Five steps
to managing your climate risks

A Guide for Public Bodies in Scotland

Supporting compliance with the Climate Change (Scotland) Act 2009

Public Bodies Climate Change Duties

About this guidance

"Five steps to managing your climate risks" is based on the first edition of Adaptation Scotland's Workbook for public sector organisations (2011). The "Five steps" provides operational guidance to managing climate risks and has been developed by Adaptation Scotland in collaboration with public bodies from across Scotland. The guidance takes into account legislative changes and builds on recent adaptation planning successes in Scotland.

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Adaptation Scotland
supporting climate change resilience

sniffer
knowledge brokers
for a resilient Scotland

Adaptation Scotland provides advice and support to help ensure that Scotland is prepared for, and resilient to, the impacts of climate change. The Adaptation Scotland programme is funded by Scottish Government and delivered by Sniffer.

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Choose your climate risk path

Severe weather is already affecting services provided by public bodies across Scotland, with operational, reputational, financial and legal consequences. This trend is projected to increase in the future. The impacts we see today may occur more frequently, with more serious consequences, compounding many of the other long-term challenges we face – rising energy prices, resource scarcity, ageing population, and social and economic inequalities. Scotland's public sector has an opportunity to become more efficient, to innovate and empower communities to respond to these challenges.

"Five steps to managing your climate risks" is part of this response. It challenges you to consider how climate change will affect your organisation's ability to deliver its critical functions and achieve its corporate vision. **There are two paths to choose from: the *resilience* path or the *business-as-usual* path.**

Climate change gives organisations an opportunity to plan for the future. Choosing the *resilience* path allows you to increase efficiency, identify cost-saving opportunities and add value to the services you provide. Taking this path helps you to comply with the Public Bodies Climate Change Duties, required under the Climate Change (Scotland) Act 2009. It can also help you address public sector sustainability reporting requirements. This path does not require radical changes; instead it will help you to build on the good work already happening in your organisation through, for example, emergency planning and business continuity planning. This path challenges you to move to the next level, and to adopt a long-term plan for safe and efficient service delivery. This path presents an opportunity to protect the public good, to safeguard this for future generations, and to **do things differently** in response to a changing climate.

Climate change also presents threats. Severe weather and climate impacts will continue to interrupt service delivery, resulting in unexpected costs for asset maintenance, and increased risk of neglecting your duty of care for employees and communities. By taking a long-term view, you can identify your climate risks and prioritise actions that will allow you to manage them. The *business-as-usual* path signifies a conscious decision not to assess your climate risks, to accept the risk of continued exposure to severe weather and climate impacts and resulting liabilities – and failure to comply with the Public Bodies Climate Change Duties.

Climate resilience is not just a response to climate change.

Effective long-term planning **contributes to sustainable development** by safeguarding people and places; by protecting and enhancing the natural environment, and by contributing to a resilient economy that can cope with volatile resource prices and supply chains. It allows you to **add value to the services you deliver**. Climate resilience can **support your organisation's carbon management efforts**, which is important as climate-related impacts can jeopardise mitigation and its financial benefits.

Choose the resilience path and your organisation will join the growing number of public bodies in Scotland that are already looking at long-term preparation, response and recovery from severe weather and climate change impacts. Your organisation will be making a commitment to take future climate impacts seriously; and ensuring that this commitment is at the heart of day-to-day decisions and investments. The decisions and investments we make today will determine how we live with climate change in years to come. Adaptation Scotland's "Five steps to managing your climate risks" will help you to follow the resilience path, by answering the following questions:

1. How might our organisation's critical functions be affected by severe weather and climate change? *(**What** do we need to protect?)*
2. Where are the opportunities to increase resilience, enhance efficiency, add value and save money? *(**How** can we safeguard and enhance critical functions?)*

Use Adaptation Scotland's guidance and develop new skills and expertise to benefit you and your organisation:

- Understand how current severe weather and climate affect service delivery.
- Use UKCP09 climate projections to understand future climate impacts.
- Use impact and risk assessments to identify and prioritise threats and opportunities.
- Identify ways to manage climate risks.
- Communicate, influence and bring about change.

Glossary

Adaptation: the adjustment in economic, social or natural systems in response to actual or expected climatic change, to limit harmful consequences and exploit beneficial opportunities (Scottish Climate Change Adaptation Programme).

Adaptation arrangements: your organisation's plans for adapting to climate change, in response to the Climate Change (Scotland) 2009 Act (Public Bodies Climate Change Duties).

Climate change: any change in climate over time, whether due to natural variability or as a result of human activity (IPCC, 2007).

Resilience: the capacity to withstand shocks while maintaining function. When change occurs, resilience provides the components for renewal and reorganisation (the opposite of vulnerability) (The Environmental Advisory Council to the Swedish Government, 2002).

Risk: the combination of the probability of an event and its consequences (ISO/IEC Guide 73).

Vulnerability: the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes (the opposite of resilience) (IPCC, 2007).

Five principles for managing your climate risks

Remember these five principles as you work through 'Five steps to managing your climate risks'.

1. **Taking a long-term view of climate resilience enables you to increase efficiency, add value and identify cost-saving opportunities.** Climate resilience presents an opportunity to protect the public good, to safeguard this for future generations, and to do things differently.

2. **Ensure climate risks are considered in light of other risks.** Climate risks cannot be considered in isolation, because when senior managers have to decide what action to take, assessments will be based on an understanding of the wider benefits – not on climate change alone. Discuss climate risks with community planning partners – and communities.

3. **Current corporate threats could occur more frequently with more serious consequences in the future.** Climate change will alter the frequency and magnitude of current corporate threats, with new ones emerging. We can plan for the consequences by moving beyond short-term emergency and business continuity planning to take a long-term view.

4. **Effective communication of risks is critical to gain corporate buy-in.** Will your corporate vision and objectives be achievable in the future? Understand your organisational goals and how climate change could help or hinder these.

5. **Climate resilience has multiple benefits.** It is more than a response to climate change. The actions you take to increase climate resilience (whether physical or institutional) should have multiple benefits for the environment, society and economy – including your carbon management efforts.

How do I use this guidance?

"Five steps to managing your climate risks" will help you to develop arrangements to manage your climate risks as required by the Climate Change (Scotland) Act 2009. These arrangements will recognise the work already happening in your organisation to manage climate risks, and will be used as a basis to identify further cost-saving actions, for example, by working with communities and community planning partners.

The Climate Change (Scotland) Act 2009 introduces a legal obligation for public bodies to address climate change through the Public Bodies Climate Change Duties. Section 44 of the Act requires that a public body must, in exercising its functions, act:

- in the way best calculated to contribute to delivery of the Act's emissions reduction targets;
- *in the way best calculated to deliver any statutory adaptation programme*; and
- in a way that it considers most sustainable.

Scottish Government guidance also states that all public bodies need to be resilient to the future climate and to plan for business continuity in relation to delivery of their functions and the services they deliver to the wider community.

You should be able to complete the *"Five steps to managing your climate risks"* within approximately six months. The timeline below provides a guide as to which milestones you should have completed and by when.

Month from start	**1**	**3**	**5**	**6**	**12**	**24**
Milestone	Briefing paper presented to Corporate Management Team	Impact assessments for selected service areas	Risk assessment and action plans for selected service areas	Adaptation arrangements report	High-level review	In-depth review
Ongoing implementation through existing internal and external mechanisms						

The Five Steps

1 Define the challenge

1.1 Identify aims and objectives

1.2 Build the business case

1.3 Establish governance of your adaptation arrangements

1.4 Define your adaptation risk and embed on your Corporate Risk Register

Milestone 1: Briefing paper presented to Corporate Management Team

2 Assess climate threats and opportunities

2.1 Understand UKCP09 key messages

2.2 Issue screening questionnaire

2.3 Full day workshop with relevant Service Managers

- Presentation 1: introduction to climate change impacts and adaptation
- Exercise 1: discussing the consequences of recent severe weather
- Presentation 2: understanding future climate change
- Exercise 2: assessing future climate threats and opportunities for critical functions (impact assessment)

Milestone 2: Impact assessments for selected services

3 Assess climate risks and identify actions

3.1 Climate change risk assessment for priority threats and opportunities

3.2 Identify and prioritise actions

3.2 Implementation plans

Milestone 3: Risk assessments and action plans for selected services

4 Report and implement

4.1. Compile key messages from Steps 1–3

4.2. Ongoing implementation

Milestone 4:
Adaptation arrangements report

5 Monitor and review

5.1. Monitor and review

5.2. Communicate progress

5.3. Identify next steps

Milestone 5: Regular monitoring and review process

1 Define the challenge

What is the purpose of Step 1?

Step 1: Define the challenge helps you to define the scope and governance of your adaptation planning arrangements. You will focus your efforts on your organisation's critical functions or core services – the things that you must protect.

Why complete Step 1?

Setting a boundary for your adaptation planning arrangements allows you to focus your limited time and resources on essential services. Once you have completed the five steps, gained political buy-in and built momentum, you will be well placed to look beyond these essential services.

By completing Step 1, you will have:

- identified what you are aiming to achieve, where your adaptation arrangements will sit within the organisation, and who can help internally and externally;
- defined adaptation as a strategic risk and gained corporate visibility and accountability by embedding this on your Corporate Risk Register; and
- presented a briefing paper to your Corporate Management Team outlining what you are trying to achieve and how you will achieve this.

Tasks to complete in Step 1		Task complete ✓
1.1.	Identify aims and objectives	☐
1.2.	Build the business case	☐
1.3.	Establish governance of your adaptation arrangements	☐
1.4.	Define your adaptation risk and embed on your Corporate Risk Register	☐
Milestone 1: Briefing paper for Corporate Management Team		☐

1.1 Identify aims and objectives

Define what you are aiming to achieve.
This guidance will enable you to:

- understand how current severe weather and climate affect service delivery;
- use UKCP09 climate projections to understand future climate impacts;
- use impact and risk assessment to identify and prioritise threats and opportunities;
- identify ways to manage climate risks;
- embed awareness and understanding of climate risks across your organisation; and
- communicate, influence and bring about change.

Identify what you would like to achieve over and above this. Do you want to embed climate resilience in existing processes? Do you want to begin to form internal and external partnerships?

Consider:

- How do your aims and objectives contribute to or enhance other corporate responsibilities, e.g. Emergency Planning and Business Continuity Planning? Use existing mechanisms to help delivery.
- How can you help deliver the framework set out in the Scottish Climate Change Adaptation Programme?
- What other organisational visions exist which can be expanded to include your aims and objectives (e.g. a sustainability vision, Scotland's Climate Change Declaration, Single Outcome Agreements)?
- Adaptation needs to be delivered in partnership so identify what community planning partners are trying to achieve in relation to climate resilience.
- Identify what you want to achieve and summarise this by writing a short vision or statement to include in your briefing paper for your Corporate Management Team.

1.2 Build the business case

You need to make the case for why your Corporate Management Team should support the time it will take to complete "*Five Steps to managing your climate risks*" – and the work that will ensue. Your management will likely want answers to the following questions:

1. Why is it necessary?
2. What is the solution?
3. What will it cost?

Much of this evidence will be gathered as you complete the "*Five steps*", but at this stage answering the following questions in your briefing paper will help convince your management of the imperative for this work.

1. Why is it necessary?

Will your organisation's strategy and vision still be achievable in the future climate? Climate change will affect your strategy and vision in different ways. Make an initial judgement as to how it might affect them, and summarise the threats and opportunities in your briefing paper.

Review your organisation's corporate risk register and make a high-level assessment of whether existing corporate risks are likely to be affected by future climate. Speak to Service Managers to understand the influences of weather and climate on corporate risks.

2. What is the solution?

Briefly outline some of the successful actions that you are already taking to increase climate resilience, e.g. working with communities. Provide reassurance that adaptation does not always require high capital expenditure, and that there are low-cost solutions with multiple benefits. Only by completing the "Five steps" will you be able to identify appropriate, win-win solutions and opportunities.

3. What will it cost?

This is a difficult question to answer. You will not know the costs and benefits until you have identified your priority risks and scoped out actions that you can take. Be open about this but provide reassurance that the actions you identify will contribute to other social, environmental and economic goals (e.g. carbon management, flood risk management).

Refer to the examples identified above. How much did these actions cost to implement? How many personnel were involved – and who? How successful have they been in reducing your organisation's maintenance, response and recovery costs?

For more information, refer to Annex 1: Policy drivers for adaptation-related action.

1.3 Establish governance of your adaptation arrangements

This step helps you develop a plan for completing the "*Five steps*". Answer the following five questions:

1. What is the status of your adaptation planning?

Have you already started your adaptation planning activities? You may already have political buy-in, or have completed a Local Climate Impacts Profile (LCLIP). Take stock of this to determine where to begin.

2. Where will your adaptation arrangements sit?

Be clear about where your adaptation arrangements will sit within your organisation. Do you have a Climate Change or Sustainable Development Strategy? You may wish to include your adaptation arrangements within this; or you may wish to develop a stand-alone Adaptation Strategy. Decide which works best, remembering the need to embed understanding and responsibility for adaptation across the organisation. Talk to your Risk Manager and agree how priority climate risks can be incorporated into your risk register(s).

3. What are your timescales for completing your adaptation arrangements?

You should be able to complete the "*Five steps*" within 6 months but it may take longer depending on your commitments. Align with major internal activities such as annual planning and budgeting as these can help with embedding climate resilience.

Know when your budgetary cycle and specifically Capital Investment Programme is being developed, and by who, so that you can influence corporate decisions and encourage project managers to incorporate climate resilient actions into planned investments. Influence business cases for capital investments so that contingency can be built in for climate resilience. Develop a timeline of significant dates in the corporate calendar such as annual management meetings and budget reviews to allow you to influence and/or be informed by corporate decisions.

4. Who will develop and deliver your adaptation arrangements internally?

Who is responsible for leading on your organisation's adaptation planning? It is likely to be the Sustainable Development or Climate Change Officer, the Emergency Planning Officer or the Risk Manager.

Who will help you plan and deliver your adaptation work? Do you have a Climate Change Working Group or a Corporate Management Team which meets regularly? Where possible use an existing group rather than creating a new group, which could have resource implications. Your group should include Service Managers and those with key corporate roles such as the Risk Manager and Emergency Planning Officer.

The group should also act as an intermediary for personnel on the ground to report severe weather and climate-related impacts. The group must be

aware of trends in critical service delivery, for example, during a heat wave social workers may report a high number of heat-related illnesses in elderly residents. These trends must be monitored so that solutions can be put in place where needed. Record anecdotal evidence, for example using an incident log, or by setting up an email account which is monitored by the adaptation lead. This will allow you to capture institutional memory.

5. Who will help to develop and deliver your adaptation work externally?

Identifying existing external-facing stakeholder groups (e.g. Community Planning Partnership and Strategic Development Partnership) can help you to develop and implement your adaptation arrangements. Doing so will provide:

- a means to communicate your aims and objectives with a wide range of partners who might share similar climate risks;
- an understanding of partners' climate risks and where these might conflict with yours; and
- the opportunity to work together to develop shared, cost-effective solutions.

Building resilience to climate change is a challenge that cannot be tackled alone. Creating a lasting awareness of climate threats and adaptation opportunities across the community will ensure threats and opportunities are addressed in the right way, at the right time.

Partnership working: Community Planning Partnerships

Coordinated action on climate change helps to deliver efficiencies. Working with other organisations to develop a joint approach to climate resilience can provide opportunities for sharing knowledge, skills and resources. The Scottish Government encourages public bodies to work together, and with other private and voluntary sector bodies, for example through Community Planning Partnerships (CPP). It is advisable to start talking to your CPP as early as possible to understand the risks they face, what actions they are already taking and to identify shared, cost-effective solutions.

Working with your CPP will allow you to understand each other's climate risks: what is a high risk for your organisation might be a low risk for others, so you need to work together to identify shared risks and cost-effective solutions. Many climate risks can only be addressed by working together to identify and resolve conflicts of interest. Other partners might be making decisions that affect you, for example, diverting run-off from the road only to cause problems on the railway. The only way to be confident that you are avoiding these consequences is to adopt a partnership approach. Failing to link up early on will result in missed opportunities for cost-effective action. If you have time, consider meeting your CPP to review future climate threats and opportunities to your Community Risk Register.

Talk to your community about their concerns and to get their ideas. Communities know better than anyone what assets are most valued and threatened by severe weather and climate factors. Communities will also know *who* in the community is most vulnerable, including elderly populations and the homeless. Understanding your community's needs and demands can also place pressure on your Corporate Management Team to take action to build climate resilience.

Gap analysis of existing policies and procedures

Identify existing processes which can be used to screen new policies, plans, strategies and projects for climate-related threats and opportunities. There will be processes and guidance which you can incorporate climate resilience into, for example, Strategic Environmental Assessment, Environmental Impact Assessment, sustainability checklists, sustainable procurement guidance, and estate asset management guidance. Refer to Annex 2 for more information.

1.4. Define your adaptation-related risk and embed on your Corporate Risk Register

Failing to understand and manage the impacts of climate change on your organisation is a strategic risk. Some organisations may wish to include this risk on the Corporate Risk Register to ensure corporate management accountability and visibility, and to help you achieve your aims and objectives. There are different options for framing your risk, including:

- "Failure to understand the threats and opportunities posed by climate change to critical functions"; and
- "Failure to comply with the adaptation requirement of the Climate Change (Scotland) Act 2009".

You will be able to alter your risk as you progress. For example, once you have measurable arrangements in place, you can change your risk to "failure to *implement* your adaptation arrangements".

Your organisation's approach to risk management will influence whether – or how – you complete this task. Talk to your Risk Manager and Emergency Planning Officer early on, as they can help you to understand your organisation's procedures for managing risks and planning for emergencies. These are two fundamental aspects of your adaptation arrangements.

Stirling Council has embedded "Failure to comply with the adaptation requirement of the Climate Change (Scotland) Act 2009" on its Corporate Risk Register. The Council is developing a strategy and action plan to control this risk. Progress towards implementing the strategy and action plan is managed through the Council's risk management structure.

MILESTONE 1
Briefing paper for corporate management/workshop participants

Collate the information you have gathered in Step 1 into a briefing paper for your Corporate Management Team. Present this to your management to gain buy-in to proceeding with the "Five steps".

Want to learn more?

Adaptation Scotland (2013) Introduction to Adaptation for Public Sector Organisations

IEMA (2013) Building the Business Case

Climate Change (Scotland) Act 2009 (Part 4)

Public Bodies Climate Change Duties: Putting them into Practice.

Scotland's Climate Change Adaptation Framework

European Commission, EU Adaptation Policy

IEMA, EIA and Climate Change

Scottish Government (2010) Consideration of Climatic Factors within Strategic Environmental Assessment

2 Assess climate threats and opportunities

What is the purpose of Step 2?

Step 2: Assess climate threats and opportunities helps you to understand how your organisation's critical functions have been affected by recent severe weather impacts, and to consider how they might be affected in a future climate. Step 2 is completed mainly through a workshop with Service Managers (see Step 2.3) who are identified through a screening questionnaire (see Step 2.2).

Vulnerability is defined as "the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes" (IPCC, 2007).

Why complete Step 2?

Before you can begin implementing adaptation actions, you need to understand the priority threats and opportunities that you face. Step 2 helps you to do this, and focus your limited time and resources on essential services. Once you have completed the five steps, gained political buy-in and built momentum, you will be well placed to look beyond these essential services.

By completing Step 2, you will have:

- understood recent and future climate trends in Scotland;
- understood how critical functions have been affected by recent severe weather impacts;
- assessed future climate threats and opportunities to critical functions, actions already underway to manage these, and relevant strengths and weaknesses (barriers) (your organisation's ability to adapt);
- helped Service Managers to understand these threats and opportunities;
- scoped initial opportunities to implement flexible actions with benefits for climate resilience, the environment, society and economy; and
- strengthened ownership and accountability for managing your climate risks.

Tasks to complete in Step 2

Task complete ✓

2.1	Understand recent climate trends and UKCP09 headline messages	☐
2.2	Issue screening questionnaire to Service Managers	☐
2.3	Establish governance of your adaptation arrangements	☐
2.4	Define your adaptation risk and embed on your Corporate Risk Register	☐
2.5	Full day workshop with selected Service Managers – Presentation 1: "introduction to climate change impacts and adaptation" – Exercise 1: discussing the consequences of recent severe weather – Presentation 2: "UKCP09 headline messages" – Exercise 2: assessing future climate threats and opportunities for critical functions	☐
Milestone 2: Completed impact assessments for selected services		☐

2.1. Understand recent climate trends and UKCP09 headline messages

In advance of your workshop you should:

1. Gather initial evidence of disruptive weather events and the consequences for your organisation. Use the Scotland wide log of weather impacts from LCLIP projects, which lists over 2000 weather event impacts; or LCLIP project findings for all completed Scottish LCLIP projects. Use case studies from elsewhere to illustrate the potentially damaging effects of these events – as well as the positive impacts if there were any. Highlighting the damage caused to similar organisations can provide a powerful message about the need for your organisation to prepare. Circulate information in advance of your workshop so that attendees can bring and/or access internal records which may contain more information. Start to populate a weather impacts table (Table 2) and continue to complete this during your discussions.

2. Familiarise yourself with the recent climate trends and future projected climate change (UKCP09 headline messages) for Scotland. You will need to present this information to workshop attendees to allow everyone to make an assessment of future climate threats and opportunities for their services' critical functions. Annex 3 contains the technical information to allow you to do this.

3. Look at the Scottish Climate Change Adaptation Programme to identify which risks will affect your organisation. How you can help to deliver the objectives policies and proposals set out in the Programme? Present headline messages during the workshop; it will be most important to identify the threats and opportunities that are specific to your organisation.

2.2. Issue screening questionnaire to Service Managers

Issue the screening questionnaire to Service Managers (Table 1). Each Service Manager should identify their critical functions or core services. They may wish to include key performance indicators, such as minimising hospital waiting times or emergency response times. The Service Manager should then answer each of the questions listed. This will help to:

1) identify which services should attend the workshop;
2) raise Service Managers' awareness of ***current*** climate threats and opportunities; and
3) provide a basis for considering future threats and opportunities during your workshop.

Once Service Managers have completed these questionnaires, assess their responses to determine which Service Managers need to attend the workshop in Step 2.3. In identifying who should attend, consider:

- Do any services share similar/the same critical functions?
- Which critical functions appear most vulnerable to current climate impacts?
- Which assets are services most dependent upon (buildings, people, transport, energy, ICT)?
- What are the climate-vulnerable assets for delivering critical functions in each service area?
- Do you think the responses are accurate?

The questionnaire in Table 1 asks Service Managers to consider which critical services are affected by current weather and climate impacts, to begin to consider future trends and the dependencies of these services. The responses will be used to identify whether a service or department should be represented at a workshop to assess and understand both current and future climate vulnerability. *Positive impacts should be identified by "+" and negative impacts should be identified by "-".*

This is an optional step; you may choose not to issue the questionnaire and instead to invite all Service Managers. Tailor the questionnaire to suit your organisation.

Table 1: Critical functions-climate risk screening questionnaire for Service Managers

Service or department	*[Insert]*			
Manager	*[Insert]*			
Critical function, service, asset or key performance indicator	*1: [Insert]*	*2: [Insert]*	*3: [Insert]*	*4: [Insert]*
Is this function, service or asset affected by:				
Heavy rainfall and flooding				
Drought				
Very hot days and heat waves				
High winds				
Snow and ice				
Could this function, service or asset be affected by:				
Increasingly mild, wet winters				
Increasingly warm, dry summers				
Increased heavy rainfall				
Less frost and snow				
Sea level rise				
Is this function, service or asset dependent on:				
Staff (internal or contractors)				
Buildings				
Transport infrastructure (road, rail, air, sea)				
Energy supply				
IT and communications				
Waste disposal				
Supply chains outside Scotland				

Table 2: Weather impacts table (with example)

Past weather impacts								Affected services and communities		Future trends	
Weather variable	**Description of impact**	**Location**	**Date**	**Consequences** (costs, service disruption, injury, reputation)	**Critical thresholds**	**Actions / plans / policies put in place to reduce this impact**	**Evidence of the effectiveness of these actions / plans / policies**	**Responsible department/ agency**	**Services/ communities that were affected**	**Might this impact become more or less frequent in future?**	**What could the consequences be of this impact in the future if no action is taken?**
Frost/ice	Sub-zero ground temperatures lead to a series of road incidents	Dundee	Dec 2012	Council worker injured leading to reputational consequences; wall needing repaired – unforeseen costs	N/A	Safe winter driving plan introduced	Number of winter weather driving incidents has decreased	Transport and roads; Police	N/A	Possibly less frequent	Continued negative health and safety and financial consequences

2.3. Workshop: assess and understand your organisation's current and future climate vulnerability

This workshop is for selected Service Managers – as determined by the screening questionnaire – and key corporate staff, including your Risk Manager, Emergency Planning Officer, Finance Manager, HR Manager, Procurement Manager and Property Manager. Allow one full day for the workshop.

The aim of your workshop is to introduce climate change impacts, vulnerability and adaptation to Service Managers, to ensure they understand the threats and opportunities for their service provision.

i) Presentation 1: "introduction to climate change impacts, vulnerability and adaptation"

Start your workshop with a brief presentation providing an introduction to climate impacts and adaptation. Adaptation Scotland has developed a presentation that can be supplemented with the information you already gathered in Task 2.1.

ii) Exercise 1: discussing consequences of recent severe weather

This exercise allows you to gather evidence of the consequences of severe weather impacts on your organisation's service continuity. Discuss with participants **the most disruptive weather events** that you have been exposed to in recent years. Using Table 2, identify consequences, the agency responsible for managing the consequences, the responses taken, their effectiveness and any critical thresholds. It might not always be helpful or possible to quantify the consequences in monetary terms; reputational or health and safety impacts might be just as important to your organisation if not more. By understanding how critical functions are already affected by severe weather and climate impacts, personnel will be able to visualise how impacts might change in a future climate.

iii) Presentation 2: "UKCP09 headline messages"

Now that participants have an understanding of your organisation's vulnerability to current climate, introduce the UKCP09 headline messages. This will

allow them to visualise how current vulnerability might be affected by future climate change. See Annex 3 for more information.

iv) Exercise 2: assessing future climate threats and opportunities for critical functions (impact assessment)

In the second exercise, Service Managers will – with your help –assess current and future climate threats and opportunities for their critical functions using Table 3. This exercise is based on a SWOT analysis. It allows you to consider your organisation's ability to respond to threats and opportunities by identifying strengths and weaknesses. This exercise enables Service Managers to draw out the detail of the impacts identified in Step 2.2 by asking two key questions:

i) How might your organisation's critical functions be threatened by severe weather and climate change? (***What*** do we need to protect?)

ii) Where are the opportunities to reduce our vulnerability and increase resilience to maintain and enhance efficiency? (***How*** can we safeguard and enhance not only these critical functions, but our other services?)

Select one critical function from each of your organisation's service areas (e.g. those with the most impacts identified in Step 2.2). Work through the exercise in the group, using the five questions outlined below. Encourage Service Managers to discuss interdependencies between service areas, as well as external dependencies. Ask Service Managers to prioritise their future climate threats and opportunities. This will narrow the focus of the climate change risk assessment in Step 3.1.

Table 3: Climate impact assessment

<table>
<tr><td colspan="2">Critical function: Timely delivery of meals to vulnerable residents</td><td colspan="2">Accountable owner: Head of Social Care</td></tr>
<tr><td colspan="2">Current threats: what are the current climate-related threats to this critical function?

– Heavy rain and flooding prevents access to certain rural residents.
– Snow blocks roads and staff may be unable to get to work. Staff from other services may need to be diverted to assist.</td><td colspan="2">Future threats: what are the future climate-related threats to this critical function?

– Increased heavy rain and flooding may block the smaller roads we depend on to access residents.
– Current vehicle specification may not withstand weather and may result in damage or the need for replacement.
– New threats may arise.</td></tr>
<tr><td>Strengths: what are we already doing well to manage these threats?

– Back up staff if core staff are off sick or unable to get to work
– Regular vehicle maintenance
– GIS database containing location of vulnerable residents</td><td>Weaknesses: what are the barriers to managing these threats (internal and external)?

– Fear of change
– Lack of political support
– Lack of money
– Further research needed</td><td colspan="2">Opportunities: what opportunities does this present for our organisation?

– Less snow in future may reduce threat</td></tr>
<tr><td colspan="4">What more can we do?
– Carry out a service-level climate change risk assessment to identify priorities
– Conduct flood risk assessments for key routes
– Overlay GIS showing locations of residents with flood risk
– Provide severe weather training to social care staff
– Engage with communities to set up emergency frozen food store in key locations such as community hall</td></tr>
</table>

Question 1: What are the current climate-related threats?
Identify the current severe weather and climate-related threats to critical functions. This is a case of expanding on the negative impacts identified during the questionnaire in Step 2.1.

Question 2: What are the future climate-related threats?
Identify the future climate-related threats to your critical functions, using your knowledge of the future climate change projections. *You will carry out a more detailed climate risk assessment later on for those threats that you perceive as highest priority.* For each critical function, discuss:

- How will future climate change 'multiply' current threats?
- How will service continuity be affected by disruption to:
  - staff access;
  - transport infrastructure (in and out);
  - buildings;
  - energy and water supplies; and
  - information and communications technology?
- How will local communities be affected?
- What will be the cumulative impacts of recurring severe events over time?
- What are the consequences of inaction for your service(s), organisation and communities? Remind participants about legal obligations, financial impacts, health and safety and reputation.

Question 3: What are we already doing well to manage these threats and what are our organisation's strengths?
You will already be delivering actions that contribute to climate resilience. However, they may not be recognised as 'adaptation'. Identify these actions so that management are reassured that this is a not a completely new subject. You want to capitalise on these actions, and recognise the multiple benefits they have not only for climate resilience but for other environmental, social and economic objectives. Identify actions already taking place across the organisation to build climate resilience relevant to each critical function. Annex 4 provides some examples to help you to answer this question.

Question 4: What are the barriers to managing these threats (weaknesses)?
This question makes you think about the weaknesses or barriers to delivering your critical functions. Is there a fear of change among staff? Is there lack of political support? Is cost a factor? Do you need to do more research? Identifying your weaknesses or barriers is an important step in identifying the further actions you should and can take.

Question 5: What opportunities does this present for our organisation?
This entire process is equally about identifying the opportunities for your organisation. Where will you be able to save time and money due to reduced need for maintenance and response? Where can you implement simple actions to save money, for example, by building community capacity to respond? Discuss these opportunities and try to quantify where possible. Identify examples of where else these opportunities have arisen such as in neighbouring organisations.

Question 6: What more do we need to do to manage the threats?
Discuss the actions that you can put in place to manage the threats you have identified. These should be flexible actions with multiple benefits – not just for climate resilience but for other environmental, social and economic objectives. Work through each critical function and identify what else you could do. Actions fall into two broad categories:

1. *Building adaptive capacity* helps to eliminate barriers or constraints and improves understanding of climate change, risks and impacts, and/or improves institutional and legal capacity. The tasks in this guidance fall into this category.

2. *Delivering adaptation actions* involves taking practical actions to reduce climate risks or exploit opportunities. Actions range from simple solutions to large scale infrastructure projects, including new flood defences and developing new services. *Practical actions are most effective – and most likely to be financed – when built into planned maintenance and investments.* Ensure you identify opportunities to incorporate climate resilience into planned projects. Actions should have multiple benefits for the environment, society and economy.

In Step 3, you will help each Service Manager to identify further actions, and prioritise these by looking at the costs and benefits.

You may not have time to complete an impact assessment for all critical functions but following the workshop Service Managers will be able to complete these themselves (and with the support of their teams).

Understanding future climate threats and opportunities: benefits of this approach

This workshop will provide an understanding of the threats and opportunities facing each service in relation to critical function delivery. Service Managers will use their operational knowledge to inform this process. By involving Service Managers you will create a widespread awareness of severe weather and climate threats and opportunities, which will cascade down through the services.

This approach allows others within the organisation to identify and implement actions that increase climate resilience. This reduces time pressure on you, and encourages climate resilience to be embedded across the organisation.

A cross-service workshop enables you to understand potential conflicts of interest, identify where actions have benefits for multiple services, and helps to avoid taking actions with negative side-effects.

In Steps 3 and 4, you will support Service Managers to conduct a climate change risk assessment for their most significant threats and opportunities, and identify and prioritise further actions.

Suggested action: Implement an improved weather and climate impact recording system

Did you have difficulty locating and accessing the evidence for your weather impacts table? If so, now is a good time to adopt a more systematic approach to recording severe weather and climate impacts. Use existing recording systems and add new fields where necessary, for example:

- What was the incident?
- Was the incident weather/climate-related?
- If so, what was the climate hazard(s) (e.g. heavy rainfall, high temperatures, high wind, snow, ice)?
- What was the specific impact (e.g. road to hospital closed by flooding)?
- What were the consequences (e.g. vulnerable patients unable to access hospital)?

Encouraging staff to report anecdotal evidence of the weather-related impact and consequences is an easy way to build up a picture of vulnerable services. In Step 4, responsibility for understanding climate threats and opportunities at the service level is delegated to Heads of Service. They – or a nominated Manager – can encourage staff to report back. Consider creating an email address to allow staff to report quickly and easily.

Starting to capture this data now will enable you to monitor the future consequences of climate-related disruption so that you can better manage your responses, and implement the right solutions. You may start to notice trends which will give you an idea of how well you are coping with disruption. Monitoring these trends will also allow you to judge the effectiveness of your actions.

MILESTONE 2
Impact assessments for relevant services and summary report

Collate the completed impact assessments and provide a summary report based on Step 2. This report should be fed back to corporate management, and used as a basis for Step 3 where you will assess climate risks and look in more detail at actions.

Want to learn more?

Adaptation Scotland (2013) Climate Trends for Scotland: this interactive tool was developed by Adaptation Scotland for investigating climate statistics produced by the Met Office – National Climate Information Centre.

Sniffer (2006) A Handbook of Climate Trends Across Scotland compiles and analyses observed climate data for Scotland between 1914 and 2004. It includes a summary of key trends, maps, graphs and tables.

UKCIP Local Climate Impacts Profile

UKCP09 Observed Trends Report (2009) compiles UK-wide observed climate data with an emphasis on maps, graphs and tables for a range of climate variables.

UKCIP Business Areas Climate Assessment Tool (BACLIAT)

3 Assess climate risks and identify actions

What is the purpose of Step 3?

Step 3: Assess climate risks and identify actions helps you support Service Managers to carry out a climate change risk assessment for the most significant threats and opportunities identified in Step 2. This enables you to assign a scoring to each threat and opportunity based on its probability and consequences. Once you have agreed the risks that you need to manage, you will help to identify further actions. Work closely with your Risk Manager throughout Step 3.

Why complete Step 3?

A climate change risk assessment allows you to focus limited resources on managing priority threats and opportunities. It will also help you to:

- detect gradual changes (climate or otherwise);
- understand changing consequences, likelihood and magnitude of your risks;
- identify actions with multiple benefits (capacity building or physical actions); and
- engage with community partners to understand their climate risks.

By completing Step 3, you will have:

- worked with Service Managers, Service Officers, your Risk Manager and key corporate staff to assign risk ratings to priority climate threats and opportunities facing your critical functions;
- helped Service Managers to identify and prioritise actions to manage priority climate risks; and
- embedded priority climate risks on the appropriate risk registers.

Tasks to complete in Step 3		Task complete ✓
3.1	Climate change risk assessments for priority threats and opportunities	☐
3.2	Identify and prioritise actions	☐
3.3	Implementation plans	☐
Milestone 3: Service-level risk assessments and action plans		☐

TOP TIPS

- Use your existing risk management system to assess and embed your climate risks. Ensure that priority risks are recorded on the appropriate risk register, whether corporate or service-level.
- Managing your climate risks through your existing risk management system allows you to monitor changes over time, identify links with other corporate risks, inform resource allocation, identify actions with multiple benefits, and avoid implementing actions with negative side effects.
- Assessing risk is equally applicable to the analysis of opportunities so ensure that you consider the opportunities that climate change could present to your organisation.
- Record the assumptions behind your risk ratings so others are aware during the risk register review.
- Estimate the costs of impacts based on the cost of past events, for example financial losses due to repairs to damaged buildings and infrastructure. This information will be important when assessing management options.
- Record uncertainties and where further information is needed to understand the risks, including data needs.
- Use your organisation's existing risk assessment methodology to complete your climate change risk assessment.
- Talk to your Community Planning Partnership about the risks they face, and what actions they are already taking to manage these risks. Doing this can lead to identifying shared, cost-effective solutions early on.

3.1. Climate change risk assessment for priority threats and opportunities

You will now help each Service Manager to assign risk ratings to the priority threats and opportunities identified in Step 2. Invite key operational staff to help with this exercise if you have time.

Complete a blank climate risk assessment table with the priority threats and opportunities identified in Step 2. Ensure these are framed ready for evaluation. For example:

- Heavy rainfall causes flooding of the IT server room leading to server down for one day.
- A heat wave causes overheating in homes leading to an increase in heat-related illness among vulnerable groups.
- Increased autumn and winter rainfall saturates the land leading to landslides.

Generic or vague descriptions, such as "IT failure" or "lack of resources" will hinder your risk assessment.

You will use your climate risk assessment table to assign risk ratings, monitor changes in risks, identify new risks, identify control measures already in place to manage risks, and identify further control measures that are needed. An example risk assessment template is shown in Table 4.

Some organisations choose to have a climate change risk register. This can be a useful way to manage your climate risks in one location. However, it can prevent climate risks being considered in day to day operations and decision making. Changes to risk ratings and new risks must be reflected in your corporate or service-level risk registers. Embed climate risks in your corporate strategy and vision to increase your chance of obtaining resources to carry out further work or implement actions to manage risks (see Box 1).

Identifying critical time thresholds

It is important to identify critical time thresholds, i.e. beyond what point does it become unacceptable to be without a service? For example, the length of time that you can maintain service provision without IT servers will be less than the time you can go without cutting the grass in local parks and gardens. This will influence the risk ratings that you assign to your threats and opportunities.

Evaluating current and future climate risks

Assessing current risk
Having analysed your climate risks you can now evaluate each risk and apply a risk ranking. **Always use your organisation's risk ranking scheme, including definitions of likelihood and consequence.** This is critical because what is a high risk for one organisation could be a severe risk for another. The definitions provided below are simply indicative; for example, it is possible that a severe risk will not result in international media attention.

For each risk, assign a measure of likelihood of the event occurring and the severity of the consequences. Do this for the *inherent* risk (without considering controls), then identify the relevant controls and reassess the *residual* risk.

Box 1: Embedding climate change adaptation duties in your Corporate Plan

SEPA's Corporate Plan outlines the agency's priorities and work programme for the five year period from 2012 to 2017. It sets out how SEPA intends to deliver its integrated objectives of protecting and improving Scotland's environment, and contributing to sustainable economic growth. A commitment to adapt to climate change under the Climate Change (Scotland) Act 2009 is embedded in SEPA's Corporate Plan. The Plan states that SEPA will:

'fulfil our duties under the Climate Change (Scotland) Act by acting:
- *in the best way calculated to contribute to Scotland's greenhouse gas emission reduction targets;*
- *in the best way calculated to contribute to Scotland's adaptation programme; and*
- *in the way we consider most sustainable.'*

Referencing your organisation's duty to contribute to Scotland's Climate Change Adaptation Programme in your Corporate Plan will help to get adaptation on the corporate agenda. This provides a solid foundation for further adaptation planning and action.

Likelihood rating	Almost certain	Likely	Possible	Unlikely
Occurrence	Frequent	Regular	Occasional	Rare or never

Rating	Consequence rating
Severe	Financial loss £X / international media attention / government or stakeholder intervention / total service disruption / fatalities
High	Financial loss £Y / national media attention / adverse comment by minister or external auditor / high service disruption / severe injury
Medium	Financial loss £Z / local media attention / service user complaints / service disruption / lost time / minor injuries
Low	Low level financial loss / isolated complaints / minor service disruption

Use your organisation's risk matrix to assign an overall rating for each risk.

	Consequence			
Likelihood	Low (1)	Medium (2)	High (3)	Severe (4)
Almost certain (4)	4	8	12	16
Likely (3)	3	6	9	12
Possible (2)	2	4	6	8
Unlikely (1)	1	2	3	4

Assessing residual risk

A range of controls exist across your organisation to reduce inherent risks, for example, emergency planning procedures which are enforced in response to forecasts for heavy rainfall and flood warnings. Taking into account the effectiveness of these controls allows you to assess your residual risk.

Examples of residual risk ratings are shown on the far right of Table 4. The risk ratings show that introducing controls has resulted in a lower residual risk rating for flooding impacts – either due to the likelihood of the impact occurring or reducing the consequences of the impact, or a combination. In contrast, in the case of higher temperatures causing buildings to overheat, the residual risk rating remains the same as the inherent risk because there are no contingency measures or controls in place yet.

Assessing future risk

Having assessed the risks arising from current weather and climate it is now important to assess future climate change risks to allow you to plan for the level of change – institutionally, financially and operationally. Taking an early and planned approach to identifying risks, opportunities and appropriate controls will help you to build resilience through actions with multiple benefits and as part of "business as usual"; develop shared, cost-effective solutions across the organisation; and identify and resolve conflicts of interest.

Future climate risk assessments are likely to show an overall increase in inherent risk due to a greater likelihood of impact and more severe consequences. Existing control measures may not be enough to reduce future inherent risk to acceptable levels. Identify where existing controls are insufficient, and scope out a list of actions you can put in place to manage these. In *Tasks 3.2 and 3.3* you will support Service Managers to look in more detail at the actions need to manage priority risks, as well as attempting to assess their costs and benefits.

Table 4: Climate change risk assessment *(note: the examples provided are for illustration purposes only)*

Priority threats and opportunities identified in Step 2

Discuss with Service Managers the critical thresholds and consequences associated with each threat

Are today's controls sufficient to reduce future risk to an acceptable level? What further action is needed?

Weather or climate impacts			2013 Inherent risk					2013 Residual risk			2020s Inherent risk				2020s Residual risk			
Climate hazard	Threat or opportunity	Consequences	Likelihood	Consequence	Risk rating	Critical thresholds	Controls	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating		Likelihood	Consequence	Risk rating	Further actions
Heavy rainfall	Flooding blocks key roads and prohibits access to hospital	Emergencies diverted to another hospital; medical supplies delayed; loss of life; reputational impact	2	4	8	Major road closures must be limited to 2 hours	Road management contingency planning; emergency planning	2	3	6	3	4	12	Same controls as 2013	3	3	9	
High temperature	Buildings overheat causing discomfort and reduced productivity	Health and safety impacts; Reputational impacts	1	3	3	Internal temperature must not exceed 28°C	Risk not currently considered	1	3	3	2	3	6		2	3	6	
High temperature	Buildings overheat causing problems in server rooms	Disrupted services; Loss of critical data	1	3	3	Server room temperature must not exceed 27°C and relative humidity level must not exceed 60%	Risk not currently considered	1	3	3	2	3	6		2	3	6	
High winds	Trees blown on to key road and rail links causing danger to staff and delays to the delivery of essential care to elderly residents	Financial losses; Reputational damage; Injury / loss of life	3	4	12	Staff should refrain from driving when winds exceeding 70mph are forecast	Driver training; Speed limits enforced; High-risk trees identified	2	4	8	3	4	12		3	3	9	

Monitoring lower priority risks

Be careful not to ignore those risks which would have serious consequences on your organisation but are highly unlikely to occur. These risks could have a catastrophic impact on your organisation and the community but as they are highly unlikely may be low on your list of priorities. It is crucial that you monitor changes in these risks and plan for them, even if you do not put in place controls immediately. Consider using scenario planning exercises to explore the consequences of these impacts for your organisation.

3.2. Identify and prioritise actions

In Step 2.3 you began exploring actions to respond to climate threats and opportunities. You will now look in more detail at actions to respond to the priority risks identified in Task 3.1. Discuss with Service Managers (and their staff) the opportunities that exist to introduce flexible actions which have multiple benefits.

Examples of actions are suggested in Annex 4. You should also look at the Scottish Climate Change Adaptation Programme to identify how you can help to deliver the objectives it sets out.

You will need to prioritise and select the most suitable actions. Use the same process that you would use to assess other decisions in your organisation when prioritising actions. Identify drivers and constraints, criteria for evaluating actions (is it flexible, sustainable, practical, legitimate, robust?) and consider cost-benefit. For more information on evaluating options refer to Section 4 of UKCIP's Adaptation Wizard. Use the guidance in Annex 7 to help you assess the costs and benefits of action and inaction.

3.3. Develop implementation plans

This task allows you to record details of the agreed action(s) as a basis for implementation (note: you may have to develop further evidence of the need for your actions). These implementation plans are the output of Step 3.

Always use your organisation's existing procedures and templates. Actions must have clear ownership and be monitored through your standard processes where appropriate. For each action, complete an implementation plan(s) which sets out the action, owner, target(s), measures of success and completion date where relevant. If this is not possible identify milestones.

Some climate risks will be shared with community planning partners, and you will need to work in partnership to identify and implement shared responses. Identify which risks and actions require joint working, and develop a plan to pursue these.

Table 5: Example action plan

Critical function	
Action (including description) Reference	
Time to implement (short, medium, long)	
Status (ongoing, complete)	
Why is the action required?	
Lead (individual and department)	
Delivery partners	
Links with other services	
Cost of action	
Cost of inaction	
SMART target	

Decision making under uncertainty

Decisions often have to be made with imperfect information. Your risk assessment will help you assess the severity of threats, while helping you to understand the consequences of action and inaction. A flexible management approach involves doing what is necessary now, delaying actions where threats are tolerable, and identifying where current understanding is less certain and further action is needed.

If there is considerable uncertainty, responses need to be robust under a range of future climates. Features of robustness include providing multiple benefits in the current climate; being flexible so that they can be altered if the climate does not change in the way initially anticipated; favouring 'soft' strategies where possible over 'hard' infrastructure projects; and incorporating safety-margins to allow for greater changes than expected. **Uncertainty should not be used as an excuse for inaction**.

MILESTONE 3
Service-level risk assessments and action plans

Want to learn more?

UKCIP Risk Framework

UKCIP Adaptation Wizard

UKCIP (2004) Costing the impacts of Climate Change: Overview of guidelines

European Commission Guidelines for Project Managers: Making vulnerable investments climate resilient

4 Report and implement

What is the purpose of Step 4?

Step 4: report and implement is about how you report and implement your adaptation arrangements. You should be able to collate this evidence reasonably quickly if you completed each of the milestones. Always use existing processes to report and implement your arrangements.

Why complete Step 4?

It is essential that you capture all your work in one location for ease of reference. Remember that it must not sit in isolation; it must interact with other corporate strategies.

By completing Step 4, you will have:

- collated and reported your organisation's adaptation arrangements through internal mechanisms; and
- started to embed climate risks in existing processes.

Tasks to complete in Step 4	Task complete ✓
4.1. Compile key messages from Steps 1–3	☐
4.2. Ongoing implementation	☐
Milestone 4: Adaptation arrangements report	☐

4.1. Compile evidence from Steps 1 – 3

In step 1.2 you established your adaptation governance arrangements, that is, where you intended to document your adaptation work. You should have collated the information gathered at each step of the guidance. Compile all of this evidence in one place and let stakeholders know that this information is available.

4.2. Ongoing implementation

Having identified your priority climate risks and how you will respond (at least in the short term) you must implement your actions. You will be able to implement some actions with relative ease; however others will require considerable investigation before they can be implemented. This investigation is an important part of your implementation phase.

The mechanisms you use to implement your adaptation arrangements depend on your organisation's specific climate risks and responses. Embed these risks and responses within existing environmental, risk and business continuity systems. Only this way will you create a widespread knowledge and understanding of climate risks and enable colleagues across the organisation to identify opportunities to increase climate resilience. The challenge is simply too big for one person or one team to address in isolation. Make sure that awareness of climate risks and adaptation is firmly rooted in day to day decision making and that it is considered integral to existing corporate priorities – not as an optional extra.

MILESTONE 3
Adaptation arrangements report

Want to learn more?

UKCIP's AdOpt tool is written for decision and policy makers who are tasked with identifying and appraising the effectiveness of climate risk adaptation measures.

UKCIP's Case Study Database provides examples of climate change adaptation in action – from a range of sectors and areas of the UK, as part of a planned programme or as a response to a particular event.

CIRCLE-2 (2013) Adaptation Inspiration

Defra and OGC (2011) Adapting your procurement

European Commission, Climate-Adapt, Uncertainty Guidance

European Environment Agency, Urban adaptation to climate change in Europe

5 Monitor and review

What is the purpose of Step 5?

Step 5: Monitor and review helps you to establish a regular monitoring and review process, and to communicate your progress to others.

Why complete Step 5?

Monitoring is essential to keep your adaptation arrangements up-to-date, to understand whether you are achieving your aims and objectives, and whether your actions are appropriate and cost-effective.

By completing Step 5, you will have:

- established a process for monitoring and reviewing your adaptation arrangements; and
- demonstrated compliance with the Public Bodies Climate Change Duties.

Tasks to complete in Step 5		Task complete ✓
5.1	Monitor and review	☐
5.2	Communicate progress	☐
5.3	Identify next steps	☐
Milestone 5: Regular monitoring and review process		☐

5.1. Monitor and review

Your adaptation arrangements should be monitored periodically as part of existing monitoring requirements for the parent Strategy, whether this is a Climate Change or Sustainable Development Strategy. If you are developing a stand-alone adaptation strategy you should make sure you have robust monitoring in place. **Ensure you review your arrangements at least once a year.**

There are various elements of your adaptation arrangements that you may want to monitor. These are outlined below. Decide which of these you want to monitor and implement a plan to do so.

i) Which aims and objectives have we achieved?

In Step 1, you laid out aims and objectives of what you wanted to achieve through your adaptation planning work. You also framed your strategic adaptation risk(s) (e.g. "Failure to comply with the Public Bodies Climate Change Duties"). Re-visit your aims, objectives and risk(s), and explore whether these have been achieved and if they need adjusted.

ii) What progress have we made? Are we satisfied?

This question asks you to consider whether your adaptation arrangements are on track. If not, why not? Do you need to adjust your plans or aims and objectives? What have you done well? Reporting your progress against the five stages of this guidance – and what you will do next – will allow you to compare your adaptation planning progress with other public bodies and across services who are using this guidance:

1. "We have defined the challenge."
2. "We have assessed and understood climate threats and opportunities."
3. "We have assessed and understood climate risks, and identified actions."
4. "We have reported on our arrangements and started to take action."
5. "We have established a monitoring and review process."

iii) What are our achievements? Are they the right ones?

This question asks you to consider whether you have identified the right priorities. Are your actions reducing climate vulnerability? Have your priorities changed? This can be difficult, as it may take years of monitoring to determine whether your actions are reducing vulnerability to climate hazards. By starting to monitor exposure now, you will be better placed to answer this question in the future.

Review your impact assessments every 12 months to ensure you identify new threats and opportunities – as well as reassessing your strengths, weaknesses and responses. These changes must be reflected in your climate change risk assessment and the risk registers which summarise your priority threats and opportunities. Your risk register reviews provide the opportunity to discuss whether new actions are needed to manage your risks.

Develop indicators to monitor changes in your climate risks based on those identified in Step 3, for example:

- Number of meals deliveries to elderly residents delayed by weather/climate impacts.
- Hours of arterial road closures due to weather/climate-induced hazards.

The action plans developed in Step 3 outline success factors and how you plan to measure the success of each action. Use these action plans as the basis to monitor how effective actions are.

If you do not have the right information to monitor the climate-related impacts on your services, establish a way to collect this now. For example, create an email address which staff can use to report weather disruption to their services.

iv) What level is our work reaching?

This question asks you to consider whether your adaptation arrangements are reaching the right level. They should be reaching the corporate level, where investment decisions are made. Do

you have corporate accountability for managing your overarching adaptation risk(s) and your climate risks? Is your Risk Manager fully engaged? If adaptation is embedded on your corporate risk register then you should have corporate accountability, but make sure it is not being ignored. Are Service Managers and officers responsible for monitoring climate risks and looking for opportunities to build resilience?

v) What have we learned?

Climate change adaptation is a continuous process during which we must learn, trial and adjust our actions to suit evolving conditions – whether climatic, environmental, social or economic. Having worked through this guidance, this question asks you to reflect on what has been learnt through the process. As you continue on your adaptation journey, build on the successes and avoid repeating mistakes.

5.2. Communicate progress

Effective communication of your adaptation arrangements helps people understand the climate threats and opportunities for your organisation, the benefits of taking action, and what you are doing to protect your organisation's critical functions. Communicating your progress can also provide leadership to other public bodies who might be struggling to develop their own plan. Being an 'early adopter' will benefit service continuity, reputation, and increase economic efficiency. Remember these five tips:

1. Gather feedback from staff and community partners.
2. Use your evaluation to increase understanding of climate risks.
3. Ask suppliers to demonstrate that they have assessed their own climate risks.
4. Do not wait until the end to evaluate and communicate – share lessons throughout.
5. Use existing groups to communicate progress.

Your adaptation arrangements and progress should be reported through existing internal systems, including:

- Emergency planning
- Risk register reviews
- Annual reporting and planning

Also use external-facing mechanisms such as:

- Scotland's Climate Change Declaration
- Single Outcome Agreements
- Sustainability reporting
- Public Bodies' Climate Change Duties

Scotland's Climate Change Declaration

All 32 of Scotland's local authorities have signed up to Scotland's Climate Change Declaration (SCCD) showing real commitment to climate change mitigation and adaptation. The SCCD template is currently being revised, and will include guidance on how to report adaptation progress. Adaptation Scotland strongly recommends that local authorities continue their commitment to the SCCD process.

5.3. Identify next steps

Now that you have completed the first iteration of your adaptation arrangements using *"Five steps to managing your climate risks"*, you can consider your next steps to becoming climate ready. Many of these will be defined as part of your arrangements, for example, you will need to review your impact assessments, risk assessments and actions. You may wish to consider how you can work more closely with communities and Community Planning Partnerships to increase climate resilience. You may also wish to talk to other stakeholders about developing a regional climate change adaptation strategy and action plan. Read about Climate Ready Clyde for more information.

Other references

The Environmental Advisory Council to the Swedish Government, April 2002. *Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations.* Scientific Background Paper on Resilience for the process of The World Summit on Sustainable Development.

IPCC (2007) Fourth Assessment: Working Group II Report "Impacts, Adaptation and Vulnerability"

Want to learn more?

UKCIP, AdaptME

Sustainable Scotland Network, Public Sector Climate Change Portal

Climate-Adapt: European Climate Adaptation Platform

GIZ (2011) Making Adaptation Count: Concepts and Options for Monitoring and Evaluation

GIZ Climate Protection Programme, Adaptation to Climate Change: New findings, methods and solutions

Annexes

Annex 1: Policy drivers for adaptation-related action

Public bodies have a legal duty to make adaptation arrangements. Part 4 of the Climate Change (Scotland) Act 2009 places duties on public bodies relating to climate change. The duties came into force on 1 January 2011 and apply to all 'public bodies', defined as a Scottish public authority within the meaning of section 3(1)(a) of the Freedom of Information (Scotland) Act 2002 (as amended). The Scottish Information Commissioner website contains information on Scottish public authorities. The duties on the face of the Act (section 44) require that a public body must, in exercising its functions, act:

- in the way best calculated to contribute to delivery of the Act's emissions reduction targets;
- *in the way best calculated to deliver any statutory adaptation programme*; and
- in a way that it considers most sustainable.

This duty states that all public bodies need to be resilient to the future climate and to plan for business continuity in relation to delivery of their functions and the services they deliver to the wider community. Public bodies can also influence Scotland's resilience by, for example, protecting ecosystem services such as natural flood management. Compliance with the duties is a legal obligation for all public bodies that are covered, and public bodies should check whether they fall within the definition of the duties in the Climate Change Act and act accordingly.

For full details of the Act refer to the Climate Change (Scotland) Act 2009 and Guidance to support public bodies in exercising their duties under the Climate Change (Scotland) Act 2009.

Other national policy drivers

In addition to the Climate Change (Scotland) Act 2009 which requires Scottish Ministers to develop a Scottish Climate Change Adaptation Programme, there are many national policy drivers which require actions that increase climate resilience if you are struggling to gain buy-in to begin adaptation planning. Create a checklist of existing (and potential future) policy commitments to build up your business case for developing a climate resilience plan, starting with those listed below. Record the stakeholders who are already committed to taking action as a result of these drivers so that you can work with them to take further action.

The *Civil Contingencies Act (2004)* requires public bodies to assess the risk of emergencies occurring and maintain plans to ensure if an emergency occurs that services are able to continue.

Two of the three meanings of the term "emergency" can be interpreted as relating to severe weather or climate change. The first is *"an event or situation which threatens serious damage to human welfare".* This includes where the emergency involves, causes or may cause loss of human life; human illness or injury; damage to property; disruption of supplies of money, food, water, energy or fuel; disruption of a system of communication' disruption of facilities for transport; or disruption of services relating to health.

The second relevant meaning is *"an event or situation which threatens serious damage to the environment".* This includes where the emergency involves, causes or may cause (a) contamination of land, water or air with biological, chemical or radioactive matter, or (b) disruption or destruction of plant life or animal life."

Other policy drivers include:

- The **National Planning Framework** which seeks to promote development which facilitates climate adaptation, and requires that development plans include policies which contribute to adaptation.

- The **Planning etc (Scotland) Act 2006** which requires that the National Planning Framework and development plans contribute to sustainable development.

- **Scottish Planning Policy** sets out national planning policy in relation to climate change which informs Strategic Development Plans and Local Development Plans. It states that *"the need to help mitigate the causes of climate change and the need to adapt to its short and long term impacts should be taken into account in all decisions throughout the planning system"* (paragraph 42).

- A number of **Planning Advice Notes** provide details of some aspects of climate change adaptation including:

  - Planning Advice Note 79: Water and drainage (2006) provides advice on water and drainage in both large and small developments.

  - Planning Advice Note 61: Planning and Sustainable Urban Drainage Systems (2001) provides advice on planning considerations relating to SUDS in policy making and development management.

  - Planning Advice Note 69: Planning and building standards advice on flooding (2004) sets out good planning and Building Standards practice in areas where there is a risk of flooding.

- The **Scottish Soil Framework (2009)** which is an important adaptation consideration for planners in relation to constraints and the protection of land in terms of the impacts of soil sealing, soil productivity under future climate scenarios and food security.

- The **Marine (Scotland) Act 2010** which has introduced powers to protect areas of importance for marine wildlife, habitats and historic monuments. There is an important connection between marine planning and climate change adaptation, and the risks associated with rising sea levels and coastal flooding and erosion need to be taken into account by planners in considering the location of new development and options for climate proofing flood prone areas.

- Under the **Flood Risk Management (Scotland) Act 2009** a National Flood Risk Assessment has been developed which will inform Flood Risk Management Strategies and Local Flood Management Plans. These will in turn help influence the location and design of new development through the planning system and the implementation of flood risk management measures.

- Scotland's **River Basin Management Plans** provide a tool to assist planners adapting to climate change by increasing resilience of the water environment through natural measures, such as the provision of green and blue networks, buffer strips next to water bodies, protecting and enhancing existing floodplains and wetlands and the incorporation of SUDS in new development.

- Scotland's **Land Use Strategy** is a key commitment of Section 57 of the Climate Change (Scotland) Act 2009. It contains principles for sustainable land use to be used when making plans and taking significant decisions affecting land, a number of which relate directly to climate adaptation.

- Climate change is recognised as a key pressure on biodiversity in the five ecosystem groups of woodland, upland, marine/coastal, freshwater/wetland, and lowland/farmland within the **Scottish Biodiversity Strategy 2006**, which may inform the protection or enhancement of sites.

- The **Scottish Forestry Strategy 2006** emphasises the role of forestry and woodland in adapting to climate change, including the contribution of trees to natural flood management and the provision of woodland habitat networks to build ecosystem and species resilience.

Organisational policy drivers

Many of the policies, plans and projects in place within and outside your organisation will either make direct or indirect reference to climate resilience, or will be threatened by climate impacts. Identify these as a starting point to understand your organisation's existing commitments to increase climate resilience.

Policy or plan	Direct or indirect reference(s) to climate resilience
Corporate strategy	
Business continuity plan	
Emergency plan	
Annual report	
Environmental policy	
Equalities policy	
Financial plan	
Asset management plan	
Sustainable development strategy	
Staff travel plan/policy	
Health plan	
Partnership agreements e.g. Single Outcome Agreement	
Strategic flood risk assessment	

Annex 2: Screening policies, plans and projects for climate-related threats and opportunities

Spatial planning provides a vital opportunity to consider the impacts of climate change and ensure that measures are taken to support adaptation. The preparation of Scotland's Climate Change Adaptation Programme alongside the third National Planning Framework (NPF3) and the review of Scottish Planning Policy provide a unique opportunity to ensure a coherent long term adaptation strategy for land use planning, and to identify real and timely measures for planners to assist adaptation at all scales.

Spatial planning has a vital role in promoting a climate resilient low carbon future through its influence on the location, type, scale, design and sustainability of new development. Planning can also assist adaptation through its capacity to:

- coordinate matters of collective concern or public good;
- manage and facilitate competing interests;
- provide a way of thinking and action across various spatial, temporal and governance scales;
- reduce or modify uncertainty;
- be a repository for spatial knowledge sets; and
- be future oriented.

Strategic Environmental Assessment

All Scottish public bodies and a few private companies operating in a 'public character' (e.g. utility companies) within Scotland are required to assess, consult and monitor the likely impacts of their plans, programmes and strategies on the environment. This process is known as Strategic Environmental Assessment (SEA) and is required by The Environmental Assessment (Scotland) Act 2005.

Part 8 of *Consideration of Climatic Factors within Strategic Environmental Assessment* provides guidance on questions to ask at the screening stage of a policy, plan or strategy (PPS). These include:

- Can the PPS influence the location and design of new developments, critical infrastructure and public services, ensuring they are not at risk of flooding?
- Can the PPS influence the location and design of new development in areas – particularly on the coast – subject to erosion?
- Can the PPS impact on the use of water, including water supply in times of drought?
- Can the PPS impact on the management of water systems, including drainage?

Using SEA can help mainstream adaptation into strategic planning, helping reduce the hazards, risks and vulnerabilities posed by climate change to systems and populations. SEA can help policies, plans and strategies to mediate climate change risks, for example by helping to avoid maladaptive decisions.

Environmental Impact Assessment

Environmental Impact Assessment (EIA) is a means of drawing together, in a systematic way, an assessment of the likely significant environmental effects arising from a proposed development. The requirement for EIA comes from European Directive 2011/92/EU.

The EIA Directive requires that EIA shall *"identify, describe and assess… the direct and indirect effects of a project on the… interaction between: human beings, fauna and flora, soil, water, air, climate, the landscape, material assets and cultural heritage"* (Article 3). However, assessing the resilience of a proposed development to climate impacts is not clearly required; although it does have a clear role to play in ensuring that new developments are resilient to severe weather and climate change. In undertaking an EIA, consider how your project could be affected by climate impacts – and ensure that these impacts do not compound impacts on human or natural systems.

More information on the adaptation information, tools and support that are currently available for planners is available from Adaptation Scotland. More information on climate change adaptation and EIA is available from IEMA

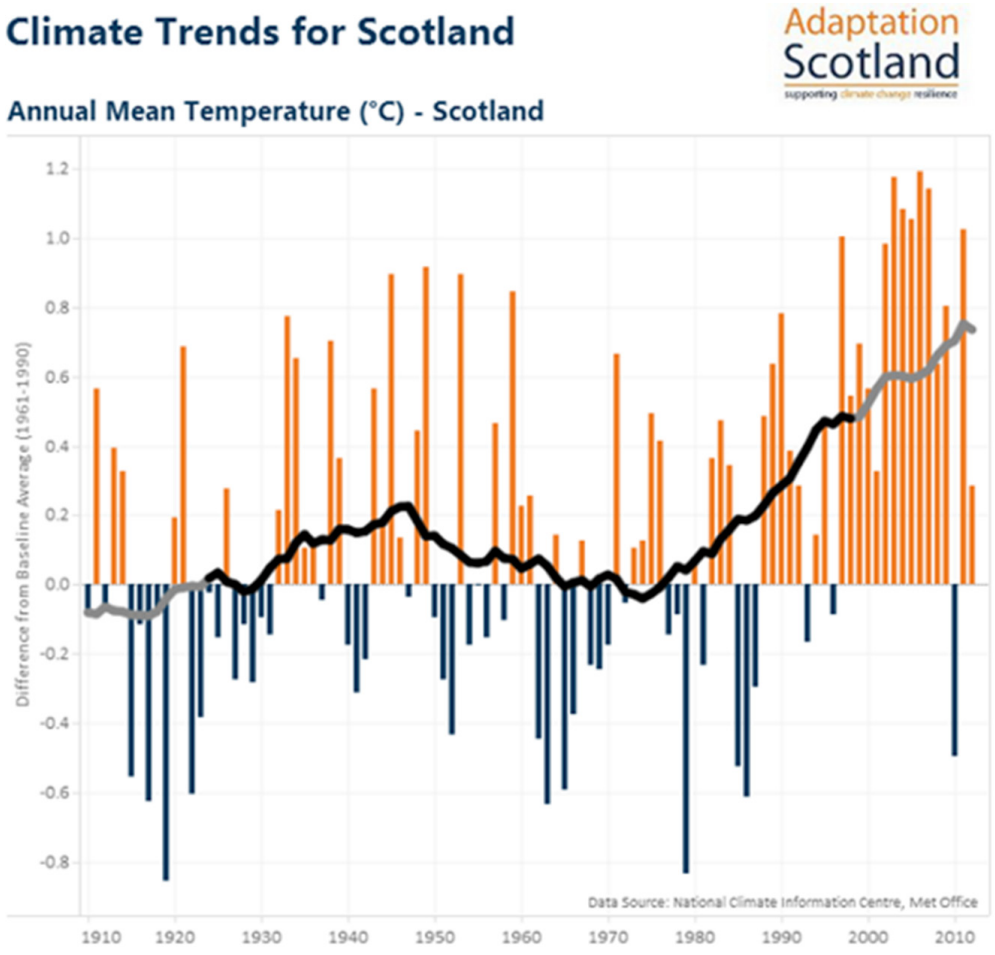
Annex 3: Recent climate trends and future projected climate change

There is unequivocal evidence that the global climate is already warming. Continued emissions of greenhouse gases will cause further warming and changes in the climate system (IPCC AR5, 2013). The legacy of what we have already emitted means that climate change over the next few decades is now unavoidable.

The world has experienced unprecedented, high-impact climate extremes since the start of the 21st century, with the warmest decade ever recorded, and extreme events ranging from tropical cyclones, to floods, heat waves and severe droughts (WMO, 2013).

In Scotland, the last few decades have been the warmest since records began, even taking account of recent cold winters (see figure). We have also seen an overall increase in rainfall, which has led to flooding in many locations, although at times we have also experienced local droughts. Sea level has continued to rise and storm surges have recently damaged our east coast ports and taken lives in the Western Isles.

We are vulnerable to weather and we need to be prepared for the consequences in our changing climate.



1 A Handbook of Climate Trends Across Scotland (SNIFFER, 2006) compiles and analyses observed climate data across Scotland over the last century (1914-2004), providing a benchmark of observed climate trends for Scotland.

Observed changes in Scotland's climate between 1961 and 2004[1]

Temperature	Recent temperatures for Scotland are the highest on record. Average annual temperature increased 1°C between 1961 and 2004. This applies across all seasons.
Rainfall	Annual precipitation in Scotland increased by 21% between 1961 and 2004, with an almost 70% increase in winter precipitation for Northern Scotland. Heavy rainfall events have increased significantly in winter, particularly in northern and western regions.
Snow cover	There has been a 25% reduction in winter days with snow cover, with even larger percentage decreases in spring and autumn. The snow season has shortened, starting later and finishing earlier in the year.
Days of frost	Since 1961 there has been more than a 25% reduction in the number of frost days across Scotland, with a downward trend since the 1980s.
Growing season	The growing season is now nearly 5 weeks longer in Scotland (comparing 1961 to 2004), with the greatest change occurring at the beginning of the season.
Sea level[2]	Sea level at all of Scotland's ports has been rising over the last century, with the rate accelerating over the last two decades (now exceeding 3-4 mm/year in 9 out of 10 ports).

Future projected changes in climate

The UK Climate Projections (UKCP09) are the latest generation of climate information for the United Kingdom. They are based on state-of-the-art climate modelling undertaken by the Met Office Hadley Centre, UK Climate Impacts Programme (UKCIP) and over thirty contributing organisations.

The key long-term climate change trends for Scotland are:

- average summer is warmer and drier;
- average autumn/winter is milder and wetter; and
- weather will remain variable (for example year-to-year), and it may become more variable.

We can also expect to see:

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

UKCP09 provides extensive climate projections data for Scotland. A selection for the three Scottish 'climate regions' (as defined by the Met Office) are shown in Figure 2.

Projected changes in summer and winter temperature and precipitation for Scottish climate regions (2050s – medium emissions scenario)[3]

North Scotland

WINTER	Mean temperature increase:	**1.6ºC** (0.6ºC – 2.8ºC)
	Mean precipitation increase:	**13%** (3% – 24%)
SUMMER	Mean temperature increase:	**2.0ºC** (0.9ºC – 3.4ºC)
	Mean precipitation increase:	**-11%** (-24% – 2%)

East Scotland

WINTER	Mean temperature increase:	**1.7ºC** (0.7ºC – 2.9ºC)
	Mean precipitation increase:	**10%** (1% – 20%)
SUMMER	Mean temperature increase:	**2.3ºC** (1.1ºC – 3.9ºC)
	Mean precipitation increase:	**-13%** (-27% – 1%)

West Scotland

WINTER	Mean temperature increase:	**2.0ºC** (1.0ºC – 3.0ºC)
	Mean precipitation increase:	**15%** (5% – 29%)
SUMMER	Mean temperature increase:	**2.4ºC** (1.1ºC – 3.8ºC)
	Mean precipitation increase:	**-13%** (-27% – 1%)

* UKCP09 provides probability ranges for future climate. The number in bold is the central estimate, with the 'very likely' range in brackets

2 Recent analysis of sea level trends by Rennie and Hansom (2010)

3 A medium emissions scenario is based on a balance of fossil and non-fossil fuel technologies.

Further support

Accessing and interpreting climate change information can be challenging. Adaptation Scotland and UKCIP recognise these challenges and support users through a range of tools, resources and training. There are a number of sources of information on recent climate trends in Scotland (see Step 2).

UKCIP eLearning Resources

UKCIP offers a wide range of online tutorials and guidance that are free to access and provide a good introduction to UKCP09. They also provide a helpdesk facility for technical issues that may arise when using the projections.

UKCP09 and other tools provide a powerful resource for decision-making that takes account of uncertainty about the future climate and complements risk assessment approaches. However, accessing and interpreting climate change information can be challenging. Customised maps, graphs and tables can be generated for a particular area (minimum 25km^2 grid), time period, emissions scenario etc. on the UKCP09 User Interface.

Material for Scotland is separated into three regions (North, East and West) to best describe the varied climate. There are no nationally aggregated values for Scotland, hence no key findings or graphs for the country as a whole, but customisable national maps are available. Maps showing changes in mean precipitation and temperature for Scotland are available in the Scottish Compendium of UKCP09 Climate Change Information.

Case studies provided by a range of organisations, including some English local authorities, illustrate the different ways in which the UKCP09 materials and information can be used.

The questions below will help identify whether you could benefit from using UKCP09. If the answer is 'yes' to any of these, then it would be worth taking a more in depth look. Is your organisation, policy or programme:

- affected by changes to averages or extremes of weather or climate;
- taking decisions or making investments with long-lifetimes, such as construction;
- making significant investments or has high value at stake, such as protecting life or natural environment;
- providing or supporting critical national infrastructure, like power supply; or
- taking decisions with significant impacts, perhaps creating a technical standard, that cannot be changed for more than a decade?

References

IPCC AR5, Climate Change 2013: The Physical Science Basis

WMO (2013) The Global Climate 2001-2010: a decade of climate extremes

Annex 4: Actions already underway to increase climate resilience

National policy	Adaptation-related actions being taken in response to national policy	Stakeholders
Civil Contingencies Act (2004)		
Planning etc (Scotland) Act (2006)		
National Planning Framework 2		
Land Use Strategy		
Scottish Soil Framework		
Marine (Scotland) Act 2010		
Flood Risk Management (Scotland) Act 2009		
River Basin Planning		
Scottish Biodiversity Strategy (2006)		
Scottish Forestry Strategy (2006)		

Annex 5: Climate change risk assessment using Corporate Risk Register

Have weather and climatic factors been considered in the current threat and consequences? If not add description based on current climate. Does this change the residual risk rating?

For threat number (1) – heavy rainfall is expected to become more frequent in future and winters are expected to become milder, therefore likelihood increases but consequences stay the same

Are existing controls sufficient to manage the increased risk? For both threats (1) and (2) the controls are insufficient due to lack of awareness of future climate.

		2013 Inherent risk				2013 Residual risk				2050 Inherent risk				2050 Residual risk			
Threat	Consequences	Likelihood	Consequence	Risk rating	Controls	Likelihood	Consequence	Risk rating	Senior management responsibility	Likelihood	Consequence	Risk rating		Likelihood	Consequence	Risk rating	Further actions
1. Insufficient investment/ oversight of infrastructure to ensure it provides the expected level of service *heavy and persistent rain and warm conditions lead to damp, mould and mites*	Disruption to critical services Reputational damage Financial loss *Health and safety risk for building occupiers, particularly those with respiratory illness*	3	3	9	Ongoing resilience improvement programmes and infrastructure upgrades	2	3	6	Head of Planning and Assets	3	3	9		3	3	9	*Training and awareness raising with building services of the need to prevent damp conditions*
2. Damage to buildings and estates (including neighbouring properties) *Severe weather likely to become more frequent and damaging*	Injury, death Inability to provide critical services *Health and safety risk. Financial consequence of building repairs.*	3	4	12	Fire policies Training and awareness Insurance	2	4	8	Head of Estates	3	4	12	Same controls as 2013	3	4	12	*Factor in climate threats to existing policies and increase understanding of future climate impacts*

Identify further actions which require a detailed action plan in Step 3. Get action plans signed-off by appropriate senior manager

For threat number (2) – severe weather is likely to become more frequent and damaging therefore both likelihood and consequence increase

Annex 6: Examples of actions which increase climate resilience

Transport	• Transport emergency planning and consequence management measures are in place. • Coastal erosion and flood risk locations are considered in siting new transport infrastructure. • Transport infrastructure is designed to withstand flooding, high winds and warmer temperatures. • Habitat corridors are provided to help species movement. • Problems on the transport network are communicated to the public, employees and businesses.
Energy	• Energy generation and supply is protected from landslides, floods, warmer weather, increased heavy rainfall, droughts. • Peat soils are protected to absorb water and reduce flood risk.
Waste	• Waste management facilities and processes take into account changes in climate, e.g. heavy rainfall events and increased run off to avoid pollution incidents.
Biodiversity and ecosystem services	• Habitats are enhanced where possible. • Natural flood management is used in catchment planning, e.g. protecting bogs and marshes to act as a buffer in intense rainfall. • Natural features are used in urban environments, e.g. living roofs to improve habitat connectivity.
Land Use (including spatial planning, agriculture and forestry)	• Sustainable Urban Drainage Systems are implemented where possible. • Floodplain woodlands and wetland habitats are created where possible. • Flood risk and coastal erosion are taken into account.
Built environment	• Buildings can maintain comfortable internal temperatures in hot and cold weather. • Buildings have suitable drainage capacity and green roofs.
Water	• Rain water storage helps plan for water shortage during seasons of high demand and low availability and reduces run-off during high rainfall. • Water consumption is monitored and measured.
Health and well-being	• Staff are aware of the threat of warmer temperatures in the workplace. • Parks and gardens provide shading during warmer temperatures.

Annex 7: Assessing the cost-benefit of adaptation actions

Estimating the costs and benefits of adaptation actions

When making decisions about implementing adaptation options, it is important to consider the economic efficiency of the projects as well as effectiveness and equity. Like any investment, a full appraisal of the costs and benefits over the lifetime of the project will enable informed decisions to be made. Climate change poses a number of challenges to this, particularly relating to the uncertainty of the timing, location and magnitude of impacts. This should not be a reason to delay action, however, and there are tools and methods that can help to deal with uncertainty.

If there is considerable uncertainty, decisions need to be robust under a range of future climates. Features of robustness include providing multiple benefits in the current climate; being flexible so that they can be altered if the climate does not change in the way initially anticipated; favouring 'soft' strategies where possible over 'hard' infrastructural projects; and incorporating safety-margins to allow for greater changes than expected.

Large-scale investment decisions

There is value in leaving options open to take account of climate information as it becomes more certain. This helps to avoid committing to irreversible projects that may not be suitable in future. Rigorous analysis of this is known as Real Options Analysis (ROA) and is data intensive and mathematically complex. Another technique for analysing options under uncertainty is Robust Decision-Making (RDM), which uses computer simulation to identify the vulnerabilities of different strategies under different scenarios and produces trade-off curves. While formalised RDM is computationally intensive, the principles can be incorporated into project design without the mathematical application. For more information see Hallegatte (2009), Lempert and Collins (2007), Lempert et al. (2006).

'Flexible pathways'[4] or 'adaptive management' works on the principle of sequencing the implementation of different measures over time. The best-known example of this is the Thames Estuary 2100 (TE2100) project. Options are left open to deal with a range of possible different future climates and decisions are made at various points along the process as more information becomes available. High level route-maps identifying points in time where decisions need to be made are used to identify response options (Reeder and Ranger 2010).

Less complex projects

Cost-benefit analysis (CBA) remains a popular tool for assessing smaller-scale, less complex options. CBA is designed to demonstrate whether the total benefits of an option outweigh the total costs. The total costs and benefits over a given time period are cumulated and discounted[5] to present day values to give a measure of the efficiency of the project (usually a net present value (NPV), or a benefit-cost ration (BCR) or internal rate of return (IRR)).

You will have identified a range of possible actions to manage a particular climate risk in Step 3. The following stages should now be followed to assess the costs and benefits of each action. We strongly suggest you consult Metroeconomica (2004) for a detailed overview of guidelines produced for UKCIP when carrying out your own assessment.

Stage 1: Identify and quantify the total costs involved over a defined period (e.g. 50 years). Include:

- initial capital costs;
- on-going maintenance costs; and
- indirect costs.

Stage 2: Identify and quantify the total benefits likely to accrue over the time period.

- Calculate the cost of the climate impact without the adaptation. In simple terms, the **economic value of the climate impact** (in £) **= the estimated impact of climate change** (physical units, e.g. the number of houses flooded; the volume of stock destroyed; the number of hospital admissions) *** the economic value of the impact** (£ per unit).

4 See also Moss and Martin (2012) for a CXC brief on flexible adaptation pathways.
5 Discounting is a technique used to determine the present day value of costs and benefits that occur in different time periods. It is based on the principle that, generally, people prefer to receive goods and services now rather than later. Public sector discount rates are prescribed in the UK Government Treasury Green Book.

How you calculate this will depend on the type of climate impact you are considering. For extreme events, such as floods or storms, you may know the probability of that event occurring in the future. In this case, you can multiply the current costs of that event by the probability of that event occurring in future years. For gradual changes, such as sea-level rise or gradually warmer temperatures, you will need to know the relationship between the climate-induced change (e.g. temperature) and the impact you are considering.

- Calculate the cost of the climate impact once the adaptation is in place. In this case you will need to know how the adaptation will modify the climate impact. The calculation will be the same as the previous one, however the estimated impact of climate change will be lower.
- The difference between these indicates the benefits of the adaptation action (i.e. the avoided damages).
- Identify the indirect benefits, such as social, environmental and cultural goods and services (Metroeconomica, 2004).

Stage 3: Estimate the economic efficiency of the project through the NPV[6]*.* The NPV is calculated in the following equation:

$$NPV = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t}$$

Where i = discount rate, N = total number of time periods, t = time period, and R = net cash flow (i.e. benefits – costs).

This equation essentially converts the costs and benefits in future time periods to their value in the current time period (known as discounting), and sums all of the time periods considered, to give one value, the NPV, for the life of the project. This allows different projects to be compared using the same metric (the NPV), or in the case of a single project, enables a decision maker to see whether the NPV is positive, in which case, based on economic efficiency grounds, the project could proceed, or if the NPV is negative, the project would not be recommended.

Want to learn more?

Hallegatte, S. 2009. Strategies to adapt to an uncertain climate change. Global Environmental Change, 19, 240-247

HM Treasury (2011) The Green Book: Appraisal and Evaluation in Central Government. London: TSO.

Lempert, R. J. & Collins, M. T. 2007. Managing the Risk of Uncertain Threshold Responses: Comparison of Robust, Optimum, and Precautionary Approaches. Risk Analysis: An International Journal, 27, 1009-1026.

Lempert, R. J., Groves, D. G., Popper, S. W. & Bankes, S. C. 2006. A General, Analytic Method for Generating Robust Strategies and Narrative Scenarios. Management Science, 514.

Metroeconomica (2004) Costing the impacts of climate change in the UK: Implementation Report. The UK Climate Impacts Programme (UKCIP).

Moss, A., Martin, S. (2012) Flexible adaptation pathways. Edinburgh, ClimateXChange.

Reeder, T and Ranger, N. (2010) How do you adapt in an uncertain world? Lessons from the Thames Estuary 2100 project. World Resources Report, Washington DC.

6 Benefit Cost Ratio or the Internal Rate of Return can also be used, but NPV is most commonly used.