



The NRM Adaptation Checklist

Supporting climate adaption planning
and decision making for Regional NRM

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Image Credit: New South Wales Inland, by leagun




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Executive Summary

This guide is designed to support climate change adaptation planning by Natural Resource Management (NRM) groups. It has been designed to help evaluation, prompt practitioners about where changes to their plans might be needed, and provide additional information which can support the amendment of plans.

Climate change will have a direct effect on the natural resources and human communities that are the focus of NRM groups. At the same time climate change will exacerbate the existing pressures that are managed by NRM groups and the responses of people and the environment to these pressures. NRM groups have been involved in developing NRM plans for their regions for long periods of time. These plans are strategic documents which guide their investment, activities and outreach, and are supported by a variety of other more detailed planning documents, background material and by annual investment plans. Most plans are developed to be adaptive in nature and to enable feedback on outcomes achieved and lessons learned to be taken into account in determining their way forward.



As yet most of the NRM plans in Australia have not fully taken climate change into account and have not fully considered actions aimed at adapting to climate change. Despite this, many existing actions remain relevant while others may need tweaking or may need to be discarded or reprioritised. This document has been developed to support NRM planners to take stock of their plans, evaluate the degree of climate readiness, and assess the forms of action that are required to develop a climate ready plan. The approach has been designed to be consistent with planning approaches already used by NRM groups, from adaptive management to resilience and risk management frameworks. The approach is developed to be fit for purpose and not to prescribe how to deal with issues, but rather to highlight the main issues and support gradual improvement.

To achieve this we outline four key challenges associated with adapting to climate change in NRM planning. These include:

1. **Making decisions for multiple possible futures** – NRM planners must find ways to plan that are consistent with the range of likely futures and possible desired outcomes. This necessarily involves a degree of uncertainty, but this need not be a barrier to planning.
2. **Employing flexible and adaptive planning processes** – New information will continue to emerge about the likelihood of future climates and consequences and planners may need to develop plans that are even more flexible and/or more rapidly adapted to incorporate this new information.
3. **Explicitly identifying and preparing for likely future decisions** – Plans need to prepare for future decisions, including understanding which decisions need to be made now and which could or should be made later, identifying and monitoring the triggers that indicate when a new decision needs to be made, and planning to gather information to support future decision-making.
4. **Strengthening the adaptive capacity of people and organisations** - There are many people and organisations that manage and depend on natural resources. Successful development and implementation of plans ultimately depends on the capacity of people to be flexible and adaptive throughout all phases of the planning process.

The 'checklist' for NRM planning frameworks developed in this guide is intended to support self-evaluation by NRM groups of their current ability to meet these four challenges. It is built around five common stages or components: (i) assessment, (ii) strategic planning, (iii) implementation planning and action, (iv) monitoring, and (v) reflection. These are built into an iterative process – necessary because the most effective responses to climate change problems may not be known and outcomes may only be achieved after trying a range of options, assessing the responses, and making appropriate changes. From this a series of self-reflective questions are posed to discuss the ways in which planning to adapt to climate change may need to be done differently compared to what might have been done traditionally. The generic approach we have taken ensures that the guidance is relevant to all NRM groups, regardless of the specific planning approaches that have been followed to date.



Mesquite spraying, Mardie Station. Credits: Teresa Belcher, Rangelands NRM



Assessment

The assessment stage is an opportunity to take stock of resources and data, knowledge, and values that will inform planning or plan adjustments to incorporate climate adaptation responses. The assessment needs to account for multiple futures.

A set of six questions are posed to determine whether sufficient building blocks and processes are in place:

- Do you understand the range of future climates over time for your region?
- Do you consider how both your natural and social systems are likely to be impacted by the likely range of future climates?
- Do you assess the capacity of your natural and social systems to absorb these impacts?
- Do you work with your communities to identify what they value in the context of future climates?
- Do you reflect on whether your broad objectives are still appropriate under future climates, and whether your existing management levers will still work under these changing futures?
- Do you use all of the above information to decide where to focus your more detailed climate-adaptation planning effort?

Strategic planning

This component is where NRM vision and overall goals and priorities are set. If these are not consistent with the challenges of climate adaptation, it can become difficult to meet climate adaptation challenges in sub-strategies and implementation plans. It is important, as part of an iterative framework, that changes are considered when the need becomes apparent and sufficient flexibility is built into plans. The following five questions were designed to check steps are in place to build just such a plan:

- Have you developed a climate-appropriate vision for your region?
- Do you check whether the principles and objectives underneath your vision are also climate-appropriate and whether they are consistent with each other?
- Does your plan include goals related to building adaptive capacity?
- Do you explicitly incorporate flexibility into either your plan or the plan review process?
- Do you try to ensure your plan and the plans of your stakeholders are consistent?

Implementation planning and action

This is where you start to make more detailed decisions about the targets and actions you might take to achieve the strategic objectives and visions. Traditionally, this more detailed planning is done separately for different domains (e.g. water, agriculture, biodiversity, etc.) and in many cases this may involve the development of separate sub-strategies and/or implementation plans – a segregation that may itself be a challenge to climate adaptation.

Here, think about how you might implement actions in the face of uncertainty (multiple futures) and dealing with the key challenge of considering which actions are appropriate at what points in time as the climate changes, and to explicitly plan to switch as the need arises.

The following eight questions have been designed to help you to approach these relatively new challenges.

- Do you assess whether our current high priority targets and actions are still likely to be your top priorities under future climates?
- Do you use a creative brainstorming process involving community and stakeholders to identify potential actions you might take?
- Have you considered taking an ‘adaptation pathways’ approach - explicitly planning to switch actions over time?
- Do you consider implementing actions in such a way that they can be modified in the future?
- When deciding which actions to take, have you thought about using a decision-making approach that considers uncertainty and risk in addition to cost and effectiveness?
- Are your sub-strategies or implementation plans strongly coordinated across domains and scales?
- Do you deliberately implement multiple different actions to address a given objective in order to ‘experiment’ and see which is most effective?
- Do you partner with the community and your stakeholders in both developing implementation plans and taking action?



Image Credit: Terrain NRM

Monitoring

In this section we consider how monitoring may be different when dealing with climate change adaptation and the need to support flexibility of your actions. We also consider the need to monitor triggers that could indicate when actions and approaches may need to be changed. Effective monitoring can be costly and we emphasise the need to be targeted and to develop partnerships to increase the scope of monitoring activities.

The following five questions have been designed to help you to consider monitoring under a climate affected future.

- Do you track emerging climate futures for your region?
- Do you monitor triggers for future decisions?
- Do you consider whether monitoring is likely to give you useful information about effectiveness of your actions given monitoring effort and time frames, and then implement monitoring only where it will be useful?
- Do you monitor changes in your region's adaptive capacity?
- Do you explore potential partnerships for building monitoring programs?

Reflection

Reflection is an integral part of any adaptive management, and under a climate affected future has additional importance. This is when you can decide if it's time to consider adjusting actions as part of an adaptation pathway or even adjust overarching objectives. This is the stage where your planning can become truly adaptive and when you can make decisions about reducing potential for maladaptation or when transformative adaptation might be required.

We have identified three questions to help you assess whether your reflection approaches are supporting climate adaptation planning and outcomes.

- Do you reflect on where you are among the range of possible futures for your region?
- Do you reflect on the processes that you followed in preparing a climate adapted NRM plan, not just the plan itself?
- Do you reflect on whether it's time to consider shifting actions, based not just on monitoring their effectiveness but also based on trigger points for future decisions?

To support you to consider the questions we elaborate on why they are important and how you might approach them in a resource constrained environment. We also provide an overview of the risks to your plans and to your ability to achieve your objectives if each question is not being addressed effectively. We then provide a series of case studies and tools to support you to address the questions and build effective plans.

The document does not aim to answer all questions or to provide links to all answers, but rather to help practitioners to ask some of the right questions and to start the journey of adapting effectively to climate change.

The approach is consistent with the Principles for the Regional NRM Planning for Climate Change Fund identified by the Commonwealth Government.

This document is not designed as an audit or judgment of NRM planning; it is designed as a means to support continual improvement and for groups to start now and build into the future.



1 What to expect in this guide

Climate adaptation presents a range of specific challenges to natural resource management (NRM) planning. These challenges are not necessarily new, but climate change and climate adaptation strengthen the need to consider them in NRM planning, potentially via innovative solutions.

In this guide, we outline approaches for responding to four key challenges that, while not necessarily new for NRM bodies, can be intensified by climate change and climate adaptation.

We then use a generalised planning framework to organise specific ideas about why and how planning approaches may need to shift to be effective under a changing climate. These ideas are posed as self-reflective questions, so NRM groups can consider whether their existing approaches are sufficient, need slight modification, or may need to be replaced with different approaches. We then provide specific

suggestions, potential tools and examples of how to meet the challenges of climate adaptation, particularly with limited planning resources. This guide identifies questions that planners need to address to meet the challenges of climate change. Our aim is not to provide all the detailed frameworks and tools to address each question, but rather to recognise that what works best for each NRM group may be quite different. Thus, we provide some tools, links to further examples, and some suggested reading to encourage you to find tools or develop new approaches that best resonate with your approach to planning.

After answering these questions and reading the case studies, you will have a clear understanding of how your planning process could be improved or extended.

Our ultimate aim is to support planners, even in small ways, to make climate adaptation part of ongoing planning and action for improved NRM outcomes.

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Conservation managers are now considering how climate will broaden their focus from species conservation to a conservation of functional roles in the landscape.



National parks managers are considering how to respond to changing species distributions into and out of park boundaries.



Water managers confront new challenges under climate change, including allocation of water to farmers and to ecosystems.



Infrastructure planners must now consider new probabilities for extreme events in designing buildings, roads, and protective structures.

2 Applying a climate adaptation lens to NRM

Approaches to NRM worldwide have been developed with regard to climate variability in the climate of the day, but not with explicit consideration of a changing future climate and a moving baseline. Climate adaptation for NRM refers to the ways in which these planning and management approaches may need to be adjusted to better cope with the challenges imposed by a changing climate. Climate change combines with and influences non-climate pressures, adding further complexity to NRM planning and increasing the need for a flexible, iterative approach.

Climate change is a dynamic process, with conditions likely to change continually over time, as they have in recent decades in many regions of Australia. Continued change seems likely over at least the coming century. Climate models can provide a range of likely future climatic conditions (sometimes referred to as climate futures), with greater certainty for the near term, and a wider range of possibilities at longer time scales. As a result, planning approaches that consider a range of possible futures and recognise the need to shift goals and actions over time will be most cost-effective given future uncertainty (see Box 2). Note, however, that sometimes the types of decisions being made do not need to consider multiple futures because proposed actions will be beneficial no matter what, and additional time spent planning will not have additional benefit. Such changes in planning are also being considered by a wide range of land managers, including conservation managers, national parks managers, water managers, and local government (see side bar). NRM planners face an additional challenge in developing integrated responses that may span a range of these sectors.

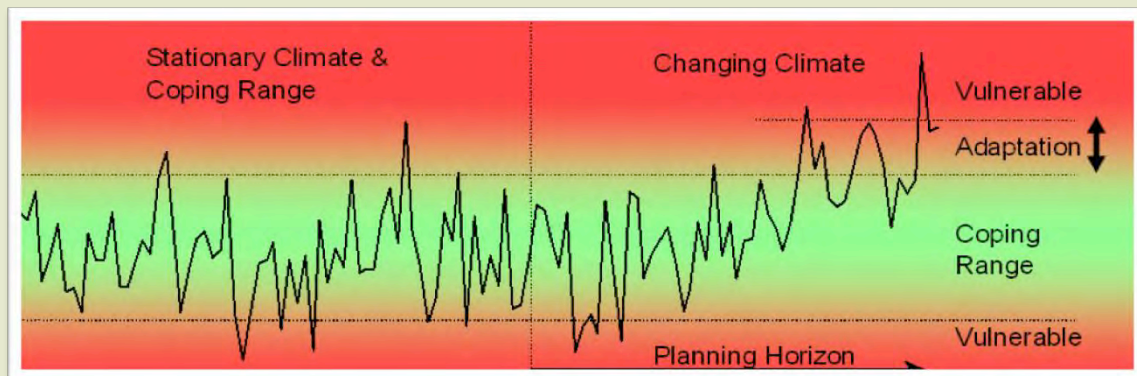
Applying this climate adaptation lens to NRM planning highlights four key challenges. While elements of these challenges may not be new and there are already good examples of NRM bodies beginning to tackle them, climate adaptation may intensify the challenges, creating a need for even more innovative solutions.

These four key climate adaptation challenges for NRM planning discussed in the remainder of this section are:

1. Making decisions for multiple possible futures
2. Employing flexible and adaptive planning processes
3. Explicitly identifying and preparing for likely future decisions
4. Strengthening the adaptive capacity of people and organisations

Box 1 A closer look at climate adaptation

Adaptation actions aim to manage climate-induced changes to human and natural systems to reduce potential negative consequences and take advantage of any emerging opportunities. Adaptation has been used to refer to both genetic change (evolution) by species to cope with a new environment, and to societal responses to manage the consequences of climate change. Natural systems are likely to have limited capacity to adjust to the rate of climate change and so as the climate changes, some form of adaptation (natural or human-assisted) is needed to increase the coping range. NRM planners may have to develop solutions to assist adaptation by both natural and human systems.



Source: Jones and Mearns 2005

A key question in predicting the ecological effects of climate change is whether species, habitats and communities will be able to adapt fast enough to keep up with their changing environment. For example, the maximum rate of adaptation will set an upper limit to the rate at which temperatures can increase without leading to a decline in, say, tree survival. Research is in its infancy with respect to enhancing biological responses to climate change, yet options do exist. For example, potential strategies that have been proposed seek to reduce stress and enhance resilience. These approaches are expected to increase the period of time over which biological response (e.g. evolution to increased temperature tolerance) can occur. Examples include habitat restoration, restoration of connectivity and management of whole landscapes as 'wildlife corridors', provision of shade for turtle-nesting beaches, assisted translocation of heat tolerant tree genotypes from warmer regions, and establishment of new populations or habitat structures.

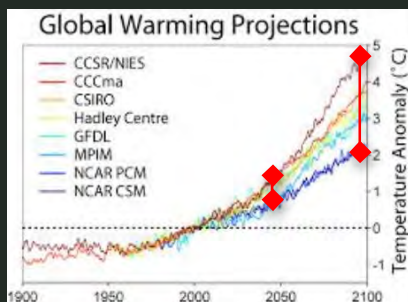
Adaptation research focuses on providing information to reduce the vulnerabilities of species and societies to risks and increase the capacity to cope with and even benefit from change. Adaptation planning involves developing a process to implement solutions based on research and experience.

Jones, R. N. & Mearns, L. O. 2005 Assessing future climate risks. In *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures* (ed. B. Lim, E. Spanger-Siegfried, I. Burton, E. Malone & S. Huq), pp. 119-143. Cambridge and New York: Cambridge University Press.

OUR KEY CHALLENGES

1. How do we make decisions for multiple possible futures?
2. How can we employ flexible and adaptive planning processes?
3. How do we explicitly identify and prepare for likely future decisions?
4. How can we strengthen the adaptive capacity of people and organisations?

RECOGNISING SYSTEM UNCERTAINTY IN PLANNING



Future temperatures may be 2-5 degrees above 1990 levels by the end of the century. The range of projections (red bars) is far greater at the end of the century than in next few decades and creates greater uncertainty at longer timescales.

Thus, planners need to have options that will help achieve good outcome across this range of futures. At shorter timescales, this uncertainty is reduced, so decisions with a shorter lifetime can be made with more confidence.

Challenge 1. Making decisions for multiple possible futures

There are many possible ways in which climate may alter regions in the future, both directly and indirectly via changes in production systems and land uses. In addition, changes in climate may also influence the effectiveness of decisions and actions taken now, such as the long-term survival of trees planted in revegetation projects. Climate change can also affect other drivers and pressures (e.g. prolonged dry periods affecting freshwater flows) which have been the focus of NRM planning and management in the past. A key challenge is to plan in ways that are consistent with the range of likely futures and even a range of possible desired outcomes, but without attachment to a particular pathway to achieve that outcome.

The need to consider multiple possible futures acknowledges that system uncertainty (Box 2) may need to be addressed in the planning process (*See sidebar*). This often leads to questions about whether and how to take action when we don't know the future. However, decisions can still be made when you are not certain of the future. Uncertainty can be managed and accommodated for in planning and should not be seen as a barrier to action as inaction itself may be more detrimental than making decisions based on an assessed risk calculation. Box 2 outlines some different types of uncertainty and where they come into the planning process, as well as basic ways in which they can effectively be tackled in planning.

Box 2 Managing under different types of uncertainty

Uncertainty can be managed and accommodated for in planning and should not be seen as a barrier to action as inaction may be more detrimental than assessing risk and making decisions based on that risk calculation. Below we outline some different types of uncertainty and where they come into the planning process, as well as basic ways in which they can effectively be tackled in planning.

1. **Natural variability** – Natural variability are the ecological conditions, and the spatial and temporal variation in these conditions, that are relatively unaffected by people, within a period of time and geographical area.’
2. **Observation/Data error** – Observation error is the failure to properly observe, measure or estimate processes and quantities. It results both from imperfect methods of observation (or simply not measuring key factors) and from sampling error, i.e. the statistical differences between a sample of individuals and the population that the sample is meant to represent.
3. **System uncertainty** – Our system understanding is limited by the understanding of all the links – thus, even with complex models, any projections (qualitative or quantitative) will have an element of uncertainty.
4. **Inadequate communication** – Inadequate communication relates to the difficulty of effectively conveying information between scientists, managers and stakeholders. When communication is ineffective, information is lost, which can manifest itself as uncertainty.
5. **Unclear objectives** – Unclear management objectives are ones that are expressed vaguely, not fully conceived, scaled improperly, or difficult to quantify.
6. **Outcome uncertainty** – Outcome uncertainty occurs when actions are not implemented properly (Link et al 2012). Outcome uncertainty can be referred to as ‘implementation error’ or ‘implementation uncertainty’ because it is commonly associated with differences between a management goal and the implementation of the management plan (i.e. when a plan specifies approach X but in practice, approach Y is actually implemented). A typical example in fisheries is when actual catches of a fished stock are not equal to the model-derived allowable catch limit. Outcome uncertainty can be especially critical to NRM because it undermines the ability to determine whether management actions and recommendations are truly working.

Table 1 . Summary of categories of uncertainty and how they can be dealt with during the different components of planning. Note that planners have the power to directly reduce uncertainty in some cases, as well as deal with it effectively.

Type of uncertainty	Occurs in which general component of planning	How to handle this uncertainty in planning – i.e. implication for decision making
Natural variability	Assessment Strategic planning	Consider the range of possible states for a system when planning adaptation, which could include multiple climate futures
Observation/Data error	Assessment	Improve observation base Use a range of conditions
System uncertainty	Assessment Strategic planning	Use a range of model configurations to make projection, if they all agree, on safer ground (this is the underlying approach of the Climate Futures Framework; http://climatechangeinaustralia.gov.au)
Inadequate communication	All components	Consider explicit language and convey information clearly, and check how it is interpreted
Unclear objectives	Strategic planning Implementation planning & action	Define the objectives and check that measurable performance against the objectives can be obtained. If not, redefine objectives.
Outcome uncertainty	Monitoring Reflection	Cannot resolve this ahead of time. Requires careful monitoring of ecological outcomes and governance actions. Record clearly what actions were taken, such that we do know what might not have worked or been carried out.

Landres, P.B., Morgan, P., Swanson, F.J., 1999. Overview of the use of natural variability concepts in managing ecological systems. *Ecological Applications* 9, 1179–1188.

Link, J. S., Ihde, T. F., Harvey, C. J., Gaichas, S. K., Field, J. C., Brodziak, J. K. T., Townsend, H. M. & Peterson, R. M. 2012 Dealing with uncertainty in ecosystem models: The paradox of use for living marine resource management. *Progress in Oceanography* **102**, 102-114.

OUR KEY CHALLENGES

1. How do we make decisions for multiple possible futures?
2. **How can we employ flexible and adaptive planning processes?**
3. How do we explicitly identify and prepare for likely future decisions?
4. How can we strengthen the adaptive capacity of people and organisations?

FLEXIBLE AND ADAPTIVE

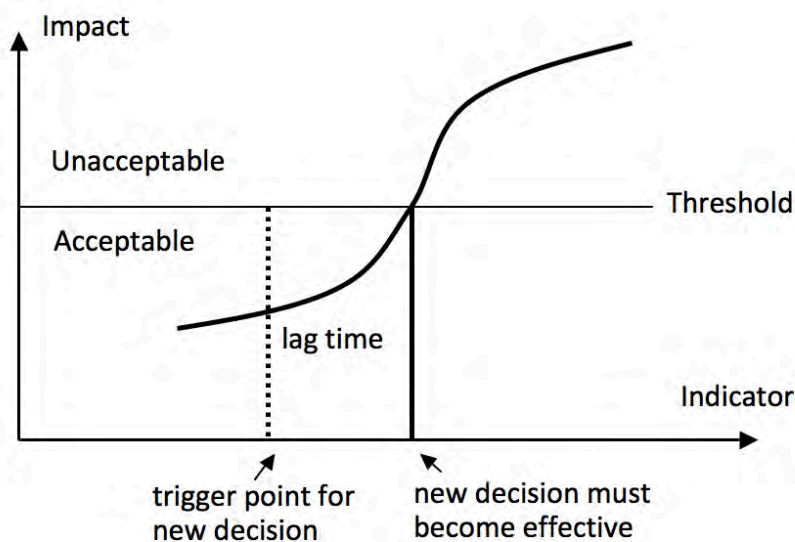
Port Phillip & Westernport CMA in Victoria developed an alternative model for their recent Regional Catchment Strategy – an online strategy that can be updated at any time (<http://www.ppwrccs.vic.gov.au/>). The process for updating involves three different levels, so minor changes can be made easily while other changes that may have significant impact on the Strategy's intent and direction would require Ministerial approval. These would be collated and approved yearly. The result is an NRM plan that can respond much more flexibly as new information becomes available.

Challenge 2. Employing flexible and adaptive planning processes

Planning processes are already designed to be adaptive and plans designed to be improved as understanding of the state of the region and the effectiveness of actions improves. However, new information will also continue to emerge about the likelihood of future climates and their consequences for a region. Over time the extent of climate-related changes such as higher sea-levels or hotter, drier conditions inland will become more apparent, providing greater clarity about the range of likely futures we will need to adapt to. Planners may need to develop plans and planning to revise plans that are even more flexible and/or more rapidly and easily adapted to incorporate new information as it comes to hand (*see sidebar*).

Challenge 3. Explicitly identifying and preparing for likely future decisions

As actions may need to change over time, it may be critical to make allowance in plans for future decision-making. This could involve understanding which decisions need to be made now and which could or should be made later, identifying and monitoring the triggers that would indicate when a new decision needs to be made, and planning to gather information so an informed decision can be made when the time comes (*see sidebar*).



OUR KEY CHALLENGES

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◀ PREPARING FOR FUTURE DECISIONS

When a pre-specified threshold is reached, reconsider the options and whether the new decision should be implemented. In the time prior to a trigger point being reached, new information might also be gathered to support the use of the threshold, and/or the next decision.

OUR KEY CHALLENGES

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LOOKING AFTER PEOPLE AND IMPROVING ADAPTIVE CAPACITY



Climate change means the status quo is unlikely to persist. Change is the new normal, and supporting people to work under conditions of constant change will be an important element of NRM work. These supporting activities might be continued outreach and extension, fostering participation in planning, development of materials to aid decision-making, and sharing lessons from other regions that have already experienced a similar change.

Challenge 4. Strengthening the adaptive capacity of people and organisations

Within a region, there are many people and organisations who manage and depend on natural resources. The ability to develop and implement more flexible and adaptive plans, and the health and resilience of regional communities, ultimately depends on the capacity of people to be flexible and adaptive throughout all phases of the planning process. Thus, NRM groups may need to consider whether and how they can improve and support the adaptive capacity of people and community based organisations in their regions (*see sidebar*).

Moving forward

To meet these challenges, some existing planning approaches may remain highly relevant, others may only need to be tweaked, and a few may need more significant innovation. In this guide our goal is to enable NRM groups to evaluate their own processes or current plans in light of this climate adaptation lens.

To do this, we have identified the general components of planning that are consistent with a broad range of planning frameworks currently in use. It reflects the thinking behind dynamic planning and management, adaptive management, resilience frameworks, systems approaches and the action learning approach (see Appendix A.1 for planning framework definitions).

We have highlighted why and how each of these general components may need to be approached a bit differently given the four key challenges posed by climate adaptation. We also provide some ideas and potential tools for meeting these challenges, illustrated with a mixture of real-world and hypothetical examples. We hope that NRM groups will find some commonality with existing approaches, but also practical ideas for progressing climate adaptation planning.

Please note that while we ask a series of questions requiring a yes or no answer, we recognise that in reality your answers will reflect where you are on a continuum between yes and no. Our approach is for guidance purposes and you should reflect on where your planning sits on this continuum and make decisions about next steps accordingly.

3 A guide to climate adaptation planning

We developed this guide with recognition that there is a great deal of variation among Australian NRM groups, not just in current planning approaches but in the degree to which plans are formalised and written, the extent to which climate adaptation has already been incorporated, and resources and capacity to undertake new planning. In addition, groups may be at very different points in their current planning cycle, from just starting to structure the next plan to finalising a new one.

This guide will support NRM groups to integrate climate change adaptation into their planning regardless of the current style or stage of planning. It is designed to support self-assessment; NRM users can consider how well their current processes meet many of the challenges that will arise due to climate change, what adaptation might be required, and how some processes might need to be adjusted to incorporate adaptation into planning. We also include guidance about relevant tools and resources to draw on if and where adjustments are desired, and provide examples to help make potential changes to planning approaches real and tractable.

A man wearing a light-colored bucket hat, sunglasses, and a blue and white checkered shirt is standing on a grassy hillside, looking out over a vast landscape. The landscape features rolling green hills, scattered trees, and a line of banana trees in the mid-ground. The sky is blue with scattered white clouds.

The challenges of climate adaptation can be met through changes in the way we think about and approach planning without necessarily requiring a great deal more information and effort.

By focusing on five general components of planning, this guide will be relevant regardless of the specific planning approach. For groups that have already considered climate adaptation in their planning and for groups that are well advanced in their current planning cycle, the self-assessment could be used to check or slightly modify current approaches. For groups starting a planning cycle and those that have not yet explicitly considered climate adaptation, the self-assessment could be used to guide resource gathering and new planning activities.

Throughout the guide, we have also attempted to highlight how new or more urgent planning challenges could be met using limited resources and capacity as well as more intensive resources. Our aim is not only to assist NRM groups who have limited resources, but also to suggest that the challenges of climate adaptation can be met through changes in the way we think about and approach planning without necessarily requiring a great deal more information and effort. Using limited resources to address each challenge may also be helpful in setting up more adaptive and flexible plans in which new information may need to be reviewed and incorporated frequently.

Given this variation in how the guide might be used, we suggest NRM groups begin by considering where they are in their current planning cycle and how they would like to use the guide. For each assessment question, we suggest that NRM groups consider whether current planning approaches address the challenge being described. If not, could current approaches be easily modified or would new approaches be of interest? The structure of this self-assessment is broad in nature and is intended to complement more detailed planning frameworks, including those that may focus on climate adaptation challenges at a range of spatial scales. The overall goal is to empower NRMs to tackle responses to climate impacts through effective adaptation.

The Commonwealth of Australia identified several principles for the Regional NRM Planning for Climate Change Fund to guide the updating of NRM plans. These principles were considered during the preparation of this guideline, and the guidance material in this document is fully consistent with them.

Getting started

We suggest NRM groups begin by considering where they are in their current planning cycle and how they would like to use the guide.

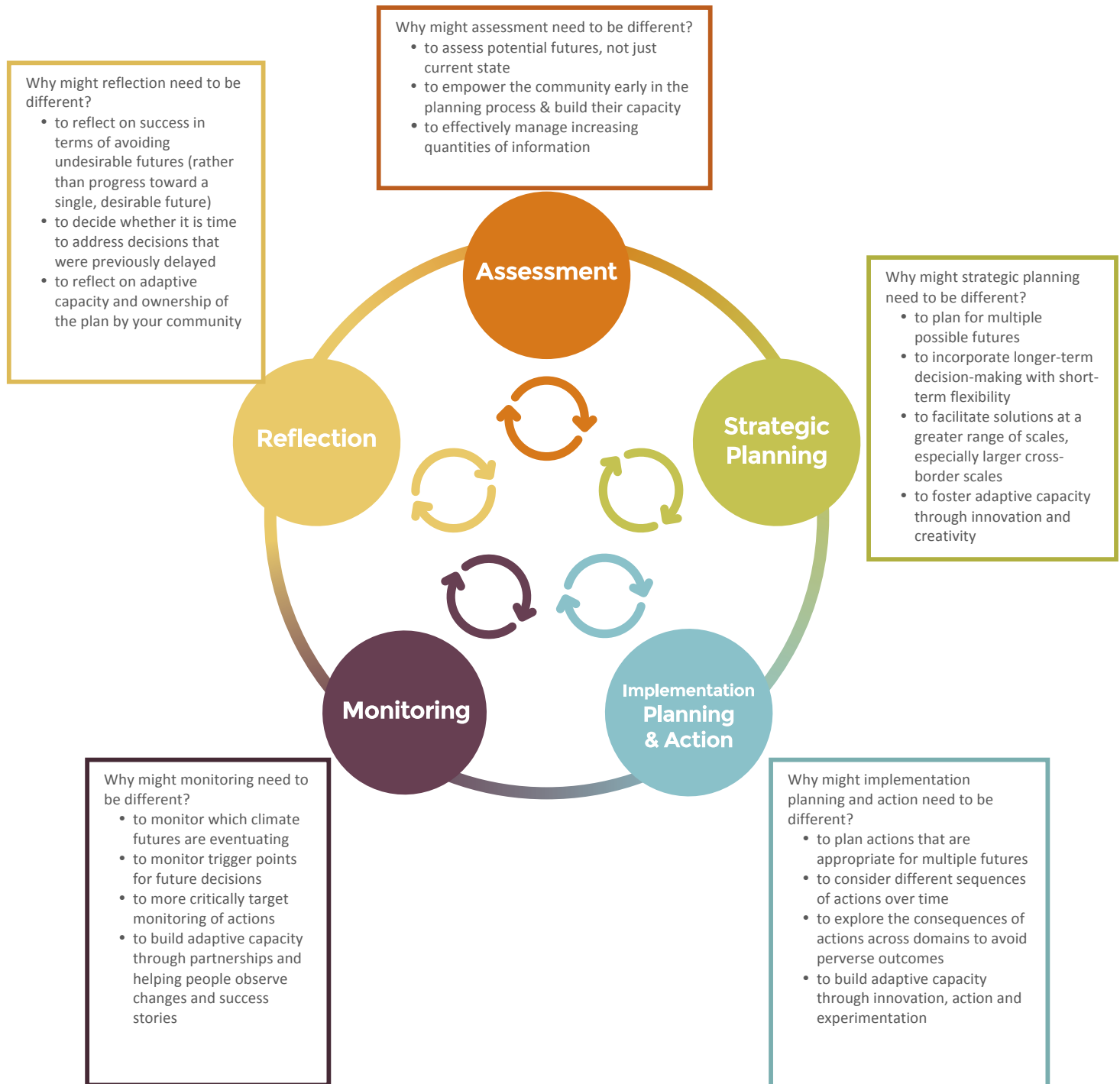
4 General components of planning

Review of the literature and practical information describing “planning frameworks”, shows that there are five common stages or components: (i) assessment, (ii) strategic planning, (iii) implementation planning and action, (iv) monitoring, and (v) reflection. While not always sequential, these components reflect an iterative planning process that is also appropriate for planning given climate change. This is because the most effective responses to climate change problems may not be known and outcomes may only be achieved after trying a range of options, assessing the responses, and making appropriate changes (the iterative process). Thus, these five general components of planning form the basis for this guide.

The most effective responses to climate change problems may not be known and outcomes may only be achieved after trying a range of options, assessing the responses, and making appropriate changes.

Within each component, the challenges posed by climate adaptation have specific implications. In Figure 1, we show the components of planning and list a few key reasons *why* each component may need to be tackled differently than it traditionally has been, given the four challenges posed by climate change. The circular arrows in the centre of the diagram are intended to show that, particularly under more flexible and adaptive planning processes, each component may be somewhat iterative and is informed by the other components. In the subsequent sections, we provide self-reflective questions for *how* each component could be tackled differently, including some potential resources, tools and examples.

Figure 1 General components of planning through an adaptation lens



This section will assist you in answering the following questions in relation to climate adaptation and planning for your region:

- 4.1.1. Do you understand the range of future climates over time for your region?
- 4.1.2. Do you consider how both your natural and social systems are likely to be impacted by the likely range of future climates?
- 4.1.3. Do you assess the capacity of your natural and social systems to absorb these impacts?
- 4.1.4. Do you work with your communities to identify what they value in the context of future climates?
- 4.1.5. Do you reflect on whether your broad objectives are still appropriate under future climates, and whether your existing management levers will still work under these changing futures?
- 4.1.6. Do you use all of the above information to decide where to focus your more detailed climate-adaptation planning effort?

4.1 Assessment

The assessment stage is an opportunity to take stock of what you have (e.g. resources, data), what you know, and what you and your communities value that will inform how you undertake or adjust your plan to incorporate climate adaptation responses. The key challenges posed by climate change suggest that assessment processes need to involve assessment of multiple futures, not just the current state of the region, and to do so by making efficient use of ever-increasing amounts of information.

The questions that follow should allow you to determine whether you have the building blocks and processes in place to meet these challenges.



IF YOU ANSWERED YES

A new round of Australian climate change projections utilising new generation global climate models (known as the CMIP5 archive)* will be available in July 2014 at <http://climatechangeinaustralia.gov.au>. While the results may not be significantly different to the previous round (2007, the CMIP3 archive), new regional detail and strengthening of confidence on key messages will allow you to stay informed on likely future changes.

IF YOU ANSWERED NO

The final projections* will be available in July 2014 but a range of current information can be found at: <http://climatechangeinaustralia.gov.au>. There are also Interim Projection Statements available for each cluster. This information will help you consider the range of possible climate futures for your region.

*Current climate projections for Australia: from the Australian Climate Change Science Program, a joint initiative of the Department of Environment, the Bureau of Meteorology and CSIRO.

4.1.1 Do you understand the range of future climates over time for your region?

Climate projections are a useful tool for considering the range of possible future climates. There are two important aspects to consider when considering a climate projection: climate change scenarios, and time scales.

Climate change scenarios are typically represented as a set of alternative emission or greenhouse gas concentration pathways. These can be characterised as those that involve low or high mitigation efforts (and thus high or low emissions) and which scenarios actually eventuate will depend on many factors such as government policies, population growth and technological developments. The concentrations from these scenarios are used as inputs into Global Climate Models (GCMs) to project the change in variables such as temperature and rainfall. The GCM results can be further processed to provide regional or local projections.

With regard to time scales, projections from various GCMs are more or less similar in the shorter term (e.g. 5, 10, even 20 years), but can start to vary greatly in the longer term (e.g. from 40 years onward). Projections offer the opportunity to explore a range of different futures and consider the associated risks for your region and allow reasonable decision making without knowing the future.

Have limited resources? Much work is already underway to develop and synthesise regionally relevant information. In particular, Regional Reports and a Climate Futures Framework will be available at www.climatechangeinaustralia.gov.au and should give a cluster-level view of likely future climates and assist you in selecting which are relevant for your planning. Given that you may wish to consider a number of points in time and several scenarios, this can result in a very large number of climate futures to consider. You may only have the resources to consider a small number in detail. For example, you may prefer to look at the 'worst-case' future, the most likely future, or a small set of two or three to encompass those that are most likely and/or best or worst cases given the issues most important in your region.

What are the risks of not considering alternative futures?

If decisions are made based only on the current climate, there is a risk that 'maladaptive decisions' will be made. For example, extensive investment in controlling a weed that decreases in distribution and is replaced by a second weed that creates a new problem could represent a waste of investment that leaves limited resources available to address the new weed problem. Not selecting a range of alternative

futures creates a risk that the one future selected may be very different to what eventuates and you and your communities will not be prepared for the future that does eventuate.

4.1.2 Do you consider how both your natural and social systems may be impacted (directly and indirectly) by the likely range of future climates?

Natural and social systems in your region are probably already exposed to a range of existing pressures, such as land-use change. Climate change is likely to exacerbate some of those pressures and will also create new pressures. Consider the ways in which existing pressures will be influenced by climate change (will it make it worse or better) and consider whether climate change may result in new pressures that you have not needed to manage before. This can be done using scenarios based on multiple future climates. Over what spatial and temporal scales are these changes likely?

Have limited resources? A growing body of literature is considering the impact of climate change on both natural systems and society. However, there are many gaps and inconsistencies in knowledge, and there may not be available information for your region. You may not have the resources nor consider it resource effective to investigate these gaps. In that case, information on impacts might be drawn from other locations that are at least partly analogous to your locality or environment (including internationally); or derived from expert opinion.

What are the risks of not doing this? Failing to consider the change in impacts and/or new impacts could reduce the effectiveness of existing management actions.

IF YOU ANSWERED YES

You are now well placed to decide which of these impacts your systems can absorb as well as which ones will actually threaten values. Use this set of potential impacts to feed into the next questions.

IF YOU ANSWERED NO

The NSW Office of Environment & Heritage has an Integrated Regional Vulnerability Assessment – a resource-intensive approach to assessment that aims to define the most vulnerable sectors at a regional level. The website includes links to an example for SE NSW as well as a guide on how to do it:

<http://www.environment.nsw.gov.au/climatechange/irvadescription.htm>

Ross and colleagues (2013) provide a less resource-intensive process by which they worked with a range of non-technical experts in the community, local government, NRM and others to determine how climate change would affect them and the assets they care about.

Ross, H., Shaw, S., Schoeman, J., Chapman, S., Cliffe, N., Rissik, D., Hounsell, V., Udy, J., Trinh, N. and. (2013) Climate roundtables in South East Queensland: Short Report. Global Change Institute. University of Queensland.

<http://www.gci.uq.edu.au/publications/climate-roundtables>

IF YOU ANSWERED YES

You are well placed to identify whether the impacts that can't be absorbed are truly a problem from the perspective of society's values, and develop community priorities as outlined in the next question of this guide. You can also use your understanding of adaptive capacity in your region to consider how to increase it and build resilience (see Implementation section).

IF YOU ANSWERED NO

CSIRO's *Vulnerability Assessment for Australia*, gives a spatially broad assessment of vulnerability and adaptive capacity that may provide a useful first overview for your region.

<http://apsrunet.apsim.info/VulnerabilityAssessmentAustralia/>

Here is a case study of communities that have undertaken assessments of their adaptive capacity: Sietchiping, R. 2006. Applying an index of adaptive capacity to climate change in north-western Victoria, Australia, *Applied GIS*, 2: 16.1-16.28.

<http://www.epress.monash.edu.au/ag/ag060016.pdf>

To assess the adaptive capacity of species, you might like to refer to the framework for assessing vulnerability of species developed by Stephen Williams and his team:

Williams et al. 2008. Towards an Integrated Framework for Assessing the Vulnerability of Species to Climate Change, *PLOS Biology*, 6(12): e325. doi:10.1371/journal.pbio.0060325.

<http://www.plosbiology.org/article/info%3Adoi%2F10.1371%2Fjournal.pbio.0060325>

4.1.3 Do you assess the capacity of your natural and social systems to absorb these impacts?

Impacts of climate change are not necessarily problematic from a management point of view. The outcome of impacts can be different depending on the capacity of your systems to absorb impacts – their 'adaptive capacity'. Thus, the challenge isn't necessarily to minimise the impacts, but to minimise undesirable outcomes of climate impacts. Ultimately the effects of climate change may be so substantial that we need to consider the capacity of natural and social systems to transform to alternative systems. Such transformation may be the only way to adapt to certain effects of climate change in the future.

When thinking about capacity of natural systems, you may wish to consider species' climate tolerances, resilience to existing climate variability like droughts, and connectivity of landscapes to facilitate species' movements. For your social systems, consider the extent that people within your region are connected to each other, and to those with knowledge or experience of natural disasters, or to those with different perspectives and experiences. Consider how the communities in your region would cope and adapt to changes in the natural system and whether the mechanisms to test innovative approaches exist (see Box 3).

Have limited resources? While formal testing is available to survey adaptive capacity, expert knowledge and historical response may also be informative of adaptive capacity. For natural systems, the science behind adaptive capacity is still limited and expert opinion may be just as useful as complex analysis and models. A simple surrogate could be the degree of existing pressures and disturbance as these will impact on the capacity of the system to cope with further change. For social systems consider how the community has engaged with climate change discussion or climate extreme related activities and planning in the past. A highly engaged and aware community is likely to have greater capacity.

What are the risks of not doing this? Many systems may naturally be able to cope with or change in response to climate change without loss in value or function. Failing to assess which systems may truly need special management under climate change could result in much wasted effort trying to manage all impacts.

IF YOU ANSWERED YES

You have a good awareness of your community expectations under future climates and can engage with them effectively. You are also able to manage change in your community and ensure they remain on side with your planning approaches. You should be able to use information on climate impacts and adaptive capacity to understand which values may be most under threat (Question 4.1.6 of this guide).

IF YOU ANSWERED NO

NRM in Australia has an outstanding track record of engaging with stakeholders, but climate change and adaptation is probably a newer topic to cover. There are many ways that one can go about doing this, but here is an example of how future climate change is made relevant to a local community. It is set in Canada, and is based on the work of Stephen Sheppard.

http://nlreda.ca/system/filestore/OM%20resource%20materials/Environmental_Planning/Local%20Climate%20Change%20Visioning%20-%20A%20New%20Process%20for%20Community%20Planning%20and%20Outreach.pdf

For more detail in a peer-reviewed journal article, see:

Sheppard, S., Shaw, A., Flanders, D., Burch, S., Wiek, A., Carmichael, J., Robinson, J., & Cohen, S. 2011. Future visioning of local climate change: A framework for community engagement and planning with scenarios and visualisation. *Futures*, 43(4): 400-412.

<http://www.sciencedirect.com/science/article/pii/S0016328711000103>

4.1.4 Do you work with your communities to identify what they value in the context of future climates?

There is more than one pathway that an adaptation plan or an action to adapt to climate change can take and this is generally driven by goals and values. For example, your community may consider the supply of potable water to be the highest priority in the future rather than an alternative view to maintain sufficient inflows in wetlands for biodiversity. While this need not lead to a trade-off in favour of one priority over another, it is important that the vision of the community is addressed in the plan. This will help build the capacity of the region to engage with, and implement, climate adaptation planning. While many plans are already strongly grounded in community values, the challenge here is to focus on what the community currently values AND will likely value under different climate futures, given all the pressures and changes they may impose.

Have limited resources? Ensuring that community consultation and engagement occurs at an early stage will ensure community buy-in and support and that your plan addresses the community's preferred vision for the future. Thus, early investment in engaging the community is likely to pay off in terms of reduced investment later in the planning process.

What are the risks of not doing this? If the direction of adaptation is in conflict with strongly held community values it will not be supported. The community may challenge any directive, and transaction costs in the future are likely to be significant. Potentially, successful adaptation to climate change will be affected.



4.1.5 Do you reflect on whether your broad objectives are still appropriate under future climates, and whether your existing management levers will still work under these changing futures?

If some broad objectives are going to become unachievable given the pressures associated with climate change, they may need more attention when developing a climate adapted plan. For example, it may be impossible to maintain the extent of a particular ecosystem type or a particular agricultural enterprise. Similarly, if existing management levers are likely to still be effective regardless of a changing climate (including at meeting new challenges), they may need less attention in the plan development. These reflections might seem unnecessary, however considering them now may help to refine your planning focus and help to source and use new information in a more targeted, more efficient way (see below).

Have limited resources? As this is a quick assessment, intended only to help focus effort, use internal discussions and expert opinion to reflect on climate-appropriate objectives and management levers

Risks of not doing this: The objectives that may need adjusting should be identified so as to avoid wasted effort in trying to achieve the unachievable or devoting extensive analysis of climate impacts and adaptation options without any likely change to your plan.

IF YOU ANSWERED YES

You will have categorised your objectives and management tools as those that remain appropriate and those that need revision. Ensure that existing management levers (e.g. communication and engagement plans) fit with these objectives. You are now ready to consider where you need to focus your adaptation efforts.

IF YOU ANSWERED NO

Michael Dunlop from CSIRO led a team that considered what types of biodiversity conservation objectives might be considered 'climate-ready' and developed a basic tool to guide practitioners through making these decisions themselves. The basic methodology could be modified for a range of domains, not just biodiversity.

Dunlop M, Parris, H, Ryan, P, Kroon, F 2013 *Climate-ready conservation objectives: a scoping study*, National Climate Change Adaptation Research Facility, Gold Coast.

http://apo.org.au/sites/default/files/docs/Dunlop-Climate-ready-conservation-objectives_0.pdf

IF YOU ANSWERED YES

You are well prepared to undertake your plan or revise your plan to consider adaptation, using the results of this final step to efficiently direct your more detailed planning efforts towards particular domains or sub-regions. Ensure you keep stock of your resources and knowledge gaps during your planning so they can be more readily updated as new information becomes available.

IF YOU ANSWERED NO

Review the information and resources you have at your disposal to determine where your greatest effort is needed. Consider convening a community consultation meeting or expert panel to identify your focus areas for planning.

The NSW Office of Environment & Heritage's Integrated Regional Vulnerability Assessment used stakeholder workshops to produce integrated narratives that combine some of the information we suggest should be combined in this assessment phase:

<http://www.environment.nsw.gov.au/climatechange/irvadescription.htm>

The Victorian Centre for Climate Change Adaptation Research (VCCCAR) developed a Climate Change Adaptation Navigator to help guide local governments through the process of adaptation. It includes some assessment components similar to what we have suggested here and provides a way to graphically depict your own choices about when and how you combine impact and options assessments.

<http://www.adaptation-navigator.org.au/>

4.1.6 Do you use all of the above information to decide where to focus your more detailed climate-adaptation planning effort?

Once you have made a stock take not just of potential climate futures and impacts but also of the capacity of systems to naturally respond, likely community values in the future, and your need/capacity to adjust objectives and management levers, it may become apparent that not every aspect of planning and management in your region requires a detailed climate adaptation focus. Use the information and resources gathered to decide where your effort may be most needed, could make the most difference, and/or might be most different than what you currently do. This may result in a particular focus on one or more sectors or domains (e.g. water, agriculture, etc.) or it may result in a spatial focus on certain parts of your region. Save more extensive use of information and resources for detailed planning in just those focus areas.

Have limited resources? Deciding where to focus your planning efforts requires little resource investment beyond the investment of time. Expert opinion and community consultation may also be included in this process.

Risks of not doing this: Deciding where to focus your climate-adaptation planning efforts is the critical step before undertaking your plan. It allows efficiency in your planning process and resources allocation. Failure to take stock and reflect here may mean that the focus of future efforts is deflected from areas of greatest importance or that too many planning resources are expended in areas of your plan where it's not needed or warranted.

Answering most of these six questions with 'yes' suggests you are advanced with regard to incorporating climate change adaptation into your assessment phase. If you were uncertain or answered in the negative for some of these questions, working through the suggested materials will position you well for improving your assessment phase of planning. No matter where you stand at the moment, a flexible and adaptive planning process can enable you to revisit your plan at a time convenient to your NRM group and update it with new information and new adaptation approaches.

Box 3 An example of an assessment used to decide where to focus adaptation efforts

Murrumbidgee CMA in New South Wales used a fairly simple process to assess climate impacts, capacity to absorb those impacts, and likely management levers to narrow their climate adaptation focus to particular parts of their catchment. They divided their catchment into socio-ecological landscapes within which land-uses and ecosystem types were broadly similar. They hosted community meetings in these landscapes and discussed basic aspects of climate change such as decreased rainfall. With their communities, they explored where people perceived that they were most vulnerable and could least absorb the changes given their current production enterprises. Through this process, they identified that their lower rainfall (currently 300-400mm) mixed cropping zone was most vulnerable in terms of production, and there will likely be pressure in the medium term for producers to shift their land-use practices to more broad-scale livestock production with perhaps some opportunistic cropping. The CMA can now focus some of its climate adaptation effort toward ensuring these land-use transitions can occur with minimal loss of natural and social capital.

For biodiversity, they used degree of land clearing as a simple indicator of vulnerability to climate change, as areas most cleared are probably where ecosystems have the least capacity to absorb climate change impacts. They were also able to overlay some existing vegetation modelling and carbon sequestration modelling as well as knowledge of where they had active Landcare groups to identify areas where they could most successfully try to rebuild landscape connectivity – a management lever they decided was most likely to help native species and ecosystems absorb the impacts of climate change. They can now focus their more detailed planning efforts on developing those connectivity programs.

HOW DID YOU FARE?

4.1.1. Do you understand the range of future climates over time for your region?

_____ Yes _____ No

4.1.2. Do you consider how both your natural and social systems are likely to be impacted by the likely range of future climates?

_____ Yes _____ No

4.1.3. Do you assess the capacity of your natural and social systems to absorb these impacts?

_____ Yes _____ No

4.1.4. Do you work with your communities to identify what they value in the context of future climates?

_____ Yes _____ No

4.1.5. Do you reflect on whether your broad objectives are still appropriate under future climates, and whether your existing management levers will still work under these changing futures?

_____ Yes _____ No

4.1.6. Do you use all of the above information to decide where to focus your more detailed climate-adaptation planning effort?

_____ Yes _____ No

The Strategic Planning section will assist you in answering the following questions in relation to climate adaptation and planning for your region:

- 4.2.1. Have you developed a climate-appropriate vision for your region?
- 4.2.2. Do you check whether the principles and objectives underneath your vision are also climate-appropriate and whether they are consistent with each other?
- 4.2.3. Does your plan include goals related to building adaptive capacity?
- 4.2.4. Do you explicitly incorporate flexibility into either your plan or the plan review process?
- 4.2.5. Do you try to ensure your plan and the plans of your stakeholders are consistent?

4.2 Strategic planning

This component is where your NRM vision and overall goals and priorities are set. If these are not consistent with the challenges of climate adaptation, it can become difficult to meet climate adaptation challenges in sub-strategies and implementation plans.

The effects of climate change may not be obvious at the start of planning, however, they may become apparent at some time in the future. As a result, some management actions and investments being implemented now may no longer be appropriate. Importantly, as part of an iterative framework, consider making changes when the need becomes apparent. The important thing is to develop a strategic plan and iterative approach that provides the necessary flexibility and allows you to make such changes.

Box 4 An example of an NRM group that has undertaken a climate change adaptation plan.

Regional NRM group South Australia Murray-Darling Basin (SA MDB), together with land managers, is aiming to maintain and enhance the biodiversity values of the region. It is expected that climate change will affect water resources, agriculture, forestry, fisheries and the natural environment, development of towns and cities, and contribute to human health concerns, and a climate change adaptation plan has been developed for the SA MDB region.

This plan considers how climate change will impact the region. The planning process included the identification of risks to those parts of the environment, society or economy that are most vulnerable to the effects of climate change. The plan also identifies knowledge and information needs and identifies priorities for the region.

A number of stakeholders are actively involved in the project including the SA MDB Management Board, Regional Development Australia, a range of relevant State Government organisations, LGA, and the university sector. Stakeholders have contributed local expert knowledge to an integrated vulnerability assessment (IVA) of the economic, social and environmental assets for the region.

<http://www.naturalresources.sa.gov.au/samurraydarlingbasin/projects/adapting-to-climate-change>

4.2.1 Have you developed a climate-appropriate vision for your region?

Given the many pressures associated with a changing climate and the diverse impacts they may have on your region, you may have a limited ability to control what your region will be like in the future. Thus, there is a real risk of failure if you specify a single vision of what you wish to achieve.

The overarching vision statements of NRM groups and their plans are often very high level and thus may be generally appropriate even with the onset of climate change. However, once climate projections and impacts associated with climate change are considered, it is important to review your vision to ensure it is appropriate and achievable.

It may be useful to articulate multiple acceptable visions for a range of possible futures and then derive a high-level vision that is consistent with all of them. It may also be useful to think about including a vision or statement about what you **don't** want in your region, to focus your planning. Doing this with your community and stakeholders can also help build their capacity to think about, and plan for, a range of possible futures.

Have limited resources? Setting climate appropriate visions, principles and objectives needn't require any additional resources – it may simply involve thinking in a different way when envisioning positive futures for your region. Developing scenarios and using visioning approaches based on multiple climate futures, explored simultaneously with experts and the community, can provide a structured way to do this.

Risks of not doing this: Not having a climate-appropriate vision can result in short term thinking and management approaches, and can lead to maladaptation. It can also result in the community and stakeholders not getting behind the work being done in your region.

IF YOU ANSWERED YES

Consider exposing more people from your region to these futures in your extension and outreach materials. If your vision is very high level, you may need to consider multiple futures more closely in your lower level principles and objectives. If you articulated multiple visions, you may need your principles and objectives to be relevant across them. Ensure this is carried forward into your implementation planning.

IF YOU ANSWERED NO

You may wish to undertake a scenario planning or future thinking exercise against which you test your possible visions.

This report from the SEQ CARI project (South-east Queensland Climate Adaptation Research Initiative) provides a description of the scenario planning process.

http://www.griffith.edu.au/__data/assets/pdf_file/0004/464251/Griffith-University-SEQCARI-Scenario-Report-Oct-2012.pdf

Victoria's Department of Environment and Primary Industries outlines a process for visioning:

<http://www.dse.vic.gov.au/effective-engagement/toolkit/tool-visioning>

IF YOU ANSWERED YES

Ensure that throughout your planning process you self-assess against these objectives and principles at all levels and stages to help keep your plan appropriate for the future. You can also start to consider whether you have goals related to adaptive capacity.

IF YOU ANSWERED NO

You may wish to work with your Board and stakeholders to get this step right. This will help drive the strategic direction of your planning document and will be a strong driver of success.

Michael Dunlop from CSIRO led a team that considered what types of biodiversity conservation objectives might be considered 'climate-ready' and developed a basic tool to guide practitioners through making these decisions themselves. The basic methodology could be modified for a range of domains, not just biodiversity.

Dunlop M, Parris, H, Ryan, P, Kroon, F 2013 *Climate-ready conservation objectives: a scoping study*, National Climate Change Adaptation Research Facility, Gold Coast, pp. 102.

http://apo.org.au/sites/default/files/docs/Dunlop-Climate-ready-conservation-objectives_0.pdf

4.2.2 Do you check whether the principles and objectives underneath your vision are also climate-appropriate and whether they are consistent with each other?

While having a clear vision is important, it is also important to ensure it is reflected in the next levels down – the broad principles, aims and objectives. These also need to be consistent with and achievable under a range of potential future climates, though with effort focused as suggested in the Assessment component. Consider:

- alterations to the scales at which you need to act,
- the risks of focusing on inappropriate objectives,
- the potential for perverse outcomes if objectives in different domains or sectors are inconsistent with each other.

Thus, this check may involve high-level risk assessments and evaluations of scale and interactions between sectors. This is a level of detail often dealt with at lower levels of planning (i.e. within sub-strategies or implementation plans) but the potential for high-level inconsistency is greater under climate change, suggesting these assessments might need to be done at the strategic level.

Have limited resources? The degree of effort and resources required to check for climate appropriate principles and objectives will vary considerably between regions, in part depending on whether current objectives are still likely to be appropriate. If recognised early then little additional planning work may be required. Where work is required, it may be a matter of diverting resources that might otherwise be used in implementation planning. If additional resources are required, the key may be to keep these strategic-level objectives relatively flexible, putting in place processes to review them frequently with small amounts of additional effort each time. In that case, the important thing is to ensure that objectives do not inadvertently reduce adaptive capacity or lock you into a maladaptive future.

Risks of not doing this: Not having climate-appropriate principles and objectives can result in short term thinking and management approaches, and can lead to maladaptation in the long term. In addition, the potential for cross-sectoral inconsistencies is high and can result in perverse outcomes. A risk analysis can help to identify and manage the risks of inappropriate objectives and consider the potential for adverse outcomes.



Box 5 An example of how consideration of climate-appropriate scales could lead to changes in objectives

Dune management could previously be focussed on one stretch of beach. Under climate change that may be inappropriate because sea level rise might affect scales larger than that specific stretch and managing one section without broader consideration may result in other issues such as exacerbated erosion. It is necessary to consider the broader implications of sea level rise to the whole coast and all bays and estuaries in a region to determine the best scale at which to operate. This consideration of scale could lead to very different framing of principles and objectives related to maintaining healthy coasts.

IF YOU ANSWERED YES

You are well placed to successfully implement your plan. Continue investing in building adaptive capacity. This is also important in the implementation planning, monitoring and reflection processes.

IF YOU ANSWERED NO

We suggest the following resource that highlights the need to develop capacity so that transformations can be undertaken if necessary:

Marshall NA, Park SE, Adger WN, Brown K, Howden SM (2012) Transformational capacity and the influence of place and identity. *Environmental Research Letters* 7 (3).Doi 10.1088/1748-9326/7/3/034022

http://iopscience.iop.org/1748-9326/7/3/034022/pdf/1748-9326_7_3_034022.pdf

The Sydney City Council developed guidelines for Local Governments to build adaptive capacity. This is a useful case study of a comprehensive process to build adaptive capacity in a regional setting:

<http://www.sydneycoastalcouncils.com.au/sites/default/files/systapproachphasethreereport.pdf>

4.2.3 Does your plan include goals related to building adaptive capacity?

Enhancing the adaptive capacity of your region can assist with implementing your plan as well as increase the chances that climate adaptation will become business-as-usual thus requiring less specific planning focus over time. Increasing or maintaining landscape connectivity has become a common approach to managing the adaptive capacity of natural systems – increasing the size and genetic diversity of populations of native species as well as providing opportunities for shifts in distribution. There are a variety of ways to build the adaptive capacity of people and organisations, the most simple being to acknowledge the legitimacy of the knowledge and values of local communities (including traditional/historical knowledge). This alone can empower people to act, and can often result in innovative and creative ideas and approaches – which may be critical to long-term success in climate adaptation.

Have limited resources? The degree of effort and time put into this component will depend on its priority and how thoroughly you wish to explore it. You could base your goals and objectives on detailed studies of adaptive capacity in your region, or on rules of thumb (like legitimising local knowledge and values, simply sharing information to give people the motivation and tools to be adaptive, and increasing native vegetation extent and connectivity).

Risks of not doing this: If adaptive capacity is not built, natural and social systems may be eroded and require much more intensive, continuous management that is difficult to implement. Reduced adaptive capacity is a serious long-term risk, as it may limit the ability to shift to more transformational adaptation approaches if they become necessary.

4.2.4 Do you explicitly incorporate flexibility into either your plan or the plan review process?

While long-term visions are an important part of any plan, the dynamic nature of climate change over time, the lack of exact certainty about future climates, and the amount of new information continually being generated means there is added pressure to be flexible about objectives over time. Many planners are only just starting to explore how to achieve this flexibility. For example, the strategic plans themselves could be flexible and dynamic, developed as online living documents open to frequent small changes. Alternatively, strategic plans could be very high level with only occasional updating, leaving frequent changes and flexibility to sub-strategies and implementation plans.

Have limited resources? At the moment, plans are often updated somewhat infrequently because the process is exhaustive and resource-intensive. There are however, several NRM groups who are looking to develop dynamic and 'living' plans. Creating flexibility involves being willing and able to truly update rather than completely re-build, and may be more possible with limited resources if many staff have planning skills rather than those skills residing in a single planner.

Risks of not doing this: If objectives are not regularly reviewed and open to change, resources may be wasted in approaches that ceased to be appropriate years ago. This could also result in missed opportunities to avoid more drastic transformational adaptation approaches.

Box 6 An example of an approach to planning that built in flexibility

The Port Phillip & Westernport CMA in Victoria used an innovative alternative model for their recent Regional Catchment Strategy – an online strategy that can be updated at almost any time (<http://www.ppwrcc.vic.gov.au/>). They recognised that sound strategy-making relies on information from many different partners, and that new or updated information is continually becoming available. They set up methods for updating that allow minor changes to happen at any time while higher level changes require Ministerial approval. Another benefit to their approach is that it helps align the Strategy with those of other RCS stakeholders who then become part of an ongoing participatory planning process.

Pioneering this alternative model has challenged the paradigm of NRM planning. The PPWCMA explicitly recognises that its Strategy – like an ecosystem – is not static. “Therefore,” says PPWCMA Chief Executive David Buntine, “the Strategy will never be ‘finished’; but rather it will always be a tool that embraces and supports adaptation”. This approach may be well-suited to meet the challenges of climate adaptation.

IF YOU ANSWERED YES

You are well placed to deal with future challenges and emerging knowledge. Ensure you maintain flexibility in future decisions and plans. You are now able to begin to look at consistency between your plan and other relevant plans in your catchment.

IF YOU ANSWERED NO

Travers and colleagues (2013) provide a case study of the Peron Naturaliste coastal region in Western Australia that highlights the tradeoffs between providing a robust, prescriptive project methodology at the initial funding stage versus exploring an emerging pathway that enables project partners to achieve intended project outcomes. This is difficult because often good-practice only becomes apparent during project implementation.

Travers, A, Rissik, D & Reis, N 2013, Climate Change Adaptation Good Practice – Case Study: Developing Flexible Adaptation Pathways for the Peron Naturaliste Coastal Region of Western Australia 2011 - 2012, National Climate Change Adaptation Research Facility, Gold Coast.

<http://www.nccarf.edu.au/localgov/case-study/developing-flexible-adaptation-pathways-peron-naturaliste-coastal-region-western>

IF YOU ANSWERED YES

You are working well with your stakeholders. Maintain this cooperation and open dialogue as you progress through the planning and implementation process. Also keep track of the processes you followed to do this and ensure that this is redone over time.

IF YOU ANSWERED NO

Ro Hill from CSIRO specialises in collaborative environmental governance. This is a paper she led that outlines and tests specific tools for the process:

Hill R, Williams KJ, Pert PL, Robinson CJ, Dale AP, Westcott DA, Grace RA, O'Malley T. 2010. Adaptive community-based biodiversity conservation in Australia's tropical rainforest. *Environmental Conservation*. 37 (1):73-82. (available on ResearchGate (www.researchgate.net))

Consider holding a workshop in order to facilitate a two-way sharing of plans, visions and objectives. Undertake a visioning exercise as part of the workshop to help identify a common vision and priorities (see 4.2.1).

A workshop could also be based on a shared understanding of vulnerability to then build common strategic visions. The UKCIP have developed a tool for assessing vulnerability using workshops:

<http://www.ukcip.org.uk/wizard/future-climate-vulnerability/baciat/>.

4.2.5 Do you try to ensure your plan and the plans of your stakeholders are consistent?

This is an important consideration for any planning let alone for climate change adaptation, though different approaches to adaptation in different organisations may make it more challenging. The best outcomes will be achieved where all plans at different scales are integrated and consistent. It helps to streamline expenditure, derive multiple benefits, reduce stakeholder confusion, and maximise outcomes. Consider that stakeholders include neighbouring NRM regions and cross-border initiatives such as landscape-scale conservation initiatives or 'wildlife corridors'. Aligning and networking at these larger scales in particular can help to ensure that your implementation options aren't limited to the spatial scale of your region.

Have limited resources? This step can be done quickly through a workshop review approach or can be done more systematically with approaches and tools to support decisions and reprioritisation. One way to facilitate alignment and consistency while maintaining individuality is through agreeing on a few climate futures to plan for among all stakeholders, and co-developing associated climate-appropriate visions.

Risks of not doing this: Not doing this can result in wasted resources, implementation of actions that are counter-productive, maladaptive and confusing to stakeholders. Perceptions of lack of leadership can also become apparent.

Box 7 An example of a planning process that involves consistency across stakeholders, is sufficiently high level to allow flexibility, and includes some focus on adaptive capacity

The Slopes to Summit (S2S) partnership of the Great Eastern Ranges Initiative (GER; <http://www.greasternranges.org.au/our-partners/ger-regional-partnerships/slopes-to-summit>) is a landscape-scale conservation initiative involving nine partner organisations, including Murray CMA in New South Wales. Decisions are made by consensus which ensures a high level of consistency with individual partner plans. Planning for the partnership focused on identifying spatial priority areas within which partners broadly concentrate their on-ground biodiversity activities, though each partner organisation has complete autonomy and flexibility to undertake the activities they wish to. A number of activities to date have focused on community engagement with the intent of improving the community's capacity to change their attitudes and actions over time.

Answering most of these five questions with 'yes' suggests you are advanced with regard to incorporating climate change adaptation into your strategic planning. If you were uncertain or answered in the negative for some of these questions, working through the suggested materials will position you well for improving your strategic planning. No matter where you stand at the moment, a flexible and adaptive planning process can enable you to revisit your plan at a time convenient to your NRM group and update it with new information and new adaptation approaches.

HOW DID YOU FARE?

4.2.1. Have you developed a climate-appropriate vision for your region?

_____ Yes _____ No

4.2.2. Do you check whether the principles and objectives underneath your vision are also climate-appropriate and whether they are consistent with each other?

_____ Yes _____ No

4.2.3. Does your plan include goals related to building adaptive capacity?

_____ Yes _____ No

4.2.4. Do you explicitly incorporate flexibility into either your plan or the plan review process?

_____ Yes _____ No

4.2.5. Do you try to ensure your plan and the plans of your stakeholders are consistent?

_____ Yes _____ No

This section will assist you in answering the following questions in relation to climate adaptation and planning for your region:

- 4.3.1. Do you assess whether our current high priority targets and actions are still likely to be your top priorities under future climates?
- 4.3.2. Do you use a creative brainstorming process involving community and stakeholders to identify potential actions you might take?
- 4.3.3. Have you considered taking an 'adaptation pathways' approach - explicitly planning to switch actions over time?
- 4.3.4. Do you consider implementing actions in such a way that they can be modified in the future?
- 4.3.5. When deciding which actions to take, have you thought about using a decision-making approach that considers uncertainty and risk in addition to cost and effectiveness?
- 4.3.6. Are your sub-strategies or implementation plans strongly coordinated across domains and scales?
- 4.3.7. Do you deliberately implement multiple different actions to address a given objective in order to 'experiment' and see which is most effective?
- 4.3.8. Do you partner with the community and your stakeholders in both developing implementation plans and taking action?

4.3 Implementation planning & action

We use the term 'implementation planning' to refer to more detailed decisions about the targets and actions you might take to achieve the strategic objectives and visions. This more detailed planning is often done separately for different domains (e.g. water, agriculture, biodiversity, etc.). In many cases this may involve the development of separate sub-strategies and/or implementation plans, though such segregation of domains may itself provide new challenges under climate change.

In implementation, the possibility of multiple futures and changing climates over time means that potential actions might need to be compared based not just on their likely effectiveness, but also on the risks of making an ineffective or overly expensive decision in the face of uncertainty. Uncertainty may be most effectively dealt with by switching actions over time in response to the climate or the amount of information at hand. Thus, one key challenge is to consider which actions are appropriate at what points in time as the climate changes, and to explicitly plan to switch as the need arises.



4.3.1 Do you assess whether your current high priority targets and actions are still likely to be your top priorities under future climates?

Under climate change, actions that are considered important now, may not be relevant or useful, and should be reprioritised. Doing this early in implementation planning can help you focus on which domains or types of actions most need special attention in planning. For example, if your region is likely to experience an influx of new species of aggressive invasive plants, your current approaches to weed management may be insufficient make a difference. Thus, while the objective of managing weeds may still be a high priority, the actions you currently take may not be, and new innovative approaches may need to be developed. This evaluation can also feed back to your evaluation of principles and objectives, and whether they are achievable under future climates.

Have limited resources? This is intended to be a quick assessment to help focus subsequent implementation planning effort. Thus, reflection on the future priority of actions can be done through internal discussions and expert opinion.

Risks of not doing this: Failure to reprioritise current actions may mean that the focus of implementation plans is not on actions of greatest importance or that too many planning resources are expended developing implementation approaches for actions that are not needed or warranted.

IF YOU ANSWERED YES

You will have begun to develop action plans in accordance with your future objectives and vision. Consider how your funding and resources may need to be organised to support these altered priorities. You are able to start considering innovative actions together with your stakeholders.

IF YOU ANSWERED NO

An example of how prioritisation was applied to adaptation options for seabirds and marine mammals is available from Alistair Hobday from CSIRO. It might provide you with some ideas on how to take into account competing priorities and multiple decisions. The document is still in press, but you can contact Alistair for more information about this.

Hobday, A. J., Chambers, L. E. & Arnould, J. P. Y. in press Methods to prioritise adaptation options for iconic seabirds and marine mammals impacted by climate change. In *NCCARF Adaptation* (ed. J. Palutikof, J. Barnett, S. L. Boulter & D. Rissik).

IF YOU ANSWERED YES

You are likely to have considered new options and outcomes not previously considered. You are also likely to have built strong connections with stakeholders and developed community buy-in to your plan. You can now start to consider how these actions fit with a pathways approach.

IF YOU ANSWERED NO

Brainstorming is quite different than the structured decision-making that is more common in NRM. A variety of tips and techniques are available on the web, including:

http://www.mindtools.com/pages/main/newMN_CT.htm

<http://creatingminds.org/tools/brainstorming.htm>

This video provides an entertaining look at how creative processes can be used to achieve new and effective end results:

<https://www.youtube.com/watch?v=M66ZU2PClcM>

4.3.2 Do you use a creative brainstorming process involving community and stakeholders to identify potential actions you might take?

There is no doubt that climate adaptation sometimes challenges us to look for solutions in new and innovative ways. Encouraging creative thinking and drawing on the diverse knowledge and backgrounds of your community and other stakeholders may lead to rapid identification of new potential actions. It could also help to build adaptive capacity and ensure strong buy-in from the community for making significant changes to the way things are done, including transformational changes.

Have limited resources? This may actually be the most cost-effective way to generate new ideas as it could be as simple as getting people together for a workshop.

Risks of not doing this: Without specifically encouraging creativity and new ideas, we are at risk of continuing to use the same actions we always have to address new problems, which is likely to be ineffective in the long term.

4.3.3 Have you considered taking an 'adaptation pathways' approach - explicitly planning to switch actions over time?

When to take a particular action may be a function not just of which climatic conditions it is most suitable for but also how much time you might need to prepare to act (lead time), how long it might take before the action achieves its desired goals (lag time), and how long the action will have a positive effect (lifetime). Which actions to take at different time periods will also depend on knowledge and risks, which will continue to change. Thus, while actions do not need to be set in stone now and different decisions can be made in the future, it can be useful to explicitly plan to do that. This could involve identifying trigger points for when to consider shifting actions, which would have to be far enough in advance to allow for lead times and lag times before the new actions need to be effective. This could also involve planning to gather the information that will be required for effective decision-making when trigger points are reached. Another advantage of this approach is that it can help to identify low risk actions to take now, while planning future decisions. Note that low risk actions aren't just no-regrets options that will achieve the desired outcomes regardless of the future climate. They are also those with limited lead and lag times and relatively short lifetimes, so they can be effective immediately but don't lock you into a particular approach for very long.

Have limited resources? The adaptation pathways concept is relatively new* so there aren't set processes to implement it yet and it's still unclear how resource intensive it might be. One way to begin is to try to do just one pathway for a particular domain or type of decision you need to make, potentially enlisting the help of an expert in adaptation decision-making. A number of these types of example projects are currently underway, and are likely to result in some suggested processes or rules of thumb to follow, as well as a better understanding of the resourcing requirements.

Risks of not doing this: Risks of not planning to make future decisions are significant, as future decisions could be made hastily with insufficient information or end up being delayed such that more expensive and controversial actions become the only options. Not identifying low-risk actions now could result in delays in taking any action at all, or delays in achieving some positive effects on the ground, even if they are short-term. This could create a perception of not achieving goals and reduce adaptive capacity of the organisation and the community.

*Also note that the term has been used widely, not just to refer to this idea of staging decisions over time, so be careful when searching the Internet for it.

IF YOU ANSWERED YES

You will be well prepared for future decisions, with existing infrastructure or resources aligned for these decisions. This will also feed from flexibility built into your plan (Question 4.2.4). You can start to consider how your actions can be modified in the future if need be.

IF YOU ANSWERED NO

Anna Moss and Suzanne Martin summarise a range of adaptation pathway projects underway globally.

Moss, A. and S. Martin. 2012. Flexible adaptation pathways. ClimateXChange, Scotland. http://www.climateexchange.org.uk/files/9713/7365/7868/Flexible_adaptation_pathways.pdf

See also Figure 7.4 in Lowe's report for one of the first adaptation pathways, identifying staged actions over time to protect the Thames estuary if and when sea levels rise different amounts

Lowe, J. A. *et al.* 2009 *UK climate projections science report: marine and coastal projections*. Exeter, UK: Met Office Hadley Centre. <http://ukclimateprojections.defra.gov.uk/media.jsp?mediaid=87898&filetype=pdf>



Box 8 An example of developing adaptation pathways for NRM in Australia

The Eyre Peninsula regional NRM group in South Australia have been the first to be involved in developing sector-based adaptation pathways, through the Eyre Peninsula Integrated Climate Change Agreement (EPICCA). To tackle such a new approach EPICCA used a staged process, building their pathways through three workshops but also using pre-workshop phone interviews and post-workshop discussion papers to distil what they learned at each step. They now have maps of their options within a range of sectors and the maps show how their options may shift over time depending on how much the climate changes. According to Annie Lane, Eyre Peninsula NRM's Regional Manager, the group found that the adaptation pathways approach "...helps to break down this climate change problem and identify ways forward that people can understand". Interestingly, the process was deemed useful irrespective of climate change, as it was fundamentally about helping achieve plans that are more efficient and that get good outcomes with reduced risk, which are simply aspects of good planning under any climate.

One critical factor contributing to the success of the project was that the pathways were built collectively by all the main stakeholders, including local government and industry groups along with the regional NRM group. Bringing all the parties into one room to work together was unusual, and very empowering. However, it might not have been possible without a good pre-existing governance structure to bring everyone to the table, emphasising the importance of building stronger relationships with stakeholders.

4.3.4 Do you consider implementing actions in such a way that they can be modified in the future?

Because of uncertainty associated with the exact magnitude and effects of climate change, there is a need to have an element of flexibility in actions as well as the planning process. This flexibility should enable you to modify existing actions without having to switch actions completely and thus start from scratch. For example, seawalls are expensive to build. If going through a significant process to build seawalls, it may be worth spending some additional funds early on to ensure the heights of the walls can be changed later if they do not prove to be sufficiently high.

Have limited resources? The resources to do this form of planning will depend on the types of actions being implemented. Where high costs may be involved, careful consideration is required about when the best time is to invest in the action and about the consultation required. Sometimes it may be appropriate not to implement actions and to wait until more information becomes available, or different approaches are identified.

Risks of not doing this: Risks associated with not taking this step could be wasted resources and being left with infrastructure that is not fit for purpose and which can be counterproductive to the adaptive capacity of the community.

IF YOU ANSWERED YES

You are in a position to undertake actions that are fit for purpose now and probably cost effective, but you have options to change these or build on them further without starting again if the need arises. Ensure these options are well documented and fed into the reflection process so future planners in your organisation will know you made these provisions.

IF YOU ANSWERED NO

It is worthwhile reading the following paper which shows how various options on the Thames Barrier in the UK have been considered and how time and cost have been considered to identify the best most cost effective options that can be expanded on over time. It should be noted that sometimes actions still need to start from scratch and community consultation and stakeholder engagement is a lengthy process that must be accounted for.

Tim Reeder and Nicola Ranger. "How do you adapt in an uncertain world? Lessons from the Thames Estuary 2100 project." World Resources Report, Washington DC. Available online at: http://ipcc-wg2.gov/njlite_download.php?id=7133

IF YOU ANSWERED YES

You will have a broad understanding of the risks involved in decision-making and an improved comfort level with dealing with uncertainty. Continue to ensure you reflect on these in your decision-making processes. Your monitoring approaches will support the decisions you make in this step.

IF YOU ANSWERED NO

The European Commission funded a project that reviewed decision support tools to see which were most compatible with the challenges posed by climate adaptation, particularly dealing with risk and uncertainty. The summary report provides a great overview of methods and there are more detailed reports for a range of individual methods, all downloadable from:

<http://www.mediation-project.eu/platform/pbs/home.html>

Alan Randall led a team to compare common decision-making approaches in Australia and their ability to handle key challenges posed by climate adaptation. Their practitioners handbook and online guide to choosing a decision-making framework can be accessed from here:

<http://www.nccarf.edu.au/publications/Handbook-decision-making-framework-climate-adaptation>

4.3.5 When deciding which actions to take, have you thought about using a decision-making approach that considers uncertainty and risk in addition to cost and effectiveness?

Most traditional decision-making approaches (e.g. cost-benefit analysis, optimisation) tend to compare among potential actions based on their cost and the chance they will be successful. Under a changing climate, additional considerations involve how confident we are of the estimate of likely success as well as the various risks involved for the decision-maker – of being ineffective as well as of expending more resources than was necessary to achieve a positive result. A number of formal approaches to decision-making for climate adaptation have been developed to do this. Thus, while you may not have a formal decision-making approach, it is worthwhile learning a bit about the formal approaches to see if what you do also allows you to consider uncertainty and risk to your organisation, and to consider whether you wish to adopt one or more of the new formal approaches.

Have limited resources? A few summary documents are available that are quick to read and explain different formal decision-making approaches and how well they meet the challenges of climate adaptation (see side bar and Appendix A.2). A number of these approaches do not necessarily require many resources to implement – they just suggest a different way of thinking about decisions.

Risks of not doing this: Without explicitly considering uncertainty, risk and the type of risks you are most averse to, you may inadvertently decide to pursue actions that carry risks your organisation does not wish to carry.

4.3.6 Are your sub-strategies or implementation plans strongly coordinated across domains and scales?

By separating implementation planning and actions into different domains or different sub-regions, it is possible that actions taken in one will adversely impact another. This risk is stronger under climate change as the adverse impacts could lead to significant maladaptation. For example, increased water use efficiency may be an appropriate adaptation response to reduced water availability. Yet leaky, 'inefficient' irrigation systems are often important sources of environmental water, and the loss of them could put significant additional stress on water-dependent ecosystems. In addition, the actions taken in one sub-region may only achieve long-term goals if they are undertaken at larger scales - across multiple sub-regions or even across multiple regions. Thus, cross-domain and cross-scale planning is critical not just when considering strategic objectives but also when considering the actions taken to achieve those objectives.

Have limited resources? Coordination across domains and scales could take many forms. While landscape-scale models that allow you to consider a number of actions and their consequences across domains may give the greatest confidence that perverse outcomes can be avoided and appropriate scales of implementation are being achieved, these are inherently resource-intensive. Regular communication between staff responsible for different domains, focused discussions on synergies and conflicts, and use of expert opinion and rules of thumb (see Box 10) may be less resource-intensive ways of accomplishing some level of coordination.

Risks of not doing this: By not at least considering cross-domain and cross-scale coordination, there is a risk of implementation plans in different domains working at cross purposes, potentially leading to maladaptation. There is also a risk that significant investment in useful actions won't achieve the desired result because they aren't implemented at the right scales.

IF YOU ANSWERED YES

You have a strategic hierarchy by which to adapt to climate change, which means your region is likely to have an effective response to the challenges of adaptation. You will also be able to engage well with stakeholders and select the most cost effective options. You can now implement a range of actions to determine which achieve the best outcomes.

IF YOU ANSWERED NO

Some spatial modelling platforms are designed to allow you to combine multiple different types of data to plan the best outcomes across domains. These could also be used to assess whether plans for one domain lead to undesirable consequences for another.

The landscape futures analysis tool <https://www.adelaide.edu.au/environment/lfpr/research/afl/lfat/> developed by Wayne Meyers and colleagues and EnSym from the Victorian Department of Environment and Primary Industries are both specifically designed with climate change in mind.

MCAS-S <http://www.daff.gov.au/abares/datta/mcass> was developed by ABARES and is a multi-criteria analysis framework that isn't inherently focused on climate adaptation, so climate change would need to be incorporated in the way an analysis was structured and the data used.



Box 9 Examples of rules of thumb that may help with cross-domain and cross-scale coordination

Based on a review of empirical studies, Brown et al. (2005) suggest that 20% of a catchment would need to be revegetated before significant long-term effects on water yield were experienced. Thus, detailed cross-domain planning might only be needed if that much revegetation is planned.

Based on models of a range of different future climates and land use changes, Doerr et al. (2013) suggest that cross-border landscape outcomes for biodiversity can be achieved in targeted areas without having to coordinate precise actions and detailed spatial plans on different sides of the border. Thus, cross-scale and cross-jurisdiction planning for things like climate change corridors might be much more tractable than sometimes envisioned.

Brown, A. E., L. Zhang, T. A. McMahon, A. W. Western, and R. A. Vertessy. 2005. A review of paired catchment studies for determining changes in water yield resulting from alterations in vegetation. *Journal of Hydrology* 310: 28-61.

<http://www.esalq.usp.br/lcb/lerf/divulgacao/recomendados/artigos/brown2005.pdf>

Doerr, VAJ, Williams, KJ, Drielsma, M, Doerr, ED, Davies, MJ, Love, J, Langston, A, Low Choy, S, Manion, G, Cawsey, EM, McGinness, HM, Jovanovic, T, Crawford, D, Austin, M & Ferrier, S 2013, *Designing landscapes for biodiversity under climate change: summary for landscape managers and policy makers*, National Climate Change Adaptation Research Facility, Gold Coast.

http://www.nccarf.edu.au/sites/default/files/attached_files_publications/Doerr_2013_Landscapes_biodiversity_climate_change_Summary.pdf

Image Credit: North East CMA Waterwatch, King River, by Simon Dallinger



4.3.7 Do you deliberately implement multiple different actions to address a given objective in order to 'experiment' and see which is most effective?

Originally part of adaptive management, this approach may be especially important under climate change. In many cases, the most effective actions are not known and it may take significant time to determine whether a particular action was useful. Thus, rather than sequentially implementing and evaluating alternative actions, we may need to implement many different approaches to achieving a goal at once to actively and simultaneously experiment with appropriate solutions. This may be a significant challenge to the philosophy that all actions implemented must be current 'best practice'.

Have limited resources? This doesn't necessarily require more resources for implementation just a willingness to spread those resources across a range of approaches, and consider that 'best practice' can incorporate a range of potential approaches.

Risks of not doing this: The risk of not actively experimenting with actions is that the time delays involved in the alternative (sequential testing and adjusting) may mean that we end up having to resort to more expensive and challenging transformational approaches in the future that could potentially have been avoided if we had discovered successful incremental solutions sooner.

IF YOU ANSWERED YES

You are following an approach that will enable you to determine the most effective outcome. Note that you will need to monitor and evaluate the outcomes of the various approaches you are experimenting with to ensure you select the best.

IF YOU ANSWERED NO

Consider your alternative options for addressing a management issue or action. Consider how you might resource a program of complementary actions to experiment with management options. Look to the monitoring section of this guide for approaches to monitoring and evaluating different practices in order to determine effective solutions.

It may be worthwhile looking at one of the original papers that put forward the idea of adaptive management, as it highlights the need to try and compare multiple options. For example:

Walters CJ, Hilborn R (1978) Ecological optimization and adaptive management. *Annual Review of Ecology and Systematics* 9, 157-188.

<http://www.jstor.org/discover/10.2307/2096747?uid=3737536&uid=2&uid=4&sid=21103083070841>

IF YOU ANSWERED YES

Your community will have good buy-in for planning actions and improved adaptive capacity in your organisation. Ensure that you maintain these partnerships into the future. You can now start to think about how you and your partners can monitor the outcomes of the actions you are implementing.

IF YOU ANSWERED NO

Consider how you might partner with your community and stakeholders. Consider the process undertaken by the Mornington Peninsula Shire.

In 2006 the Shire commenced a serious discussion with the community about Climate Change at the forum *Your Community Your Future*. This was followed in 2008 by a series of climate change 'Community Conversations' supported by an information kit titled "Climate Change: what are we doing about it" which presented scientific evidence from a study of the climate change impacts on the Western Port Region, and gave credibility to the Conversations.

Booth, P, Rissik, D & Reis, N 2013, *Climate Change Adaptation Good Practice – Case Study: Mornington Peninsula Shire Council's community engagement programs*, National Climate Change Adaptation Research Facility, Gold Coast, 8 pp.

<http://www.nccarf.edu.au/localgov/case-study/mornington-peninsula-shire-councils-community-engagement-programs>

4.3.8 Do you partner with the community and your stakeholders in both developing implementation plans and taking action?

Community engagement and communication are already strong components of NRM planning, though often focused on community values at the strategic level. Climate adaptation challenges groups to develop an even stronger focus on community involvement to develop a sense of co-ownership of plans and their implementation. This is in part because the process of being involved in the decision-making, forging the necessary networks, can strengthen the adaptive capacity of people in the region and stimulate greater innovation and experimentation. There are a number of stakeholders that are increasingly playing a greater role in NRM and climate adaptation, including various non-governmental organisations, partnership groups (like landscape-scale conservation initiatives or 'wildlife corridors') and local governments, and involving them more directly in your planning could open new avenues for implementation and strengthen your own organisation's adaptive capacity.

Have limited resources? As with all stages in the planning cycle stakeholder and community engagement processes can sometimes be time-consuming and expensive, but the outcomes are crucial under climate adaptation. To reduce time and costs, it may be possible to identify key representatives to work with on a regular basis who are also community leaders and can serve as champions for climate adaptation throughout your region.

Risks of not doing this: The risks of not directly involving the community at this stage of planning include lack of on-ground support for implementation and missed opportunities to harness new and innovative actions from the wider community and stakeholder network.

How did you fare?

Answering most of these questions with 'yes' suggests you are advanced with regard to incorporating climate change adaptation into your assessment phase. If you were uncertain or answered in the negative for some of these questions, working through the suggested materials will position you well for improving your Implementation phase of planning. No matter where you stand at the moment, a flexible and adaptive planning process can enable you to revisit your plan at a time convenient to your NRM group and update it with new information and new adaptation approaches.

Box 10 An example of partnering to develop and implement new actions

Hunter and Central Coast Regional Environmental Strategy (HCCREMS) coordinated a region wide approach to develop a comprehensive framework to guide decisions. This is represented in the two key outputs of the project, i.e. The Handbook and a supporting Workbook. The tools assist decision makers to determine appropriate management strategies for identified risks and to prepare for coastal hazards that are anticipated to worsen due to climate change. The Handbook is also being extended to a broader range of issues. Additionally, this project provides a leadership model to coordinate regional coastal adaptation decisions across council boundaries and across a range of stakeholders.

Booth, P, Rissik, D & Reis, N. 2013. *Climate Change Adaptation Good Practice – Case Study: Decision Support for Coastal Adaptation Action: The Handbook – Hunter region*, National Climate Change Adaptation Research Facility, Gold Coast.

<http://www.nccarf.edu.au/localgov/case-study/decision-support-coastal-adaptation-action-handbook-hunter-region>

4.3.1. Do you assess whether our current high priority targets and actions are still likely to be your top priorities under future climates?

_____ Yes _____ No

4.3.2. Do you use a creative brainstorming process involving community and stakeholders to identify potential actions you might take?

_____ Yes _____ No

4.3.3. Have you considered taking an 'adaptation pathways' approach - explicitly planning to switch actions over time?

_____ Yes _____ No

4.3.4. Do you consider implementing actions in such a way that they can be modified in the future?

_____ Yes _____ No

4.3.5. When deciding which actions to take, have you thought about using a decision-making approach that considers uncertainty and risk in addition to cost and effectiveness?

_____ Yes _____ No

4.3.6. Are your sub-strategies or implementation plans strongly coordinated across domains and scales?

_____ Yes _____ No

4.3.7. Do you deliberately implement multiple different actions to address a given objective in order to 'experiment' and see which is most effective?

_____ Yes _____ No

4.3.8. Do you partner with the community and your stakeholders in both developing implementation plans and taking action?

_____ Yes _____ No

This section will assist you in answering the following questions in relation to climate adaptation and planning for your region:

- 4.4.1. Do you track emerging climate futures for your region?
- 4.4.2. Do you monitor triggers for future decisions?
- 4.4.3. Do you consider whether monitoring is likely to give you useful information about effectiveness of your actions given monitoring effort and time frames, and then implement monitoring only where it will be useful?
- 4.4.4. Do you monitor changes in your region's adaptive capacity?
- 4.4.5. Do you explore potential partnerships for building monitoring programs?

4.4 Monitoring

Monitoring is an important process for assessing the success or appropriateness of past decisions and actions. Climate change adaptation is a fairly new concept and is likely to introduce new elements to your plan. This will place even greater emphasis on understanding what works (or not), when, where, how, and why.

The nature of monitoring may also need to change, as not all adaptation actions can be monitored and assessed in reasonable time frames, and monitoring of decision trigger points and climate futures may become more important than monitoring the effectiveness of some specific actions.



4.4.1 Do you track emerging climate futures for your region?

Traditionally, monitoring focuses on assessing the effectiveness of actions, or general progress toward a specific vision for a region. Under climate adaptation, there may be a need for multiple future visions, including an understanding of potential undesirable futures. Thus, some monitoring may need to focus on simply how the climate is changing, what impacts the changed climate is having (not just what is predicted to change), and your place in progress towards a range of possible futures, including avoidance of maladaptive futures.

Have limited resources? Monitoring can be a significant investment of time and resources and is generally insufficiently resourced at the moment. Consider what existing information is collected or monitored already and whether you can make minor adjustments to this to consider broader adaptation issues. Note also that tracking your region's likely future may actually be less time and resource intensive than specifically assessing the effectiveness of all implementation actions.

Risks of not doing this: Failing to monitor, or inadequate monitoring of emerging futures runs the risk of ending up in a maladaptive state – too far along a trajectory toward a future you don't want with limited ability to shift to a more desirable future state.

IF YOU ANSWERED YES

You will be well placed to fine-tune your planning and implementation actions as you progress towards a new climate future. Consider how you can disseminate this information to build consensus around your plan. This will contribute to your stakeholder engagement and capacity building. Also start to think about what triggers can be used to determine when to change actions.

IF YOU ANSWERED NO

Thanks to technology, social media and the strengthening of citizen science, we now have multiple sources of information that could aid with monitoring. Consider information from sites like Climate Watch. It is an online system for collecting, storing, interpreting and reporting indicators of biological responses to climate, with the aim of increasing public awareness of biodiversity responses to climate change. You can even register the variable you would like others to track.

It is one way of keeping track of the current state of play against planning decisions you are making for the future.

<http://www.climatewatch.org.au/>

IF YOU ANSWERED YES

You will be well placed to change your planning or implementation actions in time for new options to be effective. Ensure your monitoring considers unexpected changes that may need to trigger unexpected actions. Ensure your monitoring feeds into your plan (4.3.3 and 4.3.4).

IF YOU ANSWERED NO

Review existing monitoring or data collection considering both your activities and those of other organisations. You may find national (e.g. Bureau of Meteorology), state (e.g. <http://www.water.wa.gov.au/Tools/Monitoring+and+data/default.aspx>) or local data collection agents.

For broader information on identifying trigger points and using the monitored information, see some of the adaptation pathway references. Figure 2 in the following paper particularly shows how the value of a monitored indicator could trigger a decision such that there was enough lead-time to effectively implement new actions:

Moss, A. and S. Martin. 2012. Flexible adaptation pathways. ClimateXChange, Scotland. http://www.climateexchange.org.uk/files/9713/7365/7868/Flexible_adaptation_pathways.pdf

4.4.2 Do you monitor triggers for future decisions?

If you have considered an adaptation pathways approach, planning to make future decisions and potentially shifting your actions over time, a key component of that is identifying trigger points for making future decisions. It then becomes necessary to monitor if and when those trigger points are reached. These may often be triggers for shifting from more incremental adaptation to transitional or transformative approaches.

Have limited resources? Monitoring programs can be built on existing resources. Consider what pre-existing monitoring or data collection is occurring (including by other organisations) that might be useful sources of indicator data. Monitoring data related to triggers is likely to be fairly simple to collect or source from others (e.g. average sea level rise, summer soil moisture levels, etc.), and may not need much analysis, which makes it much less resource-intensive than traditional monitoring.

Risks of not doing this: Without monitoring, it may be very difficult to identify the point at which new (transformational) management options should be implemented, particularly if they have long lead or lag times (see 4.3.3) and thus implementation needs to begin long before the new options will be obviously needed. The risk is that ongoing incremental change creates new impacts or problems.

4.4.3 Do you consider whether monitoring is likely to give you useful information about effectiveness of your actions given monitoring effort and time frames, and then implement monitoring only where it will be useful?

There is often a perception that it is critical to monitor every type of action taken. However, if the real purpose of monitoring is to assess the effectiveness of actions and adjust them over time, many climate adaptation options may not fit into this monitoring and adaptive management paradigm. For example, many actions have long lag times and aren't expected to have positive effects until many decades after the actions have been implemented (e.g. revegetation may need to grow and mature to support range shifts of forest-dependent species). In these cases, monitoring efforts implemented now are unlikely to provide useful information. A considered approach can help ensure effort is most effectively directed.

Have limited resources? It is a virtual certainty that all regional NRM groups currently have limited resources for monitoring. However, the intention here is to be more targeted with those limited resources, and expend them only where you will be truly able to use the information to support adaptive management.

Risks of not doing this: Failing to consider temporal and spatial scales in planning monitoring programs runs two risks. The first risk is that resources are poorly used if monitoring is carried out at unnecessary frequencies or geographical locations. The second risk is that the monitoring program is inadequate to make appropriate long-term or spatially relevant assessment.

IF YOU ANSWERED YES

You will have a prioritised monitoring plan in place and will be able to justify your monitoring activities to your stakeholders. Remember, you should reflect on this over time and make changes if new information or resources become available. A good monitoring approach will include consideration of changes to adaptive capacity.

IF YOU ANSWERED NO

You may wish to work through your monitoring approaches and logic to ensure that you are not monitoring for monitoring sake and are aiming to help steer your adaptation efforts.

The UKCIP document "Monitoring & Evaluation for Adaptation" provides a review of monitoring and evaluation tools and discusses the merits and rationale for monitoring. This might help you establish what you to focus on what you are seeking to improve your climate adaptation through monitoring.

<http://www.ukcip.org.uk/wordpress/wp-content/PDFs/SEA-change-UKCIP-MandE-review.pdf>

IF YOU ANSWERED YES

You are aware of the adaptive capacity of the people and natural communities in your region and are able to make informed decisions that best suit them. Building partnerships to monitor adaptive capacity will help with cost effectiveness of monitoring.

IF YOU ANSWERED NO

Seek out the following online handbook that attempts to assist natural resource managers to assess and monitor adaptive capacity within their jurisdiction:

Marshall NA, Marshall PA, Tamelander J, Obura D, Mallaret King D, Cinner J, M. (2010) Sustaining Tropical Coastal Communities & Industries: A Framework for Social Adaptation to Climate Change. IUCN - The International Union for the Conservation of Nature. Gland, Switzerland

<http://ccsl.iccip.net/2010-022.pdf>

The capacity of a landscape to support long-term viable populations of species may be the best indicator of the adaptive capacity of natural systems. While these things aren't easy to measure, Michael Drielsma at NSW Office of Environment and Heritage has been working on ways to model them, specifically for monitoring purposes. Contact Michael (michael.drielsma@environment.nsw.gov.au) for a copy of the report 'Framework for Terrestrial Biodiversity MER' from 2012.

4.4.4 Do you monitor changes in your region's adaptive capacity?

If you have objectives and actions associated with building adaptive capacity then it's natural that you may monitor adaptive capacity. It is worth highlighting, as adaptive capacity forms the foundation for how adaptation can become a normal part of everyday business. By monitoring the adaptive capacity of your ecosystems, communities, stakeholder organisations, and your own organisation, you may be able to evaluate if and when you can devote fewer resources specifically to adaptation planning. You can also make judgements about whether proposed climate adaptations are likely to be successful given the capacity that exists within your region. Monitoring adaptive capacity will also give you the ability to assess the effectiveness of interventions aimed at increasing adaptive capacity, and provide you with the likelihood that proposed climate adaptation strategies will be supported by your stakeholders and communities.

Have limited resources? Partnering with scientists can be a great way to monitor adaptive capacity, particularly as it is currently a subject drawing strong research interest in both social and natural realms. On the social side, it is also possible to design very simple surveys yourself and collect data relatively infrequently to reduce the work load.

Risks of not doing this: In many ways, this is the ultimate measure of the success of your climate adaptation plans – are you increasing the ability of your region to adapt to climate change? If you fail to recognise progress (or lack thereof) toward that goal, you may miss the opportunity to improve your approaches or reduce your effort if warranted.

Box 11 An example of monitoring adaptive capacity

The NQ Dry Tropics NRM are partners with CSIRO, JCU and the Great Barrier Reef Marine Park Authority in hosting a Social and Economic Long Term Monitoring Program for the Great Barrier Reef and its catchments. This regional initiative attempts to monitor the human dimension of the Great Barrier Reef and as part of this, they monitor the adaptive capacity of commercial fishers, marine-based tourism operators and farmers within the catchment (<http://www.csiro.au/Organisation-Structure/Flagships/Wealth-from-Oceans-Flagship/ORCA/GBRsurvey.aspx>). Adaptive capacity is assessed to provide decision-makers and planners within the region some idea of the level of preparedness that different user groups have to incorporate new change into their working lives; whether it be to introduce new 'best practices' or to understand the level of support needed in the event of a natural disaster.

4.4.5 Do you explore potential partnerships for building monitoring programs?

Other organisations may already collect data that can be built upon to develop an appropriate monitoring program with minor modifications or additions. Data collected may prove to be a sufficient surrogate for information needed to inform your plan. Furthermore, performing monitoring in partnerships, including with the community, can further foster a strong sense of engagement, connect people directly with climate change and the benefits of adaptation, and increase adaptive capacity.

Have limited resources? Building partnerships will involve some investment of time to discover and foster relationships. Consider existing contacts and what benefits might be derived for these potential partners and therefore their willingness to drive the building of the partnership.

Risks of not doing this: Failing to capitalise on existing resources and potential partners means you may risk doubling-up on effort and wasting limited resources to collect information that can already be accessed. Failing to fully engage the community at this step (assuming they were more deeply engaged in the planning steps) carries the risk that they don't experience the successes of planning and thus lose faith and interest in participating in the climate adaptation planning process.

IF YOU ANSWERED YES

You are likely to be selecting monitoring options that achieve good outcomes, are cost effective and are seen to be important by stakeholders. You can now begin to reflect on what you are learning.

IF YOU ANSWERED NO

You may wish to take steps to determine which other organisations in your region are undertaking monitoring activities and build relationships with them. This can support discussions about shared funding and can result in real partnerships.

There are several renowned monitoring programs based on the efforts of partnerships. These include the Healthy Waterways Program in South East Queensland.

www.healthywaterways.org

Citizen science is an increasingly useful tool for getting your communities engaged in monitoring. While it's not without its drawbacks, the UK's Environmental Observation Framework recently released a guide to getting the most benefit from citizen science:

http://www.ceh.ac.uk/news/news_archive/documents/guidetocitizenscience_version2_interactiveweb.pdf



How did you fare?

4.4.1. Do you track emerging climate futures for your region?

_____ Yes _____ No

4.4.2. Do you monitor triggers for future decisions?

_____ Yes _____ No

4.4.3. Do you consider whether monitoring is likely to give you useful information about effectiveness of your actions given monitoring effort and time frames, and then implement monitoring only where it will be useful?

_____ Yes _____ No

4.4.4. Do you monitor changes in your region's adaptive capacity?

_____ Yes _____ No

4.4.5. Do you explore potential partnerships for building monitoring programs?

_____ Yes _____ No

Answering most of these five questions with 'yes' suggests you are advanced with regard to incorporating climate change adaptation into your monitoring phase. If you were uncertain or answered in the negative for some of these questions, working through the suggested materials will position you well for improving your monitoring. No matter where you stand at the moment, a flexible and adaptive planning process can enable you to revisit your plan at a time convenient to your NRM group and update it with new information and new adaptation approaches.

Box 12 An example of an adaptive management framework that incorporates monitoring

Bino et al. (2013) assisted in the development of an adaptive management framework for a Ramsar-listed wetland. It brings together current management and available science to provide an informed hierarchy of objectives that incorporates climate change adaptation and assists transparent management. The project adopted a generic approach allowing the framework to be transferred to other wetlands, including Ramsar-listed wetlands, supplied by rivers ranging from highly regulated to free flowing.

The integration of management with science allows key indicators to be monitored that will inform management and promote increasingly informed decisions. The project involved a multi-disciplinary team of scientists and managers working on one of the more difficult challenges for Australia, exacerbated by increasing impacts of climate change on flows and inundation patterns.

Bino, G, Jenkins, K & Kingsford, RT 2013, *Adaptive management of Ramsar wetlands*, National Climate Change Adaptation Research Facility, Gold Coast, 222 pp.

<http://www.nccarf.edu.au/publications/adaptive-management-of-ramsar-wetlands>

4.5 Reflection

The results from monitoring programs and information gleaned from stakeholders and your communities can be used to reflect on your progress. This is an integral part of any adaptive management, and under a climate affected future has additional importance. This is the stage at which you can decide if it's time to consider adjusting actions as part of an adaptation pathway or even adjust overarching objectives. This is the stage where your planning can become truly adaptive and when you can make decisions about reducing potential for maladaptation or when transformative adaptation might be required. It enables you to reflect on the approaches you have used in your planning and whether you have the right levels of stakeholder and community support.

While the following self-reflective points focus specifically on how reflection might be done slightly differently for climate adaptation, the best outcomes will be achieved where this is integrated with normal reflection activities across the entire plan and not only with a focus on climate change.

This section encourages you to consider the following questions in relation to climate adaptation and planning for your region:

- 4.5.1. Do you reflect on where you are among the range of possible futures for your region?
- 4.5.2. Do you reflect on the processes that you followed in preparing a climate adapted NRM plan, not just the plan itself?
- 4.5.3. Do you reflect on whether it's time to consider shifting actions, based not just on monitoring their effectiveness but also based on trigger points for future decisions?

IF YOU ANSWERED YES

You will have a good knowledge of the possible climate futures you may need to adapt to. As new knowledge becomes available you can assess whether you need to adjust your planning.

IF YOU ANSWERED NO

See the diagrams on pages 6 and 11 of this plenary talk by Mark Stafford Smith from CSIRO, which illustrate conceptually the idea of thinking about where you are in adaptive versus maladaptive space, and where you are headed. Consider making a diagram like this with more detail about what these spaces are like for your region:

<http://www.eianz.org/document/item/2204>

Once again, scenario planning tools can be helpful here to reflect on where you are tracking compared to where you could be headed. SEQ CARI description of the scenario planning process:

http://www.griffith.edu.au/__data/assets/pdf_file/0004/464251/Griffith-University-SEQCARI-Scenario-Report-Oct-2012.pdf

DEPI's (Victoria) outline of a process for visioning:

<http://www.dse.vic.gov.au/effective-engagement/toolkit/tool-visioning>

4.5.1 Do you reflect on where you are among the range of possible futures for your region?

Traditionally, reflection focuses on whether you are achieving your vision. However, during the assessment and strategic planning phases, you may have considered multiple visions based on multiple climate futures. At the reflection stage you may want to consider returning to those projections and consider if you are on an acceptable trajectory or perhaps a trajectory that might lead to an undesirable future.

This step is a chance to reflect once again on the future; on where you have positioned yourself going forward not just on what you achieved in the past.

Have limited resources? This exercise can be done without creating new projections or scenarios but by reflecting on the knowledge and experience you have.

Risks of not doing this: Failing to undertake this step does not address future and current pathways of change. It runs the risk of following a pathway with undesirable outcomes.

4.5.2 Do you reflect on the processes that you followed in preparing a climate adapted NRM plan, not just the plan itself?

Your review process should consider whether you were really able to engage everyone in visioning for the future, whether you used processes that helped you make decisions considering uncertainty and risk, whether you involved the right people in your planning, and whether your processes helped your broader community and stakeholders take ownership of your plan. Essential for a climate adaptation plan is to also consider whether the capacity of your community to deal with the challenges associated with climate change has been increased.

Have limited resources? While reflecting on the planning process must be in addition to normal reflection on the plan itself and associated implementation, it need not be resource intensive as reflection processes are usually internal discussions, possibly with some community and stakeholder engagement. Reflecting on the planning process just requires that a few additional topics be covered in those discussions or consultations.

Risks of not doing this: This step reduces the risk that you fail to recognise if your adaptation planning processes (not just the plan itself) are not working and ensures that you are able to alter your processes in response to lessons learned.

IF YOU ANSWERED YES

You will be in a position to effectively adjust your process and outcomes which increases likelihood of achieving successful outcomes.

IF YOU ANSWERED NO

This may be an ideal stage of planning to revisit this whole technical guide, quickly progressing through the checklist to see if there were elements of the planning process that deviated significantly from the suggestions here, and critically evaluating whether you believe such deviations limited the ability of your plan to effectively address climate adaptation.

IF YOU ANSWERED YES

You are in good shape to adapt effectively. You can continue the planning cycle and increase the effort you put into aspects that are important to your stakeholders.

IF YOU ANSWERED NO

You should take a simple approach to try and complete this step and develop skills to ensure you can do this effectively. This will help you to build on the work you have done in other components of the planning cycle and gradually build a comprehensive climate change adaptation plan for your region.

Have a look at a simple adaptation pathways diagram (Figure 7.4) in Lowe's report for one of the first adaptation pathways, identifying staged actions over time to protect the Thames estuary if and when sea levels rise different amounts. It gives you an idea of how multiple potential actions can be mapped according to the climate futures over which they will likely be effective, giving a clearer idea of which actions truly are options at any given time.

Lowe, J. A. *et al.* 2009 *UK climate projections science report: marine and coastal projections*. Exeter, UK: Met Office Hadley Centre.

<http://ukclimateprojections.defra.gov.uk/media.jsp?mediaid=87898&filetype=pdf>

4.5.3 Do you reflect on whether it's time to consider shifting actions, based not just on monitoring their effectiveness but also based on trigger points for future decisions?

If you have considered an adaptation pathways approach, planning to make future decisions and potentially shifting your actions over time, a key component of that is using the reflection phase to recognise when a trigger point has been reached and a new decision may need to be made. If you have adopted a very flexible and adaptive planning process, the results of this reflection could thus act as a trigger for a more complete planning review (rather than doing complete plan reviews at set time intervals).

Have limited resources? If an adaptation pathways approach was built into implementation plans and monitoring, then reflection should involve a simple assessment of whether monitoring data suggests a key trigger point has been reached. If a full pathways approach has not been adopted, this kind of reflection can still be done, but requires an assessment of whether existing actions are likely to cease being effective before new actions can be fully implemented. It thus involves expending some of the resources for developing an adaptation pathway, potentially enlisting the help of an expert in adaptation decision-making.

Risks of not doing this: This step completes the adaptation pathways approach to stimulate the next phase of decision-making. If not done, there is a risk of missing the opportunity to make a new decision in time for the resulting actions to become effective. Ultimately, this could result in missed opportunities and the need to employ more expensive, controversial adaptation options in the future.

Answering these three questions with 'yes' suggests you are advanced with regard to incorporating climate change adaptation into your reflection phase. If you were uncertain or answered in the negative for some of these questions, working through the suggested materials will position you well for improving your reflection. No matter where you stand at the moment, an adaptive planning process enables you to revisit your plan at a time convenient to your NRM group and update it with new information and new adaptation approaches.

Box 13 A case study of an adaptation plan that is regularly reviewed

The Great Barrier Reef Marine Park Authority has prepared and implemented an adaptation strategy for the GBR (The Great Barrier Reef Climate Change Action Plan 2007-2012). The document was designed to be reviewed every 5 years to ensure currency and to ensure that it is updated as new information about the effects of climate change on the reef, its stakeholders and the community which live, work and play on the reef comes to light. The Plan has now been updated and the 2012-2017 Plan is now being implemented.

A case study on this successful project can be downloaded from:
<http://www.nccarf.edu.au/localgov/case-study/great-barrier-reef-climate-change-action-plan-2007-2012>

Rooney, S, Rissik, D & Reis, N 2013, , *Climate Change Adaptation Good Practice – Case Study: The Great Barrier Reef Climate Change Action Plan 2007-2012*, National Climate Change Adaptation Research Facility Gold Coast.

HOW DID YOU FARE?

4.5.1. Do you reflect on where you are among the range of possible futures for your region?

_____ Yes _____ No

4.5.2. Do you reflect on the processes that you followed in preparing a climate adapted NRM plan, not just the plan itself?

_____ Yes _____ No

4.5.3. Do you reflect on whether it's time to consider shifting actions, based not just on monitoring their effectiveness but also based on trigger points for future decisions??

_____ Yes _____ No

5 Adapting to climate change should not be delayed

The leadership and guidance provided by NRM groups in the past have resulted in positive effects on ecosystems and local communities. The effects of climate change present a significant challenge to values, approaches used in the past and to the outcomes we can hope to achieve. Adjusting your adaptive planning and management approaches used at the moment can help you to begin or progress the journey. There is time to learn and time to get actions right, but the planning needs to start now.

Working with your stakeholders and empowering your stakeholders to act effectively is important. It is essential that options can be adjusted over time as the implications of climate change become clear. We hope this guide helps you to start or continue your journey and supports you to make effective use of the vast amount of information that will become available.

Mitigation should seek to avoid the unmanageable, adaptation is needed to manage the unavoidable.



Image Credit:
Exeter, NRM North, by Rob Burnett Images

Appendices

A.1 Framework definitions

The iterative framework presented here is consistent with a variety of other frameworks. These include:

Dynamic Planning and Management Frameworks:

Dynamic planning and management is planning and management in which goals and values *are expected* to shift in an unpredictable manner. Dealing with these uncertain shifts requires an iterative approach in which inputs are frequently assessed and the flexible approach is altered accordingly.

Adaptive Management:

Adaptive management is an iterative process of decision-making which allows flexibility as more information is known. This helps managers to take actions that deliver key objectives and to make changes to their approaches if objectives are not met.

Resilience Frameworks:

Resilience frameworks enable systematic thinking through complex socio-ecological systems. They are concerned with the ability of a system to absorb or buffer disturbances and still maintain its core economic, social and ecological attributes. They enable learning and provide mechanisms for responding to change.

Systems Approaches:

Approaches that recognise and account for the interactive nature and interdependence of external and internal factors that affect the system being managed.

Action Learning Approach:

Approaches to management in which there is no clear indication of the actions that are needed to achieve outcomes. Actions are determined in an experimental manner and changes are made depending on the outcome.

A.2 Tools to assist and further case studies

Throughout this guide we have provided tools, examples and case studies that relate to individual questions. There are many more examples and many that overlap various questions. This appendix is an annotated selection of tools, examples and case studies for further reference.

CLIMATE PROJECTIONS

Current climate projections are available from the Australian Climate Change Science Program, a joint initiative of the Department of Environment, the Bureau of Meteorology and CSIRO:

The final projections will be available in June 2014 but a range of current information can be found at: <http://climatechangeinaustralia.gov.au>. There are Interim Statements also available for each cluster.

TOOLS FOR ASSESSMENT

- The UKCIP has developed a number of tools that may be useful for assessment and building your plan.
The LCLIP tool provides a procedure for compiling past and recent local weather to assess vulnerability. It does not however consider future projections:
<http://www.ukcip.org.uk/lclip/> (compile profile of local weather)
The SES tool helps build socio-economic scenarios: <http://www.ukcip.org.uk/ses/>
- The UNEP Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies provides an overarching process of assessment and sub-processes for individual sectors.
http://www.ivm.vu.nl/en/Images/UNEPHandbookEBA2ED27-994E-4538-B0F0C424C6F619FE_tcm53-102683.pdf
- NSW OEH developed an Integrated Regional Vulnerability Assessment, a particular approach to assessment to define most vulnerable sectors at a regional level. The website includes links to an example for SE NSW as well as a guide on how to do it:
<http://www.environment.nsw.gov.au/climatechange/irvadescription.htm>
- Simple research/organising software may prove a useful way of assembling information. These allow you to 'file' or record information as you come across it including websites, documents and images. Endnote is one that is widely used, but a free one is Mendeley.

BUILDING ADAPTIVE CAPACITY

- Building natural adaptive capacity may involve the protection and restoration of 'climate change corridors' – areas where the extent and spatial locations of native vegetation allow species' distribution shifts to occur and long-term viable populations to persist. The following resources can be used to infer how long these corridors might need to be, what their orientation might need to be relative to north-south, and what proportion of native vegetation they might need to contain:

what their orientation might need to be relative to north-south, and what proportion of native vegetation they might need to contain:

VanDerwal, Jeremy, Murphy, Helen T., Kutt, Alex S., Perkins, Genevieve C., Bateman, Brooke L., Perry, Justin J., and Reside, April E. (2013) *Focus on poleward shifts in species' distribution underestimates the fingerprint of climate change*. Nature Climate Change, 3 . pp. 239-243. (<http://eprints.jcu.edu.au/24728/>)

Doerr, VAI, Williams, KJ, Drielsma, M, Doerr, ED, Davies, MJ, Love, J, Langston, A, Low Choy, S, Manion, G, Cawsey, EM, McGinness, HM, Jovanovic, T, Crawford, D, Austin, M & Ferrier, S 2013, *Designing landscapes for biodiversity under climate change: summary for landscape managers and policy makers*, National Climate Change Adaptation Research Facility, Gold Coast, 3 pp.

http://www.nccarf.edu.au/sites/default/files/attached_files_publications/Doerr_2013_Landscapes_biodiversity_climate_change_Summary.pdf

PLANNING AND DECISION-SUPPORT TOOLS

- CATLoG is a tool to enable end users to analyse and prepare for extreme events in a less predictable, complex world. Due to the lack of historical data, the tool relies on expert judgements on the frequency and severity of such events. The Tool uses a combination of quantitative (Cost-Benefit Analysis) and qualitative (Multi-Criteria Analysis) methods to frame the decision support Tool. The current version of the Tool allows users to conduct sensitivity tests, examine the impact of uncertain parameters ranging from climate impacts to discount rates. The final product is a user-friendly decision tool in the form of an Excel add-in together with a user manual booklet that demonstrates sample worked out projects. The Tool is made flexible so that stakeholders can adopt or refine or upgrade it for their context specific applications.

Trück, S, Mathew, S, Henderson-Sellers, A, Taplin, R, Keighley, T & Chin, W 2013, *Climate adaptation decision support tool for local governments: CATLoG. Developing an Excel spreadsheet tool for local governments to compare and prioritise investment in climate change adaptation*, National Climate Change Adaptation Research Facility, Gold Coast.

- The European Union's MEDIATION project produced a policy brief describing and comparing decision support methods for climate adaptation as well as more detailed briefs describing some of the most common methods. All the policy briefs can be found here:

<http://www.mediation-project.eu/platform/pbs/home.html>

- Webb and Beh undertook a review of decision support tools. Use this to find tools that will work for your organisation:

http://www.nccarf.edu.au/sites/default/files/attached_files_publications/Webb_2013_Leading_adaptation_practices_support.pdf

- An example of evaluating adaptation options with a quick cost-benefit risk tool

Hobday, A. J., Chambers, L. E., Arnould, J. P. Y., Patterson, T. A., Wilcox, C., Tuck, G. N. & Thomson, R. B. 2013 Developing adaptation options for seabirds and marine mammals impacted by climate change. Final Report. FRDC-DCCEE Marine National Adaptation Research Project 2011/0533.

- A decision-making framework for groundwater dependent ecosystems

Chambers et al. 2013. Adapting to climate change: A risk assessment and decision making framework for managing groundwater dependent ecosystems with declining water levels.

<http://www.nccarf.edu.au/publications/guidelines-risk-assessment-managing-groundwater-climate>

- A decision-making process using expert review in Murray Basin CMAs
Lukasiewicz, A, et al. 2013. Identifying low risk climate change adaptation in catchment management while avoiding unintended consequences, NCCARF, Gold Coast.
http://www.nccarf.edu.au/sites/default/files/attached_files_publications/Lukasiewicz_2013_Low_risk_climate_change.pdf

MONITORING AND EVALUATION TOOLS

- The UKCIP has undertaken a review of monitoring and evaluation tools for climate change adaptation:
<http://www.ukcip.org.uk/wordpress/wp-content/PDFs/SEA-change-UKCIP-MandE-review.pdf>
Included is their “AdaptME toolkit”:
<http://www.ukcip.org.uk/wizard/adaptme-toolkit/>
- A webinar produced by the Sea Change organisation also reviews monitoring and evaluation tools:
<http://www.seachangecop.org/node/1480>
- You may like to undertake a performance review to measure the success of your planning and implementation:
<http://www.ukcip.org.uk/wizard/adaptme-toolkit/measuring-performance/>
- The Climate Change Adaptation Navigator developed by the Victorian Centre for Climate Change Adaptation Research (VCCCAR) highlights some of the same aspects of planning that this checklist does. The Adaptation Navigator could be used as a companion approach to this checklist, with one used to develop your initial planning approaches and the other used to check and reflect on them:
<http://www.adaptation-navigator.org.au/>
- Information on the use of triggers and thresholds for climate adaptation planning can be found at:
http://www.hccrems.com.au/RESOURCES/Library/ClimateChange/HCCREMS_Literature-Review-and-Consultation-Paper.aspx
Note that this document outlines an adaptation framework that is different to, but consistent with what we describe in this guideline.

CASE STUDIES

- Example of a detailed assessment process for a specific issue - weed risk:
Hughes, L, Downey, P, Englert Duursma, D, Gallagher, R, Johnson, S, Leishman, M, Roger, E, Smith, P & Steel, J 2013, *Prioritising naturalised plant species for threat assessment: Developing a decision tool for managers*, National Climate Change Adaptation Research Facility, Gold Coast.
- Visioning a range of impacts to help plan adapted landscapes (case studies from SA)
Meyer, W 2013, *Adapted future landscapes - User guide*, National Climate Change Adaptation Research Facility, Gold Coast, 19 pp.
Meyer, W, Bryan, B, Lyle, G, McLean, J, Moon, T, Siebentritt, M, Summers, D & Wells, S 2013, *Adapted future landscapes – from aspiration to implementation*, National Climate Change Adaptation Research Facility, Gold Coast.
- Example of using experts to develop spatially-explicit scenarios of land-use change for multiple future climates that integrate direct and indirect impacts and the ability of systems to absorb them:
Doerr, VAJ, Williams, KJ, Drielsma, M, Doerr, ED, Davies, MJ, Love, J, Langston, A, Low Choy, S, Manion, G, Cawsey, EM, McGinness, HM, Jovanovic, T, Crawford, D, Austin, M & Ferrier, S 2013, *Designing landscapes for biodiversity under climate change: Final report*, National Climate Change Adaptation Research Facility, Gold Coast.
- Case study of alternative futures for a coastal community:
Morley, P, Trammell, EJ, Reeve, I, McNeill, J, Brunckhorst, D & Bassett, S 2012, *Past, present and future landscapes: Understanding alternative futures for climate change adaptation of coastal settlements and communities*, National Climate Change Adaptation Research Facility, Gold Coast 157 pp.
- Case study describing the advantages of having high adaptive capacity:
Marshall NA, Park S, Howden SM, Dowd AB, Jakku ES (2013) *Climate change awareness is associated with enhanced adaptive capacity*. *Agricultural Systems* 117:30-34. doi:DOI 10.1016/j.agsy.2013.01.003
- A case study example describing why adaptive capacity surrounding use of technology is important to develop in adapting to climate change
Marshall NA, Gordon IJ, Ash AJ (2011) The reluctance of resource-users to adopt seasonal climate forecasts to enhance resilience to climate variability on the rangelands. *Climatic Change* 107 (3-4):511-529. DOI 10.1007/s10584-010-9962-y
- A case study of using a 'decision relevant' approach that enables local government officers to make use of scarce resources more efficiently to manage short term and longer term economic impacts of coastal hazards. The approach sought to protect assets at risk whose value exceeded the costs of protection, by strategically retreating elsewhere
Travers, A, Rissik, D & Reis, N 2013, , *Climate Change Adaptation Good Practice – Case Study: Developing Flexible Adaptation Pathways for the Peron Naturaliste Coastal Region of Western Australia 2011 - 2012*, National Climate Change Adaptation Research Facility, Gold Coast, 8 pp
<http://www.nccarf.edu.au/localgov/case-study/developing-flexible-adaptation-pathways-peron-naturaliste-coastal-region-western>

ABOUT ADAPT NRM

The National AdaptNRM Impacts and Adaptation Project is a multidisciplinary endeavour that brings together a diverse group of scientists working with NRM practitioners.

While the project itself consists of researchers from CSIRO and NCCARF, our output and initiatives have been shaped and informed through the generous input of

NRM practitioners across Australia as well as a multitude of researchers, state and federal government stakeholders.

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Australia is founding its future on science and innovation. Its national science agency, CSIRO, is a powerhouse of ideas, technologies and skills for building prosperity, growth, health and sustainability. It serves governments, industries, business and communities across the nation.

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