Island Heritage Service

Historic Environment Action Plan
Climate Change Type Report

Isle of Wight County Archaeology and
Historic Environment Service

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Climate Change HEAP for the Isle of Wight

1.0 INTRODUCTION

The Isle of Wight Historic Environment Action Plan (HEAP) consists of a set of general documents, 15 HEAP Area Reports and a number of HEAP Type reports which are listed in the table below (those in bold have been written and those in italics have yet to be produced):

General Documents	HEAP Area Reports	HEAP Type Reports
HEAP Map of Areas	Arreton Valley	*Boundaries*
HEAP Introduction booklet	Atherfield Coastal Plain	*Coastal*
Isle of Wight Overview	Brading Haven and Bembridge	*Field Patterns*
Vision, Aims and Objectives	East Wight Chalk Ridge	*Industry*
References	Freshwater Isle	*Military*
Glossary of Terms	Newchurch Environs and Sandown Bay	*Mineral Extraction*
	Northern Lowlands	*Open Land Type*
	South-west Wight Coastal Zone	*Parkland/Designed Landscapes*
	South Wight Downland	**Historic Routeways**
	South Wight Downland Edge	**Rural Settlement**
	South Wight Sandstone and Gravel	*Trees and Woodland*
	The Undercliff	**Urban Settlement**
	Thorley/Wellow Plain	*Valley Floor*
	West Wight Chalk Downland	
	West Wight Downland Edge and Sandstone Ridge	

The documents in the above table (apart from those in italics) are available at the HEAP webpage hosted by the Isle of Wight County Archaeology and Historic Environment Service at http://www.iwight.com/living_here/archaeology/heap.asp

This Climate Change HEAP Type report has been produced to give an overview of how the direct and indirect impacts of Climate Change may affect the historic environment resource on the Isle of Wight.

Additional Climate Change Actions are included at the end of this report to guide all those organisations and individuals who are involved with the Island's historic environment to help to sustainably manage this fragile and finite resource for future generations.

2.0 ASSESSMENT OF THE HISTORIC ENVIRONMENT

2.1 Location, Geology and Topography

- Isle of Wight lies 5-8 km off coast of Southern England, separated by the Solent.
- England's largest island, 380 square km in area.
- Approximately 36 km long west-east by 22 km wide north-south.
- 96 km of coast, varying greatly. Solent coast is punctuated by tidal inlets and estuaries, southern coast by *chines*. There are 5 estuaries on the north and north-eastern coasts – Eastern Yar, Medina Estuary, Newtown Estuary, Western Yar and Wootton Creek.
- All three main rivers are, or have been, tidal estuaries for part of their length.
- Characterised by great variety of geology and landscape.
- Landscape dominated by central range of chalk downs running west-east and by second block of downland in south east Wight. Lower-lying clays, limestones and gravels occur to the north of the central chalk ridge with Greensand and Wealden deposits to the south.

2.2 The Nature of the Historic Environment Resource

2.2.1 Historic Environment Record is the definitive database for archaeological remains, built environment and historic landscape character.

2.2.2 The Island's Historic Environment resource is a unique and finite, non-renewable resource, in many cases highly fragile and vulnerable to damage and destruction. They can contain irreplaceable information about our past and the potential for an increase in future knowledge. They are part of our sense of identity and are valuable both for their own sake and for their role in education, leisure and tourism.

2.2.3 Because of its unique situation as an island, the Historic Environment Assets of the Isle of Wight comprise several different types. These include **Land-based** Historic Environment Assets, **Cliffs** which surround some its coastal areas, an **Intertidal Zone** between high and low water marks and a **Marine Zone** which encompasses the seabed and surrounding waters out to the UK Territorial Limit. The Historic environment assets within these zones are listed on page 4 of the Isle of Wight Heap Overview report which can be found at : http://www.iwight.com/living_here/planning/images/IsleofWightHEAPOverview.pdf

2.2.4 The Island contains Historic Environment Assets from every period of the human past. The details of these are given in pages 4 to 8 of the Isle of Wight Heap Overview report which can be found at : http://www.iwight.com/living_here/planning/images/IsleofWightHEAPOverview.pdf

3.0 DEFINING CLIMATE CHANGE

3.1 Global Climate Change

3.1.1 There is strong scientific consensus that greenhouse gas emissions resulting from human actions are causing significant and rapid changes to the climate.

3.1.2 The Inter-Governmental Panel on Climate Change published its Fourth Assessment Report in 2007 which concluded that the global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 (IPCC 2007a).

3.1.3 Among the climate changes noted in this report were a linear rise in global surface temperature over the last 50 years of twice that for the last 100 years and widespread changes in temperature extremes (IPCC 2007a to d).

3.1.4 Evidence from national Met Office sources shows the nature of some of these changes within the UK (Jenkins *et. al.* 2009a). The current set of climate change scenarios for England was released in 2009 and describe how the future climate of the UK is projected to evolve over the course of the 21st Century (Murphy *et al.* 2009; Jenkins *et al* 2009b; Jones *et al* 2009; Lowe *et al* 2009).

3.2 Projections for Climate Change on the Isle of Wight

3.2.1 English Heritage, the Government's adviser on the historic environment, state that the evidence for a changing climate is markedly apparent in the South East of England (EH 2008, 1).

3.2.2 Isle of Wight Climate Impacts Summary Report was produced for the Isle of Wight Council in November 2009 as a starting point for studying the effects of climate change on the Island (I2000 2009). It uses the latest figures from UK Climate Projections 2009 (Jenkins *et al.* 2009) at a 50% probability level to suggest:

- Temperature:
    - Increase in annual mean winter temperature by 2020 = 1.3°C;
    - Increase in annual mean winter temperature by 2050 = 2.2°C;
    - Increase in annual mean winter temperature by 2080 = 3.1°C;

    - Increase in annual mean summer temperature by 2020 = 1.6°C;
    - Increase in annual mean summer temperature by 2050 = 2.8°C;
    - Increase in annual mean summer temperature by 2080 = 3.9°C;
- Precipitation:
    - Increase in Winter precipitation by 2020 = 8%;
    - Increase in Winter precipitation by 2050 = 17%;
    - Increase in Winter precipitation by 2080 = 22%;

- Decrease in Summer precipitation by 2020 = 8%;
- Decrease in Summer precipitation by 2050 = 17%;
- Decrease in Summer precipitation by 2080 = 21%;

- Sea Level along the Hampshire Coast had been predicted to rise at a steady 6mm a year but is now expected to rise exponentially:
  - By 4mm per year until 2025;
  - By 8.5mm per year until 2055;
  - By 12mm per year until 2085;
  - Then by 15 mm per year after 2085;
  - Adding slightly to the effects of sea-level rise on the Island is the fact that land is dropping at a rate of about 1mm per year due to the earth's surface re-adjusting to the melting of the last ice sheets in Northern Europe.

- Extreme weather events will increase in frequency, severity and duration, including:
  - Droughts;
  - Heatwaves;
  - Heavy rain and flooding;
  - Extreme cold spells;
  - High winds;
  - Storms.

4.0 TIME-DEPTH

4.1 Historic Environment Indicators for long-term Climate Change

4.1.1 The Historic Environment resources of buildings, buried remains and landscapes provide an excellent source of information on:
- Long term fluctuations of climate change;
- The human response to climate change in the past;
- Past approaches to living in a low energy economy.

4.1.2 It is important that this evidence is not ignored as we consider how to adapt in the future.

4.2 Long Term fluctuations of climate change

4.2.1 The longest continuous records of temperature change come from deep sea ocean cores dating back to hundreds of millions of years ago. Cores through the ice sheets show changes in stable isotopes over the past 600,000 years (Antarctica) and 200,000 years (Greenland). These show that:

4.2.1.1 The earth experienced a cold and changeable period, called the *Pleistocene Epoch,* from 2 million to 12,000 years Before Present (BP);

4.2.1.2 The last 10,000 years have been a slightly warmer interglacial, called the *Holocene Epoch*, which has been relatively stable with some minor changes which can be identified from archaeological and historic sources:

- Britain was probably 1°C warmer during the Neolithic (4000- 2000 BC);
- Britain was cooler and wetter in the Later Bronze Age (1400 – 900BC);
- Britain was warmer in the Roman period (AD 43 – 410);
- Britain was warmer in the 12th and 13th Centuries;
- Britain was colder with particularly cold winters between the 14th and 19th Centuries (the "Little Ice Age");
- Sea level has risen by 130 m over the past 20,000 years, since the coldest part of the last glacial;
  There have been around 20 very rapid temperature rises during the past 100,000 years;

4.3 Past human responses to climate change

4.3.1 Archaeological resources consisting of buried remains, artefacts, structures, palaeo-environmental and *geo-archaeological* studies can provide us with evidence of how past communities exploited the landscape and coastlines, where people lived in safety, the conditions they encountered and circumstances which caused them to retreat from changing environments.

4.3.2 During the temperature and sea level changes which occurred up to 7000 years ago, the Palaeolithic population left the landmass of England at least twice during *glacial* cold periods to re-colonise it during the warmer *interglacials.*

4.3.3 The North Sea Plain was probably home to large numbers of Mesolithic hunters between 8000 and 4000 BC, who had to move to the surrounding higher land when the North Sea was flooded by postglacial sea level rise around 5000 BC. One such settlement was at Bouldnor which is now the foot of a submerged cliff. The precise height and date of submerged settlement can show us pace of long term coastal processes.

4.3.4 The Bronze Age farmers ceased farming the uplands of England during the cooler, wetter conditions of the Later Bronze Age.

4.3.5 The Viking colonisation of Greenland was terminated by the "Little Ice Age".

4.3.6 The challenges facing the non mobile modern world population, with its requirements for productive land, food and water resources around its fixed urban settlements and infrastructure, are different from those faced more than 7000 years ago. However, there are some significant lessons to be learnt from the examples of past climate change:

4.3.6.1 Archaeological records show the speed at which radical and long-term changes can occur. Called climate "Flips", these are far more abrupt than scientists previously thought. This knowledge must reinforce the sense of urgency with which we approach the reduction of modern greenhouse gases;

4.3.6.2 It is the people in the productively marginal areas who are most vulnerable to change such as the Bronze Age farmers of the uplands or the Viking colonists of Greenland;

4.3.6.3 Humans have proved to be able to innovate in order to help themselves to adapt to past changing environmental conditions;

4.3.6.4 The detailed geographic and temporal resolution provided by archaeological data from the land-based, maritime, coastal and intertidal zones offers considerable potential to refine climate change models in the future.

4.4 Past approaches to living in a low energy economy

4.4.1 Historic patterns of dispersed rural settlements, albeit with much lower population levels, with their work and living areas and the capabilities to produce energy from watermills, windmills and surrounding woodland may provide an alternative model for sustainable rural development.

4.4.2 The historic building stock in the UK has met with and survived changes in both climate and society. Its survival is a testament to its fitness for purpose as buildings which cannot cope with storm and flood risks or with change of use, are for the most part, quickly lost or replaced.

4.3.3 Most traditionally constructed historic buildings themselves perform well in studies which measure actual energy use.

4.3.4 Historic towns with their traditional mixed-use neighbourhoods offer a good model of sustainable development.

4.5 The Isle of Wight Historic Environment Resource as indicator for Climate Change

4.5.1 During the Middle and Late Pleistocene Epoch (c500,000 – 13,000BP), there were glacial maximums (ice ages) and 13 warmer interglacial episodes during which the climate was warm enough to encourage early human settlement. Evidence, in the form of stone tools, survives from the archaeological periods of human activity which are known as Lower Palaeolithic (700,000 to 245,000 BP); Middle Palaeolithic (245,000 to 50,000 BP) and Early Upper Palaeolithic (50,000 to 18,000 BP). Sites of particular significance from these early periods on the Isle of Wight include:

4.5.1.1 Two sequences of gravel deposits have been recorded from the site of the largest assemblage of Palaeolithic material on the Island at Priory Bay. One shows layers laid down from the warm Hoxnian Interglacial of MIS 11 (c. 365,000 BP) to the Cold Stage of MIS 8 (c. 285,000 BP). The second dates from the Purfleet Interglacial of MIS 9 (c. 344,000 BP) to the warm Aveley Interglacial at MIS 7 (c. 200,000 BP). Artefacts recovered over may years at this site show hominin occupation within the Hoxnian Interglacial, during the cold stage that followed this and during the Purfleet Interglacial (Briant *et al,* 2009);

4.5.1.2 The Pleistocene raised beach deposits at Bembridge include the Steyne Wood Clay, which has been attributed to the Hoxnian interglacial (Preece & Scourse, 1987);

4.5.1.3 Great Pan Farm, where a series of gravel deposits have been identified which were former terraces of the River Medina. Three former terraces were identified which have been roughly dated to between 60,000 years ago and 425,000 years ago approximately. The terraces form a staircase with progressively younger terraces being formed lower down the slope closer to the present course of the Medina (Archaeology South East, 2006) . We can therefore reconstruct the landscape and the changing course of the Medina which altered dramatically as a response to various climatic changes throughout this time;

4.5.1.4 Before the close of the last ice age (known as the *Devensian glacial maximum)*, an episode of intense cold drove all human occupation from Britain;

4.5.1.5 Pleistocene faunal assemblage has been recorded from Newtown which, although it contains no evidence of human activity, gives a picture of the environment from both the Ipswichian Interglacial (135,000 to 70,000 years BP), and a late Ipswichian glacial *stadial* or Devensian interglacial stadial (Munt and Burke 1986).

4.5.2 It was not until around 13,000 BP (11,000BC) that human reoccupation can be detected. The warming associated with this event leads to the onset of the Holocene Epoch (13,000 BP to present) and it is the environmental changes of the early and mid Holocene that created the coastal processes that are still eroding and modifying the Island's coastline:

4.5.3 The advance of the Atlantic Ocean into the old Channel River system eventually drowned the broad floodplain between Britain and France which was used as hunting territory by early humans;

4.5.4 During the mid-Holocene many of the deeply incised river channels that had drained the periglacial landscape began to fill with sediment caused by the new estuarine conditions of the rising sea. Brackish lagoons and new emponded coastal peat mires appeared and where they survive, they provide valuable pollen record and plant macro-fossil evidence of environmental change;

4.5.5 At Bouldnor, a submerged landscape containing a rich resource of stratified Mesolithic material and interbedded peats has been identified (Tomalin 1993; Momber 2000). Dix (2001) utilises data from Bouldnor and a range of other sources to summarise the current knowledge of Holocene sea levels in the English Channel and the Solent:

4.5.5.1 During the Pleistocene Epoch (16,000 BC), that is in the Upper Palaeolithic archaeological period, the sea level in the English Channel to the south of the Island was 130m lower than modern Ordnance Datum;

4.5.5.2 During the Early Holocene Epoch (8000BC), in the Early Mesolithic archaeological period, there was a marked rise in sea-level with the sea level being only 30 m lower than modern Ordnance Datum;

4.5.5.3 During the Mid Holocene Epoch (6500BC), in the Mesolithic archaeological period, the sea level was 15 m lower than modern Ordnance Datum;

4.5.5.4 During the Late Holocene Epoch (4500BC), in the Late Mesolithic/Early Neolithic archaeological periods, the sea level was 6 m lower than modern Ordnance Datum;

4.5.5.5 The rate of sea level rise slows down in the Later Holocene and this coincides with the onset of the Neolithic period (4500 to 2000 BC) when permanent human settlements develop for the first time. It is suspected that environmental changes within this period may have included the final severance of the Isle of Wight from the mainland. Recent archaeological evidence demonstrated that the inundation of the Solent started at around 8,500BP (Dix 2001), continuing with rapid process for over 2,000 years (Velagrakis, 2000) before the Solent became a fully marine channel, perhaps around 6-7,000BP(Tomalin, 2000). The exact date of the severance of the Island is currently being investigated by the Hampshire and Wight Trust for Maritime Archaeology;

4.5.5.6 During the Late Holocene Epoch (500BC), in the Iron Age archaeological period, the sea level in the Channel was 2 m lower than modern Ordnance Datum;

4.5.6 There is evidence of the submergence of the coastal landscape of the Island during the 3rd millennium BC. At Newtown harbour a Neolithic wooden track-way was built across the coastal marshland around 2920-2500 *cal* BC (GU-5341). In the mouth of Western Yar, another Neolithic track-way has been dated at 2920-2620 *cal* BC. These structures are now well below current sea level at -2.9 and -1.6m OD respectively (Tomalin *et al,* forthcoming);

4.5.7 Evidence of wind blown sands is shown in the results of the Isle of Wight Coastal Audit in 1999 where the accretion of sand to create ancient stabilised sand dunes which covered a Neolithic land surface at Redcliffe was shown to have started in the Early Bronze Age (c.2000 to 1600 BC) (Isle of Wight County Archaeology and Historic Environment Service, 2000);

4.5.8 The medieval town and port of Newtown (Francheville), already suffering from competition with other Solent ports, was critically damaged by French attack in the 14th century and has never been developed since. The inter-tidal and sub-tidal archaeology at Newtown is of great importance because it offers a very rare opportunity to examine an unbroken record of sediment accretion in a Solent creek location that has escaped all effects of navigational dredging. The potential record of undisturbed riverine sediment archive covers several millennia.

4.5.9 On the North-west coast of the Island, a 15 year archaeological study of the Wootton-Quarr coastal and intertidal remains has produced a chronology suggesting how human activity has retreated inland as sea levels have risen between the Neolithic and Medieval periods (Tomalin *et al*, forthcoming) , including:

4.5.9.1 Neolithic wooden fish traps (c.4000 BC) located 2-4 km to the north of the modern coastline at Wootton Creek;

4.5.9.2 The accumulation of peat along the old shoreline around 3500 BC with oak forest extending into it with wooden Neolithic trackways constructed as a response to relatively rapid sea level rise;

4.5.9.3 By 3000 BC the rising sea poisoned the oak forests and trees survive on the modern sea bed which have been radiocarbon dated to the end of the Neolithic period and the beginning of the Bronze Age at 2557 BC;

4.5.9.4 In the late Bronze Age a major phase of woodland clearance and cereal cultivation on the land based sites was accompanied by the construction of a long alignment of oak posts at the mouth of Wootton Creek around 800 BC;

4.5.9.5 By Roman times, the sea level had risen to only two metres below that today with two salt drying kilns of Late Iron Age to Early Roman date lying well below the modern High Water mark;

4.5.9.6 A Medieval tile kiln used to make tiles for Quarr Abbey lay even further inland and was dated between 1274 and 1317 AD;

4.5.9.7 Examples of where coastal archaeological remains have been protected by blankets of marine sediments laid over margins of river valleys and estuaries. These alluvial silts seal and preserve underlying landscapes and we have yet to make a fully co-ordinated investigation of these sedimentary archives.

4.6 Regular archaeological beach monitoring was also carried out on more than 150 archaeological sites discovered to be eroding in the intertidal zone of the Wootton-Quarr Project until 2004 (Isle of Wight County Archaeology and Historic Environment Service, 2008). This has shown a cumulative record of the wasting archaeological resource and given some idea of the rate of its destruction:

4.6.1 The coastline adjacent to the Quarr Abbey medieval pottery kiln had receded almost 10m between August 1992 and September 2004. The upper part of foreshore at Quarr is affected by mobile deposits, e.g. sand and gravel banks. While beach levels around some posts had gone down, others appeared to be buried beneath mobile banks and repeated surveys of Alignment Q11 show clearly how the mobile sediments are moving westwards;

4.6.2 There was a more general stripping of sediment around wooden structures, in places by as much as 300mm;

4.6.3 Considerable damage was done by oyster fishermen dredging well inshore of the mean low water mark;

5.0 IMPACTS ON THE HISTORIC ENVIRONMENT

Impacts on historic environment assets can affect several aspects of historic environment assets:

- The *Fabric of an historic environment asset* is the extant physical character of an asset or the features that give an area its historic character.
- The *Setting of an historic environment asset* is the physical surroundings of an historic feature or area influencing how it is understood and appreciated.
- The *Perception of an historic environment asset* is the different ways people value historic features and their setting.

5.1 Direct Impacts of Climate Change on Land Based Historic Environment Assets

5.1.1 Increased extremes of wetting and drying which increase weathering and erosion of structures and buildings, including:

- Physical changes to porous building materials and finishes due to rising damp;
- Crystallisation and dissolution of salts caused by wetting and drying affecting standing structures, archaeology, wall paintings, frescos and other decorated surfaces;
- Erosion of inorganic and organic materials due to flood waters;
- Relative humidity cycles/shock causing splitting, cracking, flaking and dusting of materials and surfaces, including corrosion of metals;
- Changes in deposition of pollutants through pH precipitation;

5.1.2 Changes in water table levels causing:

- Subsoil instability, ground heave and subsidence of buildings, structures and buried remains, especially on clay soils;
- Loss of stratigraphic integrity of buried archaeological deposits due to cracking and heaving from changes in sediment moisture;
- Data loss preserved in waterlogged/*anaerobic/anoxic conditions;*

5.1.2 Changes in soil chemistry causing:

- PH changes to buried archaeological evidence;
- *Eutrophication* accelerating microbial decomposition of organics;

5.1.3 Damage to buried sites and structures , upstanding structures, historic landscapes, earthworks and buildings from fluvial or flash flooding, including:

- Penetration into historic buildings;
- Damage to historic contents such as museum collections;
- Flooding from more frequent intense rainfall will make some historic buildings more difficult to insure;
- Artefact scatters, buried sites and structures and upstanding structures and earthworks on low lying agricultural land have a significant risk of loss, episodic inundation, salination, storm surges or severe weather events (EH 2008e).

5.1.4 Storm damage to veteran trees or historic plantings in historic parks and gardens and landscapes.

5.1.5 Reduction in availability of native species for repair and maintenance of timber buildings.

5.1.6 Temperature change affecting the viability of certain garden designs/varieties of plants and historically authentic tree plantings in historic parks, gardens and landscapes.

5.1.7 The spread of pests and diseases as a result of a warmer climate and milder wetter winters, which will have an effect on plant species and structures e.g. a population of North African scorpions in the 18th-century Sheerness dockyard wall, which causes problems during maintenance (English Heritage, 2008e).
5.1.8 Biological damage to organic materials, interiors and furnishings by insects, moulds, fungi, invasive species such as termites.
5.1.9 Increase in Storm events which endanger historic landscapes features, structures and buildings, such as tornadoes and strong winds.
5.1.10 Changes in hydrology which endanger buried archaeological remains including well-preserved wetland archaeology.
5.1.11 Changes in vegetation patterns that threaten the visibility and integrity of archaeological remains and historic landscapes.
5.1.12 Deterioration of structural façades due to thermal stress.
5.1.13 Freeze-thaw/frost damage inside brick, stone, ceramics and other materials that get wet and freeze before drying.

5.2 Direct Impacts of Climate Change on Historic Environment Assets in the Cliff zone, Intertidal zone and Marine zone

5.2.1 Rising sea level and changes in physical impacts causing accelerated cliff and coastal and intertidal erosion.
5.2.2 Rising sea level and changes in physical impacts causing increased severity and frequency of coastal flooding and storm surges, including the permanent submersion of low-lying areas.
5.2.3 Loss of beaches.
5.2.4 Increased '*rotational failure'* of unstable cliffs after heavy rain and landslide events.
5.2.5 Loss of saltmarsh due to '*coastal squeeze'*.
5.2.6 Breaching of coastal dune and spit barriers.
5.2.7 Marine erosion.
5.2.8 Cliff erosion - the Island has cliffs of national importance and the soft cliffs and Chines on the western coasts are particularly vulnerable to the effects of climate change through rising sea level and increased storm surges.
5.2.9 Longshore drift - eroded and weathered materials that accumulate at the base of cliffs or on the foreshore are transported from one part of a shore to another by longshore drift. Sedimentary materials may be deposited around the coastline where sediment pathways are interrupted by major headlands, estuaries or sediment sinks.
5.2.10 Scour is a common cause of bridge collapse in flooding – the foundation of the bridge gets undercut by water scouring around it. The piers set up eddies and this scours out the gravel beds creating deep holes.
5.2.11 Weathering and erosion of structures and buildings.
5.2.12 Invasion of alien fauna from more southerly latitudes, such as *Lyrodus pedicellatus*, a species of shipworm that is active all year, thus constituting a major threat to wrecks and other archaeological wooden structures. It has been recorded in Langstone Harbour and on the *Mary Rose* (English Heritage, 2008e).

5.3 Indirect Impacts of Climate Change on Land Based Historic Environment Assets

5.3.1 Indirect effects on the Historic Environment can come from *adaption* or *mitigation* actions taken by changing human behaviour to respond to the impacts of climate change:

- Under the Kyoto Protocol, the UK has agreed to reduce total greenhouse gas emissions and to increase the use of renewable energy sources, including bio-fuels;
- The revised UK Government's Climate Change Programme delivers progress on these commitments including the establishment of The Office of Climate Change (www.occ.gov.uk); the Climate Change Act; the Energy White Paper: Meeting the Energy Challenge (DTI 2007); an adaptation policy framework and a raft of initiatives aimed at the energy efficiency of the built environment (HM Government 2006; Defra 2007);
- The Climate Change Act 2008 includes the UK's targets to reduce carbon dioxide emissions, to at least 26% below 1990 levels by 2020 and to at least 60% by 2050;
- In July 2009 the Government published the UK Low Carbon Transition Plan which sets out the Government's approach to delivering emissions cuts of 18% on 2008 levels by 2020. This includes the expansion of the renewable energy sector and the building of new nuclear power stations;
- Local Authorities also have targets to improve the energy efficiency of their housing stock under the Home Energy Conservation Act 1995.

5.3.2 The reduction of carbon emissions from power generation is partly focused on the increased use of renewable energy resources including:

- Onshore wind farms;
- Nuclear power stations;
- Hydro-electric plants;
- Micro generation through installation of solar thermal and PV, heat-pump, wood-fuel and Biomass systems for communities and individual buildings.

5.3.3 Arable farmers may change their crop mix as conditions alter and water for irrigation becomes less reliable or if demand for biomass crops increases. Deep-rooting crops have a significant impact on buried archaeology, through ground preparation, root penetration, de-watering and harvesting. Changes to crops may also have an impact on the character and appearance of some historic landscapes.

5.3.4 Changes in agriculture, such as a shift towards biomass crops or intensification of certain crops may result in monoculture which will be damaging to the environment and will have implications for the appearance of the rural historic landscape. Other impacts could include changes in use of grassland, loss of headlands around hedgerows or non-renewal of agri-environment schemes which currently protect buried archaeological remains.

5.3.5 There may be changes to conventional forestry management for Biomass combustion for electricity generation in plants.

5.3.6 Farm buildings will be required to house stock that currently over-winter outside or stocking levels may have to be reduced to avoid erosion of wet land by animals and equipment. Increased demand for summer stock shelters is likely in remote locations with impacts on the character of the historic landscape, on traditional farm buildings and on any associated buried archaeology.

5.3.7 Farmers are already being advised to adapt to climate change by capturing rainfall as run-off from fields and tracks in swales or sediment ponds and to construct winter storage reservoirs to supplement summer supplies (Farming Futures 2009; I2000, 2009). They are also advised to improve drainage by sub-soiling (Farming Futures 2009). Both of these actions may have a negative impact on buried remains and are not controlled by planning legislation.

5.3.8 Engineering approaches to providing flood relief may damage archaeological remains and structures including:

- Flood water storage reservoirs;
- Flood relief channels to bypass vulnerable stretches of river or channel;
- Maintenance by deepening or widening;
- Confinement of high water levels with flood embankments or walls.

5.3.9 Restoration of degraded peatland habitats may be carried out to reduce carbon losses and to re-start sequestration. The National Trust decided it will reduce greenhouse gas emissions by managing its land as a carbon bank. This means maintaining peatlands as wetlands, preventing erosion of uplands, preventing moorland fires and sustaining active bogs where carbon can be sequestered. It also means protecting lowland soils and 'growing' their content of organic matter, through changed land use and better soil management (English Heritage, 2008e). This may have a positive impact by preservation of waterlogged deposits, peat and other historic environment elements.

5.3.9 There may be damage to historic buildings, structures and historic settlement infrastructure due to faulty or inadequate water-disposal or storage systems; historic drainage infrastructure may not capable of handling heavy rain and may be perceived as being difficult to access, maintain, and adjust.

5.3.10 The integrity of some historic buildings and landscapes could be damaged by the need to provide new and more effective rainwater flood protection features.

5.3.11 There may be problems in keeping internal temperatures within historic buildings at comfortable levels and changes in the perception of fitness for use for some structures. For example, engineering solutions which inappropriately alter the historic character and historic fabric of structures and landscapes in order to allow structures to remain in use.

5.3.12 Proposals to replace historic buildings with new stock that is ostensibly more energy efficient could result in serious losses of historic character and diversity.

5.3.13 There may be additional costs put on developers when planning consent requires preservation in situ sub surface archaeological remains as it is unclear whether current guidance for preservation-in situ will be sustainable (ADAS 2006).

5.3.14 There may be increases in tourist activity as the tourism industry on the Island benefits from a warmer and drier longer season. This may increase visitor erosion at sites and buildings of historic environment importance.

5.4 Indirect Impacts of Climate Change on Historic Environment Assets in the Cliff zone, Intertidal zone and Marine zone

5.4.1 Consequence of decisions taken now by coastal managers anticipating future climate change including:

- Emphasis on selective managed realignment of coastal defences and “soft” coastal defences (such as salt marsh) rather than “hard” defences leading to damage to archaeological remains, buildings and landscapes in the Intertidal and Coastal Zones;
- New flood defences causing major archaeological damage along historic waterfronts and in historic towns and which may impair the character of historic quay sides and waterside buildings and gardens.

5.4.2 Attempts at climate change mitigation through the expansion of the renewable energy sector, including both intertidal and subtidal offshore wind farms. Impacts from these include:

- Construction associated disturbance such as intrusive site prospection, seabed preparation, cable and foundation installation, extendible legs and anchors of construction vessels;
- Operation associated disturbance such as altered sedimentary processes and scour (localised seabed erosion) effects;
- Maintenance operations;
- Construction of shore side infrastructure;
- Decommissioning effects of removal of plants and materials.

5.4.3 The cumulative impacts of offshore renewable energy generation on offshore, intertidal and terrestrial Historic Environment features has been assessed by COWRIE (2008) and includes:

- Direct damage/destruction;
- Severance of associated features;
- Destabilisation, decay and corrosion;
- Long term preservation of buried remains;
- Loss or intrusion on setting;
- Compression;
- Alterations to views or public appreciation;
- Changes to character;
- Loss of legibility;
- Economic repercussions through tourism or regeneration.

6.0 FUTURE MANAGEMENT

6.1 Climate Change Actions:

In addition, this Isle of Wight Climate Change HEAP TYPE report can identify a number of additional actions which should be carried out by the Isle of Wight Council and all organisations who are responsible for management of historic environment assets of the Isle of Wight:

CC Action 1 –Identify which Historic Environment Assets are likely to be affected by the direct and indirect impacts of Climate Change;

CC Action 2 – The above data should be used to inform debate and decision making as to which historic buildings, upstanding structures and historic townscapes should be preserved in situ by protective measures and those protective measures should be carried out with appropriate monitoring.

CC Action 3 – Where future decisions not to protect historic buildings, upstanding structures, buried remains and historic landscapes and townscapes are made, the County Archaeology Service should lead on a prioritised programme of recording to preserve them by record.

CC Action 4 - The Isle of Wight Council and other organisations should ensure that appropriate emergency responses are in place to mitigate the impact of extreme weather on the historic environment assets in their care. This should involve :

- Assessing the vulnerabilities and producing site and room plans;
- Identifying risks and mitigation;
- Determining which emergency services, conservators, regional and national organisations, local authority emergency planners; colleagues and trades people need to be involved.

CC Action 5 – Investigate the roles of heritage volunteers as part of an early warning system and response mechanism to be able to respond to extreme events.

CC Action 6 - All conservation management plans for historic parks and gardens and historic landscapes and structures should address climate change issues (even if at this stage they only monitor changes and scope future needs) relating to:

- Storm damage to veteran trees or historic plantings;
- Reduction in availability of native species for repair and maintenance of timber buildings;
- Temperature change affecting the viability of certain garden designs/varieties of plants and historically authentic tree plantings in historic parks, gardens and landscapes;
- The spread of pests and diseases as a result of a warmer climate and milder wetter winters, which will have an effect on historic environment features.

CC Action 7 - Potential damage to historic buildings, structures and historic settlement infrastructure should be avoided when adaption and mitigation measures are taken. Wherever possible materials and locations which are sensitive to the integrity of their historic fabric and character should be used.

CC Action 8 - English Heritage's Guidance Notes on improving the energy efficiency of historic properties should be utilised by all those advising on and undertaking climate change protection works. These include:

- Protecting historic churches from lightning (EH 2000);
- Protecting historic buildings from electrical surges (EH 2003a);
- Dealing with flooding and historic buildings (EH 2004);
- Guidance on water management (EH 2008d);
- Energy conservation in traditional buildings (EH 2007c and d);
- Interim guidance for understanding SAP ratings for historic and traditional homes (EH 2007e);
- The English Heritage website Climate change and your home (www.englishheritage.org.uk/climatechangeandyourhome).

CC Action 9 - All proposals for micro-generation and mass-generation should follow the advice of English Heritage's Guidance on biomass crops (EH 2006b) and Guidance on micro-generation technologies (EH 2007a; 2007b; 2008b; 2008c) and Micro-generation equipment must be sensitively located on historic buildings. Consideration should also be given to minimising the physical impacts on historic fabric and ensuring reversibility wherever practicable.

CC Action 10 – English Heritage's Guidance Notes advice on wind energy should be followed for all proposals for its use on the Isle of Wight (EH 2005).

CC Action 11 - Proposals for agricultural adaption and mitigation, including water storage, extraction and usage should take advice from the Isle of Wight County Archaeology Service so that damage to historic environment assets can be avoided or mitigated by appropriate action.

CC Action 12 - Engineering solutions to adapt and mitigate flood relief such as flood water storage reservoirs; flood relief channels, maintenance, flood embankments or walls, should take advice from the Isle of Wight County Archaeology Service so that damage to historic environment assets can be avoided or mitigated by appropriate action.

CC Action 13 - Restoration of degraded peatland habitats should be encouraged to reduce carbon losses and to re-start sequestration as well as the preservation of waterlogged deposits, peat and other historic environment elements.

CC Action 14 - The historic environment assets and cultural heritage must be given sufficient consideration in flood defence strategy planning for the Isle of Wight coastline.

7.0 GLOSSARY OF TERMS

Adaption – Changing our behaviour to respond to the impacts of climate change
Anaerobic/Anoxic Conditions – Burial conditions in which archaeological remains are preserved due to the absence of oxygen, such as underwater.
Anglo-Saxon - The archaeological period in Britain between 410 AD and 1066 AD.
Bronze Age - The archaeological period in Britain between 2500 BC and 700 BC.
Chines - Steep-sided river valleys where a river or stream flows through coastal cliffs to the sea. The word 'chine' originates from the Saxon 'cinan' meaning a gap or yawn. The term is used only in Hamspshire, Dorset and the Isle of Wight.
Burgage plots - A piece of land in a medieval borough held from the lord of the borough subject to customary rents and services. These plots of land were typically long and narrow in order to give many properties access to the street frontage.
Coastal Squeeze - The progressive reduction and loss of coastal habitat area and natural features which can arise if the natural landward migration of areas of saltmarsh or mudflat become trapped between human made seawalls and the rising sea levels.
Commons - Open grazing land owned in medieval times by the lord of the manor on which manorial tenants had certain grazing rights.
Devensian Glacial Maximum – The coldest part of the last glaciation when the ice sheets reached their maximum extent over Britain, around 18,000 years ago.
Eutrophication - The gradual increase in nutrients in a body of water. Natural eutrophication is a gradual process, but human activities may greatly accelerate the process.
Fabric of a Historic Environment Asset - The extant physical character of an asset or the features that give an area its historic character.
Geo-archaeological - the study of the natural physical processes that affect archaeological sites such as geomorphology, the formation of sites through geological processes and the effects on buried sites and artifacts post-deposition. Frequently involves studying soil and sediments as well as other geographical concepts to contribute an archaeological study.
Glacial - An Epoch or period of extreme cold when glaciers extended over most of the land surface of Britain.
Historic Environment Asset – Any surviving archaeological remains dating to all periods between the Palaeolithic and Modern periods which make up the Historic Environment Resource.
Holocene Epoch – The more recent of the two geological periods the Quaternary Period, beginning at the end of the last Ice Age about 11,000 years ago and characterized by the development of human civilizations.
Interglacial - A comparatively short period of warmth during an overall period of glaciation. Interglacials are characterized both by the melting of ice and by a change in vegetation.
Iron Age - The archaeological period in Britain between 800 BC and 43 AD.
Long Barrow - Earthen long barrows are earthwork burial mounds of *Neolithic* date.
Lower Palaeolithic – The archaeological period in Britain between 500,00 BC and 40,000 BC.
Lyrodus Pedicellatus – A species of ship worm which is active all year round.
Mary Rose - A Tudor warship which sank off the coast of
portsmouth in 1545 AD. The ship was raised to the surface in 1982 and ongoing studies by archaeologists have revealed much information about shipping and life of that period.
Mesolithic – The archaeological period in Britain between 10,000 BC and 2000 BC.
Mitigation – Actions which are taken to reduce the impacts of Climate Change.
Mortuary Enclosure - Earthwork of *Neolithic* date in which bodies were exposed prior to burial in a *long barrow.*

Neolithic – The archaeological period in Britain between 4500 BC and 2000 BC.
Norman - The archaeological period in Britain just after the Norman Conquest of 1066 AD.
Nucleated Villages - Rural settlements of more than five dwellings – but often of much larger village size – where the dwellings are clustered together rather than being dispersed over a wider area of countryside.
Open-field - Type of medieval and post-medieval cultivation in which the arable land was divided into *strips*, *furlongs*, and fields farmed in common, usually with no physical boundaries separating individual strips. Medieval manors generally possessed either two or three arable open fields but there was much variation on this common pattern.
Palaeolithic - The archaeological period in Britain between 500,000 BC and 10,000 BC.
Palaeo-environmental remains - Ancient environmental remains and their study e.g. study of pollen, seeds, wood, charcoal and insects.
Perception of a Historic Environment Asset - The different ways people value historic features and their setting.

Pleistocene Epoch – The period from 2.588 million to 12000 years BP covering the world's recent period of repeated glaciations. The Pleistocene epoch is followed by the Holocene epoch. The end of the Pleistocene corresponds with the end of the Paleolithic period of human activity.
Ridge and furrow - Long parallel ridges of soil separated by linear depressions and providing visible evidence of medieval agriculture, although ridge and furrow was also created in post-medieval times. Ridge and furrow was formed by the use of a heavy plough, probably to aid drainage on heavy soils, but also seems to have been the product of customary medieval ploughing techniques.
Roman – The archaeological period in Britain between 43 AD and 410 AD.
Round barrow – Earthwork Burial mound of *Earlier Bronze Age* date. The most common type is the *bowl barrow*, a simple round mound often with a ditch. A *bell barrow* has a *berm* (platform) between the mound and the surrounding ditch. A *disc barrow* has a small central mound and a wide platform surrounded by a ditch and an outer bank.
Setting of a Historic Environment Asset - the physical surroundings of an historic feature or area influencing how it is understood and appreciated.
Stadial - A period of colder temperatures during the warm period separating the glacial periods of an ice age, of insufficient duration or intensity to be considered a glaciation, or glacial period. Notable stadials include the Little Ice Age.
Strip lynchets - Long, thin *lynchets* (Earthwork cultivation banks) following the contours of the hillside are of medieval date.

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