UK Climate Impacts Programme

Identifying adaptation options

UK Climate Impacts Programme

Identifying adaptation options

Table of Contents

Preface

This note provides guidance on the identification and selection of adaptation options that can be used to respond to climate risks. It builds on information previously provided in the UKCIP Risk, Uncertainty and Decision-making framework (Willows and Connell, 2003) and Measuring Progress (West and Gawith, 2005), by providing further information on the range of adaptation options available, including practical examples. It also updates this information using recent advances in the scientific literature and practical experience as reflected in adaptation actions being taken within the UK.

In presenting this information, this guidance note explores the nature and characteristics of adaptation in the context of climate risk and provides further background information and examples of adaptation strategies and options. It also presents a simple adaptation checklist which identifies certain key principles that our experience suggests are synonymous with good adaptation decisions.

This guidance note is aimed at supporting decision and policy makers who are faced with identifying and appraising the effectiveness of adaptation measures (stages 4 and 5 of the UKCIP Risk Framework) that address identified climate risks (those identified through stage 3 of the UKCIP Risk Framework). It should be considered as a companion piece to other UKCIP tools such as the Adaptation Wizard; Risk, Uncertainty and Decision-making framework, Business Areas Climate Impacts Assessment Tool (BACLIAT), Adaptation Actions database and the guidelines on costing the impacts of climate change.

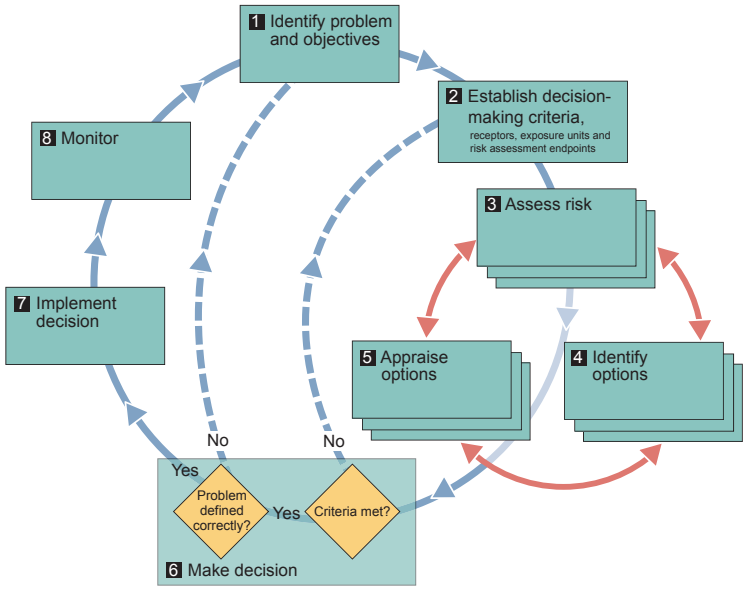
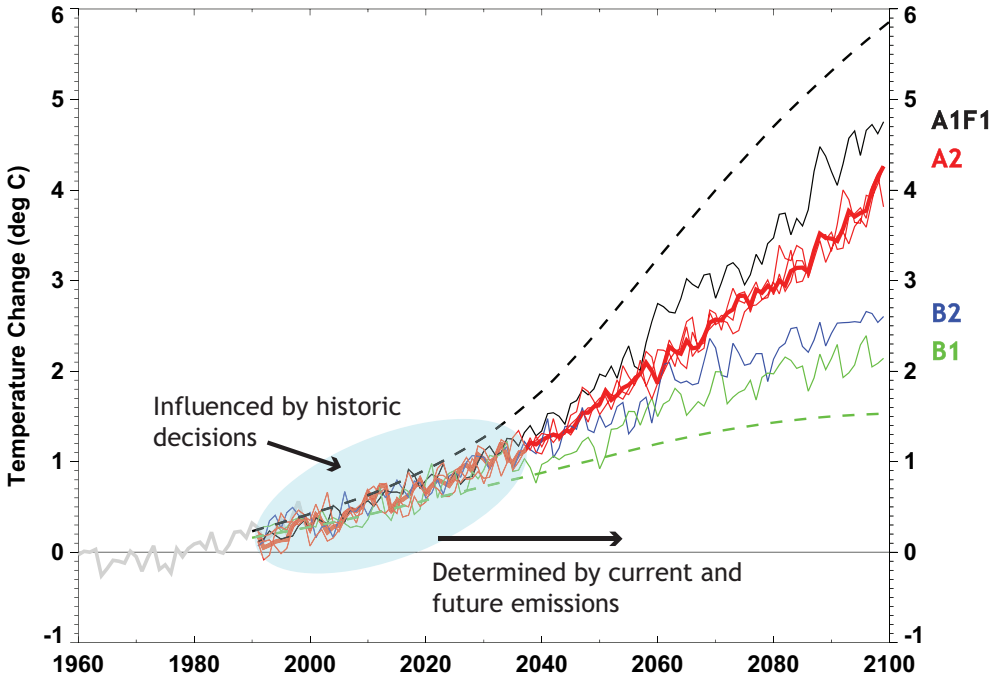


Figure 1: UKCIP Risk, uncertainty and decision-making framework.

1. What is adaptation and why adapt?

The viability, development and sustainability of social, economic and environmental systems are determined by the abilities of these systems to cope with and/or adapt to change. Historic climate variations and recent weather events (eg. storms, droughts, floods, warming temperatures, and changing precipitation patterns) demonstrate the relative and continuing sensitivities of our social, economic and environmental systems to current climate (an existing adaptation deficit) and signpost that there will be a need to consider adaptation in the context of projected changes in climate.

Negative climate impacts (or threats) result when and where events approach or exceed existing tolerance limits or thresholds. Positive impacts (or opportunities) arise when and where previously limiting factors (eg. thermal limits or snow/ice cover) no longer restrict development or activities. As limits or thresholds within managed and natural systems are often defined or assumed based on past experience, the projections of climate changes, including its variabilities and extremes, require attention – can we minimise the negative impacts and can we take advantage of the opportunities that will arise?



Source: UKCIP02 Climate change scenarios (funded by Defra, produced by Tyndall and Hadley Centres for UKCIP)

Figure 2: Projected global temperature change for four emission scenarios using UKCIP02 (Hulme et al, 2002).

Addressing the challenges associated with climate change requires an integrated approach – both limiting the magnitude and rate of change and dealing with the residual impacts and opportunities. The first of these responses is mitigation – actions aimed at reducing the sources or enhancing the sinks of greenhouse gases. However, irrespective of the success of mitigation efforts, there will still be some degree of unavoidable climate change (see Figure 1), and the projected magnitude and rate of those residual changes will still require addressing through adaptive actions. This unavoidable climate change stems from our current commitment to climate change as a result of historic greenhouse gas emissions and the persistence of these gases in the atmosphere, as well as the slow but building response of the oceans to atmospheric warming. This delayed response of the oceans will result in temperatures and sea-level continuing to increase for several decades (and in the case of sea level rise, perhaps several centuries) beyond any emission reductions resulting from mitigation measures.

As such, effective measures directed at enhancing our capacity to adapt (building adaptive capacity) and at minimising, adjusting to and taking advantage of the consequences of climatic change (delivering adaptation actions) are required and these need to be part of a balanced and prudent response to climate change.

Adaptation is needed as we are already committed to some degree of climate change irregardless of mitigation efforts (eg. up to mid-2030-40) and to address those impacts resulting from the residual changes not prevented through mitigation. Mitigation is needed to reduce the amount and rate of future climate change – avoiding dangerous or unacceptable climate change for which adaptation is limited and/or undesirable.

So what exactly is adaptation? The Intergovernmental Panel on Climate Change (IPCC) define adaptation as "an adjustment in natural or human systems in response to actual or expected climatic stimuli (variability, extremes, and changes) or their effects, which moderates harm or exploits beneficial opportunities" (IPCC TAR, 2001). Based on this definition, adaptation would appear to be an integral part of natural and human history. Indeed, the history of the development and evolution of human and natural systems contains many examples of successes and failures in adapting to the climate and its variability. It is this evidence base, along with the projected changes in climate, that have given rise to concerns that the continued viability and sustainability of many systems will be dependent on their abilities to successfully adapt to future changes in the climate (mean, variability and extremes).

ADAPTATION
An adjustment in natural or human systems in response to actual or expected climatic stimuli (variability, extremes and changes) or their effects, which moderates harm or exploits beneficial opportunities.

2. Guiding principles to inform effective adaptation

Adaptation measures will need to be fit for purpose. Ensuring that a specific measure is fit is simpler said than done. First of all, determining fitness is often only possible after the measure has been implemented and in place for some time. Additionally, the desired outcome, regardless of whether the adaptation measure was intended to build adaptive capacity or deliver an adaptive action, is often delayed, invisible or wrapped up with the implications of other introduced changes. Despite these difficulties in defining a particular adaptation measure as being good, acceptable, or successful, there are principles of good adaptation that can be used to inform the selection process. One such set of principles has evolved through practice and identifies the following aspects of the adaptation process as being characteristic of those processes that have lead to good adaptation[1]:

- **Work in partnership** – identify and engage your community and ensure they are well informed.
- **Understand risks and thresholds**, including associated uncertainties.
- **Frame and communicate SMART* objectives/outcomes** before starting out.
- **Manage climate and non-climate risks using a balanced approach** – assess and implement your approach to adaptation in the context of overall sustainability and development objectives that includes managing climate and non-climate risks.
- **Focus on actions to manage priority climate risks** – identify key climate risks and opportunities and focus on actions to manage these.
- **Address risks associated with today's climate variability and extremes** as a starting point towards taking anticipatory actions to address risks and opportunities associated with longer-term climate change.
- **Use adaptive management to cope with uncertainty** – recognise the value of a phased approach to cope with uncertainty.
- **Recognise the value of no/low regrets and win-win adaptation options** in terms of cost-effectiveness and multiple benefits.
- **Avoid actions that foreclose or limit future adaptations** or restrict adaptive actions of others.

1 Some of these principles are consistent with good participatory decision-making and thus apply more widely than just adaptation decision-making processes. As such good adaptation is dependent on general good quality decision-making or good management.

- **Review the continued effectiveness of adaptation decisions** by adopting a continuous improvement approach that also includes monitoring and re-evaluations of risks.

** SMART objectives – specific, measurable, achievable, results-oriented, and time-bound objectives.*

These principles suggest that good adaptation is founded on the engagement of an informed community with a willingness and ability to adapt. They also suggest that good adaptation requires an understanding of, and the ability to articulate, the objectives of the required action; an understanding of adaptation measures, including their feasibility; and a desire and willingness to see continued success through responsive and appropriate adaptation. Furthermore, the suggestions of implementing appropriate adaptation options (adaptive, no/low regrets and win-win), avoiding inappropriate actions, and adopting a continuous improvement approach are consistent with the precautionary approach (Rio Declaration, principle 15).

The remaining sections of this note provide guidance related to the identification, selection and role of stakeholders; dealing with uncertainty and identifying and selecting adaptation options. In terms of willingness and ability to adapt (ie. to make and/or implement a decision to adapt), these are often affected by concerns related to real and perceived barriers or constraints that can lead to questioning the need for adaptation or are seen as limiting the effectiveness of a particular option. These constraints or barriers include:

- Limited understanding of nature and extent of risks and vulnerabilities – current and projected;
- Lack of supportive policies, standards, regulations, and design guidance – deficiencies, encouraging status quo and/or presenting impediments;
- Existing legal or regulatory restrictions;
- Lack of availability or restricted access to appropriate technologies;
- Prohibitive costs of identified adaptation options when budgets are limited;
- Lack of availability of human capital (eg. availability of in-house expertise) – conflicting priorities impeding access;

BUILDING ADAPTIVE CAPACITY
is an effective strategy for eliminating barriers or constraints to adaptation - includes improving understanding of climate change and associated risks and impacts, and improving institutional and legal capacity.

- Social/cultural/financial rigidity and conflicts (existing or perceived);
- Short-term nature of decision-making and planning horizons – necessity and expectation of realising return on investment; and
- Lack of acceptance of the need to adapt related to perceptions of uncertainty such as:
- Lack of buy-in of need to adapt by decision-makers – business case has not been made and the mismatch between business planning horizons and timeframe of projections of climate change;
- Not seen as a big problem and the temptation is to wait for the impact then react;
- Belief that the uncertainty is too great to warrant taking adaptation;
- Lack of useful precedents or evidence of adaptation actions; and
- Lack of acceptance/understanding of risks associated with implementation – what if the decision is wrong?

Building adaptive capacity through improving the understanding of climate change and associated risks and specific vulnerabilities, along with actions related to understanding and improving the institutional and legal frameworks (ie. those constraining or enhancing adaptive capacity), are useful strategies for eliminating these barriers.

3. Stakeholders in the adaptation process

As suggested under the principles of good adaptation, identifying and engaging the relevant community of interest (ie. stakeholders) is considered key to success. Stakeholders contribute through the knowledge and skills that they bring to the process. The more comprehensive that knowledge and skill base is and the more informed the stakeholders are about the process and underlying factors, the more likely that the resulting adaptation decision will be deemed successful[2]. As such, one goal when assembling and engaging the appropriate stakeholder community is to ensure that together they can build an understanding of the nature and scope of the climate risks and, through a combination of scientific, technical and factual information along with local knowledge and experience, can develop socially, economically, environmentally and culturally appropriate adaptation strategies and measures.

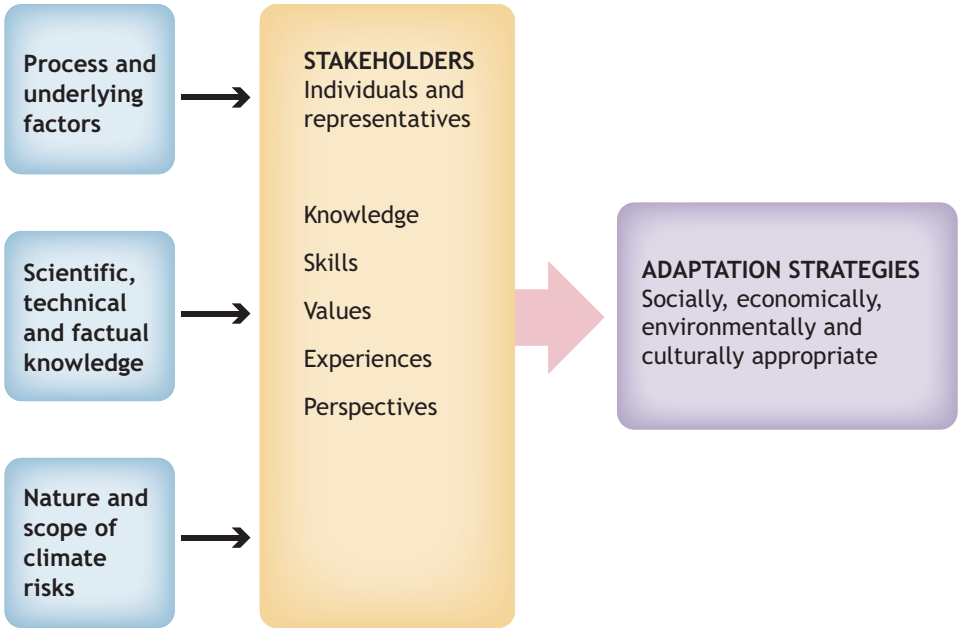


Figure 3: Roles and responsibilities of stakeholders in the adaptation process.

2 Success in this case is related to the adaptation decision-making process and is associated with the likelihood of the acceptance of the decision as well as the effectiveness of the proposed adaptation measures.

Who are these stakeholders? Those to be engaged will depend on the nature of the adaptive response being considered. As mentioned earlier, stakeholders can include individuals with necessary knowledge or skills needed to make and implement the required decision(s). This normally includes appropriate representatives from the organisation considering the adaptive responses, plus representatives from relevant professional groups, additional scientific and, technical expertise, and representatives of regulatory and legislative organisations (professional, government, and other non-governmental). In the case of adaptation, stakeholders also included those who may be effected by the introduction of a particular adaptive response (incur a potential or real benefit or negative impact). It is also recognised that stakeholders not only bring their own knowledge and skills, but in many cases also represent the interests of their respective community and are able to effect change (ie. they can act as "agents of change").

STAKEHOLDERS

- **those that can affect change**
- **those that have necessary knowledge or skills needed to make or implement decisions**
- **those affected by the climate risk and by the responses**
- **represent the interests of their community (values and expectations)**

In the case of adaptation, there are often trade-offs and/or a number of different adaptive strategies or measures that could be taken. Stakeholders are expected to bring to the assessment process their different perspectives, including those related to values and expectations. Consideration of these different perspectives is particularly important as many adaptation measures (eg. land use adaptation measures) can bring both benefits and losses depending on one's perspective. Ensuring that a broad range of perspectives are considered within the assessment and subsequent decision-making processes will further increase the likely acceptability, as well as the effectiveness of proposed adaptation measures.

This role of the stakeholders is also important from the perspective of identifying optional adaptation measures where there is potential conflicting or synergistic strategies and measures. Adaptation measures should be developed and implemented in a manner that does not make it more difficult for others to manage their climate risks (or other development goals) and adaptation-constraining or maladaptation measures should be avoided. Alternatively, synergistic opportunities may be possible by modifying and/or combining identified adaptation measures with adaptation or development initiatives being undertaken (or planned) by others. Engaging the appropriate stakeholder community can identify potentially constraining measures or synergistic opportunities that may be missed, leading to the possibility of increased costs, conflicts and damaged relationships/image.

4. Dealing with uncertainty

As pointed out earlier, not accepting the need to adapt to projected changes in climate and difficulties with taking decisions to adapt are often attributed to the lack of certainty associated with projected climate futures. Uncertainty, however, should not be used as an excuse for not taking appropriate action. Many decisions in business and politics are regularly made in the face of uncertainty (eg. investment decisions) and deciding on the need for, and type of, adaptation should be approached in a similar manner. This normally involves taking a risk management approach (such as that described in the UKCIP risk, uncertainty and decision-making framework) that involves considering both the degree of risk and the consequences of a taking a specific adaptation decision, including willingness to accept the implications of a wrong decision – aversion to risk.

When considering the appropriateness of a suite of identified adaptation options, there are often concerns related to risks, primarily financial but also image-related, associated with their selection and implementation. For example, is the identified adaptation necessary or too much (over adaptation), less than ideal or not enough (under adaptation), restrictive or simply wrong or unjustified?

An effective way of addressing concerns around making decisions in the face of uncertainty is adopting a flexible or adaptive management approach which involves implementing the required adaptation measure(s) in a phased manner. This involves doing what is needed and makes sense now to address obvious risks and delaying those for which current understanding of the associated risks are less certain yet are tolerable. As such, fundamental to this approach is a clear understanding of the risks (both existing and their evolution with time) and the scope of potential adaptation measures (see UKCIP risk, uncertainty and decision-making framework) in terms of realising the desired objectives. A flexible/adaptive management approach may be preferred after consideration of the nature of the risks and the associated costs and benefits of proposed adaptation measures in light of the associated uncertainties. It may also be preferred as it recognises that our understanding of the risks and of the efficacy of a particular adaptation measure (as well as the scope of measures available) will be changing with time. One such adaptive management approach was identified as one of the principles of good adaptation – address risks associated with today's climate variability and extremes as a starting point towards taking anticipatory actions to address risks and opportunities associated with longer-term climate change. Often understanding impacts associated with the variability of present-day weather and climate can provide both evidence of vulnerabilities and a guide to appropriate (successful) adaptation responses. Reducing risks associated with these existing vulnerabilities, especially those that are also projected to increase with time as a result

of projected climate changes, can have potentially multiple and immediate benefits to the bottom line (for both private and public organisations). These benefits can be direct and quickly realised (even immediately) through savings as a result of reduced risks and/or introductions of efficiency. They can also be indirect through such things as demonstrated social responsibility with follow-on implications for shareholder or constituency confidence.

5. Types of adaptation

Adaptation responses and decisions can be categorised as measures and strategies that contribute either to:

- **Building adaptive capacity** – creating the information (research, data collecting and monitoring, awareness raising), supportive social structures (organisational development, working in partnership, institutions), and supportive governance (regulations, legislations, and guidance) that are needed as a foundation for delivering adaptation actions; or

- **Delivering adaptation actions** – actions that help to reduce vulnerability to climate risks, or to exploit opportunities.

These two categories reflect the range of adaptation measures and strategies from which a good adaptation response can be developed.

Targeted measures directed at building adaptive capacity (see Tables 1–6, pages 16–23) are fundamental to delivering responsive adaptation actions. Many organisations have begun the process of building adaptive capacity through understanding the nature of the issue and risks, identifying and engaging the community/players, and assessing the situation (risks and thresholds) and likely adaptive responses.

Delivering adaptation actions requires consideration of purpose and social, economic, technological and environmental feasibility. In terms of purpose, adaptation is normally required because of inadequacies related to coping with existing or projected climate risks (including variabilities and extremes) or because of a desire to exploit beneficial climatic opportunities. As such, these adaptation actions and strategies are normally targeted at (see Tables 7–10, pages 24–28):

DELIVERING ADAPTATION ACTIONS
Address inadequacies related to coping with existing or projected climate risks or to exploit beneficial climatic opportunities.

- **Living with and bearing losses or risks** – accepting that pre-impact systems, behaviours and/or activities no longer can be sustained nor pursued or accepting the loss of assets as they are/will be no longer feasible or worth sustaining.

- **Preventing effects or reducing exposure to risks** – these are associated with either relocating, changing what is exposed, or building climatic resilience with the objective of allowing pre-impact systems, behaviours and activities to continue but introducing measures to reduce exposure to the new/heightened risks. It also includes eliminating exposure to risks by changing to a different use or location. These types of strategies are often adopted where the assets at risk are so valuable that a "living with risk" strategy is unacceptable. Building resilience, however, does

include 'living with risk'. Measures adopted in this latter case involve minimising exposure to risks to a defined acceptable level through reducing the consequences of the resulting impacts and/or facilitating earlier and less costly recovery following exposure. Better preparedness and contingency planning are additional approaches that can prevent effects or reduce exposure to risks.

- **Sharing responsibility for any losses or risks** – reducing the financial and social losses or exposure to risk by use of insurance, sharing the associated costs of adaptive responses, and relief efforts (eg. government, NGO or community relief efforts).

- **Exploiting opportunities** – changing use or location to exploit opportunities afforded by changes in climate and increasing capacity to manage opportunities resulting from changing climate. Measures considered under this strategy include introducing a new activity, behaviour, or species (crop) when pre-impact climate constraints no longer exist (or associated risks are no longer a limiting factor) as well as changing behaviour or practices to take advantage of more favourable climate conditions.

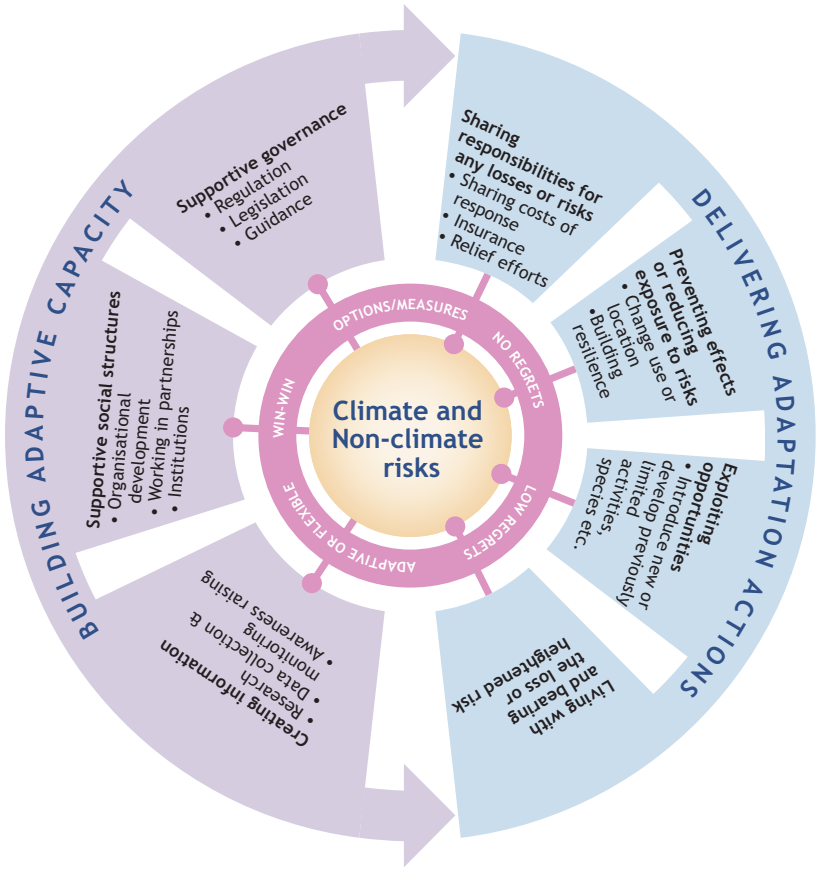


Figure 4: Framework for identifying adaptation options.

In practice, adaptation will often involve a mixture of response strategies: some building climatic resilience (eg. enhanced design specifications), some 'living with risks' (eg. increased preparedness and contingency planning), and some acceptance of loss (eg. accepting occasional losses or reductions in quality). The specific mixture will be case specific as it will depend on such things as risk aversion, as well as the values and capacity of the affected and responding community/organisation. An optimum mixture may also include adopting measures that also allow for the exploitation of opportunities (eg. changing location of existing activities deemed no longer viable at their current location and introducing new replacement activities at that original location).

Considering the nature of projected changes in climate (potentially rapid change, continuing change over the long-term, and the degree of uncertainties), an effective approach to adaptation should consist of enhancing the flexibility or resilience of hard-to-reverse investments, particularly those expected to have a long design life (eg. infrastructure for utilities, transportation infrastructure, buildings, and forest plantations) and enhancing information and its accessibility and utility (Fankhauser *et al*, 1999). In the case of infrastructure and systems, an effective approach would be to time introduction of adaptation measures to coincide with planned maintenance and/or upgrading or to take advantage of opportunities that arise with unscheduled interruptions or breakdowns. This timing could reduce the overall costs of the adaptation measure, particularly when considering associated capital and labour costs.

AN EFFECTIVE APPROACH DRAWS ON A MIXTURE OF ADAPTATION STRATEGIES:

- **Coping with risks associated with present climate variability and extremes;**
- **Introducing adaptation measures incrementally - what makes sense today but designed to allow incremental adjustments;**
- **Enhancing flexibility or resilience of hard-to-reverse investments; and**
- **Introducing adaptation measures to coincide with planned maintenance and/or upgrades.**

6. Adaptation options

When it comes to identifying appropriate adaptation measures, a prudent approach begins by recognising that there are several viable options that result in effective adaptation yet which minimise the risks associated with implementation (and are cost-effective) even in the face of associated uncertainties. These options are normally referred to as no-regrets, low-regrets, win-win and flexible/adaptive management.

No-Regrets Adaptation Options – adaptive measures that are worthwhile (ie. they deliver net socio-economic benefits) whatever the extent of future climate change. These types of measures include those justified (cost-effective) under current climate conditions (including those addressing its variability and extremes) and are further justified when their introduction is consistent with addressing risks associated with projected climate changes. The feasibility of implementing these types of options needs to be considered in the light of existing barriers and potential conflicts (as discussed earlier). In addition, focusing on no regrets options is particularly appropriate for the near term as they are more likely to be implemented (obvious and immediate benefits) and can provide experience on which to build further assessments of climate risks and adaptation measures.

Examples include: (see Tables 1–10, pages 19-31)

- Actions or activities directed at building adaptive capacity as part of an overall adaptive strategy;
- Avoiding building in high-risk areas (eg. flood plains) when locatre-locating;
- Reducing leakage from water utility infrastructure;
- Building/designing property and buildings to minimise over-heating in summer months;
- Reducing the consequences of flooding through the use of water-resistant materials for floors, walls and fixtures, and the siting of electrical controls, cables and appliances at a higher than normal level; and
- Introducing multiple season recreation facilities.

Such measures/strategies will require investments but overall are at least cost neutral when the immediacy of the targeted risks and realised benefits are considered.

Low-regrets (or limited regrets) options – adaptive measures for which the associated costs are relatively low and for which the benefits, although primarily realised under projected future climate change, may be relatively large.

Examples include: (see Tables 1–10, pages 19-31)

- Building extra climate headroom in new developments to allow for further modifications (eg. increased ventilation, drainage) consistent with projected changes in temperature and precipitation;

- Restricting the type and extent of development in flood-prone areas; and

- Promoting the creation and preservation of space (eg. verges, agricultural land, and green urban areas, including roofs) in support of biodiversity goals.

- Sharing in developing and operating additional water storage facilities (eg. water groups building and operating a joint water reservoir).

Both no and low regrets options have merit in that they are directed at maximising the return on investment when certainty of the associated risk is low.

Win-Win options – adaptation measures that have the desired result in terms of minimising the climate risks or exploiting potential opportunities but also have other social, environmental or economic benefits. Within the climate change context, win-win options are often associated with those measures or activities that address climate impacts but which also contribute to mitigation or other social and environmental objectives. These types of measures include those that are introduced primarily for reasons other than addressing climate risks, but also deliver the desired adaptation benefits.

Examples include: (see Tables 1–10, pages 19-31)

- Flood management that includes creating or re-establishing flood plains which increase flood management capacity and support biodiversity and habitat conservation objectives;

- Improving preparedness and contingency planning to deal with risks (including climate);

- Improving the cooling capacity of building through increased shading and/or alternative less energy intensive cooling strategies; and

- Green roofs and green walls which have multiple benefits in terms of reducing building temperature and rainfall runoff from buildings, and increased green spaces within urban areas, but also reduces energy use for both heating and cooling.

Flexible or adaptive management options – involve putting in place incremental adaptation options, rather than undertaking large-scale adaptation in one fell swoop. This approach reduces the risks associate with being wrong, since it allows for incremental adaptation. Measures are introduced through an assessment of what makes sense today, but are designed to allow for incremental change, including changing tack, as knowledge, experience and technology evolve.

"Delaying" introducing a specific adaptation measure (or suite of measures) can be part of a flexible or adaptation management strategy as long as that decision is accompanied by a commitment to continue building the necessary adaptive capacity while continuing to monitor and evaluate the evolving risks. A decision to delay introducing a specific action is often taken when the climate risks are below defined thresholds or when the required adaptive capacity (eg. regulatory or institutional circumstances) is insufficient to allow effective action.

Examples include: (see Tables 1–10, pages 19-31)

- Delay implementing specific adaptation measures while exploring options and working with appropriate levels of government to build the necessary standards and regulatory environment;

- Introducing progressive withdrawal from coastal areas and creation or re-establishment of floodplains consistent with risks and development lifetimes; and

- Progressive development and investments in recreation consistent with projected changes in climate (eg. progressive investments towards developing and promoting multi-seasonal recreation activities).

7. Reassessment of adaptation measures

Adaptation, to be continually effective, will need to evolve with changing internal and external circumstances and as such, should be approached as a continuous improvement process (consistent with the circular process that comprises the UKCIP risk management framework). Climate and socio-economics will continue to change as will risks and/or aversions to those risks. As such, the viability of an adaptive response will need to be periodically reassessed and improvements to existing measures or additional or alternative measures implemented in light of these changes. This continuous improvement process provides an opportunity to incorporate lessons learned through implementation and living with previous adaptation efforts, including those undertaken by others, as well as technological innovations and increased scientific understanding.

ADAPTATION SHOULD BE VIEWED AS A CONTINUOUS IMPROVEMENT PROCESS, INCORPORATING:

- **lessons learned**
- **technological innovations**
- **increased understanding of climate risks and science**

Appendix 1: Examples of adaptation options

Building adaptive capacity				
Adaptation options	**No-regret**	**Low regret**	**Win-Win**	**Flexible**
Table 1: Research				
GENERIC EXAMPLES				
Scoping studies to identify the nature of climate risks, vulnerabilities and opportunities associated with current climate and projected changes, including identifying these risks in the context of non-climatic risks.	■			
Conducting risk-based assessments to evaluate current and future climate and non-climate risks and opportunities.	■			
Increased understanding of climate and climate change, including through climate and socio-economic scenario development.	■			
Developing and testing improved decision support tools, and adaptation options and technologies.	■			
Undertaking technical/quantitative impact and adaptation assessments.		■		
SPECIFIC EXAMPLES				
A scoping study undertaken as part of the Defra cross-regional research programme assessed the impact of climate change on the management of water resource zones, and existing water infrastructure (in particular, the effect of realistic scenarios of single extreme events, and combinations of extreme events), considered the adequacy of current policy and guidance for managing water resources in the context of climate change, recommended how decision-making and management could be improved (www.futuredrought.org.uk/Defra_Home.htm).		■		
Gardening in the Global Greenhouse: The impacts of climate change on gardens in the UK – a scoping study looking at the impacts of climate change on UK gardens (both domestic and heritage gardens) and on the industry serving the gardening community (www.ukcip.org.uk).	■			
Building Knowledge for a Changing Climate (BKCC) – a portfolio of research projects which looks at how climate change will affect different aspects of the buildings, transport and utilities infrastructure, including addressing research needs in responding to those impact (www.k4cc.org).	■			
Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) – A Survey of Scottish Local Authority Activities on Climate Change – good practices from a number of Scottish LAs, both at a strategic level and in terms of service level response. Further actions are also identified that could help promote further action, including adaptation (www.sniffer.org.uk ref. CC05).	■			

■ Indicates the primary type(s) of adaptation option(s) normally associated with the described adaptation measure

■ Indicates the secondary type(s) of adaptation option(s) that can also be associated with the described adaptation measure

Appendix 1: Examples of adaptation options

Building adaptive capacity				
Adaptation options	**No-regret**	**Low regret**	**Win-Win**	**Flexible**
Table 2: Data collecting and monitoring				
GENERIC EXAMPLES				
Phenological observations.				
Monitoring of systems or components thereof that are at risk – understanding the nature of your vulnerabilities or opportunities.				
Monitoring the impacts of observed climate, including extreme events.				
Monitoring effectiveness of existing (newly implemented) adaptation measures and learning lessons.				
SPECIFIC EXAMPLES				
State of the Thames Estuary Programme aims to raise awareness, improve knowledge and aid decision-making throughout the Thames Estuary. Phase I brings together research, information and stakeholders to determine current social, economic and environmental values for the estuary as well as key threats and management requirements. As such, it establishes an initial benchmark of information for monitoring and assessing the condition of the Estuary and helps develop the framework for revising the existing Management Guidance (www.thamesweb.com/topic.php?topic_id=13).				
National Appraisal of Assets and Risk from Flooding and Coastal Erosion including the potential impact of climate change – describes the analytical methodology of identification and brings together the best available data at the country scale on flood and coastal erosion risks in England and Wales for policy development purposes (www.defra.gov.uk/environ/fcd/policy/NAAR1101textonly.pdf).				
Phenology and Climate Change – The Woodland Trust have set up the Phenology Network that involves the public in monitoring key biodiversity indicators (www.naturescalendar.org.uk).				
The Met Office Hadley Centre receives, quality controls, and archives large amounts of observed climate data. These are used for monitoring the climate, identifying the state of our climate, in studies of climate variability, extremes and change, and in climate modelling (www.metoffice.gov.uk/research/hadleycentre/obsdata/).				

Indicates the primary type(s) of adaptation option(s) normally associated with the described adaptation measure

Indicates the secondary type(s) of adaptation option(s) that can also be associated with the described adaptation measure

Appendix 1: Examples of adaptation options

Building adaptive capacity

Adaptation options	No-regret	Low regret	Win-Win	Flexible
Table 3: Changing or developing regulations, standards, codes, plans, policy or programmes				
GENERIC EXAMPLES				
National and international regulations and statutes that recognise climate risks and adaptation.	■			
National codes and standards, best practices guidelines that recognise climate risks and adaptation.	■			
National, regional and local policies and plans that recognise climate risks and opportunities and adaptation.	■			
Resource allocation that recognise the need for investment in understanding and addressing climate risks and opportunities, as well as adaptations.	■			
Protected Landscape Management Plans that seek to achieve an integrated approach to conservation and enhancement; clarity about the existing state of the area and provide a clear vision of how it might be in the future, including considering the implications of a changing climate.	■			
Enforcement of regulations and standards.		■		
SPECIFIC EXAMPLES				
Adapting to Climate Change: A Checklist for Development – a document primarily aimed at developers, their partners, design teams, architects, surveyors and engineers that contains a checklist and guidance for new developments to adapt to climate change (available through www.ukcip.org.uk).	■			
The London Plan is a statutory planning framework to guide London's development based on a practical response to the challenges facing London, accommodating population and economic growth, ensuring benefits are shared as widely as possible by all Londoners, and limiting adverse environmental impacts. Alterations to this strategy include measures to deal with climate change. An climate change adaptation strategy (in development) will identify the impacts and recommends key actions to help London and Londoners prepare for inevitable climate change (www.london.gov.uk/mayor/planning/strategy.jsp).	■			
Yorkshire & Humber Climate Change Action Plan – statement of the regions determination to be a leader in managing climate risk by providing a coordinated approach to reduce regional emissions and to develop solutions to adapt to the impacts of a changing climate – focus on actions that directly deliver on these aims (www.yourclimate.org).	■			
Highways Agency adapted calculations – all storm water calculations (hydraulic) should allow for a 20% increase in the 'design rainfall intensities' appropriate for any specified 'design return period'.	■			

■ Indicates the primary type(s) of adaptation option(s) normally associated with the described adaptation measure

■ Indicates the secondary type(s) of adaptation option(s) that can also be associated with the described adaptation measure

Appendix 1: Examples of adaptation options

Building adaptive capacity				
Adaptation options	**No-regret**	**Low regret**	**Win-Win**	**Flexible**
Changing or developing regulations, standards, codes, plans, policy or programmes (*continued*)				
SPECIFIC EXAMPLES (*continued*)				
Aberdeen City Council refer in flood guidance to the Executives SPP7 and in particular to the need to undertake work to safeguard storage capacity of floodplains and to promote sustainable drainage. The local authority intends to construct hydrologic models for all main watercourses in the city, taking into account the likely effects of climate change (www.sniffer.org.uk ref. CC05).				
Planning Policy Statement 25: Development and Flood Risk (PPS25) aims to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding and to direct development away from areas at highest risk. In terms of reducing risk, it suggests that regional planning bodies and local planning authorities should prepare and implement planning strategies that help deliver sustainable development by using the opportunities afforded by new development to reduce the causes and impacts of flooding through surface water management plans, making the most of the benefits of green infrastructure for flood storage, conveyance and SUDS; recreating functional floodplains; and setting back defences (www.communities.gov.uk/index.asp?id=1504639). Also refer to PPS1 and PPS26.				

Indicates the primary type(s) of adaptation option(s) normally associated with the described adaptation measure

Indicates the secondary type(s) of adaptation option(s) that can also be associated with the described adaptation measure

Appendix 1: Examples of adaptation options

Building adaptive capacity				
Adaptation options	**No-regret**	**Low regret**	**Win-Win**	**Flexible**
Table 4: Internal organisational development				
GENERIC EXAMPLES				
Training and individual development programmes – targeted capacity building to include identifying and evaluating climate risks.	■			
Senior management and community leader buy-in.	■			
Identifying climate change champion(s).	■	■		
Integrating climate risk and adaptation assessments into business and community planning.	■	■		
SPECIFIC EXAMPLES				
London Climate Change Partnership has been established to help ensure that London is prepared for its changing climate. It is supported by the Greater London Authority and comprises key stakeholders across different sectors of London governance and business (www.london.gov.uk/climatechangepartnership/index.jsp). The London Climate Change Agency was set up by the Mayor to help reduce carbon dioxide emissions from London. It is a commercial company wholly owned, controlled by and housed in the London Development Agency. The work of the LCCA is a key part of the Mayor's commitment to making London a sustainable world city with the objective of delivering projects that reduce greenhouse gas – mainly carbon dioxide – emissions from London.	■	■		
Transport Research Laboratory has established a Climate Change Team as part of its Centre for Sustainability that is targeted at helping organisations, including itself to prepare for changes to climate, both at home and abroad. They have targeted efforts at: identifying impacts and recommending solutions providing advice on materials and best practice for future climates and updating policies and provide training (www.c4s.info).	■	■		
Associate of British Insurers (ABI) has established a climate change lead (Jane Milne) who is also head of property and creditor.	■	■		

■ Indicates the primary type(s) of adaptation option(s) normally associated with the described adaptation measure

■ Indicates the secondary type(s) of adaptation option(s) that can also be associated with the described adaptation measure

Appendix 1: Examples of adaptation options

Building adaptive capacity				
Adaptation options	**No-regret**	**Low regret**	**Win-Win**	**Flexible**
Table 5: Awareness-raising				
GENERIC EXAMPLES				
Education and training (formal and informal), including integration into curriculum and targeted programmes or activities.	■			
Promoting conservation and efficiencies in the use of resources (eg. water and energy).	■		■	
Capacity building programmes, including communication programmes.	■		■	
Identifying and promoting successful adaptation initiatives – lessons learned.	■		■	
Conferences, events and publications.	■	■	■	
SPECIFIC EXAMPLES				
Defra is leading a cross-Governmental initiative ("Tomorrow's Climate, Today's Challenge") aimed at telling the story of climate change and inspiring collective action. The initial focus of this communications initiative is to change attitudes. This initiative has produced a website which carries easy-to-access information about climate change and how best to communicate about it, and provides free-to-use resources including a short film about climate change, a series of radio adverts, animations and a downloadable written guide about communicating climate change. Also included as part of this initiative is the Climate Change Fund initiated in 2006 to support local and regional climate change communication projects and the selection of young climate change champions (www.climatechallenge.gov.uk).	■		■	
Avoiding Dangerous Climate Change conference (and publication) held at Exeter in 2005 ahead of the UK-led G8 Gleneagles Summit. Focus is on three specific questions – 1) for different levels of global warming, what are the key impacts for different regions and sectors and for the world as a whole? 2) what would such levels of global warming imply for stabilising concentrations of greenhouse gases and pathways to achieve those levels? and 3) what are the technological options for achieving stabilisation of GHG in the atmosphere, accounting for economics costs and uncertainties? (www.defra.gov.uk/environment/climatechange/internat/pdf/avoid-dangercc-execsumm.pdf).	■			
The Environment Agency has developed a website that provides information about climate change, its causes and effects, the work they are doing to mitigate and adapt to it, international efforts and steps that all can take to reduce their "climate footprint" – our personal contribution to global warming (www.environment-agency.gov.uk/yourenv/639312/).	■			

■ Indicates the primary type(s) of adaptation option(s) normally associated with the described adaptation measure

■ Indicates the secondary type(s) of adaptation option(s) that can also be associated with the described adaptation measure

Appendix 1: Examples of adaptation options

Building adaptive capacity				
Adaptation options	**No-regret**	**Low regret**	**Win-Win**	**Flexible**
Table 6: Working in partnership				
GENERIC EXAMPLES				
Mobilising and building consistencies and capacity for developing and implementing adaptation measures. Includes promoting working in partnership to address climate risks and adaptation.		■	■	
Undertaking risk and adaptation assessments (and response implementation) through sectoral partnerships.		■	■	
Undertaking risk and adaptation assessments (and response implementation) through locality-based partnerships.		■	■	
Promoting the integration of climate risks and adaptation into existing and emerging policy and planning frameworks and strategies in key socio-economical and environmental areas.	■		■	
Undertaking risk and adaptation assessments involving linked but cross-disciplinary partnerships.		■	■	
SPECIFIC EXAMPLES				
Regional partnerships have been established in all nine regions of England, as well as in Wales, Scotland and Northern Ireland. These are stakeholder led with the achievements of milestones and outcomes dependent on the engagement, commitment, policies and practices of individual partnerships. An Inter-regional Climate Change Group that pulls together regional coordinators from each of the partnerships and supported by UKCIP provides an opportunity to discuss common issues, share experiences, and provide learning opportunities.		■	■	
Modelling Natural Resource Response to Climate Change (MONARCH) is a multi-partner project, with research led by the Environmental Change Institute, Oxford studying the impacts of climate change on a range of species and habitats. The first report from MONARCH showed how species distribution might look under a changed climate, using plants and animals from land, sea and freshwater environments as examples. The second phase of work looked at this process in more detail and how we might use this knowledge to continue nature conservation work within the context of a changing climate. The third and final phase will refine, speed up and improve the interpretative potential of MONARCH modelling (www.ukcip.org.uk).		■	■	
Building Knowledge for a Changing Climate (BKCC) is a portfolio of research projects looking at how climate change will affect different aspects of the built environment. It addresses some of the research needs of decision-makers dealing with buildings, transport and utilities infrastructure in responding to the impacts of a changing climate in the UK. It has been promoted jointly by the Engineering and Physical Sciences Research Council and UKCIP (www.k4cc.org).		■	■	

■ Indicates the primary type(s) of adaptation option(s) normally associated with the described adaptation measure

■ Indicates the secondary type(s) of adaptation option(s) that can also be associated with the described adaptation measure

Appendix 1: Examples of adaptation options

Building adaptive capacity				
Adaptation options	**No-regret**	**Low regret**	**Win-Win**	**Flexible**
Working in partnership (*continued*)				
SPECIFIC EXAMPLES (*continued*)				
At the second national councils' climate conference held in Nottingham (5 December 2005) a revised declaration (Nottingham Declaration) was put forward, with a request for local authorities to show their commitment (voluntary) to tackling climate change. The Nottingham Declaration reflects current knowledge of climate change and is accompanied by an improved package of support measures outlining milestone activities that set out actions that councils should carry out to mitigate against and adapt to climate change (www.nottinghamdeclaration.org.uk).				
The Marine Climate Change Impacts Partnership (MCCIP) incorporates a range of marine stakeholder organisations concerned about the impacts of climate change. MCCIP has been set up as a response to gaps identified in the report 'Charting Progress: an Integrated Assessment of the State of UK Seas' and its primary aims are to streamline the transfer of marine climate change knowledge to policy advisors and decision makers (www.mccip.org.uk).				

Indicates the primary type(s) of adaptation option(s) normally associated with the described adaptation measure

Indicates the secondary type(s) of adaptation option(s) that can also be associated with the described adaptation measure

Appendix 1: Examples of adaptation options

Delivering adaptation actions				
Adaptation options	**No-regret**	**Low regret**	**Win-Win**	**Flexible**
Table 7: Living with and bearing losses or risks				
GENERIC EXAMPLES				
Accept losses (habitats, species or coastal lands) where there are no other 'acceptable' or feasible options – implications for biodiversity, recreation, fishing and hunting.		■		
Allow lawns and gardens (domestic, commercial and parklands) to deteriorate.	■			
Accept that parks may no longer be able to deliver their primary mandate (conservation or protection of particular species and/or habitat.	■			
Close access to recreation areas, marinas, hiking trails and other areas, including temporary loss of land during and following extreme events.	■			
Adjust pricing to account for increased losses (eg. insurance companies accept some losses as part of business and set their premiums accordingly).	■			
Based on an assessment of the risks, decide that, beyond a commitment for a subsequent re-assessment, no further adaptation measures are required at this time.	■			
SPECIFIC EXAMPLES				
The National Trust, based on discussions with stakeholders, has decided on a management strategy for Mullion Harbour (Lizard Peninsula, Cornwall) that consists of maintenance and report for a period until the harbour suffers major damage and begins to fail, followed by a move to a managed retreat option (including demolishing and removal).	■			
Sections of the flood defences along the north of Wallasea Island were removed as part of the Wallasea Wetlands Creation Project allowing for the sea water to flood. Wallasea is a land-mark scheme for the area as it involves the managed realignment of sea defences and the creation of 110 - 120 hectares of wetland habitat. The scheme fits in with the Roach and Crouch flood management strategy and will create a more sustainable estuary shape. The scheme will also provide valuable new intertidal habitat which will compensate for losses incurred through sea level rise and coastal squeeze. The total project cost is estimated to be in the region of £7 million (www.abpmer.net/wallasea).	■		■	

■ Indicates the primary type(s) of adaptation option(s) normally associated with the described adaptation measure

Appendix 1: Examples of adaptation options

Delivering adaptation actions				
Adaptation options	**No-regret**	**Low regret**	**Win-Win**	**Flexible**
Table 8: Sharing responsibility for losses or risks				
GENERIC EXAMPLES				
Invest in insurance to cover unavoidable risks yet retain incentives to adapt.		■		■
Use other financial mechanisms that delay, share or lay-off risks (eg. subsidies to offset increased operational costs).		■		■
Lease capital goods rather than buying them, and maintenance/service contracts.		■		■
Broaden the response community through sharing the responsibility for adaptation (eg. basin wide flood management and managing water resource on a regional or national scale, creating a financial reserve through housing, agriculture or other associations).		■	■	■
Diversify business activity, market, sources of income, location, etc. as a means of spreading the risks (reducing overall exposure to risk).			■	■
SPECIFIC EXAMPLES				
The Housing Corporation is proposing to use insurance or mergers between Registered Social Landlords (RSLs) to spread the financial costs associated with the impacts of climate change between a group rather than have individuals bear the cost. Those Registered Social Landlords (RSLs) with properties at sea level, near the coast, may potentially lose them due to increases in sea level and flooding. At present, insurance will cover the cost. However, if in time insurance is no longer a viable option, the Housing Corporation will seek mergers between RSLs to 'spread' the load financially or to write off stock and the grants given to produce it. If stock is written off, this would become an example of "retreat and abandon" (www.oursouthwest.com/climate/scopingstudy.htm).		■		■

■ Indicates the primary type(s) of adaptation option(s) normally associated with the described adaptation measure

Appendix 1: Examples of adaptation options

Delivering adaptation actions				
Adaptation options	**No-regret**	**Low regret**	**Win-Win**	**Flexible**
Table 9: Preventing effects or avoiding/reducing risks				
GENERIC EXAMPLES				
Implement improved technical standards and use of climate-appropriate technologies (eg. SUDS, ventilation, insulation, building materials, etc).	■	■		
Reduce pressure on systems or areas at risk (eg. introduce alternative land cover and garden species, reduce the number of fishing/hunting licenses, reduce the number using trails, etc).		■	■	■
Introduce multiple land use strategies that account for climate risks. This includes raised buildings with less critical functions (eg. parking, parkland) at ground level in flood prone areas, natural conservation areas that double as flood management areas, etc.			■	■
Climate proof or increase resilience of new and existing infrastructure and systems, including through introduction of behavioural change. This includes managing flood risk, increasing water supply and pumping capacities, improve supply chain management, more efficient use of resources (eg. water, energy, raw materials), and dredging of waterways to enhance flows.			■	
Provide incentives that promote risk adverse behaviour (eg. development and buying). This would include linking financial terms and conditions to climate risk, and subsidising technologies that are consistent with contributing to avoiding or reducing climate risks.		■	■	
Increase the range of climate under which systems and activities remain viable. This includes initiatives directed at increasing food security; increasing the climate range over which capital stock remains viable, including through considering options and retrofits; etc.		■	■	■
Change location (i.e. move away from high risk areas), including measures such as relocating recreation facilities, relocating away from flood/erosion prone areas, relocating conservation efforts, relocating farming of particular crops (agriculture and forestry).				■
Implement emergency, contingency and disaster planning that address climate risks (eg. drought contingency plans, contingency plans to minimise impacts of disruption of services and supplies, emergency plans to deal with flooding and wildland and urban fire, etc).	■		■	
SPECIFIC EXAMPLES				
Adaptation strategy, The Royal Botanic Gardens at Kew - climate change may have positive and negative effects on species present: a warmer climate could increase this number, as well as low summer rainfall patterns could reduce them. In order to overcome this, emergency plans such as using river water or Kew lake water for irrigation are being considered.	■		■	

■ Indicates the primary type(s) of adaptation option(s) normally associated with the described adaptation measure

Appendix 1: Examples of adaptation options

Delivering adaptation actions

Adaptation options	No-regret	Low regret	Win-Win	Flexible
Preventing effects or avoiding/reducing risks (*continued*)				
SPECIFIC EXAMPLES (*continued*)				
Historical buildings efforts by National Trust – Bodiam (floor and wall specifications altered to minimise flood damage), Castle Drogo (2006 roof works factoring in extreme weather), and Grey's Court (2006 rainwater goods replacement).		■		
Norwich Union has made available a flood support microsite (of Norwich Union insurers) for home owners which gives practical guidance on how to improve the resilience of houses from flooding. It provides a number of flood resistant alterations that could be made, noting that many of those suggested will cost, but the extra cost should be defrayed by lower future claims and thus premiums. Suggested alterations include fitting plug sockets, boilers and service meters higher on walls, installing non-return valves in drainage pipes, and fitting water resistant door and window frames (www.floodresilienthome.com).	■		■	■
A rainwater harvesting system has been incorporated in the design of the Hub (community resource centre in Hewham, London, E16). This system is supplying water used for toileting flushing and irrigation is expected to contribute 50 percent savings on mains water every year. The rainwater is collected from the roof and is stored in an underground tank for future use (www.betterpublicbuildings.gov.uk/finalists/2005/hub).			■	
National Trust parks and gardens at Trelissick (path hardening and new plantings), Hughenden (new woodland management plans – beech issue), Sheffield Park Garden (new techniques for planting and maintenance), open countryside (Lake District strategy for path restoration), Peak District (new fire management strategy), and forestry (tree inspection regimes).	■		■	■
Integrated urban drainage pilot studies are testing approaches to reduce the impact of urban drainage flooding. The 15 pilots are expected to provide new tools and techniques for mapping and managing surface water following heavy rainfall events and to bring more clarity on responsibilities for those managing urban flooding. Thames Water is leading a project in North Brent, London where partners are producing a joint drainage strategy. In West Garforth, Leeds City Council and partners are developing practical ways to overcome such problems as ownership, especially for urban culverts for which there are several owners. For a full description of all 15 projects see www.defra.gov.uk/environ/fcd/policy/strategy/ha2.htm.	■		■	■

■ Indicates the primary type(s) of adaptation option(s) normally associated with the described adaptation measure

Appendix 1: Examples of adaptation options

Delivering adaptation actions				
Adaptation options	**No-regret**	**Low regret**	**Win-Win**	**Flexible**
Table 10: Exploiting opportunities				
GENERIC EXAMPLES				
Exploit new markets and social opportunities emerging as a consequence of climate change both locally and globally.		■	■	
Replace capital stock more frequently while considering the need for more appropriate capital stock.		■		■
Cultivate new agricultural crops and develop alternative land use consistent with climate (current and projected).		■		■
SPECIFIC EXAMPLES				
Otter Farm (Devon) have embarked on a growing and production plan that includes olives, almonds, pecans, persimmons, pineapple guava, grinding pepper and apricots. They have also decided to take out a little edible insurance and build the disadvantages as well as the advantages of climate change into the plan: longer hotter summers would also come with greater unpredictability in the cycles of weather, so the plan includes a greater number of smaller harvests – including 'forgotten' fruits such as medlars, quince and mulberries – in the hope that an unusually hot dry summer or an unseasonally wet cool one will still suit most of the crops grown (www.otterfarm.co.uk).		■		■
English Wine Producers have seen a growing interest in English wine over the last few years with a raised profile internationally. England is now acknowledged as the home to some outstanding sparkling wines and French champagne houses have expressed interest in exporting production to Kent. Climate change making the temperatures more favourable to produce the required grapes and the chalk geology of the Kent and Sussex hills, along with high land prices in Champagne have prompted this interest.		■		
The CairnGorm Mountain resort launched its long-term sustainability plan (dubbed Eden Project of the North), reflecting the resorts vision of being more of an educational and environmentally aware attraction (sustainable tourism based on nature) and being less reliant on winter sports (www.cairngormmountain.com).			■	■

■ Indicates the primary type(s) of adaptation option(s) normally associated with the described adaptation measure

Appendix 2: Adaptation checklist

Adaptation measures will need to be fit for purpose. Ensuring that a specific measure is fit is simpler said than done. First of all, determining fitness is often only possible after the measure has been implemented and in place for some time. Additionally, the desired outcome, regardless of whether the adaptation measure was intended to build adaptive capacity or deliver an adaptive action, is often delayed, invisible or wrapped up with the implications of other introduced changes. Despite these difficulties in defining a particular adaptation measure as being good, acceptable, or successful, there are principles of good adaptation that can be used to inform the selection process. One such set of principles has evolved through practice and identifies the following aspects of the adaptation process as being characteristic of those processes that have lead to good adaptation*:

- **Work in partnership** – identify and engage the necessary community and ensure they are well informed.
- **Understand risks and thresholds**, including associated uncertainties.
- **Frame and communicate SMART* objectives/outcomes** before starting out.
- **Manage climate and non-climate risks using a balanced approach** – assess and implement your approach to adaptation in the context of overall sustainability and development objectives that includes managing climate and non-climate risks.
- **Focus on actions to manage priority climate risks** – identify key climate risks and opportunities and focus on actions to manage these.
- **Address risks associated with today's climate variability and extremes** as a starting point towards taking anticipatory actions to address risks and opportunities associated with longer-term climate change.
- **Use adaptive management to cope with uncertainty** – recognise the value of a phased approach to cope with uncertainty.
- **Recognise the value of no/low regrets and win-win adaptation options** in terms of cost-effectiveness and multiple benefits.
- **Avoid actions that foreclose or limit future adaptations** or restrict adaptive actions of others.

- **Review the continued effectiveness of adaptation decisions** by adopting a continuous improvement approach that also includes monitoring and re-evaluations of risks.

** SMART objectives – specific, measurable, achievable, results-oriented, and time-bound objectives.*

These principles suggest that good adaptation is founded on the engagement of an informed community with a willingness and ability to adapt. They also suggest that good adaptation requires an understanding of, and the ability to articulate, the objectives of the required action; an understanding of adaptation measures, including their feasibility; and a desire and willingness to see continued success through responsive and appropriate adaptation. Furthermore, the suggestions of implementing appropriate adaptation options (adaptive, no/low regrets and win-win), avoiding inappropriate actions, and adopting a continuous improvement approach are consistent with the precautionary approach (Rio Declaration, principle 15).

Appendix 3: References

Hulme, M., Jenkins, G.J., Lu, X., Turnpenny, J.R., Mitchell, T.D., Jones, R.G., Lowe, J., Murphy, J.M., Hassel, D., Boorman, P., McDonal, R. and Hill, S. (2002) *Climate Change Scenarios for the United Kingdom: The UKCIP02 Scientific Report.* Tyndall Centre for Climate Change Research, School of Environmental Sciences, University of East Anglia, Norwich, UK. 120pp.

Willows, R.I. and Connell, R.K. (Eds.). (2003) *Climate Adaptation: Risk, Uncertainty and Decision-making.* UKCIP Technical Report. UKCIP, Oxford, UK. 154pp.

West, C.C. and Gawith, M.J. (Eds.) (2005) *Measuring Progress: Preparing for Climate Change through the UK Climate Impacts Programme.* UKCIP Technical Report. UKCIP, Oxford, UK. 71pp.