



SHEPPARTON IRRIGATION REGION (AGRICULTURAL FLOODPLAINS) LAND AND WATER MANAGEMENT PLAN 2016-2020

THE FINAL UPDATE OF THE 1990-2020 PLAN

GROWING THE NATURAL ADVANTAGE - PART A



FOREWORD

For 25 years community and agencies have worked together to tackle issues that threaten the natural resources underpinning agricultural production across the Shepparton Irrigation Region (SIR). Considerable progress has been made over this time. Implementing, reviewing and renewing our SIR Land and Water Management Plan have been essential steps. This process has ensured we set actions and targets, report on progress and reflect regional priorities. We are now implementing the last 5 years of a 30-year plan, a significant achievement for catchment management.

Our success is built on strong and enduring partnerships, an approach that is reflected in the development of this plan, the fifth and final iteration. A community led Taskforce was established under the guidance of the Sustainable Irrigation Program Advisory Group to look at the previous plan and identify emerging issues and actions to make the SIR a world-leader in the sustainable production of milk, fruit, vegetables, grains and meat. The Taskforce directed a way forward for this sustainable production that also protects and enhances our natural resources.

The Taskforce recognised the need to advocate for increased funding for the continuation of drainage, whole farm planning, and biodiversity and revegetation programs across the SIR. Community see the continued improvement in on-farm water use efficiency through the Farm Water Program as critical for the future prosperity of the region. Community also wanted more emphasis placed on projects that support water availability and farm viability, waste management, water and land stewardship and renewable energy use.

The Taskforce revised the structure for overseeing the plan implementation, forming the Shepparton Irrigation Region People and Planning Integration Committee (SIRPPIC). This Committee builds on existing partnerships and encourages innovation and community leadership development.

Together we can achieve effective land and water management and a thriving SIR.



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This update was led by the Shepparton Irrigation Region People and Planning Integration Committee on behalf of the Goulburn Broken Catchment Management Authority, 2015 and we thank them for their contribution and leadership.

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ACKNOWLEDGMENT OF TRADITIONAL OWNERS

The Goulburn Broken Catchment Management Authority acknowledges the Traditional Owners of the land in the Goulburn Broken Catchment and strongly respects the rich culture and intrinsic connection the Traditional Owners have to the land.

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THE SIRLWMP 2016-20 SUMMARY

VISION & PURPOSE

The Shepparton Irrigation Region community leads Australia in producing food in harmony with the environment.

The purpose of the plan is to support and grow the natural base that is vital for agriculture, biodiversity and people to jointly flourish.

The purpose will be achieved by realising long-term goals for five critical regional attributes: water availability, water quality, watertables, native vegetation extent, and farm and food processor viability.

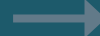
PRIORITIES

impact on one or more of the critical attributes

5-YEAR TARGETS

for implementing priorities

Update irrigation infrastructure



- 90% of the irrigation delivery system is modernised, with all irrigated land connected
- 60% of irrigated farms have been redesigned to capitalise on, and align with, modernised irrigation delivery

Build natural resource management into the farming system



- 10% of farmers are assisted each year to make changes that improve farm viability and provide long-term public benefits
- All farmers and designers have ready access to information that allows them to factor environmental sensitivities into planning

Match drainage to meet changed needs



- Irrigated land is protected from salinity and waterlogging threats by a coordinated private and public drainage network
- Groundwater pumps are ready to be used when required to mitigate risk from high watertables

Balance water availability for all users



- Five seasonal watering proposals are developed annually for priority waterways and wetlands to meet environmental outcomes, with consideration of agricultural and social needs
- Water quality is improved or maintained to meet set targets in waterways

Reconnect large areas of enhanced nature



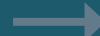
- Across three focus landscapes, the extent of native vegetation is increased by 300 ha each year
- Across three focus landscapes, 150 ha of native vegetation is enhanced each year

Build stewardship, incorporating local action and ideas



- Community-led ideas and actions and research have increased stewardship of the natural resource base
- Community and industry groups, agencies and individuals have increased capacity to contribute to the SIR vision

Maintain partnerships and good governance



- Partners actively participate in SIRLWMP-led projects
- SIRPPIC is accountable through demonstrated processes and actions that contribute to SIRLWMP implementation

Adapt by understanding change and impact



- SIRLWMP is adaptive through demonstrated processes that consider change, impact and responses

1. THE JOURNEY SINCE THE 1980s

This chapter describes how the approach to natural resource management has evolved since the first land and water management plan was developed and lists major onground achievements from the 1980s to now.

ADAPTIVE PLANNING: FROM SALINITY TO RESILIENCE

This Shepparton Irrigation Region Land and Water Management Plan (SIRLWMP) is the fifth update of the adaptive 30-year plan first prepared in 1989 (GBSPPAC 1989). It lists priority interventions for the next five years to shore up the natural base of soils, water and biodiversity. So far, Governments have invested \$450 million in implementing the plan. The investment by the local community is more than double this amount (GB CMA 2011).¹

The focus on managing the natural base evolved from an emphasis on the single threat of salinity in the 1980s to integrated catchment management in the mid-1990s, to valuing total benefits via 'ecosystem services' (such as maintaining productive soils and clean water) in the early 2000s, to the resilience of complex systems of people and nature from 2005.

Plan implementation results directly in works on the ground and increases regional resilience by connecting stakeholders: the plan and its resulting processes influence how stakeholders invest, impacting positively on natural resources.

Building on three decades of lessons and achievements, this version of the plan identifies the next phase of critical actions by bringing into sharp focus the features of the region and its people that make it a stand-out in terms of natural and other competitive advantages.

While the community-agency partnership model fostered during development and implementation of the 1989 plan remains a feature today, this update also highlights the importance of linking long-term management of natural resources more directly with the business of food production.

This update also lays down a clearer pathway between the complex system of people and nature and what needs to be done to make the regional system resilient.

HOW TO READ THE PLAN: PARTS A AND B

SIRLWMP Part A

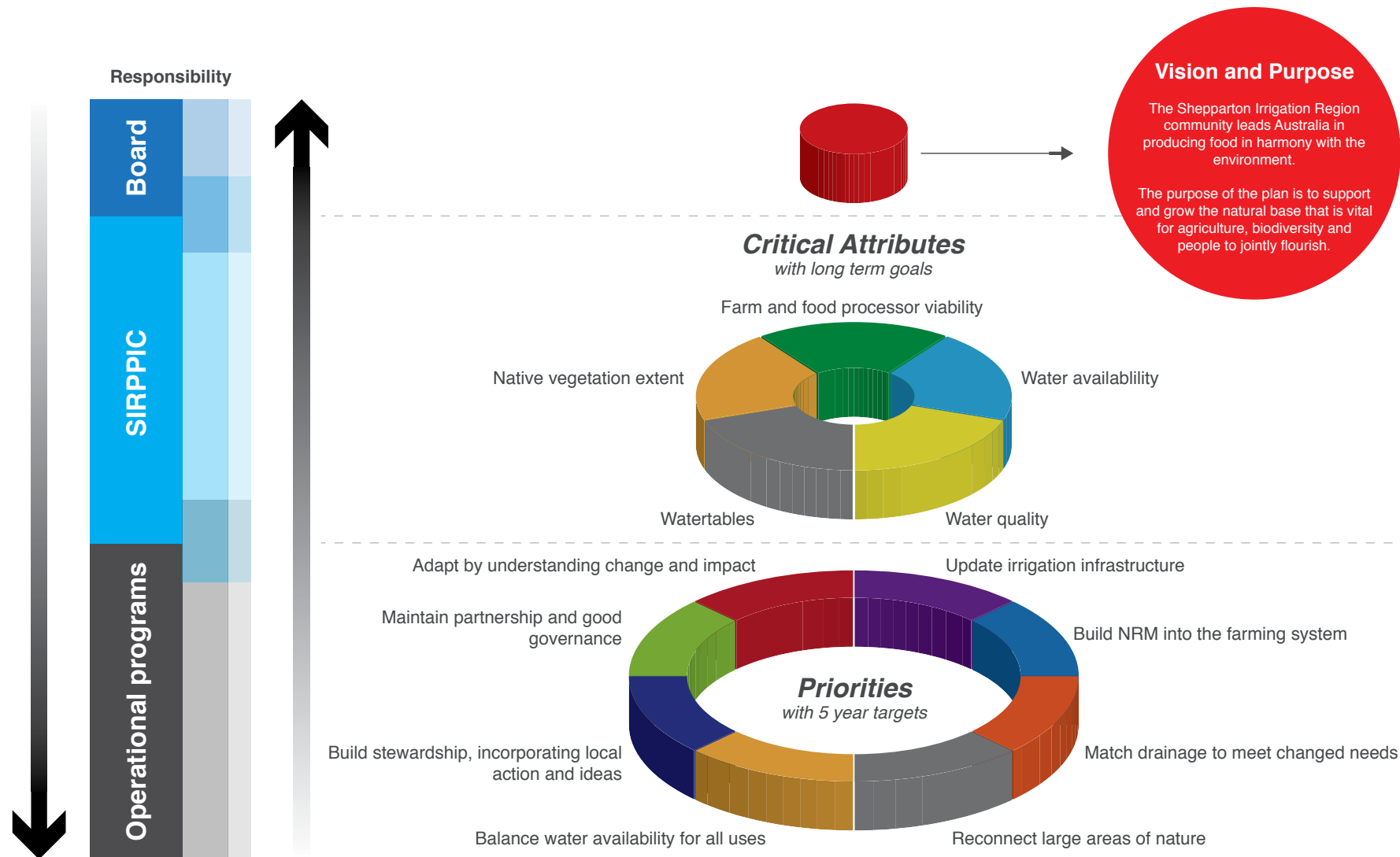
Growing the natural advantage summarises the strategic rationale, priorities and implementation approach, and establishes the framework that links the long-term vision with onground action and ongoing adaptation.

SIRWLMP Part B

SIR profile and implementation program tasks include data on the SIR's natural resources and related industries, progress to date and detailed implementation program tasks. Part B also provides greater contextual detail than is included in Part A of the plan.

¹ The \$450 million does not include all of the Goulburn Broken CMA's program investment. It also does not include the \$2 billion irrigation delivery system modernisation project being delivered across the GMID.

Figure 1. Planning hierarchy showing how vision is achieved by implementing priorities



The plan identifies five critical attributes that underpin the functioning of the SIR as a system and therefore need to be targeted for action to improve or maintain. Eight priorities have been identified to guide actions in meeting goals for these critical attributes (see Figure 1 and Chapter 5).

The Shepparton Irrigation Region People and Planning Integration Committee (SIRPPIC), which includes community and agency stakeholders, plays a key role in setting direction, monitoring implementation of this plan and adapting it to changed circumstances, on behalf of the Goulburn Broken Catchment Management Authority Board (GB CMA).

The original plan written in 1989 had a 30-year horizon, so this version could be considered as the last update. However, a major review set for 2020 is likely to find that a plan is still needed to respond to current issues and prepare for an uncertain future, consistent with the 'resilience approach'.

The SIRLWMP is one of several 'sub-strategies' that guide implementation of the overarching and adaptive Goulburn Broken Region Catchment Strategy (GB CMA 2013). The SIRLWMP also satisfies Victorian Government requirements for land and water management plans.

TWENTY-FIVE YEARS OF ACHIEVEMENT

Since 1990, the SIRLWMP has achieved much of its planned works program (Figure 2). However, while progress towards long-term strategy implementation targets is on track in most areas, it is falling behind in others.

Targets are subject to changing contexts, for example the completion of originally planned infrastructure works (drains and public groundwater pumps) was slowed due to changes in priorities for Government investment.

On-farm works, such as laser levelling, are generally on track or ahead of target due to increased investment in on-farm water efficiency projects (largely via the Farm Water Program) by the Australian and Victorian Governments and irrigators.

Whole farm plans have always been critical in implementing the SIRLWMP because they link farm and regional-scale priorities. The trend in whole farm planning investment since the 2011 plan update reflects changing Victorian Government priorities (Table 1).

This update identifies ongoing and new works to implement the final stage of the original 30-year plan.

Figure 2. SIRLWMP achievements against original targets 1990-2015 (GB CMA 2015a)

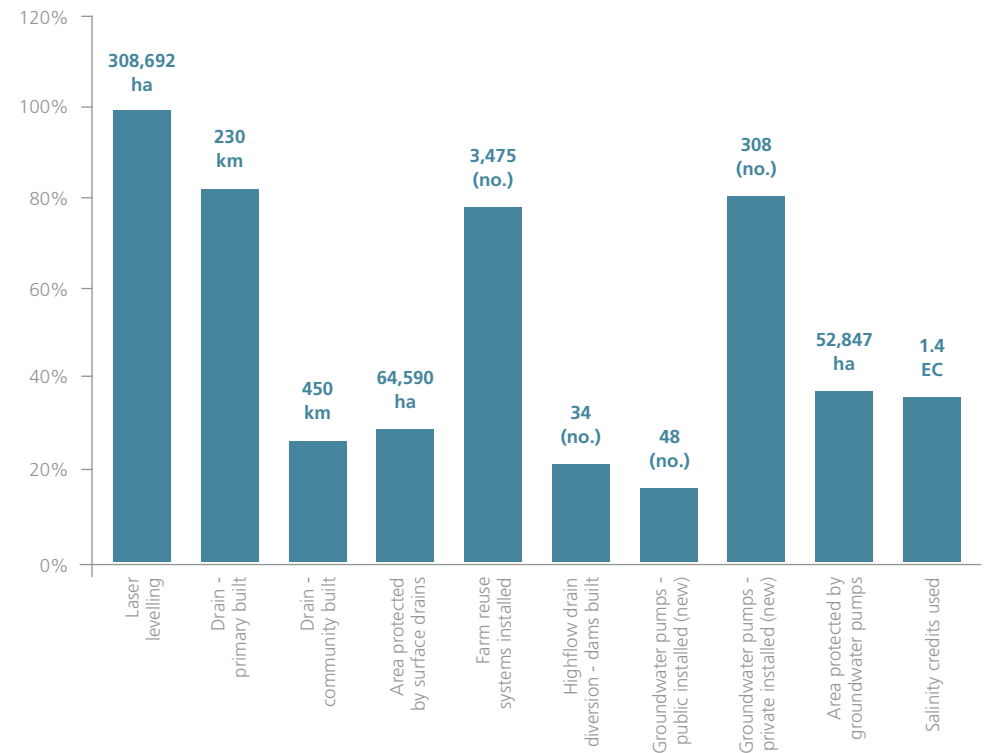


Table 1. Whole farm plan achievements (GB CMA 2009-2015)

	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Plans (n)	247	212	256	223	170	79	71
Area (ha)	20,476	16,018	21,388	23,492	17,499	8,629	6,715

2. THE REGION'S NATURAL ADVANTAGE

The Shepparton Irrigation Region is the heart of food production in Australia, founded on a wealth of natural advantages.

The region is internationally renowned for its high quality produce and innovative approaches to natural resource management, with a \$4.9 billion economy that includes \$1.38 billion of agricultural production (Monticello 2012).

The region ticks all the required boxes for efficient irrigated agriculture:

- abundant sunshine
- productive soils and a landscape suited to irrigation
- a reliable annual supply of clean water to supplement rainfall
- a state-of-the-art irrigation-delivery system
- world-class farm infrastructure and management.

Getting produce to domestic and international markets is relatively easy because the region is:

- a major node of Australia's highway network (25 per cent of Victoria's truck registrations; The Shepparton Adviser 2015)
- within two hours of seaports and an international airport
- within two hours of Melbourne (4.4 million people; Australian Bureau of Statistics 2014).

The region covers 500,000 hectares, 4.5 per cent of the Murray-Darling Basin, including 300,000 hectares of irrigated agriculture (GB CMA 2013). Annual rainfall of 440 millimetres per year (Bureau of Meteorology 2015) is supplemented by annual delivery of approximately 880 gigalitres of water (Carl Walters, pers. comm.) through a natural and constructed irrigation supply network.

Victoria's largest river, the Goulburn, meanders through the SIR and Australia's largest river, the Murray, runs along its northern border.

The region is an inland jewel that continues to attract long-term investment in agriculture, agricultural-related industries and manufacturing.

Unlike many other inland regions in Australia, the SIR population of 138,000 (GB CMA 2013) is growing. Since the first Europeans arrived in the mid-1800s, soldier settlement schemes and successive waves of migrants from many parts of the globe have resulted in a diverse, harmonious and vibrant community.

The region enjoys a rich Aboriginal heritage and has a local Indigenous population of more than 6,000, the largest in regional Victoria (GB CMA 2013). Yorta Yorta Nation, which includes eight clans, has statutory responsibilities for managing traditional cultural heritage (Victorian Government 2006)² and crown land within Yorta Yorta Country, which covers most of the SIR (State of Victoria and Yorta Yorta Nation 2004).

² The Yorta Yorta Nation Aboriginal Corporation has Registered Aboriginal Party status under the *Aboriginal Heritage Act 2006*

Residents, tourists, kangaroos, cows and others enjoy a great climate in an iconic Australian setting: agricultural woodland landscapes between vast areas of riverine forests and wetlands, including the world's largest river red gum forest, the Ramsar-listed Barmah wetlands.

The SIR has significant brand strengths in quality produce, integrated governance, and cutting-edge irrigated food production and food processing technologies. The region also enjoys an international reputation for environmental leadership. Visitors from all over the globe visit the region to better understand how the state-of-the-art irrigation delivery system and farm technologies are integrated with management of natural resources and how genuine partnerships are fostered between government, industry and the community.

Maintaining this reputation and overcoming challenges falls within the domain of the SIRLWMP, as described in the next chapter.



3. CHALLENGES, CHANGES AND PROGRESS

Natural assets provide benefits that are fundamental to our lives. Most of the region's natural assets have been highly modified from their pre-European state and continue to change: we have 'working landscapes', with complex relationships between people and nature.

The future of SIR communities depends on a strong economy and thriving biodiversity. A strong economy cannot be sustained without clean and reliable water and healthy soils. Biodiversity cannot be increased or even maintained without intervention in our working landscapes.

Thanks to many visionary leaders and the efforts of local communities, supported by successive governments, the region is well-placed for an increase in agricultural production, but this places heavy demands on the underpinning natural resource base of soils, water and biodiversity.

SIR communities are up against the same major challenge facing other regions in the Murray-Darling Basin: how to make best use of a limited supply of water as demand increases in a variable and changing climate.

The millennium drought from 1997 to 2010 highlighted the effects of reduced water availability. The restructuring of dairying and horticulture that might have taken one or two decades under 'normal' climatic conditions happened in just a few years.

People left dairying and horticulture, several major food processing factories closed and many features of the natural environment were severely stressed. However, industries are recovering: for example, the region has the highest rate in Australia of orchard plantings for the fresh-fruit market (Peter Hall pers. comm.).

The Murray-Darling Basin Plan (MDBA 2012) has been heavily influenced by lessons from the millennium drought. The planned retrieval across the Basin of 2,750 gigalitres of water for the environment has come from water saving infrastructure, on-farm efficiency and Commonwealth buyback projects. Basin Plan implementation presents opportunities as well as challenges to irrigation-dependent communities.

A once-in-a-generation water-savings project was initiated in 2007 with a \$2 billion investment in upgrades to the publicly-owned irrigation delivery system (modernisation). This GMW Connections Project aims to save 429 gigalitres of water (GMW 2015b).

So far, the project has remediated 196 kilometres of delivery channel, removed 825 kilometres of delivery channel, installed 5,801 new meters³, removed 1,962 redundant meters⁴ and saved 206 gigalitres of water (Rose Young pers. comm.). While the predicted reduction in the SIR's 'irrigation footprint' (the total area irrigated) that was initially envisaged is not happening, this project has significantly altered the irrigation landscape across the Goulburn Murray Irrigation District (GMID).

As the regional delivery system is modernised, irrigated farms are also undergoing a matching accelerated infrastructure overhaul. A total of 67.9 gigalitres of water has been saved so far through the Goulburn Broken CMA-led consortium's Farm Water Program (GB CMA 2015b). Water savings are shared between the environment and irrigators.

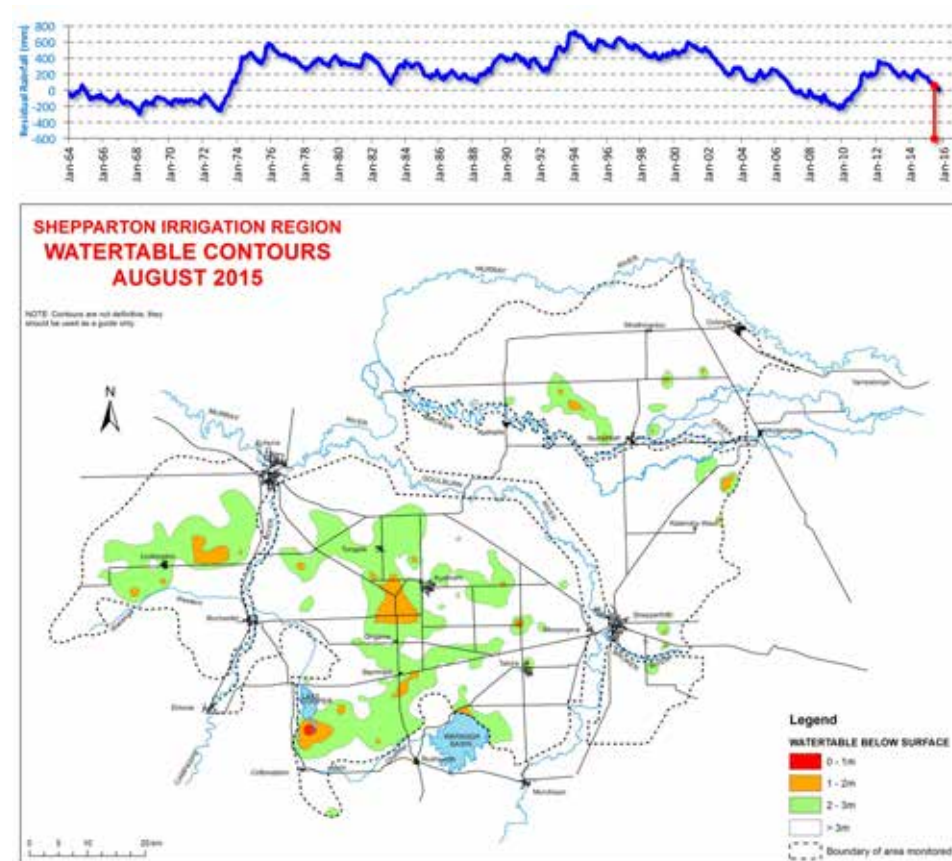
Through foresight and good management, our region's farmers have been saving water and creating significant water-use efficiencies since the late 1980s when, ironically, it was excess water that catalysed an unprecedented community-led response: the 'wet' period in an irrigated landscape from the 1950s to the 1990s

caused watertables to rise, resulting in waterlogging and salinisation of soils. Part of the solution was found to be improved irrigation efficiency, achieved by public and private investment in farm planning and farm infrastructure upgrades and water use licences which describe maximum application rates for irrigation.

Further reduced water accessions to watertables were achieved by coordinating surface water run-off and saline groundwater disposal through drains built across the region. Salt contributions from the region to downstream waterways comply with targets set by Basin Salinity Management 2030 (BSM2030) (MDBMC 2015).

A series of extreme rainfall events since the millennium drought have led to a rapid recharge of groundwater, consistent with residual rainfall: watertable-depth and water quality salinity thresholds remain critical objectives for management. (Residual rainfall is calculated as the cumulative monthly deviation from the mean and is indicative of the wetness of the soil profile and therefore watertable level; see Figure 3.)

Figure 3. Residual rainfall 1964-2015 and SIR watertable contours 2015



^{3,4}. Includes both 'backbone' and on-farm meters.



Managed drainage is critical in sustaining productivity of the soils and protecting the quality of water in rivers and streams. The shallow groundwater and surface water drainage system is being adapted to changes in water delivery and farm irrigation requirements. Implementation of remaining drainage works needs to be accelerated because of risks from climate variability in the form of more frequent and intense summer storms.

Other significant changes in climate likely to affect the region include greater variability in the 'autumn and spring breaks', increased storm events, increased temperatures and fewer frosts. The unprecedented drought and extreme bushfires and floods over the last decade have impacted on the region's people and biodiversity long after these events.

Consistent with world-wide trends, increasing production costs and lower commodity prices continue to lower profit margins, driving the need for higher production volumes or a shift in production type. When coupled with opportunities from upgraded irrigation delivery infrastructure, some enterprises are trying to capture the cost advantages of increased size.

There is a trend towards larger-scale, more intensively irrigated enterprises. As this trend continues, it means that areas on farms might be used differently, such

as changes in crop types or seasonal production. The emerging diverse land-use pattern, with irrigation demand and supply varying annually on parts of farms and in areas across the region, is creating a new set of risks and opportunities for the health of soils, water systems, biodiversity and sites of significant cultural heritage.

Reduced water availability also provides a stronger private driver for improved irrigation efficiency. There is a need to review the regional irrigation development guidelines and conditions on water use licences to ensure they remain relevant to these changing risks.

Sensitive management of waterway systems, especially regulation of flows, is critical to the ecological health of the region's many waterways and wetlands. Flows are being adjusted as part of significant water policy reforms that aim to balance delivery of water for:

- biodiversity habitat (within and downstream of the region, including wetlands outside of riparian areas)
- irrigated agriculture and associated processing industries
- domestic consumption.

There is now also pressure to recognise recreational and cultural values in using streams, storages and other water resources as part of evolving water policy.

Catchment partners communicate priorities to water policy bodies such as the Murray-Darling Basin Authority and the Victorian Government.

While water quality continues to be a priority in the SIRLWMP, significant investment over the last 20 years in water treatment plants, water reuse systems, dairy shed effluent design and management, improvements in fertiliser and water management and removal of stock grazing along streams have reduced phosphorus and nitrogen loads to below long-term targets. The five-year rolling average phosphorus load equates to a reduction of 80 per cent from the benchmark year of 1993-94 (GB CMA 2015a).

Much of the SIR has been cleared since European settlement to make way for productive agriculture and many species of plants and animals have become extinct or are 'hanging on' in ecosystems that are below threshold requirements for survival in the long term. However, many local landscapes have significant riparian and roadside corridors and patches of habitat that are acting as biodiversity reservoirs.

Efforts need to be targeted at these reservoirs and the pathways connecting them to allow plants and animals and their genes to migrate (which is becoming

even more important as the climate changes) so that species can adapt to different climatic conditions. In addition, as the likelihood and impact of fires is exacerbated during extended dry periods, natural and other assets are placed at further risk.

While the region is extremely fortunate to have a gravity-fed irrigation system, some water-use efficiencies of the modernised irrigation system can only be captured by using increased amounts of energy to operate pumps, adding to increasing energy demands from increased production and other changes. The resulting emerging challenges require actions that factor in the broad costs and benefits to the region's overall resilience. Renewable energy sources will help address increasing energy demands as we also strive to reduce greenhouse gas emissions or are faced with shortages in non-renewable energy sources. Farmers are increasingly considering ways to use waste for reducing input costs.

As challenges and changes continue to shape the region, we need to turn our efforts to identifying and managing priorities that keep the region functioning, as described in the next chapters.

THE LINK BETWEEN THE REGIONAL CATCHMENT STRATEGY AND THE SIRLWMP

The Goulburn Broken Regional Catchment Strategy (RCS; GB CMA 2013) provides the long-term vision and an integrated planning framework for managing land, water and biodiversity resources in the Goulburn Broken Catchment. It is the overarching strategy for directing implementation through sub-strategies and action plans, in accordance with government and community priorities.

The SIRLWMP aligns with the principles set in the RCS, including application of a systems approach, which is underpinned by an understanding of system resilience.

The SIRLWMP encompasses the plan for one of the Goulburn Broken Catchment's five sub-catchment social-ecological systems, the Agricultural Floodplains, as well as part of the North Central Catchment (which is in the west of the SIR).

4. THE 2020 VISION

VISION

The Shepparton Irrigation Region community leads Australia in food production in harmony with the environment.

PURPOSE

To support and grow the natural base that is vital for agriculture, biodiversity and people to jointly flourish.

The vision, purpose and narrative updates the vision set for 2020 when the original Shepparton Irrigation Region Land and Water Salinity Management Plan was prepared in 1989. Many aspects of the original plan have been realised and are important foundations for the future desired now.

HOW WE WANT TO DESCRIBE THE SIR IN 2020

The SIR is a vibrant and prosperous region where enthusiastic communities work closely with each other, government and other businesses. This joint action to meet challenges head on is a legacy of lessons learnt and the international reputation earned in the 1980s when rising watertables threatened to waterlog and salinise soils.

Effective and efficient joint action involves the integration and leveraging of partner contributions, based on a clear understanding and respect for the roles that the community, government and business play in an agriculturally dominated economy.

The community–government agency partnership helps government direct investment in natural resource projects that provide public benefits and create the confidence for business to invest. This investment has a high leverage effect: every dollar of government investment is more than matched by local contributions.

The region continues to be widely recognised for leadership in community-led environmental management, hosting delegates from across the globe each year and contributing to national and international forums. Visitors are impressed by the genuineness of government, industry and community partnerships and by practical demonstrations of cutting-edge farm and farm-related technologies that conserve and enhance the use of resources.

The region has the capacity to adapt and grow in response to changes in the climate, markets and community needs and aspirations because the natural base is shored up in a way that provides future generations with options to expand agriculture or develop other industries.

Agricultural productivity has increased as irrigation farmers capitalise on efficiencies from the completion of the revolutionary upgrade of water delivery infrastructure and associated improvements in farm infrastructure and management.

Water-sharing arrangements are becoming sophisticated, providing at least minimum flows for agriculture and other consumptive users, as well as for the environment, during extended dry periods. Environmental flow management is focused on making the most of every drop: the timing and volumes of environmental water releases are refined to allow irrigators and other users to use water simultaneously. The river channel and streamside floodplains are flooded from time to time, resulting in the re-establishment of native vegetation and the provision of good quality water.

Bird species that have been missing from the region's landscapes for decades are re-establishing, using the corridors created between large reservoirs of habitat.

The population of the region continues to grow, attracting and retaining vibrant and diverse people who are willing to work together and continually learn and develop.

Indigenous Australians actively manage large areas of their country in partnership with government and local communities. Yorta Yorta people's ecological and cultural knowledge of their country is widely appreciated and incorporated into the day-to-day management of our environment.

The SIR's natural environment inspires a common connection between its diverse people. People in the region's urban centres recognise the rivers as their lifeblood and derive a significant sense of well-being and custodianship through recreation in riverine environs. Rural people have a strong sense of responsibility for their local environment, working together to deal with problems and capture opportunities to thrive in the future.





5. REALISING THE VISION

The many relationships in our complex system of people and nature creates a risk of spreading scarce resources and efforts too thinly in trying to carry out actions to meet the purpose of supporting and growing the natural base.

This chapter describes management of this complex system by focusing on the actions with the highest impact. There are just a few high-level goals we are trying to achieve and a few interventions that enable these goals to be achieved.

CRITICAL ATTRIBUTES BEING TARGETED

To be effective and efficient, and in context of all the challenges and changes described in Chapter 3, interventions must be targeted at five attributes that are critical to the functioning of the region's complex system of people and nature. These critical attributes are:

- watertables
- water quality
- native vegetation extent
- water availability
- farm and food-processor viability.

Focusing on critical attributes fosters shared understanding of trade-offs and multiple benefits when choosing interventions: most interventions usually impact on several critical attributes because of the highly connected nature of the dynamic working landscape of people and nature. Intervention priorities are described in the second part of this chapter.

Long-term goals for these critical attributes further direct action and also act as reference points when reviewing progress.

CRITICAL ATTRIBUTES AND THE RESILIENCE-BASED APPROACH

Along with being critical to the functioning of the region's complex system of people and nature, critical attributes are targeted for intervention because they have crossed, are crossing, or could cross thresholds. Decisions about interventions are made to "manage the resilience of the current domain and avoid a domain shift or transformation", or to "enable systemic change" (Abel et al 2016), either because it needs to be encouraged or is inevitable.

WATERTABLES

Salinity associated with high watertables has been the biggest natural resource challenge in the SIR over the last three decades. We live with and actively manage high watertables and associated salinity.

Management of salt is essential to achieve a sustainable irrigation industry and protect the productive capacity of the region. Actions to manage salinity have significant benefits for agriculture, water quality, water supply security and biodiversity. There is potentially a \$100 million annual loss in regional production if no action is taken (Alexander 2014).

The Murray-Darling Basin Authority recognises that managed discharge of salt to waterways from the region is required to protect agricultural land from saline shallow water tables. The Murray-Darling Basin Authority regulates this action via obligations placed upon Victoria and the region under BSM2030 (MDBMC 2015)

The target related to Murray-Darling Basin Authority's requirements for salinity impacts on the River Murray at Morgan is discussed in the 'Water quality' attribute section.

The risks of salinisation and waterlogging have increased in recent years due to the return of wetter conditions. Watertables dropped about three metres during the millennium drought but quickly bounced back with 170,000 hectares having a watertable within three metres of the surface in 2014 (Terry Hunter pers. comm.).

The trend of the shallow watertable rise is concerning given how long it took for watertables to drop during the drought. The increased risk is clearly linked to rainfall on a wet (irrigated) catchment. Historically there have been fluctuations in available funding for surface and sub-surface drainage works for mitigating this risk.

A works program of surface and sub-surface drainage has been in place for many years to help manage watertables and dispose of surface water. This has been coupled with a range of incentives and extension to help manage drainage on farm, including whole farm planning. While funding for whole farm planning has continued to provide drainage benefits on farm, government investment in drainage works has fluctuated, leaving an incomplete drainage network that does not protect all areas still at risk.

The long-term goal is to manage shallow watertables so that soil zones at risk are not salinised or waterlogged.

The way forward

The risk of high watertables is well understood, however knowledge about how quickly the risk can increase with reasonable winter rainfall is not widely known. Partnerships with key stakeholders are very mature, nurtured continually for 30 years, however the capacity and preparedness of some partners to contribute in recent years has diminished and requires attention.

Continued monitoring of salinity threats is needed and mapping needs to be refined, with trends in watertable levels and salt content assessed and communicated. The Murray-Darling Basin Authority has now recognised that continuous communication and resulting management are crucial in the ongoing control of salinisation of irrigated landscapes (MDBA 2015).

It is important that irrigators understand and manage their drainage risks. Agencies also need to design and manage surface and sub-surface irrigation drainage networks or other options to deal with excess water when on-farm management systems are overwhelmed by extreme rainfall events.

Management of public and private groundwater pumps needs to be adapted to provide cost-effective groundwater pumping when and where required. There are approximately 80 public pumps and 800 private pumps servicing 85,000 hectares across the SIR (Terry Hunter, pers. comm.).

The drainage works program needs to be completed, using a hybrid approach to drainage (a combination of constructed and natural drainage courses to remove drainage water) as detailed in the SIR drainage program (GB CMA 2015d).

Agreed cost-sharing for onground responses are well defined. Cost-sharing for public groundwater pumps and surface drainage through GMW's tariff review and regional and state drainage reviews need to be redefined.

Landholders have a role to play in managing salinity risks on their farm and providing them with current salinity risk information is important to help with decision making.

WATER QUALITY

The high quality of the region's water resources provides for many beneficial water uses, including safe drinking, irrigation, industry, and aquatic ecosystems.

While groundwater salinity was one of the initial (1989) plan's key risks to farm production, assets and environmental features, salinity levels are generally below threshold levels of concern now. Salinity contributions from the region comply with targets managed under the Murray-Darling Basin Authority.

In the 1990s, blue-green algal blooms were becoming increasingly prevalent and water quality was found to be breaching state, national and Murray-Darling Basin guidelines (GBCaLP Board 1996). The major cause of water quality decline was from sediment and nutrients (phosphorus and nitrogen) entering waterways upstream of and within the SIR from diffuse and point sources.

The unprecedented fires in 2009 and 2013 caused areas in the upper regions of the Goulburn Broken Catchment to be particularly vulnerable to soil erosion, further increasing water quality risks through sedimentation. This sedimentation risk is also increased through stock grazing in and along waterways.

Blackwater events occurred after heavy rainfall in 2010 and 2011 following a long period of drought. Blackwater events usually happen in warmer weather after floods when most or all oxygen in the water is consumed by decomposing vegetation, impacting severely on oxygen-dependent biota. Fish deaths can be the highly visible result of a blackwater event.

Although elevated pathogen levels are unlikely, they have extremely high consequences, and a catchment approach is one component of catchment-to-tap risk management. Water businesses are required to develop, implement and maintain a risk management plan that assesses risk from catchment-to-tap and demonstrates effective barriers to protect human health from microbial risk.

Biocides and heavy metals are generally of low risk. Endocrine active compounds have been detected at low levels (Scott et al 2014).

Targeted programs have resulted in significant reductions in nutrient loads to waterways, thereby improving water quality. The five-year rolling average phosphorus load from the Goulburn Broken Catchment is below the long-term target set in 1996, equating to a reduction of 80 per cent from the benchmark year of 1993-94 (GB CMA 2015a). Sedimentation risks are being reduced by streamside revegetation and regular monitoring of water quality, including dissolved

oxygen levels, is vital to trigger responses to minimise the impact of activities that threaten aquatic life, agricultural production and human health and safety.

The long-term water quality goal is 'to maintain and improve water quality for the range of beneficial uses (values)' (GB CMA 2014).

The way forward

Continued efforts are needed in:

- stakeholder collaboration to address identified risks
- implementing the SIRLWMP and the Goulburn Broken Waterway Strategy, including incentives to remove or lessen the impact of grazing on riparian zones
- using environmental flows to maintain or improve water quality
- monitoring, reporting and reviewing, under the auspice of the regional Irrigation Drainage Memorandum of Understanding (DSE 2010), especially against various water quality thresholds indicated by the State Environment Protection Policy (Waters of Victoria), BSM2030, Australian Drinking Water Quality Guidelines and the Australian and New Zealand Environment Conservation Council
- maintaining current management activities and control risks.

Safe drinking water risk management plans need to be implemented with water authorities, including reduced stock access to water and management of point sources.

Blackwater and blue-green algal events are a major challenge for environmental-flow management and monitoring conditions, particularly during high risk periods, is the only way to manage potential risks.

A better understanding of the occurrence of biocides, endocrine active compounds and heavy metals will also be gained by targeted monitoring and research.

NATIVE VEGETATION EXTENT

The regional landscape has been transformed since the 1880s, with more than 97 per cent of native vegetation on private land cleared for settlement and agriculture.

Most remaining native vegetation is in public land reserves (such as the red gum-dominated 28,500 hectare Barmah National Park) and corridors alongside waterways and roads. Areas of native vegetation away from these reserves and corridors are mainly isolated fragments with layers, fallen logs and other habitat elements needed to host a diversity of flora and fauna. Many local species have become extinct and others are under threat.

The loss of species impacts on our long-term productive capacity as well as the natural environment. For example, many insect-eating birds that benefit crops and pastures are largely absent without shrubs and natural ground layers. Native vegetation is also nature's water purifier, preventing large loads of sediments and nutrients from entering waterways.

The biggest threats to the region's flora and fauna are the clearing, direct degradation and non-renewal of ageing habitat.

Although some clearing of native vegetation continues, the region is fortunate to have some local landscapes that have large areas of agriculture complemented by significant areas of habitat: corridors, drainage lines, large patches and scattered remnants of native vegetation, and continuous and scattered wetlands and dams.

These landscapes are critical for the long-term survival of many species in the region because they provide sufficient habitat for species and populations to move and adapt as environmental conditions vary. These landscapes also have broad habitat diversity, which many species need, such as planted indigenous shelterbelts to feed upon and large scattered paddock trees to roost in. Water levels in many of these landscapes' water bodies can also be managed because they are part of a regulated irrigation system, which can help flora and fauna adjust to changing climatic conditions.

While large areas of native vegetation have been established and protected since implementation of the SIRLWMP began in 1990, government-funded extension and incentive projects have been spread thinly across the region: they have not usually targeted specific landscapes nor been strictly guided by the goal of increasing species' populations.

Successful regional models for targeting landscapes include the Superb Parrot and Grey-crowned Babbler projects. These projects, along with conservation management and landcare networks, are community-based: they involve working with local communities to maintain and improve habitat while supporting sustainable, productive agriculture.

The long-term goal for native vegetation extent is to increase the extent of native vegetation within high priority landscapes.

The way forward

Our approach to increase the extent and quality of native vegetation is to build on these successful regional community models by targeting priority (or 'focus') landscapes that have areas of existing high quality habitat while recognising these landscapes as important for agriculture.

Plans created for these landscapes will be landholder-centric, integrating the various needs of landholders and other land managers to achieve goals for agricultural production and native vegetation and species conservation. These landscape plans could be considered as 'integrated, multi-property whole farm plans' that are consistent with a sustainable development approach.

The impact of efforts within these focus landscapes can be maximised by pooling various government agency, non-government organisation and individuals' resources and by targeting specific properties. For example, pooled resources can target water quality and biodiversity benefits simultaneously by linking large fragments of native vegetation with a river habitat corridor, resulting in improved natural filtering of water, and species being able to move in search of food and mates while being protected from predators.

There is also potential to target offset works that preserve and improve habitat within these focus landscapes. Offset works can be statutory, such as compensatory works for clearing native vegetation, and voluntary, such as when people choose to compensate for their cars' greenhouse gas emissions. Either way, arrangements can be made to protect these habitats in perpetuity.



WATER AVAILABILITY

Historically, the region's major rivers had relatively large but highly variable natural flows. Previous generations dammed the rivers to provide a more reliable water supply for stock and domestic and irrigation purposes. This has markedly changed river flows, impacting on river and wetland health. Less water now flows in the Goulburn River through the SIR in winter and spring, with a more uniform flow in summer to meet user demands.

The northern regions of Victoria have developed a relatively sophisticated approach to sharing water between consumptive, environmental and recreational users, thanks to a long history of working collaboratively. Rules have been developed to secure the supply of good quality water for irrigated food production and associated food processing industries. This has been critical to the viability, vibrancy and social fabric of our rural communities and is a big part of the competitive advantage of the SIR as a place to invest in irrigated food production. The region has built this advantage on a reliable seasonal supply of irrigation water in all but the driest years.

But these rules also needed to ensure that users all along the river systems could access water. Water extraction for consumptive use was first limited in the Murray-Darling Basin by a cap that was implemented in 1997 based on 1993-4 extraction levels (for Victoria, South Australia and NSW). The cap was then reduced as it became apparent that the riverine environments needed water to improve their health. Water savings began being returned to the river as environmental flows through various government-based water-saving schemes, such as the Living Murray program. Since 2007, further returns have been made via implementation of water-saving projects and water buy-back under the Murray-Darling Basin Plan.

Droughts are a key risk to social, economic and environmental outcomes. Droughts reduce the volumes of water available for agriculture and the environment and increase tensions between all water users. Water-supply storage capacity and management in Victoria mean short-term droughts present only low risk. The key risk is from extended drought sequences, such as the 1997 to 2010 period, which can result in extremely low natural river flows and very low water allocations.

Farmers suffered financially because of the millennium drought and have since been adapting through a period of increased water availability in preparation for future drought. (At the time of writing, very low 2015 winter and spring inflows into the region's main water storages are again threatening to impact on the levels of water availability).

Environmental needs, changing markets and agricultural demands, and population growth drive the need for a better understanding of how to make best use of available water. The water needs of each user-group and how to 'cut-the-pie' to maximise the benefits for all, particularly when conditions are dry and availability is reduced, must be well understood.

Against a backdrop of water policy reform and changes in climate, a more accurate picture of the water needs of all users and the water volumes available is emerging and driving many changes. Changes to water trading rules have transferred water between irrigation areas in a less controlled way. The 'needs' of some of these irrigation areas require revisiting to ensure the delivery systems can operate and support irrigated production in the future.

The GB CMA recognises the Murray, Goulburn, Broken and Campaspe Rivers as 'working rivers', with associated objectives and thresholds around providing sustainable environmental values while meeting economic and social needs (GB CMA 2014).

Separate water entitlements for the environment allows the environment to share more equally in the limited water available in droughts, and to target water to best minimise impacts. The allocation and use of increasing volumes of water for the environment since 2010 is helping the river environment recover, rebuilding its health so it will better withstand the impacts of extended and severe droughts. Ongoing research and monitoring will progressively improve the targeting of water for environmental outcomes, both between and during droughts. Waterway programs that improve the physical river habitat are also important in building resilience to drought.

Environmental flows have so far only targeted benefits within wetlands and the river channel. Vegetation on the floodplain and the important interaction between the floodplain and river channel have not been targeted because of the potential impact on public and private assets. Environmental risks have been reduced because we now have some water to deploy during a drought.

Farmers need to be skilled in positioning, adapting and structuring their business before and during a drought, including use of the new tools of trade such as 'carryover' water and the water market.

The maintenance of the water supply infrastructure and its associated water management arrangements are the keys to controlling water allocations and a reliable water supply. In addition, water trading and water carryover options for individual water entitlement holders allow different and targeted individual risk management, particularly in extremely low water-availability years. As major water users, irrigators and environmental water delivery partners pay charges for system maintenance and water delivery. The Victorian Government is committed to ensure clear and transparent charging arrangements as actioned in Water for Victoria (2016).

The long-term goal is to ensure that water is available and allocated to meet the needs of the environment, agriculture and social consumption when required.

The way forward

In response to the dynamic, fast-changing nature of the irrigated agricultural industry, the availability of a reliable supply of good quality water is critical, requiring a clear, transparent and fair water market to be continually improved.

Environmental features already in decline are still recovering from the millennium drought and there is a continuing need to build their health before the next drought sequence. The delivery of water to stressed rivers and wetlands, integrated with other regional priorities, is crucial to the region's long-term resilience.

Communities benefit where development occurs, but need to adapt to change. The forecast increase in the frequency and severity of droughts will increase the volatility of on-farm and public water supplies and will require farmers and rural communities to plan, invest and adapt to maintain the region's comparative advantage in agriculture (2006).

The roll-out of the Murray-Darling Basin Plan water saving projects will continue, with its success depending on a strong community-government partnership to improve water-use efficiency within both the environmental and irrigation sectors for the benefit of the region's farms and floodplains. The Victorian Government is committed to supporting communities adapt and expand production with less water (2016). This will require a mix of existing and new ideas that encompass technological, management and engineering solutions. Further research and innovative delivery is key in improving water-use efficiency.



FARM AND FOOD PROCESSOR VIABILITY

The region is dominated by agricultural production and the main agricultural industry is irrigated dairying, covering 120,000 hectares and accounting for 70 per cent (620,000 megalitres) of water use. Horticulture covers 9,000 hectares and uses approximately 7 per cent (60,000 megalitres) of the region's water. Other irrigated industries use about 22 per cent (200,000 megalitres) of the water, including cropping (for fodder and grain markets), viticulture and annual horticulture, such as tomatoes and other vegetables. (Carl Walters, pers. comm). There are also areas of rain-fed cropping and livestock production.

Food production and processing are large contributors to the region's economy and are important employers. These industries face many challenges, including domestic and global pressures 'to produce more with less'. However, industry diversity has helped develop the region's resilience to variable domestic and world markets. The impact of global market peaks and troughs have been 'smoothed out' because different industries are not usually impacted at the same time.

Farmers face challenges to remain profitable in the face of a variable climate and increasingly expensive inputs, such as land, water, nutrients, oil, technology and skills.

Irrigation farmers in the region are also paying more than in the past for irrigation delivery shares, irrigation and drainage service fees and municipal rates. These fixed charges are becoming more prominent in influencing farmers' investment decisions, particularly in the dairy industry.

Increased returns from water-use efficiencies of the modernised irrigation system can often only be gained by using energy to operate pumps and move water across the farm: farm irrigation power costs are rising from zero in the former gravity-fed system to (of the order of) 4 to 12 per cent in the modernised system (GB CMA 2015e).

If the region's farms are not viable and cannot continue to invest in adapting to change, then the whole system, including regional communities and the riverine and water environment, will suffer. Only one-fifth of Victorian farms are considered large enough to fund the level of farm investment required for productivity growth and to provide an average standard of living for a full-time farming family (Barr 2012).

There has been a shift in farm size and operations, with the demise of the 100 cow, 100 hectare farms of 30 years ago. Larger-scale farm enterprises have emerged in an attempt to increase production and profitability. New irrigation developments on individual properties are integrated with broader landscape sustainability needs by complying with development guidelines.

The Goulburn Broken Catchment is also losing about one per cent of farmland every year to other land uses (Cribbs 2012). The SIR's agricultural land use, especially horticulture, is under pressure from urban expansion around larger centres like Shepparton and Cobram. However, horticulture is beginning to expand outside of these traditional locations.

"The region has one of the highest concentrations of food processing firms in Australia including Simplot, Fonterra, Nestlé, Unilever, Murray Goulburn, Bega, and of course SPC." (Sheed 2015). The shift in farm type, size and mix has been accompanied by a change in the region's food processing industries. Several long-established companies have either closed or been amalgamated over the last two decades, although smaller niche industries have emerged.

Industry dynamics are continuously changing, with global markets and water availability for production being strong drivers. Food processors have a long-term interest in food production that is sustainable, and market forces are increasingly demanding 'clean' produce that is produced sustainably. Food processors are beginning to capitalise on the region's natural advantage in meeting these market demands and are increasing their influence in sustainable and clean food production by such means as accrediting suppliers.

The world-class water delivery system and state-of-the-art farm irrigation infrastructure being installed are helping to increase farm production and are potentially increasing profitability and viability of farming enterprises across the region. Unfortunately, irrigation infrastructure upgrades are not fully matched by sub-surface and surface drainage system improvements, making it very difficult in many cases for farmers to manage business risks from rising water tables after rainfall events.

The long-term goal is to help farm and food-processors be viable, by supporting the natural base in a way that helps them adapt quickly to changing agricultural markets and demands.

The Way Forward

Further public investment in infrastructure that encourages the efficient use of water (and saves water for the environment) will enable more farmers to choose crop types that meet changing market demands.

There is an ongoing need to create and adapt whole farm plans that tie farmer and regional needs together. Adapting farm design and planning and increasing the region's ability to manage waterlogging and rising-salinity impacts, driven by rainfall on an irrigated catchment, are two key deliverables.

A coordinated, regional approach is needed to manage waterlogging and rising salinity caused by rainfall on an irrigated landscape. This includes adapting whole farm plans and sub-surface and surface drainage systems to match the widespread changes in water delivery systems.

More than ever before, the rapid pace of change demands that ongoing regionally-based attention is paid to emerging risks and opportunities for farmers that potentially impact on natural resources. These include rising fixed and annual farming costs and new knowledge on energy use and soil management, marketing the region's clean-and-green credentials, and the 2015 China-Australia Free Trade Agreement (Australian Trade Commission 2015).

A level playing field for the water market across the southern Murray-Darling Basin needs to be retained and enhanced so that the region's agricultural industries can continue to compete and clearly manage the risks.

The interdependency of the region's farm, food processing and related industries creates the need for better and shared understanding of what makes each industry viable. This will help align different stakeholder objectives, including management of natural resources on farms.



PRIORITIES FOR ACTION

This section summarises the high-level priorities for action. The next chapter lists 5-year targets and Part B lists detailed actions.

Implementation of the priorities chosen will achieve the range of long-term goals for the five critical attributes (described earlier in this chapter). The implementation of priorities contribute to more than one attribute goal. For example, achieving goals for increasing the extent of native vegetation will make a significant contribution towards goals for water quality and the status of threatened species populations.

Eight priorities will guide action over the next five years:

1. Update irrigation infrastructure, including the irrigation delivery system and farm design
2. Build natural resource management into the farming system
3. Match drainage to meet changed needs, aligning it with modernised irrigation delivery
4. Reconnect large areas of enhanced nature
5. Balance water availability for all uses
6. Build stewardship, incorporating local action and ideas
7. Maintain partnerships and good governance
8. Adapt by understanding change and impact

Table 2 summarises the relationship between priorities and critical attributes. Knowing how all priorities impact on all critical attributes is important when making decisions.

Table 2. Relationships between priorities and critical attributes (demonstrating benefits of integrated interventions)

Priority	Watertables	Water quality	Native vegetation extent	Water availability	Farm and food-processor viability
1. Update irrigation infrastructure	HIGH	HIGH	MEDIUM*	VERY HIGH	VERY HIGH
2. Build NRM into the farming system	MEDIUM	MEDIUM	VERY HIGH	MEDIUM	HIGH
3. Match drainage to meet changed needs	VERY HIGH	MEDIUM	MEDIUM	LOW	HIGH
4. Reconnect large areas of enhanced nature	LOW	HIGH	VERY HIGH	LOW	MEDIUM
5. Balance water availability for all uses	LOW	VERY HIGH	HIGH	VERY HIGH	VERY HIGH
6. Build stewardship, incorporating local action and ideas	Actions guided by these priorities emphasise the processes that enable overall resilience of the SIR to be factored into decisions about a specific critical attribute. Implementation of these actions creates a joint approach between community, business, and local, state and national government agency partners at different levels, which is essential in addressing problems and updating understanding.				
7. Maintain partnerships and good governance					
8. Adapt by understanding change and impact					

* opportunities from planning as part of updating irrigation infrastructure

1. UPDATE IRRIGATION INFRASTRUCTURE

The GMW Connections Project was initiated to reduce water losses through modernisation of the public irrigation delivery system and to reallocate water savings to the environment and other water users. This project is being led by GMW.

Complementing the Connections Project, the GB CMA leads a consortium project called the Farm Water Program, which generates water savings on farms: the government contributes funds towards improvement of farm irrigation infrastructure and in return receives permanent water, calculated as savings generated by the works.

A fully-modernised irrigation delivery system complemented by modernised farm irrigation infrastructure is placing the region at the forefront of efficient water use and productivity.

2. BUILD NATURAL RESOURCE MANAGEMENT INTO THE FARMING SYSTEM

Irrigation whole farm plans guide implementation of farm activities. A whole farm plan provides a strategic element to farm improvements: it provides the bridge between changed farm practices and broader catchment and distribution system outcomes.

Farmers adopt desirable actions in a more timely and coordinated manner through improved knowledge provided by whole farm plans and extension services. Farmers optimise use of their natural resources, increasing productivity while not putting these resources at further risk.

3. MATCH DRAINAGE TO MEET CHANGED NEEDS

Knowledge that irrigation without drainage is unsustainable was one of the main reasons why the original SIRLWMP was prepared in the late 1980s. This knowledge remains pertinent in this update, with an added emphasis on tailoring the type of drainage works to specific and changed risks in different areas.

The emphasis of the Drainage Program is now about draining surface water, particularly after large rainfall events, through implementation of a hybrid drainage system (of constructed and natural drainage courses) in areas that still require drainage.

Sub-surface drainage needs to be adaptively managed to ensure it operates when and where required, being responsive to changing watertable conditions.





4. RECONNECT LARGE AREAS OF ENHANCED NATURE

Significant biodiversity benefits will be achieved via incentives for protecting remnant native vegetation and for planting appropriate species, which will enhance existing remnants and develop better connections between large remnants. A key mechanism for delivering these benefits will be through high priority focus landscapes. Incentives will be targeted at landholders within these landscapes.

Contributions to planning schemes that control removal of native vegetation, and direct offsetting where vegetation is removed, are also important.

Providing water to native vegetation is a critical complementary activity, which is discussed under the next priority.

5. BALANCE WATER AVAILABILITY FOR ALL USES

The region needs to continue collaborating with stakeholders across many jurisdictions to ensure that lessons learnt, especially those within Victoria's northern regions, are built into evolving Murray-Darling Basin-wide approaches to water sharing and management.

There also needs to be a continued emphasis on understanding water needs for the environment within the region, so these can be balanced and integrated with irrigation and other needs.

Much of the region's remaining native vegetation is found along waterways and in and around wetlands, providing largely connected habitats that act as key thoroughfares for fauna. Important objectives of environmental flows include provision of water to protect and enhance this native vegetation.

Water quality continues to be a key component of delivery and there needs to be ongoing efforts in improving water quality for all users, as well as monitoring and reporting against water quality targets.

6. BUILD STEWARDSHIP, INCORPORATING LOCAL ACTION AND IDEAS

People and their relationship with the region's natural resources are critical to the success of the SIRLWMP over the next five years. Stewardship of natural resources and the environment will continue to be encouraged. Community leaders will promote the region within and beyond its boundaries, and manage issues of community concern in partnership with agencies and policy-makers.

The Goulburn Broken CMA will continue to engage Traditional Owners to consider cultural values in the SIR.

7. MAINTAIN PARTNERSHIPS AND GOOD GOVERNANCE

The region's environmental features and systems are influenced and managed by many individuals, communities and organisations, which means that much of the work required to achieve the SIRLWMP vision will be undertaken by parties other than the Goulburn Broken CMA. Strong relationships between partners will therefore be critical in firstly agreeing on the management desired and then undertaking the work.

8. ADAPT BY UNDERSTANDING CHANGE AND IMPACT

The region is widely known for being quick to respond to changing circumstances, thanks mainly to strong partner connectedness. However, the pace of change is increasing and the challenge now is to be positioned to ride the frequent 'waves of change', rather than respond to them after they've gone through. This is consistent with Goulburn Broken CMA directions to develop a resilience approach (GB CMA 2013).

Apart from maintaining partner relationships, close attention needs to be paid to evaluating progress, changes in circumstances and potential new pathways.

Long-term monitoring underpins the success of an adaptive approach and ongoing investment in a sound monitoring program is critical to sound decision-making.

Chapter 7 describes the approach to make adaptation a reality, with an emphasis on the knowledge about change and impact needed and the processes that enable new knowledge to be included in decision-making.





6. IMPLEMENTATION PLAN

This chapter summarises how the priorities for action listed in the previous chapter become a reality.

IMPLEMENTATION PROGRAMS

Priorities for action will be delivered through five implementation programs:

- Farm
- Drainage
- Environment
- People
- Governance and partnerships.

These implementation programs provide a focus for managing the many details of implementation in an integrated operating environment.

The holistic implementation program goals set in the 1990s help reinforce decisions that consider impacts on the region as a complex interactive system rather than in isolation.

Although stakeholder participation in these implementation programs has been deliberately adapted to changing circumstances during the SIRLWMP's 25-year history, the core intent, structure and functioning of these implementation programs have largely remained the same.

Programs are generally supported by stakeholder working groups, with the People and Governance and partnerships programs overseen by the Shepparton Irrigation Region People and Planning Integration Committee (SIRPPIC).

Table 3 on the following page lists implementation program goals, priorities and 5-year targets.

Actions needed to achieve these targets are listed in Part B of this SIRLWMP.

Funding to achieve some of these 5-year targets will not be through SIRPPIC processes. However, SIRPPIC intends to help partners influence funding so that the targets can be achieved.

The achievement of targets and goals are subject to influences outside of the region's control.

In most cases, implementing actions (documented in Part B) are the primary indicators of progress. Other indicators such as 'community wellbeing' and 'regional economic activity' can also be pursued where they add useful context for decision-making at various levels, including vision-setting, and measuring progress towards the vision.

Table 3. Implementation programs, goals, priorities and 5-year targets

Implementation program	Program goal	Priority	5-year target
Farm	Improve land management practices on private land within the Shepparton Irrigation Region to protect and enhance the environment, to improve economic viability, and to help rural communities make informed decisions	Update irrigation infrastructure	90% of the irrigation delivery system is modernised, with all irrigated land connected
		Build natural resource management into the farming system	60% of irrigated farms have been redesigned to capitalise on, and align with, modernised irrigation delivery
			10% of farmers are assisted each year to make changes that improve farm viability and provide long-term public benefits
			All farmers and designers have ready access to information that allows them to factor environmental sensitivities into planning
Drainage	By 2020, improve the health of natural resources and improve the productivity in the Shepparton Irrigation Region by providing an appropriate Surface Water Management service in areas where the total economic, social and environmental benefits exceed the cost	Match drainage to meet changed needs	Irrigated land is protected from salinity and waterlogging threats by a coordinated private and public drainage network
	Work with community to provide innovative groundwater and salt management services which support sustainable agricultural practices and protect environmental assets across targeted areas of the Shepparton Irrigation Region		Groundwater pumps are ready to be used when required to mitigate risk from high watertables
Environment	Protect and enhance the natural riverine features in the region, improve water quality, and the social, economic and cultural values they provide	Balance water availability for all uses	Five seasonal watering proposals are developed annually for priority waterways and wetlands to meet environmental outcomes, with consideration of agricultural and social needs
			Water quality is improved or maintained to meet set targets in priority rivers and streams
	Protect and enhance natural assets and their ecosystem processes and functions in a way that provides benefits for native biodiversity, social and economic aspects	Reconnect large areas of enhanced nature	Across three focus landscapes, the extent of native vegetation is increased by 300 ha each year
			Across three focus landscapes, 150 ha of native vegetation is actively enhanced each year
People	Make the community a valued partner in identifying ways of increasing custodianship of the natural resource base and raising the profile of the region through promoting this custodianship as a competitive advantage	Build stewardship, incorporating local action and ideas	Community-led ideas and actions and research have increased stewardship of the natural resource base
			Community and industry groups, agencies, Traditional Owners and individuals have increased capacity to contribute to the SIR vision
Governance and partnerships	Continue to successfully deliver projects and programs in an integrated way with clarity of roles and responsibilities for all partners	Maintain partnerships and good governance	Partners actively participate in SIRLWMP-led projects
			SIRPPIC is accountable through demonstrated processes and actions that contribute to SIRLWMP implementation
		Adapt by understanding change and impact	SIRLWMP is adaptive through demonstrated processes that consider change, impact and responses

7. EVALUATION AND MAKING ADAPTATION HAPPEN

We know that circumstances will change, causing us to reconsider the direction set in this SIRLWMP update, from the vision to onground actions. The pace of change is also increasing. We need to be able to recognise when we need to act differently and how to make actions happen.

This chapter identifies evaluation and adaptation processes that make the SIRLWMP a live document, so that the SIR's people can continue to be proactive and responsive.

Part B lists actions in greater detail under the priority 'Adapt by understanding change and impact'.

ADAPT BY UNDERSTANDING CHANGE AND IMPACT

Priorities for action will be delivered through five implementation programs:

- the complex system of people and nature, including a highly integrated and changing operating environment
- uncertainties about the risks to the resilience of the social-ecological system, including uncertainties in measuring system elements and progress in managing them
- the inherent difficulty in going from 'action to traction': developing well thought out actions is one task; making actions happen is another.

TIMELY DECISION-MAKING AND ACTION

Given these challenges, making the right changes happen is often as much about organisational and cross-organisational culture as the quality of any written plan. The culture must continue to include strong relationships between stakeholders, which have been nurtured since the SIRLWMP was founded on joint action in the 1980s (Victorian Government 1988). Therefore, future directions, especially changes, require shared agreement.

The right people need to be focused on making decisions about the right problems at the right time. Actions need to be tailored to the roles that different people play in a large-scale process. There is a need for experts (to provide rigorous data), connectors (to link many stakeholders in a complex system), and salespeople to get the message out (Gladwell 2000).

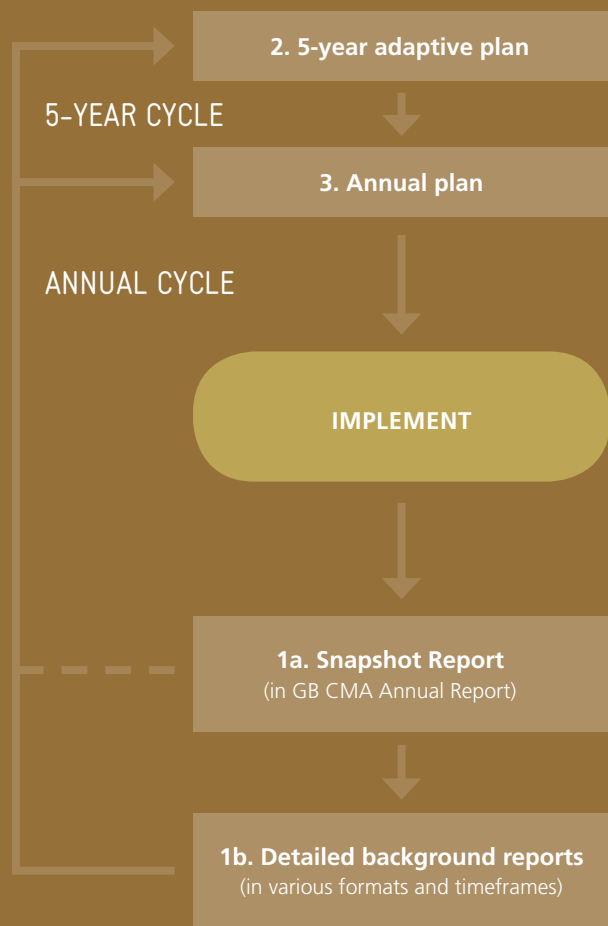
The focus for shared decision-making is on the five critical attributes that underpin the functioning of the region and the eight priorities for action to manage these attributes, as described in Chapter 5.

Information for evaluation is sorted in terms of timeframes, geographic scales, and planning cycles to help tailor information to the different stakeholders who are making decisions on direction (see Figure 4 and Table 5).

Part B includes details of broad monitoring and evaluation responsibilities of the Goulburn Broken CMA Board, SIRPPIC and program managers, aligned with different levels, from the vision to critical attribute goals to priority 5-year targets to actions.

Key roles for SIRPPIC are to continually identify 'hot issues' (by considering risks and opportunities) and to update the balance of efforts accordingly, from strategic planning to operational action. A high-level collective assessment of all issues is to be part of SIRPPIC's schedule.

Figure 4. SIRLWMP adaptive planning cycles





MONITORING, EVALUATION AND RESEARCH

Progress towards long-term goals for critical attributes and five-year targets for priorities are important indicators of the plan's success.

While some progress towards long-term goals for critical attributes can be directly measured, such as phosphorus levels in streams, much understanding of progress in the short term relies on data about onground changes and knowledge about the assumed impacts of these changes on goals. The equation: 'Outcomes = Outputs x Assumptions' is used as the basis for understanding progress and identifying knowledge gaps for research. In this plan, outcomes are described in terms of critical attribute goals and outputs are listed as actions under the priorities in Part B.

Long-term goals for critical attributes are compiled in Table 4 (next page). Specific indicators for monitoring progress against these goals are listed in Part B. Indicators of progress towards the five-year targets (Table 3) will usually simply be the extent of implementing actions (listed in Part B) against these targets. The clear presentation of these indicators is an important early implementation task.

Integration and assumptions that link priorities with critical attributes

More than 25 years of experience in implementing previous versions of this plan has resulted in significant integration: single actions often generate significant integrated benefits.

The diagram showing how single priorities contribute to several long-term goals (Figure 1) and 'Benefits of integrated intervention' (Table 2) show the many relationships between priorities and critical attributes. Although many assumptions that underpin these links have been documented, several require further investigation. This is critical evidence in understanding progress and helping make decisions as part of the adaptive process. The monitoring and evaluating of impacts of actions in all programs on all outcomes (especially critical attribute goals) is a very challenging and important task that the region pursues.

Table 5 lists SIRLWMP evaluation processes at each step of the two planning cycles (in Figure 4). The availability of items of evidence and the need to update them to answer key evaluation questions will be reviewed annually.

Table 4. Long-term goals for critical attributes

Critical attribute	Long-term goal																						
	General direction	Quantitative target																					
Watertables	Manage shallow watertables so that soil zones at risk are not salinised or waterlogged	By 2020, minimise irrigation-related salinity impacts from shallow watertables within the SIR (500,000 hectares) by improved irrigation management on farms, improved surface water management within drainage catchments, and appropriate pumping, reuse and disposal of groundwater over 216,000 hectares. <i>Stream salinity targets (which are directly related to watertable management) are listed under 'water quality'</i>																					
Water availability	Ensure that water is available to match the needs of the environment, agriculture and social consumption when required	Maintain delivery of 880,000 megalitres for agriculture within the SIR (in an average season of 100% allocation) <i>A task during implementation of the SIRLWMP update is to explore the setting of a volume target for environmental water requirements (that complements the previous target for agriculture) specific to the SIR</i>																					
Native vegetation extent	Increase the extent of native vegetation within focus landscapes	By 2030, the extent of native vegetation will be increased by 2% across nine focus landscapes (a total of 300 hectares per year)																					
Water quality	Maintain and improve water quality for the range of beneficial uses (values) (GB CMA 2014)	Murray-Darling Basin Authority salinity target (MDB Ministerial Council 2001) Manage the salinity impacts on the River Murray at Morgan (in South Australia) from implementation of the SIRLWMP, in accordance with the Murray-Darling Basin Authority's requirements, at or below 8.9 EC (electrical conductivity unit)																					
		State Environment Protection Policy Environmental quality objectives (Victorian Government 2003)																					
		<table border="1"> <thead> <tr> <th><i>Indicator</i></th> <th><i>Percentile</i></th> <th><i>Objective</i></th> </tr> </thead> <tbody> <tr> <td>Total phosphorus</td> <td>75th</td> <td>< 45 micrograms per litre</td> </tr> <tr> <td>Total nitrogen</td> <td>75th</td> <td>< 900 micrograms per litre</td> </tr> <tr> <td>Dissolved oxygen</td> <td>25th to maximum</td> <td>> 85 and < 110% saturation</td> </tr> <tr> <td>Turbidity</td> <td>75th</td> <td>< 30 Nephelometric Turbidity Unit</td> </tr> <tr> <td>Electrical conductivity (indicates for salinity)</td> <td>75th</td> <td>< 500 microSiemens per centimetre</td> </tr> <tr> <td>pH (indicates for acidity)</td> <td>25th to 75th</td> <td>> 6.4 to < 7.7</td> </tr> </tbody> </table>	<i>Indicator</i>	<i>Percentile</i>	<i>Objective</i>	Total phosphorus	75th	< 45 micrograms per litre	Total nitrogen	75th	< 900 micrograms per litre	Dissolved oxygen	25th to maximum	> 85 and < 110% saturation	Turbidity	75th	< 30 Nephelometric Turbidity Unit	Electrical conductivity (indicates for salinity)	75th	< 500 microSiemens per centimetre	pH (indicates for acidity)	25th to 75th	> 6.4 to < 7.7
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	Total phosphorus loads from the Catchment:	Reduce potential total phosphorus loads from the Catchment by 65% by 2016 (from the benchmark of 361 tonnes)																					
	Total phosphorus loads from irrigation drains:	Reduce total phosphorus loads from irrigation drains by 50% by 2016 (from the benchmark of 169 tonnes)																					
Farm and food processor viability	Help farm and food-processors be viable, by supporting the natural base in a way that helps them adapt quickly to changing agricultural markets and demands	A task during implementation of this SIRLWMP update is to explore the setting of specific targets (considering thresholds) for farm and food-processor viability																					

Table 5. SIRLWMP evaluation process checklist aligned with planning cycle steps

Planning cycle step	Evaluation action	Key evaluation questions to be considered annually*	Items of evidence in answering key evaluation questions
1a) Annual report 1b) Detailed background reports	<ol style="list-style-type: none"> 1. Complete a snapshot report of SIRLWMP implementation within the Goulburn Broken CMA's annual report 2. Prepare detailed reports for various issues, according to a continually updated evaluation schedule 	<p>What progress was made this year?</p> <p>What progress has been made in implementing the SIRLWMP?</p> <p>What are the risks to the future of the SIR?</p> <p>What next steps does SIRPPIC need to take?</p>	<ul style="list-style-type: none"> – Achievements (outputs completed against funded targets) – Achievements (including government-funded and other fund-source onground output achievements against priorities and 5-year targets (in Table 3)) – Drivers of change (including shifts in circumstances) – Risks and opportunities ('catchment condition' related to critical attributes and their thresholds; future scenarios and preventable and unavoidable system transformations)
2) Adaptive plan (SIRLWMP)	3. Update the 2016 SIRLWMP in 2021	<p>Is the (c. 30-year) vision for the Catchment or system right?</p> <p>Is the purpose of SIRPPIC clear?</p> <p>Do the medium-term (5-year) strategic approaches need to change?</p>	<ul style="list-style-type: none"> – Community values – RCS vision (alignment with SIRLWMP) – SIRPPIC terms of reference – Progress against long-term goals for the SIR's critical attributes water availability, water quality, watertables, native vegetation extent, farm and food-processor viability – Assumptions that link outputs to outcomes (long-term goals) – Governance arrangements (including partnerships) – Capacity to deliver (including social, organisational and individual) – Trade-offs and synergies (including benefit/cost)
3) Annual plan	4. Prepare an annual plan based on received funds each year	Do the preferred investment priorities need to change this year?	<ul style="list-style-type: none"> – Government priorities (resources available) – Partnership agreements
<i>Implement</i>			

* Key evaluation questions are considered annually, but levels of detail and processes in answering them vary significantly, according to SIRPPIC's perception of the status of individual issues within the adaptive planning cycle.

GLOSSARY OF TERMS AND ACRONYMS

Backbone	Publicly owned key regional irrigation channel system
Biodiversity	The variety of life in the world or in a particular habitat or ecosystem
BSM2030	Basin Salinity Management 2030 Strategy
Connections Project	The modernisation project for the publicly-owned GMW delivery system
DEDJTR	Department of Economic Development, Jobs, Transport and Resources
DELWP	Department of Environment, Land, Water and Planning
DSE	Department of Sustainability and Environment
Farm Water Program	The GB CMA managed on-farm efficiency water use program
GB CMA	Goulburn Broken Catchment Management Authority
GMID	Goulburn Murray Irrigation District
GMW	Goulburn-Murray Water
Intervention	An activity undertaken by a government to direct an economy or society
MDB	Murray-Darling Basin
MDBA	Murray-Darling Basin Authority
NRM	Natural resource management
Offsets	The replacement of lost vegetation with new or protected areas of plantings or remnants
Residual rainfall	Calculated as the cumulative monthly deviation from the mean and is indicative of the wetness of the soil profile and therefore watertable level
Resilience	The ability of the system to absorb stress while continuing to function in a desired way
SIR	Shepparton Irrigation Region
SIRLWMP	Shepparton Irrigation Region Land and Water Management Plan
SIRPPIC	Shepparton Irrigation Region People and Planning Integration Committee
Social-Ecological System	Linked and generally similar systems of people and nature, taking into account cultural, political, social, economic, ecological and technological components
System	The set of variables and the interactions, processes and mechanisms that govern them
Thresholds	A breakpoint between two states of a system that must be exceeded to begin to produce some sort of effect or response
Vision	An aspirational statement outlining how the Catchment will look in c. 50 years' time



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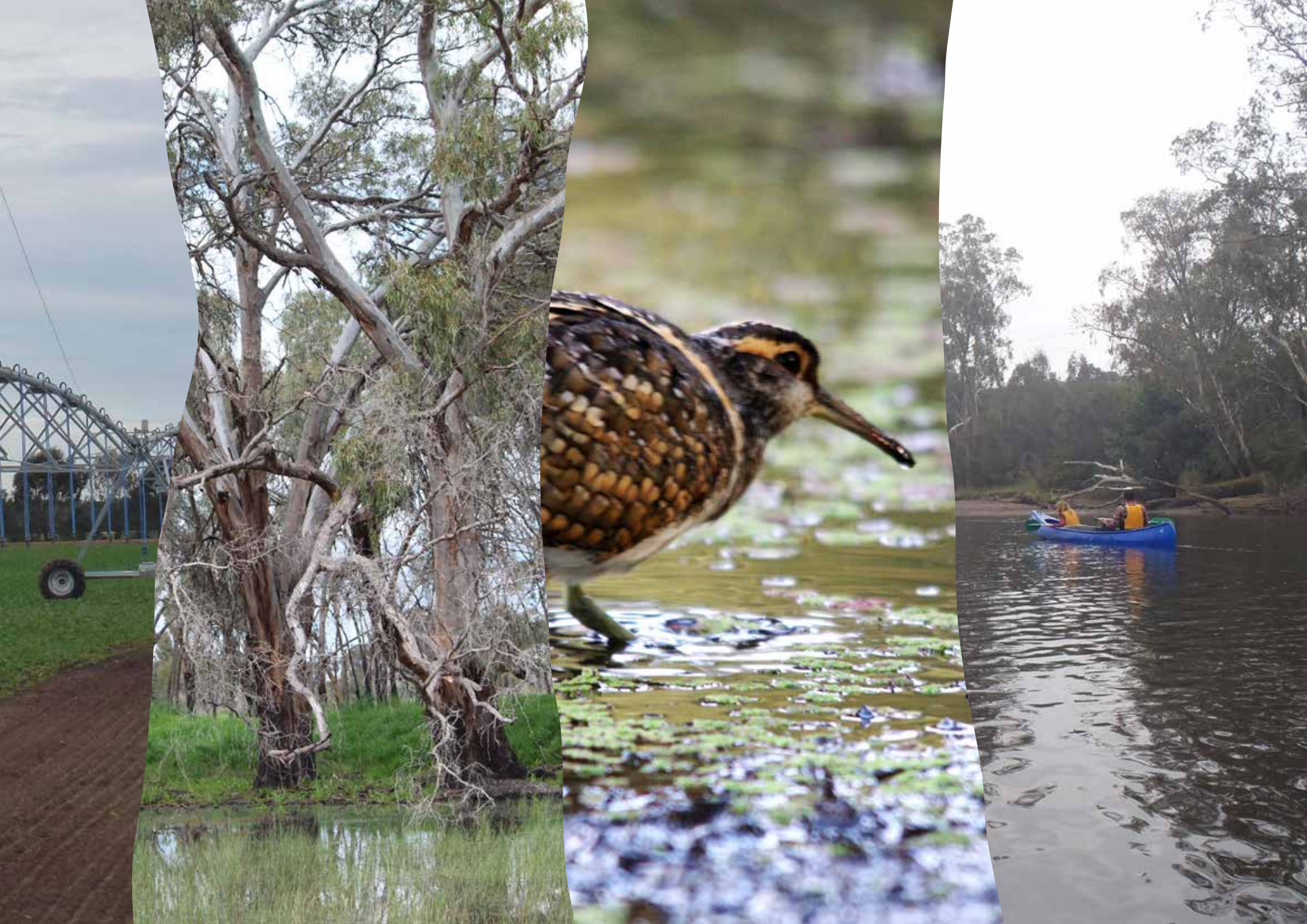
SIRPPIC MEMBERS

Back row left to right: Mark Turner (GB CMA), Lachlan Barnes (DEDJTR), Doug Brown (community rep), Patrick Rochford (community rep), Kelvin Bruce (community rep, vice-Chair), Helen Reynolds (community rep, Chair), Allen Canobie (community rep), Carl Walters (GB CMA, SIP Manager), Jenny Wilson (GB CMA), Rebecca Caldwell (GB CMA)

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Absent: Andrea Smith (community rep)





OUR PARTNERS

