A topographic map of the East Coast of Australia, showing the coastline and inland terrain. The map uses a color gradient where green represents lower elevations and purple/brown represents higher elevations, highlighting the mountainous interior. The map is oriented vertically, with the coastline on the right side.

Analysis of the Needs of the East Coast Cluster Regional Natural Resource Management Bodies in Relation to Planning for Climate Change Adaptation

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Report for the Climate Change
Adaptation for Natural Resource
Management in East Coast
Australia Project
May 2013

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Executive Summary

The Climate Change Adaptation for Natural Resource Management (NRM) in East Coast Australia Project aims to foster and support an effective “community of practice” for climate change adaptation within the East Coast Cluster NRM regions that will increase the capacity for adaptation to climate change through enhancements in knowledge and skills and through the establishment of long-term collaborations. It is being delivered by six consortium research partners:

- The University of Queensland (project lead)
- Griffith University
- University of the Sunshine Coast
- CSIRO
- New South Wales Office of Environment and Heritage
- Queensland Department of Science, IT, Innovation and the Arts (Queensland Herbarium).

The project relates to the East Coast Cluster, comprising the six coastal NRM regions and regional bodies between Rockhampton and Sydney:

- Fitzroy Basin Association (FBA)
- Burnett-Mary Regional Group (BMRG)
- SEQ Catchments (SEQC)
- Northern Rivers Catchment Management Authority (CMA) (NRCMA)
- Hunter-Central Rivers CMA (HCRCMA)
- Hawkesbury Nepean CMA (HNCMA).

The aims of this report are to summarise the needs of the regional bodies in relation to NRM planning for climate change adaptation, and provide a basis for developing the detailed work plan for the research consortium.

Two primary methods were used to identify the needs of the regional bodies: (1) document analysis of the existing NRM/ Catchment Action Plans (CAPs) and applications by the regional bodies for funding under Stream 1 of the Regional NRM Planning for Climate Change Fund; and (2) a needs analysis workshop, held in May 2013 involving representatives from the research consortium partners and the regional bodies.

The East Coast Cluster includes five of the ten largest significant urban areas in Australia, world heritage listed natural environments, significant agriculture, mining and extensive grazing. The three NSW CMAs have recently completed strategic level CAPs, with implementation plans to be finalised in 2014/2015. SEQC and FBA are beginning a review of their existing NRM Plans, to be completed in 2014 and 2015 respectively; while BMRG is aiming to produce a NRM and Climate Variability Action Strategy. The regional bodies will receive funding from the Australian Government through the Regional NRM Planning for Climate Change Fund (NRM Fund) to improve regional planning for climate change and help guide the location of carbon and biodiversity activities, including wildlife corridors. The bulk of the funding will be available for activities in 2013/2014, with smaller amounts available in subsequent years. Most regional bodies aim to have a large proportion of the planning work complete by the end of 2014. In addition, NSW CMAs are undergoing major structural change and will be incorporated into semi-autonomous statutory Local Land Services bodies from 2014. Boundaries will align with local government boundaries and there will be significant change in staff and structures.

The regional bodies in the cluster have a varying degree of climate knowledge. All plans recognise climate change as a key driver of change, but there are few specific actions or targets addressing climate change. Regional bodies also have varying capacity to analyse large volumes of spatial or modelling data. Due to the complex nature of natural resource management, all regional bodies work with key stakeholders (e.g. local government, industry groups, and community groups) to deliver NRM outcomes. Regional bodies therefore require project outputs that can be used directly in stakeholder engagement activities, and are likely to require some form of capacity building associated with each of the outputs to maximise uptake.

Some of the immediate needs of the regional bodies are a summary of information or tools that are able to be used immediately; and a summary of the key outputs and milestone dates for the project, to facilitate alignment of planning activities with research outputs.

A project framework is useful to show the linkages between research elements and the relevance of the research to the adaptive management cycle for NRM planning in which the regional bodies are engaged. A draft framework is proposed to stimulate and promote discussion on research elements and linkages; this will be refined during and following the development of the detailed project work plan. The regional bodies strongly emphasised the need to incorporate a shift to a systems based resilience approach to NRM planning, and that approach is included in the framework.

The regional bodies identified that information on climate projections would be most useful at regional and sub-regional scale, to feed into scenario planning and impact analysis. Outputs should be 'engagement ready' and there is a need for capacity building to enable regional bodies to understand and use the projections in stakeholder engagement.

There was interest in understanding the impacts of climate change projections on ecosystems (e.g. ecosystem shift), and the consequent impacts on the production of ecosystem services. It was emphasised that any modelling should be able to be used by the regional bodies with their stakeholders to allow for community input (i.e. no black box models).

The online regrowth benefits tool was of great interest to the regional bodies, as spatial mapping of carbon farming opportunities would be relevant to their funding requirements. The NSW CMAs identified an interest in development of the tool for NSW vegetation types.

Needs relating to socio-economic information included understanding the socio-economic determinants of carbon farming uptake and managing community expectations. A need was also identified to understand the vulnerability of industry groups as well as community to climate change impacts, and in particular understanding how changes in the flow of ecosystem services would interact with the vulnerability of these groups to impact on the linked ecological-socio-economic system. Responses to disasters (particularly flooding and storm surge) and recovery responses were also identified as being of interest.

An ecosystem services framework was highlighted as a useful approach to synthesising biophysical and socio-economic information in the context of a systems based, resilience approach to NRM planning. A need was identified to develop processes to move towards such an approach to NRM planning from the current asset management approach. Examples of best practice in incorporating climate science into planning, using scenarios for stakeholder engagement in planning and processes for institutionalising learning were also identified as cross-cutting needs.

The over-arching theme identified was the need for capacity building for the NRM bodies to best use the information available at any point in time. To this end a planners working group has been established to support the building of a network of informed and articulate NRM agents with knowledge of current climate science and capacity to use current tools to engage stakeholders in NRM planning for climate change adaptation. The planners working group would form the core group of the community of practice, with the broader group of stakeholders participating when activities aligned with their interests. In this way, it is anticipated that the Project will contribute to building capacity within the wider community to effectively plan for climate change adaptation.

1. Introduction

1.1. Project background

This report has been produced as part of the Climate Change Adaptation for Natural Resource Management (NRM) in East Coast Australia Project (the Project). The Project is being delivered by six consortium partners: the 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).

The Project is funded by the Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (the Department) as part of the Clean Energy Future Land Sector Package. The Regional NRM Planning for Climate Change Fund (NRM Fund) has been established as one of the Land Sector Measures to provide \$43.9 million over four financial years to improve regional planning for climate change and help guide the location of biodiversity and carbon plantings, maximise biodiversity outcomes and increase adaptation to a changing climate. The NRM Fund is being provided in two streams. Stream 1 is supporting the 54 regional NRM organisations to upgrade existing regional NRM plans to help identify where in the landscape adaptation and mitigation activities should be undertaken. Stream 2 is providing for coordination of research to produce regional level climate change information to support medium term regional NRM and land use planning. Stream 2 is being delivered through two elements:

- Element 1 is delivering regional climate projections for the whole of Australia. The projections will focus on the elements of climate change of highest priority to NRM groups.
- Element 2 is providing funding over four financial years for research institutions to work with regional NRM organisations to deliver information on climate change, its impacts and potential adaptation responses, and provide guidance on how to use that information in NRM planning through the NRM Climate Change Impacts and Adaptation Research Grants Program (Impacts and Adaptation Grants Program).

This Project is funded as part of the Impacts and Adaptation Grants Program (Australian Government Department of Industry Innovation Climate Change Science Research and Tertiary Education 2013). The objective of the Impacts and Adaptation Grants Program is to improve the capacity of regional NRM organisations to plan for climate change, by:

- improving the quality and accessibility of regionally relevant information on climate change impacts and potential adaptation responses
- providing regional NRM organisations with access to expert advice on how to apply climate change information in their planning
- encouraging the integration of local knowledge and experience into understanding of climate change impacts, opportunities and potential adaptation responses
- assisting regional NRM bodies to plan for the biodiversity impacts of climate change and capitalise on the opportunities provided by the Carbon Farming Initiative (CFI) and the Biodiversity Fund.

For delivery of Stream 2 of the NRM Fund, the 54 regional NRM organisations in Australia have been divided into eight clusters. This project relates to the East Coast Cluster, which comprises the six coastal regional bodies between Rockhampton and Sydney (Figure 1):

- Fitzroy region: Fitzroy Basin Association (FBA)
- Burnett-Mary region: Burnett-Mary Regional Group (BMRG)
- South East Queensland region: SEQ Catchments (SEQC)
- Northern Rivers region: Northern Rivers Catchment Management Authority (CMA) (NRCMA) / North Coast Local Land Services (LLS)
- Hunter-Central Rivers region: Hunter-Central Rivers CMA (HCRCA) / Hunter LLS
- Hawkesbury Nepean: Hawkesbury Nepean CMA (HNCMA) / Greater Sydney LLS.

The NSW CMAs will transition to Local Land Services (LLS) in 2014. The LLS boundaries are also shown in Figure 1.

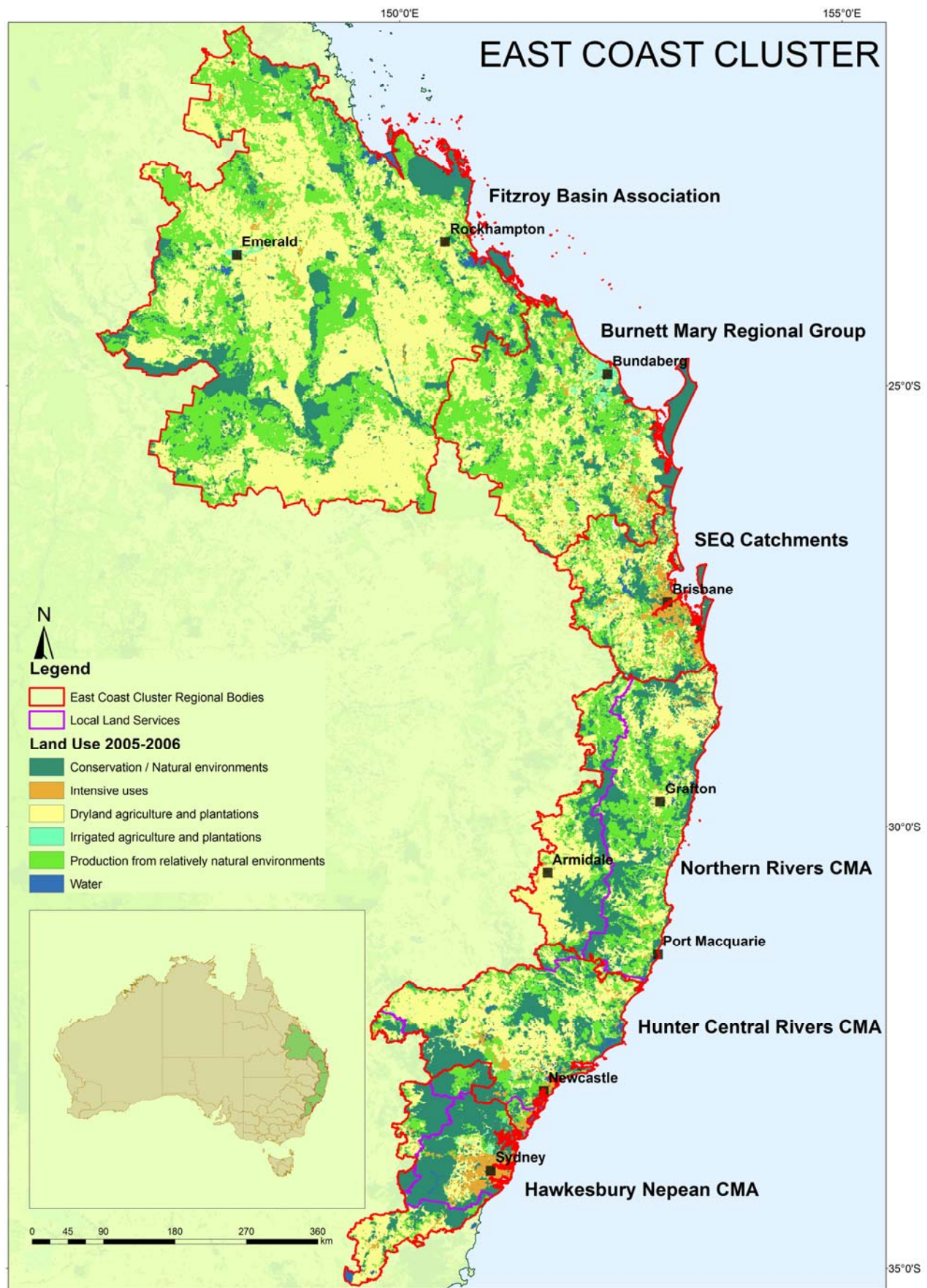


Figure 1 East Coast Cluster regions showing 2005-2006 land use

Landuse data source: Australian Bureau of Agricultural and Resource Economics and Sciences (2011)

1.2. Project aims and scope

The Project aims to foster and support an effective “community of practice” for climate adaptation within the East Coast Cluster NRM regions that will increase the capacity for adaptation to climate change through enhancements in knowledge and skills and through the establishment of long term collaborations. The Project will:

- engage with the East Coast Cluster to determine their climate adaptation needs over the range of biophysical and socio-economic conditions in the region
- collaborate in identifying a range of existing data, assessments, tools and processes suited to enhance adaptation over a wide range of regional contexts (catchment, rural, peri-urban, coastal, urban)
- support the regional bodies in the interpretation, translation, synthesis, and use of climate projections and its use in planning and decision making for NRM investment
- develop a whole-system framework to enable climate vulnerability assessments under a range of scenarios and projections that incorporate biophysical and socio-economic components
- facilitate dialogue to mainstream climate change adaptation within the Cluster, and jointly deliberate over options for planning and decision support.

A summary of the project is provided in Appendix A.

1.3. Project governance

A project reference group (PRG), comprising a lead researcher from each of the consortium partners and Chief Executive Officers (CEOs) or General Managers of East Coast Cluster regional bodies provides oversight of the project. The PRG will provide overarching guidance for the Project, facilitate communication among groups and provide feedback on project activities. A Planners Working Group (PWG) has also been established to facilitate the adoption of project outputs and outcomes by the regional bodies (discussed further in Section 5.1.3). A diagram showing the project governance structure is given in Figure 2.

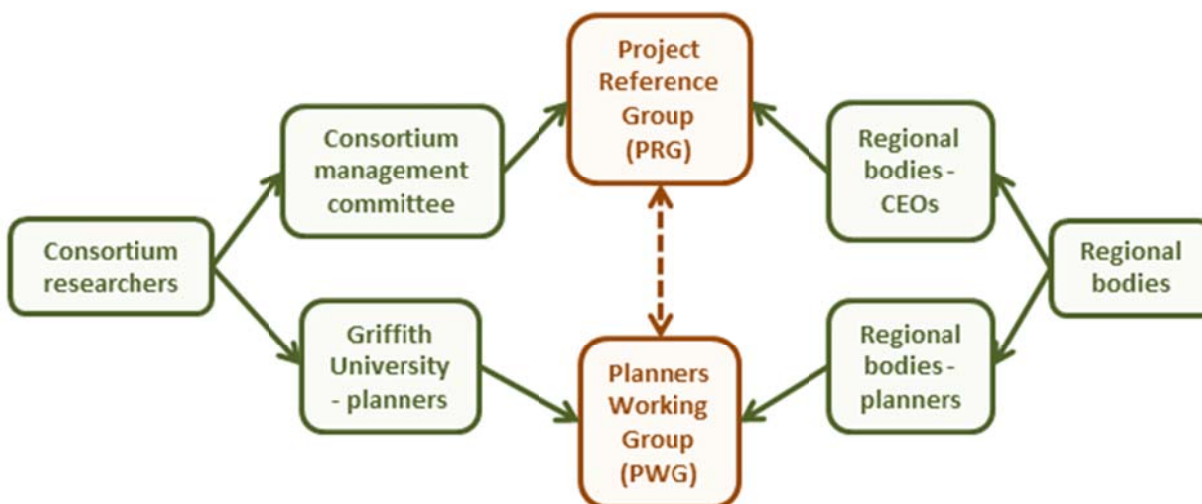


Figure 2 Governance structure for the Project.

1.4. Purpose of this document

The first component of the Project is an analysis of the needs and requirements of the regional bodies in relation to NRM planning for climate change adaptation. This component of the Project is being led by Griffith University. This document forms the first milestone for the Project. The purposes of the document are to provide:

- a project progress report to meet the first project milestone
- feedback to the workshop participants on the outcomes of the first workshop
- an opportunity for the regional bodies to clarify their needs in relation to NRM planning for climate change adaptation
- information to the consortium research partners on the needs of the regional bodies to inform the development of their project plan

- a platform for project participants to develop a shared understanding of the current state of NRM planning in relation to climate change adaptation, the decision points over the life of the project, and the timing and format of outputs required to inform those decisions.

1.5. Report structure

This report is structured in five parts following this introduction. The first part presents an overview of the evolution of NRM planning in the Australian context. The second part outlines the methodology applied by the Griffith University team to undertake the needs analysis of regional bodies in relation to NRM planning for climate change adaptation, including document analysis and stakeholder workshop. The third part presents the results that informed the needs analysis in two sections: section one summarises general information related to all six regional bodies that comprise the East Coast Cluster, and section two provides key findings that emerged from the stakeholder workshop. The fourth part discusses the implications for NRM planning for climate change adaptation based on key findings elicited by the needs analysis. The report concludes by outlining a proposed framework for integrating the project elements, highlighting the over-arching need of capacity building for the regional bodies, and identifying the next steps in the development of the Project.

2. Overview of NRM planning in Australia

Regional NRM arrangements were progressively introduced in Australia from the 1990s. From 2001 onwards, formally negotiated Commonwealth-State agreements spearheaded reforms for the delivery of community-based NRM. Under these agreements, regional bodies (groups that could demonstrably represent the community) were designated by State and Commonwealth governments to engage the community in the development and implementation of regional NRM plans and deliver effective natural resource programs (Paton et al. 2004). A key objective of the NRM planning processes was to secure regional consensus across a range of natural and community targets and priorities. Targets were scientifically informed but regionally negotiated. NRM plans were built around nationally consistent targets, with the flexibility to address regional priorities and they formed the basis for investment in strategic actions from government, philanthropic, community and the private sectors. As Figure 3 shows, there are 54 NRM regions in Australia.

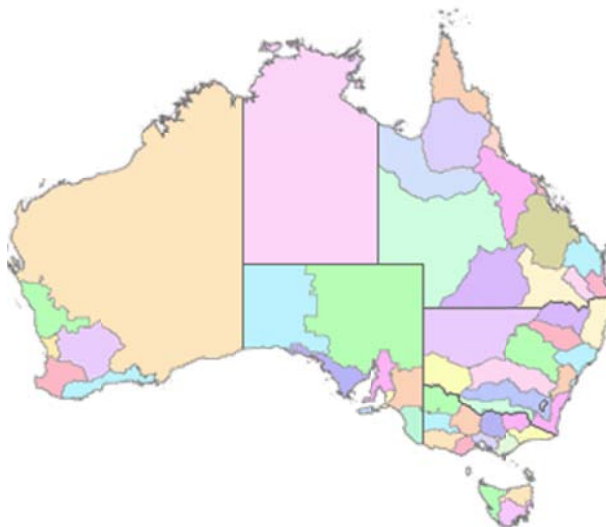


Figure 3 Australia's 54 NRM Regions, each supported by a Regional NRM body

NRM operates differently across the East Coast Cluster. Regions have different institutional foundations and capacities and plans are at different stages of development particularly in dealing with climate change. Regional bodies in Queensland are community-based, non-statutory NRM groups. These groups prepare community-based NRM plans and funding to implement the plan is sourced from the Queensland and Australian Governments, industry and philanthropic sources. Queensland's regional bodies are generally still working from their first generation NRM plans (developed around 2001), but many regions have progressed significant or partial updates to meet regionally-oriented priorities within available resources. For example, in SEQ the plan is aligned to the statutory regional land use planning process. Several NRM plans have begun to focus on climate change adaptation, improved definitions of practices and spatial mapping. Queensland's emerging NRM policy framework envisages an enhanced role for regional NRM plans and particularly their effective integration with statutory regional land use planning.

In NSW, NRM regions are statutory, catchment-based management authorities (CMAs). CMAs prepare a catchment action plan (CAP) and an investment strategy. CMA's implement incentive programs through funding provided by the NSW and The Australian Governments. The *Catchment Management Authorities Act 2003* and *Natural Resources Commission Act 2003* provide power to directly collect funds via levies that are held in the NSW Sustainability Trust. NSW has made good progress on the development of its next generation plans (CAPs), being the first spatially based NRM plans produced. A strong resilience focus underpins these statutory plans and their state-wide quality is actively supported and monitored by the NSW Natural Resources Commission (NRC). NSW Government is presently undertaking a major reform of CMAs and transitioning these organisations into semi-autonomous statutory Local Land Services (LLS) governed by local boards, with strong local action, biosecurity, emergency response and agricultural extension mandates (Dale et al. 2013, Vella et al. submitted).

3. Methodology

The Griffith University team adopted a mixed-methods approach to undertake the needs analysis, including a document analysis and a two-day stakeholder workshop. These are detailed below.

3.1. Document analysis

The document analysis was informed by the assessment of the following secondary sources:

- NRM plans and Catchment Action Plans (CAPs), and Regional Investment Strategies (RISs) (where available) for the Cluster regions
- applications for Stream 1 funding made by the regional bodies
- information on regional bodies' capacity and requirements in relation to program objectives, as compiled by the regional body planners.

The regional NRM plans, CAPs and investment strategies (where available) for each of the regional bodies (Fitzroy Basin Association 2002, Queensland Department of Environment and Resource Management 2009, SEQ Catchments 2010, Burnett Mary Regional Group 2012, Hawkesbury–Nepean CMA 2013, Hunter-Central Rivers CMA 2013, Northern Rivers CMA 2013) were analysed to identify any targets, actions or background work that would be relevant to climate change adaptation.

The applications for stream 1 funding (Burnett Mary Regional Group 2013, Fitzroy Basin Association 2013, Hawkesbury Nepean CMA 2013, Hunter-Central Rivers CMA 2013, Northern Rivers CMA 2013, SEQ Catchments 2013) were reviewed for several features of existing and proposed NRM planning, including:

- the extent to which the current plan deals with climate change
- activities required to update the plans
- relevant existing projects
- relevant tools and data
- engagement with community and stakeholders
- end product(s) of the review
- evaluation of the review and performance indicators.

As one of the initial stages in project initiation, the planners from the regional bodies considered their capacities and requirements in relation to the stated objectives of the Impacts and Adaptation Grants Program. FBA, BMRG, SEQC and NRCMA responded to questions circulated by the cluster representative from SEQC (Davidson 2013). This information was incorporated in the review of existing capacity in relation to climate change adaptation and in the summary of needs and requirements.

3.2. Needs analysis workshop

A two-day workshop was convened to identify the needs of the regional bodies in relation to NRM planning for climate change adaptation. The agenda for the workshop (Appendix B) was discussed and approved by the PRG. The workshop was held in Brisbane on the 13-14 May 2013. This was the first time the Consortium partners and regional bodies had met as a group. Most regional bodies had one representative at the workshop; two representatives were present from HCRCMA on both days and spatial analysts from SEQC attended on the afternoon of the first day. The Consortium partners were represented by one researcher from each organisation on the first day of the workshop. Cluster liaison researchers from the national projections project and the national communication project also attended the first day. A summary of the workshop attendance is provided at Appendix C.

The discussions at the workshop provided information in relation to:

- the interests and capabilities of the Consortium researchers
- similarities and differences between regional bodies in terms of regional characteristics, climate change knowledge, state of planning and research needs
- needs for climate change adaptation research that could potentially be met by the Project, and any remaining gaps

- processes for sharing information and maintaining dialogue between regional bodies and to form a community of practice around the use of climate science in NRM planning for climate change adaptation.

A summary of the workshop outcomes is provided at Appendix D.

4. Results

4.1. Regional body summaries

4.1.1 Description of cluster

The East Coast Cluster of regional bodies comprises the six coastal regional bodies from Rockhampton to Sydney. There is considerable variation in the cluster, both within and between the regions. The cluster includes five of the ten largest significant urban areas in Australia (Sydney, Brisbane, Gold Coast, Newcastle, Sunshine Coast), with the population of the region totalling over 42% of Australia's total population (ABS 2013). The cluster region is highly variable, both between and with regions. Dominant landuses include extensive urban and peri-urban development, large scale dryland grazing, large mining centres, and valuable agriculture. Internationally significant natural features in the cluster region include the southern end of the Great Barrier Reef, world heritage rainforest, unique islands and important coastal systems. Some of the features of each of the regions are described in Table 1.

Table 1 Features of the region in the East Coast Cluster

Region ^a	Size (km ²)	Population	Major centres	Industries	Features
Fitzroy	156,000	227,800	Rockhampton, Gladstone	Grazing, mining, ports, cotton, grains, horticulture, CSG	Brigalow, open woodland, Great Barrier Reef (GBR)
Burnett Mary	53,236	301,100	Bundaberg, Maryborough	dairying, grazing, forestry, irrigated cropping, fisheries and tourism	Great Sandy Straits, Fraser Island World Heritage Area (WHA), southern tip of the GBR, threatened species include Mary River Turtle, Mary River Cod, Australian lungfish
South East Queensland	23,239	2,890,500	Brisbane, Gold Coast, Sunshine Coast	Government, retail, construction	Moreton Bay and beaches, sand islands, Gondwana Rainforests WHA
Northern Rivers	50,580	512,300	Port Macquarie, Coffs Harbour, Grafton, Ballina, Lismore, Tweed	Agriculture, tourism, fisheries, nature conservation	Lord Howe Island Group, Gondwana Rainforests WHA, Solitary Islands, Cape Byron Marine Parks
Hunter-Central Rivers	33,284	1,200,000	Newcastle, Lake Macquarie	Grazing, mining, agriculture, tourism	Barrington Tops, wetlands, sub-alpine plateau
Hawkesbury Nepean	23,121	4,180,300	Sydney, Goulburn	Government, retail, construction, agriculture, horticulture	Greater Blue Mountains WHA, Sydney Harbour, coast and estuaries, extensive national parks

^a sources: (Australian Government 2011, ABS 2012)

4.1.2 State of planning

In general, regional bodies in Australia follow an adaptive planning cycle, characterised by a process that includes:

- identifying community values
- incorporating values into a plan (often in the form of a strategic plan with targets)
- identifying and prioritising actions (often using spatial mapping as a tool)
- implementing actions (with stakeholders)

- monitoring outputs and outcomes
- reviewing for improvement.

A generalised planning cycle showing these elements is given in Figure 4. The regional bodies in the Cluster are currently in different places in this planning cycle. A summary of the status of current plans for each region is given in Table 2. The Regional NRM Fund (Stream 1) provides an opportunity for all regional bodies to re-invigorate their planning processes. As a result, there is an opportunity for a new baseline of planning to be established across Australia in the next couple of years.

Cyclic (Continuous) Planning Process incorporating an Adaptive Management Framework

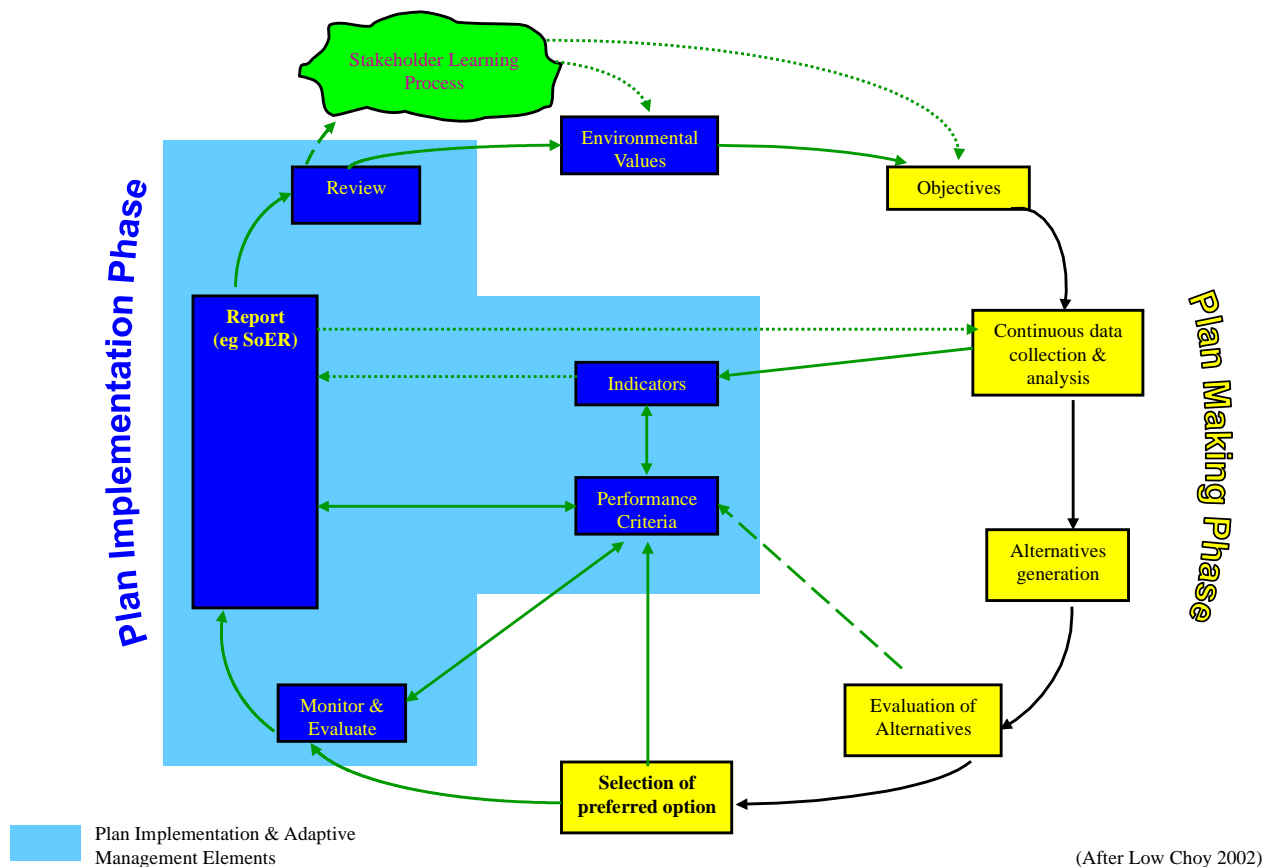


Figure 4 Adaptive planning cycle for NRM planning (after Low Choy (2002))

The NSW Government has set a standardised process for planning by CMAs. The East Coast Cluster CMAs have all recently completed 10-year CAPs, which set the strategic framework for NRM planning in each region. These will be supplemented by rolling annual 4-year implementation plans. The CMAs have commenced work on the first implementation plans; the bulk of the work will be done in the second half of 2013 and the plans will be finalised in 2014. CAPs are also reviewed every 5 years. It is currently unknown how the formation of LLS from January 2014 will affect the regional planning cycle.

SEQC's planning process is aligned with the 5-year statutory regional planning cycle. The current regional NRM plan was produced as a whole-of-government document, with implementation to be undertaken by all committed stakeholders. A Strategic Investment Plan (SIP) was developed to identify activities that would be undertaken by SEQ Catchments. The NRM Plan is due to be reviewed by June 2014, in line with the review of the statutory regional plan for SEQ.

Regional planning in the Burnett-Mary region has occurred in two phases to date. The first regional plan, *Country to Coast 2005-2012* (Burnett Mary Regional Group 2005), was developed as a community based NRM plan. A review of

the plan in 2008 was postponed, and Regional Investment Strategies (RISs) were used to direct operational activities. Regional planning recommenced in 2009 with the state government, and the Wide Bay Burnett Environment and NRM Plan was completed in 2012. However, following a change in state government, this plan is no longer supported and the region effectively has no current regional plan to guide investment and activities. An NRM and Climate Variability Action Strategy are proposed to be developed by February 2016 using funding from Stream 1.

The existing plan for the Fitzroy region was produced in 2002 and has not been reviewed. Its relevance to operational activities is therefore limited. A RIS guided investment from 2005-2008 (Fitzroy Basin Association 2009). Activities in the region since that time have been focused on specific initiatives, such as those funded by the Australian Government under Caring for our Country Reef Rescue. A revised planning package (incorporating a core strategic plan and multiple operational plans) is proposed to be developed by 2015.

All six regional bodies will receive funding under Stream 1 of the Regional Natural Resource Management Planning for Climate Change program to incorporate climate change adaptation into their plans. The bulk of this funding will be available for activities during the 2013/14 year, and the regional bodies plan to have most planning revision complete by the end of 2014.

Table 2 Status of NRM plans and reviews for each regional body

Regional body	Current plan name(s)	Date	Next review
Fitzroy Basin Association	Central Queensland Strategy for Sustainability 2004 and beyond	2002	NRM Plan package (core plan and operational plans) to be developed by 2015
Burnett-Mary Regional Group	Wide Bay Burnett Environment and Natural Resource Management Plan 2012-2031 Country to Coast 2005-2012 Country to Coast Regional Investment Strategy 2005	2012 2005 2005	NRM and Climate Variability Action Strategy to be developed by Feb 2016
SEQ Catchments	South East Queensland Natural Resource Management Plan 2009–2031 SEQ Catchments Ltd. Strategic Investment Plan 2009-2014	2009 2009	NRM Plan and Investment Strategy to be reviewed by June 2014
Northern Rivers CMA	Northern Rivers Catchment Action Plan 2013-2023	2013	Implementation plan to be developed by 2014 Climate change addendum (technical report) by 2016
Hunter-Central Rivers CMA	Hunter Central Rivers Catchment Action Plan 2013-2023	2013	Implementation plan to be developed by 2014 (Rolling 4 Year Implementation Plan)
Hawkesbury Nepean CMA	Hawkesbury-Nepean Catchment Action Plan 2013–2023	2013	Implementation plan to be developed by 2014 (annual) Climate change addendum

4.1.3 Current state of climate knowledge and adaptation in planning

There is a wide degree of variability in the degree of climate change knowledge in each region. The degree to which climate change is incorporated into regional planning also varies widely. Climate change has been highlighted as a high level driver of change requiring an adaptation response across all regions and regions have a general understanding of the likely climatic changes across the NRM region as a whole (for example, that a region generally

may become hotter with more variable rainfall). However, regions lack detailed information on potential changes at local or sub-regional scales and responses specific to climate change (as opposed to drivers of change in general) have not yet been identified. A summary of the challenges and opportunities in relation to climate change identified by the researchers and regional bodies in the needs analysis workshop is provided in Appendix E.

The development of the current generation of NSW CAPs was guided by a systems framework with a focus on planning for resilience. While climate change was often not addressed separately in the CAPs, it was identified in all three plans as one of the major drivers of change for which a resilience approach would be relevant, and adaptation to climate change was listed as an aspirational goal in the three plans. NSW CMAs are awaiting access to NARCLIM products, which will provide downscaled climate change information for NSW (and the southern part of Queensland). The structure of the CMA planning cycle, with annual reviews of implementation plans, and an ongoing assessment of planning needs, allows for incorporation of new information as it becomes available.

The SEQ and FBA plans do not include explicit consideration of climate change, while the NRM Plan for the Burnett-Mary includes aspirational targets around carbon storage and carbon farming. None of the current plans identify priority landscapes for carbon farming or improving resilience. However, some work has been done by SEQC and the Queensland Government to spatially identify priority areas for biodiversity offsets in SEQ and the Galilee Basin (in the Fitzroy region), which are likely to be almost identical to preferred locations for carbon farming. Targets related to climate change from each of the NRM plans are detailed in Appendix F.

The existing knowledge base related to climate change impacts and projections cited by the regional bodies includes:

- HNCMA have undertaken climate change vulnerability assessments for key natural assets using literature and expert review.
- HCRCMA has undertaken a stakeholder analysis of potential participants in the carbon market.
- Hunter Regional Organisation of Councils have undertaken a substantial body of work in relation to climate change, including regional scale climate projections, a regional impacts analysis and adaptation reports (Hunter and Central Coast Regional Environmental Management Strategy (HCCREMS) 2010) , climate profiles and climate impact case studies.
- SEQC has undertaken SimCLIM climate modelling to identify potential climate scenarios for the region and staff have been trained in the use of SimCLIM. Climate adaptation studies have also been prepared for Bribie Island and the Noosa Biosphere (Chapman and English 2011).
- BMRG have undertaken climate change scenarios and projections, with a focus on building local government resilience and scenarios for coasts, forestry, settlements and water.
- SEQC and BMRG have collaborated to identify priority habitat areas for threatened species, which will inform prioritisation of activities to increase ecosystem resilience.

As part of the funding arrangements for Stream 1, all regional bodies will undertake mapping to identify priority locations in the landscape for carbon farming. However, other activities proposed under Stream 1 relate primarily to plan review and the process to identify priority climate change adaptation actions. Specific climate change adaptation actions have not been identified by the regional bodies at this stage, although adaptation is generally factored into future planning.

4.1.4 Regional NRM stakeholders

The complex nature of regional NRM planning and implementation has led to a focus within all six regional bodies on collaborative relationships for delivery of NRM outcomes (Dale et al. 2013). Regional bodies cannot achieve their aims by working in isolation; ultimately, NRM outcomes depend on multiple actors (often land managers) changing their practices. Providing information or products to regional bodies in relation to climate change adaptation therefore requires an understanding of the key partners, their roles and relationships to the regional bodies. All regional bodies include a review of key stakeholders and development of an engagement strategy as part of the plan review process. Regional bodies will be developing an engagement strategy as part of their Stream 1 plan review activities by July 2013.

NSW CMAs have deliberately taken an all of government and all of community approach to the development of the CAPs and have sought input and commitment from stakeholders to priority actions. SEQC emphasised in the last NRM plan review their role as facilitator in the collaborative development of a joint government, community and industry NRM plan, where all partners commit to and implement the plan. The most recent NRM plan for the Burnett-Mary region was developed by a joint working group including BMRG, state and local government, non-government organisations, industry groups and Traditional Owners. The plan review for FBA offers an opportunity to re-engage with key stakeholders. FBA's engagement is proposed to be run through four network groups: science, policy, delivery partners and community engagement.

Key stakeholders for NRM implementation are shown in Figure 5 and include:

- Australian Government – as a significant funding provider to regional bodies, Australian Government priorities significantly influence regional body activities. However, the Australian Government does not actively participate in implementation beyond funding and review.
- State Government – The NSW State Government plays a significant role in setting the direction for and working with CMAs, and there are strong links between state government agencies (particularly the Natural Resources Commission), the regional bodies and regional NRM planning. The Queensland Government has indicated continued support for regional bodies, but appears to be reducing support for the incorporation of NRM plans and outcomes into statutory regional plans. Regional body relationships with state government are still changing.
- Local Government – local government plays a key role in providing NRM outcomes, NRM project implementation and in land use, community and conservation planning. Local governments were identified as a key stakeholder in plan development and implementation by all regional bodies.
- Industry groups are important stakeholders, particularly in plan implementation. For example, regional bodies identified that industry bodies would be likely to develop adaptation strategies if climate change impacts were effectively communicated. Some industry bodies may have received funding under the Clean Energy Futures program for adaptation actions.
- Community based groups, particularly Traditional Owners, catchment and Landcare groups, provide substantial support in plan development and implementation and are key to community engagement processes. They also provide opportunities for building the capacity, skills and knowledge of their members to improve NRM practices.
- Research institutions – most of the regional bodies have relationships with one or more research institutions, usually those that are located within their region. Research institutions may provide useful links to wider sources of information such as academic literature and international practices.
- Regional Development Australia (RDA) committees – some regional bodies have made contact with RDA committees, which use local partnerships to deliver infrastructure and services to regions. RDA committees may offer useful links to businesses and industry and provide a broader perspective on strategic regional planning. The regional sustainability planning fund may also provide some opportunities for linkages; currently, a collaborative strategic assessment for the Lower Hunter region is being coordinated by the Australian and NSW Governments.



Figure 5 Key stakeholders in NRM planning and implementation

4.2. Regional body needs for climate change adaptation planning

A summary of the identified regional bodies' needs in relation to NRM planning for climate change adaptation is given in Appendix G.

4.2.1 Biophysical research

4.2.1.1 Projections

One of the priorities identified for capacity building was improving understanding of climate change model assumptions, limitations and parameters, both for regional body staff and for the wider stakeholder groups. The regional bodies highlighted that in most cases they have minimal capacity to use or understand raw data or model outputs, and that outputs would need to be able to be used by regional body staff in stakeholder engagement activities. Outputs would be most useful at a regional or catchment scale (not cluster scale). Basic indicators such as temperature, rainfall, evaporation would be useful, but derived information such as sea level rise, extreme events and impacts on hydrology and water availability would also be required. Impacts on hydrology and water availability were identified as a potential gap. It is anticipated that projection information will be available for 2030 and 2090, and at 5-year intervals within this range. It would be useful to agree on a standard set of timeframes for use in the research projects.

4.2.1.2 Ecosystem changes

There was a general interest in the impacts of climate change (temperature, water availability and extreme events) on ecosystem extent and distribution at a regional scale, particularly for threatened or high priority terrestrial and coastal vegetation communities, but also for weeds, pests and diseases. The implications of climate change for soils were also considered as changes in soil type can further affect vegetation types. Impacts on marine systems would also be useful as regional bodies work up to three nautical miles from shore. Regional bodies highlighted that model outputs would need to be able to be integrated with their existing spatial tools (e.g. Multi-Criteria Analysis Shell for Spatial Decision Support (MCAS-S)) for use by the regional bodies with stakeholders - black box models would not be useful. Ongoing engagement with the regional bodies to ensure models and datasets are aligned with their needs will assist in maximising uptake. There was also an interest in the implications of climate change for the management and resilience of valued communities (such as rainforest) to natural hazards, particularly fire.

The regional bodies are shifting from an asset management model of NRM to a systems-based, resilience model and highlighted their preference for research on ecosystem change to be formulated using an ecosystem services approach. This would facilitate the integration of socio-economic information to provide for an improved understanding of climate change impacts on the system as a whole.

4.2.1.3 Carbon farming

There was strong interest in the regrowth calculator online tool prepared for Queensland vegetation, and in development of the tool for NSW vegetation types. It was noted that the tool would be ideal to feed into property planning and regrowth management. Spatial representation of carbon farming opportunities would be directly useful to the regional bodies in meeting their Stream 1 funding requirements, particularly in terms of development of a common framework for regional bodies to use. Also of interest was risk assessment for carbon farming, including incorporation of socio-economic constraints to carbon farming uptake, climate change impacts on species selection, impacts of fire on carbon farming (e.g. on single-aged forests) and impacts from carbon farming (e.g. on hydrology).

4.2.2 Socio-economic research

4.2.2.1 Profiling and vulnerability

The regional bodies highlighted that socio-economic information was best presented in terms of an ecosystem services framework. They are interested in understanding the community and industry beneficiaries of ecosystem services, and in particular how socio-economic characteristics of communities and industries will affect responses to changes in ecosystem services as a result of impacts of climate change. Movements of people in response to climate change and changes in population growth and location preferences are also of interest. Industry vulnerability and viability in relation to climate change impacts and adaptation responses are of particular interest, and should include consideration of potential changes in industries over medium to long time frames (noting that some industry responses may be independent of ecosystem changes from climate change).

Recent extreme weather events severely affected some of the East Coast Cluster regions triggering an additional need to improve understanding of the impacts of natural hazards (especially floods and east coast low events) on both industry sectors, community and the environment, and associated short and long term recovery periods and strategies.

There is need to better understand both the socio-economic vulnerability to climate change impacts of the various East Coast cluster regions broadly and the vulnerability of key industry sectors within regions, particularly those industries that are resource dependent such as agriculture and tourism.

Socio-economic determinants of carbon farming uptake such as property size, motivation, preference and capacity for uptake and adoption were also of interest in relation to the mapping of priority areas for carbon farming.

4.2.2.2 Engagement

Key needs highlighted in terms of community and stakeholder engagement include:

- the importance of identifying the current state of climate change knowledge and action across key industry sectors to best tailor engagement and adaptation strategies in NRM planning
- learning how to best manage and deal with community expectations associated with NRM planning for climate change adaptation given that there are limits to both adaptation itself and regional bodies' capacity to address an increasing agenda of issues attributed to NRM planning
- processes to engage with Aborigines and Torres Strait Islander people in relation to climate change adaptation, particularly associated with climate change impacts on cultural assets and resources management planning.

4.2.2.3 Case Studies

The regional bodies acknowledge that there is value in case studies that could be useful learning tools. However, more thought should be given to determine whether this is the most useful approach. In particular, the need to further explore possible alternative approaches, the scale at which case studies should focus, and how benefits and outputs could be shared and transferred across NRM regions should be considered. Additionally, case studies should reflect current trends in NRM planning and be framed around a systems thinking and resilience approach rather than being asset management focused.

4.2.3 Cross-cutting issues

4.2.3.1 Integration of NRM planning and research timelines

The Project has been designed to allow regional bodies to identify and clarify their needs in the initial stages in order to inform the Research Consortium as they scope and tailor their initial project plans to best meet these needs. An iterative approach to project planning and delivery is therefore required throughout the project, and particularly in the early project stages.

There is a need to describe the process and timeline for plan review that each of the regional bodies will be following, to identify critical decision points and the information that would be most relevant for a particular decision. Where possible, aligning this with key milestones in the delivery of the Project would provide maximum opportunities for uptake of climate science. At the very least, documenting the NRM planning and research timelines will allow regional bodies to identify information that is likely to be available in the future, and plan for its incorporation into later planning cycles.

Due to the short timeframes for regional bodies to complete activities with Stream 1 funding, the regional bodies were interested in a compilation of currently available knowledge and tools that could be immediately applied by the regional bodies, including, key website links, reports and spatial data.

4.2.3.2 Knowledge management

The regional bodies face an environment of institutional uncertainty, including uncertain and variable funding and, in the case of the CMAs, imminent structural change. There is also a complex and constantly changing governance environment in the NRM sector. Many regional bodies are expecting some degree of staff turnover during the life of the Project. To overcome and deal with this uncertainty, processes are required to institutionalise learning.

Most of the regional bodies also have limited capacity to assimilate or use raw spatial data or modelling outputs. The regional bodies stressed that they need knowledge and information, rather than data. Knowledge needs to be delivered in a way that is meaningful to regional bodies and their stakeholders. To maximise uptake by the regional bodies, the knowledge, models and datasets need to be closely aligned with the needs of the regional bodies, and be credible, of good quality and delivered at the right time. There is also a need for processes and practices to institutionalise learning, to attempt to overcome the impacts of staff turnover and the need to work with multiple stakeholders.

4.2.3.3 Integration of multi-disciplinary research

The regional bodies in the Cluster are moving away from an asset-management focus towards a systems-based resilience approach to NRM planning. This is an ongoing process, and is occurring at varying rates across the regional bodies. However, it is seen as a strong focus for moving planning processes forward, as it offers a useful approach to integrating the biophysical and socio-economic aspects of NRM planning by identifying the benefits of natural resource management to their stakeholders and communities. Identifying the flows and beneficiaries of ecosystem services provides one mechanism to assess the vulnerability of linked ecological-socio-economic systems to climate change.

Nevertheless, a systems thinking approach to NRM planning represents a key challenge as it requires the integration of knowledge and information generated by different fields of knowledge through a 'common language'.

Additionally, typically, fields of knowledge generate outputs which can only be directly applied to specific time and spatial scales further compounding the integration and transferability of knowledge across different socio-environmental systems as well as broader landscape scales and landuse planning context. Regional bodies work across multiple spatial and temporal scales (with a focus on local and regional spatial scales), using data from multiple scales. Hence, there is a need to also identify examples of best practice in systems thinking/ resilience approach to NRM planning for climate change adaptation that deal with knowledge applicability and transferability across scales.

4.2.3.4 Integration with the planning cycle

Regional bodies highlighted that there is a need to explore how climate change science can be incorporated in NRM planning using an adaptive approach, to allow for incorporation of the best available knowledge as it appears. This could include the identification of examples of best practice approaches in NRM planning for climate change adaptation. Integration of climate adaptation responses in NRM planning with other forms of planning (e.g. statutory regional planning, regional roadmaps) was also of interest, as multiple pathways are required to deliver NRM outcomes.

4.2.3.5 Outputs and tools

Outputs and products need to be delivered throughout the Project at points in the NRM planning cycle where they can be most useful. The key message from regional bodies is that outputs and tools need to be 'engagement ready'; that is, able to be used with stakeholders in conjunction with regional bodies' existing tools and processes. An understanding of the key stakeholders and communities of practice in NRM planning is therefore essential in developing tools that will be readily used by the regional bodies. Additionally, products need to be accessible, applicable and adaptable to identified regional bodies' priorities. The best way to ensure outputs meet regional bodies' needs is to continue close engagement with the regional bodies as the end users.

4.2.3.6 Capacity building

Research outputs and tools have limited usefulness if the potential users do not have the capacity to use them to their full potential, or if institutions do not have processes to transfer knowledge and capacity across staff and stakeholders. This is particularly true for complex outputs such as model results (where the use may depend on understanding the in-built assumptions and data input) and tools (which may require training prior to their use and applicability).

Regional bodies were particularly interested in building their capacity on the following areas:

- Development and use of scenario planning to support community and stakeholder engagement and related uptake towards effective NRM focused on climate change adaptation. This includes the identification of available tools that allow the input from and collaboration with community and stakeholders, as well as adaptation options to determine adaptation pathways.
- Translation of broad NRM strategic planning for climate change adaptation into viable, collaborative implementation plans, including its alignment with and impact upon NRM planning undertaken by other government and non-government organisations.
- Development of a new generation of NRM plans that are dynamic, particularly to facilitate the incorporation of changing and new knowledge as it becomes available through the adaptive management and investment components of NRM planning processes for climate change adaptation.
- Planning packages that include climate adaptation trajectories/ pathways and information, including available climate change science and impacts, processes for scenario planning and tools from other research providers.

Additionally, current and future knowledge could be disseminated to NRM regional bodies through webinars and face to face meetings to maximise information delivery and uptake.

5. Discussion

5.1. Project framework and process

5.1.1 Integration of research elements

The Project is being delivered by a consortium of researchers from different disciplines located in different places. To avoid or minimise the risk that the outputs from the project will not form a coherent whole, it is necessary (but not sufficient) to provide a framework that links the research elements in a way that relates to the needs of the end users. The end users of this project, the regional bodies, are engaged in an adaptive management cycle for NRM planning, and have expressed or demonstrated a desire to move away from an asset-based planning system to a systems based framework that links ecosystem services with people. A useful framework should therefore incorporate these elements. One possible framework is shown in Figure 6. This framework is not the final project framework, but is proposed here as a stimulus and guide for discussions to define further detail of each of the research elements. A final framework will be developed as this detail is developed.

The framework shows how the research elements of the Project may link together and feed into the adaptive management cycle for NRM planning. The regional bodies emphasised the need to move to a systems based resilience approach to NRM planning, using the concept of ecosystem services to link the biophysical and socio-economic research elements. The framework therefore shows climate change (modelled as projections) impacting on ecosystems and industries/ communities, and the impacts of these changes are manifested through changes in the supply and use of ecosystem services. The application of the research to NRM planning is facilitated through scenarios focusing on resilience planning. The whole system is underpinned by capacity building and knowledge management, which are essential to the regional bodies' uptake of research information produced and an integral part of the adaptive management cycle.

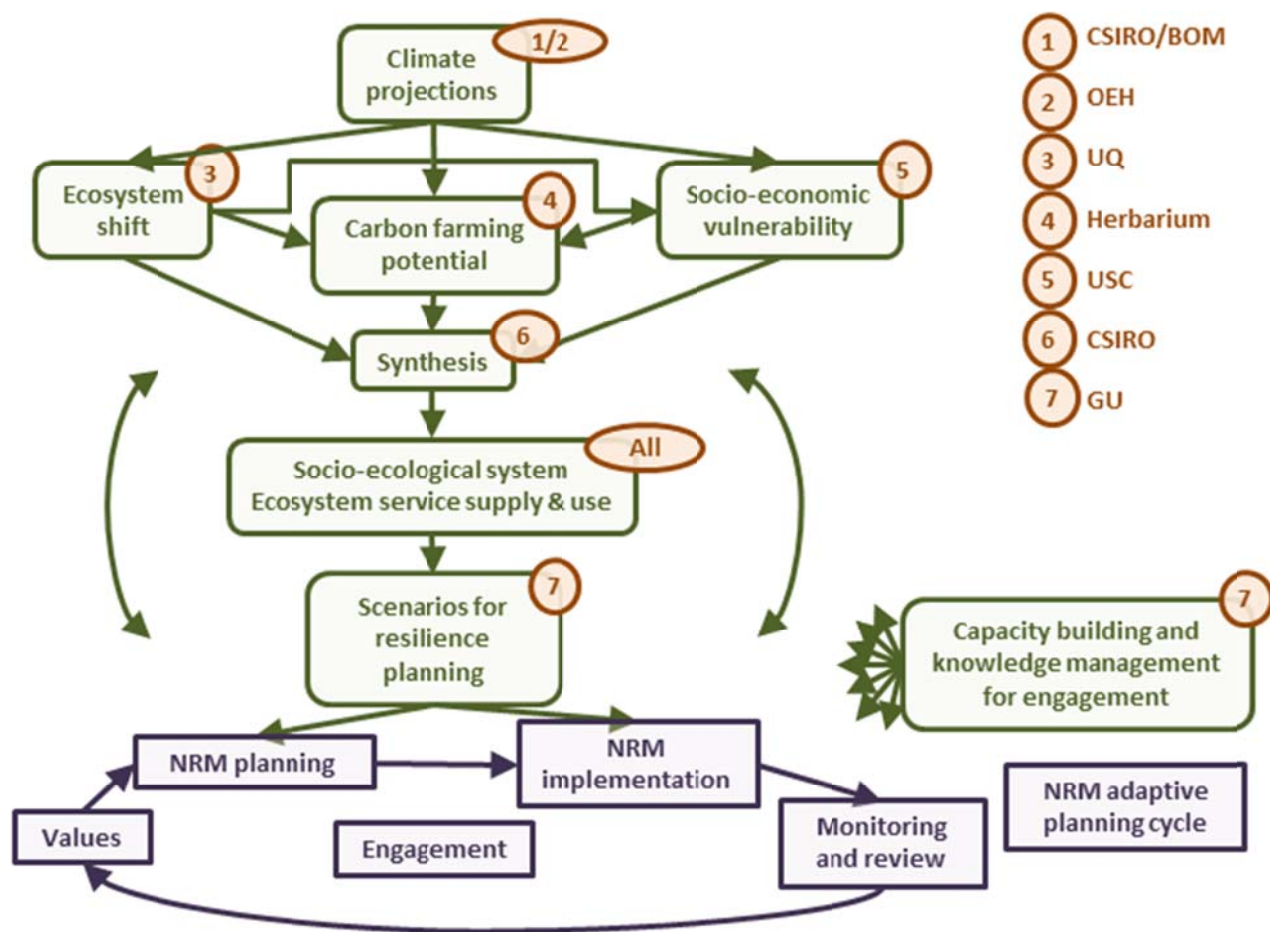


Figure 6 Possible project framework showing linkages between the regional bodies' role in adaptive planning and Project research elements, as a basis for discussion and project planning.

5.1.2 Capacity building

The over-riding theme of the needs analysis was the impact of multiple uncertainties in the socio-ecological system of NRM planning and implementation, and the need to build the capacity of the regional bodies at both an individual and institutional level. The uncertainties include changes in institutional arrangements (e.g. changing CMAs to LLS); variable levels of funding for regional bodies; high levels of staff turnover; variable staff skills; as well as uncertainties inherent in the sciences (e.g. in the climate change projections, ecosystem and socio-economic responses). The overall aim of the Project is therefore framed as empowering the NRM planners and agents to improve the resilience of the socio-ecological (NRM) system to climate change. The Project aims to achieve this by providing current science, building capacity within the wider 'communities of practice' to understand the science, providing tools to integrate the science into planning processes, and embedding the learnings from the Project to increase the longevity of any outcomes from the Project. This should include some form of capacity building activity associated with each of the Project outputs, as well as ongoing processes to improve planning and knowledge management processes within the regional bodies. This set of capacity building activities could be regarded as the 'keystone' of the Project, as without these it is unlikely that the outputs from the Project would ever turn into sustainable outcomes. Capacity building should focus on the regional bodies' planning processes as this is the primary function through which the climate and other science is operationalized and translated into forms that provide the guidance for future investments.

5.1.3 Planners working group

There is a clear need for formal engagement processes for information sharing and capacity building throughout the Project. The planners working group (PWG) will serve as the primary mechanism for these processes. It will comprise representatives from each of the regional bodies in the Cluster and from the Griffith University team. The overarching aim of the PWG is to support the building of a network of informed and articulate NRM agents with knowledge of current climate science and capacity to use current tools to engage stakeholders in NRM planning for climate change adaptation. The PWG will therefore function as a 'community of practice' (Cox 2005), that is, a group of (NRM planning) practitioners increasing their knowledge and expertise (around NRM planning for climate change adaptation) by interacting on an ongoing basis. The planners working group would form the core group of the community of practice, with the broader group of stakeholders participating when activities aligned with their interests. In this way, it is anticipated that the Project will contribute to building capacity within the wider community to effectively plan for climate change adaptation.

A draft Terms of Reference (ToR) for the PWG is provided at Appendix H. It is proposed that the PWG meet formally twice a year, with meetings to coincide with key deliverables and milestones. Discussions would continue throughout the year, through online forums and capacity building activities such as webinars. One of the key outputs of the group will be the production of planning packages that encapsulate the learnings, outputs and tools from this project.

5.2. Project linkages

As this Project is one of eight being delivered across Australia, it will be important to establish linkages with other clusters and with the national research being delivered as part of the wider program. There is a clear need for national coordination between the projects to reduce duplication and unnecessary effort, and to maximise synergies between projects. The national project team is investigating options for collaboration, including a shared online calendar, list of program participants, an online forum, and a regular teleconference with a program coordination group. A summary of Stream 2 project proposals provided by the national project team is given at Appendix I. The Clean Energy Future Fund also includes other programs that may have useful outcomes, including the Carbon Farming Futures Extension and Outreach Program, Action on the Ground and Filling the Research Gap (Australian Government Department of Agriculture Fisheries and Forestry). Coordinated mechanisms to facilitate interactions with these projects would also be useful.

The regional bodies have some existing networks to facilitate information sharing, such as the Queensland Regional Groups Collective and related groups, including a recently established planners group. The current NSW CMAs also

have a number of state-wide networks at the CEO and Board levels. There is also a National NRM Regions' Working Group, which represents the 54 regional bodies.

5.3. Alignment between Streams 1 and 2

The next major stage in the project is the development of the detailed project work plan, to be finalised in July 2013. A stakeholder engagement plan will also be developed by the end of July 2013. These documents will provide some of the major sources of information for this process. The research consortium will meet in July 2013 to discuss details of individual research projects, outputs and milestones. The regional bodies will also be modifying their work plans under Stream 1 funding (for incorporating climate change adaptation into their NRM plans) in June 2013. It is anticipated that this information will be incorporated into the research project work plan to maximise alignment between activities where possible.

6. Conclusion

Although there is great variation within the East Coast Cluster regions in environments, climate expertise and planning processes, the regional bodies are facing many common challenges and have identified several common needs. These include the need for research outputs to be presented at a regional scale and in a format that can be used by the regional bodies with stakeholders; the need for capacity building to enable the regional bodies to best use the information available at any point in time; the need for the research to be framed in terms of a systems-based approach to NRM; and capacity building to assist the regional bodies to move towards a systems-based approach to NRM planning. The planners working group will facilitate this capacity building for the regional bodies.

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8. Abbreviations

ABS	Australian Bureau of Statistics
BMRG	Burnett-Mary Regional Group
CAP	Catchment Action Plan
CEO	Chief Executive Officer
CFI	Carbon Farming Initiative
CMA	Catchment Management Authority
FBA	Fitzroy Basin Association
GU	Griffith University
HCRCMA	Hunter-Central Rivers Catchment Management Authority
HNCMA	Hawkesbury Nepean Catchment Management Authority
IT	Information Technology
LLS	Local Land Services
MCAS-S	Multi-Criteria Analysis Shell for Spatial Decision Support
NRC	Natural Resources Commission
NRCMA	Northern Rivers Catchment Management Authority
NRM	Natural Resource Management
NSW	New South Wales
OEH	Office of Environment and Heritage
PRG	Project Reference Group
PWG	Planners Working Group
RIS	Regional Investment Strategy
SEQ	South East Queensland
SEQC	South East Queensland Catchments
SIP	Strategic Investment Plan
ToR	Terms of Reference
UQ	University of Queensland
USC	University of the Sunshine Coast
WBB	Wide Bay Burnett

Appendix A. Summary Brief for the Research Consortium for the East Coast Cluster

Preamble

This Project aims 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.

The project is being undertaken under the auspice of the Australian Government’s Natural Resource Management Climate Change Impacts and Adaptation Research Grants Program (Stream 2), managed by the Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education.

The East Coast Cluster consists of the coastal Natural Resource Management (NRM) bodies in Queensland and New South Wales between Rockhampton and Sydney.

The Research Consortium comprises: University of Queensland (Consortium leader); Griffith University; University of Sunshine Coast; CSIRO; New South Wales Office of Environment and Heritage; and Queensland Department of Science, IT, Innovation and the Arts (Queensland Herbarium).

The Project will:

1. Engage with the East Coast NRM/CMA Cluster to determine their climate adaptation needs over the range of biophysical and socio-economic conditions in the region.
2. Collaborate in identifying a range of existing data, assessments, tools and processes suited to enhance adaptation over a wide range of regional contexts (catchment, rural, peri-urban, coastal).
3. Support the NRM/CMA regional bodies in the synthesis, translation, interpretation and use of climate projections and its use in planning and decision making for NRM investment.
4. Develop a whole-system framework to enable climate vulnerability assessments under a range of scenarios and projections that incorporate biophysical and socio-economic components.
5. Facilitate dialogue to mainstream climate change adaptation within the NRM/CMA Cluster, and jointly deliberate over options for planning and decision support.

The Research Consortium and NRM/CMA partners, will bring together an extensive portfolio of research and outreach capacity for climate adaptation including; the South East Queensland Climate Adaptation Research Initiative, the regional climate modelling and software tools developed by NSW OEH, QLD Gov and UQ, together with the extensive knowledge and experience that lies within the NRM/CMA groups. The Project will work with the NRM Cluster to scope their diversity and needs identifying the availability of existing information and available tools. We will develop and tailor approaches so that regional bodies can use the data, projections and tools in their own contexts. We will synthesize the available data, coordinating closely with national level data providers (e.g. CSIRO, BoM, ABARE). We will work with the NRM Cluster to develop understandings of potential changes in the conditions of regional biodiversity, natural assets, ecosystem services, in particular carbon storage, and work with the NRMs to identify key areas of concern. We will work towards assessment of the impacts and vulnerabilities of the region integrating both biophysical and socio-economic data. The Project will identify and evaluate different options for adaptation, their trade-offs and work toward refining regional planning processes to accommodate their incorporation.

Activities and products from the project will include:

1. Participatory workshops with NRMs to investigate needs and impediments to adaptation and critical areas of concern.
2. Profiles synthesizing the climate projections for the region and likely impacts on the landscape in a format that is tailored to NRM planning and management needs. This will include development of a “Tool shed” that includes existing tools for a range of tiers of assessment and some that have been further developed (e.g. online interfaces) to support regional bodies.

3. Development of case-study processes for regional integrated assessment of climate and ocean changes and adaptation options. These processes could include participatory impact assessment, scenario planning or vulnerability assessment methods modified to suit use by regional bodies.

Activities, methodologies and milestones

While the nature and extent of project activities will be dependent on NRM/CMA needs, below outlines the Research Consortiums approach to the Project. There are three main grouping of activities including 1) Enhancing engagement; 2) Synthesis of the biophysical, social and economic data and modelling tools for the region a; and 3) Integration of biophysical, social and economic data within the policy and planning frameworks of the NRM/CMA groups. Joint activities, where the NRM/CMA personnel are requested or desirable are shaded below.

1. Enhancing engagement

1. Establish Project Reference Group consisting of CEOs/Chairs of NRM/CMA groups and the Consortium Committee. The group will provide overarching guidance for the project, facilitate communication among groups and feedback on project activities. Meetings of this group will be twice per year. Project Reference Group will be established in March 2013.

1.1 Griffith University will lead the Priority-identification (needs analysis) component. We will conduct interviews and workshops with NRM/CMA groups during March-April 2013 to identify priority information needs of the NRM groups. Consultation on a draft 'NRM Needs Analysis' report and agreement with NRM group representatives on priority list and approach. Workshops and consultation completed by 30 April 2013.

1.2 NRM Needs Analysis document. Preparation of the draft 'NRM Needs Analysis' report document following the workshops and consultations. Report completed and delivered to the Cluster and DCCEE by 30 May 2013.

1.3 Project Work Plan developed. Development of a Project Workplan following workshops and consultation. Work plan circulated to the Project partners. Establish agreed work plans for Project by July 30, 2013.

1.4 Consultation workshops with NRM planning groups Consultation workshops on project outcomes throughout the duration of the project. The workshops aim to increase exchange among partners in order to further understanding of NRM/CMA needs as they arise and to integrate science outcomes within NRM activities. Three workshops to be completed by November 2015. Year 2 workshop: April-May 2014, Year 3 workshop: April-May 2015, Final workshop: April-May 2016

1.5 Reports on NRM engagement. Three reports on the engagement process will be produced. The reports will document attendance, presentations (content) and discussions of project work. These reports will provide evidence of project progress (Monitoring and Evaluation) but also are required for the group reflective process where we aim to examine our effectiveness in order to improve the engagement process. Three reports on the engagement process to be completed by November 2015. Year 2 report: May 2014, Year 3 report: May 2015, Final report: May 2016.

1.6 Ongoing support provided to NRM/CMA Planners Key contacts for the NRM/CMA groups will be identified and details provided to NRM groups within the Cluster. Discussion with the NRM Cluster will establish the most desirable style of interaction with NRM planners. Key contacts will be available on an ongoing basis to provide support to NRM planners within the Cluster to ensure effective and appropriate use of climate change information in NRM planning. Ongoing support provided until the end of the program.

2. Synthesis of biophysical, social and economic data and tools in the region

2.1 Collation of existing biophysical information (asset profiles). The QLD government (Dr Don Butler) and the University of Queensland (Prof Catherine Lovelock) and OEH NSW (Chris Lee) will work together to prepare a preliminary asset-based impact profiles based on downscaled projections (from CSIRO and NSW OEH) for agreed representative case studies. Data and models will be collated from the scientific literature, government reports and other web based resources, and data available to the research partners. Collation of key data (e.g. climate, land-cover, DEMs) for the region and identification of models used for prediction of impacts of climate change will be

completed by November 30, 2013. We will hold a meeting of key research providers during October 2013 to integrate knowledge across the region and across disciplines.

2.2 Analysis of regional biophysical information. Using the collated data and models above (2.1) we will analyse the potential for carbon farming in the cluster region. We will also assess the impact of sea level rise on natural coastal assets (where the data are adequate) and synthesise the impacts of East Coast Lows (NSW OEH) on coastal assets. We will make available models to indicate areas with potential for carbon farming, models of the influence of the East Coast Lows on coastal natural resources and a series of slides of model outputs and descriptions of methods by 30 November 2013.

2.3 Summary reports of regional asset profiles. We will prepare draft reports on available models and the impacts of climate change for the region. 1. Report reviewing existing and available tools for assessing impacts of climate change on natural resources. 2. Report summarizing down-scaled climate data for the region. 3. Report documenting potential for carbon farming (broad-acre carbon farming activities that relate directly to land management and to NRM/CMA planning activities) in the region and risks with climate change. 4. Report documenting impacts of sea level rise on case study areas as negotiated with NRM/CMA groups in the initial phases of the project. A range of reports will be completed and provided to the DCCEE and NRM/CMA groups by the end of November 2014.

2.4 Socio-economic vulnerability assessment. The University of Sunshine Coast (Prof Tim Smith, Assoc/Prof Neil Powell) will conduct social-economic vulnerability assessments of the region. They will use existing secondary data (census data and other social and economic data sets) to profile various regions and sectors, identify major trends and vulnerabilities and with spatial representation and analysis of that information. Collation and analysis of key social and economic data for the region will be conducted by May 2014. Provision of spatial coverages of data sets and analysis of trends will be available by November 2014.

2.5 Reports on socio-economic vulnerability for regions. Preparation of draft report on likely climate change related socio-economic vulnerabilities for the region. A report will be completed and provided to the Cluster and DCCEE by November 2014 that identifies socio-economic vulnerabilities for the region (and each of the sub-regions) including spatial and temporal trends that are likely to affect vulnerability now and into the future (time scales adopted will be based on available data)

3. Integration of biophysical, social and economic data within the policy and planning frameworks of the NRM/CMA groups

3.1 Social, economic and ecological impact assessments will be integrated for agreed case study areas / sectors led by CSIRO. This activity develops the frameworks (formats), data and indicators for integration that will be reported in 3.2. The framework will identify the 'nested' set of activities that allow identification of the key interdependencies between sectors/regions in responding to particular impacts and thinking about what findings or strategies can be generalised across the cluster. We will (i) examine the key variables (internal characteristics of 'case study' sectors) that link those sectors with the ecological impact assessment work and identify useful measures or indicators of social and ecological vulnerability for those particular relationships, and ii) Identify existing policy and institutional frameworks associated with those sectors resource use regimes that might enable or constrain effective adaptation. iii) Undertake conservation planning scenarios using a range of climate adaptation strategies and conservation goals. Preparation of a draft assessment framework (e.g. the format for sector based report cards or similar) by November 2013. We will collate existing data sources for agreed case study sectors/regions and short-list of key variables and/or indicators of social-ecological vulnerability in case sectors/regions to be used in assessments by May 2014. Assessment framework and reporting format finalised by November 2014

3.2 Synthesis report of socio-economic and ecological integration. Preparation of integrated assessments as a synthesis report of the socio-economic and ecological impacts of climate change across sectors and land uses for the agreed case study areas. These will include preliminary integrated assessments based on regional/sector based report card framework (for consultation with regional bodies) by May 2014. Final integrated assessments with short report format or SoE type format, for instance, incorporating regional body feedback and reflecting 1. conservation planning scenarios for different climate adaptation strategies and conservation goals, 2. links among social-

economic sectors with the ecological impact assessments, and 3. the influence of existing policy and institutional frameworks that might enable or constrain effective adaptation by November 2014.

3.3 Griffith University will lead the development of NRM Planning packages for climate adaptations options for NRM/CMA groups. Consultation with NRM to develop planning packages for adaptation to climate change based on social, economic and ecological assessments. Ongoing consultation with NRM to develop the packages will occur from November 2013 to May 2015. Completion of packages by November 2015.

3.4 Delivery of summary reports of NRM planning packages. Preparation of draft and final NRM planning packages. Completion of drafts May 2015 and final reports November 2015.

3.5 All project resources and documents available. The development of a central repository for all project documentation will be completed by February 2016.

Appendix B. Needs Analysis Workshop Agenda

Day 1

Time	Session	Comments
9.30-10.00am	Registration Morning tea available	Signing of consent forms/ attendance list
10.00-10.10am	Introduction to stream 2, background to the workshop	<i>Darryl Low Choy</i>
10.10-11.40am	Where are we at? Regional body position mapping Summary of regional bodies' current position on climate adaptation Identifying common themes, needs and strengths across regional bodies	<i>Task 1 - 10' presentation by each NRM regional body followed by plenary discussion</i> <i>Melanie Cox</i>
11.40-12.10pm	Where we would like to be in the future Visioning exercise to identify aspirations for NRM planning under climate change across East Coast Cluster	<i>Task 2 – Plenary</i> <i>Silvia Neumann</i>
12.10-12.20pm	Key challenges and opportunities to get there Identifying key climate adaptation challenges and opportunities to achieve aspirations	<i>Task 3 - Individuals to identify top 3 challenges and opportunities</i>
12.20-1.00pm	LUNCH	
1.00 -2.00pm	Climate projections panel and discussion Andrew Dowdy, BOM; John Clarke, CSIRO; Chris Lee, OEH	<i>Task 4 - 10' presentation by each panel member followed by plenary discussion –</i> <i>Melanie Cox</i>
2.00-2.30pm	Conservation planning & ecosystem change Morena Mills, UQ	<i>Task 5 - 10' presentation, 20' plenary discussion</i>
2.30-3.00pm	Carbon farming Don Butler, Herbarium	<i>Task 6 - 10' presentation, 20' plenary discussion</i>
3.00-3.15pm	AFTERNOON TEA	
3.15-3.45pm	Socio-economic vulnerability Tim Smith, USC	<i>Task 7 - 10' presentation, 20' plenary discussion</i>
3.45-4.15pm	Synthesis Bruce Taylor, CSIRO	<i>Task 8 - 10' presentation, 20' plenary discussion</i>
4.15-4.45pm	Planning packages Silvia Neumann, GU	<i>Task 9 - 10' presentation, 20' plenary discussion</i>
4.45-5.00pm	National project linkages with other clusters Barton Loechel, CSIRO	<i>Task 10 - 10' presentation, 5' questions</i>
5.00-5.20pm	Synthesis of the Day How do the components of the project fit together	<i>Task 11</i> <i>Darryl Low Choy</i>
5.20-5.30pm	Wrap-up and plan for Day 2	<i>Darryl Low Choy</i>
6.30 pm	Project Dinner	South Bank – Restaurant Mado

Day 2

Time	Session	Comments
9.00-9.15am	Summary of Day 1 and introduction to Day 2	<i>Darryl Low Choy</i>
9.15-10.15am	Needs analysis Identifying needs based on outputs from Day 1 + priority areas	<i>Task 12 – small groups</i> <i>Silvia Neumann</i>
10.15-10.45am	Report back on needs Compiling list of needs	<i>Task 13 – plenary</i> <i>Silvia Neumann</i>
10.45-11.00am	MORNING TEA	
11.00-11.45am	Remaining gaps Identifying gaps and other linkages that may fill them	<i>Task 14 – plenary</i> <i>Silvia Neumann</i>
11.45-12.15pm	Unpacking needs	<i>Task 15 – plenary</i>

	Preparing clear statement of requirements for Consortium partners	<i>Melanie Cox</i>
12.15-1.00pm	LUNCH	
1.00-1.30pm	Planners working group - TOR Formalising the planners working group Confirming Terms of Reference	<i>Task 16 – plenary Melanie Cox</i>
1.30-2.00pm	Planners working group - Modus operandi Defining modus operandi (workshops, meetings etc.) Monitoring and Evaluation Communication within cluster Engaging external stakeholders and methods to engage	<i>Task 17 – plenary Melanie Cox</i>
2.00-2.15pm	AFTERNOON TEA	
2.15-2.45pm	Exploring opportunities for uptake Defining planning continuum Identifying opportunities to evaluate incorporation of climate change science in NRM planning	<i>Task 18 – plenary Karen Vella</i>
2.45-3.00pm	Wrap-up, next steps and feedback	<i>Darryl Low Choy</i>

Regional body presentations (Task 1)

10 minutes each; 7 content slides maximum

Presentation to focus on:

- Description of region
- Status of the plan and/or implementation plan, including timing of review
- Current climate change knowledge and skills and degree to which these are incorporated in plan and activities
- Major climate change challenges for the region
- Needs and gaps in climate impact knowledge and skills
- 3 priorities for climate change adaptation research from this project

Presentations will be followed by a panel discussion examining the commonalities and differences between regional bodies in relation to challenges, strengths and needs.

Research consortium presentations (Tasks 4-9)

10 minutes each; 7 content slides maximum

Presentation to focus on:

- Brief description of potential research, including examples of what is currently available (outputs, references etc.)
- What NRM planning needs / gaps would this address?
- How does the proposal improve on what is currently available?
- What are the proposed outputs, timing and engagement activities?

20 min questions, clarification and discussion focused on how the research can be used:

- How could this research be applied to the NRM plans / activities?
- What outputs would be required to use this and what would they look like?
- How does this address gaps in: knowledge, capacity, tools
- What are the priority questions that could be answered by this research?
- How would this change what is currently being practiced?
- Other comments

Appendix C. Organisations represented at the Needs Analysis Workshop

Organisation	Representative	Attendance
Hawkesbury Nepean CMA	Catchment Coordinator	Both days
Hunter-Central Rivers CMA	Catchment Officers (2)	Both days
Northern Rivers CMA	Planner	Both days
SEQ Catchments	Planning Manager Spatial analysts (3)	Both days Day 1 afternoon
Burnett Mary Regional Group	Planning Manager	Both days
Fitzroy Basin Association	Consultant leading NRM Plan review	Both days
University of Queensland	Researcher	Day 1
University of the Sunshine Coast	Lead Researcher	Day 1
CSIRO	Researcher	Day 1
Queensland Government (Herbarium)	Lead Researcher	Day 1
NSW Office of Environment and Heritage	Lead Researcher	Day 1
National Projections team	Cluster liaisons (2)	Day 1
National project	Project contact	Day 1
Griffith University	Workshop convenors – 4 research and support staff (5)	Both days

Appendix D. Needs Analysis Workshop – Summary of outcomes

Current approaches to NRM planning

The regional bodies provided brief descriptions of their regions and aspects of NRM planning in their region. (Note regional body and consortium presentations are available on dropbox). Issues highlighted include:

- There is a wide diversity of landscapes and communities, both within and between regions – from large population centres to significant agriculture, extensive grazing and mining developments.
- The planning cycles vary between regions – NSW CMAs have recently completed strategic level Catchment Action Plans (CAPs), with implementation plans to be produced in 2014. SEQ Catchments (SEQC) has a planning cycle in line with the statutory SEQ regional plan, with the next NRM plan review to be completed in 2014. Burnett-Mary Regional Group (BMRG) worked with the (previous) state government to produce a plan in 2012 that is no longer supported by the current government, and will produce a NRM and Climate Variability Action Strategy under Stream 1 funding. Fitzroy Basin Association (FBA) will be reviewing their 2002 plan with a planning package to be produced in 2015.
- Regional bodies have received advice that the bulk of their stream 1 funding is to be spent by June 2014, but plan production will continue after that date. Revised project plans and engagement strategies to be provided to the federal government by July 2013.
- The mismatch in timing and management of stream 1 and 2 was noted.
- Regional bodies have a varying degree of climate knowledge. All plans recognise climate change as a key driver of change, but there are few specific actions or targets addressing climate change.
- NSW CMAs are undergoing substantial structural change and will be incorporated with Livestock Health and Pest Authorities from 2014. Boundaries will align with local government boundaries and there will be significant change in staff, structures, and strategic planning and technical capacity.
- All regional bodies work with key stakeholders and ‘communities of practice’ to deliver NRM outcomes (e.g. local government, industry groups, community groups).
- **Regional bodies requested a program of works detailing key milestones from the research consortium to enable understanding of the linkages between the research and the planning process, preferably to be produced before June to feed into their project planning for stream 1.**
- **The best opportunity to feed research outputs into the planning process is before June 2014 to maximise input into revision processes for NRM planning.**

Research needs

Each of the researchers provided a 10-minute presentation followed by questions and discussion on Day 1. These discussions provided the basis for the needs analysis and further discussion on Day 2.

- Climate projections – there is a need for capacity building to enable regional bodies to understand and use the projections in stakeholder engagement. Outputs need to be ‘engagement ready’. Impacts on water resources would be useful (possible gap). Projections to feed into scenario planning and impacts analysis.
- Ecosystem change – there is strong interest in an ecosystem services approach to understanding the impacts of ecosystem shift on linked industries and communities. Planning tools would need to be delivered in a way that enables regional bodies to develop scenarios and engage with stakeholders – i.e. no black boxes. Workshop around Oct 2013 and impacts milestone Nov 2013.
- Carbon farming – regional bodies were excited by the online tool (regrowth benefits calculator). NSW CMAs would be interested in development of the tool for NSW vegetation types. Spatial mapping of carbon farming opportunities would be relevant to stream 1 requirements.
- Socio-economic – major areas of interest were vulnerability of industries (including industry climate change knowledge, potential industry changes and resilience to disasters); understanding beneficiaries of ecosystem services; managing stakeholder expectations and engagement. Note milestone due Nov 2014.

- Synthesis – interest in using an ecosystem services, systems-based resilience focus to the integration of biophysical and socio-economic information. Questioned the use of case studies – unsure if it is the most useful approach and what the appropriate scale would be.
- Planning – interest in using scenarios for stakeholder engagement and to bring information together; identifying examples of best practice in incorporating climate knowledge into planning; processes for incorporating the systems based approach into NRM planning; capacity building and institutionalising learning.
- Capacity of regional bodies to use raw data or models is variable, but generally low. Capacity building is required in relation to all research outputs in terms of applying research outcomes to NRM planning and implementation.
- Outputs – delivery from the researchers needs to be ‘engagement ready’ i.e. able to be used by the regional bodies for engagement with stakeholders with minimal further input.
- There is also a need to better understand what is already available to be used by regional bodies now.
- **Regional bodies requested a capability statement from each of the researchers to better understand interests and possible projects.**
- **Suggested that researchers and regional bodies compile a list of key resources (documents, website, tools etc) that have been / are being used and may be of relevance to this project.**

Processes - Planners working group

The formation of and processes for the planners working group (PWG) were discussed on day 2. The PWG will comprise the regional bodies and the Griffith University team. The objective is to facilitate the adoption of project outputs and outcomes by the regional bodies.

- PWG to meet twice a year; meeting to coincide with key deliverables and milestones.
- Other discussions throughout the year e.g. via online forums.
- Capacity building and sharing of knowledge and experience will be a focus of the group; there was discussion of use of low cost materials such as webinars that can be used for larger groups of people and recorded. Option for first capacity building may be webinar on climate projection models with CSIRO.

Next steps

- Dropbox to share documents has been created and all project team members invited.
- Needs analysis report to be developed and circulated for comment – aim is to provide a shared understanding of regional body needs and to what extent these may be met by the research consortium (draft by end May 2013).
- Consortium researchers meeting and project work plan to be developed, identifying key milestones for each component.
- Regional bodies develop project plans and engagement strategies for stream 1 funding.
- Initiation of planners working group.
- Integration of research and regional body project plans to identify key points where information can be incorporated in planning.
- Suggestion of annual workshops with all project team members to review what has already been produced and confirm/revise further needs.

Appendix E. Challenges and Opportunities to NRM planning for climate change adaptation

Researchers - challenges

- Highly uncertain about critical issues e.g. biodiversity response to + 1 degree Celsius.
- Identifying what to do where, given so many uncertainties.
- Delivery to diverse stakeholders with reduced resources.
- Keeping up with institutional changes so research outputs remain relevant.
- Integrated planning.
- Monitoring/evaluation systems.
- Data access
- Expectations
- Handling uncertainties
- Retaining an integrated approach
- Complex governance
- Evaluating the impact that NRM actions have on regional environments in complex systems – picking out/assessing benefits
- Building the resilience of NRM bodies to survive and thrive in high pressure situations that are constantly in flux.

Researchers - opportunities

- Recent extreme events enable dialogue about climate and adaptation.
- Critical mass and NRM planning and science support across clusters.
- Always opportunities for researchers * What changes are happening? * What may this mean? * What needs to be done?
- Which impacts are going to occur – when and where?
- Opportunity to cut across projects and jurisdiction to achieve cost savings and synergies.
- Much of climate change adaptation involves more of what we already do – so we have a head start.
- Climate variability.
- Opportunity for collaboration.
- Willing audience for work.
- Political change.
- Improved alignment of research to community needs.
- New opportunities (e.g. related to increased temperature, rainfall etc).

NRM bodies - challenges

- Demonstrating all of Government support for existing plans so that the next revision is credible.
- Urbanisation and land use change reduces opportunities for mitigation to climate change.
- Making climate information and adaptation options relevant – temporal and spatial scale, parameters etc.
- Planning for/with uncertainty – clarity of action in uncertain environment (climate, institutions, community perspectives etc.)
- Lack of staffing and organisational uncertainty.
- Decline in resources.
- Conquering uncertainties in science and harnessing community energy and investment in cause.
- Overcoming political obstacles which are severe at the present moment -> just so we can actually do a plan.
- Governance uncertainty engaging beneficiaries knowledge of flows of services.
- Impacts on ecosystems, key for service provision.

NRM bodies -opportunities

- Opportunity to align baselines and science across regions.
- Opportunity to evaluate the old plan and reflect on what may or may not have worked.
- Renewed emphasis on evidence based decisions.
- Work together to progress ecosystem services e.g. Id flows and beneficiaries.
- Good idea of relationship.
- Change can bring new skills and knowledge into NRM.
- Opportunities to share research and knowledge.

Appendix F. Targets in regional NRM plans related to climate change

Targets included in the regional NRM plans relating to climate change are listed below. Note only those that specifically mention climate change or carbon are noted here, although many other targets are related to climate change activities in some way.

HNCMA

UL3: Promote actions which support urban resilience through mitigation and adaptation to impacts of climate changes

RL2: Act to reduce the risks to highly vulnerable landscapes from climate changes

(Hawkesbury–Nepean CMA 2013)

HCRCMA

Strategy 1.5 Plan for adaptation and mitigation of climate change

- a) Adaptation in areas subject to increased flooding and erosion due to climate change is planned to reduce impacts on social and economic values, prime agricultural land and biodiversity
- b) Native vegetation and soils are used to reduce levels of greenhouse gases in the air
- c) Planners and natural resource managers consider predicted impacts of climate change
- d) Corridors and habitat connectivity are designed and put in place to reduce the impacts of climate change

Strategy 3.2 Increase knowledge and awareness by organisations and institutions, individuals and communities.

- c) Barriers to natural resource management behavioural change and participation are identified and addressed.
- f) The economic and social benefits of climate change mitigation and adaptation in understood by all sectors of the community.

Strategy 4.3 Increase soil carbon

- a) Increase soil carbon to improve soil health

4.6 Understand and reduce the impact of climate change on soils

- a) The potential impacts of climate change on soils of value to agriculture and biodiversity and understood and managed for by government, industry and land managers.

Strategy 6.3 Prevent and reduce threats to biodiversity

- h) Natural resource and landuse managers and decision makers plan, prevent, minimise and mitigate the potential impacts on biodiversity of climate change and population growth, on land and in aquatic environments.

Strategy 7.1 Reduce the production and emission of greenhouse gases

- a) New and existing terrestrial and aquatic vegetation is used to absorb carbon dioxide from the air.
- b) Businesses, industry, organisations and individuals supported to reduce the production and emission of greenhouse gases.
- c) Soil carbon is increased to reduce atmospheric carbon.

Strategy 8.1 Establish a holistic governance framework for the estuarine, coastal and marine zone

- c) Planning instruments applying to estuaries and the coastal zone address the physical, biological, social and economic impacts of climate change.

Strategy 8.3 Minimise and mitigate threats to marine and estuary values, including those threats land management practices in the catchments.

- h) Hard engineered foreshore stabilisation structures including sea walls are restricted, but where necessary are designed to be adaptable and provide habitat and maintain ecosystem function.

Strategy 9.2 Create and support healthy communities with healthy people

- c) The potential for increased or new diseases resulting from climate change and degraded ecosystems, is understood, prevented or reduced.

9.4 Plan for and reduce the impacts of natural disasters

b) Impacts of natural disasters including fire and flooding on communities and community infrastructure are prevented or reduced through planning and consent bodies which consider climate change and through infrastructure management.

d) Plans are in place to help the community respond to potential shocks caused by changes in the environment and ecosystem function, such as diseases pandemic, disease in key food source, or failure of water supply.

e) Natural buffer zones are in place to provide property protection from storm events, coastal erosion and sea level rise.

f) Risks posed in fire-prone areas are minimised with minimal impact on the natural environment.

Strategy 10.2 Support local production and diversification

f) Farming practices suited to changing climatic conditions are understood and adopted by skilled, adaptable and well-resourced primary producers.

(Hunter-Central Rivers CMA 2013)

NR CMA

No specific targets (Northern Rivers CMA 2013). Relevant strategic directions (SD) and actions are listed below.

SD 2.4 Managing and mitigating the impacts of climatic variation and extreme climatic events on natural systems

2.4.1 Ensure adaptation strategies and management options for climate variation and extreme climatic events are incorporated within landscape and seascape plan development and delivery.

SD 3.2 Addressing existing and emerging threats that influence natural resource productivity and resilience, including land-use/sea-use change, climatic variation and extreme climatic events.

3.2.4 Ensure adaptation strategies and management options for climate variation and extreme climatic events are incorporated within regional land-use and sea-use planning best practice (including disaster readiness, protection of potential for food and fibre production, and climate variability risk normalisation).

3.2.5 Ensure adaptation strategies and management options for climate variation and extreme climatic events are incorporated in best practice (including disaster readiness, industry monitoring, holistic conservation and production synergies, and climate variability risk normalisation).

SD5.2 Implementing effective and collaborative processes to progress regional and SE Landscape planning, delivery and reporting.

5.2.3 Develop and implement a comprehensive regional reporting process that includes natural resource health, community capacity, engagement and partnerships, climate change and linkages to statewide and national reporting.

SD 5.3 Integrating policy and strategic initiatives (including 'climate ready' thinking) into regional and SE Landscape planning, delivery and reporting processes

5.3.1 Develop and implement a process for integrating policy and strategic initiatives (including climate ready thinking and planning) into regional and SE Landscape planning, delivery and reporting processes.

5.3.2 Enhance the capacity of the community to take advantage of new policy initiatives to improve NRM (e.g. carbon farming).

5.3.3 Enhance community understanding of the need to implement adaptation strategies to spread the risks associated with climate change.

SD 5.4 Aligning knowledge and integrating research to support evidence-based NRM

5.4.2 Support research and development into climate change impacts and adaptation options.

SEQC

A 1 – Greenhouse gas emissions: By 2031, the region will make an equitable contribution to the national and regional targets for reduction in greenhouse gas emissions.

NC 2 – Vegetation fragmentation and connectivity: By 2031, there will be no net fragmentation of larger tracts (greater than 5000 ha), and 20% of priority smaller tracts (less than 5000 ha) will be better connected than the 2003 baseline.

L 4 – Soil organic matter: By 2031, the level of soil organic matter (carbon in t/ha) in agricultural soils will be higher than in 2008 or baseline year. (Note this is framed in the document as a soil condition target not as a climate change action.)

(Queensland Department of Environment and Resource Management 2009)

BMRG

AC1 - By 2018 the utilisation of carbon storage capacity in soils, vegetation and other bio-sequestration initiatives will be greater than 2013 baseline.

AC2 - By 2018 the net benefit to primary producers from participating in carbon farming initiatives will be greater than the 2013 baseline.

(Burnett Mary Regional Group 2012)

FBA

Management action targets M9 and M10:

Practices and technology developed and implemented to minimise net greenhouse gas emissions within 10 years

Set regional targets for greenhouse gas emissions, particularly carbon maintenance and sequestration within 10 years

(Fitzroy Basin Association 2002)

Appendix G. Summary of regional bodies' needs

Need
Project planning
Project plan with deliverables and dates, noting those that are fixed or flexible (or fixed date with flexible content).
One page summary of the project for communication and engagement with stakeholders and within regional bodies.
Consortium understanding of multiple roles of regional bodies; capacity and resource constraints in using data; and networks, communities of practice and mode of operating (in partnership, not a linear process with complete control).
Identification of the alignment between the proposed consortium outputs and the decision timeframes / planning milestones for the regional bodies, based on: <ul style="list-style-type: none"> a summary of the proposed consortium outputs over the life of the project a summary of the decisions the regional bodies will be making over life of the project and the key points in the planning cycle information needs for each of the key planning decision points. This will clarify how the research outputs will inform regional NRM planning and allow the regional bodies to take into account proposed outputs when undertaking planning and engagement.
Regular (annual?) needs workshop to evaluate how consortium outputs can inform the current stage in the planning cycle for each regional body (noting that the regional bodies will be in different stages).
Project outcomes and timeframes communicated to the CEOs of the regional bodies (particularly CMAs where these roles will be changing), using examples relevant to each of the regional bodies, to ensure continued support for the project and capacity within the regional bodies to participate.
Monitoring and evaluation strategy that captures uptake of information and learnings by regional bodies.
Reflection document on the first workshop (and future workshops and capacity building).
Capability statement from researchers, including interests, skills and capacity, and scope and flexibility in this project.
Clarification on the different products / outputs to be delivered by the CSIRO and NarClim projection projects, particularly as they relate to NRM planning.
NRM process and governance
Impacts of climate change on funding priorities of investors (especially federal government) – what does this mean for what regional bodies are doing; how can regional bodies influence funding priorities; how can regional bodies respond to changes in funding sources e.g. the carbon tax.
Understanding how relevant plans and policies at state level impact on NRM planning. Understanding pathways of influence into other institutions and other types of planning – e.g. how to feed into state and local government plans, including regulatory plans, particularly where there is no explicit consideration of climate change.
Process for operating under continued uncertainty and an environment of change - this is a challenge, but climate change may offer over-arching crisis/opportunity for building multi-partisan support.
Incorporating climate change thinking into existing processes for NRM – constructing a narrative around the need to reduce future risk by undertaking actions that mitigate climate change and build resilience to climate change while managing and building resilience to current threats. This can address immediate concerns while building up understanding of the need to manage issues over longer time frames based on projections.
Knowledge management
Knowledge management tools to support community, adaptive planning and institutional engagement (data management and institutional coordination). Knowledge management needs to provide mechanisms to coordinate across institutions (e.g. local government will be custodians of some data).
Need knowledge, not data - need to ensure that there is not too much data, and that the information is relevant to decisions to be made during the project in relation to strategic NRM planning and plan implementation, and to existing tools and systems used by the regional bodies. Information needs to be legitimate, credible, salient, and available at the right time. Need ways of interpreting and unpacking data.
Processes and tools to institutionalise collective learning.
Monitoring and evaluation – need a streamlined approach that links to the quantitative reporting that regional bodies need to do, with a link between outputs and outcomes (noting that many other factors influence outcomes – NRM targets may be met but overall natural resource condition may still decline). Also needs to be able to capture outputs

Need
from other organisations e.g. local government, as plans are framed as all of government.
Climate projections
Climate change scenarios based on projections at relevant scales for regional bodies to use as a basis for community engagement. Two reports (Qld /NSW). Finer scale information may be required for spatial planning – may need guidance on applying coarser-scaled information on climate to finer-scaled ecological information.
Projections based on 20 year intervals starting at 2030 are useful to feed into 10-year NRM planning cycles – presented as a sequence of climate change impacts over the time frame. Would be useful to agree on standard timeframes for research projects.
Projections based on AR5 or best available data, including: <ul style="list-style-type: none"> - Temperature - Rainfall - Extreme events (fire, cyclones, storm surge, flooding) - Sea level rise.
Rainfall, temperature and evaporation data interpreted to provide implications for changes in hydrology.
Support to interpret regional projections, e.g. in terms of how factors such as aspect, slope, rain use efficiency etc. will create variation in microclimates and create refugia (e.g. in relation to managing threatened species and communities).
Projections provided in a way that will inform consortium research on changes in vegetation including considerations of landscape variation and associated vulnerabilities of natural assets and socio-economic impacts, and can be used in scenario planning.
A suite of products from simple tools and messages to detailed package of materials to support planning at regional scales (not cluster).
Guidance on products and capacity building within regional bodies and stakeholders to use and understand projection products, including information on model parameters and limitations to build community confidence in using the data to support community-based planning (note that planning funding from Stream 1 finished in June 2014).
Biophysical
Impacts of projected scenarios on hydrology - using climate projection outputs on rainfall, evaporation etc. to assess hydrological impacts, for example groundwater systems, recharge, flow regimes (other organisations e.g. HCR water utilities may have done some work). Outputs provided in a way that allows other impacts e.g. mining, CSG and intensive revegetation to be incorporated.
Impacts of climate change on soil management and types of soil; impacts of soil changes on industry and implications for vegetation; potential to increase soil carbon (to improve productivity) (for some areas e.g. HCR there is good spatial mapping of soils now but no information on impacts; HN has identified areas with high potential for increasing soil carbon based on aggregating soil landscape units).
Impacts of changes in temperature, hydrology and soil on vegetation, including ecosystem shift in vegetation communities – impacts on priority species and habitats and refugia (e.g. broad vegetation groups, including coastal vegetation such as mangroves) (regional bodies can interpret impacts of vegetation changes on species).
Impacts of changes in temperature, hydrology, soil and vegetation on industry sectors, particularly agriculture and water utilities (e.g. impacts of East Coast Lows on water supply and large flows).
Impacts on marine ecosystems – species shift in seagrass, mangrove and reef communities (often forgotten as NRM focuses on catchment management and ‘on-ground’ works).
A landscape scenario emphasis is required that allows outputs for ecosystem shift to be integrated with existing tools used by regional bodies (e.g. MCAS-S); black box modelling that cannot be used or manipulated by the regional bodies (e.g. with stakeholder engagement on inputs) is not supported.
Impacts on biosecurity – disease impacts on crop and biodiversity, livestock industry.
Spatial representation of carbon farming potential, including socio-economic constraints. Common framework for how regions are producing carbon farming maps – e.g. developing a common metric to maximise total benefits (not just carbon).
Total benefits = carbon benefits + biodiversity benefits + co-benefits - risks
Risks to carbon farming activities from climate change (e.g. bushfire); changes to carbon farming species to account for climate change; and impacts from carbon farming (hydrological impacts from single-aged forest). A common framework for risk assessment may be useful to enable information sharing across boundaries.

Need
Risks from carbon farming, e.g. impacts on hydrology, fire regimes, community impacts and attitudes.
Regrowth calculator applied to NSW vegetation types (Keith classes, biometric classes) to feed into property planning and prioritisation and to understand options for maintaining regrowth.
Outputs from regrowth tool to include point queries and ability to access data layers for use in other applications.
Implications of climate change for fire management for vulnerable / highly valued vegetation communities (e.g. rainforest). (For example, HNCMA has applied for a project to assess optimal intervals for hazard reduction management for local communities that are surrogates for vegetation classes, and tools to localise this for other parts of NSW. This may help manage communities that buffer vulnerable communities such as rainforest.)
Socio-economic
Potential changes in industries over next 20-50 years, noting that industries that are in the region now may not be the same as those in the future. Impacts on community and industry sectors – how will biophysical changes impact industry sectors (particularly resource dependent industries such as agriculture and tourism, noting differences between industries across regions); vulnerability “hot spots” – which sectors / industries are most or least vulnerable and climate sensitive; what are the critical pathways of change. (Noting that other drivers e.g. socio-economic changes will also impact the joint ecological-socio-economic system.)
Outputs for biophysical and socio-economic vulnerability at relevant scale; spatial and text (report) outputs.
Impacts of disasters (especially flooding and impacts of East Coast Lows) on economic sectors e.g. tourism; adaptive strategies such as industry diversification, alternatives or preparation, improving resilience; time for recovery.
Socio-economic profiling to understand the beneficiaries of ecosystem services – links to the wellbeing of community and viability of industry and flow on effects from ecosystem change to services and wellbeing. How can communities adapt to soften impacts and how can the resilience of landscape be improved to provide services.
Trends in socio-economic indicators over time for each region, identifying any climatic trends that are already evident (particularly where these can be separated from other drivers).
Principal sustainability indicators; best method for monitoring socio-economic parameters related to NRM and climate change impacts.
Socio-economic determinants of carbon farming uptake (e.g. size of property, motivation, preference, capacity for uptake and adoption).
Understanding what industry already knows about climate change (to tailor engagement strategies).
Processes for indigenous engagement on climate change; impacts on cultural resources management planning.
Managing community expectations (e.g. derived from broad scope of Catchment Action Plans).
Planning
<p>Future landscapes (scenario planning) to support community / stakeholder engagement (scenario planning could be the vehicle to get broader stakeholder buy-in)</p> <ul style="list-style-type: none"> - what tools are available, how can they be used? - which tools can be expressed visually? - Ability to include stakeholder input is important - Capacity building to undertake scenario planning with stakeholders. <p>Scenario planning input:</p> <ul style="list-style-type: none"> - population projections - sea level rise, disasters (e.g. flooding, fire) - socio-economic vulnerability / resilience (for industry sectors) - coal / CSG land uses - other planning policies - carbon price - cross-cutting case studies
Translating systems-based strategic planning incorporating resilience assessment and ecosystem services into a tool / process that is relevant in a broader landuse planning context (traditionally an asset management based approach).
How can a broad NRM strategic plan be interpreted into an implementation plan (and the implementation plan actioned).
Processes to incorporate continual improvement in information in the cyclic planning process (currently longer term strategic planning and target setting, with shorter term investment planning and action (1-5 years).

Need
Evaluating what is working in NRM planning for climate change by assessing this and other projects across Australia to provide rapid feedback.
Processes to explore adaptation options (implementation strategies) with stakeholders (stakeholders will take responsibility for actions if given a likely sequence of events) in relation to the science and trajectories.
Translation of consortium outputs to a “user-ready” format that regional bodies can apply to their planning needs – products need to be accessible, applicable, and adaptable to regional priorities.
Planning packages to include climate trajectories and information, available information on impacts, processes for scenario planning, and tools from other research providers.
Examples of best practice planning approaches to NRM planning for climate change, including case studies of how climate change knowledge is being applied.
Cross-cutting
How to move from asset based model to systems based resilience model, identifying drivers of change (shock or slow change), critical pathways of change (including mal-adaptation or path dependence) bringing biophysical and socio-economic information together (e.g. capacity to undertake NRM activity) to determine responses.
Ecosystem services focus – what industry sectors and communities are vulnerable / sensitive to changes in ecosystem services as a result of biophysical changes due to climate change; represent this on a timeline / sequence of impacts.
Processes to work with sensitive stakeholders (stakes are higher than in the past) – e.g.: <ul style="list-style-type: none"> - sequencing climate change impacts e.g. next 10, 20, 30 years - understanding sensitivities / vulnerabilities - knowing what industry already knows about climate change - knowing how to take the agenda forward when there are lots of things changing.
Case studies – how do case studies inform scenario planning; are case studies the most useful approach and what are the alternatives; what scale would case studies be drawn at; how could benefits and learnings from case studies be shared; how to maximise applicability to specific area and generalizability to other areas.
Summary of currently available information and tools, including learnings from NCCARF case studies.
Most regional bodies have limited GIS and modelling capacity - project outputs need to be “engagement ready”.
Ongoing engagement with the regional bodies to ensure outputs are useful, aligned with needs, and timely.

Appendix H. Draft Terms of Reference for the Planners Working Group

Background

This Project aims 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.

The East Coast Cluster consists of the coastal Natural Resource Management (NRM) bodies in Queensland and New South Wales between Rockhampton and Sydney. The Research Consortium comprises: University of Queensland (Consortium leader); Griffith University; University of Sunshine Coast; CSIRO; New South Wales Office of Environment and Heritage; and Queensland Department of Science, IT, Innovation and the Arts (Queensland Herbarium).

The project is being undertaken under the auspice of the Australian Government’s Natural Resource Management Climate Change Impacts and Adaptation Research Grants Program (Stream 2), managed by the Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education. The regional bodies also have funding under Stream 1 of the program to revise NRM plans and identify where in the landscape climate change adaptation and mitigation activities should be undertaken.

The Project will:

1. engage with the regional bodies to determine their climate adaptation needs over the range of biophysical and socio-economic conditions in the region
2. collaborate in identifying a range of existing data, assessments, tools and processes suited to enhance adaptation over a wide range of regional contexts (catchment, rural, peri-urban, coastal)
3. support the regional bodies in the synthesis, translation, interpretation and use of climate projections and its use in planning and decision making for NRM investment
4. develop a whole-system framework to enable climate vulnerability assessments under a range of scenarios and projections that incorporate biophysical and socio-economic components
5. facilitate dialogue to mainstream climate change adaptation within the regional bodies, and jointly deliberate over options for planning and decision support.

Planners Working Group (PWG)

The Planners Working Group (PWG) comprises the regional bodies in the East Coast Cluster and the researchers from Griffith University responsible for the planning outputs for the project. The PWG will be established following the first project workshop in May 2013. The overarching aim of the PWG is to support the building of a network of informed and articulate NRM agents with knowledge of current climate science and capacity to use current tools to engage stakeholders in NRM planning for climate change adaptation..

Objective and role

The objective of the PWG is to facilitate the adoption of project outputs and outcomes by the regional bodies.

The role of the PWG is to:

- contribute to, and provide support for, the development of NRM Planning Packages for climate adaptation options
- provide a forum for the regional bodies to share ideas, information and practices relating to climate change adaptation
- provide advice and support to the cluster representative on the Climate Projections User Panel and the Cluster Leader for the national project
- provide advice on needs of the regional bodies in relation to climate change adaptation to the Consortium researchers
- provide reviews of project outputs and comments on draft reports
- identify key contacts and information for the project, suggest target audiences for project outputs and, where appropriate, promote the project and its findings in appropriate forums
- assist the project team to disseminate the project outputs through their respective networks
- provide advice on linkages to other relevant programs and projects in the project study areas

- co-generate climate adaptation planning packages including knowledge, tools and capacity building components
- actively participate in evaluating the translation of project outputs into NRM outcomes
- guide project team to relevant data sources and information
- provide input regarding communication guidelines and strategies.

The contributions from the PWG members will be acknowledged on all relevant project outputs.

Membership

The membership of the PWG will include:

- planners from each regional body of the East Coast Cluster and proxies
- research staff from Griffith University.

It is desirable for at least one representative (planner or proxy) from each regional body to attend each scheduled activity. The secretariat for the PWG will be provided by Griffith University.

Activities

Activities of the PWG may include regular meetings, workshops, participation in discussion boards and training or capacity building sessions. Other researchers or participants may be invited as required.

Activities will be held twice a year, and/or as required, throughout the duration of the project. Activities may be scheduled to coincide with strategic project milestones when the project can benefit from expert advice and feedback. Extraordinary activities can be scheduled if required. Other activities (e.g. research collaboration, online discussions or comments on project outputs) may occur throughout the project.

Appendix I. Summary of Stream 2 project proposals

Stream 2 project proposal summaries as provided in the first national stream 2 project workshop (Australian Government Department of Climate Change and Energy Efficiency 27-28 February 2013).

Stream 2 of the NRM Fund



Facilitating NRM planning for climate change - baseline climate change knowledge for the Southern & Southwestern Flatlands

University of Western Australia

Partners

Centre of Excellence in Natural Resource Management,
University of Western Australia

Department of Environment, Water and Natural
Resources, South Australian Government

Eyre Peninsula Natural Resources Management

South Coast Natural Resource Management Inc.

Project Objectives

Provide NRM regions in the Southern and South-Western Flatlands with primary climate change impacts data which will enable them to identify where in the landscape climate-change adaptation and mitigation should be undertaken.

Synthesize and produce spatial data layers of climate change projections for biodiversity and agriculture.

Provide information that will allow NRM groups to identify priority areas for conservation (e.g. climate refuges) and revegetation (including carbon plantings undertaken as part of the Carbon Farming Initiative), high invasion potential and thus pest and weed control, and agricultural activity.

Support the incorporation of projections of biodiversity distributional and agricultural changes in the face of future climate change into NRM planning for the cluster.

Act as a catalyst for regional collaboration, with a major goal being the sharing of planning expertise and experiences across the regions.

Project Activities

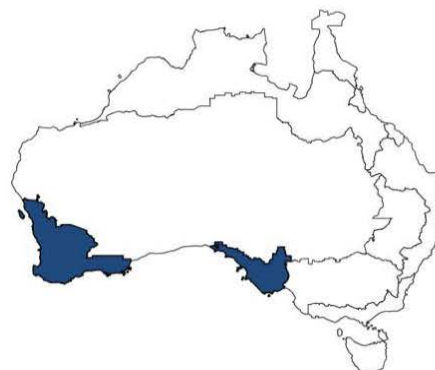
Priority identification workshops to determine priority data needs and planning tools used.

A review and synthesis of existing climate change projection research and the production of spatial data layers of climate change projections for biodiversity and agriculture to support decision-making.

Research to fill identified information gaps and synthesize knowledge of the potential large scale patterns of bioclimatic range shifts in the "Flatlands" under projected future climates using existing data from various sources (e.g. species distribution modelling, hotspot analysis, land-use projection modelling) and results from new bioclimatic modelling analysis.

Two sets of planning and training workshops to guidance and the provision of ongoing support.

Undertake Monitoring and Evaluation (M&E) at the project level and provide input into Stream 2 Program M&E.





Stream 2 of the NRM Fund

Building Resilient NRM Communities in the Central Slopes Region

University of Southern Queensland

Research Partners

NSW Office of Environment and Heritage

Qld Department of Agriculture, Forestry and Fisheries

University of Canberra (Institute for Applied Ecology)

Research and Delivery Partners

Border Rivers CMA

Central West CMA

Condamine Alliance

Namoi CMA

Queensland Murray Darling Corporation

3. Develop models of local climate impacts, identifying 'hot spots' such as threats to critical refugia or threats to cropping viability.

4. Locate climate change impacts and adaptation within broader regional change drivers and processes, such as the Murray Darling Basin Plan.

Project Objectives

To increase the knowledge and capacities of Central Slopes NRM organisations so they can better identify, develop and communicate adaptation options. The value-added by the project will be appropriate to the nature of each region and the capacity and mission of each organisation.

Project Activities

1. To identify and learn from existing data, models, tools, projects, project reports and communication strategies. This review will provide ideas for the Cluster members and other cluster teams, especially at informing draft plans.

2. Analyse NRM organisational culture and capacity so that recommendations and decision support tools are appropriate.



Climate Change Adaptation Across Australia's Monsoonal North



Charles Darwin University

Partners

CSIRO

Griffith University

University of WA

James Cook University

Description

This project will provide improved knowledge, tools and management options to NRM bodies in the Monsoonal North Cluster (MNC) to enable them to better adapt to the challenges imposed by a changing climate. The key end users for this project are the senior staff and board members of the MNC. The MNC has more modest resources than its counterparts elsewhere in Australia, with fewer senior staff with extensive experience in regional planning processes or climate adaptation science (Kate Andrews pers. comm.). Ecological information is less available in the MNC compared with elsewhere in Australia.

The MNC have advised that they are seeking an interactive mode of project delivery based on direct relationships with relevant scientists facilitated by a dedicated knowledge broker. This will build institutional capacity and allow solutions to be developed that are regionally relevant to the specific management issues faced by each organisation.

The project will work across the following broad themes:

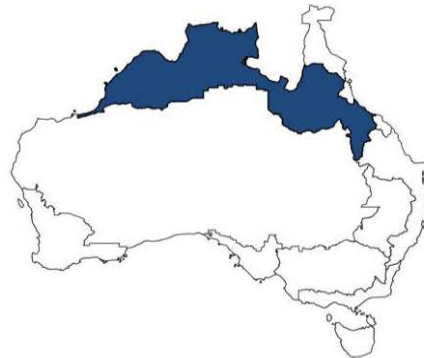
- Resilience of society and the environment
- Land and Water Resources
- Biodiversity
- Planning tools and processes
- Knowledge Brokering will be a cross-cutting theme

Our knowledge synthesis and research will focus on direct impacts (increased temperature, increased CO₂, sea level rise) and indirect impacts (such as change in pest species distribution, altered fire regimes, habitat loss). This will encourage peer-learning and develop Cluster-wide approaches to NRM planning for adaptation to climate change, as well as tailored outputs that meet the specific requirements of individual NRM bodies.

Products to be delivered include:

- species distribution models;
- risk and vulnerability assessment/models;
- scenario evaluation tools;
- maps and spatial datasets; and
- knowledge, training and mentoring workshops,
- an analysis of knowledge gaps and future research priorities.

The project plans to make full use of existing communication systems that the MNC bodies are already using, as well as the knowledge management systems of the partner organisations.





Stream 2 of the NRM Fund

Planning for climate change in the Murray Basin NRM Cluster

CSIRO

Partners

Interface NRM

Department of Environment, Water and Natural Resources, South Australia

NSW Office of Environment and Heritage

Department of Sustainability and Environment, Victoria

Overview

To further embed climate adaptation and cross-border consistency into planning, the key challenge in the Murray Basin Cluster is to respect and work with the diverse range of sophisticated planning approaches these NRM Groups already use. Thus, we have designed a flexible project to refine the links between climate adaptation modelling and planning processes. To successfully deliver, we have assembled broad-based expertise (biophysical, social, and economic; and modelling, planning and engagement) to respond to NRM Group needs that emerge, and our team includes local trusted advisors who already have extensive experience working with NRM Groups within the Cluster.

The project team is: Dr Linda Broadhurst (Project Leader, CSIRO PI); Dr Veronica Doerr (CSIRO ES); Dr Andy Reeson (CSIRO ES); Paul Ryan (Interface NRM); Dr Russell Crosbie (CSIRO LW); Dr Keryn Paul (CSIRO ES); Dr Michael Drielsma (NSW OEH); Dr Jaymie Norris (DSE Victoria); Dr Phil Pisanu (DEWNR SA); Dr Sam Nicol (CSIRO ES)

Project Objectives

Produce a Cluster-wide inventory of information and processes currently underpinning climate adaptation decisions within the Cluster to build cross-boundary synergies and identify gaps in knowledge, tools and processes.

Fill identified gaps by providing knowledge for key drivers such as carbon, biodiversity (including wildlife corridors), water, land-use change and productivity, invasive species, social-ecological dynamics and their interactions.

Work with NRM groups to develop a framework for how knowledge can inform adaptive decision-making processes at multiple scales and into an unpredictable future.

Work within the context of the likely delivery mechanisms for making plans a reality (e.g. the Carbon Farming Initiative, the Biodiversity Fund).

The project consists of three components:

Component 1 – Collate existing tools and gap analysis

Existing tools/information/products that NRM planners are currently using will be collated as will other resources that NRM planners may not be aware of but that they may find useful. This information will be synthesized into an easy to understand resource that provides information such as what each resource does, where it can be found, how it can be used or where training material can be found, when might a resource be useful and when it may not. This collated resource will be provided to the Cluster through an online shared interactive site that will be owned and maintained by the Cluster.

Component 2 – Prioritise and fill gaps

The synthesis of resources will be used by the NRM planners with guidance from the project team to identify and prioritise gaps that will help them plan more effectively for climate change. Gap filling will be contingent on the capacity and budget of the project team to undertake.

Component 3 – Realisation

Develop a decision making framework to assist NRM planners navigate the existing and new approaches including a training module for future NRM capacity building.





Climate Change Adaptation for natural resource management in East Coast Australia

University of Queensland

Partners

Griffith University

CSIRO

University of Sunshine Coast

New South Wales Office of Environment and Heritage

Queensland Department of Science, IT, Innovation and the Arts (Queensland Herbarium)

Project Summary

This Project aims 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.

Our Project will:

1. Engage with the East Coast NRM Cluster to determine their climate adaptation needs over the range of biophysical and socio-economic conditions in the region.
2. Collaborate in identifying a range of existing data, assessments, tools and processes suited to enhance adaptation over a wide range of regional contexts (catchment, rural, peri-urban, coastal).
3. Support the NRM regional bodies in the synthesis, translation, interpretation and use of climate projections and its use in planning and decision making for NRM investment.
4. Develop a whole-system framework to enable climate vulnerability assessments under a range of scenarios and projections that incorporate biophysical and socio-economic components.
5. Facilitate dialogue to mainstream climate change adaptation within the NRM Cluster, and jointly deliberate over options for planning and decision support.

The Project, and the expected collaboration with NRM partners, will bring together an extensive portfolio of research and outreach capacity for climate adaptation including; the South East Queensland Climate Adaptation Research Initiative, the regional climate modeling and software tools developed by NSW OEH, QLD gov and UQ, together with the extensive knowledge and experience that lies within the NRMs. The Project will work with the NRM Cluster to scope their diversity and needs identifying the availability of existing information and available tools. We will develop and tailor approaches so that regional bodies can use the data, projections and tools in their own contexts. We will synthesize the available data, coordinating closely with national level data providers (e.g. CSIRO, BoM, ABARE). We will work with the NRM Cluster to develop understandings of potential changes in the conditions of regional biodiversity, natural assets, ecosystem services, in particular carbon storage, and work with the NRMs to identify key areas of concern. We will work towards assessment of the impacts and vulnerabilities of the region integrating both biophysical and socio-economic data. The Project will identify and evaluate different options for adaptation, their trade-offs and work toward refining regional planning processes to accommodate their incorporation.





Stream 2 of the NRM Fund AdaptNRM—delivering regionally-relevant information for NRM

CSIRO

Partner NCCARF

Our project seeks to capitalise on the unique opportunities of a national project, delivering knowledge, processes and tools to NRM groups to support climate adaptation planning. The project will deliver tailored knowledge from existing mature intellectual property to maximise its impact for NRM planning processes. It will complement Cluster projects by providing those aspects of regionally-relevant information that can most efficiently be delivered in a combined national package.

We will deliver a set of information and data products of widespread importance in NRM planning relating to climate vulnerability and impacts on biodiversity (tabulated below), tailored to user needs. The engagement approach we are developing (which we call 'AdaptNRM') aims to efficiently link scientists providing information with end users across the country, through an engagement team who will assist NRM participants to conduct structured discussions of project information. Information will be delivered using a two-tier approach. The most important messages and fundamental adaptation planning principles will be delivered through carefully crafted, simple communication products that seek to develop a base level of understanding and capacity as broadly as possible across the country. This will be supported by more detailed and technical information and data.

The engagement process, topics covered and deliverables of the project are summarized below:

Component	Description
1. Climate adaptation knowledge sharing (AdaptNRM) – the people:	
a. AdaptNRM engagement team	The knowledge sharing and planning support will use a scalable collaborative approach (AdaptNRM). The AdaptNRM engagement team, supported by a knowledge broker, will facilitate the two way flow of information between scientists
b. Content development teams	The information in the project will be delivered as a set of modules, each of which will cover a different aspect of adaptation planning. (The likely topics are listed under 2 below, and the deliverables for each module under 3). A team of scientists with expertise in the area will develop the technical content for each module and work with the AdaptNRM team to develop this into simple communication products.
c. NRM planner groups	Groups of NRM participants will be identified at the start of the project and relationships established (hopefully in collaboration with cluster project workshops). Within each group a facilitator will be trained. Assisted by the AdaptNRM team, participants will conduct structured deliberative group discussions on each module using the guidance material provided (see 3).
2. Adapt NRM module topics (subject to revision) – the content:	
a. Understanding vulnerability and adaptation planning	Covers the social and biophysical influences that contribute to climate vulnerability. Identify broad principles for adaptation planning pathways and decision-making framework (including the types of information that are most needed and the timing of when particular decisions/information becomes important).
b. Invasive plant species	This would provide data and maps of projected shifts in distributions of invasive species, together with guidance on how to interpret the data and principles and implications for adaptation planning. Data products will be of national (or broad cross-regional) extent, but of moderate resolution, suitable for region-specific analysis. Actual data outputs and mapped presentations will be developed in collaboration with NRM groups.
c. Biodiversity (likely 2 modules for this)	This could include data and maps of projected broad macro-ecological shifts in major plant and animal groups, changes in 'effective habitat area', locations of climate change refugia, climate change corridors, and/or potential benefit of adaptation management actions (such as assisted migration and restoration of cleared or degraded habitats). Effective approaches will be developed to visualise these high resolution complex model outputs and to extract key principles for adaptation.
d. Shared learnings and M&E	Capture and share learnings across all NRM regions on their experiences in adaptation planning, including effectiveness of project contributions and requirements to effectively implement the plans.
3. Adaptation planning support products (linked to AdaptNRM modules) – the deliverables:	
a. Simple summaries for each module	Simple, plain language summaries of the key adaptation messages and background understanding for each module. (These summaries will be prepared from the technical guides developed below). Each summary will end with a set of questions to structure group discussions and provide feedback. Content from these summaries will be used to build up carefully crafted interactive PDF tools to further emphasise and communicate the most important adaptation principles
b. Technical guides	Technical guides summarising relevant information for each topic, providing guidance on how to interpret associated data sets, and extracting important principles for climate adaptation.
c. Internet access	Basic internet presentation of guidance information and data sets developed above.
d. Frequently Asked Question, responses	The group discussions of AdaptNRM modules provide the opportunity for end users to provide feedback and queries. Commonly emerging themes from this feedback will be identified and responded to by progressively building a set of FAQ responses.



Stream 2 of the NRM Fund

Integrating Climate Change Science into Rangelands Natural Resource Management - Rangelands Cluster

Ninti One

Partners

Monash University
CSIRO
Rangelands Alliance

Project Overview

The project will work with Regional NRM organisation within Rangeland Australia to:

- to make better-informed decisions and strategic investments in relation to climate change.
- identify information needs and plan responses to climate change that deliver optimum NRM outcomes and minimise maladaptation
- provide highest quality climate change adaptation information that acknowledges the complex interactions within the Rangelands NRM Cluster and can be easily integrated with information used by NRM planners, such as grazing science, biodiversity, feral animal control, economics, social science and water use
- build capacity of both NRM planners and climate change scientists to better understand on-ground challenges, fill gaps in knowledge and create multidisciplinary teams to deliver adaptive responses.

Project Activities

Workshops to define climate adaptation knowledge gaps and information needs, and provide guidance on the most

effective mechanism to deliver climate adaptation information for regional NRM planning.

The synthesis of current climate change knowledge relevant to NRM planning processes.

Assembling and delivering reports, maps, spatial databases, multimedia tools and web-based repositories to support the incorporation of climate change impacts and adaptation information into NRM planning.

Provision of ongoing support and guidance to NRM groups to enable the incorporation of climate adaptation information within regional planning.

Undertake monitoring and evaluation at the project level and provide input into Stream 2 Program M&E.





James Cook University

Partner: CSIRO

Project Overview

This cluster contains a broad range of land and seascapes including globally significant savannas, the vast majority of Australia's tropical rainforests, wetlands and low lying tropical islands. It also contains a high proportion of the Great Barrier Reef catchment. The region contains the Wet Tropics Great Barrier Reef World Heritage Areas with discussion for a third World Heritage Area nomination for parts of Cape York Peninsula. Arguably, this cluster supports more species overall than any other NRM cluster with many endemics. Only the South West of Western Australia is richer in plant species. The climate change threat to biodiversity has been especially well documented for the Wet Tropics rainforests. While much of the cluster's rainforest is in conservation reserves important areas are not, including many fragments and recovering forests on abandoned, previously cleared land. Management of off-reserve lands in response to climate change present both important opportunities and potential threats to biodiversity. Along with very high biodiversity values, there are numerous and substantial economic and cultural values including tourism, extensive and intensive agriculture, mining, fisheries and large areas of Aboriginal lands. Much of the cluster's area is "highly contested" with multiple and sometimes conflicting demands for the region's natural resources. Climate change is likely to exacerbate the issues and challenges.

Access to expertise for the Wet Tropics NRM cluster organisations will be provided through a Brokering Hub, which will establish a network between the science providers and the NRM planners and other key staff. The Brokering Hub enables seamless integration between the Stream 2-funded research to produce regional-level climate information, and the Stream 1-funded support for updating regional NRM plans with climate impact information and adaptation pathways. Three expert nodes will provide the identified science needs and will link directly into the Brokering Hub:

1. Science information availability and quality node - delivering synthesis reports and data products backed up by effective guides and tools to underpin information sharing, including through the participatory scenarios.
2. Participatory scenario and knowledge integration node - delivering scenarios that integrate scientific, local and

Indigenous knowledge and support social learning.

3. Priorities and opportunities node – delivering spatial products, data and indicators, and supporting the NRM organisations to develop GIS platforms (e.g. Community Viz) for collaborative prioritisation of carbon and ecosystem services within landscapes and for prioritisation of effort into adaptation pathways that will maximise opportunities.

An adaptation pathways co-design cycle provides the systematic framework through which the project will be delivered in partnership with the Wet Tropics NRM cluster organisations to ensure delivery to their needs. This approach combines the strengths of conventional risk management approaches to climate impact response with those of adaptive collaborative planning.

Products will build on best no regrets approaches and include:

- Syntheses of regionally relevant ecosystems and landscape impact and adaptation responses to climate change, that includes information from the scientific literature and incorporates work that the NRM organisations are championing (e.g. resilience and adaptation planning, carbon and ecosystem services, no regrets solutions, marine and terrestrial corridors).
- Regionally specific case studies that encapsulate key issues.
- Participatory scenario analysis to build on existing work and integrate local knowledge and experience.
- Planning tools.





Stream 2 of the NRM Fund

The South Coast Climate Change Adaptation Research Partnership (SCARP)

Southern Slopes Cluster

University of Tasmania

This SCARP project will facilitate collaboration between scientists and NRM decision-makers to inform climate change planning strategies for NRM. The project involves a consortium of inter-disciplinary researchers, extension professionals and knowledge brokers who will work with NRM organisations in the Southern Slopes Cluster to develop climate change adaptation pathways. The project will achieve this by:

- Working with NRM organisations to iteratively refine the demand for climate applications, and draw on a consortium of applied scientists to meet this demand;
- Implementing, monitoring and evaluating a robust partnership between researchers and NRM planners and decision-makers;
- Providing regionally relevant planning tools based on up-to-date climate change at appropriate scales and formats to address critical climate change adaptation challenges;
- Sharing information and key adaptation lessons across regions and jurisdictions;
- Assisting NRM bodies to develop the capacity to apply climate impacts and adaptation information to regional NRM planning.

First phases activities will include workshops, interviews and extensive informal communications to identify needs and priorities.

The SCARP Project Partners (and leaders) are:

- Tasmanian Institute of Agriculture (TIA) from the University of Tasmania
- University of Melbourne
- DPI Victoria
- Department of Sustainability and Environment Victoria
- DPIWE Tasmania
- University of Technology Sydney
- Office of Environment and Heritage NSW

Project governance:

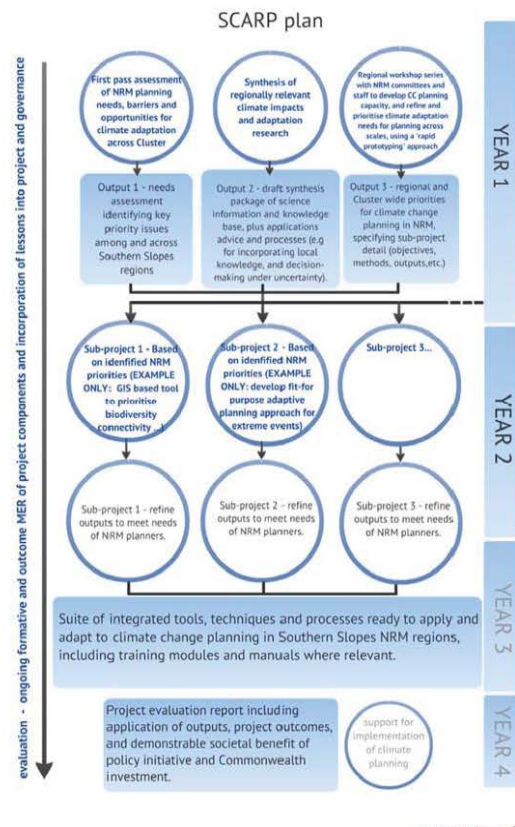
Tier 1: A steering group: an independent chair, nominated NRM organisation representatives, lead consortium members and project coordinators as secretariat;

Tier 2: The cluster working group: project staff employed and planners from each CMA (9 planners);

Tier 3: Regional working groups: key NRM staff and project staff to work directly on region specific issues.



The SCARP project will deliver 'demand driven research' tailored to meet the needs of decision-makers. This type of research works iteratively to integrate relevant science with the needs capacities of end-users in NRM, within a broader partnership model, as depicted in the schematic below:





Stream 2 of the NRM Fund

Delivery of climate change projections for Australia's NRM regions

CSIRO and the Bureau of Meteorology

Introduction

CSIRO, with support from the Bureau of Meteorology, is developing climate change projections for Australia's Natural Resource Management (NRM) sector. The projections will be used to assist in managing Australia's land and natural resources in a changing climate. CSIRO and the Bureau will be working closely with the NRM and research communities to ensure climate change projections support the medium term regional planning for climate change.

New Climate Change Projections

The new climate change projections for Australia have been funded under the Regional NRM Planning for Climate Change Fund as part of the Australian Government's Clean Energy Future plan. The Department of Climate Change and Energy Efficiency is the responsible Australian Government agency. The climate change projections that will be delivered in 2014 will be the most extensive set developed in Australia's history, with a focus on delivering information to the NRM sector to support the integration of climate change knowledge into planning processes.

What's new in 2014?

- New climate model results from the Climate Model Intercomparison Project Phase 5 (CMIP5)
- Combination of multiple downscaling methodologies for finer scale information
- Provision of ready-to-use climate change projection data sets for multiple applications
- Use of new IPCC emissions scenarios: Representative Concentration Pathways (RCPs)
- Comprehensive analysis of observed climate trends across Australia
- Comprehensive locally relevant and regionally searchable web portal

Common meteorological variables	Other variables and weather phenomenon
Temperature, precipitation, relative humidity, solar radiation, potential evaporation, wind speed, sea surface temperature, Sea Level Rise (Mean change and extremes)	Tropical cyclones, east coast lows, El Niño Southern Oscillation
Fire danger, Growing Degree Days and runoff	Snow cover, drought, hail, tornadoes

Web portal

Climate change projections for Australia's NRM regions will be delivered through the website www.climatechangeinaustralia.gov.au. This website was also used for the delivery of Australia's climate change projections in 2007. Those projections were delivered as probabilistic maps of projected change in climate variables using time slices of 2030, 2050 and 2070. For the new website, a Climate Projections User Panel will be established to ensure the website meets the needs of users. The panel will provide views about projection scope and use, presentation, delivery interface (website), guidance materials and training. Contact chris.gerbing@csiro.au to be a part of the Climate Projections User Panel.

Data sets and projections delivery

Climate change projection information will be available through both an analysis of projected changes (Technical Report, June 2014) and as application ready data sets (Full CMIP5 datasets June 2014). Upcoming stakeholder engagement will help to determine appropriate representations of future climate change for Australia's NRM regions.

Specific services and products provided to each cluster will include:

- An Element 1 climate change projections leader for each cluster
- Interim products sharing the results of climate change projections research – we would like to link with local NRM events
- A targeted report (June 2014) providing information and analysis on the projected climate changes for the region, the processes driving change and the confidence in the projections
- Access to the projections web portal, including training and guidance material on use of projections for risk assessments
- Access to a specialist projection liaison coordinator who will provide support for delivering application ready data sets.

Prior to June 2013 - Projection information based on existing CMIP3 products

July 2013 to June 2014 - Interim CMIP5-based projections with limited scope

September 2013 - Trial version of Climate Futures available.

July 2014 - CMIP5 data available for all variables. Training & guidance



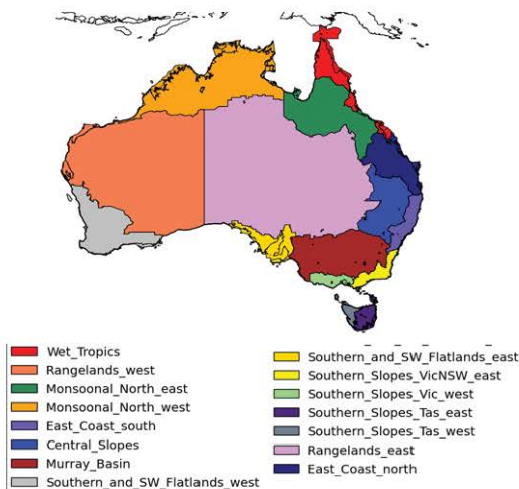
Stream 2 of the NRM Fund

Delivery of climate change projections for Australia's NRM regions continued

NRM Cluster Regions

NRM clusters have been organised according to common land use and climate characteristics. For the purposes of climate change projection modelling and analysis some clusters have been further divided (shown below). No specific sub-cluster communication products will be provided. Where sub-cluster change data is of interest please contact your relevant Element 1 cluster leader.

Figure 1. Map of the sub-cluster regions being used for climate model analysis



Climate Futures Approach

The NRM climate change projections will build on the Climate Futures approach developed by CSIRO to simplify communication and management of the growing range of global and regional climate change projection information available.

Climate Futures (Figure 2) provides easy access to climate projection information, including ranges of uncertainty, model reliability and guidance on how to choose a subset of models

Temperature	Little change	Warmer	Hotter	Much hotter
Precipitation	Up to 0.5C warmer	0.5 to 1.5C warmer	1.5 – 3.0C warmer	More than 3.0C warmer
Much wetter (more than +15%)	No evidence	No evidence	No evidence	No evidence
Wetter (0 to 15% wetter)	No evidence	No evidence	Unlikely 4 models	Very unlikely 2 models
Drier (0 to 15% drier)	No evidence	Very unlikely 2 models	As likely as not 10 models	Unlikely 3 models
Much drier (more than 15% drier)	No evidence	No evidence	Very unlikely 2 models	Very unlikely 2 models

Figure 2. Climate Futures approach – Climate Futures software will allow users to identify a small number of future climates that are representative of the “most likely”, “best case” and “worst case” climate change outcomes.

for risk assessment. Data for each cluster can be downloaded for a suite of climate variables, years and emission scenarios. Climate Futures will also include information about how the CMIP5 projections compare with those from the older CMIP3 models and dynamically-downscaled models.

Key Contacts

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