Adaptation Scotland

supporting climate change resilience

Adaptation Learning Exchange

The Engine Shed | 12 March 2018

The Adaptation Scotland programme is funded by the Scottish Government and delivered by sustainability charity Sniffer.

The Scottish Government

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Adaptation Scotland
supporting climate change resilience

Enabling organisations, businesses and communities to adapt

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The **Adaptation Learning Exchange (ALE)** for Organisations provides a collaborative process to support organisations with adaptation planning.

It aims to do this through the sharing of knowledge and ideas, highlighting good practice and increasing learning and networking opportunities.

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Adaptation Scotland

programme support for organisations

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Awareness Raising

Purpose: To raise awareness of adaptation across a wide range of organisations through adaptation 'events'.

Adaptation Learning Exchange for Organisations

The Exchange

Purpose: Coordination of the learning exchange including communication, Members Updates and organising of ALE Exchange Events.

Accelerators

Purpose: To build the capacity of organisations through a targeted professional learning programme.

Task Groups

Purpose: To enable collaborative working that provides peer support and/or deliver projects through clearly defined task groups

Place-Based Partnerships

Purpose: Develop regional / location-focussed visions, adaptation strategies and action plans.

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A Brief History of ALE

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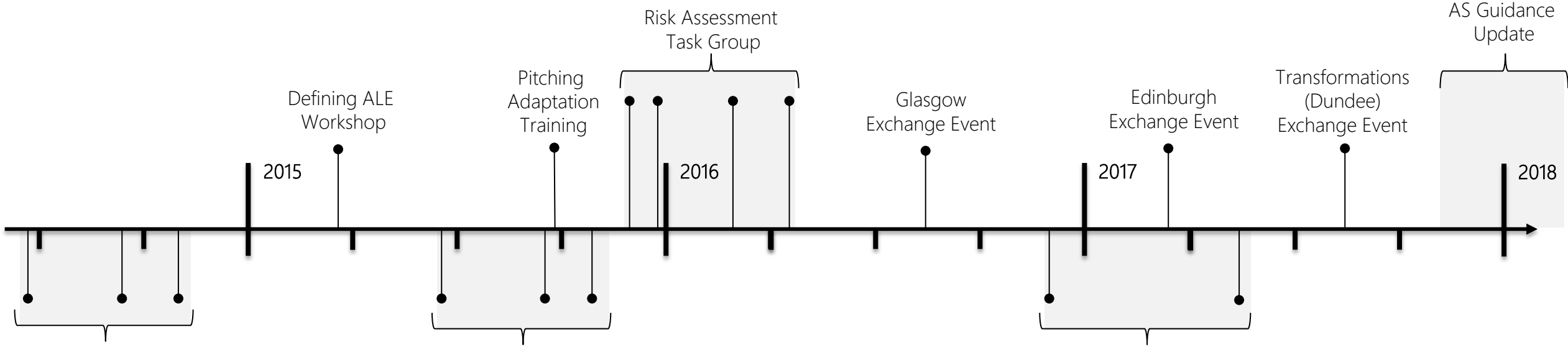

Accelerator 2014

Aberdeen City Council
Clackmannanshire Council
Dumfries and Galloway Council
East Lothian Council
NHS National Services Scotland
Scottish Borders Council
Scottish Water
Stirling Council
Transport Scotland
West Lothian Council

Accelerator 2015

(Introductory Programme)

Dundee City Council
Falkirk Council
Glasgow City Council
Loch Lomond & The Trossachs National Park
NHS Lanarkshire
University of St Andrews

CRC Accelerator

(Focused on Glasgow Region)

NHS Lanarkshire
Clyde Marine Planning Partnership
SPT
Glasgow City Council
West Dunbartonshire Council
East Dunbartonshire Council
Inverclyde Council
SNH
University of Glasgow
University of Strathclyde

The Scottish Government

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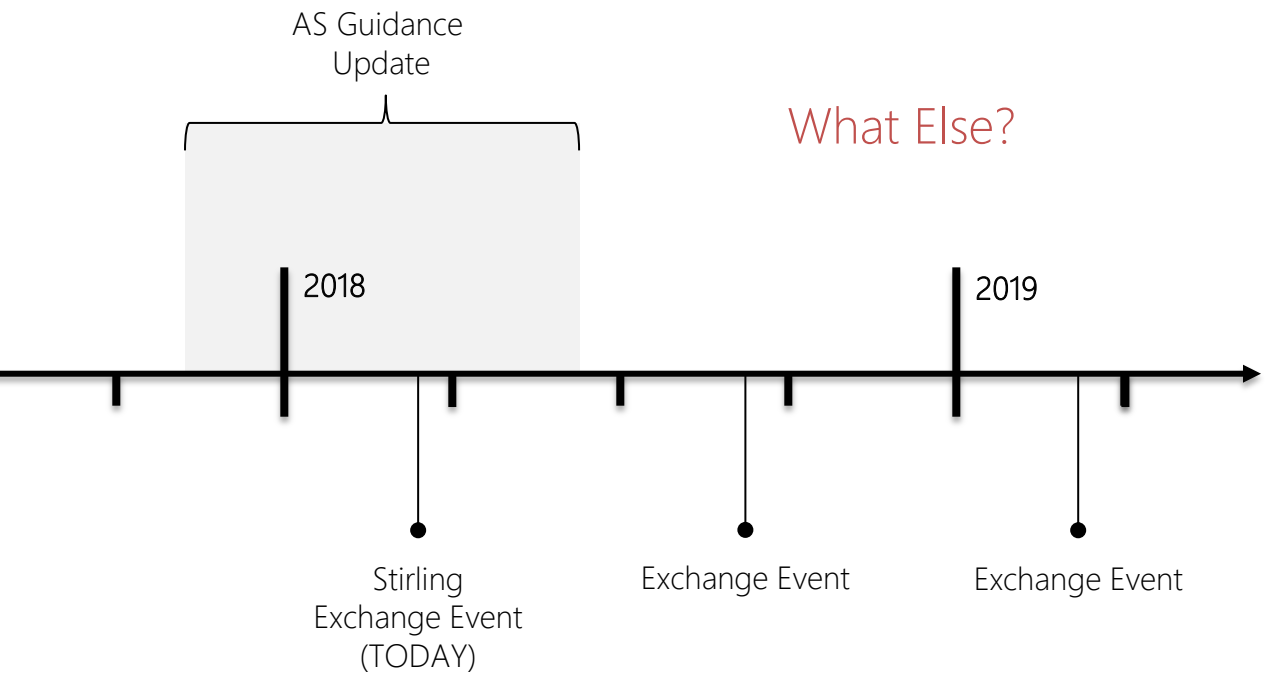
A Brief ~~History~~ Future of ALE



What Else?

The Adaptation Scotland programme is funded by the Scottish Government and delivered by sustainability charity Sniffer.

Agenda

10:00 - 10:10	Welcome and introduction
10:10 - 10:50	Historic Environment Scotland – Adaptation in Practice
10:50 - 11:05	ALE Member Pop-Ups #1
11:05 - 11:50	Adaptation Scotland – update on new Public Sector Guidance
11:50 - 12:30	Tour of The Engine Shed and HES Science and Digital Labs.
12:30 - 13:15	LUNCH
13:15 - 13:55	Adaptation Topic Updates • Dynamic Coast – Alistair Rennie • Climate Ready Clyde – Kit England • UKCP18 – Joseph Hagg
13:55 - 14:10	ALE Member Pop-Ups #2
14:10 - 14:55	Communicating Climate Risk Dynamic Coast and HES Risk Assessment
14:55 - 15:45	Collaboration and Coffee
15:45 - 16:00	Wrap Up and Close

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ADAPTATION IN PRACTICE

Dr Mairi Davies, Climate Change Manager

We are a charity dedicated to the advancement of heritage, culture, education and environmental protection.

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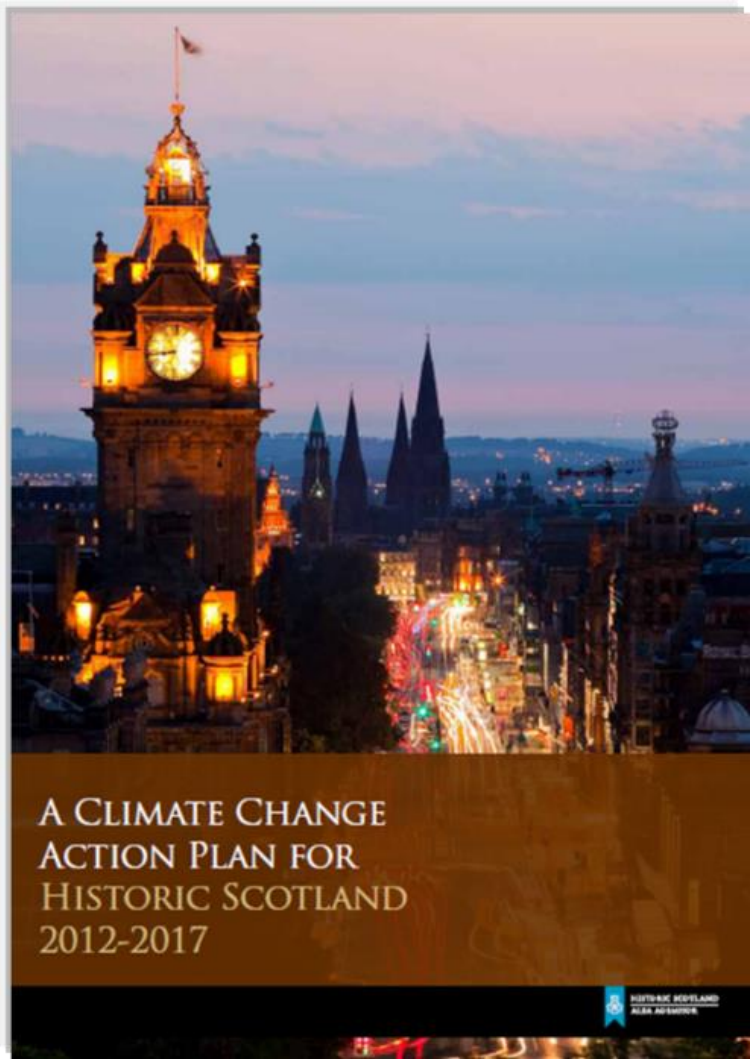
CLIMATE CHANGE ACTION PLAN

2012-2017

- Reducing energy use in our buildings
- Improving our operations
- Improving energy efficiency in traditional buildings
- Building resilience: preparing the historic environment for climate change
- Improving sustainability
- Developing and promoting sustainable tourism
- Informing and influencing others



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CLIMATE CHANGE ACTION PLAN

Strategic Themes and Actions

4. Building resilience: preparing the historic environment for climate change

Climate change models predict that the trends seen during the latter part of the 20th century will continue through this century. For example, under a low emissions scenario winter rainfall in the west coast of Scotland will increase 40-50% by the 2080s, and 50-60% in a high emissions scenario. Temperature increases across Scotland are likely to be 2-3°C (low emissions scenario) and 3-4°C (high emissions scenario).

Existing evidence indicates that parts of the historic environment are poorly prepared for climate change. For example, the Scottish House Condition Survey has identified that 75% of pre-1919 buildings are already in a critical state of disrepair. Historic Scotland's role, as stated in our Corporate Plan, to improve the condition of the historic environment and reduce the number of historic buildings and monuments at risk, requires that we take a proactive approach to "future-proof" the nation's historic environment assets. This means working not only with our own estate of properties in the care of Scottish Ministers, but also to providing support and guidance on appropriate strategies to increase the resilience of the broader historic environment, including individual buildings and urban areas, infrastructure, monuments, landscapes and archaeology.

"A proactive approach to 'future-proof' the nation's historic environment assets."

OUR RESPONSE & ACTIONS

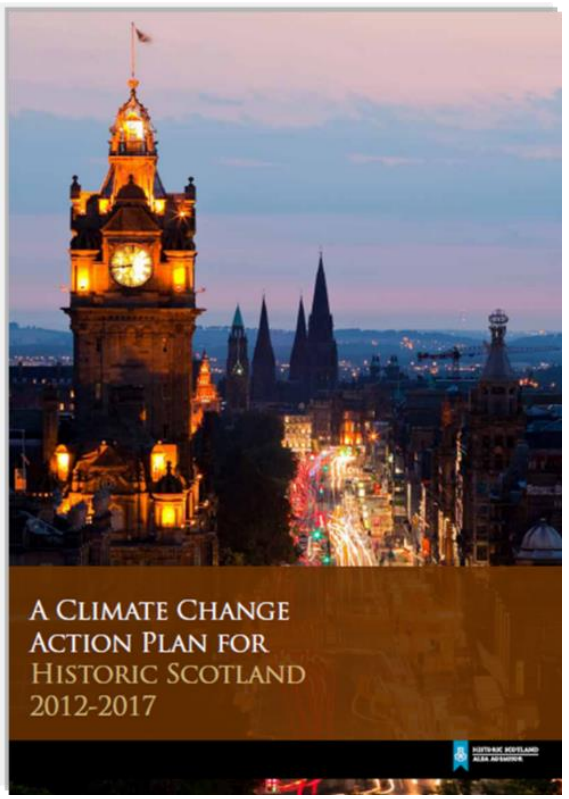
- **We will develop a methodology for assessing the impact of climate change on heritage assets including historic buildings and monuments, buried and submerged archaeology, historic landscapes, plantings and battlefields.**
- **Undertake a climate change risk assessment across the Historic Scotland estate to evaluate which sites are most at threat from issues such as coastal erosion, flooding, rainwater penetration etc.**
- **Work with a range of external partners to research and evaluate specific threats to buildings and monuments, such as increased biological growth and enhanced stone decay, and develop strategies to manage impacts.**
- **Review Historic Scotland's on-going maintenance and condition survey programmes in the light of climate change predictions to modify conservation strategies and target priority sites where necessary.**
- **Input climate change factors into estate management strategies and business continuity planning, for example where threats to sites are likely to affect future visitor numbers and income.**
- **Respond to current and emerging climate change threats by prioritising our grant funding.**

WHAT WILL THESE ACTIONS ACHIEVE?

Evaluation of climate change risk for the Historic Scotland estate will improve decision-making for prioritising the on-going conservation and maintenance programmes, thus ensuring the long term survival of the most valuable assets in our care. It will enable better use of resources which can be targeted to particular priority sites. This strategic approach will benefit the wider historic environment through the development of methodologies to assess risks and plan for future impacts, thus strengthening capacity and building resilience throughout the sector.

MEASURING PROGRESS

Progress will be measured by the development of a methodology for assessing climate change risk to historic sites, the creation of a climate change risk register for our properties and the incorporation of these into management planning and resource allocation. We will publish the results of research into climate change threats to the historic environment and amend current guidance where appropriate.



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CLIMATE READY SCOTLAND

OBJECTIVES ASSIGNED TO HES

Programme required under the Climate Change (Scotland) Act 2009

B1: Understand the effects of climate change impacts on buildings.

B2: Provide knowledge, skills & tools

B3: Increase resilience of buildings

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CLIMATE READY SCOTLAND

POLICY

B1-2: Research to identify resilience measures:

- Energy efficiency/thermal performance;
- Physical impact of changing weather patterns;
- GIS quantification of heritage assets;
- Collate action on coastal erosion and flooding.

B2-4: Implement HS Climate Change Action Plan

B2-5: Joint Agency programme

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CLIMATE READY SCOTLAND

DELIVERABLES

- Develop methodology for assessing climate change risk to heritage sites;
- Creation of Climate Change Risk Register for HS Estate & incorporation into internal planning and resource allocation;
- Publication of guidance and dissemination of advice.

We are at the forefront of researching and understanding the historic environment – and addressing the impact of climate change on its future

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5 STRATEGIC THEMES

Our five strategic themes provide the framework for our strategic outcomes, our objectives, our activities and our performance measures.

1. LEAD
We will fulfil a leading and enabling role through our activities and by supporting, empowering and collaborating with others.

2. UNDERSTAND
We will increase knowledge and understanding through investigation, research and recording activities.

3. PROTECT
We will enhance protection of the historic environment through regulation, conservation, collection and investment activities.

4. VALUE
We will promote the value of the historic environment through education, learning, outreach and skill-sharing activities.

5. PERFORM
We will create a high performing organisation that is well equipped to meet day-to-day and future challenges, and to improve the way we work and the quality of service we provide.

5 STRATEGIC THEMES

Our five strategic themes provide the framework for our strategic outcomes, our objectives, our activities and our performance measures.

1. LEAD

We will work to address the impact of climate change by leading the way in the adaptation of the historic environment to climate change, contributing to national targets and increasing resilience against the physical impacts of climate change.

KPI 3 "Managed the impact of climate change by improving knowledge and understanding."

WORKING IN PARTNERSHIP

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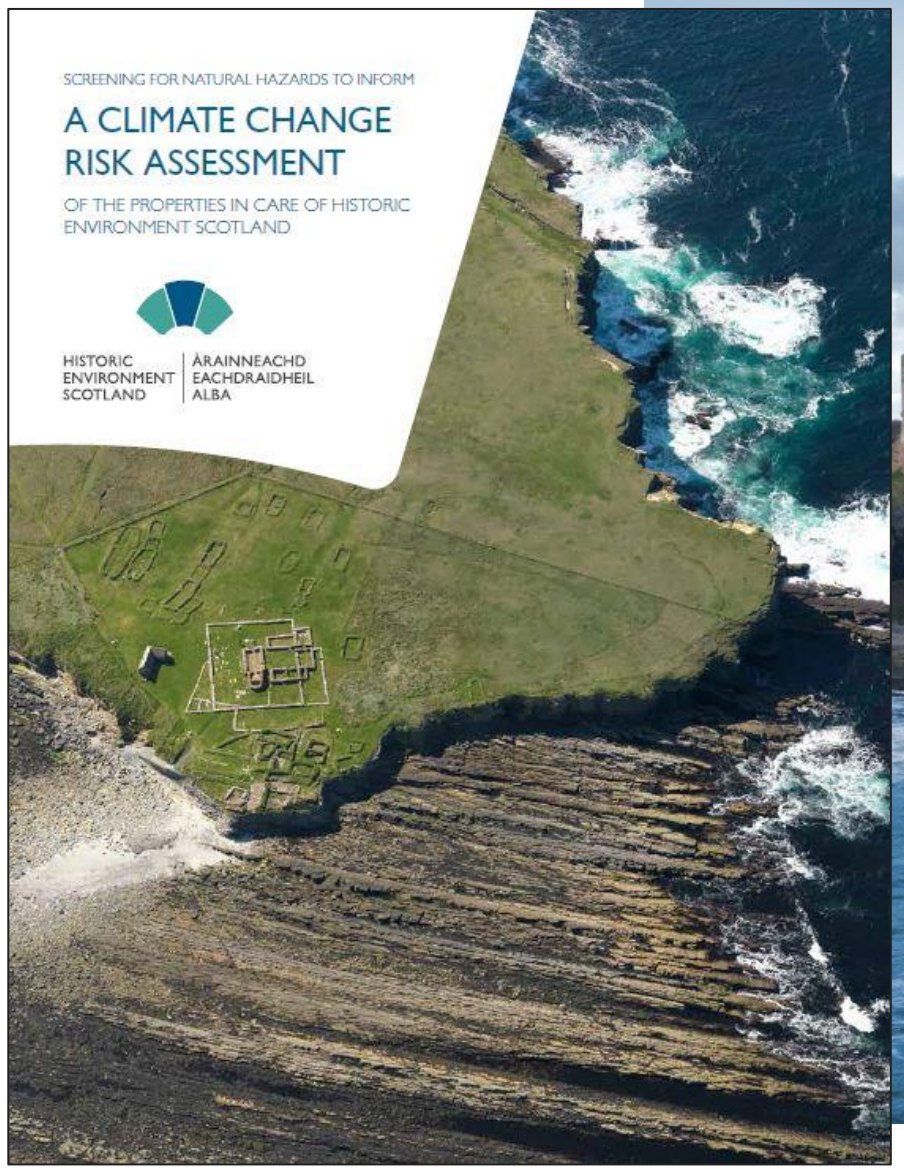
RISK ASSESSMENT

The Properties in Care of HES are on the front-line of our changing climate:

- Many are situated in some of the most susceptible areas to natural hazards.
- This project is an assessment of natural hazard risk at HES's sites.
- GIS based study, pulling together data from **SEPA** and the **BGS**.
- Looking at natural hazard risk from **Coastal Erosion**, **Ground Instability** and **Flooding** (Fluvial, Pluvial, Coastal and Groundwater).

As climate change intensifies, increased occurrence rates of natural hazard events should be expected.




Tantallon Castle

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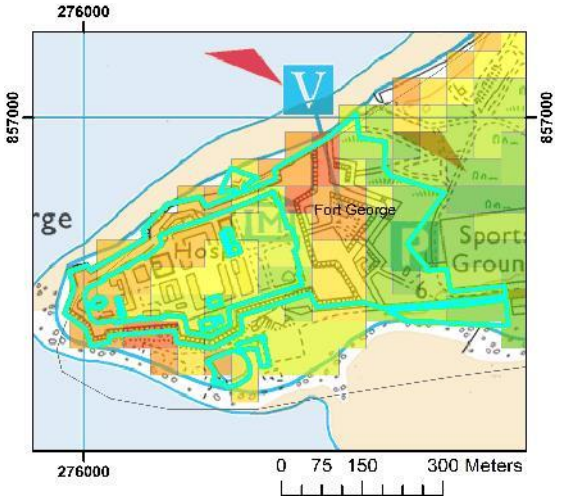
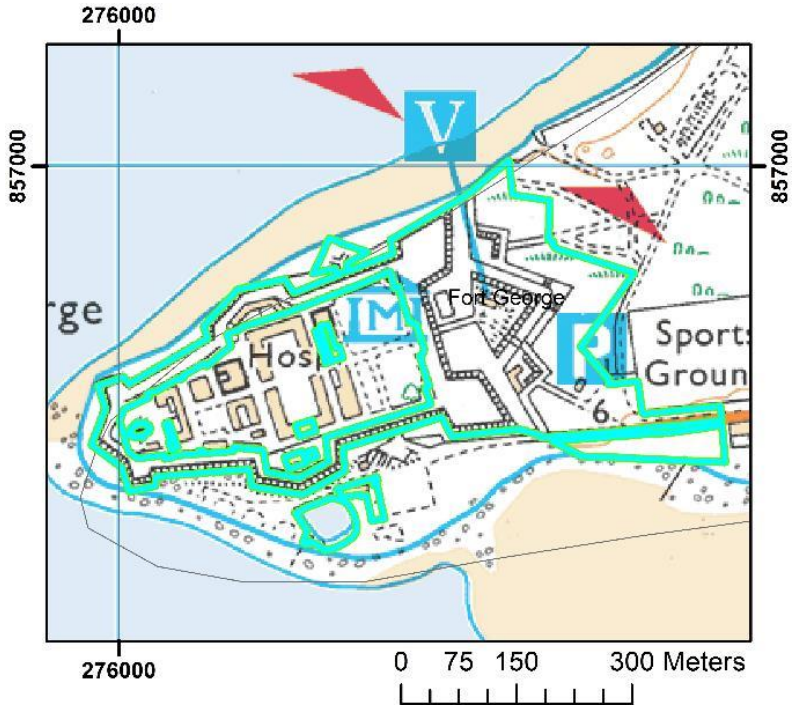
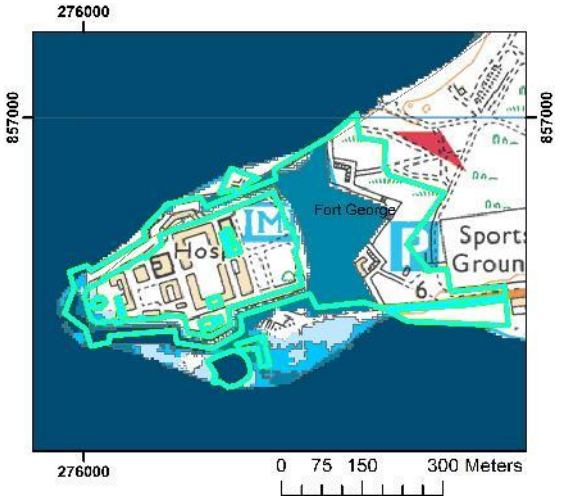
LIKELIHOOD

- Begins with spatial analysis by overlaying hazard maps with site boundary data.
- Running queries in GIS then generates a hazard profile for each site.
- Likelihood score of 1 to 5 assigned to each property, for each hazard with 5 being the 'most likely', 1 the 'least likely'.







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DATASETS USED

		Available datasets					
Likelihood	Probability	SEPA Fluvial Flooding	SEPA Pluvial Flooding	SEPA Coastal Flooding	SEPA Coastal Erosion	BGS Groundwater Flooding	BGS Landslides
5	1 in 10 chance	1 in 10 chance	1 in 10 chance	1 in 10 chance	165-175	C	E
4	1 in 100 chance	1 in 100 chance	1 in 100 chance	1 in 100 chance	150-160	B	D
3	1 in 1,000 chance	1 in 1,000 chance		1 in 1,000 chance	135-145	A	C
2	1 in 10,000 chance			1 in 10,000 chance	120-130		B
1	1 in 100,000 chance				105-115		A

The relationship between the likelihood score and corresponding datasets used as part of this project.

IMPACT

- An impact score of 1 to 5 (5 being the greatest impact) is assigned for each hazard.
- The score is dependant on the type of property and type of hazard in question

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CALCULATING RISK

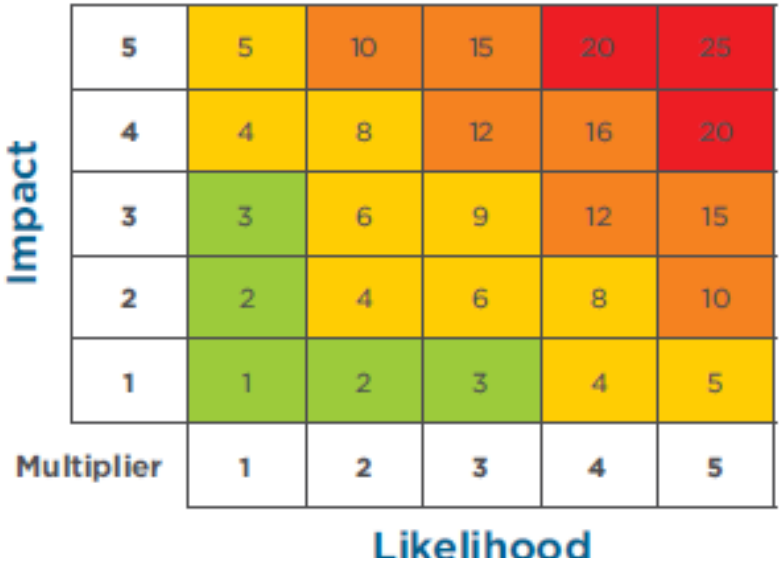

Table 1: The Risk Matrix. Multiplying the 'likelihood' by the 'impact' generates a risk score. The following description can be added to the 'likelihood' score: (1) do not believe will ever happen; (2) do not expect to happen; (3) may occur occasionally; (4) will probably occur; (5) likely to occur. See Appendix A for further information on 'impact' scores.

Risk Level	Score	Risk Level Description
Very High	4	Unacceptable level of risk exposure that requires immediate mitigating action. Action at SMT.
High	3	Unacceptable level of risk which requires controls to be put in place to reduce exposure. Action in Directorate / Consider SMT.
Medium	2	Acceptable level of risk subject to regular passive monitoring. Action in Directorate.
Low	1	Acceptable level of risk subject to regular passive monitoring. Action in Team.

Table 2: Further breakdown of 'risk ratings'. The level at which action should be discussed / taken is determined by how high the risk score is e.g. where a site records a 'very high' level of risk, action should be taken by the Senior Management Team (SMT).

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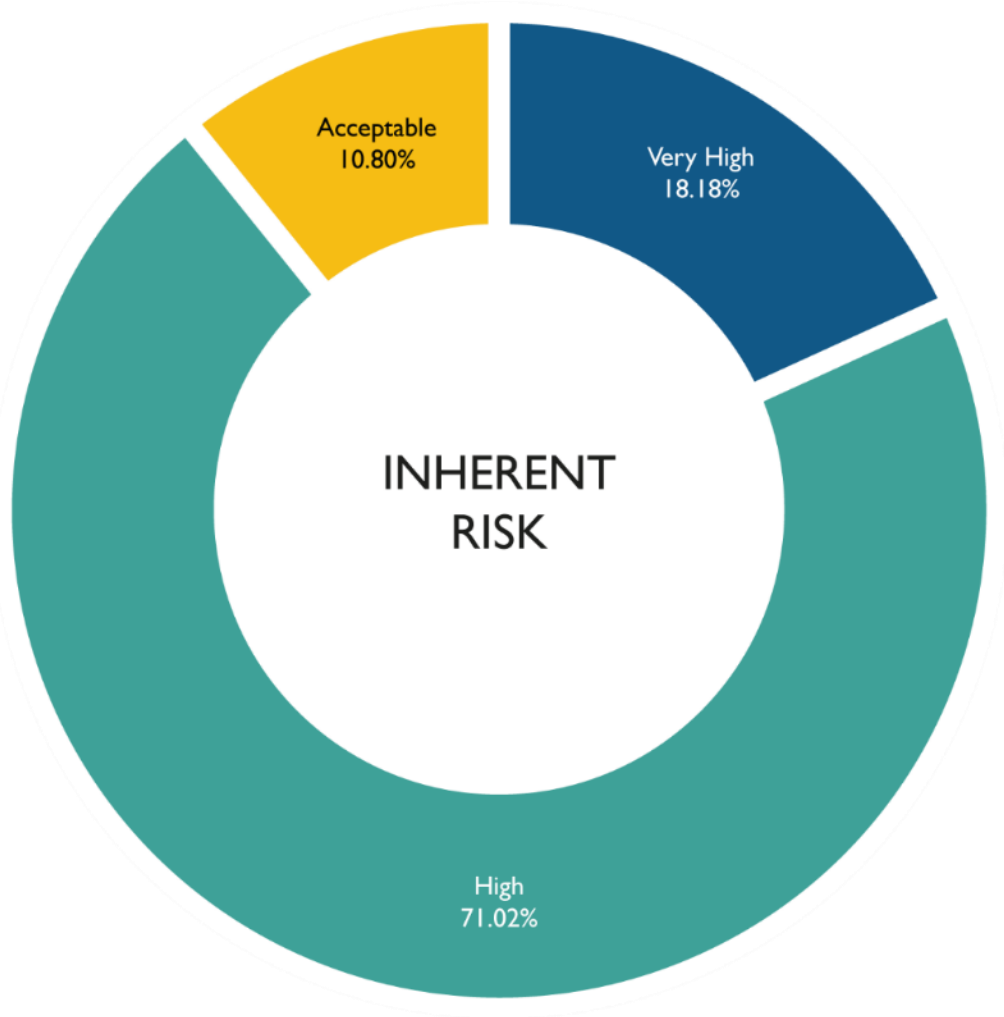
RESULTS

Inherent Risks

Out of the 352 ‘sites’ investigated:

- 89% of our sites are exposed to at least on of the hazards investigated, in a way that is considered unacceptable (High or Very High risk).

- 28 sites record ‘Very High’ levels of risk in one (or more) of the 6 hazards investigated.



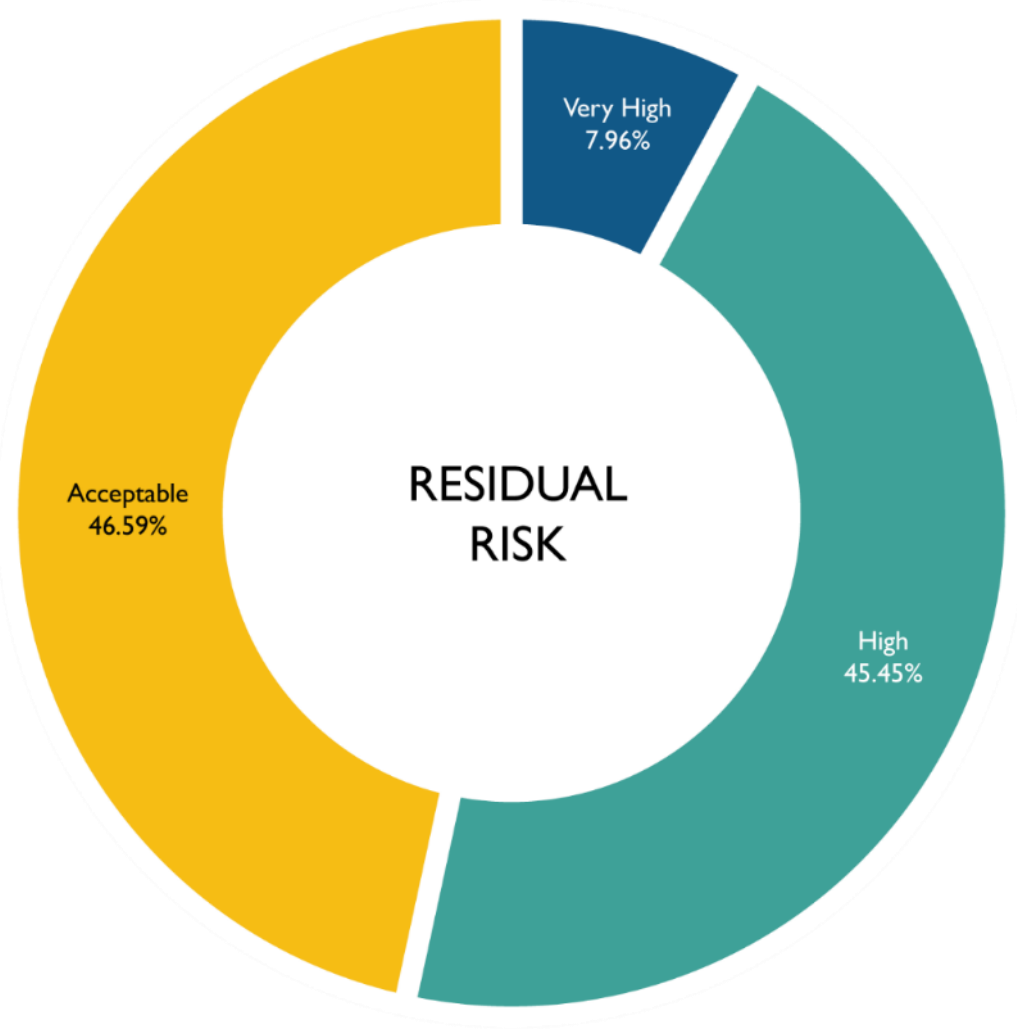
RESULTS

Residual Risks

If we consider what mitigants and controls are already in place then …

Out of the 352 ‘sites’ investigated:

- 53% of our sites are exposed to at least on of the hazards investigated, in a way that is considered unacceptable (High or Very High risk).



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RESULTS

Sites at Risk

Using the results of this assessment the next steps are too:

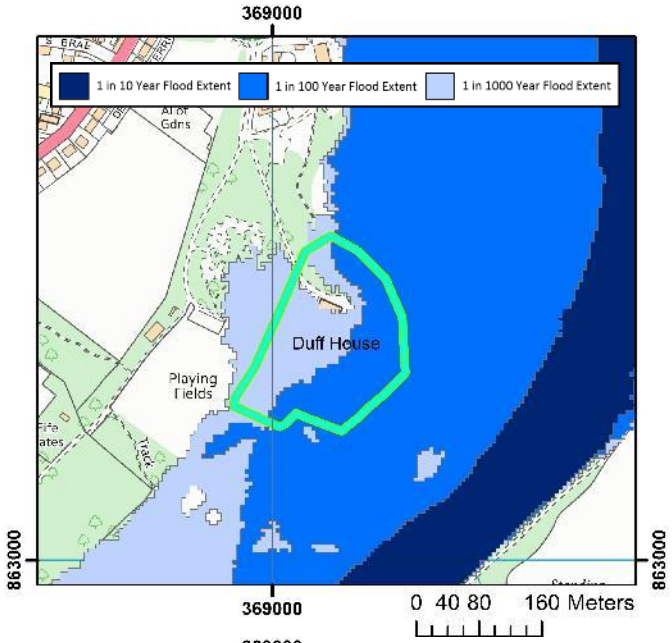
- Conduct more in depth site specific desk studies
- Site visits
- Speak with the people that run these sites
- Analysis of climate change projection data
- Work with teams at the Engine Shed to utilise their data / skills.

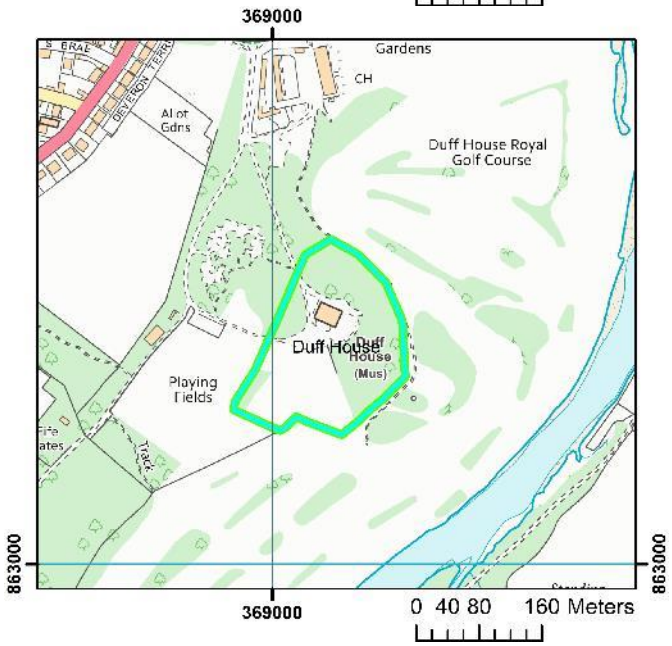
Property Name	Type	Hazards
Biggar Gasworks	A	FF, GF
Bonawe Iron Furnace	B	FF, GF, PF, CF
Brough of Birsay	D	CE
Cambuskenneth Abbey	B	FF, GF, CF
Castle Sween	C	CE
Dundonald Castle	C	LA
Eileach-an-Naoimh	C	CE
Elcho Castle	A	GF
Fort George	A	CE
Hackness Battery & Martello Tower	A	CF
Inchcolm Abbey	B	CE, LA, GF, CF
Inchcolm Island	B	CE, LA, GF, CF
Innerpeffray Chapel	B	GF
Kisimul Castle	A	CF
Mavisbank Policies	F	LA
Ness of Burgi	D	CE
Newark Castle	A	CE, GF, CF
Quoyness Chambered Cairn	B	CE
Seton Collegiate Church	B	GF, FF
Spynie Palace	C	LA
St Blane's Church	C	LA
St Serf's Church, Dunning	B	GF
Stanley Mills	A	LA, FF, GF
Tealing Dovecot	B	GF, FF, PF
Torphichen Preceptory	B	GF
Tullibardine Chapel	B	GF
Whithorn Priory Crosses (& Museum)	A	FF
Wideford Hill Chambered Cairn	E	LA

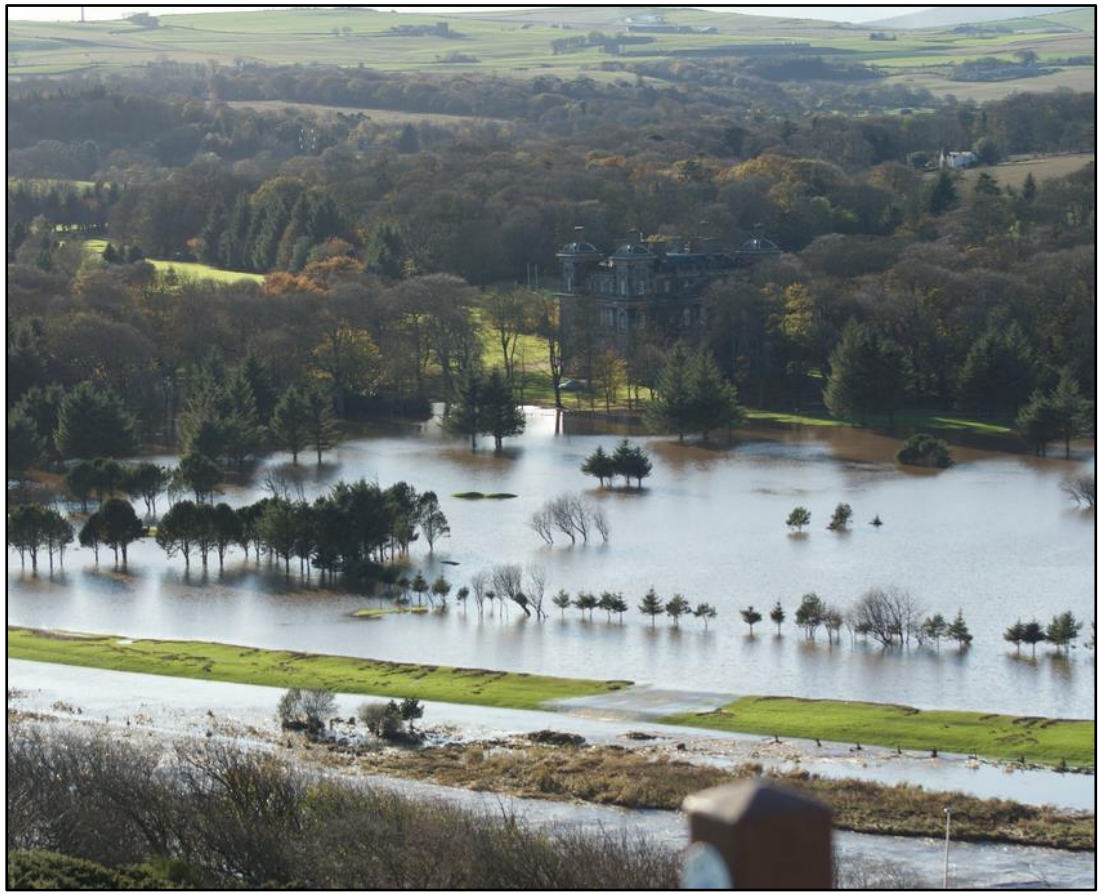
Table 9: Top 28 'at risk' sites. 'Type' refers to the six monument categories (see section 2.3). Hazards key: **FF** – fluvial flooding; **PF** – pluvial flooding; **GF** – groundwater flooding; **CF** – coastal flooding; **CE** – coastal erosion and **LA** – slope instability.

DUFF HOUSE

Fluvial Flooding







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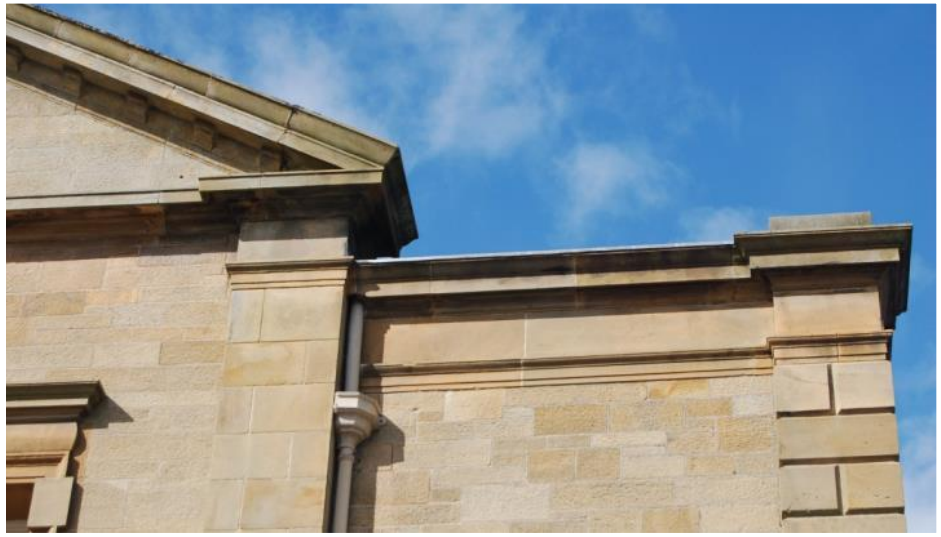
IMPACT ON TRADITONAL BUILDINGS

- Prolonged saturation of masonry
- Leaching of lime from mortars
- Staining and discolouration of masonry
- Higher internal humidity
- Increased growth of algae, vegetation and insect pests
- Rising groundwater levels / floods
- Ground shrinkage in summer
- All buildings are vulnerable to the effects of climate change!

Why are Traditional Buildings Vulnerable?

- Poor Maintenance
- Functional Details Damaged or Removed

Reinstate Weathering Details



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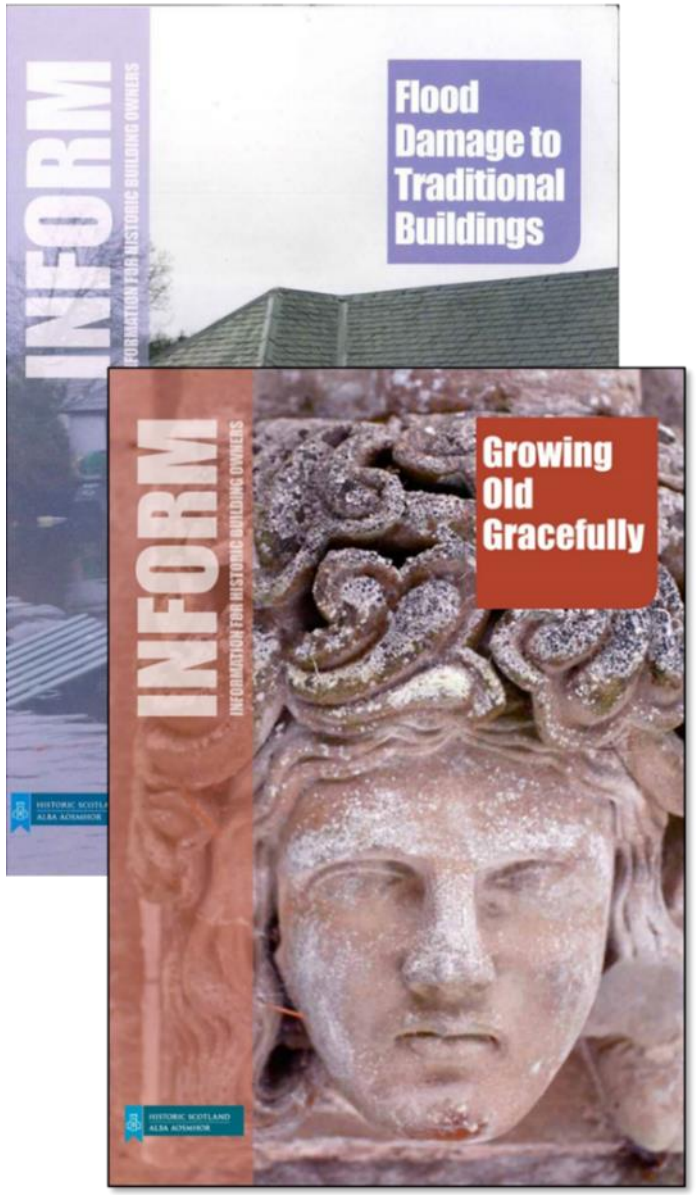


CLIMATE CHANGE

Will wetter winters change the appearance of our historic buildings?

Conservation researcher and Historic Scotland Climate Change Research Fellow **Dr Alison Wright** examines the effects of wetter winters on the greening of sandstone buildings

Dr Alison Wright
a.j.wright@abdn.ac.uk

Part of Historic Scotland's efforts to assess the impact of changing climate on our built heritage has included a project at the University of Glasgow to see how increased winter rainfall may affect the biological patinas that develop on sandstone buildings. Initial work has focused on characterising growths present on existing buildings, which are largely a mixture of green algae, cyanobacteria, and lichens.

The most important factors thought to control biological growth are aspect and the porosity of the sandstone. Aspect is undoubtedly crucial: south-facing facades support less growth as biological material is highly sensitive to solar radiation. The dominant organic compounds present in biological crusts are the pigments carotene and scytonemin, which act as sunscreens for biological cells.

Biological material only manages to penetrate a few millimetres below the surface of the sandstone. Experiments with stone blocks show that, given suitable growing conditions, green algal filaments and lichen hyphae can be found up to 3mm deep after one year's exposure. Stone blocks exposed for over 20 years do not show any greater depth of penetration, making growth self-limiting. Interestingly, it appears to be rock chemistry, rather than porosity, which has the greater influence on the amount and type of biological growth over the longer term, with more variable chemistry supporting the greatest diversity of flora. This also allows new minerals to form as lichen acids interact with the underlying stone. Most sandstone is dominated by quartz which doesn't react as readily as calcium-bearing minerals, so that the development of secondary products is not widespread.

HIGHER WINTER RAINFALL IS LIKELY TO LEAD TO GREATER GREENING OF OUR HISTORIC BUILDINGS, PARTICULARLY ON NORTH-FACING FACADES

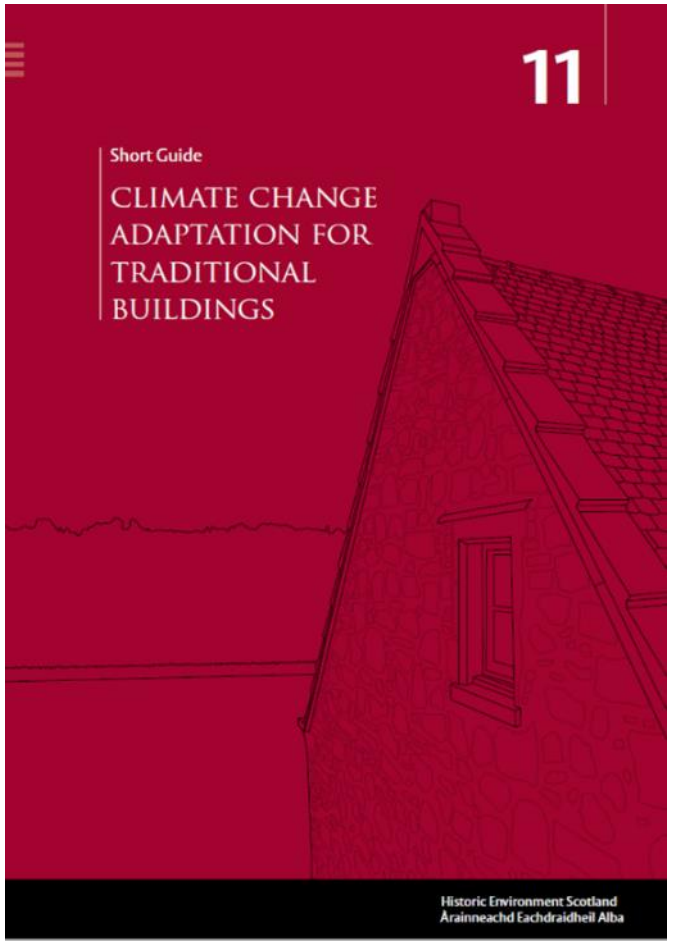
Higher winter rainfall is likely to lead to greater greening of our historic buildings, particularly on north-facing facades where the stone is not subject to enhanced solar radiation. It is also possible that increased rainfall intensity will remove material but, given the tenacity of biological activity, this is likely to be temporary unless the frequency of rainfall events is such that it prevents growth from becoming established on new (or recently cleaned) buildings. This highlights the importance of ongoing work by Historic Scotland to ensure that stone at heritage sites does not remain wet for long periods as, once growths become established, it becomes costly and potentially damaging to remove them.

Stone that remains wet for prolonged periods is prone to biological growth

5 µm

100 µm

14 | www.historic-scotland.gov.uk



Downloads: https://www.engineshed.org/

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WORKING IN PARTNERSHIP
EDINBURGH ADAPTS

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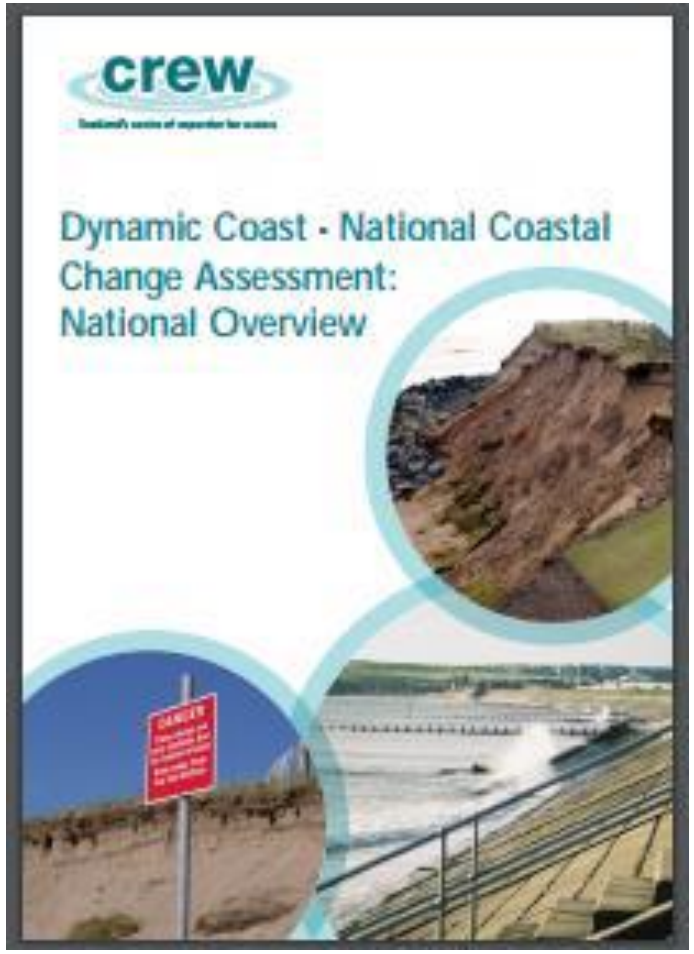
DYNAMIC COAST
NATIONAL COASTAL CHANGE ASSESSMENT



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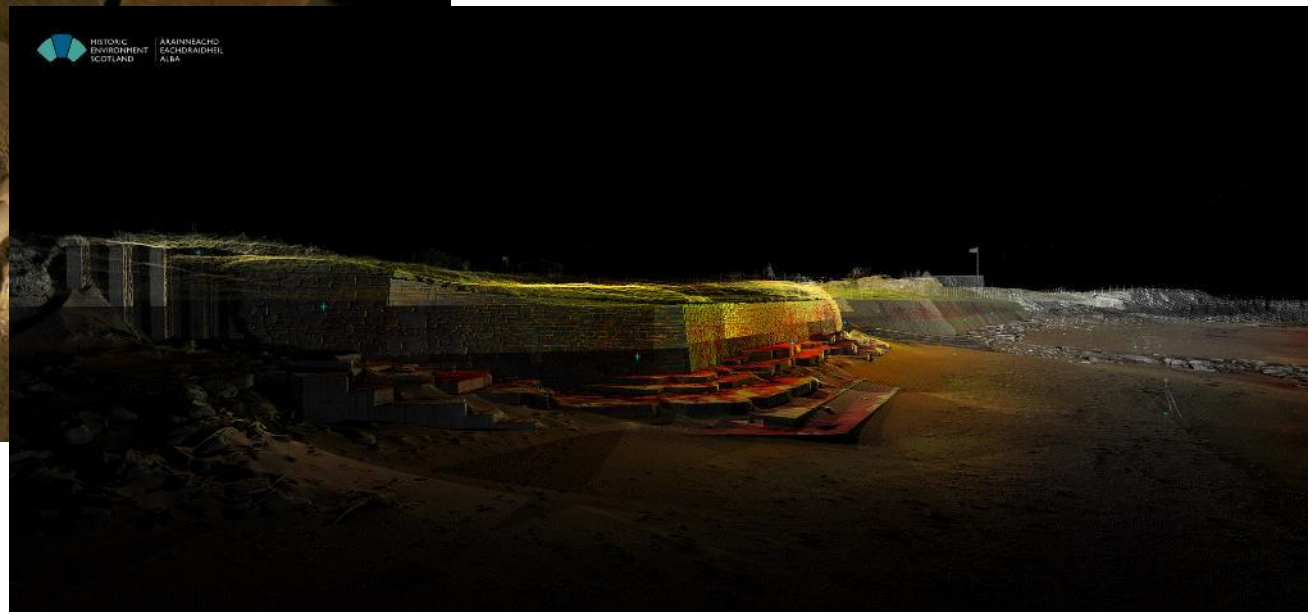

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BLOG:

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Sharing and learning

Adaptation Scotland
supporting climate change resilience

- Sharing experiences and ideas
- Space to reflect on what's worked and what hasn't
- Opportunity to identify projects and collaborators

- Pop up presentations during the day
- Networking session this afternoon

The Scottish Government

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Adaptation Scotland
supporting climate change resilience

Claudia Cowie, Aberdeenshire Council

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From mountain to sea

Aberdeenshire COUNCIL

Adaptation in Aberdeenshire

Claudia Cowie

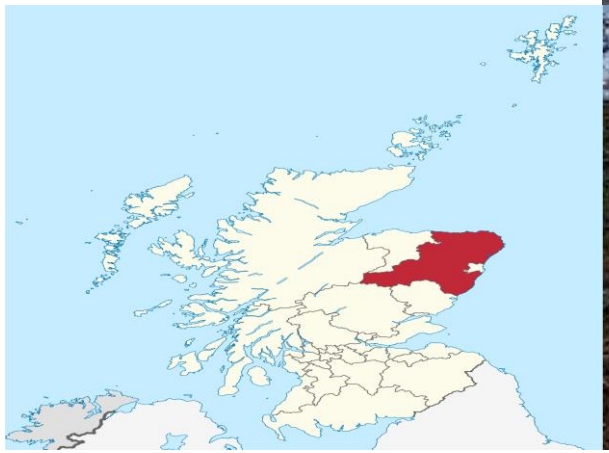
From mountain to sea

Aberdeenshire COUNCIL

Adaptation in Aberdeenshire

- Recent Progress:
  - Council Priority
  - Student project
  - ClimateXChange
  - In work plan for 2018/19

- Challenges:
  - Range
  - Focus
  - Time



From mountain to sea

Aberdeenshire COUNCIL

Adaptation in Aberdeenshire

- Focus:
  - Looking to develop strategy over the next few years
  - Internal Workshops/Questionnaire
  - Update Climate Change Risk Register
  - External Engagement opportunities

From mountain to sea

Aberdeenshire COUNCIL

Thank you

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Caitlin Hamlett, NHS NSS

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Mari-Claire Riley – Falkirk Council

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Public Sector Guidance Update

Ellie Murtagh

The Engine Shed, Stirling | 12 March 2018

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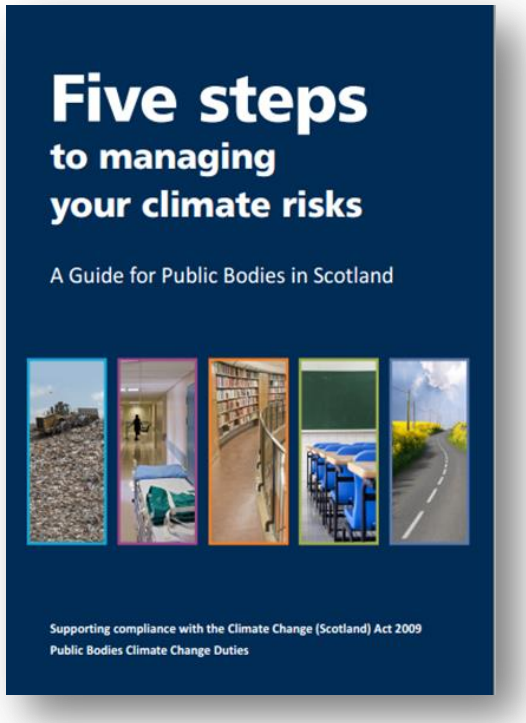

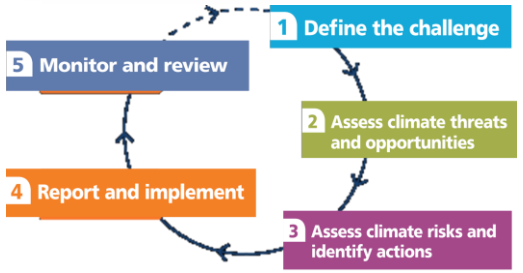

- There is a **need to support organisations at different stages of adaptation** – with the 5-Steps guidance structure it is difficult to support beginning, intermediate and advanced adaptation work.
- The 5-Steps is based on **climate change risk assessment (CCRA) as a decision-making framework**. While CCRA is an essential tool for adaptation, it is difficult to apply in practice and not always the most suitable tool – especially for a 'beginning' organisation.
- As a cycle the **5-Steps process is quite rigid**. It is common for organisations to stall in progress (esp. at CCRA) and few have completed a cycle, let alone undertaken multiple iterations. In reality, those that have been **flexible or opportunistic** have progressed furthest.
- The 5-steps cycle has **most 'capacity building' activities at early stages and largely directed at setting up a CCRA.** The AS programme supports a broader range of activity (e.g. governance; place-based partnerships) that is not easily contained within a 5-Steps risk framework – many are ongoing adaptation processes in their own right.

How could we improve the guidance?

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- Emphasis on **planning** (and managing) **an adaptation process** for an organisation – this should be flexible, customisable.
- An adaptation process (or 'cycle') should be an **iterative management process** that develops with ongoing review and planning phases.
- It should seek to develop adaptation in organisations across a range of **capacities** needed to progress adaptation – and support a framework for M&E of progress.
- Specific guidance should be provided for organisations at different adaptation **maturity stages** (e.g. beginning to advanced).
- The guidance should highlight a broader range of adaptation **tools and methods** available to organisations.

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Expert Working Group

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- Expert working group represents a range of public sector organisations, including:
  - NHS
  - Stirling Council
  - Historic Environment Scotland
  - Dumfries & Galloway Council
  - Aberdeen City Council
  - Edinburgh City Council
  - Transport Scotland
  - University of St Andrews
  - University of Glasgow
  - Scottish Water

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Framework for adaptation in organisations

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Our proposed framework…

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capacity

/kəˈpasɪti/

noun
noun: **capacity**; plural noun: **capacities**

1. the maximum amount that something can contain.
   "the capacity of the freezer is 1.1 cubic feet"
   synonyms: volume, cubic measure; More
   - fully occupying the available area or space.
     modifier noun: **capacity**
     "they played to a capacity crowd"
   - the total cylinder volume that is swept by the pistons in an internal combustion engine.
     "the cubic capacity is 1171 cc"
   - former term for capacitance.
2. the amount that something can produce.
   "the company aimed to double its electricity-generating capacity"
3. the ability or power to do or understand something.
   "I was impressed by her **capacity** for hard work"
   synonyms: ability, power, potential, potentiality; More
   antonyms: inability
   - a person's legal competence.
     "cases where a patient's testamentary capacity is in doubt"
4. a specified role or position.
   "I was engaged in a voluntary capacity"
   synonyms: position, post, job, office, appointment; More

An aspect or feature of <**an organisation's adaptation to climate change**>

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Framework for adaptation in organisations

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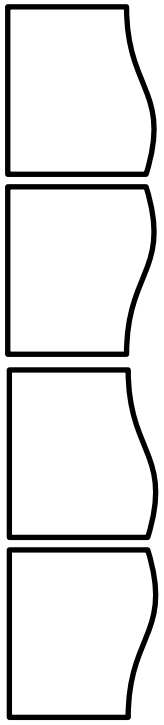
1. Capacity

aspects or features of an organisation's adaptation to climate change



1. **Organisational Capacity** *(internal and place based governance, leadership, resources, learning)*
2. **Understanding the Challenge** *(expertise, evidence and data)*
3. **Planning and Implementation** *(planning, engagement, delivering adaptation actions, M & E)*
4. **Working Together** *(collaboration, sharing, co-producing and communicating)*

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action
/ˈakʃ(ə)n/

noun
plural noun: **actions**

1. the fact or process of doing something, typically to achieve an aim.
   "ending child labour will require action on many levels"
   synonyms: steps, measures, activity, movement, work, working, effort, exertion, operation More
2. a thing done; an act.
   "she frequently questioned his actions"
   synonyms: deed, act, activity, move, gesture, undertaking, exploit, manoeuvre, achievement, accomplishment, venture, enterprise, endeavour, effort, exertion; More

The process of doing something, to <**develop a capacity of your organisation's adaptation to climate change**>

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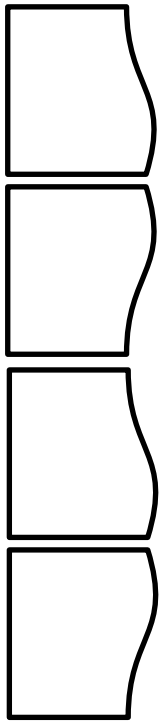
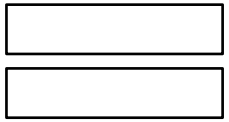
1. Capacities

aspects or features of an organisation adapting to climate change



2. Actions

doing something, to develop a capacity of your organisation's adaptation to climate change



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mature

/məˈtʃʊə/

adjective

1. fully developed physically; full-grown.
   "she was now a mature woman"
   synonyms: adult, grown-up, grown, fully grown, full-grown, of age, fully developed, fully fledged, in one's prime, in full bloom, nubile
   "she is now a mature woman"

2. having reached the most advanced stage in a process.
   "Van Gogh's mature work"

verb

1. (of a person or thing) become fully grown or developed.
   "children mature at different ages"
   synonyms: be fully grown, be full-grown, be fully developed, develop fully, come of age, become adult, reach adulthood, reach maturity More
   "kittens mature when they are about a year old"
   - develop, grow, evolve, bloom, blossom, flourish, thrive, come to fruition

2. (of an insurance policy, security, etc.) reach the end of its term and hence become payable.
   "when the policy matures it pays off the loan"

Having reached an advanced stage of <**an organisation adapting to climate change**>

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Framework for adaptation in organisations

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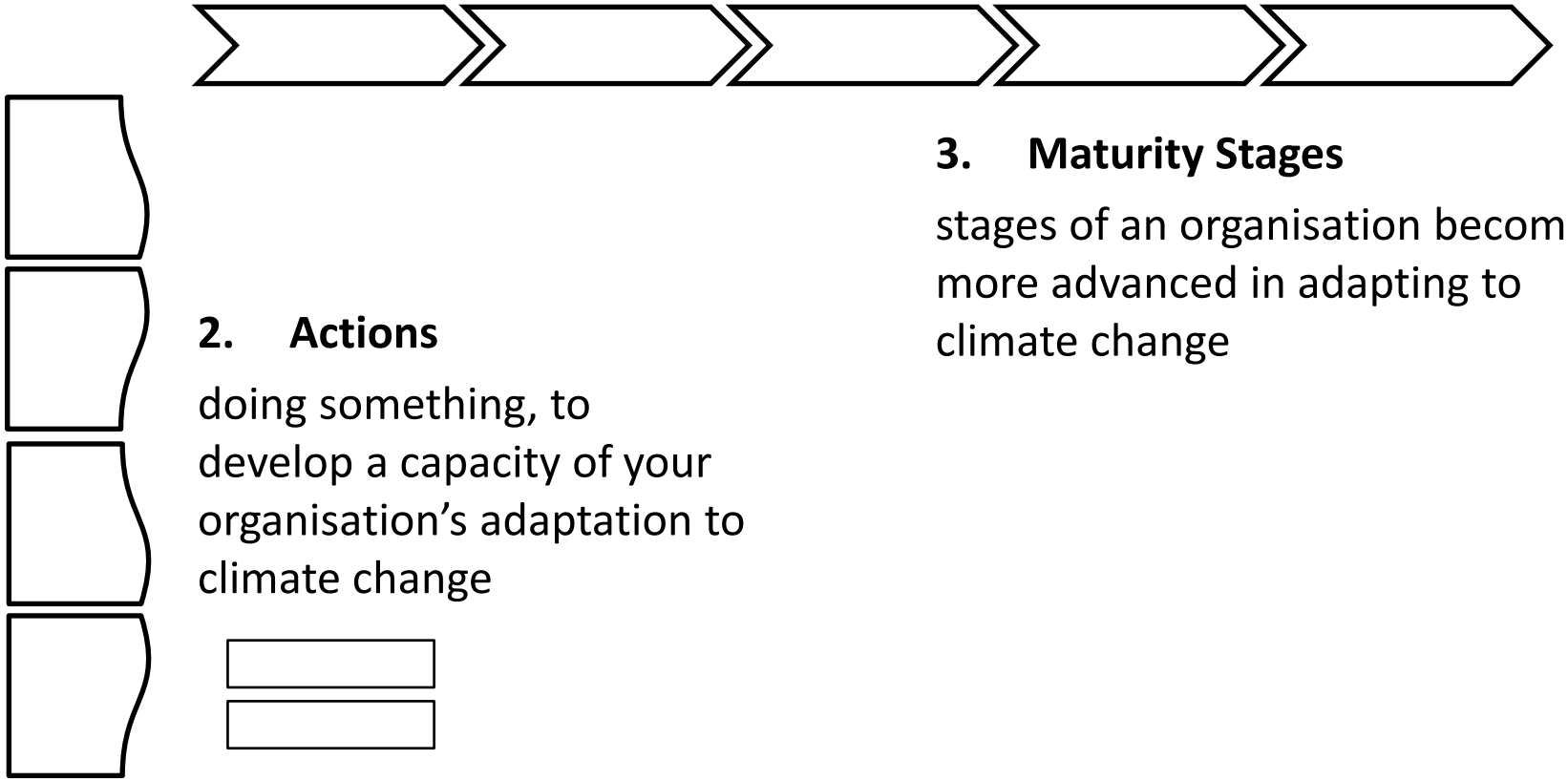

1. Capacities

aspects or features of an organisation adapting to climate change

2. Actions

doing something, to develop a capacity of your organisation's adaptation to climate change

3. Maturity Stages

stages of an organisation becoming more advanced in adapting to climate change

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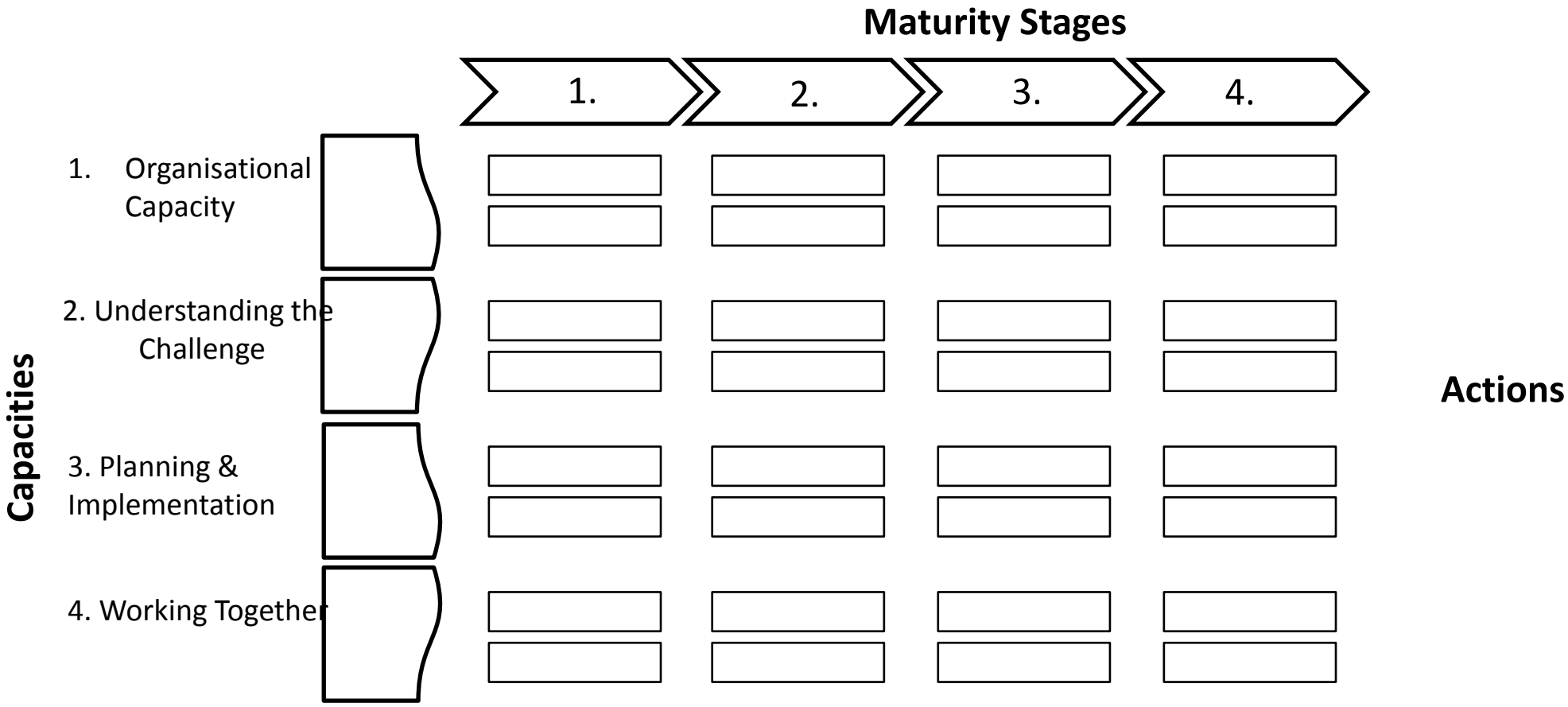

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Draft Framework

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	1	2	3	4
Organisational Capacity	**There is understanding of how the organisation is structured and what resources are available. Adaptation awareness raising begins and leadership team educated on the need to adapt. Potential governance options for adaptation work identified.**	Resources that already exist within the organisation that enable adaptation are further developed. The organisation agrees and implements a preferred governance option.	Leadership acknowledges adaptation and its importance to the organisation as a whole. Windows of opportunity are used to implement necessary action.Governance arrangements are in place and adaptation work undertaken.Organisation has resources and capacity to address climate change across all of its sectors.	Agents of change championing adaptation are active and embedded across the organisation. Adaptation is integrated in long term thinking and decision making with complete political buy in. Governance arrangements in place are continually improved and developed. Adaptation is appropriately financed and well resourced.
Understanding the Challenge	**The concepts of climate adaptation are explored and climate change, climate impacts and general adaptation actions understood.**	**How climate change challenges and opportunities relate to Scotland and local area is examined.**	**Assessment of climate change risks and opportunities relevant to organisation undertaken and understood.. There is a detailed understanding of how climate change will affect different areas of the organisation. Understanding and awareness of adaptation is being spread throughout the organisation.**	Knowledge is shared with partner organisations and a recognition of cross-organisation, sector or location risks and opportunities is realised. Ccontinual learning and research.
Planning & Implementation	**A clear set of adaptation aims, outcomes and/ or vision is achieved**.	Colleagues, stakeholders and communities work together to decide how to respond to climate impacts identified. On-going adaptation work is highlighted and quick-wins implemented.	Adaptation is more deeply integrated into wider projects, policies and plans of the organisation. An adaptation strategy or plan has been created.	Organisation is implementing actions within organisation's direct control and working with partners to develop and agree adaptation pathways and actions to address shared challenges and opportunities
Working Together	Key people or organisations suitable to collaborate with are identified and their levers for action understood. Relationship with the communications team being developed.	Initial contact and discussions with possible partners on joint working.Communications are tailored appropriately to diverse audiences.	**Governance arrangements between partners established and joint evidence base for decisions created. Communications show positive message of adaptation work.**	Partner co-funding and co-delivery occurring with value proposition of continued collaboration understood. Organisation builds further awareness and support for adaptation by promoting the plans and actions that organisation is implementing.

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Organisational Capacity -1

Examine how your organisation is structured and map out relevant existing policies and measures

Understand what resources are available for adaptation

Develop a briefing for senior leaders setting out the case for action

Understanding the Challenge – 1

Learn about climate change and what it means for Scotland

Learn about what climate adaptation is and relevant national policies

Planning and Implementation – 1

Create a scope and plan for your adaptation work

Working Together- 1

Identify who is out there and what they are doing and where you can learn or exchange learnings

Communicate appropriately what adaptation means for your organisation

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Organisational Capacity -2

Have discussions about adaptation and identify opportunities to include CCA and potential adaptation champions

Identify funding sources

Think about governance options and develop full business case for preferred option

Understanding the Challenge -2

Understand how your organisation is affected by the climate

Understand and consider what Climate Justice means for your organisation

Planning and Implementation -2

Engage colleagues in adaptation work (using adaptation hooks within non climate change policy and planning processes)

Highlight On-going work and Implement Quick-Wins

Working Together -2

Identify actions with partners and build business case for partnership

Engage and communicate within and out with your organisation on adaptation

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Example of how an organisation would progress

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	Stage One	Stage Two	Stage Three	Stage Four
Organisational Capacity	✓	✓	✓	✓
Understanding the Challenge	✓	✓	✓	✓
Planning & Implementation	✓	✓	✓	✓
Working Together	✓	✓	✓	✓

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What's being produced?

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- **Printed strategic handbook** providing high level descriptions and activities for each capacity area

- **Online interactive resource** with further detail on how to apply specific tools and methods and links to further resources for each capacity

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What's happening now?

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- Three breakout groups (10 minute rotations):
  - Approach to Update
  - Draft Framework
  - Tools and Resources

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Framework for adaptation in organisations

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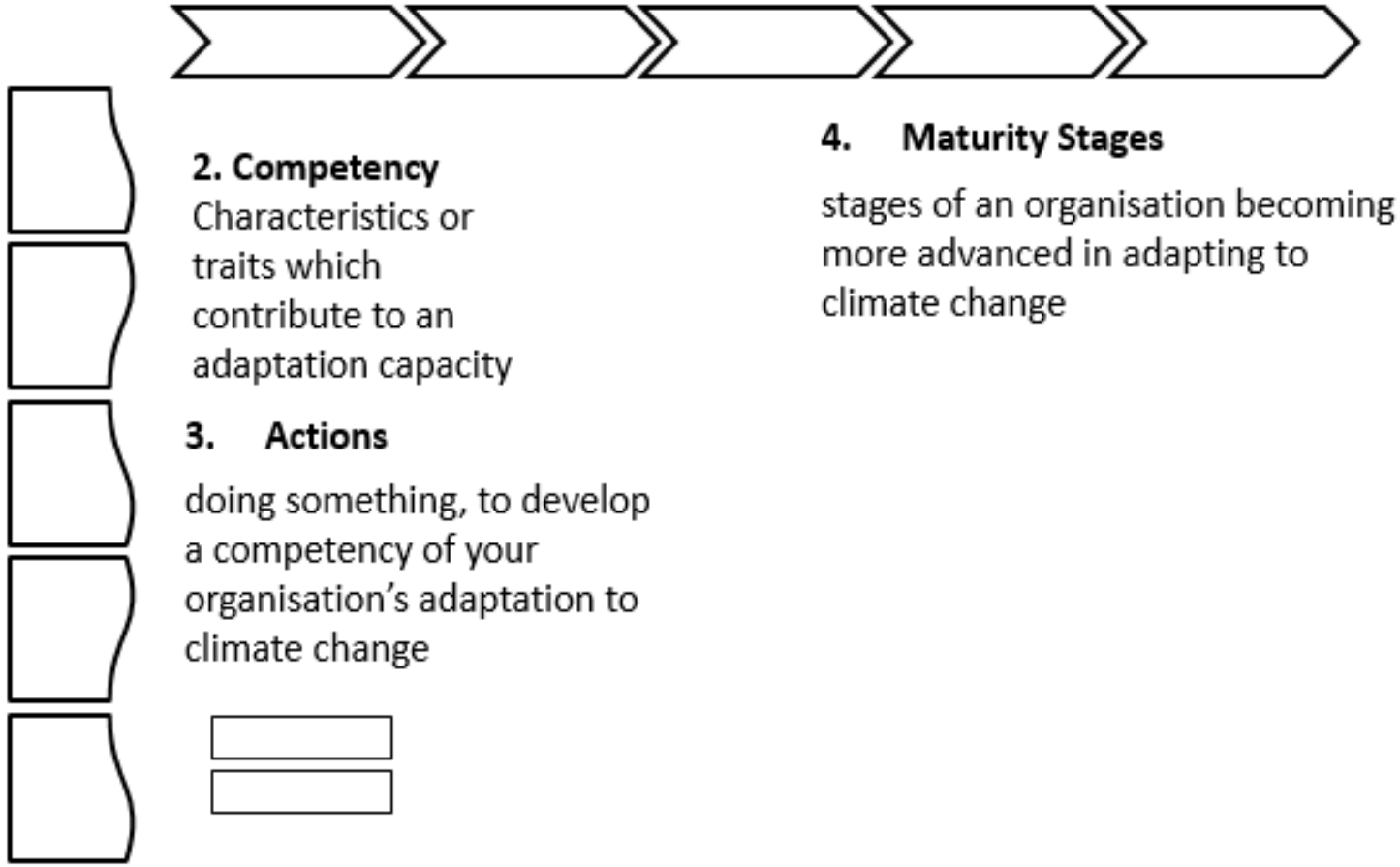
1. Capacity

Over-arching aspects or features of an organisation adapting to climate change



2. Competency

Characteristics or traits which contribute to an adaptation capacity

3. Actions

doing something, to develop a competency of your organisation's adaptation to climate change

4. Maturity Stages

stages of an organisation becoming more advanced in adapting to climate change

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1. Organisational Capacity

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- *Developing the capacity of your organisation to address climate change*

Stage 1	Stage 2	Stage 3	Stage 4
At this stage, current organisational resources (including human, physical, material, financial, information and intellectual resources) that may enable adaptation are identified and assigned. Potential governance options for adaptation action are also identified. Efforts focus on raising awareness and educating the leadership team on the need to adapt.	Further development occurring of the resources that already exist within your organisation that may enable adaptation. Assess resource availability in relation to desired ambition and seek further resources or revise plans accordingly. Agree and implement preferred governance option. Work completed to get support and buy-in from leadership for achieving it.	At stage three, the organisation has the capacity and motivation to address climate change across all of its sectors. Governance arrangements are in place and adaptation work is being undertaken. Senior leadership is aware of adaptation and acknowledges its importance to the organisation as a whole.	The organisation has accepted and embedded adaptation across its departments and adaptation is appropriately financed and well resourced. Governance arrangements are in place and are improving and developing. Agents of change championing adaptation are active and embedded across the organisation. The later stages of maturity are when the organisation has flexibility and openness to experiment with adaptation, testing innovative solutions but being understanding of what works in a local context.

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1. Organisational Capacity (cont'd)

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Actions across Maturity Stages

1	1. Examine how your organisation is structured and map out relevant existing policies and measures 2. Understand what resources are available for adaptation 3. Develop a briefing for senior leaders setting out the case for action (from organisational objectives and legislative requirement perspectives)
2	1. Have discussions about adaptation and identify opportunities to include CCA and potential adaptation champions 2. Identify funding sources 3. Think about governance options and develop full business case for preferred option
3	1. Perform gap analysis of existing policies and procedures assessing where adaptation could fit 2. Leaders actively promoting adaptation 3. Implement agreed governance arrangements
4	1. Embed adaptation across the organisation 2. Keep leaders engaged and active 3. Further develop the governance arrangements

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2. Understanding the Challenge

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- *Accessing expertise and evidence to inform adaptation by your organisation*

Actions across Maturity Stages

1	1. Learn about climate change and what it means for Scotland 2. Learn about what climate adaptation is and relevant national policies
2	1. Understand how your organisation is affected by the climate 2. Understand and consider what Climate Justice means for your organisation
3	1. Initial Climate Change Risk Assessment (CCRA)
4	1. Comprehensive CCRA for organisation (e.g. all services) completed 2. Continued Learning and Research 3. Address Maladaptation

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3. Planning and Implementation

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- *Achieving outcomes by delivering adaptation action*

Actions across Maturity Stages

1	1. Create a scope and plan for your adaptation work
2	1. Engage colleagues in adaptation work (using adaptation hooks within non climate change policy and planning processes) 2. Highlight On-going work and Implement Quick-Wins
3	1. Identify possible adaptation actions 2. Build Business Case for Adaptation Actions 3. Create Adaptation Strategy or Plan
4	1. Implement Actions 2. Review, Monitor and Evaluate Actions

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4. Working Together

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- *Finding ways to learn and collaborate with others*

Actions across Maturity Stages

One	1. Identify who is out there and what they are doing and where you can learn or exchange learnings 2. Communicate appropriately what adaptation means for your organisation
Two	1. Identify actions with partners and build business case for partnership 2. Engage and communicate within and out with your organisation on adaptation
Three	1. Develop in-house adaptation communication and training tools 2. Engage with local businesses and communities 3. Continue working with partners and establish governance arrangements
Four	1. Mainstream adaptation across partnership working 2. Continue communicating about your adaptation work

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Examples…

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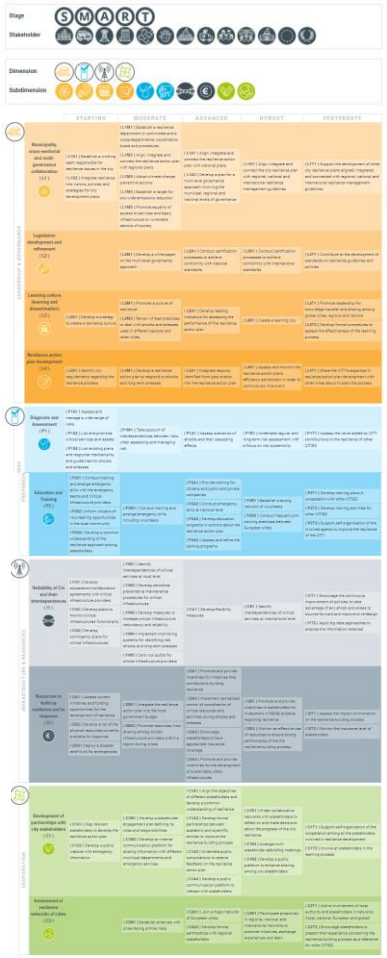
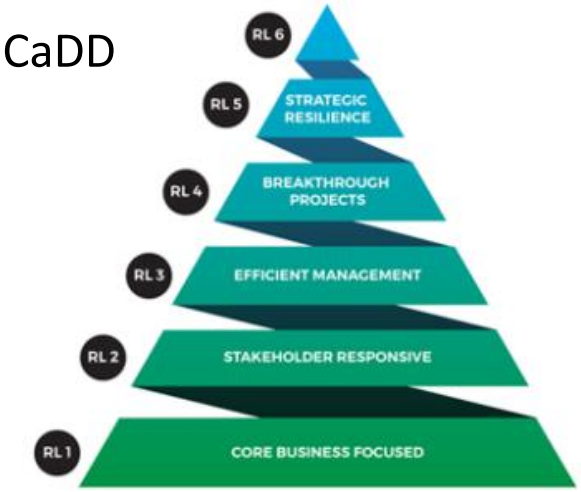
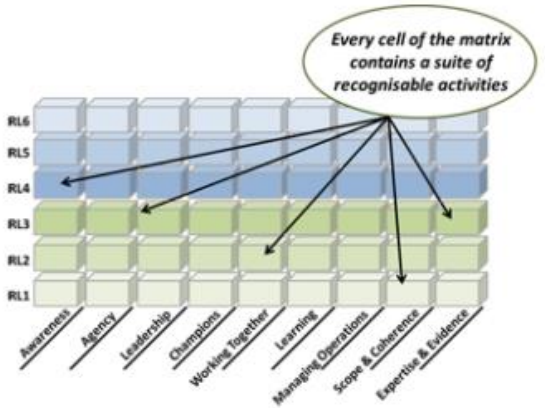


SMR Project - Resilience

	STARTING	MODERATE	ADVANCED	ROBUST	VERTEBRATE
LEADERSHIP & GOVERNANCE **Municipality, cross-sectorial and multi-governance collaboration (L1)**	(L1S1) Establish a working team responsible for resilience issues in the city (L1S2) Integrate resilience into visions, policies and strategies for city development plans	(L1M1) Establish a resilience department or committee and a cross-departmental coordination board and procedures (L1M2) Align, integrate and connect the resilience action plan with regional plans (L1M3) Adopt climate change preventive actions (L1M4) Promote equality of access to services and basic infrastructure to vulnerable sectors of society	(L1A1) Align, integrate and connect the resilience action plan with national plans (L1A2) Develop a plan for a multi-level governance approach involving the municipal, regional and national levels of governance	(L1R1) Align, integrate and connect the city resilience plan with regional, national and international resilience management guidelines	(L1T1) Support the development of other city resilience plans aligned, integrated and connected with regional, national and international resilience management guidelines
Legislation development and refinement (L2)		(L2M1) Develop a white paper on the multi-level governance approach	(L2A1) Conduct certification processes to achieve conformity with national standards	(L2R1) Conduct certification processes to achieve conformity with international standards	(L2T1) Contribute to the development of standards on resilience guidelines and policies
Learning culture (learning and dissemination) (L3)	(L3S1) Develop a strategy to create a resilience culture	(L3M1) Promote a culture of resilience (L3M2) Review of best practices to deal with shocks and stresses used in different sectors and other cities	(L3A1) Formalize the learning process and institutionalize regular debriefing meetings	(L3R1) Create a learning city	(L3T1) Develop formal procedures to assess the effectiveness of the learning process (L3T2) Promote leadership for knowledge transfer and sharing among global cities, regions and nations

CaDD





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1st Maturity Stage - Description

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Organisational Capacity	Understanding the Challenge	Planning and Implementation	Working Together
At this stage, current organisational resources (including human, physical, material, financial, information and intellectual resources) that may enable adaptation are identified and assigned. Potential governance options for adaptation action are also identified. Efforts focus on raising awareness and educating the leadership team on the need to adapt.	During the beginning stages, it is important to find out about the concepts of climate adaptation and improve understanding of climate change science, climate impacts and possible adaptation actions. This initial understanding will also enable communication to others within organisation why it is important to consider adaptation.	Planning adaptation involves establishing a strong foundation from which to build your organisation's approach. Establishing a clear set aim, set of outcomes and/ or vision is an important starting point as is developing a practical plan of method in which adaptation will be developed.	This stage focuses on exploratory and initial connections. Understanding limits of what your organisation can control. The beginning stages should focus on becoming acquainted with the communications team and understanding their timeline for actions.

Glossary

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Term	Description
Adaptation Capacity	Aspects or features of an organisation adapting to climate change. Dimensions describe what organisations that are adapting to climate change look like by highlighting the organisational attributes, characteristics and qualities needed to advance adaptation.
Action	Activities that enable organisations to adapt to climate change. Doing something, to develop a dimension of your organisation's adaptation to climate change
Tool	A method or approach which enables an action to be completed to obtain or progress an adaptation dimension. It relates to a particular procedure or way of accomplishing or approaching something.
Maturity Model	A maturity model provides a structured summary of the actions and attributes at different stages of a process. A climate adaptation maturity model will define the trajectory of a public body through measurable adaptation levels and highlight a range of tools which enable progression towards higher maturity levels.
Maturity Stage	Part of a maturity model involves structured levels which describe the behaviours, practices and processes of an organisation to produce specified outcomes. Each maturity stage has criteria which can be assessed against. They are stages of an organisation becoming more advanced in adapting to climate change.

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Dynamic Coast

Scotland's National Coastal Change Assessment

Alistair Rennie, Jim Hansom & James Fitton

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crew
Scotland's centre of expertise for waters

Scottish Natural Heritage
Dualchas Nàdair na h-Alba
All of nature for all of Scotland
Nàdar air fad airson Alba air fad

University of Glasgow

HISTORIC ENVIRONMENT SCOTLAND | ÀRAINNEACHD EACHDRAIDHEIL ALBA

SEPA

Ordnance Survey

ST ANDREWS LINKS
the home of golf

SCOTTISH GOLF

National Library of Scotland
Leabharlann Nàiseanta na h-Alba

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SCAPE

Crown Estate Scotland
Oighreachd a' Chrùin Alba

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Dynamic Coast is a Scottish Government Project, funded by CREW, managed by SNH with a research team from the University of Glasgow

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Nàdar air fad airson Alba air fad

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www.DynamicCoast.com

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"Dynamic Coast gives Scotland it's most advanced nationally consistent and locally informed understanding of the causes and consequences of coastal change that it has ever had so we have to use it and build on it now."

Environment Secretary Roseanna Cunningham

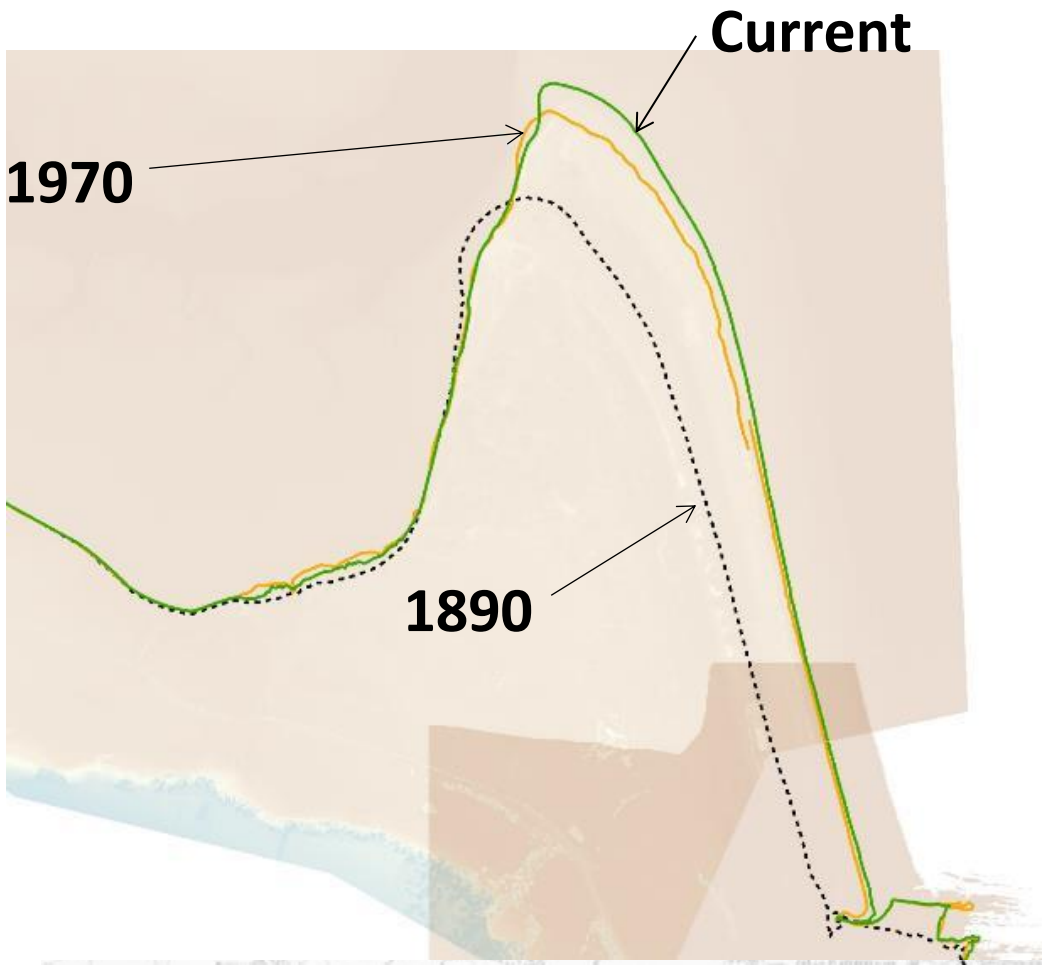
(August 2018)

What is Dynamic Coast?

Dynamic Coast shows how Scotland's erodible coastline has changed over the last 130 years.

1 million data points have quantified changes between 3 sets of maps (1890s, 1970s & now) for every beach and saltmarsh in Scotland.

These changes have been compared with our coastal assets (roads & buildings) to see what is at risk if erosion continues.



What are the headlines ?

Climate change is very likely affecting Scotland's coastline.

National trends: ↑ erosion, ↓ accretion

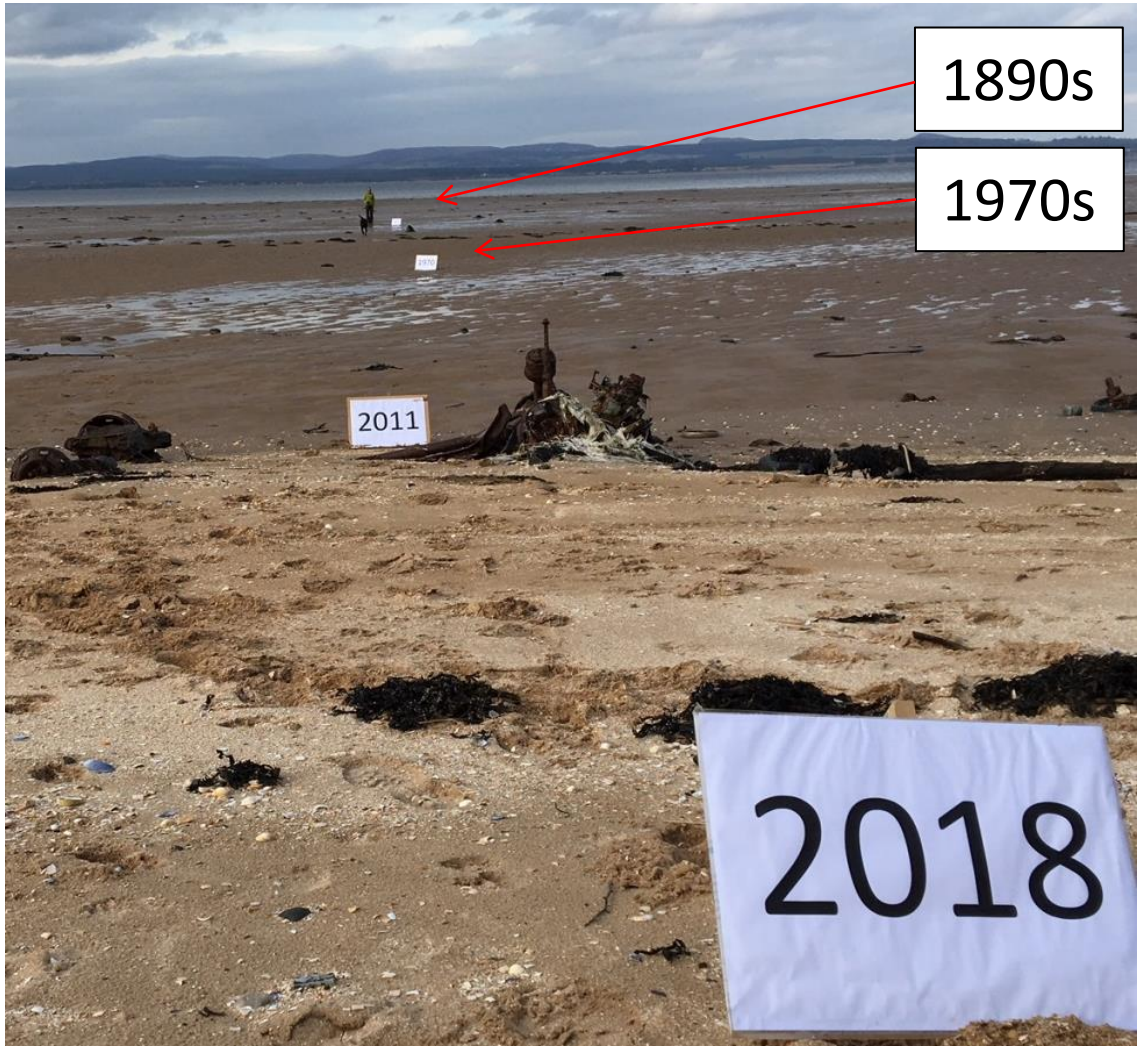
erosion rates doubling

Regional trends: differing patterns

Thinking about what drives coastal erosion and flooding, future driving processes are much quicker than recent changes.

So … 'Business as usual' plans will fail.

Position of MHWS @ RAF Tain



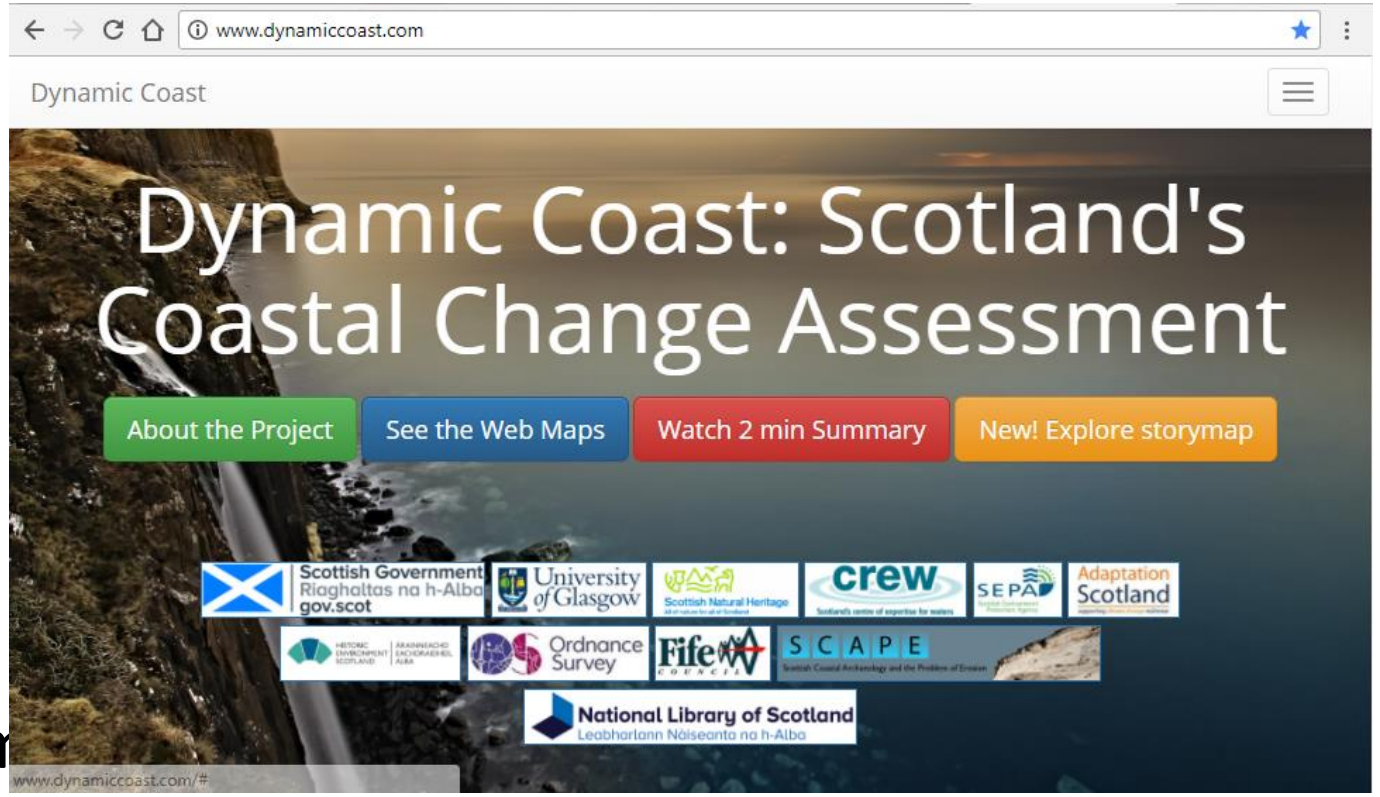
Quickening rates: 0.4m/yr → 1.2 m/yr → 1.4 m/yr

Dynamic Coast outputs

Evidence is available via DynamicCoast.com and should be used to support public sector statutory advice. Inclusion of CC is expected in all sectors.

- Maps
- Reports
- Videos
- Presentations
- Blogs & articles
- Storymap

Website has had over 4k hits in 6 m



Dynamic Coast key results

NCCA Results

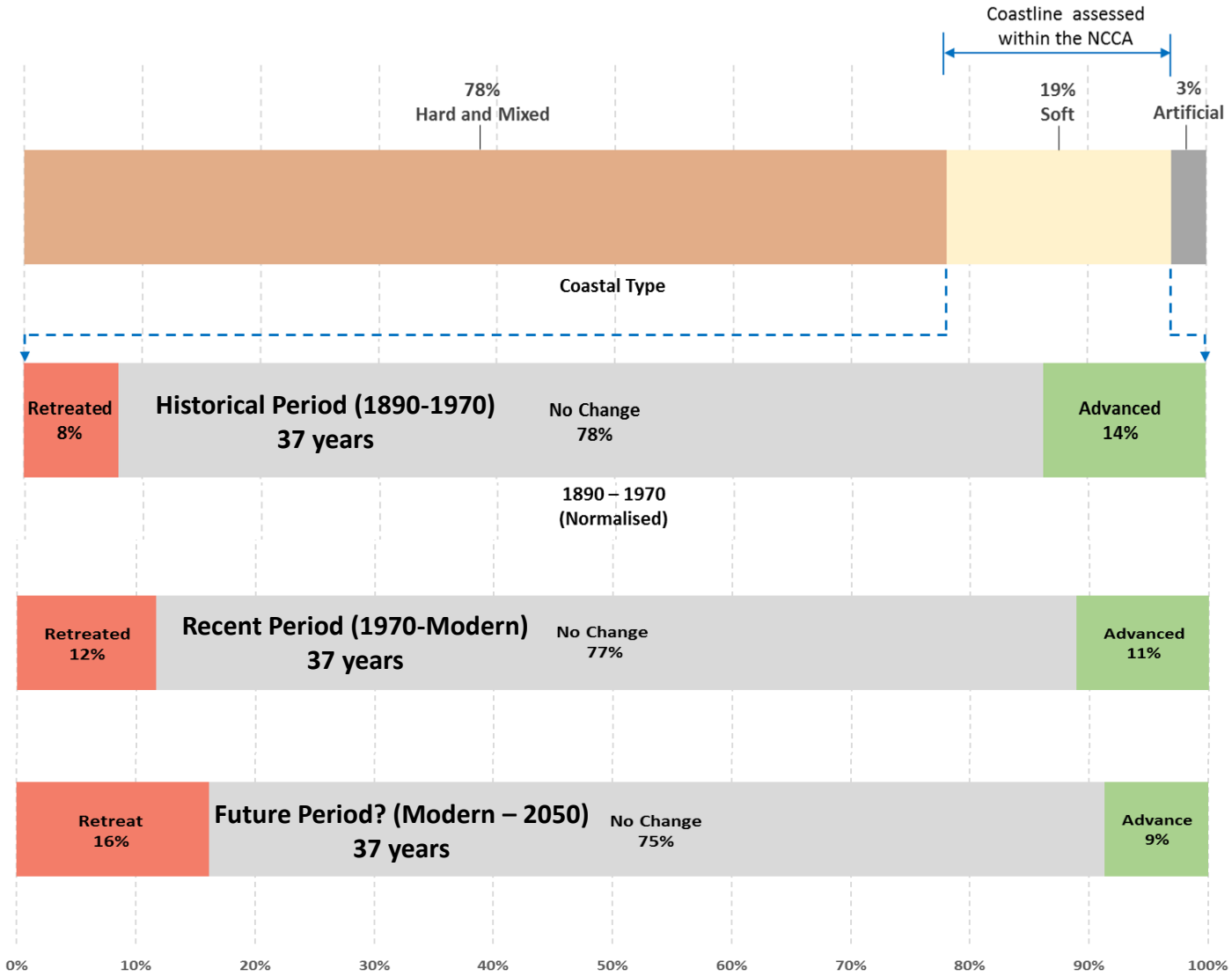
Generally:
75% soft coast dynamic stability
25% directional changes

Before the 1970s:
(normalised for time period)
8% extent of erosion
14% extent of accretion

Since the 1970s:
39% ↑ in extent of erosion
22% ↓ in extent of accretion

+ Doubling of erosion rates to 1m/yr

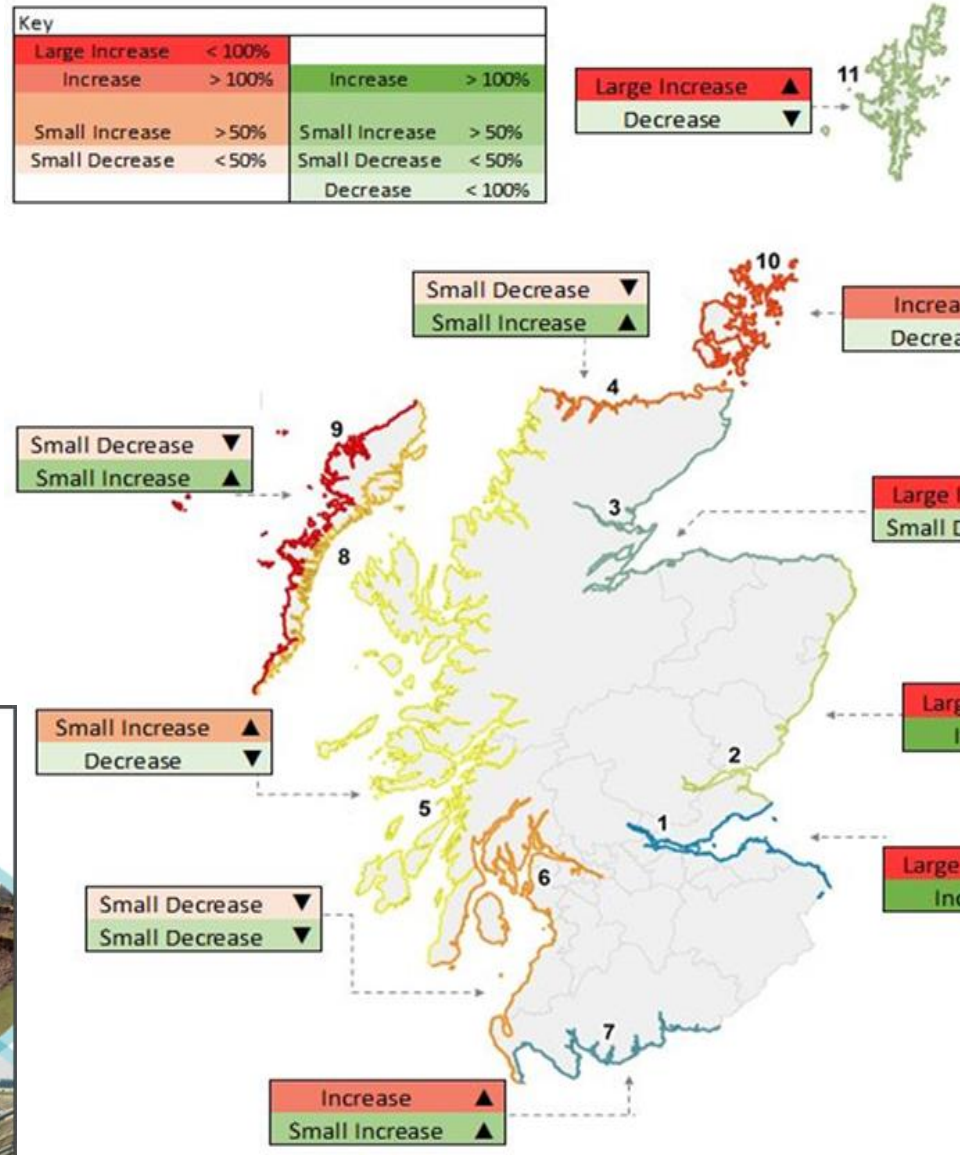
National picture dilutes more significant changes and regional patterns.



Climate change is a likely driver: (sea level, increasing wave impact & exacerbating storms; added to human factors)

Dynamic Coast key results

Regional results show geographic bias.

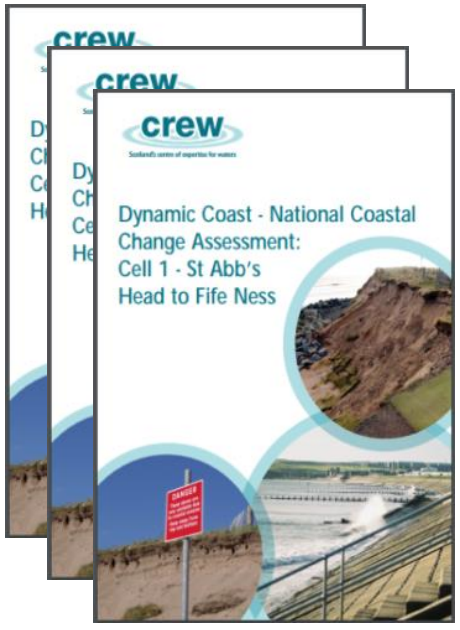


East coast:

- has seen greatest increase in erosion,
- is more susceptible to erosion,
- has a large % of assets.

North, West & South coast:

- less change from baseline,
- less susceptible,
- has a lower % of assets.



Dynamic Coast key results

Where are our coastal assets?

Used OS data & coastal type (hard, soft, artificial) to ID where assets were (NFRA).

e.g. 156km of roads lie within 10m of MHWS, 53km on soft

e.g. same # of buildings behind natural defences as built ones

Asset / Receptor	Unit	Within 10m of MHWs					Within 50m of MHWS				
		All	Coastal Type			Erodable (UPSM40+)	All	Coastal Type			Erodable (UPSM40+)
			Hard & Mixed	Soft	Artificial			Hard & Mixed	Soft	Artificial	
Community Services	#	1	1	0	0	0	78	48	20	10	45
Non Residential Property	#	463	197	103	163	245	9,045	4,393	2,309	2,343	5,101
Residential Prop	#	458	107	109	242	332	24,449	9,966	7,194	7,289	15,276
Septic Water Tanks	#	367	219	139	9	181	1,656	954	677	25	769
Utilities	#	25	10	7	8	14	312	137	80	95	184
Rail	km	15	2	9	3	9	104	27	58	18	61
Roads	km	156	87	53	16	68	1,336	733	497	107	590
Clean Water Network	km	87	50	22	16	41	931	507	304	120	452
Cultural Heritage	ha	135	63	55	17	74	1,029	471	438	120	529
Environment	ha	4,204	2,575	1,586	43	1,790	23,430	14,873	8,424	133	8,615
Runway	ha	0	0	0	0	0	3	2	0	1	2

Results available via webmaps & reports on www.DynamicCoast.com

Dynamic Coast key results

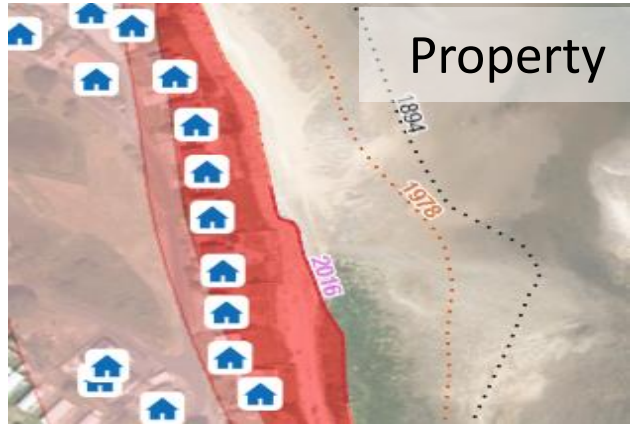
19% of the Scottish coast is soft or ‘erodible’ (3,802 km).

Between ½ and ⅓ of all coastal buildings, roads, rail and water network lie in these erodible sections.

A large proportion of our coastal assets at risk from erosion and exacerbated flooding.

£13bn protected by natural defences, whilst £5bn by sea walls.

Nature is protecting more assets than we are.



Dynamic Coast key results

What's at risk if this trend continues to 2050? next 32 years

- at least 50 residential and non-residential buildings,
- 1.6 km of rail track,
- 5.2 km of roadway,
- 2.4 km of clean water network
- as well as significant areas of runways, cultural and natural heritage sites

… all expected to be affected by coastal erosion.

These span all Coastal Cells, all Local Authorities and all asset types.

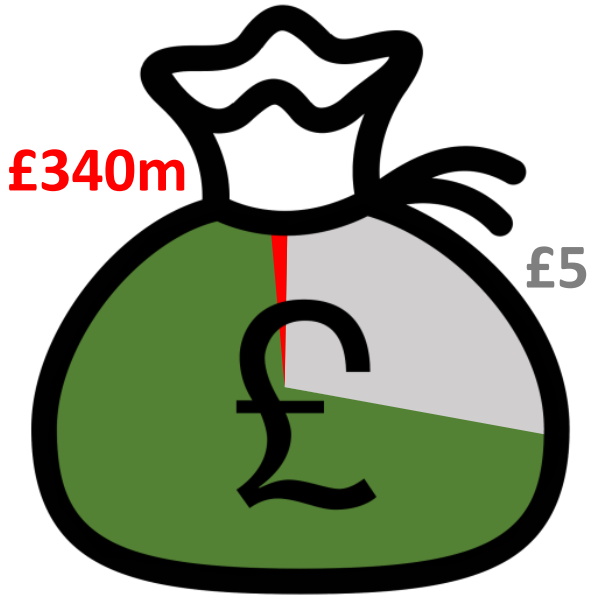
Dynamic Coast key results

Of the **£13bn** of coastal assets protected by natural defences, **£340m** are at risk in the next 30 years if recent erosion continues.

.. alongside the **£5bn** behind coastal defences.

Scotland's society and assets are not immune from erosion.

This is not just about golf courses!



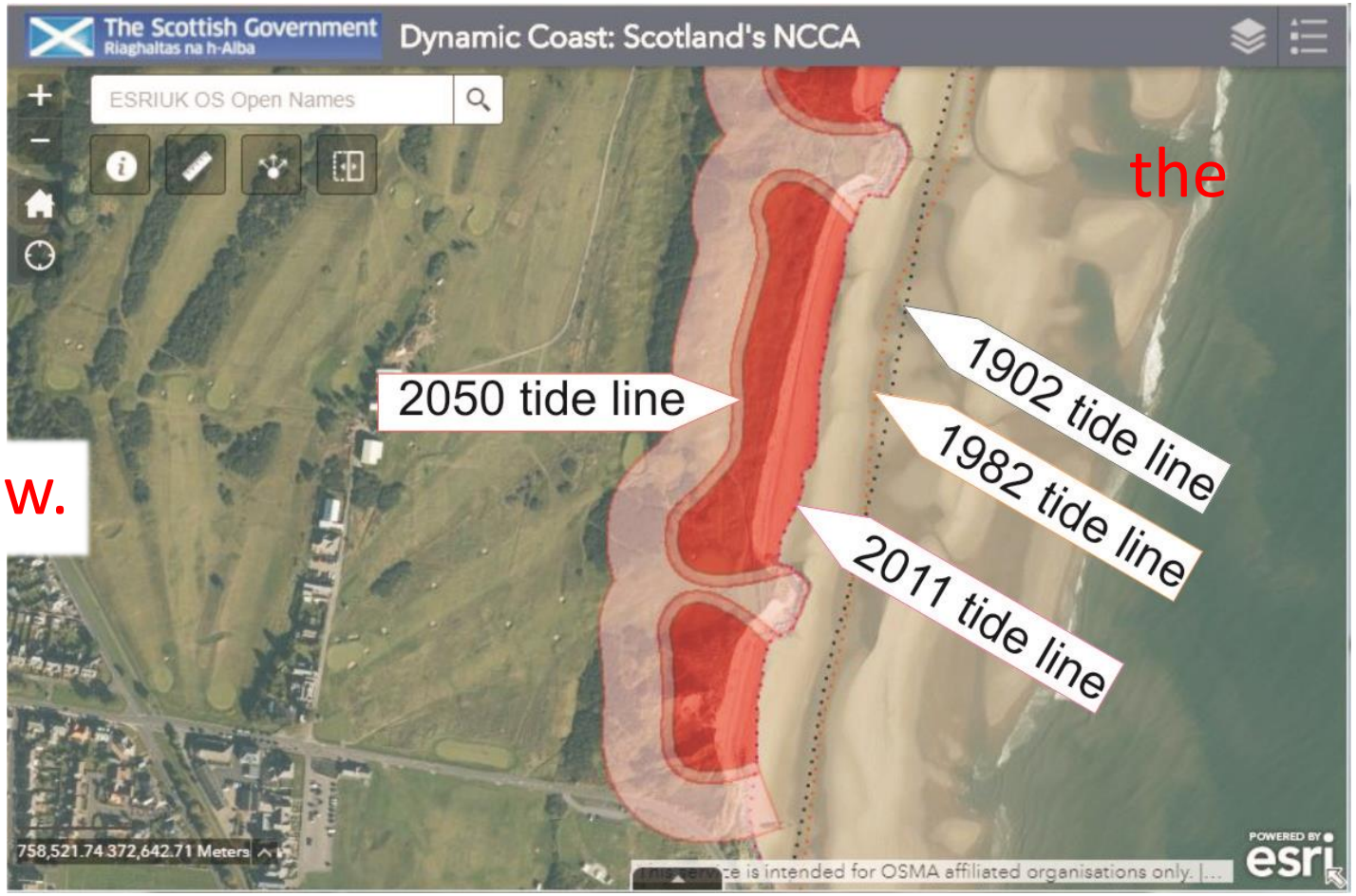
£13bn
(Within 50m of MHWS)

Dynamic Coast key results

Results show an increase in extent and rate of erosion, so anticipated losses are underestimated. We've used recent rates not future rates nor values.

So Dynamic Coast displays the minimum likely impacts.

Business, communities and statutory advisors should plan now.



Dynamic Coast key results

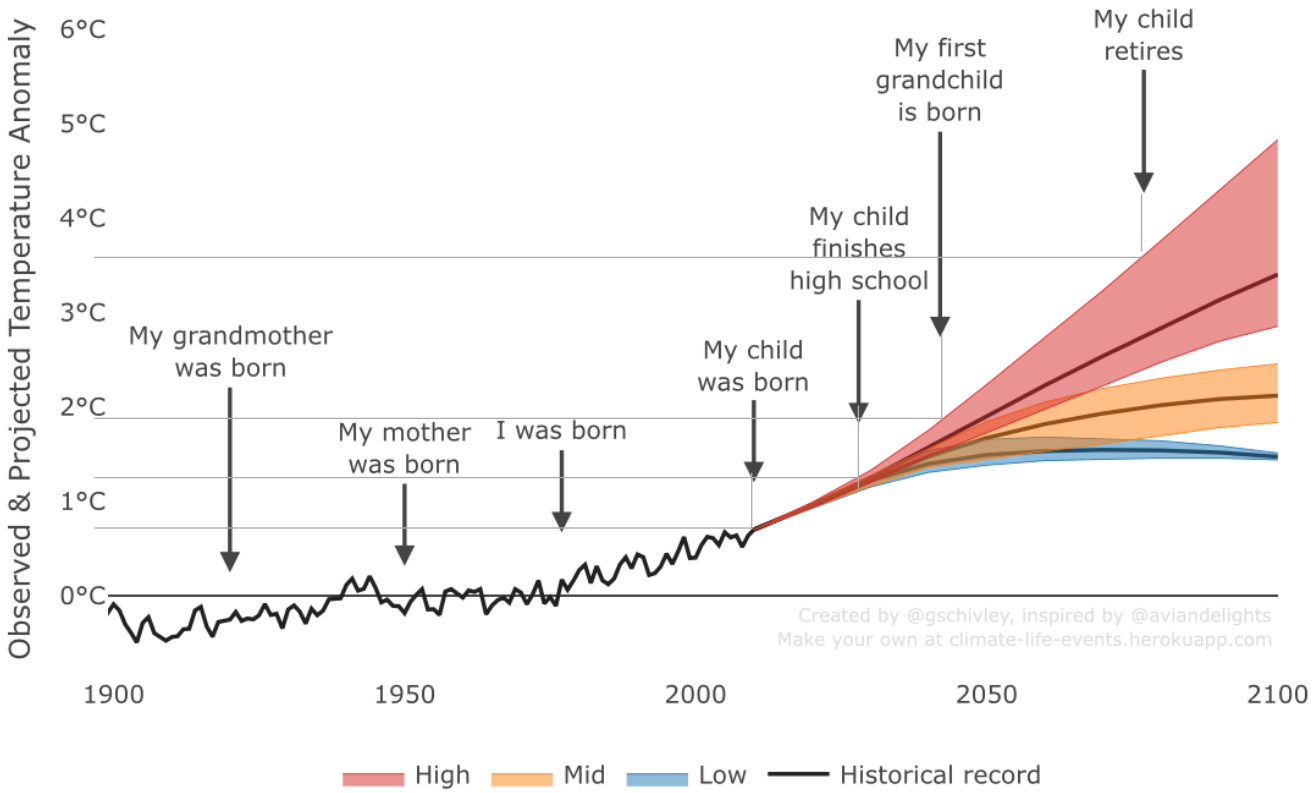
Sea level rise estimates are being increase by 20-30% (Met Office)

And will be revised by UKCP18

Accelerating erosion rates need to be part of routine planning

E.g. Fife SMP2 or
Newquay Neighborhood Plan

Considered further in next phase of Dynamic Coast research.



Dynamic Coast key results

Anticipated SLR will have significant impact on flood frequency.

M.E.S. Leith +0.3 m of sea level by 2090 = 1:100 yr event → 1:8 yr.

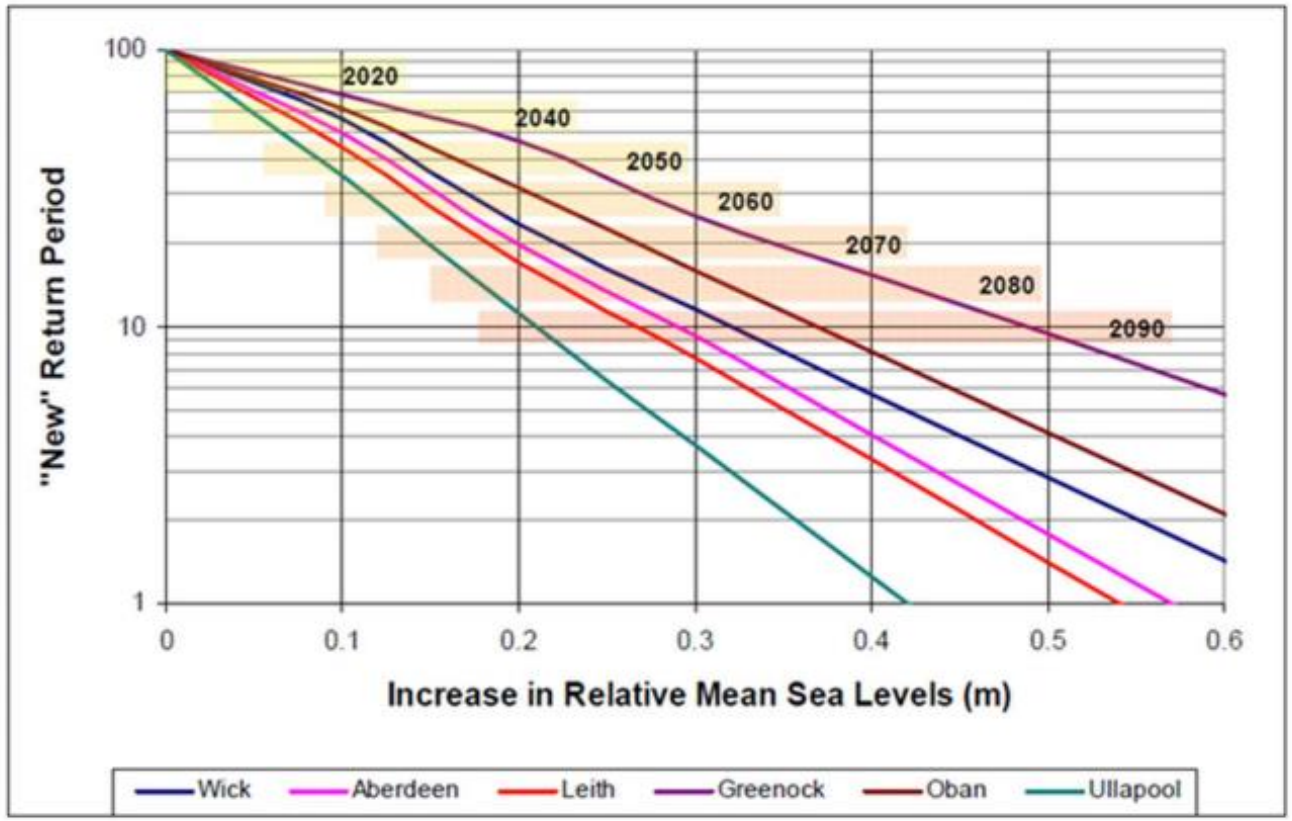


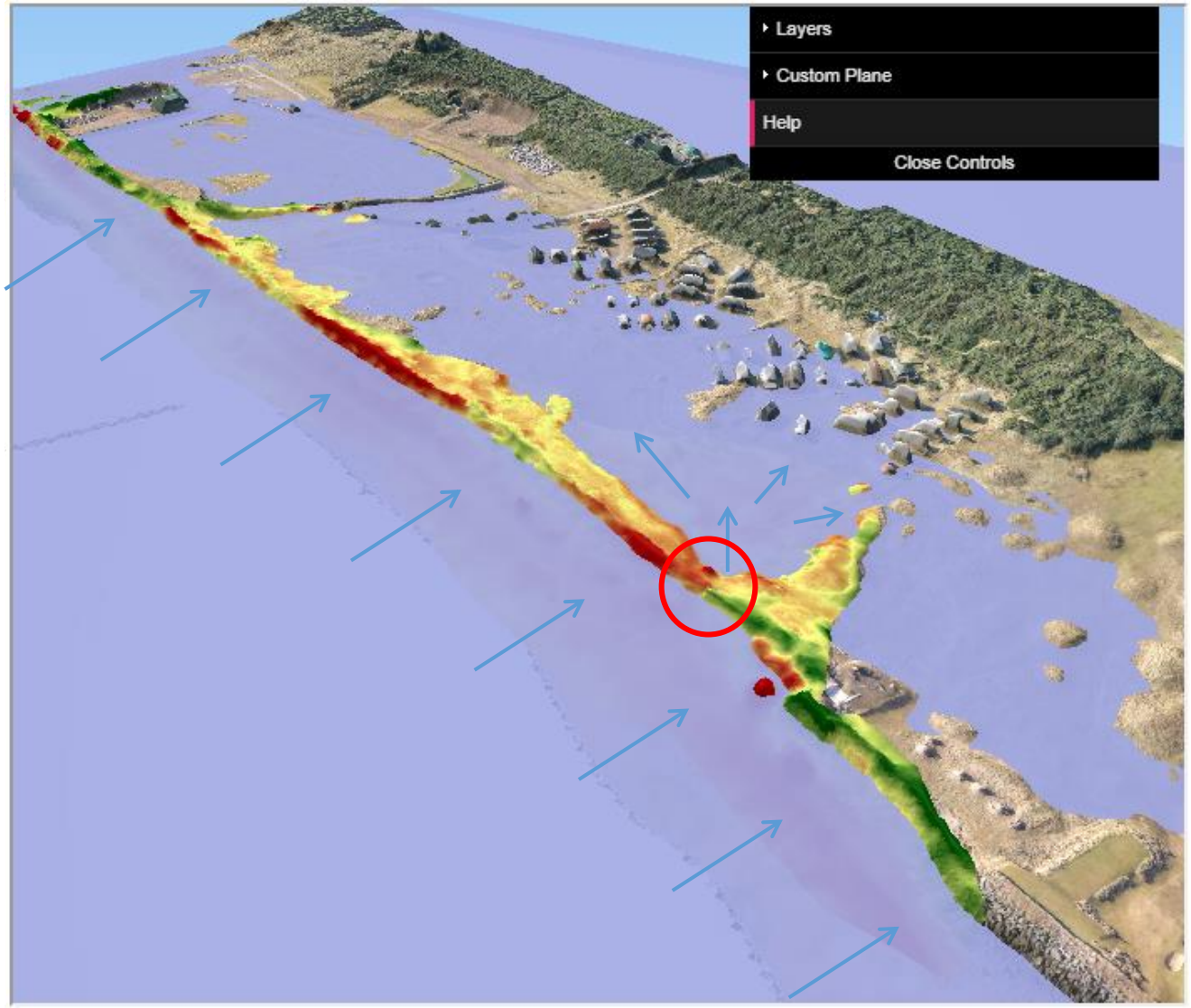
Figure 4.6: Reduction in flood return period given increases in mean sea level (Defra (2012) UKCCRA for Scotland – Technical Report. Fig3.5 p43, based on the central estimate of the Medium Emissions Scenario, locations are approximate)

In Scotland we now have a Window of Opportunity, and the Policies in place, to choose to adapt, mitigate or defend according to local, regional and national factors.

Dynamic Coast phase 2

Dynamic Coast 2 is about to start, using 3-D modelling to:

- Appraise resilience of soft natural defences,
- ID the breach-points for erosion enhanced flooding (this is how cc will impact people),
- consider impact of acceleration in future erosion extents and rates.



Dynamic Coast phase 2

2nd phase will also:

- Encourage adaptation (super sites)

Dynamic Coast phase 2

2nd phase will also:

- Encourage adaptation (super sites)
- Incorporate latest smart phone GPS+tech to ID coastal change.. vegetation edge etc
- Use UAV drones for coastal position updates at key sites
- Produce a coastal erosion disadvantage mapping

For more info… www.DynamicCoast.com

Dynamic Coast is a Scottish Government Project, funded by CREW, managed by SNH, with a research team from the University of Glasgow

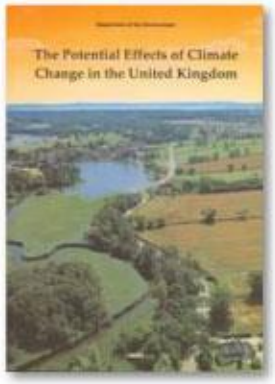
crew
Scotland's centre of expertise for waters

Scottish Natural Heritage
Dualchas Nàdair na h-Alba
All of nature for all of Scotland
Nàdar air fad airson Alba air fad

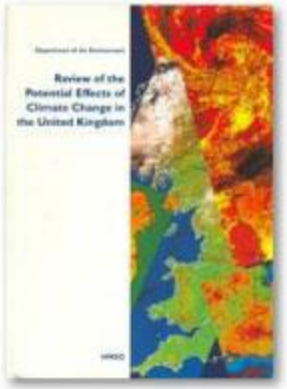
University of Glasgow

UKCP18 – The next generation climate projections for UK

Adaptation Scotland
supporting climate change resilience

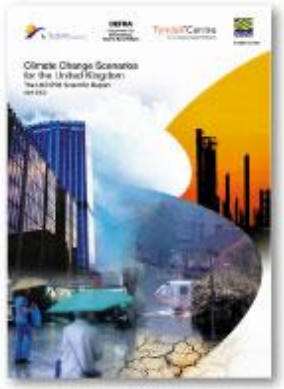


1991
CCIRG91

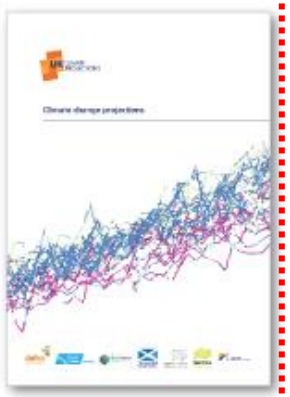


1996
CCIRG96

1998
UKCIP98



2002
UKCIP02



2009
UKCP09

2018
UKCP18

Launch November 2018

The Adaptation Scotland programme is funded by the Scottish Government and delivered by sustainability charity Sniffer.

The Scottish Government

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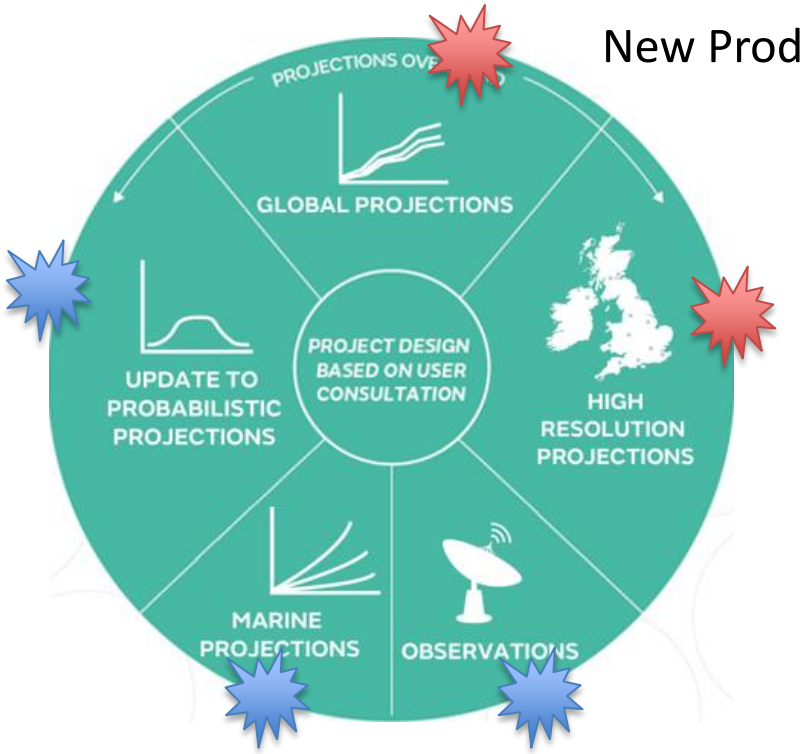
UKCP18 Project



New Products

Update from UKCP09

*no weather generator in UKCP09

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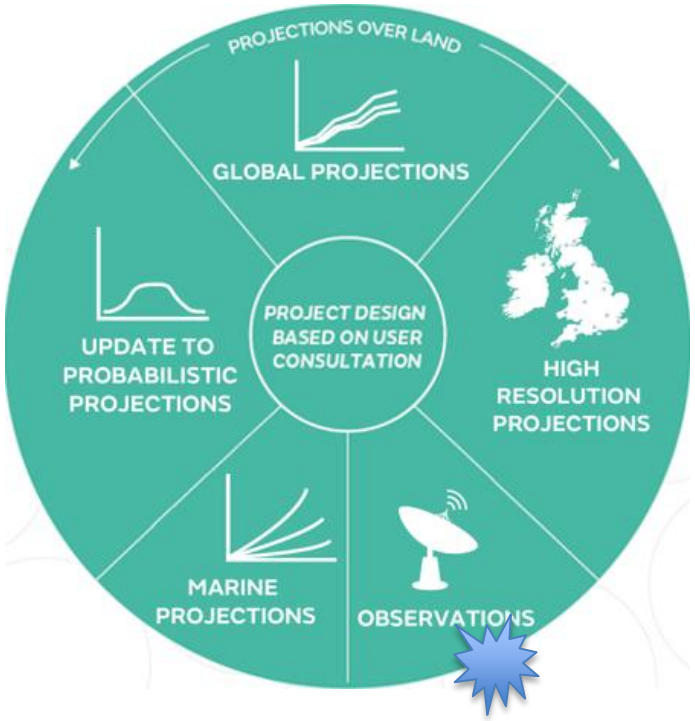
UKCP18 Observations



- State of the UK Climate Report
- **Data** on a 5km uniform grid and predefined admin regions and river basins
- Some data sets cover late 19th century to present day
- Daily, monthly, seasonal, annual and long term averages.
- **Open licence, free to use** commercially, accessible alongside climate projections
- **Updated annually**

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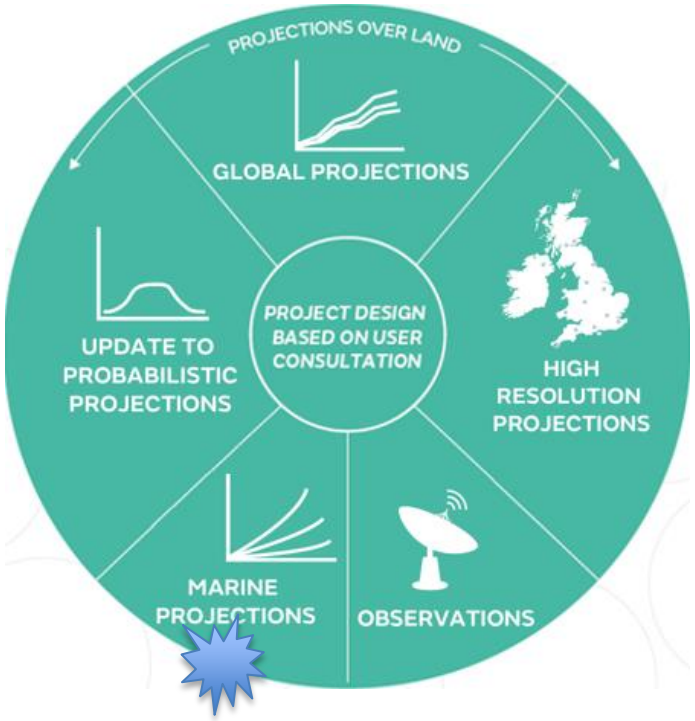
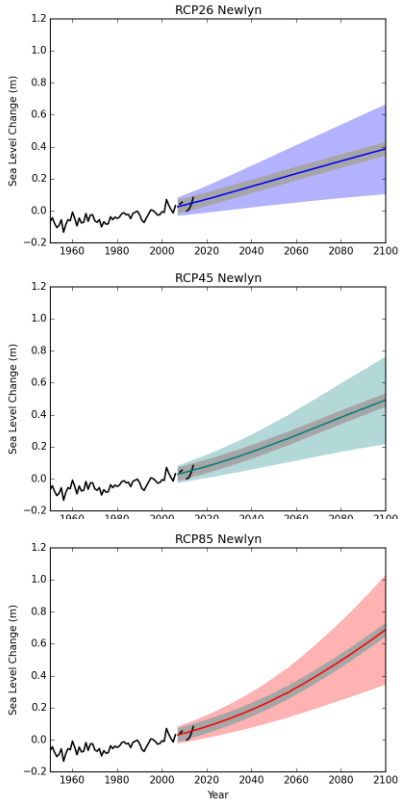
UKCP18 Marine Projections





- Projections extending to 2100
- Year to year changes in **sea level rise** and plausible **H++ scenarios**
- Updated **storm surge projections**
- Historical case studies placing actual historical storm events in future sea levels.
- Metrics: Sea level rise, storm surge

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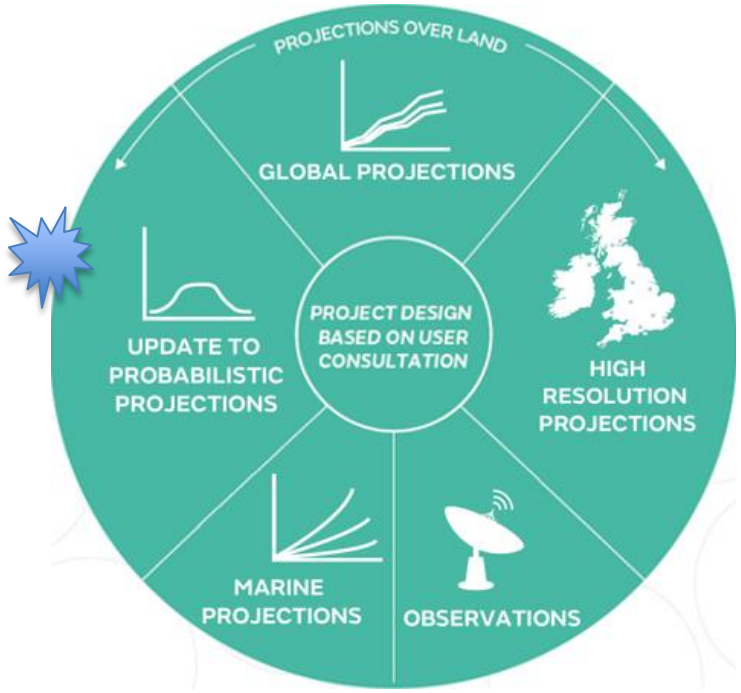
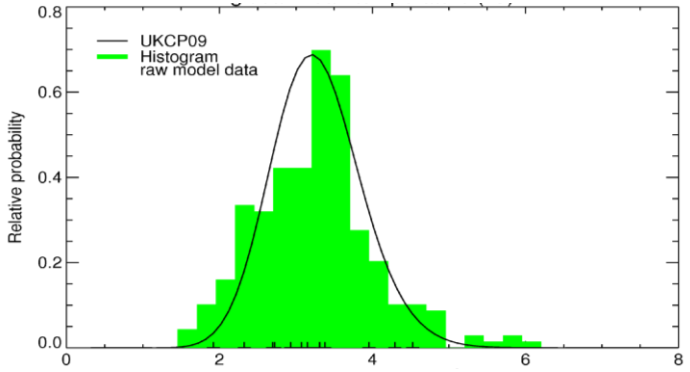
UKCP18 Probabilistic Projections over Land



- Updating the pdfs
  - New updated estimate of the spread of future climate outcomes at 25km
- Taking account of:
  - Most recent IPCC model analysis
  - New observations
  - Improved approach



Emissions scenarios (A1FI, A1B, B1)→ RCPs (8.5, 6.1, 4.5, 2.6)

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UKCP18 Probabilistic Projections over Land

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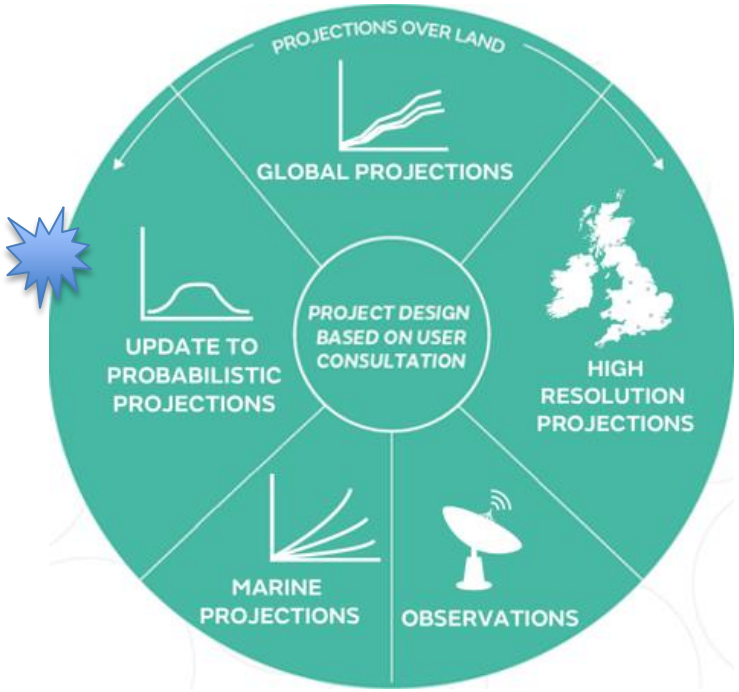
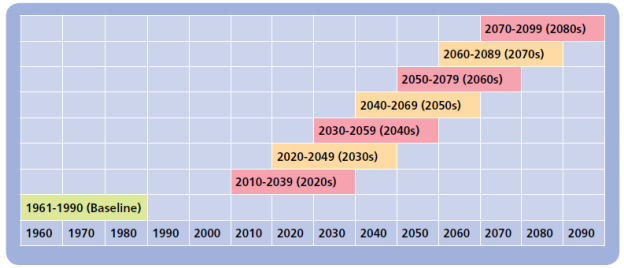
supporting climate change resilience



Single-year projections rather than 30-year means



New for UKCP18: reprocess with 1-year means, **leaving the variability in:**

The importance of including variability in climate change projections used for adaptation

David M. H. Sexton* and Glen R. Harris

The Scottish Government

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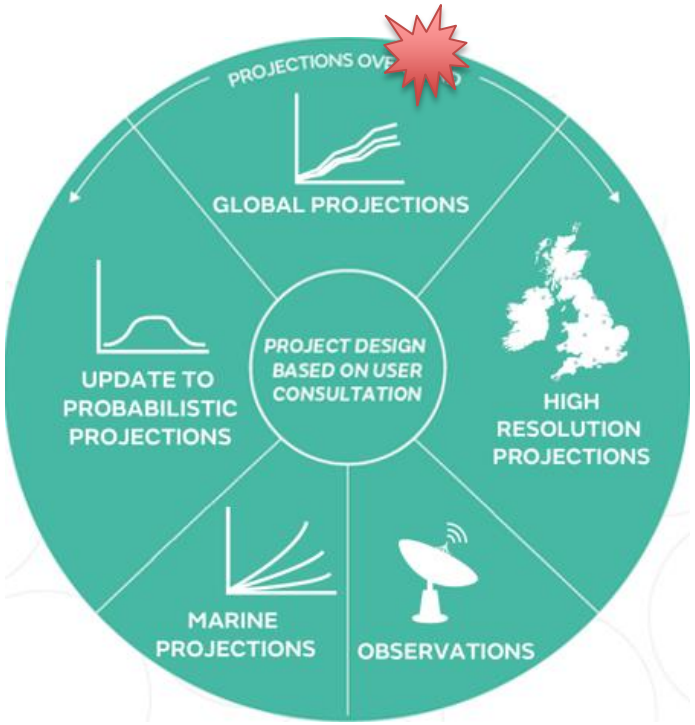
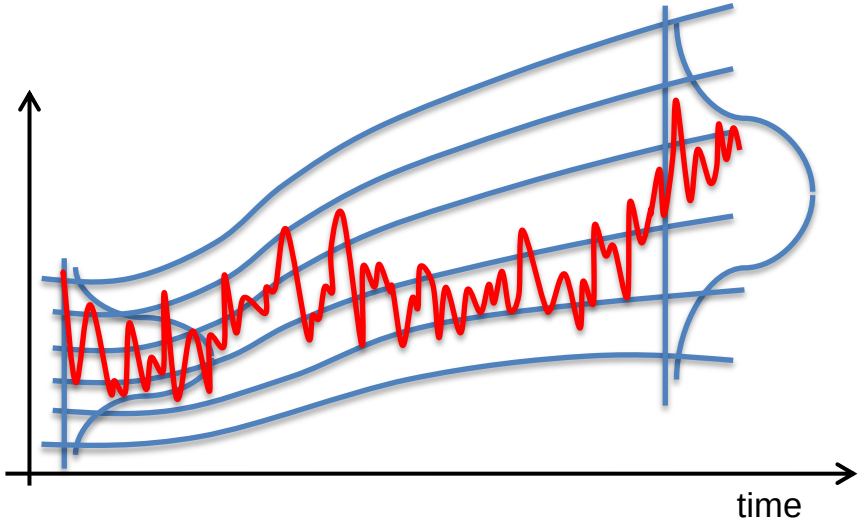
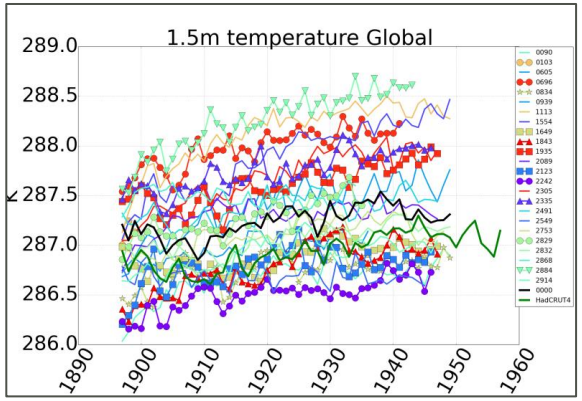
UKCP18 Global Projections



- We will produce approx. 20 realisations of HadGEM3
- 60km scale global realisations of future climate





20 x plausible global realisations at 60km

→ Input to impact models + storylines

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UKCP18 High Resolution Projections

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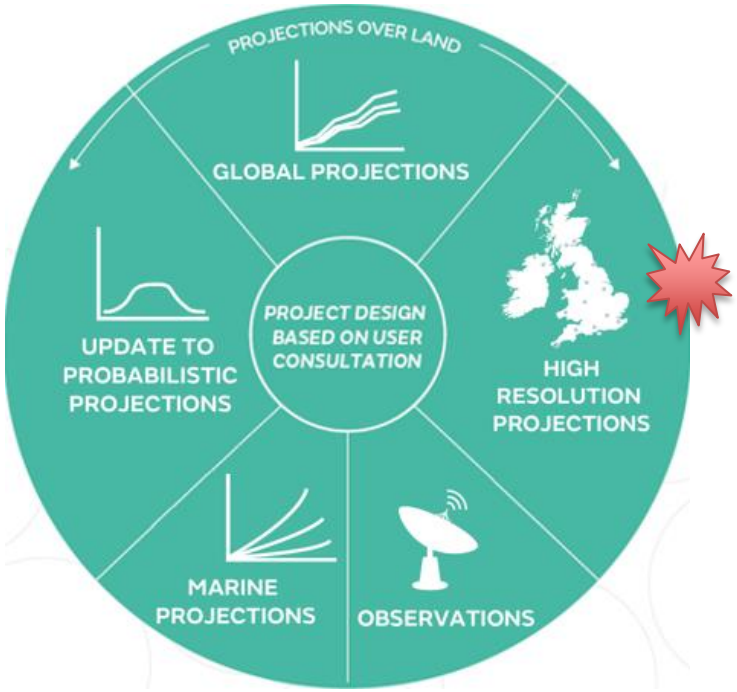
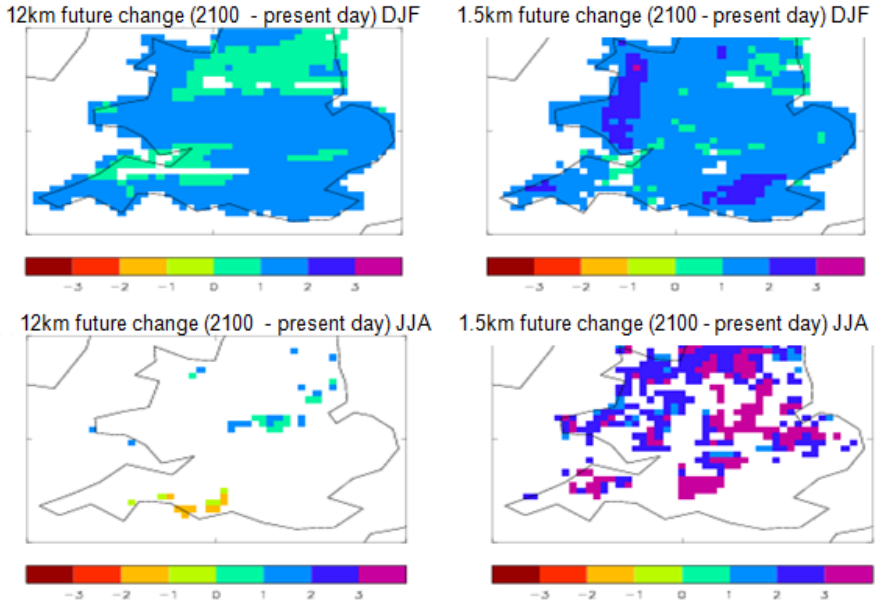
supporting climate change resilience



Downscaling at the convection-permitting scale

New physically downscaled estimates at better than 5km scale

Improved representation of fine-scale convective processes



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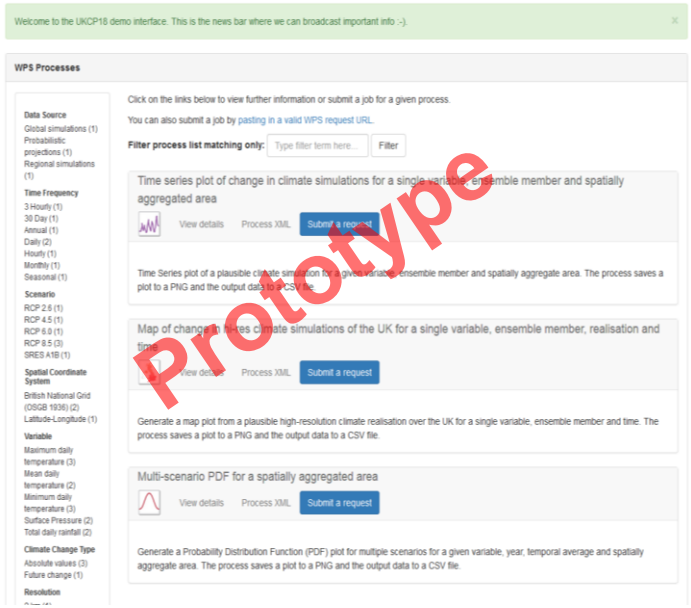
Accessing UKCP18 Data

Adaptation Scotland
supporting climate change resilience

Interactive interface



CEDA Data catalogue

Script access through API

http://wps-web1.ceda.ac.uk/wps?
Request=Execute&
Identifier=ExtractUKStationData&
Format=text/xml&
Inform=true&Store=false&Status=false&
DataInputs=
StartDateTime=2015-11-09T13%3A38%3A36;
Obs=TempDiurnal;
BBox=-12.00%7C49.00%7C3.00%7C61.00;
EndDateTime=2016-08-01T00%3A00%3A00;

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UKCP18 + Adaptation Learning Exchange

How are we going to use UKCP18?

What do we need to do to get ready?

The Scottish Government

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Progress update

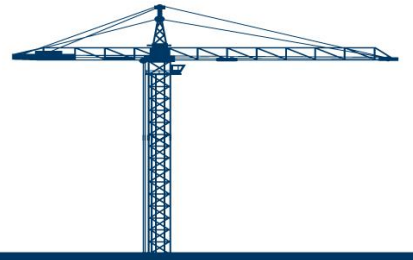
Adaptation Learning Exchange

12 March 2018

ClimateReadyClyde

Climate Ready Clyde

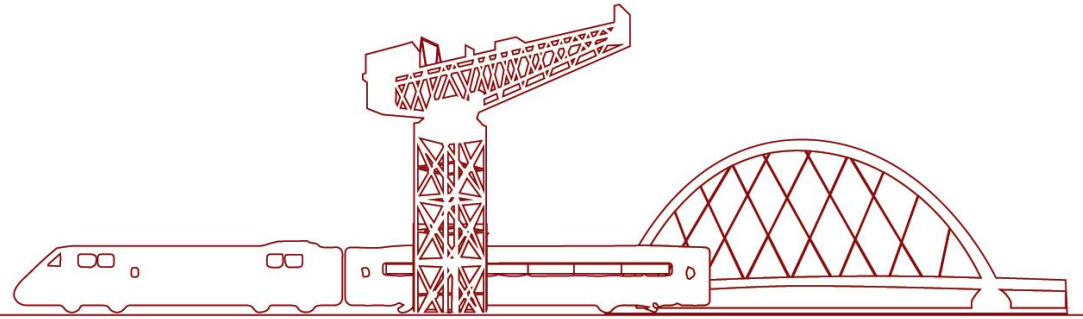
- A 3 year, initiative to support Glasgow City Region to meet the challenges of changing rainfall, and rising temperatures and seas.
- Aims to build a shared understanding across public, private and voluntary sector of climate risks and opportunities, and collaborate to implement actions and share responsibility



What it will deliver

- Climate Risk and Vulnerability Assessment (CRVA) - synthesis of new and existing evidence
- Vision, Strategy and Action plan
  - Supported by Cost/Benefit Analysis and Strategic Environmental Assessment
- Strategic leadership and advocacy for the adaptation agenda
- Tools, guidance and training to support implementation

Who's involved?



SEPA Scottish Environment Protection Agency

South Lanarkshire Council

West Dunbartonshire Council

North Lanarkshire Council

SPT

Scottish Government
Riaghaltas na h-Alba
gov.scot

East Renfrewshire Council

Transport Scotland
Còmhdhail Alba

NHS Greater Glasgow and Clyde

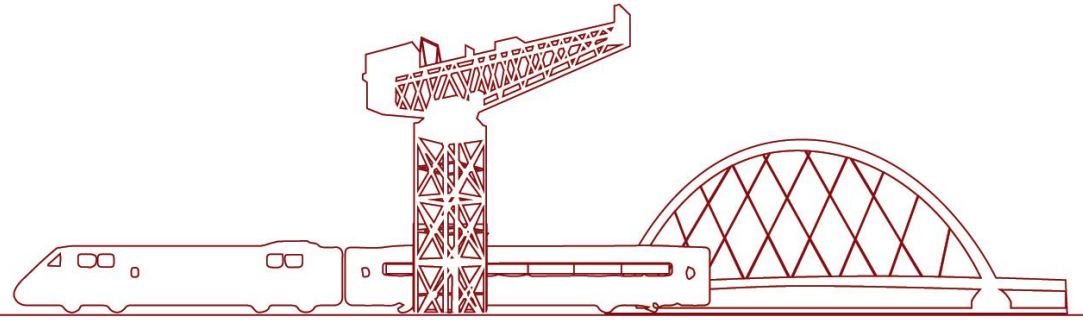
East Dunbartonshire Council

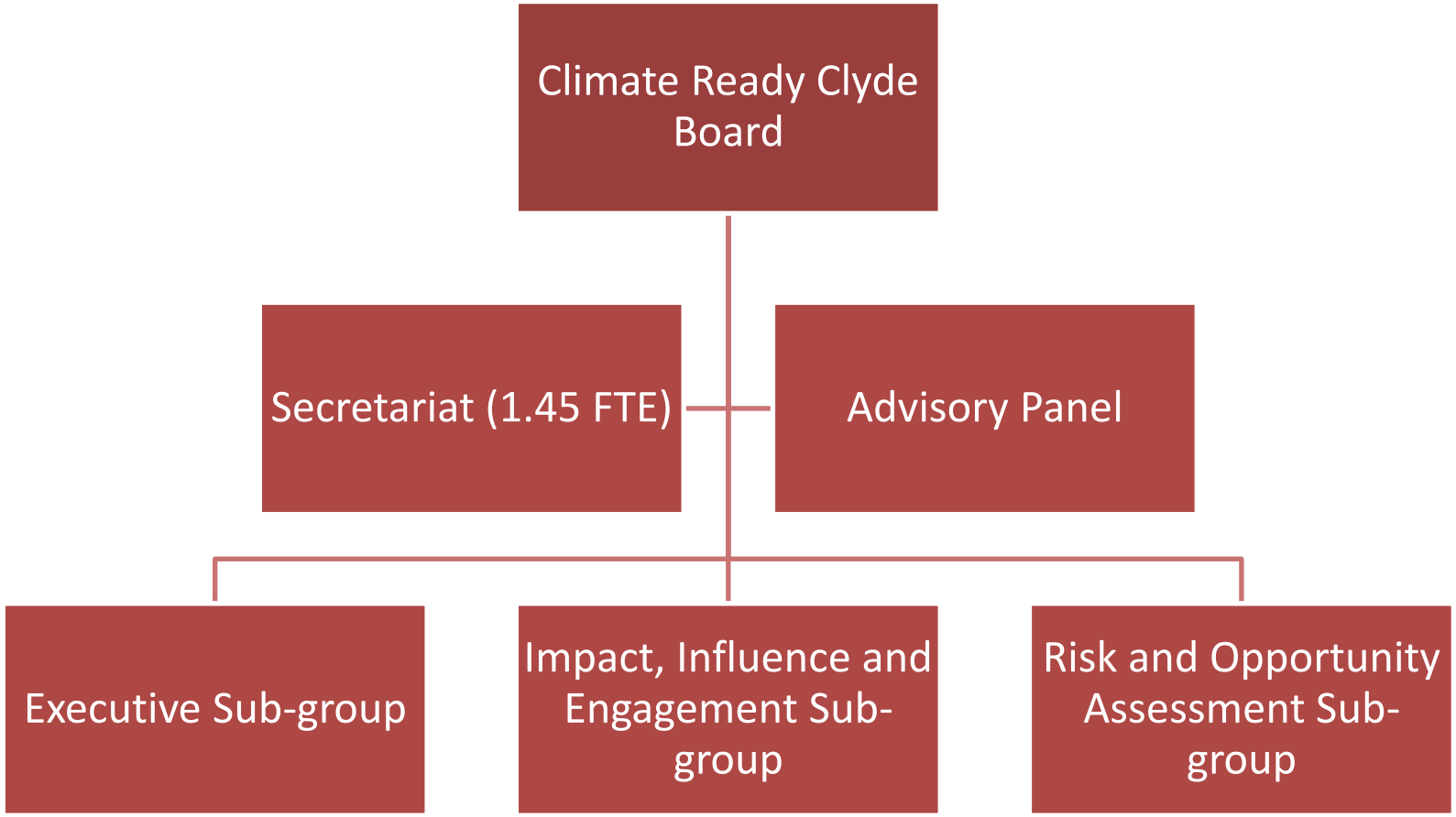
Glasgow City Council

University of Glasgow

University of Strathclyde Glasgow

Governance



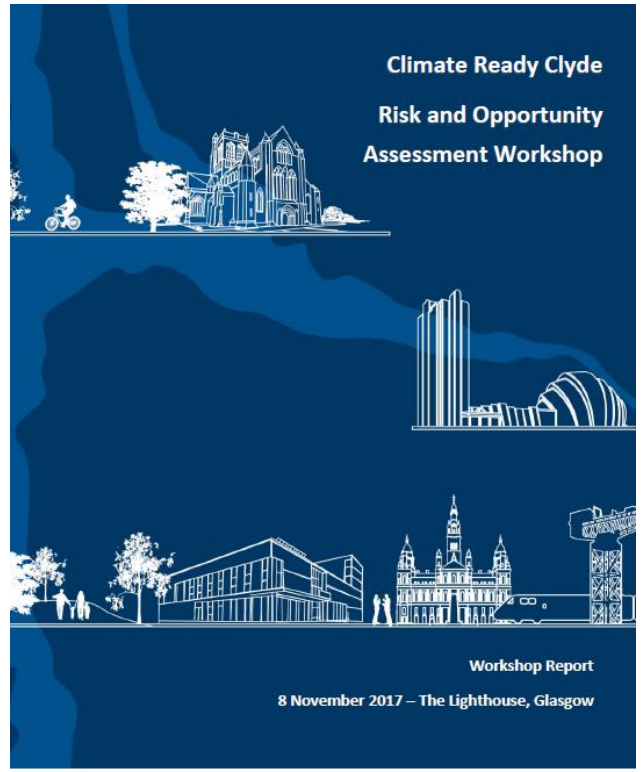

Climate Ready Clyde Board
Secretariat (1.45 FTE)
Advisory Panel
Executive Sub-group
Impact, Influence and Engagement Sub-group
Risk and Opportunity Assessment Sub-group

Governance

- Successful first year. Grant funding crucial to get collaboration underway
- Not without it's challenges! Careful, meaningful stakeholder management required
- Route to continued collaboration w. Sniffer more tricky due to public procurement – pooling of funding = over OJEU threshold so full procurement underway for secretariat support
- Now reviewing Terms of Reference, and risk register
- Differing levels of risk appetite/views/levels of seniority – and therefore appetite for progress
- New partners – SEPA (particular focus on SGA), but also discussing with SPEN/ SGN

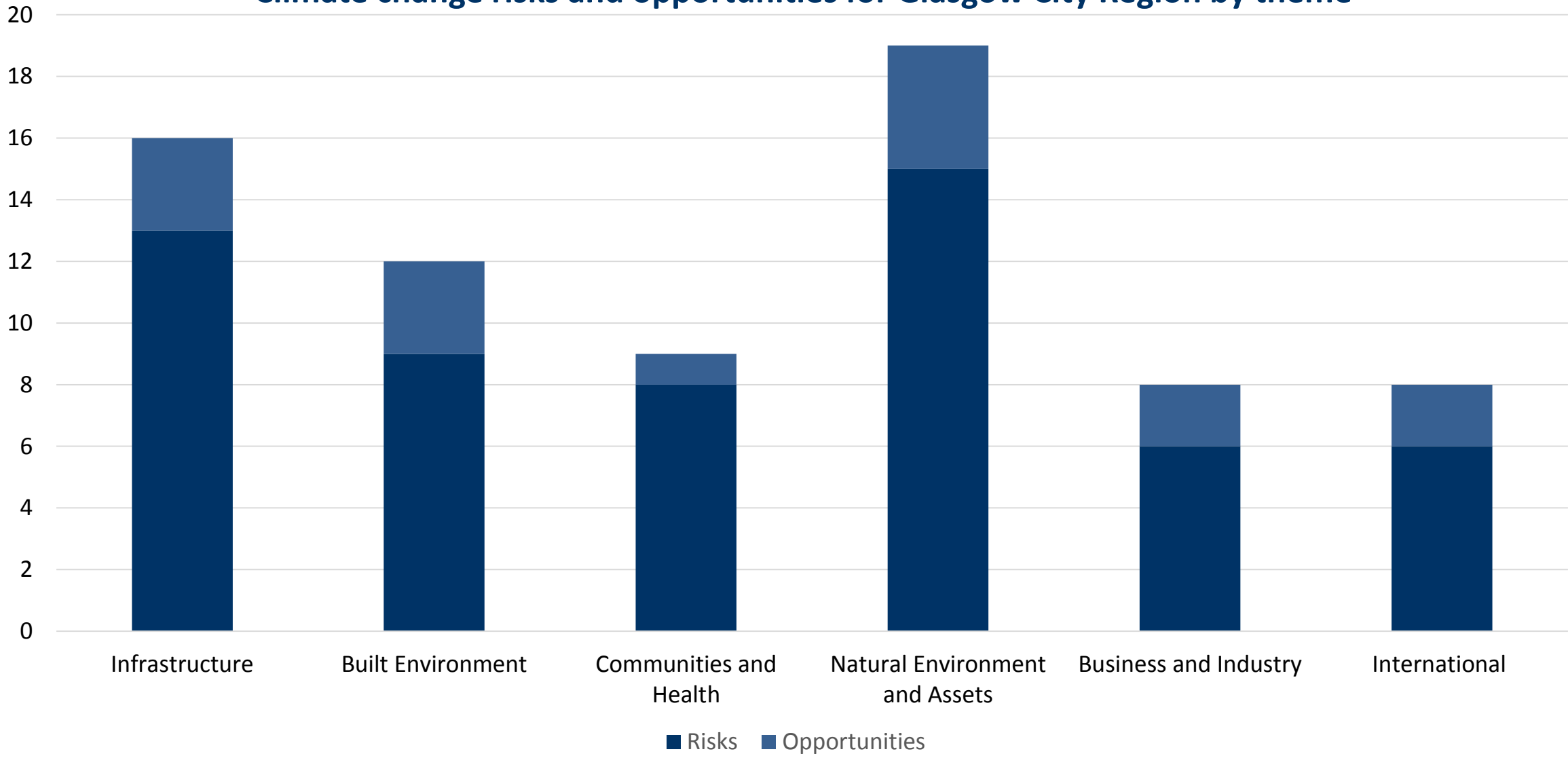
Risk Assessment and Strategy / Action Plan

- Desk-based evidence review complete, and stakeholder workshop held
- Technical write-up and informal consultation underway
- Also planning launch, comms approach and City Region Cabinet sign-off
- An evolving methodology – e.g. scoring – need to be flexible and trial new approaches
- Will ‘never be finished’ – so have to be disciplined about progress!
- Begun scoping strategy and action plan – SEA requirements, financing options etc



ClimateReadyClyde

Climate change risks and opportunities for Glasgow City Region by theme



Climate Leadership

- Regional
  - Continued advocacy of / support for climate adaptation in City Region City Deal
- National
  - Inputting into development of Second Scottish Climate Change Adaptation Programme
  - Sharing experience and insights through the Adaptation Learning Exchange
- UK
  - Responding to current consultation on Adaptation Reporting Power
  - City Region featured in forthcoming ASC publication on ‘what works’ in cities
- International
  - ISO Working Group – Inputting into development of international adaptation standards in partnership with WSP and Mott Macdonald
  - Showcasing our approach at Open European Day, Bonn, April 2018

Capacity Building and Support

- Ongoing support for adaptation strategies and mainstreaming with Glasgow City Council, University of Glasgow, East Dunbartonshire Council, South Lanarkshire Council, and SPT
- Standard input into Public Sector Reporting duties
- 3-month industrial placements for 4 organisations with University of Strathclyde
- ClimateJust training event
- Probably one of the most important aspects early on – given longer timescales for Risk Assessment, but this is changing

‘Climate-Resilient Economy’ Framework

GLASGOW CITY REGION City Deal

Regional Economic Strategy

EVIDENCE BASE

Economic implications of Climate Change for Glasgow City Region

- Assessment of impacts on GVA to 2050/2080
- Cost/benefit of adaptation options

COACCH
CO-DESIGNING THE ASSESSMENT OF CLIMATE CHANGE COSTS

Baselining the Adaptation Economy

- Adaptation sales, jobs and GVA in City Region economy + growth forecasts to 2022
- Scottish, UK and International Comparators

TOOLS AND SUPPORT

Climate Risk Screening Toolkit

- Tools and guidance to support assessment of climate impacts in project development
- High level vulnerability assessment conducted

Draft City Region City Deal Business Case Guidance

- Requirements for adaptation assessments at stages of Business Case

Study Steps and Methods

- Analysis of current economic costs of current climate variability in the Glasgow City Region – looking at 3 significant historic climate events in Glasgow City Region
- Analysis of future impacts and economic costs of medium (2050s) and long-term (2080) climate change in Glasgow City Region, including uncertainty;
- Mapping of risks and opportunities for priority business sectors, including indirect linkages;
- Analysis of early priorities for adaptation, identifying measures across three priority areas for early adaptation:
  - exploiting low-regrets; avoiding lock-in; addressing long lead times;
- Analysis of the costs and benefits of early priorities.

	CURRENT		2020s	2050s	2080s
THEME 1 - INFRASTRUCTURE					
Risks of cascading failures from interdependent infrastructure networks					
Risks to Glasgow Airport buildings and surfaces from groundwater flooding.					
Risks to Scottish Power Energy Networks sub-stations from surface water flooding.					
Risks to Scottish Gas Networks Pressure Reducing Installations (PRIs), pipelines and supporting infrastructure from flooding					
Risks to road network from river, surface water and groundwater flooding.					
Risks to rail network from river, surface water and groundwater flooding					
Risks to Scottish Power Energy Networks sub-stations from coastal flooding.					
Risks to road network from coastal flooding and erosion.	-L		-L	-L	-M
Risks to road and rail from coastal flooding and erosion.					
Risks of sewer flooding due to heavy rainfall					
Risks to bridges and pipelines from high river flows and bank erosion					
Risks to road network from slope and embankment failure.					
Risks to rail network from slope and embankment failure.					
Risks to hydroelectric generation from low or high river flows					
Risk to Scottish Power Energy Networks underground cables from drought leading to ground movement.					
Risk to railway embankments from changes to freeze-thaw cycles					
Risks to Glasgow Airport infrastructure from fracture and subsidence					
Risks to public water supplies from drought and low river flows	-L		-L	-L	-L
Risks to electricity generation from drought and low river flows	-L		-L	-L	-L
Risk to Scottish Power Energy Networks sub-stations from storms and high waves					
Risks to rail network due to high winds and waves.	-M				
Risks to Glasgow Airport from storms (including high winds and lightning)					
Risks to offshore infrastructure from storms and high waves					
Risks to Scottish Power Energy Networks cables, transformers, sub-stations, and network access from extreme heat					
Risks to road network from extreme heat.	-L		-L	-L	-L
Risks to rail network from extreme heat.	-L		-L	-L	-L
Risks to Scottish Power Energy Networks cables from ice forming on the lines will be reduced if extreme cold events become more rare					
Increased possibility of flights from Glasgow Airport due to reduced fog and snow					
Risks to Energy infrastructure from increase in vegetation growth rates/longer growing season.					
Risks to Rail network from increase in vegetation growth rates/longer growing season.					
Risks to infrastructure from wildfires					
THEME 2 - BUILT ENVIRONMENT					
Risks to domestic buildings from flooding	-H		-M	-H	-H
Risks to non-domestic buildings from flooding	-H		-H	-VH	-VH
Risks to Historic Environment Scotland properties in care from landslides, flooding or Coastal Erosion					
Risk to the wider privately owned historic environment					
Increased use of public parks due to warmer weather					
Increased maintenance of green space due to warmer weather	-L				
Increased opportuities for Community Gardens and Food growing from warmer temperatures and extended growing season					
Reduced heating demand to buildings from rising temperatures	-VH		-VH	-VH	-VH
Increased cooling demand in buildings from rising temperatures			-L	-L	-L
Risks to domestic properties from Sea level Rise	in flooding above				
Risks to non domestic properties from Sea Level Rise	in flooding above				
THEME 3 - COMMUNITIES AND HEALTH					
Risks to people and communities from flooding	in flooding above				
Risks to health and wellbeing from high temperatures	-L		-M	-M	-M
Increase in summer temperatures and heatwaves leading to excess summer deaths	-L		-M	-M	-M
Potential benefits to health and wellbeing from reduced cold			-H	-H	-H

Analysis of coverage and size of potential risks (good evidence)

-L	Low	<£1 million/yr
-M	Medium	£1 - 10 million/yr
-H	High	£10 - 50 million/yr
-VH	Very high	>£50 million/yr

-L	Low	<£1 million/yr
-M	Medium	£1 - 10 million/yr
-H	High	£10 - 50 million/yr
-VH	Very high	>£50 million/yr

Overall economic damages

- Gross Value Added (GVA) in 2014 was ~ £40 billion
- Economic costs for low-central scenario >£100 M/yr for 2050; >£200M/yr 2080 (~0.5% current GVA)
- Economic costs for high scenario >£200 M/yr for 2050; >£500M/yr 2080 (~1.3% current GVA)
- Dominated by flood related impacts (coastal, river, urban) – domestic, non-domestic, infrastructure
- Additional impacts from many smaller impacts, but unlikely to affect the macro-picture
- And also large economic benefits, notably from reduced winter heating, reduced winter mortality – approximately same order or magnitude as impact but accrue to households

Valuation - Built environment

- Domestic flooding (coastal, river, surface) - CCRA2 (Sayer et al, 2016)

Clyde and LL		
Properties at risk of flooding >1 in 75		
	Current	2080
2C	31,000	34,000
4C	31,000	41,000

Clyde and LL		
Expected Annual Damage (£)		
	Current	2080
2C	£12,000,000	£19,000,000
4C	£12,000,000	£29,000,000

Note FRMS indicate 35500 properties at risk but current EAD£67 million, so higher

- Social vulnerability - one third (11000) properties in deprived areas, rising to 13000 – 15000 in future.

- Those living in flood prone areas in Scotland experience high EAD per person (on average, £113 per person); this is over double that of England, and by 2080 rise £183 per person (high) and the risk in social vulnerable areas rises twice as fast (JRF)

- Issue of impacts of major event (1 in 100/200) – rather than EAD - multiplier effects, political risks

- Hallegatte 1 in 100 year coastal flooding event in Glasgow = $1757M (no protection)
- . Mean annual losses from event go from $4M to $95M - $824M by 2050 (low-high)

Valuation - Built environment

- Warmer temperature will bring benefits in lowering winter heating demand and reducing household energy bills (note household benefit not economic value)

- Higher benefits in Scotland as current HDD higher - Positive distributional effects (fuel poverty, household expenditure on fuel)

Average household saving (£/year)

	2020s	2050s	2080s
Low	40	61	115
Central	92	143	217
High	144	241	354

Total Glasgow City Region benefits (£) to households

	2020s	2050s	2080s
Low	35,311,431	53,775,621	100,991,213
Central	80,667,975	125,428,366	189,895,953
High	125,773,945	210,522,311	309,877,329

- Cooling demand in Scotland is low (>10 CDD) – looking forward, extreme year only 80 CDD (HDD 3000)
- Some extra demand for cooling but low = days>25C: from 4 to 10–40 in 2080, days>30C = zero in 2080
- Typical thresholds for indoor overheating 28C – studies indicate currently >0.5% of time for Glasgow
- Could still be important if strong increase in heat wave risk and UHI plus local non-acclimatisation

HDD are defined as the sum of the difference between 15.5^{o}C and daily mean temperature, on days at which mean temperature is below 15.5^{o}C only. CDD 22C

Valuation - Communities and health

- City region - Heat related mortality low economic vale, if assume period of life lost short

GC Region Numbers fatalities from heat/year			
	2020s	2050s	2080s
Low	12	27	43
Central	28	57	94
High	50	108	185

Valuation (£/year) (VOLY)			
	2020s	2050s	2080s
Low	400,165	894,652	1,453,067
Central	930,722	1,903,482	3,155,265
High	1,681,314	3,626,617	6,216,384

Valuation £/year) (VPF)			
	2020s	2050s	2080s
Low	22,508,703	50,322,839	81,732,847
Central	52,351,697	107,068,032	177,478,944
High	94,571,392	203,991,804	349,662,326

- City region - Heat related morbidity and hospital admissions

GC Region Numbers fatalities from heat/year			
	2020s	2050s	2080s
Low	1216	2718	4414
Central	2827	5782	9585
High	5107	11017	18884

Valuation £/year)			
	2020s	2050s	2080s
Low	850,351	1,901,136	3,087,767
Central	1,977,783	4,044,900	6,704,938
High	3,572,792	7,706,562	13,209,817

- But may underestimate heat island and heatwave – one study projects that heatwaves in Glasgow (>26C, 3d) will be a 1 in 3 year event by the 2050s - and issue of Urban Heat Island effect
- National Severe Weather Warning versus Heat Health Watch (28/15) but additional costs on health services (professionals, hospitals) – increase each time triggered
- Additional costs - mental health & flooding, deaths and fatalities, AQ, vector borne, food, infrastructure
- But avoided cold related mortality benefits are larger (approx. double heat mortality)

Kit England

Climate Ready Clyde Project Manager
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E: kit@sniffer.org.uk
@kitengland / @ClimaReadyClyde

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David Charles – Strathclyde University

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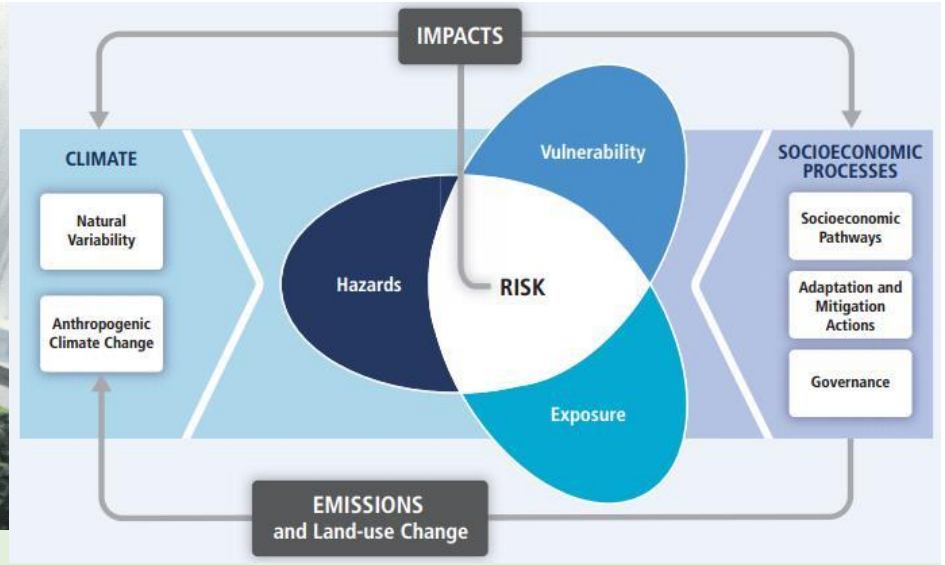
Adaptation Progress - Last year

Module 3. Assess Vulnerabilities



Use this template to plot the outputs of your sensitivity and exposure assessments. This will give you a view on the most important vulnerabilities that you should address in your project.

3a - Vulnerability to Current Climate

Sensitivity	Low	Medium	High
High	Extreme rainfall change Ground instability / landslides	Extreme temperature increase	
Medium	Water Availability Soil Erosion Air Quality Urban Heat Island	Incremental Air Temperature increase Storms	
Low			
	Exposure		

3b Vulnerability to Future Climate

Time Period: 2050s (2040 - 2069)

Sensitivity	Low	Medium	High
High		Extreme rainfall change Ground instability / landslides	Extreme temperature increase
Medium	Soil Erosion	Incremental Air Temperature increase Water Availability Air Quality	Storms Urban Heat Island
Low			
	Exposure		

Adaptation Pipeline - Coming Year

Living Laboratory for Sustainability

Strathclyde Campus as a Living Laboratory for Sustainability

Risk Management Framework

University of Strathclyde Glasgow

WE ARE
SUSTAINABLE
STRATHCLYDE

www.strath.ac.uk/sustainablestrathclyde
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twitter.com/Strath_Eco

Adaptation Barriers

- Lack of awareness of CCA activity in the sector.
- Financial constraints on capital projects.
- Responsibility often falls to an individual or team within organisations.

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Graham Esson – Perth and Kinross Council

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INTRODUCTION

- What have we done so far?
- Future Events and Activities

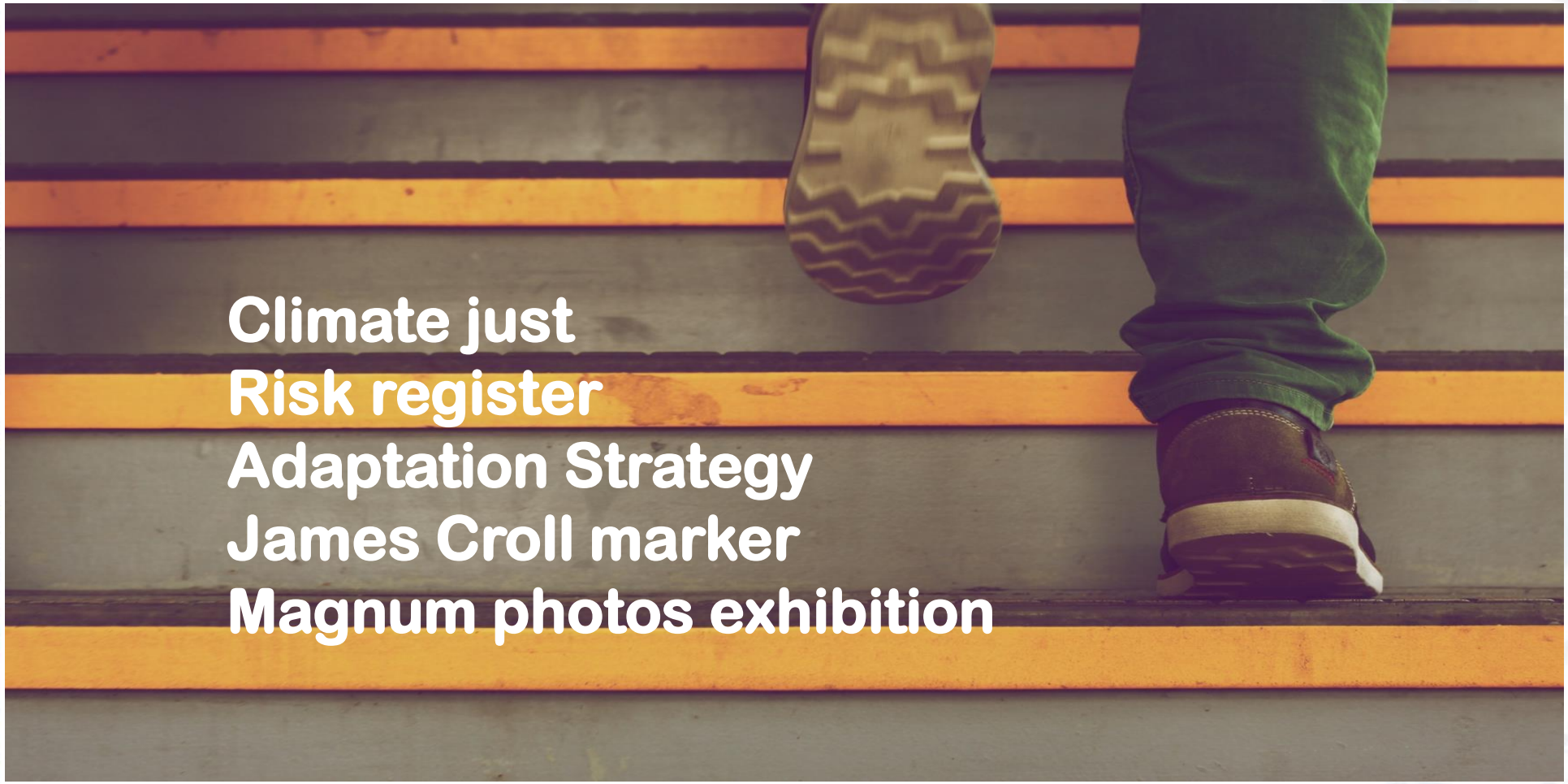
Working with communities guiding principle:

" tell me and I will forget
Show me and I might remember
Involve me and I will understand"

Confucius

Carse of Gowrie – development of toolkit, community mapping,
Strathearn- engagement using toolkit
Dunkeld –engagement using toolkit and Whole Earth exhibition
UHI, Perth college
Blairgowrie – community engagement

Next Steps



Climate just
Risk register
Adaptation Strategy
James Croll marker
Magnum photos exhibition

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Hayley Williamson – Fife Council

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Ruth Monfries – Royal Botanic Garden Edinburgh

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ASSESSING AND ADAPTING TO THE IMPACT OF PAST WEATHER EVENTS IN THE HORTICULTURE SECTOR

Royal Botanic Garden Edinburgh

Case study: Royal Botanic Garden Edinburgh

Horticulture and visitor services staff at the Royal Botanic Garden Edinburgh (RBGE) and its Regional Gardens are already adapting to climate uncertainty – dealing with floods, prolonged periods of low rainfall, unseasonable temperatures and high winds. This case study looks at the process used to investigate the impact of weather events across the different gardens and how this can be used to best deal with projected climate change.

Scotland's changing climate

We are already seeing evidence of Scotland's climate changing. Over the last few decades our climate has warmed, sea-levels have risen, rainfall patterns have changed and we have been impacted by extreme weather events. These changes are projected to continue in the decades ahead.

The UK Climate Projections 2009 data suggests that, for Scotland:

- the average climate will become warmer throughout the year;
- rainfall is likely to become more seasonal with
  - a typical summer becoming drier, and
  - a typical autumn and winter becoming wetter; and
- sea levels will rise.

We can also expect to see:

- increase in summer heat waves, extreme temperatures and drought;
- increased frequency and intensity of extreme precipitation events; and
- reduced occurrence of frost and snowfall.

Source: ukclimateprojections.metoffice.gov.uk

Adaptation Scotland

The process

1. **Getting people on board**
   The first action was to meet with the garden curators to explain the aim of the project, how it would be of value, and the output that would be produced.

2. **Gathering information**
   Next, visits to each garden were arranged to interview key personnel and gather information on:

   - observed impacts of current weather conditions and extreme weather experienced, and any adaptive actions taken as a result;
   - risks related to weather or climate change that have been identified;
   - potential opportunities arising from a changing climate; and
   - records of garden closures to visitors and staff and historic weather data.

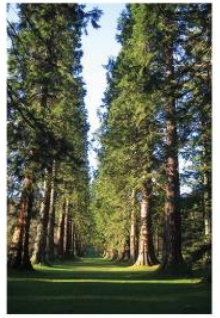
3. **Site visit**
   At each garden, the curator also did a walk round to explain the garden features and see weather impacts and adaptive actions first-hand. Visitor services staff, who are well placed to see the impact of weather events on visitors, were also consulted.

The Gardens

The Royal Botanic Garden Edinburgh was established in 1670.

During the 20th century it acquired three Regional Gardens. The four gardens experience quite different weather conditions; Inverleith in Edinburgh is the driest, Dawyck the coldest, Benmore the wettest and Logan the mildest. Together they represent one of the world's largest living collections of plants.

Across the different Gardens, most kinds of extreme weather have been experienced.



RBGE has presented this information as part of the Adaptation Learning Exchange (ALE).
The ALE was set up by Adaptation Scotland to support the public sector plan for the impacts of a changing climate.

Royal Botanic Garden Edinburgh

Ruth Monfries, RBGE

Edinburgh Adapts
Working in partnership

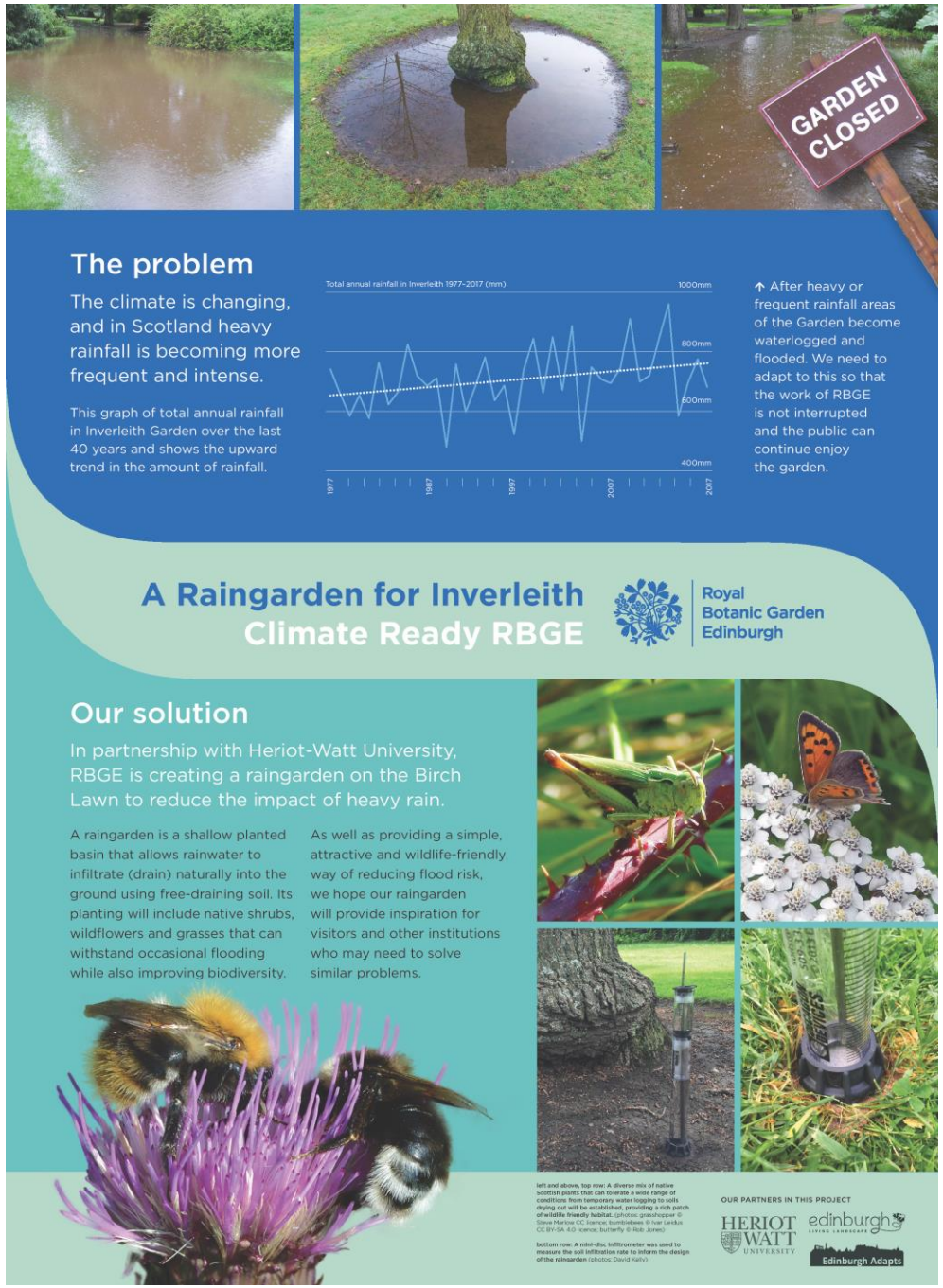
Raingarden project

Building a raingarden to reduce waterlogging and pavement flooding

Royal Botanic Garden Edinburgh

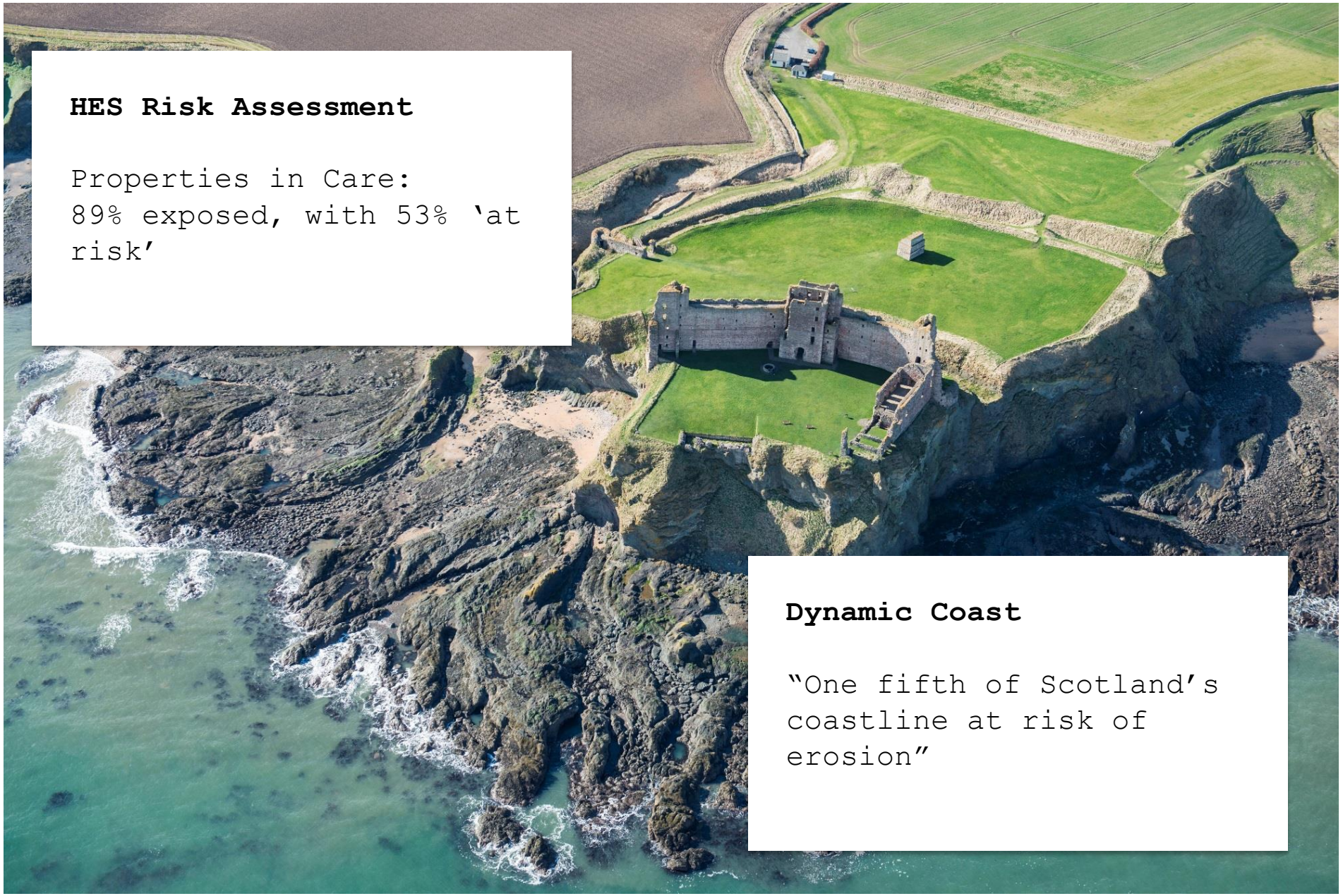
HERIOT WATT UNIVERSITY

Edinburgh Adapts



Communicating Research into Climate Change Risk

1. A difficult message from the research



HES Risk Assessment

Properties in Care:
89% exposed, with 53% ‘at risk’

Dynamic Coast

“One fifth of Scotland’s coastline at risk of erosion”

2. A successful launch…

The Guardian kicked off the media response as they had a one week exclusive on the report.

The story was picked up by the BBC.

Herald View:

"The depth of research and knowledge shown by HES researchers, meanwhile, puts Scotland at the forefront of the global challenge to protect and adapt our historic environments for the future."

Greenpeace ✓
@Greenpeace

Follow

We all know that climate change is threatening our future.

But it could wipe out our past too.

Scotland's historic sites at high risk from climate change, report says

Exclusive: Many of the country's most famous ancient sites, from Holy
the Neolithic village of Skara Brae, need urgent protection, say experts

theguardian.com

4:00 PM - 19 Jan 2018

130 Retweets **165** Likes

2 130 165

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Climate Ready Clyde @ClimaReadyClyde · Jan 17

A fantastic piece of work which has really helped us in placing the historic Environment in our work to assess climate change risks and opportunities for the City Region.

HistoricEnv Scotland ✓ @HistEnvScot

Today we published our ground-breaking report which outlines the climate change risk to our historic sites & how this will help us manage & protect them
ow.ly/xA5i30hMIEJ

3 6

You Retweeted

Stefan Simon @mcsts · Jan 17

This "report places #Scotland at the forefront of the global challenge to tackle #ClimateChange " -not surprising, kudos 2 @HistEnvScot @HESEngineShed #CulturalHeritage #Preservation

HistoricEnv Scotland ✓ @HistEnvScot

Today we published our ground-breaking report which outlines the climate change risk to our historic sites & how this will help us manage & protect them
ow.ly/xA5i30hMIEJ

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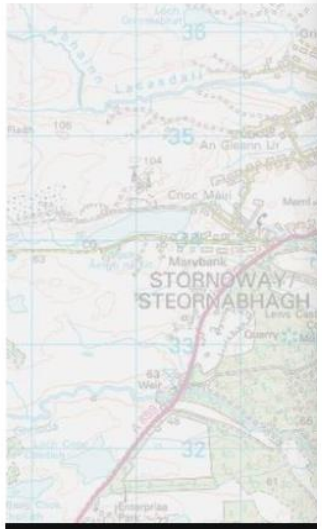
Erosion risk to
scientists say

4 August 2017



The Dynamic Coast project drew up p

Almost a fifth of Scotla
property and infrastru

A group of experts studi
predictions for the next

The Dynamic Coast pro
maps and a million data

Environment Secretary
probably get worse, and

INDEPENDENT News InFact Politics Voices

Environment

Trump's golf resort in Scotland 'could face severe flooding' due to climate change, study warns

Research predicts coastline will recede by tens of metres by 2050

Caroline Mortimer | @cjmortimer | Sunday 5 November 2017 14:48 GMT | 15 comments

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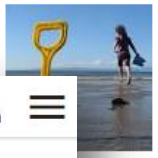
Donald Trump playing at his golf course at its grand opening in 2012 *Getty Images*

Donald Trump's controversial Aberdeenshire golf course is one of many



Erosion threatening a fifth of **Scottish coastline**, experts warn
Herald Scotland - 4 Aug 2017
Nearly a fifth of **Scotland**'s coastline is under threat of erosion over the next three decades - with property and other developments worth up to £400 million potentially in danger from rising sea levels. That was the key finding of a study on the impact of climate change and **coastal erosion** over the period up ...

New mapping tool highlights threat to **Scottish coastline**
The Planner - 10 Aug 2017
The potentially devastating effects of climate change and **coastal erosion** have come to light after experts from the **Scottish** Government, **Scottish** Natural Heritage (SNH) and the University of Glasgow studied coastlines dating back to the 1890s, to plan for the future of **Scotland's** coastal landscape.

eals risk to Scotland's coastline
y Gazette - 11 Aug 2017
ifth of Scotland's coastline is at risk of erosion, threatening some of the country's most prized **nfrastructure** within the next 30 years. The potentially devastating effects of climate change **tal erosion** came to light after experts from the **Scottish** Government, **Scottish** Natural

Revealed: climate change and the terrifying risk to **Scotland**
Herald Scotland - 26 Aug 2017
THE Sunday Herald can today reveal the true extent of the threat posed to **Scotland** by climate change. Major parts of **Scotland's** vital infrastructure are under threat from **coastal erosion** and flooding, according to the latest government assessments of the dangers of climate change. Thousands of homes and ...

erosion website could help Wemyss Caves
y - 21 Aug 2017
d that a new online tool to track **coastal erosion** could be used to help preserve the historic **Caves**. ... "The new Dynamic Coast website is a good resource for measuring the rate of **erosion** across **Scotland**, and it certainly makes information on the issue more widely **e** and ...

Award-winning Dundee **beach** 'has to be protected' from **erosion**
Evening Telegraph - 9 Aug 2017
The coastal area of the Ferry has been identified as an area at particular risk of **coastal erosion**. According to a **Scottish** Government report, one-fifth of all of **Scotland's** coasts are at risk. The report describes the threat to the country's beaches from climate change and **coastal erosion** as "potentially ...

Climate change 'putting historic Scots sites at risk'
STV News - 4 Aug 2017
Scotland's natural heritage is under serious threat from **coastal erosion** caused by climate change, it has been warned. A fifth of **Scotland's** coastline is in danger, according to scientists, including the 5000-year-old Skara Brae settlement in Orkney. The Old Course is also at risk, although natural and ...

Dynamic Coast on STV News

Don Michele Restaurant - Italian Restaurant Dundee

Like This Page · 4 August 2017 ·

Thanks for the great night to the "experts" of www.dynamiccoast.com on STV TONIGHT at 10.

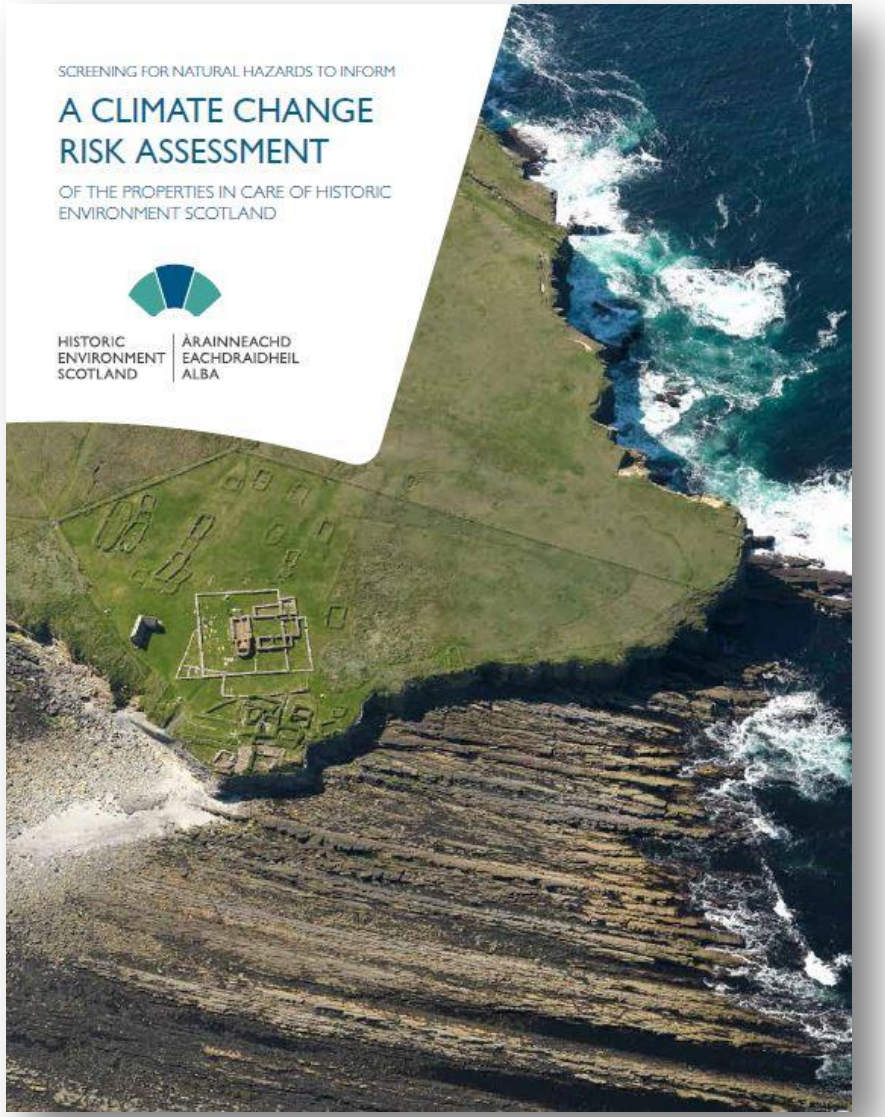
Like Comment Share

10

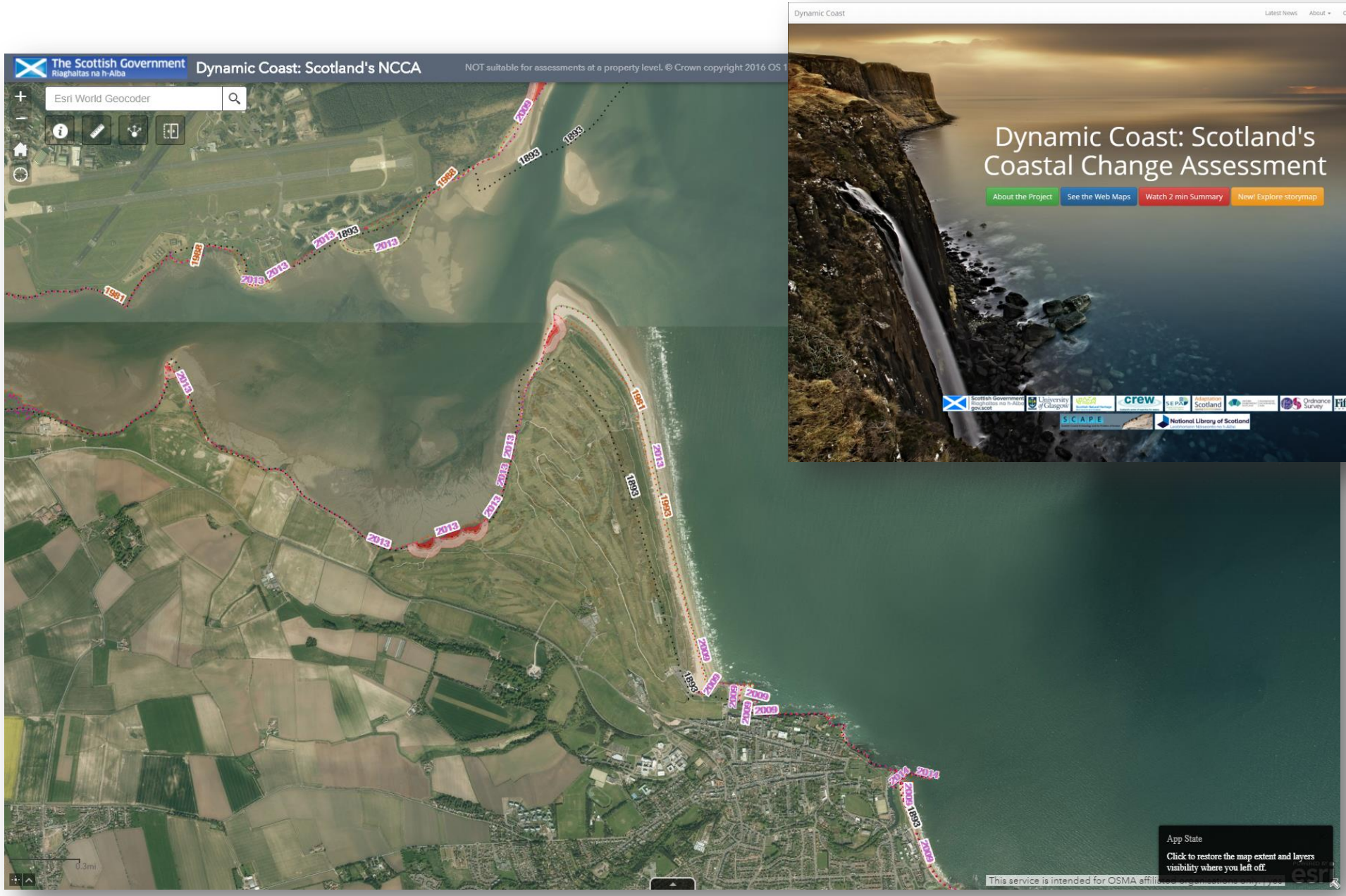
1 share

Write a comment...

3. Distillation… years of research into a few sentences


SCREENING FOR NATURAL HAZARDS TO INFORM
A CLIMATE CHANGE RISK ASSESSMENT
OF THE PROPERTIES IN CARE OF HISTORIC ENVIRONMENT SCOTLAND
HISTORIC ENVIRONMENT SCOTLAND
ÀRAINNEACHD EACHDRAIDHEIL ALBA


A CLIMATE CHANGE RISK ASSESSMENT
THE PROJECT
COASTAL FLOODING
SLOPE INSTABILITY
POWER IN PARTNERSHIPS
ON THE FRONT LINE OF CHANGE
GROUNDWATER FLOODING
COASTAL EROSION
GET IN TOUCH
REDUCING THE RISK
FLUVIAL FLOODING
FLUVIAL FLOODING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Riaghaltas na h-Alba
Dynamic Coast: Scotland's NCCA
NOT suitable for assessments at a property level. © Crown copyright 2016 OS
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Dynamic Coast: Scotland's Coastal Change Assessment
About the Project
See the Web Maps
Watch 2 min Summary
New! Explore storymap
SCAPE
National Library of Scotland
App State
Click to restore the map extent and layers visibility where you left off.
This service is intended for OSMA affil

4. Preparing for the launch…

5. What was it like on the day?

“The best laid schemes o' mice an' men
Gang aft a-gley.”

6. So what? Or so what now?

Q&A

Sharing and learning

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- Sharing experiences and ideas
- Space to reflect on what's worked and what hasn't
- Opportunity to identify projects and collaborators

20 mins networking time:

- Aim to have at least two different conversations
- Make sure everyone is included

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Do one thing

Adaptation Scotland
supporting climate change resilience

Identify the **one thing** that you are going to go away and do in response to what you've heard today.

Research shows that we are much (76.7%) more likely to do actions that we write down and are accountable to others for.

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