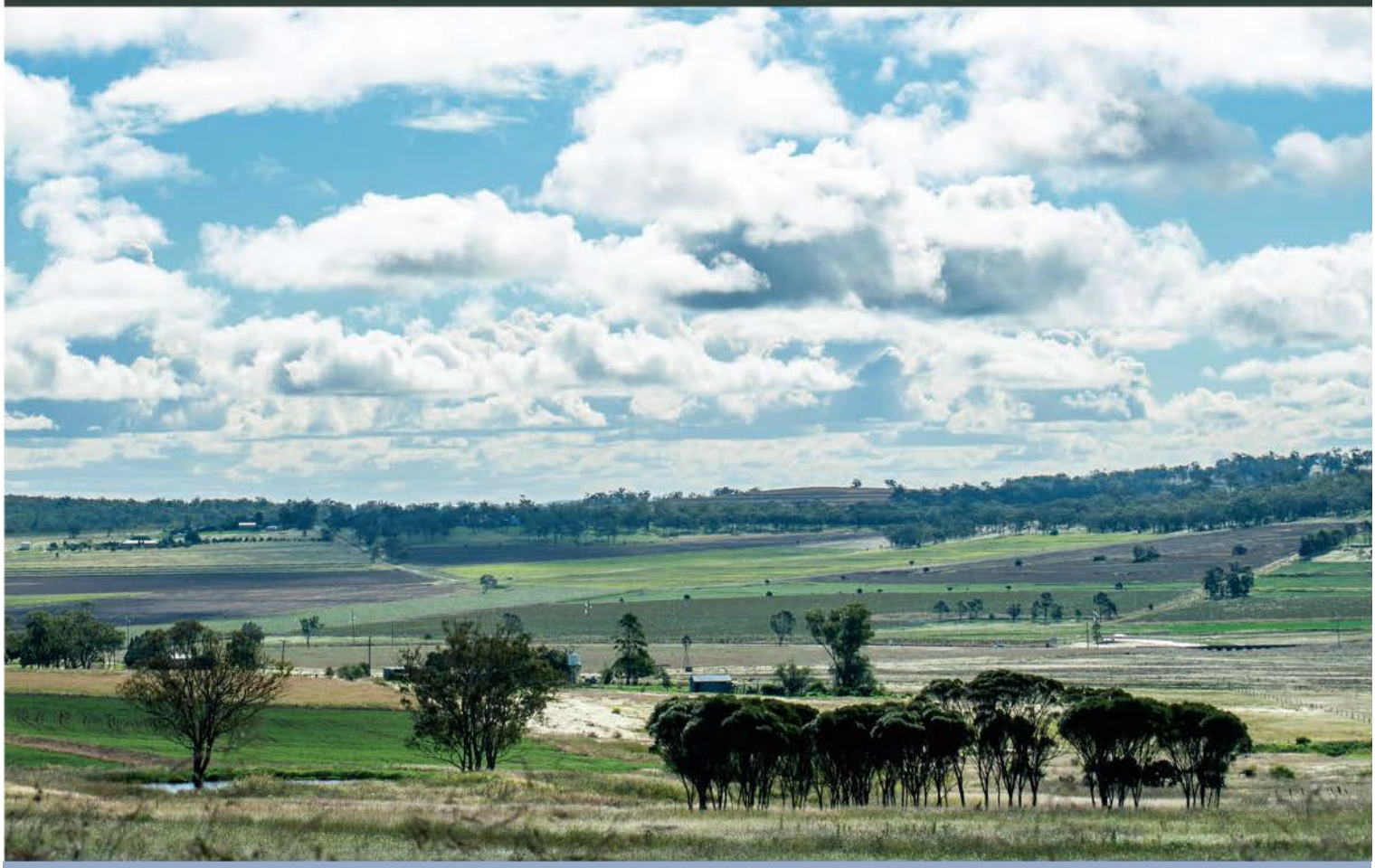
EAST COAST
NRM CLUSTER

CLIMATE CHANGE IN AUSTRALIA

IMPACTS & ADAPTATION
INFORMATION
FOR AUSTRALIA'S NRM REGIONS



ADAPTATION PATHWAYS

Background

This report has been produced as part of the Climate Change Adaptation for Natural Resource Management in East Coast Australia project. The project is being delivered by six consortium partners: University of Queensland (Consortium leader); Griffith University; University of the Sunshine Coast; CSIRO; New South Wales Office of Environment and Heritage; and Queensland Department of Science, IT, Innovation and the Arts (Queensland Herbarium) to foster and support an effective "community of practice" for climate adaptation within the East Coast Cluster regions that will increase the capacity for adaptation to climate and ocean change through enhancements in knowledge and skills, and through the establishment of long term collaborations.

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WHAT ARE ADAPTATION PATHWAYS?

Adaptation plans are developed in a context of uncertainty and change. Although we can see a need for planning to meet desired long term objectives, the prospect of multiple possible futures and uncertainties means that long term planning needs to be flexible and adaptive to change as time unfolds. Adaptation Pathways help to shape the decision-making process by allowing flexibility in planning to accommodate uncertainty, as well as allowing for more proactive rather than reactive planning (Bosomworth et al. 2015). Adaptation Pathways refers to an analytical iterative planning process that recognises there is more than one way to reach a desired future. This process involves creating a strategic vision of the future, and identifying multiple plausible sequences of actions ('pathways') to achieve long term objectives of that vision.

'Triggers' and 'tipping points' are central to adaptation pathways approaches (see Figure 1). 'Triggers', or 'signposts', refer to a pre-identified change in environmental conditions (including social conditions), or emergence of new information (Tanaka et al. 2015) that can indicate when to change to new actions or pathways (Barnett et al. 2014). Tipping points are the conditions under which an action is unable to continue to meet specified objectives. When a tipping point is met, additional actions are required and a new pathway may emerge. In this sense, adaptation pathways can be thought of as a sequence of possible actions after a tipping point, resembling decision trees or roadmaps. Each possible route taken is an adaptation pathway.

An adaptation map can be used to prepare a plan with immediate actions as well as identifying preparations that can be made in case conditions change that necessitate different actions. Adaptation pathways maps can present alternative routes (sets of actions) to get to a specified future goal (see Figure 2). Adaptation pathways maps also show moments of adaptation tipping points and available actions following a tipping point. At a tipping point, some routes may not be available, or some might be preferred by stakeholders or decision-makers over others.

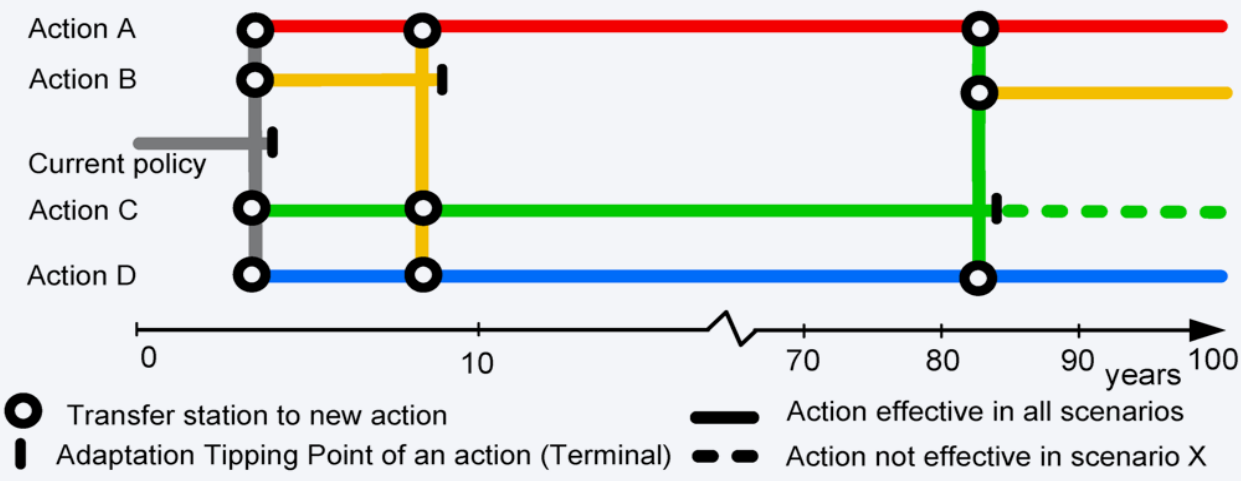

Figure 1. *Example of an adaptation pathway map (Walker et al. 2013:964)*

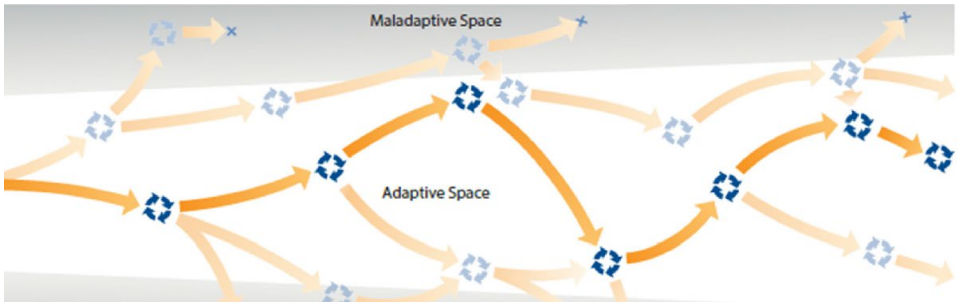

Figure 2. *Iterative Decision Cycles (from Wise et al. 2014:326)*

By exploring and sequencing potential actions based on possible future events, adaptation pathways may lead to flexible strategies that are based on consideration of an array of options, and identify when, why and how to change course (Bosomworth et al. 2015). Additionally, adaptation pathways processes can be carried out in a way that considers the potential for actions that may inadvertently 'lock in' maladaptive development trajectories, and help to consider implications of path dependency in adaptive processes, interactions between adaptation plans, and vested interests (Wise et al. 2014). Figure 2 demonstrates how a series of decisions may lead to maladaptive outcomes over time, but there may be other alternative actions that are adaptive.

Adaptation pathways approaches can be useful when there is:

- high uncertainty
- a need to facilitate adaptive management
- a need for strategic rather than reactive planning
- multiple stakeholders engaging in dialogue, and shared learning and decision-making processes
- potential for undesirable or maladaptive actions
- a need for commitment to short term actions, while maintaining flexibility in planning.

THE ADAPTATION PATHWAYS PROCESS

The Adaptation pathways process is cyclic. The process repeats due to the continued uncertainty and ever changing conditions. A simple 5 step process was chosen for the Climate Change Adaptation for Natural Resources Management in East Coast Australia project (see Figure 3).

1. The first stage is to define the objectives or targets, including key indicators that can be used to assess whether or not a goal has been reached. However, there is some debate about the usefulness of targets for long-term goals. Objectives may be revised, changed, or even abandoned over time.
2. A baseline of the current situation in an environmental, social and economic sense must be taken to deliver a starting point to envisage the results of a scenario without change, as well as providing the starting point to create possible futures. This includes looking at the historic drivers that have created the current conditions, and what is currently being done to solve these problems.
3. The third stage is to develop and assess possible future scenarios. These possible futures use the data gathered from stage two, as well as climate change projections, to predict the state of environmental, social and economic factors in the future. These possible scenarios can then be tested against different options to determine whether or not a particular future is desired.
4. Stage four involves developing the adaptation pathways that could be taken. Adaptation options are recognized and tested against each of the possible future scenarios for their resilience and ability to adapt to those conditions. Tipping points, turning points and triggers are also identified to determine under what circumstances a pathway becomes unviable.
5. The final stage of this process involves implementing the action plan decided upon, while continued monitoring, evaluation and reporting. Improvement and learning is important to continually reflect and update the strategies and pathways as emerging futures become clearer, whilst also planning for uncertainty beyond the scaled timeframes. In some cases, improvement and learning during this step of adaptation pathways will be more important than implementation and monitoring.

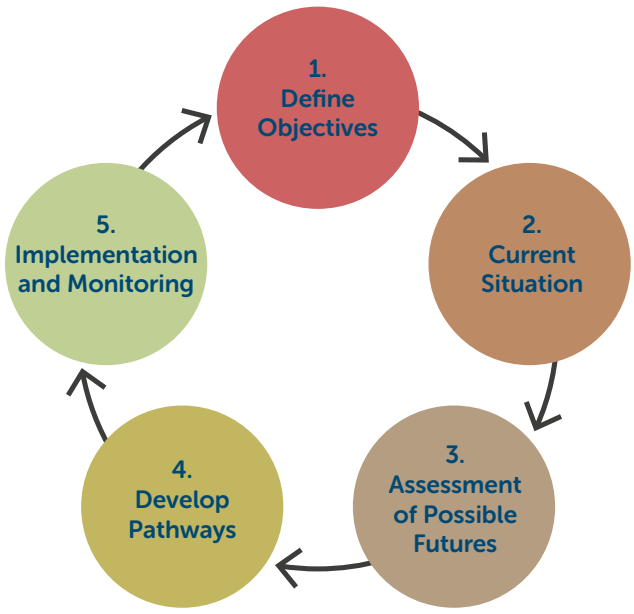

Figure 3. *The 5 steps of Adaptation Pathways*

ANOTHER APPROACH: DYNAMIC ADAPTIVE POLICY PATHWAYS

The 5 steps of adaptation pathways shown in Figure 3 is one of many approaches for adaptive policy pathways. A more detailed approach is Haasnoot et al.'s (2013) 'dynamic adaptive policy pathways' (figure 4). Haasnoot et al.'s approach involves the integration of adaptation pathways with an adaptive policy planning process. An adaptive policy planning process is used to identify different types of actions, and signposts to monitor whether adaptation is needed. Adaptation pathways are then used to explore and sequence a set of potential actions based on alternative courses of events over time.

Haasnoot et al.'s approach to dynamic adaptive policy pathways comprises 10 steps as follows:

1. Description of the study area, including objectives, uncertainties relating to the future and available information, current and potential future constraints; and specification of desired outcomes, indicators and targets to assist evaluation of actions and pathways later on.
2. Possible future situations are devised consisting of 'transient scenarios' that cover uncertainties identified in step 1, followed by consideration of opportunities and vulnerabilities.
3. A broad set of possible actions are identified that can be taken to meet desired objectives, with consideration of vulnerabilities and opportunities.
4. Possible actions are evaluated across 'transient scenarios' – a multiplicity of futures that span identified uncertainties. Adaptation tipping points, 'sell-by-dates', are identified for the actions. Vulnerabilities and opportunities are reassessed, which in some cases will trigger going back to step 3 to identify new additional actions.
5. Once the set of actions is deemed adequate, information generated in previous steps is used to assemble adaptation pathways.
6. Development of a manageable number of preferred pathways.
7. Improvement of the robustness of preferred pathways through contingency planning. Definition of actions to anticipate and prepare for in order to keep pathways aligned with desired objectives, and to enable corrective actions in case a particular action or pathway does not go as expected.
8. A dynamic adaptive plan is developed based on the results from previous steps. This plan should be able to highlight actions and decisions that need to be made right away and those that can be postponed; and should summarise targets, problems and potential and preferred pathways. Plans should specify actions to take now to keep preferred pathways open for as long as possible.
9. Immediate actions are implemented and a monitoring system is established.
10. As time passes, information relating to signposts and triggers is collected and accordingly actions are started, altered, stopped or expanded in response.

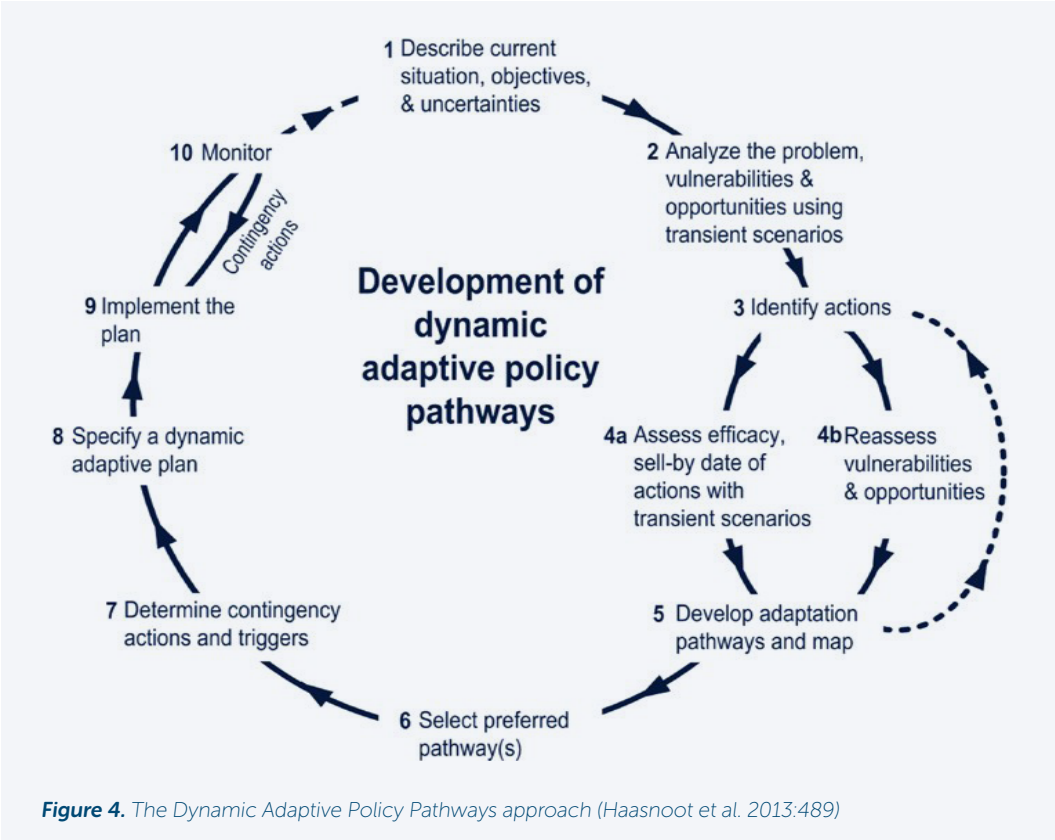

Figure 4. *The Dynamic Adaptive Policy Pathways approach (Haasnoot et al. 2013:489)*

HOW CAN ADAPTATION PATHWAYS BE USED IN NRM PLANNING?

Climate change impacts are inherently complex, leading to uncertainties. They require both long term and short term actions; concerted actions by a wide range of stakeholder groups in a context of wider change requiring flexibility in adaptation, and justify the use of adaptation pathways approaches in NRM climate change planning.

Climate change impacts can bring about numerous diverse impacts relevant to NRM, for example, impacts to key species that provide important ecosystem services such as native pollinators, seed dispersing species and pest control agents. In some places, adaptation may face physical limits due to loss of ecosystem services and interacting impacts (Werners et al. 2013). In cases where loss of ecosystem services is anticipated, the exact timing of this might be estimated with a high level of uncertainty. Meanwhile, effective NRM planning needs to ensure that when significant ecological impacts do occur, appropriate actions are taken efficiently and effectively. Additionally, there is potential for climate adaptation to be hindered by significant knowledge gaps and social questions to be addressed. NRM planning needs to be responsive to new information as it is generated while at the same time adhering to strategic goals and objectives. A pathways approach to climate adaptation allows natural resource managers to address all the challenges mentioned above by focusing on identifying thresholds and developing pathways that can be implemented under predefined circumstances (tipping points) that may include the emergence of new information, or environmental and/or social phenomena.

The capacity of important ecosystem services to continue as climate change progresses depends on the condition of important habitat and its proximity to other landuses such as farmland. Refugia habitats provide permanent or temporary protection from unsuitable conditions and enable species to survive in the long term. Identifying and protecting refugia will be an important aspect of climate change adaptation (Moran et al. 2014a). Addressing issues of shifting habitat zones, refugia, and maintaining ecosystem services, require actions that have long term implications and require strategic landscape designs (for example, enhanced connectivity and facilitated movement of key species) (Moran et al. 2014a). Long term decisions will need to be carefully considered to avoid 'locking in' maladaptive responses over time, and that also allow short term planning to occur. Pathways approaches to climate adaptation can help identify when an adaptation option or pathway may eliminate future options, and can allow NRM organisations to commit to short term actions, while developing a framework for a range of plausible future options (Bosomworth et al. 2015). Some adaptation options such as expanding irrigation infrastructure, switching crop varieties, or developing new crop varieties require both significant investment and substantial time to be developed (Tanaka et al. 2015). Pathways approaches allow planners to consider the lead time to implement an adaptation option as well as the triggers for its implementation.

NRM planning involves multiple stakeholders that can hold competing interests and divergent views relating to climate change adaptation actions. Potential for conflict between different sectors within NRM, such as agriculture, fisheries, coastal development and other sectors needs to be managed (Williams et al. 2012). A pathways approach can be useful as it can be done in a way that facilitates the incorporation of considerations of various sectors with potentially competing interests in climate adaptation planning, and identifies tradeoffs and potential conflicts across adaptation options made for different sectors or stakeholder groups (for example, the Regional Climate Change Adaptation Plan for the Eyre Peninsula). Adaptation pathways approaches can also shift the focus from debating whether or not predicted climate change impacts will occur, to dialogue on the amount of environmental change that is acceptable, and which adaptation pathways should be employed in the event that unacceptable conditions are experienced (i.e. thresholds and tipping points). This can also help to bridge the 'science policy interface' (Werners et al. 2013).

Through this process, adaptation pathways approaches can contribute to co-learning among stakeholders, including decision-makers and researchers (Bosomworth et al. 2015).

Climate change shifts the challenge for sustainable natural resource management from conservation of natural resources to enhancing resilience and adaptive capacity (Werners et al. 2013), as NRM planning is expected to keep pace with multiple changes taking place in social-ecological systems (Bosomworth et al. 2015). Many natural resource issues, such as the presence of cyanobacteria in river systems, are affected by changing climate (rainfall patterns in the case of cyanobacteria), as well as other environmental factors. Therefore climate adaptation needs to be able to encompass a range of factors affecting NRM that are not all related to climate change. An adaptation pathways approach can include readiness to a number of environmental and social changes, and can be incorporated into existing adaptation planning processes (Bosomworth et al. 2015).

Adaptation pathways can be used in NRM planning to assist in building long term decisions that meet both present and future objectives, but also allow for alterations to plans when there are inevitable changes. Through using adaptation pathways approaches, NRM organisations can develop an array of options that work reasonably well across a wide range of circumstances both now and in the future, and that assist NRM organisations to handle changes in direction in response to unforeseen events.

In addition, adaptation pathways can further complement activities and operations of NRM organisations by:

- Helping to integrate vulnerability assessments in action planning and address underlying drivers of vulnerabilities
- Providing a process of shared learning among decision-makers, researchers and other relevant stakeholders
- Facilitating dialogue regarding acceptable and unacceptable conditions and changes, possible adaptation options and pathway preferences
- Assisting the early identification of potential maladaptive actions that may result from a narrow focus, or assumptions that individual approaches or policies are 'right'.

Adaptation pathways processes can be applied by:

- NRM agencies, as well as all levels of government, to predict possible futures and to manage the policies and actions that occur so as to keep their options flexible and adapt to uncertainty
- Organisations, both local and national, to ensure their current business investments are able to adapt, as well as ensuring any future development can adapt
- Local communities, as it's also important to have a variety of stakeholders input into the process. They can add to the pathway prediction process as well as being an integral part of how the area will adapt in the future (Bosomworth et al. 2015).

EXAMPLES AND CASE STUDIES

THE PERON NATURALISTE COASTAL REGION OF WESTERN AUSTRALIA

Some regions have started to adopt adaptation pathways into their projects and policy plans. A prime example is the Developing Flexible Adaptation Pathways for the Peron Naturaliste Coastal Region of Western Australia 2011 – 2012 project.

This project was undertaken by the Peron Naturaliste Partnership consisting of 9 local governments (Bunbury, Busselton, Capel, Dardanup, Harvey, Mandurah, Murray, Rockingham and Waroona) between the capes of Peron and Naturaliste on the south-west coast of Western Australia. The region is subject to coastal inundation and erosion due to climate change.

This project was intended to be a scientifically rigorous and economically based analysis of climate change adaptation pathways for the region. A preliminary set of studies evaluated risks and impacts of sea-level rise storm events and riverine flooding under a set of sea-level and storm surge scenarios. Flexible current and future adaptation options to mitigate adverse climate change impacts were developed for a time-frame extending to 2100. The methodology used allowed decision-makers to identify assets at risk whose value exceeds the cost of protection.

The approach used also sought to allow final decision making for adaptation investments to be made closer to when they are actually needed. Exploring an emerging pathway that enables project partners to achieve intended project outcomes made it difficult to provide a prescriptive project methodology at times, as often good practice became apparent during project implementation.

This project followed three implementation phases:

1. Synthesis of coastal hazards affecting the region. This involved coastal hazard mapping upon which economic assessments of adaptation options was based. Hazard maps projected coastal inundation through a series of 'low', 'medium' and 'high' estimates of extreme water level. Hazard maps also provided estimates of which measures would provide a net economic benefit, and at what time periods;
2. A regionally-based assessment of impacts and responses, comparing current conditions with those projected for 2100. This included the calculation of a rough estimate of the cost of implementing generic adaptation measures to address erosion and coastal inundation risks at four time periods up til 2100; and
3. A locally-based assessment of impacts and responses at four case study sites. This involved identifying: land assets at risk under several climate change models, a range of feasible adaptation measures for each of the land assets at risk, and the estimated optimal year for implementing adaptation options and net benefit produced (Rissik and Reis 2013; Acil Tasman 2012).

http://peronnaturaliste.org.au/?page_id=448

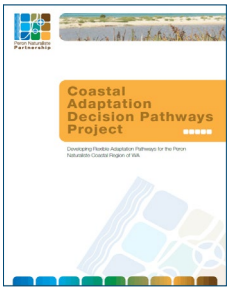

Figure 5 (left). *Coastal Adaptation Decision Pathways Project: Developing Flexible Adaptation Pathways for the Peron Naturaliste Coastal Region of WA*

Figure 6 (below). *High water levels during a flood event and coastal erosion along the Peron Naturaliste coastal region (Rissik and Reis 2013a:5)*

THE EYRE PENINSULA INTEGRATED CLIMATE CHANGE AGREEMENT COMMITTEE

The Eyre Peninsula Integrated Climate Change Agreement Committee used an adaptation pathways approach when developing their Regional Climate Change Adaptation Plan for the Eyre Peninsula. This followed a vulnerability analysis, and information to identify adaptation options which was collected by stakeholders. The Plan sought to identify key actions that affect several sectors or that are of regional importance.

Pathways were built through pre-workshop phone interviews, 3 workshops involving all main stakeholders, and post-workshop discussion papers to distil what they learnt at each step (Rissik and Boulter 2014). Pathways were developed for eight sectors (agriculture, conservation management, fisheries, roads, coastal development, peri-urban expansion, port and wharf facilities, and water resources management). These pathways were collated into a simplified regional pathway after interactions among sectors were explored with consideration to regional needs and timing of adaptation options. Special attention was given to the coordination and collaboration of cross-sectoral and regional priority actions.

As a part of this process, key decisions and their lifetimes were identified. Some adaptation options yield current benefits but are likely to cease to be effective in future. Pathway maps were developed for understanding how and when key sectors will adopt adaptation options, and for considering triggers to shifts to new actions or pathways. Some sectors, such as agriculture may require transformational responses to achieve long term adaptation, such as adopting advanced technology. Earlier planning is needed for these options and triggers for actions need to be identified.

The process of developing adaptation pathways has been deemed useful regardless of climate change, as it has assisted to develop plans that are more efficient and that yield good outcomes with reduced risk. Also, getting all the main stakeholders together – local government, industry groups and regional NRM groups etc – was an unusual and beneficial exercise (Rissik and Boulter 2014).

http://www.naturalresources.sa.gov.au/eyrepeninsula/projects-and-partners/climate-change

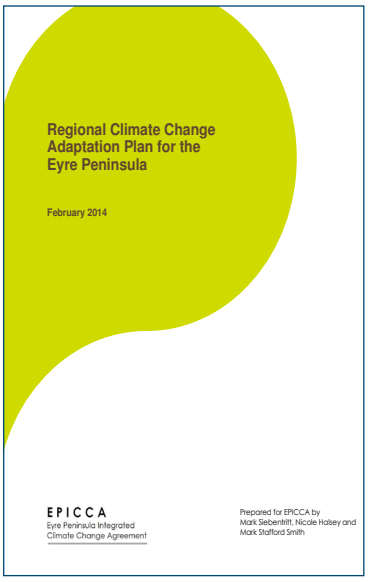

Figure 7. *EPICCA Regional Climate Change Adaptation Plan for the Eyre Peninsula, 2014*

WET TROPICS NRM CLUSTER

Adaptation pathways were identified as a key concept by the Wet Tropics NRM Cluster and guided the preparation of two reports: *Adaptation Pathways and Opportunities for the Wet Tropics NRM Cluster Region Volume 1. Introduction, Biodiversity and Ecosystem services;* and *Adaptation Pathways and Opportunities for the Wet Tropics NRM Cluster Region Volume 2. Infrastructure, Industry, Indigenous peoples, Social adaptation, Emerging planning frameworks, Evolving methodologies and Climate adaptation planning in practice*. The reports list adaptation options and issues relating to the development of adaptation pathways for the region.

An adaptation pathways approach was used with a heavy emphasis on 'co-research', collaboration between researchers and NRM organisations and participatory scenario planning. Participatory planning approaches enabled multiple stakeholders to identify adaptation pathways and options to address climate change as well as other drivers of change in the Wet Tropics region. An emphasis was put on capacity building of NRM sectors and communities so that they are flexible and have a capacity to change in response to external change, identify potential opportunities, and collaborate to generate adaptation pathways. This includes the capacity to '[build] the conditions and skills for future path generation' (Moran et al. 2014a:8).

Although biodiversity conservation has traditionally emphasised 'protection' and 'preservation' to maintain current assemblages, as environnmental change progresses the Wet Tropics NRM Cluster has instead focused on key processes that contribute to the persistence of an ecosystem, and areas that may serve as future habitat refugia. Models of likely changes in habitat can highlight areas that may provide future refugia (Moran et al. 2014a).

Also, environmental or ecological conditions were sought to be used as 'tipping points' that indicate the limitations of current management practices, and the points at which change is required. However, it was acknowledged that multiple drivers, feedbacks and time-lag effects can sometimes make it difficult to know which are suitable sign posts, tipping points and triggers to use in climate change adaptation pathways aimed at managing ecological systems (Werners et al. 2013; Moran et al. 2014a).

https://terranova.org.au/repository/adaptation-pathways-and-opportunities-for-the-wet-tropics-nrm-cluster-region-volume-1-introduction-biodiversity-and-ecosystem-services

THE HUNTER AND CENTRAL COAST REGIONAL ENVIRONMENT MANAGEMENT STRATEGY (HCCREMS)

The Hunter and Central Coast Regional Environment Management Strategy (HCCREMS) devised an adaptation pathway process for coastal adaptation to climate change. This process was developed to assist with the assessment and planning for existing and new landuse development and infrastructure in vulnerable coastal areas. The main steps in the process used in the Hunter and Central Coast Region were:

- Defining the issue
- Identifying priority vulnerable locations and indicators that can be used to measure vulnerability. This included consideration of possible changes in indicators over time
- Determining roles and responsibilities
- Establishing policy objectives (to clarify policy goals)
- Identifying adaptation options. This included identifying how long implementation of each adaptation option will take
- Assessment of options designed to reach policy objectives
- Establishing trigger points or thresholds for implementing options. These triggers can relate to biophysical thresholds (such as inundations levels, coastal recession lines etc) as well as time-based thresholds (such as timelines: 2030, 2050, 2100 etc). Where biophysical thresholds are used, well-defined thresholds are needed that distinguish between recurring events (such as flooding associated with storm tides) and one-off events (such as coastal erosion and permanent coastal inundation)
- Implementing and monitoring the preferred options.

Structured frameworks for assessing identified options, and for deriving trigger points for implementation of adaptation options were developed based on a literature review. The frameworks focused on incorporation of risk and flexibility of response under changing circumstances. Decision-making triggers are used to prompt certain management responses and/or implementation of predefined options. Trigger points allowed strategies to be adjustable and flexible. Decision-making triggers also help to monitor progress, informing implementation timelines for identified adaptation pathways.

http://www.hccrems.com.au/

http://hccrems.com.au.svr1.tempdomain.com.au/hccrems/media/RESOURCES/Climate%20Change/Background-Discussion-Paper_1.pdf

A PROPOSED LOCAL PATHWAY FOR LAKES ENTRANCE, VICTORIA

A proposed local adaptation plan for Lakes Entrance sought to use an adaptation pathways approach to adapt to sea-level rise. Prevailing approaches to adaptation involved development restrictions that were opposed by many local residents.

The proposed adaptation plan used pathway triggers that were grounded in socially salient local experiences that are meaningful for a wide range of stakeholder groups regardless of their views about climate change (Barnett et al. 2014). For example, local residents with differing views on climate change agreed that if/when inundation occurs more than five times a year on the Entrance Esplanade this justifies the initiation of several prepared policies and measures. These related to communications, flood defences, critical infrastructure and preparation for relocation. By grounding triggers in local experiences and values, Barnett et al. (2014) argue that it is easier to develop consensus around risk management in adaptation pathways approaches.

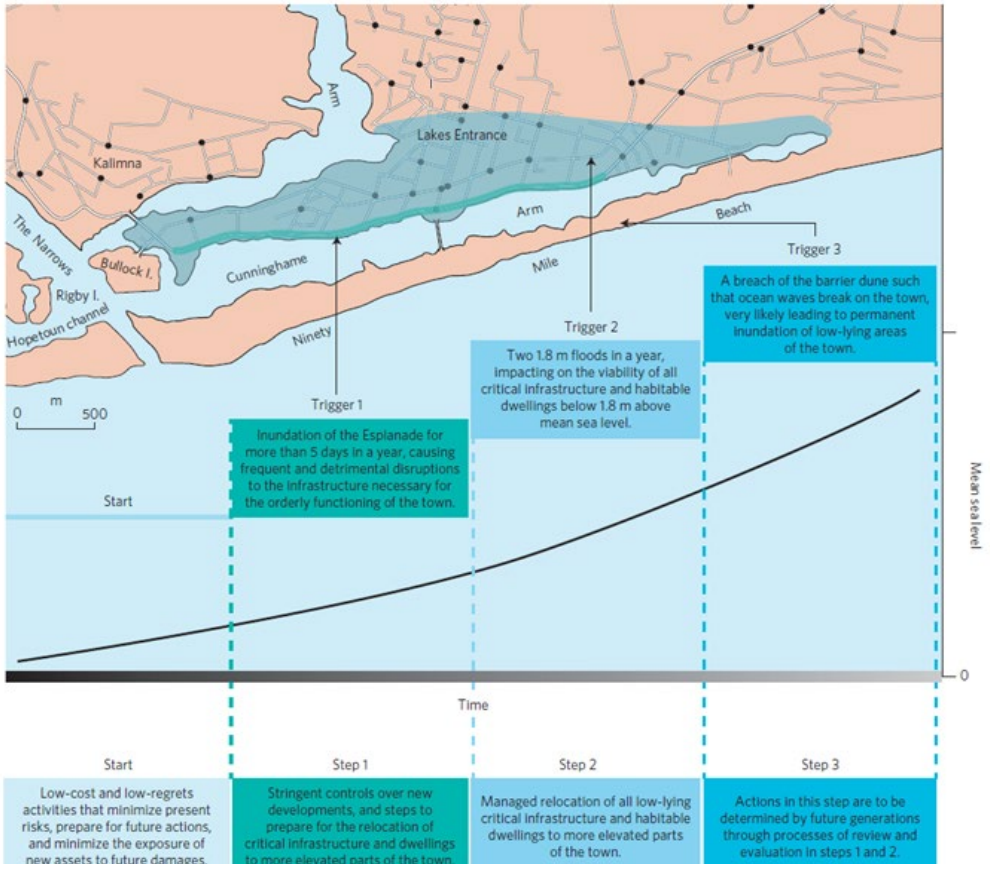

Figure 8. *Key parts of the proposed local adaptation pathway for Lakes Entrance, showing the sequence of triggers, and the policy actions they activate (Barnett et al. 2014:1104)*

THE TASMANIAN COASTAL CLIMATE ADAPTATION PATHWAYS (TCAP) PROJECT

An adaptation pathways approach was used when determining how to manage coastal areas vulnerable to sea-level rise through the TCAP Project. The project was carried out initially for four local councils in Tasmania: the Clarence City Council, Break O'Day Council, Kingborough Council and Latrobe Council. A flexible planning pathway was sought to take into consideration local factors such as topography, coastline features, and community perspectives. It also sought to increase community awareness and incorporate issues of community values as well as local risks.

The process started with hazard mapping and risk assessment for areas vulnerable to sea-level rise, coastal inundation and erosion. This included assessing assets at risk, potential courses of action and associated cost. Each local council had a focus area that was studied in detail. Following hazard mapping, preliminary potential adaptation options for local areas were identified. Risk assessments produced likely future outcomes under different adaptation options and adaptation pathways for sea-level rise.

A number of different adaptation options and pathways for climate change adaptation were developed and costed. Short term protection works in hazard areas were implemented as necessary. Community members then considered the adaptation options particularly relevant to their local area in community workshops. During workshops community members were asked questions like: "is this pathway a plausible scenario? Could it be made to happen, and if so, what would be required". Community members were also asked questions relating to adaptation options in the face of other identified drivers of change, and relating to the governance and implementation of adaptation options.

Community members were presented with several adaptation pathways tailored to vulnerable sites in their local area. They identified a preferred pathway for adaptation for each area, considering local environmental values and possible risks associated with each adaptation pathway.

https://www.nccarf.edu.au/localgov/sites/nccarf.edu.au.localgov/files/casestudies/pdf/Case%20Study_Tasmanian%20Climate%20Change%20Adaptation%20Pathways%20Project.pdf

http://www.lgat.tas.gov.au/page.aspx?u=641

http://www.ccc.tas.gov.au/webdata/resources/files/Attwater_-_Lauderdale_Scenario_Planning_Summary_Final_120308.pdf

http://www.bodc.tas.gov.au/sites/all/files/breakoday/documents/resources/final_tcap_georges_bay_report.pdf

Figure 9. *Break O'Day Council 2012*

TOOLS AND RESOURCES

Adapt NRM's "The NRM Adaptation Checklist: Supporting climate adaption planning and decision making for Regional NRM".

http://adaptnrm.csiro.au/wp-content/uploads/2014/06/AdaptNRM-Adapt-Planning-Tech-Guide1.pdf

Southern Slopes Climate Change Adaptation Research Partnership (SCARP)'s "Adaptation Pathways: a playbook for developing robust options for climate change adaptation in Natural Resource Management".

http://www.researchgate.net/publication/272158438_Adaptation_Pathways_a_playbook_for_developing_robust_options_for_climate_change_adaptation_in_Natural_Resource_Management._%28Southern_Slopes_Climate_Change_Adaptation_Research_Partnership%29

Figure 10. *1974 flood in Lauderdale, Clarence City Council (Rissik and Reis 2013b:5)*

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