Appendix 5

Our Adaptation Protocol

How will we adapt to the impacts of climate change?

Introduction

As a consequence of the significant time lag in the climate system between cause and effect, climate change over the next 30 to 40 years has already been determined by historic greenhouse gas emissions. Moreover, even if humanity is successful in making the significant reduction in emissions required to stabilise the atmospheric concentration of CO_2 at an acceptable level, global temperatures will continue to increase and sea level will rise for many centuries. For the South West, the UK Climate Impacts Programme (UKCIP) Scientific Report 2002 projects an average annual temperature increase of up to 4°C by the 2080s together with hotter drier summers, milder wetter and stormier winters, more extreme weather events and a rising sea level. Therefore, as a complement to the mitigation agenda, there is a need to develop strategies to address such risks and take advantage of any resultant opportunities.

What is Adaptation?

Climate change adaptation is the adjustment in natural or human systems in response to experienced or future climatic conditions or their effects or impacts, which may be beneficial or adverse. It embraces a number of key concepts. System *"sensitivity"* is the degree to which a particular ecological, social or economic system is affected either adversely or beneficially by all aspects of climate including variability and extremes. Sensitivity reflects a system's exposure to climate impacts hence the use of the term *"exposure unit"* to indicate the system of interest. *"Adaptive capacity"* is the ability of an exposure unit to adjust to climate change, moderate potential damages, take advantage of opportunities or cope with the consequences. The *"coping range"* is an expression of the present adaptive capacity of that system to current climatic variability. As such, it is a zone of minimal hazard and defines *"vulnerability"* or damage *"thresholds"* as benchmark levels of climate risk. For most communities, changes in average climatic conditions commonly fall within the existing coping range and therefore, it is more important to identify potential changes in climate variability, and in the frequency and magnitude of extreme events outside the present coping range. That said, a coping range is not static as it can be shifted by actions to reduce the exposure unit's sensitivity and/or enhance its adaptive capacity. Such actions are climate change adaptations.

In unmanaged natural systems adaptation is the means by which species respond to changed conditions. Such adaptations are reactive and spontaneous as natural selection takes its course. In human systems adaptation has the added dimension of anticipation motivated by both private and public interest. A distinction is drawn between *"autonomous adjustment"* and *"planned adaptation*" reflecting private and public drivers. Autonomous adjustments are initiatives taken by private decision-makers (i.e. individuals, households, businesses, and corporations) usually triggered by market or welfare changes induced by actual or anticipated climate change. Planned adaptations are the result of deliberate policy decisions on the part of a public agency (e.g. local government) based on an awareness that conditions are about to or have changed and that action is required to minimise losses or maximise benefits from new opportunities. As such, planned adaptations represent *"intervention strategies"* that are developed in the light of known or anticipated autonomous adjustments.

Adaptation Frameworks

Under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC) much work has been done to identify frameworks, methods and tools to evaluate climate change impacts, vulnerabilities and adaptations. Whilst initial development work was driven by the urgency to understand the magnitude of climate change impacts for the mitigation agenda, more recently the focus has been on adaptation linked to current climate variability and vulnerability. This change in emphasis has led to the development of a second generation of studies that begin with current climate variability and adaptation (or the lack of adaptation or maladaptation) in order to provide a grounding in reality on which to base projections of future impacts, vulnerabilities and adaptations. Such an approach addresses issues regarding climate change relevance, timeliness and uncertainty to some degree.

An Adaptation Agenda

The question is *"What does all this mean for Devon?"* By taking account of the above guidance, it is clear that the DCC adaptation protocol should lead to the creation and implementation of appropriate intervention strategies whilst also promoting autonomous adjustment at a community level. Moreover, it should be based on an assessment of current as well as future climate variability and make recommendations to continually improve the community's coping range. The choice of exposure units to be examined should reflect a prioritisation of both present and future climate risk and may be either service-related (e.g. highway maintenance) or non-sectoral reflecting specifically identified risks e.g. the Slapton Line, the Dawlish - Teignmouth rail link, the ecology of Dartmoor etc. It will consist of a suite of measures aimed at reducing vulnerable communities' sensitivity to climate impacts and/or enhancing their adaptive capacity. It will require clear-cut climate-driven decisions as well as

less obvious decisions in which climate change may be just one of many driving factors. Indeed, as much of the existing Social Services' programme is aimed at reducing social vulnerability, such work should be considered as adaptive capacity enhancement even though there may be no immediate or direct climate change driver. Consequently, the adaptation agenda will be a portfolio of hard protection measures and soft adaptive capacity enhancement measures that promote the welfare of the most vulnerable members of our community. It is likely that this decision-making process will involve a *"precautionary approach"* with an initial preference for *"no/low regrets"* measures. However as a consequence of the considerable uncertainty, it is most important that all decisions are reviewable and reversible in the light of new knowledge.

Framework for the Protocol

Given the UK's economic performance and our well-developed political, institutional and technological support systems, our adaptation potential is considered to be very high. As a consequence we are likely to be able to adapt readily to changes in average conditions, particularly if they are gradual. However, our communities are more vulnerable and less adaptable to changes in the frequency and/or magnitude of extreme weather events. In Devon, our principal sensitivities are to:

- Extreme seasons such as exceptionally hot dry summers and mild winters.
- Short-duration hazards such as tidal surges associated with storms, and heavy rainfall resulting in river valley flooding and flash floods.
- Long term coastal squeeze as a result of sea level rise acting on fixed coastal infrastructure.

Figure 17 shows the relationship between natural variability and mean climate in a climate change context. It also demonstrates the concept of a coping range – a zone of minimal hazard - within which we can deal with most climatic variability other than extreme weather events. As climate change occurs the mean climate is changed by the increasing frequency and magnitude of extreme events.

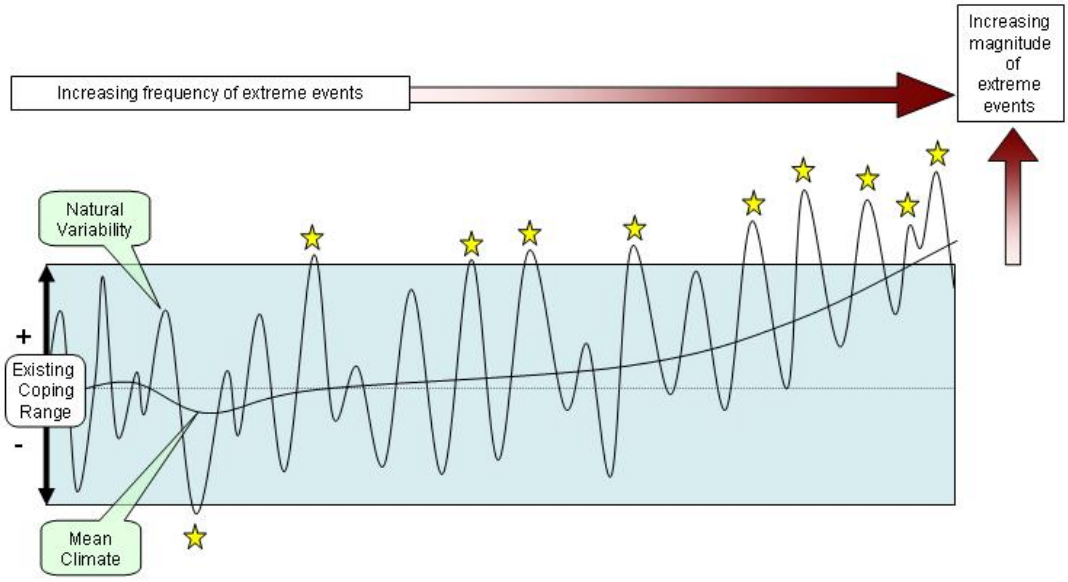

Figure 17. Natural variability, mean climate and coping range.

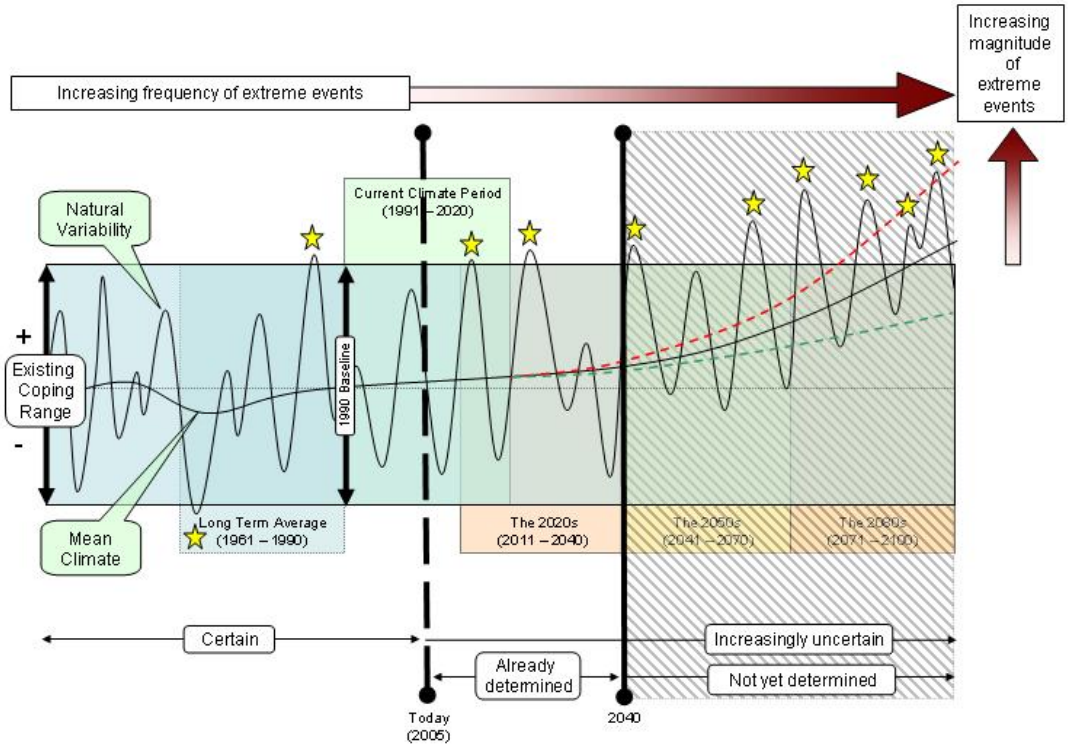

Figure 18. Climate change schematic in a temporal context.

Figure 18 puts the schematic diagram of climate change and extremes into a temporal context which runs from the early/mid 20th century to the end of the 21st century. We can be

certain about past weather and climate as reliable records of most weather variables have been collected at many stations across Devon and the UK for up to 140 years. However as we look forward, our future weather and climate becomes increasingly uncertain as we do not know future levels of greenhouse gas emissions which have yet to be determined by global population growth, economic development and technological innovation. Given the 30 to 40 year time lag in the response of the climate system to increased emissions, we know that the climate out to about 2040 is already determined and there is nothing we can do about it. That said, we can use models of past climate and the expected greenhouse gas forcing to project the changes we are likely to experience during this period. However, beyond mid-century the climate is not yet determined. Future climate projections for this period are based on four storylines of global development. It is during this period that the oft quoted headline global temperature change of 5.8°C may occur. From this view of climate change we can derive three periods in which we need to situate our adaptation response:

- Period 1. Climate certainty – the recent past.
- Period 2. Climate determined but uncertain – the next 30 or 40 years.
- Period 3. Climate not yet determined and increasingly uncertain – beyond mid century.

Given that our adaptation potential in response to gradual changes in the mean climate is good and that climate change projections over *"the 2020s"* (i.e. 2011 to 2040) show a marginal increase in average annual temperature for Devon of about 0.9°C and a marginal decrease in rainfall across the county of about 2%, adaptation should focus on seasonal extremes and short duration hazards. Using the periodic approach identified above, the first step is to examine the frequency of occurrence and impact of such events in the recent past (Period 1) as a "certain" indicator of future events over the next 20 years or so. By identifying lessons learned from these past events and applying them across the county with an additional 50 years worth of climate-proofing embodied, we will be able to create anticipatory adaptations out of reactive adaptations in which we have a degree of confidence. This concept is shown at Figure 19.

However, because of the nature of climate change there will be extreme events that we have not experienced but must prepare for. As we move forward through time our knowledge, wealth and technology will improve which will allow us to put in place more effective adaptations than we could today. It is for this reason that we should not consider at this stage those adaptations against extremes required in Period 3. The climate impact assessment needed for this forward look at anticipatory adaptations must concentrate on Periods 1 and 2 only. Clearly, this process will roll forward with time and begin to address the early years of the "not yet determined" and "very uncertain" future of Period 3 in due course.

Figure 19 also identifies the business-based Forward Planning/Investment Horizon. It can be seen that decision-making and investment cycles operating over short time scales (e.g. 5 years) are only affected by climate variability (i.e. extreme events) and not changes in mean climate. However, business decisions for the long term (e.g. 50 years) must also take into account changes in mean climate. Any business case for long term adaptation would have to use the precautionary principle as the basis for action because of the uncertainty involved.

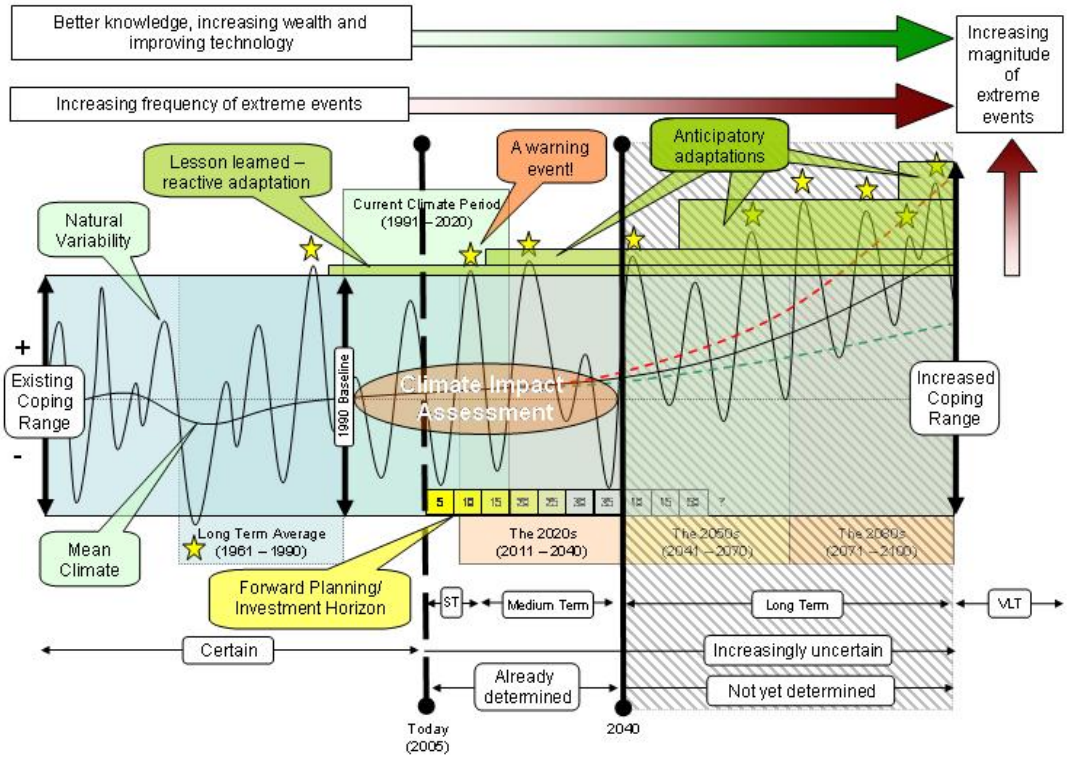

Figure 19. Climate Impact Assessment, reactive and anticipatory adaptation, and the forward planning/investment horizon.

Adaptation Principles

- Principle 1. Adaptation should focus on seasonal extremes and short duration hazards for the period to 2040.
- Principle 2. Climate events of the recent past should be used to identify potential adaptations required over the next 20 years.
- Principle 3. All adaptation measures should be climate-proofed for a minimum of 50 years.
- Principle 4. Long-term business/investment decisions (i.e. + 30 years) must take into account changes in mean climate.
- Principle 5. The business case for long term adaptations must use the precautionary principle as the basis for action.