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The Adaptive Capacity of the Management of Cultural Heritage Sites to Climate Change

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Thesis submitted in partial fulfilment of the requirements of Oxford Brookes University for the Degree of Doctor of Philosophy

Submitted: 6th June 2013

ABSTRACT

Despite the growing body of research on the concept of adaptive capacity, there is an absence of research which investigates adaptive capacity in the field of cultural heritage management. Climatic changes have potentially serious implications for the historic environment, which is itself a non-renewable resource. Cultural heritage sites can be particularly sensitive to severe weather events and to changes in climate, both due to direct impacts on built structures, archaeology and designed landscapes, but also due to changes in visitor behaviour and the potentially adverse implications of adaptive measures on heritage significance.

This research investigated the adaptive capacity of the management of cultural heritage sites in the UK, through the assessment of adaptive capacity at selected case study sites. A questionnaire survey of all UK WHS sites, a review of plans and policy, and interviews with key stakeholders at a national level also contribute to the study. An in-depth qualitative analysis of three UK World Heritage Sites was undertaken, which were Ironbridge Gorge, Fountains Abbey and Studley Royal and Blenheim Palace. Fieldwork included site visits, interviews with stakeholders involved in site management such as property managers, conservators and local authority officers, and a thorough documentary review.

A conceptual framework of adaptive capacity relevant for heritage management has been developed, which can be used as a tool for analysis, in order to highlight strengths and weaknesses in capacity. The key determinants of adaptive capacity in the framework, identified through the research, are cognitive factors, leadership, learning capacity, access to information, authority and resources. The research makes a contribution to adaptive capacity theory, with adaptive capacity theory being found to be applicable to heritage management, but with certain limitations.

Areas of weakness and strengths in adaptive capacity at the case study sites and in wider World Heritage management planning have been identified, and practical recommendations are presented. The study found that whilst progress is being made within the heritage sector on adaptation, there are significant challenges and areas where capacity could be enhanced. Notably, there is a lack of information on best practice and guidance on adaptation within a heritage context. Tools for futures thinking such as climate change scenarios are not being

widely used in management planning, and concerns about the uncertainties associated with climate data are prevalent.

Although clear top down guidance is needed to provide drivers and a framework for action, this needs to be balanced with local flexibility, in order to allow locally appropriate and sensitive decision making to protect significance. There is also a need for further collaboration and dialogue between different sectors, with sustained cooperation required to combine the approaches and requirements of those from different fields e.g. the integration of heritage concerns into the work of emergency planners.

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ABBREVIATIONS AND ACRONYMS

AONB -- Area of Outstanding Natural Beauty

CCP -- Climate Change Partnership

CCRA --- Climate Change Risk Assessment

CFMP --- -- Catchment Flood Management Plan

CLA --- Country Land and Business Association

DCLG -- Department for Communities and Local Government

DCMS --- Department for Culture, Media and Sport

DEFRA -- Department for Environment, Food and Rural Affairs

EA --- Environment Agency

EH -- English Heritage

FA & SR -- Fountains Abbey and Studley Royal Heritage Site

HBC -- Harrogate Borough Council

HHA -- Historic Houses Association

ICCROM------------- International Centre for the Study of the Preservation and Restoration of Cultural Property

ICOMOS --- International Council on Monuments and Sites

IGMT --- Ironbridge Gorge Museum Trust

IPCC --- Intergovernmental Panel on Climate Change

LCLIP -- Local Climate Impacts Profile

LIDAR-- Light Detection and Ranging

Ripon MOP -- Ripon Multi Objective Project

RSPB --- Royal Society for the Protection of Birds

NE -- Natural England

NT -- National Trust

OUV -- Outstanding Universal Value

SGCT -- Severn Gorge Countryside Trust

SPD -- Supplementary Planning Document

SSSI -- Site of Special Scientific Interest

TWC ---Telford and Wrekin Council

UKCIP --- UK Climate Impacts Programme

UKCP09 -- UK Climate Projections 2009

UNESCO ------------------------- United Nations Educational, Scientific and Cultural Organisation

WHC --- World Heritage Committee

WHS -- World Heritage Site

WODC --- West Oxfordshire District Council

YHCCP -- Yorkshire and Humber Climate Change Partnership

CHAPTER 1 THESIS INTRODUCTION

1.1. Introduction

Nearly all European regions are anticipated to be negatively affected in some way by climate change, and strategies to adapt will be necessary to address impacts arising from the warming which is already unavoidable due to past emissions (European Environment Agency, 2010). Climate instability has particularly serious implications for the historic environment (Cassar, 2007). For example, changes in rainfall patterns and temperatures, even where these may not be perceived as a major threat to modern buildings, are likely to have dramatic effects on buried or exposed archaeological sites (Cassar, 2005). Of particular concern is the increasing occurrence of damage to the historic physical environment incurred by coastal and riverside flooding, subsidence and wind and storm damage (Sabbioni et al., 2006).

The historic environment is central to a place's cultural heritage and sense of identity, and hence a resource that should be sustained for the benefit of present and future generations (English Heritage, 2008b). The historic environment represents a considerable past investment of physical, natural and intellectual resources. Its importance includes its aesthetic values, its value as an educational and recreational resource and its significant contribution to employment and economic success. However, it has been stated that cultural heritage is neither prepared nor adapted to our future climate (Sabbioni et al., 2008).The vulnerability of cultural heritage sites is a function of their exposure, sensitivity and adaptive capacity to present and potential future impacts of climate change. The capacity to adapt is a critical element in the process of adaptation (Adger and Vincent, 2005) yet, although research exists on the adaptive capacity of natural heritage, there is only limited literature on the adaptive capacity of built cultural heritage and the capacity of the management of these sites to adapt.

Research is necessary in order to understand how the historic built environment might become more resilient to future changes to the climate and to enable it to better survive climate related threats. UNESCO have stated that a key challenge is that there is presently a lack of data that is specifically relevant to understanding climate change impacts on World Heritage properties, particularly cultural properties. This situation is further compounded by a lack of adequate capacity and financial resources for research and its application. Such a lack of knowledge and capacity has made it difficult to assess the loss of key values of World Heritage properties as a consequence of climate change. ‘Addressing these gaps in knowledge, information and capacity, and performing vulnerability assessments will assist in determining priorities for management action’ (UNESCO, 2008b p5). This thesis contributes to this gap in knowledge, by investigating the adaptive capacity of the management of built cultural heritage sites in the UK. The study examines selected key determinants of adaptive capacity, producing both theoretical and practical contributions to knowledge on this subject.

The research focuses on sites which are on the World Heritage Site list, which have therefore been designated as being of ‘Outstanding Universal Value’. UNESCO argues that ‘actions taken at these iconic properties attract considerable attention and can influence the adoption of good management practices elsewhere’ (2008b p4). World Heritage Sites can act as both ‘host sites’ where pilot projects are designed, developed and implemented and ‘seed sites’ from where the message about successful response strategies can be spread (World Heritage Centre and World Heritage Centre Advisory Bodies, 2006). World Heritage Sites have therefore been selected to focus on in this research, as adaptation to climate change is a relatively new policy area, and actions on adaptation at high profile sites may have wider implications for heritage management.

1.2. Research Aim and Objectives

The overall aim of the research is to investigate the adaptive capacity of the management of cultural heritage sites to climatic change, focusing on selected World Heritage Sites in the UK. The research objectives are as follows:

1) To develop a conceptual framework of the determinants of adaptive capacity relevant to cultural heritage sites.

2) To select key determinants of adaptive capacity appropriate to the management of cultural heritage sites that will be empirically investigated and to develop methods to test and evaluate these determinants in practice.

3) To use these methods to assess the current adaptive capacity of the management of selected sites, and to identify how this capacity could be enhanced.

4) To review the implications of these findings for other similar heritage sites, and for adaptive capacity theory.

1.3. Summary of Methodology

An extensive literature review was initially carried out which identified key concepts and issues in the subject area, identified gaps in knowledge, and which contributed to the selection of the research methods. A review of literature on vulnerability, adaptive capacity theory and cultural heritage guided the development of an initial conceptual framework of adaptive capacity relevant to cultural heritage management. This initial framework was also informed by a scoping stage which included a range of meetings and site visits to potential case studies.

The methodological approach used in the research was exploratory and predominantly qualitative, employing mixed methods and rooted in the pragmatist paradigm. The methods used in the research include a questionnaire survey of all UK World Heritage Sites, semi structured interviews at international, national and local level, and documentary review. The Local Climate Impacts Profile tool (LCLIP) (UKCIP, 2009) was adapted and used throughout the research in order to examine the consequences and preparedness of recent weather events, as a way of exploring elements of current adaptive capacity, and in order to engage with stakeholders on the subject of climate change adaptation.

Multiple case studies were examined, investigating adaptive capacity at three different UK World Heritage Sites. The case studies were selected using purposive sampling, and data collected in the questionnaire stage was used to inform the development of criteria for case study selection. Semi structured interviews with professionals involved in site management, including property managers, building owners, conservators and local authority officers were carried out. Documentary evidence was used to lay the foundation for the study, to obtain factual information about the cases and to provide evidence for analysis. The selected case studies were Ironbridge Gorge World Heritage Site in Shropshire, Fountains Abbey and

Studley Royal World Heritage Site in Yorkshire and Blenheim Palace World Heritage Site in Oxfordshire.

1.4. Structure of the Thesis

The structure of the thesis reflects the methodological structure of the PhD, the chapter sequence following the stage by stage process and overall approach of the work. This introductory chapter outlines the research aim and objectives, and two literature review chapters follow. The first of these explains the key concepts, issues, and definitions in the subject area of cultural heritage management and adaptation to climate change. It includes a critical evaluation of existing research in this area, identifies the gap in knowledge and explains the justification for the research. The second literature review chapter focuses on the theoretical background, exploring the concepts of vulnerability and adaptive capacity. Different determinants of adaptive capacity and the relevant theory are explained. An initial conceptual framework of adaptive capacity relevant to heritage management is presented which has been used as a framework for the data collection and analysis.

The methodology chapter explains the philosophical approach adopted, the research methods selected for investigating adaptive capacity, and details of the techniques used to analyse the data. The data chapters are next in the sequence, where the findings of the empirical research are presented and discussed. Initially, a chapter on the international and national contexts explains current systems of World Heritage management and how climate change is being addressed, informed by interviews with key stakeholders at the international and national level. This chapter includes a review of the UNESCO Operational Guidelines, the UK National Policy context, and a review of all UK World Heritage Site Management Plans. The results from a questionnaire survey of all UK World Heritage sites, which puts the findings from the case studies into context, are also presented.

The case study chapters are presented in the order that the data was collected and analysed. The first case study was Ironbridge Gorge, Shropshire, followed by Fountains Abbey and Studley Royal, Yorkshire and Blenheim Palace, Oxfordshire. The findings at each case are presented in relation to the conceptual framework of adaptive capacity, and the evolution of the revised framework is explained, as it has developed through the cases.

The discussion chapter follows, which reflects on the findings from the empirical study, examining the wider implications of these, and presents a revised conceptual framework of adaptive capacity. The final chapter draws overall conclusions, outlines the novel contribution of the research and identifies recommendations for further work.

CHAPTER 2 THE ADAPTATION OF CULTURAL HERITAGE TO CLIMATE CHANGE

2.1. Introduction

This literature review chapter will discuss the key concepts, issues and definitions in the subject area of climate change adaptation and cultural heritage. Some case studies of the type of impacts climate change is having and may have on cultural heritage will be examined. Existing research in this area will be identified and critically evaluated and gaps in knowledge will be identified, so making the case for this research.

2.2. An Introduction to Cultural Heritage

2.2.1. Key Concepts

The historic environment includes built heritage and remains of the past such as archaeological sites and designed landscapes. It contributes to the aesthetic quality of the surroundings where we live and work, and provides spaces for recreation and learning. It is central to a place's cultural heritage and sense of identity, and hence a resource that should be sustained for the benefit of present and future generations (English Heritage, 2008b). The historic environment reflects the knowledge, beliefs and traditions of diverse communities. It gives distinctiveness and meaning to places, providing a sense of continuity and source of identity (English Heritage, 2008b).

Some heritage is of national importance e.g. the Tower of London, UK which is valued for its architectural qualities as well as its prominent role in European and British history. Heritage can evoke nostalgia for a past period, and can not only provide scientific evidence of the past, but can also embody an emotional link with it (Orbasli, 2008). Heritage can have educational value, for example through what can be learnt from historic buildings, such as construction techniques and an understanding of past ways of life. Much heritage also has economic value, stimulating domestic or international tourism and providing employment (Orbasli, 2008 ; Ruijgrok, 2006). For example, an English Heritage (EH) study on the economic value of heritage estimated that every £1 of investment in the historic environment generates £1.6 of additional economic activity over a ten year period (English Heritage, 2010b).

A body of international treaties and texts for the protection of cultural heritage has been developed by UNESCO and other intergovernmental organisations since the 1950's. The 1954 UNESCO Convention for the Protection of Cultural Property in the Event of Armed Conflict (the Hague Convention) is the earliest of these international texts and was developed in great part in response to the destruction and looting of monuments and works of art during the Second World War. Key subsequent texts[1] include the International Charter for the Conservation and Restoration of Monuments and Sites (The Venice Charter) in 1964, which become the founding document of ICOMOS (International Council on Monuments and Sites). The Convention Concerning the Protection of World Cultural and Natural Heritage was adopted by UNESCO in 1972, and linked together in a single document the concepts of nature conservation and the preservation of cultural sites.

Various definitions of cultural heritage exist, and difficulties surrounding definition have a long history (Schofield, 2008). The 1972 World Heritage Convention defines cultural heritage which is of outstanding universal value (and which should therefore be protected under the Convention) as:

‘Monuments: architectural works, works of monumental sculpture and painting, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of outstanding universal value from the point of view of history, art or science;

Groups of buildings: groups of separate or connected buildings which, because of their architecture, their homogeneity or their place in the landscape, are of outstanding universal value from the point of view of history, art or science;

Sites: works of man or the combined works of nature and man, and areas including archaeological sites which are of outstanding universal value from the historical, aesthetic, ethnological or anthropological point of view’ (UNESCO, 1972 p2).

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[1] International Conventions to which State parties are signatories are binding for member states. Charters are for guidance and may or may not be adopted by countries into their legislation.

As this research focuses on World Heritage, this definition of cultural heritage will be adopted throughout this thesis.

The conservation of cultural heritage can be defined as ‘the process of managing change in ways that will best sustain the significance of a place in its setting, while recognising opportunities to reveal or reinforce its values for present and future generations’ (English Heritage, 2008b p7). Architectural conservation ranges from preventative maintenance and carrying out minimal repairs e.g. repairing gutters, to significant modifications, to allow a new function to thrive in an old building. Conservation is concerned with the past, present and future of a building or site. Major modifications may be necessary to ensure its economic viability e.g. the conversion of former industrial warehouses to residential use, or the installation of a visitor centre at a heritage attraction. The repair and adaptation of the existing building stock to new uses is inherently sustainable, but often requires careful consideration of impacts on heritage significance. These challenges are at the heart of conservation - making balanced judgements in respect of its history, the present day needs and resources and future sustainability (Orbasli, 2008).

2.2.2. Heritage Management

The management of cultural heritage involves systems that exist at various levels: at an international level through conventions and protocols, nationally or state wide through legislation, and locally through planning guidance, through local and amenity societies, and by the enthusiasm and engagement of local communities (Schofield, 2008). Schofield presents an explanatory management framework for cultural heritage in England, which clearly illustrates both top down and bottom up processes. Principles and good practice cascade down from the state, and the wishes, values and perceptions of local communities influence decision makers. This is shown in Figure 1, and has been adapted to include site owners/managers. It could be argued that good practice does not always cascade down from the state, and that in some cases top down advice may be considered by some to be bad practice. Good practice and advice may also be developed at regional and local levels, for example by special interest groups.

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Figure 1 Management frameworks for cultural heritage matters in England. Adapted from (Schofield, 2008 p21)

Traditional approaches to heritage management may focus on resolving specific problems or issues without formal consideration of the impact of solutions on the totality of a site or its values (Mason et al., 2003). An alternative to this is the values-based approaches to management that is increasingly being adopted (Schofield, 2008), and which is participatory and consultative. Values-based approaches start by analysing the values and significance attributed to cultural resources. They then consider how those values can be protected most effectively (Mason et al., 2003). A key reason that this approach is currently considered to be good practice, is that a wide range of values are recognised which could include historic, economic, architectural, aesthetic, rarity or archaeological values. Other less tangible values include the emotional, symbolic and spiritual meanings of a place. Values-based heritage management has been most thoroughly formalised in Australia where the Burra Charter guides practitioners[2].

[2] The 1999 Burra Charter is the Australian ICOMOS Charter for the Conservation of Places of Cultural Significance, and defines the basic principles and procedures to be followed in the conservation of Australian heritage places. It is considered the best practice standard for heritage management in Australia (ICOMOS Australia, 2013).

All models for values-based conservation include a step in which the significance of the site or building in question is established (Mason, 2002). Significance embraces all the cultural and natural values that people associate with a place, or prompt them to respond to it (English Heritage, 2008b). The purpose of understanding and articulating the significance of a place is to inform decisions about its future. The degree of significance determines what, if any, protection is appropriate under law and policy. All World Heritage Sites are required by UNESCO to have a 'Statement of Outstanding Universal Value' which outline the significance of the site, by 2012.

In England, modern conservation philosophy, specifically the principles that are currently used by English Heritage (EH) to guide decision making, have been set out in an EH framework (English Heritage, 2008b). EH was formed as a result of the National Heritage Act (UK Parliament, 1983), when many matters relating to heritage conservation were removed from the Department of the Environment (Ward, 2004). EH is the Government's statutory adviser on the historic environment, and is a statutory consultee on applications for planning or Listed building consent affecting Listed structures (Grades I or II*), Scheduled Ancient Monuments and registered landscapes. Its funding comes partly from Government and partly from revenue earned from its historic properties and other services (English Heritage, 2012a).

EH inherited 400 buildings and archaeological sites from the Department of the Environment, has significant government funding, can influence legislation, advise and has the authority to take emergency action to save endangered properties. EH (2008b p22) state that conservation is achieved by all concerned with a significant place sharing an understanding of its significance, and using that understanding to:

- 'judge how its heritage values are vulnerable to change
- take the actions and impose the constraints necessary to sustain, reveal and reinforce those values
- mediate between conservation options, if action to sustain one heritage value could conflict with action to sustain another
- ensure that the place retains its authenticity – those attributes and elements which most truthfully reflect and embody the heritage values attached to it'.

These principles reflect the current 'rules of conduct' that guide conservation practice in the UK. However, it should be recognised that conservation principles themselves are products of particular times, places and circumstances and that they evolve and change over time. As Delafons (1997 p4) notes, ' the scope of conservation has widened enormously over the past 100 years and diverse influences have shaped its development.' For example, when considering the significance of heritage, culture plays a significant role. In the UK, multiculturalism has brought shifting perceptions of what buildings and places mean, and it is increasingly recognised that accepting more than one set of memories, identities and histories in our understanding of the past and present can lead to an evolving and shared future (Hasser, 2007).

Over time, values and knowledge change and new challenges emerge, and this may mean that the basis of conservation decisions changes. Climate change and the need to adapt to future climate scenarios could be one such challenge which may test the logic of current conservation philosophies.

2.2.3. Heritage at Risk

Cultural heritage can be threatened by a range of natural and man-made factors including traditional causes of decay and neglect, inappropriate use or development, obsolescence, war and political and economic pressures. Over time cultural works may be gradually damaged by ageing and decay, and major events such as natural disasters may have sudden catastrophic consequences. Heritage may be damaged by human interventions, some of which may be deliberate e.g. the destruction of the Buddhas of Bamiyan in Afghanistan, and some well-meaning. As Stovel writes, heritage is even at risk 'from the hand of the overzealous conservator' (1998 p17). As well as these factors, new and emerging risks such as climate change, and its impacts on cultural heritage 'through increased flooding, droughts and coastal erosion'(ICOMOS, 2007a p7) are now a concern.

Sabbioni et al (2008) argue that cultural heritage is neither prepared nor being adapted to our predicted future climate and that research is necessary on how to make the historic built environment more resilient to future disasters and enable it to better survive climate related threats. The risk to cultural heritage from disasters and gradual change which may occur due to climatic change is particularly pertinent as cultural heritage is a non-renewable resource. Cultural heritage can also be described as rare, valuable, and finite (Spennemann, 1998) cited in (Graham and Spennemann, 2006), and these factors make heritage particularly vulnerable. Climate change impacts may affect or exacerbate existing pressures such as natural decay, natural disasters and inappropriate use or development (Bumbaru, 2007). Climate change could generate abandonment or force inappropriate interventions that would destroy heritage or reduce greatly its significance or authenticity. However, not all impacts may be negative, and there may be opportunities as well, for example for increased visitor access and tourism.

As this thesis focuses on the particular issue of climate change, some of the background to the climate change debate will now be explored, including trends which have been observed and potential future impacts on cultural heritage.

2.3. Climate Change

2.3.1. Definitions of Climate Change

Alternative definitions of climate change exist. The United Nations Framework Convention on Climate Change (UNFCCC), in Article 1, defines climate change as: ‘a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over a comparable time period’ (United Nations, 1992 p3). However, the Intergovernmental Panel on Climate Change (IPCC) defines climate change as ‘a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use’ (IPCC, 2007b p943). As the IPCC definition includes both natural variability and human induced climate change, and given that the impacts of climatic change on cultural heritage caused by both these factors are relevant for this research, the IPCC definition of climate change is adopted for this thesis.

2.3.2. Observed Climate Change

Whilst geological history demonstrates that the earth’s climate has always been in a constant state of flux due to natural cycles (Howard, 2012), it is now widely acknowledged that significant changes are occurring to current and future climate. According to the IPCC 'warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level'(IPCC, 2007 p5). The following graph shows direct observations of recent climate change.

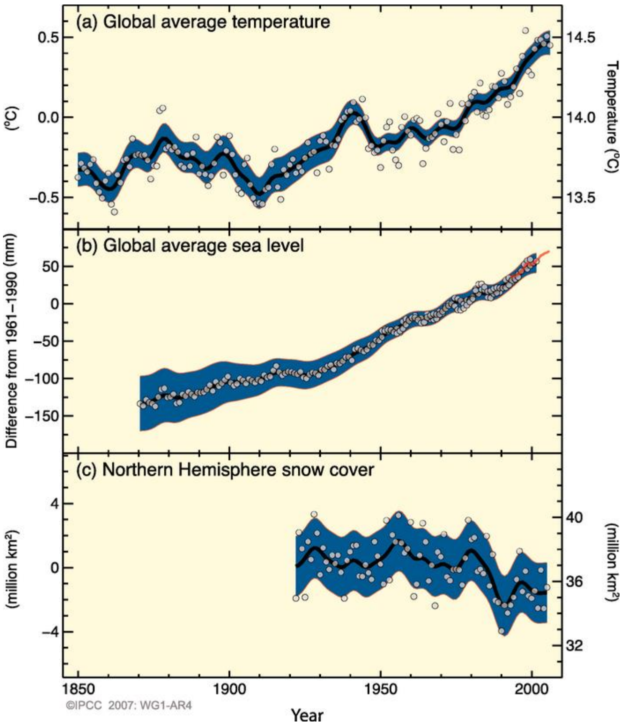

Figure 2 IPCC – Direct observations of recent climate change.
Observed changes in (a) global average surface temperature, (b) global average sea level from tide gauge (blue) and satellite (red) data and (c) Northern Hemisphere snow cover for March-April. All changes are relative to corresponding averages for the period 1961–1990. Smoothed curves represent decadal average values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties and from the time series (IPCC, 2007,Figure SPM.3).

Although there is widespread consensus about the fact that temperatures have increased, the cause of the observed changes and the rate of future change is the subject of some debate. Questions were raised in 2009 (mainly in the popular media) about the credibility of the IPCC assessments. An independent investigation of the 2007 IPCC reports (Netherlands Environmental Assessment Agency, 2010 p10), however, found that there were no significant errors in the IPCC's summary conclusions, and that 'there is ample observational evidence of natural systems being influenced by climate change on regional levels.'

The IPCC's mandate is to assess the relevant research information on climate change available in peer-reviewed literature, journals and books. They conclude that 'most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations' (IPCC, 2007c p9).

A global assessment of data since 1970 carried out by the IPCC has shown 'it is likely that anthropogenic warming has had a discernible influence on many physical and biological systems' (IPCC, 2007c p9). Impacts that have been documented include:

- Effects on agricultural and forestry management at Northern Hemisphere higher latitudes, such as earlier spring planting of crops, and alterations in disturbance regimes of forests due to fires and pests
- Some aspects of human health, such as heat-related mortality in Europe and infectious disease vectors in some areas
- Settlements in mountain regions are at enhanced risk of glacier lake outburst floods caused by melting glaciers. Governmental institutions in some places have begun to respond by building dams and drainage works
- Some human activities in the Arctic (e.g., hunting and travel over snow and ice) and in lower-elevation alpine areas (such as mountain sports)
- Sea-level rise and human development are together contributing to losses of coastal wetlands and mangroves and increasing damage from coastal flooding in many areas (IPCC, 2007c).

2.3.3. Future Climate Change and the Need for Adaptation

Evidence suggests that continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century. Even if greenhouse gas concentration were stabilised, 'anthropogenic warming and sea level rise would continue for centuries due to the time scales associated with climate processes and feedbacks' (IPCC, 2007 p16).

Costs and benefits of climate change for industry, settlement and society will vary widely by location and scale. The region that this research focuses on is Europe, and this has its own particular vulnerabilities. The most vulnerable parts of Europe are mountain areas (in particular the Alps), islands, coastal and urban areas and densely populated floodplains (Commission of The European Communities, 2009 ; European Environment Agency, 2010). Nearly all European regions are anticipated to be negatively affected by some future impacts of climate change, and climate change is expected to magnify regional differences in Europe's natural resources and assets. Negative impacts will include increased risk of inland flash floods, and more frequent coastal flooding and increased erosion due to storminess and sea-level rise (IPCC, 2007c). Opportunities may also emerge, for example crop productivity is projected to increase slightly at mid- to high latitudes and commercial timber productivity is expected to rise modestly with climate change (IPCC, 2007c).

Adaptation deals with making adjustments in response to the likely threats and opportunities arising from climatic variability and climate change (Institute of Environmental Management and Assessment, 2009). It is crucial that adaptation to climate change occurs, in order to address impacts resulting from the warming which is already unavoidable due to past emissions. There does not need to be choice between mitigation and adaptation – these two strategies must work together, and 'a combination of the two is needed to confront the threats and risks of climate change' (Wilson and Piper, 2010 p28).

Various types of adaptation can be distinguished, including anticipatory and reactive, private and public, and autonomous and planned adaptation. The capacity to adapt is a critical element in the process of adaptation (Adger and Vincent, 2005). A wide array of adaptation options is available; however, there are barriers to implementation, and there is a need for more extensive adaptation than is currently occurring to reduce vulnerability to climate change. According to the IPCC, the barriers, limits and costs of adaptation are not yet fully understood (2007c).

2.3.4. Planning for an Uncertain Future: Climate Change Scenarios

The Stern Review (Stern, 2007) concluded that while the science of climate change is reliable and the broad direction of change is clear, we do not know precisely when and where particular impacts will occur. This uncertainty presents a significant challenge for those involved in day-to-day decision making or long-term planning. As a response to this, the UK Climate Impacts Programme (UKCIP) advocate a risk-based approach to decision making on climate change adaptation (UKCIP, 2003) and recommend that, wherever possible, decision makers identify and adopt 'no regret' and 'low regret' options. These are adaptation measures considered to be worthwhile now as they would yield immediate economic and environmental benefits which exceed their cost. They would continue to be worthwhile irrespective of the nature of future climate change. A simple 'no regret' option for a historic building is, for example, to improve basic maintenance measures in order to minimise risks from storm damage (English Heritage, 2008a).

Climate scenarios are 'consistent and plausible pictures of possible future climates' (Royal Netherlands Meteorological Institute, 2010). They are used in studies exploring the impacts of climate change, and to formulate possible adaptation strategies. Climate models cannot reproduce the full complexities of the real climate system, and there are also uncertainties associated with information based on such models. Scenario development is a form of 'futures thinking.' The purpose of a futures methodology is to systematically explore, create, and test both possible and desirable futures to improve decisions (Glen, 2003). Climate scenarios are not long-term weather forecasts: they are not concerned with predicting the weather on a certain day. Rather, they provide information on the characteristics of the average weather and the chance of weather extremes (Royal Netherlands Meteorological Institute, 2010).

Scenarios are a tool which could be used by heritage managers to help plan for possible futures, and develop adaptation strategies. EH (2008a p13) state that 'decisions on how, when or whether to make adaptive changes to historic assets in order to enhance their resilience to climate change should be based on a good understanding of the pressures they are likely to face. It is important therefore that decision makers understand the uncertainties inherent in current climate change predictions and the timescales over which changes are likely to occur.'

Climate change scenarios are produced at a range of scales, globally, regionally and locally. For example, the climate projections produced by the IPCC are based on an analysis of various computer climate models running within the different scenarios that were established in 2000 – the 'Special Report on Emissions Scenarios.' Four different narrative storylines were developed which each represent different demographic, social, economic, technological, and environmental developments.

Scenarios for the UK were developed by the UK Climate Impacts Programme. The most recent version of these are the UKCP09 climate change scenarios, released in 2009, which provide four alternative descriptions of how the climate of the UK might evolve over the course of this century. The scenarios describe future climate change under alternative futures, ranging from rapid economic growth with intensive use of fossil fuels (High Emissions) to increased economic, social and environmental sustainability with cleaner energy technologies (Low Emissions). UKCP09 is the fifth generation of climate change information for the UK. The UKCP09 scenarios (an example of which is shown in Figure 3) differ from previous projections in that they are probabilistic: showing a range of possible outcomes and the probability of each outcome, based on how much evidence there is for different levels of future climate change.

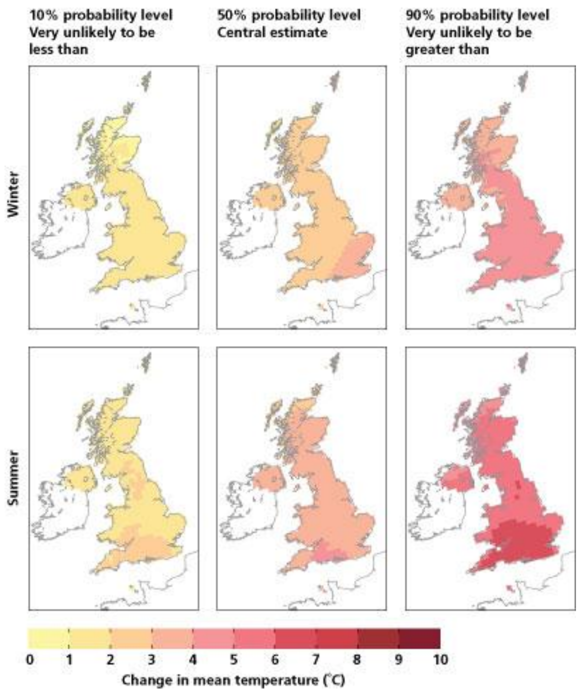

Figure 3 Example of a map of UKCP09 Climate Projections (DEFRA, 2009) © UK Climate Projections, 2009

There is little literature available which specifically examines the use of scenarios or other climate information in the heritage management field, and a lack of evidence whether these types of scenarios are being used by practitioners involved in site management. However, a limited number of recent academic studies have started to use climate projections and models to investigate potential impacts of climate change on cultural heritage (Huijbregts et al., 2012 ; Lankester and Brimblecombe, 2012 ; Sabbioni et al., 2006 ; Smith et al., 2011).

2.4. The Impacts of Climate Change on Cultural Heritage

2.4.1. Research on Impacts

Many historic buildings, sites and landscapes have experienced and survived significant climatic changes in the past and may demonstrate considerable resilience in the face of future climate change. In fact, the historic environment has the potential to contain indicators for past climate change and hold information on past human adaptation to climate change events (English Heritage, 2008a). Nevertheless, climate instability has potentially serious implications for the historic environment (Cassar, 2005 ; Howard, 2012 ; Huijbregts et al., 2012) and many historic assets are potentially at risk. There may also be opportunities for the heritage sector from changes to the climate, but these are not yet well understood.

Climate change could cause damage, generate abandonment or force inappropriate interventions, such as poorly designed adaptation and mitigation measures that would destroy heritage or greatly reduce its significance or authenticity. For example, changes in rainfall patterns and temperatures, even where these may not be perceived as a major threat to modern buildings, may have dramatic effects on buried or exposed archaeological sites, and changes to the indoor environment affect the microclimate around museum objects and could cause damage to collections. Some historic materials are extremely permeable to the environment of air and soil; changes in moisture content can occur rapidly, and these can activate damaging cycles of salt crystallisation (Cassar, 2005). Old rainwater goods may be unable to cope with changed patterns of rainfall, and acute events such as flooding can have much worse and longer term effects on historic than modern buildings (Cassar, 2005).

As well as direct impacts on built structures, there may also be impacts on the users of and visitors to historic properties e.g. due to overheating (both these kinds of impacts are illustrated in Table 1). Types of impacts will vary and both gradual changes to the climate and extreme weather events may have impacts on cultural heritage. There has been a limited number of studies on the impact of climate change on the historic environment, although research in this relatively new area has greatly increased over the last decade.

Climate Change and the Historic Environment (Cassar, 2005), a project commissioned by EH, was one of the first studies to look at climate change and cultural heritage. A scoping study designed to investigate likely risks and suitable strategies of mitigation and adaptation was carried out. The methodology included a questionnaire which gathered responses from managers and advisors in organisations including EH and the National Trust (NT), and local authority officers responsible for archaeology and Listed properties. Some possible impacts of climate change on cultural heritage in the UK that were highlighted in this study are summarized in Table 1:

Flooding	Fluvial flooding is identified as a major problem, requiring repairs and upgrading to drainage. Post flood drying is critical. Buildings and excavated archaeology are at risk of ground heave and subsidence as water recedes and water table changes. Coastal heritage may be at risk from sea level rise and storm surges. The salinity of the flood water is a particular risk factor for the historic environment.
Temperature	Rising temperatures can be a risk for the deterioration of materials and contents, as an increase in temperature can increase the rate of chemical reactions.
Pests and diseases	An increase in the numbers and/or type of pests may affect museum and plant collections. Moulds and insects can also present a threat to wooden structures.
Human comfort, health and safety	Rising temperatures may have an impact on visitor comfort and so there may be pressure to install air conditioning.
Plant physiology and distribution	Changes such as deep root penetration can be damaging to buried structures. The loss of vegetation cover due to drought can exacerbate erosion.
Extreme weather	High winds can cause damage to windows, awnings and roofs, and large trees can become hazards.
Relative humidity	Fluctuations in humidity can be extremely damaging to materials and collections.
Rainfall	Historic rainwater goods are often not capable of handling heavy rains and may be difficult to access, maintain and adjust.

Table 1 Table of selected findings from Climate Change and the Historic Environment Adapted from Cassar (2005)

Key conclusions from the research include that climate change often highlights long standing preservation issues and that a key issue is how to streamline current monitoring, management and maintenance practices to improve the stability of the historic environment, no matter how weak or strong the impact of climate change. The study highlighted that good maintenance should be promoted and that EH should promote and support local decision-making in maintenance and emergency response (Cassar, 2007). A further recommendation is that heritage agencies such as EH should participate and contribute to the measures being developed by agencies responsible for addressing climate change impacts in other sectors (such as the Environment Agency). The establishment of a coordinated damage alleviation service for dealing with the effects of extreme rainfall and high winds on the historic environment is recommended.

The Noah's Ark project (Sabbioni et al., 2006), examined the effect of climate change on Europe's built heritage and cultural landscapes over the next 100 years. This scientific research project focused on determining meteorological changes critical to built heritage, developing a Europe scale climate model and applying this to try to evaluate the impact on building materials and structures. A vulnerability atlas and accompanying guidelines were produced as an outcome of the research, which was intended to 'communicate the science and its outputs to different user groups ranging from policy makers to heritage managers' (Sabbioni et al., 2010 p xiv). A range of maps were produced which include climate maps which map climate parameters relevant to cultural heritage, damage maps which quantitatively express the damage induced by climate parameters on building materials in future scenarios, and risk maps showing areas of increasing/decreasing risk of the deterioration process of materials in different regions of Europe.

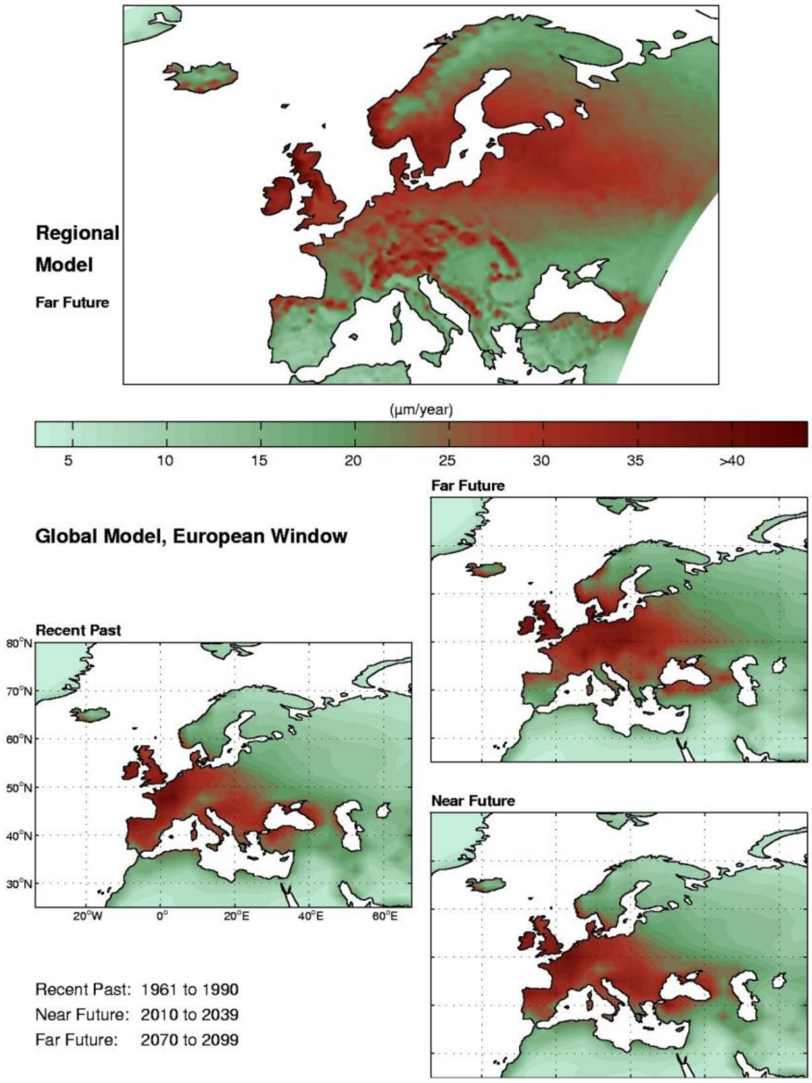

Figure 4 Damage Map. Corrosion of steel–iron and bronze caused by acidifying pollutants in urban areas (Sabbioni et al., 2010)

The maps clearly highlight the kinds of risks and potential damage to heritage, and provide for the first time projections for the deterioration of different materials in different regions. However, a limitation to their use is the broad scale at which the maps have been produced (see Figure 4 above). It may be difficult for policy makers, heritage professionals and site managers to apply the information in these maps to their specific areas/sites, and so the need for further research and the production of similar more detailed maps at smaller scales is highlighted.

Another key research project in this area was carried out as part of the 'Building Knowledge for a Changing Climate' programme. This project (Engineering Historic Futures) focused upon the potential effects of changing frequency of flooding and intense rainfall on heritage materials, particularly focusing on the wetting and drying processes of historic masonry walls. Methodologies included participative exchanges with stakeholders such as workshops and interviews to develop a specification of user requirements, intensive field monitoring at two sites, measurements at two test walls and the development of a drying model. Outcomes included the finding that maintenance, especially of guttering and mortar joints, will become increasingly important with increased rainfall (Cassar, 2007).

These and other more recent research projects (Brimblecombe et al., 2011 ; Huijbregts et al., 2012 ; Smith et al., 2011) have progressed knowledge in understanding the impacts of climate change on the historic environment, focusing on the physical impacts on historic buildings, structures and materials. New studies are emerging, such as the EU funded 'Climate for Culture' project (2009 – 2014), which involves partners across Europe and aims to estimate the impacts of climate change on historic buildings and heritage collections in Europe and the Mediterranean (Climate For Culture, 2012).

However, although the body of knowledge on potential and observed impacts of climate change on the historic environment is being developed, very little information exists on the capacity of the management of these sites to adapt to climate change. Further research on the capacity of the management systems currently in place to deal with changes in climate and associated threats and opportunities is therefore required, in order to understand current approaches and to identify how management responses could be improved.

In order to further investigate the observed and potential impacts of climate change on cultural heritage sites, and the management implications of these, a range of case studies that are available through the literature have been examined, some of which are presented here. Initially, the case of the National Trust (NT) is taken, as this is a key UK conservation organisation that is involved in the management of several UK World Heritage Sites. In order to broaden the focus from the UK to an international level, selected case studies which have been published by UNESCO[3] and ICOMOS[4] are then outlined, demonstrating a variety of impacts as well as a range of different types of cultural heritage.

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[3] UNESCO is responsible for the administration of the World Heritage List

[4] ICOMOS is an advisory body involved in the management of World Heritage

2.4.1.1. The National Trust

The NT is a UK conservation organisation, which began in 1895, has charitable status and is independent of Government. It has a variety of interests, including managing over 350 historic houses, gardens and ancient monuments, cafes and restaurants, holiday cottages, museums and art galleries and over 700 miles of coastline (National Trust, 2010a). It is the largest private society devoted to heritage conservation in the UK and relies for income on membership fees, donations and legacies, and revenue raised from its commercial operations. Several NT properties are part of several World Heritage sites in the UK[5]. The NT states that managing its estate has provided a good insight into how the changing climate is already impacting on environment and society and also on what may be needed to adapt to that change.

In its 'Forecast, Changeable' report, the NT states that 'there are various trends becoming apparent which are consistent with what the scientists and data tell us has been happening to our climate over recent years'(National Trust, 2005a p4). Some of the trends that they identify as emerging in their properties (land, buildings and contents) include:

- Visitation is increasing: A longer visiting season, with spring coming earlier and the onset of winter delayed, means some pay-for-entry properties are opening longer to meet demand and take advantage of earlier flowering times and later autumn colour etc. On the plus side, extra visitors generally means more income for conservation work, but there are increased management costs in terms of staffing and maintenance.

- Rainwater penetration into buildings: The Trust's historic buildings are struggling to cope with the volume and power of heavy downpours. 'An increased number of torrential downpours are overwhelming the capacity of rain water goods and drainage, and water is increasingly entering historic interiors through roofs, walls and from basement flooding. This can damage vulnerable decorative paint surfaces and wallpaper, and creates damp conditions resulting in mould growth and increased levels of insect infestations'(National Trust, 2005a p7).

[5] Examples of NT properties are the Bath Assembly Rooms (part of the City of Bath WHS) and Cornish Mines and Engines (part of the Cornwall and West Devon Mining Landscape WHS).

- Warmer winters: At Chedworth Roman Villa (Gloucestershire), the change from winter freeze and spring thaw cycles to more frequent freeze/thaw events is causing more of the stonework to fracture. Milder conditions also means vegetation does not die back over winter, making sites harder to record and increasing root damage. The range of some insect species is changing and their activity is increasing. Infestations with Webbing Clothes Moth and Carpet Beetle are becoming more common.

- Increased threat of fire: This is a threat in longer drier summers, putting the NT's many thatched buildings at a higher risk, and also risking damage to heathland and moorland vegetation in areas such as the Peak District.

- Impacts on growing seasons: There have been 'dramatic changes in the speed with which some plants grow in the longer, warmer growing season' (National Trust, 2005a p5).Implications include the increased time and cost of mowing grass in amenity areas for longer periods of the year.

- Higher temperatures: An increasing issue of public health is exposure to additional UV. Other health and safety areas which need monitoring include incidence of ticks and Lyme disease, increased fire risk, dehydration risk for staff and visitors, and risk of fatalities from unauthorised swimming in lakes etc.

- Water shortages: Some properties have suffered from a shortage of water during summer droughts. The Trust has over 300 private water supplies, many of which are reliant on shallow surface sources that can dry up even in short periods of drought (National Trust, 2005a).

These examples from the NT illustrate the wide range of impacts which may affect heritage sites, and the need for risk preparedness measures, particularly as existing risks e.g. fire may be exacerbated by changes to the climate.

2.4.1.2. UNESCO

UNESCO is the specialised UN agency for Education, Science, Culture and Communication. It coordinates a range of initiatives related to climate science, monitoring and adaptation, and is also responsible for the administration of the World Heritage List. UNESCO's World Heritage Centre published a report (UNESCO, 2007) which highlights a range of case studies that illustrate some impacts of climate change on World Heritage Properties. The case studies illustrate the range of impacts and types of heritage that are affected, such as marine sites, archaeological sites and historic cities, and also some of the uncertainties and difficulties in managing these changes. Changes in climate are impacting on heritage worldwide, for example the mosques of Timbuktu are being increasingly impacted by droughts and desertification, and the Chavin archaeological site in Peru is at risk from more frequent landslides triggered by glacial melt water (UNESCO, 2007).

One of the European case studies examined in the publication is the Czech Republic. In the summer of 2002 severe floods affected much of central and eastern Europe. Among the heritage sites which suffered significant damage were the World Heritage Sites of Prague and Cesky Krumlov. These two sites were inscribed onto the World Heritage list in 1992. UNESCO has stated that it considers that to some extent this event can be linked to climate change (UNESCO, 2007), and that given the IPCC predictions for future changes to average precipitation and 'the fact that World Heritage sites in the Czech Republic have proved to be particularly exposed, it is timely to implement appropriate response strategies' (UNESCO, 2007 p73).

In Prague, some buildings recorded flooding up to 2m above ground level and many waterlogged buildings collapsed (UNESCO, 2007). In Cesky Krumlov the historic centre was flooded up to 4m and about 150 buildings of the medieval Gothic and Renaissance periods suffered considerable damage (UNESCO, 2007). However, the preference of medieval builders in the Czech region to use stone, brick and lime rather than the less durable wood or raw bricks, prevented much worse damage (ICOMOS, 2003).

UNESCO explains that the biggest challenges encountered in the recovery of the floods were how to dry the waterlogged walls and structures before the winter brought frost damage (2007). Preserving the authenticity of these sites after the flood proved to be difficult because of pressures to replace historic features by modern materials assumed to be more resistant to floods (UNESCO, 2007). According to ICOMOS, problems occurred when;

'the contractors and producers of building materials took their opportunity to extract money from the situation. They started fierce campaigns, offering the owners of flooded buildings their services and products. They are very busy persuading them to make the repair of the affected buildings, not in a minimal-necessary scale, but encouraging radical reconstruction. They are offering to strip out all plaster, to replace wooden elements such as floors, windows, doors - in many cases even ceiling timbers - with steel, plastic and other modern materials' (ICOMOS, 2003).

This case study highlights the fact that post disaster recovery is often the most dangerous time for cultural heritage in a disaster hit area. In many cases, in the rush to 'get back to normal,' unthinking or seemingly uncontrollable actions may cause great damage to historic resources. For example, restorable buildings may be torn down or property owners may make inappropriate repairs.

2.4.1.3. ICOMOS

ICOMOS regularly produces heritage at risk reports, which aim to identify threatened heritage places, monuments and sites, present case studies, and share suggestions for how issues should be tackled. ICOMOS has identified that climate change poses a risk to coastal heritage in Norway (2007b). There are 3 Norwegian World Heritage sites located on the coast: the Alta Rock Art, the cultural landscape of the Vega Archipelago, and the Bryggen Wharf in Bergen. Traditional wooden coastal settlements composed of wharfs, warehouses, dwellings, and farmhouses form a typical Norwegian vernacular architecture. ICOMOS outlines that sea level rise, increasing numbers of days with rain and heavier rainfall, warmer temperatures and storms in these areas, which already have a high humidity, will expose the cultural sites to more negative conditions than experienced before' (2007b p117), and its existing vulnerabilities will be exacerbated. Direct damage may also be caused by stronger winds affecting roofing and panels, and an increase in insects and fungi attacking wooden constructions. The foundations of harbour quays, piers and storehouses are not built to resist extreme storms, and will need more intensive maintenance.

Impacts have already become visible at Bryggen Wharf. Bryggen is threatened by rising sea levels. Due to heavy rainfall and storms in combination with high tide, many of the buildings already experience flooding during the winter. 'Future forecasts predict tide levels that will flood the buildings nearest to the wharf more often. Rising tides could also threaten more of Bergen's old city centre. The winter 2006-2007 resulted in flooding 15 to 20 times, meaning that the constantly wet timber structures are now threatened by rot and fungus from this inundation combined with lengthy rainfall' (ICOMOS, 2007b p117).

The fact that maintenance is vital in mitigating climate change is highlighted at this case study, as well as by other authors (Cassar, 2007 ; Graham and Spennemann, 2006 ; Hurd, 2008). Both on-going maintenance and monitoring are key in improving resilience, for example by ensuring early warning signs of impacts are picked up and so that efficiency of established conservation works can be improved (Hurd, 2008).

2.5. Conclusion

Conservation can be defined as the process of managing change. The values-based approach to heritage management, which emphasises the understanding of the significance of a place in order to inform decisions about its future, is a key element of the UK approach to heritage management, and the UNESCO approach to World Heritage Site Management. Decisions about the management of heritage sites involve both day to day and long term planning, and include the consideration of potential threats to sites. Climate change is one of a range of factors which are a potential threat to heritage sites, for example by forcing the abandonment of sites or resulting in impacts upon a site's significance or authenticity. There are already impacts from climate change being observed, as studies by organisations such as the NT have shown. Existing vulnerabilities may be exacerbated by climatic change, and the heritage values which contribute to a site's significance, such as its aesthetic, historical, communal or economic value may be affected or even lost. Existing literature highlights the importance of maintenance, the value of risk preparedness and the particular danger of the post- disaster recovery period.

The potential impacts of climate change on cultural heritage are not yet well understood, as this is an area with limited existing research, although the knowledge base is expanding. A review of existing research shows that this focuses mainly on modelling physical impacts on historic buildings and materials. Given the key role that heritage management has in conservation, and the importance of management planning in implementing decisions on climate change, this is evidently also an important area. However, there is currently a lack of research focusing on the management of climate change adaptation at heritage sites. This research addresses this gap in knowledge, contributing to the understanding of the capacity of the management of heritage sites to adapt.

CHAPTER 3 VULNERABILITY, ADAPTIVE CAPACITY AND CULTURAL HERITAGE

3.1. Introduction

This chapter will explore the theoretical and conceptual background to the research. The concepts of vulnerability and adaptive capacity will be examined, reviewing literature to investigate different ways of defining these concepts and exploring how they can be assessed and measured. Existing literature on adaptive capacity and cultural heritage will be examined, and the applicability of existing generic theoretical frameworks of adaptive capacity to the area of heritage management will be considered. Finally, as a result of the review of different existing frameworks of adaptive capacity, determinants of adaptive capacity will be selected to focus on in the empirical part of the research, as outlined in the research objectives.

3.2. Vulnerability

3.2.1. Conceptualising Vulnerability

A general theoretical model of vulnerability emerges through the climate change literature. It is consistently stated that the vulnerability of any system is a function of the exposure and sensitivity of that system to hazardous conditions and the ability or capacity or resilience of the system to cope adapt or recover from the effects of those conditions (Adger, 2006 ; Adger and Vincent, 2005 ; Smit and Wandel, 2006). Adaptive capacity is, therefore, a component of vulnerability, along with exposure and sensitivity. Adaptations are manifestations of adaptive capacity (Smit and Wandel, 2006), and they represent ways of reducing vulnerability.

These concepts are defined in different ways and given different emphases in various fields, such as ecology, engineering, agriculture and development. The IPCC conceptualises vulnerability within a systems perspective. It judges a system to be vulnerable if it is exposed to climate change impacts, if it is sensitive to these impacts, and if it has a low capacity to cope with those impacts (IPCC, 2007b). Research by Ionescu et al. (2009) attempts to present a formal framework of vulnerability to climate change, and identifies that the definition of vulnerability requires the specification of 3 factors: the entity that is vulnerable, the stimulus to which it is vulnerable and the notion of 'worse' and 'better' with respect to the outcome of the interaction between the entity and the stimulus compared with the outcome resulting from a reference stimulus (Ionescu et al., 2009 p14).

Different authors have developed different diagrammatic representations of vulnerability. Smit and Wandel represent the basic vulnerability model in a Venn diagram format (see Figure 5 below). 'The larger sets represent the broader stresses and forces that determine exposure and sensitivity and shape adaptive capacity at the local or community level, denoted by the smaller embedded sets….the overlap recognizes that the processes driving exposure, sensitivity and adaptive capacity are frequently interdependent' (Smit and Wandel, 2006 p286). This conceptualization is helpful in that it broadly indicates the ways in which vulnerabilities of communities are shaped, and recognises that the different components of vulnerability interact and overlap.

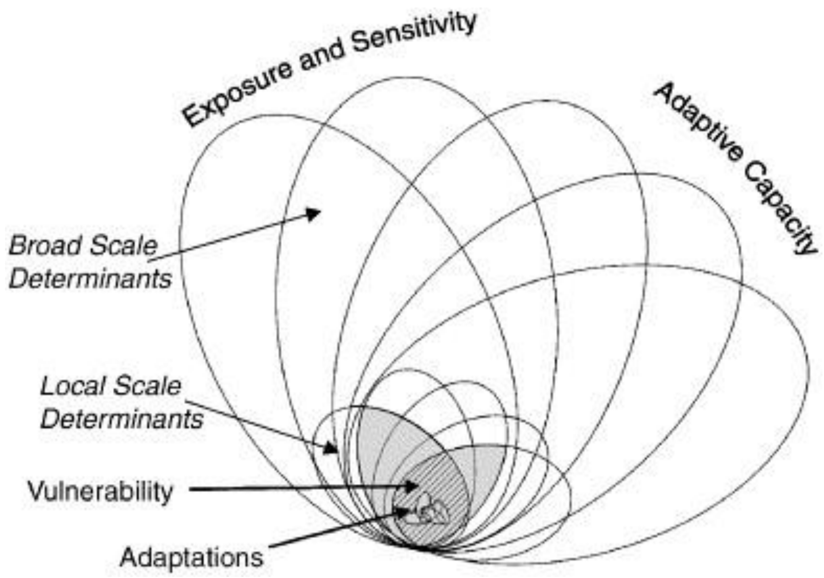


Figure 5 Model of vulnerability (Smit and Wandel, 2006)

3.2.2. Measuring Vulnerability

Challenges arise when attempting to quantify vulnerability, both due to its complexity, and difficulties defining the parameters which contribute to it. Suitable metrics for vulnerability are difficult to find, and the literature shows that vulnerability and its elements of exposure, sensitivity and adaptive capacity are difficult to measure numerically (Adger, 2006 ; Smit and Wandel, 2006). Some of the reasons for this are explained by Smit and Wandel (2006), who argue that vulnerability, its elements of exposure, sensitivity and adaptive capacity, and their determinants are dynamic (they vary over time), they vary by type, they vary from stimulus to stimulus, and they are place- and system-specific. In addition to this, 'complex and poorly understood interactions' (Adger et al., 2004 p15), which contribute to vulnerability, involving both physical processes and the human dimension, present further challenges to its measurement.

However, generic features of vulnerability exist, which provide a starting point to its investigation and assessment. Some of these features have been highlighted in a review of antecedent and current research by Adger (2006 p277), and include 'the resources available to cope with exposure, the distribution of these resources (both social and natural) across the system, and the institutions that mediate resource use and coping strategies. Where institutions fail to plan for hazards or for changing social conditions and risks, system vulnerability can be exacerbated'. In order to comprehensively understand vulnerability to climate change, a range of risks, institutional responses and resources, social and behavioural factors will need to be considered, and vulnerability will manifest itself differently in different contexts and at different scales. The generic components described here provide a helpful starting point in understanding vulnerability; however it is clear that context is crucial. In order to truly comprehend the vulnerability of a place or system, context specific factors must also be recognised.

3.3. Adaptive Capacity

3.3.1. Defining Adaptive Capacity

The concept of adaptive capacity has its origins in the natural sciences, particularly in the field of evolutionary biology. Adaptive capacity in the context of human systems is used when assessing the potential to adapt to future climate change, and as Vincent (2007) states, is a critical factor in determining the impacts of climate change. This concept can be defined in different ways. The IPCC defines adaptive capacity (in relation to climate change impacts) as 'the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences' (IPCC, 2007a p869). Another definition of adaptive capacity is as a vector of resources and assets that represent the asset base from which adaptation actions and investments can be made (Adger and Vincent, 2005 ; Vincent, 2007). Adaptive capacity is similar to or closely related to a range of other commonly used concepts, including adaptability, coping ability, management capacity, stability, robustness, flexibility, and resilience (Gallopín, 2006 ; Smit and Wandel, 2006). Different intellectual traditions use these terms in different ways which can result in ambiguities in their use and meanings. The IPCC definition of adaptive capacity has been adopted for this thesis, as this specifically relates to the field of climate change, is from a credible source, and is a widely cited definition throughout the literature.

Adaptive capacity has diverse elements, and is determined by the complex inter-relationships of a number of factors at different scales. These encompass the capacity to modify exposure to risks associated with climate change, absorb and recover from losses stemming from climate change impacts and to exploit new opportunities in the process of adaptation (Adger and Vincent, 2005). The forces that influence the ability of the system to adapt are the drivers or determinants of adaptive capacity (Kasperson and Kasperson, 2001 ; Smit and Wandel, 2006).

There are many forms and levels of adaptations, and these can be classified in many ways including by timing relative to stimulus (anticipatory, concurrent, reactive), intent (autonomous, planned), spatial scope (local, widespread) and form (technological, behavioural, financial, institutional, informational) (Smit et al., 2000 ; Smit and Wandel, 2006). Adaptive capacity has been analysed in various ways, including via thresholds and coping ranges, defined by the conditions that a system can deal with, accommodate, adapt to, and recover from (Jones, 2001 ; Smit and Wandel, 2006). Most communities and sectors can cope with, or adapt to, normal climatic conditions and moderate deviations from the norm, but exposures involving extreme events that may lie outside the coping range may exceed the adaptive capacity of the community.

3.3.2. Institutions and Adaptive Capacity

Adaptation to climate change is a multilevel process and involves 'cascading decisions across a landscape made up of agents from individuals, firms and civil society, to public bodies and governments at local, regional and national scales and international agencies' (Adger et al., 2005 p79). An increasing body of literature, including work focusing on the role of social capital in vulnerability and resilience, suggests that institutional factors are crucial in determining adaptation. Institutions affect the social distribution of vulnerability, as well as determining the management of climate sensitive aspects of society, and in turn the capacity to adapt successfully (Næss et al., 2005). For example research by Næss et al (2005) investigated how interactions between institutions at municipal and other geographic and managerial levels shaped adaptation measures that were carried out to flood risk in Norway, finding that the institutional framework gives weak incentives for proactive flood management at the municipal level.

Institutions can be defined as 'sets of rules, decision-making procedures, and programs that define social practices, assign roles to the participants in these practices, and guide interactions among the occupants of individual roles' (Young, 2002 p5). Institutions are different from organizations, and Gupta et al. (2010 p460) explain that 'although organizations can be seen as formalised patterns of rules and decision making, institutions are not equivalent to organizations, as institutions also refer to underlying ideological values and norms.' Different types of interactions and power relationships can operate within institutions, which may influence adaptation. These interactions may determine both how the decision making process develops and who has a voice in the process (Næss et al., 2005).

O'Riordan and Jordan (1999 p81) argue that institutions help to 'define climate change both as a problem and a context, through such socialised devices as the use of scientific knowledge, culturally defined interpretation of scientific findings, and politically tolerable adaptation strategies.' An understanding of adaptation therefore requires consideration of these institutional interactions, how the benefits and costs of action are perceived and communicated, and the political and social context within which decisions are made. Particular challenges for institutions include how to plan in situations of uncertainty, and how to cope with complexity (National Trust, 2013 ; The Royal Commission on Environmental Pollution, 2010).

Institutions are inherently conservative, and although this is strength it can also be a weakness. It can mean that institutions are difficult to change, and change can be a slow process. This poses a challenge for addressing and implementing new policies and practice, such as adaptation. In order to allow society to adapt quickly to environmental changes, a balance between absolute rigidity and total flexibility is needed (Gupta *et al.*, 2010). It is therefore apparent that, when exploring the management systems of heritage sites in the research, an important issue will be how much flexibility there is in the institutions involved in these systems and how open they are to change. This is particularly pertinent given that the conservation of heritage is itself regularly defined as the process of managing change (as discussed in Chapter 2), in a way that sustains heritage values and significance. Taking decisions about change to significant places may be influenced by a range of complex and inter-related interests, and, if they are statutorily protected, will be subject to a policy presumption in favour of preservation. An important determinant of adaptive capacity may be whether there is the capacity to learn from new insights and experiences in order to manage both the expected and the unexpected - the capacity for autonomous change. Another issue is how institutionalised decision making at heritage sites actually is (e.g. the role of bodies such as UNESCO, ICOMOS, and Management Committees). It will be important to understand how much decision making is independent, and what the implications of this are for adaptation.

3.3.3. Assessing/Measuring Adaptive Capacity

The development of indicators of vulnerability and adaptive capacity are important in order to assess vulnerability and identify ways this can be reduced, and to determine the robustness of response strategies over time. However, adaptive capacity and vulnerability are difficult to quantify, and there are therefore great challenges to the development of robust indicators. Adaptive capacity can in theory be identified and measured at various scales, from individual to national, however 'the assessment of uncertainty within such measures come from the contested knowledge domain and theories surrounding the nature of the determinants of adaptive capacity and the human action of adaptation'(Adger and Vincent, 2005 p399).

These debates are wide ranging and include uncertainties around climate prediction e.g. those which arise from limitations in current data and knowledge. Other debates include those around different attitudes to and perceptions of risk, as 'no two people necessarily have the same perception of a given risk and do not necessarily evaluate its significance for individual or collective behaviour in the same way' (Hulme, 2009 p181). The values and belief systems people have, for example, how they value nature or their views on their responsibility to future generations are also an area where disagreement occurs, and which will influence adaptation action. When considering adaptation, climate is one of many processes that influence outcomes, and other processes such as globalisation, economic priorities or regulation (Dessai et al., 2009) may be difficult to distinguish. Even amongst experts in the same field, disagreements exist about how adaptation itself should be defined, and, for example, over what time period an adaptation should be evaluated to assess its success (Doria et al., 2009). Methods of assessing adaptive capacity e.g. debates on whether a top down or bottom up approach is most appropriate are also issues which must be considered in the research (see section 3.3.4 for further explanation).

The range of uncertainties associated with adaptive capacity relate to the determinants of adaptive capacity as well as to uncertainty in projecting these determinants into the future (Adger and Vincent, 2005). There have been several research efforts aimed at outlining indicators of generic and specific capacities at different scales (Adger et al., 2004 ; Adger and Vincent, 2005 ; Yohe and Tol, 2002). Many of these aim to elaborate country-level adaptive capacity, primarily with a view of assisting international decision-making around investments in adaptation coming from the mechanisms of the Framework Convention on Climate Change (Adger and Vincent, 2005). Data and conceptual problems were encountered in these studies, particularly in characterizing adaptive capacity quantitatively or in characterizing uncertainty.

A study by Yohe and Tol (2002 p25) offered a 'practically motivated method for evaluating systems' abilities to handle external stress (evaluating adaptive capacity.)' The method is designed to assess the potential contributions of various adaptation options to improving systems' coping capacities by focusing attention directly on the underlying determinants of adaptive capacity. The method aimed to develop quantitative measures of adaptive capacity in order to develop indicators. For example, measures of factors such as the number of people killed by natural disasters in a certain time period, and material damage, measured in US dollars, normalized with Gross Domestic Product in each country were used. However, the authors found that many of the factors could not be quantified, and many of the component functions could only be qualitatively described.

The many challenges of dealing with uncertainty when assessing adaptive capacity are also illustrated in research by Adger and Vincent (2005). Their research paper illustrates the limits of trying to develop/use quantitative indicators, and shows that uncertainties in adaptive capacity are profound: the direction of change and the causality of many of the key determinants are contested. However, in conclusion they state that the recognition of the nature of this uncertainty, portrayed through a traceable theoretical account, is an essential starting point for use of information for decision making in this area. The implications of this for the research are that trying to assess adaptive capacity quantitatively will not be the most appropriate approach, and that issues of uncertainty must be explicitly addressed.

3.3.4. Top Down/Bottom Up Assessments of Adaptive Capacity

Approaches to assessing adaptive capacity can take a top down or bottom up approach. A top down approach starts at the global level and works down to the local. Historically, this approach to adaptation has been dominant (Brown et al., 2011) and is still common, constituting much of the literature on climate change threats and opportunities, partly due to its dominance as an approach within the IPCC reports (Brown et al., 2011). Top down assessments tend to take global climate scenarios at the starting point. This means that they are able to provide information on whom or what will be most exposed to climate change hazards, but are weaker on the social and institutional factors and socioeconomic and biophysical processes that define much of a system's sensitivity to climate hazards (Brown et al., 2011 ; Preston and Stafford-Smith, 2009). Another criticism is that assessments of vulnerability tend to 'be undertaken by researchers, with little or no participation from stakeholders, and thus do not necessarily express impacts in a manner that is widely relevant to different parties' (Preston and Stafford-Smith, 2009 p27).

An alternative, bottom up approach is generally favoured when working in a development context (i.e. in the 'Global South'). However, according to Brown et al (2011 p38) 'bottom up approaches to adaptation assessments are gaining greater currency across the board.' Bottom up approaches begin with an assessment of the current system of interest and the factors which influence its vulnerability to current weather and climate (Brown et al., 2011). 'These risk events/records are then used to trace backwards along the risk pathway, identifying current exposure, sensitivities and adaptive capacity' (Brown et al., 2011 p38). An example of a method which uses this type of approach is a tool called a LCLIP (Local Climate Impacts Profile) which has been developed by UKCIP (2009).

A bottom up assessment tends to focus on the determinants which influence, enhance or inhibit a system's existing capacity to cope with and respond to a stress of a hazard. As explained by Smit and Wandel (2006 p285) the 'aim is not to score adaptations or measure relative vulnerabilities, nor to quantify impacts. Rather the focus is to document the ways in which the system or community experiences changing conditions and the processes of decision making in the system (or that influence the system) that may accommodate adaptations or provide means of improving adaptive capacity. It employs the experience and knowledge of community members to characterize pertinent conditions, community sensitivities, adaptive strategies and decision making processes related to adaptive capacity or resilience.'

The strengths of bottom up assessments include that they tend to investigate coping and adaptive capacities more thoroughly than top down assessments. According to Füesel and Turner et al (2006, 2003) cited in (Preston and Stafford-Smith, 2009), due to the limitations of top down assessments in capturing the complexity of societal and ecological responses to climate change, bottom up assessments have been advanced as a potentially more robust tool. A particular strength is the acknowledgement and focus on current socioeconomic and political characteristics, processes and trends which are key determinants of how sensitive a system is to hazards (Brown et al., 2011). However, since this process does not necessarily engage with the future, the bottom up approach is considered to be most helpful in enhancing capacity to adapt to changes in existing hazards and stresses (Brown et al., 2011). Whilst bottom up assessments may be considered robust, one limitation is that they do not generate quantitative estimates of future impacts. This is considered by some authors to create challenges for their utility in decision-making (Preston and Stafford-Smith, 2009).

Given its strengths, the bottom up approach is considered to be appropriate for this research, given its focus on site management and the institutional processes which will influence adaptive capacity. One way of using the bottom up approach to assess adaptive capacity is to analyse how hazards are currently dealt with (University of British Columbia, 2008). Key questions to consider would include 'What are the barriers and obstacles the community has encountered when trying to prevent or address hazards, or deal with important changes? What resources were used in previous attempts to deal with these? Are there resources that would have been useful but were instead missing?' (University of British Columbia, 2008). As mentioned earlier in this section, in the UK the LCLIP tool has been identified as being a good starting point for a bottom up assessment of adaptive capacity, and this will be outlined further in the Methodology chapter.

3.3.5. Determinants of Adaptive Capacity

Despite the existence of substantial amounts of literature on adaptive capacity, no clear consensus on a conceptual framework of its determinants emerges. It has been argued (Smit and Wandel, 2006) that, to date, there is very little consensus or documented support for a robust, specific model of the determinants and processes of local exposure, sensitivity, and adaptive capacity, beyond broad categories. Several authors (Adger and Vincent, 2005 ; Smit and Wandel, 2006) highlight that determinants of adaptive capacity are not independent of each other. It is therefore difficult to isolate individual determinants: adaptive capacity is generated by the interaction of determinants which vary in space and time. The determinants of adaptive capacity exist and function differently in different contexts. For example government policies and processes and individual adaptations are not independent of each other, they are embedded in governance processes that reflect the relationship between individuals, their capabilities and social capital, and the government (Adger and Vincent, 2005).

Several authors identify that local adaptive capacity is reflective of broader conditions (Smit and Wandel, 2006 ; Yohe and Tol, 2002). At the local level the ability to undertake adaptations can be influenced by such factors as managerial ability, access to financial, technological and information resources, infrastructure and the institutional environment within which adaptations occur etc. (Adger et al., 2001 ; Kelly and Adger, 2000 ; Smit and Wandel, 2006). Some determinants of adaptive capacity are mainly local (e.g. the presence of a strong kinship network which will absorb stress) while others reflect more general socio-economic and political systems.

Some authors have endeavoured to develop frameworks of generic determinants of adaptive capacity. For example, an influential framework which is frequently referred to in the literature was developed by Yohe and Tol (2002). They outline 8 generic determinants of adaptive capacity, stating that the determinants are based on a synthesis of many case studies in the literature on natural hazards and other risks. The determinants are hypothesized to be important, with a number of anecdotes to back that claim, but the relative strength of the various determinants is unclear. Although they are presented as a list, there is no indication that the order represents relative importance. They are:

‘1. The range of available technological options for adaptation,
2. The availability of resources and their distribution across the population,
3. The structure of critical institutions, the derivative allocation of decision-making authority, and the decision criteria that would be employed,
4. The stock of human capital including education and personal security,
5. The stock of social capital including the definition of property rights,
6. The system's access to risk spreading processes,
7. The ability of decision-makers to manage information, the processes by which these decision-makers determine which information is credible, and the credibility of the decision-makers, themselves, and
8. The public's perceived attribution of the source of stress and the significance of exposure to its local manifestations’ (Yohe and Tol, 2002 p26).

Other authors discuss the presence of generic and context specific determinants (Smith, 2010). Consistent with the generic determinants reported by Yohe and Tol, a study which focused on building adaptive capacity to climate change with local governments in the Sydney coastal region, synthesized the context specific determinants as: access to resources; extent of social capital; structure and functionality of institutional arrangements; ability to generate knowledge; and capacity for social learning (Smith, 2010).

A report produced by UKCIP (Lonsdale et al., 2010) examines the attributes of organisations that have high adaptive capacity. 17 different frameworks of adaptive capacity were studied, including the Yohe and Tol (2002) determinants and the adaptive capacity wheel (Gupta et al., 2010) which are outlined in this chapter, as well as other adaptive capacity frameworks such as PACT (Alexander Ballard Ltd and Hampshire County Council, 2008). It was found that the frameworks vary greatly in the level of detail provided and the purpose for which they were developed. However, commonly cited determinants to all of them were outlined in the report, and these were found to be:

- Access to resources
- Leadership
- Learning
- Working with others
- Access to Information
- Awareness
- Communications
- Agents of Change/Champions
- Motivation
- Management of Processes
- Monitoring and Evaluation

This summary of commonly cited determinants offers an indication of generic determinants of adaptive capacity that could be key to investigate as a starting point in the research. Context specific determinants may vary greatly between World Heritage Sites, given the large variety of sites and their great range of characteristics. Previous research on adaptive capacity and cultural heritage will now be investigated, before a more in-depth investigation of different frameworks of adaptive capacity relevant to cultural heritage management is carried out.

3.4. Previous Research on Adaptive Capacity and Cultural Heritage

There is an absence of theoretical literature which deals with adaptive capacity, climate change and cultural heritage. Only one study has been found[6] which specifically addresses the issue of adaptive capacity and cultural heritage. This Australian study (Heath, 2008) states that, as yet, little is known or understood about the adaptive capacity and sensitivity of many of Australia's World Heritage values to the impacts of climate change, particularly with respect to cultural values. However, the report states that based on the current level of knowledge and understanding of climate change impacts it is possible to classify the

[6] Only one study had been found on adaptive capacity and cultural heritage up to March 2013

adaptive capacity of Australia's World Heritage values into three broad categories: low, moderate and high. This categorisation is based on a comparative analysis over all World Heritage values. However, details of how this categorisation of adaptive capacity was developed and which criteria were used are not discussed.

The key recommendations from this report include:

- The implementation of more comprehensive vulnerability assessments for each World Heritage property
- The need to assimilate the vast amount of scientific literature and data to assist with the development of best management practices for the protection of Australia's World Heritage properties. Creation and support of networks to encourage 'cross-fertilisation' of knowledge and experience amongst researchers and between researchers and managers.
- Development of a coherent climate change Management Plan for Australia's World Heritage sites, coordinated by a steering committee consisting of land managers, landowners, state and federal government representatives, and researchers.
- Capacity building, both human and institutional, in climate change science, policy and management through development of multidisciplinary training programs to improve understanding of climate variability and climate change (Heath, 2008).

When relating the issues raised in this Australian study to the list of determinants of adaptive capacity developed by Lonsdale et al (2010), the key determinants that are identified as being important in enhancing adaptive capacity are: access to information, working with others, management of processes, learning, communication and leadership.

3.4.1. Conceptual Frameworks of Adaptive Capacity

In order to develop a conceptual framework for this research, two existing frameworks of adaptive capacity have been used as a basis to explore which determinants may be important and how generic frameworks of adaptive capacity can be applied to World Heritage Site Management. The initial conceptual framework will be used as a starting point for the research, in order to focus the empirical study and therefore to help identify the most appropriate methods to be used.

The Yohe and Tol framework (2002) which has been introduced earlier in this chapter, was explored initially, given that this is the framing most consistently referred to in the adaptive capacity literature. An alternative framework, which has been developed more recently is the Adaptive Capacity Wheel (Gupta et al., 2010). This wheel is considered to be particularly relevant to this research because it seeks to show the inherent capacity of an institution to respond to change.

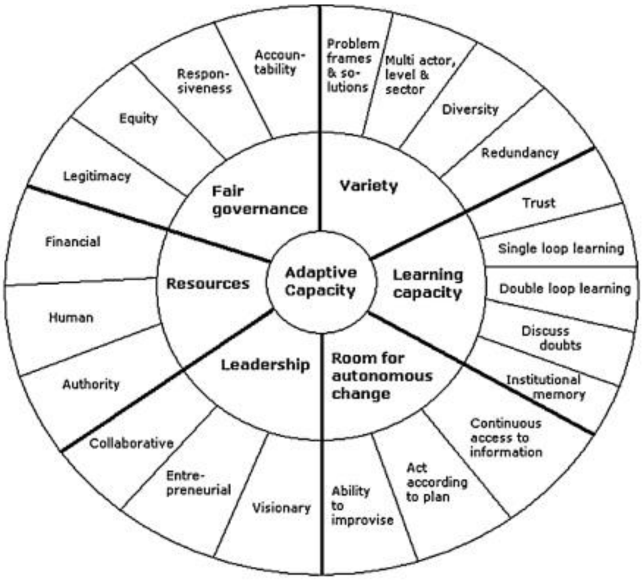
Information collected from the existing literature on adaptation to climate change and cultural heritage (Chapters 2 and 3) was synthesised and applied to these two existing frameworks, and this is shown as the questions in italics in Figure 6 and Figure 8. These frameworks illustrate the first steps of the process of drawing out key themes from the different bodies of literature on adaptive capacity and heritage management and applying these to each other. The questions illustrate the researcher's initial thoughts of ways in which these generic criteria may be applied to heritage management, and some of the questions that would be relevant to explore in the fieldwork. This process contributed to scoping the study as well as helping to inform the development of the initial conceptual framework.

Figure 6 Application of the Yohe and Tol framework: 8 Determinants of Adaptive Capacity
1. The range of available technological options for adaptation *What technological options e.g. flood gates, are available? Are these suitable for heritage properties, given the need to protect 'significance? ' What are the possibilities and limitations of technical adaptation and retrofitting given that in this context there is the consequence of endangering significance through the use of preventative measures?*
2. The availability of resources and their distribution across the population *Are the necessary financial resources to pay for adaptation measures available? Are managers willing or able to spend on adaptation (for example, expenditure on programmes for more regular maintenance, training, or revised health and safety procedures)? Are other necessary resources to implement adaptation e.g. (trained) staff available?*
3. The structure of critical institutions, the derivative allocation of decision-making authority, and the decision criteria that would be employed *How efficient and effective is the management structure at the heritage site? Is there good coordination/communication/allocation of roles between the responsible agencies? Is there guidance and decision making assistance available from local authorities/ UNESCO/conservation bodies/emergency response agencies? What regulations, programmes and tools from critical institutions exist to support decision making? What are the ethical aspects of potential conflicts between the urgent protection of people and the protection of cultural property?*
4. The stock of human capital including education and personal security *Is education on conservation/adaptation/risk preparedness accessible? What information/ knowledge*

is held by managers, occupiers and other stakeholders about what the risks are/could be, climate change scenarios and adaptation strategies? Is there knowledge of the existence of appropriate technologies? Are disaster response personnel aware of conservation, and are conservation personnel trained about disaster response?
5. The stock of social capital including the definition of property rights *Are local people involved in assisting/volunteering with conservation or emergency response efforts e.g. maintenance programmes or evacuating museum contents during a flood? What other networks exist e.g. between World Heritage Site managers, to help coordinate action, share information on best practice, provide technical/financial assistance and provide mutual support?*
6. The system's access to risk spreading processes *Is insurance available against storm damage, flooding, fire or other threats?*
7. The ability of decision-makers to manage information, the processes by which these decision-makers determine which information is credible, and the credibility of the decision-makers *What sources/ types of information are used to make decisions? Is access to expertise possible where necessary (e.g. anecdotal evidence/previous experiences/climate projections)? What are the goals/aims of decision makers, and is there trust in the decision makers themselves? Built cultural heritage can be seen as a storehouse of knowledge about survival of previous changes in climate – is this information being accessed/used by decision makers?*
8. The public's or managers perceived attribution of the source of stress and the significance of its local manifestations *How are the impacts of previous weather events perceived? What are the perceived risks of future impacts (is there uncertainty)? Do managers believe climate change exists and do they consider it to be a man-made phenomenon? How are perceptions of risk influencing readiness to undertake preventative measures?*

The Adaptive Capacity Wheel

On the basis of a literature review and a collaborative brainstorming session carried out by a group of Dutch academics, a wheel of 6 dimensions and 22 criteria were developed in order to develop a starting point for assessing the capacity of institutions to respond to climate change (Gupta et al., 2010). The six key determinants are: variety, learning capacity, room for autonomous change, leadership, availability of resources and fair governance. The authors also demonstrated the application of the wheel to the assessment of some formal Dutch institutions and 'scored' their performance against the criteria, giving a quantitative output in order to facilitate comparison.



Effect of institution on adaptive capacity	Score	Aggregated scores for dimensions and adaptive capacity as a whole
Positive effect	2	1.01 to 2.00
Slightly positive effect	1	0.01 to 1.00
Neutral or no effect	0	0
Slightly negative effect	-1	-0.01 to -1.00
Negative effect	-2	-1.01 to -2.00

Figure 7 Adaptive Capacity Wheel (Gupta *et al.*, 2010)

The wheel provides quite extensive coverage of a wide range of determinants which may affect adaptive capacity. The wheel is ‘flexible’ so new elements could be included if they were found to be relevant. The generation of quantitative results could be used to rank institutions which score ‘better’ in terms of adaptive capacity than others. Selected determinants outlined in this paper have informed other research on institutional resilience and adaptation (Herrfahrdt-Pähle and Pahl-Wostl, 2012 ; Lockwood et al., 2012 ; Raymond and Robinson, 2013).

The determinants and criteria developed by these authors could be useful in forming the basis of an initial conceptual framework to guide this research. However, the quantitative approach developed from the adaptive capacity wheel is not considered appropriate as my approach will be exploratory and qualitative. The key determinants from the Adaptive Capacity Wheel will now be taken, and initial questions relevant to the research topic outlined for each determinant.

Figure 8 Application of the Adaptive Capacity Wheel Framework
1) Variety *What different actors, levels and sectors are involved in the management structure of the WHS? Are there a range of policy options to tackle adaptation to climate change and risk preparedness? Are there overlapping measures/systems?*
2) Learning Capacity *What has been learnt from the experience of past weather events at the sites? Do the management systems allow feedback from past experiences to improve the way the site is managed? Do they now seem more prepared? Have the experiences of previous events changed attitudes towards preparing for future weather events?*
3) Room for Autonomous Change *Do staff have access to information about current/future risks e.g. flood warning systems (e.g. flood line), climate scenarios? Did/do staff have the capacity to improvise/take the initiative on the ground? Are there disaster preparedness plans/risk assessments/policies in management plans for risk preparedness and/or adaptation to increase the ability of individuals to act?*
4) Leadership *What type of leadership exists at the WHS - is there collaboration between different actors? Are those in leadership roles engaged in/endorsing adaptation? Is there an 'adaptation champion' – someone who plays a motivating role in the organisation? Are there clear lines of responsibility where adaptation is concerned?* *What leadership is there from advisory bodies/UNESCO in terms of guidance/policy on adaptation and risk preparedness?*
5) Resources *What human resources (expertise, knowledge, human labour) are available? What knowledge exists about cultural heritage amongst those instigating adaptation strategies? What knowledge do managers/staff have about risks and ways to respond? Are there opportunities for training on climate change risks, adaptation, and risk preparedness? Are the necessary financial resources available to support adaptation/risk preparedness e.g. expenditure on more regular maintenance, training? Was the necessary budget available when weather events occurred in the past?*
6) Fair Governance *If there public support for the WHS, and the way it is managed? Is there accountability within the management system?*

3.5. Selection of Key Determinants for the Research

Key factors relevant to the research have been outlined in the two conceptual approaches discussed above. There are significant similarities between the two frameworks as both consider many of the same key issues, although the language, terminology and structure are different.

The Yohe and Tol framework provides a simple flexible generic framework which could be used in many contexts and it could produce unit-less indicators. Many of these would be difficult to quantify and so could only be qualitatively described. The adaptive capacity wheel is more structured and more detailed than the Yohe and Tol framework. A strength of the adaptive capacity wheel is that it is a practical approach which could be used as a tool by researchers and social actors to assess whether and how institutions need to be redesigned. Applying the criteria in a systemic way could show which sectors need attention, and highlight areas where adaptive capacity could be improved. A weakness is that the scoring system is fairly crude and as the authors explain, 'reducing complex information into a quantitative format may reduce the information into something relatively meaningless and too aggregated' (Gupta et al., p468). The dynamics and relationships between different criteria are not represented in the wheel. Questions have also be raised about how objective the evaluation is and whether equal shares for each determinant and criteria reflect equal weights. As explained by Lonsdale et al (2010) there is also no proof that a maximum score on all the criteria will lead to better adaptation to climate change.

Given the need to focus the research it will be necessary to focus on selected determinants of adaptive capacity, as stated in the research objectives. This in itself is challenging, as determinants are interlinked, and at this stage in the research it is difficult to determine which may be the most significant. The key determinants that influence adaptive capacity may vary greatly from site to site. An exploratory approach to the research should allow the research to evolve and adapt, if it becomes apparent that a key determinant has been omitted or other factors are particularly important at a certain case study site.

The review of existing adaptive capacity frameworks has been useful as it has shown that (as also highlighted by Lonsdale et al (2010 p5)) there are key determinants which are clearly common to different frameworks of adaptive capacity. This has helped inform the selection of key determinants of adaptive capacity on which to focus the research and to investigate through empirical study are. These are:

- *Learning Capacity*
- *Room for Autonomous Change*
- *Access to Information*
- *Access to Resources*
- *Leadership*

These selected determinants have been drawn from both the two frameworks investigated earlier in the chapter, although the structure and language of the adaptive capacity wheel has been particularly influential. The determinants from the wheel which were common to several other frameworks of adaptive capacity were selected (*variety* and *fair governance* were not chosen to be further investigated). All the selected determinants have been highlighted as key to organisational adaptive capacity by Lonsdale et al.,(2010), apart from *room for autonomous change*. This has been included as it is considered to be particularly relevant to the research (as discussed earlier in the chapter), and is closely linked to *access to information*. All determinants are considered to be relevant to the field of cultural heritage management and they are of particular interest to the researcher.

These key determinants, their criteria and definitions, as developed by Gupta et al.(2010), have been adapted to guide the research. These are shown in Appendix 1: Table of Selected Determinants from Conceptual Framework, which demonstrates how these determinants translate into issues to be investigated in the fieldwork. These selected determinants will initially be explored as part of the questionnaire stage, will then be reviewed following the analysis of the results of the questionnaire, and then studied in more depth in the case study research.

3.5.1. Brief Background to Selected Determinants

3.5.1.1. Learning Capacity

According to Gupta et al.(2010) the concepts of human learning, social learning and learning capacity are integral to adaptive capacity, and learning allows for changed understanding based on experiences. Learning from direct experience is something which is picked up in several different framings of adaptive capacity, for example by Naess, Bang et al (2005).
The concepts of single and double-loop learning arise from Argyris and Schon's theory of action (1978), summarised in Figure 9. In single-loop learning, individuals, groups, or organizations modify their actions according to the difference between expected and obtained outcomes. In double-loop learning, the entities (individuals, groups or organization) question the values, assumptions and policies that led to the actions in the first

place. Institutional/organisational memory, memories and knowledge that transcend the individual, are also an important element of learning.

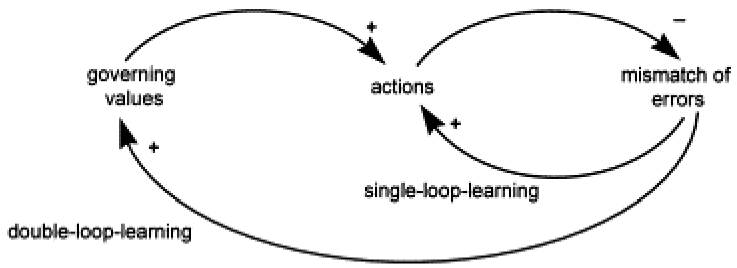


Figure 9 Single and double loop learning. (Stäbler and Ewaldt, 1998) adapted from Agyris and Schon (1978)

3.5.1.2. Room for Autonomous Change and Access to Information

According to Gupta et al. (2010) a quality of adaptive capacity is the ability of institutions to allow individuals to autonomously adjust their behaviour in response to environmental change. This includes the provision of the necessary means and information, and fostering (Agyris and Schon, 1978) the capacity of individuals and organisations to both improvise and to act according to plan (Gupta et al., 2010).

The necessary information may include access to monitoring data, and information on possible future conditions. Monitoring can be defined as the act of observing and checking the progress or quality of (something) over a period of time; keeping it under systematic review (Pearsall, 2010). The central argument for monitoring heritage is that you cannot recognize, understand, improve or maintain what you do not or cannot measure (LeBlanc, 2012). Access to information on future conditions may include the availability and accessibility of climate scenarios and projections. One basic difficulty with providing guidance and information on adaptation is striking the balance between the complexity of the issues and providing the simple, clear guidance which stakeholders desire (Brown et al., 2011).

3.5.1.3. Access to Resources

The capacity to adapt will be influenced by access to financial resources, manpower resources, key skills and knowledge (Gupta et al., 2010 ; Lonsdale et al., 2010). In addition, the legal and political mandate will affect the ability to raise resources and encourage/drive adaptation. According to Gupta, Termeer et al (2010) institutions should be able to generate sufficient resources for actors to change norms and rules, implement those changed norms and rules and live up to them.

3.5.1.4. Leadership

Leadership is a driver for change, showing direction and motivating others to follow (Gupta et al., 2010). The capacity to adapt can be influenced by the extent to which senior leaders can 'identify a vision in relation to climate change and can engage with, support and legitimise its implementation' (Alexander Ballard Ltd and Hampshire County Council, 2008 p13). Leadership is not confined to those in the top level of an organisation, and other forms of leadership may also be influential, for example, the existence of a small group of concerned individuals, who try to promote the issue within an organisation. Evidence of good leadership on adaptation includes good internal and external communication, the allocation of resources, and a public commitment to adaptation (Local and Regional Adaptation Partnership, 2008 ; Lonsdale *et al.*, 2010). According to (Gupta et al., 2010) criteria to evaluate leadership include whether leadership is visionary, entrepreneurial and collaborative.

3.6. Conclusion

Vulnerability can be conceptualised as being a function of exposure, sensitivity and adaptive capacity. Adaptive capacity is a critical factor in determining the impacts of climate change, there is an abundance of literature on adaptive capacity, yet there is no clear consensus on a conceptual framework of its determinants. There are a range of uncertainties associated with determining adaptive capacity, and it is a concept which is difficult to quantify. Determinants are interlinked, and are therefore difficult to isolate. Institutional factors are crucial in determining adaptation and to understanding adaptive capacity, especially as institutions can be inherently resistant to change.

There is an absence of existing literature which specifically deals with adaptive capacity and cultural heritage management. As part of this research, existing generic frameworks of adaptive capacity have been taken and applied to the field of heritage management, in order to identify determinants which may be particularly important to the study. In order to focus the research, five key determinants have been selected to study empirically. They have been developed into a framework, based predominantly on work by Gupta et al (2010) and are used as a basis to guide the fieldwork and subsequent analysis. The following methodology chapter will explain the approach and methods used to test this framework in practice.

CHAPTER 4 RESEARCH METHODOLOGY

4.1. Introduction

This chapter will outline the methodology used in the research. Initially the philosophical approach to the research will be explained before alternative methodologies for assessing adaptive capacity are discussed. The research methods chosen for the project will then be outlined sequentially. An exploration of issues of reliability and validity will follow, as well as details of the approach to data analysis which has been adopted.

4.2. Research Approach

4.2.1. Philosophical Approach

Research methods are driven by ontological and epistemological assumptions about the nature of the world and what we know about it. There are two main epistemological approaches to research, positivism and interpretivism.

Positivism reflects the traditional `scientific' approach to research and is ‘the position that affirms the importance of imitating the natural sciences’ (Bryman, 2008 p13). Key characteristics of positivism include the application of the methods of the natural sciences to the study of social reality and the emphasis on the empirical verification of truth. A positivist approach is often connected with use of quantitative methods associated with natural sciences, although as authors such as Bryman (2008) discuss, the connections between epistemology and ontology and research methods are not deterministic.

Some writers believe that the dominant positivist approach has ‘crowded out’ other approaches. ‘The social sciences have been dominated by a positivist epistemology which privileges scientific knowledge over an array of equally important alternatives – experiential, intuitive, local knowledges, knowledges based on practices of talking, listening seeing, sharing….’ (Sandercock, 1995 cited in Allmendinger and Tewdwr-Jones, 2005 p4). As discussed in previous chapters, adaptive capacity is difficult to ‘measure’ and is also difficult to explore using solely quantitative methods. The approach selected to research adaptive capacity was exploratory, and local and experiential knowledge were considered to be important elements of this. The positivist approach was therefore not an appropriate epistemological position in which to frame the research.

Interpretivism is an alternative approach to research to the positivist orthodoxy, and is linked to qualitative research methods. ‘Qualitative implies an emphasis on the qualities of entities and on processes and meanings that are not experimentally examined or measured in terms of quantity, amount, intensity or frequency’ (Denzin and Lincoln, 2000 p8). Qualitative researchers emphasize the value-laden nature of inquiry (Denzin and Lincoln, 2000 p8). As stated by Bryman (2008 p16) interpretivism is ‘predicated upon the view that a strategy is required that respects the differences between people and the objects of the natural sciences.’ Some criticisms of interpretivism include that it ‘fails to acknowledge the role of institutional structures, particularly divisions of interest and relations of power’ (Blaikie, 1993 p111), and that interpretivism is implicitly conservative in that it ignores the possible structures of conflict in society and hence the possible sources of social change (Fay, 1975) quoted in (Blaikie, 1993).Given that one focus of the research is on institutional structures and divisions of interest and that this is a weakness in the interpretivist approach, this was also not the most appropriate epistemological position in which to frame the research.

An alternative to these two dominant approaches is pragmatism, classed by some authors as the ‘third way’ (Armitage, 2007). Instead of searching for metaphysical truths, pragmatists consider truth to be what works (Tashakkori and Teddlie, 1998). This is the paradigm considered to be most appropriate for this research project. Rather than taking a solely positivist (quantitative) or interpretivist (qualitative) line, pragmatism allows the ‘use of whatever philosophical and/or methodological approach works for the particular research problem under study’ (Tashakkori and Teddlie, 1998). Mixed methods are compatible with pragmatism, and these can be used to triangulate data. Tashakkori and Teddlie (1998) suggest that: ‘rather than being wed to a particular theoretical style, one might instead combine methods that would encourage or require the integration of different theoretical perspectives to interpret the data’. It has been stated (Armitage, 2007) that because of the benefits of the pragmatic paradigm and its intuitive appeal, it can be adopted for social and management research endeavours as it is congruent with the mixed quantitative/qualitative approach often taken in practitioner based research.

Pragmatists accept that they will have a choice of inductive and deductive logic in the course of conducting their research (Tashakkori and Teddlie, 1998). In this research, both inductive and deductive approaches are used, although the research is predominantly inductive. An inductive strategy can be defined as an approach where theory is generated from research, whereas a deductive approach is one where research is conducted with reference to hypotheses inferred by theory (Bryman, 2008). Initially, an outline conceptual framework was formulated using existing theory, which helped guide the research and focus the fieldwork. However, given the lack of established data and theory on the research topic of adaptive capacity of the management of heritage sites, the emphasis was on an exploratory, inductive approach. Predominantly qualitative methods have been adopted since, as stated by Bryman (2008 p366), 'the emphasis in qualitative research is on seeing through the eyes of research participants, description and context, flexibility in process, and concepts and theories as outcomes of the research process.'

In summary, the approach to the research was pragmatic, using a predominantly, but not solely, qualitative approach. This involved the use of several different qualitative research methods as well as quantitative methods where appropriate, and both inductive and deductive logic.

4.2.2. LCLIP (Local Climate Impacts Profile)

As discussed in the theoretical chapter of this thesis, a 'bottom up' approach to assessing adaptive capacity was considered to be appropriate for the research, given its focus on site management and the institutional processes which influence adaptive capacity. The LCLIP (Local Climate Impacts Profile) tool was identified as being a good starting point for a bottom up assessment of adaptive capacity. This tool will now be explained in more detail.

In 2006, UKCIP developed this framework for considering the current weather and its impacts. UKCIP was established in 1997 by the UK government, based at the University of Oxford, with a remit for supporting adaptation. Their work includes the development of several tools and methods for stakeholder use. The LCLIP tool has since been taken up and used by around 100 local authorities in the UK (UKCIP, 2009). This is a method for gathering information about the impacts of past weather events in a given locality and for a given organisation. 'LCLIP is based on the recognition that understanding vulnerability to current weather is a good starting point for better understanding impacts of a future climate…the information captured in an LCLIP serves as a precursor to judging risks associated with future climate changes described in climate change scenarios' (Gawith et al., 2009 p117). Næss et al (2005) also argue that experiences from past climatic events may provide useful insights into the constraints and barriers to adaptation to future climate change, especially 'since climatic events have been described as triggers for significant institutional changes' (p126).The focus of a LCLIP is on the effects of weather now and in the recent past rather than investigating potential effects of the future climate.

One of the benefits of doing an LCLIP is explained as that it should 'prompt a local authority to consider ways to monitor the consequences of weather and climate in more systematic ways that help judge their significance both for now and in the future' (UKCIP, 2009 p8). As Gawith et al.(2009) explain, some of the advantages of using the LCLIP approach in decision making at local authorities are that the timescales of an LCLIP match the timescales of decision-making more closely than scenario timeframes do, and that 'the LCLIP demonstrates the value of high quality observed data as an entry point for engaging organisations in climate change' (p117). However, because it is based upon events and impacts reported by news media sources, the climate impacts profile is inevitably biased towards those events and issues likely to be of most interest to the target audience of each source, and should therefore not be viewed as an exhaustive scientific inventory of all weather events (Standley et al., 2009).

Use of this tool includes collecting information on:

- 'The nature and magnitude of the consequences of recent weather events
- The preparedness of responsible agencies to deal with the consequences of local weather events
- The details of the weather events and impacts that caused these consequences' (UKCIP, 2009 p5)

Sources of this information include local media reports of weather events, formal records held by the institution, and the memories and views of staff members. Although this approach has been mainly used by UK local authorities, it is stated that 'the principles of an LCLIP can be applied to all sorts of organisations, at every scale…the function of an LCLIP is to bring out these organisational characteristics' (UKCIP, 2009 p14). For example, an LCLIP carried out for Northamptonshire County Council (Powell, 2008) identified that 66 extreme weather events had had an impact on Northamptonshire over the previous ten years, with storms and excessive rain the most frequent. The south of the county had been affected more often than the north. Other findings included that ' the Records Office is the only department to actively consider the direct impact of weather on its service delivery, many departments reported taking a reactive rather than a proactive stance on responding to weather events and there is little consensus on how an emergency response should be coordinated across the council' (Powell, 2008 p4).

Given the difficulties in researching adaptive capacity (as discussed in the theoretical chapter) this tool provided a good practical starting point for an assessment of adaptive capacity. The LCLIP formed part of the research methodology, and was supplemented by additional lines of inquiry which considered the future. Examining the consequences and preparedness of recent weather events provided a good way of exploring elements of current adaptive capacity, and helped to facilitate engagement with stakeholders on the sometimes difficult subject of climate change adaptation. Interviewees were often noticeably more comfortable talking about their experiences of past weather events and adaption to these type of incidents, than when asked about future scenarios and the issue of 'climate change.'

4.3. Research Methods

4.3.1. Overview

Each stage of the research will now be discussed in more detail, and each of the methods will be tackled sequentially. Figure 10 summarises the fieldwork methodology, indicating the stages of data collection and the methods used.

4.3.2. Literature review

An extensive literature review was carried out (see Chapters 2 and 3), updated until December 2012, which served several purposes. The initial literature review identified key concepts and issues in the subject area, identified what research has been done so far, identified the gaps in knowledge and made the case for the research. Topics covered included potential impacts of climate change on cultural heritage, climate change scenarios, risk preparedness, World Heritage Site management and the theoretical concepts of adaptive capacity and vulnerability. The review also informed the development of the initial conceptual framework, the case study selection and the selection of the research methods.

4.3.3. Scoping Stage

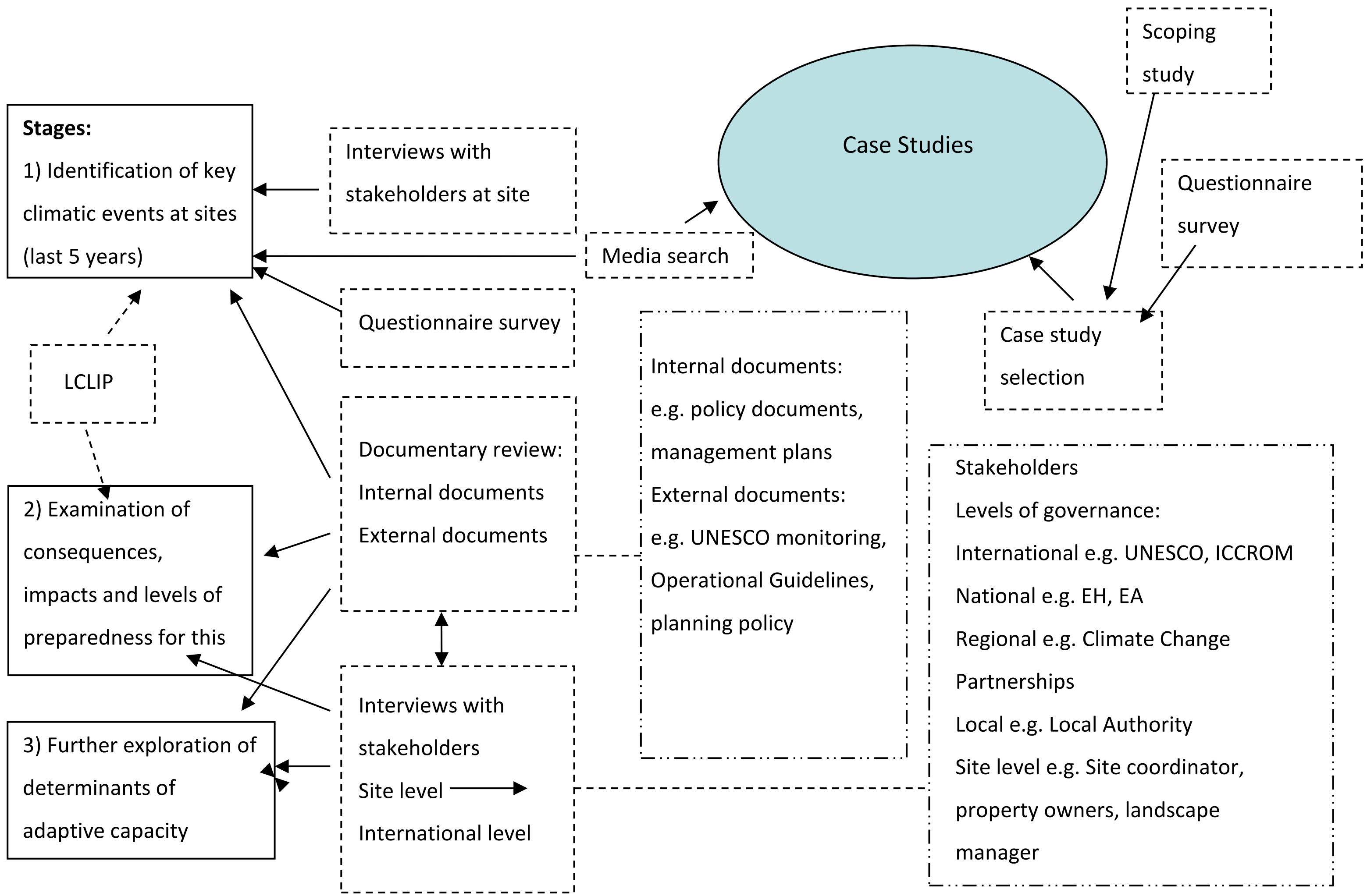
A thorough scoping stage was initially carried out, which consisted of a range of meetings, discussions and site visits. There were several aims of this. Information collected was intended to:

- identify key determinants of adaptive capacity that would be relevant in practice
- explore whether there was any existing research which was on-going on adaptive capacity
- inform the development of criteria for site selection
- assess the feasibility of particular case studies and methods
- develop contacts with 'gatekeepers' (people who can provide access to potential interviewees at the case study sites, such as site coordinators) to help progress the fieldwork stage.

An initial visit was made to the World Heritage Centre at UNESCO in Paris. A meeting with a member of the World Heritage Team was held in order to address some initial scoping questions. Discussions with ICOMOS UK highlighted a range of potential case studies. A meeting with the UK Climate Impacts Programme explored different methodologies for assessing adaptive capacity as well as alternative conceptual frameworks. The specialised libraries at UNESCO, ICCROM and the ICOMOS Documentation Centre were also visited to ensure a comprehensive review of relevant literature, and to explore the availability of non-published documentary resources. These findings from these visits influenced Chapters 2, 3, 4 and 5.

Visits to several UK World Heritage Sites were carried out to explore possible case studies and meetings were held with staff involved with management to discuss climate change issues and adaptation at the site. Site visits and meetings were held at Derwent Valley Mills, Derbyshire, Fountains Abbey and Studley Royal, Yorkshire, Blenheim Palace, Oxfordshire and

Figure 10 Stages of Data Collection



Ironbridge Gorge, Shropshire. These sites were chosen because they were identified through discussions with ICOMOS UK and through the questionnaire stage as being potentially vulnerable to climate change, and when contacted were interested in being involved in the research. These site visits informed the final case study selection. A summary of the findings are in Appendix 2.

4.3.4. Questionnaire Survey Stage

A questionnaire survey was developed and sent to all UK World Heritage Sites. The purpose of this stage was to:

- produce data on key issues from as many sites as possible to put the detailed findings from case studies into a wider context
- provide data to guide case study selection
- engage stakeholders at as many sites as possible with the research, and develop contacts with gatekeepers
- inform the initial conceptual framework and guide the selection of key determinants of adaptive capacity to focus on.

The survey was designed to include both open and closed questions, and therefore generated both quantitative and qualitative data (see Appendix 3: Distributed Questionnaire for a copy of this). Open questions were chosen because they allowed respondents to give answers in their own way, and were considered to be useful for generating unanticipated answers, where potential choices were unknown. Some closed questions were included where a range of response choices were known in advance and an advantage of including these was that the data produced could be analysed statistically.

The questionnaire focused on the experiences of weather events and the impacts of these on the site (guided by the LCLIP approach), how vulnerable/prepared site managers consider their site to be to climate change, and what steps have been taken to adapt. Questions were also asked about what factors the managers thought would influence the site’s capacity to cope with climate change, in order to obtain some initial information on the determinants of adaptive capacity from the conceptual framework. The willingness to participate in any follow up work (case studies) was also established.

One questionnaire was sent to a manager at each of the 28 UK World Heritage Site (see Figure 11 below). A manager with an overarching, coordinating role was considered to be the most appropriate person to be targeted, and in order to do this a list of World Heritage Sites Coordinators/ key contacts at each site was obtained from DCMS.

Image removed for copyright reasons

Figure 11 Map of World Heritage Sites in the UK (DCMS, 2011) © Crown Copyright

The questionnaire was designed using the Survey Monkey web tool which enabled participants to respond online, facilitating quick response times. Before the final questionnaire was distributed in early 2011, it was piloted with four heritage professionals, who provided feedback on the survey layout and questions, and the analysis of the data generated by the survey was tested.

Telephone contact was initially made with each site using the contact details provided by DCMS. In some cases identifying the most appropriate person to send the survey to was challenging as there was no clear WHS coordinator, or similar overarching role. Once the most appropriate contact had been identified, the purpose of the study explained and their agreement to take part in the survey obtained, the link to the questionnaire was sent by email. In order to boost the response rate, follow up contact was made ten days after sending the initial survey where necessary.

4.3.5. Case Study Design

Case study research is concerned with 'the complexity and particular nature of the case' (Bryman, 2008 p52). The emphasis is on an intensive examination of the setting, drawing on multiple sources of evidence and seeking to provide meaning in context (Proverbs and Gameson, 2008). This was considered to be an appropriate way of exploring the complexities of adaptation and adaptive capacity at heritage sites. A multiple case study approach was used, with the unit of analysis being World Heritage Sites, the case being bounded by the area included in the WHS inscription.

Three case studies were selected for this part of the study. The justification for focusing on three case studies, rather than one, was that as stated by Proverbs and Gameson (2008 p101), the results of investigations that focus on just one case 'will to some extent always be treated with some degree of circumspection due to the fact that they are drawn from one case and no one can be sure as to how they apply to other cases.' However 'with multiple case studies, the results will always be more compelling…and therefore easier to defend' (Proverbs and Gameson, 2008 p101). Another advantage was that it was possible to compare and contrast findings from one case to another related case. Given the complexity of World Heritage Sites and the amount of data required to thoroughly research each site, three cases were studied to allow a detailed study of each case.

At each case, as part of the LCLIP approach, initially key weather events were identified to focus on as a starting point. This was carried out through a media search[7], results from the questionnaire stage and initial interviews with key staff at the site. The stages of the case study research will now be discussed in more detail.

4.3.6. Case Study Selection

The case studies were selected using purposive sampling. Purposive sampling 'allows us to choose a case because it illustrates some feature or process in which we are interested…' (Silverman, 2005 p129). Since World Heritage Sites vary greatly and are each unique, it would not be possible to control all variables, or to select sites that were similar in many of their characteristics. However, case selection criteria were developed in order to select cases with features that were appropriate for the study of adaptive capacity.

The results from the questionnaire survey informed case study selection and so criteria were fully developed when the results from this stage had been collected. A selection matrix was developed of potential sites and selection criteria (see Appendix 6: Case Study Selection Matrix). The criteria used to select sites were:

- Cultural World Heritage Sites – Cultural sites rather than natural/mixed as there is a particular gap in knowledge/research for cultural heritage and climate change adaptation (as discussed in Chapter 2).

- Experience at the site of impacts from weather events in the last five years – this information was collected through the scoping study, questionnaire survey and media search (LCLIP).

- Managers consider the site to be vulnerable to climate change – this was established through the answers given on the questionnaire survey. Respondents were asked to indicate their level of agreement with the

[7] The media search used local and national newspaper reports available online

statement 'My WHS is vulnerable to impacts from climate change,' responses of 'Strongly Agree' or 'Agree' were taken to indicate that the site is considered vulnerable. In order to assess adaptive capacity, it was considered that sites where there is vulnerability would be most appropriate to study.

- Different management/ownership structures – there are a range of different ownership and management structures at UK WHSs. This was considered to be a variable which might influence the capacity of sites to adapt. Sites were selected which had different management and ownership structures.

- Size of the site – World Heritage Cities (e.g. Edinburgh) were excluded as case studies, due to their size and complexity, and the limited resources available for the study.

- Accessibility – this encompasses geographical location, as well as access to people and information. Sites chosen were located on the UK mainland. In order for a site to be a viable case study, it was required that managers were interested in participating in the research and providing access to the necessary information. The development of contact with gatekeepers was developed through the scoping and questionnaire stages.

The sites which met these criteria and which were selected for the study were Ironbridge Gorge in Shropshire, Fountains Abbey and Studley Royal in Yorkshire, and Blenheim Palace in Oxfordshire. Ironbridge Gorge has a complex management system which includes private landowners, local authorities and Charitable Trusts. Fountains Abbey has a less complex management system, comprising mainly the NT and EH. Blenheim Palace is owned and managed privately.

Semi structured interviews were considered particularly appropriate for this subject due to the lack of empirical evidence and understanding and therefore there was the opportunity for interviews to yield unexpected findings, not previously considered by the researcher. The use of in-depth semi structured interviews allowed a flexible approach and the collection of rich, detailed data. An interview guide provided a framework for the interviews to ensure a clear focus was maintained and to ensure that similar topics were discussed with different interviewees (see Appendix 7 for a sample interview guide). This guide was piloted on a heritage professional before fieldwork began, and amendments were made following this pilot.

The interview guide was sent to the interviewee several days in advance of the meeting. Interviewees had flexibility in how they responded to questions, and in some cases questions which were not on the guide were asked, picking up on comments made by the interviewee. Where interviewees gave consent, the discussions were digitally recorded. Interviewees were given information sheets and consent forms which allowed them to indicate whether anonymised quotations could be used in the research (see Appendix 4: Participant Information Sheet and Consent Form). The interviewees' anonymity was protected in order to facilitate the open discussion of issues, particularly as these often related to the organisation where the individual was employed.

19 interviews were carried out at Ironbridge Gorge (November 2011 - January 2012), 14 at Fountains Abbey (April - May 2012) and six at Blenheim Palace (October - November 2012, plus email correspondence with other stakeholders). Interviewees were professionals including property managers, building owners, conservators, local authority climate change officers and local authority conservation officers. Data collected through interviews and documentary review at each case study illustrate the situation at the time of fieldwork, and it is acknowledged that changes may have occurred since that time.

Five interviews with employees of bodies and agencies involved in heritage management and climate adaptation, who operate at a national and international level e.g. Environment Agency (EA), English Heritage (EH) were also undertaken, in order to develop an understanding of the international and national contexts. The majority of these interviews were carried out between November 2011 and April 2012, with the UNESCO meeting held in September 2010. Interviewees were selected both through contacting relevant bodies directly and through other contacts in the field.

Interviewees at the case studies were selected using snowball sampling. The recruitment of interviewees at the sites started with getting in touch with a key contact at each case study site. The initial contact at Ironbridge Gorge and Fountains Abbey was the World Heritage Site Coordinator. These contacts were developed during the earlier scoping and questionnaire stages. Through information in the WHS Management Plans and other publicly available documents and information provided by the WHS coordinator, a contact list of professionals who were involved in site management was developed. During each interview, respondents were asked to recommend other contacts that might be able to provide information that would progress the research. When all stakeholders who had relevant roles had been contacted, and it was considered that saturation of information had been achieved, data collection stopped.

4.3.7. Documentary Evidence

Documentary evidence was used to lay the foundation for the study, to obtain factual information about each case study, to provide evidence to analyse and to corroborate evidence from other sources. Documentary sources which were examined included publicly available documents such as World Heritage Management Plans, Catchment Flood Management Plans and planning policy documents. Internal documents which interviewees provided access to were also used, and varied case by case but included internal policy and strategies, risk assessment frameworks, flood action plans and drafts of documents such as Conservation Plans. A review was also carried out of relevant international and national documents, in order to examine the national and international context in depth. This included a review of the latest available versions of UK World Heritage Site Management Plans, and an examination of the updated version of the UNESCO Operational Guidelines.

4.3.8. Data Analysis

Data collected in the initial questionnaire stage was analysed using a mixture of techniques. The quantitative data from the questionnaire responses was analysed statistically, using Excel. The qualitative data was analysed using coding, using an inductive approach, looking for common themes in the respondents answers.

Qualitative data collected for the case studies and national/international level review (interview transcripts and documentary sources), was analysed using coding, primarily through use of NVivo software, a tool specifically designed to help coding qualitative data. The basis for the start list of codes used for the analysis was the original conceptual framework. Codes were assigned to sections of data (sentences/paragraphs), and these were used to organise and later retrieve these ‘chunks’ of data. As the analysis progressed, new codes were created, and the existing codes changed and developed. Some codes contained a large amount of data and where appropriate sub-codes emerged. Other codes did not work, for example because field material didn’t fit into those categories. In some cases the codes from the initial conceptual framework did not reflect the way issues appeared empirically. The data from each case study was coded and analysed in sequence. So, the revised coding framework which developed through the analysis of Ironbridge Gorge was used as the starting point for the coding of the Fountains Abbey case study. Through the analysis at each case, a final conceptual framework was developed.

Although NVivo formed a helpful part of the data analysis, it is acknowledged that this type of software is not universally embraced (Bryman, 2008). For example some concerns that authors have mentioned include that ‘the fragmentation process of coding text into chunks that are then retrieved... risks decontextualizing data’ (Bryman, 2008 p567). In this research, the NVivo software proved valuable as it helped reduce some of the manual labour involved in coding, and greatly assisted in organising, cross referencing and accessing large quantities of data.

The analytic technique used to carry out a rapid review of all the UK World Heritage Site Management Plans involved a keyword frequency search. A search was carried out on all plans for the terms 'climate/climatic change' and 'adaptation'. The use of 'adaptation' was counted only where it referred to adaptation to climate, rather than (for example) adaptation to change of use. This technique provided an effective way of identifying these specific themes within the large bodies of text, giving an idea of their prevalence. However, a limitation was that this approach did not allow the consideration of the context in which the words appeared, and was limited to a few key words. However, this approach provided information which helped to set the wider context for the case studies. As well as the keyword search, the full text of the three case study site WHS Management Plans was analysed in depth, and NVivo was used to identify themes within these plans.

4.4. Reliability and Validity

Reliability and validity are key concepts which are important criteria in establishing the quality of quantitative research. Validity refers to 'the accuracy and trustworthiness of instruments, data and findings' (Bernard, 2000 p46) and reliability refers to 'whether or not you get the same answer by using an instrument to measure something more than once' (Bernard, 2000 p47). However, there has been some debate amongst researchers concerning their relevance for qualitative research (Bryman, 2008 ; Silverman, 2005). For example, it has been argued (Bryman, 2008) that external validity presents a problem for qualitative researchers because of their tendency to employ case studies and small samples. He writes that the scope of the findings of qualitative investigations is limited and that from case studies it is impossible to know how the findings can be generalized to other settings (Bryman, 2008).

The concepts of reliability and validity have however been considered at the design stage of the research. Where possible, several methods and sources of data were used in order to cross check results. The mixed method approach employed (the use of questionnaires with quantitative and qualitative data, as well as interviews and documentary analysis) strengthens the findings of the research.

It is acknowledged in the research that World Heritage Sites are, by their nature, unique and vary greatly. The cases have not been selected because it is thought they would be representative of the all UK World Heritage Sites. They have been selected purposively according to particular criteria. The findings of the research are intended to generalize theory rather than to generalise results for the whole population. However Silverman (2005) explains that one approach to obtaining generalizability is to combine qualitative research with quantitative measures of populations. In this research the questionnaire survey stage was carried out in order to provide data which would help put the findings of the case studies in the context of all UK sites.

4.5. Conclusion

The methodological approach used in this research was exploratory and predominantly qualitative, employing mixed methods and rooted in the pragmatist paradigm. The research strategy was predominantly, but not solely, inductive, generating theory from the data collected during fieldwork. The LCLIP tool was used as a starting point for the fieldwork at site level. Multiple case studies were examined in order to explore adaptive capacity at different UK World Heritage Sites, and the national and international contexts were also investigated. The methods used in the research included a questionnaire survey, semi structured interviews and documentary review. Data was triangulated where possible in order to strengthen the research findings. The development and testing of these methods in order to assess adaptive capacity in the field, is one of the novel contributions to knowledge of this research. The following chapter presents the findings from the first stage of the empirical research, examining the international and UK context of World Heritage management and climate change adaptation.

CHAPTER 5 WORLD HERITAGE SITE MANAGEMENT AND CLIMATE CHANGE ADAPTATION: INTERNATIONAL AND NATIONAL CONTEXTS

5.1. Introduction

This chapter will focus on the international and national context of World Heritage management and climate change adaptation. The data in this chapter is drawn from a review of relevant documents, a series of interviews with stakeholders involved in heritage management and climate adaptation at national level in the UK and international level (see Table 2), and a questionnaire survey of all UK World Heritage Sites.

Position	Organisation
Assistant Programme Specialist, Europe and North America Team and personal correspondence with Chief of Policy and Statutory Meeting Section	UNESCO
Head of International Advice and World Heritage	English Heritage
Historic Environment Intelligence Officer (Climate Change)	English Heritage
Senior Advisor, Climate Change and Flood/Coastal Risk Management	Environment Agency
Sustainability Director	National Trust
Climate Change Coordinator	Yorkshire and Humber Climate Change Partnership

Table 2 List of interviewees who have contributed to this chapter (Nov 2011 – April 2012 and UNESCO in Sept 2010)

The chapter will primarily focus on three factors which influence adaptive capacity – leadership, authority (policy instruments, act according to plan and political will) and access to information. Firstly the international context will be examined, considering the role of UNESCO in World Heritage Site management, and progress in climate change adaptation. The chapter will then move on to focus on the UK national context, examining leadership, how the WHS management planning system is taking climate change into account and what current policy and guidance exists. Finally, the results of a questionnaire survey which was carried out of all UK World Heritage Sites are presented. This survey produced data on key issues from the majority of UK sites, placing the detailed findings from the case studies into a wider context, as well as providing information which informed the case study selection.

5.2. Introduction to World Heritage

5.2.1. The World Heritage List and the World Heritage Convention

A UNESCO World Heritage Site is a place (such as a mountain, coastline, monument or city) that is listed by UNESCO as of special cultural or natural significance. The key international treaty relevant to cultural heritage is the Convention Concerning the Protection of the World Cultural and Natural Heritage (also referred to as the World Heritage Convention), which was adopted by UNESCO in 1972. This Convention seeks to put in place 'an effective system of collective protection of the cultural and natural heritage of outstanding universal value, organised on a permanent basis…' (UNESCO, 1972 p1).

The Convention's work is carried out by the World Heritage Committee whose duties include the definition of criteria by reference to which properties may be assessed for inclusion in the World Heritage List. Members of the committee are elected from amongst the state parties to the Convention and UNESCO provides a Secretariat (the World Heritage Centre) at its headquarters in Paris to manage the committee's activities. There are also three advisory bodies to the committee - ICOMOS (International Council on Monuments and Sites) and ICCROM (International Centre for the Conservation and Restoration of Monuments) for cultural heritage and IUCN (International Union for Conservation of Nature) for Natural Heritage.

Remarking that 'the deterioration or disappearance of any item of the cultural or natural heritage constitutes a harmful impoverishment of the heritage of all the nations of the world' (UNESCO, 1972 p1), the Convention calls on state parties to identify properties of cultural and/or natural value considered to be of 'outstanding universal value' (OUV) for inscription on the World Heritage List.

Outstanding universal value is defined as 'cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity' (UNESCO, 2008a p14). The committee considers a property as having outstanding universal value if the property meets one or more of certain criteria, for example: to represent a masterpiece of human creative genius; or to be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates a significant stage(s) in human history (UNESCO, 2008a). To be deemed of outstanding universal value, a property must also meet the conditions of integrity and/or authenticity and must have an adequate protection and management system to ensure its safeguarding (UNESCO, 2008a). There are currently (July 2012) 962 World Heritage Properties, including 745 cultural, 188 natural and 29 mixed properties in 157 nations. Each party to the Convention acknowledges its duty to ensure the protection and conservation of heritage sites within its borders so that they can be passed on to generations of the future.

5.2.2. World Heritage Sites in the UK

The UK joined the World Heritage Convention in 1984 and (in 2012) has 28 World Heritage Sites (see Figure 11 which shows the location of UK World Heritage Sites). These vary considerably in size, type, ownership and management systems and represent a range of heritage values. Sites include archaeological sites, urban centres, country houses and estates, and industrial heritage (see Figure 12 and Figure 13, examples of UK World Heritage Sites). They vary greatly in size, for instance Heart of Neolithic Orkney which is relatively small and covers 15 ha to the Cornwall and West Devon Mining Landscape which covers 19,719 ha. Some sites are in single ownership, such as Blenheim Palace, which is privately owned. However, most sites have more complex ownership structures; for example, the Stonehenge World Heritage Site covers around 2,600 ha and is owned and managed by EH, the NT, the Ministry of Defence, the RSPB, farmers and householders. Religious buildings form a key part of several UK World Heritage Sites, and so organisations such as the Cathedral Fabrics Commission or Diocesan authorities may also be involved in their management.

Figure 12 Maritime Greenwich WHS, London, which played a major role in the history of astronomy and navigation.
Figure 13 The City of Bath WHS, founded by the Romans as a thermal spa, known for its 18th century neoclassical Palladian buildings.

A range of different government departments, bodies, and non-governmental organisations are involved in the management of UK World Heritage. At a national level, the lead government department in the UK is the Department for Culture, Media and Sport (DCMS), which is responsible for ensuring that the UK fulfils its obligations under the World Heritage Convention. DCMS liaises with the Devolved Administrations, the Ministry of Justice, which acts on behalf of Crown Dependencies, and the Foreign and Commonwealth Office, which is responsible for heritage in the overseas territories (English Heritage, 2009b). Other government departments have important roles relating to the implementation of the World Heritage Convention and include Communities and Local Government (DCLG) which covers spatial planning, and the roles of local authorities and DEFRA which has responsibilities for natural World Heritage Sites. WHS status in the UK does not bring any financial awards from the Government or UNESCO, although it can attract indirect funding from other sources such as The Lottery and the private sector. UNESCO is not involved in a hands-on manner with UK World Heritage Sites, and is more involved with sites in developing countries (UNESCO Interview, 2010 and EH Interview, 2012).

EH is the Government’s statutory advisor on the historic environment in England, and is DCMS’s principal advisor on matters relating to English World Heritage sites. Historic Scotland is responsible for cultural sites in Scotland as part of their wider responsibility towards the historic environment, Cadw is the Welsh Assembly Government's historic environment division and the Northern Ireland Environment Agency is the relevant department in Northern Ireland. ICOMOS UK, a non-governmental organisation, provides advice on the development of World Heritage Sites nominations, Management Plans and promotion and capacity building (English Heritage, 2009b).

5.3. Climate Change and World Heritage Management - The International Context

5.3.1. Recognition of Climate Change & Progress and Strategies published by UNESCO

The World Heritage Committee at its 29th session in 2005 recognised that 'the impacts of climate change are affecting many World Heritage properties and are likely to affect many more, both natural and cultural in the years ahead'(World Heritage Committee, 2005 p36). Given that climate change emerged as a globally recognised issue in the 1980s, this is perhaps late to first make the link to cultural heritage. However, since this time, UNESCO has made it clear that they consider climate change to be a threat which is the subject of growing concern, and that for those sites which are affected by climate change, management strategies will have to respond to these additional sources of stress in the future (UNESCO, 2007). Climate change is seen as one risk among a number of challenges facing World Heritage sites and one that should be considered in the broader context of conservation (World Heritage Centre, 2006).

A questionnaire survey was carried out by the World Heritage Centre in 2005 amongst all state parties to the World Heritage Convention to assess the extent and nature of the impacts of climate change on World Heritage properties. Of the 110 responses received from 83 state parties, 72% acknowledged that climate change had an impact on their natural and cultural heritage. 46 countries mentioned that they were undertaking specific actions to deal with the issue although most of these actions were limited to monitoring impacts (World Heritage Centre and World Heritage Centre Advisory Bodies, 2006).

In 2006 a meeting of experts was held at UNESCO headquarters in 2006 to review the nature and scale of the risks suffered by World Heritage properties specifically arising from climate change. Following this meeting, a report on Predicting and Managing the Effects of Climate Change on World Heritage (World Heritage Centre and World Heritage Centre Advisory Bodies, 2006) and a Strategy to Assist State Parties to Implement Appropriate Management Reponses were presented to the World Heritage Committee. At its 30th session in July 2006, the World Heritage Committee reviewed these two documents and took the decision to request all the States Parties to implement the strategy so as to protect the outstanding universal values, integrity and authenticity of the World Heritage sites from the adverse impacts of climate change. These documents are the first specific policy on this issue and are still referred to by UNESCO today[8]. The decisions taken are pertinent for current WHS management. In 2007, a publication was released by the World Heritage Centre entitled Case Studies on Climate Change and World Heritage (UNESCO, 2007). This presents a range of case studies from selected natural and cultural World Heritage sites around the world, and briefly illustrates some of the impacts of climate change that have already been observed, and those that may be expected in the future.

Predicting and Managing the Effects of Climate Change on World Heritage (World Heritage Centre and World Heritage Centre Advisory Bodies, 2006) states that the climate change threat to OUV has several implications for the World Heritage Convention e.g. the processes of the Convention such as nominations, periodic reporting and reactive monitoring must be reviewed and suitably adjusted to ensure they are adequate in the face of climate change. It also states that the climate change threat justifies the need to implement appropriately tailored risk preparedness measures, linking these to larger disaster risk planning efforts.

The document presents a strategy for site based mitigation and adaptation responses. A key point that is emphasised is that climate impacts must be assessed through appropriate monitoring and vulnerability assessment processes and that monitoring management responses is critical. Documenting past climatic effects and their impacts on cultural heritage is also considered important to 'enable present generations to learn from the past and pass on knowledge of the

[8] At the time of writing (February 2013), UNESCO refers to these documents

specific culture of the place and its adaptive capacity to future generations'(World Heritage Centre and World Heritage Centre Advisory Bodies, 2006 para 109).

This report examines the issue of designing Management Plans to address the issue of climate change. It states that 'if a Management Plan is specifically designed and formatted to foster its use as a working document which can be updated on a regular basis, then it can become a key tool in the effective stewardship of World Heritage sites under threat from climate change'(World Heritage Centre and World Heritage Centre Advisory Bodies, 2006 para 76). Recommendations include that the Management Plans of all sites potentially threatened should be updated, and climate change adaptation should be in their guiding principles for management over the next 25-30 years and in their revisions of the management objectives. Decision 30 COM 7.1d agreed at the 30th session of the committee in Vilnius in 2006, which requests that the issue be addressed in WHS Management Plans, has led to the requirement to incorporate climate change into reviews of Management Plans in the UK. In section 5.4.3.1 of this chapter, progress in achieving this is investigated, through a review of current UK plans.

The main objective of the Strategy to Assist State Parties to Implement Appropriate Management Reponses (World Heritage Centre, 2006) is to review the key topics that should be considered when preparing to implement preventive and/or corrective management responses to deal with the adverse impacts of climate change. It focuses on three sets of actions that need to be taken to safeguard heritage: preventive actions (such as monitoring and reporting), corrective actions (such as developing tailored programmes for specific sites) and collaboration, cooperation and sharing knowledge (for example training, education and sharing of good practice).

In 2007 a general Policy Document on the Impacts of Climate Change on World Heritage Properties was adopted aimed at providing World Heritage decision makers with guidance on several key issues relating to research needs and legal issues. Key challenges that were identified included a lack of data that was specifically relevant to understanding climate change impacts on World Heritage properties, particularly cultural properties. 'A lack of knowledge and capacity makes it difficult to assess the loss of key values of World Heritage properties as a consequence of climate change'(UNESCO, 2008b p5). The policy document also mentions potential revisions to the Operational Guidelines and reactive and periodic monitoring, in order to take into account climate change threats.

The procedures and methods for implementation of the World Heritage Convention are guided by Operational Guidelines that are regularly reviewed (the latest version of these was published in 2012). The UNESCO World Heritage Committee monitors World Heritage Sites by carrying out periodic reporting on a cyclical basis[9] and reactive monitoring, for example, in response to a natural catastrophe. The issue of how the current Operational Guidelines and monitoring systems take into account climate change will now be considered.

5.3.2. Operational Guidelines, Periodic and Reactive Monitoring

The Policy Document on the Impacts of Climate Change on World Heritage Properties (UNESCO, 2008b) provides a critical analysis of the existing provisions of the Convention and its Operational Guidelines in relation to climate change. Article 4 and 5 and 6 of the Convention are highlighted as particularly relevant. The World Heritage Committee state that they will 'specifically consider taking climate change into account in the next revision cycle of the Operational Guidelines' (UNESCO, 2008b p7), and that the Committee 'will consider strengthening the management planning and management system provisions of the Operational Guidelines concerning site level adaptation and mitigation measures' (UNESCO, 2008b p8). It is also recommended that by specifically incorporating reference to 'the precautionary approach' in the Operational Guidelines, and thereby explicitly adopting this approach as a consideration in decision making, state parties will be encouraged to deal more actively with risk and uncertainty.

[9] Periodic reporting occurs approximately every 6 years

In the revisions to the Operational Guidelines in 2011[10] (the previous version was from 2008), there were some changes made to the nomination format and management and planning requirements. Some of the recommendations made in the Policy Document on the Impacts of Climate Change on World Heritage Properties have been taken into account. However, in the 2011 guidelines[11], climate/climatic change is not specifically referred to any more than in the 2008 version, and many of the previously suggested changes have not occurred. The main alterations which are relevant to climate change issues will now be outlined.

With regard to the criteria for the inscription of properties on the list of World Heritage sites in danger, Paragraphs 179 and 180 which relate to potential danger have been amended to include reference to the 'threatening impacts of climatic, geological or other environmental factors' (UNESCO, 2011a p49). In relation to the protection and management of nominated properties, paragraph 132 now specifies that 'sustainable development principles should be integrated into the management system' (UNESCO, 2011a p33). The management system should include any long-term challenges for the protection and management of the property, referring to vulnerabilities and negative changes in authenticity and/or integrity that have been highlighted, setting out how protection and management will address these vulnerabilities and threats'(UNESCO, 2011a p107). Paragraph 119 on sustainable use has been expanded, stating that 'World Heritage properties may support a variety of on-going and proposed uses that are ecologically and culturally sustainable'(UNESCO, 2011a p29), and that legislation, policies and strategies affecting World Heritage properties should ensure the protection of OUV and promote the active participation of stakeholders in order to contribute to its sustainable protection and management.

The Policy Document on the Impacts of Climate Change on World Heritage Properties particularly highlighted the scope for monitoring to be used to specifically monitor and report climate change effects on World Heritage properties (UNESCO, 2008b). The recommendations made regarding this have not

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[10] A 2012 version of the guidelines has since been released, with no new additions in relation to risk preparedness or climate change adaptation

[11] This is true for both the 2011 and the 2012 version

been incorporated into the revised guidelines. However, there has been an addition to section 111 which specifies the common elements of an effective management system, where a new item 'c) the monitoring and assessment of the impacts of trends, changes, and of proposed interventions', has been added (UNESCO, 2011a p27). This may pick up climate impacts.

Although some changes to the Operational Guidelines have been made, many of the recommendations from the policy document on climate change have not been adopted, nor is there a specific requirement for climate change in Management Plans (although there a WHC decision on this – see section 5.3.1). There may be scope for more specific inclusion in the Operational Guidelines, in order to enhance protection of sites from climate threats.

It is well recognised that monitoring is an essential part of World Heritage Site management and is critical to management effectiveness (Stovel, 1995 ; UNESCO World Heritage Centre and ICCROM, 2004 ; World Heritage Centre and UNESCO, 2002). The UNESCO World Heritage Committee monitors World Heritage Sites by carrying out periodic reporting and reactive monitoring, and periodically reviews all World Heritage Sites on a cyclical basis. Information provided to the UNESCO general conference includes reports from State Parties on the state of conservation of the World Heritage properties located on their territories. This occurs approximately every six years, and there is a regional approach. This was last carried out for European sites in 2005/6, with the latest cycle of periodic review for Europe starting in 2012.

The policy document on the Impacts of Climate Change on World Heritage Properties (UNESCO, 2008b) states that reactive monitoring provisions should be made more specific as a basis for monitoring of and reporting on the site specific effects of climate change, and that as part of the periodic reporting process the WHC will consider a specific obligation for states to report on climate change related threats and impacts to OUV and adaptation measures to address them (UNESCO, 2008b).

The questionnaire used for the current round of periodic reporting is the same for all sites in the world. According to EH (Interview, 2012), the risk assessment elements of this questionnaire were based on a questionnaire developed for the Great Barrier Reef, where climate change is a significant issue, in terms of sea level rise, coral bleaching etc. There is a multi-stage approach to risk assessment which involves weighting the different potential risks to the site, and identifying the five most serious threats.

Climate change is explicitly addressed in the section of the questionnaire which investigates factors affecting the property. In this part of the document, information is required on the range of factors which are affecting (either currently affecting or have a strong possibility of affecting) the property both positively and negatively. Section '3.10 Climate Change and severe weather events' asks for information on a range of impacts including changes to oceanic waters, desertification, drought and flooding, and there is also space for 'other climate change impacts' to be described. Other potential impacts identified in the form may also result from climatic change and variability, such as the sections on air pollution, farming practices, invasive/alien species and local conditions affecting physical fabric such as erosion and changes to humidity.

For each negative factor which is identified in the questionnaire, there follows an assessment of the factor, investigating issues such as the spatial and temporal scale of the issue, scale of impacts and the management response in terms of capacity (high, medium, low, none to respond to the negative factor). Other questions look at the presence of appropriate management systems to protect the OUV of the property e.g. presence of an adequate management system/ plan and work or action plan and adequate financial and human resources for different disciplines e.g. research and monitoring, risk preparedness and whether there is adequate monitoring of key indicators of the state of conservation.

It is clear that the recommendation in the policy document to monitor climate change in this way has occurred and current (and possibly potential) impacts of climate change should be picked up in the current round of periodic reporting, as well as how much of a risk to OUV these particular factors are considered to be. In addition, other factors which may affect responses and adaptive capacity at the site, such as availability of resources and adequate management systems, will also be highlighted.

5.4. Climate Change and World Heritage Management - The National Context

5.4.1. Leadership on Adaptation to Climate Change and Heritage

The main government agencies which are responsible for adaptation in the UK are DEFRA and the Environment Agency (EA). The EA's principal aims are to protect and improve the environment, and to promote sustainable development. They play 'a central role in delivering the environmental priorities of central government' (Environment Agency, 2012a). The EA has an existing overarching role relating to climate change, which includes its position as the competent authority and administrator of the EU Emissions Trading Scheme and the designated joint administrator for the Carbon Reduction Commitment. The Agency also issues technical guidance to help organisations such as local authorities, water companies and the Highways Agency consider climate change when they are delivering projects with flood or coastal management issues (EA interview, 2011)(Environment Agency, 2012c). As well as this, since 2012 the EA has a new role as the 'Climate Ready' support service to help organisations adapt to climate change, building on the work of UKCIP, who had been champions of adaptation, taking over many of their functions (Environment Agency, 2012d). The EA is taking over work on scenarios in conjunction with the Met Office and will be working towards the aims of DEFRA, and will be working with a wider group of people on adaptation than previously. In the opinion of one NT source, "the EA are trying to move on from UKCPO9 scenarios and get into something that they think will be more useful to enable business organisations or a member of the public to have a more active approach to adaptation" (NT interview, 2012). However, the EA has a broad remit and does not have a specific role relating to heritage.

Within the heritage sector, the National Trust is regarded as particularly proactive on climate change issues, and they have been involved in a great deal of work on adaptation. They are regarded by other agencies and organisations as knowledgeable and active on climate change work and climate change adaptation

(EA interview, 2012). The approach of the Trust has been around integrating adaptation and mitigation, and to encourage an adaptive mind-set: “be adaptive, rather than actually adapt” (NT interview, 2012).They have aimed to build the information base on adaptation and then encourage others within the organisation to ‘enthuse’ and drive adaptation forward.

The NT was involved in pioneering work on climate scenarios and projects such as mapping flash flood risk (according to one NT source, before the EA were carrying out such work). The Trust were involved in initial work on UKCIP scenarios, trying to apply the scenarios to real sectors of activity like farming, horticulture, buildings and structures, water resources, coastal change. NT sites were used as test beds for looking at possible impacts of particular climate change projections in terms of impacts on historic structure interiors or exteriors, visitor behaviour, early flowering in orchards. A series of impacts and adaptation reports were then produced, however, many of these are still in draft and were never finished and released (NT interview, 2012).

Although the NT have been leaders on climate change adaptation and heritage issues, in recent years there has been less focus on this work. Key reasons have been a change in priorities within the Trust and a move towards a more business led approach, as well as the loss of key leaders on adaptation within the Trust, who are now focusing on other work. However, key individuals are now trying to get work on adaptation progressing again (NT interview, 2012).

EH has been less active on adaptation than the NT, but commissioned an important scoping study on climate change and the historic environment from UCL (Cassar, 2005) and have participated in studies such as the EPSRC/UKCIP’s Building Knowledge for Climate Change portfolio of projects (Walsh et al., 2007). They have also carried out several projects on coastal risk e.g. the EH Coastal Estate Risk Assessment (Hunt, 2011). EH is not currently (Jan 2013) a reporting authority[12], however, it may participate in the second round of the Adaptation

[12] An authority which has been required to submit Adaptation Plans in response to Directions to report under the Climate Change Act 2008. This currently (Jan 2013) includes key infrastructure providers, and includes the EA, NE and National Park Authorities.

Reporting Power (English Heritage, 2013b). There is a climate change team being set up at a national level, but work is not yet underway, but in time it will look at reviewing existing guidance such as the 2008 Climate Change and Historic Environment publication (English Heritage, 2008a), as well as planning future work. “We had an advisory group for climate change but quite a lot of the people who were in it were either made redundant or retired, so we’re going to have to start it up again, but we have not quite done that yet” (EH Interview, 2012). EH has suffered from significant budget cuts since 2007[13], and they are struggling to undertake all the key aspects of the organisations wide remit (House of Commons Culture Media and Sport Committee, 2011).

Support on adaptation to a range of sectors such as local authorities has come in the past from regional level partnerships, such as climate change partnerships, but these are undergoing a transition under the coalition government (UKCIP, 2011). The Yorkshire and Humber Climate Change Partnership (YHCCP) explain that some of the challenges of the restructuring are that there are no longer many organisations left which operate regionally with the necessary connections, and that this is where partnerships such as this can provide assistance. The YHCCP has links at a local level e.g. local government and voluntary groups, and aims to provide connections between the local and national policy levels (YHCCP Interview, 2012). More issues relating to the reorganisation of and changes in governance will be explored in the following section on policy, guidance and political will.

[13] Following the budget review in October 2010, there was a 32% cut in the grant to English Heritage. Since 1997 it has received cuts in its grant settlements, resulting in a real term reduction of £130m (House of Commons Culture Media and Sport Committee, 2011)

5.4.2. Authority - UK Adaptation Policy, Guidance and Political Will

5.4.2.1. The Planning Context

The British approach to World Heritage management is based on the use of the spatial planning system to protect World Heritage Sites and the development of World Heritage Management Plans (Department for Communities and Local Government and Department for Culture Media and Sport, 2009 ; 2009b). There are several key elements of the approach to the protection and management of World Heritage Sites. Firstly, World Heritage Sites are a key material consideration in the determination of planning applications (Department for Communities and Local Government and Department for Culture Media and Sport, 2009 ; English Heritage, 2009b) and it is stated that the main planning objective should be the protection of each World Heritage Site through the conservation and preservation of its OUV (Department for Communities and Local Government and Department for Culture Media and Sport, 2009). In addition, the approach encourages designating specific assets within World Heritage Sites (Listed buildings, Scheduled Ancient Monuments, parks and gardens, Conservation Areas etc.). This means that most sites have protection under additional legislation. EH state that planning authorities should include policies in their local plan to protect the outstanding universal value, authenticity and integrity of World Heritage Sites and that each World Heritage Site should have an agreed Management Plan (2009b). A stakeholder steering group and support from the key partners, including major owners, managers and communities is encouraged as is effective coordination, normally by a dedicated coordinator (English Heritage, 2009b).

Currently, at a local level, local authorities are responsible for spatial planning decisions which may involve World Heritage Sites as well as having an important role in communication, management, promotion and in some cases as owners of parts of sites (English Heritage, 2009b). The Local Authority World Heritage Forum (LAWHF) is a network of local authorities that have the whole or part of an inscribed site within their boundaries. LAWHF ‘exists to help local authorities play their part in protecting, conserving and presenting UK World Heritage Sites' (Local Authority World Heritage Forum, 2010).

Since 2010, the planning system has undergone a radical transformation as the coalition government introduces its localism agenda (UK Parliament, 2011b). In the past at a regional level both Regional Government Offices and Regional Planning Bodies could play a significant role in promoting World Heritage Sites thorough Regional Spatial Strategies and through the provision of funding to individual World Heritage Sites. The regional tier of planning has been abolished with a decentralisation of power, with communities being given more opportunities to make decisions about their area. National Indicator 188 (NI 188) which was a key driver for local action on adaptation has been lost. It was designed to help local authorities assess and address the risks and opportunities presented by a changing climate, as well as provide a tool for measuring preparedness. The loss of the regional target setting and compulsory indicators such as the RSS and NI188 is proving challenging for those tasked with working on adaptation, according to a source from the Yorkshire and Humber Climate Change Partnership (YHCCP interview, 2012). The work which the Partnership is involved with on adaptation is facing loss of funding, resource constraints, and lack of political will, and understanding the business case for adaptation is considered to be a key way forward to continue the work (YHCCP interview, 2012).

Key policy documents relevant to heritage site management and climate change adaptation are shown in Table 3. Specific policy guidance on World Heritage Sites is set out in the Circular on the Protection of World Heritage Sites (Department for Communities and Local Government and Department for Culture Media and Sport, 2009), which is supplemented by an EH Guidance Note: The Protection and Management of World Heritage Sites in England[14] (2009b).

PPS5 Planning for the Historic Environment (Department for Communities and Local Government, 2010) was the key national policy document for the historic environment, and was replaced in March 2012 by the National Planning Policy

[14] These documents apply just to England

Framework (NPPF) (DCLG, 2012), as part of a major transformation of the UK Planning system. The NPPF, which is a single, consolidated planning framework replaced many individual policy statements, circulars and guidance documents, such as the climate change supplement to PPS1 (Communities and Local Government, 2007) which set out how planning should help shape places with lower carbon emissions and resilience to climate change. Consultation responses on the draft framework highlighted the need to strengthen the protection of the historic environment, unease about the vagueness of the presumption in favour of sustainable development, and concerns over the primacy of economic growth and impacts of this on the environment (Country Land & Business Association, 2011 ; English Heritage, 2011 ; National Trust, 2011 ; TCPA (Town and Country Planning Association), 2011). Changes were made to the draft and the final NPPF has been welcomed as more balanced with a revised definition of sustainable development and clearer heritage protection (English Heritage, 2012b ; National Trust, 2012b ; TCPA, 2012). Climate change adaptation and mitigation are considered in the NPPF, with a requirement for local authorities to take into account adaptation in their local plans (Department of Communities and Local Government, 2012).

Policy Level	Key Policy and Guidance Documents relevant to Heritage Site Management and Climate Change Adaptation
International	Operational Guidelines for the Implementation of the World Heritage Convention, UNESCO, 2011
	Case Studies on Climate Change and World Heritage, UNESCO, 2007
	A Strategy to Assist State Parties to Implement Appropriate Management Reponses, WHC, 2006
	Predicting and Managing the Effects of Climate Change on World Heritage, WHC, 2006
National	UK Climate Change Risk Assessment, DEFRA for HM Government, 2012
	Planning Policy Statement 5: Planning for the Historic Environment, DCLG, 2010 (Replaced from July 2012 by the National Planning Policy Framework, DCLG, 2012)
	Rapid Coastal Estate Risk Assessment, EH, 2011
	Flooding and Historic Buildings Guidance, EH, 2010
	Climate Change Plan, DEFRA, 2010
	DCLG & DCMS Circular on the Protection of World Heritage Sites, 2009
	EH Conservation Principles: Policies and Guidance for the Sustainable Management of the Historic Environment, 2008
	Climate Change and the Historic Environment, EH, 2008
	Internal NT guidance and information such as sector climate change policy statements and NT Statements and Principles (climate change), NT intranet, 2007
	Shifting Shores: Living with a Changing Coastline, NT, 2005
	Engineering Historic Futures Stakeholders Dissemination and Scientific Research Report, UCL, 2005
	Forecast Changeable, NT, 2005

Table 3 UK policy and guidance documents

5.4.2.2. The Climate Change Policy Context

The UK Climate Change Act 2008 (UK Parliament, 2008) created a framework for cutting carbon emissions and for building the UK's ability to adapt to climate change. This included a UK wide Climate Change Risk Assessment (CCRA) which must be reviewed every five years. An Adaptation Sub-Committee was also established to advise government (Adaptation Sub-Committee, 2011 ; Adaptation Sub-Committee, 2012). In January 2012, the government published the first UK CCRA (HM Government, 2012). DEFRA is also responsible for developing a

National Adaptation Programme[15] to address the risks set out in the UK CCRA – this will be published in 2013.

The CCRA looked at over 100 risks for 11 sectors, including forestry, floods and coastal erosion, agriculture and the built environment. Heritage is included within the built environment sector of the report, and some of the potential causes of increased damage to heritage buildings noted are flooding, sea level rise, mould and pests caused by milder, wetter winters and damage caused by changes in the freeze/thaw cycle (Capon, 2010 ; Capon and Oakley, 2012). Impacts on heritage are linked to impacts on the tourism sector, and the assessment focuses on historic buildings. It is also mentioned that many historic buildings face the same risks as more modern buildings, although the consequences of these risks can be very different. For these reasons, risks which are specific to cultural heritage are not included in some of the analysis for the CCRA.

There could perhaps have been scope to look at issues relating to cultural heritage in a broader context rather than just at built heritage, and also to look at potential risks to heritage in more depth within the CCRA. Although EH was consulted in the DEFRA CCRA, references to heritage have remained limited in the final document. There may, however, be further opportunities for more inclusion in the forthcoming National Adaptation Programme, and EH are working to try to encourage this (EH interview, 2012). Despite the fact that the CCRA has not focused on heritage as much as it could have, and that there is much less activity on adaptation than on carbon reduction, the publication of the national risk assessment and the development of the national adaptation action plan do illustrate that there is the political will, desire and some funding to carry out work on adaptation, and to try and to address this gap.

As shown by the policy and guidance in Table 3, between 2005 and 2008 there was a significant amount of work carried out by the NT and a focus on this issue by EH and UNESCO WHS, with a range of reports and guidance released. However,

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[15] This plan is expected to be published in 2013 and will focus on helping UK businesses, local authorities and civil society to become more resilient or 'Climate Ready' to climate change impacts

since that time (as previously discussed in Section 5.4.1), there has been a reduced focus on the issue of climate change and there has been less guidance produced. Other issues such as the on-going economic crisis which started in 2007 have become more prominent. NT and EH both state that there is currently some interest in restarting climate change adaptation programmes and revising guidance, such as the EH Climate Change and the Historic Environment publication (EH and NT interviews, 2012).

A mixed picture emerges in relation to policy and guidance. There is a significant body of research and policy on adaptation being driven by the CCRA. However, to date, this has little focus on heritage. At the same time, significant transformations in planning policy and target setting, such as the loss of the regional tier of planning and the NI 188 indicator, are affecting the capacity of local authorities to adapt to climate change.

Other organisations such the NT and EH have been actively involved in adaptation in the past although there has been a reduced focus on climate change adaptation issues in recent years. There is the motivation amongst some in these organisations to progress the issue, although due to changes in organisational aims, competing pressures, staff losses and restructuring, this is not yet seriously underway. The forthcoming National Adaptation Programme may help to bring the issue back up the agenda in the UK, although what influence this has on heritage bodies, and on progress at a local level will need to reviewed in the future.

5.4.3. Act According to Plan: Management Planning at UK World Heritage Sites

Heritage site management can be defined simply as the way that those responsible [for the site] choose to use it, exploit it, or conserve it (Mason et al., 2003 ; Pearson and Sullivan, 1996). Management Plans have developed as a tools to help consolidate an understanding of what matters and why, and how to conserve and manage it. These documents can provide a framework for long-term decision-making for the management of sites.

For World Heritage Sites, since 1995 each nominated property must have 'an appropriate Management Plan or other documented management system which should specify how the outstanding universal value of a property should be preserved' (UNESCO, 2008a p27), its purpose being 'to ensure the effective protection of the nominated property for present and future generations' (UNESCO, 2008a p27). UK planning authorities are expected to treat relevant policies in Management Plans as key material considerations (Department for Communities and Local Government and Department for Culture Media and Sport, 2009).

The Operational Guidelines recognize that effective management systems vary according to the nature of the site as well as the legal system of the state party concerned and that Management Plans should contain both long term and day to day actions to protect, conserve and present the site. The importance of a cycle of planning, implementation, monitoring evaluation and feedback is also highlighted (UNESCO, 2008a). Significantly, the WHC considers Management Plans to have the potential to be a 'key tool in the effective stewardship of World Heritage sites under threat from Climate Change' (World Heritage Centre, 2006, p24). All UK World Heritage sites have Management Plans, some of which are now on their second or third iterations.

Most UK WHSs are complex, large and generally in multiple ownership, and this presents challenges in managing them. There can be a large number of official bodies with interests in a site. According to UK guidance, World Heritage Site Management Plans should be prepared on a participatory basis by a steering group/committee made up of key stakeholders in each site e.g. local authorities, DCMS, EH, ICOMOS UK (Department for Communities and Local Government and Department for Culture Media and Sport, 2009 ; English Heritage, 2009b).

UNESCO and its advisory bodies recommend that World Heritage Site Management Plans should have an overall vision for the site, long term aims looking forward 30 years and policies for around five years. Management planning is not a one-off exercise – constant review, update and alterations are needed as new information comes to hand, the management climate changes and new techniques and opportunities arise (Pearson and Sullivan, 1996 p213). EH recommends that Management Plans should be reviewed every five to six years, and on-going monitoring and review should be used to revise the plan (English Heritage, 2009b).

The preparation of a Management Plan is the responsibility of the site owner or the body responsible for the site. The Management Plan will either be prepared by the site coordinator, possibly with some consultative support, or by consultants. EH are involved in the production of WHS plans: “We would expect, centrally, to look at it at various stages, either when asked by our regional team or when it reaches a significant draft stage. And, right at the end of the process, we have to advise DCMS whether the Management Plan is fit for purpose. So, we have an advisory role and then we also have an assessment role at the end” (EH interview, 2012).

As discussed in Section 5.3.1, at the 30th UNESCO Session of the Committee, 2006, Decision 30 COM 7.1d, the WH Committee requested that Management Plans should assess the possible impact of climate change and the likely risk of flood, fire and other emergencies and prepare mitigation strategies as appropriate for the WHS. The EH World Heritage Team check that Management Plans have incorporated this requirement (EH interview, 2012). UNESCO request that risk preparedness measures are carried out, but after that it is largely the state party’s responsibility to manage the site, and UNESCO’s direct role is the UK is usually small unless there is a major problem. UNESCO is more directly involved in countries in the global south which suffer from acute disasters e.g. mudslides in Latin America (EH interview, 2012 and UNESCO interview, 2010). It is clear that UNESCO’s role in encouraging the consideration of adaptation at UK sites is limited to what is defined in policy and guidance, whereas EH’s role is more ‘hands on.’

Issues which EH request that sites should consider in the plan include severe weather events, increased potential of flooding, coastal erosion, and increased intensity and volume of rainfall, and a consideration of how these issues will affect the site such as the need for better rain water goods for historic buildings (EH interview, 2012). However, when EH have looked at Management Plans to see if climate change issues are included, they found that only some included it, and in several cases it was a last minute addition. An EH source explains that it is not something which is "necessarily high on people's agenda. Probably we need to do more work on training people as to what the implications might be" (EH Interview, 2012).

5.4.3.1. Review of Current UK WHS Management Plans

In order to examine the influence of the World Heritage Committee's decision on climate change[16] on management planning at a national level, a review was carried out of Management Plans for all UK World Heritage Sites, to see what progress has been made in incorporating climate change into plans. The latest available version of the plan was retrieved, and in some cases this was a draft which had recently been released for consultation. A keyword search was carried out of the plans, looking for the use of the terms 'climate/climatic change' and 'adaptation'. The use of 'adaptation' was counted only where it referred to adaptation to climate, rather than (for example) adaptation to change of use. The results are shown in Table 4.

[16] The World Heritage Committee's decision on climate change is also known as WHC Decision 30 COM 7.1d

World Heritage Site	Date of Most Recent Plan	Period of Plan	Climate/Climatic Change (frequency)	Adaptation (frequency)
Saltaire	2000	Not stated	No (0)	No (0)
Canterbury Cathedral, St Augustine's Abbey, & St Martin's Church	2001	Electronic copy not available	Electronic copy not available	Electronic copy not available
Ironbridge Gorge	2001	Not stated	No (0)	No (0)
Liverpool Maritime Mercantile City	2003	Not stated	No (0)	No (0)
Castles & Town Walls of King Edward	2004 (approx.)	Not stated	No (0)	No (0)
Maritime Greenwich	2004	2004 - 2009	No (0)	No (0)
Giant's Causeway & Causeway Coast	2005	2005 - 2011	Yes (5)	No (0)
Avebury	2005	Not stated	Yes (1)	No (0)
Cornwall and W Devon Mining Landscape	2005	2005 - 2010	No (0)	No (0)
Durham Cathedral & Castle	2006	Not stated	No (0)	No (0)
Blenheim Palace	2006	Not stated	Yes (7)	No (0)
Tower of London	2007	Not stated	Yes (6)	Yes (1)
Derwent Valley Mills	2007	Not stated	Yes (3)	No (0)
Pontcysyllte Aqueduct & Canal	2007	2007-2012	Yes (8)	No (0)
Palace of Westminster & Westminster Abbey	2007	Not stated	No (0)	No (0)
Frontiers of the Roman Empire (Hadrian's Wall)	2008	2008-2014	Yes (21)	Yes (3)
Heart of Neolithic Orkney	2008	2008- 2013	Yes (2)	No (0)
Jurassic Coast (Dorset and East Devon)	2009	2009-2014	Yes (13)	Yes (1)
Fountains Abbey & Studley Royal	2009	2009-2014	Yes (47)	Yes (3)
Stonehenge	2009	Not stated	Yes (22)	Yes (3)
City of Bath	2010	2010 - 2016	Yes (13)	Yes (3)
Blaenavon Industrial Landscape	2011	2011-2016	Yes (3)	No (0)
Old & New Towns of Edinburgh	2011	2011 - 2016	Yes (14)	Yes (1)
St Kilda	2011 (draft)	2011 – 2016	Yes (12)	No (0)
Royal Botanic Gardens, Kew	2011 (draft)	2011 - 2016	Yes (77)	Yes (2)
New Lanark	2011 (draft)	2011 - 2016	Yes (2)	No (0)

Table 4 Review of UK WHS Management Plans
Word frequency count of the use of the terms Climate/Climatic Change and Adaptation (use of the term adaptation in relation to impacts from weather events and climate change)

The UK Management Plans vary widely in their publication dates, with several recently being reviewed and in draft form, and a surprising number being significantly out-of-date. Given that the recommended lifespan of a WHS Management Plan is five to six years, at least ten plans are older than this. One site manager who was contacted explained some of the reasons why it had been difficult to update their WHS plan – the main issue was a lack of the necessary resources, as the site does not have a full time paid coordinator and the management committee receives no direct funding. As a result the plan was being "slowly updated, but with no end date in sight" (personal communication, local authority conservation officer, 2012). At another site, a WHS Supplementary Planning Document had been produced and adopted which provided more up to date guidance on planning, regeneration and conservation issues whilst the review of the plan was underway. These examples clearly illustrate that the influence of the WHC policy and guidance on management planning is dependent on the local management systems having the necessary capacity to implement requested actions.

The majority of plans from 2006 onwards, following the WHC decision, do include at least reference to climate change, but the depth to which this is covered varied greatly. Adaptation is referred to infrequently across all the plans. Sites where climate change is particularly prominent in the plan are Kew Gardens, Fountains Abbey and Studley Royal, Hadrian's Wall and Stonehenge. New Lanark, Blaenavon and the Heart of Neolithic Orkney are examples of sites which have up-to-date plans but where climate change is not addressed in an extensive way. Some sites will be more vulnerable than others, and so logically attention to these issues will vary according to the sensitivity and potential exposure of the site. However the individual motivations, interests and perceptions of those developing the plan, as well as the local capacity (e.g. available skills and resources,) will also influence the prominence of climate change within it.

5.4.4. Climate Change and UK World Heritage Sites – A Questionnaire Survey

5.4.4.1. Questionnaire Participation

This section of the chapter will present the finding of the online questionnaire survey, which was sent to one manager e.g. the World Heritage Site Coordinator, at all sites on the UK list[17] in spring 2011. Completed questionnaire responses were received from 76% of UK World Heritage Sites, and both qualitative and quantitative data was collected. Where possible, World Heritage Site Coordinators were contacted to take part in the survey. Some Site Coordinators worked for the local council and some were at charitable trusts (predominantly at the NT, which is involved in managing several sites). The opinions given in the survey therefore reflect the opinions of those from a range of management positions, although all are of those with senior managerial roles.

Not all sites were found to have a coordinator, and in some cases it was difficult to identify someone with an overall coordination role. Some respondents held different roles such as World Heritage Site Officer, Conservation Team Leader or Park Manager (at the local council), Property Director (at a privately owned site), or World Heritage Site Energy Officer (at a charity which manages the site). This demonstrates the range of management structures that are in place at UK World Heritage Sites and that the organisational systems, and level of coordination between different stakeholders, can vary greatly from site to site. As mentioned earlier, local management systems and the local capacity that exists may influence how WHC guidelines can be implemented.

The findings in this section illustrate the practical experiences of site managers dealing with the management issues which have been raised so far in this chapter. The high response rate reflected the fact that the majority of the heritage managers contacted considered the topic of climate change to be one that is a 'live' issue for them. At many sites climate change had recently been incorporated into revisions of the Management Plan, or is currently being considered for

[17] All sites excluding three in overseas territories

forthcoming revisions of the plan. Several site managers expressed uncertainty about how climate change would affect them and how to incorporate this into the plan. There was a view that research on the area of climate change and cultural heritage was needed, in particular several managers expressed an interest in finding out how other sites were tackling the issue of climate change. This corroborates earlier findings (sections 5.4.1, 5.4.2 and 5.4.3) which indicated that there may be a need for more up to date information and training for managers, as they tackle this relatively new area of work.

A good geographic spread of sites, variety of types of heritage, size of site and management systems are represented in the survey responses. The managers of different types of sites took part including archaeological e.g. Heart of Neolithic Orkney, natural e.g. St Kilda, industrial e.g. Ironbridge Gorge and ecclesiastical e.g. Canterbury Cathedral. Responses were received from Scotland, England and Northern Ireland, but there was an absence of responses from any of the Welsh WHS's. For many of the Welsh sites there was no clear Site Coordinator or similar role, and in some cases responsibility was fragmented between different bodies, making it difficult to identify a key contact to send the questionnaire to. Table 5 below lists all sites, and shows which site managers returned a completed survey, and an earlier map (Figure 11) illustrates the location of the sites.

At two of the sites (Blenheim Palace and Saltaire) two questionnaires were completed by different members of staff. These were both included in the analysis as they represent the opinions of managers with different responsibilities; in both cases one of the respondents was specifically responsible for the natural elements of the site. Many of the cultural heritage sites on the WH list have natural elements within them (such as landscaped gardens) which contribute to their OUV.

Sometimes there was a division of responsibility between those managing the natural and built elements of the site, and the types of impacts explored in the questionnaire often differed significantly between these different elements. This demonstrates the complexity of some of these heritage sites, and how responsibilities for resilience and adaptation may be fragmented between those with responsibilities for different elements of the site.

World Heritage Site	Type of site	Questionnaire respondents
Castles and Town Walls of King Edward in Gwynedd	Cultural	X
Durham Castle and Cathedral	Cultural	√
Giant's Causeway and Causeway Coast	Natural	√
Ironbridge Gorge	Cultural	√
St Kilda	Mixed	√
Stonehenge, Avebury and Associated Sites	Cultural	X
Studley Royal Park including the Ruins of Fountains Abbey	Cultural	√
Blenheim Palace	Cultural	√
City of Bath	Cultural	√
Frontiers of the Roman Empire	Cultural	√
Westminster Palace, Westminster Abbey and Saint Margaret's Church	Cultural	X
Canterbury Cathedral, St Augustine's Abbey, and St Martin's Church	Cultural	√
Tower of London	Cultural	√
Old and New Towns of Edinburgh	Cultural	√
Maritime Greenwich	Cultural	√
Heart of Neolithic Orkney	Cultural	√
Blaenavon Industrial Landscape	Cultural	X
Derwent Valley Mills	Cultural	√
Dorset and East Devon Coast	Natural	√
New Lanark	Cultural	√
Saltaire	Cultural	√
Royal Botanic Gardens, Kew	Cultural	√
Liverpool – Maritime Mercantile City	Cultural	√
Cornwall and West Devon Mining Landscape	Cultural	X
Pontcysyllte Aqueduct and Canal	Cultural	X

Table 5 World Heritage Sites in the United Kingdom of Great Britain and Northern Ireland (excluding overseas territories)

5.4.4.2. Impacts of Recent Weather Events on UK World Heritage Sites

Weather events which have affected UK WHSs during the last five years

In order to establish the current vulnerabilities of the sites to weather events, managers were asked about the types of weather events which had affected their site in the last five years, and the impacts of these events on the site. There is no suggestion that these events are linked to climate change.

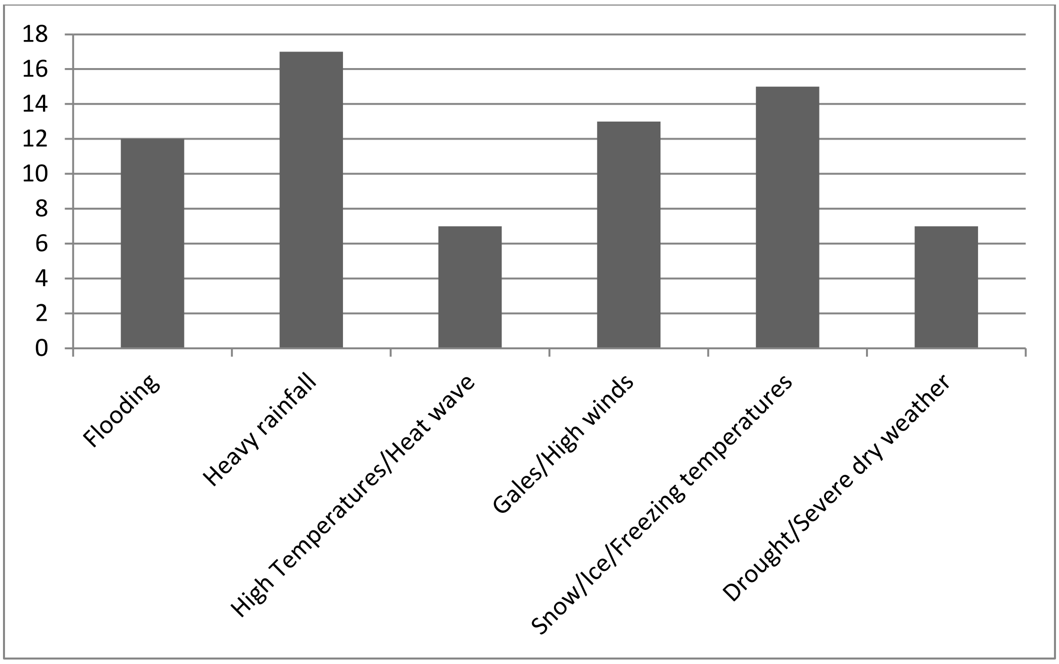

Figure 14 The number of respondents who stated that different types of weather events had affected their WHS during the last five years

Heavy rainfall, snow/ice/freezing temperatures, flooding and gales were the weather events which had had the most widespread impacts. High temperatures/heat wave and drought/severe dry weather had been experienced by fewer sites, although they were still an issue for many. The UK is well known for the variability of its weather, and its 'position in the mid-latitude westerly wind belt on the edge of the Atlantic Ocean with its relatively warm waters, yet close to the continental influences of mainland Europe', plays a major role in this (Met Office, 2012a). Changes in topography over relatively short distances, together with a long coastline and numerous islands (Met Office, 2012a), all add to the variety of weather experienced at these sites.

In addition to the options given by the questionnaire, one site (Giants Causeway and Causeway Coast) described that they had experienced freak waves and large sea swells, illustrating risks specific to coastal sites. The only site which stated that they had not been affected by any of these weather events was the Tower of London.

The information gathered from this question (as well as questions 4 and 6) have been used as criteria in the case study selection, as the LCLIP approach focuses on experiences of weather events as a hook for the investigation of preparedness and current vulnerability.

Impacts of these weather events on WHSs

A wide range of different impacts from these weather events were described by site managers, and in order to analyse these they were coded into categories. This analysis showed (Figure 15) that the types of impacts that were described most frequently were impacts and damage to built structures such as accelerated stone decay, and impacts on plants or landscape such as increased salinity of trees/shrubs. Effects described are mainly negative, but some positive impacts were outlined as well, e.g. benefits of rainfall on a dry site.

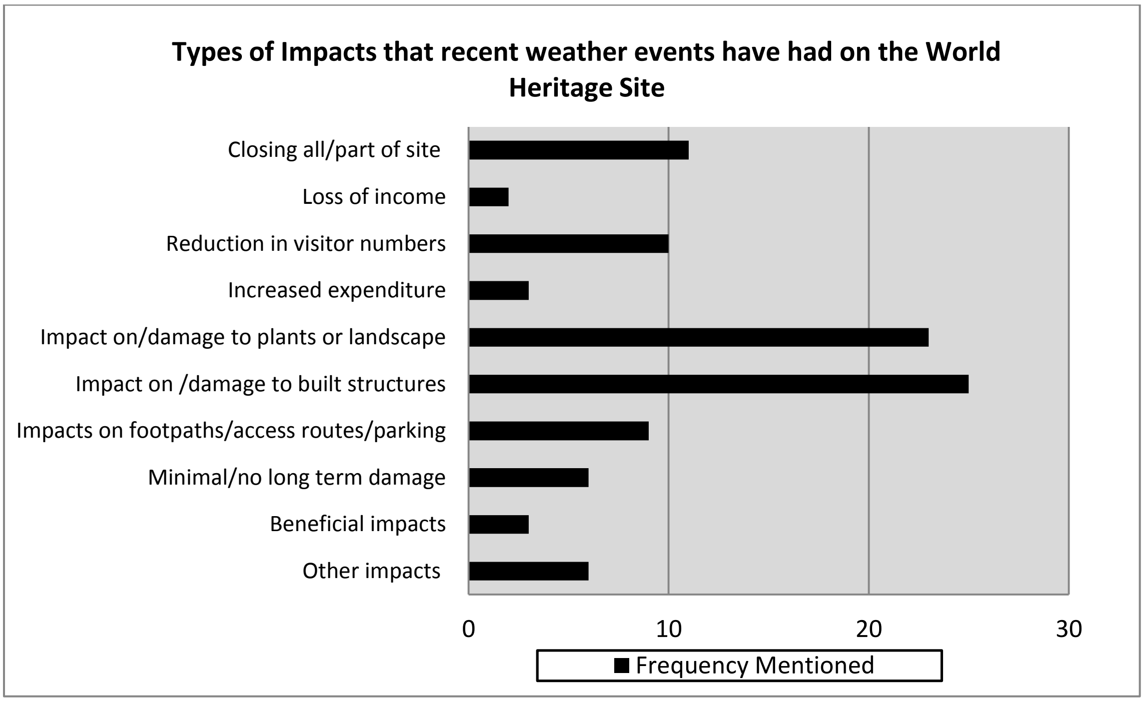

Figure 15 Frequency that different types of impacts of weather events were mentioned by respondents

The main impacts of flooding are described as having to close part of or the entire site, and impacts on built structures. For example at the Heart of Neolithic Orkney, Maeshowe, a Neolithic chambered tomb, had to be closed to visitors, and at Derwent Valley Mills, flooding has caused damage to lower ground floor rooms in the 18th/19th C cotton mills. At some sites, flooding has been experienced but has had minimal effects, for example at Saltaire where the historic park forms a flood plain which protects the rest of the site.

Heavy rainfall was reported as being an issue for most sites, and has had impacts on built structures as well as on plants and landscapes. One key issue is the inadequate capacity of historic rainwater goods that are unable to cope with the volumes of rainfall seen in recent years. This was mentioned at several sites, and in some cases, for example at some of the industrial buildings at Ironbridge Gorge, this has resulted in water ingress through windows and parts of the roof as gutters become overwhelmed. Other effects include those on plants/landscape, for example at Studley Royal where there has been 'water logging of soils, increased senility of trees and shrubs'. Not all impacts are negative; for example at the Dorset and East Devon Coast heavy rain drives landslides which are a key feature of the site. Here, the Jurassic coast is maintained by erosion, and so this process helps maintain the sites outstanding universal value.

Only a few respondents described impacts from high temperatures/heat waves on their site, for example where the impact of heat on plants and landscapes has been an issue. At Saltaire, high temperatures have caused new plant suffering and plant death and at Studley Royal and Fountains Abbey high temperatures have caused flaking and descaling on built structures. Drought and severe dry weather have had less widespread impacts than other weather events; however some impacts have been felt on plants and landscape. At Fountains Abbey and Studley Royal dry weather has impacted on landscape, plants, trees and water features such as the moon ponds, which are a key element of the landscaped Georgian water garden. At Kew Gardens, which houses the world's largest botanical collection, drought has led to the loss of stressed tree collections, particularly oaks, often due to secondary infections.

The main impacts resulting from gales and high winds are damage to plants and landscape, particularly due to tree loss, and also the need to close all or part of some sites. An unusual impact was described at St Kilda, a remote archipelago with large colonies of rare and endangered species of birds, where a trawler was wrecked on the island in 2008 due to gales, posing a threat from on-board rats to the bird life. A site manager explains that 'the risk of this sort of event occurring again will obviously increase if climate change means more gales etc.'

Snow, ice and freezing temperatures have resulted in impacts on built structures, and a reduction in visitor numbers. Damage to structures from freeze thaw is mentioned by several sites for example at the Heart of Neolithic Orkney WHS where consequences had been 'closing sites to visitors and frost damage cumulatively damaging to stonework.' At Saltaire, a Victorian industrial village, historic fabric such as cast iron rainwater goods have been damaged.

This evidence of recent impacts gives an indication of the current resilience of sites, as well as illustrating the wide range of potential impacts of climate change if events such as these become more frequent. The variety of heritage and the differences in levels of exposure and sensitivity of different elements that can exist within just one site, mean generalisation is difficult. These local characteristics are vital to developing an understanding of site vulnerability.

5.4.4.3. Potential Impacts of Climate Change on UK World Heritage Sites

Perceived Impacts of Climate Change on UK WHSs

Site managers were asked to describe any impacts they thought climate change might have on the WHS. A range of different possible impacts of climate change were mentioned by respondents, and these have been categorised (see Figure 16). These can be grouped as those on the built environment, those on the landscape/natural environment and finally impacts on the operational management of a property, which is often linked to it being a visitor attraction. Climate change is evidently more of an issue/threat for some sites than for others, and local site conditions are critical. Climate change is one of many threats to heritage, and one site manager states that other issues (e.g. inappropriate development) are more of a concern at the present time. At another (natural) site, climate change is recognised as causing changes, however these are seen as opportunities not threats, and the manager questions 'how much we should be intervening in what is essentially a natural process on a natural site?'

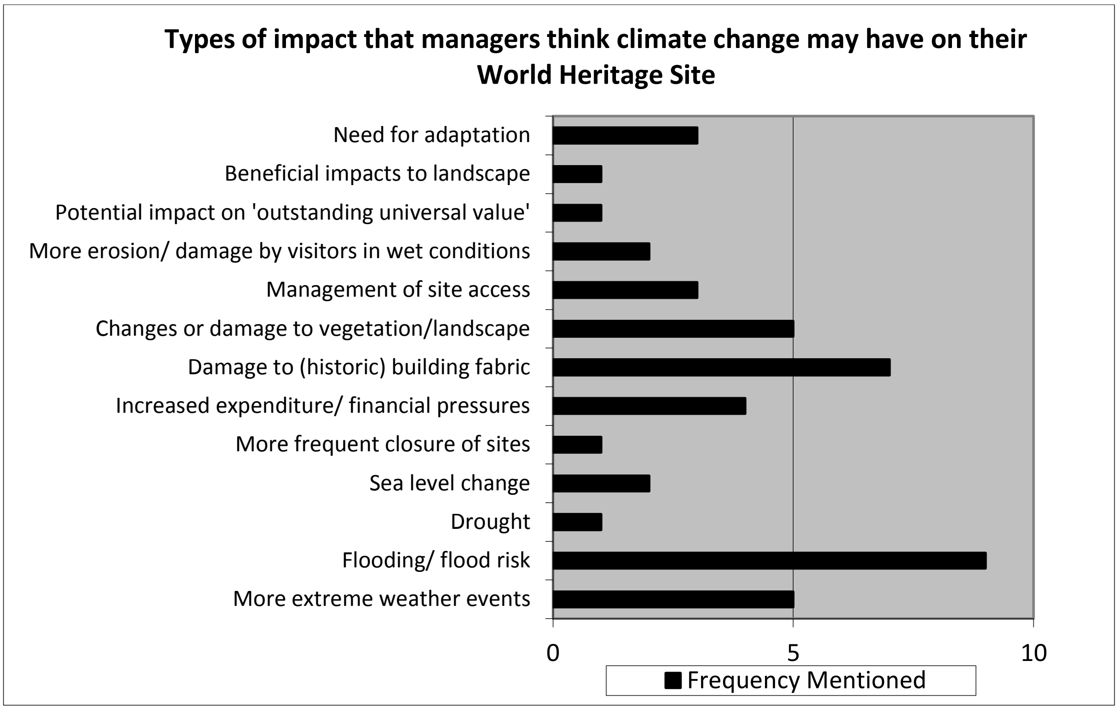

Figure 16 The potential impacts of climate change on WHSs, as described by respondents

Concerns about flooding, damage to (historic) building fabric and more extreme weather events were the issues that were brought up most frequently in questionnaire responses. Unsurprisingly, the types of events that had affected sites previously, e.g. flooding and extreme weather, were primary concerns. For example at New Lanark there were concerns about more extreme weather, especially prolonged sub-zero temperatures and heavy snowfall impacting adversely both on historic fabric and visitor numbers: 'this 'significantly increases the costs of maintenance and repairs of our Listed buildings.' At Liverpool Maritime Mercantile City a significant concern was the need to provide enhanced river defences.

Changes or damage to vegetation and landscape as well as financial pressures were also raised as potential threats by many sites. For example at the Royal Botanic Gardens in Kew, potential hazards are 'longer term fluvial flooding by the Thames. Some plant collections will no longer thrive, whereas others that currently do not may do better.' There may also be impacts on their plant collections, due to changes in growing seasons, new pests and diseases, and changes to pest behaviour. At Blenheim Palace 'longer growing seasons and therefore increased costs of mowing etc.' are raised as potential issues as well as the 'unknown impact on trees and other vegetation and therefore unknown impact on landscape.' This issue of the uncertainty of future impacts is something which is a concern for several respondents.

A range of other concerns are also evident, including management of access, for example because of storms, and potential damage caused by visitors during wetter conditions. The Dorset and East Devon (Jurassic) Coast provides an interesting contrast to most other World Heritage sites in the survey. The coast is maintained by erosion, and if coastal erosion increases, it is thought that this 'will make for a more dynamic, more exciting coastline' site' (Personal Communication, Dorset and East Devon Coast WHS Management, 2011). Managers state that the main risk is 'our response (as a community) to erosion which in the past has been the construction of coastal defences to stop that erosion. Defences obscure the geology and prevent the natural processes which in turn uncover the fossils; the three key elements of the site' (Personal Communication, Dorset and East Devon Coast WHS Management, 2011).

Vulnerability and Preparedness for Climate Change Impacts

Respondents were asked to indicate their level of agreement with two statements on climate change (Figure 17). There is a widespread perception amongst managers that there are risks to heritage sites, with most sites (81%) considering that they are vulnerable to climate change, and a minority unsure. The respondents for Dorset and East Devon coast WHS do not consider the site to be vulnerable, as explained earlier. At the majority of sites they consider that they are either fairly well prepared to deal with threats/opportunities from climate change, or are unsure.

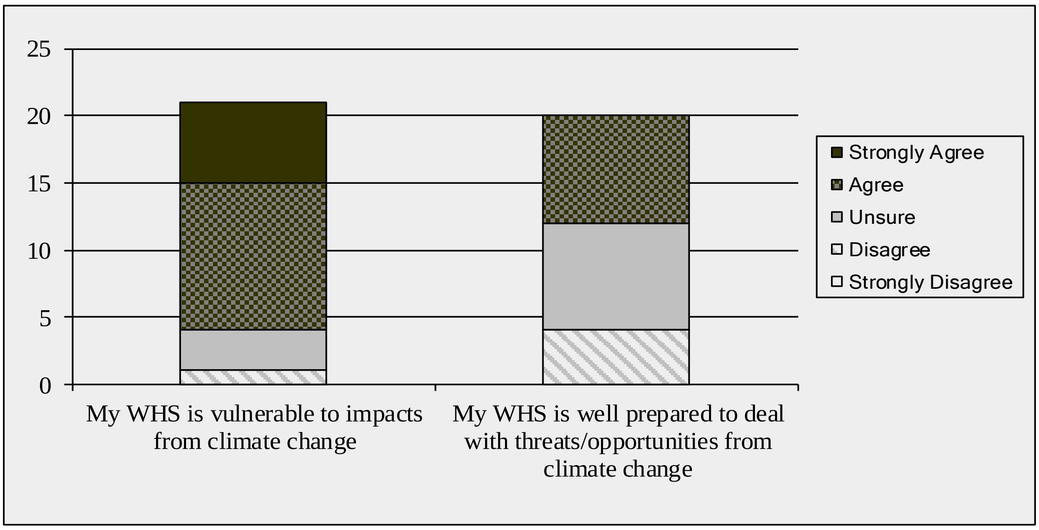

Figure 17 Respondents' levels of agreement with two statements on climate change and World Heritage

The findings from this question have been used as criteria for selecting case studies – only sites which managers consider to be vulnerable to climate change were potential case studies.

5.4.4.4. Progress and Barriers to Adaptation to Climate Change at UK World Heritage Sites

Actions Taken to Adapt to Climate Change

When asked whether any steps have been taken to adapt to climate change, 90% of respondents stated that they have taken steps to adapt to climate change, with no sites saying that they have taken no action, and 10% are not sure. It is perhaps not surprising that an overwhelmingly positive response was received, given that many managers may want to convey a positive impression of preparedness at their site.

The types of steps described have been categorised below in Table 6 and vary widely, including a range of 'scales' of action. Examples cited range from plans and policies drawn up at national, local and site level, to actions taken on the ground such as improving parapet gutters, to lobbying for national funds. The type of steps mentioned are not necessarily specifically named as 'adaptation' measures, but illustrate a broad range of approaches which may contribute to resilience. Plans and policies are the most widely mentioned step, and include

Management Plans, Flood Risk Prevention Policies, Climate Change Impact Assessments, Risk Assessments, Conservation Plans, Flood Action Plans, Shoreline Management Plans and national erosion risk mapping. Adaptation measures are also mentioned by several sites, particularly measures to adapt to flooding/flood risk. Responses have been categorised into types of measure, and these are shown below alongside selected quotes from respondents.

Type of Measures Described	Selected Examples of Quotes from Respondents
Plans and Policies	Edinburgh Old and New Towns: 'Flood risk prevention policies; currently working on a climate change impact assessment document.'
Flood Defences	Heart of Neolithic Orkney: 'Work on maintaining/extending the sea wall at Skara Brae is on-going; a working group has been established to investigate bay-wide long-term measures to address threats to Skara Brae from the sea.'
Adaptation of new/existing developments	Canterbury Cathedral: 'Parapet gutters improved and down pipes replaced with water spouts to avoid blocking in storms.'
Monitoring	Hadrian’s Wall: 'Monitoring of weather and climate conditions'
Changing planting	Royal Botanic Gardens, Kew: Plant and especially tree collections will change in terms of what is grown and where. Opportunities for different plant-based festivals for the public, e.g. autumn colour is improving and plantings to enhance this are being made.’
Maintenance	Durham Cathedral and Castle: 'Maintenance of the site includes regular risk assessments and mitigation strategies'
Employment of specialist staff/expert advice sought/staff training	Tower of London: 'Flood risk at the Tower has been considered, and expert advice sought.' City of Bath : ‘Range of activities, including guidance on adaptation/retro-fitting of buildings, staff training, employment of specialist staff’
Lobbying for funds	Ironbridge Gorge: 'Lobbying for central government funds for substantial stabilisation'

Table 6 Selected examples of different types of adaptation measures that have been implemented

Determinants Affecting the Capacity to Adapt to Climate Change

Managers were asked what determinants they thought would be important in affecting the sites’ capacity to cope with any future opportunities/threats from climate change. All determinants included in the questionnaire (see Table 7) were considered by site managers to be important in affecting the sites capacity to cope with climate change, and there was no significant difference in opinion between different determinants. However leadership, financial resources, and forward thinking were considered to be especially important.

Answer Options (closed question)	**Very important**	**Moderately important**	**Unimportant**
Financial resources	17	3	1
Leadership	18	2	1
Learning lessons from past events	10	8	2
Forward thinking e.g. risk assessments	17	4	0
Developing policies and plans for climate change	15	5	1
Access to knowledge/information e.g. training, information on best practice	16	5	0

Table 7 The importance of different determinants in affecting the site manager's capacity to adapt

When asked what other factors could be important, some key issues that managers highlighted included: the will and commitment of legislative and funding bodies to support proactive action, having a joined up government approach, and the need to communicate with local residents. Several respondents remark that it is not only important what happens inside the WHS boundary but also what happens outside it. For example what happens outside the WHS boundary but within the river catchment can have a significant impact on certain sites, particularly around flooding and siltation. The importance of 'joined up thinking' is also important, and it is key how the community in the area as a whole will respond to climate change rather than just within the WHS boundary.

Resources are another concern that is raised by several site managers, specifically 'the need to provide resources adequate to ensure robust measures are in place to protect historic sites.' The current political/economic situation is a concern, with one manager explaining that the 'current budget situation is exacerbating risks.' Other political issues are also mentioned, such as the 'struggle between the agendas of conservation and of climate change adaptation.'

The responses to this section of the questionnaire were considered in relation to the conceptual framework from Chapter 3. An attempt has been made to classify these comments according to the determinants in the initial conceptual framework (Table 8). This showed that the determinants *leadership (collaborative), resources (financial),* and *room for autonomous change (access to information/act according to plan)* were raised as important by several questionnaire respondents. This analysis gives an initial indication of some of the determinants which are influencing the capacity to adapt at UK World Heritage Sites, confirming that these determinants, which were selected for inclusion in the initial conceptual framework in Chapter 3, are relevant ones.

Comments by respondents	**Categories (from Initial Conceptual Framework)**
The will and commitment of legislative and funding bodies to support proactive action will be vital.	Room for Autonomous Change (Act according to plan), Resources (Financial)
The key need is for effective monitoring information to allow changes and impacts to be assessed	Room for Autonomous Change (Access to Information)
Landscape changes to help cope with large quantities of water without impacting negatively on the historic landscape.	Cannot be clearly categorised
The issue is not so much about how the WHS responds to climate change but how we as a community respond to the issues that will face people, property and infrastructure at risk on the same coast.	Leadership (Collaborative)
The unpredictability of what CC will mean in real terms makes detailed planning difficult.	Learning Capacity (Discuss Doubts)
Joined up government approach	Leadership (Collaborative)
Need to communicate with local residents and for proportionate approach to geotech surveys. Need to share information (e.g. LIDAR surveys). Joined up working within local government to allocate resources and seek significant external funds. Need for clarity of responsibility between authorities and EA	Leadership (Collaborative), Resources (Financial), Room for Autonomous Change (Access to Information)
Local authority budget cuts impact adversely on state of roads, drains etc. New Lanark is at the bottom of a steep hill, and flooding events in the town above result in problems for the historic site which we cannot control/mitigate.	Resources (Financial), Leadership (Collaborative)

Table 8 Determinants that respondents highlighted as important when considering adaptation, and their relationship to the conceptual framework

5.5. Conclusion

The issue of climate change impacts on heritage has been acknowledged as an issue by UNESCO since 2005, and various strategies and policies were published by UNESCO shortly after this recognition. Significant progress has been made in making the consideration of climate change a requirement for World Heritage Sites, such as the incorporation of climate change into the periodic monitoring questionnaire, and the decision to ask for Management Plans to include climate change. However, this examination of current systems of management planning has highlighted that there are opportunities for the strengthening of UNESCO guidance on adaptation.

Although this international level guidance is important, the UNESCO WHC has such a broad remit in terms of the range and type of sites with which they are involved that their 'hands on' role at a national level is limited. Capacity at a national and local level is therefore crucial in determining if and how UNESCO policies are implemented, as is illustrated by the range of different level of progress with updating UK Management Plans. The implications of this are that to be effective, top down approaches need to be balanced with efforts to enhance capacity at national, local and site level, as the adaptive framework relies on the collaboration of stakeholders operating at different scales.

In the UK, those national institutions responsible for climate change adaptation have limited heritage remit, while the heritage organisations and local governments with responsibility for heritage sites have taken on some work on adaptation, with organisations such as the NT being particularly active in the past. However, over recent years focus has shifted away from this issue, with other matters that are seen to have greater urgency taking priority. Adaptation is not an issue which has been consistently focused on, and it is clearly very much influenced by political will and leadership.

Local authorities' capacity to adapt is currently being impacted by changes to governance, as they face a new reality in which they are dealing with significant budget cuts and a localism agenda that promises them the freedom to set their own priorities. Political will is emerging as a significant factor which is affecting the capacity to adapt in the heritage context. The impact of this on adaptation work is something which will be more fully examined through research at the case study sites. The findings from this chapter have informed the development of the conceptual framework. It was apparent that authority (political will and policy instruments) should be explicitly included. This was incorporated, and the framework used for fieldwork and analysis at the case study sites is shown in Figure 43 in the following chapter.

Climate change is considered to be an important issue by the majority of UK WH Sites, with most considering themselves vulnerable. Impacts, vulnerability and adaptive measures taken vary greatly from site to site, depending on local conditions, and it may be difficult to make broad generalisations from case studies, as each site is so different. The following chapter will examine the findings from the first case study, Ironbridge Gorge World Heritage site in Shropshire.

CHAPTER 6 IRONBRIDGE GORGE WORLD HERITAGE SITE

6.1. Introduction

This chapter will focus on the first case study, Ironbridge Gorge World Heritage Site. The data in this chapter is drawn from a series of interviews with stakeholders involved in the management of the site (see Table 9 below) and a review of relevant documentary sources such as the Ironbridge WHS Management Plan and local authority policy documents. Following an introduction to the site and its system of management, risks to the site and past responses to these are considered, with reference to a review of media reports (LCLIP approach). Following this, the initial conceptual framework has been used as the starting point for an assessment of adaptive capacity, and each determinant within the framework is examined in turn. Finally, reflections on the process of analysis, implications for the conceptual framework and concluding thoughts are presented.

Organisation	Role
Telford and Wrekin Council	World Heritage Site Coordinator
Telford and Wrekin Council	Civil Resilience Team (2 officers)
Telford and Wrekin Council	Conservation Officer
Telford and Wrekin Council	Climate Change Officer
Telford and Wrekin Council	Engineers, Flood Defence Team (2 engineers)
Ironbridge Gorge Museum Trust	Chief Executive
Ironbridge Gorge Museum Trust	Operations Manager
Ironbridge Gorge Museum Trust	Front of House Manager, Museum of the Gorge
Ironbridge Gorge Museum Trust	Front of House Staff, Museum of the Gorge
Ironbridge Gorge Museum Trust	Curator
Severn Gorge Countryside Trust	Manager
Shropshire Council	Emergency Planning Team (2 officers)
Environment Agency	Environment Manager, West Midlands
English Heritage	Inspectors, West Midlands Office (3 inspectors)
Telford and Wrekin Council	Planning and Conservation Officers - follow up email contact Sept 2012

Table 9 List of interviewees (interviews conducted between Nov 2011 and Jan 2012)

6.2. Background and Context

6.2.1. Introduction to the Site

Ironbridge Gorge World Heritage Site in Shropshire is known as a symbol of the Industrial Revolution. It was one of the areas of the UK which experienced profound economic and social change between 1750 and 1820. Its landscape reflects this, containing elements of industrial progress such as blast furnaces, factories and infrastructure including the Iron Bridge, the world's first bridge constructed of iron.

Ironbridge Gorge is located to the south of Telford in Shropshire (Figure 18), and the River Severn flows through the Gorge.

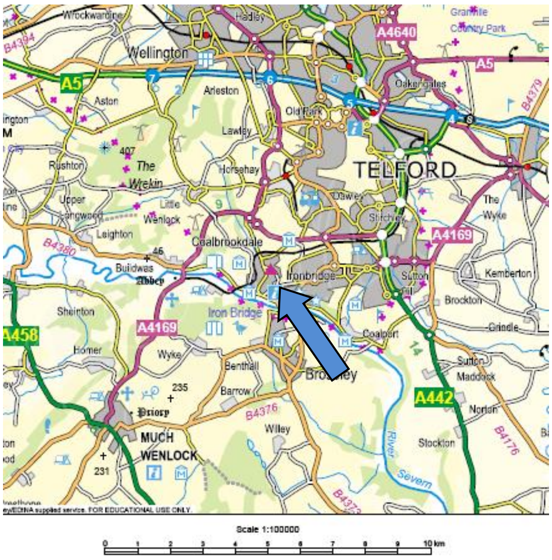

Figure 18 Map of site location (Edina Digimap, 2012)
Crown Copyright 2013 An Ordnance Survey/Edina supplied service

Today, the site is a living, working community with a population of approximately 4,000 people (Telford and Wrekin Council, 2011) as well as a historic landscape which attracts many visitors each year[18]. The WHS covers an area of 5.5km2 including a 5km length of the Severn valley, and its boundary corresponds with the Severn Gorge Conservation Area, designated in 1980 (Ironbridge Gorge World

[18] The 10 Ironbridge Gorge Museums receive over 545,000 visitors per year (Ironbridge Gorge Museum Trust, 2012)

Heritage Site Strategy Group, 2001). The boundary of the WHS is shown on the map in Figure 19.

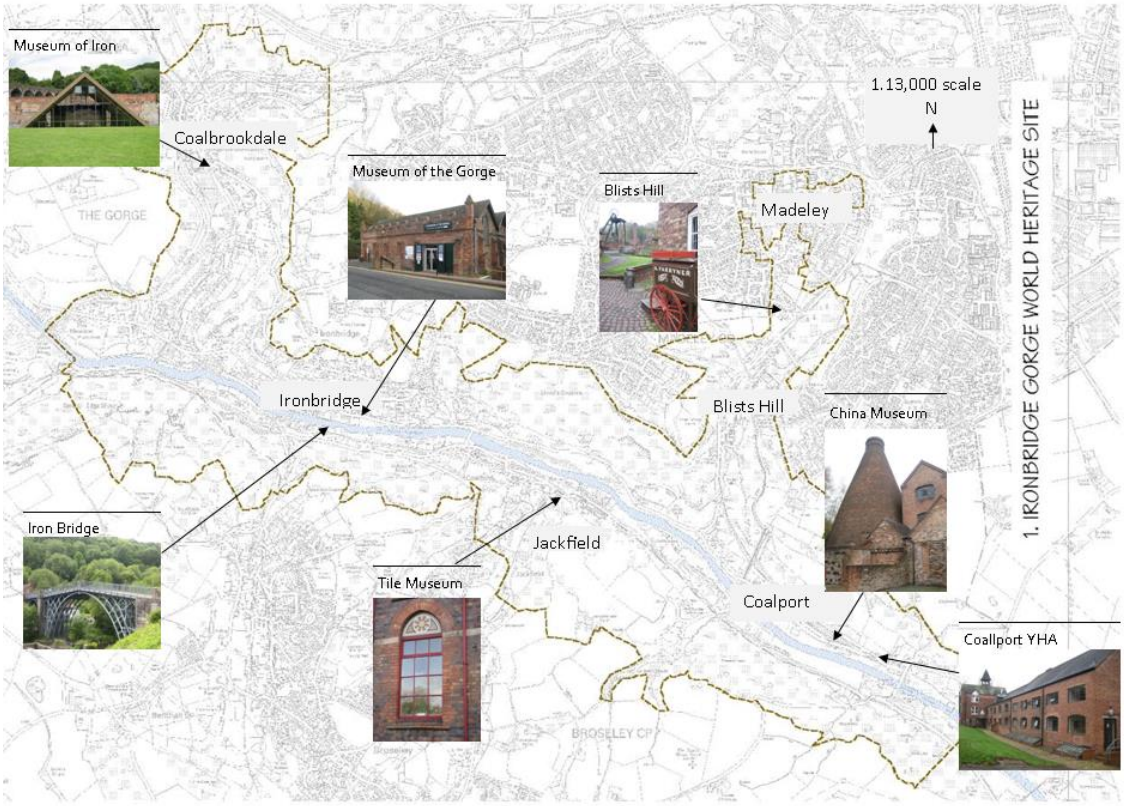

Figure 19 Map showing the WHS boundary, indicating some of the main areas and tourist attractions in the Gorge. Adapted from Ironbridge Gorge World Heritage Site Strategy Group (2001) ©Telford & Wrekin Council

6.2.2. History and Significance of the Site

The site lies at the southern end of a coalfield, is rich in mineral resources, and forms a 'remarkably complete cultural landscape' (Ironbridge Gorge World Heritage Site Strategy Group, 2001) containing substantial remains of mines, foundries, factories, workshops, warehouses, workers housing, public buildings, infrastructure and transport systems, together with traditional landscape and forests of the Severn Gorge (Telford and Wrekin Council, 2011). The people of the Gorge pioneered new means of mining coal, working iron, building bridges and applying the power of steam, and the River Severn was the principal route for the products of the coalfield out to the wider market.

The site was designated a cultural World Heritage Site in 1986, under the following criteria:

'Criterion (i) The Coalbrookdale blast furnace perpetuates in situ the creative effort of Abraham Darby I who discovered coke iron in 1709. It is a masterpiece of man's creative genius in the same way as the Iron Bridge, which is the first known metal bridge. It was built in 1779 by Abraham Darby III from the drawings of the architect Thomas Farnolls Pritchard.

Criterion (ii): The Coalbrookdale blast furnace and the Iron Bridge exerted great influence on the development of techniques and architecture.

Criterion (iv): Ironbridge Gorge provides a fascinating summary of the development of an industrial region in modern times. Mining centres, transformation industries, manufacturing plants, workers' quarters, and transport networks are sufficiently well preserved to make up a coherent ensemble whose educational potential is considerable.

Criterion (vi): Ironbridge Gorge, which opens its doors to in excess of 600,000 visitors yearly, is a world renowned symbol of the 18th century Industrial Revolution' (UNESCO, 2011b).

Figure 20 The River Severn and businesses along the Wharfage, viewed from the Iron Bridge
Figure 21 The Iron Bridge and tollgate

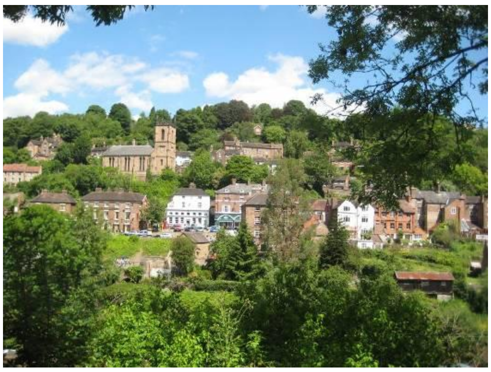

Figure 22 The settlement of Ironbridge, a Conservation Area, on the steep-sided Gorge.
Figure 23 Industrial artefacts at Coalbrookdale Museum of Iron

There are several distinct areas within the World Heritage Site, which each have their own character. These are Ironbridge, Coalbrookdale, Hay Brook Valley with Madeley, Jackfield and Coalport (see Figure 19 for locations). Ironbridge is a prime destination for tourists and contains the famous Iron Bridge (see Figure 21). In Coalbrookdale (see Figure 23), it is possible to see the remains of the blast furnace where Abraham Darby I perfected the smelting of iron, as well as a high concentration of 18th and 19th century dwellings, warehouses and public buildings. Hay Brook Valley is the site of 'Blists Hill Victorian Town,' a large open air museum and recreation of a Victorian town which is one of the most popular attractions in the Gorge, incorporating the remains of the former Blists Hill blast furnaces and brick and tile works (Figure 24 and Figure 25). The small community of Jackfield was important for navigation, coal mining, clay production and the manufacture of decorative tiles (Ironbridge Gorge World Heritage Site Strategy Group, 2001), and today it is the site of the Jackfield Tile museum (Figure 28).

Coalport is located on the north bank of the River Severn, and was a deliberate piece of urban planning, 'one of the few specially created inland ports of the industrial revolution' (Ironbridge Gorge World Heritage Site Strategy Group, 2001). Rows of terraces are set along the historic line of the canal, and the buildings that were home to the Coalport China Factory now house the Coalport China Museum (Figure 29).

Figure 24 Evidence of the area's industrial past, Blists Hill Victorian Town
Figure 25 Recreation of Victorian times, Blists Hill Victorian Town

6.2.3. Management Systems and Ownership Arrangements

Ironbridge Gorge has numerous landowners and land managers, with responsibility for particular areas and buildings within the World Heritage Site. Key landowners and managers are shown on the diagram below. (See Figure 27 for a map indicating boundaries of ownership of major land holders).

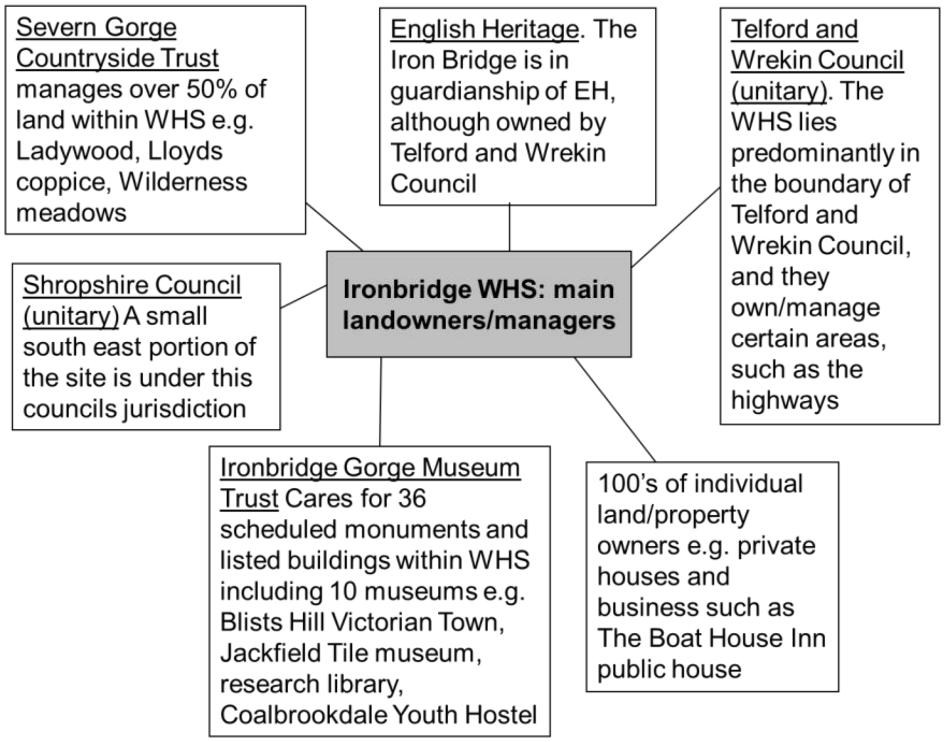

Figure 26 Landowners and managers in Ironbridge Gorge

The WHS lies predominantly in the boundary of Telford and Wrekin Council (TWC). This unitary authority has multiple roles in the management of the site, including as a community leader, service provider and estate manager. Not only is it a major landowner, it also has responsibilities in terms of planning control, conservation, responsibility for highways and other public assets, the provision of local authority services, civil resilience and climate change strategy. The World Heritage Site coordinator is based there. Two small portions of the site, one in the south and one southeast are under Shropshire Council's jurisdiction. EH are guardians of the Iron Bridge in addition to their role as statutory consultees. There are many designations within the site, including the Severn Gorge Conservation Area, more than 250 Listed buildings, seven Scheduled Ancient Monuments and two Sites of Special Scientific Interest.

Image removed for copyright reasons

Figure 27 Map of major land holders (Ironbridge Gorge World Heritage Site Strategy Group, 2001) ©Telford & Wrekin Council

The Ironbridge Gorge Museum Trust (IGMT), a registered charity, was established in 1967 to preserve and interpret the remains of the industrial revolution within the Gorge. The Trust cares for 36 Scheduled Monuments and Listed buildings within the WHS and operates ten museums including Blists Hill Victorian Town, Jackfield Tile Museum, Museum of the Gorge and the Tar Tunnel (see location map in Figure 19, and images Figure 28 and Figure 29). Coalbrookdale is the home of the Ironbridge Institute, an academic institute which is jointly managed by the University of Birmingham and IGMT.

Figure 28 Use of decorative tiles on the exterior of Jackfield Tile Museum
Figure 29 Coalport China Museum alongside the canal

The Severn Gorge Countryside Trust (SGCT) is an independent charitable trust which was established in 1991 and manages 260 hectares of land on a 999 year lease, which includes over 50% of the land within the WHS (see Figure 30). It manages 70 structures e.g. stone walls, and over 25km of rights of way. The different sites they manage are dispersed within the WHS and are rather fragmented (SGCT Interview, 2011).

Figure 30 Rare breeds of sheep on pasture managed by the SGCT
Figure 31 An example of a property in private ownership - Boat Inn Public House, Jackfield

In addition to these main landowners and land managers, there are also hundreds of individuals who own properties, businesses and land in the Gorge, and there are numerous other groups and organisations with interests in the site. These also include tourists, visitors and recreational groups, who have different and sometimes conflicting interests.

The fragmented and complex patterns of land ownership and management are illustrated by the case of the Iron Bridge itself. The bridge, its road deck, railings and tollgate are in the guardianship of DCMS, whose duties in this respect are delegated to EH. However, the tollhouse is owned by the Ironbridge Gorge Museum Trust, and the footpaths and planted banks on the north bank of the bridge are owned by TWC. On the south bank, most of the land abutting and under the bridge is managed by SGCT, and there are also several adjacent private properties, some of which are owned by the Landmark Trust (English Heritage, 2010a).

Some of the difficulties presented by having so many varied stakeholders with interests in site management are described by one member of the WHS steering group: although there is a commonality of ambition “their funding regimes and different ways those bodies are formed and constituted does not always make it easy to work together”(EH Interview, 2012). The World Heritage Site Steering Group is the main body which brings together all these diverse groups, and is therefore very important at such a complex site, assisting in the development of a cohesive strategy for the WHS.

At the time of research for this study (November/December 2011) this group was led by the World Heritage Site Coordinator, based at TWC. The Steering Group is the key overarching strategy group and the World Heritage Site coordinator is the only role dedicated to the overarching management of the WHS, with responsibilities for bringing together stakeholders and for the delivery of the Management Plan. This role therefore has the potential to be very influential in leading and coordinating work on issues such as climate adaptation.

The group meets quarterly and involves all substantial landowners, including representatives of the IGMT, SGCT, EH, Senior Planning Officers and Cabinet members from Shropshire and Telford and Wrekin Councils, Ironbridge Regeneration Partnership, the Local Ward councillor, the three parish councils and the EA. The EA have been involved in the WHS Steering group in the past, but, according to other group members, have not attended for the last two years, despite real efforts to involve them. The reasons proposed for this include the financial pressures on the EA and the restructuring that has taken place in recent times[19].

6.3. The Impacts of Past Severe Weather Events and other Environmental Risks at the Site (LCLIP Approach)

6.3.1. Media Review

The results of a review of media reports of events which affected the site during the last five years (Table 10) show that heavy rain and flooding occurred frequently and attracted regular media attention. Impacts which the media reported include the closure of the Wharfage in Ironbridge due to the deployment of flood barriers (Figure 82), and financial impacts on businesses in the area including the IGMT. The impacts of land instability also emerged frequently in media stories about the Gorge, particularly the financial burden of stabilisation work, and the significant disruption to access for residents and visitors.

Year	Type of Event	Description	Impacts	Source	Title
2007	Summer floods	Summer floods, rises in petrol prices and road closures in the area due to stabilisation work	10% fall in visitor numbers, jobs under threat at Ironbridge Gorge Museum Trust - staff asked to take voluntary redundancy.	BBC News	Jobs 'at risk' at heritage site
2007	Summer floods and road closures	Summer floods, terrible weather conditions, road closures due to land movement.	Revenue at Ironbridge Gorge Museum Trust hit, 15 people made redundant. Cost	Shropshire Star	Museum cuts 15 jobs

[19] This information was proposed by other steering group members. No contact with a local EA officer could be established to investigate the reasons for this (no response to emails or phone enquiries)

			cutting programme announced.		
2007	Land movement	Road closed to traffic for seven months due to land slippage.	Temporary road being built by council to reconnect two parts of the Gorge, (expected cost £50,000), to enable residents, visitors and traders to have access.	BBC News	Temporary road for slipping Gorge
2008	Flooding	Images of flood water in Ironbridge	Flood barriers up along the Wharfage	Shropshire Star	Photo gallery as waters rise
2008	Flooding	Rising river levels	Mother and young son had to be rescued from their car as they got stuck in flood water in Ironbridge	Shropshire Star	Rescues in flood chaos
2011	Land instability	Risks from land instability, and significant costs of stabilisation	Council delegation travelled to Europe to ask for £22m to help secure the Gorge.	BBC News	Appeal for £22m to secure Gorge
2011	Flooding	Flooding	Businesses preparing for the worst with sandbags on standby. Boat Inn at Jackfield under water & flood barriers up, Museum of the Gorge state that the closure of the Wharfage will affect the amount of visitors and also affect local trade.	Shropshire Star	The day the floods returned to Shropshire
2012	High river levels	Rapidly rising river levels and strong flow	Ironbridge regatta abandoned due to safety concerns	Shropshire Star	Ironbridge regatta abandoned over weather
2012	Storms and heavy rain	Wet summer weather, large thunderstorms and flooding throughout Shropshire	Ironbridge business states it has lost £20,000 this summer due to heavy rain and high water levels on the Severn, which have affected the canoe hire and sales business	Shropshire Star	Tornado spotted as storm clouds gather over Shropshire

Table 10 Summary of LCLIP media search for Ironbridge Gorge

The problems of flooding and land instability, two issues which the LCLIP show frequently affect the Gorge, will now be examined in more detail.

6.3.2. Impacts of Land Instability

Ironbridge Gorge has a history of land instability and landslides. The steep-sided Gorge is geologically young, and its geological structure as well as the effects of mining and tipping activities in the area have caused gradual land slippage for many years with ground failures recorded as early as 1728 (Telford and Wrekin Council, 2010b). The landslide and ground movement varies from imperceptible movement to rapid failure. Evidence of movement can be seen throughout the site, evident in cracks in paths and pavements, distorted road surfaces, leaning and cracked walls and distorted roofs (Figure 32 and Figure 33). It has been estimated that small landslides occur on an average frequency of one event per year in some areas, although there is considerable annual variation: more tend to occur in winter months and there is thought to be a relationship with high groundwater and high river levels (High-Point Rendel, 2005). With the ebb and flow of the river and flooding events, the groundwater fluctuates, and corresponding increases in water pressure within the strata adversely affect slope stability (Wardell Armstrong LLP, 2009). Six inclinometers in boreholes around the Bridge installed in 2009 by TWC's geotechnical engineering department confirm a small but continuing land movement on both banks towards the river, around 2-3mm in 18 months (English Heritage, 2010a).


Figure 32 Buckling and distortion of road, walls and buildings, Ironbridge, June 2011
Figure 33 Flexible wooden roadway in an area severely affected by instability, Jackfield, June 2011

The instability has had a range of impacts on the site, including significant financial costs, physical damage to buildings and roads and in a small number of cases the loss or abandonment of properties (see Figure 34). The impacts of the instability have included stress on the Iron Bridge itself, shown by cracks in the bridge (Figure 35), against which some remedial work has been undertaken. There is the potential risk of the failure of the bridge in the future.

Figure 34 Severely tilting cottage in the Lloyds area, which is no longer inhabited due to land movement, June 2011
Figure 35 Damage to the structure of the Iron Bridge due to movement, June 2011

Figure 36 Rockfall at Jiggers Bank, on SGCT managed land, photo courtesy of interviewee

As highlighted in the media reports in Table 10, instability has also resulted in disruption, for example due to road closures and reduced accessibility whilst stabilisation work is being carried out. Examples of some of these impacts are shown in an incident which occurred on the SGCT's land. A major rock fall in an area called Jiggers Bank cost the Trust over a third of a million pounds, including civil engineering work and the installation of a concrete buttress (Figure 36). Whilst the work was being carried out a main road into Ironbridge had to be closed, causing significant disruption to businesses, including the museums (SGCT

Interview, 2011). The Trust describe that even after this large financial investment, the problem has only been temporarily resolved for approximately 25 years before more work will need to be carried out, highlighting the fact that this long term issue is a considerable burden for land managers.

6.3.3. Impacts of Flooding

The River Severn is integral to the industrial heritage site, having provided a source of power as well as providing the means to transport raw material and finished products. However, this catchment has a long history of flooding, with records of flooding events dating back to 1634. The Iron Bridge survived a major flood in 1795 which swept away many other bridges along the river, and its survival of this event contributes to its historical significance (English Heritage, 2010a). Flood events currently present a significant problem throughout the Gorge, and are thought to be increasing in frequency and severity (English Heritage, 2010a ; Ironbridge Gorge World Heritage Site Strategy Group, 2001). The TWC LCLIP also confirms that the climate of the region has changed over the last 50 years, with precipitation dramatically increasing, particularly in the autumn (Telford and Wrekin Council, 2010c).


Figure 37 and Figure 38 Flooding in central Ironbridge before the temporary flood barrier (approx. 2000). Photos courtesy of interviewee

Floodwater has caused direct damage, disruption and costs to residents and businesses, and in addition heavy rainfall and high river levels are contributing factors to the problems of land instability (see Figure 37 and Figure 38). A significant flooding event occurred throughout the catchment in June/July 2007 as a result of a period of exceptional rainfall. The impacts of this affected several different parts of the WHS, with significant financial costs. Impacts on IGMT property were mainly at Coalbrookdale due to an overflowing culvert and furnace pool following heavy rain, causing severe flooding at the Museum of Iron and Enginuity, an interactive Design and Technology Centre. This caused several hundreds of thousands of pounds worth of damage (IGMT Interview, 2011).

Heavy rain also regularly overwhelms rainwater goods, which were built for industrial buildings in the 18th and 19th Centuries, and are inadequate for current levels of rainfall (IGMT Interview, 2011). There were severe impacts from the 2007 event on the SGCT's property (Figure 39 and 40). For example, prolonged torrential rain resulted in a landslip in an area of woodland: "So much water was going into the soil that the soil became fluid, more like liquid … I've never seen anything like this in my life, the whole woodland turned into a fast-moving river" (SGCT Interview, 2011).


Figure 39 and Figure 40 Severe flooding damage at Lydebrook Dingle woodland managed by the SGCT (2007). Photos courtesy of interviewee

Some areas of the site are more at risk than others. The Museum of the Gorge (Figure 41) and Coalport China Museum which are both alongside the river are identified by the IGMT as sites which are particularly vulnerable to flooding. A particular concern relating to the Coalport China Museum is the potential impacts on the active kilns which are used for ceramics and glass production, which, if the water rose quickly enough could be "catastrophic" (IGMT Interview, 2011). As also shown in Table 10 a key impact on the site from weather and instability has been the impacts on accessibility, tourism and trade. The Museum of the Gorge floods regularly, approximately once a year, which means that sometimes the museum has to be closed to the public, and results in a costly clean up (IGMT interview, 2011).

Figure 41 Museum of the Gorge in flood (date unknown) photo courtesy of interviewee
Figure 42 TWC and EA staff involved in barrier deployment, showing restricted access to the Wharfage, 2008, photo courtesy of interviewee

Since 2004, temporary flood barriers have been available for deployment along the Wharfage in Ironbridge (Figure 42). According to many stakeholders interviewed, the use of this barrier has greatly reduced the impacts of flooding on Ironbridge itself, preventing many of the houses and shops along this part of the Gorge from flooding. The mobilisation of temporary flood defences does however cause disruption to residents, traders and the Museum of the Gorge (IGMT interview, 2011), as the Wharfage is closed whilst it is in place. It can only protect one area of the Gorge, and, arguably, has led to increased flooding downstream (English Heritage, 2010a)(IGMT Interviews 2011).

6.3.4. Role of Different Stakeholders in Response to Flooding and Associated Landslides

There is multi-agency involvement in preparing for and responding to flooding and landslide events at the Gorge. TWC has a range of different roles in such events. Its civil resilience team and engineers are those who are primarily involved in planning for these potential risks and responding to events when they occur. The Council's engineers are central to flood response, and hold a Flood Action Plan. TWC work in partnership with the EA to deploy the temporary flood barriers, liaises with Emergency Planners and communicates with land owners and managers such as the IGMT and SGCT. The EA and TWC are then involved in procedures for barrier erection and removal, and a shared Flood Action Plan guides stakeholders' actions. The EA finance the purchasing and mobilisation of the barriers and TWC manage the actual process (TWC Interview, 2011), planning for two mobilisations of the barrier a year.

The role of the WHS coordinator in time of flood is primarily in local communications. The EA monitors the water flow upstream and land managers and residents use this information to plan their course of action. For example, managers at the Museum of the Gorge state that they ring the EA to check river levels upstream. If the level reaches approx. 5.2m then they would consider moving items out of the museum.

The Civil Resilience Team has a generic Emergency Plan for any kind of emergency which may happen in the borough, and has also put together a specific contingency plan for a landslide in the Gorge called 'Operation Tangent.' This team are involved in responding to flooding only where this is a major event. They would be notified if the barriers are erected, and then monitor the situation and put the plan for the landslide on standby, due to the fact that when the water recedes after high river levels a landslide is more likely. The Emergency Planning Team at Shropshire Council have been involved in the development of the 'Operation Tangent' plan, and if a major incident occurred then both local authorities would be involved.

As described earlier, IGMT manage several properties at risk of flooding. They have their own internal processes and mechanisms for dealing with risk preparedness and response, and systems which have been developed through experience of previous events. External agencies are not involved in this emergency response work. There is a disaster planning team which operates at a high level in the organisation. There is a 'disaster workforce list/call-out tree', and systems are in place at the museums close to the river for the evacuation of the contents for safe storage away from the flood water. The museum's curatorial department would be involved in assisting with the removal of collections if flooding is serious.

6.3.5. Learning From These Events

There are many examples of single loop learning throughout the site, particularly at the IGMT which has had regular experience of flooding at many of its properties. There is evidence of changes to routines, the development of skills and techniques and systems of communication for preparing for and dealing with flooding events. IGMT seems well prepared and organised: for example, at the Museum of the Gorge, some exhibits are now raised slightly above the floor or are on wheels, floors can quickly be mopped clean, and a large model of the Gorge which was severely damaged in 2000 was remade so that it can be split into pieces, in order to be removed more easily. “A lot of the exhibits are now on wheels so we can just wheel them out of the museum, and that’s through experience of what's happened in the past. So a bit more thought has been put into how we are going to preserve the exhibits, and the minor flooding we can cope with” (IGMT Interview, 2011). Since the 2007 event, maintenance regimes have also been slightly altered, so that more attention is paid to keeping gutters and culverts clear.

Learning is also apparent within other organisations involved with the WHS, such as Shropshire Council and the EA, who have procedures in place which have developed through their regular experiences of flooding. “We are so used to flooding, we don't actually look at it as the emergency that everybody else seems to because we know exactly what we're doing” (Shropshire Council Interview, 2011).

Other routines and procedures which have also improved include the mobilisation of the temporary flood barrier. TWC officers explain that over the last seven years the process of deploying the barrier has become far more streamlined, and the management of the process has improved. Lessons learnt from practice feed into the Flood Plan, which is updated every year to incorporate improvements (TWC Interview, 2011)(Telford and Wrekin Council, 2010a). Plans and strategies such as this hold and transmit information over time, and demonstrate institutional memory.

The major flooding events of 2007, which had widespread effects throughout the country as well as at the Gorge, have acted as a trigger for change and learning. A striking example of this is described by an interviewee at the EA involved in overseeing flood responses at the Gorge, who explains that routines, processes, tools and information have all improved due to changes instigated as a response to this major event, both in the EA and more widely. 2007 is depicted as a "wake-up call" for the government, a "defining moment, when everybody woke up to what a big flood can do and how serious it is" (EA Interview, 2011). The 2007 floods were the trigger for the Pitt Review (Pitt, 2008), which contained 92 recommendations of which thirteen were directed at the EA.

Many of the recommendations are being implemented through the Flood and Water Management Act (UK Parliament, 2010). According to the interviewee, virtually all of the recommendations for the EA have been taken forward and massive improvements are evident, in terms of the accurate prediction of events e.g. long term prediction of rain, the liaison and relationships with professional partners, training, and the tools available to respond to events[20]. "We meet up [with professional partners] regularly now, in 'peace time' just to deal with discussing emergencies or to train and exercise. It's the relationships that make all the difference, that was one of the things missing in 2007, people were thrown together, they didn't know or trust each other" (EA, 2011). This example shows evidence of single and double loop learning and institutional memory.

Learning has also occurred through training. A two day multi-agency exercise was carried out in 2010 based on a scenario of heavy rain, flooding and a landslide in the Gorge. Stakeholders involved included TWC, the emergency services and military, and this tested emergency plans such as 'Operation Tangent' and recovery and flood plans. Some participants found this to be a very useful exercise in terms of practising procedures, and from a multi-agency working point of view (TWC and EA Interviews, 2011). Landowners such as SGCT and those with heritage remits such as the WHS coordinator were not involved in this training, which was

[20] DEFRA's last Pitt Review Progress Report (DEFRA, 2012) indicated that whilst 43 of the 92 recommendations outlined in the Pitt Review have been implemented, a further 46 are "on-going"

aimed at 'first responders.' According to participants, lessons were learnt from the exercise and some changes to processes were identified which needed to be incorporated into the plans (TWC Interviews, 2011).

However, although in many areas positive changes have been made and significant learning has occurred, this is not the case in all areas. An LCLIP was carried out by TWC looking at past weather events and their impact on the area, and identifying future impacts which may occur due to climate change (Telford and Wrekin Council, 2010c). There were problems taking forward what was learnt by those involved in producing the LCLIP, and communicating this or getting interest from others within the council. Barriers to learning identified by the council officer involved included difficulties bringing together all the different service areas in order to pass on the lessons that had been learnt through the exercise and a lack of interest in the subject from other service areas (TWC Interview, 2012).

6.4. Climate Change Impacts at the Site

6.4.1. Potential Climate Change Impacts Identified by Stakeholders

The majority of stakeholders thought that climate change would have an impact on the WHS in future, although there was a great deal of uncertainty (examined in section 6.4.2). The main risks identified related to the exacerbation and interaction of existing issues, in particular an increase in the intensity of rainfall and frequency of flooding, hotter drier summers and how these changes may affect the current issue of land instability. One interviewee also raised serious concerns about the risk to heritage of trying to adapt historic buildings to become "future proof" (TWC interview, 2011). The table below contains a summary of the key climate change risks identified by interviewees.

Risks Identified	Source
Increase in heavy rainfall, flooding and impacts of this on land instability	IGMT, TWC, EH, 2011
Severe winters (increased rain, snow or ice), impacts of this on land instability	TWC, 2011
Drier summers and the impacts of a reduction in soil moisture on land instability.	TWC, 2011
Drier summers followed by sudden heavy rainfall leading to flooding and impacts on land instability	IGMT, EA, 2011
Impact of adaptations to historic buildings	TWC, 2011

Table 11 Impacts that climate change may have on Ironbridge Gorge WHS

6.4.2. Uncertainty and Climate Change Impacts

The issue of climate change as a source of uncertainty for decision makers is well documented (Adger and Vincent, 2005 ; Nichols *et al.*, 2011 ; UKCIP (UK Climate Impacts Programme), 2003), and the uncertainties around climate change are evidently causing difficulties for many of the stakeholders and decision makers at the Gorge. There is uncertainty about interpreting the causes of past events, for example whether weather patterns have changed, or whether impacts seen such as bridge movement are part of the existent land instability issues or are being exacerbated by climatic changes. The inherent uncertainty about future changes to the climate, and actions which might be needed, are a barrier to adaptation decision making in some instances, and this uncertainty is used to justify non-action (see quotations in Table 12). The discourse focuses on the need for activities and scientific approaches to reduce these uncertainties. According to Pahl-Wostl (2009), this is a characteristic of single loop learning, rather than double or triple learning, where uncertainty is accepted and new approaches to manage uncertainty are developed.

Issue Highlighted	Quote from interviewees
Uncertainty about interpreting past events	We've got that existing measurement of land movement, what we don't know is how much of that is directly attributable to climate change and how much is just geology and is going to happen anyway (TWC).
	We have seen an awful lot of flooding and quite extreme events in the last ten years, anecdotally rain intensities appear to be getting heavier. It feels slightly different to what it used to. Now whether that is just part of a normal cycle or whether it is climate change in action I don't know (EA).
Uncertainty about future change to the climate	We are not sure to what degree, but we assume that flooding will become a more common occurrence because of increased rainfall and the increased events of rain (EH).
	I think it's unbelievably difficult to plan for climate change because we don't know and I am suspicious that we could be heading into a very, very cold period ...I think that as a trained scientist, the most difficult thing for me is the confusing nature of all the data that's coming out (SGCT).
Uncertainty around impacts arising from that change and actions needed	I don't think we fully understand at all what's really happening. And for me as a land manager, I'm managing our land on a thousand year basis, because we have a 999-year lease and when I go out doing forestry works, we're talking about 80 years hence (SGCT).
	You've got to get over the barrier that you're suggesting, based on theoretical research on how the climate will change, that they spend money or change the way a service operates based on what they consider to be possibilities for 20 - 30 years down the line (TWC).

Table 12 Climate change and uncertainty

6.4.3. Cognitive factors – Individual Perceptions and Attitudes

In the initial conceptual framework in this thesis, individual perceptions and attitudes to climate change were not included as a determinant of adaptive capacity. These factors were less common to the framings of adaptive capacity which were reviewed than other objective factors such as access to resources and information. However, throughout the course of data collection, it became apparent that individual perceptions and opinions greatly influence adaptive capacity at Ironbridge, and it is often difficult to disentangle these from organisational capacity.

According to Grothmann and Patt (2005) there has been a focus on financial, technical and institutional constraints as the primary determinants of adaptive capacity, however they argue that psychological and behavioural factors such as risk perception and perceived adaptive capacity are also important. Through conversations with stakeholders, it was clear that individuals have different perceptions of the risk to the site from climate change, and also have different levels of interest in the issue of adaptation. Different levels of engagement and interest, and therefore motivation, can be linked to individuals' risk perceptions and their perceived adaptive capacity. The perception of risk from climate change, in terms of individuals' assessments of the probability of events occurring and also the severity of events occurring varies greatly, and the quotations in Table 13 below illustrate some of these issues.

An example of the issue of perceived adaptive capacity is the case of IGMT, whose Chief Executive considers there to be a special role and opportunity for the organisation arising from the site's history and involvement in the birth of the Industrial Revolution. This is an opportunity for them to engage in the debates around climate change, and provides a motivational factor. "We've entered into the debate with a lot of interest and one of the things that gives us a special role is that Ironbridge might reasonably be seen as one of the first places in the world where fossil fuels started to be burnt in significant quantities, so we've said if we're going to try and get it right, we have got a good responsibility and a good opportunity to do so" (IGMT Interview[21], 2011).

Individual job role and responsibilities also determine viewpoints, so someone with an emergency response role logically has a different perspective and interest than someone responsible for decisions on heritage conservation, and there are obvious tensions between some of these different roles and responsibilities (illustrated by the third quotation in Table 13).

The terminology used when discussing climate change can also be a barrier which can result in a lack of engagement with climate change issues. This problem of communication was experienced by the researcher and by those tasked with working on adaptation in TWC (Interview, 2012). For example, some individuals 'turn off' as soon as climate change is mentioned, and may not be familiar with climate scenarios or the term adaptation. However 'risk preparedness' and 'resilience to flooding' were often found to be issues which individuals were more comfortable engaging with.

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[21] Interview with Steve Miller, Chief Executive, Ironbridge Gorge Museum Trust

Issue Highlighted	Quotes from Interviewees
Individual Risk Appraisal (probability and severity)	I certainly believe everything I've read about climate change leading to rising sea levels and increased rainfall and harsher winters and we are highly exposed to any of those events (IGMT Interview[22], 2011)
	The line we hear quite a lot, 'it'll never happen to us', well it does, and it's just making sure that, without scaring the life out of people, that they understand the reason why we're doing what we're doing is because we want to make sure that everybody knows what their roles and responsibilities are during response (Shropshire Council)
	I'm sceptical about climate change. I'm not sceptical about the fact that it is warming, anyone would be a fool to – but I feel we are in some inter-glacial system (SGCT).
Perceived Adaptive Capacity (efficacy and costs)	I think climate change is a huge problem for the historic environment to deal with in a lot of respects. It almost seems like there is this attitude that every building has to be future proof in terms of climate change. There is no acceptance that some buildings won't be that way. There seems to be an attitude from a lot of people that there has to be a God given right to make your building more environmentally sustainable. (TWC).
	At the end of the day we can't fight nature, it's a young geological formation, you can't divert the river Severn and there will be flood events, so it's very difficult to know what's going to happen (EH).

Table 13 Cognitive factors which are determinants of adaptive capacity

6.5. Access to Information

6.5.1. Futures thinking

The engagement of different stakeholders with futures thinking varies widely in the Gorge. Some organisations, whose remit specifically includes the consideration of climate change e.g. EA and the climate change team at TWC, have used climate projections/scenarios. The EA build in a climate change element when planning and maintaining flood assets, and climate scenarios in the River Severn CFMP (Catchment Flood Management Plan), indicate an increase in the probability of large-scale flood events and risks to people, property, and critical infrastructure (Environment Agency, 2009). TWC have a pivotal role in the management of the WHS; however there are evidently difficulties in addressing climate change adaptation and futures thinking. Work began on adaptation with a dedicated member of staff and projects such as the Climate for Change Strategy and the LCLIP, which both incorporate climate scenarios. However, some within

[22] Interview with Steve Miller, Chief Executive, Ironbridge Gorge Museum Trust

the council have asserted that the council often takes a more reactive than proactive approach to issues (TWC interview, 2012), and that rather than being forward thinking, work on adaptation has often been a case of 'box ticking.' This is illustrated through a perceived lack of support for those working on futures thinking and the lack of engagement with the outputs from the LCLIP (TWC Interview, 2012).

Within other organisations whose remit does not specifically include adaptation, there is little engagement with tools such as climate scenarios, and UKCP09 was not something which the majority of stakeholders had heard of. However, the Conservation Plan for the Iron Bridge (English Heritage, 2010a) shows some evidence of futures thinking by EH. A key issue in the plan is the role of the river and the impact of climate change on flooding patterns and severity, and EH are looking at ways to model potential changes to the bridge in the future, such as running scenarios to test and identify potential weaknesses and conditions which could result in its failure.

Barriers to futures thinking are apparent amongst many of those working on adaptation at the Gorge. The primary issue is the uncertainty around climate scenarios and the difficulty in understanding and interpreting scenario information e.g. difficulties in condensing and communicating scenarios to professionals in other sectors/departments in an accurate but useful way. There were particular problems communicating uncertainties and the probabilistic nature of the UKCP09 scenarios, and making this data accessible and meaningful for stakeholders (EA and TWC Interviews, 2011/12).

Other barriers to futures thinking include pressures on human and financial resources. For example, the post of the individual who was working on climate change adaptation came to an end while they were involved in carrying out the risk assessment, which was then never completed (TWC Interview, 2012). Resources were identified as a barrier for carrying out adaptation in other council sectors, for example in the highways team. Alternative materials and methods may need to be considered in order to ensure roads in the Gorge are 'future proof', but the combination of resource constraints due to large public sector budget cuts and uncertainty around climate change make this very challenging (TWC interview, 2012).

6.5.2. Monitoring

Many different types of monitoring are occurring at the site, carried out by different organisations and individuals. These are summarised in Table 14 below. Although much of this data is not directly collected for the purposes of monitoring climate change, it could also be used for this purpose, for example monitoring data which shows changes to the bridge condition over time may also indicate changes in weather patterns. Information on the occurrence and impacts of past events such as flooding is kept by the IGMT, including written and photographic evidence and insurance claims. The way the data is collated could be improved: "we have a reasonably good record, although we possibly won't package it in the one-stop-shop that we might" (IGMT Interview, 2011). However, as climate change impacts are not yet specifically monitored by any organisation, or in the WHS Plan, these kinds of data sources have the potential to be pulled together into an indicator.

Different Types of Monitoring	Examples
Monitoring of WHS Condition/State of Conservation	Monitoring of bridge condition by EH, report on cracks in bridge by structural engineers (2009), monitoring of conservation areas (TWC)
Monitoring of Plans	Monitoring of TWC Climate Change Strategy and Action Plan[23], revised WHS Management Plan anticipated to include indicators relating to climate change (although not developed at time of research)
Monitoring of Past Weather Events	LCLIP produced by TWC, records kept by IGMT of flooding (flooding incidents, photographic evidence, insurance claims)
Monitoring of Land Instability	Inclinometers, lidar survey, individuals/landowners reporting land movement
Monitoring of River Levels/Flooding	EA monitor river levels and provide updates, for example EA contact TWC engineers and civil resilience who then also monitor situation if river starts to rise. Monitoring by EA and TWC of performance of temporary flood barriers e.g. checking for leaks
External monitoring	UNESCO periodic review (every 6 years)

Table 14 Different types of monitoring which occur at Ironbridge Gorge

[23] Although, in practice this has not been monitored as set out in the plan

Regular monitoring of land instability and river levels occurs in the Gorge, as these issues pose real risks to life and property. Both formal monitoring e.g. regular land stability monitoring by TWC, and informal monitoring by individuals occur, e.g. one land manager mentions that when he sees any evidence of land movement he calls the council who come out and check the situation (SGCT Interview, 2011). A land instability information pack (Telford and Wrekin Council, 2010b) provided for the public by TWC encourages individuals to help spot land movement on private land within the Gorge, and to come forward if they become aware of events such as doors and windows shrinking, cracks in paths, or the appearance of new groundwater springs. Individuals are encouraged to record these with dates, times and photos and contact council engineers. The public can access and monitor river levels themselves through EA resources, such as online information and services such as Flood Warning Direct. Although there are alternative methods of communication between the EA and professional partners, some land managers in the Gorge also use these publicly available tools; the easily accessible EA system of river level monitoring is also seen to be useful (SGCT Interview, 2011).

Some barriers to monitoring exist, such as limitations due to the current economic climate, and policy changes. The Iron Bridge Conservation Plan identifies the need to ensure prioritisation and allocation of resources, to ensure funding is in place to continue to monitor and maintain the Bridge and ancillary structures 'in times of reduced financial allocation' (English Heritage, 2010a). TWC's Climate Change Strategy and related Action Plan include requirements for monitoring, although, according to one council source, in practice adaptation was only monitored in relation to (the now abolished) NI188, and the strategy itself was never actually monitored (TWC Interview, 2012).

6.5.3. Guidance and Information

There is some overlap between the two nodes *guidance* and *information and policy instruments*, as policy may also act as a source of guidance. Specific policy issues are examined in the following section *policy instruments*, and Table 16 includes key plans, guidance and policy documents which are relevant to the management of the Gorge.

There is no particular guidance which is informing the incorporation of climate adaptation issues into site management. EH guidance such as the EH 'Climate Change and Your Home' website has been used by some heritage professionals, but UKCIP information has not been accessed by those outside the climate change 'community.' However, networks are proving to be helpful sources of information and guidance, as shown in Table 15. The IGMT is part of an Emergency Response Network which provides access to specialist information and skills which are not available on site e.g. the Conservation Centre at Ludlow which can help with drying out paper and artefacts (IGMT interview, 2011), and the WHS Coordinator at TWC looks to other councils who are producing WHS Management Plans for some guidance (TWC Interview, 2011).

Sources of Guidance and Information which have been accessed	Comments by Interviewees
West Midlands Emergency Response Network	Source of information, guidance and specialist skills which has been very useful for Ironbridge Gorge Museum Trust
UKCIP	Accessed by climate change team at TWC and EA but not by any other stakeholders. Scenarios are not considered to be user friendly/accessible and can therefore be difficult to use and communicate for policy making
EH publications and climate change area of EH website	Accessed by heritage professionals in TWC and found to be useful
Local Fire Service	Have given advice to IGMT on emergency plans and risk preparedness
Other councils' work and publications	Several TWC stakeholders involved in climate change and the preparation of the WHS Management Plan found that a key source of information is to look at what other councils working on similar documents are producing, and to be guided by this.

Table 15 Key sources of guidance and information which have been accessed

The majority of stakeholders involved in the site state that they would like to have access to more guidance and information in order to better understand and implement adaptation and risk preparedness. It was frequently asserted during the interviews that the information needed to plan for future risks is lacking.

More information on potential risks from climate change and modelling data is needed, such as scenarios of potential flooding at Ironbridge.

Some stakeholders recognise that the relevant information may exist, but explain that it is difficult to find, or difficult to know which source to trust. For example, one land manager explains that it is difficult to know where to go to obtain reliable information on climate change, which is free of political and big business influence (SGCT Interview, 2011). Another viewpoint is that it is not about having more information, but about using it more effectively: “it is more about using evidence and data on climate change in a better way than it has been in the past and making it more accessible and more meaningful” (EA Interview, 2011).

6.6. Authority

6.6.1. Policy Instruments

As detailed in Section 5.4.2 the National Indicator 188 ‘Planning to Adapt to Climate Change’ was the primary policy instrument for adaptation at local authorities. At TWC, a climate change role was created and the LCLIP and subsequent risk assessment[24] were driven by the need to satisfy the requirements of NI188 (TWC Interview, 2012). Since the abolition of the indicator in 2010, work on adaptation has reduced. According to one source at TWC, since the loss of NI188 “climate change adaptation work is not mandatory anymore … there's nothing to force the council into doing it and if the council isn't forced into doing something then it won’t take it seriously” (Interview, 2012). However, a new role was being created in the team at the time of research, which will include some work on adaptation.

Table 16 shows a selection of the range of policy and guidance that are available (Sept 2012) at a regional and local level for decision makers. A variety of guidance and policy at site level exist, which do not necessarily relate to the WHS area specifically, but may be relevant to certain areas within it, or at a broader scale. Local planning policy makes reference to climate change in the Core Strategy,

[24] This risk assessment was not completed

although the focus of this is on mitigation rather than adaptation. The Core Strategy makes reference to the WHS Management Plan and the issues of flooding and land instability at the Gorge. There is no specific policy framework for heritage and climate adaptation at this policy level.

The planning system was undergoing radical changes at the time of research (Nov/Dec 2011), with the release of the National Planning and Policy Framework (NPPF) imminent, and some decision makers were finding the uncertainty of this situation challenging. For example, when trying to incorporate national climate change policy into the revisions of the WHS Management Plan, one source felt that the fact that the uncertainty of the status of the WH Circular and the lack of a framework was making it difficult to write policies (TWC Interview, 2011).

Policy Level	Examples of Guidance and Policy Documents Relevant to Site Management and Climate Change Adaptation
Regional	West Midlands Regional Spatial Strategy (effectively abolished)
	Climate Change Adaptation in the West Midlands A Framework for Action (prepared for Environment Agency, 2009)
Local	A Climate for Change Strategy (TWC, 2008) and associated Action Plan (not up-to-date)
	River Severn Catchment Flood Management Plan (EA, 2009)
	Telford and Wrekin Telford & Wrekin Local Development Framework, including Core Strategy (2006-2016) + saved local policies from Wrekin Local Plan (2000)
	Local Climate Impact Profile (LCLIP) Summary Report (TWC, 2010)
Site Level (within the WHS)	Operation Tangent Emergency Plan (TWC, date unknown)
	Land Instability in the Gorge (TWC, 2010)
	Ironbridge Gorge World Heritage Site Public Realm Design Guide (Colin Davis Associates, 2011)
	Draft Conservation Plan for the Iron Bridge (EH, 2010)
	Ironbridge Gorge World Heritage Site Management Plan (2001)
	Deployment of Temporary Flood Defences at Ironbridge - Action Plan (TWC, 2010)
	Ironbridge Gorge Museum Trust Strategic Plan 2010 - 2014
	Severn Gorge Countryside Trust site management plans e.g. Management Plan for Lloyds Coppice

Table 16 Selected regional and local guidance and policy documents relevant to site management and climate change adaptation

6.6.2. Act According to Plan

The revised WHS Management Plan has the potential to provide a policy framework on adaptation to guide and influence the diverse range of organisations and individuals working within the WHS. The current World Heritage Site Management Plan dates from 2001, although the process of producing an updated plan has begun. The out-of-date existing WHS Plan does not specifically address climate change issues or adaptation, although risks from land instability and river flooding are addressed. Its strength as a policy instrument is limited due to its age. Although this document is a Supplementary Planning Document (SPD) which is adopted and therefore a material concern in development control process, the conservation officer states that it is not something which is regularly quoted in planning decisions, and that PPS5 and the World Heritage Circular are quoted more regularly than policies from the existing WHS Plan. This is described as a "reflection of the relatively poor quality of the last Management Plan" (TWC Interview, 2011).

In November/December 2011 the production of a revised WHS Management Plan was underway, led by the WHS coordinator with the involvement of the WHS steering group, many of whom were positive about the change having an up-to-date plan would make: "I think the [revised] Management Plan will be more effective, more realistic and the priorities that we have been talking about are ones which we could pursue successfully in different ways towards common aims" (EH Interview, 2011). It was clear that climate change would be incorporated into this revision, although the details of how this would be included and what monitoring indicators would be developed were still in their early stages. The timetable for production of the plan was for a draft to be released for consultation in the spring of 2012, and for adoption in 2013. Since that time, significant restructuring has occurred within TWC, and the WHS coordinator position is currently vacant (September 2012). The WHS steering group is still functioning, however the plan has not progressed further since the departure of the WHS Coordinator, and there is currently no definite timetable for its production (pers. comm with TWC , Sept 2012).

The draft Conservation Plan (English Heritage, 2010a) for the Iron Bridge is another important plan. This mentions climate change as a potential risk to the bridge specifically in relation to the increased risk of flooding, under the topic of 'disasters and risk preparedness.' The proposed action identified in this draft is limited to 'increased liaison with EA, TWC.' However EH emphasise the importance of understanding the stability of the bridge in flood conditions, and that a survey is being commissioned to investigate this further (EH interview, 2011).

Other relevant plans include the multi-agency Flood Action Plan and TWC Emergency Plans. These do not refer to climate change specifically but are relevant whatever the cause of an event such as a flood (TWC Interview, 2011). Emergency Plans developed by the councils and EA are focused on life and protecting the communities within the Gorge. Land managers such as the IGMT have developed specific plans and processes to protect the collections and heritage in their care such as the Flood Plan for Museum of the Gorge and Emergency Plan for Coalbrookdale Gallery.

TWC produced a specific climate change plan 'A Climate for Change 2008-2026', the first climate change strategy for the community, which included both adaptation and mitigation (Telford and Wrekin Council, 2008). An associated Action Plan (Telford and Wrekin Council, 2008) was developed to tackle the issues raised in the strategy, and this did drive work on adaptation forward, although the objectives in these documents were not binding (TWC Interview, 2012). However, as previously mentioned, these are not currently providing strong guidance. The Action Plan was due for its first review in 2010 and the strategy in May 2011 (Telford and Wrekin Council, 2008), but these reviews did not occur. Arguably, the voluntary nature of this climate strategy may be why they are not providing strong guidance, particularly in the light of the abolition of NI188. With so many stakeholders and such a variety of plans and strategies with different levels of influence, it is clear why an overarching Management Plan which provides a cohesive strategy for the WHS, and which incorporates adaptation, is so important.

6.6.3. Political Will

Political will is linked to other determinants, particularly leadership, policy instruments and resources. It has been difficult to obtain a clear and consistent picture of political support and motivation for adaptation. According to one source at TWC, there is a definite lack of political support, and yet others feel that there is interest and engagement from LA councillors, particularly regarding ‘sustainability’ issues. Some of these conflicting viewpoints are illustrated by quotations in Table 17. The changing political context, and deregulatory thrust of central government, is reflected in the changes to policy instruments and plans, discussed in previous sections. Organisations tasked with adaptation and flood response such as EA and Emergency Planners have limited heritage remit, and heritage protection is not something which is specifically considered in their work (see quotation in Table 17).

Political will can be demonstrated through commitments of funding. As illustrated in Table 17, there are funding commitments for the continuation of current flood defences. There is also local political commitment to raising funds to tackle land instability - the local MP has been heavily involved in campaigning on this issue (UK Parliament, 2011a). Land instability and flooding are political issues, as they directly affect the (voting) population of the Gorge, and, unlike many other heritage sites, the area is a living, working community. Any funding commitment specifically to climate adaptation is unclear.

Political Will - Varied and Conflicting Viewpoints – Selected Quotes
There wasn't really a lot of support at a cabinet level. It [climate adaptation] was always in our priority plans and in there as NI 188, and we also reported on that to the cabinet and to the council itself. So it is in there as a priority, but I think in reality it's only in there on paper as a priority (TWC)
I think there's a push from councillors and parish councils to look at sustainability issues, without them actually considering the bigger picture. So yes, there is a little bit of subtle pressure there to support applications for double glazing and PV cells … (TWC)
The solutions aren't instant and they cannot be stuck to a political system which runs on two to five year parliaments – there's got to be some much, much longer term plan (SGCT)
There's a commitment from our internal politicians to keep the flood barriers going, they're setting aside £100,000 a year to protect those residents on the Wharfage, so there's buy in there. Whether that changes as we go through time now and they're looking to cut budgets even more and, that may be one of the things that's sacrificed (TWC)
I think for flood management it's very difficult for the Environment Agency to put the historic environment as a very high up in their planning....there's also the displacement argument, if you improve one area it might simply make it worse elsewhere, so I don't think they actually place it very high up the agenda because I think it's too difficult a thing for them to manage (EH)

Table 17 Varied viewpoints on political will

6.7. Resources

6.7.1. Financial Resources

In the past, flooding and land instability have been extremely costly, including expenditure on clean up, disruption to businesses, and the cost of erecting the flood barrier. The land instability issues have been particularly burdensome. Since 2001 TWC has spent more than £16 million on stabilising works (Shropshire Star, 2010 ; Telford and Wrekin Council, 2010b). The costs of monitoring land movement are also significant. The further work required to stabilise the Gorge has been estimated at £80 million (Shropshire Star, 2011 ; UK Parliament, 2011a). The funding for this work is not locally available, and significant lobbying has been undertaken in the UK and Europe to try to secure these funds.

In October 2012 central government agreed to provide £12 million to help tackle the problem of land slippage and instability, with the balance of the funds required for works urgently required in Jackfield to be provided by TWC (BBC News, 2012 ; Shropshire Star, 2012). On-going budget cuts to local authorities have greatly affected TWC, which has a £40 million funding gap to close by 2014 (Telford and Wrekin Council, 2012a). The struggle to find the necessary resources for stabilisation works has been documented over many years (BBC News, 2003 ; UK Parliament, 2011a). The Ward Member for Ironbridge explains that whilst TWC are pleased that the Government has found money to go towards the Jackfield stabilisation works, "in the current financial climate and the budget pressures imposed on us by Government cuts on our grant funding, this is money we can ill afford to spend. However we have little choice" (Telford and Wrekin Council, 2012b). The fact that this is a long term problem, and there is a need for on-going funding for the instability issues, is emphasised by officers at TWC, and that therefore negotiations will need to continue to try to secure the long-term support required (TWC interview, 2011).

Pressure on public finances was a theme which recurred throughout interviews with different stakeholders involved in the site. As well as the implications of resources constraints on stabilisation work, this was also mentioned as a barrier to futures thinking and to incorporating adaptation into decision making (see section 6.5.1). In the Conservation Plan for the Iron Bridge, prepared for EH, the availability of sufficient resources are cited as a potential constraint in the monitoring and maintenance of the bridge, in light of government funding restraint (English Heritage, 2010a). The fact that the public sector has such multiple and significant roles in the management of the Gorge WHS, makes this site particularly vulnerable to budget cuts in this sector.

6.7.2. Human Resources

A theme which emerged from the data was that local knowledge and experience play an important part in both risk preparedness and responses to events. Local knowledge was not originally part of the conceptual framework, but was added as a new sub node during analysis, as this contributes to the capacity to adapt. There are many examples of local people and land managers visually monitoring weather and water levels and taking the necessary action to prepare for, or promptly respond to, flooding, informed by local knowledge and awareness. Examples include a landowner’s knowledge of gates and exits on private land, allowing emergency services such as the fire service quick access, and a resident’s local knowledge meaning he could advise the fire service on how to divert floodwater. In this example an elderly local man was able to advise the fire service of a culvert running under a road, and that knocking a certain wall down would release the water, subsequently saving the Merrythought factory from flooding (SGCT Interview, 2011).

The availability of sufficient manpower and skills is varied throughout the different organisations in the Gorge. For example, at the IGMT there appears to be flexibility, with staff stepping into different roles if necessary in times of emergency. The Trust also calls on external help e.g. The Emergency Response Network for the West Midlands, who provide contact with other museums and staff who can provide assistance in an emergency e.g. cleaning, drying of books or organic material.

However, the issue of pressures on human resources is mentioned repeatedly when it comes to the local authorities involved in the Gorge as well as other public agencies. Over the last four years around 850 posts have been cut in TWC, with senior management cut by over half (Telford and Wrekin Council, 2013). Restructuring and high levels of staff turnover are evidently affecting the capacity of individuals to carry out work on risk preparedness and adaptation, and are resulting in a loss of knowledge and expertise. An example of this can be seen at Shropshire Council: "With all the cutbacks and the staffing issues, we've got key people leaving that have been here for a number of years, they're either not being replaced or being replaced by people that don't have the passion, they haven't been through the emergencies that the people that are leaving have been through and I think that makes a difference because they've been through it, they know how it happens, they know what they need to do" (Shropshire Council Interview, 2011).

The lack of EA involvement in the WHS steering group, despite efforts to engage them, is thought to be due to resource pressures (SGCT and TWC, 2011), and cuts and changes have directly affected the capacity of those tasked with climate change adaptation work in the council in engaging with the production of the WHS Management Plan (TWC, 2012). It is not only work within these public bodies which is affected, but also other stakeholders within the Gorge who work with them. For example, one major land manager states that due to staff changeover at the council, should an emergency arise, he no longer knows who is responsible for what, or if the council still have the necessary contact details e.g. the Trust's emergency mobile number.

6.8. Leadership

Holistic management and effective communication and collaboration between the different stakeholders are important for the successful management of such a complex site. As identified through previous sections, the WHS steering group, led by the coordinator, is a key forum for bringing together this diverse group, some of whom lead management for particular elements e.g. the museums, the bridge, footpaths. Good relationships and communication between the different parties are evident, and there is a great deal of 'cross-fertilisation' and overlap between the different organisations, for example the Chief Executive of the IGMT is on the board of SGCT. SGCT state that they work with a wide range of different council departments and that they try to keep each other up-to-date on their organisations' activities (SGCT Interview, 2011). Many stakeholders affirm that decisions are coordinated very well. "There's lots of stakeholders but everybody is reasonably clear of where the remit is and what we would do to coordinate it, TWC are well-engaged with the World Heritage Site at the moment, they've invested in a new post and reinvigorated the World Heritage Site steering group in the last 6-18months, we're in as good position as we can be[25]" (IGMT Interview, 2011). The fact that the WHS Coordinator is currently (September 2012) no longer in post therefore leaves a gap in leadership which is especially pertinent given the complex management system.

Frequent communication and collaboration between different organisations is particularly apparent in emergency planning for instability and flooding. Risk preparedness for flooding involves civil resilience, all the emergency services, Gorge transport operators, highways as well as land owners. Examples of this collaboration include the multi-agency emergency plans and the landslide/flooding training exercise which involved a multitude of agencies. IGMT

[25] This interview took place in Nov 2011 whilst the WHS coordinator was still in post

is also part of the LSP (local strategic partnership) responsible for disaster planning.

There is clear leadership from individuals in TWC on the issues of land instability, for example efforts to lobby externally for funds, and involvement of the media to publicise the issue. There was no such high profile leader or champion specifically for the issue of climate change adaptation at the time of research. There was also no clear vision on adaptation for the WHS.

Leadership from both IGMT and SGCT on 'sustainability' issues is apparent, although adaptation is not specifically identified by either as an area of focus. The IGMT are a high profile organisation in the area, and within the senior ranks of the organisation there is a great deal of engagement with sustainability issues. IGMT have shown leadership and commitment to the area of green tourism, achieving a Silver Award in the national Green Tourism Business Scheme in 2008. Some adopted practices do address both mitigation and adaptation, such as the use of water saving devices. These practices are being publicised, helping to raise awareness of the issues. SGCT has recently won awards including a Shropshire award for Best Innovative/Sustainable Building for its recently built headquarters in Coalbrookdale, which incorporates energy efficiency measures such as sheep wool insulation, and sits on a flat platform and concrete raft foundation to help protect against any future land instability.

6.9. Reflections on Conceptual Framework of Adaptive Capacity

The initial conceptual framework was used as a starting point for the analysis using NVivo software. The nodes and sub nodes which were used as the basis for coding in the NVivo program were derived from the determinants in the initial conceptual framework. Through the process of coding and analysis, several processes occurred. New determinants emerged which were not present in the original framework and some nodes which were in the original framework seemed inappropriate or unwieldy. Links and relationships between different nodes also emerged. In concordance with the relevant literature on adaptive capacity, at this site, determinants of adaptive capacity are not independent of each other. Adaptive capacity is multidimensional, and is determined by complex inter-relationships of a number of factors at different scales (Vincent, 2007). For example, *human resources* and *financial resources* are strongly linked at the Gorge, as a lack of financial resources influences the availability of personnel; however, decisions which determine the availability of financial resources are made at a range of scales, and determinants such as *political will* are influential.

Another issue which arose during the research was the issue of variability. Systems are variable (Yohe and Tol, 2002) and adaptive capacity changes over time. Data collected can examine adaptive capacity at one point in time, but rapid changes can occur, as was evident in this case, due to changes to governance and budgetary restrictions during the period of research. Difficulties also arose in distinguishing between individual and organisational capacity; the interplay between individual actors and the institutional arrangements within which they operate is something which will be discussed further later in the thesis (Chapters 9 and 10).

The initial conceptual framework and the framework following analysis at Ironbridge are shown in Figure 43 and Figure 44. The changes to the framework which developed through the process of analysis at Ironbridge will now be explained.

A new node focusing on *cognitive factors* was added, as these issues clearly influenced adaptive capacity at this site. *Local knowledge and expertise* was also added, as a sub node of *human resources*, as length of time working at the site and in depth knowledge were seen as contributing to appropriate decision making about its future and also in assessing risk (see Section 6.7.2). Within the *learning capacity* node *institutional memory* has been added, as an important determinant which was omitted from the initial framework, but which emerged as important through the analysis.

The sub-nodes for *leadership* were altered to reflect the important determinants which emerged from the case study, and a change of terminology was also employed in an effort to make these clearer. *Discuss doubts* was removed as part of *learning capacity*, but a new node *uncertainty* was created, as wider issues of doubt and uncertainty pervade issues of adaptive capacity and this is not something which is solely part of learning. However, the position of *uncertainty* within the conceptual framework has not been established at this stage.

Authority has been moved from being a sub node of *resources*, to a node in its own right. This is to reflect the fact that *authority* is not only a sub node of *resources*, but that legal and policy instruments such as Management Plans are broader determinants. *Act according to plan* became a sub node of *policy instruments*, as it was found that there was significant overlap between these nodes during analysis. The two sub nodes of *financial resources* have been removed, as the distinction between past and future availability of resources was often unclear in the data collected and so overlap in the data distributed between these nodes was common.

Access to information was an important node with a great deal of information within it, and became a node in its own right rather than a sub node of *room for autonomous change*, which was removed as it was revealed to be to be very broad and unwieldy as a data category. As mentioned earlier, *act according to plan*, which had been a sub node of *room for autonomous change*, became a sub node of *policy instruments*. Information on the *capacity to improvise* was sparse, and this factor did not appear to be relevant at this site, therefore this node was not included in this revised framework. The process of revision of the framework will continue through analysis at each case study, so the removal and addition of nodes may be amended at a later stage in analysis if this is thought appropriate.

The process of analysis and the use of the framework has proved useful at this case for assessing adaptive capacity, and has clearly highlighted areas where capacity could be enhanced. However, some challenges which have emerged include how to deal with issues which are raised which do not fit clearly into the conceptual framework but are affecting adaptation. One example of this is the *integration of heritage into the work of other disciplines*, which is an issue affecting risk preparedness and adaptation at the Gorge, but cannot clearly be placed within the framework at this point. There are also difficulties distinguishing between context specific and generic variables. It is anticipated that by carrying out analysis at the subsequent cases, the question of how to address these issues may become clearer.

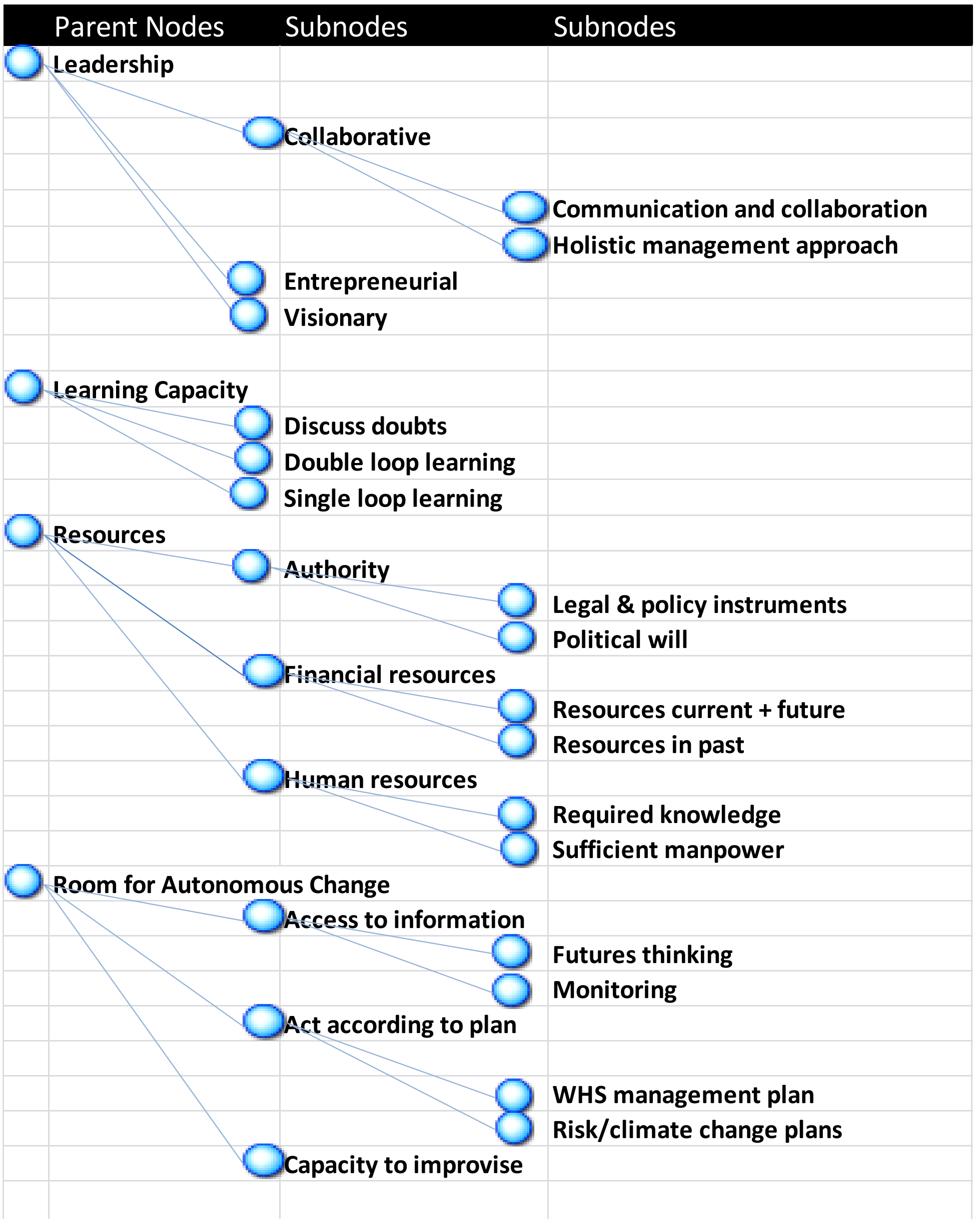

Figure 43 Initial conceptual framework (before analysis)

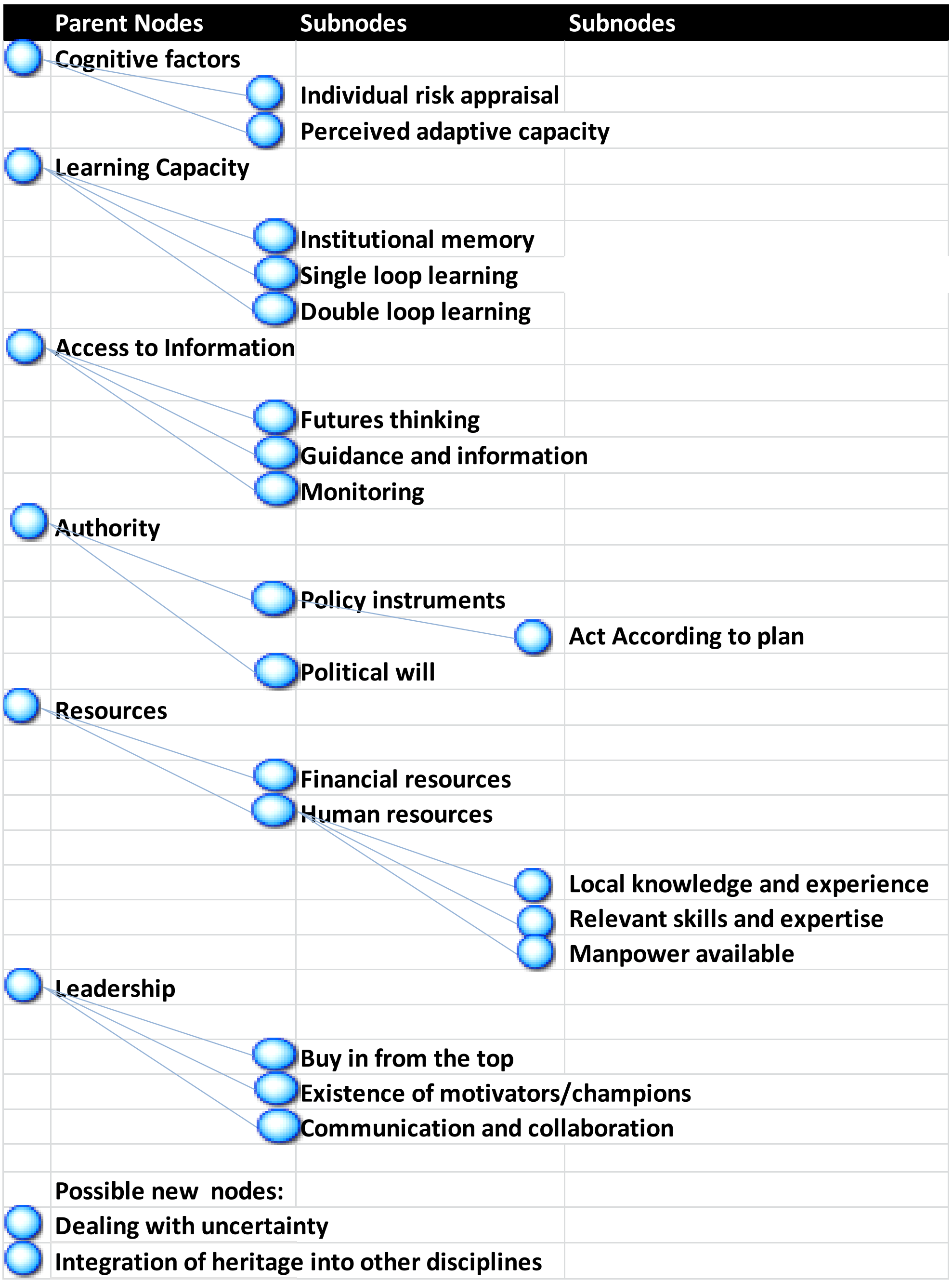

Figure 44 Revised conceptual framework (after analysis of Ironbridge Gorge case study)

6.10. Conclusion

The assessment of adaptive capacity at Ironbridge Gorge, with such complex ownership and management systems, raises challenges, as capacity varies greatly between the different organisations involved in site management, with their diverse remits. It is therefore not possible to assess 'overall' capacity for the WHS, as organisations need to be considered individually, as well as examining interactions between them. The analysis has identified some strengths and weaknesses within the system of site management, and progressed understanding of how adaptive capacity could be enhanced.

A consequence of so many different organisations being involved in site management, including local authorities who have a much broader remit than just the WHS, is that many of the activities which related to risk preparedness and adaptation are not necessarily taking place in the context of the WHS, but for a wider local area or for specific organisations within it. It is not just plans, policies and actions that are developed for the WHS itself which indicate the level of capacity. However, having a clear and up-to- date WHS Management Plan is particularly important at a complex site such as this, not only to provide a framework which specifically considers heritage issues (which many of the wider plans and policies do not), but also to guide and pull together the diverse group of stakeholders within the WHS. The valuable role of the WHS Management Plan in heritage management has been highlighted, as well the fact that having an up-to-date plan which includes a consideration of adaptation has the potential to act as a cohesive framework to guide adaptation at cultural heritage sites.

There is considerable focus on risk preparedness in the Gorge, and the serious risks of flooding and land instability are high profile issues. Doubts around climate change are a barrier to all stakeholders, and futures thinking is not widespread. Although 'climate change' is not a high profile issue for many, vulnerabilities at the site which may increase through climate change (land instability and flooding) are high on the agenda in the area, attracting political focus and resources. There are plans and procedures in place to respond to these risks which are exercised and rehearsed, and a great deal of experience, knowledge and learning on subject of risk preparedness. However, those tasked with protecting the communities in the Gorge e.g. the Emergency Planners within the two councils, the EA, police and military have limited heritage remit, and the protection of heritage, such as the Iron Bridge, is not something which is currently factored into wider risk preparedness measures. The implication of this is that collaboration and communication between different sectors, with different remits, is an important determinant which affects the capacity to adapt.

The issue of terminology is interesting, as issues such as risk preparedness, flood resilience and adaptation, are not discrete, and meanings overlap. The term climate change ‘adaptation’ is not widely used in the Gorge, but it is difficult to draw a clear distinction between this and the existing work on risk preparedness – these are different but overlapping issues.

The fact that the management of Ironbridge WHS has so much public sector involvement makes the site particularly vulnerable to the resource pressures which are affecting local government and public agencies at the current time. The deregulatory thrust of central government is also affecting progress on work on adaptation within the local authority. It is clear that the capacity to adapt is being negatively affected at Ironbridge by issues such as the loss of the NI188. The inclusion of an indicator in the revised WHS Plan which relates specifically to climate change could be very positive move to encouraging data collection and specific monitoring of these issues in the Gorge.

CHAPTER 7 FOUNTAINS ABBEY AND STUDLEY ROYAL WORLD HERITAGE SITE

7.1. Introduction

This chapter will focus on the second case study, Fountains Abbey and Studley Royal World Heritage Site. A series of interviews (see Table 18 below) and a review of documentary sources form the basis of the data for this chapter. The chapter follows a similar format to Chapter 6. Following an introduction to the site and its system of management, risks to the site and past responses to these are considered. Following this the conceptual framework developed through analysis of adaptive capacity at Ironbridge Gorge has been used as the starting point for an assessment of adaptive capacity at this case. Reflections on the process of analysis and implications of findings from this case for the conceptual framework are presented and then, finally, conclusions are outlined.

Organisation	Role
National Trust/English Heritage	World Heritage Site Coordinator and Conservation Manager
National Trust	Head of Landscape
National Trust	Archaeologist
National Trust	General Manager
English Heritage	Inspector of Ancient Monuments
English Heritage	Properties Curator
Environment Agency	Senior Conservation/Biodiversity Officer
Environment Agency	River Basin Programme Manager
Environment Agency	Flood Incident Management Team Leader
Yorkshire and Humber Climate Change Partnership	Climate Change Coordinator
Harrogate Borough Council	Principal Conservation and Design Officer
Harrogate Borough Council	Nidderdale Area of Outstanding Natural Beauty Manager (email)
Harrogate Borough Council	Emergency Planning Team (2 officers)

Table 18 List of interviewees (interviews conducted in March and April 2012)

7.2. Background and Context

7.2.1. Introduction to the Site

Fountains Abbey and Studley Royal World Heritage Site in North Yorkshire comprises the 18th century designed landscape of Studley Royal water garden and pleasure grounds, including the ruins of the Cistercian Fountains Abbey (Figure 45 and Figure 46). The site is 'an outstanding example of the triumphs of manmade design throughout different periods of human history' (National Trust and English Heritage, 2009) and forms one harmonious whole of buildings, gardens and landscapes.


Figure 45 The ruins of Fountains Abbey
Figure 46 The water garden, Temple of Piety and moon pond

The area was designated a cultural World Heritage Site in 1986, meeting the following criteria:

'Criterion (i): Studley Royal Park including the ruins of Fountains Abbey owes its originality and striking beauty to the fact that a humanised landscape was created around the largest medieval ruins in the United Kingdom. The use of these features, combined with the planning of the water garden itself, is a true masterpiece of human creative genius.

Criterion (iv): Combining the remains of the richest Abbey in England, the Jacobean Fountains Hall, and Burgess's miniature neo-Gothic masterpiece of St Mary's, with the water gardens and deer park into one harmonious whole, Studley Royal Park including the ruins of Fountains Abbey illustrates the power of medieval monasticism, and the taste and wealth of the European upper classes in the 18th century' (UNESCO, 2012b).

7.2.2. Site Location

The site is located to the west of Ripon in the County of North Yorkshire, in the district of Harrogate Borough Council (HBC), and the designated area covers 3.33 Km². The river Skell flows through the valley from the South West and exits through the Seven Bridges Valley in the direction of Ripon, and the site is located within the Nidderdale Area of Outstanding Natural Beauty (AONB).

Figure 47 Location of the site (Digimap, 2012)
Crown Copyright 2013 An Ordnance Survey/Edina supplied service

The water gardens lie at the centre of the designed landscape. To their north is Studley Royal Deer Park; to the east, Mackershaw Park and Seven Bridges Valley; and to the west, the Visitor Centre, Fountains Hall and Fountains Abbey.

Figure 48 Annotated site map showing key features of the site. Adapted from Fountains Abbey website (National Trust, 2013) Used with permission from Fountains Abbey and Studley Royal
Distance from Abbey to lake approx. 1 mile

7.2.3. History and Significance of the Site

Studley Royal is one of the few great 18th century gardens to survive substantially in its original form and is 'an outstanding example of the development of the 'English' garden style throughout the 18th century, which influenced the rest of Europe' (UNESCO, 2012b). The garden was originally designed by the Aislabie family[26]: the River Skell is integrated into the water gardens and 'borrowed' vistas from the surrounding countryside are incorporated into the design. The Skell valley was drastically remodelled, with the river itself diverted into a canal at the

[26] The landscaped garden was developed between 1670 and 1781

centre of the valley, with the creation of geometric moon ponds to either side. At the east end of the canal, a new lake was created, the junction marked by a cascade (Coppack, 1993). The garden contains canals, ponds, cascades, lawns and hedges, with statues and classical garden buildings such as the Temple of Piety and Octagon Tower (Figure 49). The Aislabies' vision survives substantially in its original form, most famously in the impressive view of the ruins of Fountains Abbey itself (National Trust, 2010b).

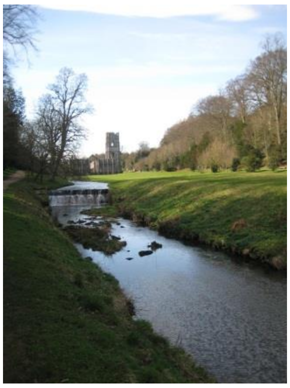

Figure 49 The Octagon Tower: A folly within the Georgian gardens.
Figure 50 A key view of the Abbey seen from the distance

The Cistercian Abbey was founded in 1132, and its ruins comprise 'one of the most extensive monastic sites in Europe and reflect the wealth and ambitions of the monks who lived there for just over four centuries' (Coppack, 1993 p11). As well as being of outstanding importance in its own right, it is a key eye catcher in the garden scheme (Figure 50) (National Trust, 2010b).

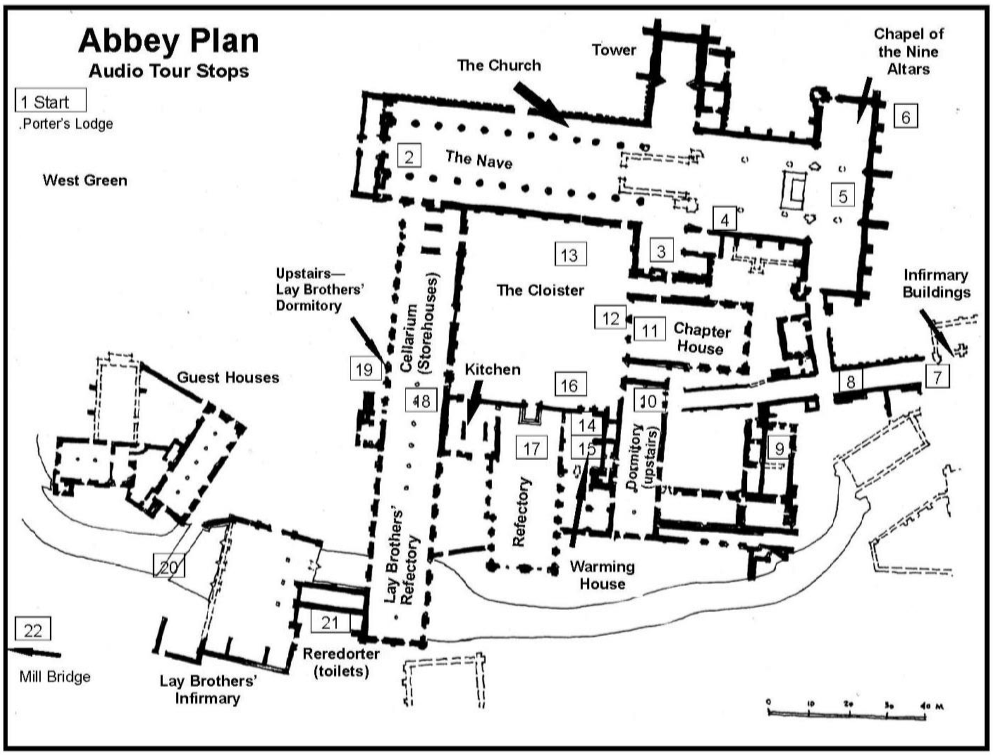

Figure 51 Plan of Fountains Abbey (NT website, 2012) Used with permission from Fountains Abbey and Studley Royal

The rest of the site includes Fountains Abbey Mill, built c.1140,'the best and oldest preserved monastic mill in the UK' (National Trust and English Heritage, 2009). It was an essential part of the monastic estate and was used for corn milling. The Jacobean Fountains Hall was partially built with stone from the Abbey around 1611 (Coppack, 1993). It has a single, tall, Elizabethan facade and is enhanced by a formal garden with shaped hedges (Figure 52).


Figure 52 The Jacobean Fountains Hall, fronted by topiary
Figure 53 Studley deer park, at the North of the site

The deer park was laid out in the 17th and 18th century, and the formal tree planting in the park includes avenues of lime and oak trees, some of which are aligned to distant landmarks such as Ripon Cathedral, integrating the wider landscape into the design. St. Mary's Church, designed by William Burges and built for the Marquis and Marchioness of Ripon in 1871, is located within the deer park (Figure 54). It is richly decorated and is considered to be an outstanding example of High Victorian Gothic architecture (National Trust, 2010b). The site also contains significant archaeological remains, including three Neolithic/Early Bronze age sites.


Figure 54 St Marys church
Figure 55 Tree lined avenue, with distant view to Ripon cathedral

According to the Statement of Outstanding Universal Value (National Trust, 2010b), the property as a whole has a high degree of authenticity in terms of form and design, materials, function, location and setting of features of the designed landscape. However, as with many other sites, both the fabric and design of the landscape of Studley Royal have been 'continually altered, through a mixed process of maturity, modification, aging and decline, and through natural growth, climatic events and development'(National Trust, 2010b, p3 - p4).

7.2.4. Management Systems and Ownership Arrangements

The site is primarily owned and managed by the NT, which are responsible for its overall conservation and management. There is a guardianship agreement with EH, who are responsible for the Fountains Abbey ruins (a Scheduled Monument), Fountains Mill, St Marys Church and a collection of monastic artefacts held in store at Helmsley, North Yorkshire. The division of responsibility is set out in the WHS Management Plan and Conservation Plan. For example, EH are responsible for the consolidation and maintenance of the ruins, including condition surveys, however the NT are responsible for other elements of its care, such as the maintenance of surfaces inside and outside the Abbey, visitor interpretation and activities.

A small area of the site is in private ownership, and has been since before the NT acquired the estate. The private ownership includes the freehold rights to a pheasant and duck shoot. The diagram below summarises the ownership and management arrangements for different elements of the site.

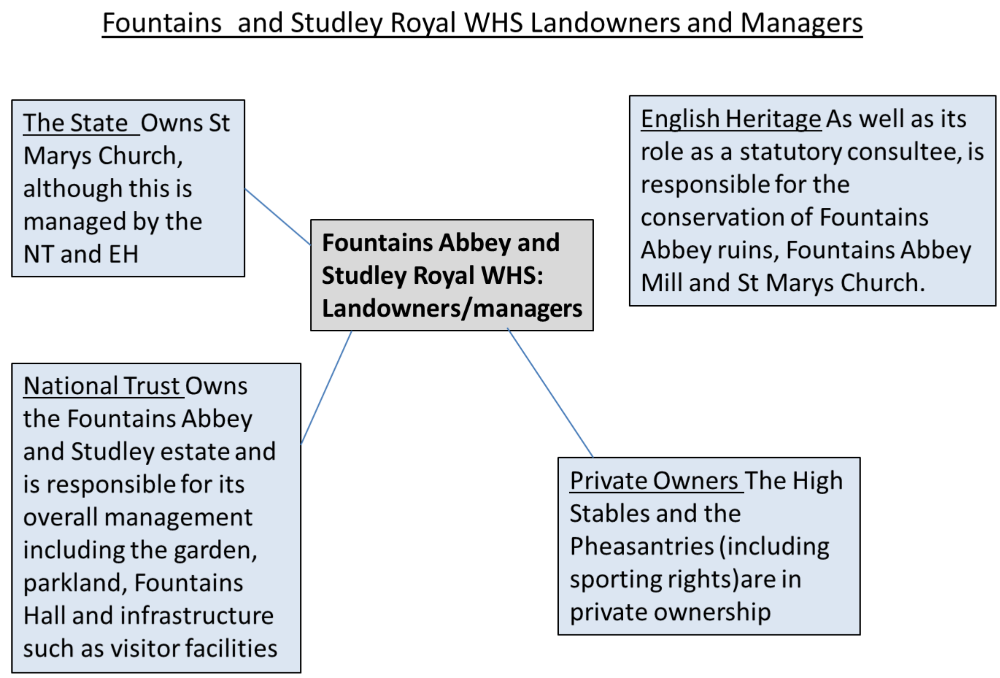

Figure 56 Ownership and management at Fountains Abbey and Studley Royal

The boundary of the World Heritage Site largely follows the area in NT ownership, and, according to the Management Plan (National Trust and English Heritage, 2009), this boundary was proposed by the UK government to the World Heritage Committee because it represented an area managed by the least number of stakeholders (see Figure 57 for map of NT ownership). Part of the historic estate is outside this area, and a buffer zone has been proposed[27] to ensure that proposals for development take into account any potential impact on the outstanding universal value of the WHS and its setting.

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[27] In May 2012 a consultation was underway by HBC on this proposed buffer zone.

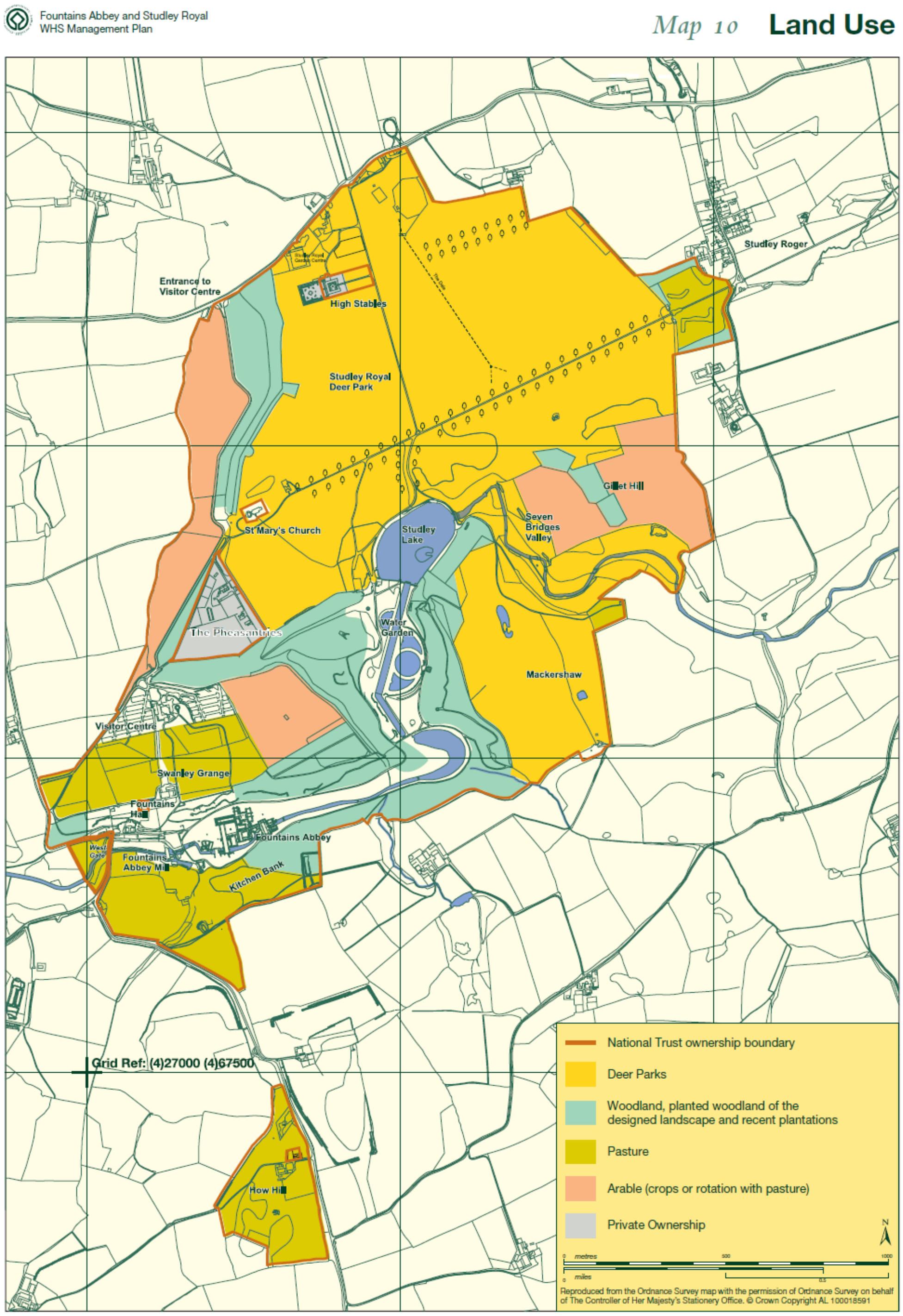

Figure 57 Map of land use at Fountains Abbey and Studley Royal (National Trust and English Heritage, 2009)

The NT is responsible for the day to day management of the site, and has on site offices in the Visitors Centre. The general manager co-ordinates all of the estate's activities, with advice from experts at the NT's Regional Office (see Figure 58 below). The site is one of the NT's busiest attractions, with 342,000 visitors in 2010 (The Guardian, 2011).

Fountains Abbey and Studley Royal WHS - Management Arrangements

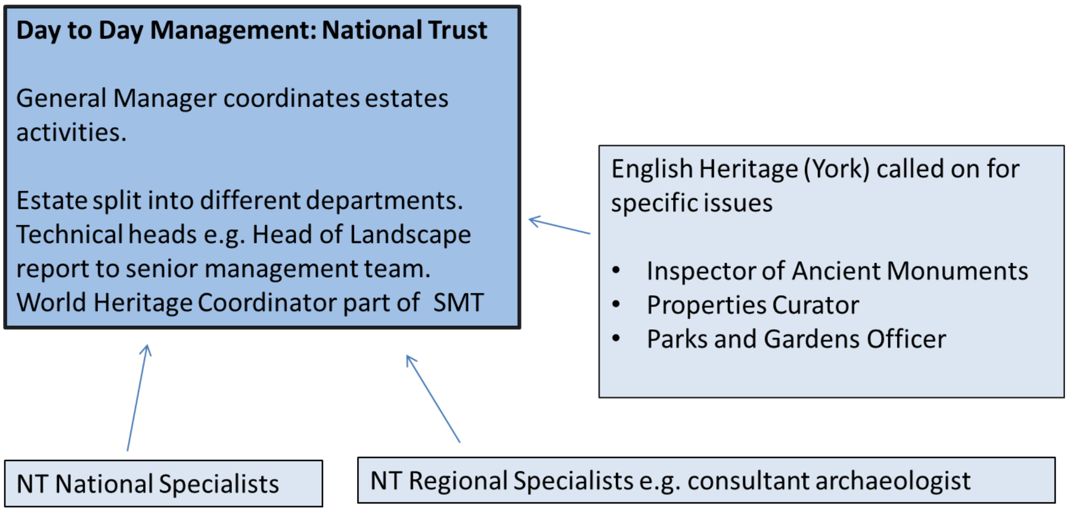

Figure 58 NT site management arrangements

EH has a dual role in the management of the site, as a statutory body as well as a management partner. EH regional officers are based in the York office, and staff are deployed to Fountains Abbey and Studley Royal (FA & SR) for matters related to the guardianship area as well as the agency's statutory role in relation to the Scheduled Ancient Monument, Listed buildings and historic parkland. HBC has planning responsibility for the estate (including Nidderdale AONB). There are a range of statutory and non-statutory designations on the property, including 54 buildings and structures which are Listed. The Abbey and its surrounds is a Scheduled Monument, and the whole site is Grade 1 on the EH Register of Parks and Gardens (English Heritage, 2013a ; National Trust, 2010b).

A World Heritage Site Coordinator is employed at the site, which is a three year post jointly funded by the NT and EH. The key purpose of the role is to co-ordinate delivery of the World Heritage Site Management Plan, but the coordinator has other responsibilities as well, including managing the delivery of the Conservation Plan (NT/EH Interview, 2012). The World Heritage Site Steering Group has been set up which is a relatively new development resulting from the coordinator's appointment. The WHS Steering Group is tight-knit and consists solely of stakeholders from EH and the NT, who meet regularly. As well as the Steering Group there is a local group of partners and consultees (statutory and non-statutory) for the World Heritage Site such as the conservation officer from

Harrogate Council, the EA and Nidderdale AONB who were involved in the development of the Management Plan, and who may be consulted on other management issues at the site (see Figure 59). Wider consultees include national bodies e.g. ICOMOS UK, national and regional level representatives of EH and local partners such as the Ripon Town Centre Manager and Ripon Civic Society (National Trust and English Heritage, 2009).

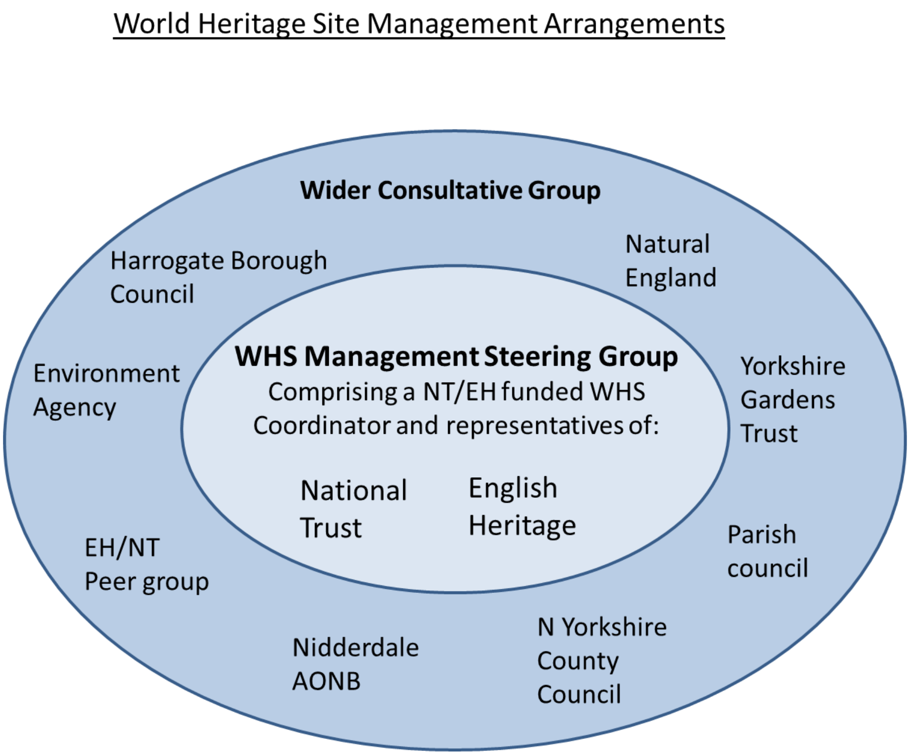

Figure 59 Diagram showing the WHS steering group and some key members of the wider consultative group (not an exhaustive list)

7.3. The Impacts of Past Severe Weather Events on the Site (LCLIP Approach)

7.3.1. Impacts of Past Weather Events on the Site

A review of media reports of recent weather events, carried out as part of the LCLIP approach (Table 19), identified flooding as a major issue which has had severe impact on the site over the last five years. The 2007 flooding event attracted a great deal of media attention, due to the damage caused to this high-profile heritage site. Media reports picked up not only the physical damage caused at the site, but also the negative rumours which circulated about the impacts of opening sluices at FA & SR on properties in Ripon[28]. Most stories reflected negative impacts of weather such as site closure, but there were also positive PR opportunities such as the story about the early blooming of snowdrops.

Other weather events which have affected the site are varied, and include gales which caused tree damage, and warm spring temperatures which influenced an increase in visitor numbers. Similar to impacts on heritage identified in previous chapters (Sections 5.4.4 and 6.3), these include impacts on historic fabric, as well as impacts on site operations, linked to FA & SR's role as a tourist attraction.

Year	Type of Event	Impacts	Title and Source
2007	Heavy rain and flash flooding - Valley, abbey, mill and water gardens under water	River walls, weirs, bridge abutments and some building damaged, previously unexposed masonry structures revealed. Opportunity presented by erosion to archaeologically record all exposed layers.	Climate change now top priority after abbey flood (Yorkshire Post)
2007	Heavy rain and flash flooding - Valley, abbey, mill and water gardens under water	Closure of tourist attraction to the public, damage to the fabric of the estate. Partial reopening of estate to allow archaeological recording to take place in parts of abbey.	Damage caused to Fountains Abbey estate (Ripon Gazette)
2007	Heavy rain and flash flooding - Valley, abbey, mill and water gardens under water	Substantial damage caused, abbey cloister worst affected, cost of damage still being assessed.	Beauty spot damaged by flooding (BBC News)
2007	Heavy rain and flash flooding - Valley, abbey, mill and water gardens under water	Areas of the site suffered damage from torrents. Erosion exposed a number of buried masonry structures as well as cutting through stratified archaeological layers. Public observation area set up in the cloister.	But at Fountains floods uncover new layers of history (Ripon Gazette)
2007	Heavy rain and flash flooding - Valley, abbey, mill and water gardens under	Rumours that Fountains Abbey estate contributed to flooding in Ripon by opening its sluice gates in water garden.	Fountains Abbey not to blame, says Trust (Ripon Gazette)

[28] Rumours that this contributed to flooding in Ripon have been found to be groundless (EH and EA interviews, 2012)

	water		
2008	Gales - Wind speeds of up to 59 mph	Around twenty trees on estate uprooted or seriously damaged. Estate closed to visitors.	Gales at Fountains Abbey & Studley Royal (NT Report)
2009	Cold, wet summer weather	90% reduction in bat sightings and some young bats found abandoned near the abbey.	Weather blamed for bat sighting fall at Fountains Abbey (BBC News)
2011	Cold winter - Winter damage to estate roads	Due to harsh winter, several estate roads closed for resurfacing	Estate Road Closures at Fountains Abbey & Studley Royal (Fountains Abbey website)
2011	Warm April	Visitor numbers up sharply from April 2012	Record breaking month for Yorkshire Tourism (BBC News)
2011	High winds	Closure of the Abbey, Water Garden and Deer Park. The shop and restaurant open as usual	Status update (Fountains Abbey Facebook page)
2012	High winds and heavy rain, flooding in water garden	Closure of estate to visitors, but visitor centre and Studley tea room open	Status update (Fountains Abbey Facebook page)
2012	Mild winter	Snowdrops in bloom several weeks earlier than usual - opportunity for photographers.	Early snowdrops at Fountains Abbey (Ripon Gazette)

Table 19 Media search of past weather events which have affected the site over the last 5 years

The Skell Valley and the site itself have a long history of flooding; in fact the Cistercian Abbey was partially constructed over the top of the river, with a system of culverts and tunnels underneath it. The heritage site suffers frequent[29] floods as the catchment for the River Skell is relatively small and very steep, consisting of soils which are prone to compaction and therefore high levels of run-off (National Trust and English Heritage, 2009).The historic area along the river including the Abbey ruins is flooded when the Skell bursts its banks (Figure 60 and Figure 61).

[29] All interviewees who were directly involved in site management had an awareness of the issue of flooding, and its impacts on the site. Interviewees describe the occurrence of up to six minor floods each year, with varying opinions on flooding frequency (NT and EH Interviews, 2012)

Given this history, and the regular occurrence of flooding at the site identified through the media review, flooding was selected to focus on in stakeholder interviews, as part of the LCLIP section of this study.


Figure 60 Severe flooding in 2007 - The Abbey Cloister
Figure 61 Severe flooding in 2007 - The Water Garden and Moon Pond (photos courtesy of interviewee)

Opinions about the resilience of the site to flooding vary amongst stakeholders, with several individuals explaining that the site is somewhat resilient due to its history of flooding. For example, there is evidence that the gardens were almost completely destroyed in the past (approximately 1725) due to a major flooding event, and then redesigned/rebuilt with significant changes to the layout of the hydrological features in the garden, which may have made the design more resilient (NT Interviews, 2012). Others feel that the site is vulnerable and that more needs to be done to address the flooding issues at the site e.g. mitigation measures could be looked at to cope with some of the fluctuations in water levels and subsequent damage to the culverts under the Abbey (EH Interview, 2012). The frequency of rapid flash flooding events is thought to have increased in recent years, and this is a cause of concern (NT and EH Interviews, 2012).

The impacts of severe floods on the site are exemplified by the 2007 occurrence. Heavy rain caused an extreme flash flooding event, the impacts of which included scouring of the culverts underneath the Abbey and the water channels, damage to landscape at Quebec[30] and to the cloister walkway, and exposure of buried

[30] Quebec is a grassy area of the water garden, see photographs and map in Appendix 9: Additional Photographs of Case Studies and Appendix 10: Annotated Site Map – Water Management at Fountains Abbey and Studley Royal

archaeology. The force of water cut a gulley in the floor of the Abbey cloister, excavating stratified deposits including “big chunks of pottery” which were then deposited elsewhere (NT Interview, 2012). This flood event was so powerful that it caused damage to site archaeology which had never previously been disturbed (see Figure 62), including some from the 1180’s in the Abbey, and in the Seven Bridges Valley area holes up to 12 feet deep cut through deposits that date to the end of the last glaciations (NT Interview, 2012).

Figure 62 Damage to the Abbey cloister and Seven Bridges area exposing archaeology, post 2007 flood event – photos courtesy of interviewee

Other impacts from such flooding events include the financial implications of clean up, and disruption to visitors. Clean-up after major floods may include the costs of the removal of silt and debris such as floating timbers, and repairing damage to the side of the river. This is estimated at between £10,000 and £50,000 per event, with approximately three major floods in the last nine years, costing a total of £85-90,000 (NT Interview, 2012).The site is sometimes partially closed during a flood event, as in most cases it is possible to shut off pathways to the affected areas whilst the rest of the site remains open. In extreme cases e.g. the flood of 2007 or the gales of 2008, the whole site may need to be closed for health and safety reasons (NT Interviews, 2012).

7.3.2. Roles of Different Stakeholders in Response to Flooding

On-site responses to flooding are taken by the NT and mainly consist of the opening of sluices and taking the decision to close or partially close areas of the site to visitors if these are deemed to be dangerous. The water is left to recede naturally, it is not pumped out, and the unanimous view amongst (on-site) interviewees is that having flood warnings would not help with the site's flooding issues, as no action can be taken to stop the water, and little can be done other than opening sluices (Figure 63 and Figure 64) and dealing with the post-flood clean up (NT Interviews, 2012).

Figure 63 The Water Gardens - open sluices in water garden following heavy rain (2011)
Figure 64 Water leaving Studley Lake, river flowing towards Seven Bridges Valley (2012)

External agencies such as the EA or local authority Emergency Planners are not involved with flooding issues at FA & SR, primarily due to the lack of heritage remit of organisations tasked with flood protection and emergency response, and the lack of a resident population at FA & SR. The EA's priorities are "to protect Ripon from flooding, to protect the population. We do not tend to make special cases if there is an ancient monument or other such sites" (EA Interview, 2012). There is also no specific monitoring of river levels to provide warnings to the site, as areas where there are settlements at risk of flooding are prioritised when it comes to installing technology such as gauges for monitoring (EA Interview, 2012).

The Emergency Planning team at HBC has responsibilities which relate to civil protection, defined by the Civil Contingencies Act 2004 (UK Parliament, 2004). Their priority areas for flood planning are defined by the EA 'Flood Warning Areas': these are areas at risk of flood, where the EA warns residents when floods are likely to occur. Fountains WHS does not fall within one of these areas, and therefore they are not involved with emergency preparation and response at FA & SR. An HBC Emergency Planner explains that, whilst Fountains WHS "may look very nice it's not valued in the same way as people or property… although it has a high profile, it's not owned by the local authority and is not really a priority" (HBC Interview, 2012).

7.3.3. What has been Learnt from Past Flood Events?

Table 20 identifies different types of learning which are evident at FA &SR, which have led to a changed understanding based on experiences. Past events have acted as a trigger to consider work to try to reduce the risk of flooding at the site, for example through investigating the possibility of water management projects in the Quebec area. Learning has taken place which has characteristics of single and loop learning. For example in decision making about on-going maintenance work at the site, one manager explains questions are asked about whether like-for-like replacements are the best way forward, or whether changes could be made for the better, despite the site's Listed status. Institutional memory is an important part of learning in an organisation, and plans and strategies are being used to transmit and hold information between people and groups over time e.g. in work by the EA and Local Authority Emergency Planners.

An interesting issue which is specific to heritage sites is the capacity for heritage to act as a resource for learning about past adaptations to weather events and changes in climate, and also as a resource for learning about climate change itself. This is particularly evident at FA & SR, and as can be seen in Table 20, stakeholders have learnt from the site about its built in resilience. The unexpected uncovering of archaeology during the 2007 floods can be viewed as a learning opportunity which was taken advantage of. However, archaeology is a finite resource and its exposure is "an unrepeatable experiment," as the archaeologist involved explains: "We did learn more about the cloister and the archaeological deposits that survived there from this exercise, and that information is now available to us... but it means that a great slice of archaeology was just washed away and lost to us forever" (NT Interview, 2012).

Different Types of Learning Identified	Examples of Evidence
Past Weather Events as a Trigger for Change	After the 2007 floods, EH asked for investigative work to be done and modelling of water flow through the Abbey, to look at how best future flooding could be dealt with (EH Interview, 2012)
	Updates to the WHS Management Plan were influenced by flooding event - 'the severe flooding experienced on the site in 2007 was unprecedented and therefore adopting a strategy to adapt to this is now a top priority in this updated plan' (National Trust and English Heritage, 2009)
Single Loop Learning and Institutional Memory	The outcomes of the Pitt review (post 2007 floods), have fed into the development to develop a multi-agency Flood Action Plan, which is regularly reviewed so that lessons from flooding events can be incorporated (HBC Emergency Planners and EA Interviews, 2012)
Double Loop Learning	Challenging assumptions by making modern interventions to make the site more resilient "Just because it was built in C18 and it's Grade 1 Listed doesn't mean they got it right - if we replace it like for like we are replicating the problems for someone else for another 100 years, that's not responsible management'' (NT Interview, 2012)
Heritage as a Resource for Learning about Climate Impacts and Past Adaptations	The uncovering of previously undisturbed archaeology during 2007, which no previous flood had affected, provided evidence of the severity of this event (NT Interview, 2012)
	Indications that in 1132 books and manuscripts were kept on the first floor of the Abbey in driest place, so that when it flooded damage was minimised (NT Interview, 2012)
	Evidence of built in resilience - the abbey fabric is lime based and breathable, and therefore dries out remarkably quickly after flooding (NT Interview, 2012)

Table 20 Types of learning from past events identified at FA & SR

7.4. Climate Change Impacts at the Site

7.4.1. Potential Climate Change Impacts Identified by Stakeholders

The majority of stakeholders interviewed said that they thought climate change would have some kind of effect on FA & SR. The potential impacts described were varied and characterised by uncertainty, but have been categorised and are shown in Table 21.

The most common concern was the impact of changes to rainfall patterns, particularly more intense rainfall, flooding and implications for water management at the site. Concerns included the overall effect of changing rainfall patterns on soil health and the effect of this on buried archaeology, as well as the impacts of changes to the climate on the appearance of the landscape. Other issues highlighted included that drier periods of weather could result in the shrinkage of foundations, more frost could result in more freeze thaw which could damage built structures such as the Abbey and higher winds could cause more tree loss and damage than are currently experienced.

Risk Identified
Impacts on built fabric **e.g. increase in periods of dry weather or amount of frosts affecting fabric of the Abbey (NT Interview, 2012)**
Impacts on landscape **e.g. damper climates and an increase in parasitic fungi attacking trees, tropical weather washing away topsoil (NT Interviews, 2012)**
Impact on archaeology **e.g. the potential for soils to de-structure as a result of longer periods of dry and more intense periods of wetting and the impact of this on the site archaeology (NT Interview, 2012)**
Impact of adaptations **e.g. potential impacts of actions taken to address flooding on the integrity and authenticity of structures (NT/EH Interviews, 2012)**

Table 21 Types of impacts that climate change may have on FA&SR

The World Heritage Site Management Plan (National Trust and English Heritage, 2009) was updated in 2009, and one of the main additions during this review was the consideration of climate change impacts as a key management issue. The changing climatic conditions are already having an effect on the vegetation that the site supports, especially the tree population (National Trust and English Heritage, 2009). Future concerns that are highlighted include an increase in the occurrence of prolonged rainfall and the risk of flash floods presenting a risk to sensitive areas of the historic landscape, and an increase in occasions of very low water levels impacting on both the ability of the river to support wildlife and the aesthetics of the water garden (National Trust and English Heritage, 2009). The draft Conservation Management Plan also identifies climate change as a threat, stating that 'there is some evidence that changing weather patterns are already posing problems to the archaeological and natural fabric and meaning of Fountains Abbey and Studley Royal' (Hilary Taylor Landscape Associates Ltd, 2010, 420). Issues identified include that hotter and drier seasons could cause problems for some of the trees and that intense rainfall will contribute to flash-flooding, erosion of limestone hillsides, and pose a threat to site archaeology.

Climate change is recognised as an issue in both Management Plans[31] and the majority of stakeholder interviews, with a broad range of potential threats being cited, particularly the exacerbation of existing vulnerabilities such as the impacts of flash floods, water management and the condition of the existing tree population. Threats rather than opportunities are identified, and the physical impacts on landscape and building fabric are the main concerns, with little focus on issues such as potential changes to site management practices e.g. visitor management, resources for mowing or maintenance.

7.4.2. Uncertainty and Climate Change Impacts

Feelings of uncertainty about what changes might occur, and what the potential impacts might be, were common to many interviewees. Uncertainty is an issue which pervades the topic of climate change adaptation, and at FA &SR the subject of uncertainty was apparent in relation to interpreting past weather events as well as uncertainty around the potential impacts of climate change and what actions to take to address these, as shown by the quotations in Table 22. In order for planned adaptation to occur, it is necessary to make a judgment about how much adaptation is required, whether it is better to manage every eventuality or to accept some level of damage. This judgment requires knowledge of both the actual and likely risks and of the acceptability of different outcomes (Lonsdale et al., 2010). The uncertainty in the knowledge required to make this judgment are presenting a barrier to adaptation here, and much discourse focuses on the need for scientifically well informed approaches to deal with uncertainty.

[31] WHS Management Plan and Conservation Plan

Issue Highlighted	Quotes from Interviewees
Uncertainty around interpreting past weather events	In the past 2 or 3 winters we have had extreme cold spells, that again is quite a new phenomenon that we hadn't really predicted…. is that part of climate change or is that something else entirely different? We don't know (EA Interview, 2012)
Uncertainty around future changes to the climate	I don't actually know what the answer to that question is. As with anybody, I do not know what is going to happen to the planet (NT Interview, 2012)
Uncertainty around impacts arising from that change and actions needed	What I would love to know is on this estate, with this river, if the rainfall goes up by X amount or if the temperature decreases by X amount.... What would be the effect? That would be the most helpful because then you can start to predict when it is about to fall down and you can potentially do something about it (NT Interview, 2012)

Table 22 Uncertainty and climate change

7.4.3. Cognitive Factors - Individual Perceptions and Attitudes

Psychological and behavioural factors such as risk perception and perceived adaptive capacity are clearly influencing the capacity to adapt. Perceptions vary widely between different stakeholders, even those working within the same organisation at the same heritage site. As stated by Hulme (2009, p245) 'climate change is framed in a multitude of ways, whether informed by the world views of those communicating or filtered by the intuitive world views of those listening.'

Through conversations with interviewees, it was clear that individuals have different perceptions of the risk to the site from climate change, and also have different levels of engagement and interest in the issue of adaptation. They also perceive the capacity to adapt at the site in different ways. A range of quotations in Table 23 below illustrate some of these key issues.

Issue Highlighted	Quotes from Interviewees
Individual Risk Appraisal (probability and severity)	The site is somewhat resilient to flooding - I don't think flooding is a catastrophic event - I mean if the Abbey flooded tomorrow, it's not a problem, and it does (NT Interview, 2012)
	There are bits of archaeology which if the soil is destructured we are going to lose…slightly unproven at the moment but it's there as a worry (NT Interview, 2012)
	That's not to say we don't worry about bits falling off the Abbey… but there is a limit as to how much you can get personally worried about it (NT Interview, 2012)
	It's a park and garden, we know that the trees are going to change, so that's going to have a big impact. We know there are going to be more flooding events (EH Interview, 2012)
	Historic interest is low down on the list of priorities….There are no settlements along the river above Fountains … there are other areas which are more at risk and in need of monitoring (EA Interview, 2012)
Perceived Adaptive Capacity (efficacy and costs)	We have looked at land acquisition further upstream... Other than that there is no capacity in the topography for heavy engineering controls which they have done one the other river in Ripon (NT Interview, 2012)
	There is definitely mitigation that could be looked at in terms of water management to... I don't think eliminate flooding, but to cope with some of the fluctuations in water levels and some of the damage that's being done (EH Interview, 2012)
	We have talked a lot about whether and how much we can build up the river walls… but the problem is that will change the appearance of the Abbey and we don't know how people will react to putting in something that is obviously modern (EH Interview, 2012)
	We think more about conservation as successful management of change now - so I think we are more prepared to make sacrifices to the archaeological record if it is crucial to the successful hydrological management of the site (NT Interview, 2012)
	What can we do in our little blip in the middle of the United Kingdom? (NT Interview, 2012)

Table 23 Cognitive factors which are determinants of adaptive capacity

The perceived probabilities of risks to the heritage site from climate change, and particularly from flooding, were wide ranging, with variations in the way individuals appraise the probability of impacts occurring and the severity of these impacts on the site. The professional role and professional interests of the stakeholders is also material; the professionals interviewed from the EA had different priorities in terms of risk than the Council's conservation officer. Clearly, the perception of risk will directly influence engagement with topic of adaptation and the motivation of an individual to take adaptive action.

Another significant cognitive factor, identified by Grothmann and Patt (2005), which was displayed at this case was perceived adaptive capacity. It is not only the objective ability or capacity of an organisation or individual which will determine if an adaptive response is taken – it is also the perception of whether adaptation will be effective and the perceived individual costs of taking this action (e.g. money, time, effort). The very wide range of opinions on the perceived efficacy of adaptive actions is illustrated in Table 23. Some individuals expressed the opinion that there was little that could be done, for example, that the capacity does not exist to adapt to flooding, whereas others considered that there is the potential to carry out actions which would improve resilience, providing factors such as resources are available. Some individuals appear to disengage from climate change issues because of a sense of disenfranchisement - that they have little power to make any difference to the outcome.

The perceived adaptation costs highlighted in interviews include the monetary costs of such action, and impacts on the historic character of the site. An interesting element of this is individual attitudes to change, and how change is perceived in terms of its potential risk to heritage character. This relates to individuals' personal (and organisations') philosophical standpoint on conservation.

It was clear during the research that some interviewees were uncomfortable[32] talking about the subject of climate change and adaptation, and it was often a difficult subject to engage people in conversation about. Some interviewees changed the topic to climate change mitigation which they seemed more at ease with, whilst others expressed the fact that climate change wasn't their area of work and deflected questions or referred the interviewer to other people. Climate change has become a sensitive and highly politicised issue, and the

[32] This was evident through body language or reluctance to talk about or give information about certain issues

research process illustrated clearly the challenges of communicating climate risks, and the polarised stances and significant psychological barriers to engagement with climate change adaptation.

7.5. Access to Information

7.5.1. Futures thinking

There was no awareness of climate scenarios such as UKCP09 amongst interviewees at FA & SR and these scenarios had not been used in decision making. However, in plans produced by organisations with an adaptation remit such as the EA and YCCP, the use of scenarios and futures thinking about climate change is clear[33]. The only site level document or interview where the UKCP09 scenarios were mentioned is in the Conservation Management Plan[34] (Hilary Taylor Landscape Associates Ltd, 2010), which was produced by consultants.

However, a proposal has been developed for some climate modelling work in partnership with a UK University to look at potential impacts of climate change on the built structures at the site. Funding for this work had not been secured, and it has therefore not yet proceeded. Barriers to futures thinking included the availability of the necessary resources to progress scenario work, a lack of trust in climate data and other competing, more 'immediate' concerns such as the ongoing economic crisis[35] (NT and CCP Interviews, 2012).

When asked what information would be useful to inform decision making in relation to future change, interviewees felt that having accurate, locally reliable information and models was very important. Some interviewees felt that In order to be able to take steps to adapt, it would be necessary to be able to anticipate or model potential changes, and so local and site level information about potential

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[33] Examples of this can be seen in the Ouse Catchment Flood Management Plan and YHCCP Adaptation Study

[34] At the time of research (2012) this was in draft, and was being produced by consultants with input from stakeholders

[35] This refers to the marked global economic decline that began in December 2007

impacts on the different elements of the site, rather than general scenarios, were desired (NT Interviews, 2012). This links back to the issues of how uncertainty can be handled in adaptation (section 7.4.2). In order to develop an adaptive approach to management, it may be necessary to develop adopt an approach which allows decision-taking under (irreducible) uncertainty, as the provision of accurate site level predictions for climate change, with low levels of associated uncertainty, is not a realistic prospect.

7.5.2. Monitoring

Information needed to take preventative or corrective actions may be picked up through monitoring of site condition or the occurrence and frequency of weather events. Many different types of monitoring are occurring, which are summarised in Table 24.

Different Types of Monitoring	Examples
Monitoring of Plans	6 monthly report produced on the delivery of WHS Management Plan, monitoring of indicators within Conservation and WHS Plans
Monitoring of Past Weather Events	Data exists which has not been compiled e.g. weather records, historical data on flooding at the site
Monitoring of River Levels/Flooding	No flood warnings from EA, but EA do have some records of river levels, and staff on site record river height once a month, and make a note of flooding events.
Monitoring of State of Conservation/Condition Surveys	Use of NT conservation performance indicators (identified in 2008 & reviewed in 2009), EH carries out condition surveys of Abbey ruins approx. every 5 yrs., day- to-day monitoring by those on site
External monitoring	UNESCO periodic review (every 6 years)

Table 24 Different types of monitoring which occur at FA &SR

One of the performance indicators in the updated WHS Management Plan (National Trust and English Heritage, 2009) used to monitor the overall conservation and management of the site specifies the requirement to record the changes on site/damage related to climate change. This includes the recording of any increase in the frequency and severity of flooding events, record of any increase in estate closure due to severe weather, record of tree loss due to high winds/unstable climatic conditions and record of additional resources needed to maintain the estate.

Despite the Management Plan indicator, as yet no formal monitoring/collection of data on weather events and their impacts is occurring (NT Interviews, 2012). One interviewee explains; "We don't really do much monitoring; we have got a big issue with data and availability of data, what data is out there and what people are collecting. Data exists, but it hasn't been pulled together or used" (NT Interview, 2012).

A significant amount of data does exist (shown in Table 24) which has been collected for a variety of other purposes, but has not been extracted to provide baseline data for monitoring. For example, there is now a weather station on site which collects information on wind speed, which is used to inform decisions on site closure, due to risks from the trees on site during high winds. Data on the state of conservation of the site is collected by the NT and EH and some data is collected on water levels by the landscape team. There are also many on-going surveys, for example fungi and botanical surveys, which if carried out over long enough periods of time may indicate whether any impacts are occurring.

Barriers to pulling this data together for the purposes of climate change monitoring were identified by interviewees. These overlap with barriers to implementing the Management Plan, which are discussed in section 7.6.2. The main common barrier was human resources, with staff not having time to carry out the work required, such as accessing and compiling the information alongside their existing responsibilities. Another key problem was the accessibility of some of the relevant information; with much data being held regionally (NT Interview, 2012).

7.5.3. Guidance and Information

The data from this node relates strongly to other nodes, in particular *policy instruments* and *human resources*. Specific policy issues are addressed in the following section 7.6.1, and Table 25 includes key plans, guidance and policy documents which are relevant to site management.

At a local and regional level, policies on climate change adaptation and heritage exist in the site WHS Management and Conservation Plans (Hilary Taylor Landscape Associates Ltd, 2010 ; National Trust and English Heritage, 2009), and in the AONB Heritage Strategy (Nidderdale AONB, 2009). An LCLIP, a Climate Change Risk Assessment and a Climate Change Strategy (Harrogate Borough Council, 2009a ; Regional Improvement and Efficiency Partnership, 2011) have been produced for HBC, although these primarily relate to the council's operations. The regional Climate Change Partnership has also produced a regional Adaptation Study (Yorkshire Futures, 2009), and a summary of climate change risks for Yorkshire and the Humber (Yorkshire & Humber Climate Change Partnership, 2012), although these regional strategies are not heritage related.

Although these strategies and policies on adaptation do exist, little guidance exists to help heritage managers put policy into practice, and interviewees had found few useful sources of information or guidance on climate change adaptation (NT Interviews, 2012). One interviewee had looked for guidance to help formulate a climate change strategy for FA & SR, and stated that publications like the UNESCO Case Studies on Climate Change and World Heritage (2007), are too general to be helpful to individual sites (NT Interview, 2012). More specific best practice case studies or methodologies were desired as well as site specific modelling information (NT and EH Interviews, 2012). However, according to the Yorkshire and Humber Climate Change Partnership, there is evidence of guidance fatigue, in local government, and the desire is to have the time and capacity to be taught to use existing tools, rather than be given more (YHCCP Interview, 2012).

The main sources of guidance which are mentioned by interviewees are the internal climate change specialists within the NT and EH. These staff are identified as the source where further information and help on specific issues such as climate change could be sought, although their assistance has mainly been with the development of the Management Plan. Heritage sites which are managed by organisations such as NT and EH (as opposed to individual landowners) may benefit from a greater resource of freely available guidance and skills due to the multiple roles these organisations have e.g. policy makers, managers and campaigners. This includes publicly available NT and EH documents e.g. Climate

Change and the Historic Environment (English Heritage, 2008a) as well as internal documents and intranet resources. There is more interest amongst site managers in access to skills than to more guidance documents; however it seems that full use of the resources within these organisations is not being made by those at site level.

7.6. Authority

7.6.1. Policy Instruments

At a regional level, the now abolished RSS for Yorkshire and Humber (Government Office for Yorkshire and Humber, 2008) included the consideration of climate impacts and adaptation as a central element of its core approach, and included reference to potential impacts of climate change on tourism, such as opportunities related to longer growing seasons, although a direct consideration of climate change impacts on heritage sites was not mentioned. Several plans and studies have been produced on climate change at a regional level, mainly by the partnerships such as the YHCCP, which provide details of potential impacts on the region as well as recommendations. An assessment of risks to different sectors in the region was published in 2012 (Yorkshire & Humber Climate Change Partnership) to coincide with the CCRA, and some impacts on natural heritage e.g. coastline are included within this; the WH Sites are mentioned, although there is no specific consideration of impacts on cultural heritage.

Policy Level	Examples of Key Policy and Guidance Documents relevant to Site Management and Climate Change Adaptation (last 5 years)
Regional	EA Ouse Catchment Flood Management Plan (Environment Agency, 2010)
	Yorkshire and Humber Plan: Regional Spatial Strategy to 2026 (to be revoked under Localism Act - effectively abolished) (Government Office for Yorkshire and Humber, 2008)
	Nidderdale AONB Management Plan and Heritage Strategy 2009 – 2014 (Nidderdale AONB, 2009)
	Climate Change Plan for Yorkshire and the Humber (Yorkshire and Humber Climate Change Partnership, 2009), Yorkshire and Humber Regional Adaptation Study: Weathering the Storm (Yorkshire Futures, 2009) and a Summary of Climate Change Risks for Yorkshire and Humber (Yorkshire & Humber Climate Change Partnership, 2012)
Local	Harrogate Borough Council Core Strategy (adopted 2009) and Saved Policies in Local Plan (Harrogate Borough Council, 2009b ; Harrogate District Council, 2007)
	Harrogate Climate Change Strategy (Harrogate Borough Council, 2009a)
	Harrogate Borough Council Climate Change Comprehensive Risk Assessment (Regional Improvement and Efficiency Partnership, 2011)
Site	Fountains Abbey and Studley Royal World Heritage Site Management Plan 2009-14 (National Trust and English Heritage, 2009)
	Fountains Abbey and Studley Royal Conservation Management Plan (Draft) 2010 (Hilary Taylor Landscape Associates Ltd, 2010)

Table 25 Policy and guidance relevant to FA &SR Site Management

At a local level, detailed protection of the WHS is provided by Harrogate Borough Council's Local Development Framework (see Table 25), with policies in the Core Strategy and saved policies in the Local Plan, which afford a very strict level of protection for the site. Climate change issues form a key element of the Core Strategy, with the focus being predominantly on mitigation and only a minor consideration of adaptation. There is no specific mention of climate adaptation and heritage. Additional non-statutory protection is afforded by the Nidderdale AONB Management Plan, the EA's Catchment Flood Management Plans and Harrogate Borough Council's Sites of Importance for Nature Conservation designation. The management of the site will also be influenced by NT and EH policies such as the NT Water Policy, Nature Conservation Policy. The Trust's position regarding climate change is outlined in documents such as these; for example in the Sustainable Management of Gardens Policy it is stated that 'The Trust will seek to conserve the significance, character of each garden and any associated important plant collections, whilst accepting the need to adapt to climate change where this is deemed unsustainable' (National Trust and English Heritage, 2009).

Under the requirements of the 1975 Reservoirs Act (UK Parliament, 1975), Studley lake was drained in 2010 to allow dam inspection work to take place. This has been used as an opportunity by FA & SR to allow work on structures which normally lie below the water's surface, to de-silt the lake, removing a silt island which was not part of the original garden design, improving the water quality and benefiting inhabitant wildlife. Removing silt and maintaining the reflective qualities of the lake and water bodies is also important to retaining features which contribute to the site's OUV (NT and EA Interviews, 2012) and (BBC News, 2010).

As at other local authorities, the work at HBC on adaptation, such as the LCLIP and risk assessment, was given momentum by NI188, which has now been abolished (YCCP Interview, 2012). However, in 2011 a comprehensive risk assessment was published which indicated that work on adaptation has continued after the abolition of the indicator. Currently, resource constraints have resulted in staff cuts and the need to strictly prioritise climate change work (Pers Comm, Climate Change Officer, HBC, 2012), but it is unclear how this is affecting work on adaptation[36].

7.6.2. Act According to Plan

The work of the NT is guided by a NT National Strategic Plan and Regional Business Plan. There are multiple site level plans at FA &SR; the Estate has a three year Property Plan which flows from these national/regional documents, as well as a World Heritage Site Management Plan and Conservation Plan. Specific subject plans include a Marketing Plan and Emergency Plan.

The World Heritage Site Management Plan (National Trust and English Heritage, 2009) guides site management from 2009-2014, and is a revision of an earlier

[36] It was not possible to interview someone from the climate change team at HBC, due to these cuts and their need to prioritise their workload

2001 version. Climate change impacts have been identified as a key management issue in the current plan, and the issue of climate change is addressed in a comprehensive way throughout the document. A long term management objective outlines the planned approach to address this issue, and a climate change monitoring indicator is included (see section 7.5.2). The long-term objective is to 'examine the impact of climate change on all objectives and adopt a strategy for accommodation and adaptation.' Key actions for the next 6 years are to:

'G1 Monitor the effects of climate change on the estate, utilising existing research and commissioning new research as required, giving an improved understanding of what is likely to be the impact of climate change on the site in the future
G2 Investigate and identify a strategy aiming to mitigate some of the worst expected effects of climate change for the site
G3 Produce and implement a plan in response to the above' (National Trust and English Heritage, 2009, p46).

This WHS Management Plan compares very favourably to plans for other UK World Heritage Sites, many of which are out of date and have not yet been updated to include climate change issues (see Table 4). The actions laid out above in the Management Plan have begun, but are in their early stages. From conversations with staff at the site, it is apparent that there are efforts underway to start to address the first action (G1), for example the proposed project to look at potential climate impacts with Leeds University. The World Heritage Site Coordinator has begun to write a discussion paper on climate change issues at the site, to try identify what some of the direct impacts and consequences may be.

Many issues were raised during the research in relation to implementation of the policies and actions in the WHS Management Plan, and some of the barriers to this. Despite the strengths of the plan in terms of addressing climate change, there does seem to be an 'implementation gap' between what is set out in the document and what has been carried out on the ground so far. Climate change is acknowledged as a challenging area of work, and some of the issues identified which are limiting implementation include access to the necessary skills and knowledge, the issue of uncertainty and limited human and financial resources.

The broad scope of potential climate change impacts and thus the overwhelming range of issues to look at is also a challenge. The types of barriers perceived by key management personnel are shown in Table 26 below, and these are also challenges to monitoring the climate change indicators from the WHS Plan. Issues raised in the cognitive section of this chapter are also influencing the implementation of the plan, with different levels of engagement and motivation amongst different individuals, many competing pressures for staff time (which may be perceived as more 'immediate'), and the need for the input of range of different staff members to effectively implement the plan.

Issue	Illustrative Quote
Skills/Knowledge	The skills that you need... you have to understand or know where to go for so many different kinds of information because you're looking at ecology, archaeology and landscape issues and it's very challenging from that point of view (NT Interview, 2012)
Human Resources	I think to properly develop for example; the type of actions that are in this plan needs someone to be doing that full time for a while (NT Interview, 2012)
Financial Resources	We have tried to get into simulation work ... although we have applied for two potential grants, we have lost out to other projects (NT Interview, 2012)
Broad scope of climate change issues	When you say, write a strategy to mitigate against the impacts of climate change, I just think it could be anything! I think it's a case of setting some priorities for specific impacts on the site and then just trying to address those (NT Interview, 2012)

Table 26 Perceived barriers to implementing climate change policies in the WHS Management Plan

The draft Conservation Management Plan, produced by external consultants with input from NT specialists and site staff, addresses potential threats and vulnerabilities to the site such as the impacts of visitors, pests and diseases, tree management, and catastrophes (which includes flooding events). Climate change is one of these threats. The UKCP09 climate scenarios are briefly referred to in the plan and climate change is also included as an issue in the framework Conservation Policies for the site. It is also recommended that an Emergency Management Plan, regularly updated, should highlight all the potentially most damaging consequences of climate change, and record considered responses.

The existence of an Emergency Plan was confirmed by two senior members of staff at the site[37]. However, it was not considered by them (NT interviews, 2012) to be a crucial document when responding to events such as flooding, due to the particular characteristics of the site. Unlike other heritage sites, there is no movable heritage e.g. furniture, museum collection, which need to be recovered in the event of a flood. This Emergency Plan therefore relates to the safety of staff and visitors.

Although both the Conservation and Management Plans address climate change, the Conservation Plan has a narrower conservation focus, and there is more emphasis on climate change as a central management issue in the WHS Management Plan. Both these plans focus on climate change impacts on heritage fabric and landscape, but there is little focus on the potential impacts climate change may have on management/operational issues.

7.6.3. Political Will

Politically, addressing flooding through Ripon and protecting its population is a high priority. A major £14.4 million scheme[38] to help reduce flood risk in Ripon has been implemented (Figure 65 and Figure 66), which, according to the EA 'will significantly reduce the risk of flooding from these rivers and will help to protect 548 residential and 96 commercial properties in Ripon city' (Environment Agency, 2012e). These measures will not help with flooding issues at FA & SR, and an NT source explains that although the issues on the river that runs through the site may be a high priority for them, for the EA and on a national scale they are low, and therefore the river has not had the investment in comparison to the rivers that run through Ripon[39] (NT Interview, 2012). According to the EA it has also been difficult to justify the cost of gauges to monitor the river which affects FA& SR, due to the fact that there are no settlements along the river above the heritage site (EA Interview, 2012).

[37] It was not possible to view the Emergency Plan. It is unclear whether climate change is specifically included as an issue in this document.

[38] This scheme is the Ripon Rivers Flood Alleviation Scheme

[39] Ripon is situated where the rivers Skell, Laver and Ure meet

 

Figure 65 Ripon – A new weir and improvements to river banks on the River Skell (2012)
Figure 66 Ripon – Improvements to river banks to defend river channel and protect property (2012)

This issue indicates how priorities for flood investment are selected, and that heritage is not a factor in this. However, past projects such as the Ripon MOP[40] do indicate that the will exists amongst many local stakeholders to commit to such work, although the main focus of this project is now the river which affects Ripon. This is due to the fact the settlement of Ripon is affected by flooding of the Laver; and no more funding for the Ripon MOP on the Skell is available. Flood management requires engagement in issues at a wider scale than just site level, and therefore wider land ownership and management issues are also a factor in the effectiveness of such schemes, and the NT have looked at land acquisition further upstream to help manage flood risk.

The wider political landscape on climate adaptation is also an influential factor when considering the capacity to adapt at site level, as discussed in Chapter 5. There is less direct involvement by the local authority in site management at FA & SR than at other sites such as Ironbridge Gorge. Nevertheless, budget cuts and changing political priorities are affecting capacity at HBC (section 7.7.2), and changes to regional level structures are affecting the wider support networks available for adaptation. In the past at a regional level, the Regional Improvement and Efficiency Partnership provided a three year programme of support and training for local authorities in Yorkshire and Humber on the subject of climate

[40] The Ripon MOP (Multi-Objective Project) was funded by the EA and provided a grant scheme for farmers to carry out capital works on the Rivers Skell, Laver and Kex Beck and their tributaries. It aimed to slow down water runoff from the land through land management projects and reduce flood risk.

change, however this concluded in March 2011. An interesting point made by an individual from YCCP is that, in London, there is a stronger mandate to put plans together and actions on adaptation than outside the capital, where work is "franchised down to smaller levels" (YCCP Interview, 2012). This is considered to be due to the governance structure and funding available in London, particularly the existence of the mayor and GLA, and the development of the London Plan (Greater London Authority, 2011) and Mayor's Adaptation Strategy (Greater London Authority, 2010).

7.7. Resources

7.7.1. Human Resources

Local knowledge and experience contribute to risk preparedness and to responding appropriately to threats at FA & SR. There were several staff members who had been working on site for over 20 years, who were considered experts on site and were looked to for knowledge of the history and resilience to flooding events. Local knowledge and experience also contribute to the ability to correctly anticipate threats e.g. interpreting local weather conditions through experience, in order to prepare for an event (NT and EH interview, 2012).

As discussed in section 7.5.3, the NT can call on its own internal specialists for specific areas of work, and when the WHS Management Plan was reviewed, an internal climate change specialist was used to assist with incorporating climate change issues into the plan. This specialist "pushed really hard for quite a lot of the climate change in the WHS Plan" (NT Interview, 2012). However, despite this resource, it seems that the necessary skills and knowledge aren't available to implement this at the site, and there does not seem to have been significant input on climate change since the review of the plan. Many stakeholders expressed the need for specialist skills, for example to assess trends and carry out modelling, as well as to provide advice on actions that should be taken in the short term (NT and EH Interviews, 2012). It is clear that access to more knowledge and skills to assist with implementation of climate change policies is important, as well as during plan formulation.

As well as access to the necessary skills, the availability of time and manpower is also a crucial determinant of adaptive capacity. The work force available on site comprises 65 regular staff, and in addition 325 volunteers contribute a variety of skills to aid the running of the site (National Trust and English Heritage, 2009). Some volunteers have helped contribute to work linked to the climate change agenda. However, regular staff are unable to commit the time required to carry out the work that is required to meet the climate change objectives of the WHS Plan alongside their existing work and other priorities at the site. As one member of staff explains "It's an area that I've been aware that we need to start progressive work on but I've just not had the chance to do...I've just not taken as far as I would like and it is down to resources in some ways, because I've got to do the other things that we are trying to address on the property" (NT Interview, 2012). As well as resource constraints at site level, there are also pressures on human resources at a wider level. For example, the local authority climate change team has seen cuts in staff[41], as part of wider cuts in local authorities, and is having to strictly prioritise work (HBC Pers Comm, 2012).

7.7.2. Financial Resources

The availability and allocation of resources is greatly influenced by political will (see section 7.6.3), and the commitment of resources by an organization reflects not only the availability of resources but how much of a priority this issue is considered to be. The issue of the allocation of financial resources by external agencies for flood management projects on the River Skell clearly illustrates this. In contrast, at the previous case study, Ironbridge Gorge, where there is a resident population, there has been a significant commitment of financial resources by central government to manage risks from land instability.

The estate is self-funding in terms of annual operating costs, and over 80% of the operating income comes from visitors[42]. This income is subject to visitors

[41] In Harrogate BC between 2010 and 2013, 19.9 % of the 2010 public sector workforce have been cut (The Guardian, 2012)

[42] Income is raised via admission fees, membership recruitment, catering, retail, events and donations

continuing to come to the estate regardless of the weather and the wider tourism market (National Trust and English Heritage, 2009). In 2009 there was a backlog of conservation project work of £10 million, and so the site also looks to external funding wherever possible to fund essential conservation and access works[43] (National Trust and English Heritage, 2009). As with other UK World Heritage Sites, there is no funding available from UNESCO. External sources of funding would need to be sought for large projects, such as the funding which was sought for the climate modelling work with Leeds University.

Finances are evidently a barrier when it comes to climate change projects at FA & SR. Several staff members mention examples of projects which could be carried out but costs may be prohibitive, for example, works to reinstate a collapsed tunnel underneath the abbey, which could help with water flow, and investment in irrigation to protect vulnerable trees in the landscape (EH and NT interviews, 2012). The commitment of financial resources for climate change adaptation can be challenging as it may be difficult to calculate the benefits financially, despite the fact that past weather events such as floods have been financially costly (section 7.3.1). As one stakeholder from EH explains "financial resources are a barrier. I'm not sure if people really know how much to spend on it [climate change]. Because our sites are charged, the guardianships are charged with making as much money as they can, so there was a period when talking about climate change was absolute anathema to them because they could see pound signs" (EH Interview, 2012).

As mentioned in section 7.6.3, wider formal networks and projects which support adaptation e.g. Climate Change team at the council and the Yorkshire and Humber Climate Change Partnership, which are publicly funded, are experiencing pressures due to the economic situation and government restructuring at the regional level (YHCCP Interview, 2012). In these times of austerity, the need for the business case for adaptation to be made - emphasising how adaptation could

[43] The site has generated funding from legacies, grants and gifts, such as from the EU *Converting Sacred Spaces* scheme. This provided £370,000 to repair river walls which have been damaged through erosion and flooding and to carry out conservation work in the Abbey (European Communities, 2008 ; National Trust and English Heritage, 2009)

save money, rather than increase costs, is seen by some as the way forward (YHCCP Interview, 2012).

7.8. Leadership

Several different types of leadership were evident at this case study including *buy in from the top, the existence of motivators/champions,* and a *holistic management approach*, both at the site itself and more widely. The General Manager of the site is engaged with the issue of climate change adaptation, and explains the need to be proactive in the way the site is managed. As an organisation, the NT, who lead site management, is considered to be forward thinking as regards climate change (see Chapter 5) and the NT is more involved with climate adaptation work on site than EH (EH Interview, 2012).

There are undoubtedly climate adaptation 'champions' within the NT who are influencing and motivating work in this area, some on site and some at a regional/national level. For example, different NT staff members have successfully pushed to get climate change recognised in both the WHS Management Plan and Conservation Management Plan[44] (NT Interviews, 2012).

There is evidence that partnerships and networks are positively influencing the capacity to adapt. Yorkshire and Humber Climate Change Partnership and Regional Improvement and Efficiency Partnership have played a motivating and supporting role in the region, encouraging the development of skills and knowledge and encouraging communication and partnership working on climate change issues. Although not directly involved with FA &SR, these partnerships have worked with HBC. Many different projects have been instigated across the region, including a climate change leadership programme, efforts to engage with the voluntary and business sector, support for local authorities to carry out LCLIPs and a financial award from DCLG for a climate change skills fund (Yorkshire and Humber Improvement and Efficiency Partnership, 2011). The skills fund included projects which had heritage elements, including a training programme for

[44] Although translating this into coherent action is proving challenging

planning officers and elected members, which included advice on how to balance climate mitigation and heritage conservation. The new role of partnerships such as this in the era of localism is still emerging, but in Yorkshire and Humber it is clear that they have helped to support local authorities to deliver targets (such as those related to NI188) and encouraged joint working.

FA & SR sits within an area with an AONB designation, and being part of the AONB 'network' is regarded as positive for the management of the property (NT Interview, 2012). The AONB management have helped influence and deliver projects which benefit FA & SR, but require a holistic approach to site management, such as the Ripon MOP (NT Interview, 2012). The AONB team are involved working with a range of different stakeholders and delivery partners e.g. EH, Yorkshire Water, landowners, Natural England (NE). A member of NT staff explains that "through the AONB we are part of a wider local network, and the AONB seem to be quite active and quite a catalyst for bringing together different partners because we are just one small property, whereas they cover a far bigger area" (NT Interview, 2012).

As well as these formal networks being valuable, informal networks are also providing beneficial connections and channels for communication. It is not just actions within the site which affect issues such as flooding, and a holistic management approach and collaboration with external agencies and landowners is an important factor in the capacity to adapt. For example, the NT are trying to influence work on moor land (which does not belong to the NT), to slow run off from the peat bogs. There are also examples of good communication with local stakeholders helping to prevent an exacerbation of flood risk.[45]

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[45] The landowners of a property further upstream which has the Skell running through it, contacted the NT to discuss building plans which may have exacerbated flooding at FA & SR, before starting work. This is considered to be as a result of the NT effectively engaging with local landowners (HBC Interview, 2012).

7.9. Reflections on the Original Conceptual Framework

The revised conceptual framework which had been developed through analysis at Ironbridge was used as the starting point for the analysis at FA &SR. Through the process of coding and analysis, it became clear which existing nodes/determinants were relevant for this case study, and new nodes also emerged. The revised framework is shown below in Figure 67.

All the existing nodes from the revised framework were found to be relevant for this site, although some new nodes were also created. Links and relationships between different nodes were evident, and, as at the previous case study, these often overlapped or were interrelated. As pieces of case study data were often relevant for several different nodes within the framework, this created some challenges during the analysis process. The use of the NVivo tool was invaluable as this allowed data to be coded to several different nodes simultaneously. However, separating data into different nodes has made it difficult to fully represent the overlaps between them. The definitions of the different nodes will need to be clarified in the final framework, in order to ensure the scope of different nodes is clearly delineated.

As at the previous case study, overlaps were particularly apparent between *human resources* and *financial resources* and between *policy instruments* and *guidance and information*. There were also clear relationships between *creation of a vision* and *act according to plan*, and between *political will* and *resources*. *World view (cognitive factors*) was a fundamental node, as individual perceptions of the same issue/situation often varied notably between different interviewees, and *cognitive factors* significantly influenced other elements of this framework e.g. the existence of *motivators/champions*, and *act according to plan*.

Heritage as a resource for learning was added as a sub node of *learning capacity*, due to the evidence of past impacts and adaptations to weather and climate at FA & SR. Within the *leadership* node, two sub nodes were added, *creation of a vision* and *holistic management approach*. A *holistic management approach* was considered particularly important in order to allow adaptive actions at a wider scale than just site level, and *communication and collaboration* contributed to this. Networks such as the AONB (which were found to be relevant both here and at Ironbridge Gorge), are included within the scope of this node, which also influenced other determinants such as *human resources* and *learning*. The *creation of a vision* for adaptation, was, on reflection, thought to be relevant to both FA &SR and Ironbridge, and was related to the node *act according to plan*.

Several new nodes were created which have not yet been placed. Their place in final framework will be reflected upon further in the discussion in Chapter 9. As at Ironbridge Gorge, *uncertainty* and *integration of heritage into other disciplines* were topics which were relevant at this case, and new nodes *tensions and conflicts between agendas* and *technological limits to protection* were also created.

The framework and the process of analysis using NVivo provided an illuminating way of investigating determinants of adaptive capacity at this case. This process is acknowledged to be subjective; and this is a characteristic of qualitative data analysis, as explained in the research methodology. The use of this type of conceptual framework and process of analysis cannot fully represent the complex interrelationships at play between determinants; however this approach has highlighted many strengths and weaknesses in capacity at FA&SR and facilitates comparison between different case studies.

Parent Nodes	Subnodes	Subnodes
Cognitive factors (world view)		
	Individual risk appraisal	
	Perceived adaptive capacity	
Learning Capacity		
	Institutional memory	
		Use of heritage as a resource for learning
	Single Loop Learning	
	Double Loop learning	
Access to Information		
	Futures thinking	
	Guidance and Information	
	Monitoring	
Authority		
	Policy instruments	
		Act According to Plan
	Political will	
Resources		
	Financial Resources	
	Human Resources	
		Local knowledge and experience
		Relevant skills and expertise
		Manpower available
Leadership		
	Buy in from the top	
	Existence of motivators/champions	
	Creation of a vision	
	Holistic management approach	
		Communication and collaboration
Nodes which have not yet been placed:		
Technological limits to protection		
Tensions & conflicts		
Uncertainty		
Integration of heritage into other disciplines		

Figure 67 Revised conceptual framework (after Ironbridge and FA &SR analysis)

7.10. Conclusion

Political will emerges as an important element of adaptive capacity at this case. The fact that the FA & SR site is not integrated into a settlement is a critical factor in understanding financial commitments and levels of activity by agencies such as the EA in relation to the site, as their remit focuses on the protection of communities and property. The organisations and agencies charged with risk reduction and response to events such as flooding do not have a heritage remit, and this is therefore low in their priorities.

FA & SR benefits from being primarily managed by the NT, an organisation which has been engaged in the climate adaptation agenda for many years. Resources and skills have been available which would not necessarily be as accessible to other sites with private land owners/managers, and the NT policies will also influence site management. The WHS Management Plan is up to date and addresses climate change adaptation in a thorough way, influenced by climate change specialists within the organisation.

However, analysis has highlighted an implementation gap, and barriers to implementing the Management Plan are currently slowing the achievement of stated indicators and objectives. Resources (human and financial) are key barriers, as is the wide range of skills and understanding required to carry forward work on the different elements of the site. It is clear that access to adequate resources is important both during plan formation and subsequently, in order to effectively implement the policies. Information on climate risks which is currently available is perceived by site managers as being too general, and trustworthy site level information rather than general scenario data is desired. Given that heritage sites often contain diverse elements with different levels of sensitivity, this reliable, local level data would be considered particularly valuable. However, the focus on technical/scientific approaches to dealing with uncertainty, and improved predictions, needs to be overcome as this data is unlikely to be available in the near future. In order to move forward, new approaches to dealing with uncertainty need to be developed e.g. adaptive management approaches or participatory scenario development.

A holistic management approach and having connections to wider networks (both formal and informal) and partnerships has been highlighted as something which enhances adaptive capacity, for example by facilitating learning. Networks within organisations such as NT, EA and EH are important – such organisations can be so large that individuals in one department often do not appear to be aware of what is happening in another part of the organisation and therefore available resources and information are not accessed. The skills and information needed to address the issue of climate change and develop strategies may not be present on site, and so in many cases external support and resources will be fundamental to the development and implementation of climate change strategies.

World view and cognitive factors such as risk perception greatly influence motivation to take adaptive action, and in the field of heritage, personal attitudes and philosophies on heritage conservation and attitudes to change are also pertinent. Both the fields of climate change adaptation and heritage conservation are filled with debate, disagreement and sensitivities.

In the current political era of deregulation and localism, and with the abolition of target setting such as performance indicators, individual motivation and perceptions may be increasingly influential. At a local level, the existence of effective communication, training and awareness raising about climate change adaptation, has the potential to greatly affect the capacity to adapt. Heritage can be a resource for learning about climate change and past adaptations, as is clear at this case study. Heritage sites such as FA &SR have a large public audience due to their high profile and significant number of visitors, and some heritage sites have the potential to be an educational resource, and a tool for communication about some of these issues of climate change impacts and resilience.

CHAPTER 8 BLENHEIM PALACE WORLD HERITAGE SITE

8.1. Introduction

The third case study, Blenheim Palace World Heritage Site, will be the focus of this chapter. This will follow a similar format to the previous two case study chapters. The data has been drawn from a series of interviews (Table 27) and a review of relevant documentary evidence. The conceptual framework developed through the analysis at the previous two case studies was used as the starting point for an assessment of adaptive capacity at this case.

Organisation	Role
Blenheim Estate	Rural Enterprises Manager
Blenheim Estate	Property Director
Blenheim Estate	Head Gardener
English Heritage	Historic Buildings Inspector
Natural England	Senior Adviser Heritage Estates, Inheritance Tax Exemption
Natural England	Oxon & Bucks Land Management Team
Email correspondence with:	
Environment Agency	Reservoir Safety Officer
Independent	Reservoirs Panel Engineer
Peter Brett Associates	Principal Hydrologist
CEH Wallingford	Flood Estimation Research & Development
West Oxfordshire District Council	Senior Planning Officer
West Oxfordshire District Council	Technical Services Manager
Climate South East	Programme Manager

Table 27 List of interviewees (conducted between October 2012 and January 2013)

8.2. Background and Context

8.2.1. Introduction to the Site

Blenheim Palace, in Oxfordshire, was built between 1705 and 1722 and was presented by the English nation to John Churchill, first Duke of Marlborough, in recognition of his victory in 1704 over French and Bavarian troops. According to UNESCO, the palace is ‘characterized by an eclectic style and a return to national roots, a perfect example of an 18th-century princely dwelling’ (2012a). The palace stands in a romantic park created by the landscape gardener 'Capability' Brown (Figure 69 and Figure 70).

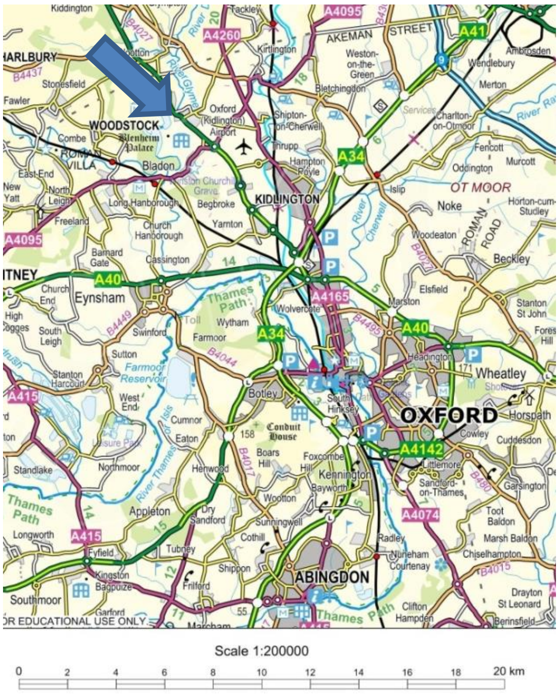


Figure 68 Map indicating the location of Blenheim Palace, Oxfordshire (Edina Digimap, 2012)
Crown Copyright 2013 An Ordnance Survey/Edina supplied service

Blenheim lies north-west of Oxford, west of the town of Woodstock (see Figure 68), and the River Glyme runs through the park. The Palace is surrounded by 10 km² of enclosed parkland, and this area constitutes the World Heritage Site (see Figure 72 which indicates WHS boundary). The World Heritage Site sits within the wider Blenheim Estate which covers approx. 49km². The palace and park are home to the 11th Duke and Duchess of Marlborough, with much of the site open to the public, attracting approximately 550,000 visitors a year (Blenheim Palace, 2012).


Figure 69 View of Vanbrugh's Grand Bridge
Figure 70 The Great Court, front façade, wings, and giant Corinthian portico of the Palace

8.2.2. History and Significance of the Site

Blenheim Palace was inscribed as a World Heritage site in 1987 for its architectural importance and its landscaped park. As well as being a work of landscape art in its own right, the park provides the setting for the grand palace, designed by John Vanbrugh and Nicholas Hawksmoor, two of England's most notable architects. The original landscape set out by Vanbrugh, who regulated the course of the River Glyme, was later modified by 'Capability' Brown who created two lakes, seen as one of the greatest examples of naturalistic landscape design (UNESCO, 2012a). The site was inscribed as a World Heritage Site under the following criteria:

'Criterion (ii): By their refusal of the French models of classicism, the Palace and Park illustrate the beginnings of the English Romantic movement which was characterised by the eclecticism of its inspiration, its return to national sources and its love of nature. The influence of Blenheim on the architecture and organisation of space in the 18th and 19th centuries was greatly felt in both England and abroad.

Criterion (iv): Built by the nation to honour one of its heroes, Blenheim is, above all, the home of an English aristocrat, the 1st Duke of Marlborough, who was also Prince of the Germanic Holy Roman Empire, as we are reminded in the decoration of the Great Drawing Room by Louis Laguerre (1719–20)' (UNESCO, 2012a).

The Palace is constructed from limestone ashlar with a symmetrical plan, including a great hall leading to the saloon with state apartments on each side. Elements of the early eighteenth century landscape survive, such as the grand avenue, formal layouts and an ancient wood pasture. A double lake bisected by Vanbrugh's bridge flows over a naturalistic cascade at its southern end.

The Park has several distinct character areas, including High Park, a remnant of a very large medieval deer forest, the Pleasure Grounds, which comprise formal gardens and ornamental areas including a sunken Italian Garden and formal terraced water garden, and Brown's Centrepiece – rolling parkland grass with carefully placed groups of trees, spanned by Vanbrugh's bridge, with a sequence of carefully framed views. The WHS boundary and some key features of the site are illustrated in Figure 71 and Figure 72.

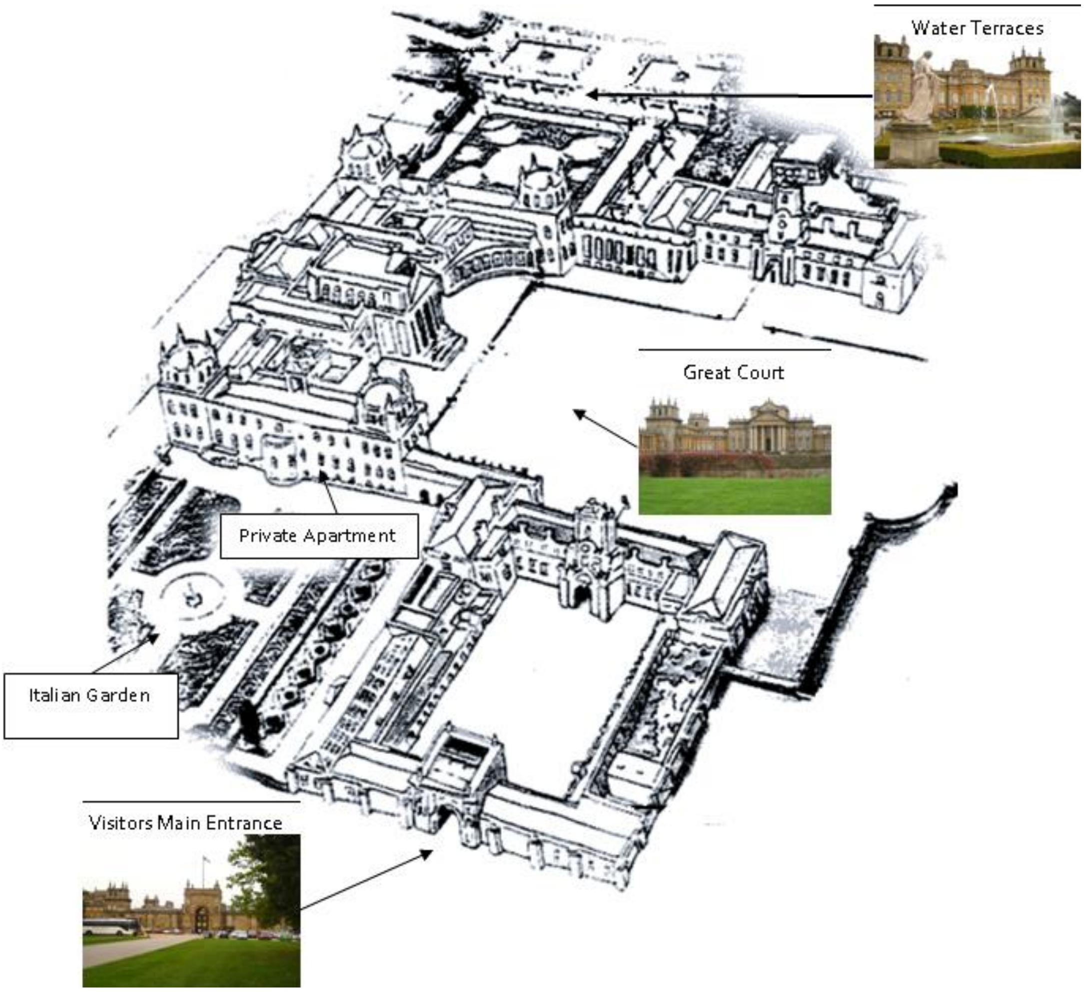


Figure 71 Plan of Blenheim Palace, adapted from Blenheim Estate (2013). Copyright permission granted by Blenheim Estate.

The lakes and the ancient woodland of High Park are designated as Sites of Special Scientific Interest (SSSI) due to the ancient trees, invertebrates and breeding birds (see Appendix 12: Map of the Blenheim SSSI). Part of the setting of the property is within the Conservation Areas of Woodstock and Bladon and part is in the Cotswolds Area of Outstanding Natural Beauty. The Property as a whole is designated as a Grade I registered Park and Garden, and forty five key buildings on the site are Grade I and Grade II* Listed Buildings with the park wall designated Grade II. There are also five Scheduled Ancient Monuments[46] within the Park (Historic Landscape Management, 2010 ; Natural England, 2012b).

[46] The five Scheduled Ancient Monuments are Bowl Barrow, Grim's Ditch (2), Roman British Temple, Medieval Pillow Mounds.

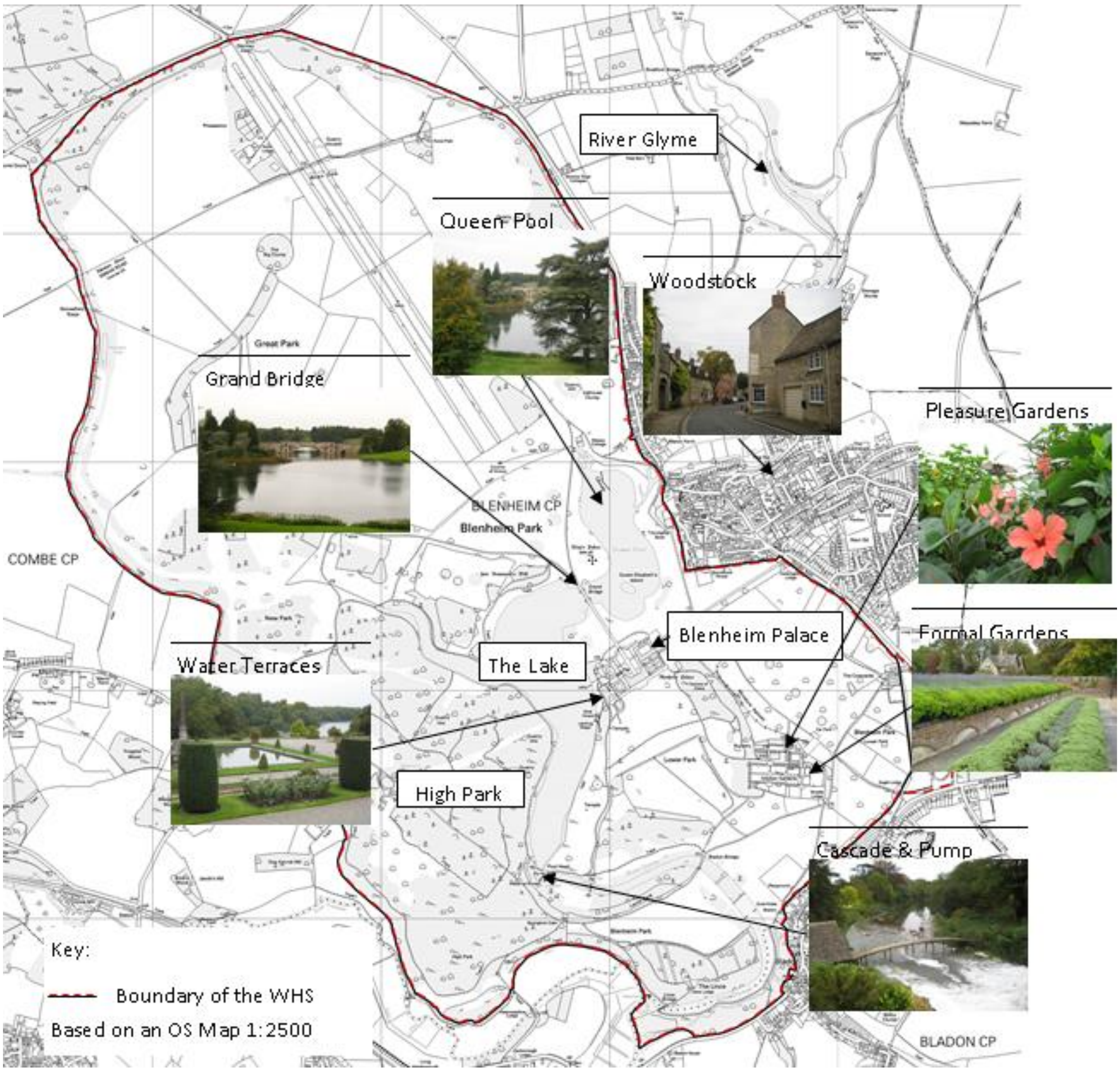


Figure 72 Map of Blenheim Palace and Park indicating the boundary of the WHS area and some key features of the site Adapted from Historic Landscape Management (2006) Copyright permission granted by Blenheim Estate.

8.2.3. Management Systems and Ownership Arrangements

The entire property is within family ownership, the successive Dukes of Marlborough, for whom it was built. The World Heritage Site is managed by the Blenheim Estate, which has primary responsibility for its management. Following a court order in 1994, Blenheim Palace, its gardens and the Park surrounding Blenheim Palace were conveyed by the 11th Duke of Marlborough to a Board of Trustees. Under the terms of the Settlement, the Duke is entitled to a life interest in the Trust. The board of Trustees provide continuity and security under successive generations of ownership of the Estate.

Since 1985 the Treasury have designated the Palace, its gardens, grounds and park as conditionally exempt from inheritance tax. As a condition of this exemption the owner must allow reasonable public access to the site and take steps for ‘maintenance, preservation and repair’ (English Heritage, 2012c). This requirement therefore greatly affects the way the site is managed, with regular monitoring of the conditions of the exemption. The running of the Palace and Park is funded by income from visitors and activities in the wider Estate.

Management of the Estate is overseen by the Chief Executive who is supported by the following staff: Property Director (responsible for all the buildings in the park, including repairs and maintenance of the palace), Head of Operations (responsible for the opening of the palace and grounds to the public and overseeing events), Rural Enterprises Manager (responsible for the management of the Parkland and woodland and supporting operations with regard to event management), Head Gamekeeper (responsible for the management of the shoot, and control of wild deer) and the Head Gardener (responsible for the presentation of the gardens, pleasure grounds, visitor areas and mowing). This team reports to the Duke of Marlborough and the Board of Trustees (Historic Landscape Management, 2006).

There is no specific World Heritage Site coordinator role; however there is a WHS steering group which meets annually, and the Rural Enterprises Manager has the effective role of the WHS Coordinator. The steering group members include representatives of the Estate and external agencies with interests in the site, including EH[47], West Oxfordshire District Council[48] (WODC), Oxfordshire County Council, ICOMOS UK and NE.

[47] Limited information was available on the role of EH at the site, due to constrained access to EH stakeholders

[48] WODC are the local planning authority

8.3. The Impacts of Past Severe Weather Events on the Site (LCLIP Approach)

8.3.1. Media Review

The media review of events indicates that there is no one particular weather condition to which Blenheim Palace is particularly vulnerable. However, over the last five years, the main focus of media reports is on the effects of weather conditions on tourism, visitor numbers and organised events which are being held at the site (Figure 73 and Figure 74). Wet weather has caused lower visitor numbers, notably due to the widespread media coverage of flooding in 2007, which is thought to have discouraged visitors to the area, although Blenheim Palace and Park were not flooded[49]. Conversely warm temperatures boost attendance at Blenheim events.

Year	Type of Event	Description and Impacts	Source	Title
2012	Heavy rain	Prolonged summer rain affects Diamond Jubilee celebrations – at Blenheim a cricket match was cancelled to protect the pitch for the celebrity match the following day.	Witney Gazette	Parties go off with a bang despite the rain
2010	Cold weather	Freezing temperatures. Fire caused when blowtorch used to try to defrost outside water pipe at Blenheim	Witney Gazette	Drama at Blenheim Palace as bird's nest starts fire
2010	Warm temperatures	Warm temperatures boosted attendance at a charity walk at Blenheim	Oxford Mail	Sun beats down on palace walkers
2008	Rain and flooding	Heavy rain in Oxfordshire. Blenheim Horse Trials cancelled due to rain and waterlogging of the course	The Oxford Times	Villagers hit by flash flood
2008	Cold weather	Heavy snow caused cancellation of charity run at Blenheim Palace	Oxford Mail	Cold snap set to continue
2007	Heavy rain and flooding	Media reports of UK flooding led to reduction in tourist and visitors numbers, including at Blenheim Palace	The Oxford Times	Flood films hit tourist trade

Table 28 Summary of media search of weather events which have affected Blenheim between 2007- 2012

[49] The River Glyme and Evenlode are in a 'flood alert area' and have regularly been on flood alert throughout 2012 and Jan 2013, although no specific 'flood warnings' have been issued for the River Glyme since 2008 (Environment Agency, 2013)

The evidence from the media review (Table 28) is corroborated by the opinions of site managers. The business is very weather dependent, so heavy rain, snow and poor weather conditions are a key issue for the Estate management, particularly due to the financial implications of reductions in visitor numbers. The summer of 2012 was one of the wettest on record (Met Office, 2012b), and this has affected Blenheim: “The amount of rain in the summer is quite a serious thing to us because it means that we don't get the same volumes of visitors through, and with June and July having been the wettest months for the last couple of years, it has had quite a serious impact on our visitor numbers” (Blenheim Estate Interview, 2012).


Figure 73 Visitor entrance – parking for cars and coach groups
Figure 74 A summer jousting event in the Palace Grounds

The cancellation of major events such as the Blenheim Horse Trials due to poor weather conditions has significant financial implications, and negative publicity after flooding events in the region was also a particular concern of site managers (Blenheim Estate Interviews, 2012). The wider Estate has suffered flooding in the past but there has been no significant flooding within the World Heritage Site boundary. Within the WHS there has however been some flooding of roads, walkways, problems for car parking and waterlogging of gardens, due to the clay soil type.

Another issue for Blenheim related to heavy rainfall is the problem of overflowing rainwater goods. As with other historic properties, the capacity of historic rainwater goods on buildings within the site is inadequate for current volumes of rainfall. This has led to the saturation of masonry and some damage to built fabric. Property managers also explain that the combination of more periods with heavy rainfall, with warm days and cold nights, has resulted in an increase in freeze thaw damage to stonework (Figure 75), which has been particularly noticed on south facing elevations over the last two years (Blenheim Estate Interviews, 2012).

Figure 75 Stonework damage (possibly freeze thaw)

Milder weather conditions, with fewer heavy frosts at the end of the growing season, have also impacted the site. "I know that certainly for us and the landscape and gardens department there is an obvious shift in the changing of the seasons over the last 20 years"(Blenheim Estate Interview, 2012). A significant increase in the length of the growing season, which has been extended at each end of the season, has had resource impacts in terms of increased mowing and an increased cost in labour and machinery to maintain the grounds. There is also an increasing prevalence of certain pests and diseases which are affecting trees and plants, and this has been attributed by some site staff to the reduction in severe frosts which would otherwise have killed these pests (Blenheim Estate Interviews, 2012).

8.3.2. What has been Learnt from Past Weather Events?

Some single loop learning in the form of changes to routines and institutional memory is apparent at the site. As a result of the problems with rainwater goods overflowing, lead boxes have been added to existing rainwater goods to ensure water runs into the drain network, without changes to the existing rainwater goods needing to be made (Blenheim Estate Interview, 2012). Other examples of single loop learning include the installation of drip-irrigation into the gardens after a period of drought. An example of institutional memory is that the issue with the rainwater goods has been flagged up in the WHS Management Plan, and a programme of repairs, many of which are identified as urgent are objectives of the Action Plan.

Double loop learning is also evident. The tree species mix is being changed in new planting schemes or when restoration of areas around the Park occurs. Historically, the Capability Brown Landscape was predominantly beech, which is vulnerable to both squirrel damage and drought, and a great deal of damage has been caused to the existing trees, particularly by the grey squirrel. The Estate now no longer uses single species planting but is moving to using a more robust mix of species, in order to reduce risks from both these factors (Blenheim Estate Interviews, 2012). This shows some acceptance of uncertainty in decision making, and progress in taking adaptive actions to manage risk. This issue is also raised in the Management Plan, explaining the need to adjust the mix of native species used in landscape conservation, demonstrating institutional memory (Historic Landscape Management, 2006).

8.4. Climate Change Impacts at the Site

8.4.1. Potential Climate Change Impacts Identified by Stakeholders

All interviewees at the Estate thought that climate change would pose some risks to the site, although the nature of these risks was characterised by uncertainty. The key risks which were identified are summarised in Table 29.

Potential climate change impacts which were identified by Interviewees	Source
Risk to landscape - potential impacts on historic landscape character and features e.g. tree species types and vegetation which can survive, beech is susceptible to drought	Blenheim Estate and NE Interviews, 2012 and WHS Management Plan
Further changes to growing season and the impacts of this on land management practices	Blenheim Estate Interview, 2012 and WHS Management Plan
Greater prevalence of certain pests and diseases in the future e.g. fungus affecting trees	Blenheim Estate, NE and EH Interviews, 2012
Impact on lake and condition of this SSSI e.g. increase in the occurrence of algal blooms	Blenheim Estate and NE Interviews, 2012
Further stone/frost damage to built fabric due to increased freeze thaw	Blenheim Estate Interview, 2012
Extreme weather events - making it more difficult to plan and hold large scale events and potential reductions in visitor numbers with increased bad weather.	Blenheim Estate Interview, 2012
Potential impacts of adaptations e.g. Works to dams/cascade to reduce flood risk	Blenheim Estate Interview, 2012

Table 29 Impacts that climate change may have on Blenheim Palace WHS

The World Heritage Site Management Plan identifies the key risks to the site from climate change as the potential for the extension of the growing season and impacts on the restoration of the historic parkland features (Historic Landscape Management, 2006). A primary concern for site managers is the potential for an increased frequency of extreme weather events and the implications of this for putting on large scale outdoor events, and the consequential financial implications of reduced visitor numbers for Estate income. The potential impact of an increase of algal blooms on the ability to hold events such as Triathlons was also a concern for site managers, and the potential impact of this on the SSSI was an issue raised by NE (Blenheim Estate and NE Interviews, 2012).

8.4.2. Uncertainty and Climate Change Impacts

As with the previous two case studies, the uncertainties around climate change are a key barrier to action on adaptation. At Blenheim, the major uncertainty around climate scenarios and the future direction of change is a clear barrier to investment and spending on adaptation. Table 30 illustrates some of the issues raised in relation to uncertainties about how to interpret past events, and significant uncertainty about future changes and what action should be taken.

There is a particular fear of taking decisions which would 'lock-in' the Estate to adapting to the 'wrong' climate scenario.

Issue Highlighted	Illustrative Quote
Uncertainty about interpreting past events	We are definitely seeing an increase in tree diseases, but it's very difficult to say whether it's actually caused by climate change, is it because it's more humid and wetter? I don't know that there is any evidence that is the case. (NE)
Uncertainty about future changes to the climate	I'm not even sure that we actually know what the climate is going to change into. We know the climate is different to what it was 20 years ago but we don't know what it is going to be like in 20 years' time (Blenheim Estate)
Uncertainty about impacts arising from that change and actions needed	What do we actually plan for? Do we plan for drought or do we plan for flooding? Do we plan for a bit of both? That is the difficulty in spending. Nobody, on a micro level like us, is going to spend a lot of time and money planning for those scenarios that might not come true when you are facing day to day issues of trying to keep the building up (Blenheim Estate).

Table 30 Climate change and uncertainty

8.4.3. Cognitive Factors - Individual Perceptions and Attitudes

Individuals' perceptions and attitudes vary throughout those interviewed, with different perceptions of risk, and different levels of engagement with the issue of adaptation. Perceived adaptive capacity is low, with a general feeling that little can be done unless there is accurate information and certainty about the direction of change, and that there are great potential costs to making the 'wrong' decision. According to Pahl-Wostl (2009) the use of uncertainty to justify non-action, and a reliance on science to find a solution, are indicative of single loop learning. This variety of viewpoints is illustrated by a selection of quotations in Table 31.

Issue highlighted	Illustrative quotes
Individual risk appraisal (probability) and motivation	I think it is a risk to the landscape because the World Heritage Site is not just the Palace, it is the whole Park, and there is a definite risk to the landscape from climate change (Blenheim Estate)
	I just think that at the moment, I don't know, because the science is still not clear, there is obviously still debate and not everybody believes in it (Blenheim Estate)
Perceived adaptive capacity (efficacy and costs)	What can you do to be honest [to adapt]? You can't dictate the weather so we have to work around it (Blenheim Estate)
	I think it would be fool-hardy to have a knee jerk reaction to anything now particularly when we are not looking at a five or ten year horizon, we are looking at a several hundred year horizon and whatever we do has got to be right for that time period (Blenheim Estate)

Table 31 Cognitive factors which are determinants of adaptive capacity

8.5. Access to Information

8.5.1. Futures Thinking

The World Heritage Site Management Plan states that 'Blenheim will need to regularly review predictions on possible future patterns for climate change to enable the development of long-term strategies that ensure the significance of the site is not compromised by climate change'(Historic Landscape Management, 2006). Despite this clear statement, the use of climate projections or scenarios by site managers and stakeholders in decision making is not occurring at Blenheim, and there are significant barriers to their use. These are primarily uncertainty, financial constraints and the issue of trust in climate data (illustrated earlier in Table 30 and Table 31). Uncertainty about the reliability of climate scenarios, and the perceived lack of scientific consensus on what will happen, is a barrier to their use in forward planning at the Estate. One member of Estate staff describes that their current approach is to tackle issues as they arise: "I think it would be important to have a consensus of the scientific community as to what the weather is going to be like. Until we know that it is almost impossible for us lay persons in the field to do anything other than sticking plasters on any problems that we might observe" (Blenheim Estate Interview, 2012).

However, although scenarios are not being used at a strategic level, some futures thinking is occurring, with examples of individuals taking future climatic issues into account in decision making. The landscape manager is taking an adaptive approach to management, taking into account the consideration of potential climate impacts on tree planting, and the introduction of a species mix rather than solely planting Beech, which is sensitive to drought. The justification for this approach is that “putting all of your eggs in one basket clearly worked in the 1700's but to think forward 100 years, who knows what the climate is going to be and putting all of your eggs in that basket seems a bit crazy” (Blenheim Estate Interview, 2012).

In the last 5 years there work has been carried out on two dams within the Estate, at the request of the EA. The reasons for these works have been so that they would comply with the Reservoirs Act 1975[50], in the interest of public safety. In the case of the Blenheim Dam (Figure 76), the Act states that the dam must be capable of holding back the water levels that would result in a 1 in 1,000 year flood and withstand over-topping in a 1 in 10,000 year flood. However, the methods used to determine the rainfall estimates used to carry out a hydrological assessment of the catchment feeding the reservoir are based on historical rainfall data. These methods do not make any specific allowance for any potential climate change effects (Reservoir Panel Engineer, CEH Wallingford, Peter Brett Associates and (Stewart et al., 2008)). This is remarkable, given that the works to the Dam were major and very costly long-term projects, and indicates a lack of futures thinking amongst institutions involved.

[50] The EA is the Enforcement Authority for England and Wales for the 1975 Reservoirs Act, and reservoir panel engineers are responsible for the design and supervision of construction, inspection of reservoirs and the on-going supervision of reservoirs. The Secretary of State is responsible for overseeing the activities of the Enforcement Authorities and making statutory instruments to prescribe regulations (British Dam Society, 2013).

Figure 76 and Figure 77 Blenheim dam, cascade and pumphouse

According to the Parliamentary Environment, Food and Rural Affairs Committee inquiry (2013) in light of the recommendations in the Flood and Water Management Act (UK Parliament, 2010) for an improvement of reservoir safety, DEFRA is committed to the review of key guidance. However this review is behind schedule, and this is described as 'disappointing' by the Committee, who 'urge DEFRA to ensure that the revised Guide to the Reservoirs Act 1975 is published no later than April 2013'[51] and recommend that the timescale of the review of Floods and Reservoirs Safety Guidance is brought forward to April 2013 (House of Commons Environment Food and Rural Affairs Committee, 2013). It is unclear whether this review will incorporate future scenarios and predictions of changes to rainfall patterns. Incorporating climate change considerations into long term projects, such as the works to the Blenheim and Bladon Dams, will clearly be needed to ensure water infrastructure is robust in the face of potential climate changes. However, in such sensitive historic landscapes the need for careful and sympathetic local approach to the implementation of legislation, to protect value and significance, is also crucial.

8.5.2. Monitoring

As part of an objective within the WHS Management Plan which focuses on monitoring potential risks and threats to the WHS, it is stated that climate change

[51] Update – on 1st May 2013 the revised Guide to the Reservoirs Act 1975 had not yet been released.

will be monitored 'particularly in relation to its effects on planting in the historic park and garden and the effect this has on staff resources and costs' (Historic Landscape Management, 2006). This clearly identifies climate change as a potential risk to the site, which will be monitored. As yet, this monitoring is not formally occurring. Nonetheless, as shown in Table 32, a wide range of data is being collected for other purposes e.g. a Met Office rainfall and weather log, biodiversity and building condition data. As at the previous two cases, there is an opportunity for this data to be used and collated in order to monitor possible impacts of climate change on the site. This would require the allocation of resources to pull together and organise this information, but would be an efficient approach and would make use of the significant quantities of existing data.

Different types of monitoring	Examples
Monitoring of fabric condition	5 yearly inspection of the Listed buildings, day-to-day observations by site staff e.g. retained architect
Monitoring of landscape	Estate has 10 years' worth of data on the trees on the estate, e.g. tree condition, NE monitor SSSI condition every 5/6 years
Monitoring of Management Plan	Progress monitored on an annual basis by steering group, and plan itself reviewed every 5 years
Monitoring of water levels	Water levels in reservoir monitored by Estate staff
Monitoring of climate change	Climate change indicator in WHS Management Plan
Monitoring of weather conditions	The Head Gardener collects rainfall data for Met office. Rainfall recorded every day and brief description of weather also recorded
External monitoring	UNESCO periodic review; Monitoring report to HMRC on achievements/plans for coming year as well as record of public access. National heritage property is subject to a quinquennial site inspection as required by the conditional exemption status.

Table 32 Different types of monitoring which occur at Blenheim Palace WHS

8.6. Authority

8.6.1. Policy Instruments, Guidance and Information

The two determinants (NVivo nodes) *policy instruments* and *guidance and information* overlap, and for this case study, they have been merged into one section. Relevant policy and guidance are shown in Table 33 below, however little specific guidance on adaptation was found to be available. Key existing policy and guidance documents for Blenheim will now be examined.

Regional
South East Plan 2006-2026, Regional Spatial Strategy for the South East- effectively abolished (Department for Communities and Local Government, 2009)
UK Climate Change Risk Assessment: South East Summary and Case Studies (South East Climate Change Partnership, 2012)
Local
Oxfordshire County Council Local Climate Impacts Profile 2007- 09 (Oxfordshire County Council, 2009)
Oxfordshire County Council's Adaptation Action Plan (Oxfordshire County Council, 2012)
West Oxfordshire LCLIP Report (West Oxfordshire District Council, 2009b)
West Oxfordshire Climate Change Policy 2008-2012 (West Oxfordshire District Council, 2008)
West Oxfordshire Local Plan to 2011 - Adopted 2006 (West Oxfordshire District Council, 2006)
Draft Local Plan October 2012 - Previously Core Strategy (West Oxfordshire District Council, 2012)
Site Level
Blenheim World Heritage Site Plan (Historic Landscape Management, 2006) Action Plan updated approx. 2011
Historic Landscape Restoration Plan (Moggridge and Cobham, 1983)

Table 33 Key regional and local policy documents relevant to site management and climate change adaptation

The South East Plan was the main regional strategic policy document[52], and climate change issues form a central element in this plan. Both adaptation and mitigation are thoroughly embedded within it in the form of cross cutting policies. The impacts of changes to the climate on tourism are one area of focus, particularly for areas such as Oxford which have a concentration of cultural heritage. However, this plan has been effectively abolished by the reforms to the planning system (UK Parliament, 2011b), with the revocation of regional spatial planning strategies.

No other regional level planning policy exists, and Oxfordshire County Council's planning role relates mainly to minerals and waste development. However Oxfordshire County Council was the first UK council to carry out an LCLIP

[52] The South East Plan replaced the Oxfordshire Structure Plan, although three policies of the Structure Plan are still in force, relating to minerals and waste, service areas and development at Upper Heyford.

(Oxfordshire County Council, 2006), which was carried out in partnership with UKCIP[53]. An updated version was produced in 2009, and an Adaptation Action Plan for the council's operations was published in 2012, which includes the goal 'to lead by example in supporting other organisations and communities on adaptation' (Oxfordshire County Council, 2012). A 2012 climate adaptation guidance document at the regional level draws on the findings of the Climate Change Risk Assessment. 'Risks for South East England' (South East Climate Change Partnership, 2012) presents a local perspective of the CCRA risks and opportunities, and some illustrations of what climate change means for people, businesses, community groups, local authorities, and other organisations across key sectors at the local level. Heritage is mentioned in terms of the potential impacts on tourism, and on areas of AONB which are along the coastline.

WODC's climate change policy document dates from 2008, and encompasses a commitment to address adaptation and mitigation. However, the current policy is out of date, is still linked to the objectives of the South East Plan and does not reflect the changes to the national planning framework. One objective of the policy was to carry out an LCLIP, which was undertaken in 2008. The local authority does not have a climate change officer (or similar post) and an updated climate change policy is currently being prepared externally.

The current Local Plan which forms the basis for determining planning applications by WODC was adopted in 2006. This includes policies for climate change mitigation e.g. renewables, but climate adaptation is not addressed. There are clear and strong policies for the protection of Listed buildings and other heritage assets, with a particular reference to Blenheim WHS stating that 'although no further additional statutory controls follow from the inclusion of a site in the World Heritage List, its inclusion does highlight the outstanding international importance of the site which should be taken into account when considering any proposals likely to affect Blenheim' (West Oxfordshire District Council, 2006).

[53] Both the 2006 and 2009 versions of the LCLIP were produced in partnership with UKCIP, who developed the tool, and who are also based in Oxford.

The successor to the current plan, the Draft Local Plan 2012, sets out how the District will move forward in the period 2011 – 2029 (West Oxfordshire District Council, 2012). Reducing the impacts of climate change is a core element of this, and policies for both mitigation and adaptation are incorporated. The WODC LCLIP recommended that adaptation should be included in revisions to the existing planning policy, and this has clearly taken place. There are also strong policies for conservation of heritage assets. Blenheim Palace is focused upon, it is identified as a major asset to the District and a key visitor attraction, and its national and international significance are emphasised. The WHS is referred to throughout the planning document with a very high level of protection for the site. The status of the WHS Management Plan is explained, stating that the Plan 'guides the management, maintenance and enhancement of the natural and built environment of this important and complex Estate and is a material planning consideration' (West Oxfordshire District Council, 2012). There are no specific policies for heritage and climate adaptation.

The World Heritage Site Management Plan, the key policy document at site level, is examined in the following section of this chapter. Natural England (NE) has an important role in providing information and guidance to the Estate managers. They advise on how the SSSIs should be protected, on what should be in the Management Plan and they are also involved in monitoring the conditions of the HMRC tax exemption. They have also produced a wealth of information and research on adaptation. For example, research publications (Morecroft et al., 2012) and examples of pilot projects are available on the NE Website. However, at a local level the provision of information or guidance on adaptation is not something which the advisers working with Blenheim are involved with, or which is part of their particular remit.

At the previous case studies some information and guidance has been available internally within organisations such as the National Trust (NT) as well as through wider networks. Networks for support and sharing of information also exist for privately owned sites such as Blenheim. The Historic Houses Association (HHA) and Country Land and Business Association (CLA) are two influential organisations which are high profile with large numbers of members[54], and are actively involved in campaigning and lobbying on their behalf, as well as providing member services such as technical and specialist advice, support, seminars, networks and information. The HHA has climate change listed on its website as a current campaign, and in 2009 the HHA held a one day conference for members looking at the issues of energy efficiency and the impact of climate change on historic houses. A climate change publication focuses on making historic houses more energy efficient (Beedell and Evans, 2009), however it is unclear whether any guidance which focuses on adaptation is available for members[55]. The CLA has been actively involved in campaigning on climate change issues from a land management perspective since 2001, and is involved in a number of industry groups covering communication of climate change awareness to land managers, such as the Rural Climate Change Forum and Farming Futures Project (Centre of Excellence for UK Farming, 2012). They have produced guidance such as an advisory handbook on climate change for land managers, which considers adaptation (Country Land and Business Association, 2010).

8.6.2. Act According to Plan

The WHS Management Plan is the key holistic plan for the extent of the WHS, and is described by managers as being broad and wide ranging (Blenheim Estate Interviews, 2012). Stakeholders such as NE provide input into the development of the plan, which the Estate then uses to guide their activities. There are other more specific documents which have been developed for certain issues e.g. business plans, building plans, woodland management plans, and a forestry plan. The Higher Level Stewardship[56] agreement with NE in 2012 is also driving the

[54] The HHA represents 1500 privately-owned historic houses, castles and gardens throughout the UK, representing ‘more properties open to the public than the NT and EH put together’ (Historic Houses Association, 2013) The CLA is a membership organisation for owners of land, property and businesses in rural England and Wales, and its 35,000 members manage and/or own between a quarter and a third of all heritage in England and Wales (Country Land and Business Association, 2013)

[55] Information on the HHA has been sourced from the publicly accessible areas of their website; no one from the HHA was available to be interviewed.

[56] Environmental Stewardship is an agri-environment scheme that provides funding to farmers and other land managers. Higher Level Stewardship involves complex types of

development of a Management Plan of High Park and a new Landscape Management Plan, focusing on the future management of trees within the Estate[57] (Blenheim Estate and NE Interviews, 2012).

The WHS Plan dates from 2006, and after five years when it was due for its first review, the decision was taken to update the action plan[58], rather than create a whole new document. The reason given for this by Estate staff, was that the cost of producing a new plan (approx. £30,000) was not considered worthwhile as most of the issues had remained the same as five years earlier[59]. The action plan was updated, adding new targets where necessary, with the intention to update the whole document at the next five year mark (Blenheim Estate Interview, 2012).

The WHS Management Plan includes several brief references to climate change, and this is highlighted as an issue which may affect land management practices and the historic parkland features. The need to consider climate change impacts in the context of risk preparedness is also stated, as well as the inclusion of a monitoring indicator in the action plan (see section 8.5.2). Some of the aims outlined, such as adjusting species choices and increasing diversity of planting in the park, have started to take place. However, other aims such as monitoring climate change indicators and regularly reviewing climate predictions are not yet being met. This implementation gap can be explained by factors including resources, competing priorities and cognitive factors (see sections 8.4.3, 8.7.1, 8.7.2).

There are emergency plans e.g. evacuation and salvage plans for the Palace, although there are no formal flooding plans or risk preparedness strategies for climate change. There is no specific climate change plan or strategy for the Estate, which considers adaptation. However a sustainability ‘action list’ exists which is a

management with agreements tailored to local circumstances (Environment Agency, 2012b)

[57] These plans are both currently being commissioned

[58] The Action Plan is part of the WHS Management Plan Document

[59] This is standard management practice and is advised by guidance documents on heritage Management Plan preparation (Natural England, 2008)

management document being used to identify tasks to help improve sustainability e.g. improving insulation (Blenheim Estate Interview, 2012). It is stated by one senior manager that a new landscape management plan is expected to take on board climate change issues which may be pertinent to the landscape (Blenheim Estate Interview, 2012). In summary, at the moment, work on adaptation which is occurring on the Estate is very much due to individual action and interest rather than being plan driven.

8.6.3. Political Will

Blenheim does not appear to be receiving any support locally towards climate change understanding or adaptation[60]. The local authority, WODC, does not currently (January 2012) have a climate change policy officer in post, and its Climate Change Strategy is being prepared externally by consultants (Pers. Comm, WODC, 2012). Regionally, some support structures still exist in the form of Climate South East, which, since the abolition of regional planning have been trying to 'salvage' some available good practice on adaptation and are joining up formally with other regional partnerships as Climate UK (Pers. Comm, Climate South East). NE, a public body which is greatly involved in site management, has a clear commitment as an organisation to action on both adaptation and mitigation. However, the climate change work that NE and EH is involved in is mainly happening at a national level, and does not seem to be proving directly useful at site level.

Blenheim, as a privately owned historic Estate, a major local landowner and enterprise, is in a very different political position than the previous two cases which have some public authority or government agency management or ownership. Political will in the local authority is therefore less of a significant factor than at other heritage sites which may be more reliant on local government for support and for the commitment of resources. It could be argued that wider networks of similar sites, for example member organisations such as the CLA,

[60] It was not been possible to engage fully with the local authority for this research – no climate change team exists and planning/conservation officers were not available for interview.

which are actively involved in political lobbying, and who have long taken climate change seriously, may be far more influential for an independent site such as this.

8.7. Resources

8.7.1. Financial Resources

The running of the World Heritage Site is funded by visitors and by income derived from activities on the wider Estate, without which the many conservation activities within the WHS could not take place. Some additional funding in terms of grant support are also received e.g. farm subsidies, woodland grant scheme and some funding through a Higher Level Stewardship agreement. A grant was also received from the then Countryside Agency (now part of NE) and EH for the preparation for the Management Plan. The Estate cannot apply for Heritage Lottery funding, due to the fact that it is privately owned.

The Estate is very business-led and the need to ensure continued economic viability of farming, forestry, tourism and other commercial activities of the Estate is emphasised by Estate staff and throughout the Management Plan. Several buildings within the Estate provide an income through residential or commercial lettings. Park Farm is a commercial centre, where the Estate's flock of 1600 sheep are managed, and is adjacent to the Blenheim Water bottling plant. Apart from Christmas Day, the site is open every day of the year to the public, and is used to host sporting events, craft and country fairs, corporate entertainment and product launches. Income is also generated from fishing hire and game shooting days and in-house farming operations (Historic Landscape Management, 2006). Income from recreational use of the WHS varies annually, having an effect on the levels of finance available to spend on conservation work beyond annual maintenance operations.

The key management objective of the WHS Management Plan is 'to produce sufficient income and enhance capital assets to provide for the family's needs and to protect and secure the heritage property with all its qualities in accordance with the wishes of its owners' (Historic Landscape Management, 2006). The costs involved in managing the Palace and Park in accordance with the aims and objectives of the Management Plan are ‘considerable’ (Historic Landscape Management, 2006), and within the plan it is emphasised that the delivery of the plan is dependent on financial resources (including external support), and that a material change in the level of income would therefore affect the delivery of the plan (Historic Landscape Management, 2006).

The work on the Estate dams to ensure they comply with the Reservoir Act 1975 added up to a combined cost of nearly £2 million. Discontent is evident about the expense of the works and the fact that the works were carried out due to necessity, but without external financial support (Blenheim Estate Interviews, 2012). ‘The project is likely to absorb all repair, restoration and maintenance funds for the next three to five years and will unfortunately have an impact on the on-going repair, maintenance and restoration projects. All consultees and stakeholders in the World Heritage Site Steering Group are asked to bear this in mind going forward’(Blenheim Estate, 2008).

In relation to climate change impacts, the potential impacts on visitor numbers and revenue, and additional costs such as maintenance due to an extended growing season are a primary concern, reflecting the business-led nature of the Estate. This business-led nature has led to a greater awareness of the potential impacts of climate change on site operations than at the previous two case studies. However, financial resources are also clearly a barrier to adaptation, particularly due to the perceived uncertainty around climate change, and with the existence of so many competing priorities. These issues, as well as a misunderstanding of the nature of climate change scenarios, are clearly illustrated in the quotation below:

“We can't spend that money adapting to one climate scenario when it might be a different climate scenario. We have so many things on our list of priorities to maintain the World Heritage Site that are identified in the World Heritage Management Plan. These things inevitably fall down the agenda when you are in a recession and trying to revive every little bit of business...I can understand peoples reluctance to spend a lot of time and money planning using scenarios when even the people who believe it is going to happen don't know which one of the scenarios is going to be here” (Blenheim Estate Interview, 2012).

8.7.2. Human Resources

The Blenheim Estate employs a large full time in-house team who cover all aspects of the running of the Estate as a whole. Heritage consultants are commissioned to provide advice as and when needed. Documents such as the Landscape Plan, WHS Plan and Statement of Outstanding Universal Value were produced by external consultants.

There is no specific member of staff responsible for climate change or adaptation work, and where work is happening on these issues this sits within existing roles. An issue raised by NE is the complex nature of the subject and the need for a range of specialist skills to consider adaptation on different site elements e.g. specialists on veteran trees, biodiversity (NE Interview, 2012). At a national level within NE, climate change specialists and on-going research projects on climate change adaptation exist (Natural England, 2013), but this particular knowledge is not being applied at a local level at Blenheim.

Some Estate staff are working on sustainability projects to reduce pollution, emissions and waste, reduce the use of energy, water and other resources, and encourage environmental awareness amongst staff and visitors (Blenheim Estate, 2012). This drive does not specifically incorporate adaptation, but includes projects such as investigating woodchip boilers for the visitor café, and carrying out a waste audit.

The implementation of the WHS Management Plan and the delivery of actions such as monitoring of impacts and examination of scenarios require significant levels of commitment and resources. Resource pressures (both human and financial) are one important barrier to the implementation of the climate change policies in the Management Plan. The commitment of staff time on adaptation is a challenge, when uncertainty pervades and there are other priorities on site. However, ‘Sustainability’ and ‘Green Tourism’ are issues to which there has been a commitment of staff time and development of skills – these kinds of projects may be beneficial for corporate image of the Estate, and may also deliver clear cost savings. However, the range of uncertainties relating to adaptation, including existing uncertainties in climate change impact estimation and future social and economic conditions, make the cost benefits of anticipatory adaptation difficult to quantify. The potential impacts of action/inaction on the values and significance of heritage also transcend the financial estimation of impacts.

8.8. Leadership

Within Blenheim Estate, there is no over-arching strategy on adaptation, rather, certain individuals are adapting autonomously as they notice issues arising. As one senior manager explains “I have not had any high level meetings to talk about climate changes, it is just what I am doing in my planning on a daily basis to adapt. At our strategy meetings, it was all about how to improve the business rather than adapt to any climate change scenarios" (Blenheim Estate Interview, 2012).
However, there is leadership buy-in to the issue of ‘sustainability,’ which focuses on mitigation, with projects such as a biomass feasibility study, and the installation of PV panels. As one Estate publication states ‘Blenheim Palace’s vision is to become an outstanding example of sustainable business and achieve a Gold Green Tourism Award, whilst encouraging visitors to reduce their own environmental footprint’(Blenheim Estate, 2012). This does not incorporate adaptation, but perhaps highlights an opportunity for incorporating adaptation into existing environmental awards and benchmarking systems.

As Blenheim is less complex (in terms of ownership structure) than many other UK WH sites, there is less need for collaboration on a day-to-day basis. However, permission may be required from NE, EH and/or the Local Planning Authority for certain projects on the Estate, and some projects and funding are delivered by external agencies e.g. the Higher Level Stewardship Scheme. The WHS steering group provides one useful forum for all to meet[61], and discuss management issues, providing an opportunity for external stakeholders such as EH and NE to provide input into the plan and as well as to discuss specific projects which might need consent (NE, EH and Blenheim Estate Interviews, 2012).

Collaboration and communication are evident between the Estate and EH and NE, for example in the form of extensive pre-application discussions in order to agree

[61] Although the Blenheim steering group meets less frequently than at the other case studies, who have more complex management arrangements

the best course of action for the works required to Blenheim Dam. The objective of the application was to gain consent for the works required to meet the legal obligation, without materially impacting the UNESCO Statement of Significance (Blenheim Estate, 2008). A number of options were considered and a solution was agreed which would best protect significance as well as complying with the regulations to reduce flood risk. No objections were subsequently raised by EH or NE to the planning applications when submitted (EH and NE Interviews, 2012) and (English Heritage, 2009a ; West Oxfordshire District Council, 2009a).

8.9. Reflections on Conceptual Framework

The suggested revised framework which was developed after analysis of the first two case studies was used as the initial framework for analysis at this case study. The adapted framework which was developed worked well for this analysis and no significant changes were made. As at the previous two case studies, *uncertainty* and *technological limits to protection* were two determinants/nodes where there was data, but which have not yet been integrated into the structure of the conceptual framework, and this will be addressed in the following chapter.

There were some nodes where less evidence was available at Blenheim than at the other two cases. There was little data for the node *political will*, partly due to the lack of availability of interviewees from local government, but this may also reflect the fact that this node wasn’t particularly relevant for this site, perhaps because as a private site it is autonomous, and also that the scope of *political will* could be interpreted in different ways. The two sub nodes *local knowledge and skills*, and *heritage as a resource for learning* also yielded little data at this site. This highlighted some of the challenges of the use of a conceptual framework such as this, as the reason for a lack of data for certain nodes could be interpreted in many ways.

Two nodes where there was significant overlap of data, was *guidance and information* and *policy instruments*. Due to this overlap, these were combined in the chapter discussion. However it is considered that they should remain separate elements in the framework, but it will be necessary to develop a very clear definition of the differences/overlap between them in the final framework.

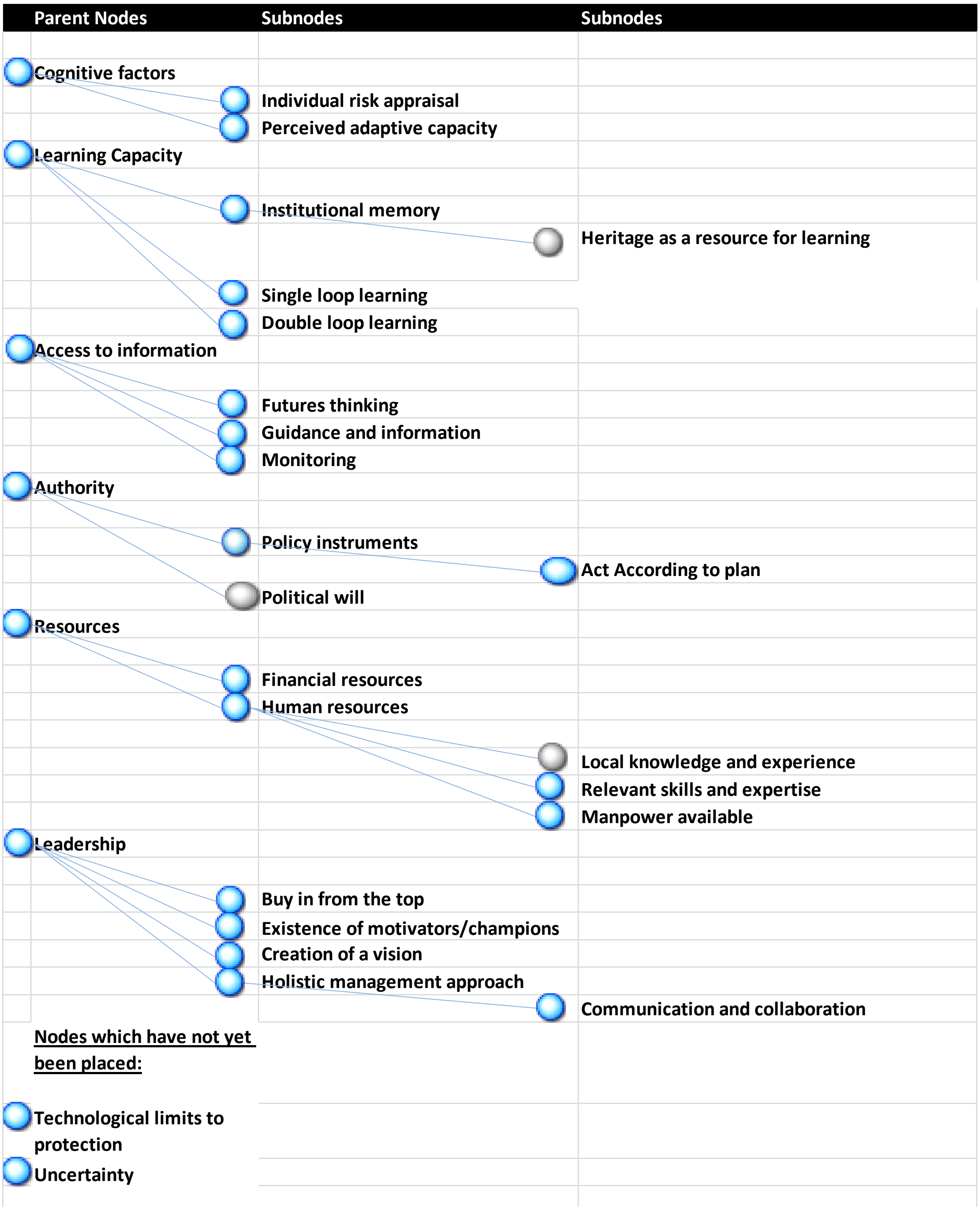


Figure 78 Revised conceptual framework following analysis at Blenheim Palace WHS (grey nodes – where little data was available)

8.10. Conclusion

Blenheim WHS is privately owned and managed, and concerns around climate change primarily relate to land management and the impact on business, and therefore revenue, which would then impact on the conservation of the Estate. In this context, climate change impacts and anticipatory action to adapt can be seen as business continuity issues. There may be opportunities to incorporate adaptation into existing green tourism and sustainability agendas at the Estate. An implication of this for heritage management more generally, is that current schemes for certification and benchmarking, and which are proudly displayed by heritage sites and used in their marketing, could be widened to include adaptation.

There is little engagement with the use of climate scenarios at Blenheim. However, some long-term actions on adaptation are being taken by interested individuals, who are adapting autonomously, and there are examples of adaptive approaches to management. This is individual action rather than being plan-led, and although climate change policies do exist in the Management Plan, as at the previous case study, an 'implementation gap' is apparent. However, a wealth of monitoring information exists, and there may be opportunities to use this to monitor changes in climate and any impacts which may arise.

At a local government level there are no clear leaders on climate change and a lack of local government drivers on adaptation. However, the local authority has less influence on this independent site than at other heritage sites with more direct local government/public agency involvement. Formal and informal networks which can support and provide guidance on issues such as adaptation for private sites are therefore very valuable.

The compulsory works to strengthen Blenheim Dam were driven by legislation; however climate change does not appear to have been considered. The dam project illustrates both the need to ensure water infrastructure is robust in the face of potential climate changes, and the challenges in ensuring a careful and sympathetic local approach to the implementation of legislation, to protect heritage significance. A key finding is the particular need for flexibility at a local level when implementing top down policy on adaptation at heritage sites, as this is crucial to enable locally appropriate decision making.

The main concern about impacts at Blenheim relates to impacts on the landscape, and there is less concern about impacts on the built structures. Climate change may impact on OUV of the site by impacts on the historic character of the landscape and changes to types of vegetation which may survive. This raises interesting questions about how far it is possible to preserve and manage a historic landscape in a changed climate. Although climate change is acknowledged as posing potential risks for the WHS, and there has been some progress in starting to consider adaptation, there are many competing priorities for site managers, and this issue is not seen as an immediate priority. Determinants which are limiting the capacity to adapt are primarily uncertainty, a lack of perceived adaptive capacity, and a lack of trust in climate data, which are making it difficult to justify the necessary commitment of resources. An adaptive approach to management may be a way to approach decision making in the face of this uncertainty. This approach, which has been developed in the natural sciences, and its application in heritage management, are issues which will be explored in the following chapter.

CHAPTER 9 DISCUSSION

9.1. Introduction

This chapter discusses the findings from the empirical study (Chapters 5- 8), examining the wider implications of these and putting the findings in the context of existing knowledge. The chapter begins by focusing the key issues which have emerged from the research, relevant to adaptation and heritage management. These include the use of climate change scenarios by heritage managers, the role of the State in adaptation and the use of WHS Management Plans as tools to integrate climate adaptation into heritage management.

The second part of the chapter critically reflects upon adaptive capacity theory, exploring how this is translated to cultural heritage management, and examines the advantages and limitations of its application to this research. A revised conceptual framework is then presented, and conclusions are drawn.

9.2. Key Research Findings in Context

The key issues which have been identified in the research, drawing together the findings from the three case studies as well as the international and national level data, will now be examined.

9.2.1. Climate Change Impacts on Heritage

The types of potential impact on cultural heritage which were highlighted through the research can be divided into different categories: impacts on the built environment and archaeology, impacts on the landscape and natural environment, and impacts on operational management. Impacts on the built environment, archaeology and landscape include both impacts from weather events and the potential impacts of adaptation itself. Impacts on site operations are often linked to heritage sites' role as a tourist attraction. Impacts such as having to close the site or a reduction in visitor numbers have implications for economic viability and revenue for conservation. Climate can act as both a resource and a constraint for tourism, for example with fine, warm weather and longer growing seasons having the potential to boost visitor numbers. Tourists have a greater adaptive capacity than tourist destinations, as they have relative freedom to avoid or shift the timing of their visit to destinations affected by poor weather/climate change (Scott et al., 2012). Another issue which emerged in the research is the impact of news reports on visitor behaviour, as the tourism industry is very image-sensitive.

9.2.2. Cognitive Factors

Cognitive factors significantly affected the capacity to adapt in all three of the case studies in the research. Some individuals were very interested in the issue of climate change and adaptation, whereas a sense of disengagement and disenfranchisement was apparent amongst others, often within the same organisation or at the same site. Perceptions of risk and of the capacity to adapt were clearly influencing the motivation and willingness of individuals to act. Findings from the research resonate with studies by Grothmann and Patt (2005) and Tam and McDaniels (2013). Grothmann and Patt elaborate a 'socio-cognitive model of proactive adaptation to climate change' which focuses on the importance of these perceptual processes, and Tam and McDaniels found that environmental world views and perceived risk were key factors in determining the acceptance of potential adaptation policies in biological conservation.

No two individuals necessarily have the same perception of a given risk, and do not necessarily evaluate its significance in the same way. Hulme (2009) argues that reasons for this are that far from being a simple problem of science or economics, differences in our world views, foundational beliefs and psychological conditioning open up the possibilities for considerable differences in the types of responses to climate change we believe are appropriate or necessary. The sense of disengagement which a minority of individuals expressed is also sometimes linked to perceived alarmism. The issue of future discounting (Giddens, 2009 ; Hulme, 2009) is an interesting one which is also relevant here - climate change effects may be felt for several generations and damage will increasingly be borne by future generations, yet people find it hard to give the same level of reality to the future as to the present. When facing many pressures and competing issues to address in site management, concerns which appear more immediate can, and often do, take precedence.

Within the heritage conservation field, personal and professional philosophies, and attitudes to change, are also crucial, particularly given that adaptation may involve adjustments or changes to existing conditions. In modern UK conservation philosophy conservation is frequently defined as the process of managing change (English Heritage, 2008b ; National Trust, 2012a), yet changes to historic landscapes and buildings require careful consideration and negotiation, and are often contested. Different attitudes to change and degrees of flexibility in approach were apparent, and this also linked to individual roles e.g. a conservation officer's remit is linked to controlling change, and may significantly vary from the stance of a landscape gardener, or manager of site operations. Conservation officers may be cautious about allowing changes which may set a precedent (in planning terms), and the wider debates that exist about how much change is appropriate in heritage conservation do not just relate to the issue of adaptation to climate change. Research in cognitive psychology has demonstrated that people frequently favour the 'status quo' over alternative futures (Samueson and Zeckhauser, 1988) cited in (Tam and McDaniels, 2013). How the definition of conservation principles are individually and institutionally interpreted influences the type of adaptation measures which are possible and appropriate in different situations.

9.2.3. Scenarios, Futures Thinking and Uncertainty

This research showed that climate change projections and scenarios are not being used by heritage managers in decision making at the case study sites. The main users were those with climate change remits e.g. local authority climate change teams or climate change partnerships, some of whom were also involved in efforts to communicate these more widely. Challenges of communicating scenarios and their usability were expressed by these stakeholders, such as the interpretation of probabilities, and difficulties balancing the simplicity of the message with the complexity of the science.

The majority of those with a heritage remit at a local level had either not heard of scenarios such as UKCP09, or indicated that, whilst in principle they could be useful, unless such models were known to be reliable and locally specific they would be of limited use. Concerns about data reliability and the contested nature of scientific data on climate change were widespread. There was a clear desire for local level projections that predict what impacts climate change would be, so that this could then be incorporated into decision making. This is particularly pertinent for sensitive historic buildings and landscapes, where decisions taken on adaptation need to be justified with clearly defensible reasoning, particularly where value and significance may be impacted by anticipatory adaptations.

Scenarios are just that - depictions of possibilities of future conditions - yet high expectations exist amongst potential users about what they should be able to provide, and at what level of certainty. The uncertainties around data on the direction and impacts of future climate change are often cited as a reason for inaction. Challenges of developing and communicating scenarios such as the UKCP09 outputs, are expressed by those tasked with their development, who cite difficulties reconciling users' expectations with what climate science can realistically provide, explaining that while interactions between users and providers of climate science is desirable, tensions exist in meeting users' desired information requirements with the development of credible and defensible climate science (Steynor et al., 2012). Users at site level desire data which can easily be understood and used in decision making. Realistically, it is not possible, in the near future, for models to predict the impacts of climate change at a very local level, with low levels of uncertainty. Therefore, approaches which work with these levels of uncertainty need to be developed, not just by heritage managers, but more widely, in order to move forward.

Flexibility has been described as a key to resilience (Adger et al., 2005 ; Fankhauser et al., 1999 ; Redman et al., 2003), as adaptation will be an on-going, iterative process which will need to continue as conditions evolve and information improves. Monitoring is key to this flexibility, boosting the capacity for anticipatory action (see section 9.2.6). Adaptation is not simply a technical challenge, but there is a need to adopt a flexible and adaptive approach, which can help cope with uncertainty. UKCIP are one of many advocates of the concept of 'adaptive management' (Brown et al., 2011). This approach, developed in the field of natural resource management, particularly influenced by the work of the ecologist Holling (1978), has been widely adopted in nature conservation (Keith et al., 2011 ; Parma, 1998), including at Natural World Heritage sites such as the Blue Mountains in Australia (Blue Mountains World Heritage Institute, 2007). This type of approach was apparent at Blenheim, in their adoption of a more mixed tree planting strategy. This is one approach to managing uncertainty which may be appropriate for cultural heritage sites, although its application from the natural sciences would need further exploration.

9.2.4. Conflicts, Synergies and Integration into Existing Agendas

Different organisations involved in site management have different interests and remits and this can present some challenges when working together. Organisations sit within established governance and legislative structures which partially direct their response and may enable or inhibit how they deal with future conditions. The research showed that, much of the time, agencies responsible for adaptation and emergency preparedness or response had little or no heritage remit. Heritage sites have their own processes and procedures in place for dealing with risks, but, unless there is a resident population, the interest of external agencies is limited. For example, the EA and Emergency Planning departments' primary role is the protection of communities and their property, and, whilst the protection of life should come first, there is also the potential for existing disaster preparedness and response mechanisms to include heritage expertise in their operations. These findings for the UK accord with international literature on disaster risk management and heritage, which argues that 'cultural heritage should be embedded into all the wider disaster preparation and response protocols and procedures through wider collaboration and co-operation between the heritage, emergency response and communications sectors' (ICOMOS ICORP, 2012).

The need to integrate adaptation and mitigation where possible is well recognised in climate change literature (Becken, 2005 ; Moser, 2012 ; Wilson and Piper, 2010), although the fact that both positive and negative interactions exist is acknowledged. At the case study sites, the mitigation agenda is further advanced than adaptation, which is still in early stages, and opportunities may exist for synergies between the two areas of work. Some current mitigation actions which are already occurring may not be identified as adaptation by stakeholders, although they could also be classed as such e.g. water saving measures. Some of these issues are further explored later in this chapter in relation to benchmarking/best practice.

There were often overlaps and synergies evident with risk preparedness measures and climate change adaptation at the case study sites, particularly as in many cases climate change is predicted to exacerbate existing threats e.g. land instability, flooding. Therefore, mainstreaming adaptation, by considering this in the context of other risks faced by heritage managers, is the most logical way to integrate climate change issues into heritage management. In many of the study's sites, this is already happening. Particularly in Management Plans, climate change, where it is being addressed, is in the context of risk preparedness, and is beginning to be embedded into these established procedures. Climate stimuli are one of many drivers for change that heritage managers are facing.

For World Heritage Sites, the protection of their OUV is crucial in order to preserve their WHS status. Alterations made to adapt to climate change, with the intention of protecting value and significance, also have the potential to impact negatively on the same values and significance. For example, the consideration of changes to rainwater goods to increase their capacity, major works to strengthen or check dams, or decisions relating to resilient planting in designed landscapes, presented great challenges in decision making at the case studies. How far designed landscapes can be kept true to their original design in a changed climate and the impacts of this on their significance is one such dilemma. Sites have seen modifications in the past, for a multitude of reasons, including autonomous adaptation to increase resilience after flooding. The vast majority of designed landscapes have evolved over a lengthy period and will include elements from several different periods (Lovie, 2007). Yet how much change is appropriate, particularly in anticipation of future impacts, does not have a straightforward or objectively ‘right’ answer. Should it be acknowledged that some elements of OUV may change over time? Compromises have evidently been made to try to balance these different issues e.g. the use of temporary rather than permanent flood barriers in Ironbridge. The on-going challenge of managing changes to heritage in ways that maintain significance is at the heart of heritage management, and the issue of climate change adaptation is just one of many areas where this delicate balancing act needs to be performed.

9.2.5. Best Practice, Guidance and Support

It is clear that there is no particular guidance on adaptation which is being accessed by heritage managers, and tools for organisations such as those developed by UKCIP (e.g. their ‘adaptation wizard’) are not helping those decision makers interviewed. There is some knowledge of publications by EH and UNESCO on climate change e.g. (English Heritage, 2008a ; UNESCO, 2007), but the scope of these publications is quite general and is therefore not necessarily being found to be helpful at site level. UNESCO’s remit and resources means its ‘hands on’ role in support at UK WHS sites is limited, with its focus on sites in developing countries who are in need. The existing EH guidance (English Heritage, 2008a) needs updating, and there was a lapse in work on adaptation by EH partly due to factors such as the major restructuring within the organisation. There is some desire for more guidance and information to help decision makers better understand and implement adaptation, particularly locally meaningful modelling data and data which is accessible and easy to understand (see section 9.2.3), and best practice case studies or methodologies. There is also a particular desire for access to people with specialist skills, perhaps more than for documentary guidance.

The main sources of information and support which are currently being accessed are through networks – both formal and informal. Sources of information are being accessed within organisations such as in the NT, who have their own specialists, through wider networks of professionals e.g. Museums Emergency Response Network, or those with similar responsibilities e.g. World Heritage Site Coordinators meetings. Some sites and local authorities look to other sites/authorities to see how they are dealing with issues and for ideas on their approach. Networks are therefore a key avenue for guidance or best practice to be disseminated. Networks are acknowledged in literature as valuable for supporting learning, allowing the sharing of information, promoting collective action and providing access to new kinds of knowledge (Lonsdale et al., 2010 ; Pahl-Wostl, 2009), and their role is certainly key in enhancing the capacity to adapt in the heritage field.

Examples of case studies of adaptation have been developed by the NT (National Trust, 2005a ; National Trust, 2005b) and UNESCO (UNESCO, 2007), but there is clearly potential for more development and promotion of guidance and particularly best practice on adaptation in the heritage sector. Existing schemes exist in the tourism sector which encourage best practice on 'sustainability', such as the Green Tourism Business Scheme, a popular national sustainable tourism certification scheme for the UK. Awards are given for levels of achievement against criteria, and these awards are used by sites (including two of the case studies) on their websites and in promotional material. At present this scheme includes some criteria which are relevant for both adaptation and mitigation (water efficiency, insulation/ventilation), although there is the potential for more measures linked to adaptation and resilience to be explicitly addressed in such schemes, helping to mainstream the issue and raise awareness within the heritage sector. As discussed by Williams et al.(2012) incorporating adaptation into existing schemes and initiatives, and identifying opportunities for climate proofing to be presented in a positive light, will enhance the chances of adaptation being welcomed.

9.2.6. Monitoring

Monitoring is linked to learning – internal and external, formal and informal monitoring provides information which can check progress on targets and provide information to inform how to act. Documenting and learning from decisions is described as essential by EH (English Heritage, 2008b). Monitoring currently occurs at many levels, for example internationally by UNESCO, who have incorporated climate change into their latest round of monitoring, and at site level, where efforts are underway at some sites to include the monitoring of climate change impacts as an element of Management Plans. Monitoring is already an important element of heritage management, and allows the measurement of the success of management actions; and the detection of the effects of changes and disturbances, and may provide information to justify preventative or corrective actions.

A substantial amount of monitoring data is being collected at all sites for a variety of different purposes and by different stakeholders. However, despite the presence of indicators at some of the case study sites, information is not currently being collected for the purposes of monitoring impacts of climate change, and an implementation gap is apparent. There appears to be a wealth of information which could be pulled together to inform such monitoring, although the motivation, skills, coordination between stakeholders and resources to pull this data into an indicator are needed.

9.2.7. Leadership

At an international level, UNESCO have shown significant leadership on the issue of climate change and heritage, making policy statements and starting to put procedures in place to ensure that this risk is considered in site management. At a national level, the NT has been the key heritage organisation which has been at the forefront of this field, although this has been less of a priority for them in recent years. There is room for EH to provide stronger leadership on adaptation, and their plan to update key guidance on climate change is a positive step towards this. The state has a key role in leadership on adaptation, and this is discussed further in the following section of this chapter.

Inspirational and enthusiastic individuals (also described an ‘agents of change and ‘champions’ (Lonsdale et al., 2010)) can have a motivating effect on others, and there were certainly some examples where individuals were trying to drive forward work on adaptation. Individual role and level of influence in an organisation is clearly relevant to how much effect this may have. A key issue relating to leadership which emerged through the research was the importance of collaborative leadership and a holistic management approach in the capacity to adapt. There were numerous examples where effective communication and collaboration, sometimes through formal and informal networks, had contributed positively to actions which improved resilience. The WHS steering group for example was cited as providing a forum for communication and collaboration which was particularly important for sites with complex management systems, and the WH coordinator had significant role at all sites in driving forward work on climate change adaptation.

9.2.8. Political Will

Political will is a key determinant influencing the capacity to adapt, affecting the ability to raise resources, and to encourage and drive adaptation. In the following section, the role of the state in adaptation is considered, which is a key element of political will. A challenge when investigating political will was understanding how the concept is defined and what its limits are. Literature on the subject explains that the concept of political will is an ambiguous one, as many definitions exist (Post et al., 2010). In this research, political will was defined as the political mandate to foster adaptation and raise resources.

An important issue which was raised during the research is how the commitment of efforts and resources to adaptation and improving resilience at heritage sites are justified. There are interesting questions around which heritage sites justify large investments in protection and which do not, and how limited funds should be prioritised. Sites which have a resident population, and where there is a direct political interest in funding protection (e.g. resident voting population), attracted significant external funding for efforts to improve resilience, influenced by long term campaigning by the local MP and local authority. As resources have been identified as a key issue in facilitating adaptation, the power to attract or justify funding to direct towards adaptation is crucial. High profile sites such as World Heritage Sites may be in a stronger position than other smaller, less well known heritage sites.

Different heritage sites have different levels of involvement by public bodies in their management. As discussed in the following section, budget cuts, changes to regional level structures and changing priorities are affecting political will locally, and these particularly impact on sites with great public sector involvement. For independent sites, becoming involved with bodies and networks involved in protecting heritage interests and campaigning on their behalf, is one way of increasing their lobbying power, and some of these bodies are involved in work on climate change.

9.2.9. Role of the State in Climate Change Adaptation

Since 2010, in the UK, the coalition government have been reducing the power of the state, promoting decentralisation, and introducing legislation such as the Localism Act (UK Parliament, 2011b) to give new powers to local councils and communities. Yet, the Climate Change Act, the provision of an Adaptation Reporting Power, the appointment of an Adaptation Sub-Committee, the CCRA and forthcoming National Adaptation Programme are all significant developments in the UK's adaptation efforts at a national level. The question of how far the state should be intervening in adaptation and how much should be devolved to a local level is a challenging one. The continuation of climate change policies, despite political changes needs to be ensured – adaptation is about long-term decision making. Political changes have evidently had a negative impact on capacity within local authorities, and the loss of target setting measures such as NI188 have not had a positive effect. This is partly due to the fact that the emphasis on freeing local authorities and communities from top-down decision making has come at the same time as radical budget cuts. Cuts to EH, the Government's statutory advisor on heritage, are also limiting the capacity of this key heritage organisation to carry out work beyond its core activities.

For heritage sites, with varying ownership structures, the direct influence of these issues is varied. At Ironbridge, where the local authority was directly involved in site management, the political changes and cuts were clearly seen to be influencing the capacity to adapt, and having a negative impact on coordination and plan development. However, for private sites or those run by independent bodies such as the NT, the influence of the local authority and national agencies on site operations was weaker, yet adaptation was being considered by both sites. Questions about how much state influence should there be and whether these sites be compelled to consider adaptation, are challenging ones. There is some influence by UNESCO, in that conditions need to be met to retain WHS Status, and the requirement to incorporate climate change considerations into Management Plans is gradually being implemented (through EH). This top-down influence has had a positive effect. Yet sites need to be free to develop locally appropriate and sensitive approaches, and so flexibility is also important.

In light of the issues raised in section 9.2.2 on cognitive factors such as future discounting, if there is no top down policy or influence it is questionable whether adaptation is something that the majority of individuals would engage with. Work by the Green Alliance suggests that since the introduction of localism, climate change work in local authorities has narrowed (Scott, 2011), supporting the experiences found in this research. An external review of government planning guidance found that up to date guidance on climate change was urgently needed (Taylor, 2012). Efforts have been made by Planning and Climate Change Coalition to produce guidance to help local authorities and private sector practitioners to consider climate change, in this new planning landscape (Planning and Climate Change Coalition, 2012).

However, some authors argue that polycentric/decentralised systems have a higher ability to adapt to a changing environment – with this leading to a higher degree of adaptiveness and robustness (Pahl-Wostl, 2009). It is also apparent through the research that although significant amounts of work on adaptation and climate change have been developed at the national level of organisations, such as within NT and NE, this information, skills and knowledge are not necessarily filtering down to site level, where they are needed. It is clear that a mix of bottom up and top down approaches is required, with a balance between local action, and the development of site level initiatives as well as some top down guidance. As argued by Giddens (2009), the State needs to act as a catalyst, a facilitator, in order to help us think ahead and introduce policies for the long term.

9.2.10. Resources

One of the challenges of adaptation is that the problem has no limits in terms of the time and resources it could absorb – this makes it difficult for heritage managers to know how much to spend on it. In the current times of budgetary constraints, and the need to prioritise work, the resources available for works which contribute to general resilience such as land stabilisation, maintenance and monitoring are under pressure, as well as resources specifically available for adaptation. There is the risk that climate change will be a reduced priority until the economic recovery occurs. However, sites' vulnerability to economic pressures and public sector budget cuts are influenced by their management systems and ownership structure, with independent sites such as Blenheim appearing to be somewhat more resilient from these resource fluctuations than those with greater dependency on public sector financing.

Through the research it is apparent that more promotion of the business case for adaptation for heritage sites could be an enabling approach, as the perception of adaptation is often that it requires significant financial investment, yet financial benefits are less clear. The benefits of adaptation in terms of avoiding unexpected costs and increasing revenue, for example by reducing disruption caused by extreme weather events, or by making the most of any strategic opportunities, for example due to longer growing season, should be emphasised. Private/independent management bodies such as Blenheim and the Ironbridge Gorge Museum Trust and the NT are already beginning to engage with some of these issues. Many studies exists which aim to value heritage in economic terms (Choi et al., 2010 ; Hooper et al., 2005 ; Ruijgrok, 2006), and there is no doubt that heritage produces economic benefits, e.g. through the regeneration of historic environments and tourism (AMIOM Consulting, 2010 ; House of Commons Culture Media and Sport Committee, 2011). However, the issue of how heritage can be valued is a contested one, as benefits such as educational and community values are difficult to value economically, and it can be argued that heritage transcends monetary valuation. Benefits of action/inaction on adaptation cannot therefore solely be valued in monetary/economic terms, although the consideration of these economic issues is a helpful approach when justifying expenditure and estimating impacts.

9.2.11. Technological Options

A key determinant in the Yohe and Tol theoretical framework (2002) of adaptive capacity is the range of feasible technological options for adaptation. This determinant was not included in the initial conceptual framework; however it was raised as an issue in the research, mainly in reference to the availability of infrastructure and technology which would be appropriate and financially viable for heritage sites. Although options may exist which may be appropriate for other types of environment e.g. permanent flood defences or heavy engineering, this type of approach was often not appropriate at these sites. It may be possible to take advantage of existing technologies which are already used in heritage management, e.g. building monitoring systems, in order to collect data which would inform adaptation decision making. However, innovative approaches are also needed, such as the development of new methods and technologies to deal with issues such as flooding, which are sensitive to historic landscapes and buildings.

9.2.12. Management Plans and Management Planning

UK WHS Management Plans, where updated, are incorporating climate change, and are certainly acting as a positive tool to encourage the consideration of climate change adaptation and mitigation into site management. However, it is clear that the implementation of strategies and policies developed at an international/national level, (such as the WHC decision which requested that Management Plans should address the possible impacts of climate change) is dependent on the local capacity to do so. Many Management Plans have not yet been updated, and some are significantly out of date.

Where plans have been updated and include climate change adaptation, there is sometimes an implementation gap, which again relates to the capacity to implement the policies in the plans. This could be classed as a coordination failure between actors and institutions. It is clear that more support for site managers in terms of access to the necessary skills, information and resources for implementation, as well as plan development, is necessary to fully take plans forward.

WHS steering groups, coordinators and plans have a particularly important role at sites which have many different stakeholders with an interest in site management. At sites with complex management systems, they can provide a cohesive framework for communication and to address issues such as adaptation, which need to be tackled in a holistic manner.

9.2.13. Heritage and Learning

Learning is a central element of adaptation and evidence of learning from past experiences of weather events exists at all cases. Experiences of events such as sudden floods have acted as significant triggers for change, and led to improvements to routines and preparedness, and at Ironbridge, with a large resident population, large scale training events for disasters help prepare first responders to deal with potential risks. At all sites, there is evidence of institutional memory, with plans and strategies being used to transmit information over time. Local knowledge, skills and awareness which have built up over time through the experience of dealing with events are particularly valuable. However, significant restructuring and changeover of staff, particularly in local authorities, is leading to the loss of some of this knowledge.

A challenge of adaptation is that whilst past events are evidently leading to learning, interpreting climate change signals is challenging due to the slow nature of change, and associated ambiguities and uncertainties. Redman et al (2003) argue that the key to enhancing system resilience is for individuals, their institutions and society at large to develop ways to learn from past experiences and to accept that some uncertainties must inevitably be faced. This acceptance of uncertainties and the development of new approaches to manage it are a characteristic of higher levels of learning (Pahl-Wostl, 2009), and this is not yet widely evident at the case studies, with single loop learning characterizing many attempts to adapt.

As shown through this research, heritage sites themselves may act as a resource for learning about past climates, and past adaptations. Much can be learned from what has survived, and what has been lost, and associated explanations of resilience. In the widely popular work of Diamond (2011), a range of past civilizations are examined, in an attempt to identify why they either collapsed or succeeded, and to consider what contemporary societies can learn from these historical examples. Redman et al. (2003) argue that data in the archaeological record reveals lessons of the long term history of human-environment interactions, and examples of adaptive cycles, where a society has undergone a minor adjustment or reorganisation to maintain itself, for example in response to different climatic conditions, e.g. the end of the Little Ice Age. There is clearly great potential for heritage to act as a tool for communication and education about climate impacts and adaptation, particularly given the large numbers of visitors and media attention high profile sites such as the three case studies attract.

9.2.14. Terminology

Throughout the research process it was clear that sometimes the terminology around adaptation was either not clearly understood or held slightly different interpretations for different individuals. Overlaps exist with other concepts such as risk preparedness, robustness, vulnerability and resilience. In some cases interviewees were noticeably more comfortable with one term than other. For example, discussing vulnerability to flood risk was in many cases an easier topic to engage an interviewee with than ‘adaptation to climate change’. In a small minority of cases, interviewees seemed to understand climate change adaptation as something which included mitigation. The terms which accompany the climate change field which have evolved from different disciplines spanning both the physical and social sciences, yet work on adaptation has not integrated this diversity into a single coherent entity (Brown et al., 2011 ; Frans et al., 2006). The terms adaptation, vulnerability and resilience, have been adopted by many different fields and often have different meanings. For example, resilience in engineering emphasises the ability of a system to return to a steady state after a disturbance such as flooding, whereas ecological resilience focuses on the ability to persist and the ability to adapt (Adger, 2003 ; Davoudi et al., 2012 ; Holling, 1973). The field of heritage conservation and heritage management has its own terminology and language, for example, adaptation could be interpreted as referring to the adaptation of a building to a new use[62]. Those within an environmental remit often had little awareness of concepts such as ‘significance’ in heritage conservation. This lack of a shared language is one barrier to communication and to the integration of these different disciplines.

9.3. Reflections on Adaptive Capacity Theory

9.3.1. Adaptive Capacity and Cultural Heritage Management

The roots of the concept of adaptation to environment, as used in climate change discourse, lie in the natural sciences, namely population biology and evolutionary ecology (Smithers and Smit, 1997 ; Winterhalder, 1980). Ecological concepts such as tolerance and resilience have been used to describe biological systems

[62] In the Burra Charter (which is considered the best practice standard for cultural heritage management in Australia), adaptation is defined as ‘modifying a place to suit the existing use or a proposed use’ (ICOMOS Australia, 1999 p2)

adaptation to changed conditions. Redman et al (2003) state that conceptualizations of adaptive cycles have arisen independently in different disciplines e.g. ecology, archaeology, economics. The adaptation paradigm has also been applied in the social sciences in the context of human – environment interaction (Smithers and Smit, 1997).

It has been argued that there are some difficulties in transferring these concepts from one discipline to another. For example, an important distinction between natural and human conceptualisations of adaptation is that humans possess the ability to take deliberate action to plan and 'manage' adaptation i.e. they can be proactive, whilst the responses of biological systems are entirely reactive. Another challenge is that decisions about the outcome or purpose of adaptation are tied to normative judgements, and issues of power and politics – what does successful adaptation look like, and who benefits from it? Some of the issues around different understandings of terminology, mentioned earlier in this chapter, are explained by this overlap and a degree of confusion between different disciplines.

As one of the aims of this research has been to look at adaptation and specifically adaptive capacity in the context of heritage management, which is a human conceptualisation, it is important to consider how appropriate it is to use this concept in the heritage management field. Decisions and interventions made in heritage management may help maintain and conserve features, sometimes in the face of natural processes of decay and change. For example, without human interventions to maintain it, a landscaped garden would naturally evolve over time, with new species populating it to adapt to changed conditions, and a wooden heritage building may over time decay and disintegrate without maintenance to stop the ingress of water. The application of the concept of adaptive capacity to heritage management therefore relates to human systems, as well as specifically to human-environment interaction, and the institutions and governance processes within which this operates. The research has highlighted that human psychology and behavioural science are also relevant disciplines, as they significantly impact decision making and the capacity to adapt.

The key theories and theoretical frameworks which were reviewed and which contributed to the initial framework for this research related to human/social systems, rather than an ecological approach. In particular, frameworks which related to adaptation in organisations were particularly influential. This initial framework of adaptive capacity was used as a starting point for the research. No existing theory of adaptive capacity relevant to cultural heritage management existed, and the conceptual framework progressed through the empirical study into the final framework which is presented in the following section. Adaptive capacity theory has been found to be applicable to cultural heritage, but with certain limitations. Behavioural and psychological factors were found to be very important and had been overlooked in many existing frameworks. Some new elements and complexities are particular to heritage management (see earlier sections in this chapter) e.g. the philosophy of the management of change in conservation, sensitivities around the appropriateness of change at heritage sites and heritage as a learning resource. The research has shown that there is value in applying the theory of adaptive capacity to heritage management, although there are limitations in representing some of the complexities, conflicts and synergies that exist which affect the capacity to adapt. The investigation of adaptive capacity in this context benefited from the qualitative approach which was taken, which allowed a representation of some of these complexities, and allowed the exploration of the behavioural and psychological elements which became part of the framework.

The research shows the importance of cooperation and sharing of ideas across traditional disciplinary boundaries – it is apparent that, as (Redman et al., 2003) argue, 'in seeking to understand social and ecological systems, many of us still address the questions using the approaches concepts and paradigms of our home disciplines.' Heritage professionals and those in the climate change field come from separate disciplines and the perspectives of natural and social sciences can be quite different. In order to fully consider adaptation in the cultural heritage field, more collaboration between those working on adaptation and those with a heritage remit is important.

9.3.2. Revised Conceptual Framework

A revised framework was developed, by examining the progression from case to case and developing a final framework which incorporated determinants which were relevant to all cases, taking into account the contextual data which had been analysed. This aim was to represent the different determinants in a way which is clear and easy to understand. The revised framework is shown below in Figure 79. The purpose of the framework is primarily to be useful, to enable researchers and users to see and reflect on important determinants that may affect capacity to adapt, and to support flexible and context sensitive analysis without being case study specific. The framework is therefore a tool to enable analysis. This framework has the potential to be applied to shed light on existing situations, and highlight how existing approaches could be improved to optimise adaptive capacity.

As explained in the methodology chapter, a bottom up approach has been used, and the framework is not intended to be a way of scoring or measuring adaptive capacity, but employs the experience and knowledge of stakeholders to document the ways in which management systems experience changing conditions and the processes of decision making which may accommodate adaptation or provide means of enhancing the capacity to adapt. This approach has led to the inclusion of the importance of psychological and behavioural factors, and individuals attitudes within an organisation as key determinants.

A number of issues were encountered in the development of the framework, including the need to clearly identify the purpose of the framework itself, whether different determinants should be weighted, the timeframe of the framework, whether overlaps and relationships could be represented, and how to incorporate the issues of uncertainty which surround the nature of the determinants of adaptive capacity. Some of these questions will now be examined in more detail.

The framework lays out five distinct yet interrelated determinants of adaptive capacity. The processes which shape these determinants are very much interdependent, and complex relationships and overlaps exist, which cannot always be fully represented. Adaptive capacity is generated by the interactions of the different determinants, as Vincent explains, 'adaptation is multidimensional and embedded in the concurrent operation of a variety of processes' (2007 p16). The qualitative nature of the research did, however, allow for expression of these complexities, which would not have been possible with a quantitative approach. A radial design was selected for the revised framework, to reflect the fact that the determinants are all interrelated, rather than the hierarchical design in which the original framework was presented.

There is an underlying assumption that positive impacts on the determinants in the framework (listed in Table 34) should enhance the systems' adaptive capacity, apart from the determinant individual *risk appraisal*, where the relationship between individual perception of risk and capacity to act is variable. However, it must be acknowledged that this assumption of positive impacts may be contested, due to the uncertainties described later in this section. For example stronger policy on adaptation may define a clearer legislative framework but could stifle the capacity to adapt autonomously, or may result in adaptations which damage heritage significance.

The framework is focused predominantly at a local level, although national level factors will influence these local determinants, and assessing certain determinants e.g. policy context and leadership may involve a consideration of national level factors. As Yohe and Tol (2002 p28) explain, 'local manifestations of macro-scale determinants of adaptive capacity are their most critical characteristics'. This research and framework capture a snapshot in time, focusing on the current status of adaptation rather than looking at the future. As experienced during the research, determinants of the capacity to adapt can shift and change over relatively short time periods. The determinants are not weighted, as their relative strength and importance will vary at different sites, and this therefore allows a flexible approach.

As Adger and Vincent (2005 p399) write, there is a great deal of uncertainty around the determinants of adaptation, stemming from the 'contested knowledge domain and theories surrounding the nature of the determinants of adaptive capacity and the human action of adaptation'. Adaptive capacity is dependent on a range of socio-economic variables for which there are specific uncertainties e.g.

the development/diffusion of technology for adaptation, economy/prosperity. For example, different theories of social and economic change will influence the interpretation of certain determinants e.g. some theories say decentralisation leads to enhanced adaptive capacity, whilst others argue the opposite (Giddens, 2009 ; Pahl-Wostl, 2009).

The framework was found to be a useful tool in the research, enabling an examination of each case in detail, highlighting weaknesses and strengths. It also facilitated qualitative comparison between different cases, illustrating their similarities and differences. However, the structured nature of a conceptual framework is by its nature somewhat limiting, in that it defined the scope of the investigation. This made the study manageable but may also have led to the exclusion of some relevant determinants. However, the way the research was designed, using a mixture of inductive and deductive logic, allowed for new nodes/determinants to emerge. A limit of the framework was that some new determinants which emerged were difficult to place within it. In particular it was not possible to represent *integration of heritage into other disciplines* and *tensions and conflicts between different agendas*. These issues have been discussed in earlier sections of this chapter.

Another challenge when developing the framework was how to characterise adaptation in a meaningful sense and to find generic determinants of adaptation which are widely relevant. At different heritage sites, context specific determinants will exist which will also be relevant. This revised framework includes determinants which were found to be relevant at the three cases, and also informed by the literature, national/international level data and the survey of all UK World Heritage Sites. It does not claim to be exhaustive, as explained in Chapter Three, however it indicates generic determinants which are considered to be widely significant.

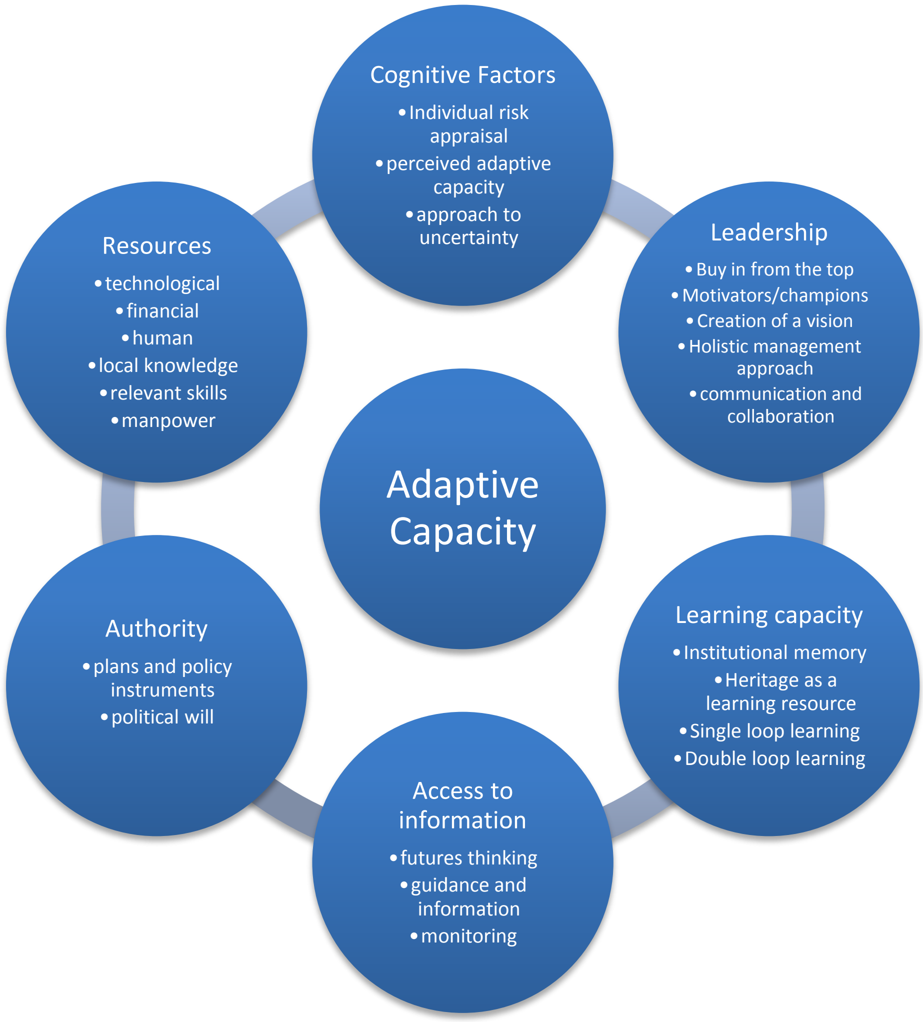


Figure 79 Revised framework of adaptive capacity relevant to cultural heritage management, developed through the research process

Factor	Sub-factors	Description/definition
Resources	Technological	The technological resources that are available for adaptation
	Financial	Availability of financial resources to support policy measures and autonomous adaptation
	Human	Availability of skills, expertise, manpower, local knowledge and experience.
Authority	Plans and Policy Instruments	Availability of plans and policy instruments to increase the ability of individuals to act
	Political Will	The political mandate to foster adaptation and raise resources
Access to Information	Futures thinking	Access and use of information such as scenarios of future conditions, in order to inform long term decision making
	Guidance and Information	Access to the necessary information, guidance and tools to support decision makers
	Monitoring	Monitoring which provides information to inform how to act and to check progress on targets
Learning capacity	Institutional memory	Memories and knowledge which transcends the individual
	Heritage as a learning resource	Tapping into what can be learnt from heritage itself
	Single loop learning	Ability to learn from past experiences and improve routines
	Double loop learning	Learning which questions values, assumptions and policies
Cognitive factors	Individual risk appraisal	Individual assessments of the probability and severity of potential risks
	Perceived adaptive capacity	Individual perceptions of the efficacy and costs of adaptation
	Approach to uncertainty	Openness to the uncertainties around climate change and adaptation
Leadership	Buy in from the top	Commitment to adaptation at a senior level within organisation
	Motivators/champions	Existence of individuals who are motivated and enthusiastic, who act as a catalyst for action
	Creation of a vision	Long term visions which include adaptation
	Holistic management approach	Incorporation of a systems thinking approach; managing system as a whole rather than in parts
	Communication and collaboration	Good internal and external communication, and collaboration e.g. through formal/informal networks

Table 34 Descriptions of the factors included in the revised framework of adaptive capacity relevant to cultural heritage management

9.4. Conclusion

The findings of the research are diverse, illuminating a range of often complex and interrelated issues. Some of these are specific to heritage management e.g. the role that heritage sites themselves may play in learning about adaptation. However, many also reflect broader matters in the field of adaptation and adaptive capacity e.g. conflicts and synergies between adaptation and existing agendas. Although some of the issues that have emerged from the research clearly relate to determinants set out in the initial conceptual framework, other unexpected and often heritage related issues emerged during the research, and these have contributed to the development of theory relevant for heritage management.

Adaptation to climate change is beginning to be considered in the heritage field, partly due to top down drivers, and in the UK, the work of bodies such as the NT who have taken a lead in the field. However, adaptation is not yet a mainstream concept in heritage management. The importance of adaptive capacity in contributing to vulnerability at heritage sites has been highlighted in the research. The broad scope of the problem, its overwhelming nature and competing pressures which are perceived as more immediate, are particular issues. The uncertainties around projected change, and the desire for accurate information before actions can be taken, are also key barriers for decision makers tasked with managing and protecting heritage sites.

A specific issue for management planning at heritage sites is how to manage change, in order to adapt whilst maintaining significance. This is a challenge which is central to this area of work. There is a need for more collaboration between those in different fields e.g. climate scientists, social researchers, conservators, land managers, in order combine the approaches and knowledge of these diverse sectors.

The theory of adaptive capacity was found to be applicable to heritage management, but with some limitations. There was a need for the incorporation of other approaches e.g. a clear consideration of behavioural factors, when assessing the capacity to adapt. The uncertainties associated with adaptive capacity theory and its determinants make it a challenging concept, whose limits should be explicitly acknowledged. A conceptual framework has been developed which can be used as a tool for the investigation and analysis of adaptive capacity, in the context of heritage management.

The following chapter will conclude the thesis, and will consider the practical recommendations for heritage management which lead on from the findings that have been discussed in this chapter. The contribution to knowledge that the research has made, and areas for further study will also be examined.

CHAPTER 10 CONCLUSIONS OF THE RESEARCH

10.1. Introduction

This final chapter revisits the research aim and objectives, which were developed with the intention of contributing to the existing gap in knowledge on adaptive capacity and cultural heritage management. The chapter will discuss how these objectives have been met, including the identification of some practical recommendations from the research. The findings are summarised and the original contribution to knowledge is then considered. Reflections on the research process, including limitations of the study, are identified, followed by a discussion of topics on which further research is required.

10.2. Revisiting the Research Aim and Objectives

The aim of the study was to investigate the adaptive capacity of the management of cultural heritage sites to climatic change, focusing on selected World Heritage Sites in the UK. This has been carried out by working towards the objectives outlined in Chapter 1, and the process of meeting these objectives will now be considered.

The development of a conceptual framework of the determinants of adaptive capacity relevant to cultural heritage sites.

An initial framework of adaptive capacity was developed through an examination of key literature on adaptive capacity, heritage conservation, climate change and World Heritage Site management. Existing framings developed for different purposes but which focus on adaptive capacity in human systems and particularly in organisations/institutions were particularly influential in the development of this initial framework. This was then tested and refined through the fieldwork process, through the use of a questionnaire survey, scoping visits, an examination of the international/national context, interviews and documentary review at case study sites, and subsequent analysis. The process of analysis and development gave insights into some of the challenges of investigating adaptive capacity, and of the applicability of this theory to cultural heritage. A final framework was developed, presented in Chapter 9, the purpose of which is to act as a tool to enable analysis. This lays out five key distinct, yet interrelated, determinants of adaptive capacity, which have been found to be significant factors affecting adaptive capacity at cultural heritage sites.

The selection of key determinants of adaptive capacity appropriate to the management of cultural heritage sites that were empirically investigated and the development of methods to test and evaluate these determinants in practice.

The literature review, scoping stage (visits to potential case studies, informal discussions with organisations such as UNESCO, ICOMOS, and UKCIP) and the analysis of the findings from the questionnaire survey guided the selection of the key determinants on which to focus, as well as informing the development of appropriate methods to use.

The existing LCLIP tool, developed by UKCIP to investigate current weather and its impacts in a locality, was adapted to use as a starting point for investigating adaptive capacity. A mixed methods but predominantly qualitative approach to research was employed, carrying out semi structured interviews with stakeholders and reviewing relevant documentary evidence. The development of the initial conceptual framework informed the development of the tools for fieldwork e.g. the structure of questions in the interview guide. Both statistical analysis and qualitative analysis, using a coding approach in NVivo were used to analyse and evaluate the results from the fieldwork.

The use of these methods to assess the current adaptive capacity of the management of selected sites, and to identify how this capacity could be enhanced.

Findings from the questionnaire were used to develop the case study selection criteria, with three cases being selected which were considered[63] to be vulnerable

[63] This was based on results from the questionnaire, asking a senior site manager about the sites vulnerability to climate change

to climate change, and which have different management systems. The three sites were Ironbridge Gorge, Shropshire, Fountains Abbey and Studley Royal, Yorkshire and Blenheim Palace, Oxfordshire. The findings from the investigation of adaptive capacity in chapters 5-8 highlighted areas where there is the potential to enhance adaptive capacity within the field of heritage management. This led to the development of practical recommendations for heritage site managers and for the wider international/national organisations involved in their management. These recommendations are:

1. There is scope for more specific inclusion in the UNESCO Operational Guidelines on the subject of climate change adaptation, for example the inclusion of more of the recommendations suggested in the UNESCO Policy Document on Climate Change on World Heritage Properties (UNESCO, 2008b). This could help to enhance protection of sites from climate threats. For example, the guidelines could specify adaptation protocols for sites that may be threatened by climate change, such as vulnerability assessments. This could assist with providing some more top-down direction, as it has become evident that in many cases site managers would like more guidance and leadership on what steps to take to start to address climate adaptation. Leadership at an international level can encourage and endorse actions taken by national or local leaders, for example to help politically justify investment in skills, resources etc.

2. The process of the transfer of knowledge on climate adaptation within large organisations such as NE, EH and the NT could be improved. It is apparent that in some cases, although knowledge and skills exist within organisations (often at a national level), at a site level heritage managers may not be fully benefiting from that knowledge. Effective knowledge transfer from specialists at a national/regional to local level, where these assets can be applied, is crucial. The establishment of wider networks and partnerships to help share knowledge and information on adaptation, in the context of cultural heritage management, would be beneficial.

3. As well as support at the development stage of Management Plans, as the inclusion of potential climate impacts and adaptation policies are considered, it is also vital that support is available for plan implementation. At present, revised Management Plans are including climate change considerations, influenced by the WHC decision on this issue. However, an implementation gap is evident, and the sufficient allocation of staff time, resources and skills, as well as uncertainty and a lack of trust in climate data are all constraining factors. A wide range of skills are needed, in order to consider the impacts of climate change on various elements within heritage sites, such as archaeology, built structures, veteran trees and water features. This is an area which warrants further exploration, and which links to the previous recommendation on the need for effective transfer of knowledge, in order to support plan implementation.

4. Adaptation should be mainstreamed into existing agendas of risk preparedness, and dealt with in the context of other risks/issues site managers are already managing. This is already happening to some degree, for example with climate change considerations often being incorporated into risk preparedness sections of Management Plans. This approach could be widened to incorporate adaptation into existing benchmarking/good practice for example, existing green tourism and sustainability schemes. This would encourage the mainstreaming of the issue, integrating it with other linked objectives such as mitigation where possible. This could also serve as a way to encourage learning through networks and the sharing of knowledge. Defining good practice may give practitioners an idea of what approach to aim for, as adaptation can appear to be a limitless/boundless problem.

5. Substantial amounts of monitoring information exist at many sites, which have the potential to be pulled together or used to monitor possible impacts of changes to the climate and the impacts of adaptive actions. This information already exists and presents an opportunity; however, motivation and allocation of resources will be needed in order to take advantage of this.

6. There is a need for further collaboration and dialogue between different sectors, and sustained cooperation is required to combine the approaches and requirements of those from different fields. For example, the integration of heritage concerns into the work of Emergency Planners is needed, such as the integration of cultural heritage assets into existing disaster management plans. Collaboration between natural scientists, social scientists and stakeholders is required in order to create and develop tools and data which could support those in heritage sector e.g. the development of modelling and scenario data which is helpful to decision makers at site level, within the confines of what current science can provide. Local knowledge and skills should be harnessed in order to develop an understanding of sites' vulnerability to climate change – there need needs to be integration of science with local knowledge.

7. Although there is a role for top-down guidance and policy for adaptation, and guidance and leadership from bodies such as EH could be strengthened, it is imperative that at a local level, there is the flexibility for careful, site sensitive decisions to be made on what is appropriate in order to protect values and significance. The benefits of taking adaptive actions will not always outweigh the costs, both financially, and crucially in this context, in terms of damage to significance caused through the actions themselves.

8. The importance of psychological factors such as risk perception and perceived capacity to adapt have been highlighted in this research. Fear is not necessarily a good motivator, especially as the risks are often perceived as being far in the future, and there are many competing concerns. The use of communication tools which purposefully or inadvertently invoke fear or anger should therefore be used with care as they may be counterproductive. A measured approach should therefore be taken by those working on climate adaptation, which takes a balanced assessment of risk, and, importantly, examines opportunities as well as threats for heritage site management.

A review of the implications of these findings for other similar heritage sites, and for adaptive capacity theory.

In Chapter 9, the findings of the research have been reviewed in relation to existing knowledge, and key issues which have emerged relevant to climate adaptation and heritage management were discussed and reflections on the implications of the research for adaptive capacity theory presented. Recommendations relevant to heritage management were subsequently made, outlined in the previous section of this chapter.

10.3. Summary of Findings and Novel Contribution to Knowledge

Impacts from changes to the climate are already being observed at heritage sites. Existing vulnerabilities may be exacerbated by climatic change in the future, and the heritage values which contribute to site significance may be affected or even lost. However, opportunities also exist, for example the possibility of longer visiting seasons. The potential impacts of climate change on cultural heritage are not yet well understood, although the knowledge base is expanding. The amount of research has increased over the last three years, with research projects such as the EU Climate for Culture which has partners throughout Europe (Climate For Culture, 2012). However, there are significant gaps in knowledge in this area, as identified in Chapters 1, 2 and 3. Existing and on-going research focuses mainly on modelling potential impacts on materials and structures. Site managers and management systems have a central role in conservation, and take decisions which seek to manage change and retain heritage significance, balancing different pressures such as the need for economic viability. However, there has been a lack of research on how management of sites are adapting to climate change and particularly of the capacity of current management systems to prepare for and deal with the consequences of climate change. There is also a lack of research on the theory of adaptive capacity and cultural heritage. The research findings have contributed to this gap in knowledge in several ways, which will now be explained.

10.3.1. Contribution to the understanding of the vulnerability of cultural heritage sites to climate change

The importance of adaptive capacity in contributing to vulnerability at heritage sites has been highlighted in the research, and by contributing to the understanding of adaptive capacity this has also contributed to the understanding of vulnerability. The research has highlighted areas of weakness in capacity as well as highlighting strengths, both at specific case studies and through the investigation of the national and international context.

At all the case study sites there was interest in adaptation, and some work was underway. Yet evidently significant challenges exist, many of which were common to all the sites investigated. Some of these key challenges include that futures thinking in regard to climate change is presenting profound difficulties, due to the perceived unreliability and uncertainties in climate projections and scenarios. Another challenge is the lack of information on best practice and guidance on adaptation within a heritage context and a need for more support, particularly the availability of skills and information for sites that are embarking upon considerations of adaptation in their management planning. The terminology used in this field can be confusing, and can hold different interpretations for individuals from different fields, and the lack of a shared language is one barrier to communication.

Psychological and cognitive factors are central to the capacity to adapt, and their influence in influencing vulnerability should not be underestimated - human psychology plays a role in navigating the expectations and concerns of stakeholders. Learning is key to developing capacity, and heritage sites have the potential to enable learning as some sites are a storehouse of knowledge about past climates and adaptations. However, at the case studies it was apparent that single loop learning characterises many attempts to adapt, and that higher levels of learning which accept uncertainty are not yet widespread.

It was evident that although top down guidance provides drivers and a framework for action, this needs to be balanced with bottom up/local decision making and flexibility, to allow locally appropriate and sensitive decisions to protect significance. Heritage concerns are not a priority for all organisations, and those primarily tasked with adaptation do not have a strong heritage remit. An adaptive framework relies critically on the collaboration of diverse sets of stakeholders operating at different scales in multi-level institutions/organisations, with different remits.

10.3.2. Contribution to adaptive capacity theory, relevant to the management of cultural heritage sites

The exploration of the application of adaptive capacity theory to cultural heritage management is a novel approach. Adaptive capacity theory was found to be applicable (when based on a human and social-ecological systems perspective) to cultural heritage management, although there were certain limitations, particularly given the contested nature of determinants of adaptive capacity, and adaptive capacity itself. Not all determinants could be fully represented in the framework, and its structured nature imposed limits to how relationships and overlaps could be represented. However, despite these limitations, the framework has proved to be useful and provides a way to identify key issues which can be improved to help enhance adaptive capacity and reduce vulnerability.

The study has contributed to knowledge by developing an analytical framework which is relevant to cultural heritage management, which has been practically tested, and can be used by other researchers. The research has also contributed to knowledge through the development of methods to test and investigate adaptive capacity in the heritage management field, and by highlighting some of the challenges in applying this theory to heritage management.

10.3.3. Reflections on the current systems of management and management planning at World Heritage Sites and the capacity of these systems to adapt to climatic change

The investigation of case studies with varying management and ownership systems, generated comparisons, reflections and a contribution to knowledge on these existing arrangements and the implications for adaptive capacity. The type of site ownership and management system was found to influence the capacity to adapt.

Management Plans are a key tool for encouraging the consideration of climate change adaptation at sites, and there is evidence that the WHC decision[64] is influencing the revision of plans to incorporate climate change. However, it has been found that not all plans are up to date, and that the usefulness of this tool is being limited by the capacity at a local level to produce and update the plans. Plan implementation has also been identified as a concern. Monitoring is a central element of heritage management practice, and its importance is crucial for monitoring impacts of climate change and adaptations. Monitoring in relation to climate change is something which has been highlighted (see 9.2.6) as an area for improvement.

The research has identified that there are some opportunities for the strengthening of UNESCO guidance on adaptation, whilst acknowledging the importance of allowing sites flexibility to tailor approaches in site sensitive ways. This is particularly pertinent given the central challenge of managing change, and questions of how to balance adaptation to a changing climate with the conservation of significance. Flexibility has been highlighted as a key element of adaptive capacity. In the field of heritage management, there needs to be an enhanced understanding of adaptation as being about flexibility, and a long term iterative approach, adopting ways of continuously adapting and managing under uncertainty rather than 'waiting' for accurate models/predictions to emerge/be developed.

[64] Decision 30 COM 7.1d requests that climate change is addressed in Management Plans

10.4. Reflections on Successes, Challenges and Limitations of the Methodology

The fieldwork process confirmed the gap in knowledge and the need for research and information on the subject of climate adaptation at heritage sites. The majority of those contacted in relation to the research were willing to be involved and there was significant interest in the outcomes of the study, with many interviewees generously contributing their time. The criteria used for site selection were helpful, leading to the selection of sites which were vulnerable to climate change, with different types of management and ownership systems. This variety led to issues being revealed which may not have emerged so clearly if the three sites had been more similar.

Lists of potential participants obtained from documentary sources (such as lists of stakeholders in published documents) were initially contacted, followed by snowball sampling. The snowballing approach worked well, and proved to be an effective way of reaching interviewees who would otherwise have been very difficult to access. However, there were some challenges recruiting interviewees from local authorities, in times of resource pressures and public sector restructuring.

There were some elements of action research in the fieldwork, although this had not been part of the original design. Action research emphasises collaboration between researchers and practitioners and the researcher is directly involved in planned organisational change (Avison et al., 2001 ; Blum et al., 2009). It was found that some individuals were reading up or researching issues before interviews, and sometimes interviews acted as a trigger for action, as issues were raised through discussions in the interview setting. This was an unexpected positive outcome of the research.

A challenge which was encountered was that there were sometimes difficulties in engaging with interviewees on the subject of climate change, particularly whilst interviews were being recorded. It was apparent that some interviewees felt that they needed to say the ‘right’ thing – climate change is politically charged and is a sensitive issue. It may also have been possible that participants in the study were self-selecting; those who were very uninterested in climate change may have been less likely to agree to participate in the research. This is a limitation of the research, as this may have influenced the findings. However, in itself, it is also a finding, as it illustrates the politically sensitive nature of the issue, and barriers to openly discussing beliefs and opinions on climate change. Another challenge was difficulties with the distinction between personal views and the views of an organisation. These are intertwined and not independent of each other, and therefore sometimes impossible to distinguish. Refining interview questions to make it clear whether it was a personal viewpoint or the stance of the organisation which was the subject of questions, helped to clarify the investigation of this issue through the research process.

A limitation of the study was that in order to investigate case studies in depth, using the qualitative methods which were considered most appropriate, the number selected had to be restricted to three sites. World Heritage Sites are, by their nature, unique, and also have greatly varying management structures. Examining more cases would have allowed more comparison and more understanding of which factors were context specific and which were generic. Care should therefore be taken in generalising findings from these three sites to other heritage sites, without taking into account site specific factors and local variations. The use of mixed methods and the use of a questionnaire survey and review of all UK WHS Management Plans provided contextual data on the topic at other UK World Heritage Sites, and were employed to strengthen the research findings. However, an examination of wider policy documents beyond those studied, or an in depth analysis of all UK WHS Management Plans, would also have been interesting and valuable, and would have allowed further investigation of the wider context, but were beyond the scope and time limits of this study.

10.5. Recommendations for Further Work

A significant gap in knowledge exists in the subject area of climate adaptation and cultural heritage management as has proved evident throughout this research. This research has made a contribution to this gap, however much more work is needed. The potential areas of study are numerous, but some ways in which this study could be extended are identified below.

There is scope for further in depth study of many of the individual determinants which are affecting the capacity to adapt. For example, it would be interesting to focus a study solely on resource issues - particularly the availability of the required skills and financial resources for adaptation and risk preparedness within different heritage organisations. An in depth investigation of the transfer of skills and knowledge on adaptation within organisations such as NE, NT and EH would also be enlightening, and may identify ways that existing and new knowledge and skills can best be transmitted to decision makers at site level.

There is scope to carry out similar assessments of adaptive capacity at further case studies, particularly those with different types of management structure and different heritage types. The analytical framework which has been developed through this research could be tested at additional sites, to further reveal both generic and context specific variables. This could be applied not just to World Heritage Sites but to other managed heritage sites, in order to investigate the capacity to adapt, highlight how this could be enhanced, and to investigate the wider applicability of the analytical framework.

Given that the integration of climate change adaptation concerns into heritage site Management Plans is a relatively recent occurrence, and implementation of these policies has been identified as an area of concern, this is also an area which warrants further investigation. Factors which are limiting implementation have been identified in this research, but further study, perhaps focusing on several sites which are at a similar stage of plan development and implementation, would help shed further light on this issue and identify ways that this implementation gap could be overcome.

10.6. Final Comments

This study has fulfilled its aim of investigating the adaptive capacity of the management of cultural heritage sites to climatic change. This has entailed a comprehensive review of the literature in the area, the development and application of appropriate research methods, a scoping study, an in-depth study of case study sites, and an investigation of the national and international context. The research has produced well supported findings, contributing to the overall understanding of the progress and challenges in adapting to climate change at heritage sites. A conceptual framework has been developed, which can be used as a tool to enable analysis. This can assist researchers and users to identify important determinants that may affect capacity to adapt, and to highlight how existing approaches could be improved to optimise adaptive capacity. There is scope for further investigation in this field, and it is important that work continues in order to reduce the vulnerability of heritage sites to climate change, and to thereby contribute to the conservation of heritage assets for future generations.

APPENDICES

Appendix 1: Table of Selected Determinants from Conceptual Framework

Determinants	Criteria to focus on	Definitions	Issues to explore in the fieldwork
Learning Capacity	Single loop learning	Ability of institutional patterns to learn from past experiences and improve their routines	What has been learnt from past experiences of weather events at the sites? Is the site more prepared now that before the weather event?
	Double loop learning	Evidence of changes in assumptions underlying institutional patterns	Have the experiences of previous events changed attitudes towards preparing for future weather events?
	Discuss doubts	Institutional openness towards uncertainties	Are doubts and uncertainties about climate change acknowledged, openly discussed?
Room for Autonomous Change	Access to information	Accessibility of data within institutional memory and early warning systems to individuals	Do staff have access/awareness of information about current/future risks e.g. flood warning systems, climate scenarios? Is training/education on conservation/adaptation available? Is there knowledge of the existence of appropriate technologies? What sources/types of information are used to make decisions?
	Act according to plan	Increasing the ability of individuals to act by providing plans and scripts for action, especially in case of disasters	Are there disaster preparedness plans/risk assessments/policies in management plans for risk preparedness and/or adaptation to increase the ability of individuals to act?
	Capacity to improvise	Increasing the capacity of individuals to self-organize and innovate; foster social capital	Did/do staff have the capacity to improvise/take the initiative on the ground?
Resources	Human resources	Availability of expertise, knowledge and human labour	Are human resources available e.g. informed staff to implement adaptation actions or to plan adaptation? What knowledge exists about cultural heritage amongst those

			instigating adaptation strategies? What knowledge do managers/staff have about risks and ways to respond? Are there opportunities for training on climate change risks, adaptation, and risk preparedness?
	Financial resources	Availability of financial resources to support policy measures and financial incentives	Financial resources –are there resources available to support adaptation/risk preparedness? e.g. expenditure on programmes such as more regular maintenance, training Was the necessary budget available when weather events occurred in the past?
Leadership	Visionary	Room for long-term visions and reformist leaders	What type of leadership exists at the WHS and are those in leadership roles engaged/endorsing adaptation?
	Entrepreneurial	Room for leaders that stimulate actions and undertakings; leadership by example	Is there an 'adaptation champion' – someone who plays a motivating role in the organisation?
	Collaborative	Room for leaders who encourage collaboration between different actors; adaptive co-management	What leadership is there from advisory bodies/UNESCO in terms of guidance/policy on adaptation and risk preparedness? What kind of collaboration exists between actors?

Table includes concepts and definitions adapted from (Gupta et al., 2010)

Appendix 2: Summary of Outcomes from Scoping Stage

UNESCO, World Heritage Centre, Paris – Summary of Meeting Findings

Meeting with Assistant Programme Specialist, Europe and North America Team, Sept 2010

- Unaware of any current research on adaptive capacity
- UNESCO's role is 'hands on' for sites in developing countries but for the developed world its function is more about putting people in contact (developing networks), a reactive role and the production of publications.
- ICCROM is the main body dealing with risk preparedness
- IUCN (natural sites) is more advanced in dealing with climate change issues than the bodies responsible for cultural sites
- Key issues for site managers in dealing with climate change are: risk awareness, having a Risk Management Plan, coordination (who is responsible for what) and having a resource buffer

This meeting helped clarify whether there was any existing research being carried out on World Heritage and adaptive capacity, confirmed that knowledge on climate change was more developed for natural sites than cultural sites, and helped identify some key issues that affect adaptive capacity.

ICOMOS Documentation Centre, Paris – Summary of Outcomes of Documentary Review

Use of documentation centre library, Sept 2010

A review was carried out of Management Plans and other site documentation held at the centre (including those from Czech Republic, German and Austrian sites). The initial research proposal for this thesis had been for an investigation of case studies from throughout Europe. Following this visit and the realization of how complex sites and their management systems are, as well as difficulties in accessing information, it was decided to narrow the study from Europe wide to a UK focus.

Derwent Valley Mills, Derbyshire - Summary of Findings from Meeting and Site Visit

Tour of site, meeting with Site Coordinator, Oct 2010

- Site is regularly affected by flooding, and this has been happening more frequently. In particular Strutts Mill, Darley Abbey, Belper gardens, Cromford Mill have been affected.
- At Milford Mill there is potential damage to historic value as a result of 'adaptation' measures (raising the site floor due to flood risk as part of site redevelopment)
- They are in a transitional stage in governance of the WHS
- Not heard of LCLIP approach, but they are interested in it.
- Interested in being involved as a case study – further contacts were given as well as recommendations for other case studies

This meeting shed light on some of the weather events the site has been affected by and their impacts. It established that the LCLIP approach had not been previously used and also gave an insight into the way the site is managed. The visit established contact with a 'gatekeeper', and provided details of further useful contacts.

ICOMOS UK, London – Summary of Findings from Discussion

Informal discussion with ICOMOS UK staff, Dec 2010

UK World Heritage sites that consider climate change to be a particular threat are: Fountains Abbey and Studley Royal, Ironbridge Gorge, Derwent Valley Mills, Devon and Cornwall Mining Landscape.

This discussion helped identify sites to contact as part of the scoping stage as well as contributing to the development of criteria for case study selection.

Blenheim Palace, Oxfordshire – Summary of Findings from Discussion

Phone call with Rural Enterprises Manager, Feb 2011

- Difficult to pinpoint what changes are climate change and what are natural variations
- Have observed longer growing seasons and experienced flooding
- They are introducing changes to their tree species planting (due to drought), which will change look of the park
- Would be happy to help more with the research

This discussion highlighted some of the weather events that the site has experienced and established that they consider climate change to be an issue that needs to be considered in the current and future management of the site. The possibility of further study at the site was discussed.

UK Climate Impacts Programme, Oxford – Summary of Meeting Outcomes
Meeting with a member of staff working on adaptation to climate change in organisations, April 2011

Current literature on frameworks of adaptive capacity was discussed. This assisted the development of a thorough review of all relevant literature and helped with the development of the initial conceptual framework.

Ironbridge Gorge, Shropshire - Summary of Findings from Meeting and Site Visit
Meeting with WHS coordinator and engineers working on land instability, tour of the site, June 2011

- There are historical issues with land instability and flooding at the Gorge
- Instability may be exacerbated by climate change because water levels and land movement correlate and there is a potential risk to OUV
- The WHS Management Plan (2001) is being revised and will be available in 2012, the next version will have performance indicators to monitor these issues
- Funding for land instability works is a real problem – have been lobbying central government for funds
- List of key stakeholders provided

- Would be interested in helping further with the research

A great deal was learnt about the site, particularly the impacts of flooding and land instability, and the management systems in place. Useful contacts were established, and the possibility of carrying out more interviews was welcomed.

Fountains Abbey and Studley Royal, Yorkshire - Summary of Findings from Meeting and Site Visit
Tour of site, meeting with Site Coordinator, July 2011

- Site has been particularly affected by gales and floods. Flooding/water management is a key issue (particularly in their water gardens). Algal blooms have also caused problems
- They are considering introducing a damming/flood management system to deal with flooding issues
- They believe climate change will be a major issue for them
- Not heard of LCLIP or UKCIP or projections
- They are interested in being involved as a case study

A great deal was learnt about the site, its management structure and the impacts of previous weather events at the site as a result of this meeting. The LCLIP approach has not been used at the site. Useful contacts were established, and the possibility of carrying out further work at the site was discussed.

Appendix 3: Distributed Questionnaire

Questionnaire survey which was distributed to staff at all UK World Heritage Sites in 2011

Climate Change and World Heritage

1.

Thank you for participating in this survey of UK World Heritage Sites, which should take 5-10 minutes to complete. Initial questions will focus on impacts of weather events at heritage sites (not necessarily linked to climate change, but in order to help understand current vulnerability to weather). There will then be several questions on climate change.

1. Which World Heritage Site (WHS) are you involved with?

2. What is your job title?

3. Have any of the following weather events (not necessarily linked to climate change) affected your site during the last 5 years?

	Yes	No
Flooding	○	○
Heavy rainfall	○	○
High Temperatures/Heat wave	○	○
Gales/High winds	○	○
Snow/Ice/Freezing temperatures	○	○
Drought/Severe dry weather	○	○

Other (please specify)

4. Please could you describe the impacts of these weather events on the site? e.g. water damage, damage from freeze/thaw, water shortages, closing site to visitors, drop in visitor numbers

Flooding

Heavy rainfall

High Temperatures/ Heat wave

Gales/ High winds

Snow/Ice/Freezing temperatures

Drought /Severe dry weather

Other

5. What impacts do you think climate change may have on your World Heritage Site?

Climate Change and World Heritage

6. Please indicate your level of agreement with the following statements on climate change and World Heritage:

	Strongly Agree	Agree	Unsure	Disagree	Strongly Disagree
My WHS is vulnerable to impacts from climate change	○	○	○	○	○
My WHS is well prepared to deal with threats/opportunities from climate change	○	○	○	○	○

7. Have any steps been taken to adapt to climate change at your site? e.g. flood defences, policies in management plan, risk assessments, staff training

○ Yes

○ No

○ Not Sure

If yes, please give details

8. What factors will be important in affecting your site's capacity to cope with any future opportunities/threats from climate change?

	Very important	Moderately important	Unimportant
Financial resources	☐	☐	☐
Leadership	☐	☐	☐
Learning lessons from past events	☐	☐	☐
Forward thinking e.g. risk assessments	☐	☐	☐
Developing policies and plans for climate change	☐	☐	☐
Access to knowledge/information e.g. training, information on best practice	☐	☐	☐

Are there any other factors that you think are important?

9. Finally, do you have any other comments/opinions on the subject of climate change adaptation and heritage sites?

Climate Change and World Heritage

10. Thank you very much for your time! Would be willing to be contacted again with any follow up questions?

◯ Yes

◯ No

If yes, please could you provide your contact details (email/phone number)? Thankyou.

Appendix 4: Participant Information Sheet and Consent Form

Participant Information Sheet

You are being invited to take part in a research study. Before you decide whether or not to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information.

What is the purpose of the study?
This survey is part of a PhD research project which is being undertaken by Helen Phillips. The aim of this study is to investigate how the management of World Heritage Sites in the UK are adapting to climate change, and to explore previous experiences of weather events at the site. In order to achieve the aim, interviews will be conducted with a range of professionals who are involved in the management of World Heritage Sites.

Why have I been invited to participate?
You have been invited to participate in this research because you were identified as being someone who might have important information and opinions which will help me to achieve the aim of this study. Interviewees were chosen who are involved in the management of World Heritage Sites in the UK.

Do I have to take part?
Your participation would be very beneficial for my study as your knowledge, opinions and point of views would help greatly to build up my thesis and to achieve its aim. However, taking part in this research is entirely voluntary. It is up to you to decide whether or not take part. You are free to withdraw from the study at any time. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form.

What will happen to me if I take part?
If you decide to participate you will be invited to take part in a semi-structured interview which may be audio-recorded with your authorisation. Each interview will be carried out at your place of work, and it will not last more than 1 hour.

What are the possible disadvantages and risks of taking part?
There is no apparent potential risk to participants and there are no costs involved in taking part.

What are the possible benefits of taking part?
If you decide to take part you will be contributing with your knowledge and information to provide a better understanding of the implications of climatic changes on heritage sites.
Participation will also help build awareness amongst interviewees of the potential impacts of climate change at the sites they are involved in, and ways that responses could be improved.

What will happen to the results of the research study?
The results of the research will be published in my PhD thesis and also in conference and journal articles. My PhD thesis will be lodged in the Oxford Brookes library. If you would like to review a copy of the transcript of your interview, before it is used for the research, please let me know.

Will what I say in this study be kept confidential?
This study respects your confidentiality subject to legal limitations. There are a relatively small number of participants in the study, so it is not possible to guarantee complete anonymity, however any quotes used in publications will be anonymised (with your consent.) This study will protect any commercially sensitive information but since some interviewees may be identifiable from the information provided, this aspect of the study is also subject to the standard legal limitations. All data collected during the field studies will be transferred on completion to Oxford Brookes University for safe storage for up to 10 years.

Who is organising and funding the research?
I am conducting this research as a PhD researcher at Oxford Brookes University, Department of Planning, School of the Built Environment, and this research is being funded by the university.

Who has reviewed the study?
This research has been approved by the University Research Ethics Committee, Oxford Brookes University.

Contacts for further information
If you have any questions regarding this research, please contact me, at: helenphillips@brookes.ac.uk.

This research is being supervised by:
Mrs Elizabeth Wilson, Department of Planning, Oxford Brookes University
Dr Aylin Orbasli, Department of Architecture, Oxford Brookes University

If you still have any concerns about the way in which the study has been conducted, please contact the Chair of the University Research Ethics Committee on ethics@brookes.ac.uk.

Thank you for taking time to read the information sheet.
Helen Phillips
Department of Planning
School of the Built Environment
Oxford Brookes University
November, 2011

CONSENT FORM

Full title of Project: The adaptation of cultural heritage sites to climatic change

Name, position and contact address of Researcher

Helen Phillips, PhD Researcher
Oxford Brookes University, School of the Built Environment, Department of Planning, Gipsy Lane, Oxford, OX3 0BP

Please initial box

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason. ☐

3. I agree to take part in the above study. ☐

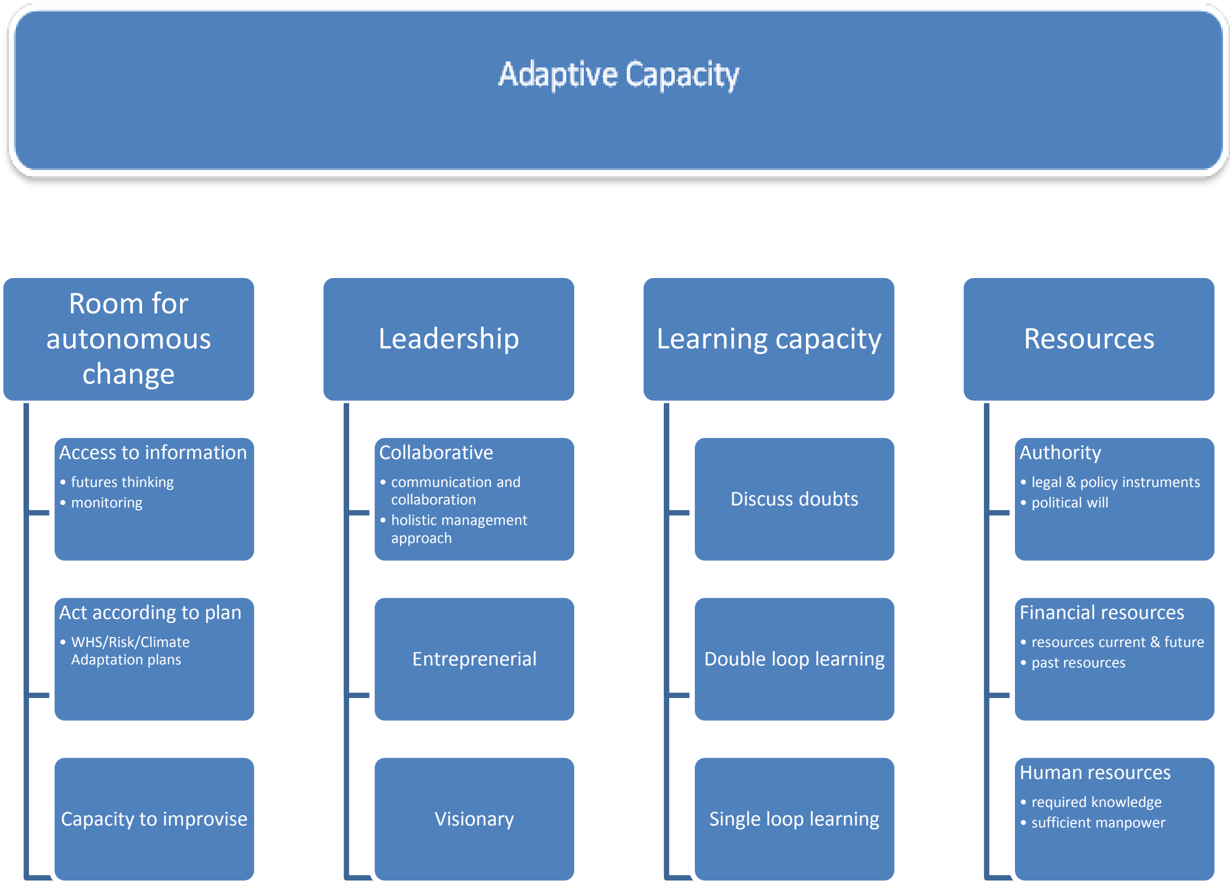
Please tick box

	Yes	**No**
4. I agree to the use of anonymised quotes in publications	☐	☐

Name of Participant ______________________ Date ______________ Signature ______________________

Name of Researcher ______________________ Date ______________ Signature ______________________

Appendix 5: Adaptive Capacity – Diagram of Initial Conceptual Framework (before case study stage)



Appendix 6: Case Study Selection Matrix

Matrix developed following questionnaire survey, and only includes World Heritage Sites which responded to the questionnaire (Spring 2011)

Respondents	Cultural Sites	Experience of impacts from weather events in last 5 yrs.	Vulnerable to CC (St Agree/ Agree)	Excl. Cities	Meet all Criteria	Ownership/Management (information mostly taken from most recent management plans, correct at their time of publication)
Blenheim	x	x	x	x	x	Private ownership and management
Canterbury	x	x		x		State ownership, Cathedral complex self-financed/governed, City Council concerned with overseeing management of WH site
City of Bath	x	x	x			Complex ownership, management partnership/ steering group
Derwent Valley Mills	x	x	x	x	x	Complex ownership, management partnership/ steering group
Dorset and East Devon Jurassic Coast		x		x		Complex ownership, management partnership/steering group
Durham Cathedral and Castle	x	x		x		3 owners/managers plus management plan steering group
Edinburgh Old and New Towns	x	x	x			Complex ownership and management including management partnership and World Heritage Trust
Giant's Causeway and coast		x	x	x		6 landowners including NT and Crown Estate, WHS management group
Hadrian's Wall	x	x	x	x	x	Complex ownership/management, including private ownership, public/private/voluntary bodies, management plan committee and 6 interest groups, primarily coordinated by Hadrian's Wall Heritage Ltd
Heart of Neolithic Orkney	x	x	x	x	x	Site in the care of Historic Scotland. Management partnership, chaired by Historic Scotland
Ironbridge Gorge	x	x	x	x	x	Complex ownership and management including Ironbridge Gorge Museum Trust, Telford and Wrekin Council, private landowners, WHS steering group
Kew Gardens	x	x	x	x	x	The Royal Botanic Gardens, Kew and Historic Royal Palaces own/manage the site in partnership, WH Site Steering group
Liverpool	x	x	x			Complex ownership and management, management steering group
Maritime Greenwich	x	x	x	x	x	Complex ownership including the Greenwich Foundation, Greenwich Hospital and private landowners, management steering group
New Lanark	x	x	x	x	x	Complex ownership, managed by New Lanark Trust in partnership with other stakeholders

Saltaire	x	x	x	x	x	Complex ownership and management, management coordinated through 3 groups made up of experts, local stakeholders and council officers
St Kilda		x	x	x		Owned and managed by NT for Scotland, with collaboration through management group
Studley Royal and Fountains Abbey	x	x	x	x	x	Owned by NT, EH and a private landowner. Managed jointly by NT and EH
Tower of London	x		x	x		Complex ownership, managed by Historic Royal Palaces

Appendix 7: Sample Interview Guide (used at Fountains Abbey and Studley Royal WHS)

Experiences and Impacts of Severe Weather Events and Climate Change Adaptation/Resilience at UK World Heritage Sites

Introductory Questions

- Job role?
- How involved in the management of the World Heritage Site? On steering committee or involved in WHS Management Plan?
- Role in risk preparedness, climate change adaptation and in responding to severe events such as flooding?
- Other key stakeholders are involved in risk preparedness and also responding to severe weather events at Fountains – their roles?

Experiences/Impacts of Recent Floods

- Has a flooding event happened at Fountains whilst in current job role? Role in responding to this flooding event? Who coordinated response?
- Any impacts on heritage? What were the resource implications?
- How are impacts assessed/monitored (e.g. condition surveys)
- Was anything learnt that has helped improve the preparation/response for future flooding events?
- Have any particular plans/policies/strategies been introduced due to the experiences of flooding events?
- Risk preparedness/disaster management systems – flood plan/emergency plan?

Climate Change Adaptation

- Climate change a risk to the WHS's? If yes, in what way?
- Who takes the lead on climate change issues for the WHS?
- Sufficient guidance/leadership from external agencies e.g. UNESCO on climate change and heritage?
- Adequate information and resources in order to plan for possible risks at the site from climate change? (Human, financial resources & information)
- Any sources of information on climate change which are particularly helpful?
- Use of information to help understand future climate risks e.g. UKCIP09 scenarios?
- What kind of monitoring occurs at the site?
- Involvement with monitoring objectives in Management Plan?
- Is climate change a political issue/ priority?

Appendix 8: Anonymised Sample of a Transcribed Interview

Interviewer: Do you have any role in terms of risk preparedness?
Interviewee: Risk preparedness is something that should go into the Management Plan. There are other people who have different kind of risk plans as well. Our curation team, the people who look after the objects if we were to ever have a museum on site, they would have their own disaster management plan. The gardener, he has his own series of plans and all of those plans are sort of nested underneath the World Heritage Management Plan. So for example, he I think has either done or is putting together the plan that is about adapting to climate change because obviously X take that very seriously, so they are thinking about what species of trees will be used when the climate changes. We also sort of look at risk preparedness, because of the rise in river levels, whether we need to build walls higher and that sort of thing, we can build the river walls higher.

Interviewer: Have you had any experience of a flooding event?
Interviewee: Yeah, lots of times unfortunately. I know from personal experience how quickly the river can rise here. It didn't always come out of its banks but it can rise very, very fast. But obviously there have been some very big flooding events, most recently obviously a couple of years ago that X probably told you about.

Interviewer: Yes, they mentioned the big one in 2007 and quite a lot of smaller ones that have happened pretty frequently.
Interviewee: That's right, yeah. They weren't as bad as in 2007. Although, I think X said that he had actually looked into the records, historic records and he had come across other examples of quite high flooding, but perhaps not quite as frequently as it is happening now.

Interviewer: When the site floods, does it always affect the Abbey or is it mainly the water gardens?
Interviewee: Both really. It will affect the Abbey, usually the kind of the areas obviously adjacent to the river, like the Monks range, the choir monks range. But the 2007, it obviously flowed right through the cloister and into the chapter house and obviously you have seen the photographs. So that was really unusual actually, that it was that far away from the river that the flooding was. It wasn't so much the flooding that was the problem, it was the speed of the water and what it ripped up in the Cloister alley way. That was the problem.

Appendix 9: Additional Photographs of Case Studies

Ironbridge Gorge

Figure 80 Interpretation panel at blast furnaces, Blists Hill Victorian Museum
Figure 81 Entrance to the Gothic style Museum of the Gorge, originally a warehouse

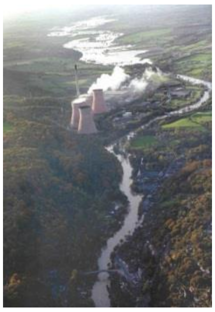


Figure 82 Flooding along Wharfage with temporary barrier in place in 2008 (photo courtesy of interviewee)
Figure 83 Arial view of the narrow Gorge in flood, date unknown (photo courtesy of interviewee)

Fountains Abbey and Studley Royal

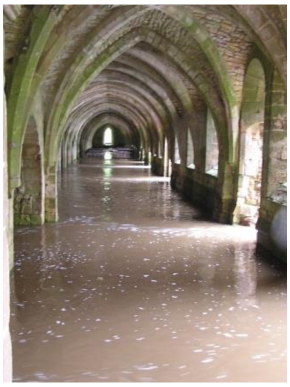


Figure 84 and Figure 85 Severe flooding in 2007 - Abbey Cellarium in flood and water overflowing into lake through water garden balustrades - (photos courtesy of interviewee)

Figure 86 Quebec – an area of the site which may be important for future flood management
Figure 87 Information board at Quebec, explaining the history of the area and the archaeological dig

Figure 88 Water damage to bank just below Rustic Bridge in 2011
Figure 89 Cumulative water damage to the landscape at Quebec caused by overflowing of the half-moon pond in 2012.

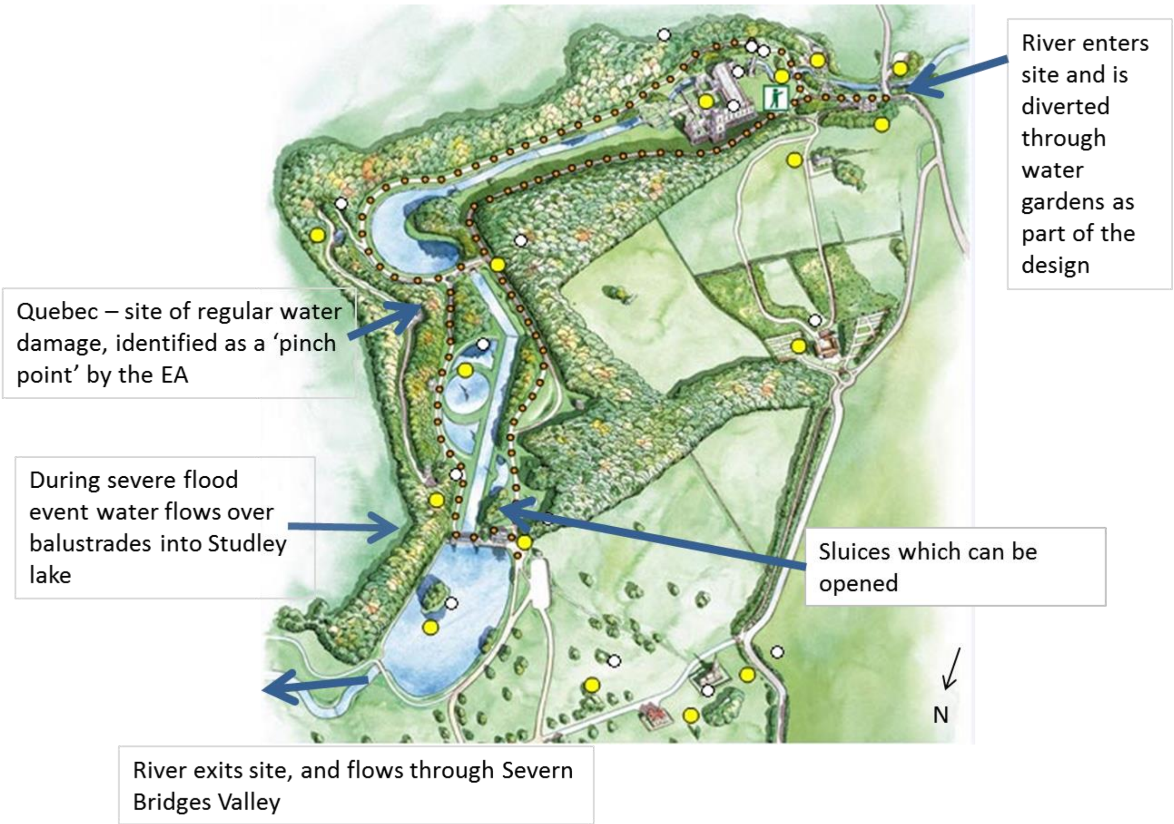
Figure 90 Culverts under the abbey, loose stonework, one of the causes thought to be fluctuations in water level in 2010 (photo courtesy of interviewee)
Figure 91 Fallen oak tree, thought to date from 1600s, caused by gales in 2008 (photo courtesy of interviewee)

Blenheim Palace

Figure 92 and Figure 93 Historic parkland and lakes with Brown's clumps and plantations

Figure 94 The historic town of Woodstock, adjacent to Blenheim Palace, which is a Conservation Area

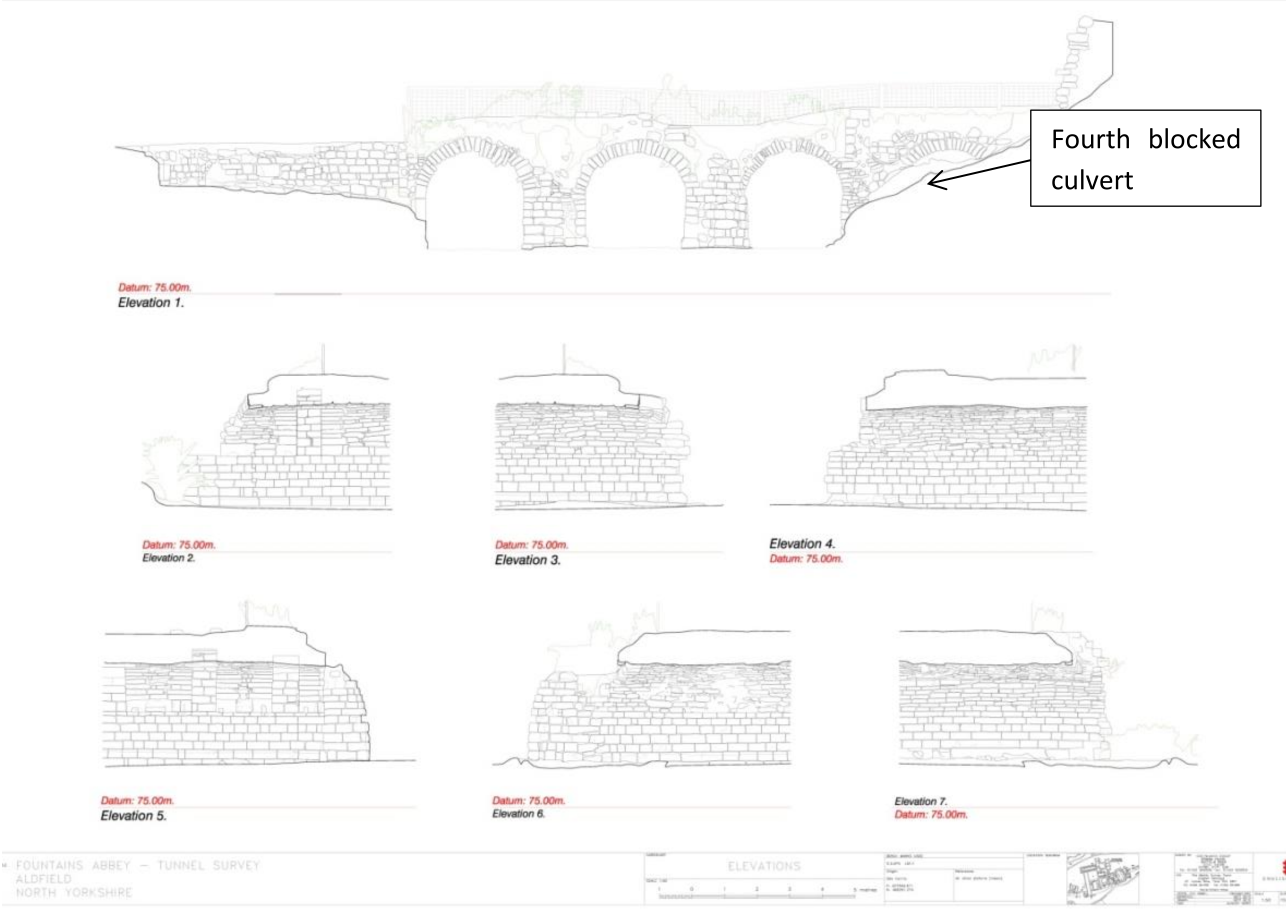
Appendix 10: Annotated Site Map – Water Management at Fountains Abbey and Studley Royal



Adapted from Fountains Abbey website (National Trust, 2013) Used with permission from Fountains Abbey and Studley Royal

Appendix 11: Fountains Abbey - Topographical Survey

Image from topographical survey carried out for EH by external consultants – showing culverts under Fountains Abbey ruins (Greenhatch Group for English Heritage, 2010) © English Heritage.



Appendix 12: Map of the Blenheim SSSI

Map indicating results of 2011 NE condition assessment of the different units within the site. Red area is open water – condition classed as 'unfavourable declining', due to siltation, water quality issues and algal blooms (Natural England, 2012a) © Natural England.

Image removed for copyright reasons

Appendix 13: Conference papers based on the research

Paper 1: Predict, Plan, Prepare and Protect: How can heritage managers adapt to climate change risks?
Presented at Heritage 2012, International Conference on Heritage and Sustainable Development, Porto, Portugal, June 2012

Paper 2: The Capacity to Adapt to Environmental Risks: The case of Fountains Abbey and Studley Royal World Heritage Site
Presented at Cultural Heritage Protection in Times of Risk: Challenges and Opportunities, Istanbul, Turkey, November 2012

Papers removed from digital copy of thesis for copyright reasons

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