



**GOULBURN
BROKEN**

CATCHMENT
MANAGEMENT
AUTHORITY

Regional Catchment Strategy Mid-term Review 2016



Table of Contents

1.	Executive Summary	4
2.	Introduction.....	5
2.1.	Guidelines and Principles.....	6
2.2.	RCS Evaluation	7
2.3.	Method for Review	8
3.	How is the Regional Catchment Strategy Performing?	9
3.1.	Is the RCS supporting the delivery of the 20 – 30 year objectives for biodiversity, land, water and people assets?	9
3.2.	Is the Vision and Purpose still appropriate?	10
4.	How is Implementation Going?	11
4.1.	To Embed the Resilience Approach	11
4.2.	Strengthening Partnerships	13
4.3.	To adapt to land-use change.....	16
4.4.	To adapt to water policy reform.....	19
4.5.	To adapt to climate variability	21
4.6.	To adapt to increased farm production.....	23
4.7.	Additional Action Required.....	25
5.	Is the Regional Catchment Strategy saying the things we think it should?	27
5.1.	Political and Strategic Changes	27
5.2.	Economic Changes	28
5.3.	Social and Environmental Changes.....	28
5.4.	Monitoring and Research.....	29
6.	What do our Stakeholders think?.....	30
7.	What do we need to do to prepare for renewal in 2019?	31
7.1.	Major considerations for RCS renewal?.....	31
	Appendix A: Understanding Progress and ratings	32
	Appendix B: Research undertaken by program 2013-16.....	36
	Appendix C: Peer-reviewed authorship by Goulburn Broken CMA staff 2013 - 16.....	49
	Appendix D: Current Research Priorities	50

List of Tables

Table 1: Evaluation and Reporting progress of the RCS	7
Table 2: Information used in mid-term review	8
Table 3: Long-term strategy implementation progress and Catchment condition at RCS mid-term review	9
Table 4: Embed resilience, strategic priorities, management measures, progress and key achievement	11
Table 5: Strengthen Partnerships, strategic priorities, management measures, progress and key achievements	13
Table 6: Adapt to land use change, strategic priorities, management measures, progress and key achievements	16
Table 7: Adapt to water policy reform, strategic priorities, management measures, progress and key achievements	19
Table 8: Adapt to climate variability, strategic priorities, management measures, progress and key achievements	21
Table 9: Adapt to increase farm production, strategic priorities, management measures, progress and key achievements	23
Table 10: Current initiative aimed at increasing progress of 6 year objectives	25
Table 11: Future initiatives needed to increasing progress of 6 year objectives	26

Table of Figures

Figure 1: Goulburn Broken Catchment	5
Figure 2: Fencing presentation held at Creighton's Creek.....	22
Figure 3: An effective silt fence after recent rains in the fire affected area.....	22

1. Executive Summary

The Goulburn Broken Regional Catchment Strategy (GB RCS) 2013-19 mid-term review provides an overview of progress towards long-term targets, strategic objectives, priorities and management measures contained within the RCS 2013-19. The Review also provides an opportunity to identify areas that require further attention and initiatives that may need to be considered in the RCS renewal phase.

The RCS Mid-term Review has been conducted using guidelines developed through the Catchment Management Authorities (CMAs) CEO's and the Victorian Catchment Management Council (VCMC). The Goulburn Broken CMA Board also developed a set of principles to be applied to the review process.

The Review was conducted using data collected through existing processes (e.g. Annual Report and Board Strategic Workshops), stakeholder workshops, an online survey and local case studies.

As articulated through the Goulburn Broken CMA's Annual Report, progress towards long-term strategy implementation varies across investment areas. Water quality in rivers and streams and Floodplain Management targets are "exceeding targets". Targets for Environmental flows, riparian and instream habitat and channel forms and biodiversity are "on target" and Shepparton Irrigation Region salinity, land health including dryland salinity and invasive plants and animals are "below target".

Progress against the RCS strategic priorities and management measures has been assessed against the following criteria: (i) Significant progress towards the management measure has been made since 2013; (ii) Progress towards the management measures is on track; (iii) An increase in effort is required to achieve the management measure by 2019. Key achievements aligned to management measures are also outlined.

Initiatives that will be or should be implemented have also been outlined to help address those management measures that require an increased effort.

The Review has also identified major political, policy, environmental, social, and economic changes over the life of the RCS and these will be considered at the renewal of the RCS in 2019. Some of the key considerations include, becoming better informed about thresholds and long-term reporting, greater Traditional Owner involvement, the best format for an adaptive RCS greater involvement of industry groups and improved understanding and initiative that consider the economic implementation of NRM activities across the catchment.

Implementation of the RCS is progressing well, with few strategic priorities needing increased effort over the next three years. The RCS is still relevant and current three years on from its endorsement, with social, political and environmental changes being addressed through sub-strategies and local plans.

2. Introduction

The Goulburn Broken Catchment covers 2.4 million hectares, extending north from near the outskirts of Melbourne to the River Murray on the border of New South Wales. The Catchment boasts a diversity of landscapes, including seasonally snow-covered alps, forest, granitic outcrops, gentle sloping plains, box woodlands and red gum floodplains.

The purpose of the Goulburn Broken Regional Catchment Strategy (RCS) is *to provide an integrated planning framework or “blueprint” for management of land, water and biodiversity resources. It is the overarching strategy for directing action, under which there are sub-strategies and local plans that implement priorities of government and the community.*

The RCS was developed, and has been implemented using a resilience approach. Resilience is the ability of the Catchment’s people and environment to absorb stress while continuing to function in a desired way.

The resilience approach to catchment management focuses on the connection between people and nature, how these connections change, and what can be done to achieve desired, balanced goals for resilience.

The RCS mid-term review gives Catchment partners an opportunity to reflect on the appropriateness of the RCS vision and purpose, communicate the progress towards long-term goals and evaluate progress towards the strategic objectives, priorities and management measures. This provides an opportunity to celebrate the successes of catchment management in the Goulburn Broken Catchment to date.

The RCS mid-term review is also an opportunity to identify areas that require further attention and initiatives that may need to be considered in the RCS renewal phase.

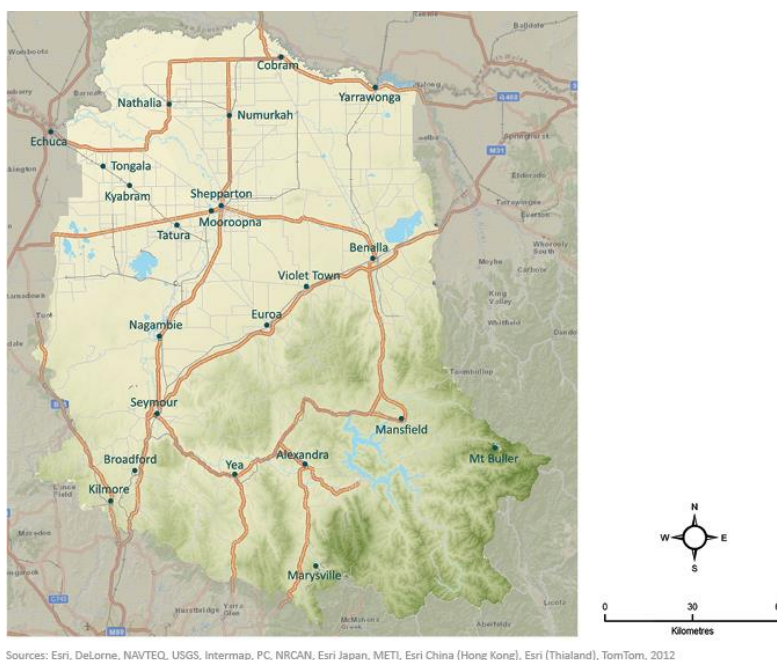


Figure 1: Goulburn Broken Catchment

2.1. Guidelines and Principles

2.1.1. Guidelines

The review process should be forward looking, assessing the RCS in terms of:

- performance and learnings to date
- any new approaches
- information and technologies which need to be considered
- any aspects or issues which are no longer relevant.

The reviews carried out by all CMAs are the first input to the RCS renewal process, which will be a collaborative process involving the Victorian Catchment Management Council (VCMC), CMAs and the Department of Environment, Land, Water and Planning (DELWP). The RCS renewal is expected to start in 2017-18. The VCMC believes that potential exists to substantially change traditional aspects of the RCS for the next iteration. The next RCS in 2019-20 is expected to require more focus on aspects such as integration, resilience, innovation, climate change, liveability and community partnerships and engagement. For this reason the mid-term review will identify those aspects for early consideration. Many of these points are emphasised in the *Our Catchment Our Communities* Strategy. This strategy is focused on how we manage the State's natural resources by ensuring catchment management partners work better together.

All CMAs will submit their completed reviews to VCMC and to DELWP, Catchments Branch, by the end of December 2016 following approval by the Goulburn Broken CMA Board. The Goulburn Broken CMA Board has been identified as the key audience for this review.

The CMAs, in conjunction with the VCMC, developed the following guidelines for the mid-term review of all Victorian RCS's.

- How is the RCS performing?**
Is it effective in supporting delivery of its priority strategic actions?
- How is implementation going?**
How are we progressing with delivery of the 6 year programs?
Is any corrective action required? If so, then what?
- Is the RCS still saying the things we think it should?**
What new information has appeared?
Is there new or additional information which needs to be considered (for the remaining life of this RCS, and to initiate our thinking for the 2019 RCS)?
Is there anything which we plan to not take any further action on?
- What do our key stakeholders think?**
What might any consultation look like?
- What do we need to do to prepare for renewal in 2019?**
Issues to be monitored?
Issues to be investigated?

2.1.2. Principles

The review will be guided by effectiveness, efficiency and appropriateness. The following principles, endorsed by the Goulburn Broken CMA Board, apply to the Goulburn Broken RCS mid-term review 2016:

1. Existing data and information collected through existing MERI processes is to be used (e.g. partner tracking information, Board Strategic workshop papers, WeConnect case studies and the annual report). Additional resources will only be applied to critical gaps in information.
2. It will engage with stakeholders through existing networks and forums where there are information gaps (e.g. Partnership Forum, Landcare Network Forum and the Indigenous Consultation Group).
3. Investment will only be directed toward gaps in information in line with the guidelines and associated information needs.
4. It will be completed by the December 2016 deadline.
5. The review will not replace the current 2013-2019 RCS document, it will be a standalone document.
6. The review will have input into program delivery and design, sub-strategy development and review, and local SES planning.

2.2. RCS Evaluation

The process and the format of the mid-term review aligns with the monitoring, evaluating and reporting processes outlined in the RCS. This includes:

Table 1: Evaluation and Reporting progress of the RCS

RCS Element	Evidence of progress
Overall	Progress against all elements listed below
Vision and Purpose	Progress towards long-term (20 to 30-year) objectives for biodiversity, water and people (drawn from sub-strategies)
6-year strategic objectives and strategic priorities	Progress in implementing management listed under strategic objectives and strategic priorities

2.3. Method for Review

The table below outlines the information used to inform the Goulburn Broken RCS mid-term review.

Table 2: Information used in mid-term review

Guidelines	Inputs
How is the RCS Performing? <ul style="list-style-type: none"> Is it effective in supporting delivery of its priority strategic actions? 	Long-term strategy implementation progress and Catchment condition (existing data collected through the Goulburn Broken CMA Annual Report)
How is implementation going? <ul style="list-style-type: none"> How are we progressing with delivery of the 6-year programs? Is any corrective action required? If so, then what? 	Performance against Drivers of Change and the enabling strategic priorities (Strengthen Partnership and Embedding Resilience) <ul style="list-style-type: none"> Annual Report data Annual Board Strategic Workshop Partner RCS progress tracking WeConnect Case studies (existing) Review workshops (Board, Partnership Team, Indigenous consultation group, NRM Chairs Forum, Senior Combined Managers Network, Staff) Individuals – online survey
Is the RCS still saying the things we think it should? <ul style="list-style-type: none"> What new information has appeared? Is there new or additional information which needs to be considered (for the remaining life of this RCS, and to initiate our thinking for 2019 RCS) Is there anything which we plan not to take any further action on? 	<ul style="list-style-type: none"> Annual Report data Annual Board Strategic Workshop Partner RCS progress tracking Scan of any new research that may need to be considered in sub-strategies, program design and delivery and the RCS renewal. Individuals – online survey
What do our key stakeholders think? <ul style="list-style-type: none"> What might consultation look like? 	<ul style="list-style-type: none"> Review workshops (Board, Partnership Team, Indigenous consultation group, NRM Chairs Forum, Senior Combined Managers Network, Staff) Individuals –online survey Partner RCS progress tracking Regional Wellbeing Survey
What do we need to do to prepare for renewal in 2019? <ul style="list-style-type: none"> Issues to be monitored? Issues to be investigated? 	<ul style="list-style-type: none"> Review workshops (Board, Partnership Team, Indigenous consultation group, NRM Chairs Forum, Senior Combined Managers Network, Staff) (new) Individuals - survey Board Strategic Workshop Annual Reports Background document identification issues to be monitored and investigated Audit by Australian Government of the Goulburn Broken CMA against the Australian Government standards

3. How is the Regional Catchment Strategy Performing?

3.1. Is the RCS supporting the delivery of the 20 – 30 year objectives for biodiversity, land, water and people assets?

The Goulburn Broken RCS supports the delivery of the Catchments' vision and 20 – 30 objectives through the implementation of 6-year strategic objectives. These objectives focus on adapting to the key drivers of change. The implementation of the strategic objectives, priorities and management measures in the RCS aims to address any risks and identifies opportunities to assist the community adapt to the drivers of change. The effectiveness of the RCS is assessed against progress towards the long-term goals and catchment condition.

Progress towards the 20 – 30 year objectives (primarily articulated in the RCS sub-strategies) are reported through long-term strategy progress and Catchment condition assessments. The Goulburn Broken long-term scorecard is reviewed and updated annually. The results and information used to generate the long-term scorecard can be found in the Goulburn Broken CMA's Annual Reports.

Table 3: Long-term strategy implementation progress and Catchment condition at RCS mid-term review

Investment area	Long-term strategy implementation progress ⁱ			Catchment Condition ⁱ		
	Strategy life ⁱⁱ	Progress	Gov't funding trend	1990 ⁱⁱⁱ	2016	Trend 0-3 Years
1 Sustainable irrigation						
1a Shepparton Irrigation Region salinity	1990-2020	Below target	↓	Poor	Satisfactory	↑
2 River and wetland health and floodplain management						
2a Environmental flows	2014-2022	On target	↑	Poor	Satisfactory	↑
2b Riparian and instream habitat and channel form	2014-2022	On target	↑	Poor	Satisfactory	↑
2c Water quality (nutrients) in rivers and streams	1996-2016	Exceeding target	●	Very Poor	Satisfactory	●
2d Floodplain management	2002-2016	Exceeding target	●	Very Poor	Satisfactory	●
3 Land and biodiversity						
3a Biodiversity	2000-2030 2010-2015	On target	●	Poor	Poor ^{iv}	●
3b Land health including dryland salinity	1990-2050	Below target	●	Poor	Satisfactory	●
3c Invasive plants and animals	2010-2015	Below target	●	Poor	Poor	●

- Strategy implementation progress considers evidence of outputs completed against targets, including onground works and tasks to improve management systems. Catchment condition ratings consider evidence of environmental or business condition, social and economic health and management systems. Catchment condition encompasses more than just biophysical condition. See the Goulburn Broken CMA Annual Report for details concern method for development
- Strategies vary in formality and comprehensiveness. Refer to the Goulburn Broken CMA's WeConnect for a list of Strategies. Strategy life includes time taken for capacity building tasks to be completed in medium term (usually three to five years) and for 'The Environment' investment areas, time taken for changes to be achieved over the long-term (usually ten to fifty years).
- Ratings for 1990 have been determined using our understanding in 2016 of what the situation was like in 1990. 1990 is a useful reference year because it was about this time that integrated catchment management began and sufficient time has elapsed since for meaningful questions about long-term change to be asked.

- iv. More than one third of the Catchment's woody vegetation (including riparian vegetation) was burnt by 2006 and 2009 fires (long-term impacts are unknown).

Ratings Legend

Annual performance and long-term strategy implementation progress	Well below target (<50%)	Below target (50-79%)	On target (80-109%)	Exceeded/exceeding target (>109%)
Catchment condition	Very poor	Poor	Satisfactory	Good to excellent
Certainty of rating	Very low	Low	Medium	High
Trend	↓ Declining	● Static	↑ Improving	↑↑ Dramatically improving

Notes about the long-term scorecard

Significant differences between investment areas in rating long-term strategy implementation progress and Catchment condition change (see table above) are often simply because of varying methods used to assess Catchment condition and set long-term targets. This reflects the infancy of natural resource management and the variation between its disciplines.

Refer to the Goulburn Broken CMA's Annual Report for information about the progress and ratings.

Goulburn Broken CMA strategies generally have a long-term focus, which encourages integration and the achievement of multiple benefits from single actions. This helps to minimise the impacts of fluctuating government commitment to different investment areas.

See Appendix A: Understanding progress and ratings, discusses issues related to measuring progress.

3.2. Is the Vision and Purpose still appropriate?

The RCS stipulates that the appropriateness of the Visions and the Purpose of the RCS should be reconsidered every three years. The Goulburn Broken CMA Board reconsiders the Vision of the Regional Catchment Strategy annually as part of a Strategic Planning Workshop. The mid-term review and the information collated as part of this process also provides an opportunity to consider their appropriateness.

Vision: Healthy, resilient and increasingly productive landscapes supporting vibrant communities.

Purpose: The RCS provides the integrated planning framework or "blueprint" for management of land, water, and biodiversity resources. It is the overarching strategy for directing action, under which there are sub-strategies and action plans that implement priorities of government and community.




The mid-term review has not identified the need for changes to the vision or purpose of the RCS at this point of time, however it does point to some key issues that may need to be considered in the RCS renewal phase.

4. How is Implementation Going?

How is the Goulburn Broken Catchment progressing against the delivery of the 6-year programs?

The Goulburn Broken Regional Catchment Strategy's 6-year objectives are based on Strategic Objectives (Embed Resilience, Strengthen Partnerships, Adapt to land-use change, Adapt to water policy reform, Adapt to climate variability and Adapt to increased farm production), Strategic Priorities and Management Measures. The following section outlines key achievements against Management Measures identified in the RCS and provides an indication of progress.

Key: The progress colour wheels in the table below offer an indicative qualitative assessment of progress towards the delivery of the 6-year strategic objective.


		
Significant progress towards the management measure has been made since 2013	Progress towards the management measures is on track	An increase in effort is required to achieve the management measure by 2019




Key Achievements: provide an insight into the types of activities that occur across the catchment, undertaken by a range of stakeholder that contribute to achieving the management measures outlined in the RCS

4.1. To Embed the Resilience Approach

This means the Goulburn Broken CMA and partner plans factor in sub-catchment and local differences, uncertain futures and knowledge, appropriate governance support, and adaptive management.

Table 4: Embed resilience, strategic priorities, management measures, progress and key achievement

Management Measure	Progress	Key Achievements 2012-16
Strategic priorities: Update and develop strategies		
Review and update existing strategic documents and sub-strategies and create new one according to need		- Sub-strategies developed post-RCS have all incorporated the resilience and SES approach. This includes the Goulburn Broken Waterway Strategy, Goulburn Broken Regional Floodplain Management Strategy (Interim), Goulburn Broken Climate Change Adaption Plan and the Goulburn Broken Biodiversity Strategy.

Management Measure	Progress	Key Achievements 2012-16
Strategic priorities: Plan at social ecological system scale		
Develop and adaptive planning process for social-ecological systems to build and enhance their resilience		<ul style="list-style-type: none"> - Local Plans developed to align with sub-strategies and community input. Strategies are available on WeConnect (http://weconnect.gbcma.vic.gov.au/) and further engagement will commence to ensure these are reflective of community priorities. - Current review of the EOI process will allow innovative project ideas at an SES Scale to be identified at any time during the year for funding consideration as well as to inform Local Plan review.
Strategic priorities: Provide adaptive management and leadership		
Build community and agency capacity to respond together to drivers of change		<ul style="list-style-type: none"> - Forums including the Goulburn Broken Partnership Forum and the Goulburn Broken Senior Combined Partners Forum provide an opportunity for leadership and capacity building. - Participation in the GMID Water Leadership Forum. - Completed journal paper titled '<i>The Goulburn Broken revisited: adaptive pathways for an Australian region with a turbulent past and uncertain future</i>'. - Presentations given to SA NRM Regional bodies and National Communities of Practice (Beechworth). - Participation by the CEO in the 2014 International Resilience Conference (Montpellier, France) with presentations to an international workshop prior to the Conference, presentation at the conference and participation in the pre-Conference field tour and session entitled "Resilience and Conservation" in Western Camargue – Rhone River delta.
Research resilience knowledge gaps to inform decision making based on thresholds and tipping points		<ul style="list-style-type: none"> - Research in the Agricultural Floodplain aimed at understanding thresholds around landscape connectivity across the catchment has been supported. - The SIR Land and Water Management Plan has identified key gaps in knowledge relating to thresholds critical to the Agricultural Floodplain. - A study has been initiated to better understand thresholds around water availability and farm viability on the Agricultural Floodplains.



4.1.1. Case study – Social Ecological Systems (SES) Local Plans





Local Plans have been developed for each Social Ecological System (SES) as we recognise the people living and working in each SES are best placed to prioritise the activities needed to build the resilience of the regions critical ecosystem services. The Local Plans have been developed to communicate priorities and actions for supporting the local community as it response to changes in land use, water policy reform, and climate change and farm production.


4.2. Strengthening Partnerships

This means community and industry groups, agencies and individuals have the capacity to contribute to the Catchment vision.

Table 5: Strengthen Partnerships, strategic priorities, management measures, progress and key achievements

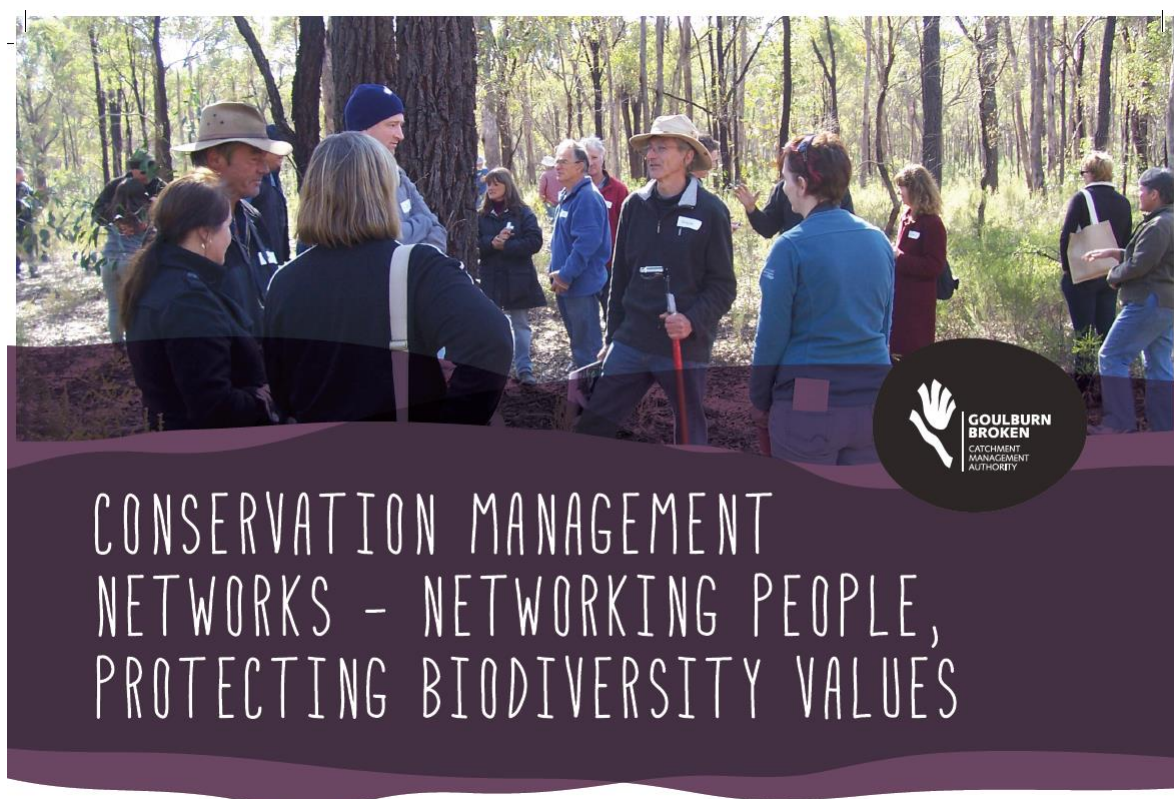
Management Measures	Progress	Key Achievements 2013-16
Strategic priorities: Reinforce relationships between agencies and industry		
Define roles and relationships with regional delivery partners		<ul style="list-style-type: none"> - Review of key partner's capability and capacity currently in progress. - Continued support of the Goulburn Broken Partnership team, the Hume Region Environment sub-groups and the Goulburn Broken Senior Combined Partner forum facilitates a greater understanding of the roles and relationships. - Development of the River Red Gum Plan which will outline roles and responsibilities of key stakeholders, initiated by Parks Victoria. - Further development of Regional Operating Agreement established in early 2015 and now subject to a review. - Industry linkages continue to be developed through programs such as the Farm Water Consortium and the Beyond SoilCare project.
Strategic priorities: Manage public land collaboratively		
Undertake works on public land and crown frontages to improve waterways and wetlands		<ul style="list-style-type: none"> - Significant number of projects that cross boundaries, including public and private lands status, CMA boundaries and state boundaries e.g. Sand ridge woodland project utilising the Woka Walla Crew and Turquoise Parrot project. - Development and support of the Tri-State Murray Alliance. - Provision of environmental water to key wetlands, some outcomes include; contributing to the recovery of lower back vegetation along the Goulburn River, recruitment of threatened wetland plants and vegetation communities and providing breeding and feeding habitat for thousands of waterbirds, - Broader community and partner organisation events focused on threatening processes such as horse, pig and deer facilitated by Parks Victoria.

Management Measures	Progress	Key Achievements 2013-16
Collaborate with Traditional Owners in catchment management		<ul style="list-style-type: none"> - Establishment of the Goulburn Broken Catchment Indigenous Consultation Group - Aboriginal Participation Guideline for Victorian Catchment Management Authorities: Implementation Plan developed - Establishment Wayne Tennant Cadetship for indigenous students to undertake NRM studies. - Establishment of the Goulburn Broken CMA and Yorta Yorta Nation Aboriginal Corporation MOU. - Development of the Yorta Yorta Nation and Taungurung Clans Country Plans. - Development and support of the Tri-State Murray Alliance. - Barmah Traditional Owner Land Management Board. - <i>"Increase in cultural training of CMA and NRM training of Traditional Owners to support work on Country"</i> Goulburn Broken Indigenous Consultation Group.
Strategic priorities: Adopt flexible engagement approaches		
Build capacity in existing and new conservation groups to deliver natural resource and productivity projects		<ul style="list-style-type: none"> - Resources are provided to Community Conservation Management Networks and Landcare Groups, through quarterly Network Chairs Forum. - Over \$2 million per annum was invested by the state and federal government in community NRM projects. - Investment in the professional development of support staff to our regions natural resource management groups. Training has been provided in Work Health and Safety, First Aid, Driver Training, the use of Social media, Websites and Blogs in the past 12 months.
Develop an engagement approach that matches landholder motivations with natural resource outcomes		<ul style="list-style-type: none"> - Increased utilisation of WeConnect to report progress against Local Plans including linking to the projects and activities being undertaken by a range of community NRM groups, Traditional Owners and partners that contribute to the achievement of the RCS. - Development of the Agricultural Floodplains priority landscapes. - NRM projects are managed in line with community needs and funders expectations, Goulburn Broken CMA projects are tailor made to provide the multiple outcomes. (e.g. Soil Care, Sand Ridge Woodlands, Woodlands and Wetlands, Fruit Industry Employment Program)
Develop understanding of social capital and community connectivity		<ul style="list-style-type: none"> - Adaptation Pathways trial in the Uplands Slopes including a review of the interactions within this Social Ecological System. - Annual survey of our volunteer based community NRM groups to ascertain the current social capital and the extent to which they are connected at local, region and state levels. - Participation in the National Wellbeing Survey through University of Canberra.

Management Measures	Progress	Key Achievements 2013-16
Continue to build online awareness and engagement in catchment management		<ul style="list-style-type: none"> - Review of the CMA's approach to the annual EOI process with input from community NRM groups. This better match the EOI process to investment opportunities which also providing an avenue to the identification of community priorities to input into Local Plans. - NRM facilitator training for Social Media, Blogs and Websites provided. - Continuing to increase Goulburn Broken CMA's social media presence. Facebook Page 'likes' increased by 85% from 388 in July 2015 to 718 in June 2016 and followers on the Twitter account increased by 65% from July 2015 to June 2016. The quarterly Connecting Community and Catchment E-newsletter has more than 900 subscribers. This is also supported by Chough-Chats (email notification tool) and the Landcare Facilitator E-newsletter.

4.2.1. Case Study – Conservation Management Networks (CMNs)






CMNs were first formed in Victoria and New South Wales in the mid – 1990s. The purpose of these grassroots groups is to tackle biodiversity issues in fragmented landscapes across public and private land. They are both a network of physical sites with biodiversity values and a network of people who work together to protect and restore these sites. Janice Mentiplay-Smith is the Goulburn Broken CMA CMN Coordinator.






4.3. To adapt to land-use change

This means opportunities for improving the environment are captured as land ownership changes, enterprises change and land management changes.

Table 6: Adapt to land use change, strategic priorities, management measures, progress and key achievements

Management Measures	Progress	Key Achievements
Strategic priority: Capture opportunities from land development		
Deliver farm planning to integrate ecological and agricultural productivity benefits		<ul style="list-style-type: none"> - Whole Farm Plans delivered through the Irrigation Modernisation Project. (see case study for details) - Euroa Arboretum provides a property assessment service and developed the <i>Healthy Hectares</i> guide
Plan land-use to minimise loss of biodiversity		<ul style="list-style-type: none"> - DELWP and LGAs worked together to provide opportunities to source native vegetation offsets for development permits. - Strategic land use planning including Regional Growth Plans and Precinct Structure Plans. - Identification of biodiversity risks prior to work being undertaken (roadsides and public land).
Manage wastewater treatment and stormwater runoff to minimise pollutants to urban waterways and wetlands		<ul style="list-style-type: none"> - A recent review of the Goulburn Broken Water Quality Strategy show that Wastewater treatment plants are no longer a major nutrient source in the catchment. - Actively involved in the development of Integrated Water Management projects under the Victorian Water Plan, including Eastbank Lake Precinct along the Goulburn River and the Kilmore Wastewater Offset Pilot.
Manage public land to minimise loss of biodiversity		<ul style="list-style-type: none"> - Parks Victoria's River Red gum management planning and visitor experience framework. - Implementation of Good Neighbour programs for weed control on public/private land interface.
Promote broader community awareness and acceptance of practices to protect and improve the condition of natural assets		<ul style="list-style-type: none"> - The SoilCare Project promotes a better understanding on soils and soil management. This has included more than 120 events over the last 3 years. - Landcare Groups and CMNs undertake over 150 community awareness Projects. - Biodiversity Spring has been running for over 10 years, increasing the understanding of the Catchment natural assets

Management Measures	Progress	Key Achievements
Strategic priority: Capture opportunities from land development (cont.)		
Promote land-use capability assessments and implementation, including use and management of water		<ul style="list-style-type: none"> - The Agricultural Floodplains are currently undertaking Land use mapping to better understand how the land in the region is being used. This project will increase understanding in the irrigation regions farming systems and how that related to the overall resilience of the Agricultural Floodplains. - The Goulburn Broken Greenhouse Alliance has undertaken a project to better understand changes in commodities under a range of climate change scenarios
Strategic priority: Plan for and manage floods		
Provide floodplain decisions and advice in land-use planning		<ul style="list-style-type: none"> - Total of 900 to 1000 applications and referrals, including floodplain management and works on waterways, were processed per annum. The average response time was 5 to 9 days. - Significant work undertaken to prepare for a VCAT hearing relating to quarrying at the Goulburn River. Further work has commenced to develop and promote an extraction planning overlay for relevant LGAs to help minimise future VCAT hearings
Understand more about the nature of flooding to manage its impact on the natural and built environments		<ul style="list-style-type: none"> - Input into 12 to 16 Flood studies and implementation plans per annum. Some led by the Goulburn Broken CMA and other by key catchment partners. This will assist prevention of inappropriate development and social and economic loss. - Significant technical contributions to the Goulburn River Constraints Management Business Case

4.3.1. Case Study – Beyond Soilcare

In 2015-16, 600 people were directly involved in the Shepparton Irrigation Region Beyond SoilCare project, funded by the Australian Government National Landcare Programme.

These landholders attended a range of events covering topics such as composting, nutrient and groundwater salinity risk management, holistic farming and cropping, co-operatives and rapid assessment of soil health.

Over 70 activities were delivered by DEDJTR and Goulburn Broken CMA staff and through Goulburn Murray Landcare Network and Goulburn Valley Environment Group's GV21 projects. Other organisations participating in activities including Dairy Australia, Kilter and Madowla Park.

Demonstration trials continue to be an important part of SoilCare delivery with four new demonstration trials initiated in 2016. These projects will investigate maize yield variability, compost banding, the effect of compaction and amelioration in irrigated soils and management of climate change impacts on perennial horticulture.





The most recent Beyond SoilCare Health Impact Survey surveyed 90 past event participants, with 74 per cent reporting they had changed practices because of the project.




4.4. To adapt to water policy reform

This means water savings are generated for the benefit of farmers, the community and environment, and waterways and wetlands receive the right volumes of water at the right times.

Table 7: Adapt to water policy reform, strategic priorities, management measures, progress and key achievements

Management Measures	Progress	Key Achievements
Strategic priority: Influence regional water policy		
Influence water policy development and implementation to secure water for improving natural resource condition without affecting social and economic wellbeing		<ul style="list-style-type: none"> - Assisted with the development of <i>Water for Victoria</i> - Water resource planning processes undertaken by Goulburn Murray Water (GMW) has had increased involvement of key stakeholders. - Provided leadership in development of Goulburn River Constraints Management business case, particularly community engagement. - Recently initiated a study of Land Use in the GMID
Create opportunities for community leaders to contribute to water policy		<p>Groups within the Goulburn Broken Catchment that create opportunities for leadership include:</p> <ul style="list-style-type: none"> - Broken and Goulburn Environmental Water Advisory Groups - Goulburn Broken Wetland Management Group - GMW Strategic Advisory Committee - Shepparton Irrigation Region People and Planning Integration Committee (SIRPPIC)
Strategic priority: Deliver water to waterways and wetlands		
Plan, deliver and monitor environmental water delivery to improve the condition of priority waterways and wetlands		<ul style="list-style-type: none"> - Priority Environmental Water flow targets have been met annually for the key rivers and wetlands, including input from community and key stakeholders through the Environmental Water Advisory Groups. - A number of technical studies have been undertaken to inform environmental water management decisions. - A number of investigations and studies into the effectiveness of environmental water have been undertaken. See Appendix B for further details - <i>"Increased awareness and improved understanding of environmental water"</i> Goulburn Broken CMA Board.
Prioritise protection of waterway and wetlands within the modernised irrigation delivery system		<ul style="list-style-type: none"> - 140 properties in the Shepparton Irrigation Region have undertaken a Whole Farm Plan over the last three years. - Incorporation of wetland areas or protection as part of whole farm planning approval processes in the agricultural floodplains in conjunction with GMW and local governments.

Management Measures	Progress	Key Achievements
Strategic priority: Use water efficiently on farms		
Modernise water delivery on irrigated land to provide ecological and productivity benefits		<ul style="list-style-type: none"> - Implementation of the Farm Water Program has delivered more than 500 projects that have generated more than 60 GL of water savings over 55, 000 ha. 52% of the saving have been return to the Commonwealth Government and 47% retained on farm. This results in a \$280 gross margin per ha per year. - Strategic Connection Project is creating a modernised irrigation system, which is resulting in more efficient water delivery to farms, and enabling water savings to be directed to improving environmental flows.

4.4.1. Case Study – Spawning success of Golden Perch

Golden Perch naturally occur in lowland rivers in the Murray-Darling Basin, primarily in warm, flowing rivers. Although widespread, they have declined in some areas, due largely to weirs that have turned flowing rivers into static pools, and barriers which block their movement.

Recent monitoring of environmental flow events in New South Wales and Victoria has shown there is a close link between free-flowing water over large spatial scale, and strong recruitment and survival of young fish.

Many agencies work together to develop and implement environmental watering programs in Victoria. These include DELWP, the Victorian Environmental Water Holder (VEWH), CMAs, land managers, water authorities, the Commonwealth Environmental Water Office (CEWO) and the Murray-Darling Basin Authority (MDBA)








Environmental water is critical for Golden Perch as they require specific flows to survive and complete their life cycle.

4.5. To adapt to climate variability

This means risks from climate variability and responses to it are managed and opportunities from the global shift towards lower use of carbon-based energy are captured.

Table 8: Adapt to climate variability, strategic priorities, management measures, progress and key achievements

Management Measures	Progress	Key Achievements
Strategic priority: Adapt to climate variability risks		
Factor risks of climate variability and identify adaptation strategies in Goulburn Broken CMA and partner plans		<ul style="list-style-type: none"> - Climate Change Adaptation Plan for NRM in the Goulburn Broken Catchment has been developed identifying landscapes most vulnerable to climate change and priority areas for adaptation and mitigation actions. - The above work has been considered in the updates of: <ul style="list-style-type: none"> o Goulburn Broken Biodiversity Strategy o SES Local Plans o Shepparton Irrigation Land and Water Management Plan o Goulburn Broken Waterway Strategy o Local Government Agricultural Future Project - <i>"Broader support and better informed approach to climate change"</i> Goulburn Broken Partnership Team
Factor risks to natural assets into public land fire management plans		<ul style="list-style-type: none"> - Establishment of the Strathbogie Community Bushfire Planning Group with DELWP Implementing "Safer Together" approach to fuel management on public land. - DELWP is working with Emergency Management to develop clear roles and responsibilities.
Strategic priority: Respond to and recover from climatic events		
Plan and implement flood, fire and drought response and recovery		<ul style="list-style-type: none"> - Mickleham/Kilmore fire response by South West Goulburn Landcare Network. - Creighton's Creek / Stewarton/ Boweya fire response by Gecko CLaN. - Wunghnu/Numurkah fire response by Broken Boosey Conservation Management Network and Goulburn Murray Landcare Network. - Drought Recovery Program implemented across the Goulburn Broken Catchment. - Each municipality has a Municipal Emergency Resource Officer or Recovery Manager that is the main contact for emergencies in their region. - <i>"Increased resilience of Landcare Groups to be able respond quickly in times of extreme events"</i> Goulburn Broken NRM Network Chairs.

Management Measures	Progress	Key Achievements
Strategic priority: Capture opportunities from a low carbon future		
Identify where carbon sequestration activities provide environmental, economic and social benefits		<ul style="list-style-type: none"> - Developed information to help guide carbon farming in the Goulburn Broken Catchment to provide multiple outcomes.
Develop mechanisms to ensure carbon sequestration activities do not threaten natural resource condition		<ul style="list-style-type: none"> - Investment in State-wide role to continue to look for opportunity - Engagement with the Emission Reduction Fund Natural Resource Management Forum facilitated by the Australian Government.

4.5.1. Case Study - Gecko CLaN Fire Recovery Program

The bushfires late in 2015 significantly impacted on communities and large areas of the landscape. Affected communities included Creighton Creek, Gooram, Longwood East, Bungeet, Stewarton, Lake Rowan, Warby Ranges, Goomalibee, Tatong, Molyullah and Swanpool. The Gecko CLaN chairperson Doug James, was burnt out in the Bungeet fire, so this made our decision that Landcare needed to be there for our members and the community. The fires impacted on 170 properties and the four main fires burnt 8,870 hectares.

In partnership with agencies, Gecko CLaN organised community information sessions. Over 210 people attended the information sessions. Following these sessions Gecko CLaN took on the role of coordinating fodder donations, organising fencing days with Waratah, feed budgeting sessions, setting up silt trap sites and organising skips for fencing waste.



Figure 2: Fencing presentation held at Creighton's Creek








Figure 3: An effective silt fence after recent rains in the fire affected area

4.6. To adapt to increased farm production

This means the natural resource based upon which future agricultural production depends is sustained and enhanced.

Table 9: Adapt to increase farm production, strategic priorities, management measures, progress and key achievements

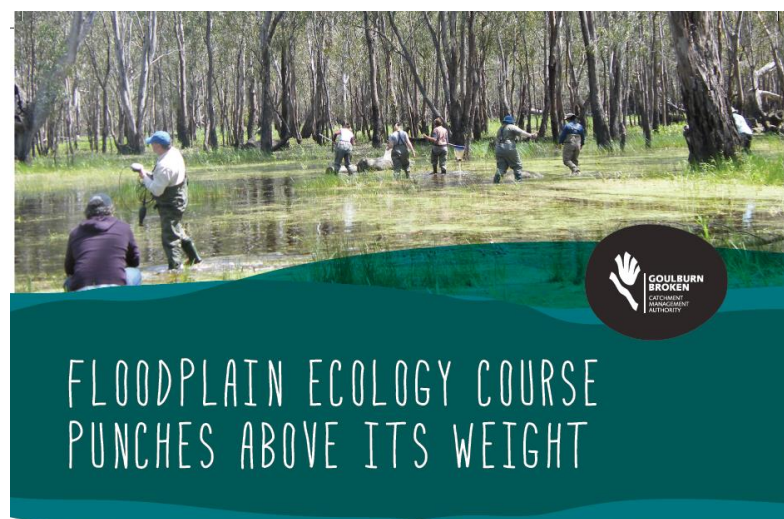
Management Measures	Progress	Key Achievements
Strategic priority Manage risk to agricultural production		
Deliver surface and sub-surface drainage works across a modernised irrigation delivery system, including adaptive shallow groundwater management		<ul style="list-style-type: none"> - Significant decline in drainage investment over the last 3 years, however base funding has maintained existing capability and capacity - Feasibility study into relocating disposal of water via public groundwater pumps from channels to drains. This is to allow operating of public groundwater pumps to continue during times of low flow channels where dilution is no longer sufficient to allow for irrigation. - Review of the Drainage Strategy has resulted in further funding for drainage works.
Strategic priority: Establish sustainable agricultural practices		
Create awareness and acceptance of sustainable management practices to improve land and soil condition		<ul style="list-style-type: none"> - Beyond SoilCare project facilitated a series of activities to help improve land management practices. - Community groups such as Gecko Clan attracted funding to implement onground sustainable agriculture projects.
Strategic priority: Increase biodiversity in agricultural land-use		
Create awareness and acceptance of land management practices that protect and improve terrestrial and aquatic habitat		<ul style="list-style-type: none"> - Goulburn Broken Local Government Biodiversity Reference Group has been in operation for 10 years. - Box Iron Bark and Floodplain Ecology Courses conducted. - Conservation Networks and Landcare Group in the Goulburn Broken run numerous field days. E.g. Bus tours to increase the understanding of the values of landscapes and field days aimed at increasing awareness around habitat requirements, - Biodiversity Spring has provided a forum for a large number of events annually. Including weed ID workshops and wildflower walks. - <i>"Improved integration between the environment, production and social drivers"</i> Sustainable Irrigation Region People and Planning Integration Committee.
Identify environmental stewardship opportunities for land managers		<ul style="list-style-type: none"> - Continuation of the Trust for Nature Covenanting initiative in the Goulburn Broken Catchment. - Implementation of long-term management agreement with incentives. - Feasibility study for a vegetation offset scheme completed.

Management Measures	Progress	Key Achievements
Work with landholders to protect and improve biodiversity on private land and build understanding of its contribution to the landscapes		<ul style="list-style-type: none"> - Projects managed by a range of stakeholders have taken place across the catchment, including the woodlands and wetland protection, threatened species projects, Conservation Management Network initiatives. - Continued support of the Dookie Seedbank and seed production areas ensures seed supply for future landscape scale revegetation. - Development of priority landscape completed in the Agricultural Floodplain to focused on revegetation, regeneration and connectivity. - SoilCare program working with landholders to better understand and manage soils.

4.6.1. Case Study - Floodplain Ecology Course

The Floodplain Ecology Course aims to promote awareness and greater understanding of the complex floodplain ecosystem in a drying climate, their ecological importance and values, the intimate connection of floodplains with the health of their parent river and how in a dynamic political setting consideration of floodplains is important to the long-term sustainable use of our waterways.

Topics covered include geology, landscape history and climate; how floodplains are formed; geomorphology, hydrology and hydraulics of floodplains, floodplain soils, vegetation and fauna, cultural perspectives; and biogeochemical processes and functions on the floodplain.



4.7. Additional Action Required

The review of the progress towards the 6-year strategic objectives show significant progress in most areas, however some areas require further attention. These areas and the initiatives to be implemented over the next 3 years are listed below.

Table 10: Current initiative aimed at increasing progress of 6 year objectives

Management measures requiring further attention	Initiatives to be implemented over the next 3 years
Research resilience knowledge gaps to inform decision making based on thresholds and tipping points	Implementation of a local planning approach informed by community, sub-strategies and science, based on understanding critical attributes and thresholds is planned in each SES over the following 3 years. Supported by <i>Our Catchments Our Communities – Integrated Catchment Management in Victoria 2016-19</i> .
Develop understanding of social capital and community connectivity	Further local planning will increase the understanding of the social capital and community connectivity. Supported by <i>Our Catchments Our Communities – Integrated Catchment Management in Victoria 2016-19</i> . Further developed the NRM and Landcare Group annual survey to gain a better understanding. Undertake the Wallis survey aimed at understanding the community awareness of the CMA and its activities.
Manage public land to minimise loss of biodiversity	The <i>Our Catchment Our Communities – Integrated Catchment Management in Victoria 2016-19</i> project will see a number of joint initiatives with public land managers aimed at minimising loss of biodiversity
Develop mechanisms to ensure carbon sequestration activities do not threaten natural resource condition	A recently funded project through the Victorian NRM Planning for Climate Change Forum will see a framework developed to achieve catchment carbon offsets, using the information developed through for the Goulburn Broken NRM Climate Change Adaptation Plan.
Deliver surface and sub-surface drainage works across a modernised irrigation delivery system, including adaptive shallow groundwater management	Recently there has been a reinvestment into the drainage program in the Shepparton Irrigation district. This will result in significant progress towards this management measure.

Table 11: Future initiatives needed to increasing progress of 6 year objectives

Management measures requiring further attention	Initiatives that need to be implemented over the next 3 years
Deliver farm planning to integrate ecological and agricultural productivity benefits	Augment whole farm planning practices within the Agricultural Floodplains and re-invest in whole farm planning in the dryland areas of the Catchment.
Plan land-use to minimise loss of biodiversity	DELWP and CMA's work together to develop plans that consider Biolinks within a social and economic framework.

5. Is the Regional Catchment Strategy saying the things we think it should?

What's new, has changed or needs to be considered in RCS implementation and RCS Renewal?

5.1. Political and Strategic Changes

Changes in State Government and Federal Government have had, and will continue to have, a significant impact on the implementation of Regional Catchment Strategy. The following lists a range of State and Federal Government policies and strategies that Goulburn Broken CMA and key partners are considering in the implementation of the RCS and sub-strategies:

- Our Catchment Our Communities - – *Integrated Catchment Management in Victoria 2016-19*
- Victorian Waterway Management Strategy
- Victorian Floodplain Management Strategy
- Water for Victoria
- Draft State Biodiversity Strategy
- Draft Victorian Climate Change Framework
- Draft Victorian Climate Change Adaptation Plan
- Changes to the Native Vegetation Regulation
- Development of Regional Partnership
- Victorian Infrastructure Plan
- Murray Darling Basin Plan
- Federal Emission Reduction Plan
- State Government's response to the CMA VAGO Review

Changes in Local Government strategy and policies also need to be considered in the RCS renewal, particularly in the areas of land use change, planning, environment and climate change.

The Goulburn Broken CMA has developed several sub-strategies and initiative since the development of the RCS that are influencing implementation and renewal.

- Goulburn Broken Biodiversity Strategy
- Goulburn Broken Waterway Plan
- Goulburn Broken NRM Climate Change Adaptation Plan
- Shepparton Irrigation Land and Water Management Plan
- Shepparton Irrigation Region Drainage Strategy
- SES Local Plans
- Tri-State Murray Alliance

Many of the other RCS key partners also have a range of new policies and strategies, including local government, Parks Victoria, GM Water, NE Water, GV Water, Trust for Nature and local NRM Groups that need to be considered in the implementation of the RCS and the renewal phase.

5.1.1. Case Study – Our Catchments Our Communities

Our Catchments Our Communities – Integrated Catchment Management in Victoria 2016-19 is focused on improving the catchment management framework. The vision is for 'Healthy, sustainable and productive land, water and biodiversity maintained through integrated catchment management that is strongly community based, regionally focused and collaborative'. The goals include:

- Effective community engagement in catchment management
- Better connections between state, regional and local planning
- Strengthened implementation of Regional Catchment Strategies
- Clearer roles, strengthened accountability and coordination
- Improved monitoring, evaluation and reporting.

Funding for the implementation of *Our Catchments Our Communities* will help progress a number of strategic priorities over the next three years, in particular in the areas of Embedding Resilience, Strengthening partnerships and Adapting to land use change.

5.2. Economic Changes

The RCS recognises that significant changes to the economy of the Goulburn Broken Catchment have an impact on the delivery of the RCS.

Recent changes to some industries may impact on the delivery of the RCS, for example, the changes to the horticulture industry and the dairy industry pricing structure may have an impacts on achieving the RCS strategic objective “Adapt to increased farm production”

5.3. Social and Environmental Changes

At a regional scale, Social and Environmental change does not appear to happen at the same speed at which political and strategic changes can. Over the three-year period the RCS has been in operation, the social and environmental changes have been more incremental, but no less significant. The following changes have been identified:

- Traditional Owners within the Goulburn Broken recognised that there has been a greater involvement in the NRM Planning across the Region. This has also been supported by the development and implementation of the Aboriginal Participation Guidelines and the establishment of MOUs.
- The last three years has seen a reduction in the capacity of key agencies, especially in the delivery of extension activities. This has meant that a whole suite of extension services have been filled by other providers, including the CMA, Landcare and industry.
- The community and key stakeholders have identified changes in deer populations having a significant impact on the regional natural resources.
- The Agricultural Floodplains, through the SIR Land and Water Management Planning process, have established critical attributes by which thresholds may be perused to help in the planning and implementation of the Vision for the Region. This process, along with the Adaptation Pathways process trial during the Climate Change Adaptation Plan development, may provide a helpful tool to align adaptation planning and the resilience approach using measurable thresholds.

Other changes observed by key stakeholders include:

- Greater acceptance of climate change science and impacts
- Changes in land use such as an increase in smaller properties with a lifestyle focus, and other industries such as equine, poultry and power generation
- Increased understanding of the resilience approach to NRM Planning
- The growth of social media as a communication tool
- Increased prevalence of environmental weeds in the south of the catchment.

5.4. Monitoring and Research

The Goulburn Broken CMA is updating its 2004 Monitoring, Evaluation and Reporting Strategy, with a shift in emphasis towards processes that facilitate responsiveness, in-line with the RCS's resilience approach. The aim of evaluation processes (listed in the draft 'Ready for change evaluation strategy') is 'for the Catchment's people to continue to be quick in adapting to changing circumstances, while retaining a strong sense of the RCS's long-term vision'. Monitoring, evaluation and research activities are consistent with this draft strategy.

As a leading NRM agency noted for evidence-based planning and knowledge application, the Goulburn Broken CMA has a strong commitment to cultivating and maintaining relationships with research agencies. This is illustrated by the diversity of organisations listed as partners in research undertaken over the past few years (Appendix B). Much of this research, and other work undertaken over the past three years, has been disseminated through presentations by Goulburn Broken CMA staff at professional conferences– enhancing the agency's standing within and beyond the NRM sector for professional planning and delivery. Appendix C details the peer-reviewed publications co-authored by Goulburn Broken CMA staff over the period 2013 -16.

The RCS is progressed by ensuring research undertaken is relevant to the strategic / management and long-term objectives of the strategy. Both Appendix B (recent research) and Appendix D (near-term research priorities as identified by program) have been annotated to detail the relevance to objectives identified in the RCS. Encouragingly, much of the research targets multiple objectives.

The renewal of the RCS in 2019 will be assisted by a comprehensive review of the Goulburn Broken CMA's research effort to identify the extent to which this research has helped inform key knowledge needs, including key environmental, social and productivity thresholds and tipping points.

6. What do our Stakeholders think?

The Goulburn Broken CMA and key stakeholders are constantly reviewing and assessing the RCS through ongoing engagement.

The Goulburn Broken CMA Board is provided with quarterly updates on RCS Implementation and undertakes an Annual Strategic Workshop where they discuss progress towards the strategic objectives of the RCS and significant policy, environmental, economic and social changes. This workshop also endeavours to identify opportunities for RCS implementation.

Monthly, the Goulburn Broken CMA Board is provided details about key activities or issues happening with the Social Ecological Systems (SESs) of the catchment.

The Goulburn Broken Catchment Partnership Team meets monthly. This provides an opportunity for partner agencies (and their staff who have direct contact with the community) to share activities that are contributing to the implementation of the RCS and identify key strategic issues that may impact on the delivery of the Regional Catchment Strategy. The Partnership Team also contributes to a partner RCS activity tracking template. This model is supported by a Senior Combined Partners Forum meeting in the north of the Catchment quarterly, involving CEO's from all partner agencies and local government mayors. This forum supports strategic discussions around major regional water and NRM issues.

The Goulburn Broken Indigenous Consultation Group also has ongoing input into the RCS. RCS implementation is a standing agenda item, whereby the group can discuss implementation and key strategic issues and opportunities.

The annual review of SES local plans supporting the RCS and the EOI process, facilitated by the Goulburn Broken CMA, provides an opportunity for the broader community to have input into RCS implementation. It also provides an opportunity to raise new issues and opportunities.

The Goulburn Broken CMA undertook additional specific stakeholder consultation for the RCS mid-term review. In line with the principles of the mid-term review, existing key stakeholder forums were used to inform the review. These included: the Goulburn Broken CMA Board, the Goulburn Broken Partnership Team, the Goulburn Broken NRM Network Chairs Forum and the Goulburn Broken Indigenous Consultation Group. All Goulburn Broken CMA staff were given an opportunity to have input into the mid-term review as they are interacting with the Goulburn Broken CMA community on a daily basis and are members of the community themselves. An online community survey was also made available during the mid-term review period.

7. What do we need to do to prepare for renewal in 2019?

7.1. Major considerations for RCS renewal?

The following issues will be monitored and investigated in preparation for the renewal of the Goulburn Broken RCS.

- The need to become better informed about thresholds within the Catchment. How to monitor them and use them in NRM planning, including discussions around transformation and implementation of an adaptive management framework.
- Establish an approach to reporting and evaluating long-term progress for discrete issues (such as biodiversity) at the whole-of-Catchment scale that links to the reporting and evaluating of long-term progress within SESs.
- Assess the impact of key achievements from implementing management measures (as listed in tables of section 4) towards the 20-30 year objectives for biodiversity, land, water and people
- The Australian Government during an audit of the Goulburn Broken CMA indicated that the RCS did not meet their expectations around Traditional Owner involvement. This mid-term review has found significant progress in Traditional Owner input into NRM Planning in the Goulburn Broken catchment, however further consideration will be required.
- Consider if a traditionally formatted Regional Catchment Strategy (and sub-strategies and Local Plans) are best for the Goulburn Broken Catchment's people and adaptive planning?
- Change in language from climate variability to climate change and also review Goulburn Broken CMA's role in climate change adaptation and mitigation.
- The improved understanding of the Goulburn Broken Social Ecological Systems.
- New information about Adaptation Pathways Planning and how to apply it to regional scale planning.
- Greater involvement of industry in regional NRM planning and implementation.
- The role and need for a Pest Plant and Animal Sub-strategy and to influence control programs for new and emerging invasive species such as deer, Indian Myna, feral cats.
- Further support for Traditional Owner input into the RCS renewal phase and what is the most appropriate mechanism to do this.
- Strengthening the RCS role in influencing strategies at a State and National level.
- Undertake a review of the completed research to identify the extent to which knowledge has been used to inform implementation, future gaps and understanding of thresholds.
- Environmental scan of emerging political trends and community priorities that could influence change.
- Completion of a research review that identifies the gaps in primary eco-system services used in the catchment or may require into the future with climate change.
- Creating a better understanding and improve communication regarding links between productivity and positive natural resource outcomes.

Appendix A: Understanding Progress and ratings

Details on each investment area within sections of this annual report justify ratings provided. Further details, including graphs and reports, are on the Goulburn Broken CMA's website, www.gbcma.vic.gov.au and in relevant sub- strategies of the Regional Catchment Strategy.

The ordering of information, which helps develop consistency and understanding across the many aspects of catchment management, is part of implementing the 2004 Goulburn Broken Monitoring, Evaluation and Reporting Strategy.

The Goulburn Broken CMA understands that measuring progress in natural resource management is almost universally difficult and the quality of data systems used to inform whole-of-Catchment-scale decisions is often poor. Nevertheless, decisions have to be made and the Goulburn Broken CMA is at the forefront of communicating progress.

Evaluation, planning levels and decision- making cycles

Decisions in catchment management have vastly different timeframes, from daily operational decisions by extension officers to once-in-six-year strategic decisions by the Goulburn Broken CMA Board. The Goulburn Broken CMA arranges data to inform three critical and connected levels of evaluation for strategic planning and implementation, as shown in the table below.

Evidence for three levels of decision-making

Evaluation level	Evaluation terminology	Typical key evaluation questions used to focus evaluation	Examples of evidence to inform evaluation
1	Annual performance	How did we go this year against what we said we would do?	Outputs (onground works and capacity building actions or tasks) achieved and funds spent against targets set – communicated through the Annual Report.
2	Long-term strategy implementation progress	How have we gone against what we said we would do when we wrote the (various) strategies? How effective were the implemented measures?	Outputs and assumptions of their impact listed in strategies
3	Catchment condition change	What 'shape' is the issue we are managing in now? Was the original strategy appropriate? Have circumstances (such as new knowledge or different weather patterns) changed sufficiently to warrant a revised strategy? Does the investment mix need to be modified?	Resource condition; trends; tipping points; indicators of resilience, adaptation and transformation responses

Annual performance

Annual performance is rated by measuring the outputs achieved against targets for the year. Targets are determined by the funds available and usually vary from those identified or implied in the relevant long-term strategy. This is because we mostly do not know what funds are available beyond one year and what funds are anticipated to be available at the time the strategy was written.

The Goulburn Broken CMA negotiates investment amounts and output targets to be delivered each year with Victorian and Australian Governments. Outputs are often common to several investment areas and targets and achievements are aggregated from projects within those areas.

There is usually a high degree of certainty in rating annual performance within a single investment area: funding is known, outputs and other indicators are well documented and accounting mechanisms are sound.

Ratings of annual performance and long-term progress help to focus investment decision-makers such as the board and government funding bodies. The use of these ratings for guiding decisions needs to be tempered by an understanding of the certainty of the rating.

Annual targets and achievements data in this report do not include outputs delivered beyond Goulburn Broken CMA's direct control, especially by those landholders who voluntarily pay for and undertake onground works.

However, data on these external outputs is also critical to inform long-term decisions and is increasingly captured by other means.

For detailed outputs in each program area, see the Annual Report.

Long-term progress

Long-term progress ratings are needed for two separate areas of focus for decision-making:

- outputs achieved against what were intended to be achieved since the relevant strategy's inception (long-term strategy implementation progress)
- condition of the issue to be managed, such as water quality, native vegetation or community capacity.

There are often several individual strategic components to rate when determining an overall long-term progress rating within a single investment area. These individual ratings have varied data quality and this affects the certainty of the overall rating. Strategies for different investment areas vary in formality and comprehensiveness, which is appropriate, so our certainty of understanding progress varies considerably.

Where outputs and long-term strategies are well defined and where they are accompanied by solid data management systems, such as for 'Investment— area 1a Shepparton Irrigation Region salinity', then the certainty of long-term progress ratings increases.

Complete implementation of a strategy does not necessarily translate to desired condition change, because of external factors and perhaps inaccurate assumptions used at the time the strategy was written, especially assumptions related to funding levels, social and political circumstances and the weather.

What does Catchment condition mean?

Measuring the condition of the Catchment has historically focused on discrete themes, including biophysical investment areas such as salinity, water quality, river health and biodiversity and non-biophysical investment areas such as community capacity.

The National Framework for Natural Resource Management Standards and Targets (2002) listed 10 similar types of theme as resource condition 'matters for target'. It also recommended indicator headings and indicators of progress. Resource condition indicator examples are depth to groundwater, soil acidity, total phosphorus levels in water and the extent of native vegetation present by interim biogeographical regionalisation of Australia subregions.

'Resource' can be interpreted from this National framework as referring to biophysical assets such as rivers, as well as to, perhaps erroneously, threats such as salinity. Resource condition can therefore be interpreted as being the biophysical state of the biophysical theme (or matter for target).

Resource condition indicators have been very useful in ordering information for decision makers whose focus is within particular investment areas. However, these indicators only provide part of the picture and there has been wide variability in their interpretation and use.

More information on the investment areas in an integrated context is needed to make better decisions. This means information on all elements that impact on particular investment areas is needed to rate the condition of the Catchment for that investment area.

The Goulburn Broken CMA promotes a broadening of focus from environmental elements only to social and economic elements also within each investment area, including the relationships between all elements.

Together, these elements form a complex, evolving, integrated socioecological system in which humans are a part of nature. Ratings of Catchment condition for an investment area are therefore ratings of the socioecological system's condition related to that investment area.

The quality and availability of indicator data for the environmental (or resource condition) component varies considerably and the Goulburn Broken CMA is in the early stages of documenting relevant social and economic indicator data. Despite the uncertainties that this presents, it is far more informative for decision making to present rolled up socioecological system ratings for Catchment condition rather than ratings based on resource condition indicators alone. Progress within investment areas is usually rated by considering more than one element. For example, threatened species and native vegetation are two component elements within the biodiversity investment area. Resource condition indicators are usually not a major consideration in rating progress within investment areas under 'The Business' because these investment areas merely have supporting functions.

Investment areas and integration

The Goulburn Broken CMA focuses on 13 highly connected investment areas under 'The Environment' and 'The Business' as describe in the Annual Report. These investment areas relate closely to the different investment areas within government.

Service delivery is integrated across these investment areas to varying degrees and occurs at all levels. Integration is obvious at the scale of whole farm plans and is evident in the information in the 'Collaborations and communities' section of the 2015-16 Goulburn Broken CMA Annual Report. Integration is not so obvious at the strategic level because strategic approaches are usually required to focus on discrete investment areas framed by government investors. Planning for large projects is increasingly integrated across the investment areas. Integration can add cost and complexity. The benefits of integration need to outweigh these costs.

Resilience, adaptability and transformability

Resilience thinking helps to expand thinking to the whole of system. This approach evolved out of the Goulburn Broken CMA's sustainability and ecosystem services thinking and is a major focus of the Regional Catchment Strategy 2013-2019.

Characteristics of desired systems include:

- **resilience:** the capacity to withstand shocks and rebuild without collapsing into a different system
- **adaptability:** the capacity of participants to influence resilience
- **transformability:** the capacity to create a fundamentally new system if necessary.

Together, these characteristics can be considered as part of the resilience package.

Thinking about resilience ensures that fundamental questions are at the forefront of our minds, such as:

- Are our systems sufficiently resilient to withstand a shock?
- Are our systems close to a threshold (or tipping point into a completely different regime)?
 - Is it better to accept that our systems are transforming into a different regime and accept that we should just focus on managing the change?
 - What interventions can or should be made to build resilience?

For the first time in this 2015-16 Annual Report, a summary of each 'critical attribute' of a social-ecological system is given. See Sustainable Irrigation section Annual Report 2015-16

- i. The above discussions on socio-ecological systems and resilience have drawn heavily from 'Resilience, Adaptability and Transformability in the Goulburn-Broken Catchment' (2009) by Walker, Abe I, Anderies and Ryan; the Resilience Alliance website www.resalliance.org and from 'Resilience Management – A Guide for Irrigated Regions, Communities and Enterprises' (2007) by Wolfenden, Evans, Essaw, Johnson, Sanderson, Starkey and Wilkinson.

Appendix B: Research undertaken by program 2013-16

Research Topic	Research Partner	Relevance to RCS
River Health & Floodplain		
<p>Fish condition monitoring in Barmah-Millewa Forest</p> <p>Fish responses to re-snagging in lower Broken Creek</p>	Arthur Rylah Inst (DELWP)	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • River Health – in-stream habitat enhanced <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Effective delivery of environmental water <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Threatened species populations • Water regime
<p>Knowledge gaps for Macquarie perch in the Goulburn Broken Catchment</p> <p>Water temperature in the mid-Goulburn and potential impacts to Macquarie perch</p>	Arthur Rylah Inst (DELWP)	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • River Health – in-stream habitat enhanced <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Effective delivery of environmental water <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Threatened species populations • Water regime • Water quality (temperature)
<p>Monitoring understorey vegetation response to flooding in Barmah Millawa Forest</p> <p>Monitoring flora and fauna responses to pest plant and animal control in Barmah</p>	Consultants	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • River Health – maintain condition of significant wetlands <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Effective delivery of environmental water <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Threatened species populations • Water regime

Research Topic	Research Partner	Relevance to RCS
River Health & Floodplain		
		<ul style="list-style-type: none"> Vegetation condition
<p>Victorian Environmental Flows Monitoring & Assessment Project</p> <p>On-going assessment of biodiversity values at Reedy, Moodie, Black & Kinnairds Swamps in response to environmental flows</p>	DELWP, ARI, Uni of Melb, Consultants	<p>Long-term Objective:</p> <ul style="list-style-type: none"> River Health – in-stream habitat enhanced <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> Effective delivery of environmental water Influence water policy to improve outcomes Build capacity to respond to change drivers Partner research organisations to improve ecological understanding <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> Water regime Threatened species populations Vegetation condition
<p>Evaluation of Moira Grass <i>Pseudoraphis spinescens</i> seed bank from Barmah Forest floodplain</p> <p>Moira Grass mapping</p> <p>Moira Grass environmental water decision framework</p>	<p>MDFRC</p> <p>CSIRO</p> <p>CSIRO</p>	<p>Long-term Objective:</p> <ul style="list-style-type: none"> River Health, Biodiversity – provide ecosystems with appropriate flooding regimes; Assist commitments to international treaties; maintain extent and quality of natural habitat <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> Effective delivery of environmental water Partner research organisations to improve ecological understanding <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> Threatened species populations Water regime Vegetation condition
Predation and population dynamics of three Murray River Turtle species	ARI, Uni of NSW, Yorta Yorta	Long-term Objective:

Research Topic	Research Partner	Relevance to RCS
<i>River Health & Floodplain</i>		
		<ul style="list-style-type: none"> • River Health, Biodiversity – provide ecosystems with appropriate flooding regimes; Assist commitments to international treaties; maintain extent and quality of natural habitat <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Effective delivery of environmental water • Partner research organisations to improve ecological understanding • Collaborate with Traditional Owners • manage impact of pest plant and animals <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Threatened species populations
Surface water extent dynamics from three decades of seasonally continuous Landsat time series at subcontinental scale in a semi-arid region	UNSW	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • River Health, Biodiversity – provide ecosystems with appropriate flooding regimes; Assist commitments to international treaties; maintain extent and quality of natural habitat <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Effective delivery of environmental water • Partner research organisations to improve ecological understanding <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Water regime • Vegetation condition
Carbon sequestration by freshwater wetlands	Deakin Uni	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • Biodiversity – maintain extent and quality of natural habitat • River health – maintain significant wetlands <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Partner research organisations to improve ecological understanding

Research Topic	Research Partner	Relevance to RCS
<i>River Health & Floodplain</i>		
		<ul style="list-style-type: none"> Identify carbon sequestration synergies <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> Water regime Vegetation condition
Ground-water dependent ecosystems (GDEs) in the Goulburn Broken Catchment and their exposure to unconventional gas development	DELWP, Jacobs	<p>Long-term Objective:</p> <ul style="list-style-type: none"> Biodiversity – maintain extent and quality of natural habitat River health – maintain significant wetlands; provide ecosystems with appropriate flooding regimes <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> Partner research organisations to improve ecological understanding Influence water policy to improve outcomes Build capacity to respond to change drivers <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> Water regime Vegetation condition Water quality
Murray-Darling Basin Environmental Water Knowledge and Research Project (Vegetation, Fish, Waterbirds, Food-webs)	MDFRC, CSIRO	<p>Long-term Objective:</p> <ul style="list-style-type: none"> Biodiversity – increase the extent and connectivity of fragmented vegetation River health – protect and enhance riparian condition <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> Partner research organisations to improve ecological understanding Effective delivery of environmental water <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> Threatened species populations

Research Topic	Research Partner	Relevance to RCS
<i>River Health & Floodplain</i>		
		<ul style="list-style-type: none"> • Water regime • Vegetation condition
Stand Condition Assessment of Forests and Woodlands of Barmah Forest	CSIRO, Deakin Uni	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • Biodiversity – increase the extent and connectivity of fragmented vegetation • River health – protect and enhance riparian condition <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Partner research organisations to improve ecological understanding • Manage public land collaboratively <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Water regime • Vegetation condition
Assessment of hydraulic habitat, and the composition of (i) macrophytes and (ii) macroinvertebrates along the lower Broken Creek	Water Tech	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • Biodiversity – increase the extent and connectivity of fragmented vegetation • River health – protect and enhance riparian condition <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Partner research organisations to improve ecological understanding • Manage public land collaboratively <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Water regime • Vegetation condition • Water quality • Riparian zone filtration

Research Topic	Research Partner	Relevance to RCS
<i>River Health & Floodplain</i>		
Effects on fish and water quality in the Broken River post Lake Mokoan decommissioning	MDFRRC, LTU	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • River Health – in-stream habitat enhanced <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Effective delivery of environmental water <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Threatened species populations • Water regime • Water quality (temperature)

Research Topic	Research Partner	Relevance to RCS
<i>Land & Biodiversity</i>		
Long-term monitoring of fauna responses to management actions, including birds and reptiles	ANU	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • Biodiversity – increase the extent and connectivity of fragmented vegetation • River health – protect and enhance riparian & wetland condition • Soil health – protect environmental values and ecosystem services; promote sustainable farming practises; manage impact of pest plant and animals <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Partner research organisations to improve ecological understanding • Capture opportunities for biodiversity outcomes from land-use change <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Threatened species populations • Vegetation condition
Fauna responses to revegetation at 'Wetlandia'	Fed Uni	

Research Topic	Research Partner	Relevance to RCS
Land & Biodiversity		
How much revegetation is enough?	Deakin Uni	<p>Long-term Objective:</p> <ul style="list-style-type: none"> Biodiversity – Maintain / increase the extent and connectivity of fragmented vegetation River health – protect and enhance riparian condition Soil health – protect environmental values and ecosystem services; promote sustainable farming practises; manage impact of pest plant and animals <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> Partner research organisations to improve ecological understanding Capture opportunities for biodiversity outcomes from land-use change <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> Threatened species populations Vegetation condition Landscape connectivity
How does the variation in farming landscapes affect bird, bat and bee species and distribution?	Deakin Uni	
Key habitat variables that affect bird species distribution at the landscape scale'	LaTrobe Uni, ARI	
Monitoring change in Seasonal Herbaceous wetlands under different management regimes	Rakali Consulting	<p>Long-term Objective:</p> <ul style="list-style-type: none"> Biodiversity – Maintain / increase the extent and connectivity of fragmented vegetation River health – protect and enhance riparian condition Soil health – protect environmental values and ecosystem services; promote sustainable farming practises; manage impact of pest plant and animals <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> Capture opportunities for biodiversity outcomes from land-use change <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> Threatened species populations Water regime

Research Topic	Research Partner	Relevance to RCS
Land & Biodiversity		
		<ul style="list-style-type: none"> Vegetation condition
The use of seed production areas (SPAs) for ex situ conservation and restoration	CSIRO, UoM	<p>Long-term Objective:</p> <ul style="list-style-type: none"> Biodiversity – Increase the extent and connectivity of fragmented vegetation Soil health – protect environmental values and ecosystem services; promote sustainable farming practises; <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> Partner research organisations to improve ecological understanding Capture opportunities for biodiversity outcomes from land-use change <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> Landscape connectivity Threatened species populations
Fauna responses to revegetation	Fed Uni	<p>Long-term Objective:</p> <ul style="list-style-type: none"> Biodiversity – Maintain / increase the extent and connectivity of fragmented vegetation <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> Capture opportunities for biodiversity outcomes from land-use change <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> Threatened species populations Landscape connectivity

Research Topic	Research Partner	Relevance to RCS
Farm Water Program		
Salt and Water Balance project	GMW, DELWP	Long-term Objective:

Research Topic	Research Partner	Relevance to RCS
Farm Water Program		
		<ul style="list-style-type: none"> • River health – maintain / improve significant wetlands; • Salinity - ground water management • Soil health – protect environmental values and ecosystem services; promote sustainable farming practises • People – facilitate the adoption of best management practises <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Build community and agency capacity to respond to change drivers • Capture opportunities for biodiversity outcomes from land-use change <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Watertable depth & extent • Land available for irrigated agriculture
Market segmentation of groundwater users in the Shepparton (Vic) and Murray (NSW) Irrigation Regions	Geoff Kaine Res, NSW DPI, GMW	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • People – facilitate the adoption of best management practises; build community knowledge for new and emerging threats and thresholds • Salinity - ground water management <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Build community and agency capacity to respond to change drivers • Develop adaptive planning for social-ecological systems <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Watertable depth and extent • Land available for irrigated agriculture

<i>Research Topic</i>	<i>Research Partner</i>	<i>Relevance to RCS</i>
Farm Water Program		
Understanding water availability and farm viability across the GMID	RMCG, DELWP	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • People – facilitate the adoption of best management practises; build community knowledge for new and emerging threats and thresholds • River health – maintain / improve significant wetlands; • Salinity - ground water management • Soil health – protect environmental values and ecosystem services; promote sustainable farming practises <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Build community and agency capacity to respond to change drivers • Develop adaptive planning for social-ecological systems • Influence water policy to secure water for ecological, social and economic wellbeing • Effective delivery of environmental water <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Watertable depth and extent • Land available for irrigated agriculture • Productive capacity and community viability • Viability of agricultural properties outside irrigation
Goulburn Broken Native Vegetation Management and Offset Scheme Feasibility Study	Biosis, Local Government, DELWP	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • River health – maintain / improve significant wetlands; • Biodiversity - Maintain / increase the extent and connectivity of fragmented vegetation • Soil Health - protect environmental values and ecosystem services; promote sustainable farming practises <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Build community and agency capacity to respond to change drivers • Capture opportunities for biodiversity outcomes from land-use change

<i>Research Topic</i>	<i>Research Partner</i>	<i>Relevance to RCS</i>
Farm Water Program		
		<p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Threatened species populations • Vegetation condition & extent • Landscape connectivity
Soil Health Impact Survey	First Person Consulting	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • People – facilitate the adoption of best management practises; build community knowledge for new and emerging threats and thresholds • Soil health – protect environmental values and ecosystem services; promote sustainable farming practises <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Build community and agency capacity to respond to change drivers • Develop adaptive planning for social-ecological systems <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Productive capacity and community viability
Assessing the impact of Beyond Soilcare project: using the Goal Attainment Scaling Technique	DEDJTR	
Adapting the whole farm planning approach across the GMID and MID Stage 1	DELWP, DEDJTR, GMW	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • People – facilitate the adoption of best management practises; build community knowledge for new and emerging threats and thresholds • River health – maintain / improve significant wetlands; • Salinity - ground water management • Soil health – protect environmental values and ecosystem services; promote sustainable farming practises <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Build community and agency capacity to respond to change drivers • Capture opportunities for biodiversity outcomes from land-use change • Develop adaptive planning for social-ecological systems • Influence water policy to secure water for ecological, social and economic wellbeing

<i>Research Topic</i>	<i>Research Partner</i>	<i>Relevance to RCS</i>
Farm Water Program		
		<ul style="list-style-type: none"> • Effective delivery of environmental water <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Productivity losses • Land available for irrigated agriculture • Watertable depth & extent • Nitrogen and phosphorous loads (water quality)
Mt Scobie ground-water pumping and conjunctive re-use	DELWP	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • Salinity - ground water management • Soil health – protect environmental values and ecosystem services; promote sustainable farming practises • People – facilitate the adoption of best management practises <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Build community and agency capacity to respond to change drivers • Capture opportunities for biodiversity outcomes from land-use change <p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Productivity losses • Watertable depth and extent • Vegetation condition & extent • Landscape connectivity
Assessment of flooding regimes and water distribution within border-check irrigation systems – identifying improvements in water use efficiency	DELWP	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • Salinity - ground water management • Soil health – protect environmental values and ecosystem services; promote sustainable farming practises <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Build community and agency capacity to respond to change drivers

<i>Research Topic</i>	<i>Research Partner</i>	<i>Relevance to RCS</i>
<i>Farm Water Program</i>		<p>Resilience Threshold(s) informed:</p> <ul style="list-style-type: none"> • Productivity losses • Watertable depth & extent • Nitrogen and phosphorous loads (water quality)

Appendix C: Peer-reviewed authorship by Goulburn Broken CMA staff 2013 - 16

- Arthur, A.D., Reid, J.R., Kingsford, R.T., McGinness, H.M., Ward, K.A. and Harper, M.J. (2013). Breeding flow thresholds of colonial breeding waterbirds in the Murray-Darling Basin, Australia. *Wetlands*, 32(2), pp.257-265.
- Broadhurst, L., Hopley, T., Lan, L. and Begley, J. (in prep) The benefits of seed production areas (SPAs) for ex situ conservation and restoration. *Ecological Restoration and Management*
- Capon, S.J., Lynch, A.J.J., Bond, N., Chessman, B.C., Davis, J., Davidson, N., Finlayson, M., Gell, P.A., Hohnberg, D., Humphrey, C., Kingsford, R.T., Nielsen, D., Thomson, J.R., Ward, K.A. and Mac Nally, R. (2015). Regime shifts, thresholds and multiple stable states in freshwater ecosystems; a critical appraisal of the evidence. *Science of The Total Environment* 02/2015; DOI:10.1016/j.scitotenv.2015.02.045.
- Colloff, M.J., Ward, K.A. and Roberts, J. (2014). Ecology and conservation of grassy wetlands dominated by spiny mud grass *Pseudoraphis spinescens* in the southern Murray–Darling Basin, Australia. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 24(2), pp.238-255.
- Durant, R.A., Nielsen, D.L. and Ward, K.A. (in press) Evaluation of *Pseudoraphis spinescens* (Poaceae) seed bank from Barmah Forest floodplain. *Australian Journal of Botany* <http://dx.doi.org/10.1071/BT15288>.
- Ladson, A.R. and Judd, D.A., (2014). A review of the effect of floodplain gravel mining on river stability, in: *Proceedings of the 7th Australian Stream Management Conference*. p. 349.
- McGinness, H.M., Arthur, A.D., Ward, K.A. and Ward, P.A. (2014). Floodplain amphibian abundance: responses to flooding and habitat type in Barmah Forest, Murray River, Australia. *Wildlife Research*, 41(2), pp.149-162.
- Vivian, L.M., Ward, K.A., Zwart, A.B. and Godfree, R.C. (2014). Environmental water allocations are insufficient to control an invasive wetland plant: evidence from a highly regulated floodplain wetland. *Journal of Applied Ecology*, 51(5), pp.1292-1303.
- Vivian, L.M., Ward, K.A., Marshall, D.J. and Godfree, R.C. (2015). *Pseudoraphis spinescens* (Poaceae) grasslands at Barmah Forest, Victoria, Australia: current distribution and implications for floodplain conservation. *Australian Journal of Botany* 63: 526–540. <http://dx.doi.org/10.1071/BT15090>.
- Ward, K.A. (2014) Colonial waterbird breeding in Barmah-Millewa Forest and the use of environmental water. In: *Birds of the Murray-Darling Basin* (Ed Kingsford, R., Lau, J. & O'Connor, J.). Birdlife Australia Conservation Statement No. 16 (May 2014). Pp: 40-42. ISSN 0815-5208.
- Vesk, P.A., Morris, W.K., McCallum, W., Apter, R. and Miles, C., 2016. Processes of woodland eucalypt regeneration: lessons from the bush returns trial. *Proc. R. Soc. Vic.* 128, 54. doi:10.1071/RS16005

Appendix D: Current Research Priorities

Research Topic	Relevance to RCS
<i>River Health & Floodplain</i>	
Fish population dynamics in the Goulburn - Murray River system: Do environmental flows designed to promote spawning result in population recruitment, and if so, does recruitment extend into both Goulburn & Murray systems?	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • River Health – in-stream habitat enhanced <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Effective delivery of environmental water
Carbon pools and flux in river systems: What is the relationship between floodplain and in-stream carbon metabolism; and what role does increased lateral connectivity play in food-chains and life-cycles?	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • River Health – in-stream habitat enhanced <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Effective delivery of environmental water • Identify carbon sequestration synergies
Understanding and managing impacts of carp virus: What are the potential social / economic and ecological impacts to catchment communities and ecosystems from the introduction of the carp virus? What positioning is required by the Goulburn Broken CMA under a release scenario?	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • River Health – in-stream habitat enhanced • People – build capacity to participate in catchment management; develop knowledge of emerging threats and thresholds <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Effective delivery of environmental water • Influence water policy to improve outcomes • Build capacity to respond to change drivers
What do migratory birds do when they go? Considerable amounts of environmental water are used to assist bird breeding (particularly in Barmah). While we have data on resultant increases in nesting, and to a lesser extent, fledging, little is known about the contribution to population recruitment	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • Floodplains, Biodiversity – provide ecosystems with appropriate flooding regimes; Assist commitments to international treaties; maintain extent and quality of natural habitat <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Effective delivery of environmental water

Research Topic	Relevance to RCS
	<ul style="list-style-type: none"> Partner research organisations to improve ecological understanding
Land & Biodiversity	
<p>Threatened species and communities:</p> <p>Is our current understanding of the suite and status of threatened species and communities across the catchment sufficient to guide effective management actions?</p>	<p>Long-term Objective:</p> <ul style="list-style-type: none"> Biodiversity – increase the extent and connectivity of fragmented vegetation River health – protect and enhance riparian condition <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> Partner research organisations to improve ecological understanding Capture opportunities for biodiversity outcomes from land-use change
<p>Revegetation outcomes - tree-planting is good, right?</p> <p>We need to be able to understand the outcomes of revegetation activities more deeply: To what extent has catchment revegetation modified fragmentation / connectivity? Are there particular fauna guilds that benefit more than others; what guilds / species of concern aren't impacted (positively) by revegetation – are other actions required?</p>	<p>Long-term Objective:</p> <ul style="list-style-type: none"> Biodiversity – increase the extent and connectivity of fragmented vegetation River health – protect and enhance riparian condition Soil health – protect environmental values and ecosystem services; promote sustainable farming practises; manage impact of pest plant and animals <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> Partner research organisations to improve ecological understanding Capture opportunities for biodiversity outcomes from land-use change
<p>What do (and don't) we know about remnant vegetation on private land?</p> <p>The CMA largely focuses on the conservation and management of remnant vegetation on private land given the nature of funding (e.g. NLP) and the role of state agencies charged with public land management. To what extent are CMA-directed funds affecting the extent, condition and protection of vegetation on private land? What obstacles (e.g. lack of funds for on-ground management) hinder greater effectiveness?</p>	<p>Long-term Objective:</p> <ul style="list-style-type: none"> Biodiversity – Maintain / increase the extent and connectivity of fragmented vegetation River health – protect and enhance riparian condition Soil health – protect environmental values and ecosystem services; promote sustainable farming practises; manage impact of pest plant and animals <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> Partner research organisations to improve ecological understanding Capture opportunities for biodiversity outcomes from land-use change
Sustainable Irrigation	

Research Topic	Relevance to RCS
Understanding the hydrologic drivers and inter-relationships of those drivers with the Corop Lakes landscape and developing appropriate water (surface drainage & environmental watering regimes) and land use management actions/influence	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • River health – maintain / improve significant wetlands; • Salinity - ground water management • Soil health – protect environmental values and ecosystem services; promote sustainable farming practises • People – facilitate the adoption of best management practises <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Build community and agency capacity to respond to change drivers • Capture opportunities for biodiversity outcomes from land-use change • Develop adaptive planning for social-ecological systems • Influence water policy to secure water for ecological, social and economic wellbeing • Effective delivery of environmental water
Adaptation pathways for irrigation regions: a case study of the Shepparton Irrigation Region (funded 2016)	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • People – facilitate the adoption of best management practises; build community knowledge for new and emerging threats and thresholds • River health – maintain / improve significant wetlands; • Salinity - ground water management • Soil health – protect environmental values and ecosystem services; promote sustainable farming practises <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Build community and agency capacity to respond to change drivers • Capture opportunities for biodiversity outcomes from land-use change • Develop adaptive planning for social-ecological systems • Influence water policy to secure water for ecological, social and economic wellbeing • Effective delivery of environmental water
Understanding water availability and farm viability across the GMID Stage 2: further work on understanding thresholds around water availability and farm viability as 2 critical attributes in the SIR (funded 2016)	<p>Long-term Objective:</p> <ul style="list-style-type: none"> • People – facilitate the adoption of best management practises; build community knowledge for new and emerging threats and thresholds • River health – maintain / improve significant wetlands;

Research Topic	Relevance to RCS
	<ul style="list-style-type: none"> • Salinity - ground water management • Soil health – protect environmental values and ecosystem services; promote sustainable farming practises <p>Strategic Management Objective:</p> <ul style="list-style-type: none"> • Build community and agency capacity to respond to change drivers • Capture opportunities for biodiversity outcomes from land-use change • Develop adaptive planning for social-ecological systems • Influence water policy to secure water for ecological, social and economic wellbeing • Effective delivery of environmental water

