Historic Environment and Climate Change in Wales

Sector Adaptation Plan Monitoring

Interim Report of Activity: Year 1, 2020

Historic Environment Group
Climate Change Subgroup

May 2022

The Historic Environment Group (HEG) is a high-level forum set up by the Welsh Ministers in 2004 to take a strategic overview of issues and opportunities in the historic environment and to promote common approaches. The group is made up of representatives from the major organisations in Wales with historic environment interests.

The HEG Climate Change Subgroup is charged with assessing and reporting to HEG on how the historic environment sector in Wales should address the challenge of climate change.

Cover photograph: Excavation of St Patrick's Chapel at Whitesands Bay, Pembrokeshire.

Contents

1. Introduction

In 2020, the Historic Environment Group (HEG) published *Historic Environment and Climate Change in Wales Sector Adaptation Plan* (SAP), building on the high-level strategic actions identified in the Welsh Government's adaptation plan *Prosperity for All: A Climate Conscious Wales*.

You can download the Historic Environment and Climate Change in Wales Sector Adaptation Plan, published in 2020, from the Cadw website

You can download the Prosperity for All: A Climate Conscious Wales, published in 2019, from the Welsh Government website

The SAP identifies the risks and opportunities of climate change for the historic environment of Wales and sets out the headline actions needed to adapt to the impact of these changes. The actions are arranged around the three overarching and linked objectives of increasing our knowledge, increasing our capacity, and building our resilience.

The *SAP Monitoring and Evaluation Framework* sets out the process for evaluating progress against the published SAP actions and the Welsh Government indicators in *A Climate Conscious Wales*. It also sets out a four-year timeline for reporting activity and a formal monitoring and evaluation report in advance of updating the SAP in 2025.

Year	Outcome	Timeline	Status
0	Historic Environment Group (HEG) published the Historic Environment and Climate Change in Wales Sector Adaptation Plan	2020	Complete
1	2020 Sector Adaptation Plan Actions and Activities #1 consultation survey	2020-21	Complete
1	2020 interim report of activity (this report)	2020-21	Published Summer 2022
2	2021 Sector Adaptation Plan Actions and Activities #2 consultation survey	2021-22	Complete
2	2021 Interim report of activity	2021-22	
3	2022 Sector Adaptation Plan Actions and Activities #3 consultation survey	2022-23	
3	2022 Interim report of activity	2022-23	
4	Full monitoring and evaluation report	2023-24	
5	Updated SAP	2024-25	

You can download the SAP Monitoring and Evaluation Framework, published in 2021, from the Cadw website

The HEG Climate Change Subgroup is charged with formally requesting and collating evidence of activity to help evaluate progress against the published actions, and to identify gaps and priority areas that require further attention.

This is the first interim report of activity covering the year 2020, as set out in the Monitoring and Evaluation Framework. It provides an early indication of activity and will help inform the formal monitoring and evaluation report that will be submitted to the Welsh Ministers in 2024.

This report describes the call for evidence and reviews it against the SAP action plan and *A Climate Conscious Wales* indicators (see section 2 for details of the indicators and actions). Selected case studies are included to illustrate a range of historic assets and adaptation activity that has been used to combat the risks of climate change. These are intended as examples of various projects; other equally important work is still ongoing.

2. Indicators and Actions

Indicators in Prosperity for All: A Climate Conscious Wales

Caring for the historic environment

HE1. Knowledge: Complete and publish the Historic Environment and Climate Change Sector Adaptation Plan.

HE2. Knowledge: Improve understanding of the threats and opportunities for the historic environment from a changing climate.

HE3. Capacity: Develop the methodologies, tools and guidance needed to build adaptive capacity.

HE4. Resilience: Increase resilience of the historic environment by implementing actions to respond and adapt to the risks.

Protecting our coasts and seas

MC1. Resilience: Improve the resilience of habitats and heritage in Wales's coastal zones from the impacts of climate change.

MC4. Knowledge: Carry out research to better understand the impact of climate change on marine ecosystems, ecosystem services and marine heritage.

Actions identified in the Historic Environment and Climate Change in Wales Sector Adaptation Plan

The headline actions in the SAP are grouped into seven themes under three overarching and linked objectives. Full details of the outputs and broad outcomes for each action are listed in the SAP table in section 4.

Knowledge: Increase our knowledge and understanding of the threats and opportunities for the historic environment from a changing climate

1. Knowledge exchange/collaboration

2. Mapping and monitoring the resource

3. Research priorities

Capacity: Develop the methodologies, tools and guidance to work with others and build adaptive capacity

4. Dissemination and promotion

5. Collaborative working

6. Training and guidance

Resilience: Increase resilience of the historic environment by implementing actions to respond and adapt to the risks

7. Taking action

3. Call for evidence

The HEG Climate Change Subgroup called for evidence for this report on two separate occasions:

- June to July 2020: initial consultation with HEG members
- December 2020 to January 2021: open invitation consultation, shared with HEG, delivery partners, a range of organisations and over social media.

The bilingual consultation was hosted on the Cadw website. It included a PDF introducing the published SAP action table with examples of relevant activities already captured, plus instructions on how to submit new evidence. An online survey form was provided for the submission of evidence.

The consultation closed on 18 January 2021. Analysis of the responses shows that:

- 17 organisations from across Wales responded
- a mixture of public, private and third sector organisations, including universities, local authorities, National Parks, large public bodies and charitable trusts submitted evidence
- respondents included those from officer to more senior levels within an organisation
- respondents included those operating at a national, regional and local level
- the responses from the two consultations show that the sector is carrying out work and activities that meet all priority action areas
- a wide range of case studies from across Wales and the sector were submitted during consultation, including activities that cover the broad spectrum of the historic environment.

4. Progress against Sector Adaptation Plan actions

The table at the end of this section sets out the headline actions needed to adapt to the impacts of climate change on the historic environment of Wales. The activity column in the table captures individual activities undertaken in 2020 against these headline actions. Progress against each action is summarised below.

Knowledge exchange and collaboration

1.1: Active promotion and dissemination of the SAP in the first year since publication has been good. Multiple channels have been used, from direct emails to and within organisations and networks across multiple sectors, to the use of social media and articles, the latter more focused on the historic environment sector.

The preparation and implementation of a monitoring and evaluation framework within the first year will help to ensure that the intended outcomes and impacts of the SAP and related activity will be tracked, and action taken in response. However, much of the awareness raising and sharing has been instigated by the HEG Climate Change Subgroup and HEG members. Expanding the sphere of influence of the SAP and reference to it by other sectors is key to accelerating this initial momentum. The production of a communication strategy would help with this.

1.2 and 1.3: Use of existing active networks, partnerships, working groups and committees has been favoured over establishing a new knowledge exchange group. Members of the HEG Climate Change Subgroup have found this to be an effective way of connecting across Wales and the UK by being represented within these fora. This has enhanced collaborative working, increased knowledge and has built capacity, but not resources. There is still an intention to establish a spatial mapping group, which would be aided by a resource commitment. The outputs could lead to more prioritised and successful adaptation.

Mapping and monitoring

2.1: Whilst there has been no new publishable mapping analysis, understanding the threats and opportunities for the historic environment from a changing climate has improved through the preparation of new case studies to showcase the actions and activity relating to the SAP. These are published as part of this interim report and will be added to the Cadw website.

Significant progress has also been made through the CHERISH and the National Trust Hazard Mapping projects, with far reaching implications for use as an improved evidence base for monitoring, decision-making and adaptation strategies. Other examples of activity include a

Cadw-funded, pan-Wales survey of historic features associated with rivers and riparian environments being undertaken by the Welsh Archaeological Trusts, and a range of organisation-bespoke, purpose-led methodologies, trials, scoping and new evidence activity, all contributing to continuous improvement in baseline data and understanding.

2.2: The use of unmanned aerial vehicles (UAVs), fixed point photography and wider accessibility of LiDAR data has increased the provision of data to inform management strategies and prioritisation. This increase, combined with volunteer-led monitoring and condition surveys, has made positive progress towards achieving the intended SAP actions for mapping and monitoring.

Research priorities

3.1 and 3.2: Several projects and activities are helping to improve our understanding of climate risk factors and the impacts of these on the historic environment. Projects such as CHERISH and Changing Coasts, along with targeted work by the Welsh Archaeological Trusts, Bangor University: Centre for Applied Marine Sciences, and National Museum Wales, are providing valuable data in respect of the marine and coastal environment; the Carneddau Landscape Partnership Scheme on the marginal and upland environment, and work by Cadw, the National Trust and Welsh School of Architecture, Cardiff University in the built environment. One example was submitted of PhD research assessing the exposure of parkland trees to wind and wind directions and the future impacts of this from climate change. Such focussed research remains a priority and there is a need to ensure that University work is more adequately captured in evidence gathering.

3.3: One strand of the Carneddau Landscape Partnership Scheme will help improve our understanding of the positive and negative effects of a longer growing season on the maintenance and management of the historic environment. There is a need for further work on both individual historic assets and across other environments, including designed landscapes, parks and gardens.

3.4: Natural Resources Wales and Snowdonia National Park Authority provided evidence of how UKCP18 projections can be used to identify opportunities for the historic environment and the economy, specifically in relation to woodland creation and planting.

Dissemination and promotion

4.1: The HEG Climate Change Subgroup has developed a SAP monitoring and evaluation framework that outlines terms of reference and roles and responsibilities. The subgroup oversees the SAP on behalf of HEG; monitoring, reporting and reviewing progress. The subgroup will identify, establish and coordinate working groups that focus on specific activities and priorities. It will act as the link between HEG and the working groups, facilitating the flow of information.

4.2: While the appointment of a Heritage and Climate Change Consultant within the National Trust is positive, the need for a Climate Change Manager for the historic environment sector in Wales is still outstanding.

Collaborative working

5.1: A number of HEG Climate Change Subgroup collaborative partnerships are being developed, see 1.2 above.

5.2: The SAP is embedded in the Historic Environment section of the Welsh Government climate adaptation plan *Prosperity for All: A Climate Conscious Wales*. HEG Climate Change Subgroup members continue to engage with the preparation of climate risk documents and in responding to various consultations.

5.3: HEG Climate Change Subgroup members and other stakeholders have come forward with a number of potential additional case studies, a selection of which are published as part of this interim report (see section 5) and will be added to the Cadw website.

Training and guidance

6.1 and 6.2: The Fit for the Future network remains an invaluable resource for knowledge-sharing and collaboration across organisations and sectors, and the MSc in Sustainable Building Conservation at the Welsh School of Architecture at Cardiff University now includes lectures on climate change mitigation and adaptation. Nevertheless, more needs to be done to embed climate change adaptation into training standards, qualifications and continued professional development (CPD) for practitioners.

6.3: Activities included the publication of guidance on *Flooding and Historic Buildings in Wales* by Cadw, the development of best practice guidance documents on monitoring change in the coastal zone by CHERISH, and the establishment of a HEG Climate Change Subgroup peatlands working group.

Taking action

7.1: A number of plans were evidenced that include climate change impacts as part of the assessment at both a landscape and site-based scale. It is likely that many more plans and emergency actions are being put in place in response to risks and impacts that could also be regarded as adaptation. Key to the success of this action will be raising awareness of the need to embed climate change adaptation in all conservation management planning, as well as encouraging more reporting and sharing of good practice and difficulties encountered for broader learning across the sector.

7.2: Several new place-based and all-Wales character assessments are being developed to inform action plans, some clearly linking character with climate change.

7.3: A wide range of activity was reported relating to historic assets at risk that include monitoring, excavation, mapping and research, assessment, repair and project work. This is an activity area that links closely with mapping, monitoring and research priorities, and delivers well on the overarching themes of increasing our knowledge and building our resilience.

7.4: Despite the pandemic, stakeholder and community groups were well considered and included within the projects reported by the three National Parks, CHERISH and the Welsh Archaeological Trusts. These activities are improving monitoring and helping to raise awareness.

7.5: Improved management and resilience of trees as part of the historic environment and landscape was made possible with new good practice guidance, climate responsive planting plans, and tree and hedgerow related grant schemes that can enhance the landscape. Connections between tree planting and flood management to benefit historic assets was also evident.

7.6: Adapting to new ways of working have arisen during the pandemic. Reduced travel to meetings is one example that has had benefits for the sector's carbon footprint by reducing emissions. Changing internal operational practices reflect the awareness and concern for future environmental sustainability.

Headline action table and evidence of activity for 2020

Details of any abbreviations and links to resources in the text can be found at the end of this report, sections 7 and 8.

Knowledge: Increase our knowledge and understanding of the threats and opportunities for the historic environment from a changing climate					
	Description of the action	Output(s) from the action	Broad outcome/impact	Activity 2020	CCW Indicator
1. Knowledge exchange/collaboration					
1.1	Dissemination, promotion and stakeholder engagement of the Historic Environment and Climate Change Sector Adaptation Plan. For example: • Communication Strategy. • Stakeholder engagement with politicians and senior decision-makers. • Monitor and evaluate strategy.	• Publication of the Historic Environment and Climate Change Sector Adaptation Plan. • Secured resources and practical actions to deliver the plan.	• Raised awareness of the challenges posed by climate change on the historic environment. • Direct action to improve our knowledge, build capacity and increase the resilience of the historic environment to climate change. • Provision of a strategic framework to take forward adaptation actions.	• HEGS – SAP launched at HEG Feb 2020. • HEGS – SAP Published on Cadw website Feb 2020 and sent to key stakeholders. • HEGS – Press release, social media posts, article in Heritage in Wales Feb/March 2020. • HEGS – Activity log created to record dissemination and promotion. • HEGS – Action Plan activity stakeholder engagement initiated through HEG June 2020. • HEGS – Monitoring and Evaluation Framework devised March-November 2020. • BBNPA – SAP shared with senior management to inform National Park Management Plan 2021-2025. • PCNPA – SAP incorporated in Archaeology Action Plan, shared to contribute to the Climate Change Action Plan. • NLHF – SAP is signposted in the NLHF Environmental Guidance. • NT – SAP shared across NT and Fit for the Future environmental network. • RCAHMW – SAP shared across organisation and staff presentation given. • HEGS – current members include Cadw, NRW, RCAHMW, GAT, NT, PCNPA, SNPA, GGAT.	• HE1
1.2	Establish a knowledge exchange group(s) for researchers and practitioners to share ideas, information and good practice, and to help identify future research and funding opportunities in Wales. For example: • Establish a climate and heritage management group. • Establish a spatial mapping group.	• Knowledge exchange group(s) established and active. • Identification of future research priorities for Wales.	• A coordinated approach, maximising knowledge and resources, leading to capacity building and more successful adaptation.	• HEGS, WATs, Cadw – Supported by Cadw funding, the WATs are planning a range of climate change projects for 2021/2, focussed on the heritage assets associated with rivers and floodplains. • SNPA – Welsh Peatlands Sustainable Management Scheme funded full time Research Hub Coordinator (Swansea University) to build research capacity and identify research priorities (see 3.1). • WVAONB – Partnership work between the Lower Wye Valley Catchments to identify Natural Flood Management (NFM) & Green Infrastructure (GI) measures and Sustainable Drainage Systems (SuDS) to reduce the risk of flooding, surface water run-off and continued damage to specific routes on the Public Rights of Way / Highway network in the AONB. (see 2.1, 7.3). • ALGAO: Cymru – held a virtual meeting to setup a Countryside Committee with a climate change element included as an agenda item. Climate change was also raised as an issue at the Planning Committee. • BBNPA – Development of BBNP Historic Environment Partnership. • Cadw – Establishing a HEGS peatland working group. • SNPA – Participation in ECOTWIN (EU Green Deal) application via Living Wales scheme (assessing climate change impacts on Natura 2000 sites via modelling using remote sensing data).	• HE2 • MC4
1.3	Participation from Wales in established UK and wider climate heritage groups and networks. For example: • Fit for the Future network. • Historic Environment Adaptation working group. • Climate Heritage Network.	• Welsh attendance at climate heritage groups and networks.	• Collaborative working maximising knowledge and resources, leading to capacity building and more successful adaptation.	• HEGS – Members are linked/part of Fit for the Future, HEAWG and Climate Heritage network. • NLHF – Members of the Heritage Sector Climate Change Forum (see 6.2). • PCNPA – signed up to the Heritage Declares non-affiliated group that aims to tackle the impact of Climate change within a Historic Environment context. • RCAHMW and Cadw – Members of Fit for the Future, and Climate Heritage Network.. • RCAHMW, Cadw, NRW, GAT – attend Historic Environment Adaptation Working Group Meetings (shared membership). • RCAHMW and partners – CHERISH Participate and liaise with other networks and bodies in relation to climate change and coastal heritage e.g. SCAPE, CITiZAN, FPAN.	• HE2 • MC4

	Description of the action	Output(s) from the action	Broad outcome/impact	Activity 2020	CCW Indicator
2. Mapping and monitoring of the resource					
2.1	Improving baseline data. Develop standardised methodologies and assessment tools to both identify historic assets and prioritise those at risk. For example:	• Improved baseline data sets. • Improved consistency and comparability of data. • Publicly available and regularly updated central repository of spatial mapping datasets.	• Improved understanding of the threats and opportunities for the historic environment from a changing climate. • Improved evidence base for monitoring, statutory protection,	• RCAHMW – Pilot spatial mapping projects during development of SAP. • RCAHMW and partners – CHERISH project targets Welsh Islands to improve baseline data through lidar and ground survey and use of UAVs, GNSS and terrestrial laser scanning for condition monitoring at coast edge and intertidal sites. Also marine survey and mapping of shipwrecks and sea bed (see 2.2, 3.1-2, 6.3, 7.3-4). • RCAHMW – Met Office soil moisture indexes purchased annually for targeted aerial reconnaissance programme. • NRW – Method for inputting historic advice on heritage features within Forest Resource Plan process agreed.	• HE2 • MC4

	• Wales spatial mapping work including environment/asset specific mapping and analysis. • Data enhancement programmes. • Use of soil moisture indexes to target aerial reconnaissance during dry periods.		decision-making and adaptation strategies.	• Cadw – Testing grassland restoration and management techniques on 3 damaged scheduled monuments; Tym Barlwm, Caerphilly from wildfires 2018. Castell Tinboeth, Llananno, Powys, severe drought. Skirrid Fawr, Monmouthshire, with NT, erosion by stock and visitors. • SNPA – Tomen y Mur motte mound archaeology management seeking to increase water retention to protect covering sward. • WATs – scoping to establish climate change priorities within WAT regions to inform investigative work programmes. The aims of these projects are to identify adaptation techniques on a regional basis. The projects will provide recommendations for adapting to climate change within the trusts' areas (see 7.1, 7.3-.4). • SNPA – Carneddau Landscape Partnership Scheme includes high resolution lidar for large areas; lidar data server for citizen science project; training for public use of lidar; mapping and ground recording of archaeological and other features through citizen science (see 2.2, 3.1-3, 6.2, 7.1-5). • SNPA – UAVs for condition baseline recording of prehistoric cairns. • SNPA – Carneddau Landscape Partnership Scheme Lost Farmsteads project recording names of existing and extant Ardudwy agricultural buildings, includes volunteer and community training days. • SNPA/SU – annual landscape surveys at Bron Aber and Dyffryn Dysynni. PhD work – N Wales early fields, climate change and the historic environment. • SU – Cook, Isabel (2019) Climate Change and Cultural Heritage: developing a landscape-scale vulnerability framework to measure and manage the impact of climate change on coastal historic landscapes. PhD thesis, University of Sheffield. • NT/OU – developing property climate risk scoring and reporting, producing "report cards". • NT – Liaising with Met office on accessing climate data and guidance. • NT – Lead on scoping a climate change heritage adaptation manual for the UK heritage sector, including a decision-making tool and technical tools / advice. With HES, Historic England, Cadw and Department of Communities, NI (see 6.3). • NT – Coastal adaptation project in Wales to review coastal adaptation plans/management across all aspects of the coastal estate, including the historic environment. A new risk assessment for all coastal sites, drawing on National Trust specialist expertise, together with the skills and knowledge of partners in Wales. (see 7.3). • WVAONB partnership – Assessment and evaluation of natural flood management options & opportunities on four historic paths and Unclassified County Roads (see 1.2, 2.2, 7.3). • BUCAMS – Marine mapping using multibeam sonar, WW1 WW2 shipwrecks (>60% are currently unknown or miss-identified). Researching the effects of marine processes on wreck sites, integrity of marine structures and importance of these sites with biodiversity. (see 3.1, 3.2, 5.3, 7.3).	
2.2	Establish and implement targeted monitoring regimes on identified historic assets. For example: • Develop and publish case studies to outline different monitoring approaches to ensure consistency of data and approach. • Establish online/mobile application to record incidents/ impacts e.g. of pests and disease. • Establish a link to scheduled monuments and listed buildings at risk monitoring work.	• Targeted monitoring programme and condition data. • Best-practice guidance document/technical notes for monitoring assets at risk drawing on case studies.	• Improved understanding of the threats for the historic environment from a changing climate. • Provision of data for historic assets to assist the development of management strategies and prioritisation.	• RCAHMW and partners – CHERISH project monitoring on 13 coastal sites using UAV and ground survey. Case studies and approach published in 2020/21 (see 2.1, 3.1-2, 6.3,7.3-4). • PCNPA – Changing Coasts project using fixed point photography. Communities/public submit photographs at 16 specific coastal path points to monitor change and erosion (see3.1-2, 7.3-4). • PCNPA – setup a system to monitor the condition of scheduled monuments within the National Park using volunteers. (see 7.4). • SNPA/NT – Carneddau Landscape Partnership Scheme targeted monitoring of assets with volunteers and general public (e.g. fixed point monitoring) (see 2.1, 3.1-3, 6.2, 7.1-5). • SNPA, NT, Cadw – Carneddau Landscape Partnership Scheme Scheduled Monument condition survey, establishing a method for volunteers, including for non-designated monuments. • NT – initial risk monitoring at Tredegar, Bodnant Garden. • NT – Up to date condition surveys on built properties are in progress (completed 2022) to assess climate change impacts to ensure that a complete baseline of all buildings is up to date and adaptation and maintenance plans are consistent. • HEGS – Work with HEAWG UK on CCRA3 HE case studies. • WVAONB partnership – Assessment and evaluation of natural flood management options & opportunities on four historic paths and Unclassified County Roads (see 1.2 and 2.1). • BBNPA – Established a Volunteer Condition Monitoring programme. (see 7.4). • BCBC – Eastern Prom Scheme. Western Breakwater is a flood and coastal erosion risk management project. Includes relict dunes monitoring and minor management to conserve and enhance the relict dunes in their current stable and re-naturalised state. (see 7.3).	• HE2 • MC4

	Description of the action	Output(s) from the action	Broad outcome/impact	Activity 2020	CCW Indicator
3. Research priorities					
3.1	Improve understanding of the interacting and cascading relationships, and cumulative impacts of climate risk factors. For example: • Building condition, location and socio-economic factors. • Changing land use and redundancy of agricultural buildings resulting in a cumulative loss of historic landscape features and changed settings. • Increases in invasive species that may impact on historic assets. • Acidification of seawater and increase in marine species which pose potential threats to wrecks/timber structures in marine conditions. • Measures to address chronic and acute pollution from historic mining. • Risks to building fabric from increased humidity, moisture, wind and driving rain, and the knock-on impact on indoor air quality and the health of building occupants. • Cumulative impact of successive extreme weather events on historic assets. • The frequency, range and potential regional variations of extreme weather events and their impact on the historic environment.	• Reports and recommendations.	• Adaptive actions take inter-relationships and cumulative impacts into account, thereby minimising the potential for maladaptation, leading to improved management of historic assets and the creation of best-practice guidance.	• PCNPA – Changing Coasts project (see 2.2, 3.2, 7.3-4). • SNPA – Carneddau Landscape Partnership Scheme Lost Farmsteads project (see 2.1). • WATs – identify and prioritise targeted projects (see 2.1). • RCAHMW and partners – CHERISH project monitoring on cumulative impacts and regional variations, now and in the past (see 2.1-2, 3.2, 6.3,7.3-4). • Cadw – Hosting Welsh Government funded Climate Resilience Embedded Researcher to investigate the risks and adaptation of buildings. • AC-NMW – Marine invasive species projects NS 56 American bivalves invading Welsh shores, NS 54 BRIGIT (Xylella project) species identification, NS 19 Identifying and tracking the present, past and future of Britain's changing snail and slug fauna. • SNPA – Monument condition review (see 2.2). • SNPA – Importance of palaeoenvironmental record and ecofacts vulnerable to climate change/conditions. HLF funded Cyfoeth Ein Corsydd and Carneddau Peatland Science project (see 1.2). • NT – Partnership discussions beyond heritage including commercial sector (e.g. Nestle/Ikea) to alleviate/mitigate flooding. • NT – Making provision for staff, volunteers and visitors in more extreme weather – especially heat. • NT – Challenge of adapting traditional spaces in low-cost, de-carbonised way (e.g. Tredegar House Brewhouse). • BUCAMS – Marine mapping and research (see 2.1, 3.2, 5.3, 7.3). • WSACU – MSc Sustainable Building Conservation includes lectures on climate change mitigation and adaptation, students also tackle this in own designs and proposals. • WSACU – Hygrothermal Monitoring of Timber-Frame Replacement Infill Panels Research project funded by Historic England - the risk of interstitial condensation and increased moisture content and risk to surrounding historic fabric. A test cell, embedded sensors and infill panels (wattle-and-daub, woodfibre/woodwood composite, expanded cork board and hempcrete) within reclaimed oak frames. Also, the effect of increased heavy rainfall events and thermal conductivity. • BU – PhD to 2022, assessment of exposure of parkland trees to wind and wind directions and how likely to change under future climate change (Chirk Castle Registered Parkland).	• HE2 • MC4
3.2	Research to improve knowledge of past and present climate change impacts on historic assets e.g. decay/erosion/accretion.	• Research results, case studies and recommendations.	• Increased understanding of stages, timescales and outcomes leading to improved management and adaptation interventions to build resilience.	• RCAHMW and partners – CHERISH project monitoring (see 2.1-2, 3.1, 6.3,7.3-4). • PCNPA – Changing Coasts project (see 2.2, 3.1, 7.3-4). • NRW, WATs and Cadw – Liaison day Oct 2020 Glasdir mine Coed y Brenin to look at erosion and site stability postponed (Covid) skype instead. • WATs and partners – Fieldwork projects at coastal sites in Pembrokeshire and Gwynedd – Covid restrictions on fieldwork. • SNPA/NT – Carneddau Landscape Partnership Scheme Skylines project raises awareness of montane heath, prehistoric cairns and the relationship between climate change, landscape, vegetation and human impact across millennia. • BUCAMS – Marine mapping and research (see 2.1, 2.2, 3.1, 5.3, 7.3). • WATs – 4 Cadw-funded climate change and historic environment scoping projects to identify adaptation techniques and provide recommendations for adapting to climate change within the trusts' areas. • DAT – 2 excavations to record the most vulnerable parts to coastal erosion which will accelerate as the climate changes and sea levels rise; St Patrick's Chapel (early medieval) EU-funded excavation, St Davids; Port y Rhaw (Iron Age coastal fort) Cadw-funded excavation, Solva, Pembrokeshire.	• HE2 • MC4
3.3	Improve understanding of the positive and negative effects of a longer growing season on the maintenance and management of the historic environment.	• Report and recommendations.	• Improved long-term adaptation and maintenance programmes.	• SNPA/NT – Carneddau Landscape Partnership Scheme Skylines project strand (see 3.2). • SNPA – Opportunities to contribute and feed results of Carneddau vegetation management and monument condition monitoring into studies. • SNPA – Opportunities for partnership working e.g. our contacts with Henfaes research farm, Bangor Univ., and their medium and long term research on aspects of diverse aspects of land management including climate impacts.	• HE2 • MC4

3.4	Work with UKCP18 projections to identify opportunities for the historic environment and the economy e.g. planting of woodland and forestry; establishment of new industries relating to adaptation; changing leisure opportunities; increased use of UK coastal resorts.	• Identification of opportunities.	• A combined beneficial response to adaptation will encourage uptake and identification of new opportunities, including tourism investment.	• NRW – Adaptation to climate change is embedded in NRW Forest Resource Plans to UK Forestry Standard and NRWs verification of Glastir woodland creation proposals. • SNPA – Facilitating woodland planting by identifying areas of little risk to heritage assets and suitable in relation to historic landscape character.	• HE2

Capacity: Develop the methodologies, tools and guidance to work with others and build adaptive capacity					
	Description of the action	Output(s) from the action	Broad outcome/impact	Activity 2020	CCW Indicator
4 Dissemination and promotion					
4.1	Creation of a steering group to oversee the delivery of the HEG SAP and to monitor and review progress. The steering group will establish and coordinate working/subgroups as necessary.	• Steering group formed from representatives within Wales.	• The provision of a strategic framework through which the action plan is delivered.	• HEGS – to take forward.	• HE3
4.2	Creation of a dedicated (full-time equivalent) Climate Change Manager post for the historic environment sector in Wales.	• Climate Change Manager in post.	• Direct action to help steer and guide the delivery of the HEG SAP and to play a central role in raising the profile of the climate change work across the historic environment sector in Wales.	• NT – appointed a Heritage and Climate Change Consultant (with archaeological background) to central NT Historic Environment Team. This does not negate the need for a Climate Change Manager for the historic environment sector in Wales	• HE3

	Description of the action	Output(s) from the action	Broad outcome/impact	Activity 2020	CCW Indicator
5. Collaborative working					
5.1	The steering group to coordinate and encourage stakeholder engagement and promote partnership working to ensure efficient use of resources across sectors.	• Cross-sector partnerships and coordinated working will ensure resources are targeted effectively and efficiently.	• Effective delivery of the HEG SAP actions. • Raised awareness of the historic environment across the wider sector which will help prevent secondary damage and maladaptation to the historic environment. • Improved cross-sector working.	• See 1.1 and 4.1. • NRW, WATs and Cadw – MoU signed Feb. 2020 to raise awareness of the historic and natural environments and enhance cross sector working. • NRW, WATs and Cadw – work to identify "at risk register sites" on the NRW managed estate. • FMAGW – Ability to disseminate resources to museum sector. • FMAGW – Declared a Climate Crisis (October 2019) as part of the 'Culture Declares' movement. • PCNPA – signed up to the Heritage Declares non-affiliated group that aims to tackle the impact of climate change within a historic environment context. (see 1.2). • BBNPA – Historic Environment advice and input to developing land management strategies; Woodland expansion, Riparian Improvements, Peatland restoration.	• HE3
5.2	The steering group/working group to work with officials across Wales to embed the HEG SAP in national and local government policy statements, plans and codes	• The historic environment will feature in the Welsh Government Climate Change Adaptation Plan for Wales. • The HEG SAP considerations will be linked and noted in, for example: – Shoreline Management Plans. – Relevant Planning Policy Wales supplements.	• Help prevent secondary damage and maladaptation to the historic environment.	• See 1.1 and 4.1. • WG – the SAP is embedded in the WG adaptation plan, Prosperity for all: A climate conscious Wales. • Cadw – Responding to consultations - National Strategy for Flood and Coastal Erosion Risk Management in Wales 2019. • Cadw/NRW – contributed to the draft UK Climate Change Risk Assessment (UK CCRA3). • NRW – Historic environment considered in major projects assessing coastal adaptation options for managed realignment or retreat for Flood Risk Management assets facing change. • NT – Includes historic environment and climate considerations in responses to consultations, and planning enquiries.	• HE3
5.3	Provide, promote and maintain a publicly available case study resource to illustrate climate change risks and impacts	• Case study resource.	• Raised awareness of the challenges posed by climate change and	• HEGS – Initial case studies published in the SAP. Potential additional case studies identified include:	• HE3

	affecting the historic environment and examples of adaptation. All should be able to contribute to this resource.		adaptation on the historic environment. • Demonstration of a range of practices and evidence of direct action.	• WVAONB partnership – Assessment and evaluation of natural flood management options & opportunities on four historic paths and Unclassified County Roads. • BUCAMS, CHERISH – Marine mapping and research. • BBNPA – Waun Fignen Felen Archaeological Assessment to inform the peatland restoration scheme. • GGAT – Numerous examples of damage/erosion leading to survey and excavation often done in partnership with others. • DAT – ST Patrick's Chapel excavation, St Davids, Porth y Rhaw excavation, Solva. • WSACU – Hygrothermal Monitoring of Timber-Frame Replacement Infill Panels Research project. • Storm damage to Scheduled Monument turnpike road revetment at Pont y Benglog, Nant Ffrancon. • Cadw/NRW – Roath Brook Flood Scheme affecting the registered parks at Roath Mill Gardens and Waterloo Gardens in Cardiff (grade II registered).	

	Description of the action	Output(s) from the action	Broad outcome/impact	Activity 2020	CCW Indicator
6. Training and guidance					
6.1	Identify and support the training of historic environment practitioners specialising in the impacts of climate change and adaptation of the historic environment.	• Trained climate change historic environment practitioners.	• Raising standards to embed climate change considerations in the historic environment.	• NRW – identifying historic environment training needs within NRW, SAP to be included. • NT – Fit for the Future environmental network practitioners register of members. • WSACU – MSc Sustainable Building Conservation includes lectures on climate change mitigation and adaptation, students also tackle this in own designs and proposals.	• HE3
6.2	Climate change historic environment practitioners to provide training and support within and across sectors in the impacts of climate change and adaptation of the historic environment. For example: • Produce an e-learning module on the historic environment and climate change. • Organise slots at meetings, training events and workshops with other sectors.	• Planners and developers can advise authoritatively through pre-application advice e.g. on the design and implementation of adaptation proposals. • Grant officers can ensure changes and adaptation actions are sensitive to the historic environment. • Owners can identify and implement management and adaptation opportunities. • Community groups established to develop programmes to identify, monitor and record historic assets at risk.	• Raised standards to embed climate change considerations in the historic environment. • Improved cross-sector working, knowledge and understanding, decision-making and the quality of adaptation actions.	• NLHF – Working with Fit for the Future to help applicants embed environmental sustainability within projects, covering membership costs for project duration. • SNPA – Carneddau Landscape Partnership Scheme plans for accredited training in recording and monitoring of historic assets e.g. with Agored Cymru and Conwy Culture Centre. Establishment of community heritage volunteer groups and opportunity to share good practice to seminars/conferences with e-resources (see 2.1-2, 3.1-3, 7.1-5). • WSACU – MSc Sustainable Building Conservation includes lectures on climate change mitigation and adaptation, students also tackle this in own designs and proposals.	• HE3
6.3	Work collaboratively across sectors to develop and disseminate joint guidance/ advisory notes that increase the knowledge, understanding and resilience of the historic environment to climate change.	• Guidance/advisory notes produced and promoted. • Inclusion of climate change adaptation into all aspects of heritage management. • Heritage management and business plans with climate change adaptation embedded. • Management practices undertaken that showcase climate change adaptation.	• Improved cross-sector working, knowledge and understanding, decision-making and the quality of adaptation actions. • Prevention of secondary damage and maladaptation to the historic environment. • Improved management of the historic environment. • A well-managed and appropriate programme of adaptation measures.	• RCAHMW and partners – CHERISH project best practice guidance documents on monitoring change in the coastal zone to be published 2021. (see 2.1-2, 3.1-2,7.3-4). • Cadw – Published guidance on Flooding and Historic Buildings in Wales, July 2019. • NLHF – Environmental sustainability guidance published May 2020. • Cadw – Establishing a HEGS peatland working group. • NT – Lead on scoping a climate change heritage adaptation manual for the UK heritage sector (see 2.1). • SNPA – raise the importance of cross-referencing with natural heritage too. Cynllun Eryri is taking a 'place plan approach' to assessments, including natural, historical and intangible.	• HE3

Resilience: Increase resilience of the historic environment by implementing actions to respond and adapt to the risks					
	Description of the action	Output(s) from the action	Broad outcome/impact	Activity 2020	CCW Indicator
7. Taking action					
7.1	Prepare and implement emergency/adaptation plans (utilising the principles and methods developed for conservation management plans) for vulnerable areas or sites as identified in 2.1 and 2.2. Plans to include multiple work streams if several agencies have identified the need for adaptation measures.	• Identification of significance, threat, vulnerability and adaptive action. • Partnership working with all agencies.	• The prioritisation and effective management of resources.	• SNPA – Carneddau Landscape Partnership Scheme Landscape Conservation Action Plan (5 years) 23 partners, includes vegetation management programme focused on heritage assets (see 2.1-2, 3.1-3, 6.2, 7.2-5). • SNPA – Liaison with NT and Cadw over storm damage to Scheduled Monument turnpike road revetment at Pont y Benglog, Nant Ffrancon. • GC & Partners – The Slate Landscape of Northwest Wales World Heritage Nomination. Climate change impacts on the nominated property have been assessed and are considered in the developing Property Risk Strategy (aligned with descriptions and outcomes noted in the SAP), the overall property management plan and developing local management plans for elements of the property. • WATs – scoping to establish climate change priorities within WAT regions to inform investigative work programmes. The aims of these projects are to identify adaptation techniques on a regional basis. The projects will provide recommendations for adapting to climate change within the trusts' areas (see 2.1., 7.3, -4).	• HE4
7.2	Undertake programme of landscape and urban characterisation to inform management of change in both rural and urban areas.	• Produce characterisation reports for areas at risk, and feed results into conservation management plans	• Improved conservation and management of change.	• SNPA – Carneddau Landscape Partnership Scheme Landscape Character Assessments produced informing Landscape Conservation Action Plan (see 2.1-2, 3.1-3, 6.2, 7.1-5). • NRW – evidence report 396 Communicating landscape change from adaptation and mitigation in a changing climate. • NRW & Clwydian Range & Dee Valley AONB – a strategy for Landscape and Nature Recovery in a Changing Climate includes historic environment (in preparation). • RCAHMW – work in progress on Cwmbran characterisation report.	• HE4
7.3	Prioritised work programmes relating to historic assets at risk such as those identified through 7.1, spatial mapping work (2.1), baseline monitoring (2.2) and through other local and national adaptation plans e.g. shoreline management plans. Where possible to be preceded by a management plan. Direct actions could range from survey, record and monitoring through to maintenance and conservation measures, erosion control or moving significant vulnerable assets to a place of safety.	• Work programmes underway. • Improved protection and preservation of historic assets. • Improved management of historic assets.	• Mitigation and improved resilience of the historic environment. • Acceptance of inevitable change. • Partnership working and cross sector coordinated response.	• RCAHMW and partners – CHERISH project management plans for principal study sites. Excavation at several 'at risk' coastal sites, e.g. Dinas Dinlle with GAT, NT and Cadw. (2.1-2, 3.1-2, 6.3,7.4). • PCNPA – Changing Coasts project (2.2, 3.1-2, 7.4). • PCNPA – set up a system to monitor the condition of scheduled monuments within the National Park using volunteers. (see 2.2, 7.4). • BBNPA – Waun Fignen Felen archaeological baseline assessment to inform the peatland restoration scheme and active conservation management at a number of heritage sites, to manage / improve condition, including impact from increased erosion and changing land management practises i.e. Garn Goch, Glynneath Gunpowder works, Pen-twyn. • NMW – Burry Holms, Gower, early Mesolithic to prehistoric sites research on archaeology eroding from the island edges and past climate and environmental change taken towards publication. • SNPA – Carneddau Landscape Partnership Scheme. (see 2.1-2, 3.1-3, 6.2, 7.1-5). • SNPA – work undertaken on ancient track through Maen y Bardd Scheduled Monument landscape to repair and alleviate water erosion damage caused by storm events • WWAONB partnership – Assessment and evaluation of natural flood management options & opportunities on four historic paths and Unclassified County Roads (see 1.2, 2.1, 2.2). Solutions include interventions on adjacent land, intercepting water flow rates, path cross drains & grips. Delivery of the project outputs is on-going, as and when funding becomes available. (see 1.2, 2.1, 2.2). • BUCAMS – Marine mapping and research (see 2.1, 2.2, 3.1, 3.2, 5.3). • NT – Coastal adaptation project to review coastal adaptation plans/management across all aspects of the coastal estate, including the historic environment. (see 2.1). • NT – Work programmes at Tredegar House where increased flooding events due to extreme weather events identified as a high risk; Dyffryn Mymbyr house, Snowdonia (Grade II Listed), the gable end of the house has a slated gable end to mitigate water ingress in an aesthetically appropriate way and Bodnant Gardens, Conwy following flooding additional drainage has been put in place, visitor routes diverted, planting regimes have been adjusted and site management practice tightened up. • PCC – Enabling roof works to a listed building to cope with the increased periods of heavy rainfall. • DAT – Recent examples of work at work St Patrick's Chapel excavation, St Davids and Porth y Rhaw excavation, Solva, Pembrokeshire. (see 7.4). • BCBC – The scheme at Eastern Prom – Western Breakwater a flood and coastal erosion risk management project. Works include strengthening, crest raising, dune management and provision of rock armour. (see 2.2)	• HE4 • MC1

7.4	Establish stakeholder/community groups able to monitor assets and respond to significant events such as wild fires and storms to maximise the potential for the discovery of new historic assets and the recording and monitoring of them.	• Stakeholder/community groups established. • Monitoring regimes in place.	• Improved knowledge, management and resilience of the historic environment. • Raised awareness and appreciation of the historic environment.	• RCAHMW and partner – CHERISH monitoring networks with local community for Albion shipwreck and Dinas Dinlle (see 2.1-2, 3.1-2, 6.3,7.3). • PCNPA – Changing Coasts project community and stakeholder group (see 2.2, 3.1-2, 7.3). • PCNPA – setup a system to monitor the condition of scheduled monuments within the National Park using volunteers. 50% + of scheduled monuments in the Park have been allocated to these volunteers and almost half of these had been visited by volunteers by the end of 2020. (see 2.2, 7.3) • SNPA – Carneddau Landscape Partnership Scheme to help people discover, record, celebrate and care for the cultural and natural heritage of the Carneddau. (see 7.1, 7.2, 7.3). • GGAT – projects and work with volunteers. • DAT – Work with volunteers on projects such as St Patrick's Chapel excavation, St Davids and Porth y Rhaw excavation, Solva, Pembrokeshire. (see 7.3). • BBNPA – Established a Volunteer Condition Monitoring programme. (see 2.2).	• HE4 • MC1
7.5	Encourage and implement new planting regimes where trees and hedgerows form a key component of the historic environment to reduce the impact of the spread of disease and increased storminess.	• New planting regimes that are responsive to plant health trends and are of suitable provenance. • The preservation of traditional field boundaries.	• Reduced impact of the spread of diseases and storms. • Improved management and resilience of trees in the historic environment. • Retention and survival of historic character and integrity.	• NRW – Good Practice Guides on forest resilience covering species, structural and genetic diversity. • NRW – Hafod estate new planting plans responding to climate and historic landscape. • NLHF, WG – Local Places for Nature and Community Woodlands two new environmental grant programmes. • SNPA – Carneddau Landscape Partnership Scheme Carneddau Connectivity. National Grid Landscape Enhancement Initiative for more hedges and trees in better condition to cope with change and disease appropriate to the historic landscape, heritage assets and traditional local styles. • SNPA – Carneddau Landscape Partnership Scheme Carneddau uplands riparian and scattered tree planting to help slow down water flow. Peatland repair. Reducing flooding along watercourses near assets.	• HE4
7.6	Build a resilient recovery from the COVID-19 pandemic.	• Organisational climate and sustainability plans, policies and actions.	• New ways of working that reduce emissions and prepare for climate change.	• Cadw, NRW, SNPA BBNP, RCAHMW and many other organisations – review of internal operational practice resulting in changed behaviour and new working practices for fieldwork, use of remote monitoring, meetings, reducing travel and carbon footprint, reduced paper use. • RCAHMW – established a Future Generations Group and an Environmental Policy Statement May 2020. • NLHF – applicants to Heritage Emergency Fund are expected to consider the future environmental sustainability of their organisation and project.	• HE4

5. Case studies

The following selection of case studies present evidence that adaption activity was already well underway during the review period at a variety of historic assets in Wales. We intend to feature further case studies in future reports.

You will be able to download SAP monitoring and evaluation reports and case studies from the Cadw website

Each case study sets out the risk or opportunity and the adaptation activity. The codes refer to the risks identified in the SAP (Tables 1 and 2, pages 8-11), the headline adaption actions in the SAP and the indicators in *A Climate Conscious Wales*, as set out in Section 2 of this report.

We hope these examples will inspire all stakeholders in our historic environment to review and implement appropriate adaptation action in response to the threats and opportunities posed by climate change.

CASE STUDY 1: Buildings and Settlements

Hygrothermal Monitoring of Timber-Frame Replacement Infill Panels

Risks

- More flooding events, increased ground moisture and precipitation, FL1
- Frequent high winds, storms and heat/cold events, EX1

Improving energy efficiency in traditionally constructed buildings is important to achieve a more sustainable environment; inappropriate energy retrofits may lead to moisture accumulation within the external envelope. With more frequent extreme weather events, increased ground moisture and precipitation, this risk may increase. Whilst numerical modelling can assist in identifying these threats, physical testing is still required. Research to date has focused on solid masonry construction leaving the impact of energy retrofits of historic timber-framed buildings, of which approximately 68,000 survive in the UK, unknown.

Adaptation Action

- Knowledge: 2 Mapping and monitoring the resource, 3 Research, HE2
- Capacity: 5 Collaborative working, 6 Training and guidance, HE3
- Resilience: 7 Taking action, HE4

This research project, funded by Historic England, aims to establish the risk of interstitial condensation and increased moisture content within replacement infill panels for historic timber-framed buildings, and the risk posed to the surrounding historic fabric.

To assess the hygrothermal (moisture and thermal) performance of replacement infill panels for historic timber-framed buildings, a test cell, with an internally controlled climate, was constructed at the Welsh School of Architecture, Cardiff University with collaboration from the University of Bath, Ty Mawr Lime Ltd, Royston Davies Conservation Builders and UK Hempcrete.

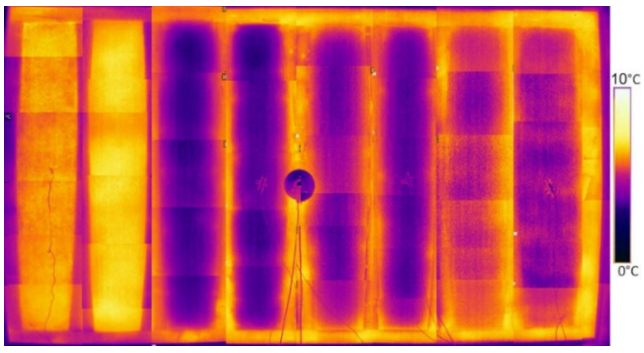
This test cell allows the monitoring of four different replacement infill panels within a reclaimed oak frame that forms part of the north facing external envelope, exposed to the Cardiff climate. The infill materials are wattle-and-daub, a wood fibre/wood wool composite detail, expanded cork board and hempcrete. The impact of the internal and external render is also being investigated, with half of the panels finished in a natural hydraulic lime (NHL 3.5) and the other half in lime-hemp render.

Hygrothermal conditions are being monitored within the panels using embedded sensors. Concurrently, hygrothermal simulation will be undertaken using measured internal and external climate data to allow comparison between simulated and measured conditions and allow the evaluation of the use of numerical modelling for the assessment of this type of construction.

The project allows the study of the effect of increased heavy rainfall events, with two major storm events occurring so far since the beginning of the project. These include Storm Alex

which resulted in the Met Office recording the wettest day on record. Initial results suggest that those infill materials that are less moisture permeable concentrate moisture arising from wind-driven rain in the outer render, and can potentially trap moisture between the infill and historic timber frame.

The project is due for completion in March 2022, it is hoped that monitoring can continue beyond that date to assess long term conditions. For further information contact the principal investigator Dr Chris Whitman Whitmancj@Cardiff.ac.uk



View of test cell at Cardiff University (top).

Rectified image of infill panels prior to application of external render (bottom left).

External thermography showing the hygrothermal performance of different infill panels (bottom right).
© Chris Whitman

CASE STUDY 2: Marginal and upland

Storms and Flooding on a Roman Road

Risks

- More flooding events, increased ground moisture and precipitation, FL1
- Frequent high winds, storms and heat/cold events, EX1
- Changes in lifestyle and leisure patterns, LEI1

The Roman road between the legionary fort and town at Chester and the important auxiliary base and seaport of Segontium, Caernarfon, crossed the mountains of northern Snowdonia through the pass of Bwlch y Ddeufaen. The road runs through an exceptionally rich archaeological landscape with important features ranging from Maen y Bardd Neolithic cromlech (a communal tomb of large stone-slabs), Iron Age roundhouse settlements and field systems to medieval settlement. The road remained an important route along the north Wales coast until road and rail engineering created an alternative route along the coast. It is still in use today as an important access route for local farmers and as a leisure facility for walkers, riders and cyclists.

Towards the Bwlch y Ddeufaen pass, well-preserved sections of Roman road are visible. In the scheduled area around Maen y Bardd, the road, here a sunken track, can act as a conduit for water draining from the mountain above. A careful system of side ditches and culverts, some of them made with impressive stone slab covers, managed the water historically. Over recent years, the quantity of water flowing into and along the track during storm events has been exceeding the capacity of these management features. As a result, the surface has been scoured into ruts and potholes, some almost a metre deep. Water flowing towards the village of Rowen has destabilised a metalled public road resulting in catastrophic collapses.

Adaptation Action

- Knowledge: 3, Research, HE2
- Capacity: 5 Collaborative working, 6 Training and guidance, HE3
- Resilience: 7 Taking action, HE4

Close maintenance and observation of the track is key to protecting against further significant damage, as well as helping to reduce the flooding and erosion impact on Rowen. The Snowdonia National Park Authority, Conwy County Borough Council Highways Department and Cadw worked together during the winter of 2020/21. Significant lengths of side ditch were cleared of silt, culverts were cleared and damaged portions of track repaired with cobbles and shale. The track should now be able to cope better with peak water-flows, with as much water as possible being carried across it into historic drainage lines beneath the track. There is more work to do, and it is hoped that after a further phase of repair to the track it will be

maintainable through a rolling programme of annual small-scale repair and maintenance in conjunction with local landowners.

A section of Roman road, a sunken track, after heavy rain (top).

Mending a large pothole on the Roman road caused by water scouring (bottom).

CASE STUDY 3: Marine and Coastal

The U-Boat Project Wales 1914-18 and CHERISH Project

Risks

- Migration and proliferation of pests, diseases and invasive species, PD2
- Frequent high winds, storms and heat/cold events, EX1

With increased storminess, the higher energy in oceans brings more turbulence. As well as increased physical disruption to the foreshore and intertidal sites, changing currents and increased energy underwater will have an impact on submerged archaeology. Changes in water pH, mostly acidification, may also affect the long-term stability of underwater cultural heritage, increase attrition of metal objects, and cause as yet largely unknown effects on timber.

In order to ensure our marine heritage is considered in the scope of climate change adaptation, heritage agencies, commercial partners and higher education establishments need to work together to raise awareness and promote research and collaborative working around data collection and sharing. This will then allow us to establish the baseline state of our underwater historic environment and consider the potential changes as a result of climate change.

Once we know more about the potential impacts, we can work to ensure that underwater cultural heritage considerations are included in relevant plans and policies, such as the Wales National Marine Plan, and seek to incorporate environmental monitoring into marine licensing conditions where appropriate.

Adaptation Action

- Knowledge: 1 Knowledge exchange/collaboration, 3 Research, MC4
- Capacity: 5 Collaborative working, 6 Training and guidance, HE3
- Resilience: 7 Taking action, HE4, MC1

The impact of climate change on the maritime environment has recently been a focus of study in two projects. The first of these was the U-Boat Project Wales 1914-18: Commemorating the War at Sea. This project was funded by the National Lottery Heritage Fund between 2017-19. It was a collaboration between the Royal Commission on the Ancient and Historical Monuments of Wales, Bangor University (Centre for Applied Marine Sciences) and the Nautical Archaeology Society. Results from the project included research and historic environment record enhancement on 168 First World War wrecks, detailed marine survey using multibeam sonar on 17 wrecks and marine ecology surveys on three wrecks.

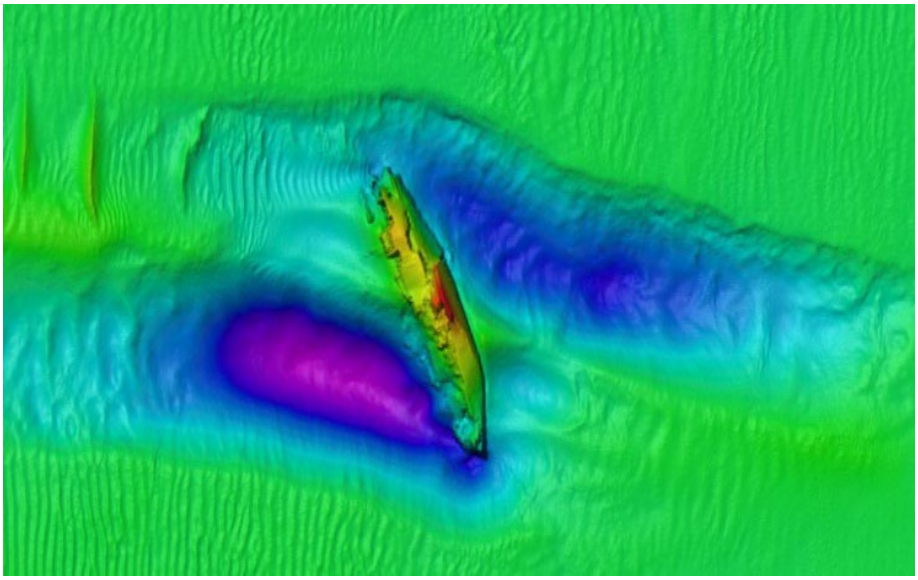
Visit the U-Boat project Wales 1014-18 for further information

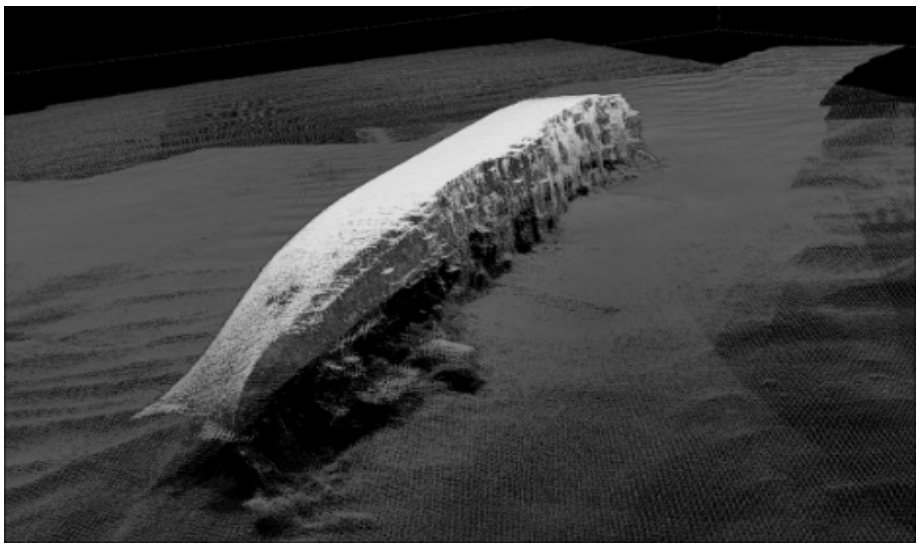
The second project is CHERISH: Climate Change and Coastal Heritage Project (2017-2023). One element of this European-funded Ireland-Wales project is marine survey led by the Geological Survey Ireland. In Welsh and Irish waters, CHERISH is collecting a range of marine geophysical datasets that determine the bathymetry (water depth) of the study areas and the nature of the sediments on and below the seabed. Alongside this, new shipwrecks have been recorded and detailed surveys of targeted shipwrecks undertaken.

Visit the CHERISH page for further information

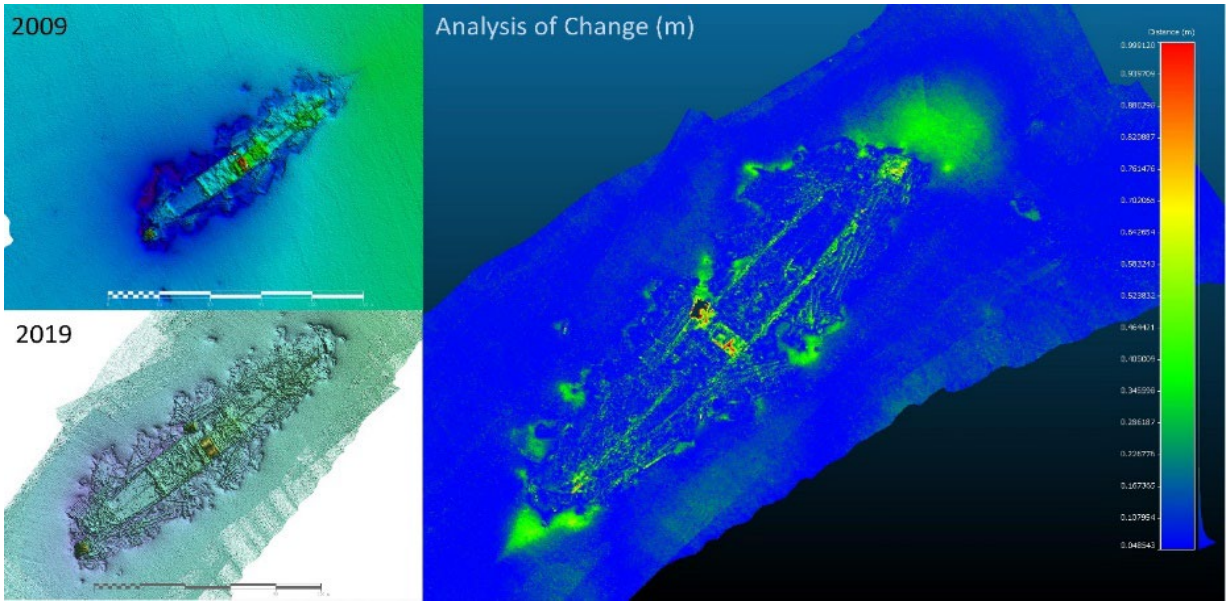
The surveys and investigations undertaken during both projects have helped to raise awareness and improve our knowledge and understanding of offshore heritage assets. For example, on-going research suggests that more than 60 per cent of shipwrecks are currently unknown or misidentified (M Roberts 2021, personal communication).

The marine surveys, wreck dives and ecological surveys also provided essential baseline data against which future surveys can be compared to monitor rates of change and provide a context for understanding climate change processes and site integrity.





Images taken from the multibeam sonar survey undertaken by Bangor University (Centre for Applied Marine Sciences) as part of the U-Boat project. The SS Apapa was travelling from West Africa to Liverpool when she was sunk by U-96 off Point Lynas, Anglesey on 28 November 1917 with the loss of 77 passengers and crew.



An example of monitoring change from the CHERISH project. This is the wreck of the Manchester Merchant in Dingle Bay, Co. Kerry. Comparison of INFOAR 2009 and CHERISH 2019 maritime survey datasets indicates there has been up to 0.5 metres of change in exposure at the bow and stern of the vessel, and up to 2 metres elevation change in the centre of the wreck where the ships boilers are breaking down in response to wave and storm action.

CASE STUDY 4: Marine and Coastal

St Patrick's Chapel, Whitesands, Pembrokeshire

Risks

- Rise in sea levels, SL1, SL2
- Frequent high winds, storms and heat/cold events, EX1, EX3

The scheduled monument of St Patrick's Chapel, Whitesands, owned by the Pembrokeshire Coast National Park Authority, comprises the remains of a small, buried chapel and cemetery dating from the early medieval period. Chronologically, the site contains archaeological evidence from the eighth century to the sixteenth century. Because of the area's importance for pilgrimage, the buried material is likely to enhance knowledge of Christian practice from the early Medieval period. Due to its proximity to the sea, the site suffers from coastal erosion, and this is likely to continue as a result of rising sea levels and more frequent and severe storms. The last attempt to protect the site from erosion, by using large boulders, failed in 2014 when a severe storm washed the boulders away and led to the exposure of burials.

Adaptation Action

- Knowledge: 3 Research
- Capacity: Capacity: 5 Collaborative working, HE3
- Resilience: 7 Taking action, HE4, MC1

Adaptation action was in the form of rescue excavations. The work, largely undertaken by the Dyfed Archaeological Trust in partnership with the University of Sheffield, took place initially between 2014 and 2016. A further season was completed in 2019 as part of a European-funded project called Ancient Connections.

The excavations have revealed the importance of this intervention; over a hundred burials ranging in date from the eighth through to the eleventh centuries were revealed. Excavation information has also helped the Pembrokeshire Coast National Park Authority produce new interpretation resources, including a digital reconstruction drawing of the chapel completed during 2020. The excavation at the site was widely publicised and hundreds of people turned up to view the excavations, which also appeared on local and national television. Such publicity helps raise the awareness of the impacts of coastal erosion on the historic environment.

Remains of the later phase of St Patrick's Chapel, exposed during the 2019 excavation (top).

2020 digital reconstruction showing Medieval period chapel (bottom).

CASE STUDY 5: Designed Landscapes, Parks and Gardens

Bodnant Garden

Risks

- More flooding events, increased ground moisture and precipitation, FL1
- Frequent high winds, storms and heat/cold events, EX1

Bodnant Garden is a grade I registered garden. It is renowned for its formal terracing and lawns, which contrast with the sculpted river valley, artificial ponds, winding paths, and North American conifers of Pochin's Dell. On Boxing Day 2015, flooding from the River Hieraethlyn inundated the Dell and a newly opened area upstream. There were other localised areas of run-off causing damage within the garden and to the visitor facilities.

Once the flood waters subsided, site managers were left with eroded paths, erosion to the riverbank, damage to bridges, alongside driftwood and deposits of silt and shale strewn across large areas of the garden. Plants were torn from their roots and the remaining plants were left with roots completely stripped of soil. The clean-up operation took over six weeks for six members of staff.

Adaptation Action

- Knowledge: 2 Mapping and monitoring the resource, HE2
- Capacity: 5 Collaborative working, HE3
- Resilience: 7 Taking action, HE4

Since then, a range of adaptation measures has been implemented to help reduce the impact of future flooding events.

The profiles of paths and visitor routes in the worst affected areas have been adjusted to improve run-off. Work to strengthen path construction, using geotextiles or through binding the surface layers of paths, has reduced wash out when the river floods. In most places, these strengthening works have decreased rutting from over two feet to a few inches, and so reduced the amount of work and materials needed for repair.

Planting regimes have also been adjusted in the affected areas to favour more water-resistant plants and to increase ground cover vegetation. Reinforcing ditch banks and establishing grass along them has helped prevent extensive erosion in subsequent floods, and site management practice has been tightened to include the regular clearing of drains and ditches to prevent them blocking and contributing to damage.

Managing team expectations has also been important. Staff now understand that some areas, which can be made resilient, will be allowed to flood. This will help slow the force of the water flow from the river and dissipate its destructive force.

A water management plan aims to establish a sustainable supply of quality water to irrigate the garden and reduce effects of the more frequent flooding events. But there are recommendations yet to implement and recognition that adaptation actions are an ongoing process.

The gardens inundated with flood water during the winter of 2015-16 (top).

Damage to the paths during the winter of 2015-16 (bottom left).

Damage to the riverside wall and uprooting of Rhododendrons during the winter of 2020-21 (bottom right).

6. Conclusions

This interim review demonstrates that a wide range of climate change adaptation activities were undertaken during 2020. They span most types of historic asset and all contribute towards meeting the headline actions identified in the SAP and the related historic environment sub-actions in *Prosperity for All: A Climate Conscious Wales (see Section 1).*

Good progress has been made during the year on increasing our knowledge and understanding of the threats and opportunities for the historic environment. Much of this effort has focussed on identifying and recording good quality baseline data, resulting in an enhancement of the Historic Environment Record. This will help us to monitor change, to influence future land and asset management, and to target limited resources to the areas in greatest need.

CHERISH is a particularly noteworthy project that continues to deliver against a number of the headline actions. Several activities have also been initiated that pave the way for future outputs. These include the establishment of the HEG Climate Change Subgroup peatland working group and the increased focus on SAP priorities for Cadw-funded projects undertaken by the Welsh Archaeological Trusts. However, more work is needed to develop the methodologies, tools and guidance to build capacity, and to implement activities that increase the resilience of the historic environment.

The development of the *Monitoring and Evaluation Framework* was a positive step forward. It clarifies the roles and responsibilities of HEG, the HEG Climate Change Subgroup and the working groups, as well as providing a framework for evaluating progress against the SAP actions. Whilst it is unclear at this stage how much of the activity captured in the review has been directly influenced by the priorities identified in the SAP, the next review should help to clarify whether the SAP is proving to be a positive driver of change and identify areas where further action may be required.

The development of a communication plan by the HEG Climate Change Subgroup will undoubtedly help to raise awareness. However, the limited financial and staff resources available to subgroup members remains a serious concern. The creation of a dedicated Climate Change Manager post (SAP action 4.2) and the appointment of a historic environment and climate change 'champion,' supported by appropriate budgets, remain key priorities. These actions would do much to increase the sphere of influence of the SAP and increase engagement with other sectors.

7. Abbreviations

AC-NMW: Amgueddfa Cymru – National Museum Wales

ALGAO: Cymru: The Association of Archaeological Officers Cymru

BBNPA: Brecon Beacons National Park Authority

BCBC: Bridgend County Borough Council

BU: Bangor University

BUCAMS: Bangor University, Centre for Applied Marine Sciences

CCRA3: Climate Change Risk Assessment 3 (2022)

DAT: Dyfed Archaeological Trust

FMAGW: Federation of Museums and Art Galleries of Wales

GAT: Gwynedd Archaeological Trust

GGAT: Glamorgan Gwent Archaeological Trust

GC: Gwynedd Council

GNSS: Global Navigation Satellite System

HE: Historic England

HEAWG: Historic Environment Adaptation Working Group

HEG: Historic Environment Group

HEGS: Historic Environment Group Climate Change Subgroup

MoU: Memorandum of Understanding

NLHF: National Lottery Heritage Fund

NRW: Natural Resources Wales

NT: National Trust

OU: Oxford University

PCNPA: Pembrokeshire Coast National Park Authority

PCC: Powys County Council

RCAHMW: Royal Commission on the Ancient and Historical Monuments of Wales

SAP: Sector Adaptation Plan

SNPA: Snowdonia National Park Authority

SU: Sheffield University

UAV: Unmanned Aerial Vehicle

WATs: Welsh Archaeological Trusts

WG: Welsh Government

WSACU: Welsh School of Architecture, Cardiff University

WVAONB: Wye Valley Area of Outstanding Natural Beauty

8. Links to Resources

Historic Environment and Climate Change in Wales Sector Adaptation Plan:
https://cadw.gov.wales/sites/default/files/2020-02/Adaptation%20Plan%20-%20FINAL%20WEB%20-%20English%20%281%29.pdf

Historic Environment and Climate Change in Wales Sector Adaptation Plan Monitoring and Evaluation Framework:
https://cadw.gov.wales/sites/default/files/2021-10/Historic%20Environment%20and%20Climate%20Change%20in%20Wales-Sector%20Adaptation%20Plan%20Monitoring%20and%20Evaluation%20Framework-June-2021.pdf

Cadw guidance Flooding and Historic Buildings in Wales:
https://cadw.gov.wales/sites/default/files/2019-07/Flooding%20and%20Historic%20Buildings%20in%20Wales%20Eng.pdf

Carneddau Landscape Partnership Scheme:
https://www.snowdonia.gov.wales/looking-after/carneddau-partnership

Changing Coasts:
https://www.pembrokeshirecoast.wales/get-involved/changing-coasts/

CHERISH Climate Change and Coastal Heritage project:
http://www.cherishproject.eu/en/

Fit for the Future Network:
https://www.fftf.org.uk/home

National Grid Landscape Enhancement Initiative:
https://www.nationalgrid.com/uk/electricity-transmission/planning-together-riio/visual-impact-provision/landscape-enhancement-initiative

NLHF guidance Environmental sustainability:
https://www.heritagefund.org.uk/good-practice-guidance/environmental-sustainability-guidance#heading-16

NLHF Local Places for Nature and Community Woodlands grant programmes:
https://www.heritagefund.org.uk/funding/local-places-nature-guidance

NRW - Good Practice Guides on forest resilience covering species, structural and genetic diversity:
https://naturalresources.wales/guidance-and-advice/environmental-topics/woodland-management/planning-for-the-future/making-woodlands-more-resilient/?lang=en

NRW - Communicating landscape change from adaptation and mitigation in a changing climate
https://www.whiteconsultants.co.uk/wp-content/uploads/2020/04/Communicating-landscape-change-final-report-310320r.pdf

NRW, WATs and Cadw's Memorandum of Understanding:
http://www.dyfedarchaeology.org.uk/policies/naturalresourceswalesmemorandum.pdf

RCAHMW Environmental Policy Statement:
https://rcahmw.gov.uk/about-us/corporate-information/future-generations/environmental-policy-statement/

UK Climate Change Risk Assessment (UK CCRA3):
https://www.theccc.org.uk/publications/third-uk-climate-change-risk-assessment/

Welsh Government - Prosperity for all: A climate conscious Wales
https://gov.wales/prosperity-all-climate-conscious-wales