?a=subjects&s=item&key=S YT oyOntpOjA7a ToxNjI0O2k6MTTzOjk6I kZSZW V0d29wZCI7fQ==&pg=590) The reference clearly indicates the treacherous nature of the sandbanks around Fleetwood, and the importance of the shipping channels at this early time.

4.5.7. It is during the 11th and 12th centuries that references to the inshore fisheries on the Lancashire coast were first mentioned. Fishing on the shallow mud flats and sandbanks for shrimps and prawns, cockles and mussels, white fish and salmon have all been recorded from this period. Fishing for each type of fish or shellfish is seasonal, and families were able to work in each of the fisheries to ensure food and income all year round (Lynn Ashgar pers. comm.).

4.5.8. Rossall came into the ownership of the crown in 1206, and was presented to the monastery of Dieulacres Abbey in Staffordshire by King John in 1216. The Allen family held Rossall on lease from the abbot of Dieulacres, establishing a grange locally from which they could manage sheep grazing on behalf of the Abbey (Porter 1876: 275). In addition to the Rossall land, the Dieulacres Abbey also owned a number of other land parcels in the area, including at Bispham, Great Eccleston, Thornton and at Freckleton on
the River Ribble. It has been suggested that the Freckleton land may have been a transhipment port with wool transported via the coast from Rossall to Freckleton, then moved onto river barges for transport up the River Douglas towards Leek for sale along with the rest of the Abbey’s wool (Marshall 2009: 52).

4.6. Coastal and Seafaring Activity: 1509 – 1815 AD.

4.6.1. The Allen family was ejected from the Rossall estate by the Fleetwood family in 1579, who had purchased the property at the time of the dissolution (Marshall 2009: 53). The site of Ross Hall is marked on John Speed's 1610 map of Lancashire. The site of the original Ross Hall was eventually lost to the sea through coastal erosion (2005), but Porter (1876: 275) describes how in ‘earlier years the foundations of red sandstone and the remnant of an old ivied wall were visible near the edge of the cliff, all being sufficiently traceable to indicate that the mansion had been one of no mean dimensions’. Speed’s 1610 map suggests that the location of Ross Hall could lie somewhere close to the Study Area (Figure 4). The descriptions of substantial foundations visible on the edge of the coastal cliff indicate the potential for remains of the site to be preserved within the surface sands beyond Rossall.

4.6.2. The loss of settlements to coastal change and rising tides is well reported in the area, including the loss of a village named Singleton Thorp which was washed away in 1555 (Shotter and White 1995: 86) somewhere to the west of Cleveleys. Reports of submerged masonry off the west coast of the Fleetwood peninsula could relate to the early Ross Hall or lost village of Singleton Thorp.

4.6.3. As with earlier periods fishing was central to the economy and diet of Medieval Britain. The shallow water and inshore fishing industry continued to be a primary method of income for many coastal families, focused around small fishing communities along the coast not the larger towns. Lancaster was the major port in the area at this time, ideally located for the growing trade with the West Indies and American colonies.

4.6.4. By the 18th century Lancaster had grown to become the fourth largest slave trading port in England, with over 29,000 African slaves transported to the Americas between 1736 and 1807 (http://collections.lancsmuseums.gov.uk/narratives/narrative.php?irn=44). The Isle of Man also played a part in the provision of restricted cargo, often from the East Indies, and armaments to slave ships, and a point to offload valuable tobacco and rum cargo (Wilkins 1999). Legislation to regulate the slave trade in 1799 restricted shipping from Liverpool, Bristol and London, resulting in many Lancaster merchants moving to Liverpool. Merchants that stayed in Lancaster became involved in the shipping of raw and manufactured goods.

4.6.5. A small number of shipwrecks are recorded as having been lost in the vicinity of the Study Area during this period but their remains have not yet been located (Appendix V). These shipwrecks include a Spanish armed cargo ship or warship lost in 1643 after running aground somewhere near Fleetwood (3006). It was bringing arms to the Parliamentarian forces during the English Civil War, but was looted and set on fire by Royalists. The only other wreck for which there is any real information is East Indiaman Traver
which was wrecked after a collision near Rossall Point (3005). The rich cargo was claimed by the Squire at Rossall but much of it was looted by locals.

4.6.6. Yates’ 1768 map of Lancashire shows a number of features on the Fleetwood peninsula including the new Rossall Hall inland and to the south of the earlier Hall (Figure 4). The map also the Rossall Point Landmark, which was erected in 1766 by the Lancaster Port Commissioners to assist the navigation of ships entering Morecambe Bay through Lune Deep. The landmark is described ‘… to be 60 feet high from surface of ground and 20 feet in diameter at base, to be reduced in a regular manner to 6 feet the summit’ (http://collections.lancsmuseums.gov.uk/narratives/narrative.php?print=yes).

4.7. Coastal and Seafaring Activity: 1816 – 1913 AD

4.7.1. Shipping in the vicinity of the Study Area changed dramatically in the 1830’s with the construction of the town of Fleetwood and its port.

4.7.2. The town of Fleetwood was designed and planned as a seaside resort for Preston’s working class by Sir Peter Hesketh Fleetwood, whose family had owned Rossall Hall and the surrounding lands since the dissolution. The primary purpose of the new town was to provide an easily accessible seaside resort for the working class, with a railway link from Preston. As part of the development a port on the Wyre was planned, which would provide year round employment for locals.

4.7.3. The first construction projects at Fleetwood included the Marine Hall, complete with gardens and open air baths, a Chinese style pagoda and the Fleetwood Arms Hotel which opened in 1836. After the completion of a number of attractions focused turned to local housing and the port. The customs house was completed in 1838 with completion of two onshore lighthouses in 1840. In addition, a third light was constructed, the Wyre Light, on the sandbanks at the confluence of the River Wyre and Lune Deep. The Wyre Light was the first offshore beacon of its type in the world to come into service, being constructed of cast iron screw piles (Lynn Ashgar pers. comm.). Much of the building material for Fleetwood arrived by boat, with 314 vessels recorded as bringing building materials from Preston, Lancaster, Barrow, Ulverston, Flit, Wick and Liverpool in 1840.

4.7.4. When the Preston to Fleetwood railway opened in 1840 the link created the fastest route between London and Glasgow using train then ship. Imports through Fleetwood rose dramatically from 7,051 tons in 1840 to 144,622 tons by 1846. Imports included guano from Namibia, sugar from the West Indies, Flax from Russia, grain from California, timber from Canada and the Baltic. The bonded warehouse dates from 1840 and records show wine, spirits, tea, tobacco and a range of goods from the East Indies (Lancashire County Council 2005: 20) were warehouses at Fleetwood illustrating the range of shipping coming into the area.

4.7.5. Shipping in the 1840’s expanded from cargo shipments to include passenger steamers to Ardrossan, day trips to Piel and Glasson Docks, across Morecambe Bay and to the Isle of Man. Daily steamers plied the route between Fleetwood and Ireland from 1850 carrying passengers, mail
and cargo. In 1877 the route carried 45,412 passengers and 71,563 tons of cargo (Lynn Ashgar pers. comm.).

4.7.6. The success of shipping from Fleetwood enabled the construction of a new dock, which was opened in 1877. Shipments peaked around 1892 when the docks were reported to be so full that no more ships could enter the harbour. The opening of Preston Dock in 1892 and the Manchester Ship Canal in 1894 saw an end to large ships docking at Fleetwood, and a decline in cargo shipping into the 20th century (Lancashire County Council 2005: 20).

4.7.7. Fishing had always taken place on the mud flats and sand banks around Fleetwood with a small fleet of smacks based in the Wyre. By the 1890’s the fishing fleet had grown dramatically with over 100 trawlers registered at Fleetwood. Towards the end of the 19th century Fleetwood became England’s premier port for landing Hake and the third largest fishing port in England. To support the industry Fish Dock was opened in 1908 (Lancashire County Council 2005: 20).

4.7.8. Sixty-nine ships are recorded as wrecking in the vicinity of the Study Area during this period, for which no remains have been located, summarised in Appendix V. There are no known shipwreck sites from this period within the Study Area or the wider vicinity.

4.7.9. The 69 casualty records provide an insight into the nature of shipping in the area. The majority of wrecks were schooners or barques with fishing smacks, ketches and flats also represented. Just three of the recorded wrecks were steamers with one additional paddle steamer wrecked in the area. Whilst there is little information about the ships recorded in the database provided, the majority of those with information were cargo or fishing boats. The variety of boats wrecked in the vicinity includes examples of two significant vernacular boat designs, the smack, or nobby and the flat. The term smack is just one of many used to describe the Lancashire ‘nobby’, a local one or two manned cutter rigged trawler used for inshore fishing of cod, flatfish, herring, mackerel, sprats, whitebait and shrimp from the 1800’s (Miller 2009). Flats were a significant development in cargo transport in the north-west of England, particularly on the canals and rivers of the area. The classic form, the Mersey flat, was flat bottomed with curved bilges with a single mast, but it is interesting to note that the wreck register records these vessels being used for cargo transport across Morecambe Bay, such as Willy which foundered at Rossall in 1853 whilst en route from Barrow-in-Furness to Saltney.

4.7.10. The wreck of the schooner Blue Bell wrecked at Cleveleys in 1898 with a cargo of turnips may be the closest recorded wreck to the study area, however no remains have been found of this site (3020).

4.7.11. The government purchased the North Euston Hotel in Fleetwood in 1859, which was opened as a school of musketry in 1861. A further set of barracks were laid out to the west of the town which included a hospital, rifle range and accommodation for 220 men and twelve officers by 1876 (Lancashire County Council 2005: 23). An additional rifle range is marked on the OS maps from 1891 to the immediate east of the Study Area with targets marked on land immediately above high water. The rifle ranges to the east of the study area continued to be marked on OS maps through to the 1950’s.
and present the possibility of associated ordnance to be found in the inshore sections of the Study Area.

4.7.12. The Rossall beach groynes are first marked on OS maps in 1894 and remains of the original structures may remain in situ beneath the current seawall and beach groynes.

4.8. Coastal and Seafaring Activity: 1914 - Present

4.8.1. By the turn of the 20th century fishing had become the mainstay of the Fleetwood economy, and had grown to become the largest fishing port on the West coast. Three fishing fleets operated out of Fleetwood, the inshore fleet catching prawns, flatfish and estuary salmon, the middle water trawlers operating locally and as far as Scotland and the Faroe Islands for hake, whiting and cod, and the distant water trawlers fishing Iceland, Norway and Arctic waters for cod, plaice, sole, haddock and halibut (Freethy 2010: 47). To support the growing industry the population boomed with locals finding employment in associated industries such as ship building, sail and rope making. Infrastructure to support the growing fish trade was built, including an ice house in 1908 and fish curing sheds in 1938. The fish packing shed built in 1912 had been extended to include a fish market by 1933 by which time the population of Fleetwood was over 23,000 (Lancashire County Council 2005: 20).

4.8.2. The Fleetwood fishing fleet continued to expand until 1914 when many trawlers were converted to minesweepers and the U-boat threat restricted the movements of older sailing trawler (Freethy 2010: 44). Records of wrecked Fleetwood trawlers during the First World War illustrate the extent of their operations with ships lost in Iceland, Malta, Egypt, the North Sea and in the English Channel. Many were lost as a result of U-boat action, mines or collision, however none were lost close to the Study Area (http://www.fleetwood-trawlers.info/index.php/lost-vessels/).

4.8.3. The four year decline in fishing during the First World War allowed a significant recovery in the fish stocks, and the inter-war period saw an increase and growth in fishing from Fleetwood. A number of east coast fishing companies moved to Fleetwood, which was well positioned for easy access to the Northern deep sea fisheries, and had access to cheaper coal from the Lancashire mines. Before Depression hit in the 1930’s there were 200 fishing vessels operating out of Fleetwood, but this fell to 112 as the Depression set in (Freethy 2010: 48).

4.8.4. The size of the fishing fleet increased during the Second World War as many of the Hull and Grimsby based boats relocated to Fleetwood, which was comparatively safe compared to the Humber and North Sea. Whilst there were mine fields in the Irish Sea, it seems that the Fleetwood and Morecambe Bay area was relatively mine free with the Lancashire Maritime Museum database recording just one ship lost as a result of a mine within the Morecambe Bay area. Many of the Fleetwood steam trawler crews and boats were converted to minesweepers serving in the Royal Navy Patrol Service during the Second World War. Losses to the RN Patrol Service were high with over 100 vessels lost by the end of 1940. Forty-one Fleetwood trawler men were lost during the Second World War on RN Patrol Service (Freethy 2010: 88). Much of the wartime fishing from Fleetwood was
undertaken from the older sailing trawlers which had not been requisitioned for minesweeping duties.

4.8.5. Fleetwood trawlers were also involved in the Dunkirk rescue operations and as support vessels in the Normandy landings. Other wartime duties included keeping the Arctic Convoy routes clear of mines (Freethy 2010: 88).

4.8.6. Two shipwrecks are known in the vicinity of the Study Area *Lyra* (2006) and *Sunbeam* (2007). *Lyra* was a screw steamer built in Sunderland in 1881 and wrecked in 1922. *Sunbeam* was a British steam trawler lost after a collision in 1922. Five casualties are recorded in the vicinity of the Study Area between 1914 and 1945, most of which became stranded on the shallow sand banks in the area. The Belgian steam trawler *Comandant Bultinck* was wrecked on Rossall Beach near the School in 1929 with the loss of three members of the crew (3079). A number of photographs of the wreck have survived some of which record huge crowds on the beach looking on at the wreck (http://www.rossallbeach.co.uk/wreckedrossallbeach.htm). There is no information as to what happened to the wreck, however no remains of the ship have been reported. It is possible that the site was salvaged, but there is potential for some remains to survive within the beach sediments, possibly within the Study Area.

4.9. Coastal and Seafaring Activity: post-1946

4.9.1. Fishing continued to be the primary source of maritime based income for Fleetwood locals throughout the post-war years. Like other fishing ports Fleetwood trawlers were caught up in the Cod War of the 1970’s and experienced significant decline in the later parts of the 20th century.

4.9.2. Improvements in navigation technology, seabed mapping, weather forecasts and channel marking have significantly reduced the number of shipwrecks around the UK coast, however a few fishing vessels are known in the area. One wreck is known in the vicinity of the Study Area dating to this period, *Galilean* (2008) and a further two casualties are recorded in the wider area (3083 and 3084). All post-1946 shipwrecks around Morecambe Bay have been fishing vessels.

5. RESULTS: AVIATION ARCHAEOLOGY

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

5.1.2. A guidance note published by English Heritage (EH) entitled Military Aircraft Crash Sites (English Heritage 2002) outlined the case that aircraft crash sites not only have significance for remembrance and commemoration, but they also have an implicit cultural value as historic artefacts, providing information on the aircraft itself and also the circumstances of its loss (English Heritage 2002: 2).
5.1.3. Research by Wessex Archaeology (2008) into the variety of sources recording military and civilian aircraft wrecks indicates that records of actual losses are poor, and of location even worse. The scoping study focused on the English Channel and North Sea but identified significant disparities between the available records and databases compiled to date. Recent discoveries of previously unknown and unexpected aircraft wreck sites (http://www.rafmuseum.org.uk/cosford/conservation-centre/dornier-17-conservation-project.cfm) illustrate the potential for new finds of aircraft wrecks.

5.1.4. Although the extent of knowledge of air crash sites on the seabed is limited, Wessex Archaeology has broadly characterised the resource by drawing out a few generalisations on importance and special interest (Wessex Archaeology 2008). It is with regards to the three broad chronological divisions outlined by Wessex Archaeology that aviation archaeology will be discussed here:

- **Pre-1939**: The period of intense and rapid development of a new technology, from the advent of powered flight to the outbreak of World War II. Although at least 119 different aircraft models were used by the military in the UK during this period, examples of only 24 survive today anywhere in the world. This, alongside the fragility of the airframes and the relative scarcity of flights over water deem any aircraft remains dating to this period of special interest;

- **1939-1945**: By the onset of World War II, advances in technology had greatly extended the reliability and range of aircraft. Such technological innovation enabled aircraft to increasingly undertake long-range flights, including many flights across the MAREA Study Area. This period also saw the highest number of aircraft casualties – and human casualties – in the history of aviation and as such has special significance;

- **Post-1945**: A period characterised by the rapid development of jet propulsion technology and its use in both military and civilian aviation applications.

5.2. **Aviation Archaeology: Pre-1939**

5.2.1. Fixed wing aviation first began in the early 1900s in the UK, with the first fixed wing flight across the English Channel in 1909 (www.rafmuseum.org.uk/milestones-of-flight/british_civil/1909.cfm).

5.2.2. Military association with aviation begins in Britain with the establishment of the Royal Flying Corps in 1912 and the later Royal Naval Air Service (RNAS), created in July 1914. During World War I, the potential of airpower as an independent sector of the armed forces became increasingly clear (Lake and Francis 1998: 13). The patrols of the RNAS had pioneered the role of airpower from purely reconnaissance motives to an increasingly strategic role, and by April 1918 the Royal Air Force (RAF) had been established as an independent force (Lake and Francis 1998: 13).
5.2.3. Aircraft were first used by the Isle of Man Steam Packet Company for passenger transport from 1936, with flights to Liverpool, Blackpool and Manchester providing a quick alternative to sea travel (Hendry 2009: 97).

5.2.4. There are no records of aircraft wrecks or casualties within the vicinity of the Study Area from this period.

5.3. **Aviation Archaeology: 1939-1945**

5.3.1. By the World War II advances in aeroplane technology enabled flights over water to take place with a much lower level of risk and airpower became increasingly important at a military strategic and operational level. In the years immediately prior to the Second World War, the Royal Air Force increased dramatically in size. The Lancashire coastal airfields were of strategic importance for the patrolling of the Irish Sea shipping lanes, defence, training and undertaking Air Sea Rescue operations. Two aircraft wrecks are recorded within the vicinity of the Study Area, both caused as a result of low flying accidents in 1943, summarised in Appendix V and their approximate locations are shown in Figure 3.

5.3.2. A review of maps showing the location of World War II Air/Sea Rescue Operations suggest that at least six recorded Air/Sea Rescue Operations took place within 10km of the Study Area, of which four were recorded as unsuccessful. The positions are difficult to illustrate due to the small scale of the maps. Research elsewhere indicates that there is a large disparity between the recorded Air/Sea Rescue Operations and the estimated losses for this period. Although the locations of these operations is not necessarily accurate, the records provide indicate the potential density of aircraft crash sites within the vicinity of Study Area.

5.3.3. Commercial aircraft may also have been lost in this period, although none were recorded by the Air Accidents Investigation Branch (AAIB) in the vicinity of Study Area during this period. The acknowledged incompleteness of the AAIB records raises the potential for unrecorded losses in the region (Wessex Archaeology 2008).

5.4. **Aviation Archaeology: 1945 - Present**

5.4.1. Throughout the periods prior to 1945, military activity provided the dominant impetus for aircraft design and development, however, following World War II there was a steady and rapid rise in commercial flights. Initially ex-military aircraft were used to transport people and cargo, with aircraft such as the American B-29 and the British Lancaster converted into commercial aircraft (Wessex Archaeology 2008: 68). Flights soon became an available means of travel within and around the UK.

5.4.2. Despite the volume of aviation activity across the UK, there have been very few major losses. The AAIB lists 120 civil aircraft losses at sea around the UK between 1946 and 1994, most of which comprise light aircraft or helicopters associated with the offshore oil and gas industry (Wessex Archaeology 2008: 68). Two civil aircraft losses occurred within the vicinity of the Study Area, one between Blackpool and the Isle of Man and the second near Pilling. No further positional information is available, and as such are not illustrated in any of the report figures, but it is possible that their remains could lie within the Study Area.
6. RESULTS: ARCHAEOLOGICAL SUMMARY

6.1. Prehistoric Archaeology Summary

6.1.1. No archaeological sites dating to the Pre-Devensian period through to the Last Glacial Maximum have been located within the vicinity of the Study Area, and given the nature of the geology identified through the marine geophysical assessment it is unlikely that in situ material from this period is likely to survive. There is the possibility that redeposited artefacts from this period could survive in secondary contexts, however given only one find from these periods has been found in Lancashire the potential is very low.

6.1.2. Unit 3 identified in the sub-bottom profiler data is interpreted as a possible terrestrial channel feature (7500) of early Holocene date, cut before the recent marine transgression. The Poulton Elk demonstrates that there were communities living and hunting in the vicinity of the Study Area from the post-glacial period onwards. With lower sea levels at this time, the Study Area would have been dry land, and could also have been exploited for its food resources. If the channel feature proves to be a terrestrial palaeochannel, the potential for the survival of both in situ and derived archaeological artefacts and palaeoenvironmental evidence within it from the post-glacial period is high.

6.2. Maritime Archaeology Summary

6.2.1. This assessment has shown that there is potential for the remains of vessels which date from the Mesolithic period to the present day within the vicinity of the Study Area. Traditional fishing techniques have been used to collect shell fish and white fish from the sandbanks of the Study Area, using hand held and boat deployed methods from at least the early Medieval period. The Study Area is outside the shipping channel into and out of Lancaster and Fleetwood, and has therefore not been a focus of shipping activity in itself. It has, however, been demonstrated that a number of ships have been wrecked the beach at Rossall, and it is possible that their remains could survive within the beach sands.

6.2.2. The shallow sand banks around the Study Area, off Rossall Beach, are of a type demonstrated elsewhere to provide good preservation environments for wooden shipwreck remains. Wrecked or stranded vessels on the Sands may, however, have been subjected to salvage by locals shortly after the event and could, therefore, leave little in the way of an archaeological deposit.

6.2.3. Consideration must be given to the potential for isolated finds that may have come to be on the seabed having been lost or discarded either by ships or people fishing. The potential of these finds to provide information about past activities on the foreshore is great and could be of particular local interest.

6.2.4. In addition to ship and inshore fishing related finds, there is also some potential for the remains of buildings associated with the early Rossall Hall and grange to be preserved within the foreshore sands of the Study Area.

6.2.5. Thirteen seabed anomalies were identified during the marine geophysical assessment which may be of anthropogenic origin and potentially of archaeological interest. No further information about these sites is available.
at this stage however some or all of the anomalies could be associated with shipping or shipwreck events, or foreshore fishing activities. There is also the possibility that some of the anomalies could be related to the masonry remains of the original Rossall Grange or Hall.

6.2.6. Overall, given the small number of recorded wrecks in the area and the small size of the seabed anomalies the potential for maritime archaeological remains within the Study Area is low. Only one anomaly 7013 was visible as a seabed anomaly with a magnetic signature, and provides the most likely target for a site of archaeological potential.

6.3. Aviation Archaeology Summary

6.3.1. Despite the small number of known aircraft crash events, the potential exists for the presence of previously unrecorded crash sites on the seabed within the Study Area. The seabed environment generally provides a favourable preservation environment for aircraft remains, making the discovery of fairly intact aircraft on the seabed far more likely than for those sites discovered on land.

6.3.2. Despite this, due to the varied levels of preservation, and sometimes ephemeral nature of their remains, aircraft crash sites are not easily identifiable in marine geophysical survey. Furthermore, the remains of military aircraft which are found receive blanket protection under the Protection of Military Remains Act 1986, whereby no disturbance of a military aircraft wreck is permitted without a licence from the MoD.

6.3.3. Overall, given the small size of the Study Area and the small number of recorded aircraft crashes in the area, the potential for aviation remains within the Study Area is low.

7. CONCLUSIONS

7.1.1. One palaeo-landscape feature of potential early Holocene date has been identified from the marine geophysical data within the Study Area. Whilst a detailed and full interpretation of the feature was not able to be made based using the data provided, the feature should be treated as of potential high archaeological interest. The presence of important archaeological evidence for early Mesolithic human activity at Carleton to the south of the Study Area, and the known preference for riverside sites indicates the potential for archaeological remains to be present within the submerged sediments in the Study Area.

7.1.2. Mitigation measures relating to the potential for submerged prehistoric remains are likely to include detailed sub-bottom profile survey of the possible valley feature and archaeological assessment of geotechnical samples. This will provide an understanding of the nature of sediments within the feature and the potential for survival of palaeo-environmental sediments or archaeological remains.

7.1.3. Thirteen seabed anomalies have been identified during the assessment of marine geophysical data which may be of anthropogenic origin and potentially of archaeological interest. The anomalies could be ship,
shipwreck or aviation related finds, but further interpretation is not possible at this stage.

7.1.4. Mitigation measures relating to seabed anomalies could include further high resolution geophysical survey, ROV or diver investigations to clarify the nature of the anomalies. Avoidance of all anomalies should be considered from both an engineering and archaeological perspective, however if this is not possible, further investigation and recording of anomalies of an anthropogenic origin is likely to be required.
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http://www.lancashire.gov.uk/environment/landscape/landscapecharacass/chap2.2.asp
www.hwtma.org.uk/investigations-in-2010
http://lanternimages.lancashire.gov.uk/index.php?a=subjects&s=item&key=SYToyOn tpOjA7aToxNjI0O2k6MTTzOjk6IkZsZTV0d29vZCI7fQ==&pg=590
http://www.fleetwood-trawlers.info/index.php/lost-vessels/
http://www.rossallbeach.co.uk/wreckedrossallbeach.htm
http://www.rafmuseum.org.uk/cosford/conservation-centre/dornier-17-conservation-project.cfm
www.rafmuseum.org.uk/milestones-of-flight/british_civil/1909.cfm
http://finds.org.uk/database
APPENDIX I: MARINE HISTORIC ENVIRONMENT LEGISLATION AND PLANNING GUIDANCE

The table below outlines the current legislation and guidance applicable to archaeological sites within England’s territorial waters.

<table>
<thead>
<tr>
<th>Legislation and Guidance</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection of Wrecks Act (PWA) (1973): Section One</td>
<td>Wrecks and wreckage of historical, archaeological or artistic importance can be protected by way of designation. It is an offence to carry out certain activities in a defined area surrounding a wreck that has been designated, unless a licence for those activities has been obtained.</td>
</tr>
<tr>
<td>Protection of Wrecks Act (1973): Section Two</td>
<td>This provides protection for wrecks that are designated as dangerous due to their contents and is administered by the Maritime and Coastguard Agency through the Receiver of Wreck.</td>
</tr>
<tr>
<td>Protection of Military Remains Act (1986)</td>
<td>Under the Protection of Military Remains Act (1986), all aircraft that have crashed in military service are protected. The MoD also has powers to protect vessels that were in military service when lost. The MoD can designate ‘controlled sites’ around wrecks whose position is known and can designate named vessels as ‘protected places’ even if the position of the wreck is not known.</td>
</tr>
<tr>
<td>Ancient Monuments and Archaeological Areas Act 1979 (as amended)</td>
<td>This Act is primarily land based, but in recent years it has also been used to provide some level of protection for underwater sites. Scheduled Monuments and Areas of Archaeological Importance are afforded statutory protection by the Secretary of State, and consent is required for any major works. The law is administered by English Heritage and the Department of Culture, Media and Sport.</td>
</tr>
<tr>
<td>Merchant Shipping Act (1995)</td>
<td>This Act sets out the procedures for determining the ownership of underwater finds that turn out to be ‘wreck’, defined as any flotsam, jetsam, derelict and lagan found in or on the shores of the sea or any tidal water. It includes ship, aircraft, hovercraft, parts of these, their cargo or equipment. If any such finds are brought ashore, the salvor is required to give notice to the Receiver of Wreck that he/she has found or taken possession of them and, as directed by the Receiver, either hold them pending the Receiver’s order or deliver them to the Receiver.</td>
</tr>
</tbody>
</table>
### Legislation and Guidance

<table>
<thead>
<tr>
<th>UK High Level Marine Objectives</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>The UK government high level marine objectives outline the government wide objectives to achieve sustainable development in the marine environment. The objectives state that the marine historic environment includes 'Individual sites and assets of historic, archaeological, architectural or artistic interest, whether or not they are afforded statutory protection by heritage protection legislation'. The objectives also promote the use of spatial planning which ‘recognises the protection and management needs of marine cultural heritage according to its significance.’</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Marine and Coastal Access Act 2009</th>
<th>This Act introduced a new system of marine planning across the UK, supported by a Marine Policy Statement adopted in March 2011 and Marine Plans, which are currently in development. The new system for marine planning dovetails with terrestrial Planning Policy Statements (see below). The Marine Policy Statement requires the consideration of seascapes and the historic environment based on the following principles:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The historic environment should be conserved in a manner appropriate and proportionate to its significance.</td>
<td></td>
</tr>
<tr>
<td>- Opportunities should be taken to contribute to our knowledge and understanding of our past from the historic environment and making this publicly available, particularly if a heritage asset is to be lost.</td>
<td></td>
</tr>
<tr>
<td>- The absence of designation for heritage assets does not necessarily indicate lower significance and non-designated assets should be considered subject to the same policy principles as designated heritage assets.</td>
<td></td>
</tr>
<tr>
<td>- Developments proposals should avoid or minimise conflict with the conservation of an asset's significance.</td>
<td></td>
</tr>
<tr>
<td>- Developments should adopt a general presumption in favour of the conservation of designated heritage assets within an appropriate setting proportionate to its significance.</td>
<td></td>
</tr>
<tr>
<td>- Substantial loss or harm to designated assets should be exceptional.</td>
<td></td>
</tr>
<tr>
<td>- Where the loss of the whole or a material part of a heritage asset’s significance is justified, suitable mitigating actions should be required to record and advance understanding of the significance of the heritage asset before it is lost.</td>
<td></td>
</tr>
</tbody>
</table>
**Legislation and Guidance** | **Summary**
--- | ---
**Policy Statement 5: Planning for the Historic Environment (2010)** | Policy Statement 5 sets out the Governments overarching aim that the historic environment and its heritage assets should be conserved and enjoyed for the quality of life they bring to this and future generations. The objectives with regard to planning are to deliver sustainable development, conserve England’s heritage assets in a manner appropriate to their significance and to contribute to our knowledge and understanding of our past by ensuring that opportunities are taken to capture evidence from the historic environment and to make this publicly available, particularly where a heritage asset is to be lost.

**England’s Coastal Heritage: a statement on the management of coastal archaeology (1996)** | This statement sets out a number of principles for managing coastal archaeology. These include the promotion of preservation *in situ*, that finds should be managed in accordance with the principles which apply to terrestrial archaeological remains, that marine and terrestrial remains must be considered seamlessly, that a precautionary approach should be adopted and that planning policy should be applied to the treatment of subtidal archaeological remains in order to secure best practice.

**European Landscape Convention (2000)** | The European Landscape Convention (2000) became binding on the UK from 1 March 2007. Its principal clauses require the Government to protect and manage landscapes and to integrate landscape into regional and town planning policies including its cultural, environmental, agricultural, social and economic policies. The Convention applies to the entire territory of the UK and includes land, inland water and marine areas. It is not regarded as applying to sea areas regulated by the UK that lie beyond territorial waters.

**Code of Practice for Seabed Developers, Joint Nautical Archaeology Policy Committee (JNAPC) 2006** | This voluntary code provides a framework for seabed developers similar to the principles found in current policy and practice on land. The aim of the Code is to ensure a best practice model for seabed development. The Code offers guidance to developers on issues such as risk management and legislative implications.

**COWRIE: Historic Environment Guidance for the Offshore Renewable Energy Sector (WA, 2007)** | Of relevance to the offshore renewable energy sector, this guidance is intended to promote the development of best practice in relation to the marine historic environment. It is also intended to promote an understanding of conservation issues arising from the effects of offshore renewable energy projects on the historic environment.
<table>
<thead>
<tr>
<th>Legislation and Guidance</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>COWRIE: Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy (Oxford Archaeology, 2008)</td>
<td>This report provides guidance for the assessment of cumulative impacts on the historic environment from offshore renewable energy projects. It outlines the cumulative (additive / changes) and synergetic (impact interactions) effects that should be considered.</td>
</tr>
<tr>
<td>COWRIE: Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector (Draft) (Emu 2010)</td>
<td>This report provides guidance on how best to achieve the integration of offshore geotechnical investigations and their data outputs, arising from offshore renewable energy projects, with archaeological historic environment analysis, and ensure optimum use of geotechnical data.</td>
</tr>
<tr>
<td>Revised Draft Overarching National Policy Statement for Energy (EN-1) (DECC 2010a)</td>
<td>This National Policy Statement (NPS) sets out national policy for energy infrastructure, and the importance of archaeological assessment in the development process.</td>
</tr>
<tr>
<td>Revised Draft National Policy Statement for Renewable Energy Infrastructure (EN-3)</td>
<td>This NPS, taken together with the overarching NPS (EN-1), provides the primary basis for decisions by the Infrastructure Planning Commission (IPC) on renewable energy infrastructure development applications. It sets out the importance of the historic environment and the ways it can be impacted be development, outlines guidance for application assessments, IPC decision making, and mitigation measures.</td>
</tr>
<tr>
<td>Revised Draft National Policy Statement for Energy (EN-5)</td>
<td>This NPS, taken together with the overarching NPS (EN-1) provides for decision making on above ground electricity lines of 132kv and over and other electricity networks associated with a Nationally Significant Infrastructure Project e.g. substations and converted stations.</td>
</tr>
<tr>
<td>Identifying and Protecting Palaeolithic Remains: Archaeological Guidance for Planning Authorities and Developers (English Heritage 1998)</td>
<td>This draws attention to the importance of Palaeolithic remains and states that they must be considered in line with planning policy when potentially affected by development proposals.</td>
</tr>
<tr>
<td>Military Aircraft Crash Sites (English Heritage 2002)</td>
<td>This provides archaeological guidance regarding the significance and future management of military aircraft crash sites. It outlines the importance of aircraft crash sites and indicates that they should be considered where they are affected by development proposals.</td>
</tr>
<tr>
<td>Model Clauses for Archaeological Written Schemes of Investigations (Crown Estate and WA, 2010)</td>
<td>This document outlines Model Clauses which can be referred to in scheme-specific Written Scheme of Investigation (WSI) without the need to repeat them in the WSI itself. The Model Clauses draw upon a corpus of practical experience in developing and agreeing methodological clauses WSI-by-WSI in the course of Round 1 and Round 2 offshore wind farm development, and in the course of other forms of marine development.</td>
</tr>
<tr>
<td>Legislation and Guidance</td>
<td>Summary</td>
</tr>
<tr>
<td>--------------------------</td>
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</tr>
<tr>
<td>The scope of Strategic Environmental Assessment of North Sea areas SEA3 and SEA2 in regard to prehistoric remains (2002)</td>
<td>Suggestions are made in these documents for the discussion of protocols and a reporting regime for the commercial sector, regarding prehistoric archaeological remains: ‘The ideal structure would require or encourage the industry and its sub-contractors to check whether their activities are in archaeological prospective zones, and to identify, and report, when their activities positively detect prehistoric artefacts, or, in the case of acoustic surveys, provide very strong evidence. If this can be achieved at minimal or acceptable cost/delay to industry, then there is a positive advantage in allowing operators to start activities in zones of archaeological potential, while avoiding positively identified sites, if any.’ (section 8.6)</td>
</tr>
</tbody>
</table>
APPENDIX II: GAZETTEER OF ARCHAEOLOGICAL SITES WITHIN THE STUDY AREA, INCORPORATING SURFACE GEOPHYSICAL ANOMALIES

<table>
<thead>
<tr>
<th>WA ID</th>
<th>Name / Classification</th>
<th>Easting</th>
<th>Northing</th>
<th>Archaeological Discrimination</th>
<th>L (m)</th>
<th>W (m)</th>
<th>H (m)</th>
<th>Magnetic Amplitude (nT)</th>
<th>Description</th>
<th>Sources</th>
<th>External References</th>
</tr>
</thead>
<tbody>
<tr>
<td>7001</td>
<td>Magnetic</td>
<td>496384</td>
<td>5972535</td>
<td>A2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>Very small but distinct anomaly, possible piece of very small ferrous debris.</td>
<td>6012</td>
<td>-</td>
</tr>
<tr>
<td>7002</td>
<td>Magnetic</td>
<td>496378</td>
<td>5972459</td>
<td>A2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>Very small but distinct anomaly, possible piece of very small ferrous debris.</td>
<td>6013</td>
<td>-</td>
</tr>
<tr>
<td>7003</td>
<td>Dark Reflector</td>
<td>496219</td>
<td>5972497</td>
<td>A2</td>
<td>1.0</td>
<td>0.9</td>
<td>0.5</td>
<td>-</td>
<td>Rounded dark reflector with a long shadow. Visible alongside a similar anomaly (7004). This is visible within an area of clipped data.</td>
<td>6014</td>
<td>-</td>
</tr>
<tr>
<td>7004</td>
<td>Dark Reflector</td>
<td>496219</td>
<td>5972501</td>
<td>A2</td>
<td>1.0</td>
<td>0.6</td>
<td>0.2</td>
<td>-</td>
<td>Dark reflector with a long shadow. This is located close to a similar anomaly (7003). Both anomalies are visible in an area of clipped data.</td>
<td>6015</td>
<td>-</td>
</tr>
<tr>
<td>WA ID</td>
<td>Name / Classification</td>
<td>Easting</td>
<td>Northing</td>
<td>Archaeological Discrimination</td>
<td>L (m)</td>
<td>W (m)</td>
<td>H (m)</td>
<td>Magnetic Amplitude (nT)</td>
<td>Description</td>
<td>Sources</td>
<td>External References</td>
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</tr>
<tr>
<td>7005</td>
<td>Dark Reflector</td>
<td>496216</td>
<td>5972495</td>
<td>A2</td>
<td>1.1</td>
<td>0.5</td>
<td>0.5</td>
<td>-</td>
<td>Dark reflector with height. No similar anomalies are located in the area. The features are visible in a line of clipped data.</td>
<td>6016</td>
<td>-</td>
</tr>
<tr>
<td>7006</td>
<td>Dark Reflector</td>
<td>496106</td>
<td>5972484</td>
<td>A2</td>
<td>1.7</td>
<td>0.6</td>
<td>0.5</td>
<td>-</td>
<td>Dark reflector with height. No similar features are located in the area. The data for this line was clipped.</td>
<td>6017</td>
<td>-</td>
</tr>
<tr>
<td>7007</td>
<td>Bright Reflector</td>
<td>495633</td>
<td>5972477</td>
<td>A2</td>
<td>1.7</td>
<td>1.2</td>
<td>0.0</td>
<td>-</td>
<td>Bright reflector forming a rounded shape with a projection. This is located within an area of comparable bright reflectors which represent geological variations. This feature is quite distinct. It is present within an area of clipped data.</td>
<td>6018</td>
<td>-</td>
</tr>
<tr>
<td>7008</td>
<td>Magnetic</td>
<td>495493</td>
<td>5972520</td>
<td>A2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>Very small, relatively broad anomaly. Probably natural.</td>
<td>6019</td>
<td>-</td>
</tr>
<tr>
<td>WA ID</td>
<td>Name / Classification</td>
<td>Easting</td>
<td>Northing</td>
<td>Archaeological Discrimination</td>
<td>L (m)</td>
<td>W (m)</td>
<td>H (m)</td>
<td>Magnetic Amplitude (nT)</td>
<td>Description</td>
<td>Sources</td>
<td>External References</td>
</tr>
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<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------</td>
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</tr>
<tr>
<td>7009</td>
<td>Dark Reflector</td>
<td>495012</td>
<td>5972485</td>
<td>A2</td>
<td>2.0</td>
<td>0.6</td>
<td>0.7</td>
<td>-</td>
<td>Dark reflector with height. Visible in an area of clipped data. No similar features are located nearby.</td>
<td>6020</td>
<td>-</td>
</tr>
<tr>
<td>7010</td>
<td>Dark Reflector</td>
<td>494676</td>
<td>5972503</td>
<td>A2</td>
<td>1.3</td>
<td>0.7</td>
<td>0.0</td>
<td>-</td>
<td>Distinctive dark reflector visible in an area of clipped data. No similar features are located nearby.</td>
<td>6021</td>
<td>-</td>
</tr>
<tr>
<td>7011</td>
<td>Magnetic</td>
<td>494641</td>
<td>5972513</td>
<td>A2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>Small but distinct magnetic anomaly, possible small piece of buried ferrous debris. Possibly related to nearby anomaly 7013.</td>
<td>6022</td>
<td>-</td>
</tr>
<tr>
<td>7012</td>
<td>Dark Reflector</td>
<td>494687</td>
<td>5972455</td>
<td>A2</td>
<td>0.7</td>
<td>0.4</td>
<td>0.4</td>
<td>-</td>
<td>Small dark reflector with a long shadow. This is visible in an area of clipped data. A similar dark reflector with height is visible nearby - anomaly 7013.</td>
<td>6023</td>
<td>-</td>
</tr>
<tr>
<td>WA ID</td>
<td>Name / Classification</td>
<td>Easting</td>
<td>Northing</td>
<td>Archaeological Discrimination</td>
<td>L (m)</td>
<td>W (m)</td>
<td>H (m)</td>
<td>Magnetic Amplitude (nT)</td>
<td>Description</td>
<td>Sources</td>
<td>External References</td>
</tr>
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<td>---------</td>
<td>---------------------</td>
</tr>
<tr>
<td>7013</td>
<td>Debris</td>
<td>494629</td>
<td>5972473</td>
<td>A2</td>
<td>3.1</td>
<td>0.8</td>
<td>0.4</td>
<td>3</td>
<td>Dark reflector with height. This is located in a band of stretched data, so the length dimension is inaccurate. It appears as a very small, relatively broad magnetic anomaly. A similar anomaly (7012) is located nearby; as is a magnetic anomaly (7011), to which this may be related. The features are visible in clipped data. Possibly a piece of ferrous debris.</td>
<td>6024</td>
<td>-</td>
</tr>
</tbody>
</table>
### APPENDIX III: GAZETTEER OF SUB-BOTTOM PROFILE FEATURES WITHIN THE STUDY AREA

<table>
<thead>
<tr>
<th>WA ID</th>
<th>Name / Classification</th>
<th>Archaeological Discrimination</th>
<th>Description</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>7500</td>
<td>Base of Channel</td>
<td>A1</td>
<td>Possible simple N-S trending channel feature cut into the Upper Till Member of the Cardigan Bay Formation. Feature is only well-defined on three survey lines so exact extents and depths are uncertain. Single phase of acoustically chaotic fill, though there are hints of some well-layered structure in places. Possible Early Holocene deposits, possibly SL2 Member of Seabed Sands Formation. Depth Range: 0.5m - 8.2m BSB.</td>
<td>6500</td>
</tr>
</tbody>
</table>
APPENDIX IV: GAZETTEER OF KNOWN ARCHAEOLOGICAL SITES IN THE VICINITY OF THE STUDY AREA

<table>
<thead>
<tr>
<th>WAID</th>
<th>Name</th>
<th>Period</th>
<th>Details</th>
<th>Easting</th>
<th>Northing</th>
<th>External Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>-</td>
<td>Mesolithic</td>
<td>Tree stumps and trunks visible on foreshore in peat bed.</td>
<td>496662</td>
<td>5970335</td>
<td>PRN35152 (Lancs HER)</td>
</tr>
<tr>
<td>2002</td>
<td>-</td>
<td>Roman-British</td>
<td>Location of a Red terracotta Roman vase (LCC Date 1) netted in 1949 by fishermen. No further anomalies identified at this location by the geophysical data.</td>
<td>495616</td>
<td>5972002</td>
<td>PRN348 (Lancs HER)</td>
</tr>
<tr>
<td>2003</td>
<td>-</td>
<td>Roman-British</td>
<td>Possible Roman road and building uncovered in the early C19.</td>
<td>496674</td>
<td>5974236</td>
<td>PRN347 (Lancs HER)</td>
</tr>
<tr>
<td>2004</td>
<td>-</td>
<td>Roman-British</td>
<td>Late Roman coin hoard discovered in 1840 consisting of coins dating from Constantius II to Honorius, c.AD 317-423.</td>
<td>496674</td>
<td>5974236</td>
<td>PRN346 (Lancs HER)</td>
</tr>
<tr>
<td>2005</td>
<td>Medieval</td>
<td></td>
<td>Possible site of Deserted Medieval Village (Ross Hall?)</td>
<td>496917</td>
<td>5971920</td>
<td>PRN18799 (Lancs HER)</td>
</tr>
<tr>
<td>2006</td>
<td>Lyra</td>
<td>1914-1945</td>
<td>Finnish built cargo steamer built 1881. Lost 1922</td>
<td>492595</td>
<td>5974431</td>
<td>PRN26929 (Lancs HER)</td>
</tr>
<tr>
<td>2007</td>
<td>Sunbeam</td>
<td>1914-1945</td>
<td>British steam trawler lost after a collision 1916</td>
<td>492744</td>
<td>5975668</td>
<td>PRN26923 (Lancs HER)</td>
</tr>
<tr>
<td>2008</td>
<td>Galilean</td>
<td>Post-1945</td>
<td>Fishing vessel wreckage 1987</td>
<td>493307</td>
<td>5974662</td>
<td>PRN26928 (Lancs HER)</td>
</tr>
<tr>
<td>2009</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown wreck shown on current Admiralty Chart 2010. Number of HER casualties recorded in vicinity, but all have been located elsewhere.</td>
<td>493383</td>
<td>5977569.6</td>
<td>-</td>
</tr>
</tbody>
</table>
### APPENDIX V: GAZETTEER OF SHIP AND AIRCRAFT CASUALTIES IN THE VICINITY OF THE STUDY AREA

<table>
<thead>
<tr>
<th>WAID</th>
<th>Name</th>
<th>Period</th>
<th>Details</th>
<th>Wreck Type</th>
<th>External Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>3001</td>
<td>Employment</td>
<td>1509-1815</td>
<td>Stranded at Bispham, Red Bank. 1702</td>
<td>Ship</td>
<td></td>
</tr>
<tr>
<td>3002</td>
<td>Jannet</td>
<td>1509-1815</td>
<td>1802 wreck of a cargo vessel at Rossall or Lytham.</td>
<td>Ship</td>
<td>MLA30044</td>
</tr>
<tr>
<td>3003</td>
<td>Lord John Campbell</td>
<td>1509-1815</td>
<td>Lost with all hands off the Lancashire Coast. 1797</td>
<td>Ship</td>
<td></td>
</tr>
<tr>
<td>3004</td>
<td>Mary &amp; Betty</td>
<td>1509-1815</td>
<td>Lost on the Lancashire Coast 1740</td>
<td>Ship</td>
<td></td>
</tr>
<tr>
<td>3005</td>
<td>Traver</td>
<td>1509-1815</td>
<td>East Indiaman in a collision whilst carrying rich cargo, which was claimed by the Squire at Rossall and plundered by other locals. A seaman who jumped from the Traver to the other vessel was the only survivor. 1775.</td>
<td>Ship</td>
<td></td>
</tr>
<tr>
<td>3006</td>
<td>Unknown</td>
<td>1509-1815</td>
<td>1643 wreck of Spanish armed cargo vessel or warship which stranded at Rossall Point en route from Spain to England with ammunition destined for the Parliamentarians in the English Civil War. This wooden sailing vessel was then seized by the Royalists and</td>
<td>Ship</td>
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<tr>
<td>3007</td>
<td>Unknown</td>
<td>1509-1815</td>
<td>Wrecked near Fleetwood 1642</td>
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<td>3008</td>
<td>Young William</td>
<td>1509-1815</td>
<td>Sailing vessel on passage between Malaga and Dublin, lost on the Lancashire Coast. All except 2 lost. 1755</td>
<td>Ship</td>
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<tr>
<td>3009</td>
<td>Abana</td>
<td>1816-1913</td>
<td>A Norwegian Barque lost at Norbreck in a gale 21/12/1894</td>
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<tr>
<td>3010</td>
<td>Ada</td>
<td>1816-1913</td>
<td>A Schooner lost near the Imperial Hotel 07/11/1862</td>
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<td>MLA30129</td>
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<tr>
<td>3011</td>
<td>Ada</td>
<td>1816-1913</td>
<td>7th November 1880. A wood brig, built 1826, on passage Dublin for Maryport in ballast, stranded near Cleveleys, crew of four saved, vessel a total loss</td>
<td>Ship</td>
<td>MLA30065</td>
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<tr>
<td>3012</td>
<td>Adel Grunde</td>
<td>1816-1913</td>
<td>1883 wreck of a Norwegian barque which stranded off Rossal Point. A wooden sailing vessel built in 1857 which was en route from Liverpool for Halifax with a cargo of salt.</td>
<td>Ship</td>
<td>MLA30123</td>
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<tr>
<td>3013</td>
<td>Ann Mitchell</td>
<td>1816-1913</td>
<td>On voyage from Belfast and stranded on Bernard's Wharf in force 10 winds.22/01/1860</td>
<td>Ship</td>
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<tr>
<td>3014</td>
<td>Ann Paley</td>
<td>1816-1913</td>
<td>1827 wreck of English barque which stranded off Cleveleys near the River Ribble. A wooden sailing vessel built in Liverpool in 1827 which</td>
<td>Ship</td>
<td>MLA30044</td>
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was en route from Liverpool for Lisbon with a cargo of tea.

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<tr>
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<tr>
<td>3015</td>
<td>Anna</td>
<td>1816-1913</td>
<td>A Salvage Steamer working on the wreck of HMS Foudroyant, wrecked at Blackpool in force 4 winds. 1897</td>
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<td>3016</td>
<td>Anna Dixon</td>
<td>1816-1913</td>
<td>A schooner driven onto Bernard's Wharf.</td>
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<td>3017</td>
<td>Annie Reed</td>
<td>1816-1913</td>
<td>1875 wreck of a British craft which stranded off Shell Bank. A wooden sailing vessel.</td>
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<tr>
<td>3018</td>
<td>Aurora</td>
<td>1816-1913</td>
<td>A Brigantine working on the wreck of HMS Foudroyant, wrecked at Blackpool in force 6 winds.17/08/1897</td>
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<td>3019</td>
<td>Betsy</td>
<td>1816-1913</td>
<td>Lost on the west side of Bernard's Wharf.05/01/1865</td>
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<td>3020</td>
<td>Blue Bell</td>
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<td>A Schooner inbound for Liverpool and stranded at Cleveleys in a force 7. Lost1898</td>
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<td>3021</td>
<td>Braddy</td>
<td>1816-1913</td>
<td>Sailing from Whitby. Lost on the Lancashire Coast.22/02/1833</td>
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<td>3022</td>
<td>Britannia</td>
<td>1816-1913</td>
<td>Wooden Sloop lost near North Wharf in force 10 winds. II crew lost.02/11/1861</td>
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<tr>
<td>3023</td>
<td>Catherine</td>
<td>1816-1913</td>
<td>Inbound to Fleetwood from Newry. The Schooner stranded on Bernard's Wharf.19/02/1860</td>
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<td>3024</td>
<td>Charles Brunel</td>
<td>1816-1913</td>
<td>A Barque lost near North Wharf.January 1869</td>
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<td>3025</td>
<td>Charles Chaloner</td>
<td>1816-1913</td>
<td>A Barque inbound to Fleetwood from Quebec. Stranded on Bernard's Wharf in a force 8 NW gale.18/09/1878</td>
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<td>3026</td>
<td>Devonshire Lass</td>
<td>1816-1913</td>
<td>A force 9 SSE storm broke this Smack from her moorings and drove her onto Bernard's Wharf. 1903</td>
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<td>3027</td>
<td>Diana</td>
<td>1816-1913</td>
<td>A Schooner rigged Steam Fishing Liner. Lost in a force 6 near Fleetwood. 1898</td>
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<td>Dotterel</td>
<td>1816-1913</td>
<td>A Smack lost in Lune Deeps after a collision. 1885</td>
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<td>3029</td>
<td>Duncan</td>
<td>1816-1913</td>
<td>Inbound to Duddon and lost in the Wyre. All drowned. 1823</td>
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<td>3030</td>
<td>Eleanor</td>
<td>1816-1913</td>
<td>A schooner sailing between Troon and Runcorn. Ashore on Bernards Wharf. 1853</td>
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<td>3031</td>
<td>Elizabeth Ann</td>
<td>1816-1913</td>
<td>A Ketch run down by SS Duke of Cornwall at Wyre Light. 1910</td>
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<td>3032</td>
<td>Elizabeth Ellen Fisher</td>
<td>1816-1913</td>
<td>A Schooner stranded on Bernard Wharf.1879</td>
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<td>3033</td>
<td>Erling Skjalgson</td>
<td>1816-1913</td>
<td>A force 10 NW storm blew this Norwegian Barque onto North Wharf.</td>
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<td>3034</td>
<td>Eskham, Fleetwood</td>
<td>1816-1913</td>
<td>1874 wreck of an English sloop which sprang a leak and foundered two miles west of Fleetwood in a gale. A wooden sailing vessel built in Ulverston in 1847 which was en route from Liverpool for Barrow-in Furness with an unknown cargo.</td>
<td>Ship</td>
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<tr>
<td>3035</td>
<td>Falmouth</td>
<td>1816-1913</td>
<td>Wrecked in a storm with all hands, at Rossall Point. 1894</td>
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<td>3036</td>
<td>Fly</td>
<td>1816-1913</td>
<td>Lost on the Lancashire Coast. 1833</td>
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<td>3037</td>
<td>Foam</td>
<td>1816-1913</td>
<td>A Schooner stranded on Bernard's Wharf in force 9 winds. 1895</td>
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<td>3038</td>
<td>Hilda</td>
<td>1816-1913</td>
<td>A Flat stranded near Wyre Light. 1909</td>
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<td>3039</td>
<td>HMS Foudroyant</td>
<td>1816-1913</td>
<td>A 2nd rate Man o' War sunk at her moorings off Blackpool in a force 8 storm. 1897</td>
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<td>3040</td>
<td>Jane Roper</td>
<td>1816-1913</td>
<td>Schooner, wrecked in Jan 1860 on Shell Wharf</td>
<td>Ship</td>
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<td>3041</td>
<td>Jean Campbell</td>
<td>1816-1913</td>
<td>A Brig outbound from Liverpool in force 9 NW winds, wrecked at Norbreck. Three crew lost. 1890</td>
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<td>3042</td>
<td>Kittiwake</td>
<td>1816-1913</td>
<td>A Cutter blown onto North Wharf in force 9 winds. 1895</td>
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<td>3043</td>
<td>Klara</td>
<td>1816-1913</td>
<td>1906 wreck of a Norwegian barque which stranded off Rossall Point in a gale, en route from Bouchoutche to Preston with deals. Constructed of wood with yellow metal in 1857, she was a sailing vessel.</td>
<td>Ship</td>
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<td>3044</td>
<td>Lillies</td>
<td>1816-1913</td>
<td>A Smack wrecked south of Bernard's Wharf. 1863</td>
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<td>3045</td>
<td>Little Trojan</td>
<td>1816-1913</td>
<td>1889 wreck of an English flat which foundered near Rossall Point, Fleetwood whilst en route from Preston to Piel, Isle of Walney, with coal. Built of wood, she was sailing vessel.</td>
<td>Ship</td>
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<td>3046</td>
<td>Louisa</td>
<td>1816-1913</td>
<td>A Barque which sank in a gale off Fleetwood. 1897</td>
<td>Ship</td>
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<td>3047</td>
<td>Lyra</td>
<td>1816-1913</td>
<td>1861 wreck of an Irish paddle steamer which stranded off Rossall Point. A wooden steam vessel built in Greenock in 1848 which was en route from Belfast for Morecambe with a cargo of iron.</td>
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<td>Margarethe</td>
<td>1816-1913</td>
<td>A Russian Barque sailing from Fleetwood and driven onto Bernard's Wharf in a force 9 storm. 1898</td>
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<td>3049</td>
<td>Mayflower</td>
<td>1816-1913</td>
<td>A Ketch lost on Shell Wharf in a force 11 storm. 1894</td>
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<td>3050</td>
<td>Minnie</td>
<td>1816-1913</td>
<td>A Sloop sunk at her moorings in Fleetwood Harbour after a collision with SS Saltburn. 1913</td>
<td>Ship</td>
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<td>3051</td>
<td>Minnie</td>
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<td>A Ketch lost off Fleetwood after a collision. 1898</td>
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<td>3052</td>
<td>New Brunswick</td>
<td>1816-1913</td>
<td>A Norwegian Barque stranded on Bernard's Wharf in wind conditions NW force 11. 1890</td>
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<td>3053</td>
<td>No Name</td>
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<td>A ferry lost in the Wyre. 1863</td>
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<td>3054</td>
<td>Old Hunter</td>
<td>1816-1913</td>
<td>1906 wreck of a British schooner which stranded at Shell Wharf. This wooden sailing vessel carried a cargo of coal. 1906</td>
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<td>Pearl</td>
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<td>A 68 ton jigger flat lost at Rossall Landmark in force 10 NNW winds. 1895</td>
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<td>Pioneer</td>
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<td>A Smack wrecked on Bernard's Wharf. 1863</td>
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<td>Prince Charlie</td>
<td>1816-1913</td>
<td>A Smack lost due to collision near Wyre Light. 1892</td>
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<td>Prudhoe</td>
<td>1816-1913</td>
<td>A Barque lost on the Lancashire coast. 1866</td>
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<td>3059</td>
<td>Resolution</td>
<td>1816-1913</td>
<td>A Smack lost near Fleetwood in force 9 winds. 1895</td>
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<td>Robert</td>
<td>1816-1913</td>
<td>Smack, lost with all hands 8m WNW of Fleetwood in a force 8 WSW gale. 1862</td>
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<td>Secret</td>
<td>1816-1913</td>
<td>SS City of Manchester collided with the Smack off Fleetwood. 1904</td>
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<td>3062</td>
<td>Sir Robert Peel</td>
<td>1816-1913</td>
<td>1886 wreck of an English schooner which stranded near Fleetwood while en route from Arnside to Fleetwood with granite boulders. Built in 1840, she was a wooden sailing vessel.</td>
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<td>Splended</td>
<td>1816-1913</td>
<td>A Schooner outbound from Ardrossan. Lost on Bernards Wharf. 1857</td>
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<td>St Lawrence</td>
<td>1816-1913</td>
<td>1884 wreck of a Norwegian barque which stranded on Shell Wharf Bank. A wooden sailing vessel built in 1852 which was en route from Apalachicola for Fleetwood with a cargo of deals and timber.</td>
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<td>Success</td>
<td>1816-1913</td>
<td>A schooner lost near Fleetwood in a force 9 gale. 1853</td>
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<td>Superb</td>
<td>1816-1913</td>
<td>A Ketch driven onto Bernard's Wharf in WNW force 7 winds. 1891</td>
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<td>3067</td>
<td>Thermont</td>
<td>1816-1913</td>
<td>A Barque. Lost her anchors in a WNW gale and stranded on Bernard's Wharf. 1860</td>
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<td>3068</td>
<td>Thomas Dugdale</td>
<td>1816-1913</td>
<td>A Steamship caught by the tide and wrecked in the Wyre Channel. 1879</td>
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<td>Thornton</td>
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<td>A Schooner stranded and lost in the Wyre in force 9 SSW winds. 1883</td>
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<td>Lost near Wyre Water. 1831</td>
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<td>Unknown</td>
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<td>A fishing vessel lost near Shellwharfe Buoy whilst under tow. 1901</td>
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<td>Venus</td>
<td>1816-1913</td>
<td>A Swedish Barque foundered off Fleetwood. 1882</td>
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<td>Vermont</td>
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<td>A Barque lost 3m off Fleetwood. 1860</td>
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<td>3074</td>
<td>W. K. Chapman</td>
<td>1816-1913</td>
<td>Stranded at Rossall Point. 1875</td>
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<td>Willy</td>
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<td>1853 wreck of an English flat which foundered at Rossall. A wooden</td>
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<td>sailing vessel en route from Barrow-in-Furness for Saltney with a cargo</td>
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<td>WK Chapman</td>
<td>1816-1913</td>
<td>1875 wreck of a British craft which stranded on Rossal Point. A wooden</td>
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<td>Zion Hill</td>
<td>1816-1913</td>
<td>A Schooner inbound to Lancaster from London. Stranded and lost on King's</td>
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<td>Scar. 1877</td>
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<td>3078</td>
<td>Bragi</td>
<td>1914-1945</td>
<td>An Icelandic Trawler lost off Wyre Light. 30/10/1940</td>
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<td>Commandant Bultinck</td>
<td>1914-1945</td>
<td>1929 wreck of a Belgian fishing vessel which was lost near Rossall</td>
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<td>Point. This steel steam vessel, built in 1911, departed from Belgium on</td>
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<td>Enterprise II</td>
<td>1914-1945</td>
<td>A Tug lost on the Ribble Bar. 1931</td>
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<td>3081</td>
<td>Evangaline</td>
<td>1914-1945</td>
<td>A Ketch stranded on North Wharf. 1916</td>
<td>Ship</td>
<td></td>
<td></td>
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<tr>
<td>3082</td>
<td>Stella Marie</td>
<td>1914-1945</td>
<td>A Danish MFV lost on King's Scar Bank 1941</td>
<td>Ship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3083</td>
<td>Corona</td>
<td>post-1946</td>
<td>Motor fishing vessel stranded near Fleetwood Dock. 1975</td>
<td>Ship</td>
<td></td>
<td></td>
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<tr>
<td>3084</td>
<td>Hamoaze</td>
<td>post-1946</td>
<td>Fishing vessel under tow to Glasson. Blown onto Knott End Sands and lost</td>
<td>Ship</td>
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<td></td>
<td></td>
<td></td>
<td>1967</td>
<td></td>
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<tr>
<td>3085</td>
<td>Lysander Mark III V9666</td>
<td>1939-1945</td>
<td>Aircraft V9666 was a Westland Lysander Mark III army cooperation</td>
<td>Aircraft</td>
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<td></td>
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<td></td>
<td>aeroplane, which crashed on 11th February 1943. It collided with the</td>
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<td></td>
<td>mast of a ship while low flying and crashed in the sea, possibly off</td>
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<td></td>
<td></td>
<td></td>
<td>Fleetwood.</td>
<td></td>
<td></td>
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<tr>
<td>3086</td>
<td>Avro Anson Mark I LT767</td>
<td>1939-1945</td>
<td>Aircraft LT767 was a British Avro Anson Mark I trainer or transporter,</td>
<td>Aircraft</td>
<td></td>
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<td></td>
<td></td>
<td>which crashed on 18th of August 1943. It belonged to 10 Air Gunners</td>
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<td></td>
<td></td>
<td>School, and was low flying when it crashed into the sea off the coasts</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>of Lancashire or Cumbria, possibly a point a</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Geological time periods discussed in the text

**Figure 2**

- **Quaternary**
  - **Epoch**
    - **Pleistocene**
      - **Sub-epoch**
        - **Middle Pleistocene**
        - **Late Pleistocene**
  - **Holocene**

- **Palaeogeography**
  - **Island/Peninsula**
  - **Occupation**

- **Archaeological Industries**
  - **Lower Palaeolithic**
  - **Middle Palaeolithic**
  - **Upper Palaeolithic**
  - **Mesolithic**

- **British Stages**
  - **Comeran Complex**
  - **Anglian**
  - **Hoxnian**
  - **Wolstonian**
  - **Devensian**
  - **Ipswichian**
  - **Upton Warren**
  - **Flandrian**

- **Approximate "Sea level"**
  - Relative to present day
  - -30 to -120

- **Cool**
  - 18 dO^18

- **Warm**
  - 3.5

- **H. antecessor**
- **H. heidelbergensis**
- **H. neanderthalensis**
- **H. sapiens**

- **Increase in occupation**
- **Human absence**

- **Epoch Period**
  - **Quaternary**
    - **Pleistocene**
      - **Middle Pleistocene**
      - **Late Pleistocene**
  - **Holocene**

- **British Stages**
  - **Comeran Complex**
  - **Anglian**
  - **Hoxnian**
  - **Wolstonian**
  - **Devensian**
  - **Ipswichian**
  - **Upton Warren**
  - **Flandrian**

- **Archaeological Industries**
  - **Lower Palaeolithic**
  - **Middle Palaeolithic**
  - **Upper Palaeolithic**
  - **Mesolithic**

- **Notes**
  - Human absence
  - Increase in occupation
  - Presence
  - Absence

- **Dates**
  - 04/08/11
  - Revision Number: 0

- **Scale**
  - N/A

- **Illustrator**
  - KJF

- **Path**
  - W:\Projects\78290\Drawing Office\Report figs\DBA\11_08_03
Map showing seabed anomalies, shallow geological features of possible archaeological potential and archaeological sites around the Study Area

Figure 3
Speed's 1610 Map of Lancashire (A) and Yates 1786 Map of the Fleetwood peninsula (B)