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National Trust

For caretakers of historic and beautiful places

Introduction to Climate Change Adaptation

About this guidance

This guidance is intended to provide owners and managers of historic and beautiful places with useful, practical information about options, thresholds and methods for decision-making when considering climate adaptation pathways.

The guidance is designed to be easily navigable. Although our places and assets, and how people interact with them, are all connected, we need to be able to deal with climate change adaptation in manageable pieces. Consequently, the guidance is organised into fourteen sections, divided by asset and activity type, based on the National Trust's operations, consultancy and central teams. The chapters within each section are focused on particular asset and activity types which may be impacted by climate hazards, together with adaptation measures and key examples.

Each guidance chapter contains the following information:

- background information on that asset/activity
- why it matters that we consider this asset/activity in the context of climate hazards
- a table of hazards, impacts and potential options
- detail on adaptation measures and potential thresholds for a change in approach
- a worked example of the range of adaptive pathway options for that asset/activity
- case studies and other useful information (signposting, references, etc.).

The guidance is not intended to be detailed, technical instruction. Instead, it is aimed at the practitioner (operations manager, climate adviser, generalist) who is faced with taking decisions about looking after a place in the face of climate hazards and uncertainty.

It has been developed with advice from the four UK government and advisory agencies for heritage: Historic Environment Scotland, Historic England, Cadw and the Department for Communities, Northern Ireland. Further advice and case studies have been contributed by English Heritage and the National Trust for Scotland.

Image credit: Lyme Park, National Trust (photo by Imogen Wood).

Why do we need to adapt to climate change?

Climate change refers to long-term shifts in temperatures and weather patterns. Since the 1800s, human activity has been a key driver of climate change, primarily due to the burning of fossil fuels (like coal, oil and gas), which produces greenhouse gases such as carbon dioxide.

We can see the impacts of climate change all around us. In recent years, we have experienced the highest temperatures since records began, as well as long-lasting droughts and more instances of flooding. In the future, sea level rise is likely to increase coastal flooding related to storm surges.

Climate change presents the single biggest threat to the places in the National Trust's care and the single biggest challenge to our mission – to look after nature, beauty and history for everyone to enjoy, now and in the future. We predict that more than 70 per cent of the places in our care will be at medium or high risk of climate-related hazards by 2060.

Climate change adaptation is about changing the way we manage our historic and beautiful places to reduce the risks posed by climate change. All aspects of our places are potentially at risk, from buildings, collections and gardens, to rivers, lakes, countryside and coasts. We need to act now in order to understand climate hazards, identify impacts and plan our response.

By 2050 our **average winter** will be

+1° warmer

+5% wetter

meaning more heavy rainfall events and more severe flooding.

Our **average summers** will be

+10% drier

+1.5° warmer

which could bring longer droughts and water shortages.

Sea levels will have risen

+10 to 30cm

since the year 2000, bringing with them serious impacts for our coasts.

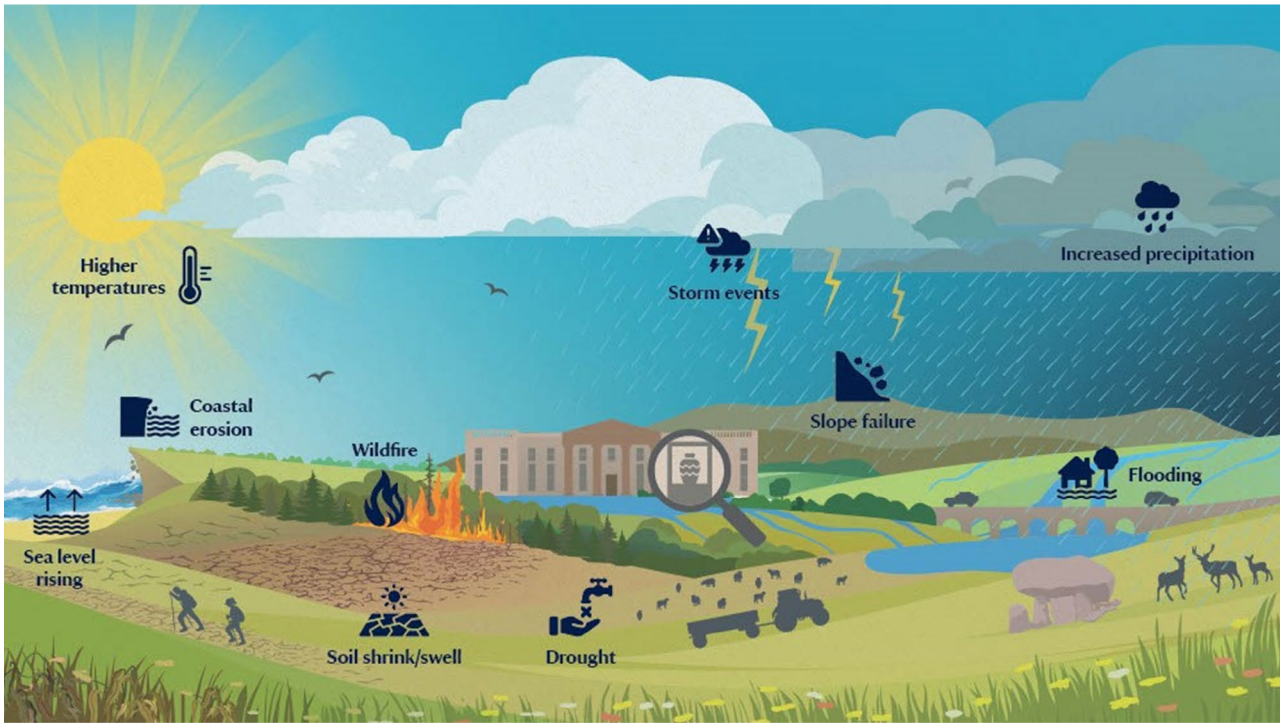


Image credit: top, Climate projections drawn from the Climate Change Committee's 2023 report to Parliament, *Progress in adapting to climate change*; below, infographic showing the range of potential climate hazards affecting a typical National Trust site.

What do the impacts of climate change look like?

The impacts of climate change will be individual to each place and to each feature or asset.

Impacts can include an increase in wildfires affecting buildings, people and landscapes; scorching and damage to gardens from higher temperatures; increased tree falls due to storm activity; more water ingress and flooding of buildings, gardens and parklands; and desiccation of important nature reserves and archaeological sites. The changing climate can also have an impact on human activity, safety and wellbeing. Our climate is changing, we are already seeing the impacts, and it is important that we develop ways to adapt.

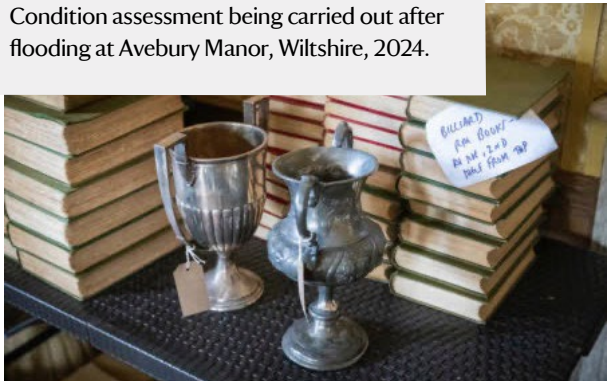
The parterre after drought conditions at Wimpole Estate, Cambridgeshire, 2022.

Rain overspilling guttering at Woolsthorpe Manor, Lincolnshire.

Storm damage to giant redwood at Sheffield Park and Garden, East Sussex.

Wildfire on Big Moor, Peak District, Derbyshire.

Condition assessment being carried out after flooding at Avebury Manor, Wiltshire, 2024.



Erosion of cliffs threatens the hillfort at Dinas Dinlle, Gwynedd.

Image credit: clockwise from top left: © National Trust Images/James Dobson, Chris Lacey, Laurence Perry, Paul Harris, James Dobson, Adam Kirkland.

What is climate change adaptation?

Climate change adaptation is about changing the way we manage the places in our care to reduce the risks posed by climate change. Adaptation is different from climate change mitigation, which is about reducing and capturing the greenhouse gas emissions that cause climate change.

Adaptation is one of the four key elements of the National Trust's climate RACE, which drives our ambition to protect our places and against which we can measure the changes we make:

RACE - reduce, adapt, capture, and engage

- We will **reduce** our carbon emissions from all of our activities, to be carbon net zero by 2030
- We will take account of the need to be resillient and **adaptable** to a changing climate in every choice we make
- We will **capture** more carbon from our land, to be carbon net zero by 2030
- We will **engage** others - telling our story widely to inspire action from supporters and policymakers

Our adaptation handrail

Working with staff and drawing on external expertise, the National Trust has developed a property-facing approach which we call the 'adaptation handrail'. This allows local property teams to identify those assets and activities that are most vulnerable at their sites, and to plan a tailored adaptation pathway. The handrail is flexible and allows for a measure of uncertainty around when impacts will occur, but it also proposes concrete, measurable actions. Other heritage organisations have implemented alternative methods — such as the Climate Vulnerability Index process developed for UNESCO World Heritage Sites, which looks at community vulnerability alongside the vulnerability of a site's outstanding universal value.

Develop an impact assessment for each property, using data from our hazard maps and the experience of those on the ground to assess current and future impacts of climate change.

→

Hold workshops with local teams to plan adaptation pathways for assets or activities identified as being at highest risk.

→

Use the Weather Impact app to identify when thresholds or tipping points for action are reached.

→

Once thresholds are reached, implement the adaptive actions that have been identified as part of the pathway planning process.

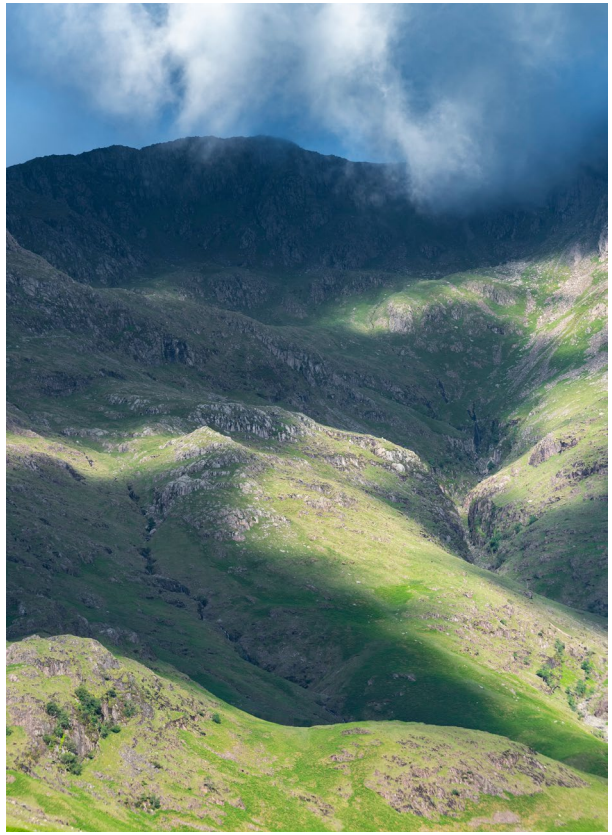


Image credit: The Langdale Pikes seen from Great Langdale campsite (© National Trust Images/Paul Harris).

Climate change adaptation – key considerations

Whether or not we meet the international goal of limiting global warming to 1.5 degrees centigrade, we still need to prepare for the effects of climate change that are already locked in. This means adapting beautiful and historic places so that they can cope with increasing climate hazards.

However, adaptation does not have to mean radical change. It may be incremental: often, the first step is to conduct research to better understand the problem. We might also start by implementing increased monitoring to gauge how quickly an asset is deteriorating as a result of a particular climate hazard. We can then use this information to explore a range of adaptive responses. For physical assets, there is likely to be a spectrum of possible adaptations, ranging from more frequent maintenance and small, sympathetic like-for-like changes to building fabric, through to landscape-level adjustments to the flow of water through a site, and – in some very rare cases – adaptive release.

Buildings, gardens and parklands, and wider landscapes can all be adapted to withstand the impacts of climate change. Spaces in which collections items are stored can also be adapted so that environmental conditions are more tightly controlled. But adaptation is not just about looking after physical assets; it is also about activities such as visitor operations. We need to plan for shifts in visitor numbers and behaviour; we also need to make sure our people (staff, visitors, members and supporters) are looked after. Adaptation includes any change in management strategy that takes account of present or future climate conditions – for example, simple steps such as directing visitors away from waterlogged lawns and paths, or adding temporary shelters to allow staff or visitors to escape from summer heat, are both adaptive actions.

Even if a site is not currently experiencing any climate change impacts, the team will need to make sure that any decisions they make are climate-informed. This means making sure that any plans – for instance, maintenance plans, or plans for new buildings or infrastructure projects – take account of climate projections. Our hazard maps are a good starting point for teams to find out what the major climate hazards will be for their sites between now and 2060.

Adaptation is as much about people and process as it is about physical interventions on a site. Within the adaptation handrail process outlined earlier, it is important to bring the whole team on board and to ensure that the process is documented for future reference. It is also important to engage the right people in the process. When dealing with any aspect of the historic environment, you may need to consult with experts and stakeholders to help you understand significance and where there might be capacity for change, and to identify what kinds of adaptation will be acceptable.

Designations and permissions

Before planning any adaptive measures, check whether your site, or the relevant assets within it, are designated and subject to statutory consents.

When planning adaptations to a historic building, for example, you should always consult an appropriate building professional such as a conservation-accredited building surveyor or architect, and the local authority (if the building is designated). Other assets may also be subject to special protections – for example, National Landscapes or Sites of Special Scientific Interest.

Image credit: The rear garden at Shugborough Estate, Staffordshire, under flood water (© National Trust Images/David Goacher).

Exploring adaptation options

This guidance sets out to provide site managers and decision-makers with a suite of options for adapting to climate hazards (which are based on the three central concepts of climate adaptation: resist, accept, direct a change). It also explains when and why a response may need to change from the current approach.

Climate change acts as a risk multiplier and can exacerbate existing hazards, such as flooding, heat and landslip, as well as introducing new hazards. The overall level of risk associated with climate change is complex to calculate, and takes into account the possible climate scenarios facing an asset, activity, or place, alongside their vulnerability and the potential for compounding impacts. Using our hazard maps, we can begin to understand the likelihood of a particular hazard impacting a site in the future. We can then consider measures for adapting to potential hazards and the points or thresholds at which these measures might be triggered.

Choices and changes for our significant places generally follow the inverted pyramid of the Adaptive Release diagram opposite, with maintenance the most frequent option. Triggers and thresholds for change are nevertheless likely to be site specific, depending on multiple drivers and factors associated with an asset's composition, context and use. Using a Dynamic Adaptive Policy Pathways approach (as outlined in the next section) to plan how and when a change may be triggered can help formulate long-term conservation planning and principles for a site. It can also target condition/state based on the inevitability of climate change and its associated impacts.

In the following simple example, a footpath in a designed landscape on a principal visitor route is adequate until compounding pressures for change trigger a different approach to the management of that asset:

Maintenance

The path is satisfactory and simply requires occasional pothole repairs, vegetation clearance and surface washing; drains also need to be cleared out alongside the path. The threshold for a change of approach may be related to the patchwork appearance caused by maintenance, the lack of resilience of the material to shrink/swell impacts, or the number of health and safety incidents associated with distorted path surfacing.

Conservation

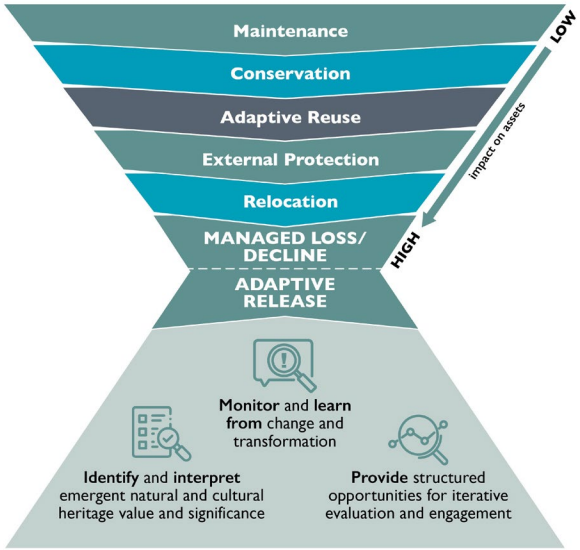
As a result of more frequent wet and dry periods, shrink/swell incidents distort surfaces to the point where health and safety is adversely affected. The additional need for improved access and capacity means the path surface is changed and its area widened.

Before any action is taken, knowledge of the existing systems is required to understand the problem, what has gone wrong, and what makes the footpath special in the context of the designed landscape. This knowledge will help to inform any change in approach.

For a building, a coastal asset or an asset connected more directly with the natural environment, such as a woodland or reservoir, the change in response is likely to be more complex and follow a number of different pathway options.

Adaptation response options: from maintenance to adaptive release

The outputs from research on how to manage sites in a more holistic and sustainable manner are shown in the diagram below. The usual option of maintenance is at the top of the inverted pyramid and the infrequent option of Adaptive Release at the bottom. This collaborative research was carried out by Historic England, the National Trust and the University of Exeter.[1]



[1] Caitlin DeSilvey, Harald Fredheim, Hannah Fluck, Rosie Hails, Rodney Harrison, Ingrid Samuel, & Amber Blundell (2021), 'When Loss is More: From Managed Decline to Adaptive Release', The Historic Environment: Policy & Practice, 12 (3–4), 418–433. https://doi.org/10.1080/17567505.2021.1957263

Approaches to developing adaptive pathways

Climate change always involves some degree of uncertainty: we might have a good idea of how the climate is going to change at a particular site, but we do not always know exactly what the impacts will be, or when they will occur. To help manage this, one option is to use a Dynamic Adaptive Policy Pathways (DAPP) approach. The key benefit of this is flexibility: once the pathway is planned out (and visualised as in the diagram below), decision-makers are still able to move flexibly between different adaptation options.

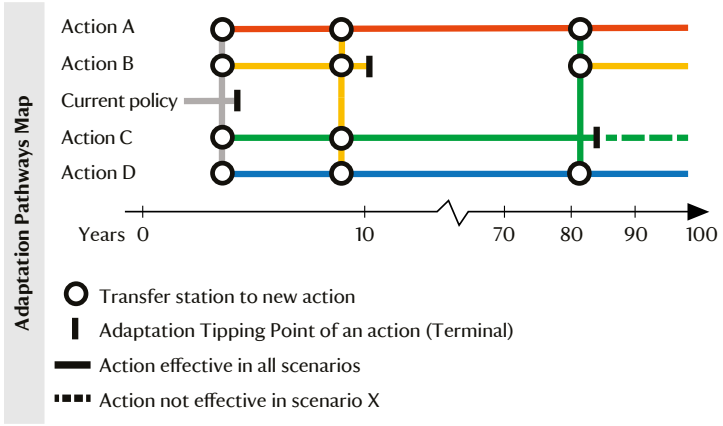
One key tip to bear in mind when reading our guidance is that you do not need to worry about the detail of these diagrams. They are intended only to be indicative; available adaptation options and tipping points will be different for each site, asset and climate scenario.

In the DAPP approach, a multi-disciplinary team considers the acceptable outcomes for an asset, and the tipping points for action to arrive at an agreed pathway. This can be based on the lists of options given in each chapter of the guidance, though these are not exhaustive. If statutory protections apply, we recommend involving relevant stakeholders in the pathway planning process. Once all options for pathways are identified, a cost-benefit analysis can be created to help arrive at a preferred approach. This is illustrated by the 'scorecard' below, which sets out the costs, benefits and side effects of different routes through the pathway map. Once the pathway has been planned, there should be a continual review process, with checks in place to determine when agreed thresholds for action are reached.

An alternative method to the Dynamic Adaptive Policy Pathways approach, and one that we are implementing as part of our pathway planning workshops at National Trust places, is that used by the Climate Action Unit at University College London. In this approach, operators and decision-makers think of the most extreme/worst-case scenario outcome for an asset or activity and work backwards along the thresholds for change towards less extreme options/outcomes to identify a pathway.

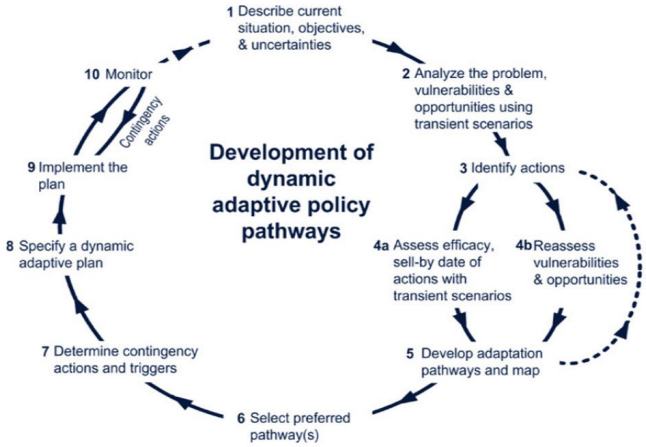
Dynamic pathways: tipping points

In the adaptation pathway map (below left), tipping points (represented by the vertical black lines) occur when the current/proposed policy ceases to be tenable. The horizontal lines representing the potential pathway are either whole (action effective in all scenarios) or dashed (action potentially ineffective based on other pathway scenarios).[2] The key with adaptive pathway planning is to avoid being locked into an irreversible course of action that would prevent the exploration of alternative pathways as the situation changes in the future.



Pathways scorecard

	Path actions	Relative Costs	Target effects	Side effects
1		+++	+	0
2		+++++	0	0
3		+++	0	0
4		+++	0	0
5		0	0	-
6		++++	0	-
7		+++	0	-
8		+	+	---
9		++	+	---



[2] Dynamic Adaptive Policy Pathways approach (Haasnoot, Kwakkel, Walker & Ter Maat, 2013). For a brief video explainer on the DAPP approach, see https://www.youtube.com/watch?v=yLS4PubQVgc

Case Study – Mount Stewart, Northern Ireland

In 2022, the National Trust teamed up with the Department for Communities, Northern Ireland, to look at the hazards, impacts, options and thresholds for Mount Stewart, an internationally significant site on the north-east shore of Strangford Lough. This case study is intended as a useful guide to the thinking and range of activities that might be undertaken when planning adaptive pathways for a site. But please remember that this is not prescriptive, and that the approach will need to be tailored to the individual site.

Mount Stewart had already been the subject of much thinking around climate adaptation. An area of made ground, known as the Sea Plantation, which lies between Strangford Lough and the main coastal road, had experienced flooding and collapse of coastal defences. Both the site operations team and local people had been aware of the risk of flooding and erosion to the road. For some time, different specialists working on Mount Stewart had been puzzling over increases in soil salinity of the gardens, potential submergence of key infrastructure, the longevity of the site's tree species and impacts on farming. This project aimed to give more certainty to scenarios that may occur at Mount Stewart (as well as nearby Grey Abbey, a Department for Communities property in care) and explore the decision-making pathway for implementing adaptive measures over time. The project consisted of three main elements:

UCL Climate Action Unit pathways workshop

Climate researchers and facilitators from UCL brought together members of the local community, site operators and consultants with senior decision-makers at the National Trust to discuss the impacts of predicted change. The purpose of the workshop was to create an adaptation pathway by exploring adaptation options and determining the thresholds at which a change might be triggered.

This workshop included the statutory authorities because permissions for change would almost certainly be needed, though the choices may be limited and potentially at odds with traditional conservation principles.

Hazard mapping and microclimate modelling by Atkins

The National Trust has collated data from a number of sources and worked with regulators to produce its hazard map, conceived as a flagging tool for climate hazards. This light-touch, high-level map of hazards was used in conjunction with a model of Mount Stewart's microclimate produced by Atkins to further explore the climate hazards most relevant to the place, including flooding, increased temperatures, and sea level rise.

Kassandra IDSS report

Kassandra were commissioned to use their existing Integrated Decision Support System Tool to create a digital twin of Mount Stewart, and visualise possible climate scenarios. This created a picture of the resilience of different aspects of the place: its assets, use and components, and their interaction. This work was underpinned by a detailed technical note on the likely climate trajectory for the locality up to 2100, produced by Atkins as part of their microclimate modelling.

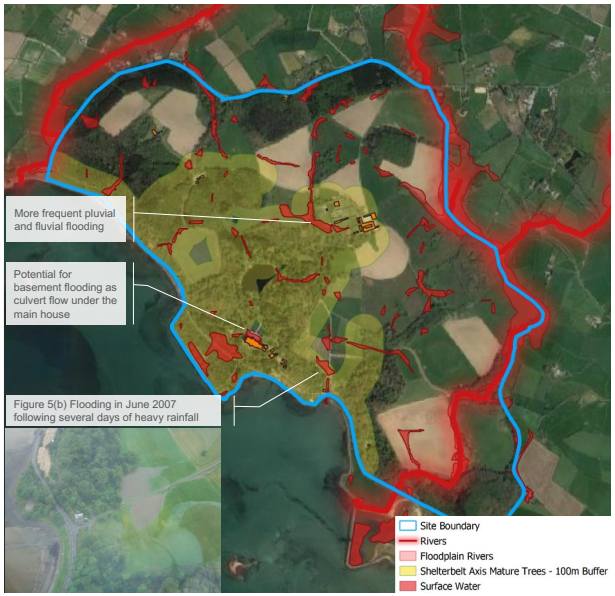
Baseline information

In order to inform the study at Mount Stewart, some basic information was needed about what makes the site special. This enabled the decision-making process to understand and focus on the features and areas of activity that together give the site its unique Spirit of Place.

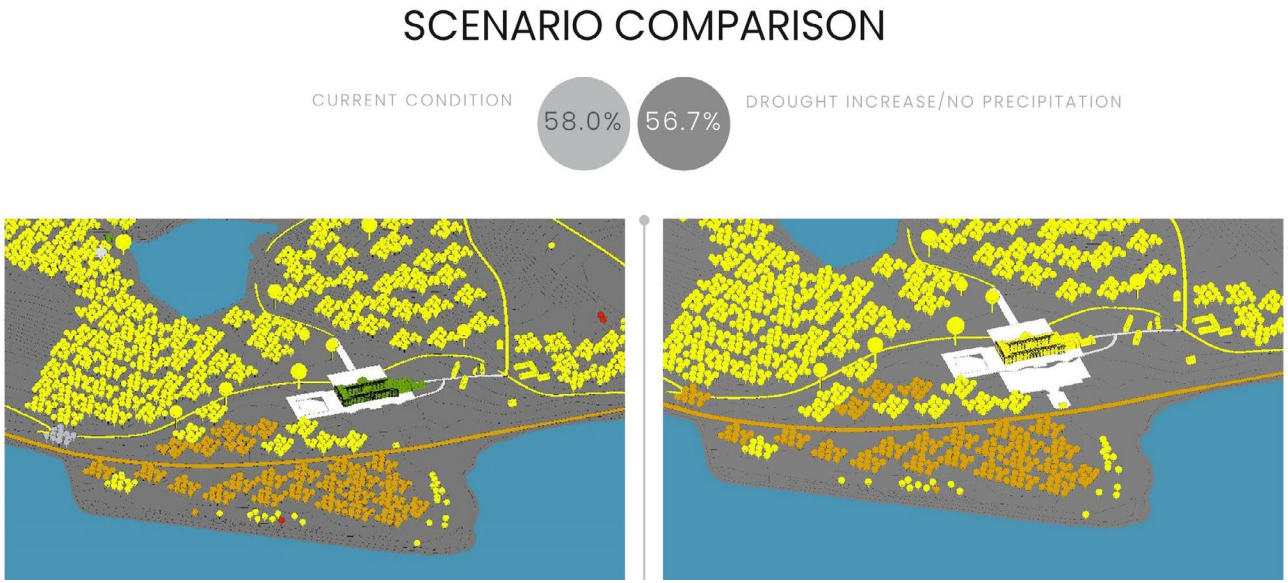
A spatial plan is a piece of work in its own right which recognises the issues and opportunities of a site, and underpins a masterplan for the place and its future (projects, vision, use, phased changes). We had already undertaken this piece of work, which encompassed much of the baseline information needed, including:

- Statement of heritage significance.
- Ecological information and plans.
- Visitor, audience and insight data.
- Environmental and climate data.
- Expert knowledge – anecdotal reports from users and operators, volunteers and visitors all help to build a picture of perceived risk.
- Condition reports and point-in-time surveys, especially where these may indicate trends and vulnerabilities.

Case Study – Mount Stewart (continued)



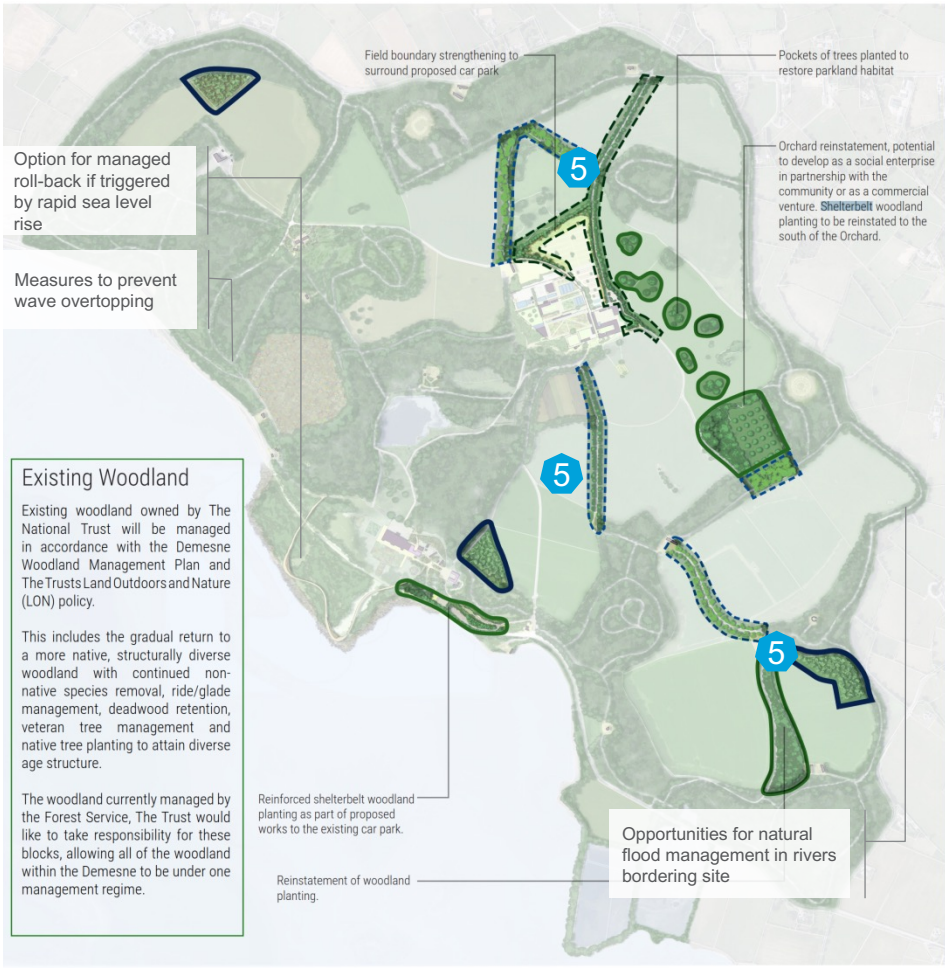
The Atkins microclimate study highlighted Mount Stewart's vulnerability to drought, heatwaves, and other hazards, and gave detailed projections for pluvial flooding across the demesne, which when compounded with coastal flooding issues really highlighted the need for adaptation pathway planning on a place-wide basis.



The Kassandra digital twin helped to visualise threats to the entire place and how these knocked on to neighbouring places such as Grey Abbey and the main road around Strangford Lough. The digital twin helped to highlight the most vulnerable areas of the site and to demonstrate how the individual assets and activities within these would be impacted, as well as options for adaptation, drawing on the spatial and masterplanning data for the site as outlined above.

Case Study – Mount Stewart (continued)

Some of the immediate 'low risk' adaptation actions identified as part of the pathway planning workshop, such as using flora to act as a dense shelterbelt from the incoming sea water, had already been included in Mount Stewart's spatial plan. Other potential adaptation options explored included:



1. In the short term, improvements to defences to protect the lowest lying part of the Sea Plantation; in the longer term, working with natural processes rather than fighting against them, moving towards managed realignment, roll-back and habitat creation.
2. Drainage improvements, including lake outlet control, sustainable drainage systems and natural flood management.
3. Additional shelterbelt and woodland planting.
4. Improved on-site monitoring using remote sensing, in addition to data gathering from government agencies.
5. Drought-resistant herbal leys (mixes of grasses, legumes and forage herbs) sown in pastures, and more drought-resistant woodland species.

The data and modelling by Atkins and Kassandra were developed alongside a facilitated pathway planning workshop that took into account the need for the site's decision-makers and operators to manage risk and take decisions based on probabilistic data – which is not easy.

The UCL Climate Action Unit helped consultants and operations staff to consider pathways, options and thresholds through a place-based approach, by breaking the site into manageable chunks based on vulnerability and local knowledge, and then prioritising these based on feedback from the room. As outlined above, the workshop process encouraged participants to consider the most change that could be tolerated, or the 'worst case scenario' for an asset or activity, and then work back from this point to the present, considering steps and thresholds for change along the way.

Glossary of terms

Adaptation options – there are three principal types of adaptation response: **(1) resist**, meaning that you maintain current management strategies in the hope of preventing climate impacts from affecting the asset or activity; **(2) accept**, meaning that you cease or reduce the previous resistance to exposure, accept that the asset or activity is vulnerable and that loss will occur over time; and **(3) direct a change**, which is when you make a change to the management of the asset or activity to reduce impacts, increase resilience, and/or expand adaptive capacity.

Asset/activity – a feature of a site (for example, a monument, building, habitat), or an area of operations (such as visitor services, commercial activity) which may potentially be impacted by climate change. Chapters of this guidance are generally themed around individual assets or activities, with the exception of the 'Places' section, where chapters deal more holistically with hazards (for example, wildfire) that may affect multiple assets or activities.

Exposure – the exposure level of a site is an extrapolation of the overall vulnerability of assets/activities, multiplied by the level of potential impact, multiplied by the significance of the aspect.

Hazard/climate hazard – in simple terms, a climate hazard is the threat posed to assets/activities by changing long-term weather patterns. It is distinct from impact (see below); a climate hazard does not always equate to an impact. More technically, a hazard may consist of a single climate factor, or a combination of climate and other factors (for example, soil, riverbed, geomorphology). For instance, landslip is a hazard resulting from an interaction between climate (especially wind, rain, sea level rise), and geomorphology.

Hazard map – this is a way of mapping hazards to places using a grid system to show levels of risk. The National Trust's hazard maps can be explored here. Hazard maps should be treated primarily as a flagging tool; the data they provide should be combined with on-the-ground observation of the impacts of climate on assets and activities.

Impact – the level of change that a climate hazard inflicts on an asset or activity. This may range from no impact, to mild, to complete loss. It may consist of physical damage, or it may take another form; for example, a drop in income resulting from a reduction in visitors to a flooded site.

Significance – in heritage terms, significance is a measure of how important the asset/activity is to the core purpose of the organisation. Significance is measured as the sum of an asset's values (aesthetic, evidential, value to people and historical value, as well as nature value).

Threshold – the trigger point at which a change in management approach is prompted, and where teams will need to decide on adaptation options. These decision-making thresholds will not necessarily be determined by climate hazards alone; they may relate to maintenance costs, health and safety, or other operational considerations.

Vulnerability – the susceptibility of an asset/ activity (for example, visitors, monuments) to a hazard (such as higher temperatures, flooding). Vulnerability is determined not just by the hazards themselves, but by other factors such as current management and condition; for instance, a well-maintained building will be less vulnerable to climate hazards than one in disrepair.

Further references

Historic England and UCL have published a vocabulary of climate change hazards for the heritage sector, aligned to the methods and definitions of the Intergovernmental Panel on Climate Change (IPCC).

See Helen Thomas, Philip Carlisle and Scott Orr, 'Creating a Vocabulary of Climate Change Hazards for Heritage' (2024), https://historicengland.org.uk/research/results/reports/13-2024