



## Environmental Statement

### Chapter 20. Cultural Heritage: Marine Archaeology

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### 20.0 Cultural Heritage: Marine Archaeology

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## 20.0 Cultural Heritage: Marine Archaeology

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### 20.1 Introduction

20.1.0.1 This Chapter contains an assessment of the potential effects of the Project, on the Maritime Cultural Heritage resource. The Chapter describes the relevant legislation and planning policy and then presents the methodology of the assessment, the baseline information of the study area, and an assessment of the potential impact of the construction, operation and decommissioning phases of the Project on marine archaeology. Where appropriate and relevant, mitigation measures have been suggested to reduce or eliminate any significant impacts and residual impacts are then presented. The potential effects of the Project on the terrestrial cultural heritage resource are discussed in Chapter 21 of this ES.

### 20.2 Legislation, planning policy and guidance

#### 20.2.1 Introduction

20.2.1.1 The primary legislation relating to archaeology in Wales is contained in *Welsh Office Circular 60/96 Planning and the Historic Environment: Archaeology* (1996). This document and associated national and local planning guidance is set out in the Chapter dealing with terrestrial cultural heritage (Chapter 21).

20.2.1.2 In addition, there are a number of Acts and guidance documents that relate specifically to maritime cultural heritage lying within the 12 nautical mile territorial limit. These are as follows:

- i. Protection of Wrecks Act 1973;
- ii. Protection of Military Remains Act 1986;
- iii. Merchant Shipping Act 1995;
- iv. Seas, Shores and Coastal Areas: Maritime Policy (Countryside Council for Wales 1996)
- v. Joint Nautical Archaeology Policy Committee Code for Practice for Seabed Development (JNAPC 2008);
- vi. Cowrie Historic Environment Guidance for the Offshore Renewable Energy Sector (COWRIE 2007); and
- vii. Identifying and Protecting Palaeolithic Remains: Archaeological Guidance for Planning Authorities and Developers (English Heritage 1998).

20.2.1.3 Maritime archaeological sites in the UK are not protected, unless specific action has been taken to protect them. However, there are two separate Acts under which wrecks which may be of archaeological interest may be designated, namely the Protection of Wrecks Act 1973 (PWA 1973), (which has two relevant sections - noted below), and the Protection of Military Remains Act 1986 (PMRA 1986). Designation of wrecks in Wales is also possible under a third Act, the Ancient Monuments and Archaeological Areas Act 1979 (AMAA 1979). In addition, there are UK-wide provisions applying generally to people who find or take possession of wrecks, including wrecks of archaeological interest, under the Merchant Shipping Act 1995 (MSA 1995).

- 20.2.1.4 The PMRA 1986 and the MSA 1995 are administered UK-wide by the Ministry of Defence (MoD) and the Maritime and Coastguard Agency (MCA) respectively. Section 2 of the PWA 1973, which deals with dangerous wrecks, is also administered UK-wide by the MCA. However, Section 1 of the PWA 1973, which deals with wrecks of historic or archaeological importance, and the AMAA 1979 are administered by Cadw for wrecks within Welsh waters.

#### **Protection of Wrecks Act 1973: Section 1**

- 20.2.1.5 Section 1 of the PWA 1973 enables the Secretary of State to protect wreck sites from unauthorised interference if they are of archaeological or artistic importance.
- 20.2.1.6 Under the Act, it is an offence to carry out certain activities in a defined area surrounding the site, unless a licence for those activities has been obtained from the Welsh Government (in this instance, Cadw acting on its behalf).

#### **Protection of Wrecks Act 1973: Section 2**

- 20.2.1.7 Section 2 of the PWA 1973 provides protection for wrecks that are designated as dangerous due to their contents, and is administered by the Maritime and Coastguard Agency (MCA) through the Receiver of Wreck (RoW).
- 20.2.1.8 While Section 2 of the Act is not used to designate sites because of their archaeological interest, it is possible that a dangerous wreck designated under this section might also be of archaeological interest.

#### **Protection of Military Remains Act 1986**

- 20.2.1.9 Under the PMRA 1986, all aircraft that have crashed in military service are protected, and the Ministry of Defence (MoD) has similar powers to protect vessels that were in military service when they were lost. The MoD can designate named vessels as "Protected Places" even if the position of the wreck is not known. In addition, the MoD can designate "Controlled Sites" around wrecks whose position is known. In the case of Protected Places, the vessel must have been lost after 4th August 1914, whereas in the case of a wreck protected as a Controlled Site no more than 200 years must have elapsed since loss.
- 20.2.1.10 For Controlled Sites or Protected Places, it is not necessary to demonstrate the presence of human remains. Diving is not prohibited at a Protected Place but it is an offence to tamper with, damage, move or remove sensitive remains. However, diving, salvage and excavation are all prohibited on Controlled Sites, though licences for restricted activities can be sought from the MoD. Additionally, it is an offence to carry out unauthorised excavations for the purpose of discovering whether any place in UK waters contains any remains of an aircraft or vessel which has crashed, sunk or been stranded while in military service.
- 20.2.1.11 In November 2001, the MoD reported on the public consultation on Military Maritime Graves and the Protection of Military Remains Act 1986. The report recommended that a rolling programme of identification and assessment of vessels against the criteria be established to designate all other British vessels in military service when lost, as Protected Places. This process commenced in 2006, and in 2008 the scope of vessels that may be designated by the Act was widened to include merchant vessels.

### **Merchant Shipping Act 1995**

- 20.2.1.12 Within the context of the Merchant Shipping Act 1995 (MSA 1995), 'wreck' refers to flotsam, jetsam, derelict and lagan found in or on the shores of the sea or any tidal water. It includes a ship, aircraft or hovercraft, parts of these, their cargo or equipment. It may be of antique or archaeological value such as gold coins, or a yacht or dinghy abandoned at sea or items such as drums of chemicals or crates of foodstuffs (Definition from the Marine and Coast Guard Agency web site <http://www.dft.gov.uk/mca/>).
- 20.2.1.13 The ownership of underwater finds recovered from the sea is decided in line with a set of procedures detailed in the MSA 1995. If finds are brought ashore the salvor is required to give notice to the RoW that he/she is in possession of the material. This applies whether material has been recovered from within or outside UK Territorial Waters.
- 20.2.1.14 Ownership of unclaimed wrecks from within Territorial Waters lies with the Crown or with a person to whom rights of wreck have been granted. The RoW has a duty to ensure that finders who report their finds receive an appropriate salvage payment. In the case of material considered being of historic or archaeological importance, a suitable museum is asked to buy the material at the current valuation and the finder receives the net proceeds of the sale as a salvage payment.

### **Seas, Shores and Coastal Areas: Maritime Policy (Countryside Council for Wales, 1996)**

- 20.2.1.15 This policy covers cultural heritage, historic landscapes and amenity issues. It also stresses the need for sustainable development and holistic management.

### **Code of Practice for Seabed Developers, Joint Nautical Archaeology Policy Committee 2006 (JNAPC)**

- 20.2.1.16 This is a UK-wide code developed in conjunction with key industries. The JNAPC Code is voluntary but provides a framework that seabed developers can use in conducting their activities in an archaeologically sensitive manner. This code of practice is consistent with planning policy guidance and should continue to be followed by the renewables industry.

### **Historic Environment Guidance for the Offshore Renewable Energy Sector, COWRIE 2007**

- 20.2.1.17 The guidance is intended to promote the development of best practice in relation to the marine historic environment for the offshore renewable energy sector. It is also intended to promote an understanding of the conservation issues arising from the impacts of offshore renewable energy projects on the historic environment, and in this way, develop capacity amongst developers, consultants and contractors. The guidance is aimed at:
- i. the offshore renewable energy sector;
  - ii. environmental consultants involved in offshore renewable energy development;
  - iii. archaeological consultants and contractors involved in offshore renewable energy development;
  - iv. regulatory authorities and bodies;

- v. national and local curators; and
- vi. the wider public.

### **Historic Environment Guidance for Wave and Tidal Energy (Firth, A. 2013)**

- 20.2.1.18 Guidance, specifically aimed at the wave and tidal sector was published in 2013. The guidance is intended for everyone involved in developing wave and tidal energy to ensure that 'development is sustainable with respect to the historic environment'. Cadw are a signatory to this guidance which outlines the following key issues:
- I. In satisfying environmental requirements to address the historic environment in the course of consent, Developers create knowledge and understanding that can also be used to generate social and economic benefits for the wider public.
  - II. Provisions for managing archaeological data should be set up at the start of a project.
  - III. Site investigations for archaeological purposes are an integral element of overall site investigations and should be planned accordingly.
  - IV. Anomalies on the seabed can be difficult to characterise without direct observation; better field-based evidence of the forms and origin of anomalies will benefit individual schemes and the wave and tidal industry as a whole.
  - V. Publicly accessible research is intrinsic to historic environment practice and enables all parties to gain maximum benefit from the investigations that are undertaken.

## **20.3 Assessment methodology**

### **20.3.1 Introduction**

- 20.3.1.1 The content of this marine cultural heritage assessment has been guided by the Standard and Guidance for Historic Environment Desk-Based Assessment issued by the Institute for Archaeologists (IfA 2011); NPPF (CLG 2012); Appendix 10 of the Good Practice Guide for the Preparation of Environmental Statements issued by the former Department of the Environment (DoE 1995); and Environmental Impact Assessment: a Guide to Procedures issued by the former DETR and the National Assembly for Wales (2000).
- 20.3.1.2 The desk-based assessment examines the maritime archaeological resource through the collation of existing written, cartographic, photographic and electronic evidence. The aim is to identify the likely character, extent, quality and significance of the known or potential maritime cultural heritage resource and identify key receptors which could potentially be affected by the Project proposals.
- 20.3.1.3 The specific objectives of the desk based assessment were to:
- i. identify known heritage assets within or in the vicinity of the Project;
  - ii. identify areas with the potential to contain any unrecorded archaeological remains;
  - iii. identify geophysical anomalies that may represent heritage assets within or in the vicinity of the Project; and
  - iv. identify, where possible, the condition of any archaeological remains.

20.3.1.4 The Offshore Works forming part of the Project, covered by this assessment, lie within Swansea Bay between the dredged channels of the Rivers Tawe and Neath, adjacent to and south of the Port of Swansea (Figure 20.1, Volume 2). The Lagoon seawalls encompass an area extending c.4km out into the Bay, with a total seawall length of around 9.5 km.

20.3.1.5 This ES proceeds on the basis of the outline construction programme as discussed in Chapter 4, Section 4.5.2, which anticipates construction starting in 2015 and with the main construction lasting for about three years. The assessments contained in this chapter are not materially sensitive to works commencing within the anticipated validity of the DCO, which is five years, or to an extension of (say) a further year-or-so.

## 20.3.2 Study areas

20.3.2.1 The known marine archaeological resource was established for a broad data collection area that extends across the whole of Swansea Bay, to the north of a line drawn between Port Eynon and Sker Point, with a 500m buffer applied to the outer edge. This broad data set was accessed in order to establish the general level of known maritime archaeology within the Bay. This area is referred to in this Chapter of the ES as the "Broad Study Area" (Figure 20.2, Volume 2).

20.3.2.2 The data was then filtered such that only sites lying within an area that will be occupied by the Offshore Works plus a 500m buffer were considered in detail. This area is referred to as the "Site Study Area" (Figure 20.3, Volume 2).

## 20.3.3 Intertidal walkover surveys

20.3.3.1 Two walkover surveys were undertaken, on 15th January 2013 and 27th February 2013, the repeat survey being undertaken in order to validate the results of the first survey after a period of stormy weather. The surveys were undertaken within the "Site Study Area" by two people and the full extent of the intertidal area exposed on the survey dates was visually inspected. The locations of existing archaeology, and the records, maps, charts and aerial photographs that underpinned the desk-based assessment were available to the surveyors. Existing records were amended and new sites were recorded with written descriptions and photography, and position fixed to an accuracy of +/-1m.

## 20.3.4 Sources

20.3.4.1 The known and potential archaeological remains were assessed through the collation and analysis of data from a number of sources. The major repositories of information consulted are as follows:

**Table 20.1 Assessment sources**

| Source                                                                     | Data                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| United Nations Educational, Scientific and Cultural Organisation (UNESCO)  | <ul style="list-style-type: none"> <li>List of World Heritage Sites; and</li> <li>Tentative List of sites for World Heritage status (July 2012). <a href="http://whc.unesco.org/en/tentativelists/">http://whc.unesco.org/en/tentativelists/</a></li> </ul> |
| Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW) | <ul style="list-style-type: none"> <li>Aerial photographs</li> <li>List of archaeological monuments and events</li> </ul>                                                                                                                                   |
| Cadw                                                                       | <ul style="list-style-type: none"> <li>Archaeological records</li> </ul>                                                                                                                                                                                    |

| Source                                                             | Data                                                                                                                                                                                                                                                                                   |
|--------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Welsh Assembly Government (visited 16.01.13)                       | <ul style="list-style-type: none"> <li>• Aerial photographs</li> </ul>                                                                                                                                                                                                                 |
| Glamorgan Gwent Archaeological Trust (GGAT)                        | <ul style="list-style-type: none"> <li>• List of archaeological monuments and events</li> </ul>                                                                                                                                                                                        |
| United Kingdom Hydrographic Office (UKHO) (visited 11.01.13)       | <ul style="list-style-type: none"> <li>• Records of wrecks and obstructions</li> <li>• Historic maps and Admiralty Charts, documents and publications</li> </ul>                                                                                                                       |
| Receiver of Wreck                                                  | <ul style="list-style-type: none"> <li>• Wreck records</li> </ul>                                                                                                                                                                                                                      |
| Portable Antiquities Scheme (PAS)                                  | <ul style="list-style-type: none"> <li>• Consulted with Mark Lodwick (04.01.13) and received unpublished PAS records</li> <li>• Online PAS database (11.01.13)</li> </ul>                                                                                                              |
| Glamorgan County Record Office (visited 14.12.12)                  | <ul style="list-style-type: none"> <li>• Historic maps, Admiralty charts, documents and publications</li> </ul>                                                                                                                                                                        |
| University of Wales, Trinity St David Library (visited 16.01.2013) | <ul style="list-style-type: none"> <li>• Publications</li> </ul>                                                                                                                                                                                                                       |
| Online sources                                                     | <ul style="list-style-type: none"> <li>• Including the British Geological Survey (BGS) Geology of Britain Viewer and Local/Regional Plan information from the Local Planning Authorities (CCSC and NPTCBC) (LPA) websites.</li> </ul>                                                  |
| Intertidal Surveys                                                 | <ul style="list-style-type: none"> <li>• Intertidal surveys were carried out on 15.01.2013 and 27.03.2013 in order to assess the visible cultural heritage resource, to examine the current topography and sediment cover, and to assess change following storm conditions.</li> </ul> |
| Results of Marine Geophysical Survey (Titan February 2012)         | <ul style="list-style-type: none"> <li>• Archaeological assessment of the results of sidescan sonar, magnetometer, bathymetric and seismic (Boomer) data</li> </ul>                                                                                                                    |
| Results of magnetometer survey (Stratascan October 2013)           | <ul style="list-style-type: none"> <li>• Magnetometer survey undertaken with the inter-tidal zone in order to pin-point the location of a wreck (Wreck 05).</li> </ul>                                                                                                                 |

### 20.3.5 Chronology

20.3.5.1 The dating of archaeological remains relies on three distinct chronologies, these are as follows:

20.3.5.2 Absolute (or calendar) dates, which are suffixed with BC (before Christ), and are generically known as 'big BC'. Such dates are part of our present day calendar (i.e. a date of 3,523 BC occurred 5,536 years ago [as at 2013]);

20.3.5.3 Calibrated radiocarbon dates, which are either related to our modern calendar as BC dates, or presented as BP (before present) dates. BP dates are calculated in years before 1950, and take into account the increased radioactivity background count following the proliferation of nuclear testing after this date. Therefore, a calibrated date of 4,500 BP indicates a point in time 4,563 years before today.

20.3.5.4 Uncalibrated radiocarbon dates, which are suffixed with bc (generally known as little bc), and are the original radiocarbon determinations based on the half-life of C14 without compensating for changes in the background count.

- 20.3.5.5 Archaeological convention dictates that dates that relate to the Lower, Middle and Upper Palaeolithic periods are referred to in terms of years BP, whilst the Mesolithic and later prehistoric periods are usually quoted in years BC. These conventions are adhered to in this report.

## 20.3.6 Significance criteria

- 20.3.6.1 The methods for assessing the potential effects of the Project on the heritage resource conform to the regulatory framework as set out in the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 (the EIA Regulations). The assessment takes into account the significance (importance) of each asset, and the likely impact (without mitigation) of the Project upon them, in order to assess the potential effects. For the purposes of this document, significance is defined as the value of the heritage asset arising from heritage interest, which may be archaeological, architectural, artistic, or historic. Significance can also be derived from an asset's setting. Taking these criteria into account, each identified heritage asset can be assigned a level of significance in accordance with a five-point scale (see Table 20.2).

**Table 20.2 Criteria for establishing the significance (heritage value) of heritage assets**

| Significance/<br>heritage value | Asset Categories                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High                            | Remains of inscribed international importance, such as World Heritage Sites.<br>Scheduled Monuments.<br>Designated wrecks.<br>Undesignated archaeological assets of schedulable/designatable quality and importance.<br>Sites and areas that can be shown to have particularly important qualities in their fabric or historical association. |
| Moderate                        | Conservation Areas.<br>Undesignated wrecks, monuments or sites that are of special interest and can be shown to have qualities in their fabric or historical association of regional importance.                                                                                                                                              |
| Low                             | Undesignated wrecks, monuments or sites of local importance or of modest quality.<br>Assets that are damaged so that too little remains to justify inclusion into a higher grade.                                                                                                                                                             |
| Not significant                 | Assets identified as being of no archaeological, architectural, artistic, or historic value.<br>Assets whose values are compromised by poor preservation or survival or of contextual associations to justify inclusion into a higher grade.                                                                                                  |
| Uncertain                       | Sites, monuments or areas of identified archaeological potential not yet investigated.                                                                                                                                                                                                                                                        |

- 20.3.6.2 The assessment of impact includes the consideration of an asset's setting, whether designated or not. With regard to historic landscapes, preliminary consultation was undertaken by TLSB with Archaeological Advisor Neil Mayland of GGAT and Cadw. It was considered that the Project will not affect any areas of registered historic landscape. As a result, an Assessment of the Significance of Impact of Development on Historic Landscapes (second edition) (ASIDOHL2) is not required as part of the EIA. Notwithstanding this, an assessment of the potential effect on historic landscapes and gardens is being undertaken, and is considered within Chapter 13: Seascape and Landscape Visual Impact Assessment.

- 20.3.6.3 The magnitude of an impact can be judged on a five-point scale (see Table 20.3). The impact score is arrived at without reference to the importance of the asset and the impact is assessed without taking into account any subsequent mitigation proposals.

**Table 20.3 Criteria for establishing the magnitude of impact on a cultural heritage asset**

| Impact Rating | Description of Impact                                                                                                                                                                                                                                                        |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High          | Change such that the significance of the asset is totally altered or destroyed. Comprehensive change to setting affecting significance, resulting in changes in our ability to understand and appreciate the resource and its historical context and setting.                |
| Medium        | Change such that the significance of the asset is affected. Changes such that the setting of the asset is noticeably different, affecting significance resulting in changes in our ability to understand and appreciate the resource and its historical context and setting. |
| Low           | Change such that the significance of the asset is slightly affected. Changes to the setting that have a slight impact on significance resulting in changes in our ability to understand and appreciate the resource and its historical context and setting.                  |
| Minimal       | Changes to the asset that hardly affect significance. Changes to the setting of an asset that have little effect on significance and no real change in our ability to understand and appreciate the resource and its historical context and setting.                         |
| No change     | The development does not affect the significance of the asset. Changes to the setting do not affect the significance of the asset or our appreciation of it.                                                                                                                 |

- 20.3.6.4 Only those heritage assets on which there is a potential for impact have been included within the impact assessment. Assessment of the significance of effect takes into consideration any design mitigation or additional mitigation proposed during development. It should be recognised that mitigation measures, for example landscaping or areas of ecological compensation, can themselves be a source of impact.

- 20.3.6.5 The assessment of the level of overall significance of the effect taking into consideration mitigation is arrived at by cross-referencing between the significance (value) of the asset (Table 20.2) and the magnitude of impact (Table 20.3) as shown in Table 20.4. The assessment of the overall significance of effect of the Project on each identified heritage asset can be Negligible, Adverse or Beneficial. Effects are only considered to be significant if they are major or moderate.

**Table 20.4 Matrix for establishing overall significance of effect**

| Significance / value of asset | Magnitude of impact                          |            |            |          |          |
|-------------------------------|----------------------------------------------|------------|------------|----------|----------|
|                               | No Change                                    | Minimal    | Low        | Medium   | High     |
| High                          | Negligible                                   | Minor      | Moderate   | Major    | Major    |
| Moderate                      | Negligible                                   | Minor      | Minor      | Moderate | Major    |
| Low                           | Negligible                                   | Negligible | Minor      | Minor    | Moderate |
| Not Significant               | Negligible                                   | Negligible | Negligible | Minor    | Minor    |
| Uncertain                     | Determinable only on definition of the asset |            |            |          |          |

- 20.3.6.6 This assessment is required to report on the significance of an effect and does not make a judgement on whether ‘substantial’ or ‘less than substantial’ harm will be caused. The judgement of whether an impact causes ‘substantial’ harm is based on whether the impact on the individual asset has an impact on the wider historic environment; where the significance of an asset is such that its loss would be detrimental to the understanding of the unique values of the wider asset type. This may include extensive physical damage to an asset or loss of critical elements of an asset’s setting. The identification of ‘substantial’ harm is therefore one of professional judgment and not directly equitable to the significance of the effect.

## **20.4 Baseline**

### **20.4.1 Introduction**

- 20.4.1.1 The known and potential marine cultural heritage resource within the Site Study Area is discussed in relation to two distinct types of archaeology: prehistoric archaeology, relating to the potential inhabitation of the area during periods of lower sea level; and maritime and coastal archaeology, relating to seafaring and the use of the inter-tidal area for a wide range of activities.
- 20.4.1.2 The prehistoric archaeology is discussed with reference to what is known about sea level change during the last one million years (the approximate period for which hominin (human and pre-human hominid) activity is known for the British Isles. This has been done in order to establish when the Site Study Area was dry land, and consequently available for exploitation by hominins.
- 20.4.1.3 Thereafter, the geology and palaeo-environment of the area has been assessed in order to determine whether deposits relating to those periods when the area was dry land may potentially survive. This is followed by a discussion of the archaeological evidence for those periods where there is potential for the survival of deposits. This discussion runs from the Lower Palaeolithic period up to the end of the Iron Age, at which time the sea level rose to a point close to its current position.
- 20.4.1.4 Maritime archaeology within the Site Study Area is discussed in relation to known wrecks and the potential for further wrecks. The inter-tidal zone has been separated out from the main maritime section due to the potential for non-shipwreck related archaeology.
- 20.4.1.5 Known sites within the Site Study Area are listed in Appendix 20.1, Volume 3, and details of sea level change within the area is summarised in Appendix 20.2, Volume 3. Sites within the Broad Study Area are illustrated in Figure 20.2, Volume 2 and sites within the Site Study Area are illustrated in Figure 20.3, Volume 3.

### **20.4.2 Submerged prehistoric archaeology baseline**

#### **Sea level change**

- 20.4.2.1 The sea level during the periods of the Palaeolithic varied from being much lower than at present, transforming areas such as the Bristol Channel into large coastal plains overlooked by the cave sites identified along the carboniferous limestone of the modern coastline, to being higher than current levels, which resulted in the formation of raised beaches such as those along the Gower Peninsula (Aldhouse-Green 2000: 10;

Murphy 2002: 45; Nayling 2002: 26). These changes in sea level were caused by the expansion and recession of the ice sheets during periods of glaciation. Enough water was locked up in ice during the glacial maximums for sea level to be up to 120m lower than today.

20.4.2.2 Factors such as the weight of the ice sheets causing the land to be pushed down, and the corresponding post-glacial, isostatic rebound of the land complicates the picture. However, the general picture is one of lower sea levels during periods of glaciation. Thus by logging the glacial periods and the position of the ice sheets relative to the site it is possible to establish the periods when the site was neither submerged, nor covered in ice, and thus available for habitation by hominins.

20.4.2.3 Appendix 20.2, Volume 3 summarises the research into the situation within the Swansea Bay area in relation to the glacial periods, the archaeological periods, the environment, sea level and the location of the ice sheets. From this it can be seen that for a substantial amount of the last one million years – the period of known hominin activity within the British Isles – the area of the site was either submerged or under an ice sheet. Thus any consideration of the potential for hominin activity within the Site Study Area may be focused upon the following time windows:

- i. Lower Palaeolithic: Either side of the Anglian glacial maximum around, 425,000 Before Present (BP), some activity is possible – though for most of this period of glaciation the Site Study Area would have been under ice.
- ii. Middle Palaeolithic: The Site Study Area was both dry and close to a known hominin activity area (on the Gower Peninsula) around 225,000 BP, and again at around 69,000 BP.
- iii. Upper Palaeolithic-Iron Age: The Site Study Area would have become dry during the onset of the Devensian glaciation, but is then likely to have lain under the edge of the Welsh ice cap. However, from approximately 13,000 BP, receding ice and the warming climate would have made the area inhabitable and some form of dry land or inter-tidal activity will have remained possible until sea level reached its current level at the end of the Iron Age.
- iv. Although evidence appears to indicate that the Site Study Area would have been uninhabitable during much of the period of hominin habitation of Britain, due to the presence of ice sheets or the sea, the factors which indicate these conditions, such as the presence of glacial moraine or marine deposits, may not be entirely reliable, or lack sufficient detail to be certain of their presence at a local scale. As such, caution is required when identifying periods in which the site was uninhabitable, particularly during the last glacial maximum, c.24,000 BP- 14,000BP, when Swansea Bay appears to have lain at the very edge of the ice sheet. Also, there is only sufficient evidence to map the fine detail of the sea level curve for the period after the Devensian glacial maximum.

20.4.2.4 The retreat of the ice sheets following the last ice age marked the beginnings of the Holocene epoch. During the early Holocene sea levels stood c.55m lower than those of today, leaving the Bristol Channel as dry land, with the coastline running to the west of Lundy island (Bell 2007: 8-9; Fitch & Gafney 2011: 89). During the Holocene, sea levels rose to 37m below their current level during the early Mesolithic period (c.9000 BC). At this time the majority of the Bristol Channel remained as dry land, with the beginnings of an estuary running between Ilfracombe and Swansea Bay.

- 20.4.2.5 Studies of offshore peat deposits around the coast of Wales indicate that the sea level rose to 16.2m below the present Ordnance Datum (OD) by c.5,500BC (Savory 1984: 39), leaving sites along the Gower close to the coast. Swansea Bay remained as dry land at this time, with the coastline running south-east from the Mumbles area (Bell 2007: 8-9). By around 3,000BC the sea level stood at c.7.3m below its current level (Savory 1984: 39), and during the early Bronze Age, at around c. 2,000BC, the shoreline is thought to have extended to within Swansea Bay following the modern curvature of the bay, with the sea level c.5m below its present level (Savory 1984: 39).
- 20.4.2.6 These figures are based on broad curves representing sea level rise. Peat deposits from within Swansea Bay give a more detailed picture of the local sea level changes (Figure 20.2, Volume 2). The general trend of sea level rise continued throughout the Holocene as the sea level curve suggests. However peat deposits from within Swansea Bay indicate that the general trend of marine transgression was interspersed with periods of regression, and is likely to have been a more dynamic process than the coarse, regional sea level curve suggests. As part of the assessments relating to the Project, bathymetric and seismic data has been used to assess sea level changes since c.10,000BP, in order to aid with the understanding of the potential for the presence of submerged prehistoric archaeology within the Site Study Area.

### Geology

- 20.4.2.7 Having established that there are a limited number of periods during which hominin activity within the Site Study Area was possible (Appendix 20.2, Volume 2), the geology of the area was assessed in order to determine whether any material from those periods was present.
- 20.4.2.8 The bedrock geology of Swansea Bay and the wider area of the Bristol Channel is dominated by mudrocks, with narrow belts of sandstone and shales, inter-bedded with limestones. Outcrops of Carboniferous limestone are present across this marine area, and are also known from coastal areas including on the Gower Peninsula, and the Pembrokeshire coast (Jenkins et. al. 2005: 1).
- 20.4.2.9 The underlying geology of Swansea Bay is dominated by rocks of chiefly Devonian and Carboniferous age (365 - 275 million years old), which are arranged in a large east-west oriented syncline. The oldest rocks, the Carboniferous Limestones, have resisted erosion from tides and currents and form the Gower Peninsula, extending from Mumbles Head beneath Swansea Bay and outcrop on the Vale of Glamorgan near Porthcawl. Northward from a line extending between Mumbles Head and Porthcawl, the solid geology is made up of a narrow exposure of Millstone Grits and Coal Measure sequences. The Bay itself is likely to have formed through the erosion of the Coal Measure sequences, following a break through the limestone and grits.
- 20.4.2.10 None of the bedrock deposits contain any archaeological potential. However, faults running through the Coal Measures are occupied by the Neath and Tawe rivers. A geophysical study of the marine area of Swansea Bay has shown that buried channels continuing on a south-western trajectory from the River Neath, crossing the bay to the south of the Mumbles, are extant (Al-Saadi & Brooks 1973). These channels may contain deposits relating to former dry land periods in the form of river gravels.
- 20.4.2.11 The surface geology within the area of the Site Study Area comprises a thin layer of glacial outwash deposits of sands and gravels, extant particularly within the north-

western area of Swansea Bay. In offshore areas of Swansea Bay, Holocene marine deposits are underlain by outwash deposits and glacial tills (Pye 2009), primarily deposited during the Wolstonian and Devensian glaciations. Boreholes taken from the area adjacent to Mumbles have revealed thick drift deposits (Al-Saadi & Brooks 1973: 150-2), with a single borehole, taken approximately 1.5km to the south of the site, recording a thick sequence of post-glacial deposits (Al-Saadi & Brooks 1973: 150).

- 20.4.2.12 The archaeological analysis of marine geophysical data (Titan, 2012) indicated the presence of a thin veneer of sand covering the Site Study Area. This layer overlies a deposit of boulder clay (glacial till) that is up to 10m thick. The junction between the boulder clay and the underlying bedrock is marked by a pronounced erosion surface. The surface of the boulder clay is cut by a small shallow channel that is filled with fine sediments including organic material.
- 20.4.2.13 The interpretation of this shallow geological sequence is that the bulk of the material overlying the bedrock is sediment deposited by the Devensian glacier, with some evidence for the survival of post-glacial deposits in the form of the material infilling the channel incised into the surface of the boulder clay. All of this material relates to the Late Upper Palaeolithic and later periods of human activity, and there is no evidence for the survival of earlier – Lower Palaeolithic to Early Upper Palaeolithic deposits.

#### **Palaeo-environment**

- 20.4.2.14 Although the sea level data (Appendix 20.2, Volume 3) suggests the potential for hominin activity within the Site Study Area during the Lower and Middle Palaeolithic, the shallow geology evidence indicates that only deposits relating to the Late Upper Palaeolithic and later periods survive. Evidence for the environment of this period is relatively sparse.
- 20.4.2.15 The subsequent middle Devensian period, from c.50,000BP until c.24,000BP was characterised by a steppe and tundra environment, with faunal remains indicating the presence of hyena, woolly rhinoceros, reindeer and horse (Caseldine 1990: 28). The last glacial maximum followed this period.
- 20.4.2.16 Following the retreat of the ice palynological studies indicate that from c.13,000-10,000BP the climate warmed and the landscape was dominated by grasses, rushes and shrubs primarily of the varieties *Gramineae*, *Cyperaceae*, *Rumex* and *Artemisia*, with birch becoming more prevalent during a warm phase, around 12,500BP (Aldhouse-Green 2000:10; Caseldine 1990: 25). This generally corresponds with the wider landscape of south-west Britain during this period (Fitch & Gaffney 2011: 9). Following the establishment of a birch population, areas of woodland expanded and became more widespread by around 12,000BP (Caseldine 1990:25).
- 20.4.2.17 The Younger Dryas, between 10,800BP-10,000BP marked a period of climatic deterioration characterised by falling temperatures and a generally wet climate. Little evidence of human occupation dates from this period, and it is thought that much of Britain may have been abandoned until c.10,300BP (Fitch & Gaffney et. al. 2011:9). However, a number of the limestone cave sites in Pembrokeshire and the Gower peninsula exhibit evidence of continued occupation during this period, including Paviland and Cathole (Murphy 2002: 46), although evidence is relatively sparse (Aldhouse-Green 2000: 19).

- 20.4.2.18 The earliest phases of the Holocene were characterised by a period of rapid warming, which saw the spread of juniper, then birch, pine and hazel by c.7350BC (9300BP). Around 6250BC-5550BC (8200- 7500 BP), oak and elm became established, with lime, ash and alder adding to the mixed woodlands from 5550BC – 2550 BC (7500- 4500 BP) (Aldhouse- Green 2000: 24).
- 20.4.2.19 A considerable number of submerged forests have been recorded around the coastline of Wales. The majority have been dated to the Mesolithic or Neolithic periods, although there are exceptions, such as those within Swansea Bay, which date to the Iron Age (Bell 2007: 10; Fig 3). The forests grew on basal soils formed during the Holocene, and were eventually surrounded by peat deposits which accumulated around the trees.
- 20.4.2.20 Significant changes to the climate and environment occurred around c.1,000BC and continued until around the 5th century BC, known as the Sub-Atlantic phase. A slightly earlier date has been suggested for coastal regions, which may have seen climatic deterioration from c.1,250BC. These climatic changes included higher rainfall, and a decrease in summer temperatures, which coincided with the series of sea level changes during this period, and the accumulation of peat bogs caused by the increased rainfall (Davies & Lynch 2000: 141).
- 20.4.2.21 Around c.400 BC climate conditions saw a period of amelioration, which lasted for around 1000 years. Peat deposits continued to accumulate across areas of Wales during the earlier part of this period, caused by deforestation of tracts of land for grazing (Davies & Lynch 2000: 141), which also led to an increase in areas of heath and grassland.

#### **Depositional sequence within the Site Study Area**

- 20.4.2.22 Within the boundaries of the Site Study Area, the sequence of deposits has been mapped out by seismic (boomer) geophysical survey (Titan 2012) and geotechnical coring (Atkins 2013). Further details of these surveys are presented in Chapter 6: Coastal Processes, Sediment Transport and Contamination. The results of these surveys have formed the basis of the following archaeological assessment of the sub-seabed sediments.
- 20.4.2.23 **Unit 1:** The uppermost deposit over most of the area is a thin veneer of sand (Figure 20.4, Volume 2), which thickens to form a 4m-thick bank within the vicinity of the offshore end of the current course of the River Neath. In other areas, there are a series of mounds of sand and gravel up to 2m thick. This deposit is interpreted as a modern mobile seabed sediment, its basal unit is a thin gravel that covers the underlying deposits.
- 20.4.2.24 **Unit 2:** In the centre of the Site Study Area, running roughly north – south, there is a shallow palaeo-channel filled with fine sediments including organic material that has no surface expression on the current seabed (Figure 20.3, Volume 2). The channel is approximately 300m wide and can be traced for approximately 1km across the site. The position of the feature in the sequence, i.e. close to the surface and sealed only by the modern seabed deposits, suggests that it may represent a relatively recent former course of the River Neath, before it was canalised by the construction of the training walls such as those shown on a late 19<sup>th</sup> century chart (Figure 20.6, Volume 2). If this is the case, then the archaeological potential inherent within the organic infill is lessened from the point of view of sediments that may help to inform the prehistoric landscape.

- 20.4.2.25 **Units 3 and 4:** Over the rest of the Site Study Area, two main deposits dominate the sequence: there is a ridge of boulder clay running north – south across the centre of the site (Unit 4), this is stratigraphically succeeded by a mixture of fine silty sands that becomes increasingly gravelly to the north west (Unit 3) (Figure 20.4, Volume 2). Unit 3 is up to 20m thick in places (more normally 12m) and infills a series of palaeochannels cut into the Unit 4 boulder clay on either side of the central ridge. In places there are organic deposits within the fills that indicate to possible presence of peats. These deposits generally occur over 10m below the present day seabed, with only one instance, in vibrocore VC202 where possible organic deposits occur higher up – at 4.65m below the seabed.
- 20.4.2.26 The boundary between Unit 3 and the unit 4 boulder clay is an erosion surface overlain by the coarser basal deposit of Unit 3. Unit 4 is a heterogeneous till that overlies landscape features cut into the underlying bedrock.
- 20.4.2.27 The interpretation of these two units is that Unit 4 comprises a post glacial till laid down by the retreating Devensian ice sheet during the period after the glacial maximum at around 22,000BP. The thick Unit 3 deposits either side of a ridge of the glacial till suggest that post glacial melt-water cut two broad valleys that were subsequently occupied by the rivers Tawe and Neath. The valley fills suggest initial high energy gravel deposits and the fragmentary survival of later lower energy organic sediments. However, the bulk of the Unit 3 deposits is a fine, horizontally-bedded, silty sand that appears to have a low archaeological potential, and may be the result of infilling of the valley hollows after the marine transgression.

#### **Lower and middle palaeolithic archaeological potential**

- 20.4.2.28 For the Lower, Middle and Upper Palaeolithic there are a series of periods when Swansea Bay would have been on dry land, not covered by ice sheets, thus making the area inhabitable (Appendix 20.2, Volume 3). However, the absence of any deposits within the area dating from these periods means that the archaeological potential is limited to the presence of derived artefacts within later deposits; typically, this manifests itself as flint tools within river gravel deposits.
- 20.4.2.29 The earliest evidence of hominin activity in Wales is from Pontnewydd Cave in north Wales, remote from the Site Study Area. Generally, evidence from the Lower and Middle Palaeolithic in Wales is rare, with artefacts occurring primarily in secondary deposits, resulting from the reworking of material during the series of successive glaciations and marine transgressions. Evidence comes primarily from cave sites, including Pontnewydd Cave, Denbighshire and Coygan Cave, Carmarthenshire.
- 20.4.2.30 Remains of early *Homo neanderthalensis* dating to c.225,000BP with stone tools of the Levallois type have been recorded, as have remains of classic Neanderthals, dating to c.50,000BP. The latter were found with stone tools of the Mousterian type, typically associated with Neanderthal populations of the Middle Palaeolithic, at Coygan Cave (Aldhouse-Green 2000:5; 13). Mousterian tools have also been recorded from Paviland Cave c.22km to the west of the Project.
- 20.4.2.31 Acheulian handaxes, dating from c.250,000BP, have been found in the Severn Estuary in the gravels around Sudbrook, and from Caldicot dating to c.225,000BP. Additionally a handaxe dating to c.50,000BP has been found at Caldicot, along the Severn Estuary

(Murphy 2002: 45). A stray hand-axe has also been found at Rhosili, on the Gower peninsula to the west of Swansea.

- 20.4.2.32 Therefore, although the only potential is for the presence of derived artefacts from this period, the general scarcity of evidence from Wales means that even stray finds would be important.

#### **Upper palaeolithic archaeological potential**

- 20.4.2.33 The Late Upper Palaeolithic spans the period of 26,000BP-10,000BP, covering the latter part of Devensian glacial maximum and the onset of the climatic recovery that saw the ice recede and the area of the Site Study Area become inhabitable (Appendix 20.2, Volume 3). As deposits of this period lie within the seabed, archaeological evidence from the surrounding area is considered in order better to understand the potential for the presence of material within the site.
- 20.4.2.34 A series of caves located on the Gower peninsula to the west of Swansea has produced evidence of Upper Palaeolithic activity - the first in Wales for the presence of anatomically modern humans. These include Worms Head Cave, Hounds Hole and Goats Hole, Long Hole and Cathole (Aldhouse-Green 2000:8-9). The latter two lie within the westernmost part of the Broad Study Area. The Paviland burial was found in Goats Hole Cave and has been dated to c.26,000 BP (Murphy 2002: 45). This cave has produced evidence indicating a long period of, at least intermittent, use, with artefacts found dating from c.23,000 BP and evidence of ivory working from 21,000 BP (Aldhouse- Green 2000: 19). These finds come from a period when ice sheets extended into Swansea Bay, fed by the valley glaciers of the Tawe and Neath.
- 20.4.2.35 The Upper Palaeolithic saw an increase in the distance travelled by traded materials, with some European sites exhibiting evidence of trade spanning up to 700km. In a Welsh context, the Paviland burial was found buried with seashells, acquired from the seashore, at least c.30km away (Aldhouse-Green 2000: 17). This implies travel over distances, and trade networks, and indicates that the area of the now submerged coastal plain was travelled across during the Upper Palaeolithic.
- 20.4.2.36 Studies into the submerged landscape in the Bristol Channel area indicate that, by around 13,000BP, during a period of climatic amelioration, the area was characterised by relatively flat land, crossed by a series of rivers running into large lakes, bordered by higher areas representing the modern Welsh and English coasts (Bowen 1980:10; Fitch & Gafney 2011), and overlooked by the caves on the Gower and Pembrokeshire peninsulas. Rivers are known to have been focal points in Palaeolithic landscapes, and *The Palaeolithic Rivers of Southwest Britain* project has identified the importance of floodplains as routes during this period, highlighting the potential for artefact deposition in these areas, including in the area of the submerged Neath valley which crosses the Site Study Area.
- 20.4.2.37 A geophysical study carried out within the Swansea Bay area has mapped the now sub-marine course of the river Neath Valley (Al-Saadi & Brooks 1973). This study recorded that the valley extends across Swansea Bay from the north-east corner, where the mouth of the Neath now lies, to the south-west, beyond Mumbles Point (Al-Saadi & Brooks 1973: 153). Peat shelves recorded at Port Talbot have been subject to radiocarbon dating, indicating that they began forming at c.10,000 BC, during the Late Upper Palaeolithic period (Sherman 2011: 3) (Figure 20.2, Volume 2).

- 20.4.2.38 These peat beds are the earliest recorded in the area. However, their presence, in addition to the presence of later peats recorded in investigations spanning the late-19th century onwards (Nayling 1998) across Swansea Bay and in the immediately adjacent hinterland (Figure 20.2, Volume 2), indicate the potential for further peats of this date to be present within the area, including the Project site. Any such peats have the potential to hold archaeological and palaeo-environmental information relating to this period. A buried channel was identified in the geophysical survey data (Titan 2012) subject to archaeological analysis as part of this study. It was identified close to the centre of the site, is thought to contain organic remains and therefore has a high Palaeo-environmental potential. However, the nomadic hunter-gatherer lifestyle of the populations means that sites of this period are likely to be small and widely spread with only a low chance of a site surviving within the Site Study Area.

### **Mesolithic archaeological potential**

- 20.4.2.39 The Mesolithic period, of 10,000 BP - c.5500 BP in Wales, is characterised by evidence of transient hunter-gatherers who, particularly in the later Mesolithic period, appear to have moved on a seasonal basis between upland and coastal locations. It appears that the primary focus was on the latter, with the upland areas showing relatively little evidence of activity apart from hunting. Early Mesolithic patterns are more difficult to understand, due to changes in the sea level which occurred during the period (Aldhouse-Green 2000), although the recorded evidence indicates a similar upland/coastal pattern.
- 20.4.2.40 Due to sea level rise, coastal sites dating from the early Mesolithic, (10,000BC- 6500BC) have all been inundated. Likewise inland sites dating to the early Mesolithic may now appear coastal, and, as such, patterns are more difficult to deduce than for the later Mesolithic period, when former coastal sites may be located in modern inter-tidal zones in some areas.
- 20.4.2.41 Evidence from the Mesolithic period generally is primarily from lithics (stone tools). However, a few major excavations carried out in coastal areas have recorded evidence of well-preserved organic remains, including pollens, which can be used to reconstruct past environments, and timber representing the remains of archaeological features or prehistoric woodland. Frequently, these sites are found in association with peat deposits, responsible for their good preservation.
- 20.4.2.42 The dates recorded for the lower peat shelves within Swansea Bay are consistent with their formation during the early Mesolithic period (Godwin 1940: 311; Sherman 2011) (Figure 20.2, Volume 2). The earliest date recorded for these peats comes from the basal peat layer recorded at Port Talbot, which has been dated to c.10,000 BC (Sherman 2011: 3). A sub-tidal core taken from peat deposits within the Bay has also given dates of c.9800- 8800 BC (Sherman 2011: 3). A number of excavations carried out prior to the construction of the Swansea docks have also recorded buried peats at depths of -13.7m to -15.2mOD within Swansea South Dock and Kings Dock (Sherman 2011: 1). Boreholes taken from Crymlyn Bog, to the east of Kings Dock, recorded up to nine levels of peat, from c. 8050 BC onward (Godwin 1940: 311).
- 20.4.2.43 The formation of the peat during this period is likely to indicate marine transgression followed by a regressive phase in which the peat formed, supported by the presence of marine clays interspersing the peats (Godwin 1940; Nayling 1998:6). Sea level studies for this period indicate that the sea level was around -37m below OD during the early

Mesolithic and -16.2m OD during the later Mesolithic. The geophysical survey of buried valleys within Swansea Bay recorded the presence of a deep channel, cut up to 80m into the bedrock, extending from the mouth of the River Neath past Mumbles Head (Al-Saadi & Brooks 1973: 147; 153). Although admiralty charts from the 19th century onward indicate that these depths are greatly lessened by the presence of sediments, depressions in the sediment such as those recorded on the 2012 Admiralty Chart 1179 (Figure 20.8, Volume 2), hint at the presence of the underlying buried valley. The early formation in peat in the area of the docks may relate to the inundation of the Neath valley prior to the general encroachment of the area by marine transgression.

- 20.4.2.44 Palynological studies carried out on the peats found within Swansea Bay indicate that the area was characterised by birch and pine woodland during the early Mesolithic period (Godwin 1940:311). When coupled with the information relating to sea level, and buried valleys, it appears that the site is likely to have lain in an area encompassing several environmental niches, including riverine and woodland, with the coast located just beyond Mumbles Head at the close of the Mesolithic period. The location of Mesolithic sites in areas where a series of different ecological niches could be exploited, is increasingly acknowledged by research (Gardiner 2011). This pattern has been identified at other sites along the south Wales coast, such as Ogmere-by-Sea (Gardiner 2011: 15).
- 20.4.2.45 In addition to palaeo-environmental evidence derived from peats of this period, Mesolithic sites within the Broad Study Area comprise a series of flint scatters located along the Gower Peninsula, and Paviland Cave, which was also re-occupied (Murphy 2002: 46). These indications of Mesolithic activity in the area, together with the favourable environmental conditions both for Mesolithic activity and the preservation of evidence, indicates some potential for Mesolithic remains. No evidence of peat shelves were recorded during the intertidal survey carried out for the Project. However, this is likely to be due to sediment accumulation in this area. Since the training of the Neath channel, sediment has accumulated at a rapid rate, contributing to the formation of the dunes at Crymlyn Burrows. Evidence of peat deposits are recorded in boreholes taken from Crymlyn Bog (Godwin 1940), and also during the construction of Swansea docks (Nayling 1998:6). This evidence, in addition to a series of other peat shelves across Swansea Bay (Figure 20.2, Volume 2), indicates that peats may survive beneath the sands within the Project site.
- 20.4.2.46 Any such peats will have a high palaeo-environmental potential. However, due to the low site density for the period, there is only a low potential for the presence of archaeological sites. However, if Mesolithic sites are present they are likely to be larger and more visible than their Palaeolithic predecessors.

#### **Neolithic archaeological potential**

- 20.4.2.47 During the Neolithic period (4000-2400BC), sea levels rose to c.-7.3m OD by around 3,000BC (Savory 1984: 39), and to c.-5m OD at around 2,000BC, with a coast form which followed the modern curvature of Swansea Bay. It is likely that the marine transgressions and regressions continued during this period, gradually subsuming the Neath valley between Mumbles Head and the modern day mouth of the River Neath. As such, the environment during this period is likely to have been much like the Mesolithic environment, with riverine and coastal elements, eventually dominated by the advancing coastline during the latter part of the Neolithic. It is suggested that during

this period, rivers formed foci of activity, based on concentrations of Neolithic finds around these areas, such as at Merthyr Mawr and Ogwr (Grimes 1984: 124).

- 20.4.2.48 Species of oak, hazel and birch have been recorded, dating from the Neolithic period from peat shelves across Swansea Bay (City and County of Swansea 2012; Godwin 1940: 318). Neolithic hand axes and flint flakes have been found across this area, indicating activity within the woodland present in Swansea Bay during this period. Pollen cores, particularly from upland sequences, indicate a period of deforestation around 2,500BC thought to be due to human farming activities, followed by peat accumulation (Lynch 2000: 83).
- 20.4.2.49 Evidence for Neolithic settlement in Wales is relatively sparse, although evidence of general activity during this period comes predominantly from lowland areas. Hearths, pits, post holes and evidence of domestic debris, thought to relate to individual farmsteads, appear to represent the pattern of settlement in Wales (Lynch 2000: 49-53). Coastal sites of habitation have been identified at Merthyr Mawr Warren and Ogmere, along the south Wales coast (Lynch 2000b: 86).
- 20.4.2.50 Evidence for Neolithic activity is recorded within the Broad Study Area, and, as with the Mesolithic period, and Holocene generally, peat shelves recorded from across Swansea Bay (Figure 20.2, Volume 2) indicate the potential of this type of deposit to hold archaeological and environmental evidence. Deposits containing organic remains were recorded at -7.6 to -9.1mOD within Swansea Dock and potentially date from this period. The concentrations of Neolithic remains found in association with rivers in south Wales, and the lowland focus of remains of general Neolithic activity, also indicate the potential for there to be evidence of Neolithic activity within the Site Study Area.
- 20.4.2.51 Any Neolithic peats will have a high palaeo-environmental potential and, due to the low site density for the period, a low potential for the presence of archaeological sites. If Neolithic sites are present, in addition to stone tools, there is the potential for pottery, houses and field monuments.

#### **Bronze Age archaeological potential**

- 20.4.2.52 The Bronze Age, 2,400BC-700BC, saw sea level rise to c.5m below its current level by around 2,000BC (Sherman 2011: 1). This would have left the coastline closely following the curve of the Bay extant today, with the sea present in an arc extending roughly from Mumbles Head to Port Talbot. The course of the now-submerged section of the Neath valley would have formed an inlet and the sea would also have extended up the smaller submerged Tawe Valley to the north.
- 20.4.2.53 Peat shelves have been recorded within the intertidal zone adjacent to the areas of Brynmill, Blackpill and Oystermouth, covering large areas of the western part of Swansea Bay, in addition to areas in the east including Kenfig and Margam. Glamorgan Gwent Archaeological Trust has carried out a survey of the Brynmill peats, dating them to the Middle Bronze Age, while the same investigation recorded a Late Bronze Age date for the Oystermouth peat, indicating inundations of Swansea Bay throughout this period (Sherman 2011; City and County of Swansea 2012). It has been suggested that the peats formed during this period due to a range of sand dunes located between the peat and sea, which restricted drainage allowing peat shelves to form behind them.

- 20.4.2.54 Remains of a middle Bronze Age hurdle trackway, dating from 2,140BC to 1,930BC have been discovered in Swansea Bay within the Brynmill peat shelf in the western part of the bay (Sherman 2011:11). Further surveys within the western part of the Bay in the Oystermouth area recorded two structures. The first structure to be identified was covered up by sands before it could be recorded, however a second structure, possibly a trackway, had a radiocarbon date of 1040BC- 910 BC (Sherman 2011:13). The macrofossil evidence taken from samples of the peat above and surrounding the trackway indicated an environment dominated by shallow water, probably relating to a freshwater marshland area. Although indications of nearby drier fenland are also suggested by the evidence, indicating a mixed fenland environment with wetter and drier areas (Sherman 2011).
- 20.4.2.55 A series of Bronze Age artefacts have been found within the Bay, including a sword, socketed axe, rapier, dagger and hair ring (Sherman 2011: 18). However, in comparison, little evidence of settlement or burial has been recorded within the hinterland of the Bay, although numerous monuments and settlements are recorded of this date along the Gower Peninsula. Evidence within the area of Swansea Bay is limited to a small amount of pottery, post holes and a hearth reflecting occupation, with evidence of settlement recorded on Coltshill near the Mumbles (Sherman 2011: 18).
- 20.4.2.56 Based on the relative paucity of evidence for occupation in the area, a model comparable to that based on the evidence from Bronze Age sites at Goldcliff, Redwick and Greenmoor Arch has been suggested by Sherman (2001). In those areas, settlements have been recorded close to trackways, similar to those identified within the Bay. The environmental evidence collected from the Oystermouth peat samples suggested that animals, such as cattle, may have been present in the area (Nayling 1998: 11). Sherman (2011: 19) suggests that the trackways may have been used to guide the animals between the drier points in the fenland environment. A row of worked timbers recorded in the Brynmill peat shelf may reflect an occupation structure (Sherman 2011: 18).
- 20.4.2.57 As discussed for earlier periods, peat deposits are recorded within Swansea Bay and there is some potential for similar deposits to survive within the Site Study Area. Based on the evidence for Bronze Age activity recorded within peats in the Swansea Bay area, any peat deposits within the Site Study Area have a high palaeo-environmental potential and, due to the fact that Bronze Age finds within the area are focused upon the peat deposits, a moderate potential for the discovery of archaeological material.

#### **Iron Age archaeological potential**

- 20.4.2.58 During the Iron Age period, of 700BC- 43AD, Swansea Bay lay at the interface between the *Silures* tribal area to the east and the *Demetae* to the west (Davies & Lynch 2000: 184). This period saw the construction of a series of hill forts and promontory forts along the coast in the Swansea Bay and Gower area. These sites fall within the general trend of Iron Age sites in coastal Wales (Murphy 2002: 52). The location of some of these monuments, with access from the sea via sandy beaches, indicates the use of the marine sphere, for trade, fishing, or gathering of marine resources. With the exception of these monuments, there is relatively little evidence of Iron Age settlement within the area, although pottery dating from this period has been found in cave sites on the Gower peninsula. Isolated finds of artefacts dating to this period have also been recorded, including from the peat shelves across Swansea Bay (Sherman 2011: 18).

- 20.4.2.59 The series of peat shelves recorded within Swansea Bay has horizons which have been dated to the Iron Age. A brushwood trackway has been recorded within the Brynmill peats, dating from between 103BC and 118AD, indicating a late Iron Age or Romano-British date (Sherman 2011: 9). A tangentially sawn plank, thought to have been worked in the late Iron Age was also recorded in this area, in addition to a series of other undated wooden features. Additionally a footprint has also been found within these peat deposits, and has likewise been dated to the Iron Age, as has a human skull found in the western part of Swansea Bay, at Blackpill.
- 20.4.2.60 Evidence for settlement along the south coast of Wales during this period indicates that the low lying areas susceptible to inundation were gradually abandoned, although evidence of limited activity during the Iron Age on the Gwent Levels has been identified, for example at Magor, Goldcliff and Redwick (Davies & Lynch 2000: 142). Based on the similarities between the Iron Age trackways identified within Swansea Bay, and those recorded along the coast of South Wales, a model of settlement similar to that for the Bronze Age has been suggested. This is based on settlement located close to trackways, with drier areas of the fenland used for grazing animals (Sherman 2011). As such, the potential for such remains to be present within the Site Study Area, is dependant on the presence of peat deposits.
- 20.4.2.61 By around OAD the sea level in the area reached a point close to its present level; as such, the potential for Iron Age and later activity within the offshore areas of the site is purely maritime (i.e. wreck) related.

### 20.4.3 Marine archaeological baseline

#### Introduction

- 20.4.3.1 Records of wrecks and obstructions recorded on the seabed located within the Broad Study Area (Figure 20.2, Volume 2) and Site Study Area have been collected from a range of sources, including Seazone (representing the records of the UK Hydrographic Office (UKHO)), the RCAHMW and GGAT. This data has been filtered to focus in detail only upon those sites that lie within the Site Study Area (Figure 20.3, Volume 2), and this data set has then been enhanced by the archaeological analysis of marine geophysical data (sidescan sonar, Magnetometry and bathymetry) supplied by Titan (2012).

#### Known wrecks

- 20.4.3.2 Within the Broad Study Area that extends out to the edge of Swansea Bay there are records of wrecks, obstructions and seabed features recorded by the UKHO as well as loss records recorded by RCAHMW and GGAT. Those sites that lie outside the footprint of the Project are shown on Figure 20.2, Volume 2 and have been used for context rather than as sites that will be discussed in detail.
- 20.4.3.3 There are three records relating to wrecks within the Site Study Area, and a feature noted on an aerial photograph dating to 1966 that possibly represents the remains of a shipwreck. These sites are as follows:

**Table 20.5 Known wreck sites**

| ID No. | Wreck Name                             | Type          | Date Sunk              | UKHO No. | Other Info                                |
|--------|----------------------------------------|---------------|------------------------|----------|-------------------------------------------|
| 01     | <i>Raven</i>                           | Schooner      | 1923                   | 69928    | Coal Cargo                                |
| 02     | <i>Bobie</i>                           | Steamship     | 1942                   | 70637    | Built 1883.                               |
| 05     | Crymlyn Burrows Intertidal Wreck       | Barge or Trow | Post-medieval or later | -        | Built for heavy cargo such as coal or ore |
| 33     | Wreckage(?) shown on aerial photograph | Unknown       | AP taken in 1966       | -        | Wreckage noted close to docks             |

20.4.3.4 Two of the records (01 and 02) are UKHO records for wrecks where the vessel was subsequently salvaged. Record 01 relates to the loss of coal schooner the *Raven* in 1923, and record 01 to the loss in 1942 of a steamship, the *Bobie*. In both cases, although the vessels have been lifted, the presence of some remaining debris on the seabed may be expected. Record 33 – features seen on a 1966 aerial photograph – may represent evidence of the remains of material from the wreck of the *Bobie* as the two sites lie only 150m apart.

20.4.3.5 Record 05 relates to the discovery and recording of a wreck within the inter-tidal zone close to Crymlyn Burrows (Nayling 1997). The site contains the substantial remains of a wooden sailing vessel that was identified as a barge or trow that was used to carry coal or ore. The vessel measured 15m by 7.5m and was aligned east-west roughly parallel with the shore. It could not be accurately dated, but is likely to be 19<sup>th</sup> century or earlier.

20.4.3.6 The given position of the wreck is recorded in the report as approximate, with the report indicating a position ‘some 150m seaward of the present (i.e. 1997) line of sand dunes’. The given position is only accurate to the nearest 100m, and even this level of accuracy must be treated with a degree of caution. As a result, a geophysical (magnetometer) survey was commissioned in order to clarify the situation (Stratascan 2013). This survey undertaken on the 17<sup>th</sup> October 2013 identified a possible anomaly to the west of the given position of the wreck, and produced no anomalies elsewhere within the survey area.

### Geophysical anomalies

20.4.3.7 There were 25 sidescan anomalies within the area of confirmed or potential anthropogenic origin (Figure 20.3, Volume 2). None could be classed as a wreck or of high or medium archaeological potential. They may be summarised as follows:

- i. 15 anomalies that represent debris of potentially anthropogenic origin;
- ii. 5 anomalies that are interpreted as wire or ground tackle associated with channel marker buoys; and
- iii. 5 anomalies characterised by areas of disturbed or reflective seabed.

20.4.3.8 All of the geophysical anomalies are of low archaeological potential. There is also a scatter of magnetic anomalies that are not associated with features on the surface of the seabed. It is not possible to interpret these anomalies further. Some may represent buried cultural remains, but overall their potential must be classed as uncertain.

### **Other marine features**

- 20.4.3.9 In addition to the wreck records and the geophysical anomalies, there is a series of records located within the offshore area that relate to maritime features (Figure 20.3, Volume 2). These include features associated with the Swansea Port approaches (06-12) and features associated with the canalisation and navigation of the Neath River (13-23). All of these features appear to be modern in origin.

### **20.4.4 Potential maritime archaeology**

- 20.4.4.1 The potential for further wrecks is discussed by period, as follows:

#### **Prehistoric**

- 20.4.4.2 No direct physical evidence of Mesolithic boats has been found to date in Wales. However, Mesolithic dug-out canoes are known from elsewhere in Europe. A possible dug-out canoe has also been recorded at Perth in Scotland, although this identification is by no means certain (Burov 1996: 12). Indirect evidence also indicates the existence of Mesolithic boats in Britain, including the habitation of islands, mainly in Scotland, which would have required crossing expanses of water (Rainbird 2007: 145).
- 20.4.4.3 It has been suggested that similarities in chambered tombs from Scotland, France, Ireland and Wales represent maritime connections spanning the western Atlantic seaboard in the Neolithic period (Sheridan 2003). The location of chambered tombs along the Welsh coastline is generally understood to reflect the role of the sea in Neolithic society, providing connections to this wider Atlantic network (Grimes 1984: 123-124). Further evidence of seaward connections comes from typological similarities between pottery styles on different islands, and the introduction of fauna to areas, in particular islands, to which they are not native (Rainbird 2007: 146- 149). However, although a number of factors which appear to indicate Neolithic seafaring capabilities can be identified, no physical remains of boats dating to this period have been recorded (Lynch 2000: 54).
- 20.4.4.4 Bronze Age boats have been recorded from sites along the Welsh coast, including from Goldcliff and Caldicot (Rainbird 2007: 156). The vessels are plank boats, comparable with the near-complete examples found at Ferriby on the Humber Estuary, and although their presence indicates travel across water, their open seagoing capabilities are debated (Rainbird 2007: 156). The comparisons made above with the evidence of occupation at Goldcliff and within Swansea Bay make the finding of a boat on the Goldcliff site particularly relevant for assessing the potential for maritime remains within Swansea Bay.
- 20.4.4.5 Evidence of Iron Age vessels is scarce in Welsh waters, and across Britain in general. However, trade networks in the Iron Age are known to have been far reaching, connecting communities across Europe, with a major sea route, referred to as the western Atlantic system, spanning the western edge of the European continent, passing between Wales and Ireland, and along the western coast of Scotland, connecting these areas (Cunliffe 1995: 117). Despite this proxy evidence, the relative paucity of Iron Age boats across Britain indicates only a limited potential for such remains to be present within the Site Study Area.

**Roman**

- 20.4.4.6 The Roman period, from 43-410 AD, is represented within the wider area by a series of features. A Roman road ran from Neath to Loughor, to the north of the Gower Peninsula, crossing the River Tawe at a ford, c.2.5km to the north of the site (Sherman & Evans 2004: 27-28), which lay within the wider network of Roman roads leading from Cardiff to Neath, via Kenfig, and onward from Loughor to Carmarthen. A Roman fort and possible urban settlement have been identified at Neath, in addition to a fort recorded at Loughor, between which a series of other military installations are recorded (Sherman & Evans 2004: 28).
- 20.4.4.7 Pottery dating from the 3rd century AD, recorded from Hen Gastell next to the River Neath, is thought to have been imported from the nearby Roman fort at Neath (Wilkinson 1996: 17). Additionally a series of find spots are also recorded, ranging from coins to brooches and pottery sherds, a number of which have been retrieved from the intertidal zone. A possible Roman villa has also been identified at Oystermouth church. These findings indicate Roman activity within the area.
- 20.4.4.8 It has been suggested that Swansea may have been a Roman shipping area, which connected with the nearby road network via rivers, such as the Tawe (Sherman & Evans 2004: 12). This suggestion is based on the proximity to the Roman road identified crossing the Tawe, and may be supported by the series of findspots. It has also been suggested that the numbers of Roman coins found on beaches across the Broad Study Area may indicate maritime traffic, with the possibility that the coins reflect the use of the beach areas for trading (Locock 1996: 11).
- 20.4.4.9 Within the wider area, extensive evidence of Roman civilian and military occupation along the Severn Estuary attests to the strength of Roman presence in the area, and it is thought that many of these settlements were sited on rivers and the coast to take advantage of maritime connections (Murphy 2002: 55). Direct physical evidence of Roman shipping along the south Wales coast comes from the Caldicot Level, c.70km to the east of the Swansea Bay where the Barland's Farm boat, dating to the Roman period, has been recorded (Nayling & McGrail 2004). Evidence of Roman shipping is also derived from documentary sources recording the Roman knowledge of the British coastline, in addition to other indications, such as the presence of Romans within Britain, which would have necessitated travel across the English Channel (Murphy 2002: 55).
- 20.4.4.10 Maritime connections during the Roman period are thus well attested, and the suggestion of Swansea as a shipping centre during this period highlights some potential for associated maritime remains, including remains of boats or other features of the maritime landscape, including quays, wharves and jetties which are also known from this period. However, as no evidence of Roman ships or associated maritime features have been recorded within the Site Study Area to date, the potential for their presence in the Site Study Area must be considered to be limited.

**Early medieval**

- 20.4.4.11 Excavations carried out at Hen Gastell prior to the construction of the M4, on the western bank of the River Neath, close to the river mouth, recorded evidence of an early medieval settlement (Wilkinson 1996), thought to date to between the 6th to 8th centuries. The finds from this site have a wide range of origins, including the eastern

Mediterranean and Byzantine Empire. Although the presence of these goods at Hen Gastell would tend to suggest connections with the continent, it has been argued that they may have arrived in south Wales from sites in south-west England, where these goods were exchanged for tin, lead and silver. As such, the presence of these goods may indicate trade across the Severn during the early medieval period (Wilkinson 1996).

- 20.4.4.12 Place-name evidence may indicate a Scandinavian presence at Swansea during the 9th-10th centuries. The name Swansea itself is thought to derive from the components 'Sveinn' and 'ey', the former being a personal name, and the latter meaning an island (Jones 1995:2). It has been suggested that the island element of Swansea referred to an island which had formed between two forks of the River Tawe, built up from sediment from the river, which existed during the early medieval period (Jones 1995:3). Other Scandinavian place names further west of Swansea include the names of small islands, including Grassholm and Skokholm (Jones 1995:2), of which the holm element bore the meaning small island, or islet.
- 20.4.4.13 It has been suggested that Swansea formed the focus for activity in this area, possibly being a trading centre or port (Jones 1995:2). However, archaeological evidence of a Scandinavian presence in the area is limited to a glass bead from Hen Gastell hillfort at Briton Ferry (Redknap 1998; Wilkinson 1992: 23) and a single Hiberno-Norse ringed pin, found on Norton Beach in Swansea Bay (Redknap 2007:86). Ringed pins of this type have been found across the North Atlantic, in the Isle of Man, mainland Scotland, the Hebrides, Orkney, Shetland, the Faroe Islands (Stummann Hansen 1995), Iceland, Newfoundland and Ireland (Larsen & Stummann Hansen 2001: 118), where they are thought to have originated at the trading centre at Dublin. The similarity between the ringed pin found in Swansea Bay, and those recorded across the North Atlantic, indicate a trade network across this area in which a variety of goods and materials were exchanged (Graham-Campbell 2001), and with which Swansea appears to have been connected.
- 20.4.4.14 These early medieval connections, therefore, indicate the necessity for boats during this period, but none have been identified within the Broad Study Area dating to this period. The seagoing capabilities of the Scandinavians are well discussed (e.g. Crumlin-Pedersen 2010). However no ships dating to this period have been identified in Wales, although a sword guard dating to c.1100, discovered on a reef near Ramsey Island, may indicate the presence of a Scandinavian wreck off the Pembrokeshire coast (Murphy 2002: 58).

### Medieval

- 20.4.4.15 It is thought that the town of Swansea dates from the medieval period (1066-1539), fitting into a pattern of growth of urban centres during this period connected with the Edwardian, Anglo-Norman and earlier Norman conquests of Wales (Murphy 2002: 60). These invasions were frequently associated with the construction of castles. Following the Norman invasion, a castle was constructed in Swansea in 1106, by Henry de Beaumont. This castle was destroyed by the Welsh, and a second was built at the end of the 13th century, the remains of which survive today. A series of other medieval structures and finds are recorded within the Swansea Bay area, including mills, churches, a deserted rural settlement, rabbit warrens and a ferry. The latter is known from documentary sources from the 12th century and was located at Briton Ferry, on the River Neath, and provides an indication of the use of boats within the Swansea Bay area during the medieval period (Wilkinson 1996: 3).

- 20.4.4.16 During the medieval period maritime connections contributed to an important economic network (Locock 1996: 12). Pottery distributions indicate connections between the south Wales coast and southern England, focused around the port of Bristol. Additionally, physical remains of medieval boats have been recorded at Magor Pill in south Wales, and Pwll Fanogl in north Wales (Murphy 2002). The Magor Pill boat, excavated from the Severn Levels has been dated to the 13th century and was clinker-built, in the tradition of the earlier Norse ships. The boat was found to be carrying a cargo of iron ore (Murphy 2002: 63), indicating the kind of goods traded in this area during the medieval period. At this time ships in the area, taking advantage of the large tidal range, were beached or anchored in bays (Locock 1996: 12).
- 20.4.4.17 A possible medieval wreck, the *Ann Francis*, has been tentatively identified on Margam Sands within Swansea Bay. This is based on scattered finds in this area, including two 16th-century coins (Locock 1996).
- 20.4.4.18 There appears to be some potential for maritime remains, comprising ships or boats to be present within the Site Study Area, due to the foundation of a settlement of Swansea, and contemporary examples of shipping along the south Wales coast.

### Post medieval

- 20.4.4.19 A number of documentary loss records are listed by the RCAHMW and the HER within the Broad Study Area. The majority of these records date to the post-medieval and modern periods. Positions for the losses are typically vague and the records are ascribed to 'named locations', such as 'Swansea Bay' or 'Off the Mumbles', that do not relate to the actual points of loss. Although most of these named locations are located a considerable distance from the Site Study Area, the imprecise nature of the recording of losses means that there may be potential for the wrecks to lie within, or close to it.
- 20.4.4.20 The table below contains a summary of these documented losses, including the type of craft and, where known, the date at which it was lost. This breakdown provides an insight into maritime activities, particularly during the later post-medieval and modern periods. These figures can be best understood in the context of the development of the port of Swansea.

**Table 20.6 Documented losses within Swansea Bay**

| Period | Dates     | Type Of Ship         | No. of ships | Total |
|--------|-----------|----------------------|--------------|-------|
| Modern | Post 1950 | Motor Vessel         | 1            | 1     |
|        | 1900-1950 | Steamship            | 10           | 30    |
|        |           | Tug                  | 4            |       |
|        |           | Schooner             | 4            |       |
|        |           | Lifeboat             | 2            |       |
|        |           | Ketch                | 2            |       |
|        |           | 'Four Master'        | 1            |       |
|        |           | Barque               | 1            |       |
|        |           | Ex-Liberty Ship      | 1            |       |
|        |           | Whale Factory Ship   | 1            |       |
|        |           | Trow (Cargo Vessel)  | 1            |       |
|        |           | Steam ship           | 1            |       |
|        |           | Trawler              | 1            |       |
|        |           | Alfred Holt Vessel   | 1            |       |
|        | 1850-1900 | Barque               | 9            | 43    |
|        |           | Schooner             | 9            |       |
|        |           | '2 & 3 masted ships' | 6            |       |
|        |           | Pilot Cutter         | 2            |       |
|        |           | Steamship            | 2            |       |

| Period        | Dates     | Type Of Ship           | No. of ships | Total |
|---------------|-----------|------------------------|--------------|-------|
|               |           | Smack                  | 2            |       |
|               |           | Tug                    | 2            |       |
|               |           | Collier                | 2            |       |
|               |           | Lifeboat               | 2            |       |
|               |           | Ketch                  | 1            |       |
|               |           | Craft                  | 6            |       |
|               | 1800-1850 | Brig                   | 6            | 25    |
|               |           | Sloop                  | 2            |       |
|               |           | Smack                  | 2            |       |
|               |           | Schooner               | 2            |       |
|               |           | Barque                 | 1            |       |
|               |           | Cargo Craft            | 3            |       |
|               |           | Craft                  | 8            |       |
|               |           | Small Craft            | 1            |       |
|               | Unknown   | Unidentified           | 6            | 6     |
| Post Medieval | 1750-1800 | West India-Man (Cargo) | 1            | 5     |
|               |           | Sloop                  | 1            |       |
|               |           | Admiralty Tender       | 1            |       |
|               |           | Craft                  | 1            |       |
|               |           | Craft (Cargo)          | 1            |       |
|               | 1700-1750 | Brig                   | 1            | 1     |
|               | Unknown   | Unidentified           | 25           | 25    |

### The growth of the Port of Swansea:

20.4.4.21 During the post-medieval period the Port of Swansea grew around the mouth of the River Tawe. It is thought that by the beginning of the 18th century the port was one of the largest in Wales (Locock 1996). During the early post-medieval period, prior to the construction of the modern docks at Swansea, ships were beached along the banks of the River Tawe. It is also likely that wharfs were built up around this area (Locock 1996). Early mapping dating to the latter part of the post-medieval period indicates that piers had been constructed around Fabians Bay, located in the area now occupied by the Swansea docks, providing protection for ships (Locock 1996). These features are not shown on earlier maps, including Bower's 1729 Map of Swansea (Figure 20.5, Volume 2), and as such indicate developments around the port of Swansea during the latter part of the post-medieval period.

### Modern

20.4.4.22 During the modern period, from 1800 to the present, the development of the Port of Swansea continued. The growth of the port may reflect an increase in industry within this area of Wales. The coal trade saw a dramatic increase from 1840, in particular from the port of Swansea. Prior to this period the coal industry had been principally focused on domestic or foundry use, transported by coastal trade across the Bristol Channel and Irish Sea. Following 1840, the coal trade found overseas markets, and, as such, expanded rapidly (Hicks 2002). It is, therefore, likely that the peak in documented losses between 1850- 1900 relates, at least in part, to the coal trade.

20.4.4.23 In 1840 the first docks were constructed at Swansea, followed by the construction of a channel five years later which re-aligned the Tawe. The construction of the North Dock and South Dock took place in the mid-19th century on the west side of the river. During the latter part of the 19th century a series of docks were constructed on the west side of the river including the Prince of Wales dock, with the addition of King's Dock and Queen's Dock in the early 20th century. The docks on the western side of the river fell out of use by the 1930's (Locock 1996).

- 20.4.4.24 The general upward trend in the numbers of documented losses identified during the post-medieval period continued throughout the modern period, in tandem with the continued development of the port of Swansea, with 25 documented losses recorded between 1800 and 1850, and 43 between 1850 and 1900. After 1900, the documented losses recorded decrease, to 30 between 1900 and 1950, and 1 recorded after 1950. This pattern appears to reflect the peak in dock building and use in the mid-19th to early 20th century. The documented losses also indicate that a number of fishing vessels were lost over the post-medieval and modern periods, indicating fishing to be an important industry in the area.
- 20.4.4.25 The construction of the docks has acted as a focus for other maritime developments within the area, such as the dredging operations to straighten the course of the River Neath and the construction of man-made river fronts (Wilkinson 1996: 3). Other dredging operations are associated with the course of the River Tawe, and sailing routes leading from this river, and the docks, out into Swansea Bay.
- 20.4.4.26 These alterations to the environment have a series of implications for marine archaeology in the area. First, dredging is associated with areas of direct physical impact on any archaeological remains lying on the seabed, or preserved in deposits beneath the sea floor. Additionally modern developments, in particular the training of the River Neath channel, is thought to have caused alterations to the sedimentation in the Swansea Bay area, giving rise to increased sedimentation within the site and leading to the formation of, for example, Crymlyn Burrows. These alterations to sediment movement and accumulation are likely to have covered archaeological remains in areas of increased sedimentation, and exposed to the processes of erosion remains in other areas (Tidal Lagoon Swansea Bay 2012: 21). Evidence of modern sand accumulation at Crymlyn Burrows was noted during a site visits in January and February 2013, when a railway sleeper exposed in the face of the sand dunes lying on the outer edge of Crymlyn Burrows was observed to be overlain by a considerable depth of sand (Figure 20.9, Volume 2).

#### **Aircraft losses**

- 20.4.4.27 In addition to the documented losses of ships, a number of aircraft are also thought to have been lost in the Swansea Bay area: the Miles Martinet I Hp143, whose engine cut out forcing it to land at Hunts Bay, Southgate, Glamorgan, on 8 August 1945; the Bristol Beaufighter IIF T3146 which crashed during a forced landing near Swansea on 26 May 1942; and Armstrong Whitworth Whitley V T4163 which crashed after take-off from Stormy Down at Kenfig Sands on 15 June 1941. Additionally, Fairey Battle I V1211 crashed on the approach to the drogue dropping area at Kenfig on 2 May 1941, and the Vickers Wellington VIII HX482 was shot down by a US tanker off Swansea on 19 August 1942. Although the remains of these aircraft are not precisely located on the seabed, any remains relating to the aircraft are designated as a Protected Place under the Protection of Military Remains Act 1986.
- 20.4.4.28 The dates recorded for the loss of these aircraft shows that they were lost during the Second World War, although some of the details relating to these losses indicate that they were not necessarily lost during fighting.

### Intertidal archaeology

- 20.4.4.29 Although the sea level throughout the post-Roman period has been close to the present day level, the coastline appears to have undergone some alterations. Most notable within the Swansea Bay area is the accumulation of the Crymlyn Burrows sand dunes. This sediment accumulation is thought to relate, at least in part, to the construction of the training wall along the River Neath training channel, reported by the Coastline Response Survey (Tidal Lagoon Swansea Bay 2012: 21), causing the expansion of the Crymlyn Burrows 0.9km southward since the mid-19th century. The development of the coastline in this area is illustrated in Figures 20.5-20.8, Volume 2.
- 20.4.4.30 As the coastline was 0.9km to the north of the current high water line, the potential for quays, jetties, piers, harbours and other remains typically sited at the land/sea interface is very limited. Additionally the location of the coastline has implications for boat beaching areas during this period (i.e. given the distance of the coastline from the current high water line, the potential presence of beached boats is again limited). The increased sedimentation to the east of the docks has also had a potential effect upon the visibility of the sort of inter-tidal archaeology that is easily visible to the west.
- 20.4.4.31 A large number of fish traps and weirs have been recorded in the area. The bulk of the visible sites are focused around the western part of Swansea Bay although some have also been recorded in the Project site (Figure 20.3, Volume 2). The weirs formed barriers of wood or stone which guided the fish into traps, usually consisting of nets or baskets in varied forms (O'Sullivan 2003: 451). Studies into British fishing weirs have highlighted the range in dates recorded for these constructions, with examples from the Severn Estuary recorded in a palaeochannel at Cold Harbour Pill among the earliest in Britain, dating to the Late Bronze Age (O'Sullivan 2003: 455), although an early Neolithic example is known from elsewhere (English Heritage 2011: 2), and an example dating from between 6100 and 5700 BC is known in Ireland. Documentary sources provide more extensive evidence for the use of fishing weirs and traps through the early-medieval period, with an apparent peak in use during the medieval period, from the 12th-14th centuries. It is possible that the increase in fish traps and weirs during this period was due to a connection with the fish trade, which saw considerable intensification during the medieval period, across Europe (Barrett et. al. 2004).
- 20.4.4.32 A number of fish traps were recorded on a chart of 1883-4 (Appendix 20.1, Volume 3). These stretched for c.200m and appeared similar to the extensive features to the west. Therefore even though much of this complex lies under the current docks, it represents evidence that the area to the east of the dock may contain a similar density of archaeology to the area to the west, with a possible explanation for their non-appearance being the heightened sand levels associated with the Crymlyn Burrows formation.
- 20.4.4.33 Notwithstanding this, a number of probable fishing weirs were observed during successive intertidal surveys within the site (24-32, Appendix 20.1, Volume 3) (Figures 20.10-20.11, Volume 2). These were visible as lines of stones close to the low water mark (Figure 20.10, Volume 2). The features are generically 'Y' or 'W' shaped and, although not formally dated, appear to be modern (possibly 19<sup>th</sup> century) in origin.
- 20.4.4.34 Oyster fisheries developed in the Oystermouth area of Swansea Bay, with a peak in the industry during the latter part of the 19th century (Nayling 1998: 21). These fisheries are thought to have been associated with a jetty, oyster perches and wrecks identified

in the Oystermouth area (Nayling 1998: 22). It is possible that further remains of the oyster fisheries are preserved beneath sediments in other areas of the Bay (Nayling *Pers. Comm.* 2013).

## **20.5 Summary of baseline**

### **20.5.1 Prehistoric archaeology**

20.5.1.1 Due to the absence of contemporary deposits, the potential for Lower, Middle and Early Upper Palaeolithic archaeology within the Site Study Area is restricted to derived artefacts occurring within later sediments, or deposits that lie deeply buried under the boulder clay well beyond any excavation associated with this Project. The Unit 4 boulder clay and later Unit 3 infill sediments (Figure 20.4, Volume 2) recorded within the site have the potential to contain re-deposited remains of this date.

20.5.1.2 The site lay under the outer edges of the Devensian ice sheet. Consequently, the prehistoric potential for the application site is focused on the period after the withdrawal of the ice and before the inundation of the area caused by sea level rise. Although there is a general level of potential on the surface of the boulder clay ridge running down the centre of the site, any sites at that level are likely to have been eroded by the rising sea. Therefore, the greatest area of potential lies within any preserved peat deposits within the infilled valleys on either side of the ridge.

20.5.1.3 Peat shelves and deposits have been identified across Swansea Bay in investigations from the late 19th century onward, including within the area of the docks at -13.7m OD to -15.2m OD, with some fragmentary evidence higher up at -7.6m OD. The earliest peats date from the Late Upper Palaeolithic, with eight or nine successive phases of peat identified in other areas across the bay, culminating in the levels dating to the Iron Age identified at Brynmill. There is the potential for there to be peats containing archaeological or palaeo-environmental remains spanning the Holocene, within the Site Study Area. However, the evidence suggests that these lie deeply buried, the only deposit of possible archaeological interest lies at 4.65 m below the current sea bed in an area close to the navigation channel into the port. To the south of this point, any such deposits lie deep within the valleys that run under the eastern and western edges of the site, beyond the investigative limits of the geotechnical survey carried out in 2012 (Atkins, 2013).

### **20.5.2 Maritime archaeology**

20.5.2.1 The very low level of known wrecks within the Site Study Area is likely to be a reasonable indication of the overall chance of finding new sites. However, the discovery of the inter-tidal wreck (05 on Figure 20.3, Volume 2) in 1996 and its subsequent (and current) burial does emphasise that there is some potential for the discovery of further wrecks within the seabed sediments of the Site Study Area. Any such finds may date as far back as the Mesolithic, but later wrecks are more likely. The degree of potential burial for any sites cannot be stated with any certainty. However, based on the thickness of the surface sediment and the composition of the underlying shallow geology, for wrecks of medieval and later date (i.e. those most likely to occur) burial beneath more than 2m of sediment is considered unlikely.

## Intertidal archaeology

- 20.5.2.2 Fishing weirs have been identified across Swansea Bay, notably to the west of the docks. Within the Site Study Area, lines of stones thought to represent the remains of fishing weirs have been recorded and there is evidence to suggest that raised sand levels may be masking a wider range of features. The degree of potential burial for any sites cannot be stated with any certainty. However, based on the thickness of the surface sediment and the composition of the underlying shallow geology, for fish traps of medieval and later date (i.e. those most likely to occur) burial beneath more than 2m of sediment is considered unlikely.

## 20.6 Impact assessment

- 20.6.0.1 This section considers the potential impact of the Project on the known and potential maritime archaeological resource during the construction and operational phases. The decommissioning phase is not relevant for this topic, see 20.6.3 below.

### 20.6.1 Construction phase impacts

- 20.6.1.1 The main permanent, offshore and near-shore elements of the Project and their potential impacts are as follows:

**Table 20.7 Construction phase impacts**

| Scheme Element                                                  | Potential Impact                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Permanent seawalls                                              | The lagoon seawall will impact archaeological features on the surface of the seabed. This will affect an area 40m to 100m wide along the full length of the seawalls.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Dredging to provide material for the core of the Lagoon seawall | <p>Dredging by suction-cutter dredger will remove any archaeological features within the dredged areas. Dredging will take place on the site of the Turbine and sluice gate housing structure and on one of two options within the area enclosed by the seawall. The dredging locations are shown in Chapter 4: Project Description (Figure 4.8 and 4.9).</p> <ol style="list-style-type: none"> <li>1. A sub-rectangular bowl measuring up to 640m by 330m will be dredged to accommodate the turbine and sluice gate housing structure. This will be dredged to -14.35m CD in the centre of the area (c.9m to 10m below current bed level), with the sides sloping up from a point c.100m in from the outer edge. The dredged material will be used for the construction of the seawall.</li> <li>2. Option 1 for the dredging of the remaining material for the sea wall involves the excavation of a 500m wide strip parallel to the line of the seawall down to a depth of 2m below current seabed level (purple on Figure 4.8). There is also a potential secondary dredging area in the centre of the lagoon. The central area would be used if not enough suitable material could be sourced areas around the edges of the lagoon.</li> <li>3. Option 2 for the dredging of the remaining material for the sea wall involves the excavation of five 450m wide holes down to a depth of 15m below current sea bed level (Figure 4.9).</li> </ol> |
| Temporary offshore turbine enclosure                            | Construction of a temporary cofferdam bund around the turbine construction site and the dewatering of the area will impact upon any surface archaeology exposed by the dredging of the bowl to house the turbine and sluice gate housing structure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

|                                           |                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Turbine and sluice gate housing structure | Concrete structures will impact archaeological features on the surface of the seabed, and remove subsurface features where the turbine housing is sunk into the seabed over an area measuring at most 440m by 67.5m. Around the perimeter of the structure sheet-piles will be driven into the seabed to a depth of 10m, and a 30m wide, concrete scour protection mattress will be installed. |
| Construction vessels                      | Anchors and/or spud legs of construction vessels will impact upon archaeological features on the surface of the seabed                                                                                                                                                                                                                                                                         |

### Archaeological significance

- 20.6.1.2 The archaeological significance of the known and potential archaeological features may be summarised as follows:

**Table 20.8 Table of Archaeological Significance**

| ID No.(s)<br>(Figure 20.3, Volume 2) | Description                                                                                                              | Significance Rating |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------|---------------------|
| 01-02                                | Lifted Wrecks                                                                                                            | Not Significant     |
| 03                                   | Documented aircraft loss                                                                                                 | High                |
| 04, 24-25, 27-32                     | Post medieval/modern fish traps                                                                                          | Low                 |
| 05                                   | Inter-tidal wreck                                                                                                        | Moderate            |
| 06-12                                | Swansea Port approach features                                                                                           | Not Significant     |
| 13-23 & 26                           | Neath Channel features                                                                                                   | Not Significant     |
| 36, 40-42, 56                        | Geophysical anomalies identified as wire or ground tackle for buoys                                                      | Not Significant     |
| 33-35, 37-39, 43-55 & 57-58          | Features and geophysical anomalies identified as potentially anthropogenic debris                                        | Unknown             |
| n/a                                  | Potential buried maritime archaeology – principally 19 <sup>th</sup> century and earlier shipwrecks                      | Low-High            |
| n/a                                  | Potential buried prehistoric archaeology – principally Late Upper Palaeolithic to Iron Age sites and associated deposits | Moderate-High       |
| n/a                                  | Potential buried inter-tidal archaeology – principally Roman to post-medieval fish traps                                 | Low-Moderate        |

- 20.6.1.3 In addition to the known archaeological features, table 20.8 lists three categories of archaeological potential that have been established by the baseline study. The available evidence indicates that: shipwreck sites will be rare, but where they occur medieval and post-medieval finds are more likely; Prehistoric sites dating from the Late Upper Palaeolithic to the Iron Age potentially exist within the area, possibly at depths of -7.6mOD though with clear evidence at -13.7mOD; and that fish traps of Roman to post-medieval date are likely given the evidence elsewhere within the Bay, but if they exist within the area they are buried.

### Magnitude of impact

- 20.6.1.4 The following table summarises the magnitude of impact broken down by activity type:

**Table 20.9 Magnitude of impacts**

| Scheme Element                     | Nature of the Impact                  | Magnitude of Impact                                                                                                                                        |
|------------------------------------|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Permanent Breakwater Bund seawalls | Impact on the surface of the sea bed. | Impact upon known sites visible on the surface of the sea bed will be Low. Impact upon currently unknown, buried archaeology will be No-change or Minimal. |

|                                                                 |                                                                                                                                                           |                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dredging to provide material for the core of the Lagoon seawall | Dredging will remove sediments to a variety of depths around the turbine and sluice gate housing structure and within the dredging area of the lagoon.    | Impact upon known sites visible on the surface of the sea bed will be High. Impact upon currently unknown, buried archaeology will be High for sites that lie wholly within the dredged volume, and Low to Moderate for sites that lie on the margins of the dredged area. |
| Temporary offshore turbine enclosure                            | Impact to the surface of the area dredged out to accommodate the turbine and sluice gate housing structure, and possibly deeper impact from sheet-piling. | There are no known sites at this depth below the sea bed, impact upon currently unknown, buried archaeology will be Low to Moderate. Impact from piling will be Minimal.                                                                                                   |
| Turbine and sluice gate housing structure                       | Impact to the surface of the area dredged out to accommodate the turbine and sluice gate housing structure, and deeper impact from sheet-piling.          | There are no known sites at this depth below the sea bed, impact upon currently unknown, buried archaeology will be Low to Moderate. Impact from piling will be Minimal.                                                                                                   |
| Construction vessels                                            | Impact upon the surface of the seabed                                                                                                                     | Impact upon known sites visible on the surface of the sea bed will be Low. Impact upon currently unknown, buried archaeology will be No-change or Minimal.                                                                                                                 |

20.6.1.5 The magnitude of impacts in relation to known and potential archaeology may be summarised as follows:

**Table 20.10 Magnitude of impacts in relation to known and potential archaeology**

| Scheme Element                                                  | Impact                                                                    | Archaeological sites Affected (Figure 20.3, Volume 2)                                                              |
|-----------------------------------------------------------------|---------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Permanent Breakwater Bund seawalls                              | Impact on seabed surface                                                  | <b>1, 2&amp; 42</b> and potential maritime archaeology                                                             |
| Dredging to provide material for the core of the Lagoon seawall | Turbine enclosure dredge area impact to up to 10m below current bed level | Potential maritime archaeology and potential prehistoric archaeology                                               |
|                                                                 | Option 1 (purple area) impact to -2m below current bed level              | <b>10, 33, 37-39, 43, 48-49 &amp; 52-54</b> , potential inter-tidal archaeology and potential maritime archaeology |
|                                                                 | Option 1 (pink area)                                                      | <b>24-25, 27-31, 44-47, 50-51 &amp; 55</b> potential inter-tidal archaeology and potential maritime archaeology    |
|                                                                 | Option 2 impact to -15m below current bed level                           | Potential maritime archaeology and potential prehistoric archaeology                                               |
|                                                                 | Option 2 area dredge in the north western area of the lagoon              | <b>33, 52 &amp; 54</b> , potential inter-tidal archaeology and potential maritime archaeology                      |
| Temporary offshore turbine enclosure                            | Impact to surface of dredged area at up to 10m below current bed level    | Potential prehistoric archaeology                                                                                  |
| Turbine and sluice gate housing structure                       | Impact to surface of dredged area up to 10m below current bed level       | Potential prehistoric archaeology                                                                                  |
| Construction vessels                                            | Impact on seabed surface                                                  | <b>16, 33, 40 &amp; 56</b> and potential maritime archaeology                                                      |

20.6.1.6 The sites not subject to any impact are as follows: 3-9, 11-15, 17-23, 26, 32, 34-36, 41 & 57-58.

### Significance of effect

- 20.6.1.7 Those sites subject to impact are set out above, however only those sites with an identifiable level of significance (i.e. High, Medium or Low) and those sites for which significance is rated as uncertain have been taken forward to this assessment of Significant Effects (Table 2.11). Those sites rated as Not Significant (see Table 20.8 above) or No impact (see paragraph 20.6.1.6) have been excluded.

**Table 20.11 Assessment of significant effect**

| ID No.(s)                                | Archaeological Significance | Magnitude of impact                                                                          | Significance of Effect |
|------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------|------------------------|
| 05                                       | Moderate                    | No Change                                                                                    | Negligible             |
| 24                                       | Low                         | High                                                                                         | Moderate               |
| 25                                       | Low                         | High                                                                                         | Moderate               |
| 27                                       | Low                         | High                                                                                         | Moderate               |
| 28                                       | Low                         | High                                                                                         | Moderate               |
| 29                                       | Low                         | High                                                                                         | Moderate               |
| 30                                       | Low                         | High                                                                                         | Moderate               |
| 31                                       | Low                         | High                                                                                         | Moderate               |
| Potential buried maritime archaeology    | Low-High                    | High (for sites in dredge areas)                                                             | Moderate to Major      |
| Potential buried maritime archaeology    | Low-High                    | Minimal (for sites subject to anchoring impact)                                              | Negligible to Minor    |
| Potential buried prehistoric archaeology | Moderate-High               | Minimal to Medium (for sites within Option 2 dredge areas and turbine enclosure dredge area) | Minor to Major         |
| Potential buried inter-tidal archaeology | Low-Moderate                | High (for sites in dredge areas)                                                             | Moderate to Major      |
| Potential buried inter-tidal archaeology | Low-Moderate                | Minimal (for sites subject to anchoring impact)                                              | Negligible to Minor    |

- 20.6.1.8 Sites 33, 37-39 and 43-55 are of unknown significance. Although these sites will be subject to some level of impact, the significance of this impact cannot be ascertained exactly, but is anticipated to be at most Minor based on the evidence available. The impact upon these sites will be addressed through mitigation.
- 20.6.1.9 An impact of Moderate Significance is predicted for sites 24-25 and 27-31. These are all inter-tidal fish traps that will be impacted by if Option 1 (purple) dredging is progressed. This effect will be addressed through mitigation.
- 20.6.1.10 Moderate to Major impacts are possible upon currently unknown maritime, prehistoric and inter-tidal archaeology. This impact only affects areas with a low to moderate levels of archaeological potential and will be addressed through mitigation. This is discussed further in the following section.

## Mitigation

20.6.1.11 Recommended mitigation for the known sites during the construction phase is as follows:

- i. The observance of a development exclusion zone around the position of wreck 05 to ensure that no impact occurs. Note: through additional geophysical survey the likely location of the wreck has been identified. This is within Crymlyn Burrows SSSI foreshore. No works will be undertaken within the SSSI and as such the wreck will not be affected.
- ii. A watching brief during dredging will allow for the identification of those sites for which a significance rating was not possible (**33**, **37-39** and **43-55**) and for the monitoring of activity in the vicinity of sites **24-35** and **27-31**. The watching brief will involve the implementation of a protocol for the reporting of material recovered from the dredge head, with provision for monitoring of dredging by a suitably qualified archaeologist where the discovery of material suggests the present of an archaeological site. The protocol will include provision for the recording and investigation of any recovered material, and for the assessment of any sites that are discovered during dredging.

20.6.1.12 All mitigation measures will be detailed in a written scheme of investigation (WSI) which will be agreed with CADW and GGAT, prior to construction commencing.

## 20.6.2 Operation phase impacts

20.6.2.1 Operation phase impacts will primarily relate to changes to the sedimentation patterns within and around the Lagoon. In particular any areas where the seabed levels are reduced.

## 20.6.3 Decommissioning impacts

20.6.3.1 There are two main options for future decommissioning either continuous operation or removal of turbines and sluice gates (Chapter 4, Project Description). As the works to remove the turbines and sluice gates will be within the turbine housing, there will be no effects on marine archaeology.

## 20.7 Cumulative and in-combination impact assessment

20.7.0.1 Developments listed in Chapter 2: EIA Process and Assessment of Significance were considered along with the Project, in relation to the potential for cumulative and in-combination impacts on the marine cultural heritage resource. In all cases, there will be no cumulative or in-combination impacts upon known marine, inter-tidal or submerged prehistoric archaeology.

## 20.8 Conclusion

- 20.8.0.1 This Chapter assesses effects on historic features within a study area, which includes the marine elements of the proposed Project. Within the report, a distinction is made between assessing the effect of the Project upon known cultural heritage features and areas of archaeological potential.
- 20.8.0.2 The Chapter is based on a desk-based assessment, inter-tidal walkover surveys and the archaeological analysis of geophysical and geotechnical data. These assessments identified a small number of known sites and three distinct areas of potential archaeology that could potentially be affected by the Project: Submerged pre-historic archaeology, Maritime archaeology and inter-tidal archaeology.
- 20.8.0.3 Effects on historic features are considered for construction, operation and decommissioning of the Project. The assessment found that there is only limited potential for effects on known historic features. However, in certain areas the impact is such that it may have a significant negative effect upon any buried and therefore currently unknown archaeology in those areas. These possible negative effects will be limited by the mitigation measures in the form of a watching brief during dredging.

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