



VICTORIAN
CATCHMENT
MANAGEMENT
COUNCIL



CATCHMENT CONDITION
AND MANAGEMENT
REPORT

2017

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Printed by Impact Digital, Melbourne.

ISBN 978-1-76047-654-0 (Print)

ISBN 978-1-76047-655-7 (pdf/online)

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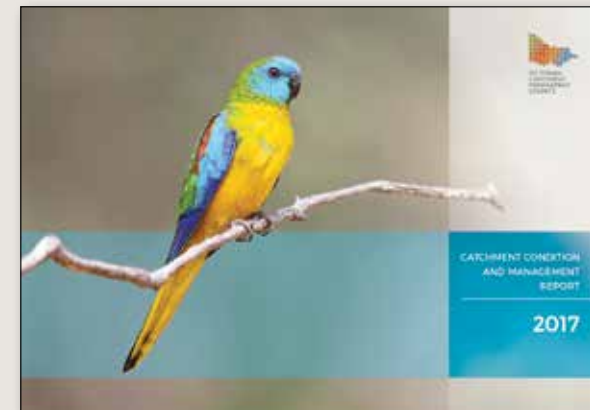
Traditional Owners acknowledgement

The Victorian Catchment Management Council (VCMC) proudly acknowledges Victoria's Aboriginal community and their rich culture and pays respect to their Elders past and present.

We acknowledge Aboriginal people as Australia's first peoples and as the Traditional Owners and custodians of the land and water on which we rely. We recognise and value the ongoing contribution of Aboriginal people and communities to Victorian life and how this enriches us. We embrace the spirit of reconciliation, working towards the equality of outcomes and ensuring an equal voice.

Cover image

VCMC chose this cover shot of the Turquoise Parrot (*Neophema pulchella*) because it symbolises a success story in habitat management and conservation results. The local community and landholders have worked together with researchers and ecologists to design and build the nest-boxes and modified hollow logs, the work aligns with regional catchment management priorities, and there is greater community awareness and understanding of the species and its habitat. The resurgence of the Turquoise Parrot demonstrates what collaborative efforts across science, government, regional organisations and community can achieve.



Photograph and information by Chris Tzaros, Birds, Bush and Beyond. Tzaros, C (2016). Dark Past, Bright Future? In *Australian Birdlife*, 5, (3), 20-25.

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Chair's foreword

In the 20th Anniversary year of the VCMC and the Catchment Management Authorities (CMAs), the VCMC presents the fifth *Catchment Condition and Management Report*, as required in the *Catchment and Land Protection Act 1994* (CaLP Act). This is to provide the Minister/s responsible with a report on the condition and management of the land and water resources in Victoria. The report provides VCMC's key messages and recommendations on the condition of catchments and underpinning management structures. VCMC recognises the continued need to refine collective actions for the sustainability of productive land management in parallel with environmental restoration and/or maintenance of the land and water resources of the state.

VCMC and its partners have benefitted through direct engagement with the Traditional Owner organisations in Report development and supports the complementarity of the Aboriginal Participation Guideline for Victorian Catchment Authorities: Implementation Plan – Pathways to Participation, launched in 2016.

In the period since the previous report, VCMC has seen several significant points of focus, which are already bringing clarity to the implementation of integrated catchment management in Victoria. The Victorian Auditor-General's report – *Effectiveness of Catchment Management Authorities* (September 2014), led to the Victorian Government's response with the development of *Our Catchments Our Communities*, the State's first integrated catchment management policy, itself sitting within the new policy *Water for Victoria*. These latter two provide an example of policy initiatives giving direction to both statewide commitments and strengthening of a regional delivery focus for land and water resources. A review of the *Marine and Coastal Act* may provide further opportunities for collaborative statewide reporting. Another initiative is the establishment of the Vic Catchments Forum, which comprises an industry-wide grouping of CMA Chairs as a vehicle for building partnerships and exchanging

information across the catchment management sector. The Forum held its first meeting in February 2017.

VCMC has outlined its assessment methodology and the themes and indicators used, based on the *Our Catchments Our Communities* strategy. VCMC recognises any assessment of condition understands the restoration and rehabilitation of damaged natural systems occupies a necessarily long time sequence. *Our Catchments Our Communities* recognises the timeframes and at the same time, implementation of on-ground activity, about which future *Catchment Condition and Management Reports* might report.

Innovation is an important component of providing sound reporting into government and to that end this report is adopting an approach in illustrating regional condition and management by including regional snapshots, as outlined in Chapter 4. This has been made possible by working even more collaboratively with the CMAs, Melbourne Water (as the waterway manager for Port Phillip and Westernport CMA region) and many regional partners. It is also recognition of the significant role played by the CMAs. Delivery of programs/policy frameworks/project initiatives across land, water, biodiversity and coastal themes, with multiple regional partners, provides Victoria with a nation-leading delivery framework. Arguably the most critical point in this framework is the role of Community Engagement (CaLP Act). Integrated catchment management success needs strong connections across local/regional communities, as well as the policy frameworks of Government, in small part illustrated by the snapshots of Chapter 4. VCMC is firmly of the view Government must continue to enhance these connections by advancing the necessary resourcing for CMAs to enable the ongoing delivery of those frameworks. Integrated catchment management must, by necessity, incorporate environmental-economic accounting as discussed later in this report to fully meet statewide and regional community expectations.



Innovation has been demonstrated with and through actions of CMAs and partners and I note these few examples to illustrate the point, from this report; Corangamite CMA with Federation University has developed an NRM Planning Portal; a Tri-state alliance for cooperation across state and CMA jurisdictions; and the East and West Gippsland CMAs working together on the Gippsland Lakes Coordinating Committee.

VCMC has further developed collaborative relationships with the Office of the Commissioner for Environmental Sustainability. VCMC directly participates in the Commissioner's Environmental Reporting Projects Control Board, the Stakeholder Reference Group, and the Technical Advisory Group. VCMC recognises the opportunity such collaboration brings to improve reporting within each jurisdiction and to draw on the partnership expertise of each organisation. Simply put, this integration has functional benefits for each organisation beyond this report and by extension into the Commission's coming *State of the Environment* report in 2018.

VCMC also sees the opportunity for further innovation in future reports through enhanced digital applications, bringing together greater effectiveness and efficiencies across multiple performance measures in our assessment frameworks. The application of emerging technology must be developed and supported by government agencies, through regional bodies such as the CMAs to measure and evaluate against substantial government investment and demonstrate the many outcomes at all levels.

VCMC takes full responsibility for this report and I acknowledge here the contribution of the entire project team, Dr Phil Wallis, Patricia Geraghty, Neil Meyers and Tracey Koper and each VCMC member. Our report reviewers, Professor Barry T Hart AM, Associate Professor Catherine Allan, Professor Ted Lefroy and Ms Christine Forster AM, must also be thanked for their critical and insightful commentary. As mentioned support and collaboration provided through the Office of the Commissioner for Environmental Sustainability, DELWP, Melbourne Water, Department of Economic Development, Jobs, Transport and Resources, Environment Protection Authority Victoria, Traditional Owner organisations and the CMAs have all provided information and feedback in the preparation of this report.

The key messages and recommendations herein are a synthesis by VCMC of the contributions of these parties and a judgement of the overall needs to advance integrated catchment management in the state of Victoria. As Chair, I commend this *2017 Catchment Condition and Management Report* to the Ministers The Honourable Lisa Neville MP, Minister for Water, and The Honourable Lily D'Ambrosio MP, Minister for Energy, Environment, Climate Change and Suburban Development.



Angus Hume
Chair



Photo: VCMC



Photo: Tracey Koper



Photo: Tracey Koper

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1

Introduction

What we found

VCMC's fifth *Catchment Condition and Management Report* represents 20 years of reporting at five-yearly intervals about our catchments. Recognising this milestone, this report presents both an assessment of catchment condition, based on information available over the last five years, as well as an assessment of 20 years of trends in catchment condition and management, in **Chapter 1**.

Significant policy reform has taken place since the last report in 2012. Victoria has a statewide integrated catchment management strategy, *Our Catchments Our Communities*, in addition to new water policy in *Water for Victoria*, a statewide biodiversity plan *Protecting Victoria's Environment – Biodiversity 2037*, and a long-term plan for addressing climate change in the *Climate Change Framework*. How these new policies fit into integrated catchment management, and the problems they seek to address, are detailed in **Chapter 2**.

For the first time, VCMC looks beyond just statewide condition reporting, presented in **Chapter 3**, to regional reporting, in **Chapter 4**, done in collaboration with CMAs, Melbourne Water, and their regional partners. A consistent set of five themes form the basis of this reporting: land, water, biodiversity, coasts and community.

As with past *Catchment Condition and Management Reports*, this report has been limited by a lack of data and inaction on previous recommendations around developing robust processes for reporting. VCMC has identified a need for an independent investigation of the consolidation of catchment condition and management reporting, which forms the basis of **Recommendation 1: Improve the quality of reporting**.

Likewise, monitoring of condition is inconsistent and often ad-hoc or project-based, and does not enable CMAs to demonstrate

outcomes against the priorities in Regional Catchment Strategies. VCMC would like to see greater consistency of monitoring to inform catchment condition and management reporting, focused on Regional Catchment Strategy goals and SMART targets, as proposed in **Recommendation 2: Implement mandatory monitoring**.

Community involvement and co-investment is key to the success of integrated catchment management, but information on these and on what is important or concerning to communities is inconsistent or lacking. Community participation numbers only tell part of the story, and are not always consistently collected across the CMAs. Better information on the views of community and the quality of community involvement is needed to enable better decision making and policy development. This is reflected in **Recommendation 3: Involve catchment communities**.

VCMC's 20-year assessment is that condition is declining or stable across the five themes, but that management of catchments has improved and has a largely positive outlook. To make progress towards improving catchment condition, secure funding for catchment management programs is required to maintain management effort over the long term, as proposed in **Recommendation 4: Provide a five-year funding cycle**.

VCMC makes these recommendations (Table 1), derived from the information in this report, from the combined expertise and experience of the members and the project team, and from many other sources.

The recommendations align with VCMC's vision:

“Victoria will have healthy rivers flowing through ecologically sustainable and productive catchments”

Table 1. Recommendations of the Victorian Catchment Management Council, 2017.

	Recommendation	Lead partners	When
1	Improve the quality of reporting Consolidate statewide reporting for catchment condition and management to improve the quality of reporting.	Independent agency*; oversight by DELWP	2018 - 2019
2	Implement mandatory monitoring Undertake consistent reporting of condition and management across the state using SMART targets to prioritise the Regional Catchment Strategies.	DELWP and CMAs	2018; for inclusion in CMA Annual Reports 2018-19
3	Involve catchment communities Adopt an on-going, measurable engagement process with all catchment communities to enable improved decision making and policy development.	DELWP and CMAs	2018; and annually from then on
4	Provide a five-year funding cycle Support cost-effective investment by government in the CMAs in achieving community-led priorities through the Regional Catchment Strategy framework.	DELWP	2018

* Independent of the current catchment and environmental reporting framework

About our catchments

VCMC considers that the integrated catchment management model, with regional delivery through the CMAs and their partners, continues to be the preferred way to manage priorities for land, water, biodiversity, coastal and community resources of Victoria. This is supported by the policy statements in *Our Catchments Our Communities* (DELWP 2016a).

The Regional Catchment Strategies, established in the *Catchment and Land Protection Act 1994* are the key regional documents for catchment planning and are based on alignment between state policies and community values and services. The CMAs develop the strategies in collaboration with their partners and communities. VCMC views these Regional Catchment Strategies as the basis of effective integrated catchment management in Victoria, under the framework of *Our Catchments Our Communities*. The Regional Catchment Strategies provide for cross-agency collaboration at the regional level.

However, analysis of the goals and targets in the current Regional Catchment Strategies demonstrated that the goals and objectives are formulated at different levels, and use different language and metrics. While these variations can be explained in terms of regional differences and the lack of a unifying policy in the past, the recent collaborations around goals and targets point in one direction: there is general agreement that more consistency would be an improvement. Indeed, more consistency in monitoring and reporting is acknowledged in *Our Catchments Our Communities*, which is needed against SMART (specific, measurable, attainable, relevant and time-based) targets for the agreed themes across the state.

This monitoring and reporting should be undertaken by CMAs and their regional partners, and aggregated by the agencies involved in statewide reporting: Department of Environment, Land, Water and Planning (DELWP), the Commissioner for Environmental Sustainability and VCMC. There should be additional statewide monitoring of aspects of catchment condition undertaken by DELWP and other agencies to fulfil their specific needs.

Environmental-economic accounting could play a significant role in providing this consistency, through providing a useful framework for organising and analysing the data.

There is no ongoing program of monitoring at statewide level across the agreed themes of land, water, biodiversity, coasts and community, using simple, robust, useful, aggregable and easily collectible indicators, despite the significant amount of project reporting, water data collection and input-output information undertaken by multiple agencies across the state. The roles of DELWP, VCMC and the Commissioner for Environmental Sustainability regarding statewide monitoring, evaluation and reporting are not clear.



Photo: Tracey Koper

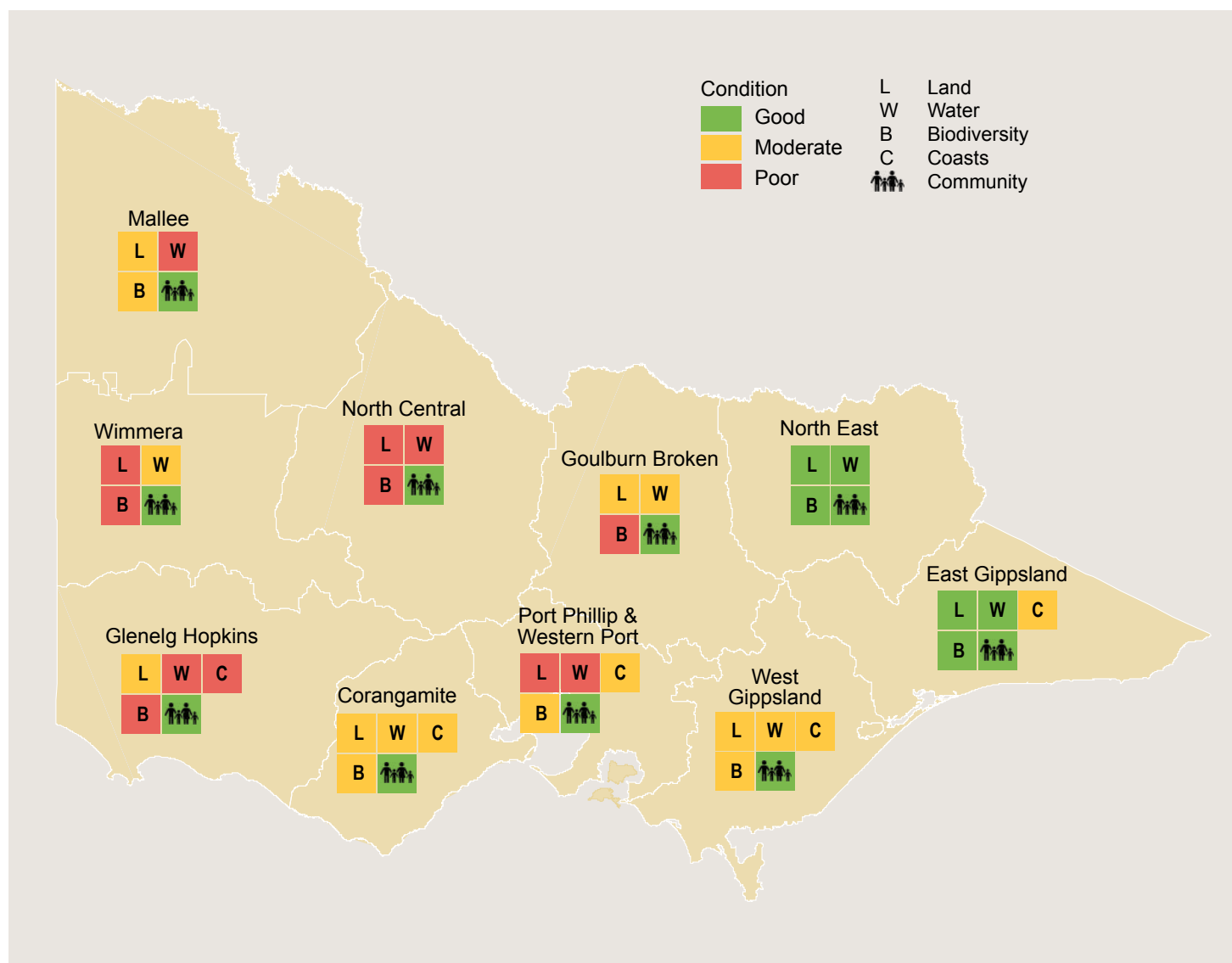
About our communities

In assessing the community theme, the measure for 'condition' was the number of community participants in CMA engagement events over three years between 2013-14 and 2015-16, and the 'trend' was the change over that period. There was generally good engagement perceived at the regional level, and the trend has been highly positive.

While numbers of community participants were used as an indicator, as this was the only quantitative measure reported across all CMA regions, VCMC recognises the limitations of these data for reporting on the quality of community involvement and co-investment. There are various surveys and benchmarking studies that seek to understand the views of communities regarding aspects of the condition and management of their catchments, but none of these tell a story at the scale at which VCMC reports.

A more consistent and comprehensive set of measures and accountabilities for community participation, perspectives, priorities, and concerns needs to be developed to better understand the outcomes of community involvement and co-investment in integrated catchment management. Since the contribution of Aboriginal communities greatly enriches integrated catchment management, this set of measures should include aspects around Aboriginal views, involvement and co-investment, and how these change over time.

Citizen science in monitoring and reporting on catchment condition and management is important for various reasons: more information is made available to all interested parties; community awareness and involvement is increased; and better decisions can be ensured. Citizen science has an important role to play in drawing a richer picture of catchment condition, in conjunction with government monitoring programs and should be strongly supported.



Assessment of catchment condition 2017

VCMC has assessed the condition of the catchments across the state as shown in Figure 1, using the five themes from *Our Catchments Our Communities*. This assessment is more qualitative than quantitative as it draws on the information available to this report from the last five years, combined with the CMAs' 2015-16 annual report assessments of catchment condition and management. Note that a 'Coasts' theme is used since marine information is not available to include in 2017. Assessment of condition is rated on a three-point scale as 'good', 'moderate', or 'poor', and applies to the last five years, 2012-16.

Condition across the state follows the general east-west trajectory of previous assessments, with the better conditions in East and West Gippsland, Corangamite and the North East CMA regions. This report demonstrates these regional differences in more detail in Chapter 4.

Figure 1. VCMC's assessment of catchment condition based on information available over the last five years, 2012-16.

Assessment of 20 years of catchment condition and management, 1997–2017

VCMC has assessed the trends in both condition and management of land, water, biodiversity, coasts, and communities over 20 years (Table 2). This assessment is qualitative and draws on the information available in this report and in VCMC's previous reports in 1997, 2002, 2007 and 2012.

The statewide assessment of condition trends is generally either stable or declining across the biophysical themes, due to such factors as the legacy effects of over 200 years of development pressure across much of the state, since European settlement, and to weather variability and climate change. However, it is encouraging that the assessment of the effectiveness of management is either 'neutral' in the case of coasts (but with a 'positive' prospect in

that area) through to 'positive' and 'highly positive' for the other themes. There is a notable lack of data for measuring community condition, as described earlier in this report. Management efforts have increased and improved over the past 20 years, especially regarding water and waterways. VCMC is keen to assert that these management efforts need to continue and be accelerated if the overall decline in catchment condition is to be addressed. As it must be if our state is to prosper and our catchments are to continue providing all the services and benefits expected by our communities.

LAND

Condition: In VCMC's past assessments, measures of land condition have focused on soils, including erosion, salinity, acidification and soil structure. The 2002 assessment suggested a declining trend in overall land condition, but noted that data were variable at best across the five indicators used in that report. Insufficient data on soil health was highlighted in the 2007 and 2012 reports so no assessments were made. The information presented in this report indicates an increase in percentage bare soils over five years from 2011–2016 across the state, but little overall change from 2000–2016. Noting the significant lack of condition data in this theme, and recognising the increasing impacts of climate change, VCMC assumes 'Declining' condition of land statewide.

Management: As reported in successive VCMC assessments, there is no statewide land management or soil management strategy for Victoria. However, there have been programs to address aspects of land and soil management over that period, including the National Action Plan for Salinity and Water Quality led jointly by the Australian and Victorian State Governments, Natural Heritage Trust and successor programs, and a variety of regional and local activities including those by individual landholders who recognise the impacts of land degradation and declining soil health on agricultural productivity and on environmental condition. Such information has resulted in VCMC's qualitative assessment of the trend in land and soil health management effort over the past 20 years as 'Positive'.

Table 2. Assessment of catchment condition and management trends, 1997–2017.*

Theme	Catchment condition trend 1997–2017	Catchment management trend 1997–2017
Land	↓ Declining	↗ Positive
Water	→ Stable	↑ Highly positive
Biodiversity	↓ Declining	↗ Positive
Coasts	↓ Declining	→ Neutral
Community	↑ Improving	↑ Highly positive

* Note that this assessment is qualitative, based on available information

Assessment of catchment condition trend is rated on a three-point scale as '↑ improving', '→ stable', or '↓ declining'. Assessment of catchment management trend is rated on a five-point scale as '↑ highly positive', '↗ positive', '→ neutral', '↘ concerned' or '↓ highly concerned'.

WATER

Note that various themes and indicators were used in the 2002, 2007 and 2012 reports under the section headings of Rivers, wetlands and streams; and Managing water resources (2002); Water resources: Rivers and streams, Groundwater, Lakes and wetlands, and Estuaries, coasts and marine areas (2007); and Water resources: Rivers and streams, Wetlands and Groundwater (2012).

The following analysis follows the structure used in this 2017 report. The assessments over the past 20 years by VCMC in this report were made at the theme level of 'Water' rather than of the components as in previous years, using the condition and trends in the condition of rivers as the key focus for the catchment management sector.

Condition: Rivers The first use of the Index of Stream Condition was in the 2002 report, based on the findings from the survey in 1999. The statewide condition was assessed as 'Moderate' but no trend was available since this was a benchmarking exercise. The 2007 report incorporated the findings of the second Index of Stream Condition, which was conducted in 2004 and assessed the statewide condition as 'Poor' in the west and 'Moderate' to 'Good' in the east, with trends stable across the state. Since there was no new information in the intervening five years, these assessments were assumed to persist in the 2012 report. The 2010 Index of Stream Condition was published in 2013 using a different method from the previous surveys, all of which can be used as benchmarks of condition. They show minimal change in condition over the three surveys. VCMC has assessed the current overall condition as 'Moderate', with variations at the regional level; and the trend as essentially stable.

Estuaries: Estuary condition was rated as 'Unknown' in the 2002 report., due to lack of information other than for Port Phillip and Western Port Bays and the Gippsland Lakes. In 2007, the rating was 'Assume Poor' due to the number of modified estuaries across the state but lack of data prevented a more rigorous assessment. Estuary condition was described but not assessed in the 2012 report due to lack of data. Estuaries are described in this report but are not assessed separately.

Wetlands: The 2002 report did not assess wetland condition or trend. Lakes and wetlands were combined in the 2007 report but data were insufficient to do other than rate their condition as 'Assume Poor' with a 'Declining' trend. Some data were available but not on a statewide scale. In 2012, wetland extent and condition were assessed, using new information, but both indicators were rated as 'Assume Moderate' due to variability across the state and incomplete data; and as "Assume Declining' in trend. As for estuaries, wetlands have been described in this report but are not assessed separately.

Groundwater and dependent ecosystems: In 2002, groundwater allocation and use was assessed as 'Good' and 'Stable' at the statewide level, although there was some regional variation. The indicator of groundwater availability was assessed as 'Moderate' to 'Good and 'Stable' in 2007 but the groundwater quality data were not sufficient to enable an assessment. Groundwater condition and quality were both rated as 'Assume Moderate' in the 2012 report, and the trend was rated as 'Unknown' for both indicators due to the lack consistent and reliable statewide data. Groundwater and dependent ecosystems have been described in this report but are not assessed separately.

Water resources: There was some information in the 2002 report on various aspects of water quality: pH, stream phosphorus, electrical conductivity, nitrogen and median stream turbidity. Results for both condition and trend at the regional level were highly variable across the state, as was the availability of data. Therefore, no statewide assessments were made. Water quality was an indicator in the 2007 report and assessed the statewide condition as 'Poor' in the west and 'Moderate' to 'Good' in the east, with trends stable across the state. Water resources are briefly described in this report. Note that there is much information about various aspects of water resources: stocks and flows, averages over different time periods, water quality data, environmental water, consumption figures and so on, as found in *Water for Victoria* (DELWP, 2016a) policy documents and many other publications. A separate overall assessment of the condition of water resources in Victoria has not been made.





Photo: Phil Wallis

Management: VCMC has assessed the management of Victoria's water, including all the aspects mentioned, above as 'Highly Positive'. This is the result of concerted efforts over the past 20 years. Some of the highlights in management activities are described elsewhere in this report in the section on water management. While some gaps remain, these policy documents and their implementation, supported by strong government investment, effective institutional arrangements and community involvement have combined into an effective management system.

BIODIVERSITY

Condition: The extent and condition of native vegetation has been the key indicator of biodiversity in the VCMC's reports since 2002. The statement that "Loss of extent and condition of native vegetation since European settlement is recognised as the greatest historical impact on native biodiversity" (VCMC, 2002, p. 28) still resonates, as does the assessment that the ratings for these indicators would not be expected to change in the short-term. Those ratings were 'Poor' condition and 'Declining' trend in 2002, as was the case for the other indicator used: conservation status of species at the State and bioregional level. The assessment in 2007 showed no significant change but differentiated between land types: the ratings were that native vegetation extent and condition were 'Good' and 'Stable' in largely intact landscapes across the state but 'Poor to moderate' and 'Declining' in largely fragmented areas. In 2012, the ratings stayed the same, an assumption in the case of native vegetation condition since there was no new information over the preceding 5 years. In both the 2007 and 2012 reports, the assessment of the conservation status of native species was 'Poor' and 'Declining'. VCMC assesses the statewide condition of biodiversity as 'Poor' and 'Declining' in this 2017 report, although it varies at the regional scale as described in Chapter 4. The reasons for the low ratings are myriad, including impacts of settlement, weather variability and climate change, continuing native vegetation loss, and the impacts of pest plants and animals.

Management: There has been significant effort in addressing the issue of biodiversity loss in Victoria including government programs and investment, market based incentives, activities by dedicated groups and individuals. Successes have been demonstrated at the local level, as illustrated in some of the stories in this report. However, even though significant improvement in the condition of biodiversity at the state level is not expected in the short to medium-term, VCMC has assessed the management efforts over 20 years as 'Positive' and headed in the right direction.

COASTS

Condition: There has been very little assessment of coasts, and none of marine areas in the preceding VCMC reports. There was an indicator called 'Estuary condition' in the 2002 report. but it was acknowledged that even for this limited area of the coast, no assessment of statewide condition could be made because of lack of information. The only data available related to Port Phillip Bay, Western Port Bay and the Gippsland Lakes. This same indicator was used in the 2007 report, but condition was rated as 'Assume Poor' again because of the lack of information. A second indicator was 'Beach recreational water quality' using EPA data based on *E. coli* measurements at various popular beaches around Melbourne, showing poorer water quality after rainfall, when storm water delivered urban run-off into the bay. The 2012 report included a case-study on estuary condition but did not report more widely on coasts due to there being no significant data on which to make an assessment. In this 2017 report, Coasts has been included as one of the five major themes, based on those agreed in the *Our Catchments Our Communities* (DELWP, 2016b) strategy. However, monitoring of their condition is still very fragmented, focused on specific locations or issues (Commissioner for Environmental Sustainability, 2013). VCMC has used regional information to make a general assessment of the condition of coasts as 'Declining' over the past 20 years. And at this stage, there is even less information about the condition of marine areas. Various mechanisms are currently being put into place to start addressing this lack of baseline data about the coasts and marine areas of Victoria.

Management: Despite the great awareness of Victorians of the value of coasts and their involvement in activities in their management and protection, management arrangements at the institutional level have been complex and fragmented. The *Victorian Coastal Strategy* (VCC, 2014) set out a vision and framework for managing the coasts but its recommendations were not always implemented. As stated above, various mechanisms are in place to address many legislative, institutional, information and resourcing challenges facing the management of coasts and marine areas. Hence, VCMC has assessed current management as 'Neutral' in 2017, but with a positive outlook for the future.

COMMUNITY

Condition: This theme is not about the 'condition' of the community. Rather it is about community involvement in integrated catchment management activities, which covers many aspects from attending a field day, to responding to a survey to being active in or running a volunteer organisation. The difficulty in deciding what measure to use and why is illustrated in the approaches used in the VCMC reports since 2002. In the 2002 report, the indicators used in the theme called 'Community attitudes' were: awareness of NRM (natural resource management) issues and organisations; and Landcare participation. The former was described using available participation numbers in some citizen science activities, and selected survey results about awareness of CMAs and NRM concerns. The Landcare participation indicator used available numbers derived from census data. Overall both indicators were rated as 'Unknown' since there were no generally agreed and reliable measures available. In 2007, a different approach was used, dealing with the biophysical themes separately and then analysing some major impacts on those themes. This section covered: social landscapes, demographic information; structural adjustment; and community engagement and volunteering, including indigenous engagement. Available information on involvement in Landcare and other programs such as Bushcare was included but there was no

general assessment made. In 2012, a similar approach was used, with 'Community participation in catchment management' and 'Indigenous involvement in catchment management' described as related issues, separate from the biophysical themes. Steady growth in the numbers of participants in Landcare and other community-based integrated catchment management groups was shown over 2006-11. But there were many caveats around these data: which groups were included, the method used, and the limitations of using numbers of participants as a measure of involvement and commitment. In this report, the five themes reflect those in *Our Catchments Our Communities* (DELWP, 2016b) with 'Community' given equal weighting along with the four biophysical themes of land, waterways, biodiversity and coasts. The overall assessment of community involvement in integrated catchment management in 2017 is rated as "Good" across all the CMA regions and hence at the statewide level, based on the available data, plus other anecdotal evidence such as the newsletters produced by CMAs which illustrate the number, breadth and value of community engagement activities across the state.

Management: Again, 'management' of the community is not an accurate description of the intent of this theme. Rather it concerns the support provided to communities to enable and enhance their involvement in integrated catchment management activities. The successive reports since 2002 describe policies and actions which were designed to provide such support, including Landcare programs and grants; the numerous community engagement activities organised by CMAs and by various other parties; and policies and programs related to increasing Traditional Owners' involvement in integrated catchment management. VCMC assesses the management efforts over the past 20 years as 'Highly positive' in terms of increasing support by governments, CMAs and other organisations for community involvement in a range of integrated catchment management activities. This reflects the increased awareness over time by governments and other organisations of the central importance of communities, urban and regional, in protecting their catchments.





Photo: Phil Wallis

Background

About the Victorian Catchment Management Council

What is the VCMC?

The Victorian Catchment Management Council (VCMC) was established under the *Catchment and Land Protection Act 1994 (CaLP Act)* as the statewide advisory body on catchment management in Victoria. Its current members were appointed in September 2015 by the Governor in Council on the recommendation of the Minister for Water (The Hon Lisa Neville MP), reflecting the major land and water uses in the State, as well as experience and knowledge of land protection, water resource management, primary industry, environment protection for conservation, and local government, plus a nominee of the Secretary of the Department of Environment, Land, Water and Planning. VCMC's functions are described in the *CaLP Act* and include advising on matters to do with statewide catchment management, on the condition of the state's land and water resources, on priorities for statewide catchment management and on priorities for research and investigations into statewide catchment management. VCMC also establishes any guidelines for a regional catchment strategy or a special area plan (refer *CaLP Act* Sch.2 cl.2(2)).

About this report

Why has VCMC produced this report?

The main driver for VCMC is the *CaLP Act* S. 9J(2): 'The fifth annual report of the VCMC, and each annual report at five-yearly intervals thereafter, must include an assessment of the condition and management of land and water resources in Victoria.' Note that this assessment has been developed as a separate report alongside the Annual Report, every five years since 1997.

VCMC produces this report as an assessment of the condition and management of land and water resources in Victoria.

The information itself is brought together in this report at the statewide level, which is of interest to land and water managers throughout the State (and beyond), and for the first time includes regional snapshots. The report is not only a five-yearly assessment of condition; it also considers the management of the land and water resources (our natural assets) and how efficient and effective our management interventions are. While others can and do undertake such analyses, VCMC brings its independent expertise in assessing the information available and makes conclusions and recommendations, as required under the Act. These recommendations should be of interest to policy developers and decision-makers at various levels, including at the most senior levels of organisations and in government.

Who is the report for?

The report is laid before each House of Parliament by the relevant Minister/s (those responsible for the *CaLP Act*) so it is a public document. In the first instance the audience for the report is the responsible Minister/s.

While VCMC must produce this report under legislation, it is an opportunity to bring together a comprehensive range of information about the land and water resources in Victoria, and an assessment of both their condition and management, along with overall findings and recommendations. Within this scope, the report has been developed for a broad audience and aims to raise the profile and importance of the link between improved catchment management and the health of natural resources. Anyone involved in catchment management can use this report, whether they are policy developers, decision makers, public land and water managers, Traditional Owners, private property owners, students or concerned citizens. This report will contribute to knowledge and understanding about catchment management in Victoria, to improved resource condition, and to more effective management into the future.

Have the recommendations from the previous report been addressed?

The recommendations in the previous *Catchment Condition and Management Report* (VCMC, 2012) were:

- That robust processes be established to determine the condition of the State's land and water resources and the effectiveness of land protection measures.
- That this crucial function be assigned to an independent and appropriately resourced entity, with the task of reporting annually on progress towards the implementation of these processes, and every six years on overall condition.
- That a State Integrated Catchment Management plan be developed to define, explicitly, the quality of the land and water resources that will maintain and enhance long term land productivity, while also conserving the environment.

There has been some progress against the first recommendation. The lack of such processes was identified in the Victorian Auditor-General's September 2014 report on *Effectiveness of Catchment Management Authorities* (VAGO, 2014). A project team comprising DELWP, CMAs, VCMC and the Office of the Commissioner for Environmental Sustainability was set up to determine the key themes and develop some possible indicators for common use. The major issue was that there was and continues to be little current and ongoing monitoring of any of those suggested indicators, especially on a consistent, statewide basis. Further work progressed through the CMAs, trialling a report card approach based on the key themes and on indicators for which some reporting and assessment is possible, at least at the regional level.

No progress has been made against the second recommendation. The call for the kind of institutional change embodied in the recommendation in 2012 has been reviewed for this report. Instead of providing a solution, VCMC recommends an independent

review of statewide reporting for catchment condition and management, reporting which is currently undertaken by DELWP, the Commissioner for Environmental Sustainability in the five-yearly State of the Environment reports and by VCMC. It remains unclear about the respective reporting roles of these bodies, and there is some duplication. VCMC recommends that the review would be undertaken by an independent agency, external to the current reporting bodies.

Significant progress has occurred against the third recommendation: *Our Catchments, Our Communities* (DELWP, 2016b) strategy was released in April 2016, subtitled *Integrated Catchment Management in Victoria 2016-19*. More information about this strategy is provided later in this section.

The strategy goes a long way to addressing VCMC's third recommendation and VCMC recognises the importance of its development and release. However, the latter part of Recommendation three has not yet been addressed: the definition of ... 'the quality of the land and water resources that will maintain and enhance long term land productivity, while also conserving the environment'. It is hoped that the implementation of the strategy will further advance the setting of goals and targets for the quality of our land and water resources.

What was the VAGO report on Catchment Management Authorities about?

The Victorian Auditor-General released the *Effectiveness of Catchment Management Authorities* report in September 2014 (VAGO, 2014). In his response to this report, Adam Fennessy, Secretary of then the Department of Environment and Primary Industries committed to an Action Plan, with five key initiatives. These actions were undertaken by five project teams comprising staff from DELWP, CMAs, VCMC and the Office of the Commissioner for Environmental Sustainability, under a Project Control Board chaired by Angus Hume, Chair VCMC.

The five key initiatives were:

1. Development of an overarching strategy for integrated catchment management
2. Review of CMAs' Statements of Obligations under the *Catchment and Land Protection Act* and *Water Act*
3. Development of a business case to government with funding for Regional Catchment Strategy implementation
4. Development of a framework for catchment condition and reporting, including appropriate catchment condition indicators
5. Improvement of information collation and access to support state and regional catchment condition and management Monitoring, Evaluation and Reporting (MER)

These five areas are important to the continuing relevance and continual improvement of the catchment management framework in Victoria. The first, fourth and fifth initiatives had direct bearing on VCMC's recommendations in its *Catchment Condition and Management Report* 2012. Specifically, the audit called for an approach towards a "long-term vision, goals, priorities and performance measures to drive long-term catchment management improvements at a whole-of-state level" (VAGO, 2014, p. 15). The project teams essentially completed work on all five key initiatives in the Action Plan.

Achievements of *Our Catchments Our Communities*, as of June 2017

Goal 1: Effective community engagement in catchment management

- The offer of leadership development grants attracted 79 applicants in the first year across three categories: (1) Women in Leadership (2) Innovation (3) Aboriginal Leadership applicants. Four grant recipients were approved by the Minister for Water and presentations were made at the Catchment Summit in June 2017.

Goal 2: Better connections between state, regional and local planning

- Analysis and recommendations for improved, regional and local planning completed. Biodiversity Plan 2037 and regional roundtables are ensuring better connections to leverage outcomes for the Regional Catchment Strategies.

Goal 3: Strengthened implementation of Regional Catchment Strategies

- Nineteen new projects coordinated by CMAs are underway to deliver integrated catchment outcomes worth \$16 million over four years.

Goal 4: Clearer roles, strengthened accountability and coordination

- New state level catchment partnership framework completed for new Catchment Partnership Agreements to be developed regionally.
- The first of four annual Catchments Summits, in June 2017, celebrated "working better together" and fostered relationships underpinning collaboration and partnerships.

Goal 5: Improved monitoring, evaluation and reporting

- The CMAs have adopted a new catchment condition annual reporting template promoting consistency across the sector.
- Key reporting agencies are aligning their reporting to the Framework for Catchment Condition and Management Reporting.

What was *Our Catchments Our Communities* about?

VCMC recommended in its 2002, 2007 and 2012 *Catchment Condition and Management Reports* that a State Integrated Catchment Management plan be developed. It was envisaged that such a plan would present a vision for Victoria's regional landscapes, underpinned by a natural resource management strategy, investment plan and whole-of-government implementation plan. It would also define explicit, long-term targets for the condition of land and water resources.

The release of *Our Catchments Our Communities* (DELWP, 2016b) set the direction for integrated catchment management at a state level in Victoria for 2016-2019 and was developed by a group comprising DELWP, CMAs and VCMC. It was a response not only to the VCMC's recommendations over the years for a statewide integrated catchment management strategy but specifically to the recommendations in the *Effectiveness of Catchment Management Authorities* report as described earlier.

The strategy described the strengths and achievements of the catchment management framework in Victoria, the roles of the CMAs and the catchment management partners and the focus on the community as the centre of the framework. It provided a framework for goal-setting and collaboration among catchment management partners. Implementation of the strategy through collaborative efforts is well underway and VCMC will track progress, especially regarding the work on priorities, targets and performance measures to drive long-term catchment management improvements at the statewide level.

About this assessment

How was condition and management assessed?

The assessment framework used in this report primarily focuses on the relationships between catchment management objectives, management actions, and outcomes (Figure 2).

This assessment framework builds on DELWP's existing *Monitoring, Evaluation and Reporting framework: land, water and biodiversity* (DSE, 2012).

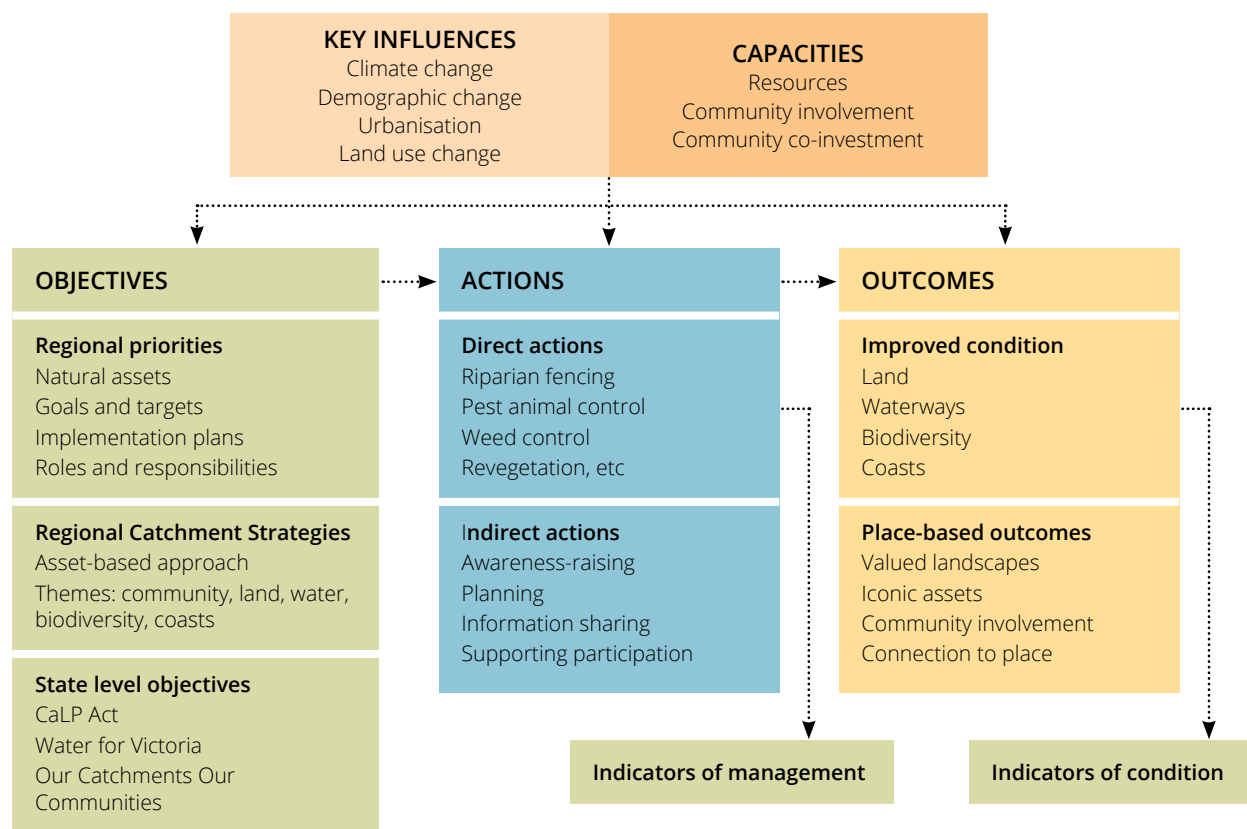


Figure 2. Assessment framework for the Catchment Condition and Management Report 2017.



Photo: Phil Wallis

The objectives of integrated catchment management in Victoria are drawn from three levels: (1) the catchment management framework, including key policy initiatives; (2) regional catchment strategies and their asset-based approach; and (3) regional priorities and through the implementation of Regional Catchment Strategies. Together, these objectives translate to a set of management actions that are both direct, such as on-ground works, and indirect, such as planning or awareness-raising. Indicators of management, sometimes referred to as 'outputs', are collected by CMAs and reported through the annual *Actions and Achievements* report. For example, the area of weed control conducted, or number of participants at engagement events. Actions are assumed to translate to outcomes for improved asset condition, as well as place-based outcomes for communities. Indicators of condition are individual or combinations of biophysical measures that are proxies for condition.

What themes and indicators have been used?

The *Catchment Condition and Management Report* 2017 follows the five reporting themes adopted by *Our Catchments, Our Communities*: (1) land, (2) waterways, (3) biodiversity, (4) community, and (5) coasts (DELWP, 2016b, p. 47). One or two indicators have been chosen under each theme, aiming as much as possible to meet the criteria that they are measurable on a statewide scale, the method of assessment is repeatable to show trend and to be repeated in future, and they provide an indication of condition of the theme in question. Detailed metadata relating to each indicator is provided in the Data Sources section.

An important factor in choosing repeatable measures is it takes a long time (more than 20 years) to restore or rehabilitate damaged natural systems and ecosystems, so measures of condition need to span this time frame. There are a range of uncertainties relating to indicator data, and assumptions about how the indicators relate to changes in condition. These are documented in each section where indicators are used.

For each theme, a range of 'supporting information' is also reported, including benchmark measures of condition (e.g. Index of Stream Condition) and other relevant information that supports the narrative about condition.

Where does this report fit with State of the Environment reporting?

The *Catchment Condition and Management Report* 2017 is the fifth such report issued by the VCMC, and focuses on reporting land and water condition in the context of integrated catchment management. The Commissioner for Environmental Sustainability releases a five-yearly *State of the Environment* report (2008, 2013, and forthcoming in 2018) that has a broader scope than the *Catchment Condition and Management Report*. VCMC and the Commissioner for Environmental Sustainability are working together to ensure consistent environmental reporting.

The Office of the Commissioner for Environmental Sustainability process for developing environmental reports is set out in the *State and Benefit* framework for the 2018 *State of the Environment* report. The framework is the guiding document for environmental reporting by the Commissioner until 2018. It has been endorsed and tabled by the Victorian Government, and supported by key stakeholders and environmental advocacy groups.



2

Integrated Catchment Management in Victoria

The Victorian Catchment Management Council:

- Supports the integrated catchment management framework
- Recognises that substantial progress has been made through *Our Catchments Our Communities* towards a statewide integrated catchment management strategy, but that implementation requires continued commitment and resourcing
- Identifies a need for greater consistency in Regional Catchment Strategy goals and objectives, including the use of SMART goals
- Sees that integrated catchment management is not just about CMAs and their partners, but can expand across borders (e.g. Tri-State Alliance)
- Recognises that since there is continual and sometimes unexpected change in the environment, the catchment management sector needs to embrace adaptive management to ensure agility and the ability to be proactive in the longer-term

This chapter provides: (1) an overview of integrated catchment management in Victoria, including a description of governance arrangements and key stakeholders; (2) a summary of the goals and objectives that appear in State strategies and Regional Catchment Strategies; and (3) a summary of key influences.

What is integrated catchment management?

Integrated catchment management is an important concept in managing natural resources that recognises the interconnectedness

of waterways, land, biodiversity, coasts and communities. Understandings of what is considered to be a 'catchment' have evolved over time, from purely hydrological / engineering origins to recent interpretations as social-ecological systems (Molle, 2009).

Integrated catchment management was formally adopted into Victorian legislation with the *CaLP Act*, but concepts of catchment-based management had been in practice for decades prior. For example, efforts under the State's Salinity Program, and the evolution of arrangements for the management of the Murray-Darling Basin have reflected a catchments approach.

Today, Victoria has 10 catchment management regions, each with its own CMA. 2017 marks 20 years of operation of CMAs in Victoria.

Integrated catchment management, as a system for governing catchments, is perceived differently from multiple perspectives. It can encompass all the people, organisations, policies and institutional arrangements that are involved in governing. The governance of other systems (e.g. regional development) overlaps and influences the governance of catchments.

Victoria's integrated catchment management framework seeks to embrace adaptive management. Adaptive management refers to a step-by-step process of planning, doing, monitoring and reviewing that forms a feedback mechanism for further iterative cycles of the same process. Figure 3 shows how feedback to further planning makes management 'adaptive'. Closing the circle turns 'management' into 'adaptive management'.

VCMC presents a perspective on Victoria's integrated catchment management governance system (Figure 4) with the aim of highlighting some of the key roles and functions, followed by a more detailed description of selected individual roles.

Management

Plan → Do → Monitor → Review

Adaptive Management

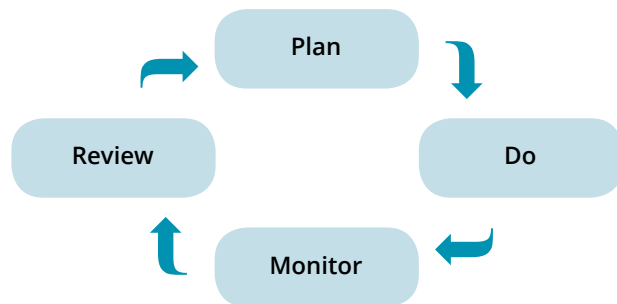


Figure 3. From management to adaptive management.

Source: Wallis et al., 2015



Figure 4. One perspective of a Victorian integrated catchment management governance system.



Photo: Phil Wallis

Communities: Local and regional communities are the foundation of catchment management whether in formal groups or as individuals, through volunteering, monitoring, and active conservation practices by landholders. These communities include the myriad Landcare, Friends of, recreational, and environment groups, committees of management, conservation management networks and special interest groups across the state.

Aboriginal communities and Traditional Owners: Aboriginal communities and individuals contribute to catchment management through sharing of traditional knowledge, land management, planning projects and programs, and identification and protection of cultural values. Traditional Owner Corporations hold significant rights to the land and water and are equal partners in ensuring catchment health. Some parks and reserves are jointly managed with the State through Traditional Owner Land Management Boards.

Catchment Management Authorities: The CMAs are established under the *CaLP Act* across the state, and are responsible for the development of Regional Catchment Strategies, advising ministers on the condition of land and water resources and on regional priorities, coordinating catchment works and encouraging the participation of landholders in integrated catchment management. Under the *Water Act 1989*, the nine regional CMAs and Melbourne Water have responsibility for waterway, floodplain and drainage management.

Victorian Catchment Management Council: refer earlier in report.

DELWP: The Victorian Government Department of Environment, Land, Water and Planning manages Victoria's natural and built landscapes through policies, programs, investment, regulation, governance, regional service delivery and administration of government agencies including VCMC and CMAs. DELWP works with CMAs and other agencies in managing public land, forests, water resources, catchment and waterways, and in emergency management, climate change action, biodiversity research and community groups such as Landcare.

Parks Victoria: Manages the state's national, state, regional and metropolitan parks, reserves and many cultural assets, providing services for managing land and waterways for conservation, recreation, tourism, water transport, and for public purposes.

DEDJTR: The Victorian Government Department of Economic Development, Jobs, Transport and Resources includes agriculture, fisheries, forest industries, biosecurity, regional development and tourism, and works with private and public sectors to grow the economy and employment in these areas.

CES: The Commissioner for Environmental Sustainability prepares the five-yearly *State of the Environment* report for Victoria, in alignment where relevant with VCMC's *Catchment Condition and Management Report*; undertakes yearly strategic audits of Victorian Government agencies and public authorities, and works and consults with all sectors of Victoria's communities.

Agricultural industries: These groups contribute to catchment management through providing information, best practice management options and extension services to their extensive networks of landholders, leading to sustainable and profitable agricultural enterprises.

Federal Government: The Departments of the Environment and of Agriculture and Water design and implement policies and programs dealing with conserving the environment, water and heritage, promoting climate action, and ensuring competitive, profitable and sustainable agricultural industries. Funds to CMAs are provided through their programs.

Local Government: The local councils throughout Victoria contribute to catchment management through such functions as regulation of land use and development, strategic planning, public land management, and support to landholders and communities.

Non-governmental Organisations: These organisations, independent from government, support collective conservation efforts, raise awareness, and advocate for a range of community priorities. Philanthropic organisations fund a wide range of projects in integrated catchment management.

Research institutions and universities: These institutions provide much of the scientific evidence that underpins decisions in catchment management, filling in knowledge and information gaps and guidance on effective tools and methods to use in the field.

Melbourne Water: As well as providing a range of water supply, sewage disposal and treatment services, Melbourne Water is the waterway manager for the Port Phillip and Western Port region.

VEWH: The Victorian Environmental Water Holder is an independent statutory authority set up under the *Water Act 1989* to manage Victoria's environmental water entitlements to benefit Victoria's rivers, wetlands and floodplains and the plants and animals that rely on them.

Water Corporations: Victoria's 19 water corporations provide water services including water supply, sewage and trade waste disposal and treatment, water delivery for irrigation and domestic and stock purposes, drainage, and salinity mitigation services.

Tri-State Natural Resource Management

The Tri-State Natural Resource Management Regional Alliance is an example of collaboration across catchment and state boundaries, along the broad Murray River corridor. Six regional bodies comprise the Alliance: North East, Goulburn Broken, North Central and Mallee CMAs in Victoria, plus the NSW Murray Local Land Services and the South Australian Murray-Darling Basin NRM Board. It was formalised through signing a Memorandum of Understanding in 2015. Each of the six members has responsibilities to manage natural resources along the Murray River corridor, founded on community-based regional catchment strategies or plans. The Alliance members, either as leaders or partners, have achieved some big wins in recent times, such as the \$200 million Farm Water Program, and the \$500 million The Living Murray program.

Working together, the members of the Alliance have developed a series of initiatives over a five-year period, at a scale beyond what each could do individually. These include coordinating tree planting programs with up to 60 community based teams annually; a feral cat eradication program along the Murray corridor; whole-of-Murray monitoring and strategic adaptive management; linking infrastructure works supporting investment in large scale farms across the three States to

grow exports, small businesses and jobs; environmental works to attract bird-watchers; and the creation of corridors for protection of endangered flora and fauna. The Alliance's vision is about effecting landscape scale change across jurisdictional boundaries, working collaboratively with their communities, in a way that maximises social, economic and environmental outcomes for the River Murray corridor and the nation.



Photo: Jasmine Blake

What are the current key policies?



Our Catchments Our Communities

Our Catchments Our Communities (DELWP, 2016b) is the statewide integrated catchment management strategy that articulates the strengths and achievements of the catchment management framework in Victoria, the roles of the CMAs and the catchment management partners and the focus on the community as the centre of the framework.

The five goals of *Our Catchments Our Communities* are: (1) Effective community engagement in catchment management; (2) Better connections between state, regional and local planning; (3) Strengthened implementation of Regional Catchment Strategies; (4) Clearer roles, strengthened accountability and coordination; and (5) Improved monitoring, evaluation and reporting.



Water for Victoria

The Victorian Government's water policy *Water for Victoria* (DELWP, 2016a) presents a long-term strategic plan for managing water in the face of climate change and population growth. The plan deals with waterways and catchments, agriculture, cities and towns, Aboriginal values, and the recreational values of water.

Water for Victoria identifies 36 priority waterways. These are based on regional priority waterways in the 10 regional waterway strategies developed by CMAs and Melbourne Water. These 36 sites are the focus of 30-year programs of restoration. These will include 10 long-term evaluation sites, one in each CMA region. The boundaries for the 36 priority waterways vary depending on local context, and include landscapes, river reaches, wetlands, lakes, estuaries, and floodplains.



Protecting Victoria's Environment – Biodiversity 2037

The Victorian Government released a statewide biodiversity plan in 2017, *Protecting Victoria's Environment – Biodiversity 2037*, that sets out a long-term (20 year) vision for Victoria's biodiversity (DELWP, 2017a). It also constitutes the *Flora and Fauna Guarantee Strategy* under the *Flora and Fauna Guarantee Act 1988*.

The plan sets out two main goals: (1) Victorians value nature; and (2) Victoria's natural environment is healthy, which are both supported by a range of targets.



Climate Change Framework and Adaptation Plan

The Victorian Government has developed a *Climate Change Framework* that presents a long-term plan to 2050 to transition Victoria to a future with clean energy, while minimising the impacts of climate change through adaptation (DELWP, 2016c). Importantly, the Victorian Government has committed to an emissions reduction target of net zero by 2050 and to reduce emissions to 15-20% below 2005 levels by 2020 (DELWP, 2016c).

In addition to setting emissions reduction targets, the Victorian Government has developed a *Climate Change Adaptation Plan* that will help guide action to manage current impacts and manage the long-term risks of climate change (DELWP, 2016d). Sectoral adaptation planning will occur from 2017, with sectoral planning in part focused on water, natural environment, and primary production. Regional planning will also occur through nine regional partnerships, though the location of these are not aligned with the CMA regional boundaries.

LAND	WATER	BIODIVERSITY	COASTS	COMMUNITY
Maintain and enhance the condition of land resources <ul style="list-style-type: none"> • Maintain and enhance soil condition • Address threats to soils • Increase ground cover and reduce soil erosion 	Manage water resources <ul style="list-style-type: none"> • Protect groundwater resources • Support productive and recreational use • Promote efficient use of water for irrigation • Reduce sediment and nutrient loads • Prepare for floods 	Maintain diversity of species and ecological communities <ul style="list-style-type: none"> • Improve status of threatened species and communities 	Manage threats to coastal assets <ul style="list-style-type: none"> • Plan for adaptation to changing conditions • Investigate the threat of seawalls 	Manage catchments collaboratively <ul style="list-style-type: none"> • Increase community awareness of catchments • Set priorities jointly with community • Grow partnerships between land managers, industry, community and agencies
Capture biodiversity and carbon sequestration opportunities	Support ecological function of waterways <ul style="list-style-type: none"> • Provide water to meet ecological objectives • Maintain resilience of instream fauna and riparian zones 	Improve habitat <ul style="list-style-type: none"> • Maintain and improve native vegetation condition and connectivity • Halt decline in condition and extent of native vegetation 	Maintain quality of coastal assets <ul style="list-style-type: none"> • Maintain and improve the condition of estuaries • Maintain the health of the bays 	Foster increased participation <ul style="list-style-type: none"> • Build capacity of community to participate • Support land managers to incorporate environmental outcomes
Improve productive values of land <ul style="list-style-type: none"> • Promote sustainable agriculture • Manage risks to agriculture 	Protect and improve waterways <ul style="list-style-type: none"> • Maintain extent and improve quality of wetlands • Protect and improve condition of rivers and streams 	Improve integrity of ecosystem processes <ul style="list-style-type: none"> • Manage ecologically appropriate fire regimes 	Limit catchment impacts on coasts <ul style="list-style-type: none"> • Understand impacts of nutrients and sediment • Increase sustainability of land use 	Respect Traditional Owner connection to land and water <ul style="list-style-type: none"> • Build relationships between Traditional Owners and natural resource management agencies
Protect environmental values of soils <ul style="list-style-type: none"> • Enhance ecosystem services 		Reduce impact of invasive plants and animals <ul style="list-style-type: none"> • Limit the risk of pathogen movement 		

Figure 5. A summary of catchment management objectives in Victoria. Source: Regional Catchment Strategies 2013-19

What are the goals of integrated catchment management?

A range of policies, strategies and plans define goals and objectives for integrated catchment management in Victoria, at commonwealth, state, regional and local scales. Regional Catchment Strategies, for the period 2013-2019, were reviewed and over 200 objectives summarised (Figure 5). Note that each Regional Catchment Strategy presented objectives at different conceptual levels (vision, goals, objectives, strategies, actions) and over different time frames. For this analysis, six-year and twenty-year management objectives were used.

These regional goals, in addition to the five goals of *Our Catchments Our Communities* (DELWP, 2016b), are referred to throughout this report to assess outcomes for catchment condition and management.

In the land theme, strategic objectives are centred on protecting soils and maintaining the productive values of land, while also protecting environmental values. Meeting these objectives involves Victoria's private landholders, who manage more than 50% of the state's land area. Programs focused on land health in CMAs emphasise incentive-based approaches, and education and capacity-building to promote sustainable agriculture.

The water theme considers both the management of water resources and the ecological functioning of waterways. As CMAs and Melbourne Water are the statutory waterway managers, there is broad scope for contracting on-ground works and working with the Victorian and Commonwealth environmental water holders to deliver flows. Management activities on private land focus on stock exclusion and protection or enhancement of riparian habitat and revegetation.

Biodiversity theme objectives are oriented towards habitat management, particularly native vegetation. As with the land theme, CMAs and other agencies work with private landholders to protect native vegetation fragments on their land, and to connect fragments together, particularly in proximity to publicly-managed parks and reserves.

The community theme emphasises increased participation in catchment management, including collaboration in setting objectives, fostering partnerships, and capacity building and awareness raising.

The coasts theme only applies to the five coastal CMA regions, and highlights the protection of natural assets on the coast (e.g. estuaries, coastal wetlands) and limiting the impacts of catchments on coastal and marine environments.

What are the key influences on condition and management?

Victoria's catchments are continually undergoing change, driven by a host of factors, individually and in concert. Exploring the full range of influences of catchment change would be a large task, and not particularly useful due to the complex, interconnected and uncertain nature of catchment systems. Instead, we discuss the major influences on catchment management across the state and explore some of their effects on our catchments. These influences include climate change, demographic change and urbanisation in agricultural systems, and land use change.

Climate change

Our climate is changing, and Victoria's catchments are already experiencing the effects of this change. Changes in air temperature, rainfall and sea level are of particular note; other variables such as atmospheric carbon dioxide concentrations, wind speed, solar radiation and relative humidity are also important (Wallis et al., 2015).

Victoria's climate is projected to continue changing (see CSIRO and Bureau of Meteorology, 2015; Timbal et al., 2016). The Victorian Government has flagged that it will continue to invest in climate science through the Victorian Climate Initiative with CSIRO and the Bureau of Meteorology (DELWP, 2016a).

Climate observations

Temperature

Victoria's average temperatures have been consistently higher than average over the last 20 years, by greater than 1 °C in some years (Figure 6). Victoria's climate has warmed by approximately 0.06 °C per decade from 1911-2014, following global warming trends (Timbal et al., 2016).

Any assessment of warmer conditions on Victoria's land and water resources and communities requires long-term and consistent data. For example, Chambers et al. (2008) explore the role climate plays on the life cycle of the critically endangered Helmeted Honeyeater *Lichenostomus melanops cassidix* between 1989 and 2006. The study found that Helmeted Honeyeater populations in Yellingbo Nature Conservation Reserve bred and laid eggs earlier across this period. The average number of eggs laid each breeding season also reduced. These changes correspond to mild warming and a reduction in rainfall.

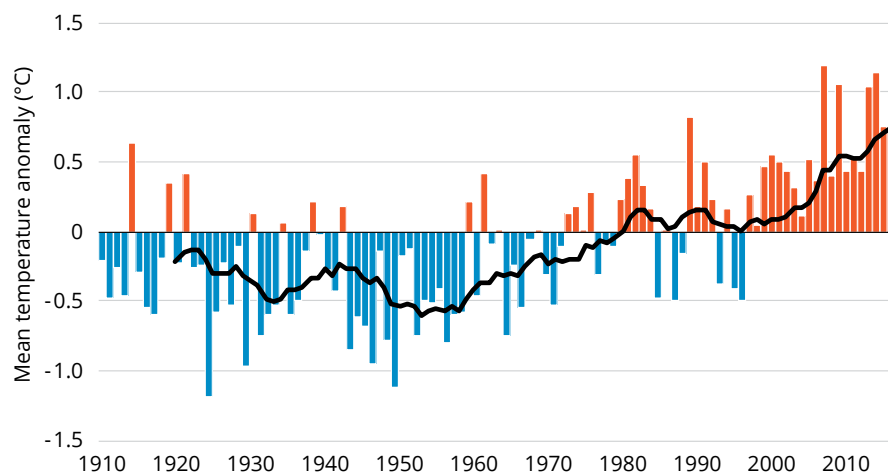


Figure 6. Annual mean temperature anomaly - Victoria (1910-2016) based on 1961-1990 30-year climatology, 11-year running average shown by black curve.

Source: Bureau of Meteorology, <http://www.bom.gov.au> accessed 17 February 2017

Rainfall

Victoria's rainfall has been variable over the last century. More recently, Victoria experienced an extended dry period between 1997-2009, known as the 'Millennium Drought' (Figure 7). Widespread rain in 2010-11 provided some relief from the dry conditions, but followed a pattern of more rainfall during late Spring and Summer, and less rainfall during Autumn and Winter (Timbal et al., 2016).

Despite the wetter conditions experienced in 2010-11 (including record rainfall in parts of Victoria's east in 2011), large areas in the central and western parts of the state subsequently experienced below average or very much below average rainfall between 2013-2017 (Figure 8). The data shown in Figure 7 and Figure 8 suggest a relatively dry period for the state, on average, though 2016 was a wetter year. The impact of these drier conditions is described throughout Chapter 3.

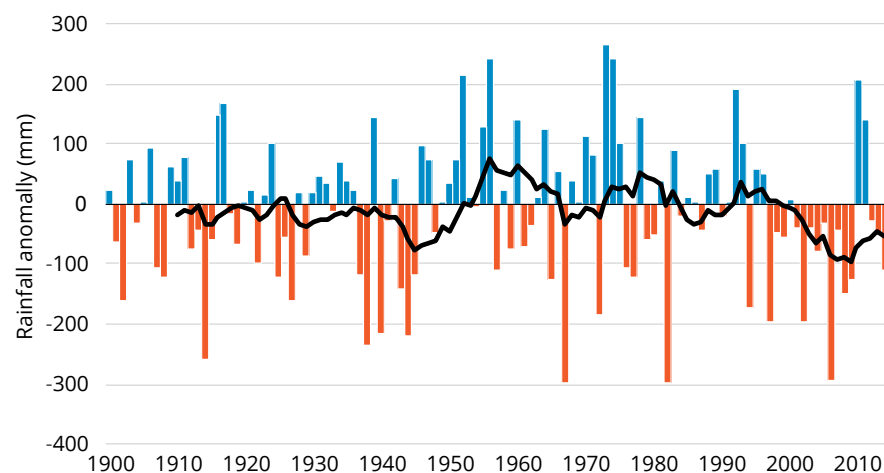


Figure 7. Annual rainfall anomaly - Victoria (1900-2016) based on 1961-1990 30-year climatology, 11-year running average shown by black curve.

Source: Bureau of Meteorology, <http://www.bom.gov.au> accessed 17 February 2017

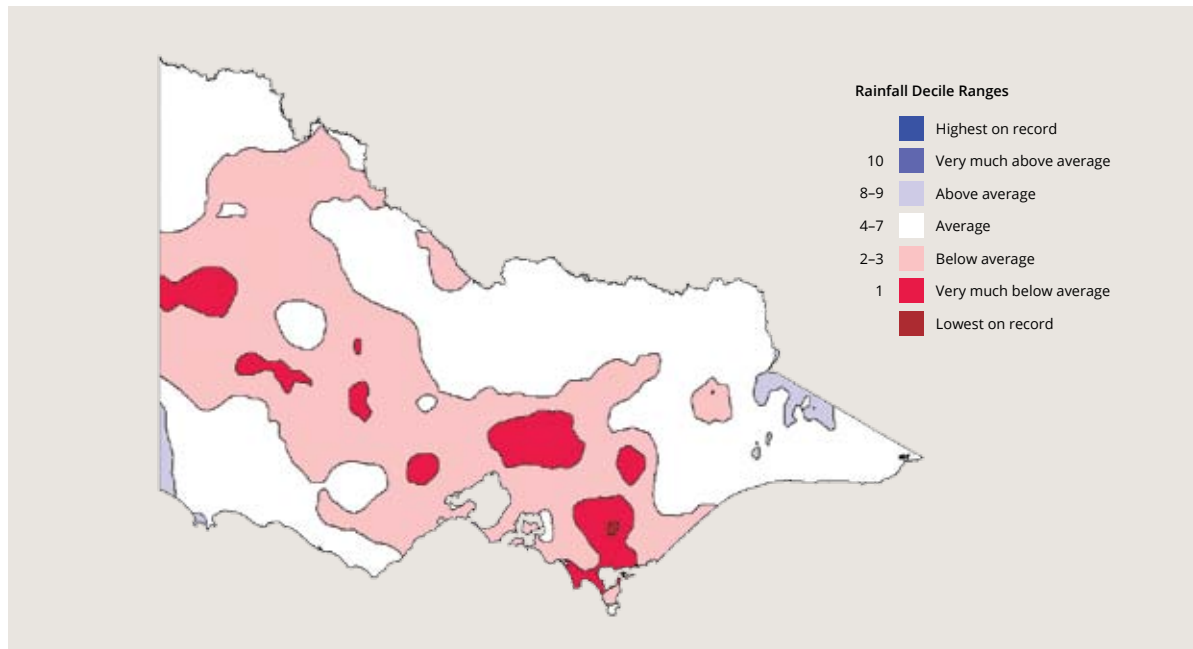
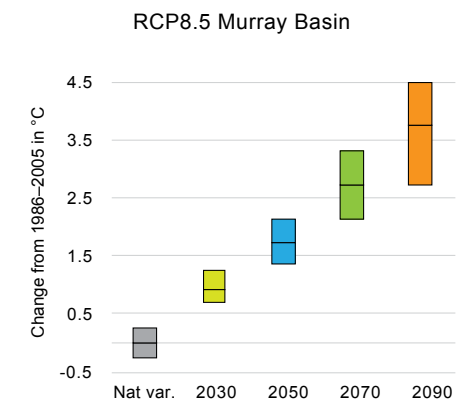
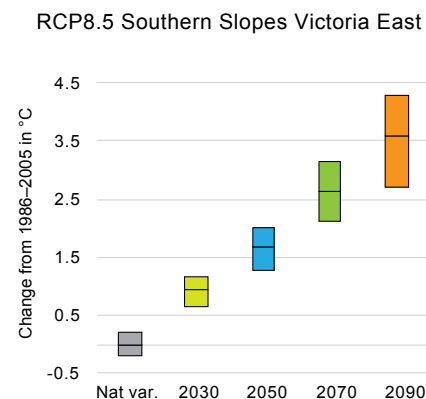
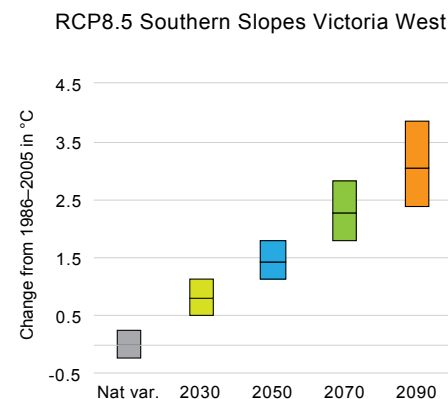


Figure 8. Victorian Rainfall Deciles, 1 July 2013 to 30 June 2017.

Source: Bureau of Meteorology, <http://www.bom.gov.au> accessed 3 July 2017

Figure 9. Projected change on annual average surface temperature (°C) relative to 1986-2005 under a high emission scenario (RCP8.5): (a) Victoria south west; (b) Victoria south east; (c) Murray Basin. Shading represents 10th and 90th percentiles. Source: Climate Futures Toolkit



Sea level changes

Sea levels have risen globally over the past decades, and Victoria has followed this trend. Victoria's sea level has risen between 1-3 mm per year from 1993 to 2015, though rates of sea-level rise vary from year to year (CSIRO and Bureau of Meteorology, 2016, p. 15). Since 1993, the rates of sea level rise in Australia's south-east have been higher than the global average of 1.7 mm per year during the 20th century (CSIRO and Bureau of Meteorology, 2016). As sea levels rise, the effect of high tides and storm surges on coastal environments and local communities will become progressively greater.

Climate projections

Projecting climate change is a complex exercise; projection outcomes are influenced by which emissions pathways are used (low-high) and the type and number of climatic models used (CSIRO and Bureau of Meteorology, 2015; IPCC, 2014; Timbal et al., 2016).

When using modelled climate projections, only a single model and emissions scenario can be used to ensure internal consistency. The Australian Government's Climate Futures Tool uses a 'consensus of models' framework for their climate projections (Australian Government, 2017).

Regions planning for climate change

Victoria's CMAs recently produced plans for dealing with climate change through the Australian Government's *Regional Natural Resource Management (NRM) Planning for Climate Change Fund* (see <www.nrmclimate.vic.gov.au>). Through the development of these plans CMAs and their regional and research partners developed approaches to climate change planning, including adaptation pathways planning (Bosomworth et al., 2017) (Figure 11), spatial assessments of vulnerability, and adaptation actions for priority landscapes and catchment assets. The capacity of Victoria's catchment managers to plan for climate change has been improved as a result (Clear Horizon Consulting, 2016).

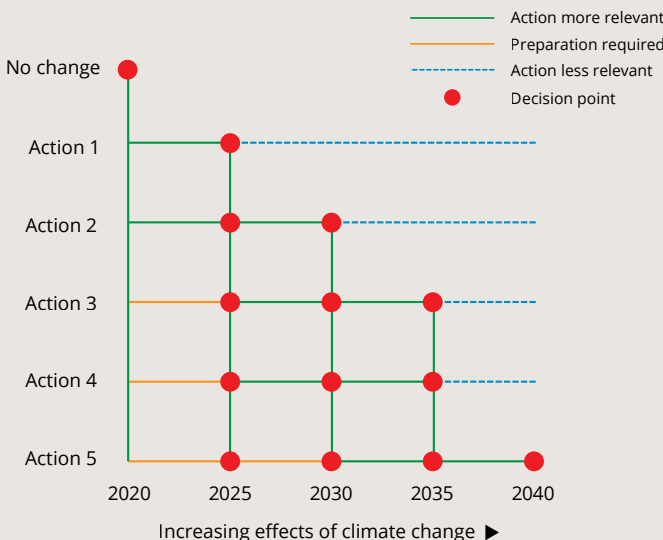
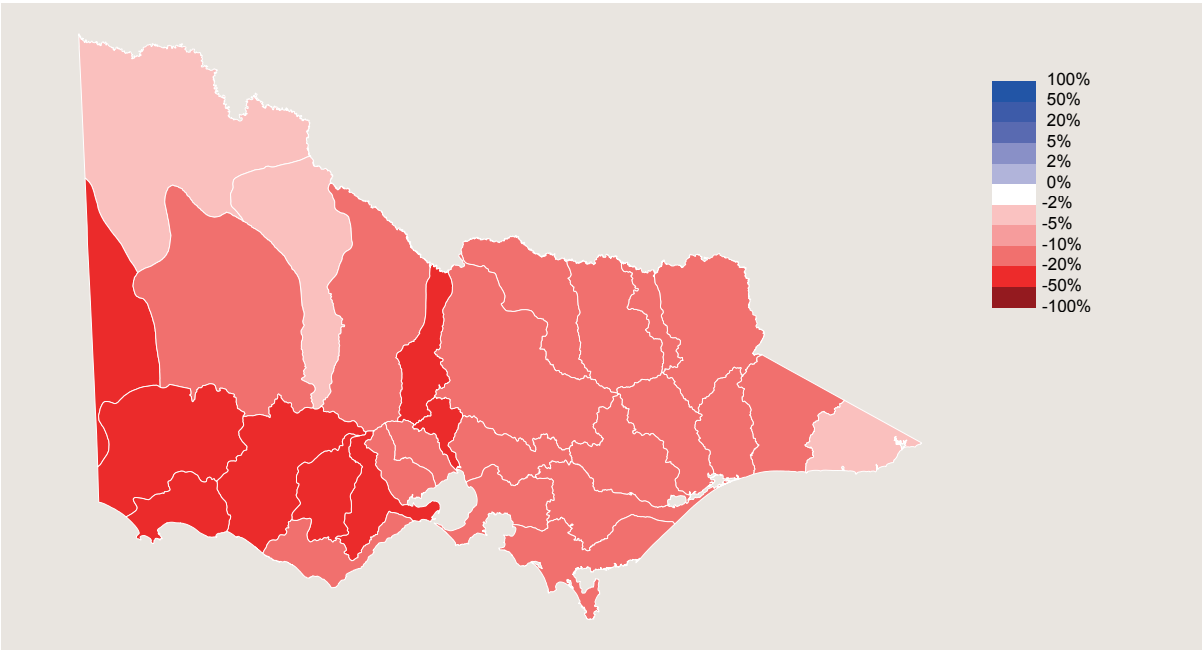


Figure 11. An example of adaptation pathways planning.

Source: Adapted from GHCMA, 2016a, p. 16



Temperature and rainfall

The Climate Futures Tool indicates that Victoria faces a potentially hot and dry climatic future, with the high emission scenario showing temperature increases of up to 4 °C (Figure 9), a decline in Autumn and Winter rainfall and no clear change in projected late Spring and Summer rainfall (Timbal et al., 2016).

Surface and groundwater availability

Surface and groundwater availability is fundamentally important to freshwater systems. It determines the distribution and abundance of freshwater species, the distribution and structure of vegetation, and the rates of most ecosystem processes (Kernan et al., 2011).

Figure 10. Percentage change in basin runoff by 2065 under a high emission scenario (RCP8.5), using the median percentile of a hydrological model informed by multiple climate models.

Source: Potter et al., 2016

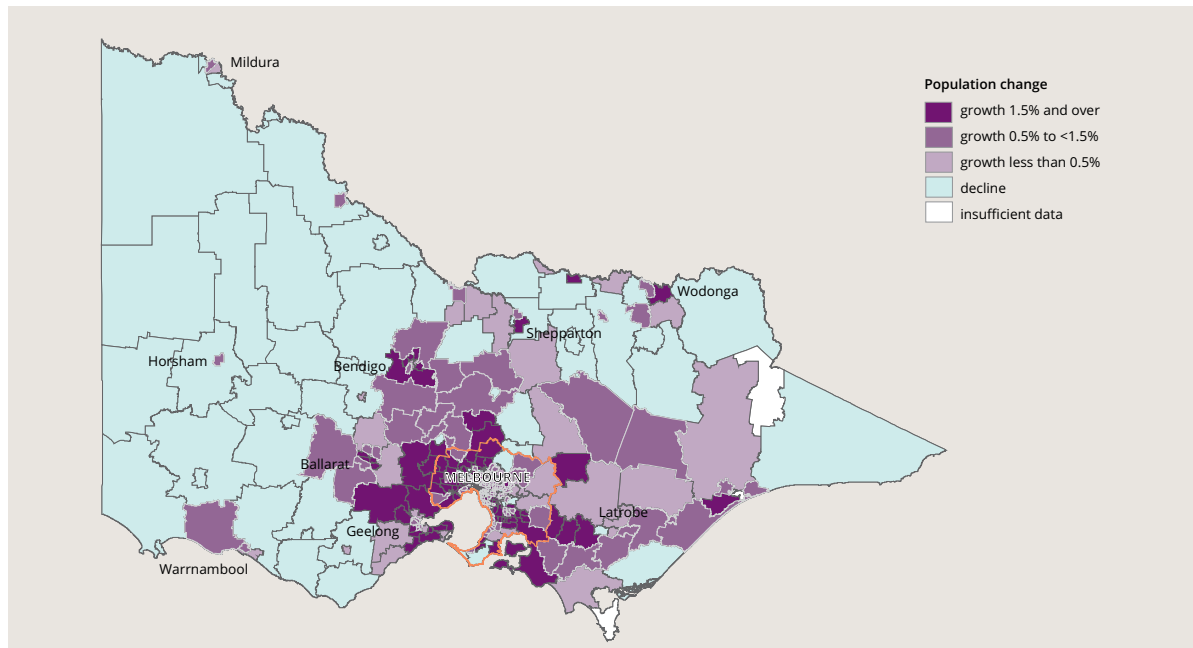


Figure 12. Average annual population change, Statistical Area Level 2 (SA2), Victoria, 2006 to 2016. Source: ABS, 2017a

Victoria's overall stream flows have decreased by around 50% or more over the last 20 years (Potter et al., 2016). Figure 10 shows the projected changes in surface water runoff for Victoria's 29 river basins under a medium emissions scenario. Surface runoff is projected to decline across the state, with particularly dramatic declines in Victoria's south-west and central areas. Declines are predicted to be less severe in Victoria's north-western and far eastern regions. Local factors such as sub-surface geology, soil permeability and moisture levels, vegetation cover and the pattern of individual rainfall events all help determine how much rainfall ends up as streamflow (DELWP, 2016e, p. 6).

Groundwater recharge is associated with rainfall and with water losses from rivers and floodplains (Barron et al., 2011). Changes in the amount, timing and variability of rainfall can impact on renewable groundwater resources. Any reductions in recharge may be compounded by potential changes in land use due to a changing climate; for example, a change from annual cropping to perennial vegetation would further reduce recharge (Barron et al., 2011).

The potential impacts of projected higher temperatures, lower rainfall and changes in runoff on land, water, biodiversity and coasts are highlighted throughout this report.

Demographic change and urbanisation

Victoria became Australia's fastest growing state in terms of population in 2015. Victoria's population is projected to reach 10.1 million people by 2051 – almost double what it is today (DELWP, 2016f).

Population growth can have a significant impact on natural resource condition and management in Victoria. This section looks at growth rates in Victoria's urban centres and rural areas, and briefly discusses their impact on the condition and management of land and water resources.

Urban centres

'Urban centres' refers to metropolitan areas such as Greater Melbourne and regional cities such as Geelong, Ballarat and Bendigo (VCMC, 2012).

Melbourne's outer north-west and south-east have experienced substantial population growth (at least 1.5% per year over this period) (Figure 12) and urban expansion over the past 10 years. Regional centres such as Geelong, Bendigo, Shepparton and Wodonga have also experienced high rates of population growth and urbanisation. For example, around three-quarters of people in the Corangamite CMA live in the urban centres of Ballarat and Greater Geelong (CCMA, 2013a).

Little Stringybark Creek

Urban waterways are heavily impacted by urbanisation, through the conversion of pervious catchment areas (grass, forests, etc.) to impermeable surfaces, such as roads and roofs, and particularly through the practice of using stormwater pipes to drain runoff from these areas directly into receiving waters. Stormwater retention technologies, including rain gardens, infiltration chambers, and rainwater tanks, support more natural flows of water by enabling retention of water in the catchment and infiltration to ground water.

The Little Stringybark Creek project asks whether it is possible to restore the ecological function of an urban stream by retrofitting stormwater infrastructure at a catchment scale to enable more natural hydrological conditions in the stream. The site, located in the outer eastern suburbs of Melbourne, was chosen to answer this question, as it was degraded to a point where intervention might have an impact.

The project originated in the Cooperative Research Centre for Freshwater Ecology, and is currently led by The University of Melbourne, in collaboration with Melbourne Water, and Yarra Ranges Council.

A series of works programs from 2008 to 2017 have utilised a combination of reverse auctions, where private landholders put in a bid for the level of subsidy they require to install systems, market-based incentives, and direct action to invest in stormwater treatments on both private and public land. In 2013, a special planning provision called an Environmental Significance Overlay was established to ensure new urban development would not connect additional impermeable surfaces to the drainage network.

While monitoring continues, the project has achieved improvements to water quality and flow regimes (Walsh et al., 2015). The project is also a good story of fostering collaboration between a large range of stakeholders from research, government, industry and community.

<<https://urbanstreams.net/lsc>>

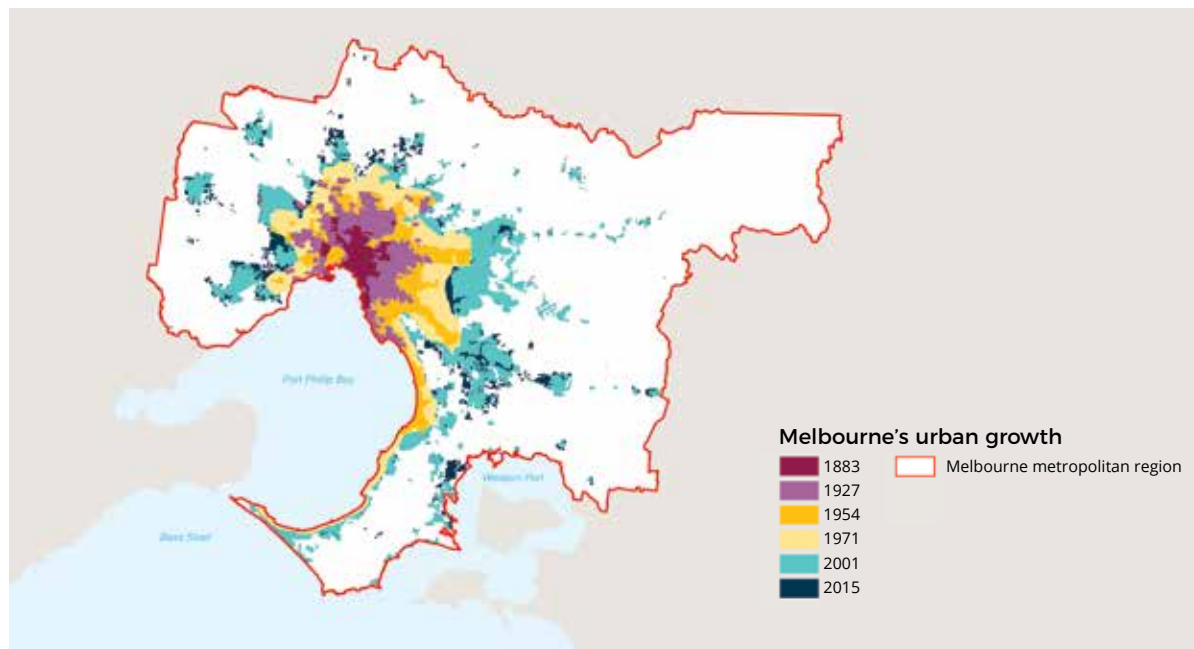


Figure 13 shows how rapidly and extensively Melbourne has grown over the last 132 years. Rapid urban population growth and expansion places pressure on nearby land and water resources. These resources are typically altered to meet the social and economic requirements of a growing population. Examples include native vegetation removal or loss of productive farmland to meet housing demands, increased surface and groundwater extraction for domestic use, and a decline in vegetation and water condition through increased recreational activities. The story of the Little Stringybark Creek highlights some of the challenges in addressing the impacts of urban growth in protecting our waterways.

Melbourne and the major regional centres of Ballarat, Bendigo and Geelong are expected to almost double their population size over the next 40 years (DELWP, 2016f). Most of this growth (80%) is concentrated in and around Melbourne, with the western suburbs

Figure 13. Progression of Melbourne's urban growth from 1883 to 2015.

Source: DELWP, 2017b

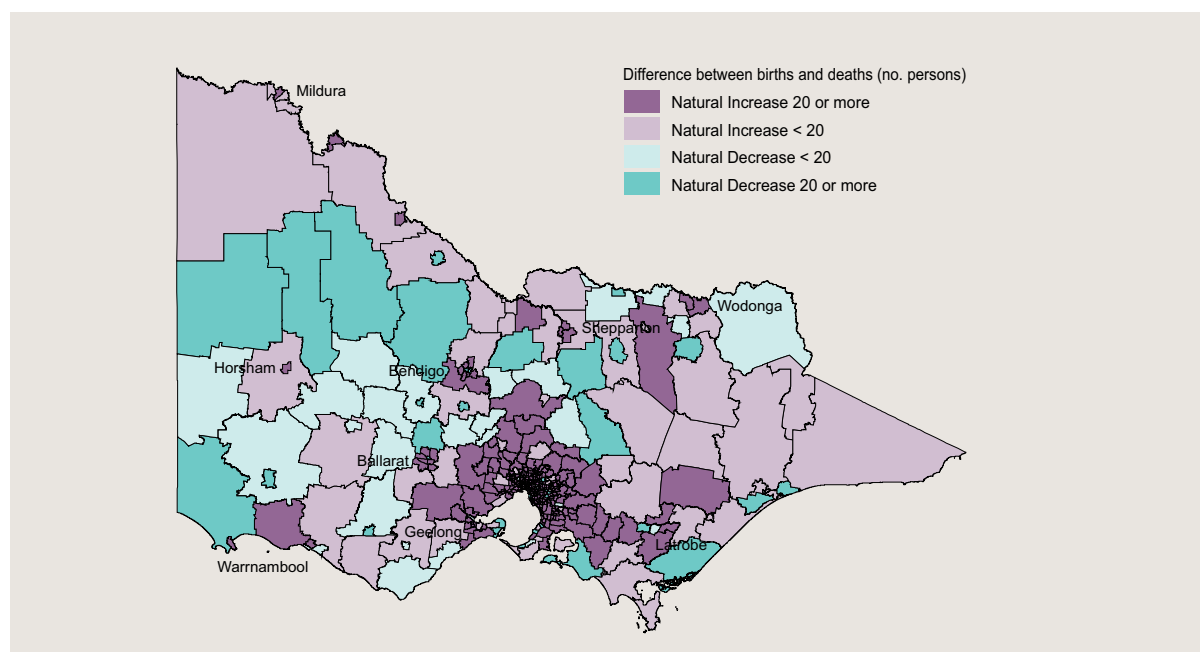


Figure 14. Natural increase, Statistical Area Level 2 (SA2), Victoria, 2015.

Source: ABS, 2016a, 2016b

of Melbourne, including Melton and Wyndham, among the fastest growing in Victoria (DELWP, 2016f).

Planning for growth

State government, local governments and CMAs play an important role in accommodating this predicted population growth in a manner that protects natural resources. For example, *Plan Melbourne* (DELWP, 2017b) provides a strategic plan for Melbourne's city and suburbs until 2050. *Plan Melbourne* maintains Melbourne's Urban Growth Boundary, and encourages mid-rise and high-rise buildings in the inner and middle suburbs. It also protects Melbourne's green wedge areas from housing development. These areas contain not only parks and reserves, but provide other uses that support Melbourne's growing population, such as protected

water catchments. Regional Growth Plans also provide direction for use and development of land across eight Victorian regions.

Similarly, the Melbourne Strategic Assessment program (DPCD, 2009) was developed in response to expanded urban growth in Melbourne. The program aims to manage the impact of urban development in Melbourne's growth areas through the protection and management of threatened vegetation communities and animals. To date, areas of nationally threatened grassland and high priority habitat for the nationally threatened Golden Sun Moth and Spiny Rice-flower have been protected in Melbourne's west (DELWP, 2016g).

While maintaining and enhancing environmental values is often difficult in an urban setting, programs to improve the health of Port Phillip Bay and urban waterways such as the Yarra and Maribyrnong Rivers have received significant funding in recent years. One advantage of a large population is that that community groups like 'Friends of Merri Creek' can mobilise large numbers of volunteers to look after local waterways or parks. These large-scale management programs and smaller voluntary activities also recognise the importance of recreational, cultural, social and economic values that contribute to overall well-being and liveability.

Rural areas

'Rural areas' refers to Victoria's non-urban areas: that is, those areas located outside of Melbourne and regional cities such as Geelong, Ballarat and Bendigo (VCMC, 2012).

Victoria's population is growing at different rates across the state. In contrast to urban centre hotspots, some parts of the state have experienced a population decline over the past decade. Figure 14 shows this decrease in places such as the Wimmera and the far south-west.

Population densities across rural Victoria are often low outside of regional centres. This reflects the continuing trend for young people to leave rural areas and relocate to larger population centres to access employment, education, and training opportunities. As noted

in VCMC (2012, p. 84), population decline does not necessarily correlate with economic decline: improvements in agricultural technology and farm consolidations may require a smaller workforce, but can result in enhanced agricultural productivity and economic prosperity.

Population decline can have a significant impact on the ability of communities to undertake catchment management activities. Declining populations may lack the means to effectively manage land and water resources (for example, through volunteering) (VCMC, 2012). As the Mallee CMA's *Regional Catchment Strategy 2013-2019* notes:

“The growth of our urban areas at the expense of our rural population presents a great challenge in sourcing the necessary co-investment of time and resources from a diminishing (and ageing) population of rural landholders and community-based NRM groups. There is a risk that there will be insufficient people on the ground in large parts of our region to help implement the interventions that will protect and enhance our assets and the services that they provide.” (MCMA, 2013, p. 23).

That said, there are still many opportunities to engage individuals and rural communities in integrated catchment management activities, especially where there is already a strong community commitment to improve land and water resource condition across a region. For example, the ‘Anglesea, Aireys Inlet Society for the Protection of Flora and Fauna’ or ‘ANGAIR’, sees a high proportion of its members volunteering each week.

Changing agricultural systems

In 2012-13, Victoria’s agricultural industries covered a total land area of 10.6 million hectares (Figure 15), of which 6.1 million hectares supported grazing, and 4.5 million hectares supported cropping.

In 2014-2015, Victoria produced \$13.1 billion or around 20% of Australia’s total agricultural production from 3% of the total area of farms in Australia. This high proportion of production provided by Victoria has remained steady for an extended period. While Victoria produces around 20% of all Australian crops, Victorian farmers provide nearly 25% of Australia’s gross meat and nearly 50% of all other livestock products (Figure 16).

Total agricultural production in Victorian has increased by over \$1.5 billion since 2012-13 through to 2014-15 primarily through a 10% increase in total livestock production while cropping decreased by 10% over this period.



Figure 15. Total area of each state used for agriculture.

Source: ABS, 2017b

This follows a nationwide trend where the gross value of Australian agriculture increased by \$2.8 billion to \$53.6 billion in 2014-15, despite large areas of the country reporting very dry conditions for much of the year, the gross value of livestock slaughtering and other disposals increased by \$4.0 billion to \$18.7 billion while the gross value of crop production decreased by \$1.4 billion to \$26.8 billion (ABS, 2017b).

Higher farm gate prices, due to strong international demand, were the main drivers for the increase in the gross value of livestock slaughtering and other disposals. Reductions in crop production due to unfavourable growing conditions and a lack of water for irrigation, were the main drivers for the decrease in the gross value of crops (ABS, 2017b).

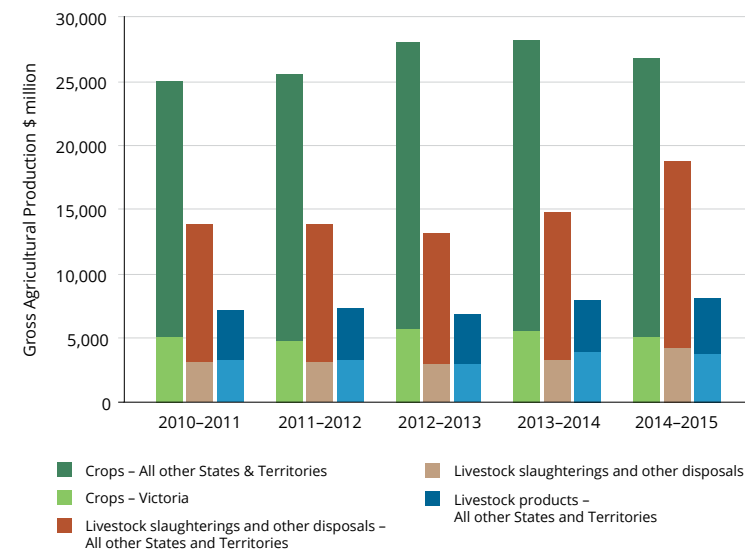


Figure 16. Total Victorian agricultural production by type compared to other states. Source: ABS, 2017b

Cherie Reilly, Birchip Cropping Group

Cherie Reilly farms 'Laurelville' at Corack and 'Moallaack' at Swan Hill with her husband Richard, brother-in-law Neville and his wife Kate, and her husband's parents Linton and Barbara. The Reillys have also recently purchased an irrigation property in NSW.

Their farming system includes broadacre farming businesses which are predominately cropping (80%) plus 1,000 first-cross ewes and 120 Angus cattle. The cropping breakdown is generally wheat 30%, barley 20%, canola 10%, lentils 15%, vetch 15%, lupins 5% and fallow 5%.

In early 2017, Cherie reported that "most paddocks have had one if not two summer weed sprays and paddocks are being prepared with some windrow burning on lentil and canola paddocks. The 2016 oat paddocks were mulched soon after harvest to reduce stubble load for cropping. Fertiliser has been ordered and is being back loaded at present to coincide with grain delivery to port. Seed has been cleaned and is ready to go and some minor maintenance on the Seed Master air seeder is happening."

Workforce challenges

A challenge faced by the Reillys resulted from grain sales and marketing after the 2016 season. They stored a lot of wheat and oats for logistical reasons at harvest (and because of the low grain prices), which meant that some staff would be transporting grain and additional labour would be required to put the crop in.

Cherie reflected that "We have been lucky to have great staff, including back-packers, working with us as this helps maintain morale and motivation on a day-to-day basis. It is hoped in the future we can keep attracting great staff to work on the farm."

Source: Birchip Cropping Group, Farm in Focus, 6 April 2017

Land use change

Changing land use is a key influence on catchment condition in Victoria. Most change has occurred since European settlement, with widespread clearing of native vegetation. However, land use change continues to impact on natural environments at regional and local scale through urban development, agricultural intensification, and the conversion of irrigated land to dry land.

Land use is mapped at the statewide scale, for 2006, 2010, 2014 and 2016, through the *Victorian Land Use Information System* (2016 data are presented in Figure 17 and Table 3). The dominant land use is primary production, which covers approximately 50% of the state, followed by conservation reserves, which accounts for another 40% of land area.

Table 3. Victorian land use categories, total area.

Land use	Area (ha)	Percentage (%)
Primary production	12,370,331	49.9%
Conservation reserves	10,118,001	40.9%
Residential	949,250	3.8%
Unclassified private land	916,694	3.7%
Infrastructure and utilities	254,099	1.0%
Community services	61,764	0.2%
Sport, heritage and culture	31,539	0.1%
Extractive industries	24,592	0.1%
Industrial	24,312	0.1%
Commercial	14,868	0.1%

Note: *Victorian Land Use Information System* categories include some non-terrestrial areas

Source: DEDJTR, 2017a

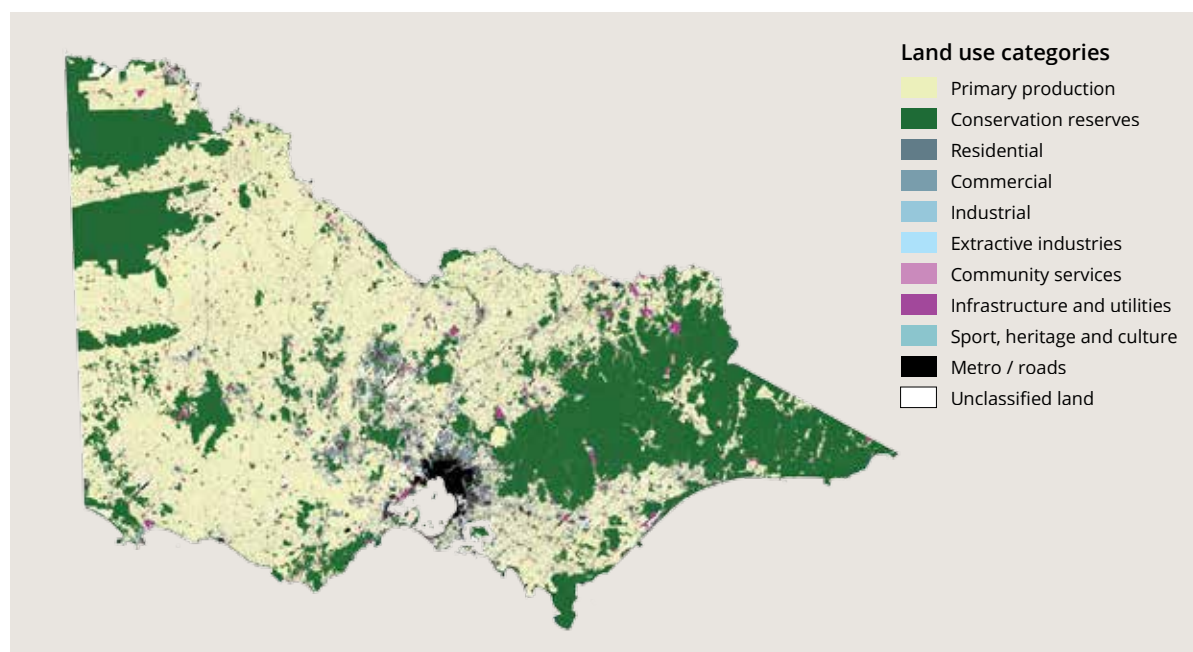
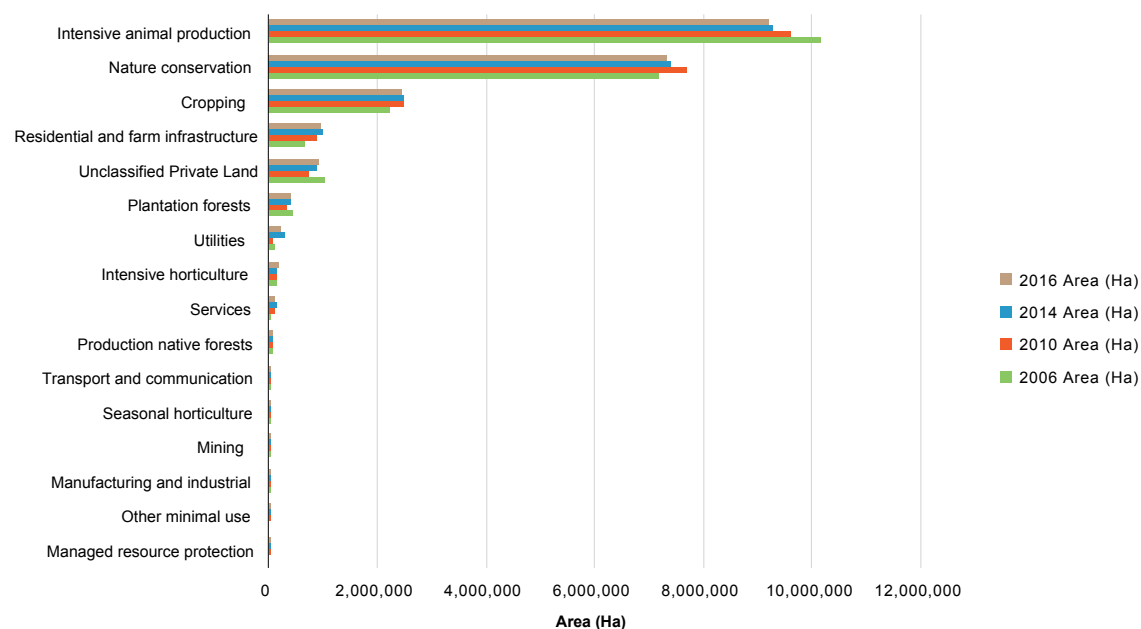


Figure 17. Victorian land use categories. Source: DEDJTR, 2017a

The land use data in the *Victorian Land Use Information System* is drawn from the Valuer General Victoria and uses Australian Valuation Property Classification Codes. To compare land use across different years, the data was converted to the nationally agreed Australian Land Use and Management Classification, following the method published by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES, 2011).

At the statewide scale, notable changes include a decrease in the area use for animal production (both dryland and on irrigated pastures) by approximately 960,000 ha (-10%) over ten years, and an increase in cropping by approximately 200,000 ha (+10%) over the same period.



Some of the changes are more pronounced at regional scale. For example, cropping increased in the North Central region by 167,868 ha (5.6% of the region) from 2006 to 2014. Animal production decreased in the Goulburn Broken region by 188,957 ha (7.8% of the region) over the same period, which is consistent with the findings of the *Regional Irrigated Land and Water Use Mapping in the Goulburn Murray Irrigation District* report, which shows a significant shift away from dairy production since 2000 (GBCMA, 2017).

Figure 18. Land use categories derived from the Victorian Land Use Information System and converted to Australian Land Use Management classifications. Source: DEDJTR, 2017a



3

Our State

The Victorian Catchment Management Council:

- Has made a qualitative assessment of the condition of catchments based on available statewide information and on the more extensive information available at the regional level, as presented in Chapter 1
- Acknowledges the challenge for statewide bodies (DELWP, VCMC, OCES) to satisfactorily undertake their reporting roles when the monitoring programs on which they depend are not fit-for-purpose
- Recognises that the assessment of condition at the statewide scale is largely negative, and the cumulative impacts of urbanisation and land use intensification on Victoria are significant and can only be tackled effectively over the longer term. These are largely legacy effects
- Notes that management efforts over the past 20 years have been substantial, combining government policy and funding, coordination by CMAs and other agencies and with the involvement, private investment and collaboration of organisations, communities and landholders
- Emphasises, however, that management efforts need to escalate in both scale and effectiveness and be informed by good science, especially regarding the accelerating impacts of climate change and population growth in Victoria

This section reports on the five *Our Catchments Our Community* themes at a statewide level: land, water, biodiversity, coasts, and community.

The four biophysical themes (land, water, biodiversity and coasts) include a summary of the theme, which defines the assets and their importance to Victorians. Key influences are described, building on those detailed in Chapter 2. An assessment of condition is given, where possible, based on available data and supporting information. Management processes are outlined, highlighting both existing and forthcoming initiatives.

Each theme includes a story of innovation: (1) a statewide ecosystem account for land; (2) five years of the Victorian Environmental Water Holder; (3) measuring changes in Suitable Habitat in the North Central region; and (4) Gippsland Lakes: from the 1850s on. The community theme emphasises the ways that people strengthen integrated catchment management through local connection to place.



Photo: Jasmine Blake



Photo: Tracey Koper

Land



The Victorian Catchment Management Council:

- Finds that the condition of land used for dryland cropping and grazing, as indicated by an increase in area of bare soils, has declined from 2011 to 2016
- Recognises the challenges in reporting on this complex theme, especially since there is no overall statewide strategy, and few goals or targets in place
- Identifies that increased land prices around Melbourne and several regional cities impact on land use and agricultural productivity in those areas
- Acknowledges that new technologies can help track change, such as satellite monitoring of ground cover, but that understanding changing land management practices requires extensive on-ground monitoring
- Recommends further development of environmental-economic accounts at statewide and regional levels, in line with the national approach, as explored in this section; Government must lead this

About Victoria's land

Victoria's land resources underpin the state's economic activity through primary production, provide essential ecosystem services through conservation, and enable housing and services for a growing population.

Of Victoria's nearly 23 million hectares of terrestrial land, public land accounts for 37% and private land 63% (VEAC, 2016). Primary production is the dominant land use across the state,

making up approximately half of the total land area, followed by conservation reserves.

Victoria's agricultural land and its farmers generated over \$13 billion in gross value in 2014-15, representing an increase of \$1.5 billion over the last five years (Figure 19). Dryland agriculture accounted for 62% and irrigated agriculture 38% of gross value in 2014-15.

Some challenges faced by agricultural industries in Victoria include invasive plants and animals, the availability and security of water

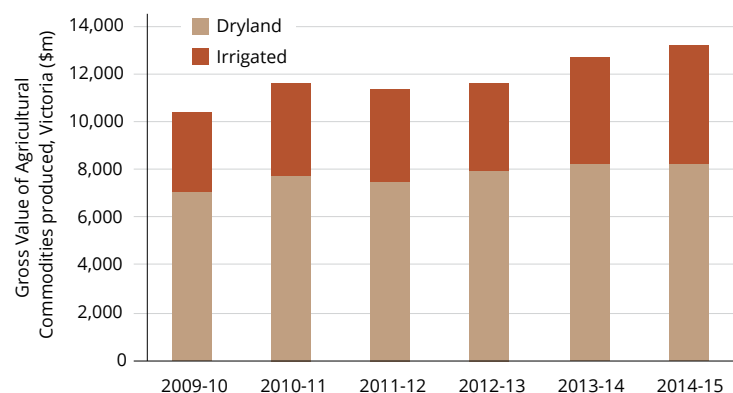


Figure 19. Gross value of agricultural commodities produced in Victoria, 2009-10 to 2014-15. Source: ABS, 2017b

supplies for irrigation, and increasing urban house prices and sub-division of land for peri-urban development.

Victoria's conservation reserves, which include National Parks, State Parks and Wilderness Parks, and other protected areas, account for approximately 40% of Victoria's land area, but contain approximately 70% of remaining native vegetation (VEAC, 2016). Parks provide, among other services, water supply, climate regulation, air filtration, and habitat provision. The economic contribution of tourism associated with park visits has been estimated at approximately \$1 billion in gross value added annually (Varcoe et al., 2015).

Key influences

Agricultural practices

Agricultural practices are a major influence on land condition across the state. Victoria's agricultural producers are progressively taking up land management practices that protect the resource on which production depends. These include reduced or no-till farming, maintaining crop stubble or planting cover crops, stock exclusion from rivers and streams, weed control, water use efficiency, nutrient management and more. For example, dryland winter cereal farmers

in Victoria have progressively taken up conservation agriculture (FAO, 2015) approaches over the past 40 years, with an 80% cumulative adoption of no-till reported (Bellotti and Rochecouste, 2014; Llewellyn and D'Emden, 2009). Reduced use of summer fallow (to <10%) has been reported in the Mallee region (Drendel, 2012).

Climate and weather

Climate and weather have a strong influence on vegetative cover (BOM, 2017). Increased seasonal temperatures can increase water use by plants, or reduce growth rates of plants. Longer-term climate cycles, such as El Niño or La Niña can lead to drier or wetter conditions. Weather events such as frost, flooding, intense rainfall, extreme heat or strong winds can have negative effects on crops.

A drier and warmer climate is expected to impact on Victoria's land in several ways, largely through changes to soil health and agricultural productivity. Nuttall (2007, pp. ii-iii) suggests that "Soil carbon is expected to decrease due to decreased net primary production". Agricultural productivity may be affected through drought and heat stress on plants and animal production systems, and increased pest plant and animal and disease movement and establishment across Victoria. For example, Victoria's February and November 2009 heat waves caused extensive crop losses including sunburn of fruit and vegetables (Webb et al., 2010). An increased incidence of fire may lead to smoke taint during wine production (as experienced following Victoria's Black Saturday bushfires in 2009), the destruction of crops and livestock, and lost productivity due to the fire risk from machinery on high-temperature days.

Carbon sequestration in soils

Agricultural land has a relatively high potential to store carbon, due to intensive management and as a result of depletion of soil carbon in some areas (ENRC, 2010). While opportunities to "farm carbon" have been limited (e.g. under Carbon Farming Initiative / Emissions Reduction Fund), the potential for incentives to drive carbon sequestration remains. For example, the *Climate Change Act 2017* (Vic) provides for soil and forest carbon sequestration on both private and public land.

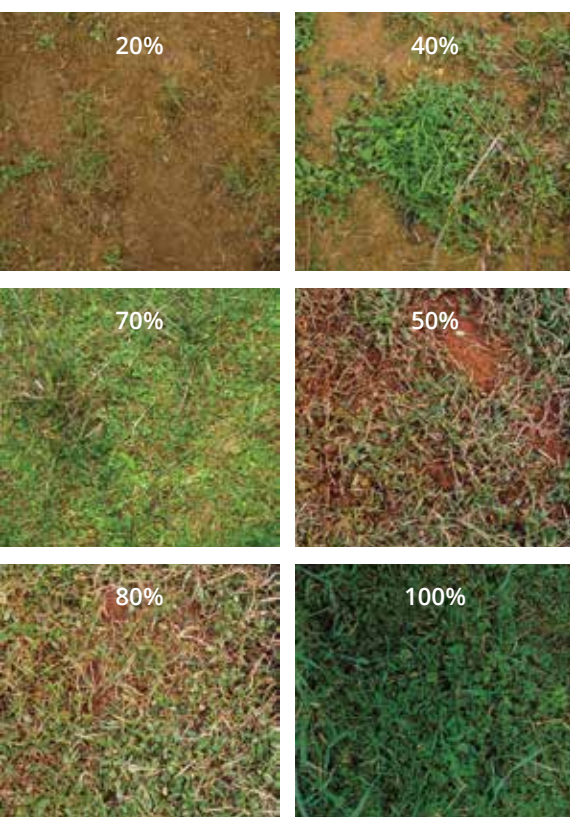


Figure 20. Photos showing examples of groundcover levels. Source: DEDJTR, 2017b

A significant challenge is not just increasing soil carbon but keeping it there. The soil carbon most useful to farming is the decomposing organic matter which is also the most likely to change and can be lost very readily under adverse conditions, such as drought. Another challenge for carbon sequestration in soils is measurement, both in establishing baseline measures of soil carbon and in quantifying any changes over time. There are also issues of permanence, with Emissions Reduction Fund projects required to store carbon for 25 or 100 years, which presents challenges given the projected impacts of climate change. Projects are also required to demonstrate additionality, meaning carbon sequestration in addition to that which would have occurred anyway. The lack of a mature market for Australian Carbon Credit Units is another limiting factor. Nevertheless, sustainable farming practices can lift soil organic carbon over time, or at least stem the rate of soil organic carbon depletion, contributing to both production and environmental values, including ecosystem services.

Condition

Fractional land cover

The last *Catchment Condition and Management Report* looked at soil health (VCMC, 2012) as a proxy for land condition, finding that the lack of benchmarks for a range of soil parameters made it difficult to assess condition. The report presented information on dryland salinity, threat of wind erosion, and levels of soil organic carbon, most of which has not been updated in the interim.

The indicator used for land condition at the statewide level in this report is fractional land cover, specifically the bare soil fraction derived from satellite observations. Bare soil is a proxy for erosion risk, as exposed soil is more likely to suffer wind or water erosion. Reducing the percentage of bare earth in Victorian agricultural landscapes can also contribute to both environmental and production values by reducing soil erosion, increasing or stabilising soil carbon as bare earth is a net source of carbon dioxide, and increasing moisture retention.

The threat of wind erosion results from a combination of the susceptibility of soils to erosion with the protection afforded by groundcover (Hopley et al., 2013). In the absence of soil susceptibility data, remotely sensed measures of groundcover have been used to determine land condition for the state.

Fractional land cover comprises three components: bare soils, non-photosynthetic vegetation, including dead plant matter such as crop stubble, and photosynthetic vegetation, including living plants (Figure 20). As both photosynthetic and non-photosynthetic vegetation provide groundcover, bare soils is used to determine groundcover levels.

The recommended amount of groundcover to maintain an acceptable risk of erosion in eastern Australia is 70%, and 50% is given as the minimum threshold for erosion risk in the Mallee region (DEDJTR, 2017b; Hopley et al., 2013). Some limitations of using remotely sensed cover include errors in the satellite imagery caused by cloud and smoke, and areas of bare soils caused by fires. In addition, the resolution of the imagery does not distinguish between areas with homogenous cover and those with clumps of cover interspersed with bare soils.

At the statewide scale, across all land use types, an analysis of the bare soil fraction is drawn from the Australian National University's *Australia's Environment in 2016* (Van Dijk and Summers, 2016), from annually averaged records (Guerschman et al., 2015) on a gridded basis (500 m), combined with annual average rainfall for all of Victoria (Figure 21).

At this broad scale, bare soil percentage appears to have a weak inverse linear relationship with annual rainfall (i.e. wetter years have less area of bare soil). A statewide average on this time scale is not sufficient to show the influence of changing agricultural practices. There has been little variation statewide over last 17 years, with a range of 11 to 16% average annual bare soil fraction.

A more detailed analysis, using monthly fractional cover data, and comparing bare soil percentage statewide (30-100% Vic) to areas of dryland agriculture (30-100% Dry), shows the seasonal variability of bare soils in Victoria (Figure 22).

An increase in bare soil percentage is evident from 2011 to 2016, peaking in summer 2015-16 with approximately 40% of Victoria's dryland production areas at elevated risk of erosion with bare soil percentage >30%. Notably, the dryland areas of the state have a higher proportion of bare soils over the summer period, but a lower proportion during the wet season. There are several explanations for these seasonal cycles of bare soils, linked to cycles of climate and agricultural systems. For example, grain growers spray summer weeds to conserve moisture for winter crops, and mixed farmers graze stubble, allowing stock to eat weeds and stubble, both resulting in bare soils over summer.

Management

Private land

No overall statewide strategy currently exists to guide the management of private land in Victoria. However, a range of regional programs for land and soil health are managed through CMAs.

The Department of Economic Development, Jobs, Transport and Resources operates a Land Health Program that supports dryland producers to improve agricultural productivity and healthy soils. The Program provides training on sustainable cropping practices, soil conservation, grazing management, farm planning and farm water supply. Projects are delivered in collaboration with other regional groups, including grower groups, Landcare and CMAs. Further research into weeds and plant diseases needs to be supported.

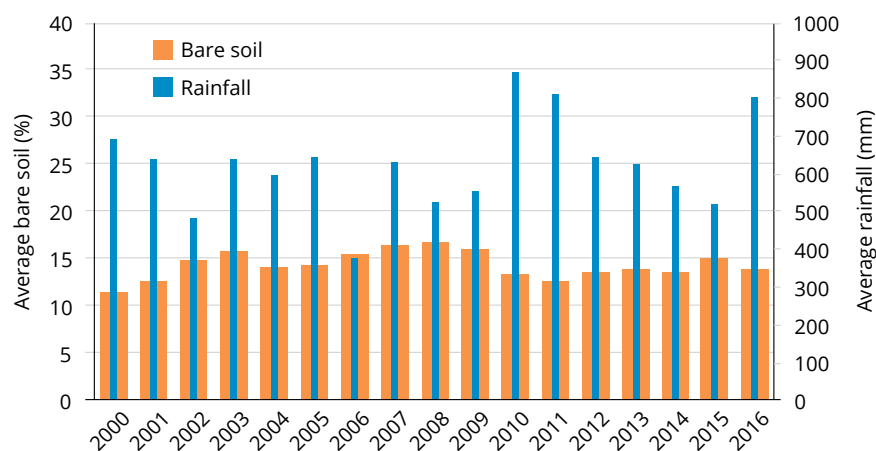


Figure 21. Annual mean percentage bare soil and annual mean rainfall for Victoria 2000-2016. Source: Van Dijk and Summers, 2016

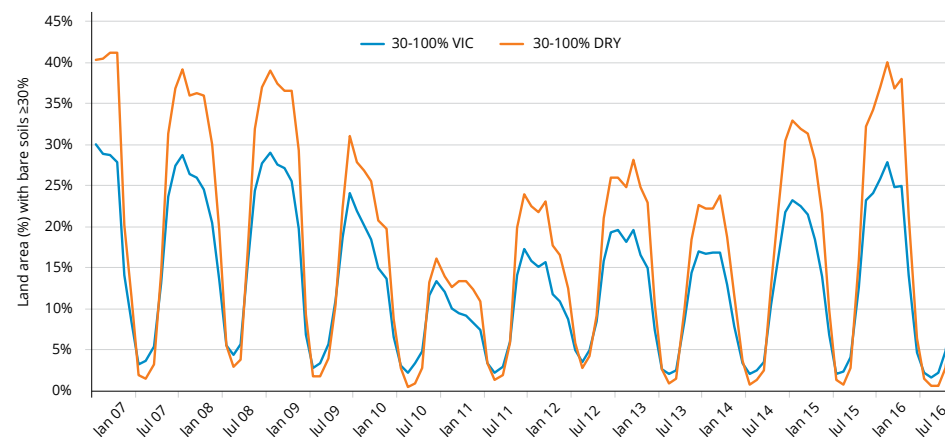


Figure 22. Time series (monthly from 2007-2016) of land area (%) with bare soils $\geq 30\%$, for all of Victoria (22,699,347 ha) and for dryland areas (11,766,298 ha) based on VLUIS classification. Source: DEDJTR, 2017a; EnSym; Guerschman et al., 2015

Under the *CaLP Act* 1994 s.20, land owners have responsibilities to 'take all reasonable steps' to avoid causing land degradation which causes or may cause damage to other landholders, conserve soil, protect water resources, and eradicate and/or prevent growth and spread of particular weeds and pest animals. Farmers should be supported to meet these obligations.

The Victorian Government's *Food and Fibre Sector Strategy* (DEDJTR, 2016a) highlights the production challenge of generating more output and value from our land and water resources, sustainably.

Public land

The use of Crown land in Victoria is governed by the *Land Act 1958*, the *Forests Act 1958*, the *Crown Land (Reserves) Act 1978* and the *National Parks Act 1975*. The *Parks Victoria Act 1998* provides for Parks Victoria to manage parks, reserves and other land under the control of the State.

Statewide ecosystem account for land

Environmental-economic accounting is a way of measuring and reporting on the extent and condition of environmental assets, the services they provide, and the economic and other benefits that flow to society. An international standard, the United Nations System for Environmental-Economic Accounting, has been widely adopted (SEEA-CF, 2014; SEEA-EEA, 2014; UNEP-WCMC, 2016). In Australia, the Wentworth Group of Concerned Scientists have also developed the *Accounting for Nature* framework (Wentworth Group of Concerned Scientists, 2008).

In Victoria, the role of environmental-economic accounting is increasingly recognised in policy and strategic documents, appearing in *Our Catchments Our Communities* (DELWP, 2016b, p. 47), the biodiversity plan '*Protecting Victoria's Environment – Biodiversity 2037*' (DELWP, 2017a, pp. 30–31), *Water for Victoria* (DELWP, 2016a, p. 59), *Victoria's Climate Change Adaptation Plan 2017-2020* (DELWP 2017 p. 42), *Climate Change Framework* (DELWP, 2016c, p. 32), and the *Framework for the Victorian 2018 State of the Environment Report: State and Benefit* (Commissioner for Environmental Sustainability, 2015). A strategic plan has also been

developed to consolidate statewide accounting for environment and other government portfolios such that best practice environmental-economic accounting is consistently applied and integrated into policy and decision-making by 2020 (DELWP, 2015a).

This report uses the System for Environmental-Economic Accounting to develop an ecosystem account for land at the statewide scale. The standard conceptual model for this reporting focuses on spatially-defined assets and the condition of those assets, and the services and benefits they provide (Figure 23). The purpose of the overall framework is to articulate the links between asset use and benefits.

The Victorian Government has invested in an Environmental Systems Modelling Platform (EnSym), which among other features, assists in the application of market-based approaches to environmental management (<https://ensym.dse.vic.gov.au>). The ability of EnSym to produce environmental-economic accounts from complex spatial data is a strength that puts Victoria at the forefront of environmental-economic accounting.

In the following example, an ecosystem account for Victoria's dryland agricultural areas is presented, using area at risk of erosion as a measure of asset condition. The ecosystem services provided, along with the economic and other benefits, are discussed but are not assessed quantitatively. In moving towards a set of environmental-economic accounts for Victoria, consistent approaches for quantifying services and benefits, in relation to counterfactual scenarios, will be necessary. This ecosystem account is a small step towards that goal.

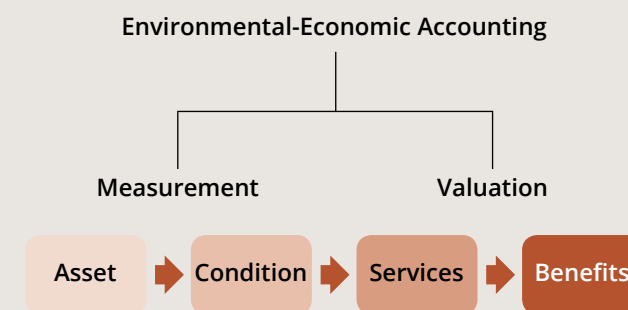


Figure 23. Environmental-economic accounting conceptual model. Source: DELWP, 2015a

Asset	Condition	Services	Benefits
Victoria's dryland area: 11,766,298 ha	Area of dryland at higher risk of erosion, percentage bare soil 30-100% for each ha (100 m grid)	Agriculture: Victoria's dryland areas support food and fibre production. Soil stabilisation: Land with higher levels of ground cover (and low levels of bare soils) protect soils from wind and water erosion. Salinity amelioration: Ground cover can help in reducing the impacts of salinisation. Carbon storage: Ground cover can reduce loss of soil carbon, and sequester carbon by enabling crop residues to add to soil organic matter (Reicosky and Forcella, 1998). Water availability: Cover crops can improve water infiltration, but their water use can also adversely impact yields of dryland crops (Dabney et al., 2001).	Gross agricultural value: 2010-11: \$11,618.0 m (\$7,737.30 m dryland) 2014-15: \$13,143.61 m (\$8,208.86 m dryland) The gross value of dryland agriculture in Victoria increased by approximately 6% from 2010-11 to 2014-15. Grain crop yields: Grain crop yields increased from 2010 to 2011, and declined from 2012 to 2015 (Figure 24b).

Year	Dryland area with ≥30% bare soil in March (%)
2007	41%
2008	36%
2009	37%
2010	25%
2011	13%
2012	23%
2013	28%
2014	24%
2015	31%
2016	37%

Figure 24a. Dryland area with 30-100% bare soils (higher risk of erosion) in March, 2007-16. Source: DEDJTR, 2017a; EnSym; Guerschman et al 2015

Victoria has a total land area of nearly 23 million ha, of which 50% is used for dryland grazing, cropping and other non-irrigated productive uses. Between March 2011 and March 2016 (approximate time of greatest risk), there was an overall shift to higher fractions of bare soils statewide (Figure 24a).

70% groundcover (or <30% bare soil) is given as the minimum threshold for erosion risk in eastern Australia (DEDJTR, 2017b; Hopley et al., 2013).

Season	Wheat for grain (t/ha)	Oats for grain (t/ha)	Barley for grain (t/ha)
2007-08	1.3	1.6	1.6
2008-09	1.1	1.3	1.3
2009-10	2.0	2.0	2.0
2010-11	1.0	1.0	2.0
2011-12	2.4	1.8	2.4
2012-13	2.0	2.0	2.3
2013-14	2.0	2.0	2.0
2014-15	1.8	1.4	1.5

Figure 24b. Grain crop yields for Victoria, 2007-08 to 2014-15
Source: ABS, 2016c

Note: For more information on this approach, see <www.vcmc.vic.gov.au>

Water



The Victorian Catchment Management Council:

- Finds that the condition of Victoria's waterways are stable or declining, but face increasing pressure from climate change and reduced availability of water resources
- Acknowledges the quantity and quality of data about water and waterways from various agencies but identifies issues with statewide condition and trend information, and with the scale and frequency of monitoring programs
- Supports a balance of intervention monitoring and benchmarking of waterway condition into the future at the right intervals
- Commends the release of the Water Plan *Water for Victoria* (DELWP, 2016a)

About Victoria's water

Water is important to Victorians, both as a resource to be utilised and as a key part of our natural environment. Water resources underpin a range of uses, including recreation, the supply of water to cities and towns, agricultural use for irrigation and stock watering, and water for the environment. Victoria's waterways include approximately 35,000 wetlands (DELWP, 2016h), including several of international significance, over 85,000 km of rivers that underpin regional economies, and over 120 estuaries, many of which run through major urban centres.

Victoria's waterways and catchments have been impacted by past land use and river management practices, including clearing of riparian vegetation, regulation of rivers and extraction of water, the

introduction of invasive species, nutrient pollution and sedimentation. Water resources are being stretched to their sustainable limits from irrigation and the need to support urban consumption.

Water for Victoria (DELWP, 2016a) provides a plan for a future with less water as Victoria responds to the impact of climate change and a growing population. The actions set out in the plan aim to support a healthy environment, a prosperous economy with growing agricultural production, and thriving communities.

Key innovations in the plan include a focus on some values of water that have been given little attention in the past, including Aboriginal and recreational values of water. In implementing the plan, the water sector is working with communities and other agencies to explore opportunities to maximise shared or complementary

benefits of all water uses, without compromising the needs of the environment, agriculture, towns, businesses, and people.

By sharing benefits from the storage, delivery and use of water, Victoria's limited water resources will be optimised to help meet the objectives of key groups in the community, including Traditional Owners and Aboriginal Victorians, and recreational users. For example, the strategy asks water corporations to consider shared benefits in their storage management and river operation decisions, and for their part, that CMAs and the Victorian Environmental Water Holder also consider shared benefits in their environmental watering decisions.

As part of *Water for Victoria*, the Victorian Government has allocated \$222 million, in addition to ongoing substantive investment in environmental water, to improve the health of waterways and catchments over four years, 2017-18 to 2019-20 (DELWP, 2016a). The magnitude of this and other major investments in water resources and waterways (e.g. environmental water) necessitate a renewed focus on measuring management outcomes and improvements to condition over time.

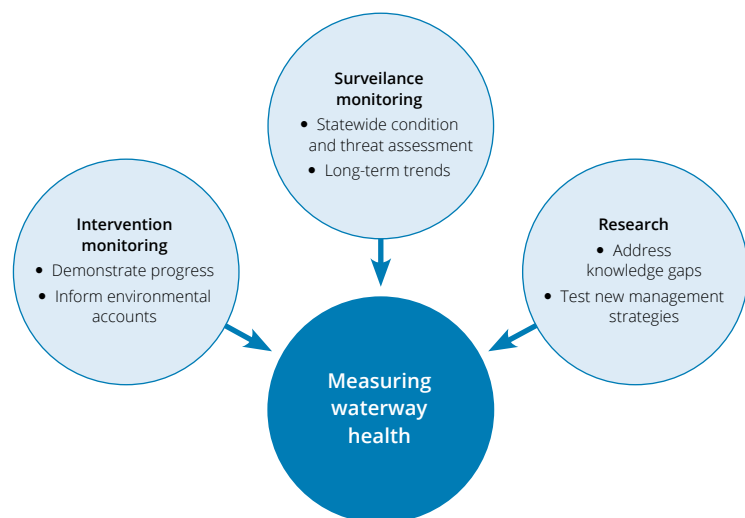


Figure 25. Three approaches to measuring waterway health.

Source: adapted from DELWP, unpublished discussion paper

While monitoring of the quantity of water resources is well-established in Victoria (e.g. annual water accounts; DELWP, 2016e), measuring changes in waterway condition is a challenging and long-term endeavour. Three broad approaches to measuring waterway health outcomes are currently being used (Figure 25): (1) benchmarking / surveillance monitoring, (2) intervention monitoring, and (3) targeted research programs (DEPI, 2013a).

Condition benchmarking approaches, such as the Index of Stream Condition, have been produced approximately every five years. The Index of Stream Condition was determined to be too frequent to detect changes in condition due to management activities at a statewide scale. Consequently, there is a proposed shift to less frequent Index of Stream Condition, to alternate with the Index of Estuarine Condition and Index of Wetland Condition, meaning a statewide assessment for each resource is conducted every 12 years (DELWP, unpublished discussion paper).

Benchmarking approaches to measuring waterway condition, while important in tracking long-term change, do not clearly link to management actions undertaken. Therefore, it is argued, demonstrating outcomes at a statewide scale would take a long time, in the order of 20+ years. It is proposed that intervention monitoring programs will provide condition information in the shorter term.

A shift is underway towards intervention monitoring based on tracking the impacts of management interventions on waterways at local and regional scales on shorter time frames. The intervention monitoring framework set out in *Water for Victoria* recognises the long-term nature of improving waterway condition and includes four key phases: (1) planning and target setting, (2) taking action, (3) recovery and growth, and (4) target achieved. This framework is to be trialled at 10 sites over the next four years. The Riparian Intervention Monitoring Program and Wetland Intervention Monitoring Program are examples where sites have been established to track responses to management interventions. Intervention monitoring also takes place at Icon Sites under The Living Murray Program, managed through the Murray Darling Basin Authority, and the Mallee, North Central, and Goulburn Broken CMAs.

Programs such as the *Victorian Environmental Flows Monitoring and Assessment Program* combine research and intervention monitoring to determine ecological responses to environmental flows, so that measured outcomes are evidence-based. Melbourne Water monitors river health, including water quality at over 100 sites across their region, platypus, fish, frogs, birds, vegetation, macroinvertebrates, and amenity. The Environment Protection Authority Victoria, in partnership with Melbourne Water, monitors water quality in the Yarra River, with a focus on recreational water quality. Citizen science also plays a role, with programs such as Waterwatch and EstuaryWatch contributing important on-ground measures and observations of condition and change.

Key influences

Climate change

The potential impact of climate change on Victoria's waterways includes increased water temperatures, leading to reduced oxygen, eutrophication and a reduction in water quality. More frequent and intense rainfall events can lead to increased turbidity and eutrophication. Reduced streamflows can lead to increased salinity. Wetlands are among the most vulnerable ecosystems to climate change (DSE, 2013; Jin et al., 2009). Increased drought frequency and intensity, decreases in freshwater flows, decreasing groundwater levels, rising sea levels and increases in coastal storm surges may affect low-lying coastal wetland areas.

Climate change will see a reduction in the water flowing into Victoria's waterways. Hydroclimatic projections for Victoria in 2040 and 2065 predict declines in rainfall and an amplified decrease in runoff, which is the water that is drained from the land into waterways (Figure 10), particularly in the south west (Potter et al., 2016). Evaporation will increase across the whole state, because of increasing temperatures.

Water resource development for consumptive uses

The development of water resources for consumptive use has had, and continues to have an impact on the health of waterways and catchments (Kingsford et al., 2017). The over allocation of water to productive uses is, to some degree, being addressed through recovery efforts for environmental water. Changes to water regimes resulting from river regulation can mean that some waterways receive much higher water volumes in summer than they would normally experience.

Water pollution

The pollution of waterways can result from point sources, such as sewage treatment plants and other industrial discharges, or from diffuse sources, such as stormwater from urban centres, or runoff of nutrients from agricultural areas. Water pollution can include sediment and nutrients, litter, chemicals, and organic matter. These can cause degradation of waterways, for example sediments can reduce the light available to plants for photosynthesis, and organic inputs can reduce oxygen availability.

Management interventions

Restoration of waterways can improve their condition over time. Restoration activities include fencing to exclude stock from waterways, weed removal on riparian land and wetlands, revegetation to stabilise banks, intercepting nutrients, and improving habitat and wetland vegetation, constructing fish passages, re-snagging streams, removing barriers to fish passage, restocking fish, eradication of pest species, removal of sediment, and restoring water regimes.

Environmental Water

The use of environmental watering to improve waterway condition is a relatively new feature of Victoria's approach to water management (see Victorian Environmental Water Holder story in this section). The desired outcomes of environmental watering not only include ecological improvements, but also shared benefits for recreational users, cultural flows and Aboriginal environmental water outcomes, and water quality improvements.

Invasive fish

The introduction of Carp (*Cyprinus carpio*) into Victoria's waterways has had significant effects on native fish populations, waterway condition, and impacts on water quality (King et al., 1997; Vilizzi et al., 2014, 2015). The *National Carp Control Plan* is examining the introduction of Cyprinid herpesvirus (CyHV-3 or carp herpesvirus) to reduce carp numbers and is developing a risk management plan as well as a series of complementary actions to support native fish following the proposed release of the virus (FRDC, 2017; McColl, 2016).

Also, eastern gambusia (*Gambusia holbrooki*) and redfin (*Perca fluviatilis*) have had major impacts on native fish populations through predation, disease transmission and competition for space, habitats and food, as have trout (at least three species, but primarily *Salmo trutta* and *Oncorhynchus mykiss*) in the areas they have established (Humphries and Walker, 2013; Lloyd et al., 1986; Macdonald and Tonkin, 2008; Morgan et al., 2004). Trout and redfin are targeted by recreational anglers and trout are actively stocked in parts of the state (Fisheries Victoria, 2009). Furthermore, waters suitable for trout are shrinking as climate change results in warmer waters and lower water levels (Morrongiello et al., 2011).

Condition

Rivers

Rivers are the water that flows on the surface of the land, drawn from their surrounding catchments. They are home to a broad range of water bugs, fish, aquatic plants, and iconic species like the platypus. They are also a readily available source of water for consumptive, recreational and traditional uses. The condition of Victoria's rivers has been influenced by activities such as water extraction, widespread historical clearing of land, urbanisation, introduction of pest plants and animals, and river regulation.

Victoria's rivers are regularly sampled by water authorities and the Environment Protection Authority Victoria to monitor water levels and a range of water quality parameters. The Water Measurement

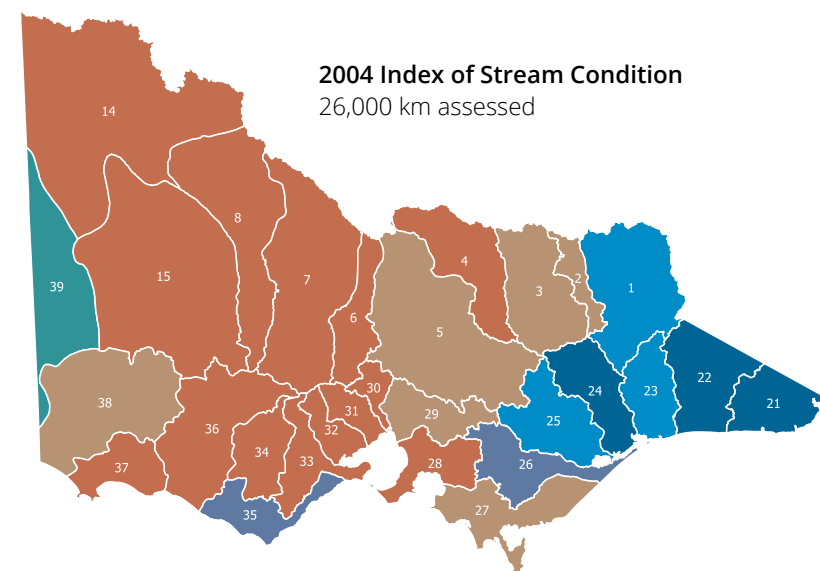
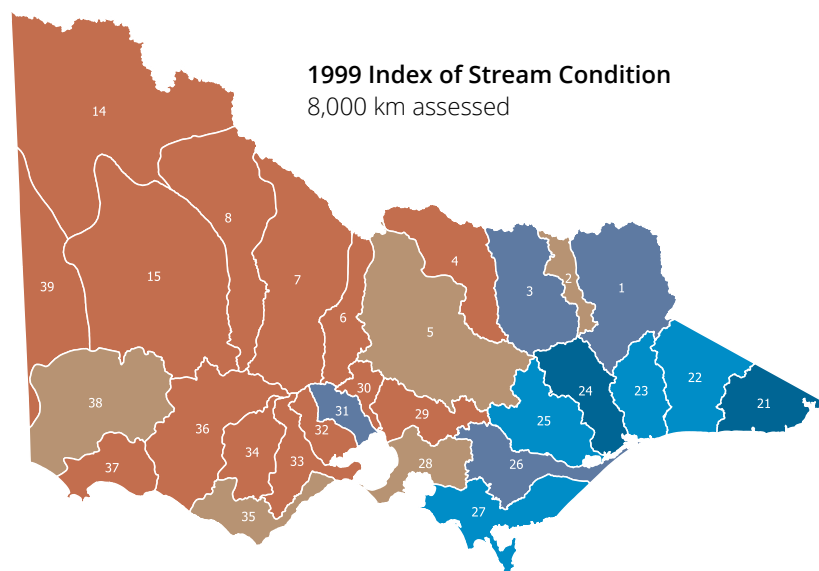
Information System provides a portal to a wide range of surface and groundwater quantity and quality information. Also, RiverMAP, a model that uses water bug samples collected across the state, is used to estimate the river health at more than 50,000 stream reaches across Victoria.

Periodic benchmarking is important for bringing together a range of water quantity, quality, and site condition data, to establish measures of river condition across the state. The 2010 Index of Stream Condition (published in 2013) showed that 66% of Victoria's river reaches by length were in moderate, good or excellent condition, and 32% in poor or very poor condition (DEPI, 2013b).

Although the Index of Stream Condition was conducted in 1999, 2004 and 2010, it can only be used as a benchmark of condition at these particular times and is not recommended for assessing trends in condition (DEPI, 2013b, p. 8). However, as Figure 26 demonstrates, there was minimal difference in condition reported over each of the three assessments.

The 2010 Index of Stream Condition assessed approximately 29,000 km of rivers across Victoria and found that 12% of river length was in excellent condition (>70% condition score), 11% in good condition (51-70% condition score), 43% in moderate condition (31-50% condition score), 19% in poor condition (11-30% condition score), and 13% in very poor condition (<10% condition score), while the remaining 2% of stream length had insufficient data to determine condition.

Based on these reports at a statewide scale, Victoria's rivers are likely to be either in a stable condition or in declining condition. Given the ongoing disturbance of past catchment impacts and the increasing pressures of climate change and population growth, it could be expected that these trends will continue at a broad scale. However, at local and regional scales where management interventions are restoring riparian land and enhancing flow regimes, improvements to condition can be expected.



Environmental Condition



Basin Names

1 Upper Murray	14 Mallee	27 South Gippsland	35 Otway
2 Kiewa	15 Wimmera	28 Bunyip	36 Hopkins
3 Ovens	21 East Gippsland	29 Yarra	37 Portland
4 Broken	22 Snowy	30 Maribynong	38 Glenelg
5 Goulburn	23 Tambo	31 Werribee	39 Millicent Coast
6 Campaspe	24 Mitchell	32 Moorabool	
7 Loddon	25 Thomson	33 Barwon	
8 Avoca	26 Latrobe	34 Corangamite	

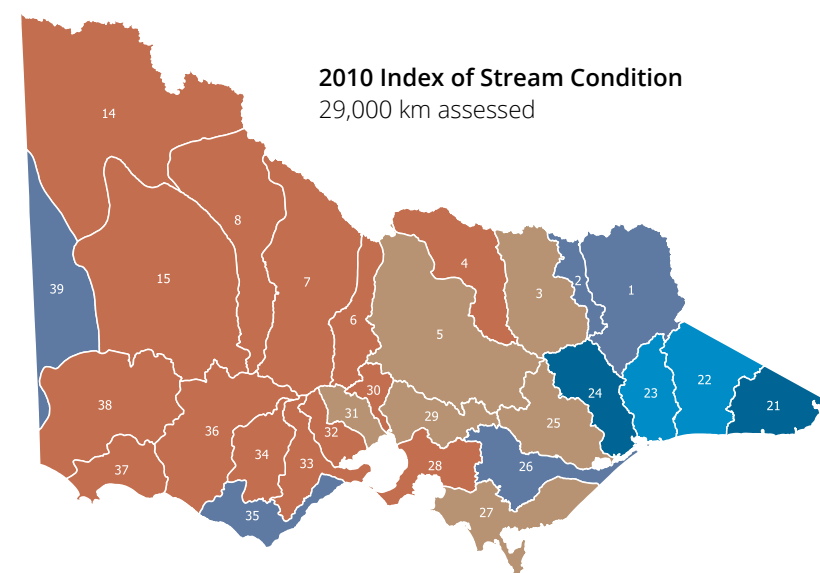


Figure 26. Percentage river length in good or excellent condition, 1999, 2004, and 2010 Index of Stream Condition. DEPI, 2013b; DSE, 2005

Estuaries

Estuaries are the interface between marine and freshwater environments, and are ecologically important as habitat for waterbirds, breeding grounds for fish, and as sites for seagrass, saltmarsh, and mangrove vegetation.

Victoria's estuaries, of which there are more than 100, are mostly found at the mouths of rivers that flow into marine environments, but also occur at coastal inlets and lagoons. Estuaries can extend for more than a kilometre and are often brackish (slightly salty water), some of which have a distinct 'salt wedge' where freshwater is layered over salt water, such as the Yarra River estuary (Beckett et al., 1982).

The condition of estuaries is dependent on stream flow, particularly for the opening of an estuary mouth to the sea. The Estuary Environmental Flows Assessment Method was developed to inform water planning for Victoria's estuaries by defining the flow regimes required to maintain or improve estuary health (Lloyd et al., 2012). Deciding whether to artificially open an estuary is a complex task, and estuary managers are guided by the Estuary Entrance Management Support System, which allows them to account for



Figure 27. Wye River estuary mouth. Source: EstuaryWatch, www.estuarywatch.org.au

risks of inundation and impacts on a range of social, economic and environmental values (DEPI, 2013c).

EstuaryWatch is a citizen science initiative to measure the condition of Victoria's estuaries. Monitoring includes taking regular photographs of each estuary mouth (e.g. Figure 27), making observations of the state of the estuary (open or closed, water level, etc), as well as recording a range of physical and chemical parameters. Monitoring is typically monthly, but can also be done in response to high rainfall events, storm surges and other periodic events.

DELWP is currently undertaking an Index of Estuarine Condition that will assess the condition of Victoria's estuaries across five themes: fauna, flora, water quality, physical form and hydrology. The water quality theme will incorporate data from EstuaryWatch and CMAs. The assessment is underway and is anticipated to be completed in 2020.

Wetlands

Victoria's wetlands are defined as areas subject to inundation, and can be classified as shallow and temporary, or deep and more permanent, and as freshwater or saline (Papas and Moloney, 2012). A recent revision of Victoria's wetland classification system revealed an inventory of 35,429 wetlands comprising 784,025 ha across the state (DELWP, 2016i). There are 143 wetland ecological vegetation classes associated with these wetlands (DEPI, 2013d). Wetlands are threatened by changes in water regime, native vegetation clearing, poor water quality, invasive plants and animals, unsustainable uses such as livestock grazing, and physical disturbance such as cropping, drainage and the construction of dams within wetlands (Casanova and Casanova, 2016).

The condition of high value Victorian wetlands were assessed in 2009-10 and 2010-11 through the Index of Wetland Condition, the results of which were presented in the previous *Catchment Condition and Management Report* (VCMC, 2012). High value wetlands included Victorian wetlands listed under the Ramsar Convention (an international treaty for the protection of wetlands, of which Victoria has 11 listed sites), those in the 2001 Directory of Important Wetlands in Australia, as well as certain wetlands in the

Wimmera region. A total of 827 wetlands, representing a relatively small proportion (6%) of naturally-occurring, non-alpine wetlands in Victoria, were assessed across the two phases. While some further assessments of wetland condition have been conducted as part of tender programs, no further statewide assessments have been conducted, and the next is planned for reporting in 2025 (DELWP, unpublished report).

A recent Victorian Auditor-General's report on protecting Ramsar wetlands (VAGO, 2016) highlighted that, for Ramsar sites, management outcomes, while effective, are not linked clearly to identified management plan actions. Furthermore, monitoring and evaluation was identified as an area for improvement in Ramsar site management.

Short to medium term monitoring of wetland condition is taking place through the Wetland Intervention Monitoring Program, currently underway from 2016-17 to 2020-21. For example, removing livestock grazing from a wetland would be expected to result in improved soil condition and native vegetation regeneration within three to five years; a much shorter time frame than the proposed 12-year frequency of the Index of Wetland Condition.

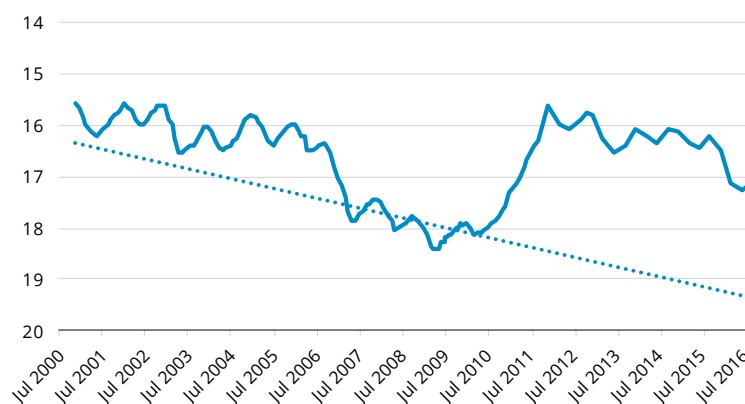


Figure 28. Example of a hydrograph showing longer-term (17 year) trend depth below natural surface (m), from Warrion in south west Victoria. Source: DELWP Monthly Water Report, December 2016

Groundwater and dependent ecosystems

Groundwater is water beneath the surface that resides in pores and cracks in the rock and soil. Large areas of groundwater form what is called an aquifer, which can be thought of as an underground store of water. Groundwater and surface water (rivers and wetlands) are often connected, though not all waterways have a groundwater source input. Groundwater is said to 'recharge' from the input of water from the surface. Likewise, 'discharge' of groundwater occurs when it is extracted by pump, when water naturally emerges at the surface as baseflows to rivers and streams or in wetlands, and discharge to marine areas.

Victoria's groundwater levels and salinity are monitored across approximately 2,500 bores as part of the State Observation Bore Network (DELWP, 2016e). Groundwater is managed as either Water Supply Protection Areas, which are areas proclaimed under the *Water Act 1989* to establish a statutory management plan, and Groundwater Management Areas, which are areas of intensive groundwater development.

As at March 2017, long term (greater than 10 years) groundwater level trends for Water Supply Protection Areas included nine categorised as stable, two as declining and three as rising. Short term (less than five years) trends of groundwater levels included six categorised as declining and eight as stable. However, it can be difficult to report trend based on rising / stable / falling aquifers over annual or five-yearly periods as it may mask a longer-term trend. For example, Figure 28 can be interpreted as stable over 17 years, declining from 2011-16, or increasing over the last 12 months.

Groundwater dependent ecosystems are waterways with a groundwater input for some or all the time, and non-waterway or terrestrial ecosystems dependent on groundwater. Many of Victoria's nearly 35,000 wetlands are groundwater dependent, with approximately 15,000 having a very high, high, or moderate probability of a groundwater source, 3,465 with low probability, and just over 17,000 unknown (DELWP, 2016h).

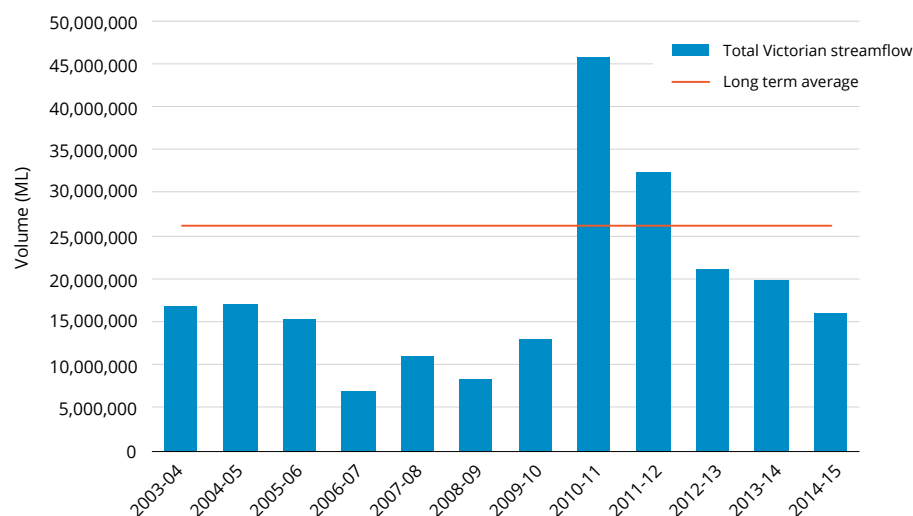


Figure 29. Total Victorian Streamflow and long-term average. DELWP, 2016e

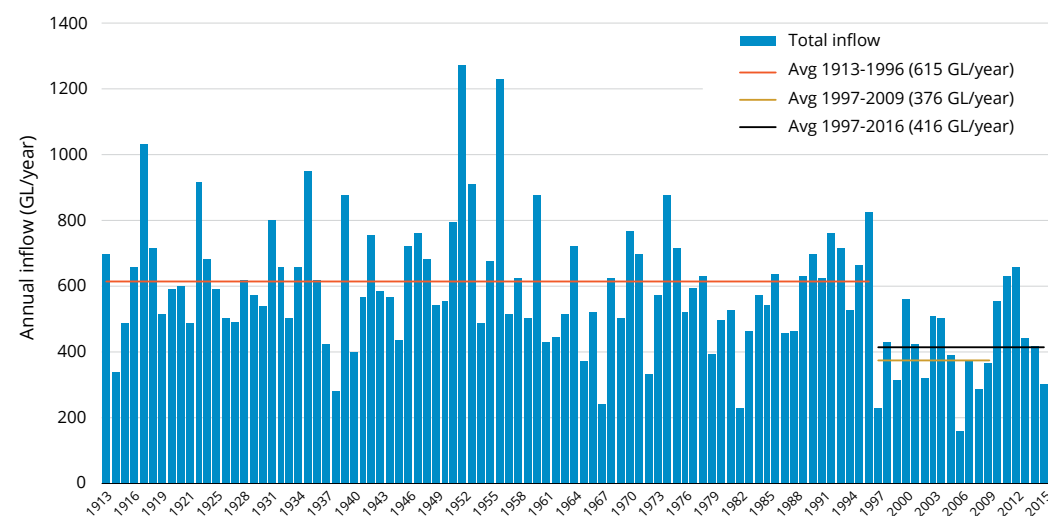


Figure 30. Total inflows to Melbourne's water storages, 1913-2016. Source: Melbourne Water

Water resources

Victoria's water resources are the stocks and flows of water across the state. These include water used for consumptive purposes, such as irrigation, city and town water supply, as well as water for the environment that supports waterways. The pressures of climate change and a growing population mean that Victoria's water resources may be stretched beyond their sustainable limits.

Total streamflow is one measure of water quantities across the state, and provides an indication of the rainfall received in a year. It also provides a sense of the conversion of rainfall to runoff, which can indicate the dryness of the catchments. A time series of total Victorian streamflow shows that a long sequence of dry years, representing the latter part of the Millennium Drought (1997-2009), are punctuated by two years of above average streamflow (Figure 29). Since 2012, there has been a return to drier conditions, although 2016 was a year of above average rainfall, but streamflow has not yet been reported for that period.

Since the dry conditions of the Millennium Drought, Victoria's water authorities have begun to use a post-1997 average inflow scenario as the basis of long-term water planning (Figure 30). This represents approximately 70% of the previous long-term average from 1913-1996, but is still higher than the inflows experienced during the Millennium Drought.

Management

Water for Victoria

Water for Victoria: Water Plan (DELWP, 2016a) is the current policy for managing water in Victoria. The waterways component of the policy highlights 36 priority waterways, 10 long-term ecological research sites, and their respective monitoring, evaluation and reporting plans, and a shift towards targeted investment monitoring.

According to *Water for Victoria*, Victoria's water industry is responsible for nearly a quarter of greenhouse gas emissions

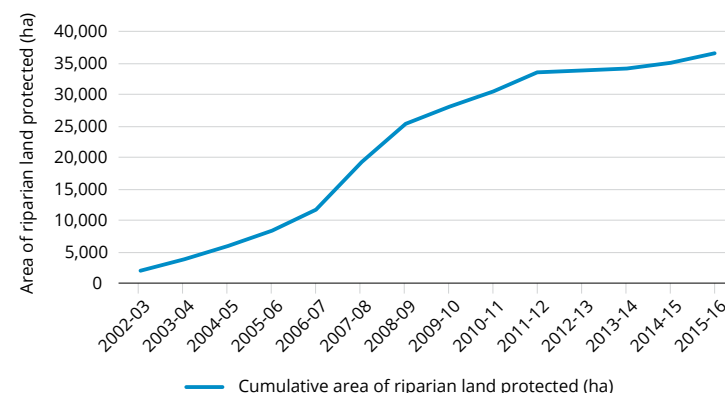


Figure 31. Cumulative area of riparian land protected (ha), 2005-06 to 2015-16. Source: Aither, 2015; DSE, 2010; DELWP, unpublished

from government activities (DELWP, 2016a, p. 30). The Victorian Government has set a goal of net zero emissions from Victoria by 2050, but under the Plan, water corporations will explore a pathway to achieving this goal by 2030.

Riparian management

Healthy riparian land provides all manner of benefits: to waterways, to recreational users, to the cultural values of Traditional Owners, for improved drinking water quality and to productive farming. Riparian vegetation sometimes comprises the only trees and shrubs in otherwise cleared landscapes, giving shade, filtering nutrients and sediment from entering waterways, providing food for fish and reducing bank erosion. In recognition of these benefits, work on riparian land, such as fencing and revegetation, has been undertaken by CMAs (and their predecessors) and government over decades throughout the state in partnerships with landholders and community groups.

A summary of activities from 2002-03 to 2015-16 in protecting riparian land (Figure 31) and constructing riparian fencing (Figure 32) shows the cumulative effort achieved by funding

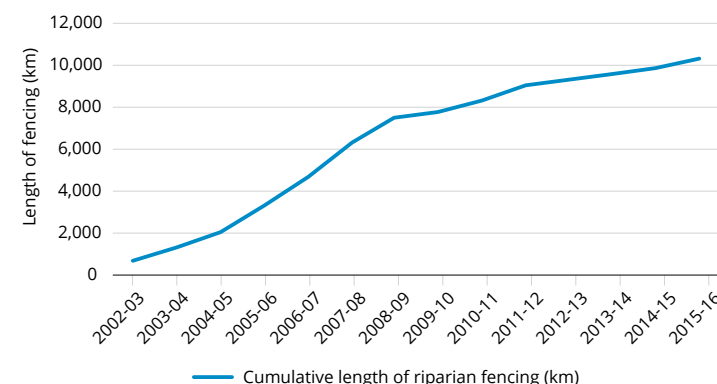


Figure 32. Cumulative length of riparian fencing (km), 2005-06 to 2015-16. Source: DSE, 2010; DELWP, unpublished

provided largely through the state government's waterway health program. Note that Melbourne Water data is included for 2002-03 to 2008-09 only.

The Victorian Government has provided additional funding to implement its *Regional Riparian Action Plan* over the period 2015-16 to 2019-20, to accelerate the implementation of appropriate works to improve riparian condition across the state (DELWP, 2015b).

These works include revegetation, fencing to manage stock, weed management and supporting off-stream stock watering. They are undertaken by CMAs working collaboratively with landholders and community groups such as anglers and Landcare, using incentives and grants to assist in funding the activities.

There are five-year targets in the *Regional Riparian Action Plan* and the following figures show the measures delivered in Year one (2015-16) against those targets (Table 4).

CMAs will continue to monitor progress against the Plan's targets until the end of the Plan in 2020. Current progress is at a good rate. The assumption is that these measures will result in the improved condition of riparian land and the adjacent waterway in those places

where works occur, therefore increasing all the associated benefits to various users. Those condition outcomes need to be measured at the appropriate reach and time scale.

The Riparian Intervention Monitoring Program is a long-term intervention monitoring program aimed at demonstrating the responses of riparian land to management activities. It is being undertaken on a selection of sites around Victoria by CMAs and Melbourne Water in conjunction with landholders.

Victorian Waterway Management Strategy and Regional Waterway Strategies

The *Victorian Waterway Management Strategy* (DEPI, 2013c) and 10 *Regional Waterway Strategies* provide a framework for DELWP, CMAs, Melbourne Water and communities to improve the condition of the state's waterways. These strategies build on the previous *Victorian River Health Strategy* (DNRE, 2002).

State Environmental Protection Policy (waters) review

The *State Environmental Protection Policy* (SEPP) provides standards and statutory obligations for the protection of the state's natural environment. The SEPP (Waters of Victoria) and SEPP (Groundwater of Victoria) are currently being reviewed in light of recent policy changes, and will form a single *State Environmental Protection Policy* for all surface and groundwater in Victoria.

Victorian Rural Drainage Strategy

A Rural Drainage Strategy is currently being developed for Victoria to clarify who is responsible for drainage of rainfall runoff in rural areas. A lack of attention to drainage functions and infrastructure was an unintended consequence of the Millennium Drought, and now it is unclear which agencies are responsible for managing drainage infrastructure, much of which is in disrepair. The strategy is expected to provide clarity in managing rural drainage, and is planned for release in late 2017.

Table 4. Riparian management outcome measures and aspirational targets 2015-16 to 2019-20, and progress in 2015-16 delivery.

Target	Five-Year Target	Year 1 delivery
Length of riparian land where works have been undertaken to protect or improve its condition	2,490 km	768 km
Area of waterway vegetation works undertaken to improve the health and resilience of waterways	28,190 ha	11,588 ha
Number of landholders who have worked with the CMA to undertake riparian works	1,810 people	417 landholders

Note that these figures refer to nine CMA regions, excluding metropolitan Melbourne where Melbourne Water does not receive government funding under the Plan.

Victorian Floodplain Management Strategy

The *Victorian Floodplain Management Strategy* (DELWP, 2016j) evaluates the risk of flooding in Victoria and clarifies roles and responsibilities for communicating and managing floodplains. It follows major flooding that occurred in 2010-12, after a prolonged dry period with relative focus on drought and water supply.

Yarra River Action Plan

The *Yarra River Action Plan* (DELWP, 2017c, p. 8) responds to recommendations made by the Yarra River Ministerial Advisory Council. The Plan brings together water, environment and planning portfolios and adopts a strategic approach to managing the whole Yarra River. As part of the plan, the Commissioner for Environmental Sustainability in future will provide regular evaluation of the condition of the river and its parklands as part of the *State of the Environment* report.



Photo: NCCMA

Five years of the Victorian Environmental Water Holder

Instead of water flowing across the landscape naturally, water is captured and diverted for use in towns, cities, industry and farming. Some of our rivers give up more than a third, and sometimes up to a half of their water for homes, farms and businesses. This has disrupted natural seasonal flows, and many rivers now run higher when water needs to be delivered for farming and urban use. These changes have interrupted many of the natural river and wetland processes that native plants and animals need to survive, feed and breed (VEWH, 2016).

Established on 1 July 2011, the Victorian Environmental Water Holder (VEWH) is the independent statutory body responsible for managing Victoria's environmental water entitlements (water for the environment). Water for the environment is critical to maintain and improve the health of Victoria's rivers, wetlands and floodplains, which provide so many benefits for Victorians (VEWH, 2016).

The VEWL seeks to meet environmental demands for water and avoid water supply shortfalls through adaptive planning and efficient use of water for the environment. This includes using management tools such as return flows (using the same water 'twice' to meet environmental demands in different rivers), carryover and trade. Other options, including working with water storage managers to alter the timing and route for water delivery to towns, industry and farms, can also help to achieve environmental objectives efficiently without negatively impacting on other water uses and users (VEWH, 2016).

Throughout the year, the VEWL assesses environmental demands for water compared to available water supply. This includes considering factors such as environmental demand for water in the current year (and the following year where known), potential operational opportunities and constraints, and current and forecast water availability and climate conditions.

The decisions VEWL makes about where and when to deliver water (i.e. prioritisation) are influenced by many factors such as the previous watering history in a river or wetland, environmental or public risk considerations, or seasonal conditions in that region. These judgements and decisions can be extremely difficult, often involving trading off the potential risks of one adverse outcome compared to another. In prioritising one environmental watering action and river or wetland site over another, the VEWL always seeks to maximise environmental outcomes for Victoria.

The rivers and wetlands supported with environmental water management in 2015-16 align very well with the 36 priority waterways identified in *Water for Victoria* (DELWP, 2016a).

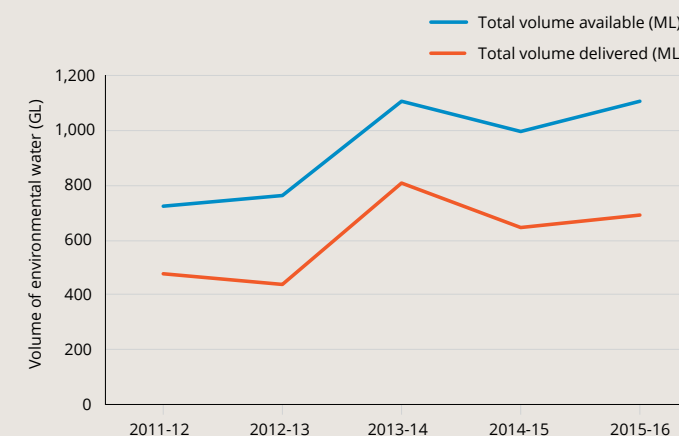


Figure 33. Environmental water availability and delivery in Victoria from 2011-12 to 2015-16. Source: VEWL, 2016

Biodiversity

The Victorian Catchment Management Council:

- Concludes that the generalised condition of biodiversity at the statewide level continues to decline; however, there are successes at the local level and these can be accelerated through more information and targeted research, increased collaboration in management, and investment that is commensurate with community expectations and the magnitude of the issues being addressed
- Notes the net losses of native vegetation on private land and suggests exploring greater use of incentives for landholders to redress this imbalance
- Recognises the challenges of measuring biodiversity condition and trends at a statewide scale, and recommends strategic investment in this area
- Commends the release of the biodiversity plan *Protecting Victoria's Environment – Biodiversity 2037* (DELWP, 2017a)
- Acknowledges the impacts of climate change, human population increase and clearing on native vegetation and biodiversity more generally in Victoria; and supports new thinking and innovative solutions, building on the approach in the biodiversity plan



About Victoria's biodiversity

The concept of 'biological diversity' represents all the living components of the natural world, their connections to other living and non-living components, and the way this diversity is expressed

at genetic, species and ecosystem scales. The focus on biodiversity in this report relates primarily to terrestrial environments.

Victoria's biodiversity has been adversely impacted by past land management practices, including clearing of native vegetation, and

the introduction of pest plants and animals. While management efforts have made significant progress in protecting what remains, there are ongoing challenges from legacy impacts and from climate change.

In 2017 a new statewide plan for protecting biodiversity was launched. *Protecting Victoria's Environment – Biodiversity 2037* represents a contemporary approach to managing biodiversity (DELWP, 2017a). It brings together the latest conservation science and social science to help achieve the plan's vision: that Victoria's biodiversity is healthy, valued and actively cared for.

The plan includes goals and targets for achieving this vision and will be accompanied by a Monitoring, Evaluation and Reporting Framework that describes a collaborative program that will promote learning, measure progress and guide future actions and refinement of targets.

Key influences

Historical land use

A long-term history of land clearing has led to removal of over 50% of Victoria's native vegetation. While large contiguous tracts of high quality native vegetation are conserved in the state's parks and forests, a proportion is in fragmented landscapes – largely on private land. As reported previously (VCMC, 2012) the losses from clearing on private land are thought to exceed the gains from revegetation and regeneration.

Pest plants and animals

Pest plants and animals are a major problem for Victoria's biodiversity, as they compete with native species for resources, predate on native fauna, cause erosion and other physical disturbances, and can affect the functioning of ecosystems. Prohibited pest animals are declared under the *CaLP Act 1994*. Established pest animals in Victoria include foxes, hares, goats, pigs, wild dogs, and rabbits. Pest plants are classified under the *CaLP Act 1994* under four categories of noxious weeds, including: (1) State Prohibited Weeds (highest category of weeds); (2) Regionally

Prohibited Weeds; (3) Regionally Controlled Weeds; and (4) Restricted Weeds. It is difficult to determine exactly the number and distribution of invasive species in the state (ENRRDC, 2017).

Deer are increasingly a problem and are being seen in parts of the state where they have not been seen before. Recent observations have been made of Sambar deer in Wilsons Promontory National Park, where they were thought not to be present. Deer are declared as 'game' rather than 'pests', and four deer species found in Victoria are legal to hunt (Game Management Authority, 2016). The impacts of deer on the environment include damage and destruction of native vegetation and regeneration, increased revegetation costs, as well as damage to orchards, vegetable gardens, pastures, and fencing. They can also cause erosion and concentration of nutrients.

Pest plants and animals are perceived as a big problem by communities across Victoria (Figure 44). Data on numbers and trends are not available at the statewide level. More investment in monitoring, research and implementation programs is required if community expectations about reducing the impacts of pest plants and animals are to be addressed.

Climate change

The potential impacts of higher temperatures on plants and animals include changes in the timing of life cycle events, as well as changes in distribution. For example, temperature sensitive plants and animals (such as those in Victoria's alpine areas) are generally expected to move to higher latitudes and altitudes in response to increasing temperatures. Plants and animals with highly specific habitat requirements, limited dispersal ability or those in fragmented habitats may find this difficult, leading to more local extinctions (Steffen et al., 2009).

As the climate becomes less suitable for extant vegetation communities, it is likely that there will be a gradual change in the species composition and dominance as some species and communities are replaced by others, leading to a shift in the floristics and structure of the community (Wallis et al., 2015).

Condition

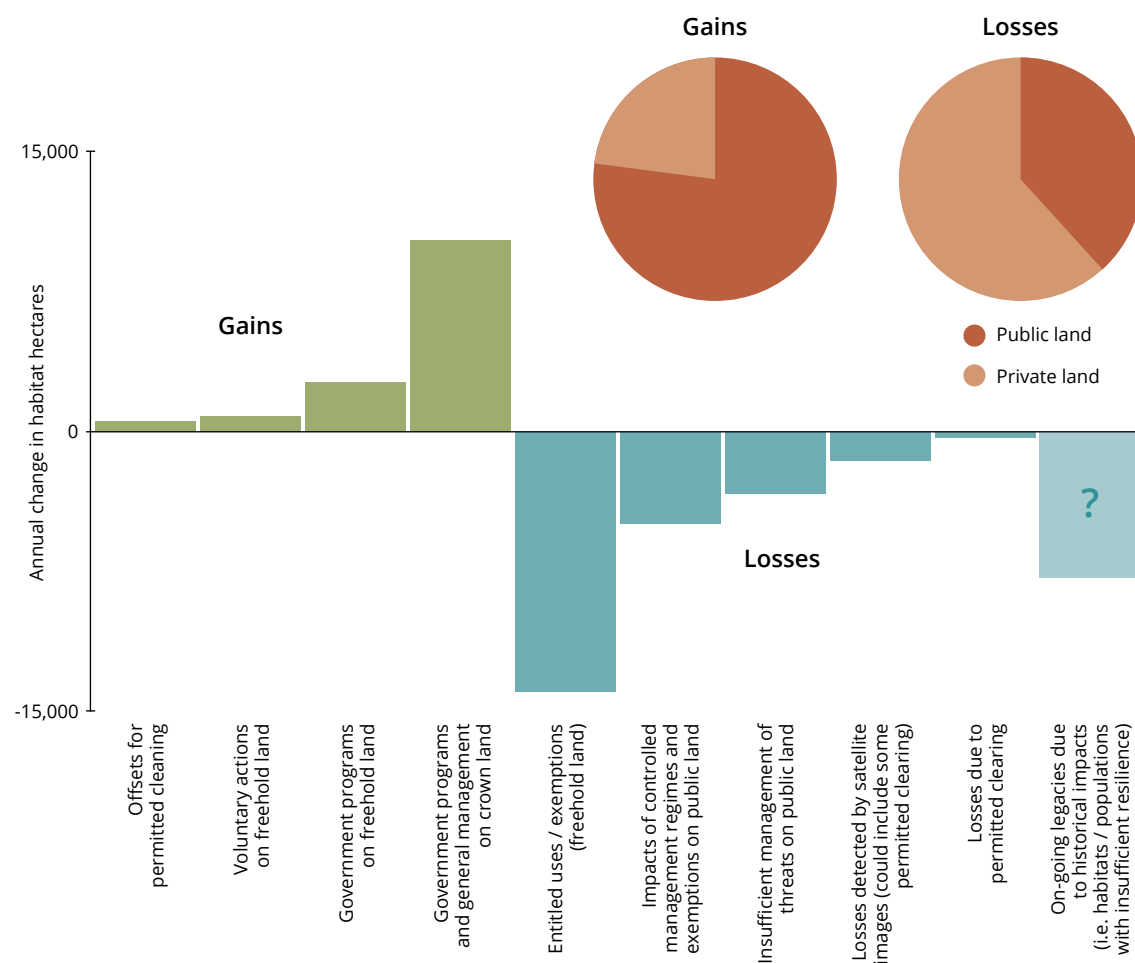
Native vegetation

Victoria's native vegetation includes a diverse range of indigenous plants, including trees, shrubs, grasses, and herbs. It provides habitat and food sources for native fauna, and underpins ecosystem services for society. Past land clearing removed approximately 50% of the state's native vegetation, leaving much in a fragmented state. A recent assessment of public land reported that while public land accounts for 40% of the area of Victoria, it supports 70% of remaining native vegetation (VEAC, 2016).

The change in extent and condition of native vegetation in Victoria is estimated in two ways. Firstly, modelled products, reported in the previous *Catchment Condition and Management Report* (VCMC, 2012), estimate broadscale changes in native vegetation extent and condition using a combination of satellite imagery and environmental data. Secondly, a net gain accounting method supplements the broadscale approach by examining site specific changes in extent and conditions due to different formal 'transactions' or decisions (i.e. approval of vegetation clearing or investment decisions) resulting in losses and gains.

The *Native Vegetation Net Gain Accounting First Approximation Report* (DSE, 2008) presented an analysis of progress against the government's policy of a reversal of native vegetation extent and condition decline. The accounting method used distinguished between two main landscapes: (1) largely undisturbed areas that are relatively stable and resilient to disturbances; and (2) fragmented landscapes with a long history of vegetation removal and decline in the condition of remaining fragments.

The Net Gain accounting approach used both native vegetation extent and condition data to produce a 'habitat hectares' metric, which represents a site-based measure of vegetation quality in relation to a benchmark. In summary, the first approximation reported a gain in 'habitat hectares' on public land, and a loss on private land (Table 5), for a net loss of around 4,000 habitat hectares per year, based on a measurement period of 1994 to 2004.



A qualitative update on the net gain accounting was conducted in 2015 to provide an indicative scale of the contribution if a range of activities to changes in native vegetation across the state for the year 2014. The consultation paper for *Protecting Victoria's Environment – Biodiversity 2037* (DELWP, 2016k) included a graphical summary of gains and losses (Figure 34).

Figure 34. Relative changes in native vegetation estimated using the net gain accounting approach. DELWP, 2016k, p. 15

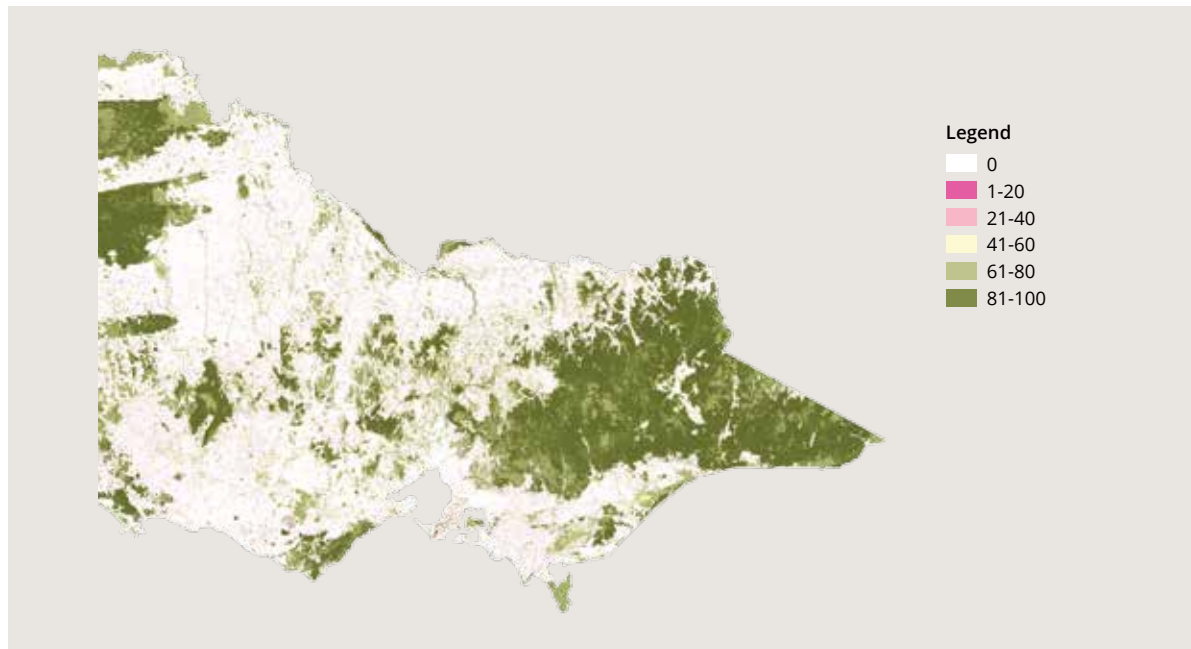


Figure 35. Map of native vegetation condition as modelled in 2010.

Source: DELWP, 2017d

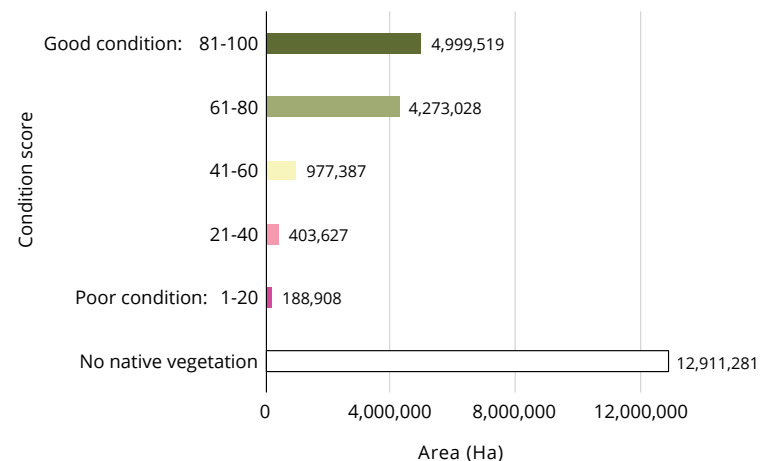


Figure 36. Chart of native vegetation condition as modelled in 2010.

Source: DELWP, 2017d

Table 5. Native vegetation net gain or loss. Source: DSE, 2008

	Public land	Private land
Gains sub-total	+ 8,760 HHa / yr	+ 4,560 HHa / yr
Losses sub-total	- 2,860 HHa / yr	- 14,550 HHa / yr
Net outcomes	+ 5,900 HHa / yr *	- 9,990 HHa / yr *

* due to significant uncertainties associated with the underlying assumptions, particularly about the amount of vegetation in each of the categories, these figures may be under- or over-estimates, possibly up to 20%

The activities estimated to be causing the largest loss of native vegetation are entitled uses, such as grazing and removal of firewood, as well as exempted clearing, such as clearing for firebreaks, fencing, and fuel reduction. However, this estimate is based on relatively broad assumptions. Illegal clearing is also an unknown, but potentially significant, contribution to native vegetation losses. While clearing of native vegetation is regulated by Local Government Authorities, and where permitted, offsets are created, this is only a small component of total loss and gain.

With limited new information since the last *Catchment Condition and Management Report* in 2012, the assessment that the extent of native vegetation in intact landscapes is stable, and declining in fragmented landscapes, are likely to still hold true. Overall, a net loss of native vegetation is assumed to be occurring in Victoria.

The likely condition of native vegetation in Victoria, as determined by a modelled condition score relative to a pre-settlement condition benchmark, was produced in 2010 (published in 2013). This modelling combines estimates of site condition and landscape context. Areas with higher condition scores are presumed to be in better condition, while those with low scores are presumed to be in poorer condition. The map in Figure 35 shows the distribution of native vegetation, and its modelled quality (darker areas, corresponding to higher scores, are better quality). The map clearly shows the concentration of better quality native vegetation in the

east of the state and the Mallee, with fragmented landscapes across the centre and west.

A graphical summary (Figure 36) shows the distribution of condition scores, with slightly more than half the state likely to contain negligible native vegetation, approximately 40% with native vegetation in good or reasonably good condition, and the remaining areas in poor condition.

An assessment of trend in native vegetation condition cannot be made beyond previous assessments, as no new data has become available in this time. As with native vegetation extent, it is assumed that native vegetation condition is relatively stable in intact landscapes and declining in fragmented landscapes.

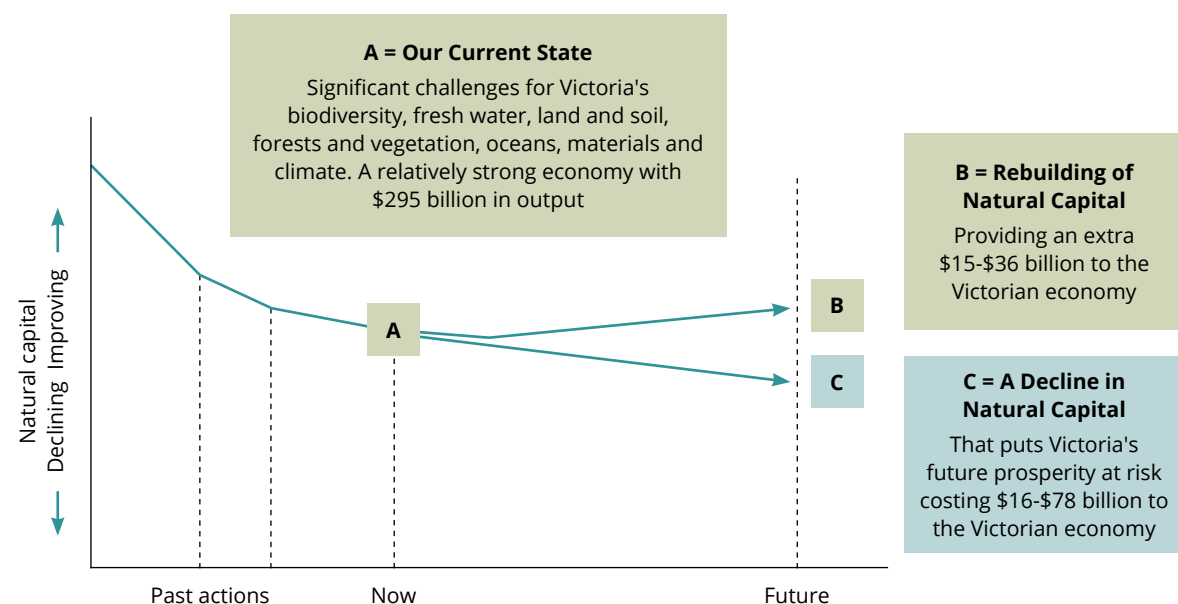
Management

Protecting Victoria's Environment – Biodiversity 2037

The newly released statewide biodiversity plan, *Protecting Victoria's Environment – Biodiversity 2037*, constitutes the *Flora and Fauna Guarantee Strategy* under the *Flora and Fauna Guarantee Act 1988*. The plan sets out two main goals: (1) Victorians value nature; and (2) Victoria's natural environment is healthy, which are both supported by a range of targets.

The biodiversity plan makes the case for protecting Victoria's biodiversity through the lenses of 'ecosystem services', which are the provisions that support human life, and 'natural capital', which are the stocks of resources provided by nature. The strong focus on renewed investment and co-investment is, in part, a recognition of the long-term under-investment in planning, management, protection, evaluation and reporting for biodiversity and the natural environment (DELWP, 2017a, p. 10). The biodiversity plan portrays a conceptual long-term trajectory of the loss of biodiversity across the state, and two potential future trajectories of either rebuilding, or continued decline (Figure 37).

The biodiversity plan establishes people and their connection to nature as a foundation to future success and makes the case for protecting biodiversity to maximise additional benefits to society



such as improved health and wellbeing and the cultural practices of Victoria's Traditional Owners and Aboriginal Victorians.

The biodiversity plan acknowledges the game-changing influence of climate change and that management techniques, goals and targets will need to evolve as ecosystems change. The plan highlights that environmental assets such as green infrastructure will also play an increasingly important role in managing the impacts of climate change.

The biodiversity plan represents a deliberate shift away from planning for threatened species one at a time. It emphasises the importance of species' specific circumstances and needs, however it recognises that species are embedded in ecosystems and are collectively subject to threats and management responses. The biodiversity plan is therefore focused on ecosystems and ecological processes that can be managed for the benefit of the greatest number of species, particularly given the impacts of climate change. This means re-balancing efforts and investment to increase the focus on prevention, as well as the critical care of biodiversity.

Figure 37. A representation of the decline in natural capital caused by past actions, with the case for choosing a new trajectory. Source: DELWP, 2017a, p. 29

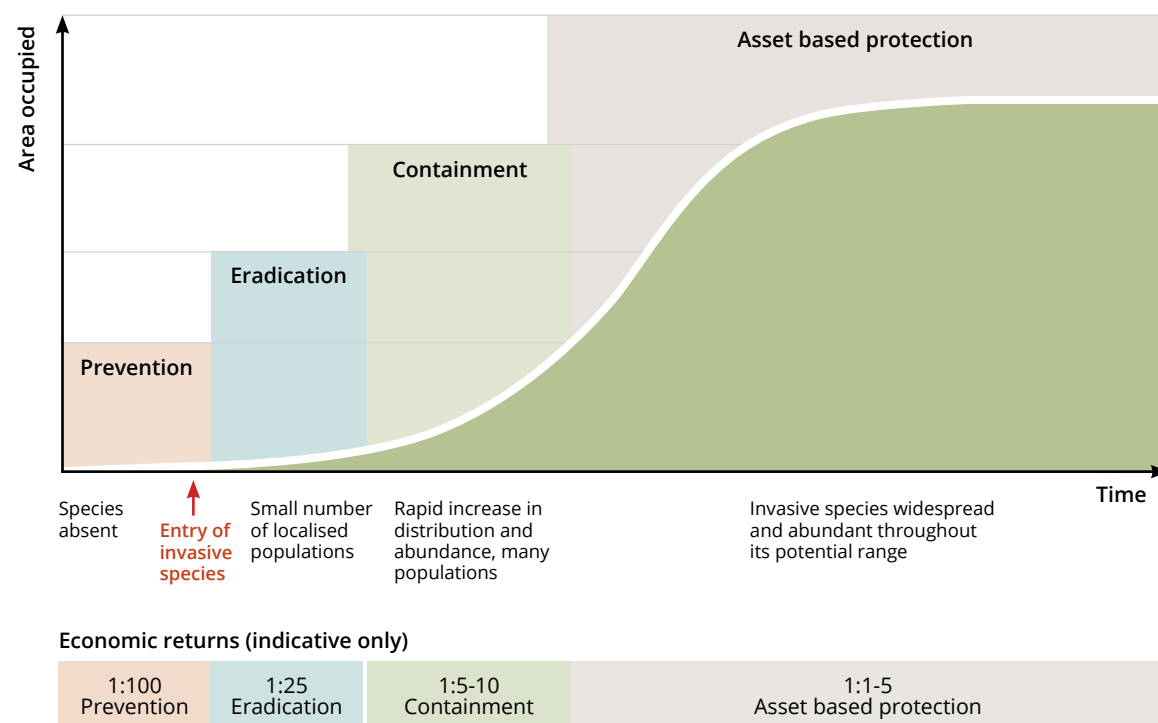


Figure 38. Risk-based framework for acting on invasive plants and animals.

Source: Victorian Government, 2010, p. 14

A key element of the biodiversity plan's implementation will be a new 'biodiversity response planning' process. Stakeholders and partners will be brought together through these area-based, collaborative planning forums to respond to five-year statewide targets through that strategic delivery of on-ground actions.

All actions that are taken towards achieving the plan's targets will be reported in a more consistent and transparent way to ensure that progress and effectiveness can be reviewed. The plan puts a strong emphasis on the collection of targeted data for evidence-based decision making and making data more accessible for stakeholders and the community.

Review of the *Flora and Fauna Guarantee Act 1988* and Native Vegetation Clearing Regulations

In conjunction with the development of *Protecting Victoria's Environment – Biodiversity 2037*, a review of the *Flora and Fauna Guarantee Act 1988* is underway. A Consultation Paper was released for public comment in January 2017. The consultation paper included a range of proposed reforms including establishing measurable objectives and statewide targets (DELWP, 2017e).

Similarly, a review of native vegetation clearing regulations in 2015-16 led to a set of proposed changes to the *Victorian Planning Provisions* and a new incorporated document that describes how to assess and compensate the removal of native vegetation (DELWP, 2016l).

Invasive plants and animals

The Victorian Government's policy framework on invasive plants and animals has not changed since the last *Catchment Condition and Management Report* in 2012, and supports a biosecurity, risk-based approach (Victorian Government, 2010). The framework emphasises prevention or early eradication of invasive species prior to their broader establishment as the most cost-effective actions to take (Figure 38). CMAs also have invasive plant and animal strategies for their regions.

An inquiry into the control of invasive animals on crown land was conducted by the Environment, Natural Resources and Regional Development Committee, and reported in June 2017. One of the key findings was that accurate population numbers do not exist for invasive species in Victoria, and it was recommended that resources be allocated to measure numbers and their impact (ENRRDC, 2017). It was also found that control programs for invasive species do not incorporate sufficient monitoring and evaluation.

The Australian Government also has a *Pest Animal Strategy* and *National Weeds Strategy*, both released in 2007 and currently under revision for the 2017-2027 period.

In March 2017, a variant of the calicivirus called Rabbit Haemorrhagic Disease Virus K5 (RHDV1 K5) was released across Australia to boost biological control agents already released into the environment.

Threatened species listings

Two lists of threatened species are produced: (1) a set of advisory lists for rare or threatened plants, threatened vertebrate fauna, and threatened invertebrate fauna in Victoria, which are maintained by DELWP; and (2) the Threatened List under the *Flora and Fauna Guarantee Act 1988*, where listing of species triggers the preparation of an Action Statement that outlines what is needed to manage threats. It is difficult to track progress in the protection of threatened species, as threatened species lists are not currently suitable measures of condition or trend.

Measuring Changes in Suitable Habitat in the North Central region

Change in Suitable Habitat is the Victorian Government's new key performance indicator through which it will measure progress toward the targets in the new biodiversity plan, *Protecting Victoria's Environment – Biodiversity 2037* (DELWP, 2017a). The overarching statewide target in this plan is a net 100% increase in hectares of 'Suitable Habitat' across all Victorian species.

Change in Suitable Habitat is the increase in the likelihood that a species will persist at a location at a future time (e.g. 50 years) in response to sustained management of relevant threats, expressed as the proportional increase in hectares of Suitable Habitat a species has received under a sustained management regime, compared with no management. Change in Suitable Habitat can be calculated across the range of a species and can be combined across many species allowing comparisons to be made between species, places and actions.

Actions at sites included in the analysis will be based on DELWP standard output data reported by organisations delivering on-ground works.

Reporting on Change in Suitable Habitat

To demonstrate how management actions and their contributions to the Change in Suitable Habitat could be reported, DELWP used a set of 2013-14 activity data from the Campaspe Coliban area. Five different types of actions were reported over a range of sites that could result in Changes in Suitable Habitat (Table 6).

Analysis of the Change in Suitable Habitat that would result from these management actions showed there would be a mean increase in hectares of Suitable Habitat of 72.5% across the 552 species predicted to occur in the project area. For Victorian Rare or Threatened species predicted to occur in the project area (258 species), the mean increase in Suitable Habitat is slightly less (Table 7).

Improving investment outcomes

Analyses of the sites and management actions revealed that changing the management action to a more cost-effective activity at a site could yield a greater Change in Suitable Habitat for the same level of investment. Aligning actions being undertaken with the most cost-effective activities could therefore increase the mean percent change in suitable habitat over the 50-year time horizon and improve progress towards the statewide target.

In the Campaspe Coliban case study, if the same level of investment across the project sites was directed towards the most cost-effective management action for each site, there would be an expected mean increase in hectares of Suitable Habitat of 111% across all species in the project sites, compared to the predicted 72.5% for the existing management actions. In this case study, sites where fox and grazing control were implemented had generally achieved the best outcome. However, changing the management action at sites where weed and rabbit control were conducted to these more cost-effective activities would be necessary to deliver maximum results in predicted Change in Suitable Habitat.

Caveats and Assumptions

The values provided here for each management action assumes that the reported actions would continue for 50 years, and estimated benefits do not occur if an action is not sustained for this time horizon. Therefore, when calculating benefits, actions will be counted in

the first year of works only. The area across which actions were undertaken for each individual species targeted contributes to the Change in Suitable Habitat, even where the location of the action or the action itself overlaps.

The calculated benefit data applies only to the project areas. For instance, it is assumed that, for a project area where fox control is being reported, fox control has been undertaken throughout the entire extent of the area. A reduced rate will be applied to actions that are not the most cost-effective action for an area, or where a lower standard has been applied to the work, or where only a portion of the project area has been treated.

Table 6: Area of each management action implemented through projects in the Campaspe Coliban area.

Action Area	Hectares
Fox Control	1,160
Grazing Control	681
Rabbit Control	3,363
Revegetation	4,971
Weed Control	5,475

Table 7. Mean percentage increase in Suitable Habitat across all species and for Victorian Rare or Threatened species for both the actions undertaken in the activity area and what would be expected to be achieved under the most cost-effective management regime.

Management Regime	Mean % Increase in Suitable Habitat Achieved of species predicted to occur in the project area	
	All Species (552 species)	Victorian Rare or Threatened Species (258 species)
Actions Undertaken	72.5%	65.6%
Most cost-effective actions	111%	88.3%

Coasts

The Victorian Catchment Management Council:

- Is unable to make any sound assessment of the condition of the coasts and marine areas, due to lack of information
- Acknowledges the progress made in reporting on this theme through the *State of the Bays 2016* report issued by the Commissioner for Environmental Sustainability
- Understands that there are increased community awareness and expectations about the condition and management of Victoria's coasts and marine areas
- Acknowledges that there are positive changes occurring in the management of coasts and marine areas which will require relevant information and research, good governance and increased collaboration across agencies and communities
- Recommends that additional resources are provided to coastal and marine aspects of integrated catchment management



About Victoria's coasts

Victoria's has 2,512 km of coastline featuring sandy beaches, rocky shores, mangroves, salt marshes, kelp forests and seagrass meadows (DELWP, 2016b). Victoria's coasts and marine environments are home to more than 12,000 species of plants and animals, of which 80% are found nowhere else (VCC, 2014; VNPA, 2010). Parts of the coast are protected in 13 marine national parks and 11 marine sanctuaries, covering almost 63,000 hectares or 5.3% of Victoria's marine waters (DELWP, 2016m).

Although integrated catchment management incorporates the coastal zone as part of the interface between catchments and the marine environment, it is sometimes unclear which parts of the physical environment are included. Previous studies have defined the coastal zone as "the strip of land within five km of the coast and the marine area to the limit of state waters (three nautical miles from shore)" (URS, 2007; WorleyParsons, 2013).

The monitoring of condition of Victoria's coasts is currently very fragmented, focused mainly on specific issues or in particular



Photo: Tracey Koper

locations, such as marine national parks (Commissioner for Environmental Sustainability, 2013). At the same time, Victorians have a great awareness of the coasts and are active participants in its management and protection (VCC, 2014).

In 2016, the Commissioner for Environmental Sustainability released the *State of the Bays* report, which provided a baseline study of the condition of Port Phillip Bay and Western Port (Commissioner for Environmental Sustainability, 2016). The main finding of *State of the Bays* was a recognition of the need to develop an ecosystem-wide understanding of the bays. To achieve this, it was proposed that a framework for coordinating and prioritising marine science from the public sector be developed.

The Victorian Government is currently creating a new *Marine and Coastal Act* to reform the coast and marine management system. This would replace the current *Coastal Management Act 1995* and simplify the complex set of institutional arrangements currently in place (DELWP, 2016m). The proposed new Act would also include improvements to the current system of monitoring, evaluation and reporting.

Previous *Catchment Condition and Management Reports* have not assessed coastal and marine condition due to a lack of statewide data. Since 'coasts' appeared as a theme in *Our Catchments Our Communities* (DELWP, 2016b), this report attempts to make an assessment. A more comprehensive State of the Coasts report is proposed to appear in the 2018 *State of Environment* report issued by the Commissioner for Environmental Sustainability.

Key influences

Climate change and sea level rise

The effects of climate change on coastal and estuarine include changes to in-stream habitat, degradation of riparian habitat, reduced water quality and the spread of pest plants and animals. Coastal communities such as those near the Gippsland Lakes area are particularly vulnerable. This area is already vulnerable

to flooding, but any substantial changes in sea level (greater than 1 metre) may lead to permanent inundation, requiring communities to relocate (Gippsland Coastal Board, 2008).

Sea level rise has the potential to impact on the natural and built environments of the coastal zone. The Victorian Planning Provisions (Clause 13.01-1, 04/02/2016) allow for a sea level increase of 0.2 metres over current flood levels (1 in 100 years) by 2040, and for 0.8 metres by 2100.

Coastal development

The management and development of coastal land is recognised as a key influence on the condition of the coast (VCC, 2014). These impacts include increased stormwater runoff from increased area of impervious surfaces, erosion, litter, nutrient and sediment pollution, and disturbance of nesting wildlife.

Marine pests

Marine pests include non-native plants and animals that have been introduced into Victoria's marine environment. In many cases their reproduction and spread have negative impacts on ecosystem functioning and the amenity of the environment. Significant marine pests in Victoria's coastal waters include the Northern Pacific Seastar (*Asterias amurensis*), European Fan Worm (*Sabella spallanzanii*), and Japanese Kelp (*Undaria pinnatifida*), all of which are well-established in Port Phillip Bay and other parts of the coast (Parks Victoria, 2017a). Eradication efforts are relatively local and labour-intensive, for example removal of Northern Pacific Seastar by hand in St Kilda harbour.

Nutrient and sediment runoff from catchments

Diffuse pollution from catchments, including sediments and nutrients, are influences on the condition of coastal waters. Nutrient pollution, such as nitrogen and phosphorus, can change the equilibrium of nutrient cycles in coastal waters, and potentially cause algal blooms. Sediment pollution can reduce light penetration to submerged plants.

Condition

Mangrove and saltmarsh retention

Mangroves and saltmarsh are defined in a range of ways, commonly referred to as a type of wetland with vegetated communities that exist in the intertidal zone (Victorian Mangrove and Saltmarsh study, 2011). Mangroves and saltmarsh are located close to areas of human settlement, and are therefore subject to disturbance (Sinclair and Boon, 2012).

A study published by Sinclair and Boon (2012) provides a summary of mangrove and other coastal marsh retention across most of the Victorian coast (Figure 39). While the assessment shows that

20 of the 30 stretches of coast assessed retain >80% of mangroves and coastal marsh (under Gippsland Lakes scenario 1), other areas have declined significantly. The authors of the study recognised the future threat of sea level rise, which will necessitate an upslope retreat of marshes that will be impossible in many instances without conversion of private to public land.

Management

Victorian Coastal Strategy 2014

The *Victorian Coastal Strategy* presents a vision and framework for managing the coast (VCC, 2014). It identifies five key coastal

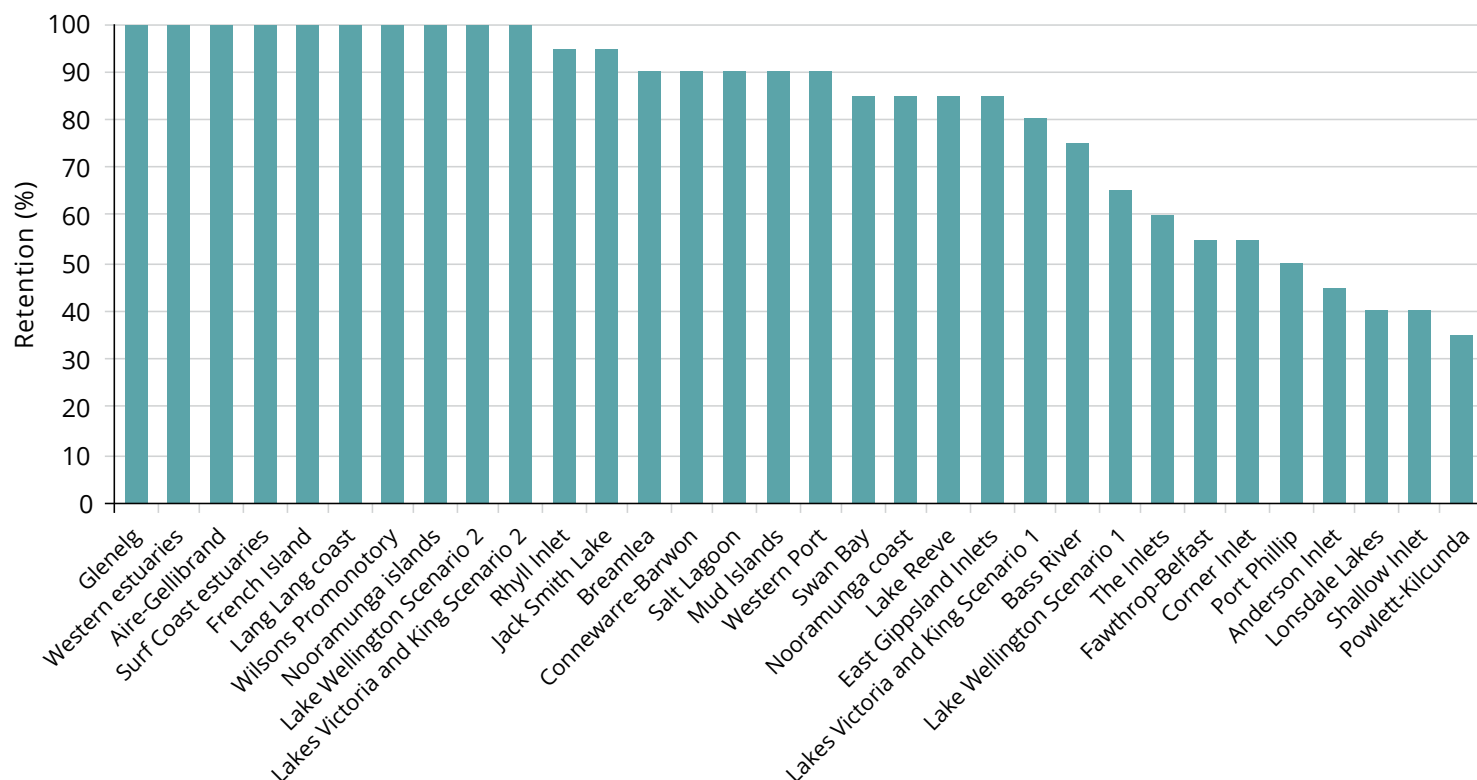


Figure 39. Percentage retention (compared to modelled pre-1750) of mangroves and other coastal marsh at selected sites on the Victorian coast.

Source: Sinclair and Boon, 2012

issues that need careful attention, including population growth, a changing climate, coastal land and infrastructure, valuing the natural environment, and marine planning.

The strategy also highlights issues with monitoring, evaluation and reporting, recommending action to establish an index of coastal condition (VCC, 2014, p. 85). It suggests adopting an environmental accounting approach to reporting on the condition and value of coastal and marine assets, to track changes over time.

Proposed Marine and Coastal Act

A new *Marine and Coastal Act* is being developed, and a consultation paper released in 2016 outlines some of the proposed reforms

(DELWP, 2016m). A series of legislative and non-legislative changes to Victoria's coastal and marine management system are proposed that will help Victorians manage coastal and marine areas now and into the future.

Consultation with a range of stakeholders and coastal communities will help identify challenges, including impacts from climate change, population growth, and ageing coastal infrastructure, and ways to address them. It is proposed that CMAs will play a greater role in coastal zone management than they currently do, including a stronger emphasis on coastal and marine issues in Regional Catchment Strategies (DELWP, 2016m, pp. 43–44).

The Victorian Government is currently preparing a Bill, which is expected to be introduced to Parliament in late 2017. In addition, a transition plan is being prepared that will outline the government's policy reform program.

Port Phillip Bay Environmental Management Plan

A new *Port Phillip Bay Environmental Management Plan* was released in 2017, and outlines three main goals for the bay: (1) Stewardship of the Bay is fostered across community, industry and government; (2) Water quality is improved to ensure environmental health and community enjoyment of the Bay; and (3) The Bay's habitats and marine life are thriving (DELWP, 2017f). The plan also includes several actions focused on monitoring aspects of the bay's condition, including indicator species, key habitats, and marine pests.

Coastal Committees of Management

Community-based Committees of Management of crown land reserves are appointed under the *Crown Land (Reserves) Act 1978* and conduct works and improvements to protect Victoria's coast. These are volunteer Committees and community volunteers give thousands of hours of their valuable time each year to managing coastal land (VCC, 2014).



Photo: EGCMA

Gippsland Lakes: from the 1850s on

The Gippsland Lakes are a system of coastal lagoons separated from the Tasman Sea by the coastal dunes of the Ninety Mile Beach. There are five rivers that terminate at the lakes – the Latrobe, Avon, Nicholson, Tambo and Mitchell rivers. The area was first settled in the late 1850s as a holiday spot for local pastoralists. An artificial entrance was first created in the 1870s, west of the natural entrance. Before the permanent opening of the entrance in 1889, the Lakes were a series of coastal lagoons with minimal marine influences, almost entirely populated by freshwater species. When the entrance was opened permanently, the level of the Lakes dropped and marine species began to invade, resulting in the present ecosystems. The Gippsland Lakes were listed as a Wetland of International Importance in 1982, and the Ninety Mile Beach Marine National Park was proclaimed in November 2002.

Commercial and recreational fishing in Gippsland Lakes

The thriving East Gippsland fishing industry is the largest employer of this sector in regional Victoria, with Lakes Entrance the home of one of Australia's largest fishing ports with catches supplied to markets in Melbourne and Sydney.

Figure 40 shows the annual catch for all commercial fishers in the Gippsland Lakes since 1978-79. The average take from 1980 to 2000 was about 820 tonnes per year. However, since 2000-01 licence holders have taken an average of about 249 tonnes of fish

per year (a 70% reduction), with a landed value of about \$1.1 million (DEDJTR, 2016b).

The Gippsland Lakes is a highly valued destination for recreational fishers. It is estimated that on an annual basis, the recreational catch may be equal to or exceed that of the commercial sector for some species.

Gippsland Lakes Monitoring and Management

In 1986 the Environment Protection Authority began regularly monitoring water quality at five sites within the Gippsland Lakes. In 2013, EPA Victoria published a long-term water quality report based on all data collected as part of this fixed sites monitoring program. It found that the Gippsland Lakes continue to be under enormous pressure from catchment inputs, with nutrients levels and sediments continuing to threaten the ecological health of the system. Water quality was primarily driven by the proximity to river inputs and to the entrance, and the water depth (EPA Victoria, 2013).

In 1998, the Gippsland Coastal Board engaged the CSIRO to conduct an environmental audit of the Gippsland Lakes. Long term changes in ecological character in the Gippsland Lakes were primarily attributed to changed water and salinity regimes associated with the permanent artificial entrance to the Lakes from the sea, and reduced water quality and quantity associated with changed land and water use in the catchment. This study found that the system was

approaching a level of severe environmental damage that may be difficult to reverse.

The Gippsland Coastal Board, in partnership with key stakeholders, then commissioned the 2001 Gippsland Lakes Environmental Study. This study found that nutrients entering the catchment were the most important factor contributing to toxic blue-green algal blooms and recommended that continued integrated catchment management and nutrient reduction activities across public and private land would improve the health of the Lakes and prioritised nutrient reduction as a more effective way to improve water quality than increasing freshwater flows through the system.

In response, the State Government appointed the high-level Gippsland Lakes Taskforce in 2001. The Taskforce developed an overarching plan to provide a high-level and integrated approach to the management of the Gippsland Lakes and their catchments, which aimed to reduce nutrient pollution of the Gippsland Lakes by 40% by 2022. Between 2000 and 2009, the State Government allocated \$21.7 million to implementation projects that worked towards this goal (Gippsland Coastal Board, 2016). An INFFER analysis conducted in partnership with the Gippsland Lakes Taskforce in 2010 found that the costs of achieving the targets in the 2002 Gippsland Lakes Future Action Plan were likely to be much larger than available budgets (Roberts et al., 2010). While it would be feasible to achieve 40% phosphorus reduction,

it would incur very large costs of \$993.7 million over 20 years and a low benefit to cost ratio (0.02). Lower phosphorus reduction goals of 20% and 10% were shown to be less expensive and more cost-effective, using current incentives such as irrigation modernisation, enforcement of dairy effluent management farm planning and streambank stabilisation. These results provided the basis to develop a stronger business case for greater public investment, including the need for long term funding if more than incremental gains were to be made (Roberts et al., 2010).

In 2010, a Traditional Owners Land Management Agreement was secured by the Gunaikurnai. It covers 10 parks and reserves in Gippsland, including the Gippsland Lakes Coastal Park. The Gunaikurnai Traditional Owner Land Management Board is currently developing a Joint Management Plan in consultation with Parks Victoria and DELWP (Parks Victoria, 2017b).

In 2011 the Gippsland Lakes Task Force produced a report card that used six key indicators, including Water Quality, Algal Blooms, Wetlands, Birds, Seagrass and Fish. This used the same methods as the Gippsland Integrated Natural Resources Forum report card, but with a detailed focus on the natural assets in the Gippsland Lakes system. In that report card, the overall condition of the Lakes was rated as 'Moderate'. The condition of Wetlands and Water Quality was the highest rating, being in good condition. Birds, Algal Blooms and

Seagrass were rated as moderate, and fish were rated as poor (Gippsland Lakes Task Force, 2011).

In January 2016, the Minister for Environment, Climate Change and Water Lisa Neville announced the Gippsland Lakes Coordinating Committee, co-chaired by the Chairs

of the West and East Gippsland CMAs, to reinvigorate and focus on improving the health of the Lakes through on ground management activities and community engagement. The many previous studies provide a sound basis for the Committee's work.

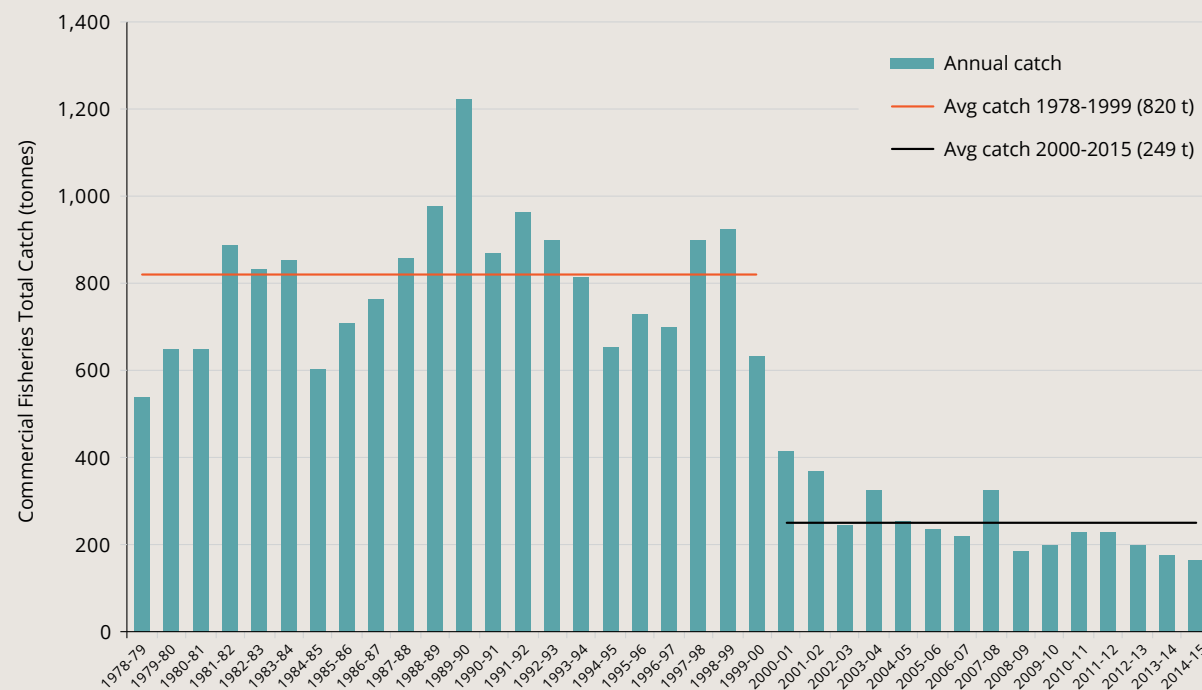


Figure 40. Commercial fisheries total catch in the Gippsland Lakes. Source: DEDJTR, 2016b

Communities

The Victorian Catchment Management Council:

- Recognises the substantial value of local and regional organisations in contributing to protecting and improving natural assets and other integrated catchment management outcomes
- Perceives a lack of information about communities' concerns regarding catchment condition and management, what services they expect and what they are prepared to do or give towards optimising these services
- Understands the importance of including citizen science in monitoring and reporting efforts in integrated catchment management
- Identifies that better measures of community involvement in catchment management are needed, that reflect changes in attitude, knowledge, skills, co-investments, and participation



Background

Communities matter

Victoria's communities play a vital role in integrated catchment management. Local communities are well placed to understand local catchment conditions and respond to local catchment issues. Community members expend much time and effort in catchment management activities, often through unpaid voluntary work.

In purely financial terms, it is estimated that Victorian communities co-contributed approximately \$116 million in 2015-16 to catchment management in CMAs (Victorian Catchment Management Authorities, 2017, p. 8), though this estimate was based on a simple multiplier and needs to be treated with caution. This is potentially equivalent to both national and state government investment, as well as investment from other sources. This figure does not take into account the intangible benefits to the community of participation in catchment management. These include contributions to physical and mental wellbeing, social capital, and engaged and resilient communities.

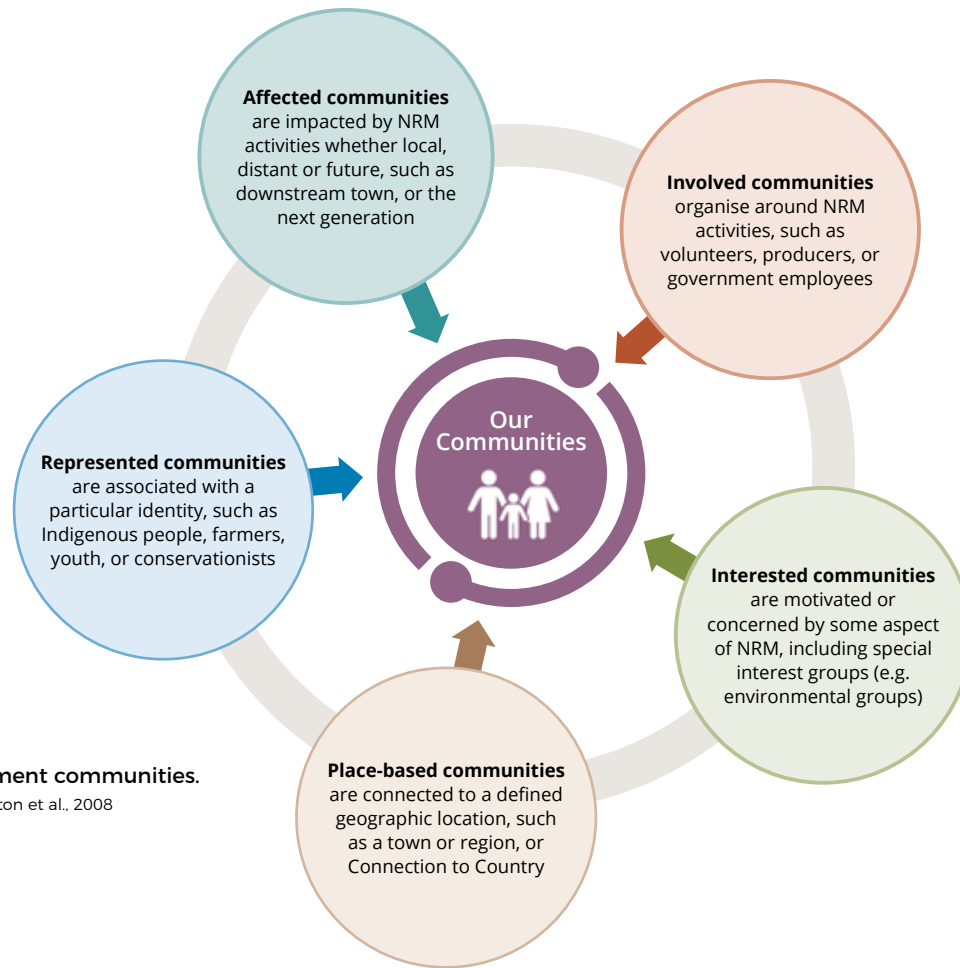


Figure 41. Our catchment communities.

Source: derived from Harrington et al., 2008

What do we mean by 'community'?

Figure 41 shows the different relationship that communities can have within the sphere of catchment management. Naturally, there are a diverse range of community members within each of these community types. For example, a community member could simultaneously have Indigenous heritage, sit on a government advisory group, be a volunteer with a local conservation group and own a farm.

Measuring community involvement

'Community' is one of the key themes for indicators of catchment condition identified by *Our Catchments Our Communities* (DELWP, 2016b, p. 47), focusing on measures of community participation. The next sections examine three aspects of community that influence catchment condition and management in Victoria:

- (1) 'Community participation' reports on some of the ways that Victoria's communities are leading innovation in integrated catchment management in Victoria.
- (2) 'Community perception' discusses our communities' perceptions of catchment condition and management.
- (3) 'Traditional Owners' recognises and highlights examples of joint and co-operative management of Victoria's lands and waters by Aboriginal communities.

Community participation

Communities throughout Victorian are involved in various catchment management activities, such as habitat conservation, citizen science, and capacity-building and advocacy.

Habitat conservation

Communities engage in habitat conservation work on private and public land across Victoria. While a substantial amount of conservation work is conducted individually on private land, several organisations support collective conservation efforts (e.g. Victorian National Parks Association, Conservation Volunteers Australia, Creeklink, and Trust for Nature).

Probably the best-known community conservation initiative in Victoria is Landcare, which operates across scales from local Landcare groups, to regional Landcare Networks, to national bodies including the National Landcare Network and Landcare Australia (see the story on Landcare in this section).

30 years of Landcare

Landcare started Winjallock near St Arnaud in 1986 and was initially established to tackle land degradation. Landcare is about community driven local action and is supported but not driven by government. Its impacts go beyond dealing with local issues, with community members working together achieving broader environmental and social benefits.

There are now about 600 Landcare groups and networks, with around 60,000 members across Victoria (Figure 42). The groups cover about half of Victoria's total area, working on private land in the main (68% of all private land) but also on public land in some areas (22% of all public land).

There is no 'typical' Landcare group: they vary in size, the area they cover, their focus, the level and type of activities they undertake and their public profile. Many help protect and restore waterways, habitat, coasts and degraded farmland, at a local to landscape scale. Others improve the productivity of farmland or assist in emergency responses to flood, fire or drought, or work in areas of public urban land.

The *Victorian Landcare and Catchment Management* magazine highlights the broad range of Landcare activities that members undertake in Victoria. A recent edition included information on crowd funding, a day in the life of a Riverkeeper, Landcare connections with Traditional Owners, and on blogging for nature.

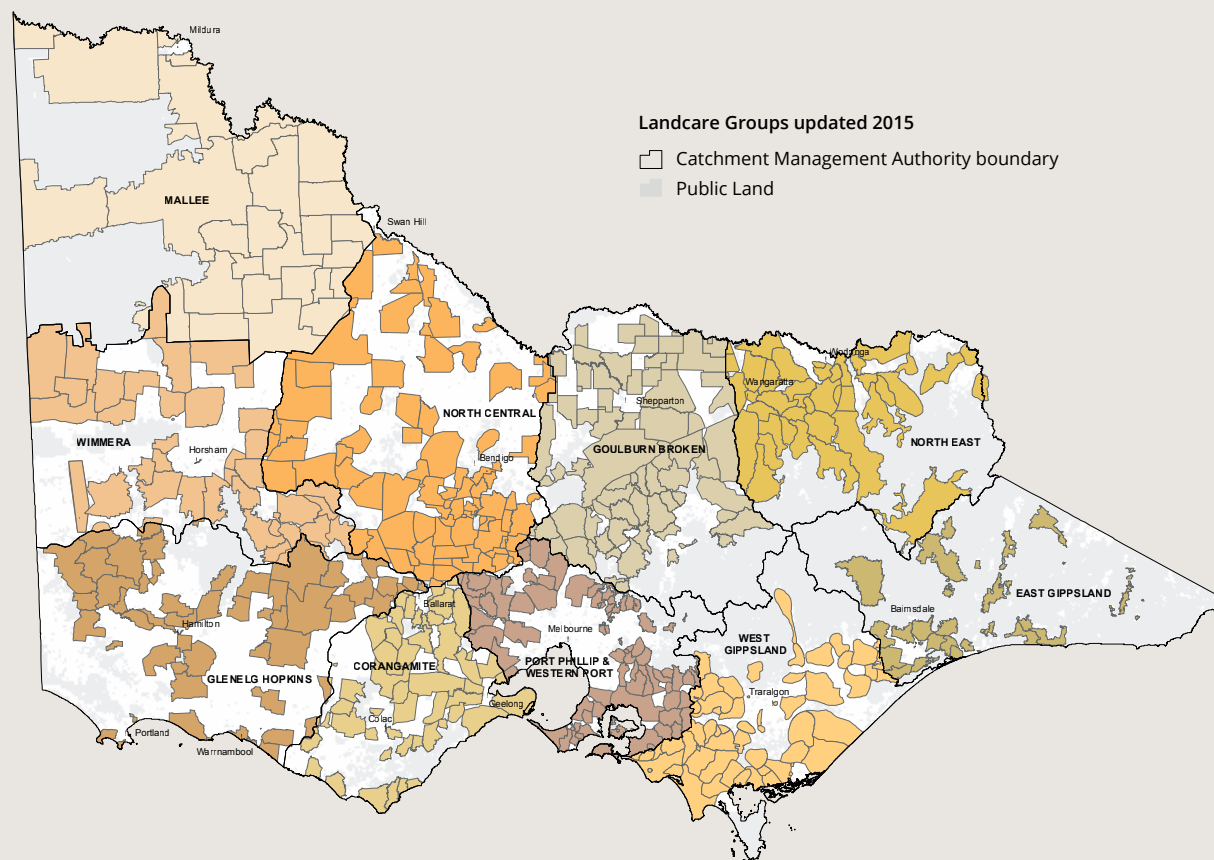


Figure 42. Distribution and coverage of Landcare groups across Victoria, 2015. Source: DELWP

Animals and secret cameras encourage land-holders to care for nature at Christmas Hills



Photo: Neil Meyers

Establishing connections between landholders and the rich local flora and fauna has been a core objective for the Christmas Hills Landcare Group (CHLG). Large areas of remnant woodlands and forests occur on private land in the area, with several rare and threatened species using this vegetation as habitat. The group has undertaken some innovative ways to engage with landholders.

Animals as an attraction

The CHLG arranged for the Wild Action Zoo to bring a selection of native animals to the local primary school spring fair in 2012. The animals were a hit: the school hall was packed with more than 140 people, many of them school-aged children. The crowd was thrilled with the parade of kangaroos, koalas, wombats, kookaburras, Masked Owls, Lace Monitors and blue-tongue lizards. In 2014 the group engaged Blacksnake Productions to bring a selection of snakes and lizards, with as many local species as possible, to an end-of-year event for members. The animal presenter advised on what landholders can do to care for reptile habitat on their properties. There were 30+ people in attendance with a good selection of young people, who said they had come because of the snakes. Then in 2015, Full Flight Conservation Centre provided a flight display of birds of prey. The annual general meeting was held between a presentation by an expert guest speaker on birds of prey and the bird display, and more than 60 people stayed for the meeting and even more watched the birds of prey show.

Cameras reveal the hard to see

Since 2011, the CHLG has made motion-sensing infrared cameras available to landholders, first as still images and later taking short

videos of local fauna. Landholders from more than 40 different properties have participated, and the majority continue to be involved. So far, the Brush-tailed Phascogale, a small carnivorous marsupial that occurs in Christmas Hills, but is nocturnal, has now been captured on motion-sensing cameras on 26 different properties. When landholders were offered nest boxes specifically suited to phascogales to be installed on their property the response was strong, with 80+ nest boxes being installed on 25 different properties in Christmas Hills. The Slender-tailed Dunnart was first detected by one of the cameras in 2014 and has been reliably captured at four different properties since. Artificial habitat for dunnarts and ground-mounted nest boxes have since been installed on 22 different properties to retain and grow this small local population.

Late in 2015, CHLG member and regular camera user, Phil Styles, caught a fleeting glimpse of a small animal in his garden. Photographs taken on his mobile phone were inconclusive but there was some hope that the animal was the tiny and rarely seen Eastern Pygmy Possum. A camera was set up in the banksia shrubs in Phil Styles' garden: and it was confirmed that his original sighting was indeed an Eastern Pygmy Possum! The owners of 21 properties at Christmas Hills plan to set up and monitor nest boxes designed to suit Eastern Pygmy Possums on their property.

The Christmas Hills Landcare Group has found that providing landholders with the ability to discover what lives on their properties has been a very effective way of connecting people to nature, inspiring landholders to take actions to care for habitat on their properties.

Philanthropic trusts fund some community-based conservation projects across Victoria, such as the Helen Macpherson Smith Trust, Norman Wettenhall Foundation (Wettenhall Environmental Trust), Eucalypt Australia, Purves Environmental Fund, Ian Potter Foundation, and the Myer Foundation. There are also groups that purchase land, or create covenants with private landholders, such as Trust for Nature and Bush Heritage Australia.

For those living in urban areas, 'friends of' groups, project-based volunteer opportunities, and programs such as Zoos Victoria's 'Act for Wildlife' mean that urban communities can also contribute to conservation outcomes.

There are a range of factors that influence community participation in conservation activities. Many rural areas are experiencing an overall decline in population and an increasingly ageing demographic (see Chapter 2). There is a challenge to draw younger people out of Melbourne and regional centres to participate in rural conservation activities, including catchment management, although Intrepid Landcare has recently launched in West Gippsland.

Citizen science

Victoria's communities are active contributors to the collection of environmental monitoring data, and participants in research projects. 'Citizen science' is a valuable community co-investment towards monitoring and research, and can vastly increase the number of observations that can be recorded.

There are numerous examples of citizen science programs in Victoria. Some programs, such as Earthcare St Kilda's little penguin monitoring, have been operating for over 30 years. Other significant citizen science programs strongly linked to integrated catchment management include Waterwatch and EstuaryWatch, highlighted in *Water for Victoria* as achieving environmental, social and economic outcomes in locally-prioritised areas (DELWP, 2016a; EstuaryWatch and Waterwatch Victoria, 2017). Communities also contribute their observations of the natural environment to statewide spatial

Connecting Country woodland bird monitoring program

Connecting Country is a community-based conservation program located in central Victoria's Mount Alexander region. It is guided by a 10-year strategic plan that incorporates a strong monitoring and evaluation framework.

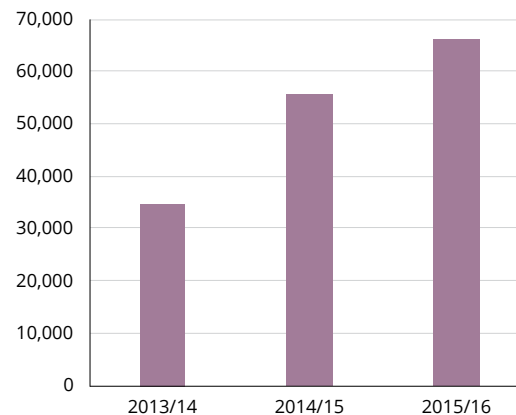
Part of this framework is a long-term monitoring program for woodland birds, developed by Connecting Country in collaboration with expert ecologists. Approximately 50 sites are regularly surveyed across the region using a standard method, comparing 'reference' sites with relatively intact vegetation, to 'restoration' sites, and 'modified' sites. Connecting Country became an affiliate of BirdLife Australia in 2014, and has contributed nearly 13,000 bird records to the Birddata database.

[<https://connectingcountry.org.au>](https://connectingcountry.org.au)

databases such as the *Victorian Biodiversity Atlas*, and national databases such as the *Atlas of Living Australia*.

BirdLife Australia's *Birddata* web portal and mobile app is a central repository for bird survey data, and includes data from the *Atlas of Australian Birds* and other monitoring projects. Melbourne Water's *Frog Census* is a community program for monitoring frog populations, which uses an app to record frog calls for expert identification. There are numerous opportunities for communities to get involved in citizen science, including the Victorian National Parks Association's *NatureWatch* and *ReefWatch* monitoring programs, the Earthwatch Institute's *ClimateWatch* program, the Mammal Survey Group Victoria, the Environment Protection Authority's *Citizen Science Program* and more.

Figure 43. Number of participants at CMA engagement events. Source: Victorian Catchment Management Authorities, 2017, p. 19



Capacity-building and advocacy

Victoria's communities work together to provide a voice for our natural environments, and to develop their own place-based visions of the landscapes in which they live. Community learning and capacity-building activities can enhance collaboration and community-government interactions.

There has been growth in the number of participants at CMA engagement events such as field days, presentations, training and workshops (Figure 43). These events are designed to raise or improve skills or increase collaboration between communities and organisations (Victorian Catchment Management Authorities, 2017, p. 19). As shown, the number of participants at regional engagement events has increased since 2013-14. It should be noted that the 2013-14 data capture only State funded outputs, whilst the 2014-15 and 2015-16 data includes outputs from State and Commonwealth funding sources.

In addition to CMA events, organisations such as the Environmental Farmers Network and Farmers Climate Action provide a collective voice for members to influence government policy on environment. Similarly, the Natural Resources

Gardens for Wildlife

Gardens for Wildlife is a program developed in partnership between the Knox Environment Society (KES) and Knox City Council to encourage residents and local businesses to foster wildlife in their gardens. The program began in 2006 and has over 700 households registered as members.

The program involves an initial garden assessment and provides a report with plant suggestions, as well as vouchers for free plants from the KES local native plant nursery. The main goal is to attract local native wildlife to gardens by planting preferably indigenous vegetation, removing weeds, and creating vegetative structure suitable for birds, insects and other wildlife.

The Gardens for Wildlife program has built the capacity of residents to connect with other members of their communities, recognise local biodiversity, and has enhanced residents' relationship with council (Mumaw and Bekessy, 2017). Other urban local government municipalities are now looking to adopt similar programs in their own municipalities.

<http://www.knox.vic.gov.au/g4w>

Conservation League of Victoria and Victorian Landcare Inc work to build the capacity of communities to engage in on-ground action, and through their joint project *Community Learning for Environmental Action* focus on the social aspects of conservation, including organising community action, collaborating with partners, and influencing decision makers. In the urban space, Clearwater is a capacity-building program, funded by Melbourne Water and DELWP, focused on supporting Integrated Water Management in urban environments.

Community perceptions of catchment condition and management

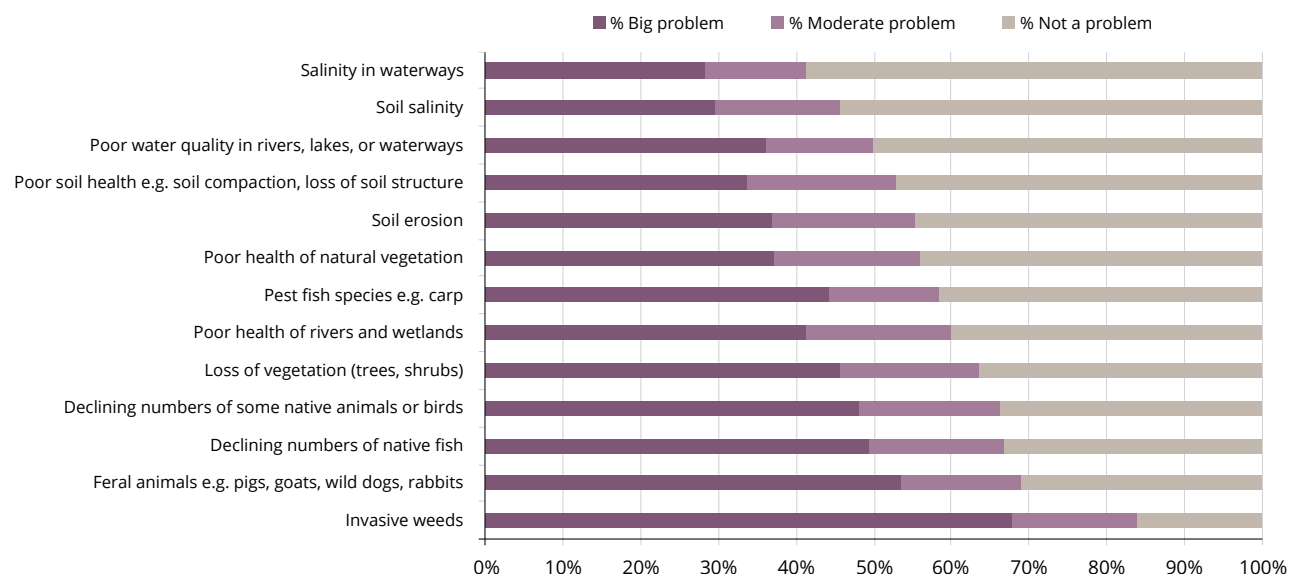
This section highlights community perceptions of catchment condition and management in Victoria. Social surveys offer one avenue for organisations involved in integrated catchment management to ask what communities think and what they want to see achieved through government investment into the environment. The tools used to assess community views are often imprecise and can suffer from low response rates. The importance of careful survey design and involvement of expert social scientists cannot be underestimated.

Community perceptions of environmental problems

The *Regional Wellbeing Survey 2015* (Schirmer et al., 2016) is an annual survey of residents living in Australia's rural and regional areas. The survey reports on community perceptions of environmental health across each of the CMA regions in Victoria. Respondents were asked to rate 13 environmental issues as 'a big problem', 'a moderate problem' or 'not a problem'. While there are some regional differences (see regional report cards in Chapter 4), findings are mostly consistent across the 10 regions, with the main problem perceived as being pest plants (Figure 44).

It is important to note that these are perceptions of environmental health, and not a direct measure or indicator of environmental condition. Community attitudes to environmental health can also change with changing circumstances such as drought and floods. Only 5,411 Victorians responded to the 2015 survey, corresponding to approximately 0.1% of Victorians and 0.4% of rural and regional Victorians.

In a survey of residents and landholders near Gunbower Island in Victoria's north, the North Central CMA set out to determine the social acceptability of projects including environmental watering (Mendham and Curtis, 2015). The study reported that residents were concerned about the possible negative impacts



of environmental watering, such as causing blackwater pollution events. More thought that environmental watering on Gunbower Island was unacceptable (36%) than thought it was acceptable (24%), although 40% of respondents were unsure.

Community attitudes to Victoria's coasts have been examined in conducted in 1996, 2000, 2007, and 2012. A majority of respondents to the 2012 survey agreed that the coast was well managed (67%). This percentage was lower than the 2007 survey (74%) but similar to the 2000 survey (67%) (Ipsos-Eureka, 2012). However, those surveyed were generally unsure about what was involved in coastal and marine management, and who is responsible for managing these environments. Top concerns about issues affecting the marine environment included overfishing / illegal fishing (29%), pollution (21%), over development (14%), pollution from stormwater (12%) and climate change (11%).

Figure 44. Perceived environmental health measures 2015 for Victoria.

Source: Schirmer et al., 2016

Traditional Owners

This section focuses on agreements for recognition, settlement and joint management with Traditional Owner groups, as well as a story of Indigenous and environmental partnership in improving catchment condition and management.

Victoria has 10 Registered Aboriginal Parties, which are organisations that hold decision-making responsibilities for protecting Aboriginal cultural heritage in a specified geographical area. Traditional Owners groups cover most of Victoria's land area (Figure 45).

Role of Indigenous communities in catchment management

Aboriginal communities contribute to catchment management through the development of Country Plans by Traditional Owner Corporations, input into planning, programs and projects, sharing of traditional knowledge, and identification and protection of cultural values (DELWP, 2016b).

Traditional Owners rights over Crown land and waterways are recognised in settlement agreements and governance arrangements (DELWP, 2016b). A brief history is outlined here.

The first native title claim in Victoria was made in 1994 by the Yorta Yorta people. Although the claim was contested through the Federal Court and High Court and resulted in a negative determination in 2002, two years later the Victorian Government entered into a co-operative management agreement with Yorta Yorta over certain public lands that formed part of their native title claim area.

Native title was determined to exist for the first time in Victoria for the people of the Wotjobaluk, Jaadwa, Jadawadjali, Wergaia and Jupagulk peoples of the Wimmera in December 2005; and the Gunditjmara people in the south west of Victoria were found to hold native title in March 2007. The Victorian Government consented to both of these Federal Court determinations.

The first agreements under the *Traditional Owner Settlement Act 2010* (Vic) were reached with the Gunaikurnai people of Gippsland in 2010 and the following year Federal Court found that the Gunditjmara and Eastern Maar peoples hold native title over some areas of Crown land in the south west of Victoria. More recently, in 2013, the State and the Dja Dja Wurrung people entered into a Recognition and Settlement Agreement under the *Traditional Owner Settlement Act*. Under that agreement, the Dhelkunya Dja Land Management Board was established in 2014 to jointly manage, with Parks Victoria, six parks and reserves across north-central Victoria granted as Aboriginal title (DELWP, 2015c). Settlement agreements now cover over 40 parks and reserves across the state. Traditional Owner Land Management Boards also set the strategic direction and develop joint management plans for 'appointed' Crown land, parks and reserves in a Traditional Owner group's recognised Country (DELWP, 2016b).

Greater recognition and involvement in catchment management

Aboriginal people have deep connections to Country, including land and waterways and their resources, and hold strong aspirations for greater involvement in their management. As Dja Dja Wurrung Clans Aboriginal Corporation (2014, p. 20) notes, "Traditional Aboriginal culture revolved around relationships to the land and water – relationships that hold deep physical, social, environmental, spiritual and cultural significance. Today, the land and its waterways remain central to our cultural identity and aspirations for community and economic development".

Traditional Owners often have cultural obligations to manage traditional lands and waters (DELWP, 2016b). The importance of Aboriginal involvement in catchment management has been recognised for some time (e.g. see VCMC, 2012). Increasingly, Aboriginal knowledge, experience and practices are being incorporated more formally into catchment management through a series of statewide policy and program initiatives. That said, engaging with Traditional Owners to develop strategies for participation in natural resource management is still a relatively new area.

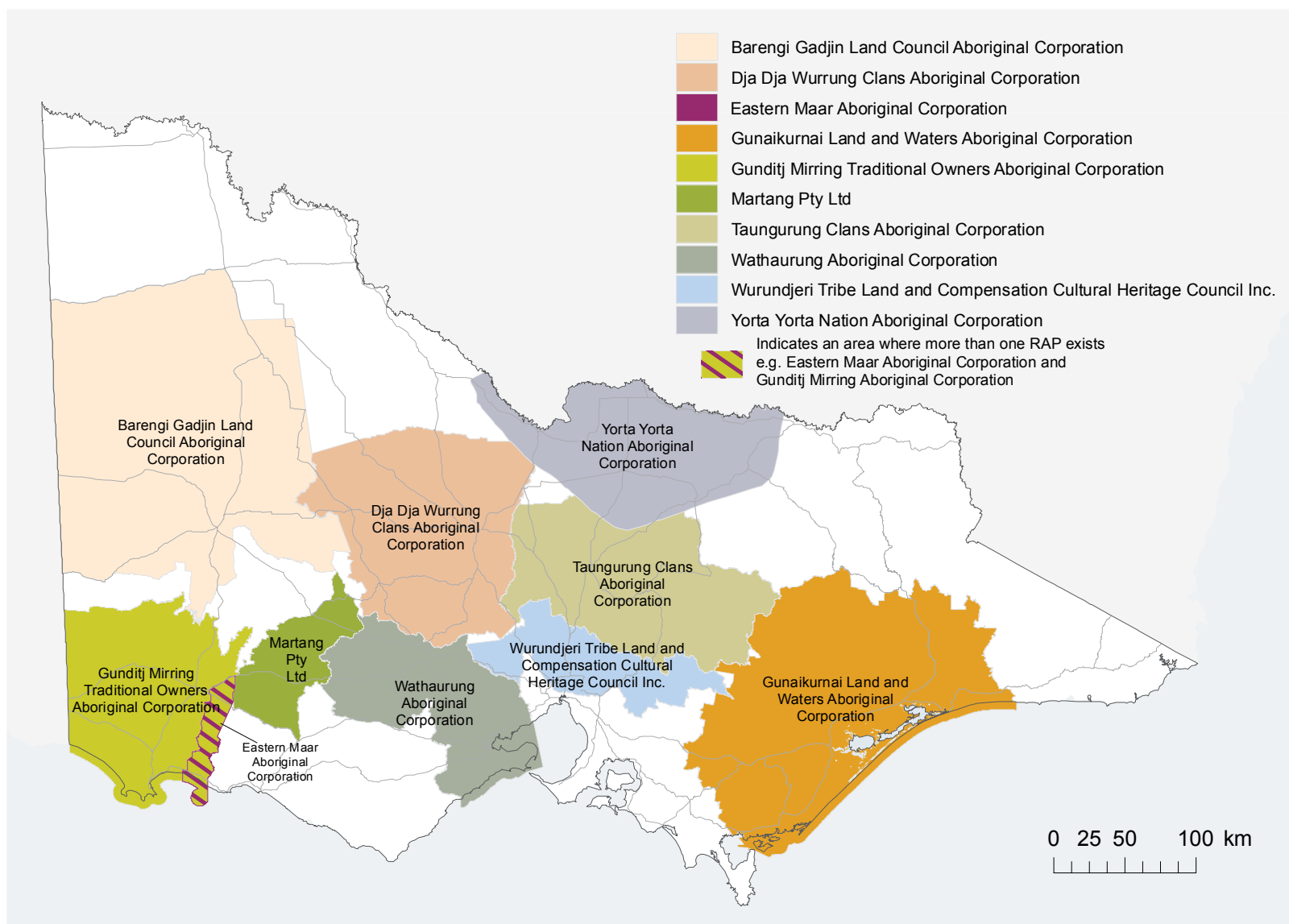


Figure 45. Registered Aboriginal Corporations in Victoria.

Source: VEAC, 2016, p. 86

DELWP has recently adopted an *Aboriginal Inclusion Plan* in 2015 that acknowledges Traditional Owners as custodians of the land, and aspires to embed traditional cultural practices into policy (DELWP, 2015c). With respect to catchment management, the framework aims to improve Aboriginal participation in management for cultural and economic purposes, and to integrate Aboriginal traditional ecological knowledge with contemporary western ecological knowledge to deliver better environmental management outcomes.

The state government's *Water for Victoria* strategy sets out a co-designed Aboriginal Water Program that will invest in local projects to identify local Aboriginal water values, uses and objectives (DELWP, 2016a). The water sector will partner with Traditional Owners to include Aboriginal values and knowledge in water resource planning, and support Aboriginal access to water for economic development.

At a regional level, CMAs are working closely with Traditional Owners to increase participation in decision making around land and water resources. For example, the North Central CMA, in conjunction with the Murray Darling Basin Authority and Barapa Barapa people, recently undertook the Barapa Barapa Water for Country project. The project allowed Traditional Owner groups to become active participants in the design and monitoring of an environmental watering regime. Traditional Owner groups were able to spend time with CMA staff to communicate their perspectives and values, which were then embedded in the watering plans (Victorian Catchment Management Authorities, 2017). Wimmera CMA, in partnership with Barengi Gadjin Land Council (BGLC), provides training, traineeship and employment opportunities training, and cultural awareness activities to increase Indigenous participation and engagement in land and water resource management in the region.

Indigenous and environment partnership

The Gunaikurnai Land and Water Aboriginal Corporation (GLaWAC) and the West Gippsland CMA signed their first Memorandum of Understanding in 2013, formalising a long partnership between the organisations. WGCMA CEO, Martin Fuller, said they came together at the Knob Reserve at Stratford to sign the understanding, the culmination of 10 years work between the organisations. "The MoU is an undertaking to work together on projects in the Gunaikurnai native title area in the areas of Aboriginal Cultural Heritage and natural resource management," said Mr Fuller. "When the initial MoU was signed we agreed to celebrate the agreement every two years to confirm this understanding and commitment."

Since the initial signing in 2013, the GLaWAC and West Gippsland CMA relationship has gone from strength to strength. "We're working together well in NRM but also by getting our staff, Board and volunteer advisory groups to go through cultural heritage training with GLaWAC, giving them a better understanding and appreciation of Gunaikurnai culture and history," continued Mr Fuller.

Source: VCMC (2017)



4

Our Catchments

The Victorian Catchment Management Council:

- Appreciates the collaboration by all CMAs and Melbourne Water in the development of the innovative approach in this report, in convening regional round tables, by the provision of information and case-studies, and in their contribution to analyses and evaluation
- Can use regional information to draw a picture of what is happening at the regional level regarding selected aspects of catchment condition and management. These are presented in the statewide map in the first Chapter of this report
- Acknowledges the significant importance of Victoria's regional delivery model in managing this state's land, water and biodiversity assets, with CMAs collaborating with many partners in planning, implementation, monitoring and reporting, and community engagement
- Concludes that there continues to be a lack of reportable information on condition, trends and outcomes in a comparable form across the CMAs, despite significant efforts regarding management actions, outputs and some simple catchment indicators
- Considers that opportunities should be explored for looking beyond government funding for catchment management, including partnerships with non-government and philanthropic organisations, industry and educational institutions

For the first time, the *Catchment Condition and Management Report* includes a specific chapter on Victoria's catchment management regions, called 'Our Catchments'. Produced in collaboration with the CMAs, Melbourne Water, and a range of regional partners, this chapter aims to tell a story of condition and management at the regional scale, including:

- A summary of the actions and achievements of Victoria's CMAs for the last few years
- An analysis of expenditure by CMAs
- An outline of the *Aboriginal Participation Guideline for Victorian Catchment Management Authorities*
- A summary of the CMA catchment condition reporting trial

VCMC's approach to regional reporting is detailed, including information on the indicators used. A report card and stories of innovation in catchment management, for each region, illustrate some of the challenges and opportunities in integrated catchment management across Victoria.

What is happening at the regional scale?

Actions and achievements

Starting in 2013-14, Victoria's CMAs have collectively reported their management activities in an annual *Actions and Achievements* report (Victorian Catchment Management Authorities, 2014, 2015, 2017). The reports collate information presented as 'standard outputs', which are a common set of management activities used to consistently measure and report what CMAs are delivering, as described in the monitoring, evaluation and reporting framework for land, water and biodiversity in Victoria (DSE, 2012).

Actions and Achievements has three focus areas for catchment management priorities. These include the need to engage Victoria's communities in natural resource management, with data such as the growth in number of participants at CMA engagement events one output that can be easily used to monitor participation (see Figure 43).

The second focus area is to protect and improve the condition of Victoria's land, waterways and biodiversity. Major activities include, for example, establishment or modification of vegetation, area of weed control, and area of pest animal control, of which management effort has increased over the last three years (Figure 46).

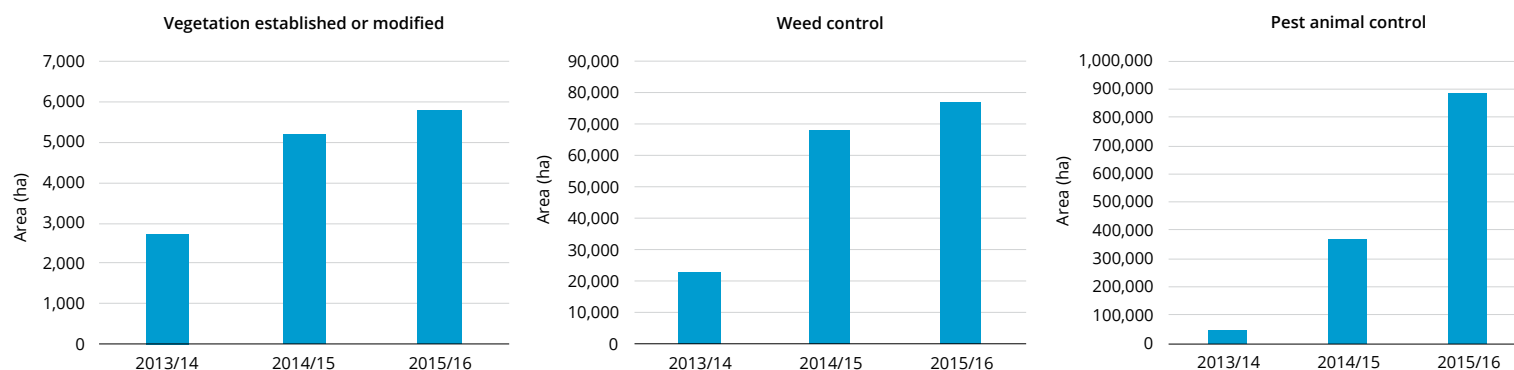


Figure 46. Area (ha) of vegetation established or modified, area (ha) of weed control, and area (ha) of pest animal control. Source: Victorian Catchment Management Authorities, 2017, p. 21. Note that the 2013-14 Report captured only State funded outputs. The 2014/15 and 2015/16 data includes outputs from State and Commonwealth funding sources.

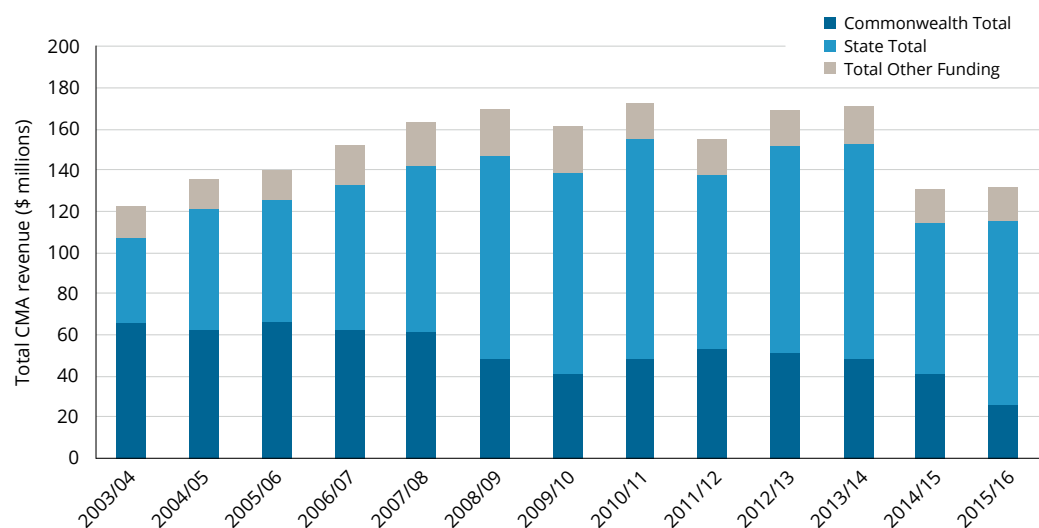


Figure 47. Total Income for all CMAs by Source. Source: CMA annual reports

The final focus area is providing good governance and leadership. Outputs reported include, for example, the number of plans and strategies developed, the number of assessments undertaken, or number of agreements developed.

Actions and Achievements enables Victoria's CMAs to tell a consistent statewide story about what is done with state and Commonwealth funding. Currently it does not capture the significant work delivered across the state by non-CMA programs, community groups, and volunteers in catchment management.

Expenditure in catchment management

Measuring expenditure in integrated catchment management can provide an indication of the relative importance placed on the condition of the environment. The amount of effort that can be put into the management of environmental resources is determined by the level of investment available.

Figure 47 shows the significant support from the Victorian State Government to the CMAs over an extended period, and that the proportion of this support has increased over time, while investment from the Australian Government has declined overall.

When analysed with other financial information, data show that CMAs deliver operational activities efficiently, with approximately 80% of their combined average income spent on on-ground operational works, which include planning, coordination and implementation. They have also been shown to be efficient organisations from the perspective of dollars spent on on-ground operational works per full time equivalent employee.

Expenditure in CMAs should not be used as a direct measure of management effectiveness; dollars spent on managing the environment does not necessarily improve the natural resource condition particularly over a short time, it may in fact reduce the rate of loss or risk. The effectiveness of investment in integrated catchment management can also be obscured by other factors, including drought, fire and floods.

CMA Aboriginal participation guideline

The *Aboriginal Participation Guideline for Victorian Catchment Management Authorities* was developed to act on CMAs' commitment to engage and work with Traditional Owners and Aboriginal communities to manage and improve the health of land and waters in Victoria. It establishes a statewide approach for use by CMAs to respond to regional variations in cultural diversity, experience in working with Traditional Owners and Aboriginal communities, and natural resource management priorities.

It needs to be applied consistently by CMAs to ensure the full and effective participation of Traditional Owners and Aboriginal communities in catchment management across Victoria.

The key principles are:

- Meaningful participation is based on fairness, equity and mutual respect
- Aboriginal culture, knowledge and obligations to country are diverse
- Protocols are important
- Good engagement takes time and support
- Trust depends on shared understanding and clear communication
- Aboriginal leaders have many demands on their time
- Passing on traditional knowledge is important
- The health and wellbeing of people and country are all one

The guideline acts on CMAs' commitments to be transparent in supporting Traditional Owner and Aboriginal community aspirations for recognition of rights, reconciliation, participation, employment and economic development through natural resource management.

CMA catchment condition reporting trial

For CMAs, an annual report on catchment condition and management is a requirement of the *CaLP Act 1994*. In 2016, Victoria's CMAs, supported by DELWP, established a project to adopt a consistent approach to annual reporting on catchment condition. An assessment of catchment condition is essential in understanding progress in integrated catchment management and the impacts of prevailing seasonal circumstances, such as extended drought. This enables decisions to be made about managing risks and capturing opportunities.

The trial was also a response to Action 4 of the response to the Victorian Auditor General's audit into *Effectiveness of Catchment Management Authorities* (VAGO, 2014), and for the implementation of Goal 5 of *Our Catchments Our Communities* (DELWP, 2016b). Goal 5 is "Improved monitoring, evaluation and reporting". The reporting themes proposed under the goal were adopted in the CMA condition reporting trial (and in this report), and included: land, water, biodiversity, coasts and community.

The assessment approach used in the CMA catchment condition reporting trial draws on the regional expertise of CMA staff, and has the potential to further include regional partners and community in making condition assessments. The rating scale used by most CMAs in 2016 to make annual condition assessments included: positive, neutral, concerned, and highly concerned. It is worth noting that assessments are from the perspective of the catchment manager based on available evidence, and CMAs can report on regionally-relevant evidence most suited to their context.

Challenges remain in meaningfully reporting on catchment condition and management, at appropriate temporal and spatial scales. Annual reporting at a regional scale by CMAs can complement and be complemented by five-yearly reporting at a statewide scale by the VCMC. Benchmark measures, such as the Index of Stream Condition, may only need to be reported every 10 years or more. There is also an emerging opportunity to develop consistent environmental accounts for each theme, reported both annually and every five years, as the implementation of environmental-economic accounting progresses across the sector (DELWP, 2015a).

Data collection is a key issue, and while much effort has gone into providing consistent catchment indicators, until these can be supported with cost effective data collection, progress on reporting on catchment condition is limited. Annual reporting of CMAs goes some way towards resolving this, however it is currently open to interpretation between organisations rather than providing a consistent approach. The initiation of Vic Catchments may support this.

An improved monitoring, reporting and evaluation approach would enable outcomes to be measured, in addition to outputs, and would allow CMAs to improve their ability to adaptively manage performance and identify appropriate management interventions. In addition, providing a clear definition of what performance standard we are working towards in integrated catchment management would enable measurable progress reporting and analysis.

VCMC Regional reports

This report presents a set of regional report cards that give an example of changes in catchment condition in each of Victoria's regions. Each report card is accompanied by an assessment of catchment condition across the five reporting themes, drawing on the indicator data presented in addition to assessments made in CMA annual catchment condition reports.

VCMC recognises the limitations in using these indicators for reporting condition and trends over time. Among these limitations are the lack of data availability, that indicators are only proxies for catchment condition, and the challenges of accounting for regional variation in natural environments. For example, average annual rainfall varies across Victoria, which means that some parts of the state may be assessed as being in 'poor' condition on some measures. Table 8 presents a summary of catchment indicators proposed in *Our Catchments Our Communities*, selected indicators from the CMA condition reporting trial, and those used in this report. We discuss each of the indicators under the five themes as follows.

Land

The regional indicator used to report on land condition is based on the fractional cover algorithm developed by CSIRO, which uses remotely sensed imagery from the MODIS platform to determine bare soil, non-photosynthetic vegetation, and photosynthetic vegetation fractions (Guerschman et al., 2015). This is the same source of data as used by Van Dijk and Summers (2016), which has

been adopted by the CMAs for annual reporting. The data used in this report was processed using EnSym to filter by dryland area, based on VLUIS land use data, using monthly data from March of each year as a proxy for the Autumn break. Areas of >30% bare soil are at high risk of wind and water erosion (>50% for the Mallee). Data are reported for 2008-16. The bare soil indicator reveals higher erosion risk in the north west of the state, largely due to natural climatic conditions. Low values in southern parts of Victoria do not necessarily mean a low risk of erosion, as the indicator does not incorporate other aspects of erosion risk, including slope, elevation, soil type and chemistry.

Water

The Index of Stream Condition is used to provide a benchmark of condition, based on the 2010 assessment (DEPI, 2013b). It is relevant to note that the benchmark occurred at a time of drought in some western parts of the state. Also, while a large number of river reaches were assessed, not all rivers and streams in the state were included in the assessment. Basin streamflow is reported for rivers across the state, based on the Victorian water accounts from 2010-11 to 2014-15 (DELWP, 2016e). The river basins reported do not always align with CMA regions.

Biodiversity

Currently there are no measures of biodiversity that enable consistent and comparable reporting across all of Victoria's regions. Tree cover, while useful as a raw measure, does not allow a distinction to be made between native and non-native vegetation, such that monoculture plantations may enhance the tree cover rating for a region. Also, some vegetation communities have naturally low levels of tree cover, for example grasslands. As a measure of biodiversity, tree cover does not indicate the diversity, species richness, density or condition of vegetation communities and ecosystems.

Coasts

The retention of coastal vegetation, including mangroves, saltmarsh and other coastal marsh, is reported for each of the five coastal CMAs (Sinclair and Boon, 2012). While this is one of the only coast-wide assessments of condition conducted in recent years, it is only a snapshot of change since European settlement. There are many other coastal vegetation communities unique to the coastal environment that ought to be considered, but data are lacking.

Community

Regional participation data has been taken from three years of CMA *Actions and Achievements* reports as an indicator of community involvement in integrated catchment management. In addition, community perceptions of environmental health are presented for each region, highlighting the top three problems perceived by the community (Schirmer et al., 2016).



Photo: PPWCMA



Photo: Phil Wallis



Photo: Phil Wallis

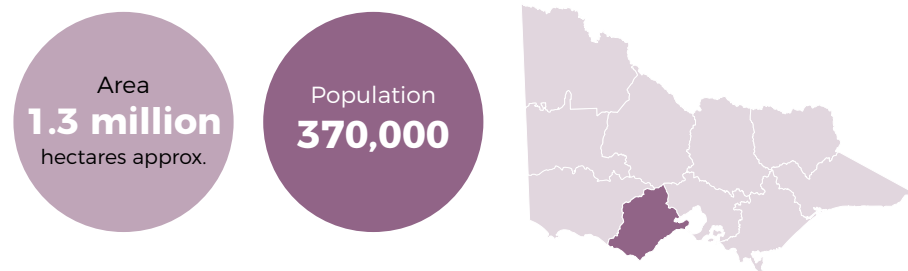
Table 8. Summary of reporting themes, catchment indicators from the CMA condition reporting trial.

Source: Unpublished condition reporting trial report

Theme	Indicators proposed in <i>Our Catchments Our Communities</i>	Selected indicators used by CMAs	Regional indicators used by VCMC
Land	<ul style="list-style-type: none"> Land managed for conservation 	<ul style="list-style-type: none"> Land managed for conservation Land cover: bare soil 	<ul style="list-style-type: none"> Land cover: Dryland area with 30-100% bare soil in March
Water	<ul style="list-style-type: none"> Condition of waterways Water quality in major lakes and bays 	<ul style="list-style-type: none"> Index of stream condition 	<ul style="list-style-type: none"> Index of stream condition Basin streamflow
Biodiversity	<ul style="list-style-type: none"> Extent and quality of native vegetation Health of native species 	<ul style="list-style-type: none"> Strategic biodiversity score Tree cover 	<ul style="list-style-type: none"> Tree cover
Coasts	<ul style="list-style-type: none"> Protection of coastal and marine environments 	<ul style="list-style-type: none"> Level of protection for coasts 	<ul style="list-style-type: none"> Mangrove and saltmarsh retention
Community	<ul style="list-style-type: none"> Community participation in environmental programs Community use of parks Traditional Owners participation 	<ul style="list-style-type: none"> Community participation Landcare group health survey 	<ul style="list-style-type: none"> Community participation in CMA engagement events Community perceptions of environmental health

Corangamite

REGIONAL CONTEXT



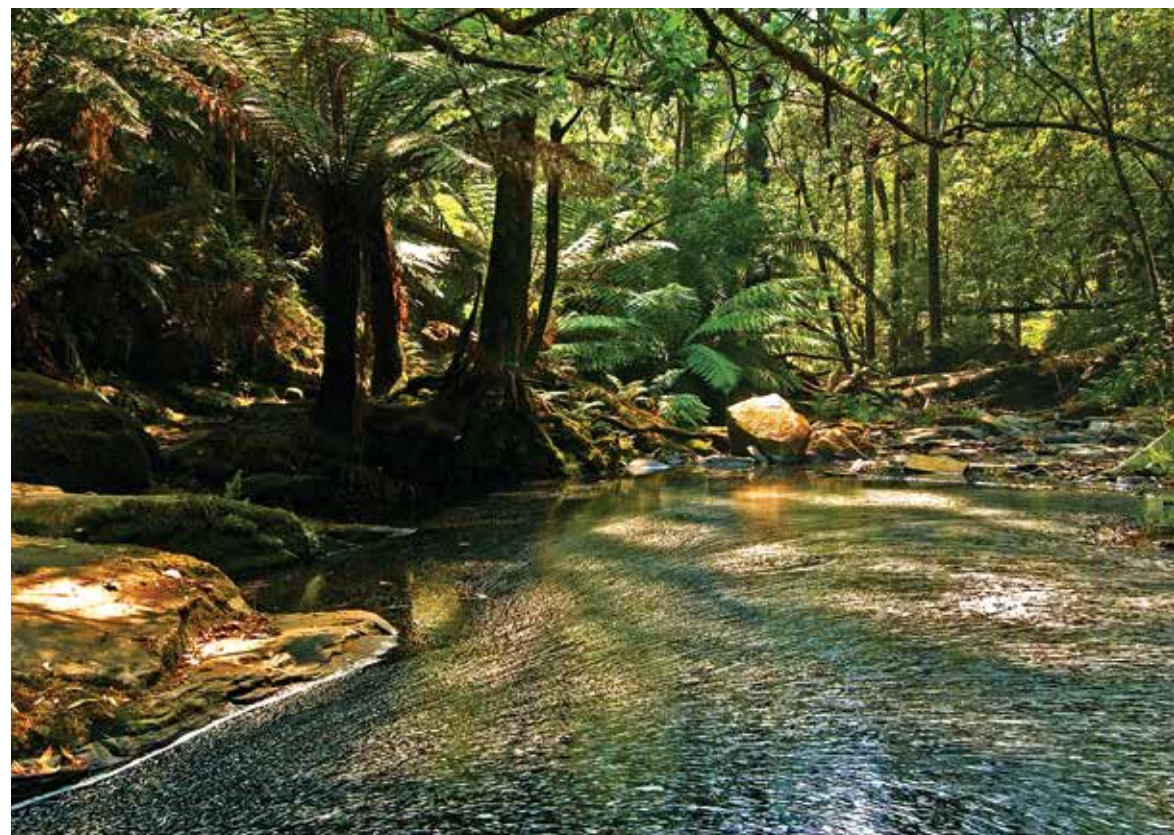
AGRICULTURE: Based on 2012 VLUI data (Victorian Land Use Information Scheme), 68% of the region is under agriculture production (908,173ha); 98% of this agriculture is on private land, 2% on public land (forestry).

SIGNIFICANT NATURAL FEATURES: Great Otways National Park, Victorian Volcanic Plains bioregion.

MAJOR WATERWAYS: Gellibrand, Moorabool, Barwon, Yarrowee and Leigh Rivers, large number of wetlands including Ramsar sites Port Phillip Bay – Western Shoreline and Bellarine Peninsula, and the Western District Lakes.

INDIGENOUS HERITAGE: Aboriginal Traditional Owners within the Corangamite CMA region include Wadawurrung (Wathaurong Aboriginal Corporation), Eastern Maar Aboriginal Corporation, Guli-Gad Aboriginal Corporation and Kuuyang Maar Aboriginal Corporation. There are also two Aboriginal Cooperatives - Wathaurong Aboriginal Co-operative and Ballarat and District Aboriginal Co-operative.

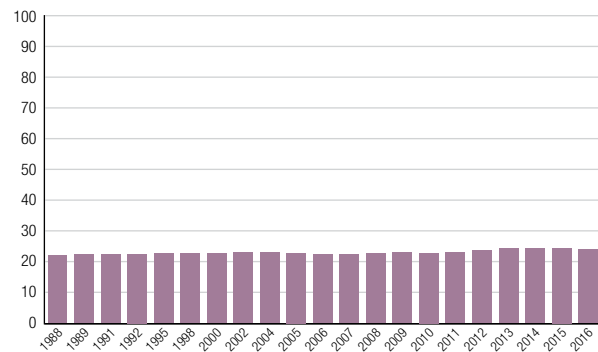
Source: CCMA, 2013a



Erskine River. Photo: Alison Pouliot

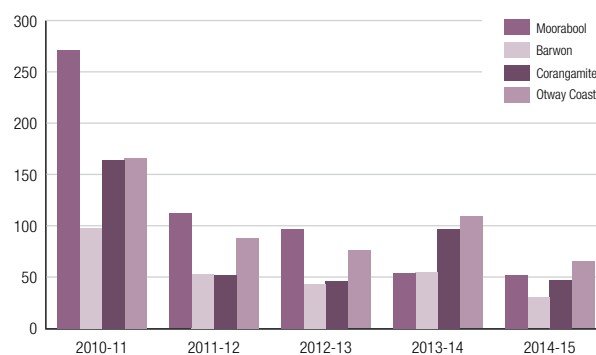
REPORT CARD

BIODIVERSITY Tree cover



Average annual percentage (%) tree cover for the Corangamite region 1988-2016. Source: Van Dijk and Summers, 2016

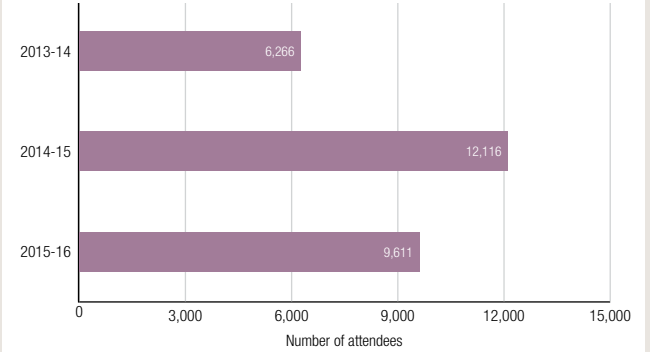
WATER Streamflow



Basin streamflow (%) compared to long-term average.

Source: Victorian Water Accounts

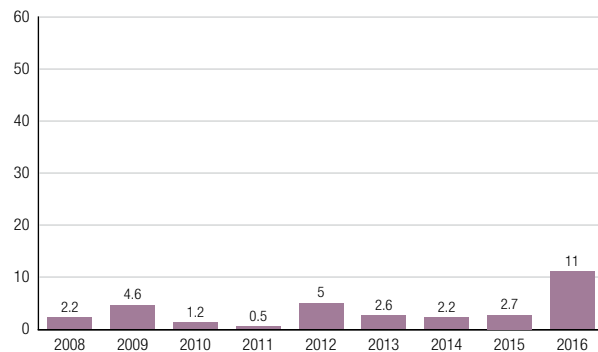
COMMUNITY Participation



Community participation in CMA engagement events.

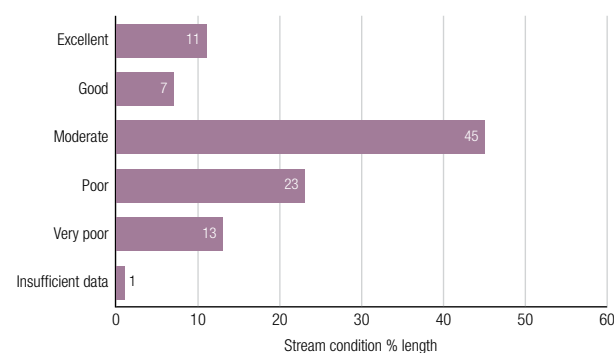
Source: Victorian Catchment Management Authorities, 2014, 2015, 2017

LAND Exposed soil



Percentage (%) Dryland area with 30-100% bare soils (higher risk of erosion) in March, 2008-2016. Sources: DEDJTR, 2017a; EnSym; Guerschman et al., 2015

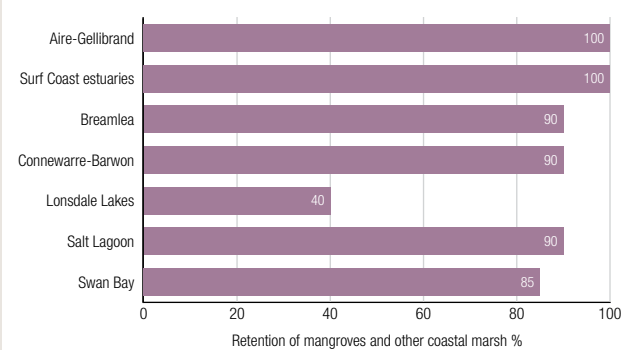
WATERWAYS Stream condition



Index of Stream Condition 2013 summary for the Corangamite region.

Source: DEPI, 2013b, p. 112

COASTS Vegetation retention



Estimated total retention (%) of Mangroves and Other Coastal Marsh from pre-1750 to ~2008. Source: Sinclair and Boon, 2012

ASSESSMENT OF CATCHMENT CONDITION

LAND

- ▶ The Corangamite region has exhibited minimal risk of erosion from bare soils in dryland production areas over the last nine years. Land degradation results from erosion, acidification, loss of organic matter and decline in soil structure. The Corangamite CMA rates its land resources as being in moderate condition and stable (CCMA, 2016).

WATER

- ▶ According to the last index of stream condition benchmark conducted in 2010 (DEPI, 2013b), some 18% of stream reaches assessed are in excellent or good condition, mostly in Otway Coast Basin, while the remainder of the catchment is mostly in moderate or poor condition. Basin streamflow has declined from 2010-11 to 2014-15, with subsequent years remaining relatively dry.

BIODIVERSITY

- ▶ The Corangamite region has moderate levels of tree cover (approximately 25%) that has increased slightly over the last 20-30 years, and is primarily located in the Otway ranges. The region has large areas of grasslands on the Victorian Volcanic Plains, which naturally has low levels of tree cover. The Corangamite CMA assessed biodiversity as in 'moderate' condition, with a declining trend (CCMA, 2016). Heathlands, grassy ecosystems and woodlands are particularly threatened in the region.

COASTS

- ▶ There is high retention of mangroves and other coastal marsh across all sampled coasts, except for Lake Lonsdale, which has suffered extensive losses of a range of saltmarsh types. Losses are reported to result from changes to drainage, conversion of coastal land to pastures, and changes to hydrological regimes (Sinclair and Boon, 2012).
- ▶ The Corangamite CMA assessed the condition of its coasts as 'moderate' to 'good', but in decline, in its 2015-16 annual report (CCMA, 2016). Condition is highly variable across the region's coastline, as a large proportion is contained within conservation reserves. Protection and enhancement of saltmarsh vegetation communities is taking place across Glenelg Hopkins, Corangamite, Port Phillip and Western Port, and West Gippsland regions, using a tender process (CCMA, 2016).

COMMUNITY

- ▶ Community participation has been relatively stable over three years. A range of programs foster participation, including Landcare Programs, Indigenous Participation Programs, Waterwatch and EstuaryWatch (CCMA, 2016).
- ▶ The top three community concerns about environmental health relate to invasive weeds (79% of respondents), feral animals (63%), and declining native fauna (62%); all considered a problem by respondents (Schirmer et al., 2016). These findings are consistent with the Corangamite CMA's Rural Community and Land Use Profile project, which found that 43% of respondents were very concerned about pest plants and animals, 39% about degradation of rivers and streams, 33% about loss of native wildlife, and about one quarter of landholders are very concerned about soil degradation (CCMA, 2013b).

CASE STUDY

An innovative approach to catchment management through technology: NRM Planning Portal

“The portal allows Landcare groups and their partners to exchange and share insights and information about past and proposed catchment management activities online. This information was previously only available to a small number of people as maps, unpublished documents, or in people’s memories.”



Figure 48. Screenshot of the NRM Planning Portal. Source: CCMA

LOCATION: Corangamite

PARTICIPANTS: Corangamite CMA, Centre for eResearch and Digital Innovation (Federation University), Landcare, local governments, Trust for Nature, Parks Victoria, agricultural industry groups, water corporations, environment groups, Aboriginal groups, private landholders, government and non-government investors. The project has been principally funded through the Australian Government’s National Landcare Program and the Victorian Government’s integrated waterway and catchment programs.

OBJECTIVES: To identify joint local and regional integrated catchment management priorities in the region, including opportunities for co-investment. To enable community priorities to be considered alongside regional, state and national strategies, improving project delivery, partnerships and overall project outcomes.

The NRM Planning Portal <www.ccmaknowledgebase.vic.gov.au/nrmpp> provides an innovative approach to support integrated catchment management in the Corangamite region. The portal uses spatial technology and environmental datasets to help Landcare networks and their partners to understand the impact of their management activities (e.g. looking after native vegetation, cleaning up creeks and wetlands, and managing erosion and salinity).

The portal also helps groups to share information and knowledge about past works and projects and to come up with joint priorities for potential partnerships and investment. This is the first time

that management priorities, at different scales and underpinned by different motivations, can be viewed together over the entire region.

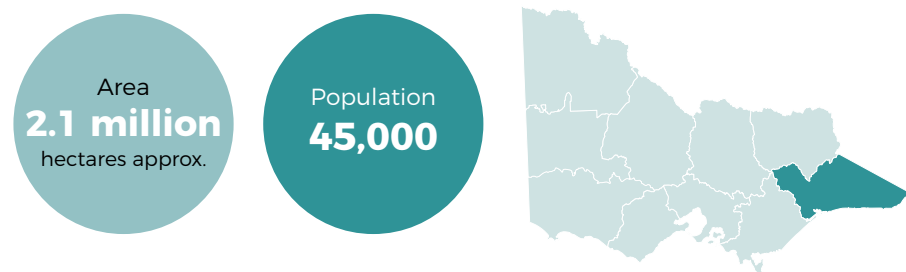
The web-based portal currently contains a range of local and regional Landcare management priorities for two Landscape Zones, with eight new Landscape Zones to follow by mid-2018. Priorities for key regional stakeholders such as Local Government Authorities, Parks Victoria, water corporations and Trust for Nature will also be incorporated into the portal during this time.

The portal allows Landcare groups and their partners to exchange and share insights and information about past and proposed catchment management activities online. This information was previously only available to a small number of people as maps, unpublished documents, or in people’s memories. This information allows CMAs and other groups to set strategic management priorities for land and water resources in the region.

The rapid and easy access to information on activities and priorities saves both time and money (for example, it helps avoid duplication in effort). It also helps Landcare partners to target funding bids, support the coordination of integrated on-ground activities, and provide for new opportunities for regional investment. The process of visualising management activities (Figure 48) has understandably generated pride in Landcare groups at seeing their on-ground achievements.

East Gippsland

REGIONAL CONTEXT



Agriculture: 17% of catchment is private land, mostly used for grazing, and some irrigated horticulture and dairy.

Natural features: Snowy River National Park, Errinundra National Park, Croajingolong National Park, Cooperacambra National Park, Cape Howe Marine National Park.

Major waterways: Gippsland Lakes (Ramsar listed), Snowy River, Mitchell River, Tambo River, Bemm River and Sydenham Inlet.

Indigenous heritage: Native Title for much of the Gippsland Region is held by the Gunaikurnai people. Traditional Owners include the Gunaikurnai Land and Waters Aboriginal Corporation.

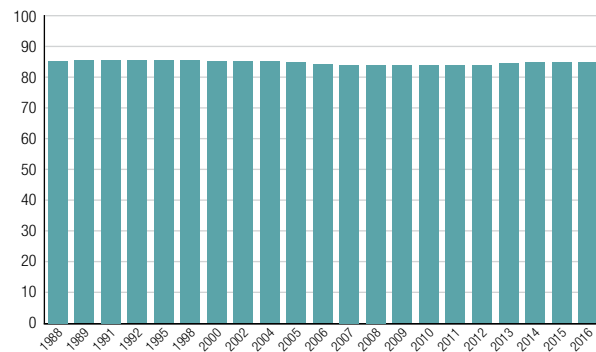
Source: EGCMA, 2013



Benedore River Estuary. Photo: EGCMA

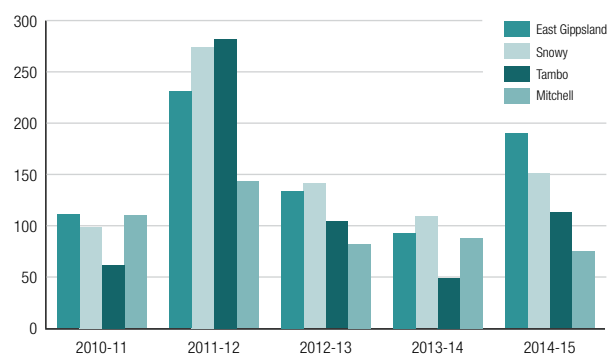
REPORT CARD

BIODIVERSITY Tree cover



Average annual percentage (%) tree cover for the East Gippsland region 1988-2016. Source: Van Dijk and Summers, 2016

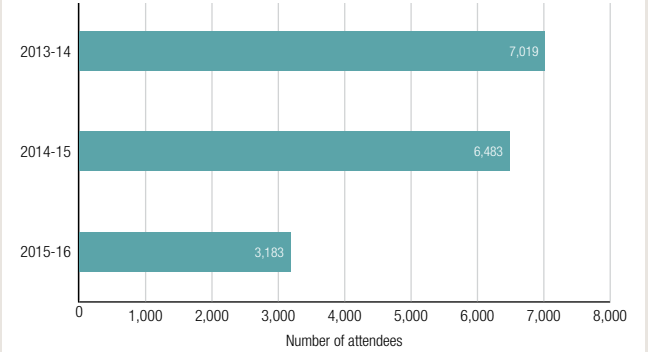
WATER Streamflow



Basin streamflow (%) compared to long-term average.

Source: Victorian Water Accounts

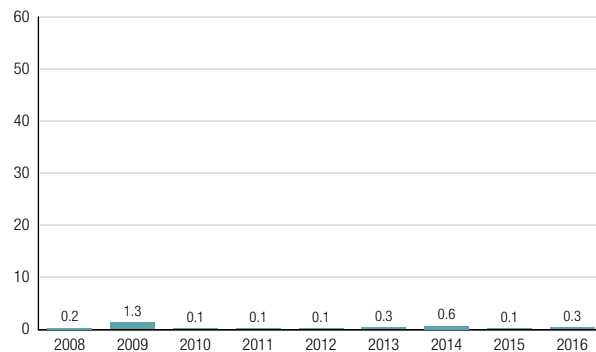
COMMUNITY Participation



Community participation in CMA engagement events.

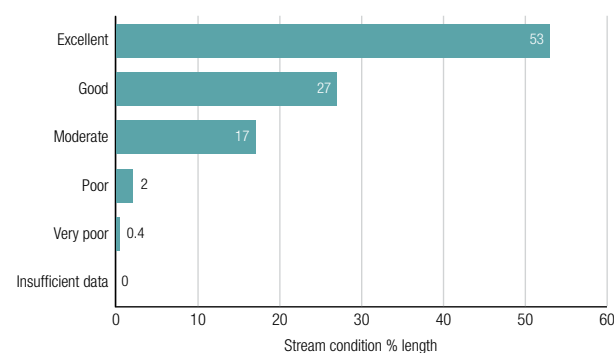
Source: Victorian Catchment Management Authorities, 2014, 2015, 2017

LAND Exposed soil



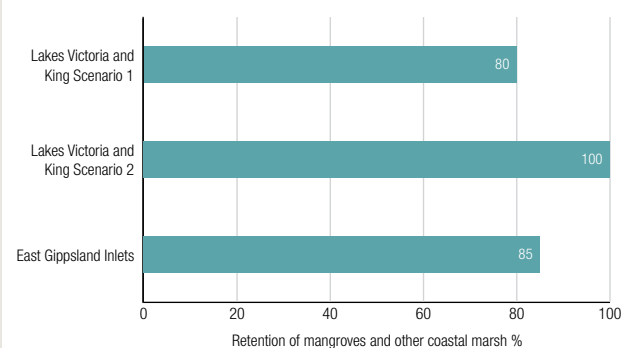
Percentage (%) Dryland area with 30-100% bare soils (higher risk of erosion) in March, 2008-16. Sources: DEDJTR, 2017a; EnSym; Guerschman et al., 2015

WATERWAYS Stream condition



Index of Stream Condition 2013 summary for the East Gippsland region. Source: DEPI, 2013b, p. 72

COASTS Vegetation retention



Estimated total retention (%) of Mangroves and Other Coastal Marsh from pre-1750 to ~2008. Source: Sinclair and Boon, 2012

ASSESSMENT OF CATCHMENT CONDITION

LAND

- ▶ The East Gippsland region has almost negligible risk of erosion from bare soils in dryland production areas over the last nine years. This is largely due to relatively high average annual rainfall, varying from 600 mm to 1,000 mm across public land in the catchment. The East Gippsland CMA reports that there is no significant evidence of poor condition for its soils (EGCMA, 2016).

WATER

- ▶ According to the last index of stream condition benchmark conducted in 2010 (DEPI, 2013b), almost three quarters (70%) of stream reaches assessed are in excellent or good condition. A very small proportion (2.4%) of river reaches, on the Snowy and Mitchell basins, are in poor or very poor condition, mostly due to limited vegetation width. Basin streamflow was high in 2011-12 and 2014-15.
- ▶ The East Gippsland CMA reports improved condition of riparian sites, based on their application of the works monitoring method (EGCMA, 2016).

BIODIVERSITY

- ▶ The East Gippsland region has widespread tree cover (85%), as approximately 83% of the region is public land held in state forests and national parks. The East Gippsland CMA assessed biodiversity in the region as remaining stable through 2015-16, with small gains in habitat enhancement (EGCMA, 2016).

COASTS

- ▶ The extent of saltmarsh in Lakes Victoria and King have all been influenced by the artificial opening of these systems to the Southern Ocean. Increases in salinity may have increased saltmarsh extent over and above naturally-occurring saltmarsh. Thus two scenarios were assessed, with Scenario 1 based on extensive pre-European distribution, and Scenario 2 on more limited pre-European distribution (Sinclair and Boon, 2012).
- ▶ The East Gippsland coast is protected by an extensive network of national parks, coastal parks, marine national parks, and a marine sanctuary (EGCMA, 2016). The CMA reports that the coast is in a stable condition.

COMMUNITY

- ▶ Community participation has slightly declined over three years. However, the reduction in community participation is due to the CMA undertaking a more targeted approach to community engagement and having more one on one discussions with community members (EGCMA, 2016).
- ▶ The top three community concerns about environmental health relate to feral animals (92% of respondents), invasive weeds (77%), and declining numbers of native fish (57%); all considered a problem by respondents (Schirmer et al., 2016).

CASE STUDY

Enhancing soil health through better management: the Topsoils project



Photo: EGCMA

“This project combines biophysical science about soil characteristics with social science about farmer attitudes and practices to enable more targeted management practices. The project aims to provide further training and have 10,000 hectares of land under improved management practices by 2018.”

LOCATION: East Gippsland

PARTICIPANTS: East Gippsland CMA, Department of Economic Development, Jobs, Transport and Resources, East Gippsland Landcare Network, Far East Victoria Landcare, Greening Australia, Southern Farming Systems, and Snowy River Interstate Landcare Committee. Funded by the National Landcare Programme.

OBJECTIVES: To support farmers in managing soils by identifying soil health factors that limit production, and to work in partnership with farmers to improve soil management practices.

Soil health is a key regional management priority in the East Gippsland region. The East Gippsland CMA has adopted a regional strategic approach towards maintaining soil health, with a long-term objective of “[Maintaining]...the productive values and stability of agricultural land and soils” (EGCMA, 2013, p. 31), and short-term objective of supporting best practice management and assessing the viability of agricultural land.

With this in mind, the CMAs Topsoils project is a multi-partner regional project to benchmark current soil condition, soil fertility and farming practices.

The project has sampled soil and plant data over nearly 100,000 hectares of farming land in East Gippsland, or approximately 25% of total farmland in the region. This includes information on soil type, pH, chemical elements, salinity and organic matter. Over 200 farmers were involved in soil sampling.

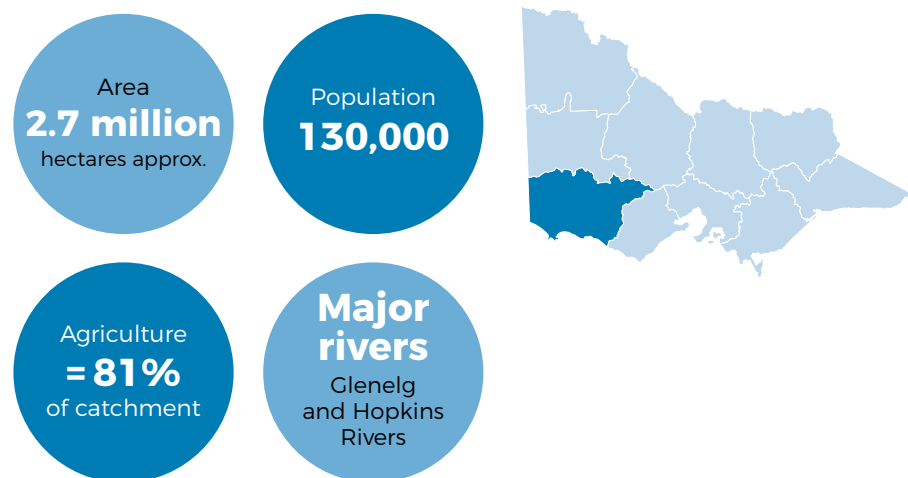
Farmers were also asked about their soil management attitudes and practices as part of the project. The results from the questionnaire, as well as soil and plant data, were used to develop three demonstration sites and a training program for farmers. The demonstration sites were opened to the public in 2016, in combination with workshops on assessing soil condition, and how this is affected by farm management practices.

This project combines biophysical science about soil characteristics with social science about farmer attitudes and practices to enable more targeted management practices. The project aims to provide further training and have 10,000 hectares of land under improved management practices by 2018.

The CMA also hopes that there will be long-term, sustainable change in soil management by farmers in the region. The training program and demonstration site field days have generated a good understanding of the differences in soils across the region. It is not yet clear whether these extension activities have led to changes in soil management practices.

Glenelg Hopkins

REGIONAL CONTEXT



SIGNIFICANT NATURAL FEATURES: Budj Bim National Heritage Landscape (Mt Eccles/Lake Condah/Tyrendarra Area), Grampians (Gariwerd) National Park (listed on National Heritage Register), Kanawinka Geopark (UNESCO listed).

MAJOR WATERWAYS: Glenelg River (Heritage River), Hopkins River, Lake Bookar (part of the Western District Ramsar Lakes), Seasonal Herbaceous Wetlands (GHCMA, 2014a).

INDIGENOUS HERITAGE: Traditional Owner Corporations include Gunditj Mirring Traditional Owners Aboriginal Corporation and Eastern Maar Aboriginal Corporation.

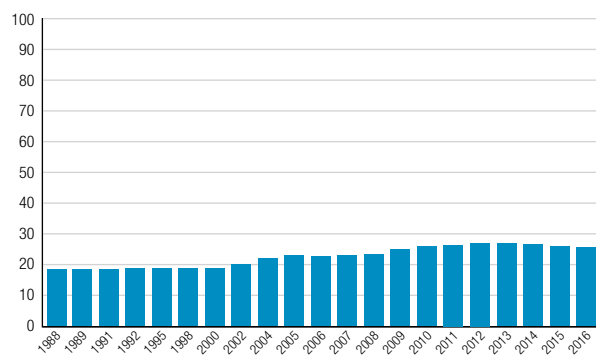
Source: GHCMA, 2013



The condition of the Glenelg River is a long way from what it once was before the Glenelg River Restoration Project. Photo: GHCMA

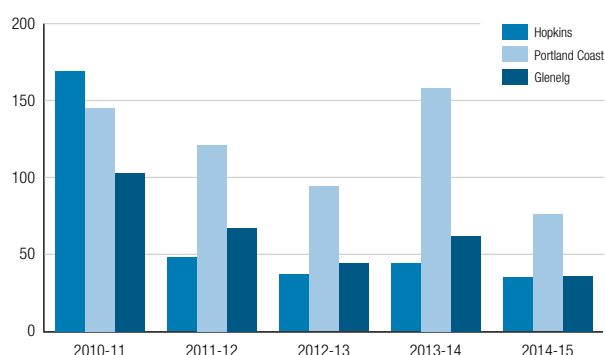
REPORT CARD

BIODIVERSITY Tree cover



Average annual percentage (%) tree cover for the Glenelg Hopkins region 1988-2016. Source: Van Dijk and Summers, 2016

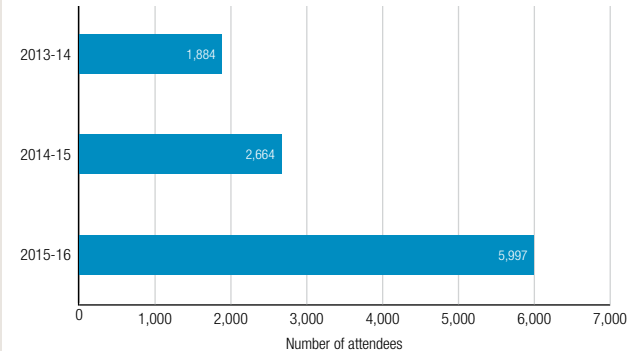
WATER Streamflow



Basin streamflow (%) compared to long-term average.

Source: Victorian Water Accounts

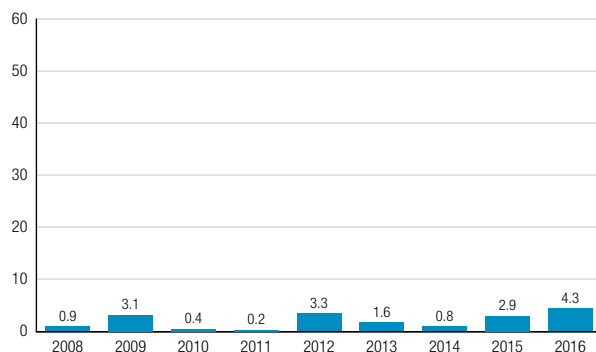
COMMUNITY Participation



Community participation in CMA engagement events.

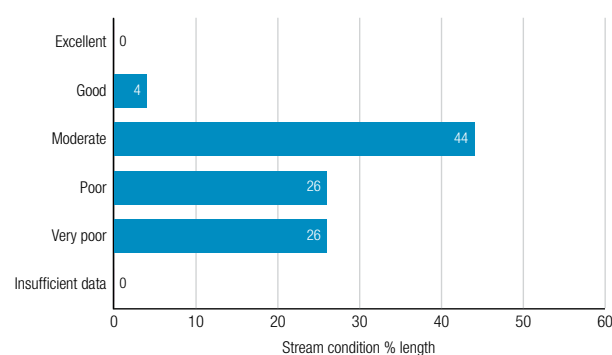
Source: Victorian Catchment Management Authorities, 2014, 2015, 2017

LAND Exposed soil



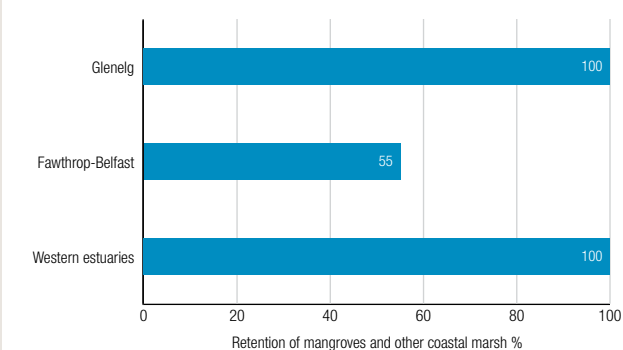
Percentage (%) Dryland area with 30-100% bare soils (higher risk of erosion) in March, 2008-16. Sources: DEDJTR, 2017a; EnSym; Guerschman et al., 2015

WATERWAYS Stream condition



Index of Stream Condition 2013 summary for the Glenelg Hopkins region. Source: DEPI, 2013b, p. 124

COASTS Vegetation retention



Estimated total retention (%) of Mangroves and Other Coastal Marsh from pre-1750 to ~2008. Source: Sinclair and Boon, 2012

ASSESSMENT OF CATCHMENT CONDITION

LAND

- ▶ The Glenelg Hopkins region has a minimal risk of erosion from bare soils in dryland production over the last nine years. After a low of almost no dryland area with bare soil >30% in 2011, the last few years have begun to ramp up. Wetter conditions prevailed in the latter half of 2016.
- ▶ While bare soils and groundcover are a proxy for erosion risk, particular soil types are more susceptible to erosion. In the Glenelg Hopkins region, erosion risks are high to very high for sheet and rill erosion across 18% of the catchment, 12% for gully and tunnel erosion, and 16% for wind erosion (GHCMA, 2014b).

WATER

- ▶ According to the last Index of Stream Condition benchmark conducted in 2010 (DEPI, 2013b), all stream reaches assessed as being in 'good' condition were found in the Glenelg basin. The Glenelg and Portland basins were otherwise mostly in 'moderate' condition. Much of the Hopkins basin was assessed to be in 'poor' or 'very poor' condition. The Hopkins and Portland basins have been largely cleared for agriculture, while Glenelg basin is more forested (DEPI, 2013b). The 2010 benchmark was conducted during a particularly severe drought period in the region (GHCMA, 2016b). Basin streamflow was below the long-term average in 2014-15.
- ▶ In its 2015-16 annual condition report, the Glenelg Hopkins CMA rated the condition of their wetlands as 'good' to 'excellent' for 64% of wetlands surveyed, drawing on results from the 2009 Index of Wetland Condition. Estuary condition was rated as 'moderate' to 'good' based on a trial assessment of the Index of Estuarine Condition (GHCMA, 2016b).

BIODIVERSITY

- ▶ Tree cover has increased from approximately 19% in 2000 to 26% in 2006, mainly in the 'green triangle' area (south west), likely due to increases in plantations and farm forestry.
- ▶ In its 2015-16 annual condition report, the Glenelg Hopkins CMA rated the extent of vegetation as 'poor', reflecting widespread clearing in the past. Remaining vegetation is concentrated in conservation reserves, and a small proportion protected through covenants on private land.

COASTS

- ▶ Western estuaries and the Glenelg coastal marsh area are relatively intact, while the Fawthrop Lagoon (near Portland) and Belfast Lough (Port Fairy) have been modified (Sinclair and Boon, 2012). Parts of the Western estuaries lie outside the region. The data are probably only accurate for the coastal marsh very low in the estuary systems. Coastal marsh higher in the estuary system has been reduced as a result of grazing and development.
- ▶ In its 2015-16 annual condition report, the Glenelg Hopkins CMA rated the condition of its coasts as 'generally poor', recognising that the coast is under pressure from sea level rise, flooding, erosion and development. Coastal vegetation is largely fragmented.

COMMUNITY

- ▶ Community participation has increased over three years. The Glenelg Hopkins CMA has a strong emphasis on building partnerships with a diverse range of partners to improve participation in natural resource management. The Glenelg Hopkins CMA has a focus on building partnerships with other groups in the region, particularly Landcare, anglers, and Traditional Owner groups (GHCMA, 2016b).
- ▶ The top three community concerns about environmental health relate to invasive weeds (78% of respondents), feral animals (60%), and declining numbers of native animals (58%); all considered a problem by respondents (Schirmer et al., 2016).

CASE STUDY

Engaging with angling communities



Photo: GHCM

“The engagement sessions allowed for in-depth discussions about environmental flows and river health management with anglers, tailored to their local area and fishing interests.”

LOCATION: Glenelg Hopkins

PARTICIPANTS: Glenelg Hopkins CMA, angling community, funded by the Victorian Environmental Water Holder.

OBJECTIVES: To trial a targeted approach in engaging angling communities to illustrate the benefits of environmental flows on the Glenelg River.

Glenelg Hopkins CMA and the Victorian Environmental Water Holder have identified a need to increase community awareness of environmental watering, and to promote the benefits of flows for fish to the angling community.

Glenelg Hopkins CMA piloted a series of targeted engagement activities along the Glenelg River in May and June 2016. The day-long events aimed to communicate the shared benefits of environmental flows with anglers. Fish ecologists carried out fish sampling demonstrations using electro-fishing and approved net fishing techniques. Anglers were asked to weigh, measure and count the fish that were caught. Information on fish population dynamics, distribution and environmental flow requirements was provided to anglers at the event, to improve their understanding of the importance and benefits of environmental flows and integrated river health works in the Glenelg River. The CMA used social media to record and publish the day's events.

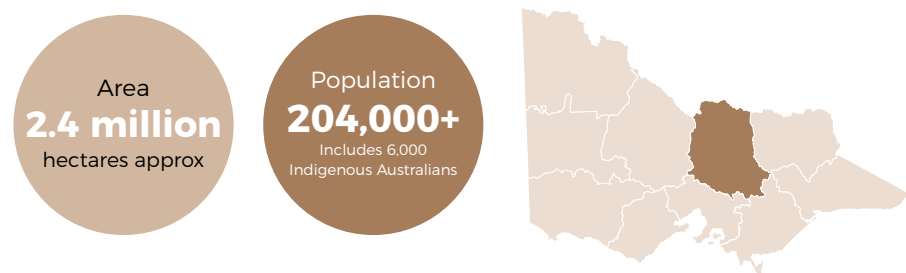
There was significant interest in the engagement days, with more than 100 people attending the four events. Each event provided an informal forum for the exchange of information between environmental water managers and anglers. The engagement sessions allowed for in-depth discussions about environmental flows and river health management with anglers, tailored to their local area and fishing interests.

Anglers provided positive feedback on both the format and content of the engagement days. Anglers were particularly interested in understanding how environmental flows benefit fish. The engagement day activities provided an opportunity to share knowledge and observations about the significant responses by native fish to environmental flows in the Glenelg River.

The CMA was able to successfully use social media to promote the issues discussed at each event. As a result, some environmental groups have indicated their interest in having similar sessions with a broader environmental focus, including plants and birds.

Goulburn Broken

REGIONAL CONTEXT



AGRICULTURE: approximately 1,000,000 hectares of dryland agriculture and 270,000 hectares irrigated agriculture with a gross value of agricultural production of over \$2.1 billion (within an annual economic output for the Catchment of over \$15.9 billion).

SIGNIFICANT NATURAL FEATURES: Barmah Forest (icon site of The Living Murray program, National Park and Ramsar listed), Alpine National Park, Lower Goulburn National Park, Lake Eildon National Park, Cathedral Ranges State Park, Heathcote-Graytown National Park.

MAJOR WATERWAYS AND WETLANDS INCLUDE: Goulburn River, Broken River, Winton Wetlands, Lake Eildon, Kanyapella Basin, Gaynor Swamp, Yea Wetlands, Alpine bogs and significant deep and shallow groundwater aquifers.

THREATENED SPECIES AND ECOLOGICAL COMMUNITIES

INCLUDE: Superb Parrot, Bush Stone-curlew, Squirrel Glider, Grey-crowned Babbler, Regent Honeyeater, Mountain Pygmy Possum, Alpine Sphagnum Bogs, Grey Box Grassy Woodlands and Buloke Woodlands of the Riverina and Murray-Darling.

INDIGENOUS HERITAGE: Traditional Owners in the north of the Catchment are represented by Yorta Yorta Nation, whose traditional lands include the northern plains of the Goulburn and Murray Rivers. The south of the Catchment forms part of the traditional lands of Taungurung Clans, which includes the mountains and rivers to the Great Divide. Traditional Owners' knowledge of land and water resources and cultural heritage in the landscape is rich and unique.

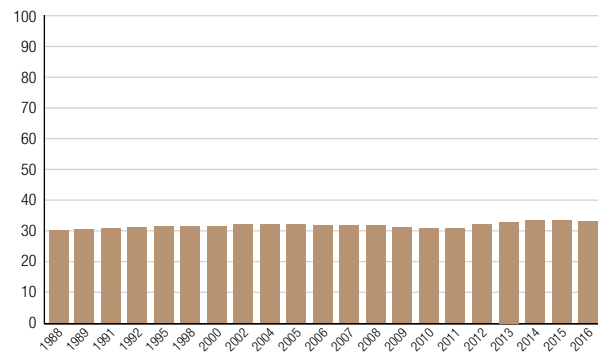
Source: GBCMA, 2016



Goulburn River, Acheron Cutting. Photo: Mark Turner

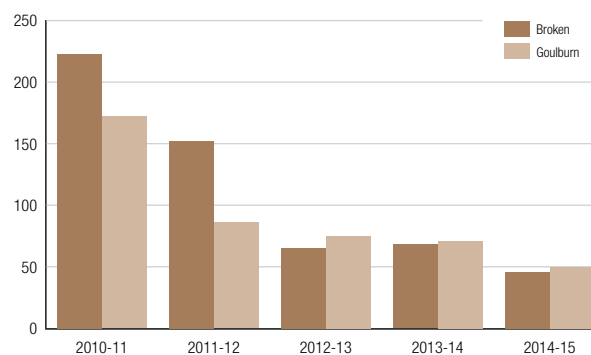
REPORT CARD

BIODIVERSITY Tree cover



Average annual percentage (%) tree cover for the Goulburn Broken region 1988-2016. Source: Van Dijk and Summers, 2016

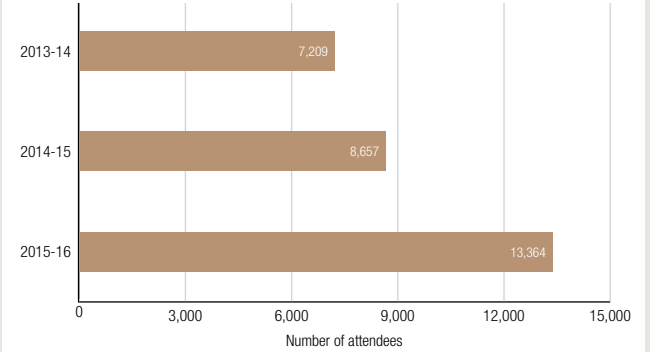
WATER Streamflow



Basin streamflow (%) compared to long-term average.

Source: Victorian Water Accounts

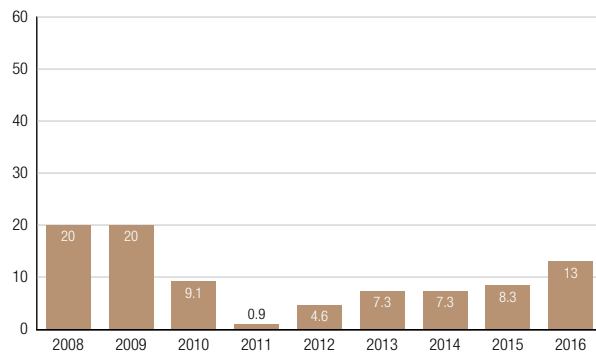
COMMUNITY Participation



Community participation in CMA engagement events.

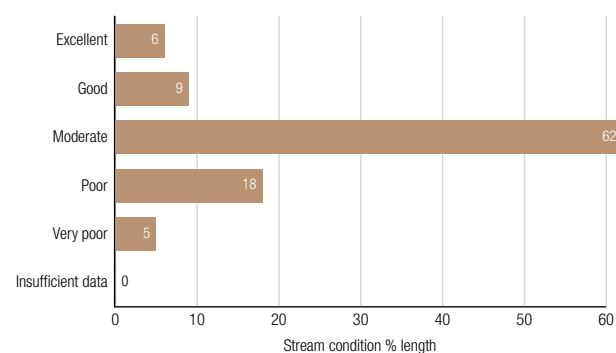
Source: Victorian Catchment Management Authorities, 2014, 2015, 2017

LAND Exposed soil



Percentage (%) Dryland area with 30-100% bare soils (higher risk of erosion) in March, 2008-16. Sources: DEDJTR, 2017a; EnSym; Guerschman et al., 2015

WATERWAYS Stream condition



Index of Stream Condition 2013 summary for the Goulburn Broken region. Source: DEPI, 2013b, p. 30

ASSESSMENT OF CATCHMENT CONDITION

- ▶ The Goulburn Broken CMA's approach to evaluation, which stretches back to the 1980s, ensures that emerging issues and lessons from the past are continually built into strategy development. The framework is used in the Annual Report across all work programs, with a rating scale for catchment condition of very poor, poor, satisfactory, and good to excellent (GBCMA, 2016). The Victorian Auditor General (2014) found that the Goulburn Broken CMA 'is the most advanced of the four CMAs (of five in the assessment) in that it has a pre-existing monitoring, evaluation and reporting framework developed in 2004'.
- ▶ The CMA is continuing to develop its approach to monitoring, evaluation and reporting and is now exploring how long-term progress can be used to further improve understanding and decision making. This aligns with the Regional Catchment Strategy's emphasis on system resilience and the focus on critical attributes and thresholds emerging from local planning (GBCMA, 2013).

LAND

- ▶ The Goulburn Broken region has a slightly elevated risk of erosion from bare soils in dryland production areas, particularly since 2011. The Goulburn Broken CMA encourages landholders to maintain ground cover greater than 70%. The Goulburn Broken CMA's most recent catchment condition report gives a satisfactory rating for land health and a stable trend,

based on an assessment of soil health indicators (GBCMA, 2016). Improving the condition of land is critical to growing the Catchment's sustainable agricultural industries as well ensuring the ongoing provision of important ecosystem services including clean water, habitat and aesthetically pleasing landscapes for communities to live.

WATER

- ▶ The 2010 Index of Stream Condition showed that some reaches in the upland streams of the Goulburn River were in reference condition or rated as 'excellent'. A majority of stream reaches assessed (62%) in Goulburn and Broken Basins were rated as 'moderate' (DEPI, 2013b). Basin streamflow for both the Goulburn and Broken river basins peaked in 2010-11 due to widescale natural flooding, and have since returned to more natural patterns.
- ▶ The CMA reports that phosphorus loads from irrigation drains are below the long-term target, and rates water quality in waterways as satisfactory (GBCMA, 2016). Environmental flows were rated as satisfactory, as were riparian and instream habitat and channel form, both of which were trending towards improved condition. The distribution and abundance of large bodied native fish species such as Trout cod, increased in several waterways, evidence of the benefits of the improved condition of some waterways.

BIODIVERSITY

- ▶ Tree cover has been stable over the last 17 years, taking in approximately 30% of the catchment, mostly located in the southern (upland) part of the catchment. The CMA reports that catchment condition for biodiversity continues to be poor, and that native vegetation extent targets are not being met, requiring additional investment in revegetation and reducing clearing impacts (GBCMA, 2016). Despite this, targeted revegetation activities are having a positive impact on the landscape, supporting increased populations of native fauna including threatened species including threatened woodland bird community which includes Grey-crowned Babbler, Dimond Firetail and Turquoise Parrot, and the EPBC-listed Regent Honeyeater.

COMMUNITY

- ▶ The Regional Catchment Strategy reflects the views of the community, and their concerns include: water policy and associated water availability for agriculture and the environment, climate change, land-use changes, and agricultural viability (GBCMA, 2013).
- ▶ Community participation was high in 2016 (20.2% of statewide participation figures) and has increased over three years. The top three concerns of the broader community about environmental health relate to invasive weeds (88% of respondents), declining numbers of native fish (79%), and pest fish species (79%); all considered a problem by respondents (Schirmer et al., 2016).

CASE STUDY

Improving river health and farm productivity through better irrigation



Photo: GBCMA

“Modern irrigation infrastructure has saved farmers time and effort in farm management, and has improved agricultural productivity through better watering efficiency and more consistent water flows across farm properties. More broadly, the program has boosted regional development, creating new jobs and promoting industry confidence and co-investment in the region.”

LOCATION: Goulburn Murray Irrigation District

PARTICIPANTS: A consortium led by Goulburn Broken CMA, including North Central CMA, North East CMA, Goulburn-Murray Water, Dairy Australia, Murray Dairy, Northern Victorian Irrigators, state and local government. Funding sources include the Australian Government's On-Farm Irrigation Efficiency Program, Victorian Government's Northern Victorian Irrigation Renewal Program, the Victorian On Farm State Priority Projects Initiative and the Victorian Farm Modernisation Project.

OBJECTIVES: To assist irrigators to achieve water savings by improving on-farm irrigation systems.

The Goulburn Murray Irrigation District (GMID) is one of the oldest and largest irrigation districts in Victoria. The GMID encompasses a large stretch of the Murray River and its surrounds in Victoria's north. Much of the GMID has ageing and inefficient surface irrigation infrastructure. Outdated infrastructure means a less efficient irrigation system, and more water lost just to get water from the river to farms.

Infrastructure upgrades are considered the best option to save water for the environment, and to maintain and support improved agricultural productivity. The water savings are shared between farmers and the environment.

Works to date have primarily involved modernising larger channels in the GMID (known as the 'backbone'), and connecting non-backbone or 'spurs' customers with pipes. Works include laser grading, drainage reuse, micro systems, sprinkler irrigation, gravity channel surface irrigation, pipe and riser systems, irrigations scheduling, farm channel upgrades, and plastic lined channels.

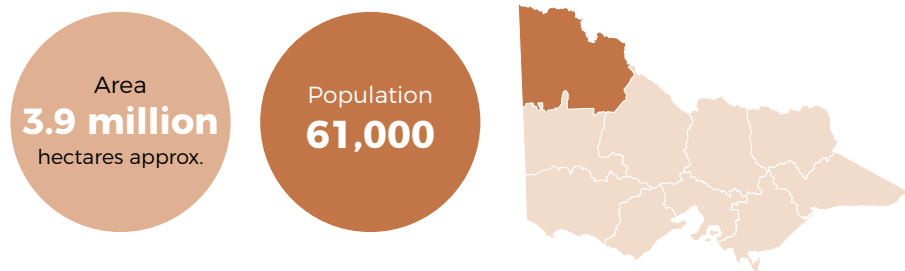
More than 500 projects were completed as of May 2017. However, there is still estimated to be around 70,000 – 100,000 hectares of farm systems that need to be modernised.

As of May 2017, 70 GL of water has been saved as a result of infrastructure upgrades. This has led to more water being available to protect and restore river health, while more efficient water delivery systems have reduced groundwater accessions and nutrient runoff, and helped address re-emerging salinity and water table issues in the region.

Modern irrigation infrastructure has saved farmers time and effort in farm management, and has improved agricultural productivity through better watering efficiency and more consistent water flows across farm properties. More broadly, the program has boosted regional development, creating new jobs and promoting industry confidence and co-investment in the region.

Mallee

REGIONAL CONTEXT



AGRICULTURE: 62% of catchment, mostly dryland cropping, areas of irrigation extend from Nyah to South Australia border adjacent to the Murray River corridor and a small groundwater district around Murrayville.

NATURAL FEATURES: Murray-Sunset, Wyperfeld and Hattah-Kulkyne National Parks, and Big Desert Wilderness Park.

MAJOR WATERWAYS: Hattah Lakes (Ramsar listed), Lindsay-Mulcra-Wallpolla Islands.

INDIGENOUS HERITAGE: Traditional custodians are the Latji Latji, Wotjobaluk (Wergaiai), Wadi Wadi, Wamba Wamba, and Yupagalk peoples.

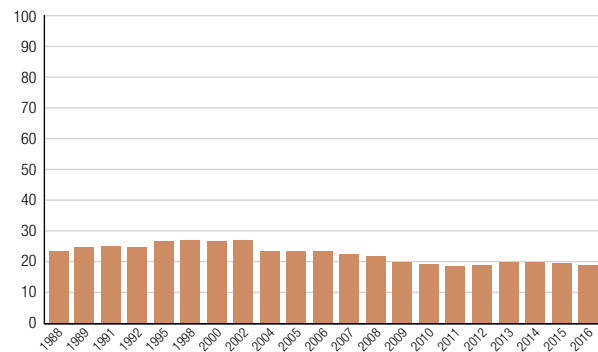
Source: MCMA, 2013



Paddling in a canoe is the best way to explore Lake Carpul. Photo: MCMA

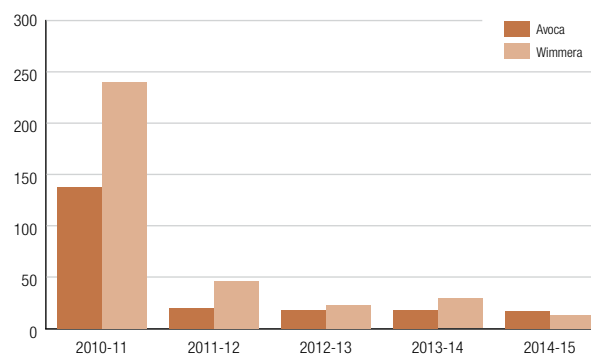
REPORT CARD

BIODIVERSITY Tree cover



Average annual percentage (%) tree cover for the Mallee region 1988-2016. Source: Van Dijk and Summers, 2016

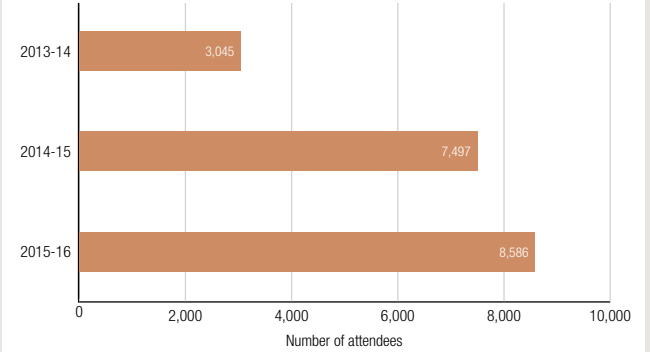
WATER Streamflow



Basin streamflow (%) compared to long-term average.

Source: Victorian Water Accounts

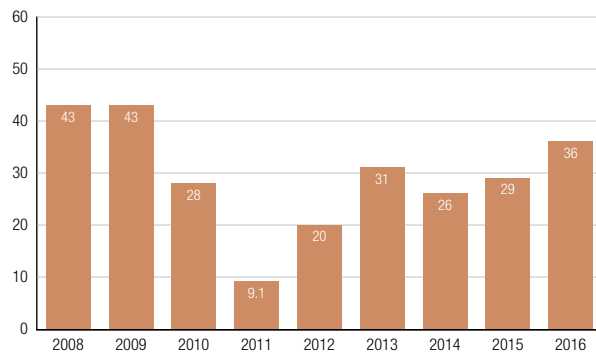
COMMUNITY Participation



Community participation in CMA engagement events.

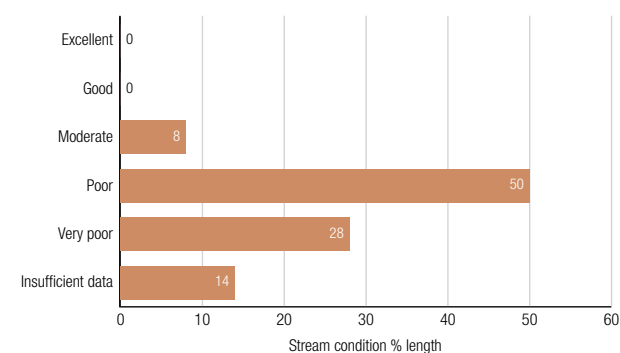
Source: Victorian Catchment Management Authorities, 2014, 2015, 2017

LAND Exposed soil



Percentage (%) Dryland area with 50-100% bare soils (higher risk of erosion) in March, 2008-16. Sources: DEDJTR, 2017a; EnSym; Guerschman et al., 2015

WATERWAYS Stream condition



Index of Stream Condition 2013 summary for the Mallee region.

Source: DEPI, 2013b, p. 52

ASSESSMENT OF CATCHMENT CONDITION

LAND

- ▶ The Mallee region has an elevated risk of erosion from bare soils in dryland production areas, particularly since 2011. Mallee is assessed differently to other regions, due to its natural aridity, with a 50% groundcover threshold for best practice used instead of 70% for the rest of the state. Levels of bare soil are lower than those experienced at the end of the Millennium drought, possibly indicated greater risk management and changes in land management practices, such as reductions in the use of conventional fallow (MCMA, 2016).

WATER

- ▶ Stream reaches assessed under the Index of Stream Condition occur in the Mallee, Avoca and Wimmera Basins, generally in poor condition at the end of the Millennium drought when most stream reaches were experiencing stress (DEPI, 2013b).
- ▶ Streamflow for the Avoca and Wimmera basins were as low as 17% of the long-term average from 2011-12 to 2014-15. No long-term data exists for streamflow in the Mallee basin. According to the Mallee CMA, groundwater levels declined from 2014-15 to 2015-16 in 81% of bores sampled (MCMA, 2016).

BIODIVERSITY

- ▶ In the Mallee region tree cover is approximately 20%, mostly contained in Big Desert Wilderness Park, and Wyperfield, Murray-Sunset and Hattah-Kulkyne National Parks. A decline in tree cover is evident over the last 20-30 years. The Mallee CMA reports that terrestrial habitat in the region is 'stable' to 'improving', though fragmented vegetation in cleared agricultural landscapes are declining in condition (MCMA, 2016).

COMMUNITY

- ▶ Community participation has increased over three years. The Mallee CMA has a strong focus on improving community capacity for natural resource management, with baseline data from 2012-13 demonstrating 'medium' levels of capacity in the region (MCMA, 2016).
- ▶ The top three community concerns about environmental health relate to invasive weeds (95% of respondents), pest fish species (87%), and declining numbers of native fish (84%); all considered a problem by respondents (Schirmer et al., 2016).



Photo: MCMA

CASE STUDY

To fence or not to fence?

Changes in vegetation condition on private land in the Mallee

LOCATION: Mallee

PARTICIPANTS: Mallee CMA, Arthur Rylah Institute, private land managers.

OBJECTIVE: To determine the long-term impact of stock exclusion fencing on vegetation condition on private land across the Mallee.

Much of the native vegetation in Victoria's Mallee region is highly fragmented, particularly on private land. Those areas of native vegetation that remain are thus considered important to retain, and are managed accordingly.

Uncontrolled stock grazing is considered a serious threat to remnants of native vegetation in the region. Uncontrolled grazing by domestic livestock can change the structure of remnants (e.g. remove grasses and small woody shrubs), lead to increased soil erosion and compaction, encourage the spread of weeds and affect processes such as litter decomposition and nutrient cycling.

The Mallee CMA carries out a range of on-ground works to improve native vegetation condition. Fencing to exclude stock grazing is considered a cost-effective means to improve vegetation condition. Fencing can be used to protect areas of native vegetation from domestic stock grazing. It promotes natural regeneration and woody plant recruitment in degraded remnants.

The Mallee CMA began a long-term monitoring program in 2009 to determine whether the installation of stock exclusion fences on private land would lead to an improvement in vegetation condition. Figure 49 shows the predicted relationship between grazing removal and vegetation condition.

The monitoring program will allow the CMA to determine the effectiveness of its on-ground activities, and help indicate where it can get the most management "bang for buck" (i.e. fencing native vegetation patches or linear areas of vegetation). It will also allow the CMA to determine native vegetation management priorities in the region.

Twenty five patches of privately owned and publicly managed remnant vegetation were monitored in Spring 2009/10, 2012 and 2015 to determine if there was an improvement in vegetation condition as a result of stock exclusion fencing, with another 38 linear remnant vegetation sites (see Photo) monitored during Spring 2011 and 2016. Public land monitoring sites were used as the reference (or control) site to determine the effectiveness of stock exclusion fencing on private 'investment' sites.

The monitoring program showed that native vegetation condition improved in patches of privately owned, fenced remnant vegetation. This is likely to be a result of the stock exclusion fencing, as these changes did not occur in un-grazed public land monitoring sites.

The results were less clear-cut in privately owned, fenced, linear native vegetation sites: while woody plant recruitment was higher than in the un-grazed public land monitoring sites, overall vegetation condition declined due to an increase in weed cover. Linear remnants are more prone to edge effects, which are changes in biotic and abiotic conditions that occur at an ecosystem boundary (VEAC, 2010), than larger patches of native vegetation. Any improvements in vegetation condition may therefore be slower (e.g. >10 years) than in larger connected remnants (<10 years).

This information can be used to prioritise investment in vegetation management in the region. For example, if the goal is to improve vegetation condition, fencing large and medium-sized remnants may be the first investment priority, as recovery can occur over shorter time scales than in linear remnants.

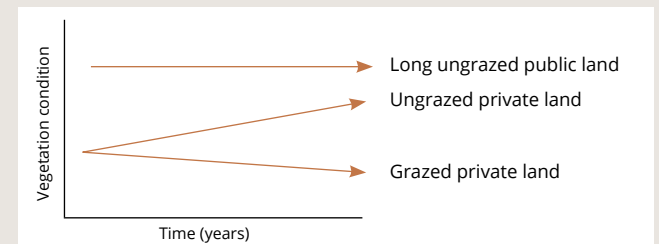
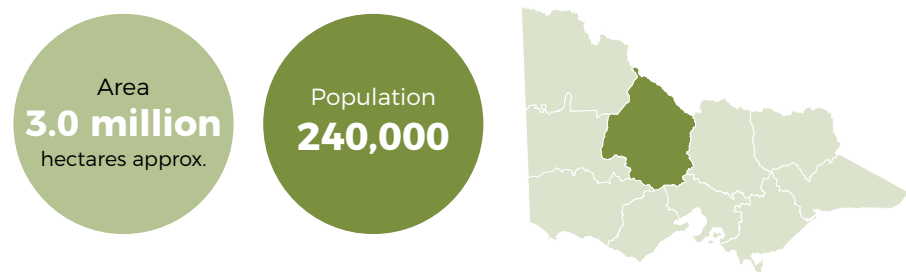


Figure 49. Anticipated changes in vegetation condition associated with the removal of livestock grazing.

North Central

REGIONAL CONTEXT



AGRICULTURE: 57% of catchment area (1.7 million hectares, source: regional sustainable agriculture strategy). Irrigation, dryland cropping, mixed farming, diverse farming zones.

SIGNIFICANT NATURAL FEATURES: Box-Ironbark forests and remnants, grasslands and grassy woodlands.

MAJOR WATERWAYS: Loddon and Campaspe Rivers, Gunbower Forest wetlands and Kerang Lakes (both Ramsar listed).

INDIGENOUS HERITAGE: The North Central region includes the traditional land of the Dja Dja Wurrung, Barapa Barapa, Wemba Wemba, Yorta Yorta, Taungurung, Wadi Wadi and Wergaia (the Wergaia are represented by the Barengi Gadjin Land Council).

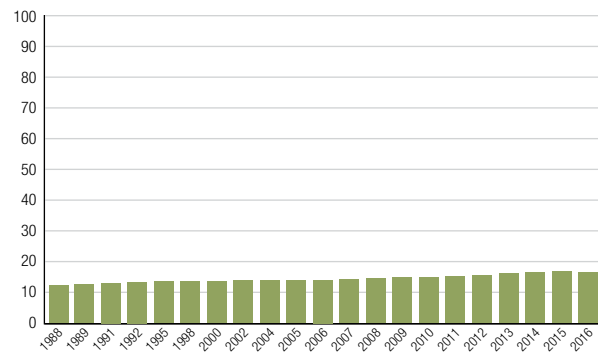
Source: NCCMA, 2013



Slender darling-pea *Swainsona murrayana* in one of Victoria's northern plains grassland. Photo: NCCMA

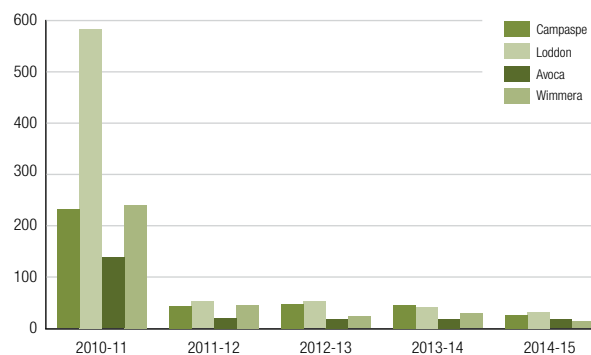
REPORT CARD

BIODIVERSITY Tree cover



Average annual percentage (%) tree cover for the North Central region 1988-2016. Source: Van Dijk and Summers, 2016

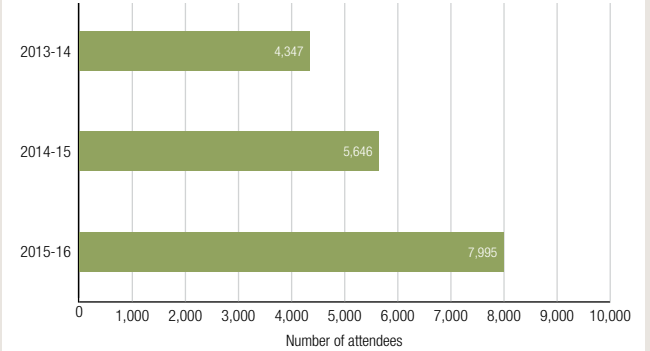
WATER Streamflow



Basin streamflow (%) compared to long-term average.

Source: Victorian Water Accounts

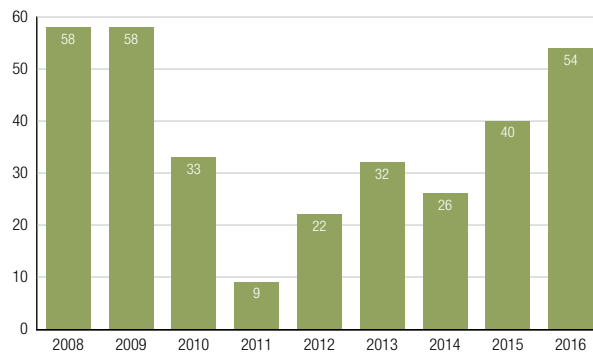
COMMUNITY Participation



Community participation in CMA engagement events.

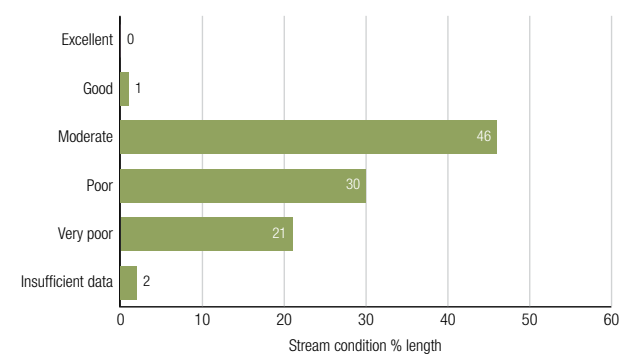
Source: Victorian Catchment Management Authorities, 2014, 2015, 2017

LAND Exposed soil



Percentage (%) Dryland area with 30-100% bare soils (higher risk of erosion) in March, 2008-16. Sources: DEDJTR, 2017a; EnSym; Guerschman et al., 2015

WATERWAYS Stream condition



Index of Stream Condition 2013 summary for the North Central region.

Source: DEPI, 2013b, p. 40

ASSESSMENT OF CATCHMENT CONDITION

LAND

- ▶ The North Central region has an elevated risk of erosion from bare soils in dryland production areas, with a dramatic increase since 2011. Drought conditions have returned to the region in the last few years.

WATER

- ▶ According to the last Index of Stream Condition benchmark conducted in 2010 (DEPI, 2013b), only one stream reach was assessed as being in 'good' condition, found in the Campaspe basin. The majority of stream reaches assessed within Campaspe and Loddon basins were mostly in 'poor' or 'very poor' condition, while the Avoca basin was predominantly in 'moderate' condition. The part of the Wimmera basin in the North Central region, the Avon-Richardson system, was mainly in 'poor' condition. Basin streamflow was significantly below the long-term average from 2011-12 to 2014-15, and condition have not eased since.

BIODIVERSITY

- ▶ The North Central region has relatively low tree cover (approximately 15%) that has increased over the last 20-30 years. The low levels seen reflect past land clearing practices, as well as the presence of native grasslands that have naturally low levels of tree cover. The North Central CMA assessed the condition of biodiversity as 'poor', though it is thought to be improving (NCCMA, 2016). The condition of ecological vegetation classes across the region was assessed using 2005 and 2013 data for vegetation extent and condition, with improvement modelled for some vegetation classes, including Eucalypt Open Forests.

COMMUNITY

- ▶ Community participation has increased over three years. The North Central CMA also reports an increase in Landcare group health score, and rates community participation as positive (NCCMA, 2016).
- ▶ The top three community concerns about environmental health relate to invasive weeds (88% of respondents), poor health of rivers and wetlands (79%), and declining numbers of native fish (75%); all considered a problem by respondents (Schirmer et al., 2016).

CASE STUDY

Protecting Northern Plains Native Grasslands: Remnant Grassland Ecosystems Project



Photo: NCCMA

“The project, in partnership with Trust for Nature, has increased the number of covenants on priority sites containing grassland, permanently protecting habitat for the Plains Wanderer and other threatened plants and animals. The combination of permanent protection and on-ground works should mean improvements in grassy ecosystem condition over time.”

LOCATION: North Central

PARTICIPANTS: North Central CMA, Trust for Nature, private landholders, DELWP, Parks Victoria, Northern Plains Conservation Management Network, Bush Heritage Australia, Barapa Barapa and Wamba Wamba Traditional Owners, local municipalities. Funded by the National Landcare Programme.

OBJECTIVES: To support landowners to protect privately-owned remnant grassy ecosystems in the lower Loddon and Avoca catchments.

Privately-owned remnant grassy ecosystems in Victoria's north central region are highly fragmented. Native grasslands were settled and developed early by Europeans due to their suitability for grazing without the need for clearing of trees and shrubs. They are among Victoria's most heavily cleared ecosystems and are now listed as nationally threatened. The project aims to protect and restore some of these fragmented ecosystems in the Northern Plains.

Many plants and animals that rely on these ecosystems are also threatened due to the scale of past and ongoing habitat loss. The critically endangered Plains Wanderer is only found in limited remnants of grasslands in the region. The project aims to protect and enhance habitat for this species.

On-ground works to assist land managers to improve the condition of their grassland areas include fencing, pest and weed control and revegetation.

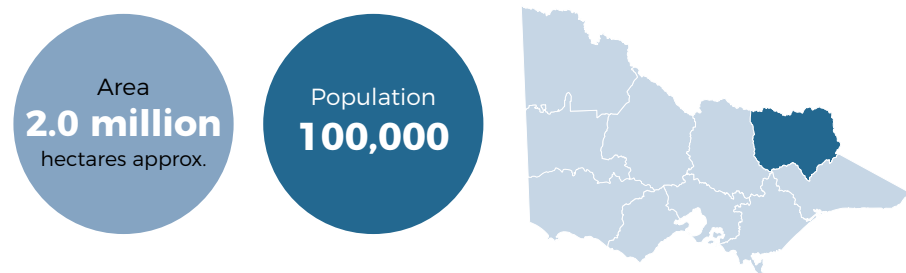
Future activities include population surveys of threatened species, plant propagation and re-introduction, and community engagement through field days. The project also aims to engage Traditional Owners in, and increase their capacity for, grassy ecosystem management (Australian Government, 2015).

The project, in partnership with Trust for Nature, has increased the number of covenants on priority sites containing grassland, permanently protecting habitat for the Plains Wanderer and other threatened plants and animals. The combination of permanent protection and on-ground works should mean improvements in grassy ecosystem condition over time.

Further to this, the success of the project to date has meant that the partnership between the CMA, conservation organisations, private landholders and Traditional Owners has led to further partnerships being established, enhancing future efforts to protect these threatened ecosystems and their plants and animals (Trust for Nature, 2015).

North East

REGIONAL CONTEXT



AGRICULTURE: 45% of catchment area is private land, mostly used for agriculture.

SIGNIFICANT NATURAL FEATURES: Alpine National Park, Mount Buffalo National Park, Chiltern- Mt Pilot National Park, Warby-Ovens National Park.

MAJOR WATERWAYS: Ovens, King, Kiewa, Mitta Mitta and Upper Murray River basins, Lake Dartmouth, Lake Hume, Ryans Lagoon, Black Swamp.

INDIGENOUS HERITAGE: Traditional Owner groups include the Yorta Yorta Nation Aboriginal Corporation, Taungurung Clans Aboriginal Corporation, and the Gunaikurnai Land and Waters Aboriginal Corporation.

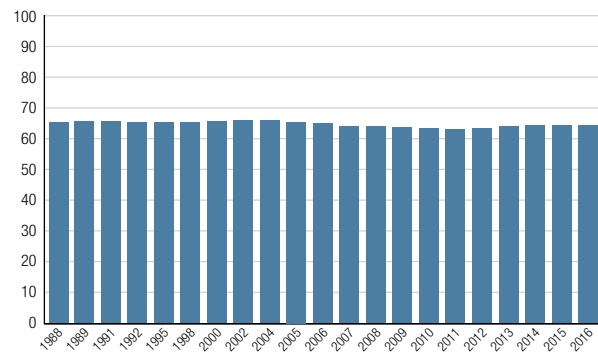
Source: NECMA, 2013



Mornings at Mt Buffalo. Photo: NECMA

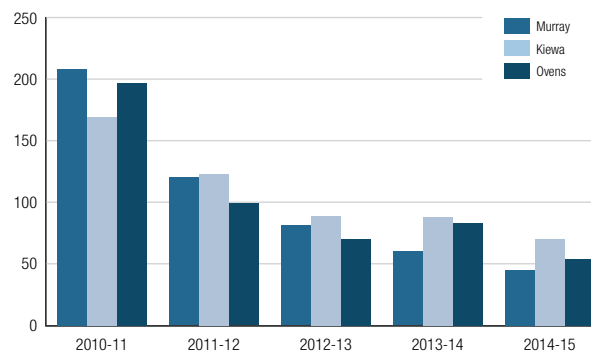
REPORT CARD

BIODIVERSITY Tree cover



Average annual percentage (%) tree cover for the North East region 1988-2016. Source: Van Dijk and Summers, 2016

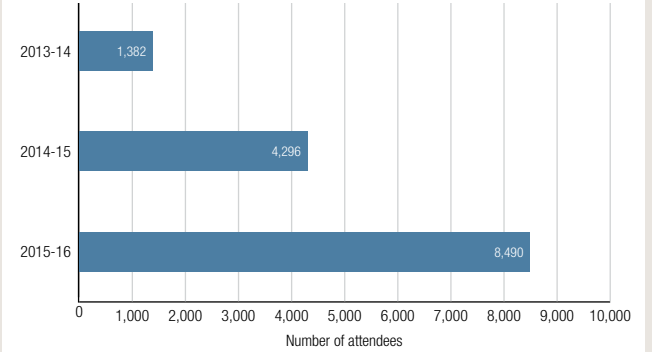
WATER Streamflow



Basin streamflow (%) compared to long-term average.

Source: Victorian Water Accounts

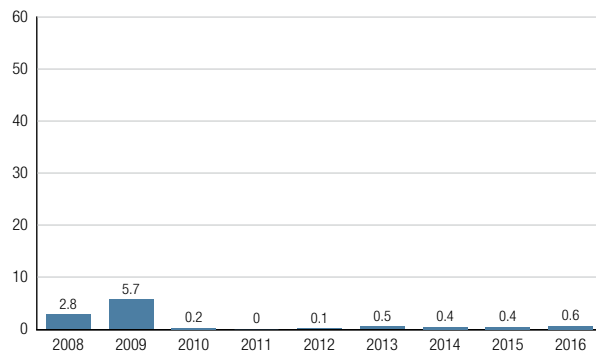
COMMUNITY Participation



Community participation in CMA engagement events.

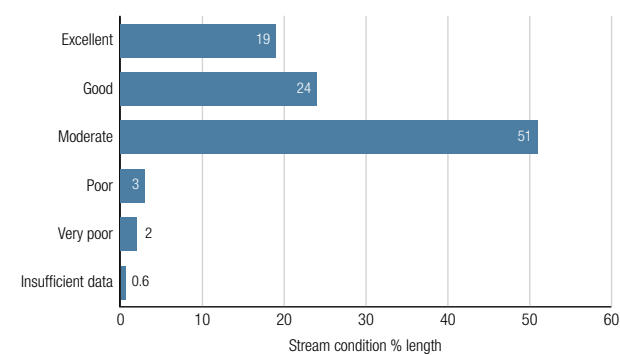
Source: Victorian Catchment Management Authorities, 2014, 2015, 2017

LAND Exposed soil



Percentage (%) Dryland area with 30-100% bare soils (higher risk of erosion) in March, 2008-2016. Sources: DEDJTR, 2017a; EnSym; Guerschman et al., 2015

WATERWAYS Stream condition



Index of Stream Condition 2013 summary for the North East region.

Source: DEPI, 2013b, p. 18

ASSESSMENT OF CATCHMENT CONDITION

LAND

- ▶ The North East region has had almost negligible risk of erosion from bare soils in dryland production areas over the last nine years. The North East CMA reports that low bare soils is a result of climatic conditions, rather than changes in land management practices or tenure (NECMA, 2016). Soil health issues include erosion, decline in soil structure, loss of organic matter, and the presence of acidic soils.

WATER

- ▶ According to the last Index of Stream Condition benchmark conducted in 2010 (DEPI, 2013b), nearly half of the region's stream reaches assessed are in 'excellent' or 'good' condition, particularly in the Upper Murray Basin. Most remaining reaches in 'moderate' condition, primarily in Kiewa and Ovens River Basins. Very few reaches were assessed as being in 'poor' condition. Basin streamflow has been slightly below the long-term average from 2012-13 to 2014-15 in the Murray, Kiewa and Ovens systems.

BIODIVERSITY

- ▶ The North East region has widespread tree cover (approximately 65% on average), with nearly 55% of the region protected in state forests and national parks. The North East CMA reported areas of continued ecosystem decline due to the long-term impacts of land clearing, inappropriate land use and livestock grazing, and invasive pest species (NECMA, 2016). Deer are a species of particular concern to the community.

COMMUNITY

- ▶ Community participation has increased over three years. Local government and the North East CMA provide opportunities for community engagement and strategic partnerships in the integrated management of catchments (NECMA, 2016).
- ▶ The top three community concerns about environmental health relate to invasive weeds (86% of respondents), pest fish species (75%), and feral animals (74%); all considered a problem by respondents (Schirmer et al., 2016).

CASE STUDY

Protecting catchment health through strategic planning



Photo: Lance Williams

“While Native Vegetation Precinct Plans for new developments have been around for a while in Melbourne’s urban growth areas, this story presents an example of strategic planning to protect natural assets in a regional urban area.”

LOCATION: North East

PARTICIPANTS: North East CMA (NECMA), City of Wodonga, Metropolitan Planning Authority, North East Water, DELWP, Goulburn Murray Water.

OBJECTIVES: To develop a strategic planning approach to growth in the Wodonga area that protects land and water resources.

The City of Wodonga is one of the fastest growing regional centres in Victoria. A proposed development corridor, the Leneva-Baranduda precinct, is projected to double the area of Wodonga over the next 40 years. The current land use is predominantly agricultural, but also contains areas of native vegetation including some areas of the threatened Box-Gum Grassy Woodland ecological community. The protection of native vegetation and waterways in this area is considered a priority.

While Native Vegetation Precinct Plans for new developments have been around for a while in Melbourne’s urban growth areas, this story presents an example of strategic planning to protect natural assets in a regional urban area.

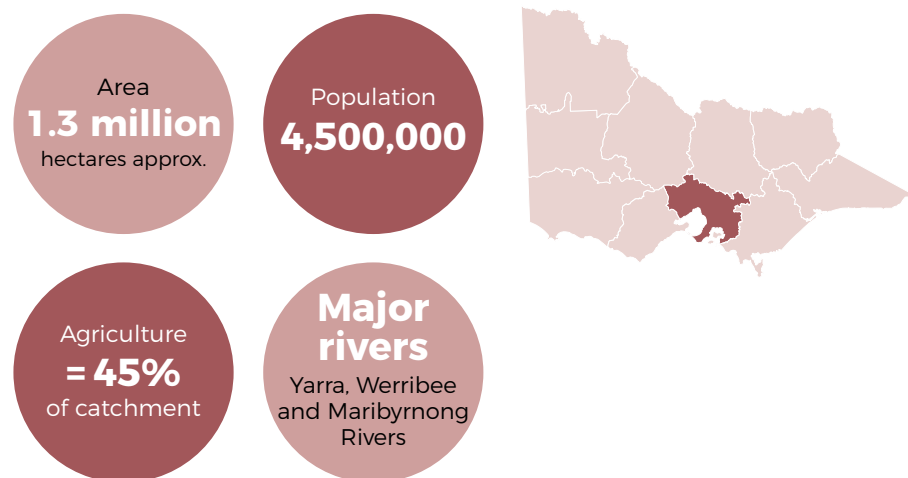
The Leneva-Baranduda growth corridor provides NECMA and other state and local government agencies with a unique opportunity to plan an integrated, sustainable and water-smart development, whilst meeting the needs of a growing population. This is the first time that this type of approach to growth area planning has been used outside of metropolitan Melbourne.

To date, government agencies have developed the draft Leneva-Baranduda Growth Area Framework Plan, Leneva Valley and Baranduda Native Vegetation Precinct Plan and Leneva-Baranduda Integrated Water Management Plan. The Native Vegetation Precinct Plan provides guidelines to protect, manage and enhance native vegetation health and habitat value in the growth area. The Water Management Plan sets out objectives for waterway management in the growth area. The Plan ensures that waterways are incorporated into new urban development in a way that protects and enhances water quality, biodiversity, and recreational opportunities.

This strategic approach to protecting land and water resources is an innovative example of planning for growth in a regional centre.

Port Phillip and Western Port

REGIONAL CONTEXT



SIGNIFICANT NATURAL FEATURES: Port Phillip Bay and Western Port, Phillip Island, Dandenong Ranges National Park, Yarra Ranges National Park, Brisbane Ranges National Park.

MAJOR WATERWAYS: Yarra River, Werribee River, Maribyrnong River, Edithvale-Seafood Wetlands (Ramsar listed), Port Phillip Bay Western Shoreline and Bellarine Peninsula Ramsar site, and Western Port (Ramsar listed).

INDIGENOUS HERITAGE: Wurundjeri Tribe Land Compensation and Cultural Heritage Council, Wathaurung Aboriginal Cooperative, Boon Wurrung Foundation, and Bunurong Land Council Aboriginal Corporation.

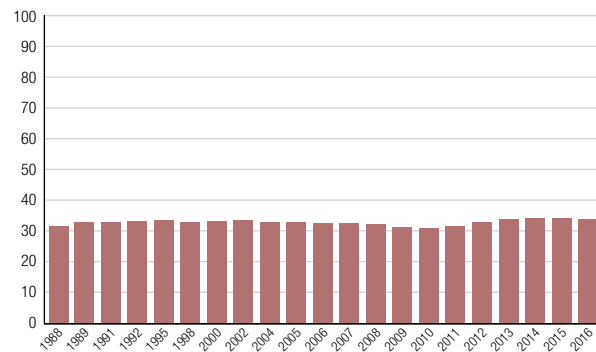
Source: PPWCMA, 2016



Melbourne's natural environment is a drawcard for residents and tourists. Photo: PPWCMA

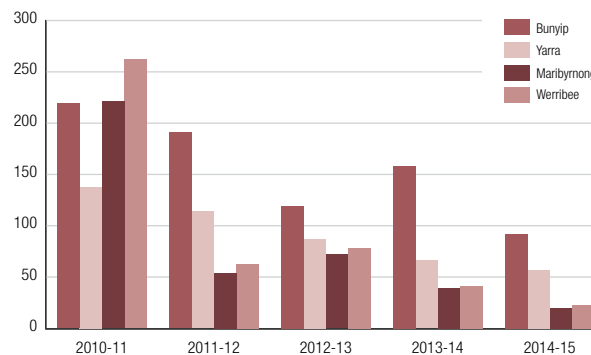
REPORT CARD

BIODIVERSITY Tree cover



Average annual percentage (%) tree cover for the Port Phillip and Western Port region 1988-2016. Source: Van Dijk and Summers, 2016

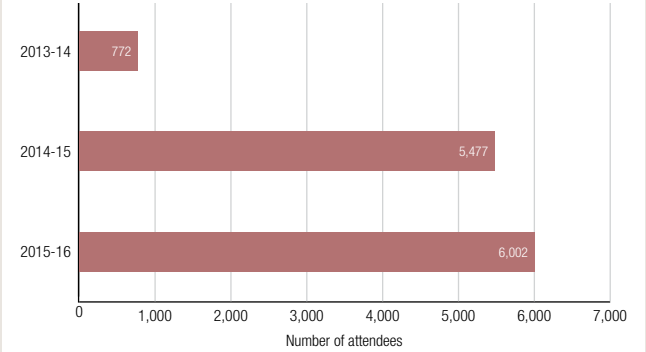
WATER Streamflow



Basin streamflow (%) compared to long-term average.

Source: Victorian Water Accounts

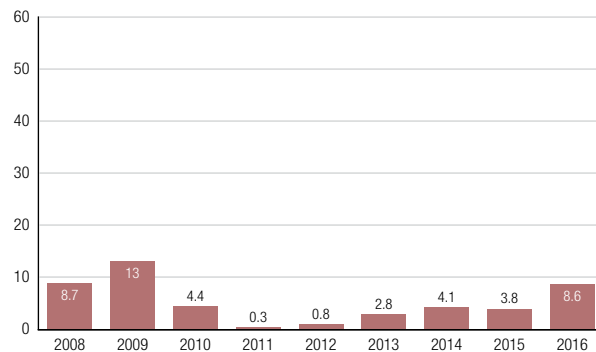
COMMUNITY Participation



Community participation in CMA engagement events.

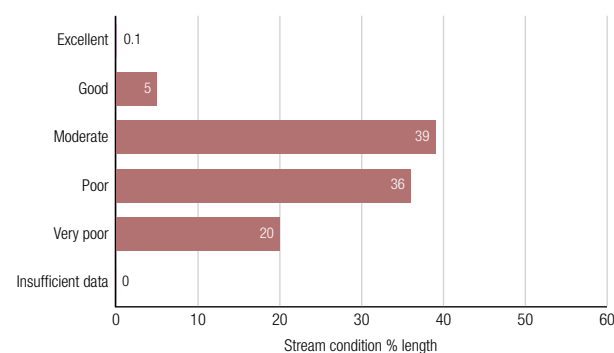
Source: Victorian Catchment Management Authorities, 2014, 2015, 2017

LAND Exposed soil



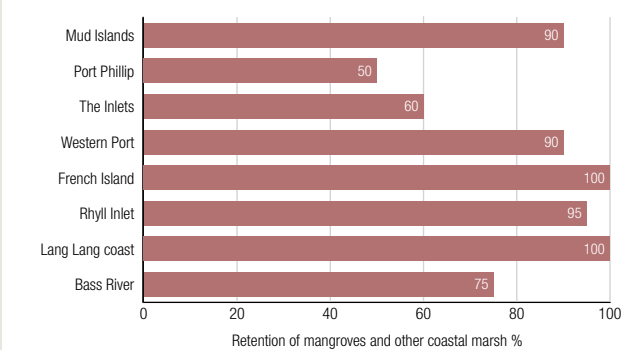
Percentage (%) Dryland area with 30-100% bare soils (higher risk of erosion) in March, 2008-16. Sources: DEDJTR, 2017a; EnSym; Guerschman et al., 2015

WATERWAYS Stream condition



Index of Stream Condition 2013 summary for the Port Phillip and Western Port region. Source: DEPI, 2013b, p. 98

COASTS Vegetation retention



Estimated total retention (%) of Mangroves and Other Coastal Marsh from pre-1750 to ~2008. Source: Sinclair and Boon, 2012

ASSESSMENT OF CATCHMENT CONDITION

LAND

- ▶ The Port Phillip and Western Port region has had minimal area of bare soils in dryland production areas over the last nine years, compared to other regions. Other erosion risk factors, such as wind storms or rain events, have not caused significant erosion events in recent years.
- ▶ Urbanisation has been and continues to be an important influence on land condition in the region through increases in the proportion of land with impervious surfaces (PPWCMA, 2016).

WATER

- ▶ According to the last Index of Stream Condition benchmark conducted in 2010 (DEPI, 2013b), stream reaches assessed included the Bunyip, Yarra, Maribyrnong, Werribee, Moorabool, and parts of the South Gippsland Basins, which are generally assessed as being in 'moderate' or 'poor' condition. Basin streamflow has declined since 2010-11, with the exception of the Bunyip basin, which has remained above or close to the long-term average. Melbourne Water regularly assesses river health in Dandenong, Maribyrnong, Werribee, Westernport and Yarra catchments across a range of measures. The overall health of waterways is gradually stabilising or improving due to the work of many organisations and the leadership of Melbourne Water.

BIODIVERSITY

- ▶ Tree cover across the Port Phillip and Western Port region is moderate, comprising approximately 30% of the land area. Tree cover is mostly represented in Yarra Ranges National Park, Lerderderg State Park, Brisbane Ranges National Park, and French Island National Park. The Port Phillip and Westernport CMA reports that around 40% of the land area contains native vegetation, some of which is grasslands that naturally have low levels of tree cover (PPWCMA, 2016). Vegetation losses associated with urbanisation and intensive land management continue to be a challenge.

COASTS

- ▶ The *State of the Bays 2016* report comprehensively assessed the condition of Port Phillip Bay and Western Port, and concluded that both are generally healthy given their proximity to large urban areas (Commissioner for Environmental Sustainability, 2016). Aspects of the condition of Port Phillip Bay have improved over a few decades, particularly nutrients, water clarity, and algae levels.
- ▶ The region shows high retention of mangroves and coastal marsh, except for low retention of saltmarsh in Port Phillip Bay due to urbanisation (Sinclair and Boon, 2012).

COMMUNITY

- ▶ Community participation has increased over three years. The Port Phillip and Westernport CMA supports a range of region-wide and local projects, in partnership with local government, Landcare, and land managers (PPWCMA, 2016).
- ▶ The survey results need to be interpreted with caution as sample size is small compared to the region's population of 4.5 million people. The top three community concerns about environmental health relate to invasive weeds (80% of respondents), feral animals (66%), and declining numbers of native animals (62%); all considered a problem by respondents (Schirmer et al., 2016).



Photo: PPWCMA

CASE STUDY

Protecting Ramsar wetlands through partnerships and community support

LOCATION: Port Phillip and Western Port

PARTICIPANTS: Port Phillip and Westernport CMA (PPWCMA) has formal partnership agreements established to deliver environmental actions with Hobsons Bay City Council, Parks Victoria, Western Port Biosphere, Phillip Island Nature Parks, French Island Landcare, Bass Coast Landcare Network, Mornington Peninsula Shire, City of Casey, BirdLife Australia, BlueScope Steel and Lang Lang Foreshore Reserve Committee of Management. Funding from the Australian Government's National Landcare Programme and DELWP.

OBJECTIVES: To protect the ecological values of Western Port, and Port Phillip Bay Western Shoreline and Bellarine Peninsula Ramsar sites.

Western Port and the western shoreline of Port Phillip Bay wetland sites support a wide range of plants and animals of conservation significance. The sites are listed as wetlands of international importance under the Ramsar Convention on Wetlands. Australia has an obligation under this convention to manage these sites to maintain their ecological character. To help fulfil this obligation, the PPWCMA is coordinating the Ramsar Protection Program.

PPWCMA undertook a series of prioritisation workshops and steering committee meetings with stakeholders and

community groups. These allowed program partners to identify and implement priority management strategies and actions for each wetland site.

The program aims to reduce threats to the sites such as pest plants and animals. On-ground management activities include annual fox and rabbit control, weed control and fencing at the wetland sites. These on-ground works help improve the health and resilience of the wetlands. It also aims to promote community participation and involvement in wetland management, with opportunities to volunteer on a wetland protection project. PPWCMA also supports landholders that wish to protect and improve wetland values on their land. The CMA works with local communities to improve their understanding of these internationally significant wetlands. More than 500 people have attended special events such as open days and wetland tours, training programs and workshops.

The program demonstrates how collaboration and individual land management by program partners, as well as other stakeholders, can help protect our wetlands. Land managers previously conducted pest plant and animal control works to varying levels and without the benefit of overall coordination. The program allows PPWCMA to coordinate local community and government organisations in their efforts to protect the wetlands.

Partners now participate in collaborative planning to coordinate the timing of on-ground management works across multiple land tenures. This helps improve the efficiency and effectiveness of management programs at the sites. The program provides a catalyst for establishing good working relationships with neighbours, whether they are government organisations with responsibility for land in the region, or local landholders (PPWCMA, 2013).

The program also demonstrates how the wider community, particularly local residents and visitors, can play an important role in protecting the wetland sites. Targeted community engagement has led to a significant change in community perceptions of wetlands and in management behaviour. For example, there has been an increase in the uptake of private landholder incentives to protect wetlands.

The Ramsar Protection Program is now seeing significant improvements in the condition of critical wetland habitat. For example, the condition and extent of saltmarsh vegetation communities has improved as a result of pest plant and animal control activities. This in turn has led to localised increases in waterbird abundance, diversity and breeding, with increased sightings of migratory water birds.

CASE STUDY

Working with local communities to improve waterway health: celebrating 21 years of the River Health Incentives Program

LOCATION: Port Phillip and Western Port

PARTICIPANTS: Private landholders, community, local government. Funded by Melbourne Water.

OBJECTIVES: To work in partnership with the community to improve waterway health and support best practice land management near stream frontages.

Melbourne's population is projected to double by 2050. Waterways and wetlands in the Port Phillip and Western Port region face threats to water quality and riparian vegetation from factors such as urbanisation, weed invasion, erosion and poor land management practices (e.g stock access). Waterways in the region in the poorest condition most often occur where rivers, streams and creeks flow through rural and urban landscapes where riparian vegetation is poor and drainage from agricultural lands and hard urban surfaces flows to waterways.

Melbourne Water's River Health Incentives Program (RHIP) is celebrating 21 years of partnership with landowners, local government, Parks Victoria and community groups, providing funding and technical support to improve the condition of waterways in the region. Since the Program began 21 years ago, it has facilitated more than 12,000 environmental projects across Melbourne's waterways and has worked with over 230 community groups, 38 councils and 4,300 individuals to improve the environmental health of Melbourne's rivers and creeks.

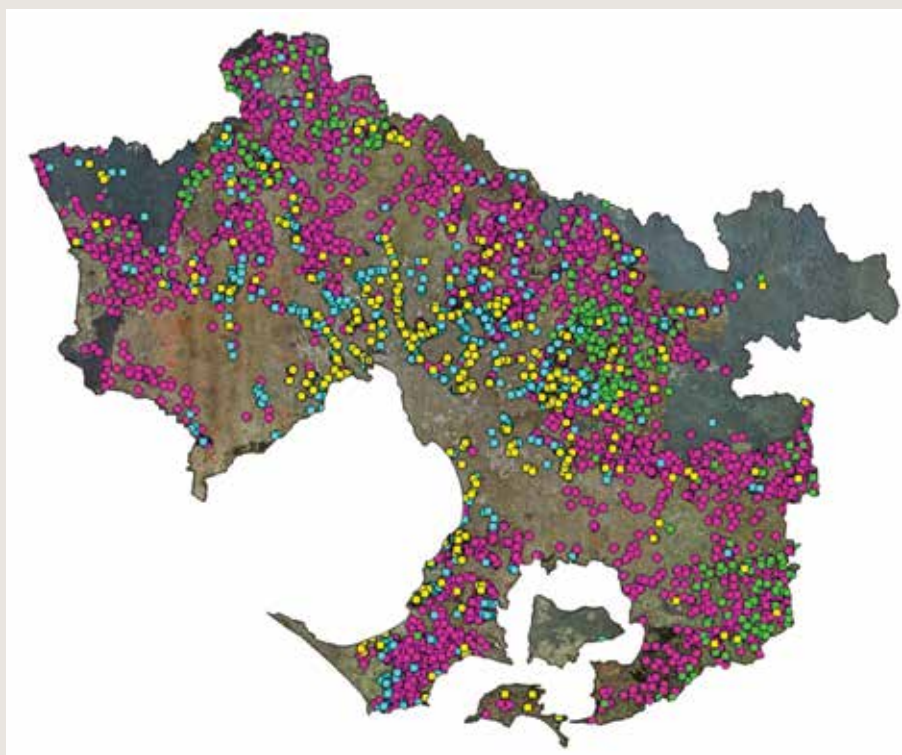


Figure 50. Sites funded under the River Health Incentives Program, 1996-2016.

Source: Melbourne Water

“The efforts of the community though the Program, along with other Melbourne Water works programs, contribute to the overall health of waterways in the region by, for example, improving riparian vegetation, and reducing sediment and nutrient flowing into streams. Improvements in river health are expected over the long term, especially in areas that are not impacted by increased upstream development.”

Melbourne Water provides a range of incentives suited to different types of landholders and aspects of waterway health. Figure 50 shows sites funded under these programs over the past 21 years.

On-ground management works funded through the Program include fencing waterways to exclude stock, weed control, minor river bed and bank stabilisation, revegetation works, whole farm planning and nutrient and sediment reduction works. Public and private landholders and the community share costs and/or provide in-kind support towards delivering management activities. Other Melbourne Water works, such as woody weed removal projects, often work in tandem with the activities delivered under the Program.

The programs also provide advice and training to local landholders to help them develop their management skills, and to increase their knowledge about land and waterway condition and management.

The efforts of the community though the Program, along with other Melbourne Water works programs, contribute to the overall health of waterways in the region by, for example, improving riparian vegetation, and reducing sediment and nutrient flowing into streams. Improvements in river health are expected over the long term, especially in areas that are not impacted by increased upstream development.

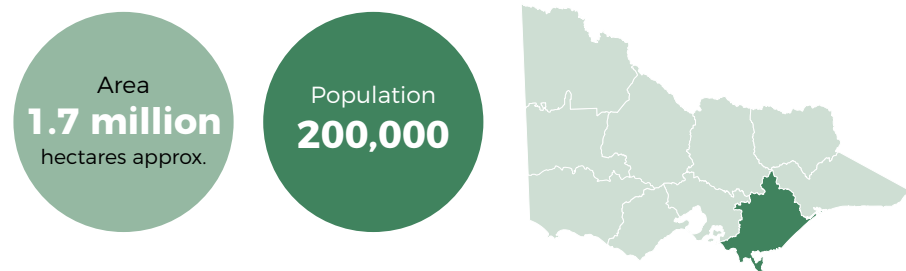
The Program also provides more intangible benefits through its focus on community collaboration and participation. For example, the Program builds on existing knowledge and enthusiasm for waterway management and shares costs and effort with the recipients. This approach has resulted in increased empowerment, stewardship and advocacy amongst land managers and the community.



Photo: Melbourne Water

West Gippsland

REGIONAL CONTEXT



AGRICULTURE: 54% of catchment area is private land, much of which is used for agriculture. The main agricultural enterprises are dairy, grazing and meat production, forestry and vegetables.

SIGNIFICANT NATURAL FEATURES: Corner Inlet (Ramsar listed) Gippsland Lakes (Ramsar listed), Wilsons Promontory National Park, Tarra Bulga National Park, Victorian Alps.

MAJOR WATERWAYS: Thomson, Latrobe, Macalister, Avon, Perry, Powlett, Tarwin and Tarra Rivers.

INDIGENOUS HERITAGE: Gunaikurnai peoples (Brataualung, Brayakaulung, Tatungalung), Kulin peoples (Bunurong, Boon Wurrung, Wurundjeri).

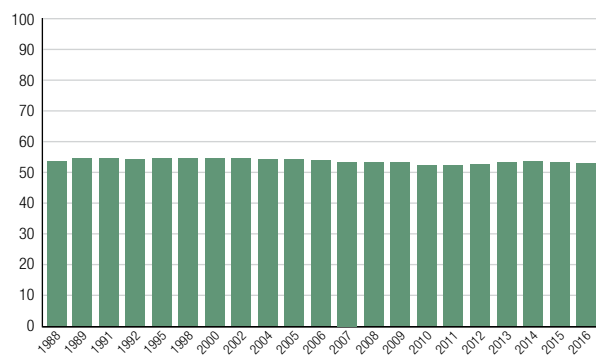
Source: WGCMA, 2012



Aerial view of Anderson Inlet. Photo: WGCMA

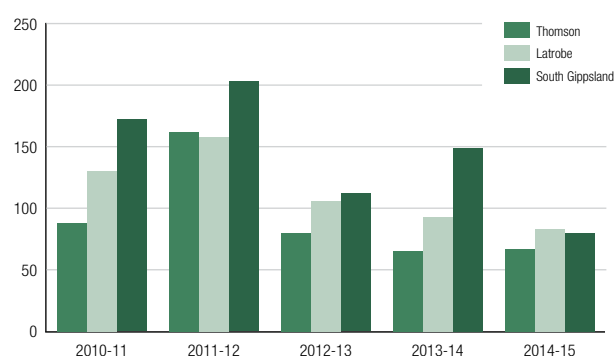
REPORT CARD

BIODIVERSITY Tree cover



Average annual percentage (%) tree cover for the West Gippsland region 1988-2016. Source: Van Dijk and Summers, 2016

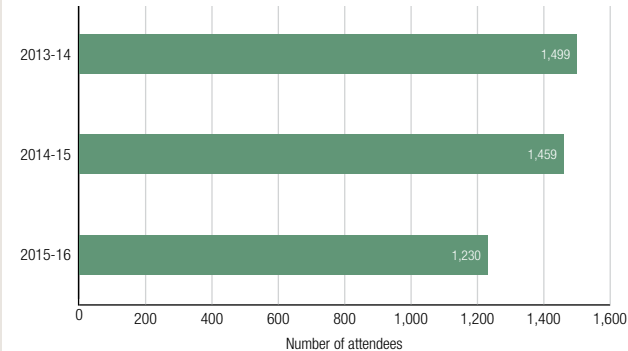
WATER Streamflow



Basin streamflow (%) compared to long-term average.

Source: Victorian Water Accounts

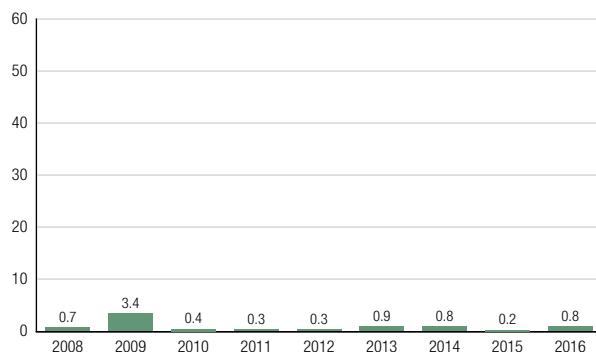
COMMUNITY Participation



Community participation in CMA engagement events.

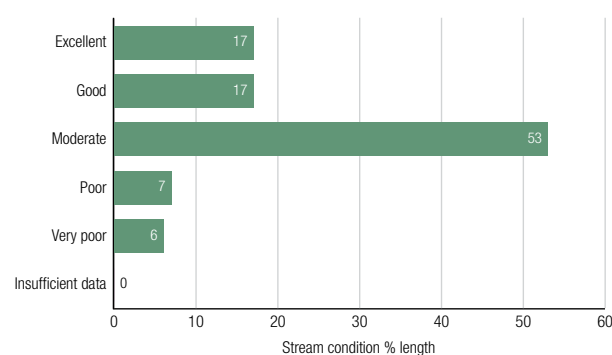
Source: Victorian Catchment Management Authorities, 2014, 2015, 2017

LAND Exposed soil



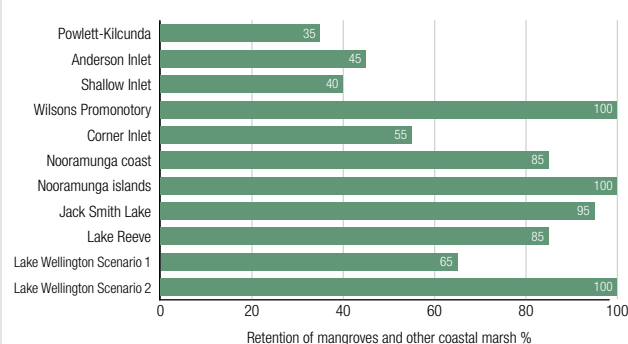
Percentage (%) Dryland area with 30-100% bare soils (higher risk of erosion) in March, 2008-2016. Sources: DEDJTR, 2017a; EnSym; Guerschman et al., 2015

WATERWAYS Stream condition



Index of Stream Condition 2013 summary for the West Gippsland region. Source: DEPI, 2013b, p. 84

COASTS Vegetation retention



Estimated total retention (%) of Mangroves and Other Coastal Marsh from pre-1750 to ~2008. Source: Sinclair and Boon, 2012

ASSESSMENT OF CATCHMENT CONDITION

LAND

- ▶ The West Gippsland region has had almost negligible risk of erosion from bare soils in dryland production areas over the last nine years. However, erosion risk is present in parts of the catchment with steep slopes and approximately 24% of private land was modelled as being at high or very high risk of gully and tunnel erosion (WGCMA, 2016).

WATER

- ▶ According to the last Index of Stream Condition benchmark conducted in 2010 (DEPI, 2013b), 34% of stream reaches assessed were in 'excellent' or 'good' condition, mostly located in Thomson and Latrobe Basins. The majority of stream reaches assessed in the region were in 'moderate' condition (DEPI, 2013b). Basin streamflow was above the long-term average from 2010-11 to 2011-12, and close to or slightly below the long-term average from 2012-13 to 2014-15.

BIODIVERSITY

- ▶ Tree cover in West Gippsland is relatively high (approximately 50% on average) and has remained stable over last 20 years. Areas of high tree cover are primarily located in northern part of the catchment, along the Great Dividing Range. The West Gippsland CMA reports that native vegetation extent is 'poor' to 'moderate' in the catchment's lower reaches, mainly as a result of fragmentation on private land.

COASTS

- ▶ The West Gippsland coasts shows three sections with low retention of coastal marsh, primarily due to conversion to pasture (Sinclair and Boon, 2012), though the West Gippsland CMA reports that 7,632 ha of mangroves and saltmarsh were recently mapped in the Corner Inlet stretch, a figure that exceeds the estimated pre-1750 area (Sinclair and Boon, 2012; WGCMA, 2016).
- ▶ The region has several coastal national parks and coastal parks that provide higher levels of protection for the areas of coasts covered, reportedly more than 56,000 ha (WGCMA, 2016).

COMMUNITY

- ▶ Community participation has remained stable over three years. West Gippsland CMA works with Landcare, private landholders and government agencies to deliver catchment management outcomes (WGCMA, 2016).
- ▶ The top three community concerns about environmental health relate to invasive weeds (81% of respondents), feral animals (70%), and declining numbers of native fish (62%); all considered a problem by respondents (Schirmer et al., 2016).



Photo: WGCMA

CASE STUDY

Improving catchment health through local connections: Corner Inlet Connections project



Figure 51. Location of Corner Inlet in the West Gippsland region.

LOCATION: West Gippsland

PARTICIPANTS: West Gippsland CMA, Parks Victoria, Birdlife Australia, DELWP, South Gippsland Water, local government, Environment Protection Authority, Agriculture Victoria, industry partners, research organisations, community groups, Gunaikurnai Land and Waters Aboriginal Corporation, Australian Government.

OBJECTIVES: The Corner Inlet Connections project aims to protect catchment health through partnerships between government agencies, landowners and the local community.

Corner Inlet (Figure 51) is located about 200 km south-east of Melbourne in the West Gippsland region. It is the third largest coastal bay in Victoria and includes a complex network of intertidal mangroves, saltmarsh, mud banks, seagrass beds, rocky islands and deeper channels.

The area supports unique plant communities, provides a feeding, nesting and breeding area for thousands of waterbirds, and is one of the most important areas in Victoria for shorebirds. The site is listed under the Ramsar Convention as a wetland of international significance. It is culturally significant to the Gunaikurnai, Bunurong and Boon Wurrung peoples, and is an important farming and fishing area.

In recent years, local fishers, recreational users and communities have expressed concern about the health of land and water resources at the site. Land uses such as farming, forestry and urban development have contributed to sediment and nutrient

loads entering waterways from the surrounding catchment, and threatened environmentally significant areas. Pest plants and animals are also a problem.

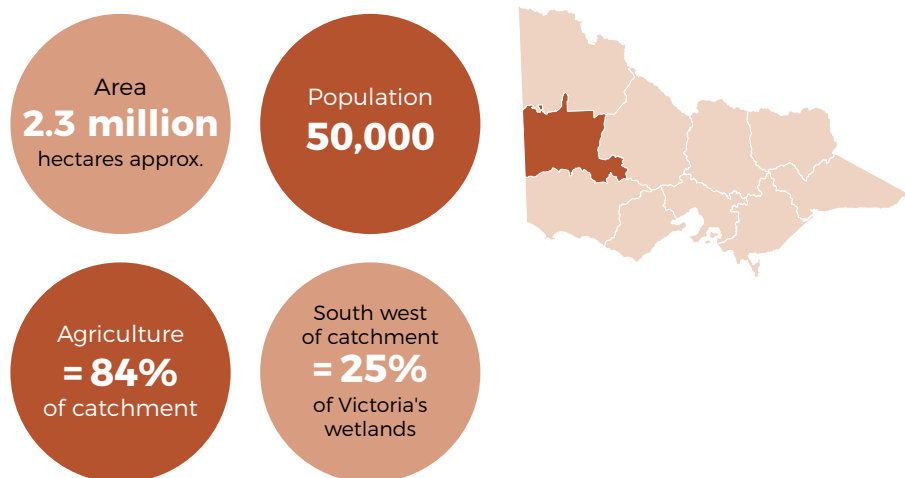
Corner Inlet Connections is a partnership between government agencies, landowners, industry and the local community. The partnership aims to maintain and improve the environmental, agricultural and economic sustainability of the inlet and its surrounds. In particular, the project seeks to raise community awareness about the connection between catchment health and the health of the Ramsar site, through knowledge and skill sharing and practical on-farm improvements.

On-ground works to address water quality issues include the protection of saltmarsh vegetation and rivers through stock exclusion, and revegetation of rivers, creeks and drains. The CMA has carried out control programs for gully, hill slope and drainage erosion issues, whilst local farmers have substantially improved effluent and fertiliser management on their dairy farms. Parks Victoria, Yarram Yarram Landcare Network and local landholders have undertaken a range of pest plant and animal control works on both public and private land.

These on-ground works were complemented by a range of media articles, field visits and community days to increase community awareness of, and participation in, the need to protect catchment health. These community engagement activities have lifted the profile of Corner Inlet as a community asset, helping to safeguard catchment health into the future.

Wimmera

REGIONAL CONTEXT



SIGNIFICANT NATURAL FEATURES: Grampians (Gariwerd) National Park, Little Desert National Parks, the Black Range, Mt Arapiles–Tooan State Parks and the Pyrenees Range.

MAJOR WATERWAYS: Wimmera River flows into terminal lakes, Lake Albacutya and Lake Hindmarsh, which are significant wetlands. South west of catchment contains 25% of Victoria's wetlands.

INDIGENOUS HERITAGE: Traditional Owners include the Barengi Gadjin Land Council Aboriginal Corporation.

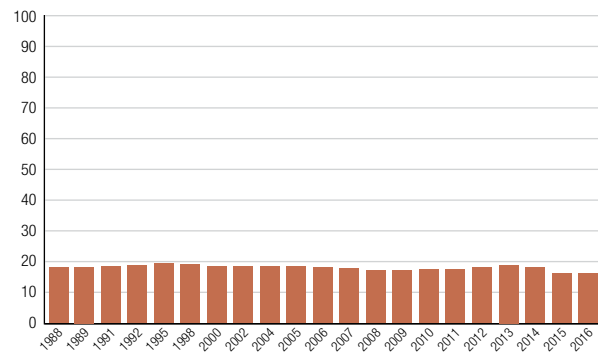
Source: WCMA, 2013



Wimmera River, Jeparit. Photo: David Fletcher

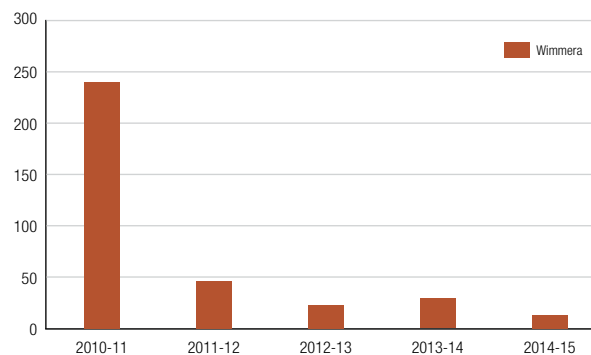
REPORT CARD

BIODIVERSITY Tree cover



Average annual percentage (%) tree cover for the Wimmera region 1988-2016. Source: Van Dijk and Summers, 2016

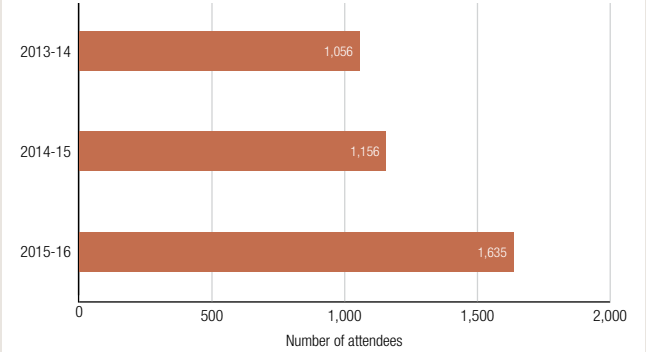
WATER Streamflow



Basin streamflow (%) compared to long-term average.

Source: Victorian Water Accounts

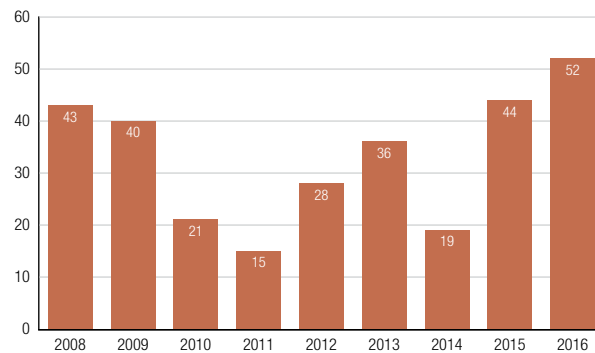
COMMUNITY Participation



Community participation in CMA engagement events.

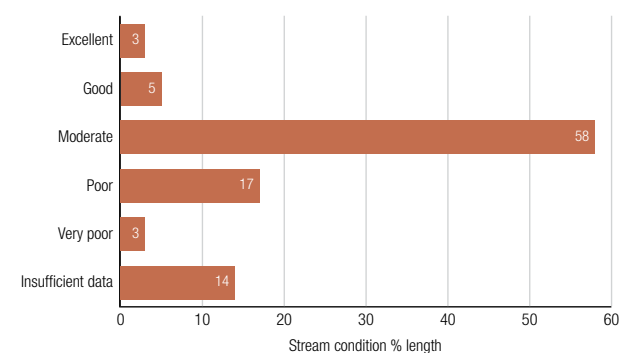
Source: Victorian Catchment Management Authorities, 2014, 2015, 2017

LAND Exposed soil



Percentage (%) Dryland area with 30-100% bare soils (higher risk of erosion) in March, 2008-16. Sources: DEDJTR, 2017a; EnSym; Guerschman et al., 2015

WATERWAYS Stream condition



Index of Stream Condition 2013 summary for the Wimmera region.

Source: DEPI, 2013b, p. 52

ASSESSMENT OF CATCHMENT CONDITION

LAND

- ▶ The Wimmera region has had an elevated risk of erosion from bare soils in dryland production areas in the last two years at levels higher than the end of the Millennium drought, though the Wimmera CMA reported no major erosion events in the last year (WCMA, 2016). 2010-11 and 2014 were years of lower risk due to favourable climatic conditions.

WATER

- ▶ According to the last Index of Stream Condition benchmark conducted in 2010 (DEPI, 2013b), stream reaches assessed are mostly in moderate to poor condition, with some river reaches in the Wimmera basin in excellent or good condition in the northern Grampians National Park. There is insufficient data for most stream reaches in the Millicent Coast basin. Basin streamflow for the Wimmera system has declined significantly from 2010-11 to 2014-15. High stream flows in 2010-11 were the result of floods in September 2010 and January 2011 and there have been dry rainfall years since.

BIODIVERSITY

- ▶ Tree cover is mostly contained in Little Desert National Park, Grampians National Park, and other parks and has slightly declined in the last two years. West Wimmera is comprised of over 30% grasslands. According to the Wimmera CMA, the region experienced little change in biodiversity condition over the last year, and weed invasion was reduced as a result of the persistent dry conditions (WCMA, 2016). However, the dry conditions also meant that revegetation has varied rates of plant survival and have also caused a decline in native grassland condition.

COMMUNITY

- ▶ Community participation has increased over three years. The Wimmera CMA boosted its participation numbers as a result of increased funding in 2015-16, though population decline continues to put pressure on Landcare groups in the region (WCMA, 2016).
- ▶ The top three community concerns about environmental health relate to poor health of rivers and wetlands (83% of respondents), invasive weeds (83%), and declining numbers of native fish (82%); all considered a problem by respondents (Schirmer et al., 2016). Recent research by Curtis and Mendham (2017) supports community concerns mentioned around the impact of reduced water flows on the long-term health of waterways as this was the top issue along with reduced opportunities for recreation as lakes dry out. Decline in soil health was also of high concern.

CASE STUDY

Bringing together scientific and Indigenous perspectives on biodiversity



Photo: Kathryn Walker

“The project helped build trust and understanding between non-Indigenous partners and Traditional Owners by demonstrating how we will actively seek to involve Aboriginal people in programs according to their specific community aspirations and interests.”

LOCATION: Wimmera

PARTICIPANTS: DELWP Grampians, the Barengi Gadjin Land Council (representing Traditional Owners in the Wimmera region from Wotjobaluk, Jaadwa, Jadawadjali, Wergaia and Jupagulk family groups), Wimmera CMA, Horsham Primary School, Department of Education and Training (DET) and the Local Aboriginal Education Consultative Group.

OBJECTIVES: To enable primary school students to learn about local plants and animals from both a scientific and Aboriginal perspective, and engage Aboriginal communities and build partnerships.

The Nyupun pilot project was set up in 2016 as part of a broader effort to increase Aboriginal participation and engagement in integrated catchment management in the Wimmera (Victorian Catchment Management Authorities, 2017). The word “Nyupun” means ‘Spiritual Being’ in the local Wotjobaluk culture. The pilot project aims to support local Aboriginal and Torres Strait Islander students by bringing local Indigenous culture into the classroom.

The eight-week pilot class involved 13 students from Horsham Primary School, and an expanded version of this project is due to be developed in 2017. Students received a Nyupun flora or fauna species local to the region and learnt about the Nyupun’s significance in the Wotjobaluk culture.

The project demonstrates the importance of increased participation by and engagement of Aboriginal community members in Wimmera integrated catchment management activities. It also highlights the benefits of strong ongoing partnerships and working relationships between Aboriginal groups and public and private land and water managers.

The students subsequently became involved in other activities including tree planting activities and community engagement events. The relationship between the Barengi Gadjin Land Council and Horsham Primary School families improved as a result of the project. The project helped build trust and understanding between non-Indigenous partners and Traditional Owners by demonstrating how we will actively seek to involve Aboriginal people in programs according to their specific community aspirations and interests. It has helped build momentum for a significant increase in participation and engagement of the wider Aboriginal community in projects over the last 12 months, including an increase in Aboriginal staff in the CMA.

The program also provides a good example of how Aboriginal knowledge of plants and animals can complement Western, scientific perspectives on ‘biodiversity’, and thus benefit catchment management activities.

Data sources

Theme, data source	Reference
Land Victorian Land Use Information System (VLUIS)	DEDJTR, (2017a) Victorian Land Use Information System 2016. Victorian Government Department of Economic Development, Jobs, Transport and Resources, Melbourne, Victoria.
Land Gross value of agricultural commodities produced in Victoria, 2009-10 to 2014-15	ABS, (2017b). 7503.0 - Value of Agricultural Commodities Produced.
Land Fractional land cover, bare soils	Guerschman, J.P., Scarth, P.F., McVicar, T.R., Renzullo, L.J., Malthus, T.J., Stewart, J.B., Rickards, J.E., Trevithick, R., (2015). Assessing the effects of site heterogeneity and soil properties when unmixing photosynthetic vegetation, non-photosynthetic vegetation and bare soil fractions from Landsat and MODIS data. <i>Remote Sensing of Environment</i> 161, 12–26.
Water Index of stream condition	DEPI, (2013b). Index of stream condition: The third benchmark of Victorian river condition. Victorian Government Department of Environment and Primary Industries, East Melbourne, Victoria. DSE, (2005). Index of Stream Condition: The Second Benchmark of Victorian River Condition. Victorian Government Department of Sustainability and Environment, East Melbourne, Victoria.
Water Total Victorian Streamflow Basin Streamflow	DELWP, (2016e). Victorian Water Accounts: 2014–2015. A statement of Victorian water resources. Victorian Government Department of Environment, Land, Water and Planning, East Melbourne, Victoria.
Water Total inflows to Melbourne's water storages	Melbourne Water, https://www.melbournewater.com.au/waterdata/waterstorages/Pages/Inflow-over-the-years.aspx

Theme, data source	Reference
Water Environmental water availability and delivery	VEWH, (2016). Annual Report 2015-16. Victorian Environmental Water Holder, East Melbourne, Victoria.
Biodiversity Native vegetation net gain and loss	DELWP, (2016k). Protecting Victoria's Environment Biodiversity 2036 - Public Consultation Draft. Victorian Government Department of Environment, Land, Water and Planning, East Melbourne, Victoria. DSE, (2008). Native vegetation net gain accounting first approximation report. Victorian Government Department of Sustainability and Environment, East Melbourne, Victoria.
Biodiversity Native vegetation condition	DELWP, (2017d). Native Vegetation Regulation (2013) Native Vegetation Condition (2010) version 2: 75m resolution - Victorian Government Data Directory. https://www.data.vic.gov.au/data/dataset/native-vegetation-regulation-2013-native-vegetation-condition-2010-version-2-75m-resolution (accessed 4.7.17).
Biodiversity Tree cover	Van Dijk, A.I.J.M., Summers, D., (2016). Australia's Environment in 2016. The Australian National University. http://www.wenf.org/aus-env .
Coasts Percentage retention (compared to modelled pre-1750) of mangroves and other coastal marsh at selected sites on the Victorian coast	Sinclair, S., Boon, P.I., (2012). Changes in the area of coastal marsh in Victoria since the mid 19th century. <i>Cunninghamia</i> 12, 153–176.
Community Community perceptions of environmental problems	Schirmer, J., Yabsley, B., Mylek, M., Peel, D., (2016). Wellbeing, resilience and liveability in regional Australia: The 2015 Regional Wellbeing Survey. University of Canberra, Canberra, ACT. Data sourced from the 2015 Regional Wellbeing Survey, Victorian NRM regions data tables, Version 1.01 July 2016.
Community Number of participants at CMA engagement events	Victorian Catchment Management Authorities, (2017). Actions & Achievements Report 2015-16. Corangamite CMA, East Gippsland CMA, Glenelg Hopkins CMA, Goulburn Broken CMA, Mallee CMA, North Central CMA, North East CMA, Port Phillip and Westernport CMA, West Gippsland CMA, Wimmera CMA, Colac, Bairnsdale, Hamilton, Shepparton, Irymple, Huntly, Wodonga, Frankston, Traralgon, Horsham, Victoria.

Acknowledgements

The VCMC would like to thank the following people for their contribution to this report

Adam Green
Adrian Moorrees
Amber Clarke
Andrew Rhodes
Ann Kollmorgen
Anne Buchan
Anthony Boxshall
Barry Hart
Bec Hemming
Brad Drust
Brett Ahmat
Bruce Turner
Catherine Allan
Chris Norman
Chris Walsh
Christine Forster
Dale Watson
David Brennan
David Buntine
David Cummings
Doug Evans
Fiona Deppeler
Fiona McKenzie

Geoff Steendam
Gillian Sparkes
Gordon Forbes
Graeme Dear
Graham Phelps
Ian Campbell-Fraser
Irene Kelly
James Shaddick
James Todd
Jane Fisher
Jane Young
Jason King
Jenny Collins
Jessica Barnes
Johanna Slijkeman
John Robinson
Julie Edwards
Karen Moodie
Kath Rowley
Kate Brunt
Katie Warner
Kelly Snell
Kevin Wood

Leon Metzeling
Mark Eigenraam
Martin Fuller
Michael Rees
Nadine Gaskell
Neil McCarthy
Nicola Waldron
Nina Cullen
Paul Bennett
Paul Reich
Paul Wilson
Paula Camenzuli
Peter Vollebergh
Scott Rawlings
Sheri Burmeister
Ted Lefroy
Tim Fletcher
Tracey Jones
Troy McDonald
Trish Grant
Vivienne Clare
Zaida Contreras

VCMC:

Angus Hume (Chair)
Alana Johnson
Amity Dunstan
Geoff Park
Joan Liley
Lance Lloyd
Peta Maddy

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Patricia Geraghty
Phil Wallis (Project Manager)
Tracey Koper
Neil Meyers

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