Historic England

English Heritage

Climate Change Adaptation Report 2024

Research Report Series 070/2024

Climate Change Adaptation Report 2024

Authors: Kate Guest, Claire Marchetti, Lucy More, Paul Lankester
Other contributors: Claire Hedley, Tamsin Foster, Benedict Lyte
2024

Print: ISSN 2398-3841
Online: ISSN 2059-4453

The Research Report Series incorporates reports by Historic England's expert teams, their predecessors and other researchers. Many Research Reports are interim, to make available the results of specialist investigations in advance of full publication. Although subject to internal quality assurance they are not usually refereed externally and their conclusions may sometimes have to be modified in the light of information not available at the time of the investigation. Where no final project report is available, readers should consult the author before citing these reports.

For more information email Res.reports@HistoricEngland.org.uk or write to:

Historic England, Fort Cumberland, Fort Cumberland Road, Eastney,
Portsmouth PO4 9LD

Opinions expressed in Research Reports are those of the author(s) and are not necessarily those of Historic England.

© Historic England

Contents

© Historic England

Illustrations

Tables

© Historic England

1. Introduction

1.1 Scope and Purpose of the Report

This report has been jointly prepared by Historic England (hereafter HE) and the English Heritage Trust (hereafter English Heritage) in response to the Government's Fourth Adaptation Reporting Power (ARP4) call under provisions in Part 4, Section 62 of the Climate Change Act 2008.

The report includes:

- A summary of the statutory and other functions of the organisations
- The current and future projected impacts of climate change on the organisations
- Proposals for adapting to climate change
- An assessment of progress towards implementing the policies and proposals set out in previous reports

This report builds on the Third Adaptation Reporting Power (ARP3) report submitted jointly by HE and English Heritage and includes updated risk assessments and adaptation plans.

Identifying climate-driven risks and the necessary adaptation measures are an essential part of climate action. For heritage organisations such as HE and English Heritage, this means understanding and responding to organisational and operational risks, as well as risks faced by the historic environment that we are tasked with protecting.

This report considers climate-driven risks for HE as an organisation in relation to its management of personnel, facilities and equipment, as well as to its role as champion of England's heritage. It also considers climate-driven risks to heritage assets on the National Heritage List for England and in the National Heritage Collection which are cared for and opened to the public by English Heritage.

The report will focus primarily on the work undertaken by HE and English Heritage in relation to climate change adaptation, while acknowledging that mitigation is the first essential step to reduce impacts to reduce the need for adaptation. The report will not, however, go into detail on the work being undertaken regarding climate change mitigation as this is not the intended objective of the report.

© Historic England

2. Organisation profiles

2.1 Historic England

2.1.1 Functions and Duties

HE is a non-departmental public body established under the National Heritage Act 1983 as the Historic Building and Monuments Commission for England. HE is sponsored by the Department for Culture, Media and Sport (DCMS), through whom we report to Parliament.

Our strategic aim is to protect, champion and save the places that define who we are and where we have come from as a nation. Our mission statement is *'to improve people's lives by protecting and championing the historic environment'*.

Our statutory powers, duties and functions stem from the National Heritage Act 1983 and are to:

- Secure the preservation of ancient monuments and historic buildings in England (including UK territorial waters adjacent to England)
- Promote the preservation and enhancement of the character and appearance of conservation areas situated in England
- Promote the public's enjoyment of, and advance their knowledge of, ancient monuments and historic buildings in England and their preservation (including UK territorial waters adjacent to England)

We are responsible to the Government for the care and operation of the National Heritage Collection – over 400 historic buildings, sites and monuments under the nation's ownership or protection – which is managed on our behalf by English Heritage. We support English Heritage in its care and maintenance of the Collection under a financially self-sufficient operating model.

2.1.2 Structure and Governance

HE is overseen by a Chair and a Board of up to 16 Commissioners selected by government. This Commission sets HE's overall strategic direction and corporate aims, as published in our Strategy and Corporate Plan. Day-to-day management of the organisation is overseen by the Chief Executive and Executive Team, who consider organisational performance and financial management, including oversight of the corporate risk register.

© Historic England

We have nine offices across England and employ over 1000 staff, a significant number of which are homeworkers.

Adaptation is a factor in the way our organisation is governed. All of our strategic decision-making, budget-setting, major action-planning and risk-management activities are informed by the priorities and activities set out in our Corporate Plan. They are also guided by our progress towards achieving our corporate aims.

2.1.3 Corporate Priorities and Activities

HE's corporate priorities are set out in our Corporate Plan (2023- 2026).

Advising government on matters related to the historic environment is a core part of our role. While sponsored by DCMS, we provide advice across the whole of government and its departments, including its many arm's-length bodies.

In addition to advising government, HE also:

- Advises local planning authorities on development of local planning policy and decisions taken under the terrestrial planning system
- Advises the Marine Management Organisation on development of marine planning policy and licensing decisions taken in the marine area
- Undertakes research to underpin our advice and to help those that manage and care for the historic environment to take informed management decisions
- Assesses and recommends to the Secretary of State assets worthy of legal protection due to national significance
- Manages the National Heritage List for England which includes over 400,000 entries ranging from prehistoric monuments and landscapes, office blocks and offshore wrecks, all of which benefit from legal protection
- Provides grants and financial support to those who own or manage historic assets, including local authorities, to carry out repair works, and to assist organisations who want to encourage better understanding, management, and conservation of the historic environment in its many and varied forms

© Historic England

- Works in partnership with and supports other heritage organisations, communities and individuals, and other external partners with shared interests to champion and care for the historic environment

- Builds capacity and skills across the heritage sector and among those with overlapping interests through training, guidance and advice.

Our capacity to undertake all of these activities, including climate change related actions, is dependent on the level of Grant-In-Aid that we receive as a result of the Spending Review process, as set out in the section below.

2.1.4 Delivering Climate Action

HE is wholeheartedly committed to addressing the climate emergency. In March 2022 we published our Climate Change Strategy setting out our vision, work and activities, and proposals for working with the heritage sector, stakeholders and government to combat climate change. Our vision is that by 2040, our heritage will have played an important role in the global fight to limit climate change and its impact on people and places. We will have enabled people to live more sustainably and adapt to a changing climate, while conserving our irreplaceable heritage for future generations.

This commitment and the prioritisation of climate change activity across government requires HE to undertake new range of duties without any additional resource; on the contrary, our resources have continued to diminish as we receive below-inflation Grant-In-Aid financial settlements.

As a result, we are having to reprioritise work and be very selective about the activities that we carry out, limiting our ambition, capacity, and ability to deliver climate action.

We are prioritising climate change organisationally and carrying out what action we can, but it is increasingly challenging to understand the threats, assess the risks and take the necessary steps to adapt and prepare without sufficient resources. Therefore, there is a caveat to all our planned activity, both internal and sector-facing: our ability to deliver the necessary identified actions will depend upon receiving sufficient resources in our spending review settlement. Continuation of the reduction in resources will necessarily require us to cut back on planned activity in future years.

Despite these limitations, we have since formalised our commitments by developing Climate Action as one of our top corporate priorities in our Corporate Plan (2023-2026). Climate Action accounts for over a quarter of the target outcomes in this plan. Our Climate Action Outcomes are:

© Historic England

A. Our own carbon emissions continue to reduce and remain on target to achieve Net Zero by 2040

B. More organisations in the heritage sector are committed to achieving Net Zero by 2050 or earlier

C. Approaches to adaptation are continuously improved and shared, including the handling of unavoidable losses

D. People are better equipped to make historic buildings and places more resilient to our changing climate

E. More buildings and places have been adapted for resilience and carbon saving

F. Climate change policy across local and national government better reflects the positive role of heritage

We also published our Carbon Reduction Plan in March 2022, which presents our baseline data (based on 2019–20 emissions) and our near and longer-term targets.

In addition to commitments set out in our corporate documents, HE has also made commitments to better understand and respond to the risks from climate change in the Government's Third National Adaptation Programme (NAP3) under risk H11: Cultural Heritage.

Figure 1: A flooded car park near Odda's Chapel, Tewkesbury, in 2016. Flooding can cause damage to historic buildings and landscapes, as well as access issues for visitors, staff and emergency responders. © Historic England

2.1.5 Climate Change Programmes

HE's portfolio of Climate Action work is divided across two dedicated programmes. Each programme is managed by its own governing body, overseen and chaired by an Executive Senior Responsible Owner. The governing bodies ensure the right work is included in the programme to deliver our Climate Action Corporate Plan activities, determine appropriate resourcing levels for each programme, approve any changes required to achieve our goals, oversee delivery, monitor progress, and manage risks and issues.

As set out above, all planned future action within these programmes is dependent on HE receiving sufficient resource within our Spending Review settlement.

Historic England to Net Zero

The first programme focusses on internal operations to improve our sustainability, climate change risk and adaptation planning, and our transition to Net Zero, in line with our Greening Government Commitments. The register of climate-driven risks to HE's ability to carry out our functions is managed through this programme. A Risk Register, Adaptation Action Plan, and Risk Management Strategy were developed and reviewed by our Executive Team and Audit and Risk Assurance Committee (ARAC). ARAC will review these on an ongoing basis, and the documents will be subject to an audit by the Government Internal Audit Agency in Quarter Three of 2024/2025.

Monitoring the risks and oversight of the Adaptation Action Plan is the responsibility of this programme. Individual risks, however, are owned by a range of Directors across the organisation to ensure integration and to fully embed actions within planned and ongoing activities. In some cases, such as our Estates Strategy, this has resulted in a governance change to be inclusive of wider risks and objectives. This will help maintain the efficiency of planned maintenance, decarbonisation, and adaptation work to ensure ongoing climate resilience.

Climate Change Programme

The second programme focusses on our external commitments, including the large programme of work we are undertaking to better assess and communicate climate-driven risks faced by heritage and the adaptation responses needed. Our work to deliver commitments under NAP3 is delivered under this programme.

© Historic England

2.2 The English Heritage Trust

2.2.1 Functions and Duties

English Heritage is an independent charity formed in April 2015. English Heritage cares for and manages the National Heritage Collection through a Property Licence and Operating Agreement with Historic England.

English Heritage's function, as set out in its Articles of Association, can be summarised as:

- To conserve the National Heritage Collection of over 400 unique sites, monuments and artefacts, in keeping with their status as part of England's national heritage.
- To bring history to life in the places where it happened by opening the sites and monuments to public access, through exhibitions, events and educational programmes, supported through online content.
- Through the blue plaques scheme, to advance public appreciation of the history of building and landmarks in London by showing where people of historical, artistic, scientific and religious significance lived and worked.

2.2.2 Structure and Governance

As a registered charity English Heritage is governed by a board of trustees who delegate day-to-day responsibility for the running of the organisation to a senior management team. Our Articles of Association set out how English Heritage is governed, with our charitable purpose detailed as above. English Heritage has an average headcount of 2,507 employees and 4,922 volunteers.

Our Strategic Plan guides our decision making and the activities which help us to achieve our strategic functions.

In April 2025, we'll celebrate our first ten years as a charity and we are currently developing a new long-term vision for our second decade. This vision – and a new strategy to support it – will be diverse, inclusive and inspiring.

© Historic England

2.2.3 Corporate Priorities and Activities

Our third Strategic Plan, Sharing our Past, Shaping our Future, for the period 2022-2025 sets out four strategic priorities: inspiration; conservation, stewardship and sustainability; involvement and inclusion; and financial sustainability.

We aim to achieve our functions and strategic objectives through a combination of activities. We will create inspiring visitor experiences that bring the story of England to life. Through our expertise in conservation and stewardship, our sites and artefacts will be brought into a sustainable condition, and as we progress towards Net Zero we'll build our reputation as leaders in addressing the conservation challenges posed by the climate crisis.

We are finding new ways to involve more people in our work. We're committed to doing more to inspire diverse audiences and new generations to explore and enjoy England's story. Digital technology will transform how we engage with our visitors and supporters, opening up new ways of communication and driving innovation in our storytelling.

2.2.4 The National Heritage Collection

The National Heritage Collection is a diverse portfolio that includes, but is not limited to, industrial monuments, castles, historic houses, abbeys, forts, stone circles and a large part of Hadrian's Wall. English Heritage also manages around 1,000,000 historic artefacts which are an integral part of the Collection and assist in interpreting and presenting sites to the public as well as providing a valuable research resource. Opening these sites to the public is central to our function; we welcomed over 6 million visitors over the 2023/24 financial year.

2.2.5 Delivering Climate Action

As a charity we are acutely aware of the impact that the changing climate is having, and will have, on the National Heritage Collection in our care. We are taking action across all our work, aiming to reduce and ultimately eliminate our contribution to the causes of climate change as well as working to identify the hazards, vulnerability and exposure of sites to climate risks in order to inform work programmes, skills training and adaptation approaches. Sustainability is a priority for the organisation with a dedicated team to lead this work. This is embedded in the organisation's Strategic Plan (2022-25), under the Conservation, Stewardship and Sustainability priority, which states that we will assess the vulnerability of our historic sites, landscapes and artefact collections to climate change through trials and research, identifying opportunities for adaptation to build resilience.

© Historic England

A Climate Action Plan, based around four pillars, sets out clear pathways for decarbonisation, sustainable operations and adaptation supported by developing skills, training and communication, with associated key performance indicators under each pillar. Actions are owned across the organisation, with many staff and volunteers actively contributing to ensuring we become a truly environmentally sustainable organisation. Since February 2023, our Climate Resilience Lead has focussed on understanding the impact of climate change and how we need to adapt, following the methodology of ISO 14091:2021. Site-specific climate change risk assessments have adapted the TransformAR methodology.

To achieve the objective of conserving The National Collection we have adopted an approach called 'Sustainable Conservation'; an integrated, long-term strategy that goes beyond obvious defects to address the risk factors that can lead to disrepair. It demands that we work to reduce vulnerability and the causes of deterioration and that we increase our resilience to the impacts of climate change.

Figure 2: A WWI gun emplacement at Kilnsea, East Yorkshire has collapsed onto the beach due to coastal erosion. © Historic England Archive

Our aim is to embed climate informed decision making into the day-to-day processes of the organisation. Work to review our project management system will embed a sustainability appraisal as part of the development and delivery of projects, ensuring climate adaptation is considered from the outset. In addition, organisation-wide engagement has been carried out to ensure colleagues are aware of the expertise available. A dashboard is in the early stages of development to provide access to information on climate risk. Initially this will be for staff, but a publicly accessible version is envisioned. This will be supported by expert guides to empower colleagues to embed climate resilience in their area of the organisation. These guides will form part of a toolkit, including climate change risk assessment templates, case studies and an interactive 3D model layered with information around climate impacts and adaptation. The toolkit will grow over time, with initial content available early in 2025.

The toolkit will be shared with the heritage sector to assist organisations and individuals who also need to understand how to make their heritage assets climate resilient. Further to this, in partnership with World Monuments Fund, we launched Coastal Connections, an international project to build a network of communities and organisations who manage coastal heritage to share knowledge and best practice.

© Historic England

3. Understanding Risks to Heritage

3.1 Third UK Risk Assessment and National Adaptation Programme

The Climate Change Committee's Third Independent Climate Change Risk Assessment (CCRA3) published in 2021, followed by the Government's third risk assessment in 2022, was the first round to formally acknowledge the risks to cultural heritage from climate change (Risk H11). This is a positive step, but due a limited evidence base regarding risk, the coverage of potential climate hazards and cultural heritage assets was limited in scope. As a result, the adaptation actions developed for the subsequent Third National Adaptation Programme (NAP3) published in 2023 are also limited to assets mentioned in the risk assessments. There is a need, therefore, to develop and present a more robust evidence base to ensure all relevant hazards and assets are considered in the fourth round of risk assessment and adaptation planning. This is currently underway, with the first call for evidence for the Climate Change Committee's Fourth Independent Risk Assessment (CCRA4-IA) closing in September 2024.

Due to the evidence gaps, many of the actions contained in NAP3 are focussed on developing the evidence base. NAP3 Actions for Risk H11: Cultural Heritage are:

1. Historic England will develop its capacity and capability to model long-term impacts of climate change on cultural heritage caused by increased temperatures, increased rainfall, sea level rise and extreme weather, including in-combination effects by 2025.

2. Historic England, in consultation with DCMS, will work with partners to identify the research needs to develop methods to assess the vulnerability of intangible cultural heritage to climate hazards from 2024, using approaches developed for tangible heritage in the UK and overseas. The approaches to developing an evidence base will be improved to inform CCRA4 development in 2026.

3. By summer 2024, Historic England, in consultation with DCMS, will develop an action plan identifying partners it can work with, such as the Environment Agency, to understand and communicate the threat to cultural heritage from flooding and coastal erosion. This will inform future adaptation and decision-making. [Action 2.3 in our Adaptation Plan below at Table 1.]

4. Historic England will work with partners to ensure technical guidance on adapting historic buildings to the impacts of climate change is available and fit for purpose to a range of audiences by 2025.

© Historic England

5. DCMS, working with arm's-length bodies where appropriate, will develop (2023/4) and implement (ongoing) an engagement plan to raise awareness across government and relevant public bodies of the critical role that cultural heritage can play in supporting climate change adaptation.

6. DCMS and Historic England, will develop relevant indicators by the end of 2025 to monitor and track progress against the goals set in NAP3*.

There also needs to be greater acknowledgement within the national risk assessment and adaptation planning framework of the interdependencies between the historic environment and other risk sectors (such as buildings, infrastructure and land management). Recognising heritage assets as a subset of assets within other sectors could provide low cost, quick win ways to improve the evidence base and development of integrated solutions for heritage, delivering co-benefits using less resource.

The CCRA3 sector briefing for heritage notes the following as important crossover risks for cultural heritage, although there are no references in the risks themselves:

- H3. Risks to people, communities and buildings from flooding
- H5. Risks to building fabric
- N18. Risks and opportunities from climate change to landscape character

We recommend greater integration in CCRA4-IA and will make the case for this through our responses to the calls for evidence running until mid-2025. Our third 2022 Adaptation Reporting Power submission (section 8.3, pg. 37) sets out some of the broader links between the historic environment and broader sector risks identified in CCRA3, and we would further recommend linking heritage to additional CCRA risks, particularly around the natural environment and infrastructure.

* Note that Defra no longer requires the development of indicators for NAP3 actions. Instead we will develop desired outcomes for well-adapted cultural heritage to inform adaptation planning and action setting for the Fourth National Adaptation Programme (NAP4).

© Historic England

3.2 Understanding and Managing Risks: Evidence, Tools and Approaches

Table 1 below presents a summary of current and ongoing work undertaken by HE and English Heritage since our Third Adaptation Reporting Power (ARP3) submission, in partnership with others, to better understand climate-driven risk and to develop adaptation approaches for heritage assets within our remit.

Much of this work will continue until at least March 2025 and beyond, subject to HE receiving sufficient resources through our Spending Review settlement, as set out in section 2.2.4 above. Our capacity is limited through receiving below-inflation Grant-in-Aid settlements and therefore we need to be selective in developing our planned activities.

Work is categorised as per the steps needed to progress through:

1. Risk scoping
2. Data and evidence collection
3. Analysis and risk assessment
4. Risk management
5. Capacity building through sharing our learning

Where work has generated new evidence on climate-driven risks relating to the historic environment, this evidence will be submitted to the Climate Change Committee through their formal evidence submission processes to inform CCRA4-IA, but a summary of our current understanding of risks is set out in section 3.3 below.

Section 6 of Table 1 below sets out our anticipated future work beyond March 2025, subject to government funding. The actions listed in Table 1 provide our Adaptation Plan regarding risks to the historic environment that we will report progress against in our Fifth Adaptation Reporting Power (ARP5) submission anticipated for 2029.

A summary of our improved understanding of the available evidence base for climate-driven risks faced by the historic environment due to the work carried out since ARP3 is presented in section 3.3 below.

© Historic England

3.2.1 Adaptation Action Plan for Heritage

Table 1: Summary of current and ongoing adaptation work carried out by HE and English Heritage since the Third Adaptation Reporting Power (ARP3) submission.

Adaptation Themes	Adaptation Action Plan for Heritage
1. **Risk scoping** Identifying climate hazards relevant to heritage assets	1.1 Joint HE/UCL Institute for Sustainable Heritage and Heritage Adaptation Working Group (UK and Irish heritage agencies, English Heritage, National Trust and National Trust for Scotland) to develop a climate hazard vocabulary of standard terms covering over 50 hazards. HE to publish a research report (13/2024) and structured terminology on the Forum for Information Standards in Heritage (FISH). (Complete)
	1.2 Develop a mechanism for local Historic Environment Records (HERs), a primary source of information for planning and land-management, to use the vocabulary through the ARCHES for HERs software. (Ongoing)
	1.3 Work with Department for Culture, Media and Sport (DCMS) and partners to identify the research needs for assessing climate-driven risks to intangible cultural heritage, learning lessons from risk assessment of tangible heritage assets. (Ongoing)
2. Data and Evidence Collection Identifying datasets and tools to assess relevant hazards	2.1 Review of heritage risk assessment approaches (13/2023) to assess existing data, tools and risk assessment methods for hazards identified in 1.1 above. (Complete)
	2.2 Catalogue up to date climate data for priority hazards within 1.1 to enable internal risk assessment and evaluate asset-based climate change risk assessments for their applicability to the heritage sector. Research report (16/2024) and accompanying Zenodo database. (Complete)
	2.3 Using outputs from 1.1, identify partner organisations, such as the Environment Agency, who can help us to understand and communicate the threat to cultural heritage from flooding and coastal erosion, and other coastal hazards such as wave impacts. (Complete)
	2.4 Support development of Environment Agency National Flooding and Coastal Erosion Risk Management dataset. This includes revised coastal erosion risk mapping (NCERM2) and improvements to national flood risk maps using the new national flood risk assessment (NaFRA2). (Ongoing)
	2.5 Attend Environment Agency workshops on Shoreline Management Plan (SMP) next steps and display of NCERM2 data on the SMP Explorer and provide ongoing feedback ahead of public launch. (Ongoing)

© Historic England

Adaptation Themes	Adaptation Action Plan for Heritage
3. Analysis and Risk Assessment Using the data and tools to assess risk to heritage	3.1 Progress joint HE/UCL Institute for Sustainable Heritage collaborative doctoral PhD research to develop a scalable methodology for conducting multi-determinant climate change risk assessment for the historic environment. (Ongoing)
	3.2 Analysing the National Heritage List for England to calculate the number of designated assets at risk from priority hazards in the vocabulary at 1.1. (Ongoing)
	3.3 Joint HE/English Heritage advice and report on the threat of insect pest migration to moveable and immovable heritage assets to inform Department for Energy Security and Net Zero (DESNZ) project 'Mapping climate-related hazards to buildings', and publish research.[1] (Ongoing, See Case Study 1 in Appendix I)
	3.4 Commission analysis of coastal monitoring data collected by National Network of Regional Coastal Monitoring Programmes to assess actual and likely change on a site-by-site basis. (Ongoing)
	3.5 Support Defra and Environment Agency Coastal Transition Accelerator Programme (CTAP) projects including Changing Coasts East Riding and Coastwise (North Norfolk). (Ongoing)
	3.6 Model the risk faced by a selection of designated assets from coastal erosion, flooding and inundation. The 'A Matter of Time and Tide' project will take a subset of Scheduled Monuments from the National Heritage List for England and examine individual monuments and asset types against the NCERM2, UKCP18 Sea Level Projections and OS Terrain Slope datasets, the latter two selected as proxies for modelling inundation risk due to sea-level rise and increasing storm surge levels. (Ongoing; See Case Study 2 in Appendix I)
	3.7 Expand work carried out under 3.6 to other asset types once the methodology is proven. (Ongoing)
4. Risk Management Developing approaches for impacts, including loss	4.1 Develop, in collaboration with partners, a decision-making framework and toolkit to help owners and managers prepare for and manage climate-change driven impacts to heritage sites, including the unavoidable loss of heritage assets - informed by a review of the policy and regulatory landscape (18/2022) in relation to adaptive management. (Ongoing)
	4.2 English Heritage will work with HE and the Heritage Adaptation Working Group to add value to 4.1 by developing further technical guidance and tools to help people understand and manage climate change impacts on historic sites and collections. (Ongoing)
	4.3 Commission a pilot study with The Environmental Design Studio to better understand the impact of flooding on historic and traditionally constructed buildings and to examine why some historic buildings fall out of scope for receiving Property Flood Resilience (PFR) grants. (Complete, awaiting publication. See Case Study 3 in Appendix I)
	4.4 Work with the Environment Agency to support technical understanding of heritage assets within their adaptation schemes. (Ongoing)
	4.5 Develop desired outcomes for well-adapted cultural heritage in order to inform adaptation planning and action setting for the Fourth National Adaptation Programme (NAP4). (Ongoing)

© Historic England

Adaptation Themes	Adaptation Action Plan for Heritage
5. Capacity Building Sharing our learning and knowledge with others	5.1 Share work via HE climate change and technical advice web pages to help sector organisations use available data to understand the climate change risk to their assets and adapt to the impacts of climate change. (Ongoing)
	5.2 Supporting government-led projects mapping climate change hazards and their impacts, including projects led by the Department for Energy Security and Net Zero (DESNZ) to understand the impacts of future wind-driven rain and to map the ways different building types, including historic buildings, are exposed and vulnerable to climate-related hazards. (Ongoing)
	5.3 Review existing HE technical guidance on adapting historic buildings to the impacts of climate change to ensure it is fit for purpose and up to date. (Ongoing)
	5.4 Develop and share web content to help owners and managers understand and carry out climate change risk assessments using outputs from 1.1, 1.3, 2.1 and 2.2 above. (Ongoing)
	5.5 Share the decision-making framework and toolkit developed in 4.1 above to help owners and managers prepare for climate-change driven impacts. (Ongoing)
6. Planned Future Work Subject to spending review decisions and budget allocation from DCMS	6.1 Develop methods to assess and analyse data to determine the exposure of heritage assets to priority climate hazards to inform CCRA4 and those who manage and care for the historic environment. This work is ongoing.
	6.2 Analyse in-combination hazards, as noted in CCRA3, determining what is possible given some datasets include combined hazards (for example, wind-driven rain) while many others only show individual hazards. This work will begin from 2025.
	6.3 Map asset types against hazards to which they have known vulnerability, particularly coastal assets against erosion. Historic England is developing a project to map and assess risks to coastal archaeological assets pending the release of the Environment Agency coastal risk data. This work is ongoing.
	6.4 Understand vulnerability of different types of assets to key hazards set out in CCRA3 and continue to identify adaptation responses. This work will begin by 2026.
	6.5 Systematic monitoring of climate change risk to heritage assets through Historic England casework. Work is ongoing to integrate the monitoring of climate change risk through our casework and Heritage at Risk systems.
	6.6 Share ongoing research into risk assessment and adaptation with heritage decision-makers, increase sector collaboration on priority issues and avoid duplication of efforts by identifying shared priorities for future work. Historic England is working to develop collaborative research partnerships on priority areas of work such as the management of loss.
	6.7 Develop our approach to managing assets using adaptation pathways, including the risk of partial or complete loss of material fabric of heritage assets. This work will continue into 2025/2026.
	6.8 Develop technical advice to inform heritage owners and managers as they plan adaptation options for their sites using knowledge from best practice such as that shown at Case Study 6 in Appendix 1, covering the heat pump at Shrewsbury Flaxmill Maltings.
	6.9 Work with heritage partners to develop desired outcomes for well-adapted heritage using a theory of change to inform the development of adaptation actions for NAP4. This work will begin from 2025.

© Historic England

Improved Understanding of the Available Evidence Base

3.3.1 Strategic work led by Historic England

Following work undertaken since our Third Adaptation Reporting Power (ARP3) submission we have an improved and agreed understanding across UK heritage bodies of the 50 main climate hazards that may impact the historic environment, as set out in Creating a Vocabulary of Climate Change Hazards for Heritage (2024).

We also have an improved understanding of some key places where UK data, information and tools to access and analyse the data can be found. Useful sources of information include:

- The Climate Projections User Interface for the UKCP18 Met Office products
- The University of Reading's UK Climate Risk Indicators Explorer
- Forest Research's Climate Matching Tool
- UCL's EuroCORDEX-UK plot explorer

As a result of work with the UCL Institute for Sustainable Heritage to develop a scalable methodology for conducting multi-determinant climate change risk assessment for the historic environment, analysis is being carried out on the impact of priority hazards on designated heritage assets using outputs from the above hazard vocabulary and data scoping work. This builds on work from 2022 by 3Keel for HE to map certain hazards to historic sites (Research Report 27/2022) and will inform our response to CCRA4.

The priority hazards for this initial phase of analysis are average temperature patterns and high temperature events, average precipitation patterns and high-precipitation events. The analysis considers the impacts of these hazards across all designated asset types on the National Heritage List for England and suggests that all designated assets, over 400,000 sites, will see an increase of three degrees in average temperatures by 2065, coupled with a decrease in annual rainfall, particularly in the south-west. This will especially affect Registered Parks and Gardens and may impact which plants are suitable to these designed landscapes, particularly trees – see Case Study 5 in Appendix 1. It is also likely that London and surrounding areas will see even higher summer temperatures (with a rise of 3.4°C in annual temperatures) leading to increased needs for adaptation measures within the built historic environment - see Case Study 4 in Appendix I.

© Historic England

Additionally, following the Environment Agency's release of updated flood and coastal erosion risk data (expected early 2025), the 'A Matter of Time and Tide' project will use these datasets to assess risk to particular asset types (Table 1: Action 3.6). See Case Study 2 in Appendix I.

We are currently undertaking further analysis of future seasonal trends to refine annual projections and feed specific information about risks to heritage assets into the evidence gathering process for the CCRA4 technical report.

We will then continue to develop risk assessment and management approaches, including to understand the vulnerability of assets to hazards, per the sector adaptation plan at Table 1.

3.3.2 Summary of current understanding of sector risks, including observations from English Heritage sites

To varying degrees climate-driven risks have the potential to impact all types of heritage asset, including but not limited to historic buildings and structures, collections, landscapes, buried archaeology, marine landscapes and wrecks. Historic fabric is at risk from hazards such as changing precipitation patterns, increased humidity, drought, landslide, coastal erosion and changes in ocean chemistry. New or increased levels of invasive species or biological growth threaten building fabric and collections, and historic landscapes through damage to trees and other plants. Inevitably, climate change will mean a departure from the more predictable seasonal weather patterns of the past.

The new climate hazard vocabulary for heritage sets out over 50 hazards that may affect heritage globally. Using this, Table 2 sets out the main climactic impact drivers and hazards impacting cultural heritage in England, including the ability of HE and English Heritage to carry out their functions, with examples of issues already seen at English Heritage and other sites. Impacts can vary widely between asset types depending on the projected change in climate hazards, the vulnerability of assets and existing response mechanisms.

It is challenging to estimate financial impacts for each risk across the English Heritage estate, or the heritage sector as a whole. It is also important to note that there are non-financial impacts relating to total economic value.[2] However an indication of costs for works to Hurst Castle, a large and complex English Heritage site, are included in Case Study 7 at Appendix I. In summary, these works are not financially viable to English Heritage. It is essential that they are supported by grants, without which adaptation will not be feasible, and important designated heritage assets will be lost.

© Historic England

Table 2: Summary of key climactic impact drivers, associated hazards and impacts already observed at English Heritage sites.

Climactic Impact Driver and associated hazards	Impacts on heritage	Examples from English Heritage Sites
Coastal change: relative sea level, coastal flood, coastal erosion	Britain's coastline has changed continually, but the rate of change and where its greatest impacts will be are affected by these coastal hazards. Rising sea levels, coastal erosion and coastal flooding are likely to impact a large number of heritage assets and landscapes across the country. Consequences are potentially the total loss of or significant damage to individual heritage assets.	Examples include the undermining of foundations at Hurst Castle which led to a partial collapse of the structure (see Case Study 7 at Appendix I), and unstable cliffs at Daws Castle. Several sites will be especially vulnerable to tidal flooding from sea level rise, such as Piel Castle and Bayards Cove Fort, while others are already protected by sea defences. In the shorter term, to maintain visitor access ongoing adaptation is needed, such as the realignment of paths and fences at Dunstanburgh Castle and Tintagel Castle. In the longer term more significant, and costly, adaptation solutions will be required, such as coastal defence works at Hurst Castle and Reculver Towers and Roman Fort. In some instances, it may be possible to implement a managed loss approach, such as adaptive release, but this is not zero-cost.
Heat and Cold: average temperature, high temperature events, uncontrolled fire	In the sea, temperature increase is affecting conditions that have previously preserved a rich maritime heritage. On land, it may lead to changing patterns of land use that could present challenges for terrestrial heritage. Increasing temperatures give rise to different flora and fauna, some of which may be harmful to our heritage. This is likely to have a major impact on plants, particularly trees, affecting the appearance of designed landscapes. New pests and diseases may affect designed landscapes, buildings, and collections. Some collection materials and building fabric can also be impacted by high temperature events. Increasing temperatures and reduced summer precipitation will increase risk of uncontrolled fire which will affect archaeological sites, historic buildings and structures and collections.	At Rangers House a collection of Limoge enamels is affected by high temperature events. The glass/metal interface expand and contract at different rates when the temperature changes, this causes losses of the glass surface particularly at high temperatures. These risks have been measured as increasing.[3] Tintagel Castle has previously had a wildfire, destroying turf over a considerable area. Recently smoke from a wildfire on neighbouring land caused Tintagel to close. See Case Study 4 in Appendix I for an example of adaptation in part due to high temperatures at Blenheim Palace, owned by the Blenheim Estate.
Wet and Dry: average precipitation patterns, heavy precipitation events, wind-driven rain	Intense pluvial events, and persistent periods of rainfall on saturated or impermeable ground, can damage buildings, flood historic areas and landscapes, affect planting in designed landscapes, and exacerbate erosion. Wind-driven rain can erode materials, damage surfaces of buildings, and increase the risk of water penetration into porous materials.	An increase in the intensity of rainfall is already causing damage to several sites in English Heritage's care: Walmer Castle, Brodsworth Hall and Osborne House all have current issues with rainwater ingress. This is causing damage to the historic collections, requiring expensive conservation, but more importantly loss of original material and significance. Whilst these sites are experiencing increased precipitation already, there are additional factors which increase the vulnerability of these sites. As such climate change is exacerbating the impacts of these risks. These changes will increase the likelihood of overtopping of gutters and flash flooding from excess surface water, having a cascading impact on the operational aspects, as such increasing the risk of site closure and income loss. Flooding can also affect access to site for staff, visitors, and emergency responders.

© Historic England

Climactic Impact Driver and associated hazards	Impacts on heritage	Examples from English Heritage Sites
Heat and Cold & Wet and Dry: average humidity patterns, rapid humidity fluctuations	Collections are heavily impacted by fluctuations in humidity, and high and low humidity events, leading to potential issues with their long-term preservation and conservation. Previous research projecting future climate indoors indicates an increase in these risks.[4]	An increase in mould occurrence and insect pests can already be seen across historic assets. This requires increased vigilance to ensure control measures are effective at over 30 sites. The efficacy of some control measures will reduce due to climate impacts. Control will be required more frequently, in some instances increasing energy requirements.
Wet and Dry: hydrological, agricultural and ecological drought, landslide, shrink-swell, desiccation	Drought can harm plants that make up designed and historic landscapes, affect archaeological deposits, in particular waterlogged deposits, affect the stability of buildings and other structures. It can affect ground stability and exacerbate erosion. Desiccation of wetlands can have a dramatic effect on the preservation of waterlogged archaeological and palaeo-environmental material. The drying out of certain geologies, for example clay, can affect ground stability and increase subsidence affecting historic structures and archaeological sites.	An increase in harm to plants from drought conditions can already be seen across several sites, at Audley End House and Gardens the trees are put under stress by drought conditions, which is exacerbated by periods of heavy rain causing waterlogging also causing stress. This is affecting plant health and gradual losses are occurring.
Compound hazards, a combination of multiple climate hazards that occur in close proximity in time or space, or that interact with other environmental conditions, having greater impact than isolated hazards	Several potential risks could manifest due to compound hazards. Further research is needed to understand the potential future impacts on heritage, such as assessing how changes in temperature and relative humidity will affect insect pest populations and plant growth.	Work is ongoing and planned to further understand compound hazards and their impacts on heritage assets – see the sector adaptation plan at Table 1. This will inform future resource planning to manage these risks.

© Historic England

4. Managing Risks to Functions and Duties

4.1 Historic England Risk Assessment and Adaptation Planning

4.1.1 Risk Assessment Scope

Our risk assessment focuses on 20 climate risks (both threats and opportunities) to our operations and our ability to perform our functions. The Risk Register has been developed to address all risks included in the Task Force on Climate-related Financial Disclosures (TCFD) implementation guidance and takes account of the risks in CCRA3. Risks have been categorised using the climate change risk taxonomy published in the National Audit Office good practice guide for Audit and Risk Assurance Committees.

We have adhered to The Fourth Adaptation Reporting Power Report (ARP4) Guidance from Defra, Treasury's guidance relating to the Task Force on Climate-related Financial Disclosures (TCFD) and benchmarked our efforts against ISO 14090:2019 and ISO 14091:2021. Due to resource constraints, we have conducted a high-level risk assessment in accordance with ISO 14091:2021 and following government guidance on adapting risks to public sector, and will continuously improve this as our organisation matures.

In risks and opportunities relating to our function as advisors, or in the ongoing adaptation and mitigation within our offices, we are sometimes the provider of best practice and are currently drafting independent advice and guidance to support climate change adaptation and mitigation. This includes Historic England's Advice Note (HEAN) on Adapting Historic Buildings for Energy and Carbon Efficiency. Where relevant, we will continue to adhere to our best practice as it emerges, completing our Plan-Do-Check Act cycle.

The register is based on Defra's ARP4 template, adjusted to include the Adaptation Action Plan template, plus information specific to HE's risk management approach (such as the scoring matrix).

4.1.2 Risk Assessment Scenarios

The climate change scenarios included in the Risk Register were developed by Frazer-Nash Consultancy and are based on national climate information and linked to the Network for Greening the Financial System (NGFS) climate scenarios; Net Zero 2050 scenario (1.5°C and consistent with RCP2.6), Delayed Transition scenario (2°C and consistent with RCP2.6) and Hot House scenario (3°C+ and consistent with RCP 6.0). All NGFS scenarios are based on Shared Socioeconomic Pathway 2 (SSP).

Each risk is scored and assessed for each scenario with additional consideration of proximity of the risk for each scenario; Short Term (to 2030), Medium Term (2030-2040) or Long Term (2040+).

4.1.3 Hazard Identification and Risk Screening

We identified the climate hazards most relevant to our functions and locations, considering the likelihood and impact of different hazards and the actions required to address the relevant risks. Acute physical hazards, such as extreme weather events like heatwaves and pluvial or fluvial flooding, and chronic hazards, such as changes in average temperature patterns, were considered alongside transition risks, such as changes in policy or regulations.

Due to the nature of our work, the fact that we are a national organisation with offices and activities across the country, and our desire to produce a functional and proportionate risk register and action plan, we amalgamated some of the chronic physical hazards and grouped them under ‘extreme weather events,’ a term used in NAP3. A broad range of hazards were considered when developing the risks, impacts and actions included in our Risk Register and Adaptation Action Plan, which were determined through a series of workshops and meetings with relevant specialist staff and senior management. The risks in the Risk Register will be reviewed regularly by the HE to Net Zero programme’s governing body, and new and emerging risks will be identified during regular meetings of this group.

Climate-driven risks relevant to delivery of our functions are those outlined on pages 5-9 of the National Audit Office good practice guide for Audit and Risk Assurance Committees.

4.1.4 Risk Analysis, Evaluation and Adaptation Planning

Since our ARP3 submission in January 2022 we have made significant progress assessing risks to the delivery of our functions.

The following tables summarise our highest scoring risks only, in ascending order, alongside the adaptation action we are planning to take.

© Historic England

The financial impacts have not yet been calculated, though we plan to complete these over the next year. As set out in Section 2.2.4, it is challenging to undertake new actions without additional resource, and our existing resources are diminishing as we receive below inflation Grant-in-Aid financial settlements. There is a caveat to all the planned adaptation actions set out below, in that our ability to deliver future planned action depends upon receiving sufficient resources in our Spending Review settlement.

Upstream and/or downstream interdependencies are identified within the Risk Register and the impact scoring has been adjusted to reflect the impact of the interdependencies. Our Adaptation Action Plan considers upstream and downstream interdependencies.

Figure 3: High summer temperatures and dry weather increase the risk of uncontrolled fire which can affect archaeology, historic landscapes and structures as well as posing a threat to life. © Historic England Archive

Table 3: Summary of risk of changing technical, policy, and legislative environment on HE advice, and adaptation actions resulting from this risk.

Risk 1 – Threat and opportunity	HE Risk Register ref: 016
Risk description	Due to a changing technical, policy, and legislative environment (in particular in relation to building adaptation) there is a risk that staff no longer have the required skills, knowledge and capacity, and give advice that is poor or non-compliant. If this threat is well managed, there is an opportunity for HE to strengthen our position as England's credible advisor on historic building adaptation.
Climate-related hazard	Climate-related policy and legislation.
Physical / transition risk category	Transition: Mitigation: Policy and regulatory risks/ Litigation and liability risks.
Dependencies or interdependencies?	Interdependency or dependency (downstream).
Impact	Non-compliance with new legislation resulting in litigation and associated fines. HE's ability to provide relevant expert advice is reduced. Reputational damage. Potential for maladaptation of heritage assets or damage of historic environment. Increased requests from government departments for HE policy advice.

Risk Assessment Status	**1.5°C Scenario**	**2.0°C Scenario**	**3.0°C Scenario**
Proximity of risk	Short term	Medium term	Long term
Likelihood score	3	4	2
Impact score	5	5	5
Risk rating	15	20	10

Adaptation action plan	
Actions to address risk	016.1 A new Learning and Development (L&D) framework has been developed to enable the Learning and Development team to undertake coordination of requirements (like this) across groups and departments to ensure training is delivered. 016.2 Continued and more formalised collaboration of L&D team with teams in Policy & Evidence and Regions responsible for designing and delivering training to staff. 016.3 Organisation Development staff are made aware of changes to technical, policy, legislative changes in relation to building adaptation that might trigger the need for upskilling via the Climate Change Programme Board, who will agree specialist support to advise on the content of any training. 016.4 The Climate Change Adaptation Team will continue to: • build strong relationships with relevant national public bodies, offering advice where appropriate • publish historic building adaptation advice and guidance
Category of action	3 - implementation of actions to address impacts / risks and maintain delivery of the organisation's functions.
Monitoring and evaluation	Process evaluation: L&D team have regular meetings with staff in Regions responsible for training and a training plan is agreed, implemented and monitored. Impact evaluation: Relevant staff report that they have the skills and knowledge to do their job (assessed via staff survey and pulse survey). Anecdotal evidence that our advice is in line with policy and legislation.
Implementation timetable	Implementation plan agreed October 24. New model in place April 25. Monitoring part of KPI already in place. Collation of anecdotal evidence ongoing.
Status of actions	Planned/ current.
Benefits / challenges / barriers experienced	None as yet.

© Historic England

Table 4: Summary of risk of damage and loss of power to HE offices and adaptation actions resulting from this risk.

Risk 2 – Threat	HE Risk Register ref: 004
Risk description	Due to changes in average temperature patterns and an increase in extreme weather events (for example flooding), there is a risk that our offices are more susceptible to damage and loss of power.
Climate-related hazard	Extreme weather – all types.
Physical / transition risk category	Physical – acute.
Dependencies or interdependencies?	Interdependency or dependency (downstream).
Impact	Damage to facilities which will require repairs. May impact the workforce being able to carry out Business-As-Usual (BAU) activities. May impact tenants and result in additional costs. Potential pest damage to archive. Potential loss of archive material/data in Swindon and Fort Cumberland and requirement for financial expenditure for repairs. Potential damage to equipment (including lab equipment at Fort Cumberland) and requirement for financial expenditure for repairs. Potential disruption to scientific experiments. Potential for reputational damage.

Adaptation action plan	
Actions to address risk	004.1 This risk will be assessed on a site-by-site basis and risk management included in the Facilities Management compliance processes. 004.2 Advice on adaptation or mitigations will be sought from the Climate Change Building Adaptation Team.
Category of action	2- consideration of impacts, risks and likely actions with stakeholders.
Monitoring and evaluation	Site specific assessment of risk with proposed adaptations/ mitigations will be incorporated in our HE to Net Zero Estates works programme.
Implementation timetable	Completion by June 2025.
Status of actions	Planned.
Benefits / challenges / barriers experienced	None as yet.

Risk Assessment Status	**1.5°C Scenario**	**2.0°C Scenario**	**3.0°C Scenario**
Proximity of risk	Medium term	Medium term	Medium term
Likelihood score	2	3	5
Impact score	4	5	5
Risk rating	8	15	25

© Historic England

Table 5: Summary of risk of mitigating climate change and complying with reporting requirements and legislation, and adaptation actions resulting from this risk.

Risk 3 – Threat and opportunity	HE Risk Register ref: 015
Risk description	Due to the need to implement climate change mitigations across our operations and estate and comply with climate change reporting requirements and legislation, there is a risk that funding will need to be diverted away from other BAU activities or that HE is non-compliant. There is also an opportunity for a long-term reduction in operational costs.
Climate-related hazard	Climate-related policy and legislation.
Physical / transition risk category	Transition: Adaptation: Financial risk/ Mitigation: Litigation and liability risks.
Dependencies or interdependencies?	Interdependency or dependency (downstream).
Impact	BAU activities have to be reduced to comply with reduced budget availability. Non-compliance with new legislation resulting in litigation and associated fines. Necessity of reducing waste, water usage, and improving the energy efficiency of our buildings is likely to reduce our overheads and increase staff comfort levels.

Risk Assessment Status	**1.5°C Scenario**	**2.0°C Scenario**	**3.0°C Scenario**
Proximity of risk	Short term	Medium term	Long term
Likelihood score	3	3	1
Impact score	4	4	4
Risk rating	12	12	4

Adaptation action plan	
Actions to address risk	015.1 External funding for this work will be sought through Spending Review bids, grants (such as public sector incentive schemes), and philanthropy. 015.2 We will continue to plan with Government Property Agency (GPA) for relevant works to Cambridge and Swindon to be funded by GPA.
Category of action	3 - implementation of actions to address impacts / risks and maintain delivery of the organisation's functions.
Monitoring and evaluation	External partial or full funding is secured for decarbonisation activity across the estate. GPA fund relevant decarbonisation works to Swindon and Cambridge offices.
Implementation timetable	Grant funding applications begin May 2024. Completion by April 2028 (target date for securing all necessary funding).
Status of actions	Current.
Benefits / challenges / barriers experienced	There is a relatively high level of uncertainty related to the availability of government funding. Public sector funding schemes are very oversubscribed, and an initial grant bid has already been rejected on this basis.

© Historic England

Table 6: Summary of risk of increased casework, advice, and grant funding in relation to climate change and adaptation actions resulting from this risk.

Risk 4 – Threat	HE Risk Register ref: 010
Risk description	Due to an increased demand for casework, advice, and grant funding to address climate change issues, there is a risk that we employ insufficient people to meet the higher demand, or grant funds are oversubscribed, insufficient or diverted away from our original intent.
Climate-related hazard	Extreme weather – all types.
Physical / transition risk category	Transition: Adaptation: Strategic uncertainty risk.
Dependencies or interdependencies?	Interdependency or dependency (downstream).
Impact	Potential that objectives of original investment are not met leading to damage to historic environment and reputational damage. Damage to HE's reputation as unable to process casework at required rate. Reduced income due to reduced capacity for charged-for services. Reduced capacity of staff to work in other priority areas. Minor diversion of funds to tackle climate impacts and less ability to support wider repairs to heritage at risk.

Risk Assessment Status	**1.5°C Scenario**	**2.0°C Scenario**	**3.0°C Scenario**
Proximity of risk	Medium Term	Medium term	Long term
Likelihood score	3	4	5
Impact score	3	3	3
Risk rating	9	12	15

Adaptation action plan	
Actions to address risk	010.1 Our new casework system should enable us to monitor the levels of casework related to climate change and will use this information to inform any reprioritisation of work/ staffing if required. 010.2 We will continue to work with sector partners to plan for and manage climate-driven loss, for example a pilot with the National Trust on managed loss. HE grants are being more tightly focused around the corporate priorities, including climate change. To the extent these are used for preventive works, it may reduce reactive work. In addition, the North West region are piloting proactively building a climate change linked pipeline of grants. 010.3 We will continue to undertake relevant research and produce guidance for asset owners and managers, thereby reducing the likelihood of reactive casework. 010.4 Climate resilience and climate hazards will be included in relevant assessments undertaken by HE staff (for example Heritage at Risk). 010.5 Climate hazards will be considered when establishing major programmes and included in contingency budgets where relevant. 010.6 We will factor this risk into HE workforce planning modelling.
Category of action	3 - implementation of actions to address impacts / risks and maintain delivery of the organisation's functions.
Monitoring and evaluation	We understand the level of climate change-related casework we engage in and monitor it to inform staffing levels. We successfully develop and launch our approach to loss. We continue to produce relevant and useful guidance relating to climate change, and it is accessed by a significant proportion of our audience. All relevant assessments (for example Heritage at Risk) include a climate resilience and climate hazards assessment.
Implementation timetable	Ongoing - for annual review by the Climate Change Programme Board.
Status of actions	Current.
Benefits / challenges / barriers experienced	None as yet.

© Historic England

Table 7: Summary of health and safety risk during site visits and adaptation actions resulting from this risk.

Risk 5 – Threat	HE Risk Register ref: 003
Risk description	Due to an increase in extreme weather events, there will be an increased risk to staff health and safety during site visits as they operate in a higher risk environment (heat, flooding, etc.).
Climate-related hazard	Extreme weather – all types.
Physical / transition risk category	Physical – acute and chronic.
Dependencies or interdependencies?	Interdependency or dependency (downstream).
Impact	Minor increase in safety incidents and/or service disruption due to staff being more frequently unable to complete their tasks (including statutory casework). Potential for consequential damage to historic environment. Potential for rejection of discretionary projects as a result of increased health and safety risk. Potential for reputational damage.

Risk Assessment Status	**1.5°C Scenario**	**2.0°C Scenario**	**3.0°C Scenario**
Proximity of risk	Medium term	Medium term	Medium term
Likelihood score	3	4	5
Impact score	3	3	4
Risk rating	9	12	20

Adaptation action plan	
Actions to address risk	003.1 This risk is already included in the risk assessments completed prior to arranging any on site activities and, where applicable, is discussed with site owners or managers in order to ensure sufficient mitigations or adaptations are planned. 003.2 Historic England site visit policy/guidance is routinely updated to reflect changes to this risk.
Category of action	3 - implementation of actions to address impacts / risks and maintain delivery of the organisation's functions.
Monitoring and evaluation	All future risk assessments for on-site activity consider the impact and likelihood of extreme weather events, and plan for mitigations.
Implementation timetable	Ongoing – for review on an annual basis.
Status of actions	Current.
Benefits / challenges / barriers experienced	Unexpected extreme weather events cannot be predicted, possibility that new owners/ managers are unaware of potential for extreme weather events.

© Historic England

Table 8: Summary of risk of staff illness and discomfort and adaptation actions resulting from this risk.

Risk 6 – Threat	HE Risk Register ref: 005
Risk description	Due to extreme weather events and changes in average temperature patterns, there is a risk that work productivity decreases due to illness and discomfort working in our buildings and offices (including home workers' homes).
Climate-related hazard	Extreme temperature events/ Changes in average temperature patterns.
Physical / transition risk category	Transition: Adaptation: Productivity risk.
Dependencies or interdependencies?	Interdependency or dependency (downstream).
Impact	May reduce productivity and impact the workforce and tenants being able to carry out projects and BAU activities (including statutory casework). Potential for consequential damage to historic environment. Potential reputational damage. Potential for additional costs incurred in relation to tenants.

Risk Assessment Status	**1.5°C Scenario**	**2.0°C Scenario**	**3.0°C Scenario**
Proximity of risk	Medium term	Medium term	Medium term
Likelihood score	3	4	4
Impact score	3	3	3
Risk rating	9	12	12

Adaptation action plan	
Actions to address risk	005.1 We will assess practical options for improved thermal regulation in our offices and where possible address them with appropriate resources. 005.2 Future offices to be selected with thermal regulation in mind - the Building Services Engineering Team will be consulted on this subject when selecting new offices in the future. 005.3 Consideration of risk included in home working policies and management plans.
Category of action	3 - implementation of actions to address impacts / risks and maintain delivery of the organisation's functions.
Monitoring and evaluation	Improved thermal regulation across office estate. Improved planning for impact on homeworkers.
Implementation timetable	Completion of thermal regulation by 2040.
Status of actions	Current.
Benefits / challenges / barriers experienced	Funding these works will be a significant challenge (see actions for risk 015).

© Historic England

Table 9: Summary of risk of increased workload and technical knowledge requirements of heritage sector staff and adaptation actions resulting from this risk.

Risk 7 – Threat and opportunity	HE Risk Register ref: 018
Risk description	Due to a changing technical and policy environment, and a significant increase in workload, sector staff (Local Authorities, Construction Industry) do not have the sufficiency of skills and knowledge to carry out heritage activity effectively.
Climate-related hazard	Climate-related policy and legislation.
Physical / transition risk category	Transition: Mitigation: Policy and regulatory risk.
Dependencies or interdependencies?	Interdependency or dependency (downstream).
Impact	Sector staff are unable to support heritage activities effectively. Increased urgency for HE's sector skills support. Potential for consequential damage to historic environment. Potential increase to HE's casework load. Reputational risk for HE (related to poor or inconsistent local authority decision making).

Risk Assessment Status	**1.5°C Scenario**	**2.0°C Scenario**	**3.0°C Scenario**
Proximity of risk	Short term	Medium term	Long term
Likelihood score	3	4	1
Impact score	3	3	2
Risk rating	9	12	3

Adaptation action plan	
Actions to address risk	018.1 The Sector Skills Team will identify the partners who can have the greatest reach and impact in this area (including those in government), work with them to ensure they understand the scale of the risk and the opportunities in this space, and help shape the actions which will address sector needs. This will include both upskilling the existing workforce and bringing in new entrants. 018.2 We will deliver the Historic England Advice Note (HEAN) and associated training and ongoing support to develop local authority staff confidence and capacity. 018.3 We will continue to grow, and promote, our climate change training offer to support local authority staff to develop and maintain their understanding. 018.4 We will work directly with sector partners to ensure our expertise and understanding shapes the educational and CPD offer for the construction workforce, to increase baseline understanding of historic building repair, maintenance and retrofit/adaptation.
Category of action	3 - implementation of actions to address impacts / risks and maintain delivery of the organisation's functions.
Monitoring and evaluation	We have partnerships in place with influential organisations. We have delivered our HEAN-related training. We have influenced the educational and CPD offer for the construction workforce.
Implementation timetable	Already in progress; to complete by 2030.
Status of actions	Ongoing.
Benefits / challenges / barriers experienced	None as yet.

© Historic England

4.2 English Heritage Trust Risk Assessment and Adaptation Planning

4.2.1 Risk Assessment Scope

The risk assessment aims to cover all aspects of the work we undertake, split into five themes: Assets, Collections, Gardens and Landscapes, People and Operations. This covers our internal operations, visitor experience and looking after the National Heritage Collection.

The approach begins with a national climate change risk assessment.[5] This uses the risk assessment methodology set out by the IPCC assessment report 6 (AR6)[6 7], whilst aligning with existing internal processes to enable the embedding of climate resilient thinking. At present hazards have been mapped across all sites. Data relating to vulnerability and exposure has been assessed. Currently response has not been assessed nationally. This risk assessment is in its infancy and is in a process of continual development. It will include the development of issue specific risk assessments directly related to the delivery of our core functions. For example, the risk associated with rainwater ingress and falling masonry. Opportunities arising from climate change will also be considered.

Figure 4: The Cobb, Lyme Regis, shown being battered by waves during Storm Francis in 2022. © Historic England Archive

From the national climate change risk assessment historic sites will be prioritised, either on overall risk, or in relation to specific threats, due to resource constraints. Given the unique nature of each of the sites in our care individual site-specific risk assessments are fundamental, particularly in understanding critical risks. Five pilot site-specific climate change risk assessments have been completed in order to develop the methodology of these assessments. One critical part of these is working with internal stakeholders who manage different aspects of a site. Each stakeholder is an expert in their respective area, and thus understands the current issues that will be affected by climate change, and new issues that could arise, with support and expertise from the Climate Resilience Lead. It is essential that these colleagues are involved in the process, ultimately, they will be responsible for the aspects they manage, and thus the success of adaptation solutions. By necessity these will vary by site and one size will not fit all in a heritage context.

These site-specific climate risk assessments develop adaptation pathways for critical risks for each area of the organisation. They consider current risks alongside climate change projections, ensuring the most critical impacts independent of climate change are considered. They also identify dependencies and cascading risks, for example water and electricity supplies and transport networks (see section 4.2.4 for further detail).

The national and site-specific risk assessment methodologies will continually evolve, to keep up with the latest scientific developments, but also to learn from one another to be fed back into the sector toolkit. This will be supported with regular meetings with specific teams, and wider engagement to ensure climate resilience is embedded in the organisation.

Our project management system now includes sustainability and climate resilience. The post project review stage will identify lessons learnt about climate risks and opportunities, ensuring future projects capture these.

4.2.2 Risk Assessment Scenarios

In the first instance, readily accessible national datasets have been used, with a focus on Representative Concentration Pathway (RCP) 8.5. The overall methodology relies on assessing site-based indicators to understand how climate change is progressing at specific sites, i.e. decoupling the climate projections and their associated uncertainty from the need for adaptation. As such the specific emission pathway chosen is most relevant to the national risk assessment, which is used to prioritise individual sites for site-specific risk assessments. In some instances, the data is in the form of expected warming levels; both +2°C and +4°C have been used. This aligns with the Climate Change Committee (Climate Change Committee 2021) recommendation to prepare for a +2°C world and plan for a +4°C world.

© Historic England

The timeframe used varies by hazard. Where multiple baselines are available the most recent is used. The tendency is towards far future projections, i.e. 2070-99, but with mid-century and late-century options also used, i.e. 2040-69 and 2060-80. The national climate change risk assessment will be reviewed annually, incorporating new data and ideas around identifying exposure and vulnerability. At review the methodology will also be considered. For example, incorporating shorter time horizons for some areas of risk where these may be more significant in the short term, and as such considering alternate emission scenarios based on the latest scientific evidence.

The spatial accuracy of the data varies by hazard; predominantly the regional 12km grid square United Kingdom Climate Projections (UKCP) are used. However, some sites, for example coastal sites, will fall outside of the coverage of this dataset. In these instances, either data from a global (60km) model is used, or the closest 12km grid square is used as a proxy value, whilst noting the limitations of doing so, and keeping this in mind when considering outcomes. In some cases, 5km hex grid data is used, as developed by The National Trust and partners (including English Heritage and Historic England). Some site-specific risk assessments assess further data at greater spatial accuracy where specific risks are critical.

Temporal accuracy is an important area for improvement in the national risk assessment. As such sites at greater risk may not be prioritised soon enough for individual assessment. The national risk assessment and site-based risk assessments will be seen as a continual learning process, each informing the other on what data is required to ensure sites are prioritised effectively. Modelling uncertainty is approached differently depending upon the spatial scale. At the national scale the median model output from UKCP is considered. At a site-specific level wider outputs are considered. It is important to note that adaptation actions will be triggered by site-based indicators, and thus are decoupled from modelling uncertainty.

Further work is required to attribute confidence in risk assessment results. Our current confidence assessment follows that of the climate impact drivers, as assessed by the Intergovernmental Panel for Climate Change (IPCC) for Europe.[8]

4.2.3 Hazard Identification and Risk Screening

Identifying hazards is not the same as identifying risks. Understanding risk involves not only identifying the hazards but also vulnerability and exposure to those hazards, as well as existing control measures, i.e. response.[9] We are making good progress in understanding relevant climate hazards[10] and we are continuing to work to understand the vulnerability and exposure of our organisation, however our understanding of climate risk is still at an early stage. The main current risks to cultural heritage are identified in Table 2.

© Historic England

We have also considered the climate risks that do not directly relate to the care of heritage. Primarily these relate to extreme temperature and the impact on people, but also extreme weather events affecting access to sites.

With the two-level approach the site-specific risk assessments will highlight new ways in which climate risks may impact sites which can then be fed back into the national risk assessment to ensure adequate prioritisation.

Figure 5: Rainwater systems can be overwhelmed during heavy downpours and adaptation measures may be required to increase capacity. See Appendix I, Case Study 4.
© Historic England

4.2.4 Risk Analysis, Evaluation and Adaptation Planning

The main climate changes that will impact upon our work are set in section 3.3.2. Whilst the most significant risks are detailed earlier, they will vary on a site-by-site basis. Further work is required to consider individual site risks alongside one another in a risk assessment. The approach will follow traditional risk assessment methodologies and the potential likelihood and severity of each risk.

There are also risks to those working in or using the historic environment, including from increased indoor temperatures. There are associated impacts on heritage such as increased visitor numbers on warmer days, which includes potential for both increased revenue and increased impact on vulnerable areas such as eroding pathways. Overheating may impact site-based infrastructure such as communications and catering equipment, affecting operational activity at sites.

Interdependent and Cascading Risks

No specific interdependencies have been identified, but as further site-specific risk assessments are completed it is plausible that these exist. However, we have a number of dependencies to maintain our function. It is critical that staff can access our sites to ensure they are effectively cared for, and that emergency response can access sites in a timely manner. As such, travel/transport infrastructure is important. Access to electricity and water ensures sites can effectively open to the public, and in some instances ensure critical equipment operates to maintain historic collections.

There are also some cascading risks such as coastal change which could have an impact on waterway navigation. For example, if Hurst Castle was left undefended from coastal processes eventually it would collapse and provide a risk to waterway navigation. Additionally, the Castle itself acts as a sea defence, protecting designated natural heritage (Hurst Castle and Lymington River Estuary SSSI). The collapse of the Castle has also closed a public right of way, affecting the users of the landscape around Hurst spit and their wellbeing. There are many examples where coastal erosion could have a cascading impact on local amenity, including public rights of way.

At one site two UKPN transformers are located within structures under our care. Various impacts could create a cascading risk affecting properties served by the network.

Increased risk of ground instability has the potential to create a cascading risk where water supplies cross our sites. Flooding at our sites may overwhelm local drainage, creating a cascading risk to users downstream, potentially creating further flooding.

© Historic England

Increased severity of wildfires poses a cascading risk to local fire services, as seen in the UK heatwave of 2022, with significantly more wildfires than during other years. This risk is likely to occur at such times of other wildfires, resulting in resources being stretched, potentially placing heritage at increased risk of loss.

English Heritage Adaptation Action Plan

The general approach taken is to embed climate resilience into organisational processes, for example our project management system, aiming to ensure that climate resilience is considered when investment decisions are made. We are also implementing an environmental management system, which includes climate impacts and adaptation. Other opportunities include trialling climate resilience in conservation management plans.

This approach works hand in hand with site-specific climate change risk assessments to develop adaptation action plans, triggered by monitoring of site-based indicators. The next phase of understanding climate risk will focus on site-based indicators and identify measures to implement ahead of completing risk assessments, ensuring evidence is available as needed. Further thought will be given to trigger points and the lead in time required to enact adaptation projects. Organisational key performance indicators (KPIs) to monitor progress against adaptation will also be developed. The existing climate action plan KPI is for 50% of sites to be assessed by 2025. Also included is the development of an organisational resilience plan to cover transitional risks to a low carbon economy.

One of the top 5 risks on the corporate risk register is climate change affecting our ability to open sites and causing damage to sites. This register sets out the risks that senior management have identified as most likely to impact on the organisation’s strategic objectives and is scrutinised by the board of Trustees at the Audit and Risk Committee twice annually.

It is too early in the risk assessment work to have a detailed adaptation action plan at every site that we care for. It will take a considerable amount of time to assess sites individually. Whilst this work continues, there is a wider strategy of how to approach adaptation and ensure it becomes embedded within organisational decision making. This is critical as we must ensure that existing resources are used appropriately and that we do not make poor decisions now which impact us for many years ahead. However, it is important to note that climate adaptation competes against other organisation priorities, such as visitor experience and historic significance, and so can be challenging to implement.

© Historic England

Work to ensure adaptation becomes embedded within decision making has included:

- Making future climate projection information available to decision-makers, along with guidance, support and advice to empower action across the organisation
- Ensuring climate resilience is considered for major projects as part of our project management system review, ensuring sustainability is a core feature of projects
- Scoping of planned projects identifying those which require adaptation measures
- Engaging directly with teams that are critical to implementing climate adaptation, working with them to develop adaptation options
- Working to identify specific areas of high risk across the organisation through the national risk assessment. We will aim to target these at a strategic level

Direct examples of adaptation include working with our project managers to advise on climate adaptation, resulting in several examples where adaptation has been delivered. At Whitby Abbey a replacement roof project increased the size of rainwater goods by 100% to cope with projected increased rainfall intensity. In a holistic approach the underground drainage system was surveyed to ensure it had capacity to cope with increased rainfall. Materials with greater climate resilience were selected and lightning protection added.

At Furness Abbey improvements have been made to pedestrian access across site. The site has frequent surface water flooding, and significant areas within the Environment Agency flood zones two and three. The scheme design considered the high likelihood of flood, ensuring raised accessways were securely fixed to the ground (requiring scheduled monument consent) to prevent movement during flood events. In order to improve climate resilience, when selecting construction materials properties such as ability to resist flood damage were a key consideration.

Upcoming projects which include improvements to climate resilience are planned at several sites, including North Leigh Roman Villa. Here the ruin wall heads are protected using soft capping. Research has identified that some sedum species used in soft capping are not climate resilient[11] and as such we will consider how a climate resilient approach can be taken.

© Historic England

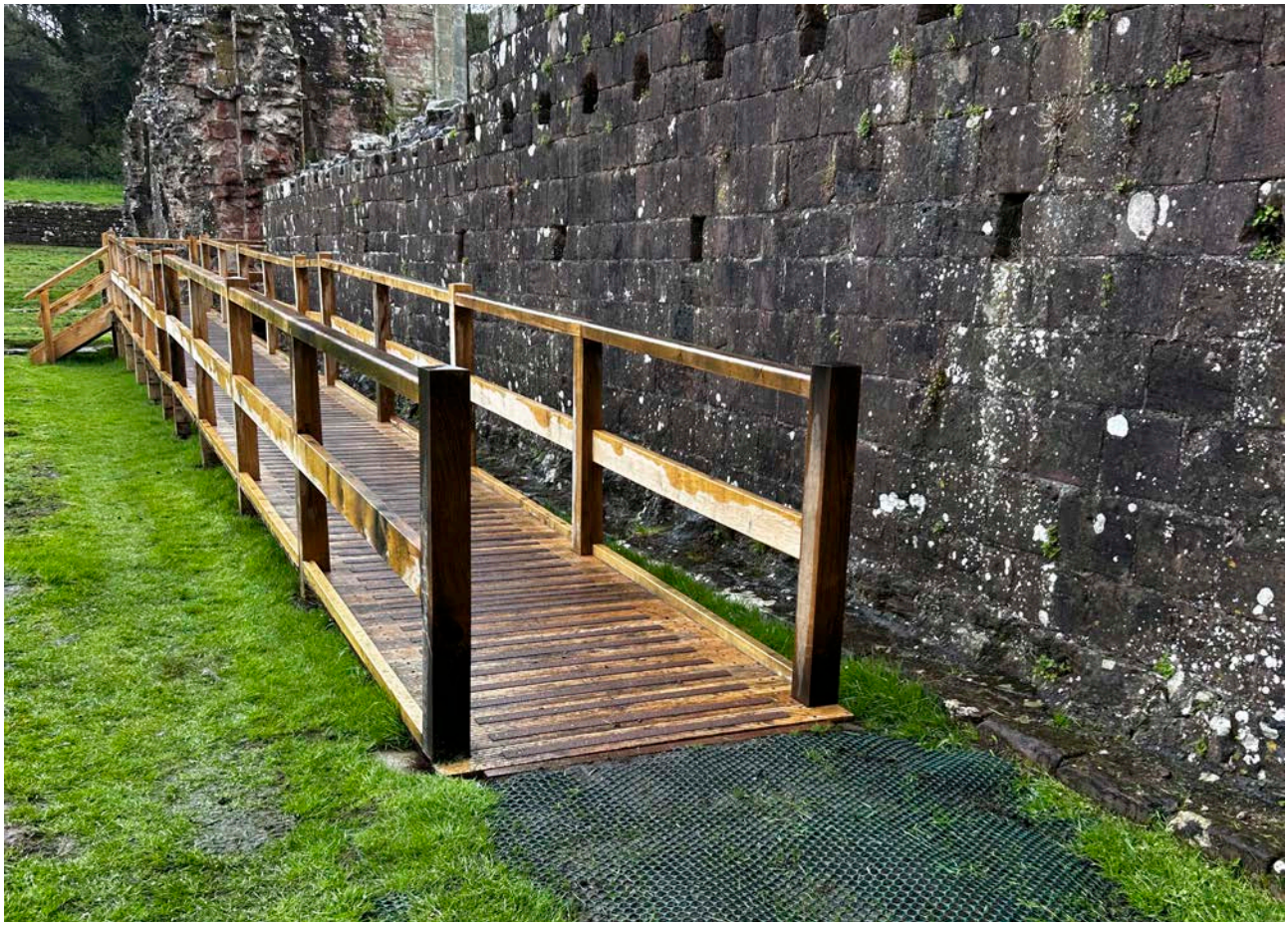

Figure 6: At Furness Abbey, Barrow-in-Furness, improvements have been made to pedestrian access across the site, which has frequent surface water flooding. © English Heritage Trust

This example highlights the need for specific research to understand the impact from compound hazards, as discussed in Table 2. Data is available for changes in temperature and precipitation, and for general metrics such as drought severity and growing degree-days. However, this research indicates that each species needs individual assessment, with the potential to have a significant impact on different areas of the organisation.

A major project is underway at Walmer Castle where there are ongoing water ingress problems. Improvements to the roof will ensure that there is sufficient capacity for the projected changes in future rainfall. In the longer-term specific plans include a project at Brodsworth Hall and Gardens. At Brodsworth Hall there are also problems with the rainwater disposal systems having never been fit for purpose. The impact of climate change has exacerbated this, increasing incidences of rainwater ingress, which will only further increase in the future. The aim is to utilise an existing unused water storage tank

to harvest the rainwater for use in the gardens, improving their climate resilience, as well of that of the building. This has the beneficial impact of reducing mains water usage, thus reducing carbon, and reducing the reliance on the local water supply.

There are several sites where coastal erosion is a significant concern, which is likely to result in the loss of heritage. Each of these needs careful consideration of which strategy to employ. It is important to note that there is not an option with zero cost. If erosion is allowed to continue it is important to record historic assets which may result in archaeological excavation at considerable cost.

Part of the overall strategy to understand when adaption measures will be required will be the use of site-based indicators. These identify the progress of climate impacts at a local level, leading to unacceptable outcomes, evidencing the need for action. Appropriate time will be given for the planning and implementation of adaptation measures. Site-based indicators can be utilised to monitor and evaluate the success of adaptation measures.

Adaptation actions identified from the site-specific risk assessments include prioritisation as part of the process to understand which impacts pose the greatest risk at each site, and these are selected for in depth adaptation pathway development. In future the national risk assessment will prioritise risks based on their potential impact on our core functions. For example, we will consider coastal erosion, and the potential catastrophic loss of a historic asset compared to flooding and the impacts that this can bring.

© Historic England

Appendix I: Case Studies

Case Study 1: Insect Pest Migration Work to Understand Hazards

A collaboration between English Heritage and HE has culminated in an unpublished report on the threat of insect pest migration to moveable and immovable heritage assets. The report aims to highlight future risks that may require further research to understand the full impact.

An extension of this work has subsequently been published (Brimblecombe, 2024). The report has fed into a project on mapping climate-related hazards to buildings, led by the Department for Energy Security and Net Zero, which focusses on building related climate risks, with one specifically being insect pests. The project aims to:

1. Understand the sensitivity of building types and fabrics to climate-related hazards.

2. Map exposure to the identified climate-related hazards in the UK.

3. Identify priority segments of the building stock that are highly sensitive to climate-related hazards and areas of the UK that are highly exposed to climate-related hazards.

Case Study 2: Managing Loss at Seaford Head Hillfort, East Sussex

At Seaford Head, historic map evidence has demonstrated 50 – 60m of cliff erosion, and matching degree of site loss, over the past 150 years.

HE commissioned Archaeology South-East to carry out a pilot study to explore how an archaeological site at threat from coastal erosion, accelerated by climate change, could be rapidly recorded ahead of its loss. This project focused on the Seaford Head Hillfort, East Sussex, which has also been added to the Heritage at Risk register.

The project delivered a summary of the current knowledge and created new data through desk-based assessment, walkover, drone photogrammetry, and topographic and geophysical surveys. Revised research aims and proposals for future phases of fieldwork were established, and a scalable cost model produced. The project also provided an opportunity to assess the Chartered Institute for Archaeologists' (CIfA) digital toolkit for triaging archaeological digital data.

© Historic England

Figure 7: Aerial view of Seaford Head hillfort, a scheduled monument at risk from coastal erosion. © Historic England

Case Study 3: Building Adaptation Research on Property Flood Resilience Outliers

Historic England commissioned a pilot study with The Environmental Design Studio to better understand the impact of flooding on historic and traditionally constructed buildings and to examine why some historic buildings fall out of scope for receiving Property Flood Resilience (PFR) grants.

The study identified flood-resilience measures being used which are not appropriate for traditional buildings, types of measure not currently being considered, and a gap in knowledge about resilience and recovery of traditional buildings, particularly listed buildings and those of timber-framed construction.

The outcomes of this project have identified different solutions that could allow continued use of buildings at increased risk of flooding. For the pilot area, the study considered alternative scenarios to dealing with buildings subject to increased flood risk. Each scenario was assessed against a multicriteria assessment to include cost over the building's lifetime; suitability for the user; exposure and vulnerability to current and future flood events; recovery time; and impact on the significance of the building.

Historic England is a partner in FLOOD-CDT: the Centre for Doctoral Training for Resilient Flood Futures, funded by the Natural Environment Research Council (NERC), Environment Agency and others. Through FLOOD-CDT, HE is engaged in co-designing PhD research projects on flood resilience relating to heritage and will support Collaborative Doctoral Training activities.

Case Study 4: Building Adaptation at Blenheim Palace: The Orangery Roof Project

Blenheim Palace in Oxfordshire is an eighteenth-century Grade I listed building and, with its surrounding estate, a World Heritage Site. The Palace is a significant example of the work of architects John Vanbrugh and Nicholas Hawksmoor.

Originally a solid roofed orangery, The Orangery at the Palace, has had many functions since it was built in the eighteenth-century, from conservatory, theatre and office to its more recent function as a restaurant for visitors to the site.

In 2023, The Orangery Roof Project oversaw the replacement of the Orangery's nineteenth century glass roof, which was nearing the end of its useful life, with its likely original solid-roof form of timber and slate. Historic England commented on the design proposals and was consulted during the planning process.

During the project, the gutters were also widened from 100mm to nearly 500mm to significantly increase rainfall capacity. All windows were repaired, and sash weights reintroduced to further reduce the need for air conditioning.

As well as being part of the Palace's 10-year £40 million restoration project, this work will help the site adapt to the challenges of increasing temperatures and, combined with additional insulation, also contribute to its energy saving targets.

Figure 8: (Left) The interior of the Blenheim Palace Orangery before the work was carried out. (Right) The interior of the Blenheim Palace Orangery following the completion of the work.
© Blenheim Palace

Case Study 5: Understanding Risks to Trees in Designed Landscapes

Utilising the Climate Assessment Tool[12] developed by Botanic Gardens Conservation International, lists of tree species at English Heritage garden sites were assessed for their resilience to climate change. The analysis considers how well the future climate is matched to the climate in which the species are currently present based on mean annual temperature.

Across 14 gardens, having a geographical spread from Belsay Hall in the North and Osborne House in the South, although excluding the Southwest, 151 trees were identified as being affected by climate change. This includes several native species, as well as species of high value as principal specimens in the landscape. Such as *Sequoiadendron giganteum*, *Cedrus* (Cedar) and *Quercus* (Oak) amongst others.

A number are significant plants at the gardens, and as such are particularly vulnerable, having a detrimental effect on the heritage, atmosphere, and presentation of the gardens were they to be lost or unable to cope with anticipated change. Examples include *Sequoiadendron giganteum*, a feature tree at Belsay, Audley End and Osborne, or *Acer pseudoplatanus* which is native and common in woodland at many sites across the National Heritage Collection. The Tree Register of the British Isles lists 144 trees that are noted as champion trees at regional, county or national levels. Notable specimens of early introductions of plants to horticulture include the Douglas Fir at Belsay, the Royal Oak at Boscobel and the Audley Oak at Audley end.

Figure 9: The Royal Oak at Boscobel House, a descendant of the oak tree in which King Charles II hid for a day in 1651 as Cromwell's soldiers searched for him below.
© Historic England. English Heritage Trust

Some trees, for example *Fagus sylvatica* (Common Beech) are present in large quantities. Should these no longer be viable in future this will have a significant impact on landscape presentation, affecting the sense of feeling of a place. Where the landscape itself is significant this will need sensitive management and adaptation.

Given the long life of trees it is essential to look forwards hundreds of years, ensuring climate resilience is considered when planting new specimens to ensure the best chances of survival. At English Heritage we have substituted *Aesculus carnea* (Red Horse Chestnut) at Marble Hill, which is better suited to the conditions on site. Historically, the choice would have been *Aesculus hippocastanum* (Horse Chestnut).

Case study 6: Shrewsbury Flaxmill Maltings Ground Source Heat Pump

The new ground source heat pump at Shrewsbury Flaxmill Maltings demonstrates that centuries-old buildings can also adapt to use sustainable energy sources and play their part in efforts to tackle climate change. The low carbon energy source is an important part of Historic England's regeneration project and our organisation's commitment to climate change mitigation.

The Shrewsbury Flaxmill Maltings site has eight listed buildings. The Grade I listed Main Mill, built in 1797, was the world's first iron-framed building and paved the way for modern skyscrapers.

The restoration of the Main Mill and the Grade II listed Kiln was supported by the National Lottery Heritage Fund.

The ground source heat pump system has been designed to provide an estimated 69% of energy usage for the Main Mill and Kiln, with the remainder provided by a natural gas boiler. The floor area is 3,999m².

The heat pump reduces carbon emissions associated with space heating by an estimated 46%, from 45 tonnes to 23 tonnes per year.

The heat pump extracts heat from the ground via 10 vertical boreholes at a depth of 187 metres. These are underneath the line of the former Shrewsbury and Newport Canal towpath, a new green corridor with a pedestrian and cycle route.

The heat pump installation comprises two Stiebel Eltron 59kW pumps. They supply water up to 57°C to a 1000 litre buffer vessel, a thermal store for the heat sourced from below the ground. From the buffer vessel, hot water is distributed through the building heating pipework, radiators on the upper floors and the ground floor underfloor heating. The radiators are sized to cope with the reduced water flow temperatures from the heat pump.

© Historic England

If the demand from the building exceeds the output from the heat pumps, gas fired boilers provide a top-up heat source. For example, in the coldest weather conditions. The operating temperature of the overall heating system will automatically be reduced in mild weather to maximise the use of the heat pumps, and to optimise their efficiency.

Case Study 7: Adaptation at Hurst Castle (English Heritage)

Managed by English Heritage, Hurst Castle is located in an extremely vulnerable position on a natural shingle spit in The Solent. Changing coastal dynamics are causing the spit to retreat, which led to the loss of shingle that normally protects the Castle's foundations. This led to structural failure along the West Wing in 2019 and the partial collapse of the East Wing in 2021.

Figure 10: Aerial view of Hurst Castle and spit. © English Heritage Trust

Following the partial collapse of the East Wing in 2021, English Heritage responded by making the affected areas safe, clearing debris from the beach, underpinning the sections of the wall adjacent to the collapsed section, and constructing new adaptable sea defences to protect the vulnerable sections of the battery wing. This was principally funded by a DCMS Cultural Recovery Fund grant of £2.34m, awarded by Historic England.

Figure 11: The collapsed section of Hurst Castle's C19 East Wing in 2021.
© World Monuments Fund Britain

This first phase of reactive work was followed by a property-wide stabilisation investigation, which included detailed geotechnical investigation of the spit and castle foundations, and bathymetric and lidar surveys to assess the depth and extent of shoreline and adjacent seabed. This concluded that the West Wing remained at significant risk of collapse and provided options for structural stabilisation and new coastal defences along the full extent of the seaward castle wall. The cost of this work (£610k) was part funded by the National Heritage Memorial Fund (£500k), the Environment Agency, a corporate sponsor, and a private donor. Historic England awarded a further £250k to strengthen failing groynes along the West Wing in February 2023.

The stabilisation review concluded that options to permanently defend Hurst Castle from projected sea level rises with extensive engineered defences could be up to £110m. A simpler option of depositing rock armour along the length of the Castle – essentially joining up the new defences along the East Wing and existing defences along part of the West Wing – could cost in the region of £6m. Whilst this would not provide a permanent solution, it could present a more affordable and adaptive response allowing 20-30 years of life before further modifications may be needed to adapt to increasing sea level rise. A 'do nothing' option would otherwise result in further collapse along the West Wing, leading to the eventual closure and ruination of the Castle as rising sea waters, worsening storms and tidal surge events continue to undermine and destabilise the structure. There is no 'no cost, no risk' option and doing nothing now would lead to significant future cost to English Heritage, which without additional funding would result in funds being diverted away from other high need conservation projects.

Figure 12: A rock armour revetment has been added to the East Wing of Hurst Castle following the collapse. © Historic England. English Heritage Trust

Hurst Castle is part of a natural environment with important designations. It cannot be considered in isolation and we are working with local partners to contribute to The Hurst Spit to Lymington Flood and Coastal Risk Management Strategy. The project aims to create a clear strategy to balance community needs, flood defence, the natural environment and heritage, and create a sustainable future for the coastline in this area.

Recognising that the challenges of managing Hurst Castle are not unique, we launched a joint initiative with World Monument Fund called Coastal Connections to build an international network of coastal heritage sites for sharing practical solutions. Coastal Connections is developing resources and principles for guiding future management decisions, ranging from implementing hard-engineering and nature-based sea defences to citizen science initiatives for remembering and recording heritage. Coastal Connections is based on the principle that sharing knowledge is the best way to adapt, learn and build resilience. Through this work we will help those who care for coastal heritage to address the challenges of climate change together.

Hurst Castle is at the forefront of our climate adaptation work. It showcases the collaborative and holistic approach taken to care for the historic environment in its entirety.

References

1 Brimblecombe, P. (2024) Predicting the changing insect threat in the UK heritage environment, *Journal of the Institute of Conservation*, 47:2, 133-148, DOI: 10.1080/19455224. 2024.234 7205

2 Düvel, E., & García-Portela, L. (2024) The ethics of climate change loss and damage. *WIREs Climate Change*, e910. https://doi.org/10.1002/wcc.910

3 Downes, S., Thickett, D. and Lambarth, S. (2021) Damage assessment and mitigation measures for enamels displayed in historic buildings. In Transcending Boundaries: Integrated Approaches to Conservation. ICOM-CC 19th Triennial Conference Preprints, Beijing, 17–21 May 2021, ed. J. Bridgland, J. Paris: International Council of Museums.

4 Lankester, P. (2013) *The impact of climate change on historic interiors* (Doctoral dissertation, University of East Anglia).

5 Lankester, P., and Knight, R. (2024) Towards a National Heritage Climate Change Risk Assessment. *Studies in Conservation*, 1–14.

6 Begum, R.A., Lempert, R., Ali, E., Benjaminsen, T.A., Bernauer, T., Cramer, W., Cui, X., Mach, K., Nagy, G., Stenseth, N.C., Sukumar, R., and Wester, P. (2022) Point of Departure and Key Concepts. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., Okem, A., Rama, B. (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 121–196, doi:10.1017/9781009325844.003.

7 Reisinger, A., Howden, M., Vera, C., et al. (2020) The Concept of Risk in the IPCC Sixth Assessment Report: A Summary of Cross-Working Group Discussions. Intergovernmental Panel on Climate Change, Geneva, Switzerland. pp15

8 Bednar-Friedl, B., Biesbroek, R., Schmidt, D.N., Alexander, P., Børsheim, K.Y., Carnicer, J., Georgopoulou, E., Haasnoot, M., Le Cozannet, G., Lionello, P., Lipka, O., Möllmann, C., Muccione, V., Mustonen, T., Piepenburg, D., and Whitmarsh, L. (2022) Europe. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., Okem, A., Rama, B. (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 1817–1927, doi:10.1017/9781009325844.015.

9 Cardona, O.D., van Aalst, M.K., Birkmann, J., Fordham, M., McGregor, G., Perez, R., Pulwarty, R.S., Schipper, E.L.F., and Sinh, B.T. (2012) Determinants of risk: exposure and vulnerability. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., Barros, V., Stocker, T.F., Qin, D., Dokken, D.J., Ebi, K.L., Mastrandrea, M.D., Mach, K.J., G.-K. Plattner, G.-K., Allen, S.K., Tignor, M., and Midgley, P.M. (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 65-108.

© Historic England

10 Deru, J., Dowding, D., Crowe, E. and Fluck, H. (2022) Mapping Climate-Related Hazards to Historic Sites. Historic England Research Report

11 Richards, J., Cooke, E.L., Coombes, M., Jones, J., and Viles, H. (2023) Evaluating the robustness of nature-based solutions: future resilience of sedum-based soft capping as a conservation approach for heritage sites in Britain and Ireland, *Physical Geography*, DOI: 10.1080/02723646.2023.2212422

12 Climate Change Alliance of Botanic Gardens. Climate Assessment Tool v1. Botanic Gardens Conservation International. Richmond, U.K. Available at https://cat.bgci.org. Accessed on 30/05/2023

Historic England

Historic England's Research Reports

We are the public body that helps people care for, enjoy and celebrate England's historic environment.

We carry out and fund applied research to support the protection and management of the historic environment. Our research programme is wide-ranging and both national and local in scope, with projects that highlight new discoveries and provide greater understanding, appreciation and enjoyment of our historic places.

More information on our research strategy and agenda is available at HistoricEngland.org.uk/research/agenda.

The Research Report Series replaces the former Centre for Archaeology Reports Series, the Archaeological Investigation Report Series, the Architectural Investigation Report Series, and the Research Department Report Series.

All reports are available at HistoricEngland.org.uk/research/results/reports. There are over 7,000 reports going back over 50 years. You can find out more about the scope of the Series here: HistoricEngland.org.uk/research/results/about-the-research-reports-database

Keep in touch with our research through our digital magazine Historic England Research HistoricEngland.org.uk/whats-new/research

ISSN 2398-3841 (Print)
ISSN 2059-4453 (Online)
© Historic England