# Regional Water Strategy

## Border Rivers

NSW GOVERNMENT

November 2022

**Published by NSW Department of Planning and Environment**
dpie.nsw.gov.au

**Title** Regional Water Strategy

**Sub-title** Border Rivers

**First published** November 2022

**Department reference number** PUB22/1078

**Cover image** Image courtesy of Floodplain Harvesting Team, Department of Planning and Environment – Water.
Barwon River, Mungindi.

**More information** water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies

# Acknowledging First Nations people

The NSW Government acknowledges First Nations people as its first Australian people and the traditional owners and custodians of the country's lands and water. We recognise that First Nations people have lived in NSW for over 60,000 years and have formed significant spiritual, cultural, and economic connections with its lands and waters.

Today, they practice the oldest living culture on earth.

The NSW Government acknowledges the Bigambul, Githabul, Gomeroi, Kambuwal, Kwiambal and Ngarabal people as having an intrinsic connection with the lands and waters of the Border Rivers Regional Water Strategy area. The landscape and its waters provide First Nations people with essential links to their history and help them to maintain and practice their traditional culture and lifestyle.

We recognise that the Traditional Owners were the first managers of Country and that incorporating their culture and knowledge into management of water in the region is a significant step for closing the gap.

Under this regional water strategy, we seek to establish meaningful and collaborative relationships with First Nations people. We will seek to shift our focus to a Country-centred approach, respecting, recognising and empowering cultural and traditional Aboriginal knowledge in water management processes at a strategic level.

We show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places where First Nations people are included socially, culturally and economically.

As we refine and implement the regional water strategy, we commit to supporting the health and wellbeing of waterways and Country by valuing, respecting and being guided by Traditional Owners/First Nations people, who know that if we care for Country, it will care for us.

We acknowledge that further work is required under this regional water strategy to inform how we care for Country and ensure First Nations people/Traditional Owners hold a strong voice in shaping the future for Indigenous/Aboriginal and non-Aboriginal communities.

Artwork courtesy of Nikita Ridgeway.

# Minister's foreword

**The Hon. Kevin John Anderson, MP**
**Minister for Lands and Water, and**
**Minister for Hospitality and Racing**

We need healthy rivers, healthy farms and healthy communities. The way we manage water deeply affects the livelihoods of people in NSW.

Water is the most precious resource we have. Everyone and everything relies on water. It supports our towns, the rich cultural heritage of our Aboriginal communities, our industries and our natural environment. Water underpins the Border Rivers region's health and prosperity.

The Border Rivers region faces many water challenges. The way we manage these affects the lives and livelihoods of all people in the Border Rivers region. This has led the NSW Government to develop a long-term strategic vision for water. Our vision sets the direction and lays a path to improve water security, river health and cultural outcomes in NSW. Central to this vision is a holistic approach to water management. This will help us ensure that water is used sustainably and fairly, and it will help us prepare for a more variable and changing climate.

The Border Rivers region is located within the traditional lands of the Bigambul, Githabul, Gomeroi Kambuwal, Kwiambal and Ngarabal nations. These traditional custodians have cared for the Border Rivers region's rivers and catchments for over 60,000 years.

The region is home to over 32,000 people and the towns of Inverell, Glen Innes, Tenterfield, Ashford, Boggabilla and Mungindi. Farms and agriculture drive the region's economy.

Developing the Border Rivers Regional Water Strategy required us to take a detailed look at what makes this region unique. We considered its relationship with water and its needs and challenges, and we developed innovative ways to deliver safe and secure water supplies that are sustainable and resilient, both now and into the future.

We developed the regional water strategies using the best and latest scientific evidence. This helped us to understand the risks to water users, even in the most extreme climatic conditions. We engaged leading academics to develop new methods to better understand the Border Rivers region's climate. These new methods and data supplement our historical climate records with new evidence from the field of paleoclimatology. More than 500 years of climate data helped us better understand historic climate variability. We have also applied the NSW Government's climate change projections to this new data to understand the impacts of a worst-case 'dry' climate scenario.

The climate modelling showed that extreme dry and wet periods worse than we've seen since European settlement have occurred in the past. These events are likely to become more frequent and severe in the future. Understanding these possible climate risks lets us plan for these events and make sure we are prepared if they do arise.

The contribution of the Border Rivers community has been instrumental in developing and finalising the strategy. We consulted with Aboriginal communities, local governments, industry and environmental groups, water users and members of the public. We listened to the feedback we received to make sure we deliver a strong strategy for the whole Border Rivers.

I would particularly like to thank the Aboriginal communities across the region who engaged with us and contributed their voices to this strategy. Water is an essential part of their culture and is critical in Caring for Country. I hope this strategy will start to dismantle the major barriers to Aboriginal people's water rights and access. I look forward to working collaboratively with Aboriginal communities in the Border Rivers region to achieve better water outcomes.

I would also like to thank local councils for their significant contributions and for their engagement and support. We will continue to partner with local councils as we implement the strategy.

I am proud to launch the Border Rivers Regional Water Strategy. I hope it will contribute to a healthy environment, resilient community and a vibrant regional economy.

Image courtesy of Robert Cleary, Department of Planning and Environment. Ironbark Creek Campground, Kings Plains National Park.

# Contents


| | | |
|---|---|---|
| **1.** | **About the Border Rivers Regional Water Strategy** | **8** |
| | The regional water strategies | 10 |
| | Objectives of regional water strategies | 11 |
| | Fitting regional water strategies with other water plans and policies | 12 |
| | Development of the Border Rivers Regional Water Strategy | 15 |
| **2.** | **The Border Rivers region** | **20** |
| | Water use in the Border Rivers region | 23 |
| **3.** | **What the future climate could look like in the Border Rivers region** | **26** |
| | Climate snapshot | 28 |
| **4.** | **Key challenges in the Border Rivers region – what we will focus on first** | **32** |
| | Challenge: Increased surface water security risks for towns in the region | 34 |
| | Challenge: Risk of reduced water availability will impact the regional economy | 36 |
| | Challenge: Addressing barriers to Aboriginal water rights | 38 |
| | Challenge: Sustaining the health and resilience of aquatic and floodplain ecosystems | 40 |
| | Challenge: Improving connectivity to support downstream needs | 44 |
| **5.** | **Responding to the challenges** | **48** |
| | Priority 1: Address knowledge gaps and make information easily accessible | 52 |
| | Priority 2: Do more with less water | 58 |
| | Priority 3: Make the region more resilient to climate variability | 64 |
| | Priority 4: Share water differently to address critical needs of Border Rivers and downstream users | 72 |
| **6.** | **Implementing the strategy** | **78** |
| | Getting our timing right | 79 |
| | Ongoing monitoring, adaptation and reporting | 81 |
| **7.** | **Attachment 1** | **82** |
| | Gomeroi and Kamilaroi water challenge statement | 83 |

Image courtesy of Michael Van Ewijk, Department of Planning and Environment. Macintyre River, Kwiambal National Park.

# About the Border Rivers Regional Water Strategy

# 1

Image courtesy of Destination NSW. Townscape, Glen Innes.

Secure, reliable and resilient water sources are critical to regional communities in NSW. They contribute to the appeal and prosperity of rural areas, regional towns and cities. They create cultural connections to Country and support community well-being. Water in the right places at the right times is also vital for healthy regional landscapes and sustainable ecosystems. Changing water demand, increased climate variability and shifting community expectations mean we need to plan and invest in improved long-term regional water security.

The Border Rivers Regional Water Strategy identifies the key regional challenges we need to tackle over the coming decades and outlines the actions that we will undertake to respond to those challenges. The best and latest climate evidence, along with a wide range of tools and solutions, has been used to chart a progressive journey for our water needs for the next 20 years and beyond.

Image courtesy of Bron Powell, Department of Primary Industries – Fisheries. Macintyre River between Budelah Nature Reserve and Mungindi, NSW.

# The regional water strategies

Across NSW, valuable and essential water resources are under pressure. A more variable climate, as well as changing industries and populations, mean we face difficult decisions and choices about how to balance the different demands for this vital resource and manage water efficiently and sustainably into the future.

The Border Rivers Regional Water Strategy is one of a suite of catchment-based strategies across the state (Figure 1). The strategies identify critical challenges that we need to tackle over the coming decades and outline the priorities and actions that we will undertake to respond to those challenges.

**Figure 1. Map of NSW regional water strategy regions**

# Objectives of regional water strategies

Regional water strategies will set out a long-term 'roadmap' of actions to deliver 5 key objectives (Figure 2). Each regional water strategy identifies the key challenges that impact on our ability to achieve the objectives and identifies priority actions that address the challenges and work towards meeting at least one regional water strategy objective.

**Figure 2. Regional water strategy objectives**

### Deliver and manage water for local communities

Improve water security, water quality and flood management for regional towns and communities.

### Enable economic prosperity

Improve water access reliability for regional industries.

### Recognise and protect Aboriginal water rights, interests and access to water

Including Aboriginal heritage assets.

### Protect and enhance the environment

Improve the health and integrity of environmental systems and assets, including by improving water quality.

### Affordability

Identify most cost effective policy and infrastructure options.

Our aim is for each strategy to have a comprehensive, balanced package of options that delivers on all the regional water strategy objectives and aligns with the priority actions of the NSW Water Strategy.

When formulating plans to share water, the NSW Government must take all reasonable steps to prioritise the protection of water sources and their dependent ecosystems.[1]

During extreme events, such as drought, our focus is on securing water for critical human needs. At these times, under section 60 of the *Water Management Act 2000*, critical human needs are the first priority and the environment is the second priority. Outside of these extreme events, we have greater flexibility to deliver across all the objectives.

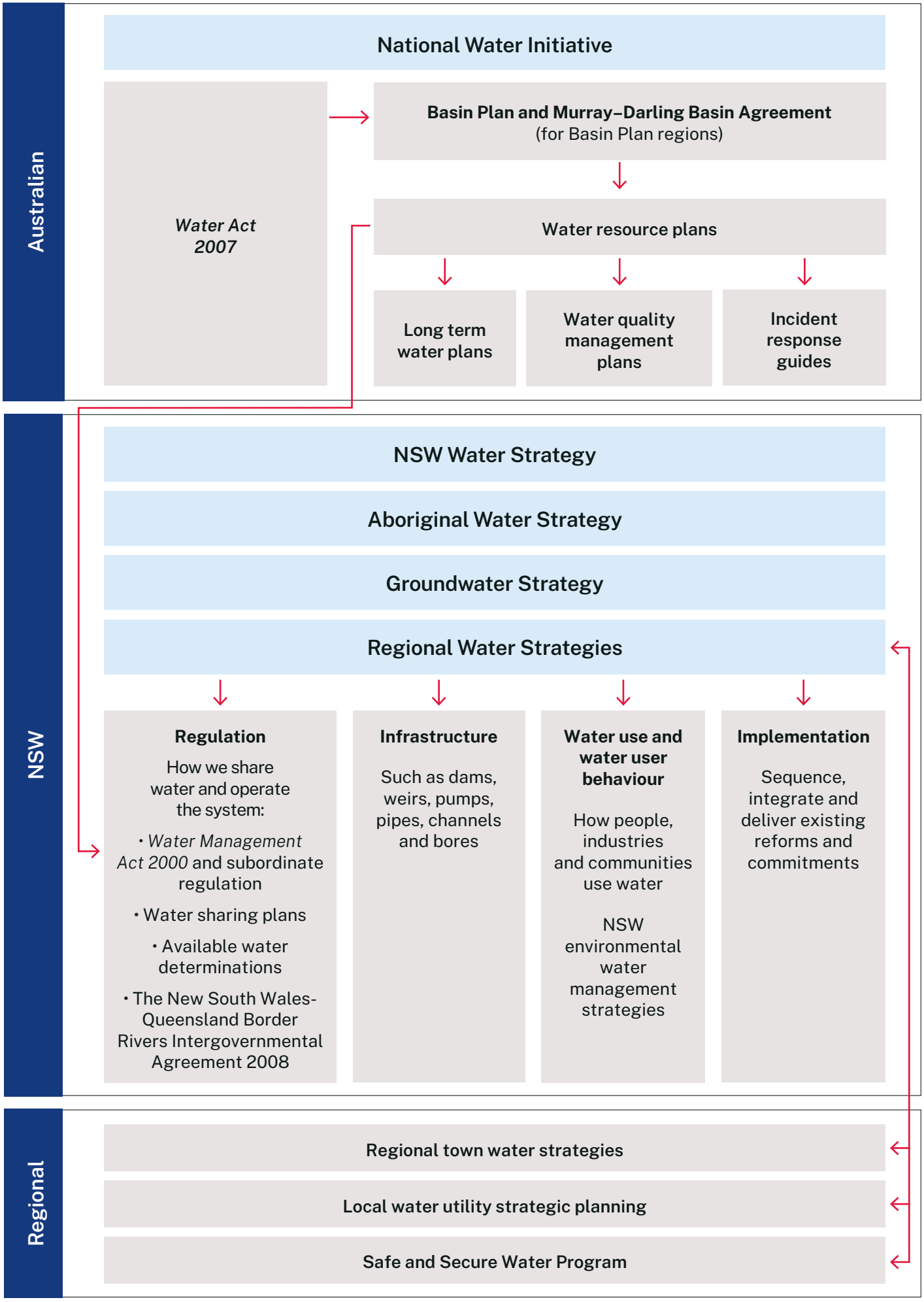
1. Subsections 9(1)(b), 5(3)(a) and 5(3)(b) of the *NSW Water Management Act 2000*.

# Fitting regional water strategies with other water plans and policies

Each regional water strategy across the state sits within a broader policy and planning context, including a range of policies and plans that guide the management of water resources in NSW (Figure 3).

Image courtesy of Jane Humphries, Commonwealth Environmental Water Office. Barwon River upstream of Mungindi Bridge.

**Figure 3. NSW water policy and planning context**



The strategic planning framework for water management in NSW includes the NSW Water Strategy, which is underpinned by a range of catchment-based regional and metropolitan water strategies. The NSW Water Strategy was developed in parallel with these strategies and guides the strategic, state-level actions that we need to take. The regional water strategies prioritise how those state-wide actions, as well as other region-specific, place-based solutions, are to be staged and implemented in each region.

As part of delivering the NSW Water Strategy, the NSW Government is delivering other state-wide strategies including:

- the Aboriginal Water Strategy – co-designed with Aboriginal people to identify a program of measures to deliver on First Nations' water rights and interests in water management
- a NSW Groundwater Strategy – to ensure sustainable groundwater management across NSW[2]
- the Town Water Risk Reduction Program – to identify long-term solutions to challenges and risks to providing water supply and sewerage in regional towns in collaboration with local councils
- a new state-wide Water Efficiency Framework and Program – to reinvigorate water use efficiency programs in our cities, towns and regional centres.

The NSW Water Strategy and the Border Rivers Regional Water Strategy also complement other whole-of-government strategies, including the 20-Year Economic Vision for Regional NSW, the State Infrastructure Strategy and the Draft New England North West Regional Plan 2041.

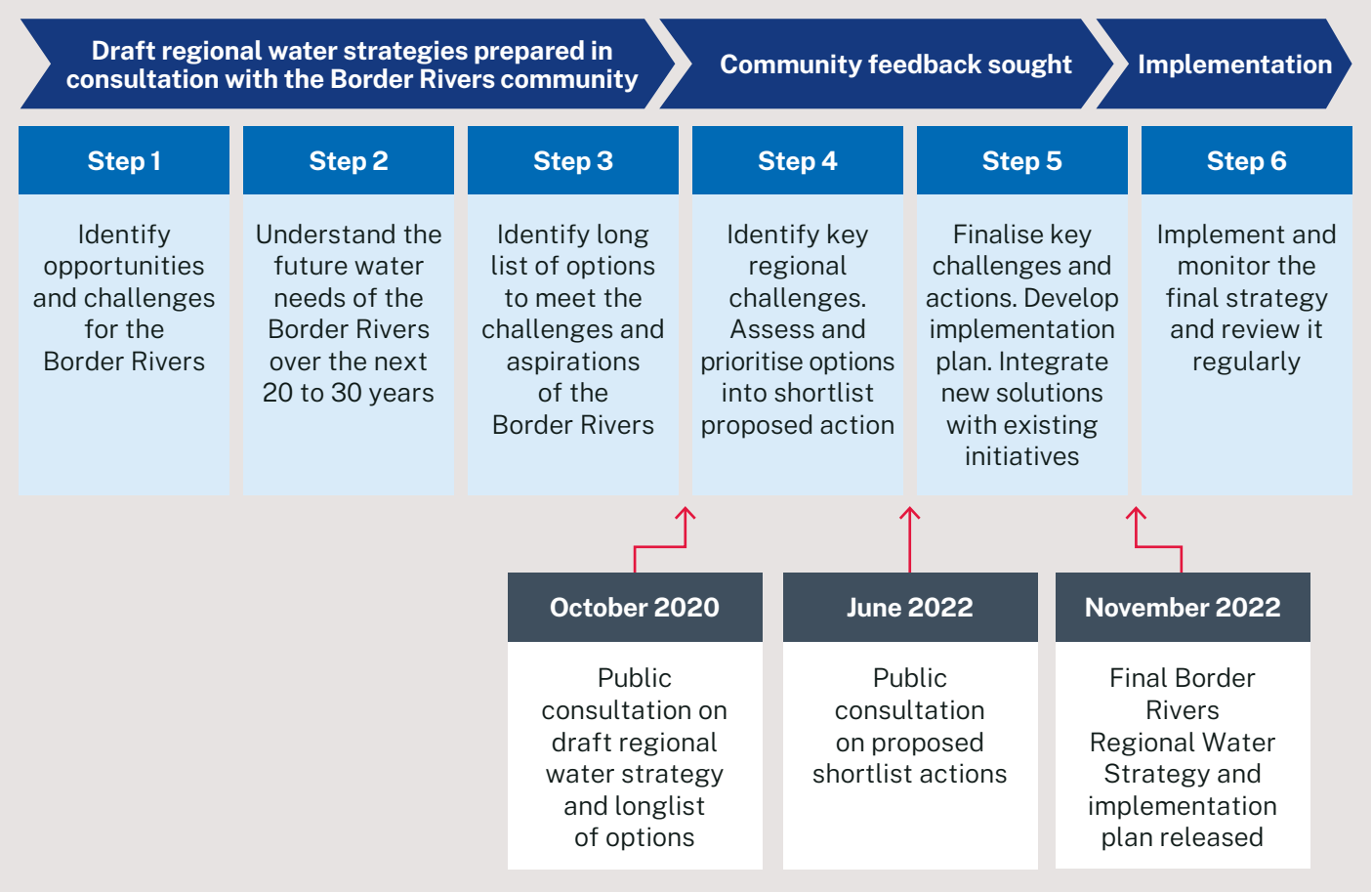
Image courtesy of Department of Planning and Environment. Cows graze on farmland near Glen Innes, NSW.

2. Available for download at: water.dpie.nsw.gov.au/plans-and-programs/nsw-groundwater-strategy

# Development of the Border Rivers Regional Water Strategy

The strategy has been developed using an evidence- and risk-based approach informed by extensive community consultation at each step of the process. The NSW Government has taken a 6-step approach to preparing and implementing regional water strategies as shown in Figure 4.

**Figure 4. Process for developing regional water strategies**




## What informed the Border Rivers Regional Water Strategy

We used feedback from the community, and the most recent data taken from a wide range of sources, to inform the regional water strategies and ensure that they are based on a robust evidence base. This information has been used to help identify the challenges that need to be tackled first, and the measures that will best support the region over the next 20 years. Information used to develop the strategy included:

- new climate data
- extensive community consultation across a broad range of interests
- economic, ecological and hydrological analyses
- a range of existing studies
- existing commitments and reforms.

## Climate data in the regional water strategies

The regional water strategies are underpinned by ground-breaking new climate data. Our new climate datasets and modelling give us a more sophisticated understanding of past and future climatic conditions. These improved datasets integrate recorded historical data with paleoclimate data[3] to give a modelling tool that generates 10,000 years of synthetic climate data. This information provides a much better understanding of the natural climate variability under current climate conditions. When combined with climate change projections, we can better understand how this natural climate variability will be influenced by human-induced climate change. We use both of these scenarios to assess risks to future water availability in each region.

This updated climate information has been used in developing the regional water strategy and comparing the effectiveness of the actions. It will also support all water users in making more informed decisions and better plan and prepare for climate risks.[4]

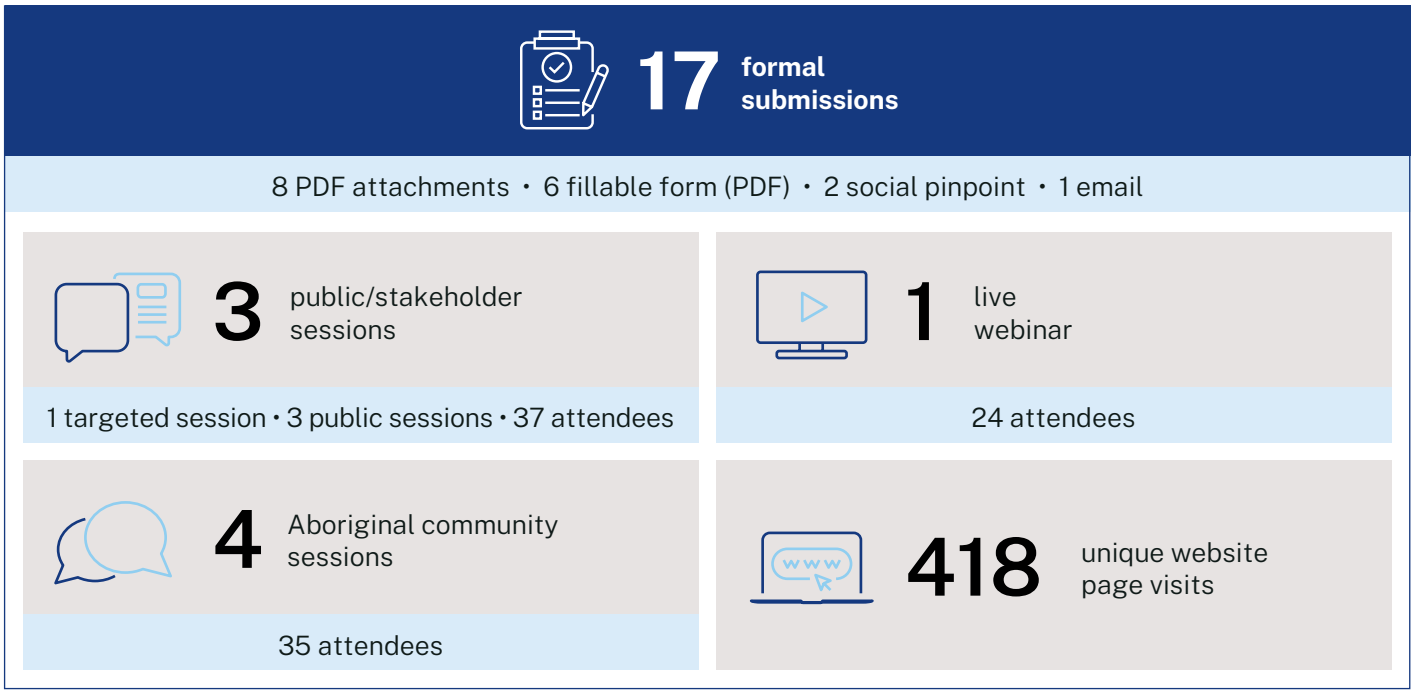
The section *What the future climate could look like in the Border Rivers region* sets out the results from the analysis of the new climate data for the region. We will continue to use the best and latest evidence about the future climate to help develop solutions for water challenges in the region.

## Extensive community consultation

Developing an effective and lasting regional water strategy requires input from Aboriginal people, landholders, community members, local councils, and industry and environmental groups. We would like to acknowledge and thank all these groups and individuals for the time and effort they have given to providing input into the strategy.

We sought feedback on the Draft Border Rivers Regional Water Strategy through 2 public exhibition periods, as well as a range of targeted engagement sessions (Figure 5). Community feedback was critical in shaping the final regional water strategy and implementation plan.[5]

**Figure 5. Stakeholder engagement during public exhibition on the shortlisted actions consultation paper**




3. Data reconstructed from before instrumental records began, using sources such as tree rings, cave deposits and coral growth.
4. More information about these new climate datasets and how they are being used in our river system models is in the *Regional Water Strategies Guide*, www.industry.nsw.gov.au/water/plans-programs/regional-water-strategies
5. www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/what-we-heard/border-rivers-regional-water-strategy

The key insights we heard during our most recent consultation with landholders, local councils, Aboriginal communities, stakeholders and the general public are provided in Figure 6 below.

**Figure 6. Key insights from consultation on the Draft Border Rivers Regional Water Strategy**

| Feedback theme | Feedback summary |
|---|---|
| **Climate and water data, information and modelling** | • There was support for considering climate variability and climate change in the strategy, but stakeholders would like to receive additional information about the likelihood of the worst-case scenarios modelled and suggested that the worst-case modelled scenario is not appropriate to inform short term water decisions.<br>• Suggestions for additional gauging stations in the upper catchment to help provide information about impending floods. |
| **Aboriginal water management, business and place-based opportunities** | • Strong support for all actions that delivered on Aboriginal water rights. |
| **Water infrastructure options not shortlisted** | • Mixed responses to the decision not to progress infrastructure options. In particular, some stakeholders wanted further analysis to be undertaken on inland diversion schemes and for that analysis to consider broader social, community and connectivity benefits. |
| **Environmental health, ecosystems and water quality** | • General acknowledgement that without a healthy environment, ecosystems and water quality would be compromised.<br>• There were mixed views about floodplain harvesting. There was general agreement that floodplain harvesting should be regulated. However, aspects of the policy to regulate and manage water taken under floodplain harvesting rules were not supported by some stakeholders. |
| **Water security, reliability and risk management** | • There was support for improving the water security for towns, although some stakeholders expressed concern that drinking groundwater might have health impacts.<br>• There was little support for the conversion of general security licences to a smaller number of high security licences, but identifying efficient, locally appropriate opportunities to manage regional and individual risk and reliability was supported. This included on-farm and industry efficiency, improved water security for towns and industries, and mechanisms to support economic diversification, including use of recycled water. |
| **Strategic land and water planning** | • Stakeholders advocated for improved transparency around drought operations in water management, and in managing and mitigating the impacts of floods. |
| **Inter-jurisdictional water management and collaboration** | • There was strong support for exploring opportunities to improve cross-border collaboration and communication to support a consistent approach for water management across the whole region. |
| **Improving connectivity** | • There was general support for implementing connectivity objectives through water sharing plan rules rather than through temporary water restrictions. However, any rules need to be clear, transparent and fair.<br>• Aboriginal outcomes need to be reflected in the connectivity objectives.<br>• Stakeholders noted that initiatives to improve riparian land management and fish passage are important to help deliver the ecological outcomes sought in the connectivity work proposed as part of the Draft Western Regional Water Strategy. |
| **Strategy implementation and oversight** | • Alignment with other major documents such as the NSW Water Strategy, the Aboriginal Water Strategy and the Groundwater Strategy was considered critical to the success of some actions.<br>• The implementation of the regional water strategy needs to be transparent and reviewed regularly to remain relevant. |

# Economic, environmental and hydrological analyses

Robust assessments have been used to prioritise the actions in the regional water strategy, including:

- hydrologic analysis of options with the potential to change the supply, demand or allocation of water
- cost-benefit and cost-effectiveness economic analyses through rapid and detailed assessments
- assessment of environmental impacts based on expert opinion, and detailed environmental watering requirement assessments based on hydrologic modelling
- qualitative assessments based on feedback from experts, Aboriginal people and the community.

More detail on the approach and results of these analyses is available on the department's website.[6]

The various analyses in the regional water strategies are based on the best available information at the time. As with all types of analyses, a range of assumptions are made. Significant changes to the critical assumptions used in the strategy may trigger the need to review or amend the strategy.

Critical assumptions adopted within the analyses include:

- **Town water supply risks** focused on surface water availability and do not include any consideration of existing alternative supply sources such as groundwater or desalination plants.
- **Population changes** have been included in accordance with the medium population growth forecasts in the NSW Government's Common Planning Assumptions. Towns within the Border Rivers region were assumed to have population growth that is flat rather than decreasing.
- **Water use and industry mix in the region** were assumed to be constant over the 40 years examined. Significant changes in the nature of the crops produced, or the industry mix in the Border Rivers region, will change the amount of water used and may require a review of the strategy.

Climate variability outside the bounds of the variability of the climate datasets used to inform this strategy may also necessitate a review of the Border Rivers Regional Water Strategy.

Image courtesy of Destination NSW. Rotary Park, Tenterfield.

6. www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/what-we-heard/border-rivers-regional-water-strategy

# Existing studies

A significant amount of work has been undertaken to understand the risks affecting water resource management in regional NSW.[7]

In the Border Rivers, this has included consideration of catchment studies, water security reports and existing water allocation and drought planning, as well as regional development, infrastructure and environmental strategies prepared by NSW Government departments and agencies. The following studies were critical for informing the Border Rivers Regional Water Strategy:

- WaterNSW's 20 Year Infrastructure Options Study for Rural Valleys[8]
- the Mole River Dam strategic business case[9]
- the Dumaresq-Barwon Border Rivers Commission's annual reports[10]
- Independent Review of the Northern Basin First Flush Assessment[11]
- the *Independent Assessment of Social and Economic Conditions in the Murray–Darling Basin*, commissioned by the Australian Government[12]
- the Department of Planning and Environment's Long-Term Water Plan for the Border Rivers[13]
- the Australian Competition and Consumer Commission's inquiry into markets for tradeable water rights in the Murray–Darling Basin.[14]

The strategy has also been guided by NSW's commitments under the Murray–Darling Basin Plan.

# Building on existing commitments and reforms

The NSW Government has made significant commitments to address the risks associated with water in regional NSW and to prepare our regions for the future.

Some of the state-wide water reforms include:

- improving water and sewage services for Aboriginal communities
- improving compliance and transparency around water use and access
- implementing robust metering laws to make sure that 95% of the potential water taken in NSW is accurately measured and monitored.[15]

In 2020, the NSW government also commenced implementation of all of the environmental water reforms that arose from the Water Reform Taskforce, which that was set up following the *Independent investigation into NSW water management and compliance* report.

During the recent drought, the NSW Government assisted the Border Rivers regional councils to undertake emergency works to address water security issues funding projects for the towns of Tenterfield, Glen Innes, Mungindi, Ashford and Bonshaw under the Safe and Secure Water Program.

The Aboriginal Water and Sewage Program funds water supply operation and maintenance for the Aboriginal community at Toomelah.

Regional water strategies build on the foundation provided by existing NSW Government commitments, actions implemented by local government and reforms to improve water security and reliability in our regions.

7. More information is in the *Regional Water Strategies Guide*, www.industry.nsw.gov.au/water/plans-programs/regional-water-strategies
8. Available at: www.waternsw.com.au/projects/infrastructure-studies/20-year-infrastructure-options-study
9. A summary of the hydrological results from the Mole River Strategic Business Case are available in Attachment 2 in the *Draft Regional Water Strategy Border Rivers: Shortlisted Actions – Consultation Paper,* www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/what-we-heard/border-rivers-regional-water-strategy
10. Available at: www.brc.gov.au/publications
11. Available at: www.industry.nsw.gov.au/water/allocations-availability/northern-basin-first-flush-assessment#:~:text=The%20Independent%20Panel's%20final%20report%2C%20which%20assesses%20management%20of%20the,Northern%20Basin%20First%20Flush%20event
12. Available at: www.mdba.gov.au/publications/independent-reports/independent-assessment-social-economic-conditions-basin
13. Border Rivers Long-Term Water Plan: www.environment.nsw.gov.au/topics/water/water-for-the-environment/planning-and-reporting/long-term-water-plans/border-rivers-consultation
14. Available at: www.accc.gov.au/focus-areas/inquiries-finalised/murray-darling-basin-water-markets-inquiry-0#:~:text=On%207%20August%202019%20the,in%20the%20Murray%2DDarling%20Basin
15. The NSW and Australian governments have committed $23.6 million and $12.5 million respectively to the metering program to ensure that meters are upgraded effectively. This includes rebates for water users who switch to telemetry-based systems.

# The Border Rivers region

2

Image courtesy of Destination NSW. Sinclair Lookout, Glen Innes.

**Figure 7. Snapshot of the Border Rivers region**

Border Rivers Aboriginal people (the **Bigambul, Githabul, Gomeroi, Kambuwal, Kwiambal** and **Ngarabal nations**) have lost access to land and water. Water is deeply entwined with Aboriginal culture and Aboriginal people's connection to country.

**32,000**
population

**Key towns include:**

Inverell, Glen Innes, Tenterfield, Ashford, Boggabilla and Mungindi. Region is also serviced by Moree and Goondiwindi (QLD).

**Main rivers:**

Dumaresq River, Macintyre River and Severn River.

Region supports rich and diverse range of water dependent **plants, animals** and **ecosystems,** including nationally listed Boobera Lagoon, Pungbougal Lagoon and Morella water course.

**Major water storage:**

Pindari (NSW) with a storage capacity of 312 GL and Glenlyon (QLD) with storage capacity of 254 GL.

Region's economy is **highly dependent on agriculture** dominated by irrigated cotton in the west and beef cattle in the east.

Irrigators have a low reliability of water. General security B licences receive on average 35% of their allocation by the end of the water year.

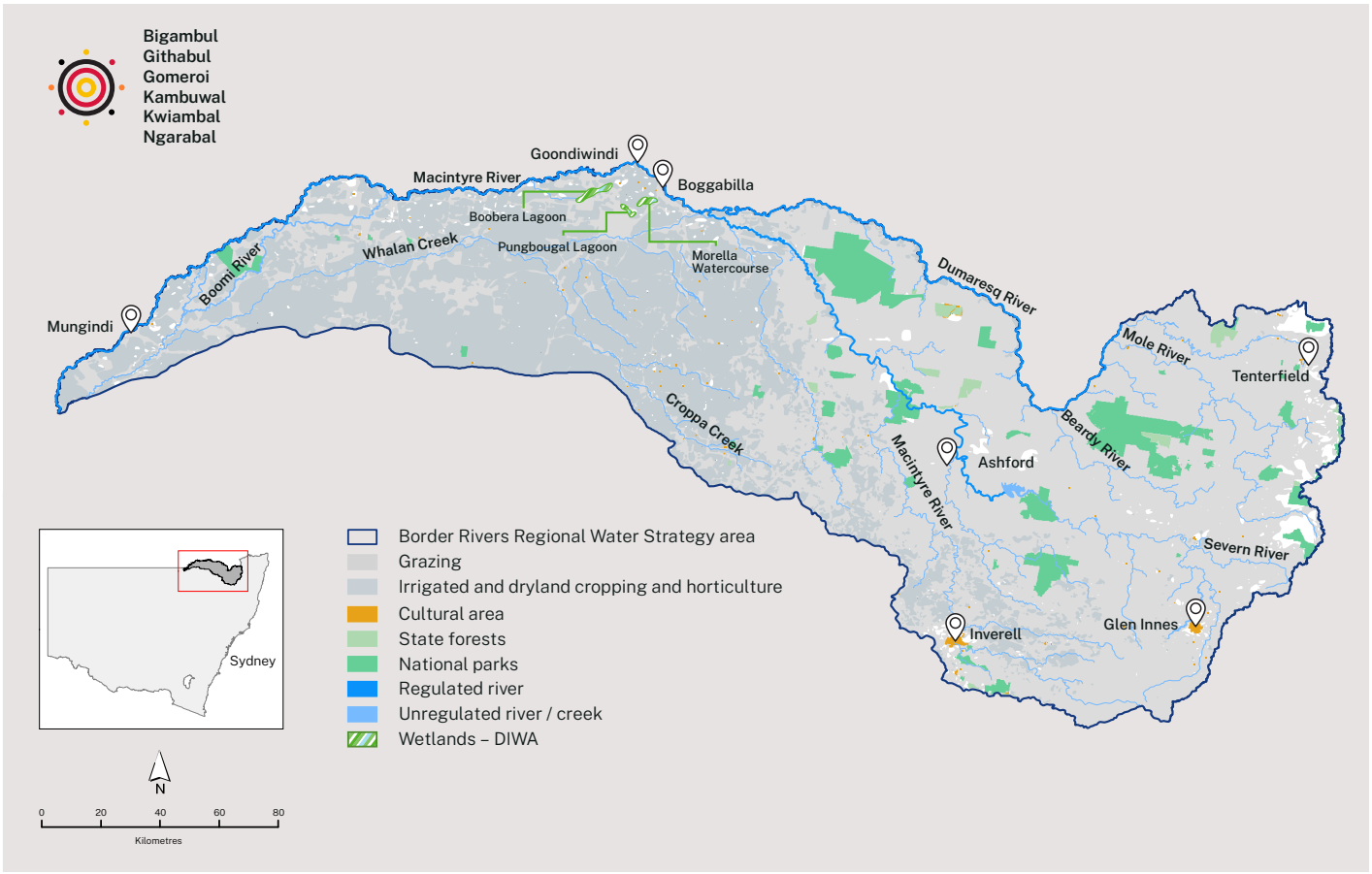
**Water for the environment:**

Approximately 1% of licences, or 4,200 ML of water entitlements are managed by state and federal environmental water holders.

**Groundwater sources:**

Alluvial sources, Great Artesian Basin, Inverell Basalt and New England Fold Belt. Groundwater resources in the upper catchment have lower reliability and yield.

**Figure 8. Map of the Border Rivers region**




The Border Rivers region is located on the traditional lands of the Bigambul, Githabul, Kambuwal, Gomeroi, Kwiambal, and Ngarabal people, who have been caretakers of their Country for over 60,000 years.

The region is in northern inland NSW where the landscape changes from hills and mountains in the east to flat alluvial plains in the west. It is bound by the Queensland border to the north and west, the western slopes of the Great Dividing Range to the east, the Gwydir catchment to the south and connects to the Barwon–Darling River in the west.

The region relies primarily on surface water for town and recreational use, cultural needs, environmental needs, agriculture and industry use. Groundwater availability and quality varies across the region according to the geology and location, with some high yielding groundwater sources in the west of the catchment but patchy groundwater availability in the east.

As well as meeting the daily needs of households and towns, water contributes to the region's amenity and liveability, and protects and conserves ecological assets and Aboriginal cultural heritage. Water also benefits many industry sectors, including agriculture which is the main driver of the regional economy and local employment.

The primary industry in the east of the catchment is grazing, with irrigated agriculture and cotton production dominating the western part of the region along the regulated rivers.

The Border Rivers is also home to a wide variety of aquatic ecosystems including ecologically and culturally significant wetland complexes. It is home to the nationally significant Morella Watercourse, Boobera Lagoon and Pungbougal Lagoon, which are located on the Macintyre River floodplain. They are some of the few permanent waterbodies in the northern Murray–Darling Basin.

The region experiences extreme river flow variability, with many years of low flows interspersed by high flow events. Agriculture and environmental water releases rely on these high flow events and supplementary licences to underpin businesses and deliver water to important environmental assets along the river.

Aboriginal people in the region rely on water for their health, wellbeing and connection to Country. They value maintaining connectivity to land and water, and the region's rivers are considered 'classrooms' for maintaining the continuity of Aboriginal culture.

# Water use in the Border Rivers region

The Border Rivers catchment is unique in that it spans both NSW and Queensland. Regulated river flows, regardless of their state of origin, are shared 57–43% between NSW and Queensland respectively, with these sharing arrangements covered by the 1946 New South Wales–Queensland Border Rivers Agreement.[16]

Major dams in the catchment include Pindari Dam (312 GL) on the Severn River near Inverell and Glenlyon Dam (254 GL) on Pike Creek in Queensland.

The region's largest water user is agriculture, with most of the surface water and groundwater licences held by agricultural enterprises (Table 1).

Approximately 1% of the licences are managed by state and federal environmental water holders.

Local water utilities hold less than 1% of the surface water licences.

**Table 1. Regulated and unregulated river licences in the Border Rivers catchment**

| Regulated Border Rivers catchment (NSW only) | | Unregulated Border Rivers catchment (NSW only) | |
|---|---|---|---|
| **Entitlement** | **Proportion of shares compared to total share pool (%)** | **Entitlement** | **Proportion of shares compared to total share pool (%)** |
| **Domestic and stock** | 0.3 | **Domestic and stock** | 1.2 |
| **Local water utility** | 0.2 | **Local water utility** | 6.3 |
| **High security** | 0.3 | **Unregulated (general)** | 92.5 |
| **General security** | 66.6 | | |
| **Supplementary** | 32.5 | | |

Source: Water Sharing Plan for the Border Rivers Regulated River Water Source 2016, and Water Sharing Plan for the Border Rivers Unregulated River Water Sources 2012.

16. www.brc.gov.au/about

Most of the water taken in the Border Rivers region is from surface water sources, although there is an increased demand on groundwater during drought as surface water supplies decrease (Figure 9).

**Figure 9. Surface water and groundwater extraction in the Border Rivers region**

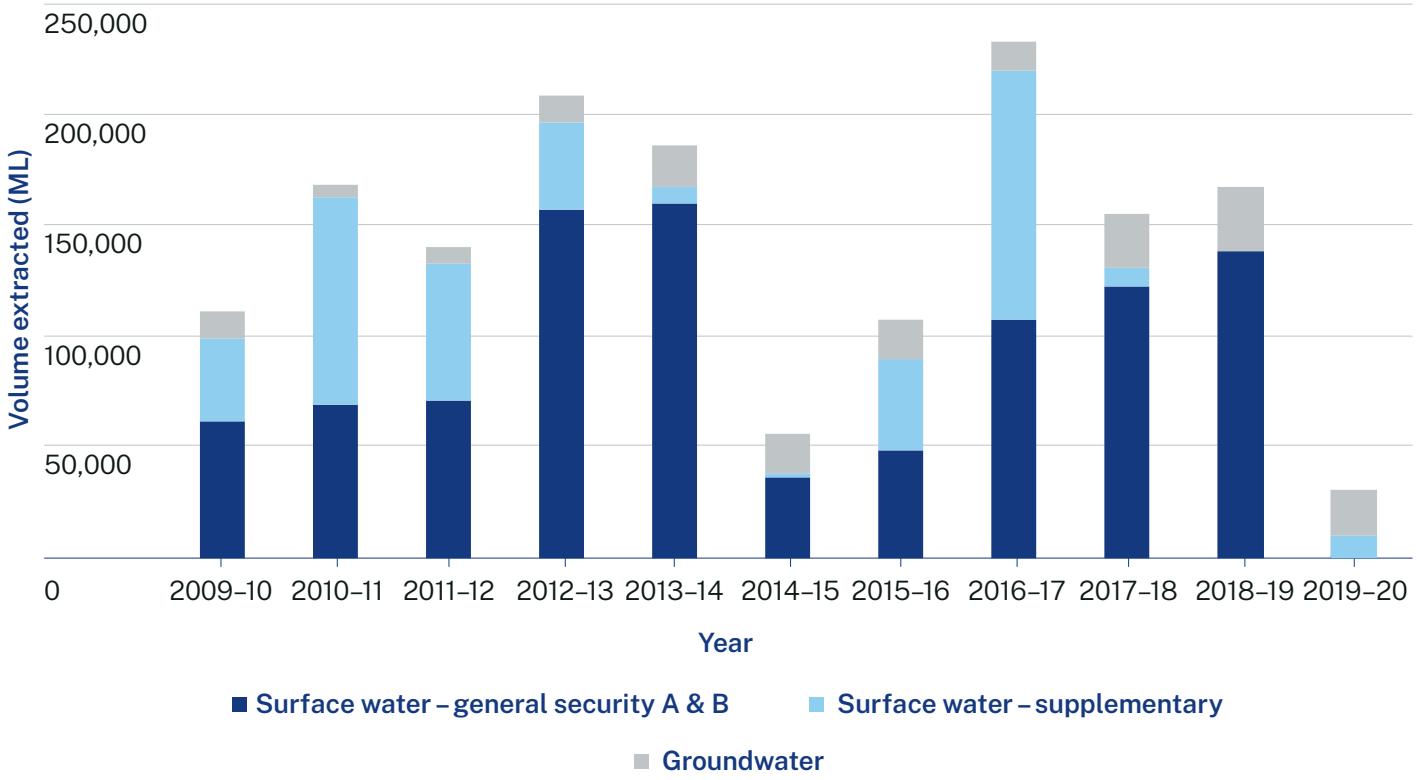



Image courtesy of Department of Planning and Environment. Groundwater monitoring bore, NSW.

Image courtesy of Sam Heagney, Department of Planning and Environment. Farm grain storages, Mungindi.

# What the future climate could look like in the Border Rivers region

3

Image courtesy of Simone Cottrell, Department of Planning and Environment.
View of Macintyre River and native vegetation.

## Climate data and modelling used to develop the strategy

We have used 3 climate datasets to understand the key regional challenges and to assess the effectiveness of actions under different climate change scenarios:

- **historical data:** about 130 years of observed rainfall, temperature and evaporation records collected by the Australian Bureau of Meteorology
- **long-term climate variability risk data (stochastic data):** 10,000 years of stochastically-generated climate data developed using paleoclimatic information by the University of Adelaide
- **dry climate change scenario:** modified version of the long-term climate variability data, scaled up or down using the NSW and Australian Regional Climate Modelling (NARCliM) climate projections. These scaling factors compare the baseline period of 1990–2009 with climate projections for the periods 2020–2039 and 2060–2079. We apply these scaling factors to every climate timeseries used in the modelling.

Combined, these 3 datasets provide us with a range of plausible climate futures that cover a range of wet and dry sequences.[17]

### Why have we used the dry 'worst-case' future climate scenario?

The regional water strategies have planned for climate change by using a dry 'worst-case' climate change scenario. The dry future climate change scenario[18] is the SRES A2, which represents a high carbon emissions scenario and thus results in higher projected climate change impacts on the region.[19] This is not a forecast of how climate change is expected to eventuate, but it is one possible future outcome.

This scenario assumes that governments around the world will not take any action to reduce carbon emissions. This scenario may not occur because many governments around the world are already taking action on climate change. However, using this 'worst-case' scenario helps us to plan strategically and to focus on the key challenges facing a region. It also helps us understand how different options might work in a very dry climate in the future.

Considering the worst-case climate scenario together with current climatic conditions is appropriate for this type of strategic-level assessment. It allows us to assess the full range of risks to the water system. We will need to complete more refined assessments of climate change risk when we implement many of the regional water strategy actions. These additional assessments will be based on both the action's planning horizon and the latest climate science.

This recognises that policy and operational decisions with short-term planning horizons should be based on shorter-term climate scenarios and risk management. When making long-term infrastructure and investment decisions, we will need to consider how the climate may change decades into the future. These longer-term climate scenarios may be more extreme than the shorter-term climate scenario.

Our climate science is continuously improving. The regional water strategies are an important first step to better understand each region's climate and the potential vulnerability of our towns, communities, industries and the environment to a more variable and changing climate. We know that the future climate is uncertain, and work is progressing to further enhance our understanding of each region's climate and how it affects our vital water resources, including groundwater.

17. For further details about the new climate data and modelling, please refer to, www.dpie.nsw.gov.au/water/plans-and-programs/ regional-water-strategies/climate-data-and-modelling
18. The scenario uses the regionally downscaled factors from the NARCliM 1.0 Project to adjust the long-term past climate scenario rainfall and evapotranspiration data. Further information on the NARCliM 1.0 Project is available on the NSW Government, AdaptNSW website: www.climatechange.environment.nsw.gov.au/climate-projections-used-adaptnsw
19. The SRES A2 assumes a 2°C warming over the regional water strategy planning horizon.

# Climate snapshot

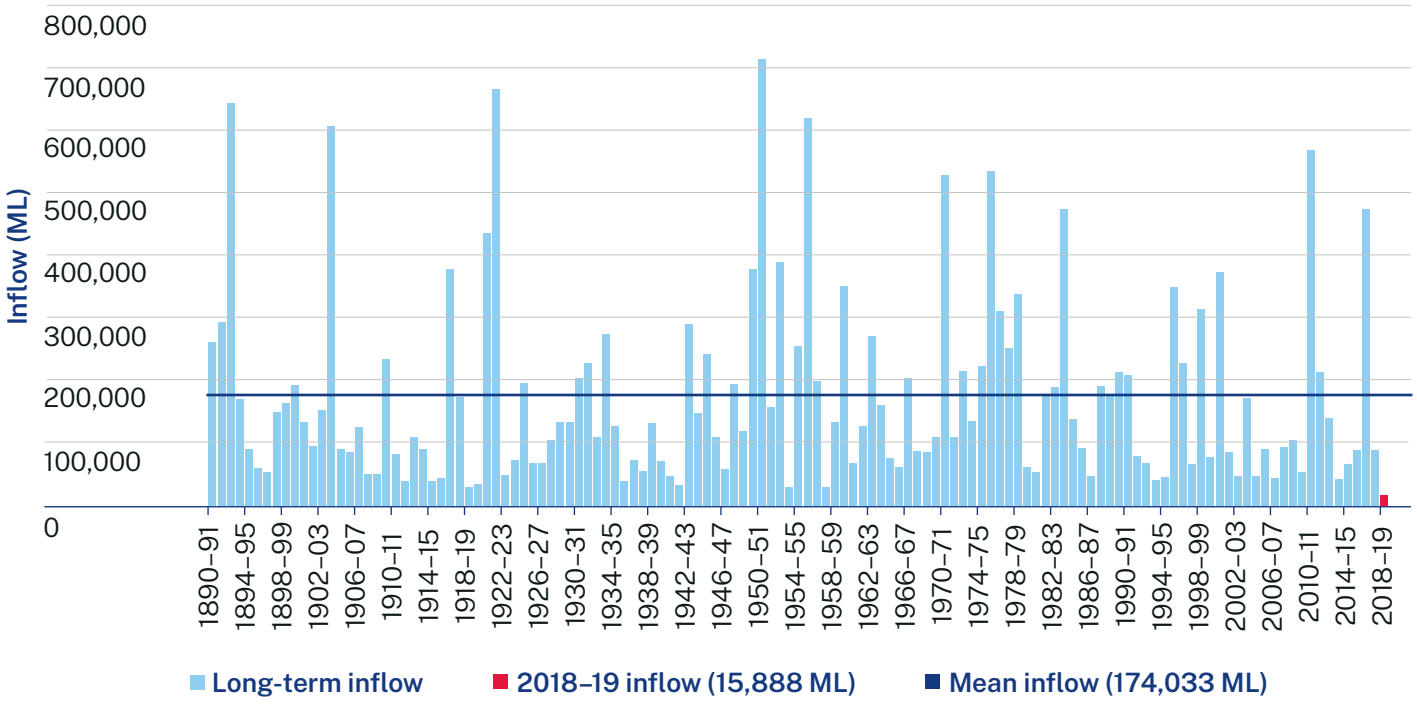
## The Border Rivers region has a naturally variable climate

Over the past 130 years. the region has cycled between wet and dry periods:

- The 1900s to 1940s was a comparatively dry period and most of the recorded short droughts (one to 5 years) and decadal droughts (10 years) occurred in this period.
- The 1950s to 1990s was a comparatively wet period.
- Since the Millennium Drought, the observed record suggests a return to a dry period.

The observed historic record also shows that within these dry and wet cycles, there are multiple years of low inflows interspersed by years with large inflows (Figure 10).

**Figure 10. Long-term inflows into Pindari Dam against mean and 2018–19 inflows**



# Our latest data suggest that a future climate could be even more variable

We don't know for sure what the future climate will be like. It may be similar to what we have experienced in the past, or it might be drier than we have seen in our lifetimes.

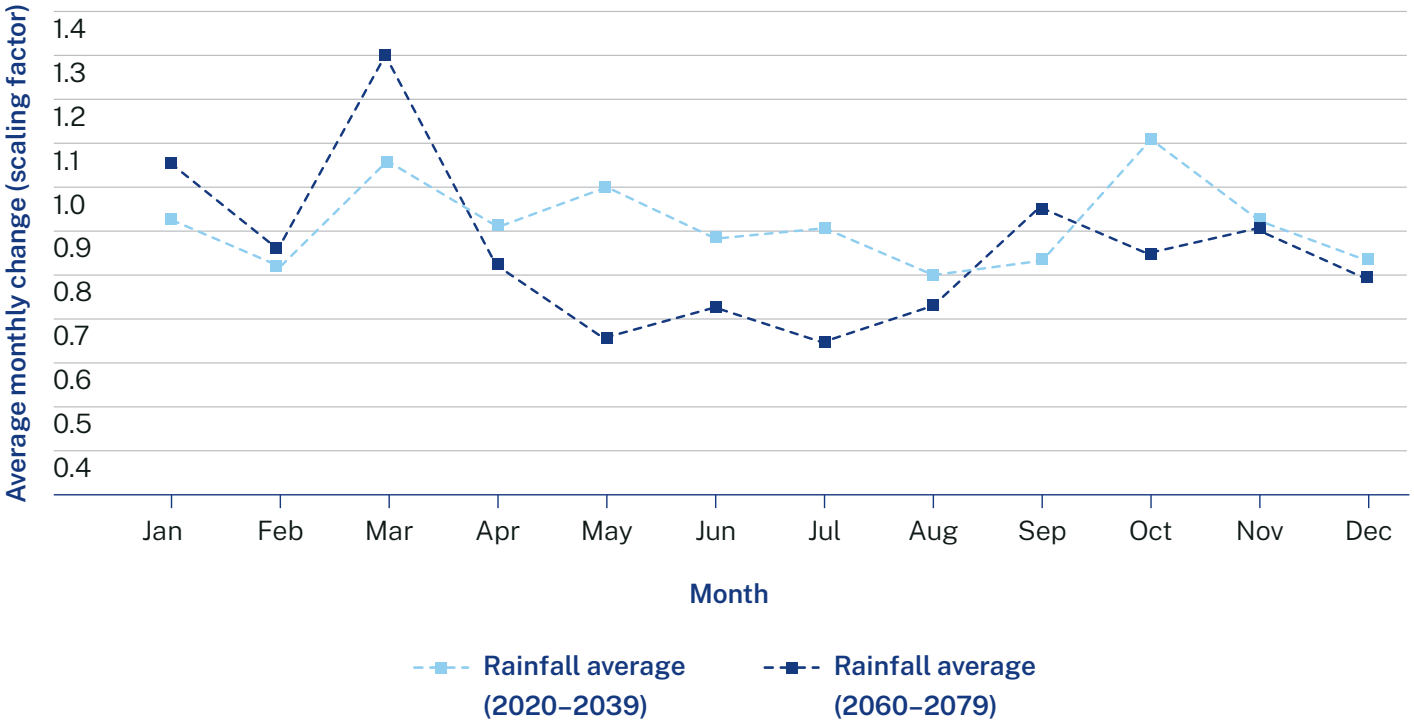
The NSW Government has invested in new climate datasets. This new data has improved our hydrological modelling and gives us a better understanding of the natural variability of the climate, beyond the observed historical records.

Our analysis of different climate projections for the Border Rivers region tells us there could be more extreme wet and dry periods than what we have observed in our lifetimes. There is a potential for:

- changing rainfall patterns, with a reduction in average annual rainfall – shifts in seasonal patterns are expected to cause a decrease in winter and spring rainfall by around 30% by 2070, and an increase in summer and autumn rainfall compared to levels between 1990 and 2009 (Figure 11)
- less frequent but more intense rainfall events – with the potential for peak flows higher than those we have seen in the observed historical record
- more prolonged droughts and more frequent, shorter periods of drought
- reduction of annual average inflows into Pindari and Glenlyon dams – median annual inflows could potentially decline by approximately 45% if the worst-case climate change scenario were to eventuate.

We need to plan for this uncertainty and fully understand the future risks we face.

**Figure 11. Average monthly changes in rainfall for the Border Rivers region from climate change (NARCliM) projections**



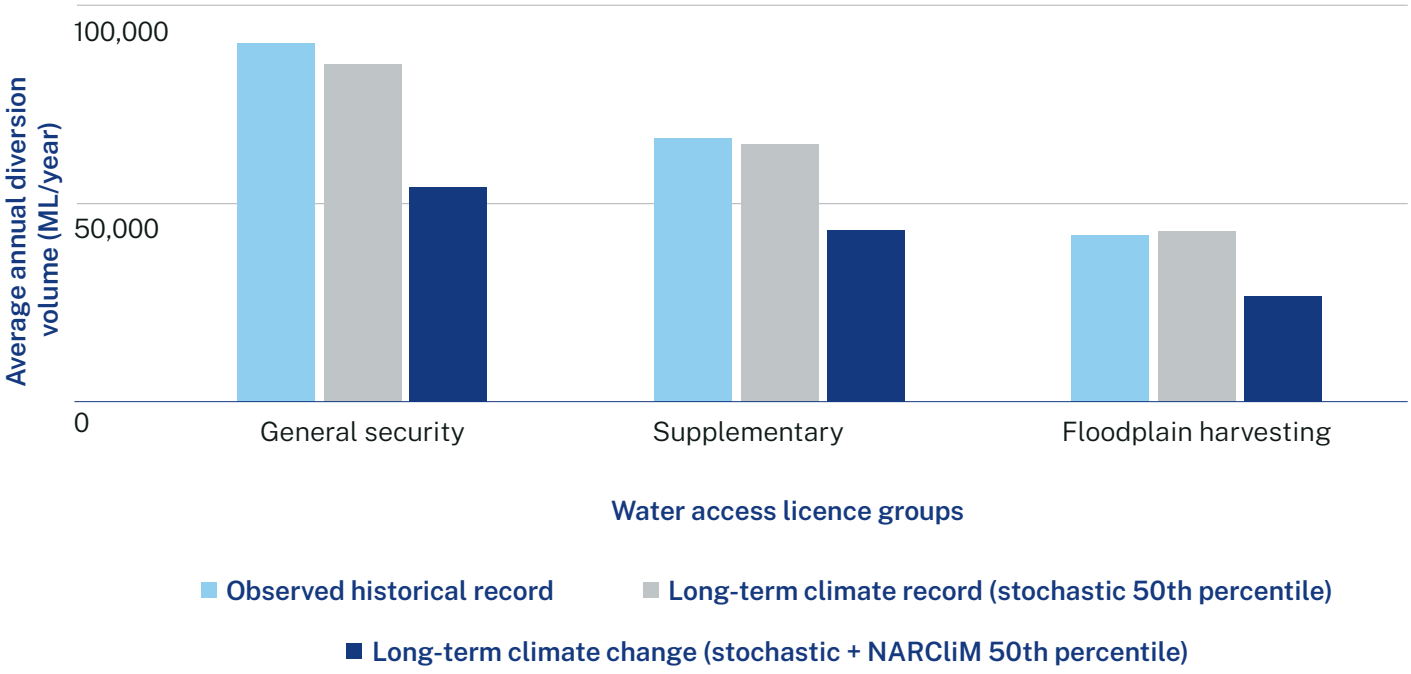
# Storages could sit at lower levels, impacting on water availability for all users, but they are unlikely to be empty

Securing water for critical human needs is the highest priority during extreme events. To help plan for this, we have looked at the 'worst-case' scenarios and modelled how long Pindari Dam and Glenlyon Dam could have their combined storage volume below 5% (28,339 ML). Our analysis suggests that Pindari and Glenlyon dams are unlikely to be empty under any of our modelled climate projections but could sit below 5% capacity for longer periods than previously understood.

This could impact on the reliability and availability for water for town water supply, stock and domestic uses, irrigation, industrial uses and environmental water licences.

Average water availability for water users supplied from Pindari and Glenlyon dams may be similar to that experienced in the region's historical records if our future climate is similar to our paleo-informed long-term historical projections. However, under a dry climate change scenario, with lower inflows on average, general security, supplementary and floodplain harvesting could be impacted by approximately 40% (Figure 12). While these scenarios may not occur, the analysis helps us to understand what we may need to do to begin to prepare for a more variable or changing future climate.

**Figure 12. Possible impacts on average annual diversions by Border Rivers regulated rivers water access licences and floodplain harvesting under the 'average' 130-year period of the future climate change projection period compared with the observed record**



In general, our modelling suggests extreme events could become more extreme – both at the wet and dry ends of the spectrum. Under a dry climate change scenario, the median volume of water flowing in the Border Rivers region each year could reduce by 45%, impacting all parts of the flow regime.

This would reduce the size and frequency of the large flows that are needed to replenish floodplain habitats. The number of times regulated and unregulated rivers stop flowing could increase by 15–25% (Figure 13) and the duration and frequency of these cease-to-flow events could also increase.

**Figure 13. Impact of climate risk on cease-to-flow events in the Border Rivers**

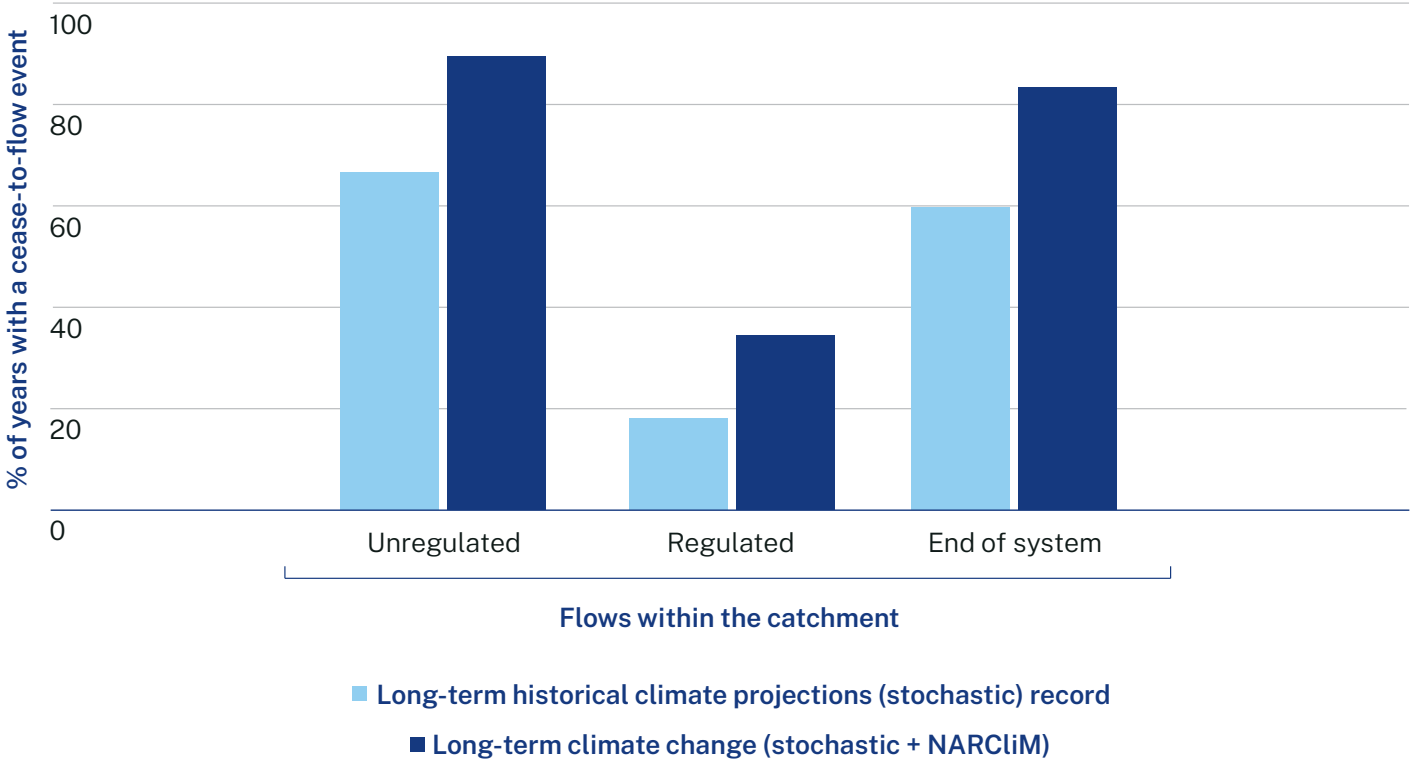



Image courtesy of Jane Humphries, Commonwealth Environmental Water Office. Barwon River upstream of Mungindi Weir.

# Key challenges in the Border Rivers region – what we will focus on first

4

Image courtesy of Bron Powell, Department of Primary Industries – Fisheries.
Macintyre River between Boonangar Road and Mungindi, NSW.

Like all regions across Australia, the Border Rivers faces a more variable and changing climate. We need to transition to a scenario where we do more with less water, make smarter decisions about our water use and management – armed with better knowledge and information – and protect our most critical water needs.

We have identified 5 key challenges that are immediate priorities for the region:

- Increased surface water security risks for towns in the region
- Risk of reduced water availability will impact the regional economy
- Addressing barriers to Aboriginal water rights
- Sustaining the health and resilience of aquatic and floodplain ecosystems
- Improving connectivity to support downstream needs.

Addressing these will help us achieve the vision and objectives we have set for the Border Rivers Regional Water Strategy.

Image courtesy of Floodplain Harvesting Team, Department of Planning and Environment. Aerial view Mungindi, NSW.

# Challenge: Increased surface water security risks for towns in the region

Less reliable flows in rivers and creeks will increase water security and water quality risks for towns and rural landholders that rely on these water sources.

All towns in the Border Rivers rely primarily on surface water. Approximately 30% of the region's population are rural landholders and remote communities without access to reticulated town water. During droughts these households rely on water carted from nearby towns, placing an increased demand on town water supplies during these periods.

Climate risks could increase the times when surface water is not available.

The results of our modelling analysis suggest that, with the exception of Tenterfield, the risks of surface water shortfalls are relatively small for major towns in the eastern part of the catchment (Table 2). In extreme drought, deliveries in the regulated river can be suspended, creating small surface water security risks for the towns of Mungindi and Boggabilla in the western part of the catchment. Towns are likely to be able to meet surface water shortfalls from existing groundwater backup supplies, although this would need to be accompanied by water restrictions and there would be additional costs for pumping and treatment of the groundwater. Support for these measures requires further community engagement and discussion.

During the 2017 to 2020 drought, Tenterfield received support from the NSW Government to establish emergency groundwater bores but the existing water treatment plant was unable to appropriately treat the water. Additional funding has been allocated to upgrade the town's water treatment plant.

While work is ongoing to secure groundwater supplies for towns in the eastern catchment, the groundwater is in fractured rock, which is generally low yielding. The long-term capacity of these aquifers to sustain town demand during extended droughts is unknown.

We have also heard that during extreme droughts and bushfires, towns in the region experience a significant increase in demand for water to support fire-fighting efforts, as well as from the region's rural residents who are not connected to reticulated water. These risks will increase in the future.

**Table 2. Risk of town water supply shortfall under paleo-informed climate projections**

| Town | Adequate back up groundwater drinking water supply available? | Surface water supply shortfalls average % of time | |
|---|---|---|---|
| | | Paleo informed climate projections | Long-term worst-case climate change projections |
| Tenterfield | Yes* | 2.3% | 11.3% |
| Glen Innes | No** | 0.4% | 1.5% |
| Ashford | No | 0.0% | 0.0% |
| Boggabilla | No | 0.3% | 2.7% |
| Mungindi | Yes | 0.5% | 4.2% |
| Inverell*** | No | 0.0% | 0.0% |

* Water quality treatment issues need to be resolved.

** Glen Innes has a groundwater supply although it cannot sustain town demand. Groundwater is used to top up surface water storages during drought, extending the life of available supply.

*** Inverell sources its water from Copeton Dam in the Gwydir Valley.


Image courtesy of Department of Planning and Environment. Post Office, Tenterfield.

# Challenge: Risk of reduced water availability will impact the regional economy

The region's main economy of agriculture relies on water accessed through general security licences, which have low reliability. A drier future could increase the frequency and severity of droughts and further reduce the reliability of licences. This would have significant impacts on the regional economy.

Agriculture is the largest employer in the region and contributes around 20% of the region's economic output. The major economic contribution in agriculture comes from irrigated cotton grown on the alluvial plains downstream of Boggabilla and beef cattle grazed on rainfed pastures in the eastern part of the catchment.

The region is vulnerable to drought and many farm businesses have adapted to the region's highly variable climate by producing annual or seasonal crops and investing in technology and improved management practices. The cotton industry has improved whole farm irrigation efficiency and producers now achieve almost twice as much cotton from the same amount of water as 25 years ago.[20] Other improvements by farm businesses include the adoption of no-till and conservation farming methods.

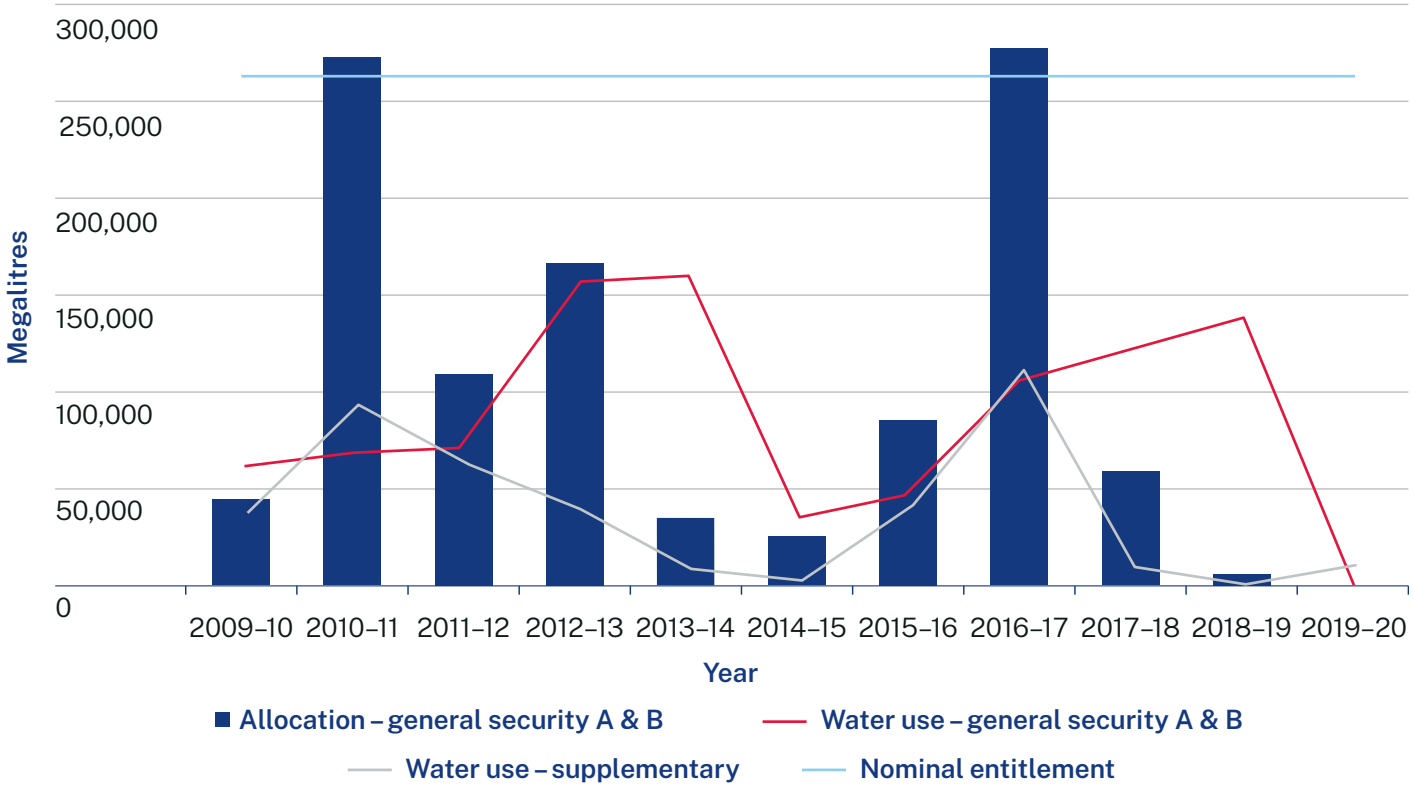
The long periods of low flows and infrequent high flow events in the region create low reliability for water-dependent industries. Many water users rely on the few years of high flows to underpin their businesses.

General security B licences, which make up the bulk of water licences in the region, have an average end of year licence allocation of 35% – making these licences in the Border Rivers some of the least reliable water licences in the state. Water users with general security licences in the regulated Border Rivers can carry over their unused water allocation from one year to the next. If irrigators have access to supplementary or floodplain flows in the lead up to or during the summer cropping season, they use this and carry over their general security water for future use (Figure 14).

This pattern of water use means that droughts that extend beyond one to 2 years can result in little to no water being available for agriculture, as Pindari and Glenlyon dams have typically been drawn down by then and the remaining supplies are reserved for essential needs.

20. Australian Cotton 2020, *Cotton with a Conscience: Social Report*, retrieved 20 September 2020 from, www.cottonaustralia.com.au/cottons-water-use

**Figure 14. General security and supplementary availability and use in the Border Rivers Valley 2009–10 to 2019–20**




The importance of agriculture to the region, and the occurrence of droughts, has led to a 'boom and bust' cycle in local employment and economic activity. For example, during the 2017 to 2020 drought, the gross domestic product of the New England North West region of NSW, which includes the Border Rivers, declined by more than 12% – reflecting lower employment, reduced capital utilisation and drought induced productivity losses.

A dry future climate change scenario could significantly reduce the reliability of general security licences, with general security B licences receiving only 10% of their allocation by the end of the water year (30 June). If practices don't change, the corresponding reduction in economic profit generated by irrigated annual agriculture could be up to 35% under a worst-case climate change scenario. A more variable or changing climate would also impact water supply reliability in unregulated rivers and creeks, which support many of the region's mixed farming and grazing enterprises.

Reduced water reliability could put at risk the viability of the Border Rivers regional economy. Encouraging investment in practices to improve water use efficiency and in industries that are less reliant on water and that capitalise on the strengths of the region will be critical in supporting the long-term economic development of the region.

# Challenge: Addressing barriers to Aboriginal water rights[21]

'We can't sing our song no more, we can't live on the river no more to look after her, for you all.' (Gomeroi)

'Yaama Nginda Gomeroi Wunnungulda. We are Gomeroi, we have our way of doing business. You have to be invited to sit around our fire. We share language and we engage together. You are asked to identify who you are and what you represent and be clear in your intent. Then, and only then can we do business together.'

## Aboriginal people have lost access to water and Country

Aboriginal people in the Border Rivers region have always been closely linked to rivers and wetlands, and this relationship is essential to culture, community and connection to Country, air and water. Deeply entwined with Aboriginal culture and Aboriginal people's connection to Country is the relationship with water. As the first managers and carers of this natural resource, Aboriginal people have rights and a moral obligation to care for water under their law and customs. These obligations connect across communities and connected surface water and groundwater systems.

The historical dispossession of land and the effect of colonial era settler laws continue to impact Aboriginal people's access to water. Fences and locked gates on public land such as crown land, travelling stock reserves and state conservation areas prevent Aboriginal people from accessing Country, carrying out cultural practices and using traditional knowledge to care for and manage waterways. Access to waterways is critical to providing a purpose and pathway for young people to connect to culture and provide a space for healing, as well as for food, medicine and teaching.

There are already steps being taken by governments to address this. For example, the National Parks and Wildlife Services is developing a new model for Aboriginal joint management of the NSW national parks estate. It is anticipated the new model will provide for the potential handback of title to all NSW national parks – covering nearly 10% of the State – over a 15 to 20-year period, subject to the land being leased back (long term and for nominal rent) to the NSW Government for its continued use and management as national park.

We know from consultation undertaken regionally and for the NSW Water Strategy that there is strong community support for Aboriginal water rights and access, with the small amount of water in Aboriginal ownership frequently identified as a key area for improvement.

21. This challenge statement was developed in consultation with the Gomeroi/Kamilaroi Water Engagement Committee in 2021. Attachment 1 sets out the statement from the Gomeroi and Kamilaroi water engagement committee.

# Government needs to ‘sit by the fire’ and improve consultation processes with Aboriginal people

Current water legislation and water management do not fully reflect Aboriginal water values. This is made worse by the limited involvement of Aboriginal people in water consultation processes due to:

- consultation timeframes and processes around water policy changes that do not allow the time needed for Aboriginal cultural governance processes. This erodes trust
- a complex set of state and federal laws and systems around water management that is often not explained in a plain English or a visual manner
- the need for more resources and support for Aboriginal groups to drive their engagement in water management. Often, Aboriginal people, as well as individual members of the broader community, need to give up personal time and limited resources to have a say in water consultation processes.

Changing this requires government to ‘flip the model on its head’ and develop an engagement approach that is appropriate for Aboriginal communities. To do this, water policy makers, planners and managers need to ‘sit at the fire’ and develop a governance structure that is familiar to Aboriginal people, supported by the time that is needed to engage, consult and listen genuinely. Investing this time will help build respect and trust between all parties and identify the different needs, challenges and interests of each Aboriginal community.

Image courtesy of Bron Powell, Department of Primary Industries – Fisheries. Billabong on the floodplain of the Macintyre River, NSW.

# Challenge: Sustaining the health and resilience of aquatic and floodplain ecosystems

Development has contributed to changes in flow variability, water quantity and water quality. This has impacted the health of water dependent ecosystems and assets in the region and connected valleys, affecting the resilience of water dependent ecosystems.

The Border Rivers supports a rich and diverse range of water-dependent plants, animals and ecosystems including instream aquatic habitats, riparian forests and floodplain systems. The water-dependent flora and fauna in these ecosystems are an important part of our shared biodiversity resources, have cultural value for local Aboriginal communities and support the economic value, liveability and wellbeing of the region. Preserving these values will continue to support the communities of the Border Rivers and connected valleys.

Key environmental assets in the region include the nationally listed Morella Watercourse/Boobera Lagoon/ Pungbougal Lagoon complex and the sections of the Macintyre, Severn and Dumaresq rivers included in the Lower Darling Endangered Ecological Community.

The Border Rivers region is a stronghold for native fish, supporting 16 species including 5 threatened fish species. Protecting these fish and their habitats will help to replenish native fish populations across the northern Basin. Wetlands and waterholes also support internationally and nationally significant waterbirds such as brolgas, Australian painted snipe, black-necked stork and magpie geese.

## Changes in flow patterns from development impact the health and resilience of aquatic ecosystems

The ability to sustain the native fish of the Border Rivers to support populations in the rest of the Basin is impaired by physical structures such as dams, weirs and floodplain infrastructure that do not have fishways and restrict the ability of native fish to move to breed and find ideal habitat.

Government programs have been addressing this through fish restocking programs and actions to progress fish passages on weirs.

Aquatic species, including native fish and birds, can survive prolonged cease-to-flow conditions by taking refuge in naturally occurring pools found in the river channel, as well as permanent and semi-permanent waterholes (or billabongs) on floodplains. Water management can help retain water of appropriate quantity and quality in these areas, providing key habitat that native species rely on to survive and bounce back after periods of drought.

Over the last 50 years, land use changes and water extraction have resulted in less water in rivers and wetlands and modified how water moves through the region's landscape and connected systems. Changes to the natural river flows and floods have affected the health of floodplains and downstream waterways and disrupted the lifecycle of the plants and animals that depend on them. Our modelling has shown that development has the greatest impact on flows in the lower part of the Border Rivers where the number of large fresh and bankfull events at Mungindi has likely been reduced by approximately 50% post irrigation development (shown in Figure 15 and Figure 16). The impacts have not been as significant upstream of Boggabilla, where there has been an increase in large fresh events at Holdfast (Figure 17 and Figure 18).

**Figure 15. Modelled change in total number of different flow events[22] in the Barwon River at Mungindi. It illustrates what would have occurred with no development compared to what would have occurred if current development was in place over the last 130 years**

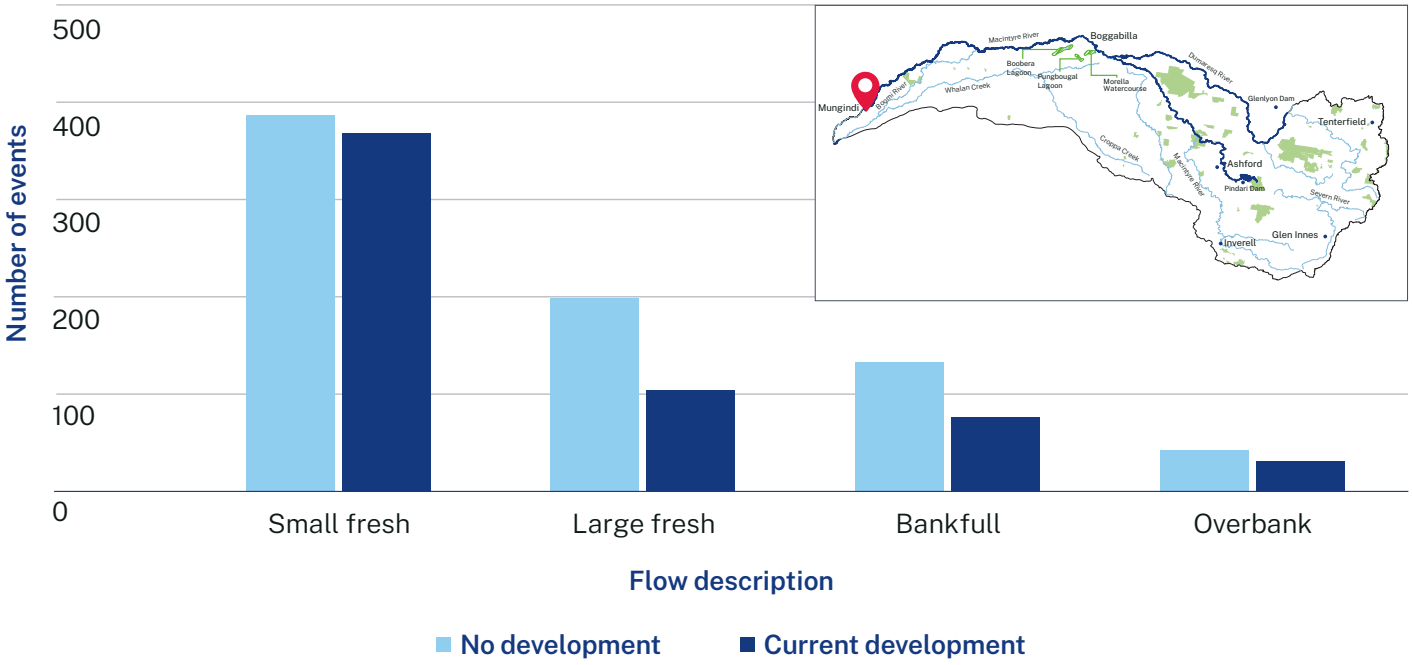
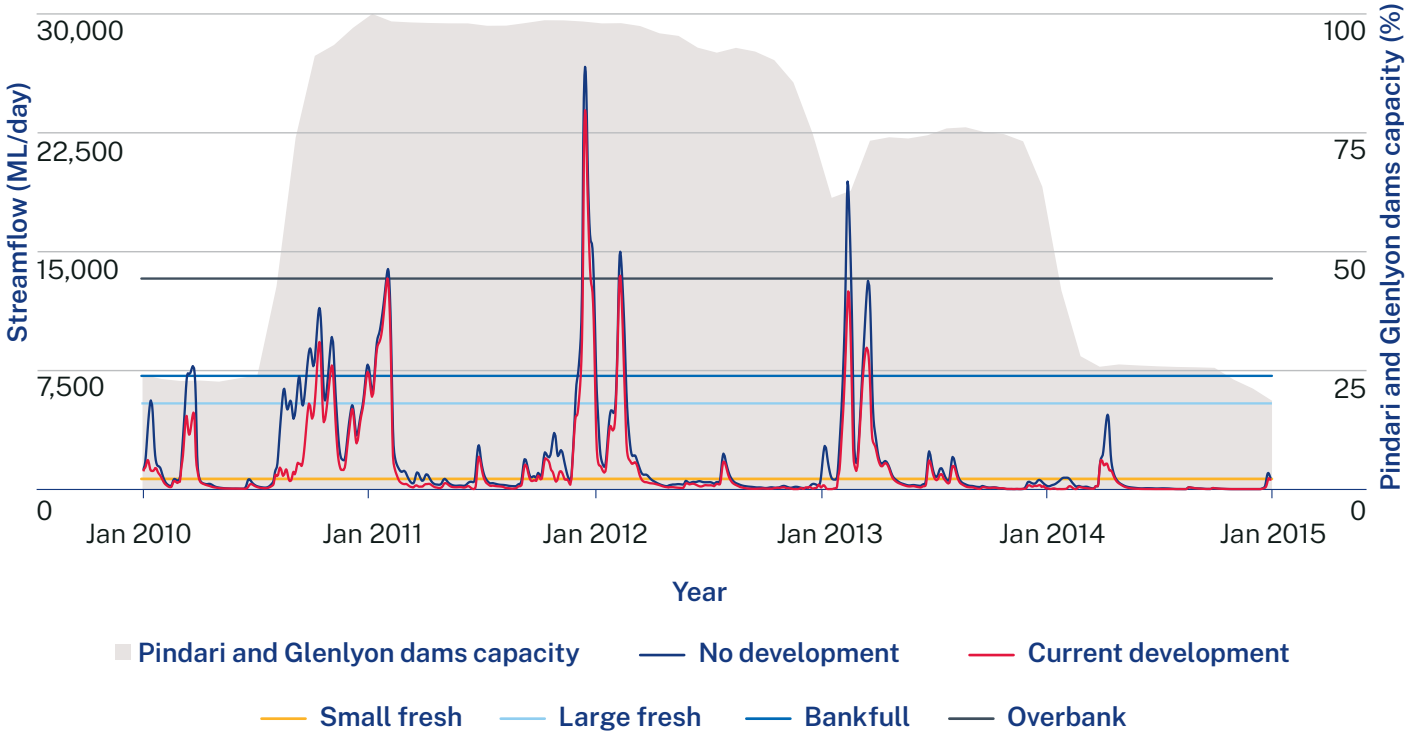



**Figure 16. Modelled change in no development and current development flows in the Barwon River at Mungindi over an 'average' 5-year period, with actual system storage (Pindari and Glenlyon dams)**




22. The categorisation of flow events in Figures 15 to 18 has been adopted from the environmental watering requirements at the relevant location as identified in the Border Rivers Long Term Water Plan. Categorisation of events was based only on the volume of the flow over the specified number of days being met and not the time of the year it occurred. The duration and timing of these events is important in maximising the ecological outcomes of these events. For more information on environmental watering requirements, see NSW Office of Environment and Heritage 2018, *NSW Border Rivers Long Term Water Plan Parts A and B*, www.environment.nsw.gov.au/topics/water/water-for-the-environment/planning-and-reporting/long-term-water-plans/border-rivers-consultation

**Figure 17. Modelled change in total number of different flow events in the Macintyre River at Holdfast over the last 130 years, with and without irrigation development**

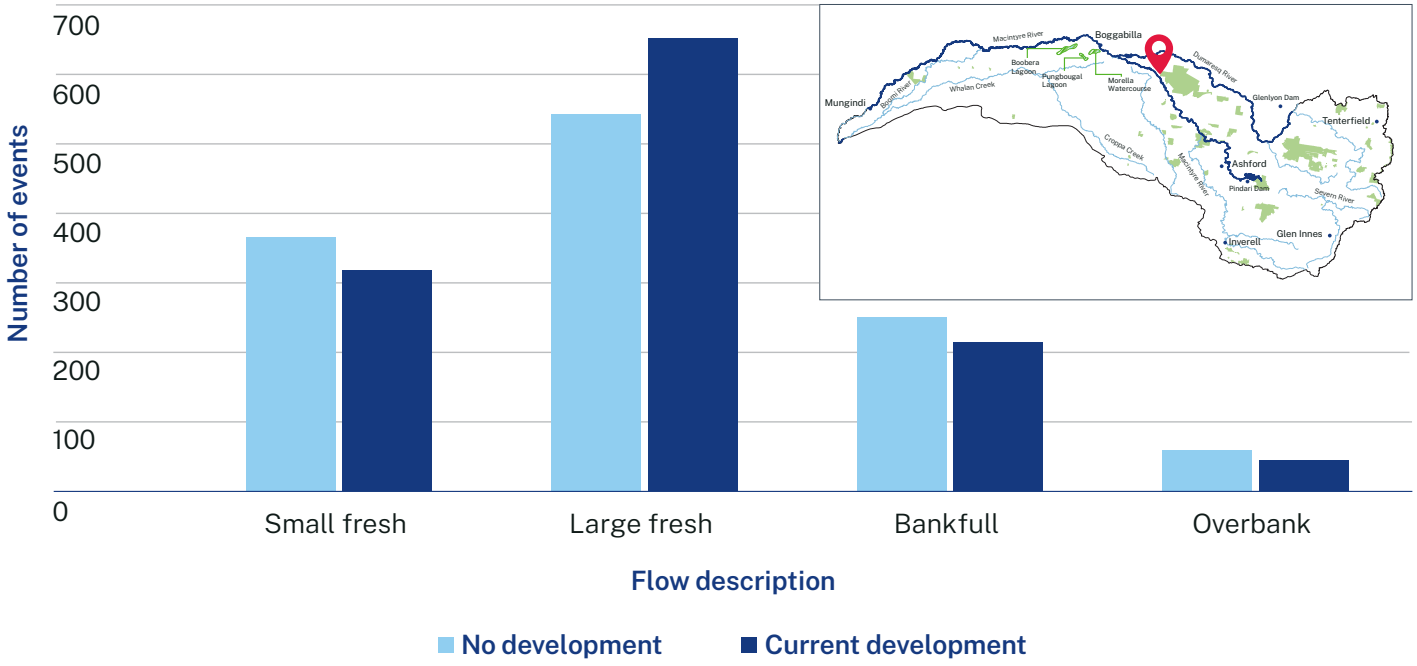
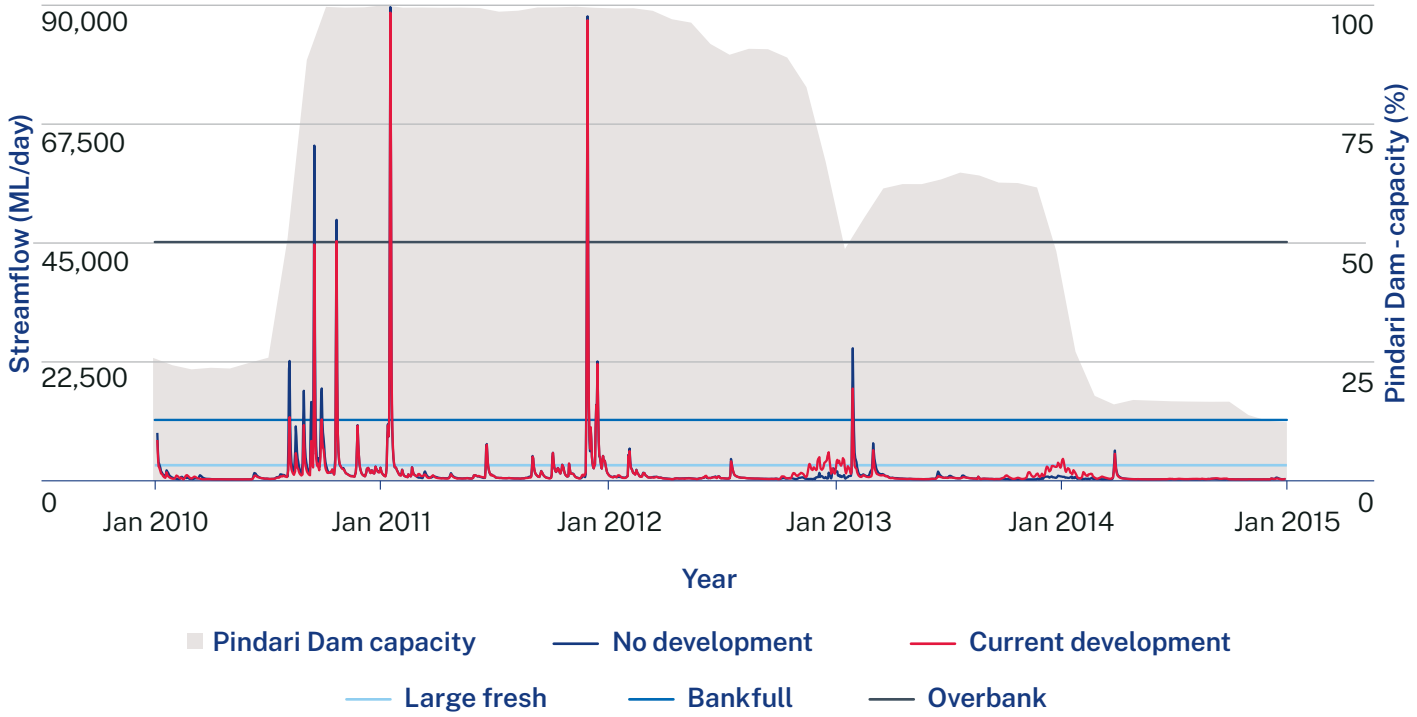



**Figure 18. Modelled no development and current development flows in the Macintyre River at Holdfast**



In some regions in the northern Basin unconstrained floodplain harvesting, which is the capture of water that flows across the Border River Valley floodplain by irrigators for later use, has increased above the legal limits set under water sharing plans and the Basin Plan. Licensing and managing floodplain harvesting within legal limits is a 'game changer' for the Border Rivers. It will deliver environmental and downstream benefits by reducing floodplain harvesting take to within the water source legal limits and is expected to deliver up to a 5.5 GL increase in average annual flood volume across the Border Rivers Valley floodplain in years when floods occur.[23, 24]

Reducing the impact of river regulation and infrastructure and improving the condition of key habitats can support the health and resilience of aquatic ecosystems. This can be achieved by improving fish passage, screening diversions, addressing cold water pollution, protecting the first flow of water after a dry spell and providing or protecting key flow components such as base flows, freshes and overbank flows in wetter years. These actions can help to maintain these vital habitats, reduce the risk of fish deaths, retain threatened species and provide water to the wetlands and floodplains that characterise the lower Border Rivers.

## Aquatic species remain under stress from degraded habitats and water quality risk

Water quality is an important driver of ecological processes. Changes to water quality have occurred due to a combination of factors including introduced species, loss of riparian vegetation, changes to river flows, river regulation infrastructure and land use. High flow from rainfall and run-off can result in more soil and nutrients being washed into waterways, making the water less clear and prone to excessive algal growth when flows reduce, impacting on the quality and quantity of refugia during dry times. Dams and weirs in the western part of the Border Rivers catchment often have algal bloom events, and dams can cause cold pollution downstream. For example, Pindari Dam has had consistent high blue-green algae alerts over the last 5 years and can cause cold water pollution over 100 km downstream of the dam. These changes impact the quality of the water for town and household use, affect the amenity of the rivers and increase the stress on aquatic species.

During the recent drought, fish deaths were reported in the Macintyre and Severn rivers and numerous other unregulated waterways throughout the Border Rivers region. These deaths were attributed to extremely low water availability and associated water quality deterioration. Fish deaths were also triggered by short, sharp increases in river flow that flushed organic material and deoxygenated (hypoxic or 'blackwater') water from pools along the waterway and led to larger scale 'blackwater' events.

## Climate change will exacerbate these challenges

Our new climate modelling shows that climate patterns in the region could change, with consequences for rainfall patterns and associated water flows. This modelling indicates that under a dry climate change scenario, there could be 15% to 25% more cease-to-flow events and fewer overbank flows.

These changes may not occur. But if they do, it could result in fewer events that trigger native fish movement and spawning and water bird breeding, and the drying-up of key habitats.

23. Department of Planning, Industry and Environment 2020, *Environmental outcomes of implementing the Floodplain Harvesting Policy in the Border Rivers Valley*, www.industry.nsw.gov.au/water/plans-programs/healthy-floodplains-project/water-sharing-plan-rules/border-rivers
24. Detailed analysis to inform the floodplain harvesting licence rules is available at: www.industry.nsw.gov.au/water/plans-programs/healthy-floodplains-project/water-sharing-plan-rules/border-rivers.

# Challenge: Improving connectivity to support downstream needs

Extended cease-to-flow and low flow periods create risks for towns, basic landholder rights and high priority environmental needs at the end of the Border Rivers system and further downstream. A drier future could increase the frequency and the severity of cease-to-flow and low flow periods.

The Border Rivers is part of a connected system. On average, approximately 64% of the inflows (from NSW and Queensland together) into the Border Rivers flow downstream to the Barwon–Darling River.[25] This makes up approximately 20% of the inflows to the Barwon–Darling River. These contributions are mostly from large flows. There are ecological, industry and community needs, including critical human and environmental needs in the Barwon–Darling system that rely on surface water flowing from the Border Rivers catchment and other catchments in the northern Basin. These needs include:

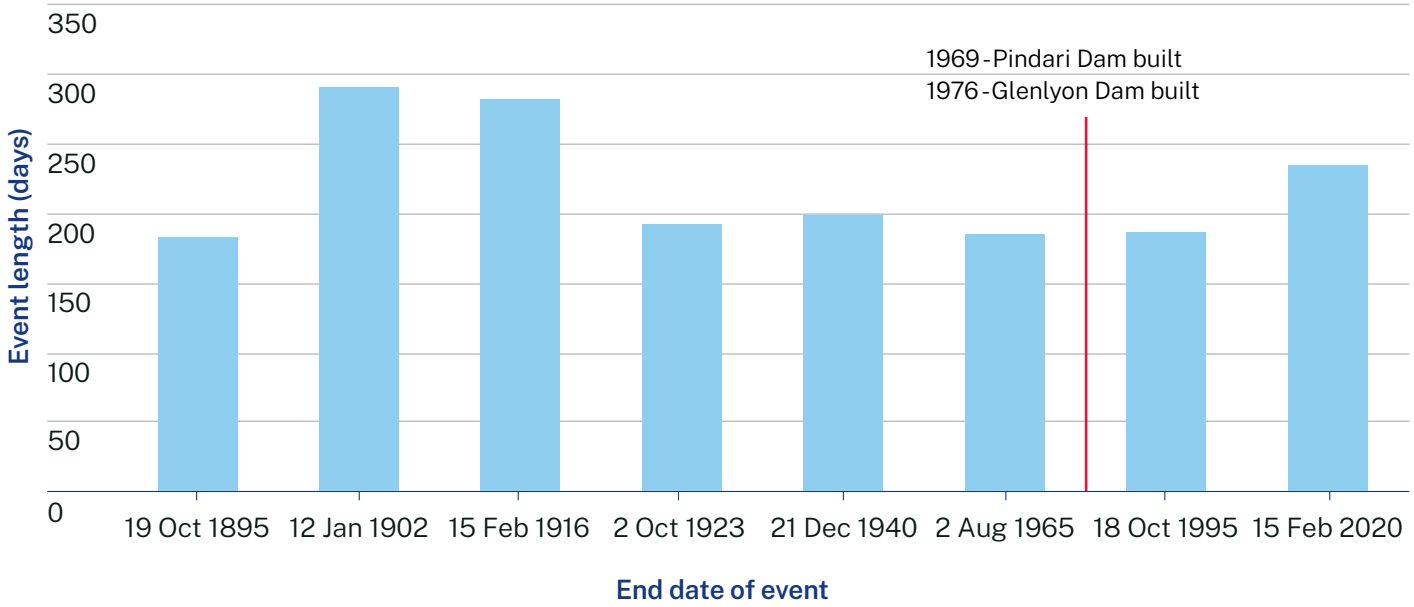
- basic landholder rights within the Border Rivers and along the Barwon–Darling River
- water to protect and enhance riverine habitats and aquatic species movement corridors for native fish species, including recreational, cultural and threatened fish species
- town water supply for communities at the end of the Border Rivers and along the Barwon–Darling system.

We have also heard that there are cultural needs that need to be met across the catchments.

Low flow and cease-to-flow events occur naturally in the Border Rivers region during dry years. Historical records show that in the last 130 years, 6 of the 8 longest cease-to-flow periods at Mungindi occurred before the influence of upstream development became significant (shown in Figure 19). When these events last for extended periods, critical human needs and environmental health are most at risk.

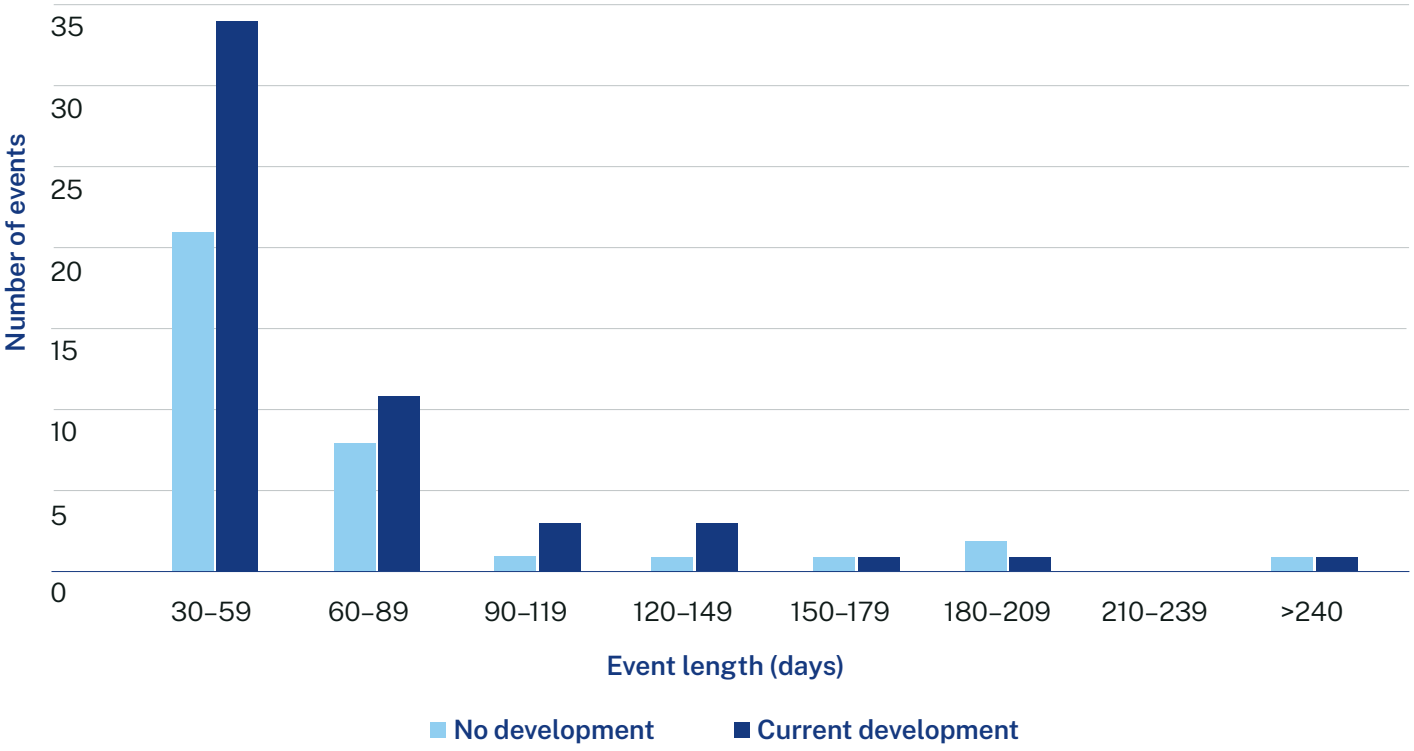
25. This is the proportion of the average Inflow from the Border Rivers into the Barwon–Darling as a proportion of long-term average modelled mid system flows in the Border Rivers. Further information is available in the report *Stocktake of northern basin connectivity rules — analysis of implementation and effectiveness,* available at, www.industry.nsw.gov.au/water/environmental-water-hub/outcomes

**Figure 19. Longest periods when the river stopped flowing at Mungindi over the last 130 years (observed historical records)**




Development has likely increased the number of shorter cease-to-flow events and low flow periods (see Figure 20). However, longer cease-to-flow events are driven by the climate, rather than irrigation development because very little inflow occurs during these events. Dams have been operated in recent years to avoid cease-to-flow periods for as long as possible, prolonging low flows periods by keeping the river running and reducing no flows.

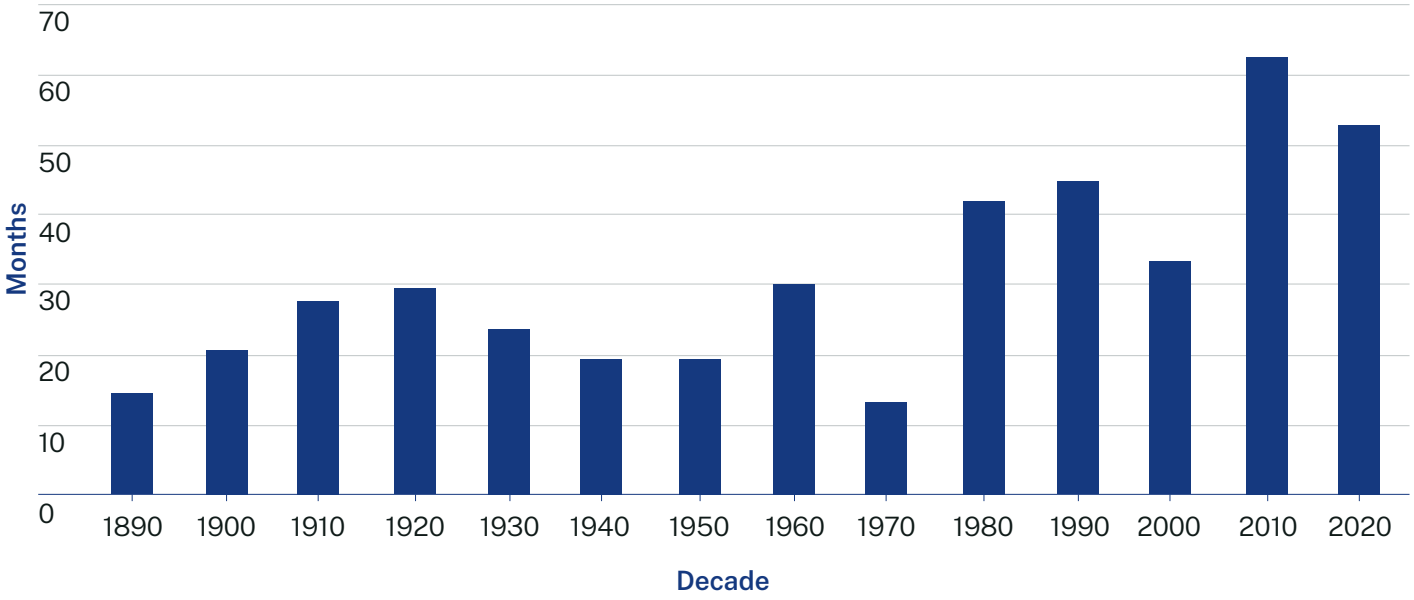
**Figure 20. Modelled number and length of cease-to-flow periods (<10 ML/day) at Mungindi – what would have occurred with no development compared to what would have occurred if current development was in place over the last 130 years**



Development has also likely reduced the size of flow events that follow dry periods and increased the duration between large fresh events. Along with changes to other aspects of the flow regime, this is expected to have impacted the resilience of water-dependent ecosystems in the Barwon–Darling and their ability to recover after extreme events such as extended dry periods.

Figure 21 shows how the longest period in a decade between large fresh[26] events greater than 5,400 ML/day at Mungindi has increased in recent decades compared to those in the earlier part of the 20th century.

**Figure 21. Maximum period in each decade between freshes greater than 5,400 ML/day at Mungindi (observed historical records)**




Our modelling suggests that if long-term climate conditions in the Border Rivers are similar to the historical climate, the average amount of water flowing to the end of the system is likely to remain relatively stable under current levels of development. If a dry climate change scenario occurs over the coming decades, we could see up to a 40% reduction in median annual inflows into the Barwon–Darling River from the Border Rivers catchment. Cease-to-flow events at Mungindi could become twice as likely compared to the long-term historical record and there could be a 60% reduction in the average daily end of system flow at Mungindi. This will place greater stress on critical human and environmental needs in the Border Rivers and the Barwon–Darling, with the impacts increasing further downstream.

The Border Rivers catchment is one of the catchments providing inflows into the Barwon–Darling. Addressing the risks to the Barwon–Darling requires a multi-valley approach to improving connectivity.

Progressing actions to improve connectivity can provide opportunities and benefits to a range of water users and the environment but may involve trade-offs – often actions will have conflicting impacts between the environment and irrigation use. Understanding the impacts of these trade-offs is critical before progressing long-term actions to improve connectivity.

26. The categorisation of large flow flow events in Figure 21 has been adopted from the environmental watering requirements at Mungindi as identified in the Border Rivers Long Term Water Plan. Categorisation of events was based only on the volume of the flow over the specified number of days being met and not the time of the year it occurred. The duration and timing of these events is important in maximising the ecological outcomes of these events. For more information on environmental watering requirements see NSW Office of Environment and Heritage 2018, *NSW Border Rivers Long Term Water Plan Parts A and B*, www.environment.nsw.gov.au/topics/water/water-for-the-environment/planning-and-reporting/long-term-water-plans/border-rivers-consultation

Image courtesy of Jane Humphries, Commonwealth Environmental Water Office.
Barwon River downstream of Mungindi Weir, NSW.

# Responding to the challenges

# 5

Image courtesy of Robert Cleary, Department of Planning and Environment.
Kings Plains National Park, NSW.

The vision for the Border Rivers is to support the delivery of healthy, reliable and resilient water resources for a liveable and prosperous region. To achieve this, we need to position the region so there is the right amount of water of the right quality delivered in the right way for people, Aboriginal communities, towns, industries and the environment.

To address the 5 challenges in the Border Rivers region, we have prioritised actions that aim to:

1. Address knowledge gaps and make information easily accessible
2. Do more with less water
3. Make the region more resilient to climate variability
4. Share water differently to address critical needs of Border Rivers and downstream users.

Together, the actions can improve the Border River's readiness to adapt to a more variable climate and support the difficult decisions we need to make to deliver healthy, reliable and resilient water resources for the region's future.

**Important note:** The regional priorities do not override the priorities around water sharing set out in the *Water Management Act 2000*. The priorities help identify the range of actions that need to be progressed in the region over the coming decades. Each priority contributes to all of the objectives of the regional water strategies. The actions are not listed in any priority order.

Image courtesy of Destination NSW. Anzac Park, Glen Innes.

**Figure 22. Border Rivers Regional Water Strategy: overview of strategy vision, water security challenges and priorities**

**Vision**

Our vision for the Border Rivers is to support the delivery of healthy, reliable and resilient water resources for a liveable and prosperous region.

**Objectives**

- Deliver and manage water for local communities
- Recognise and protect Aboriginal water rights, interests and access to water
- Enable economic prosperity
- Protect and enhance the environment
- Affordability

**Regional challenges to meeting our vision and objectives**

Increased surface water security risks for towns in the region

Risk of reduced water availability will impact the regional economy

Addressing barriers to Aboriginal water rights

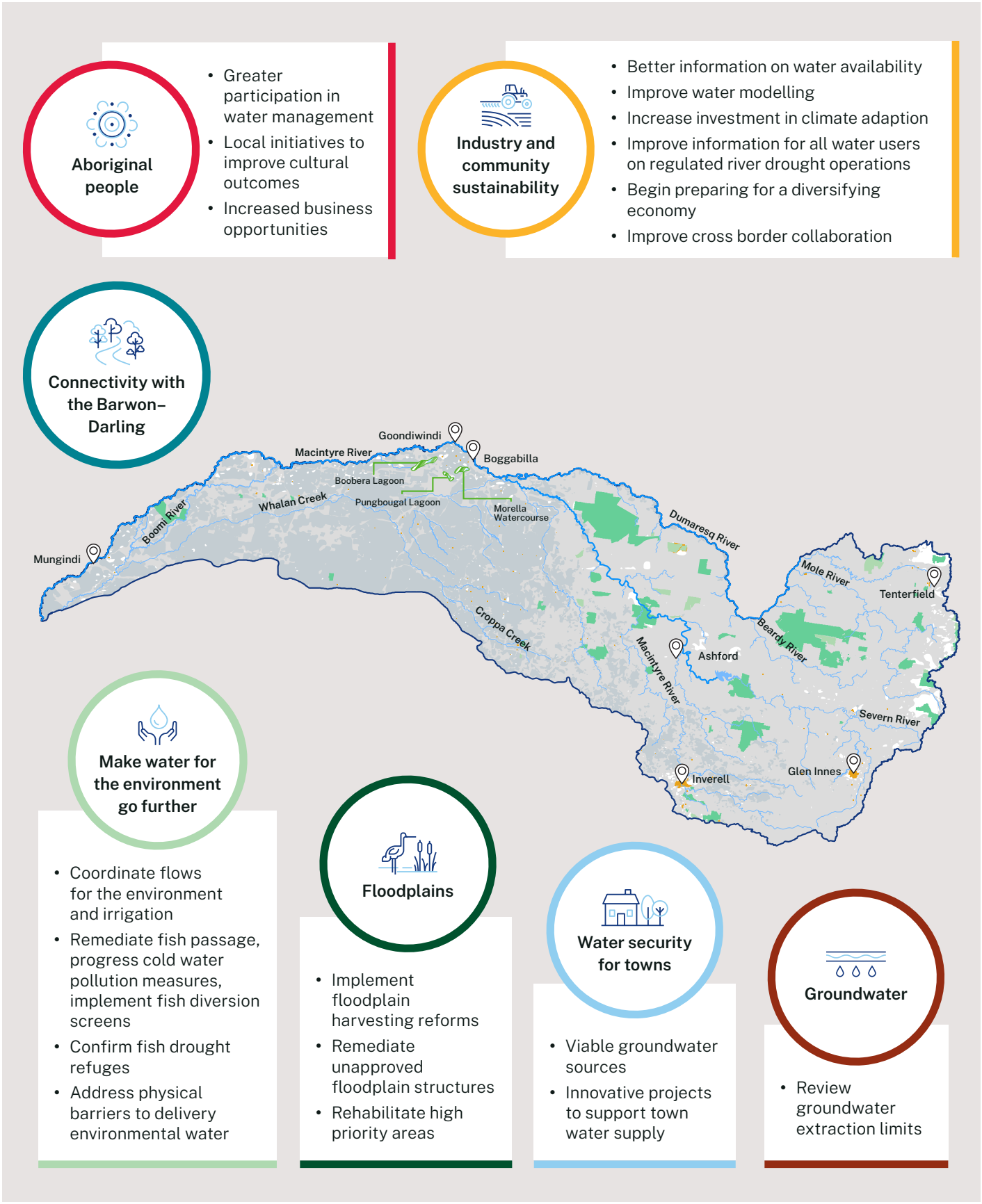
Sustaining the health and resilience of aquatic and floodplain ecosystems

Improving connectivity to support downstream needs

Page 34

| Priority 1 | Priority 2 | Priority 3 | Priority 4 |
|---|---|---|---|
| **Address knowledge gaps and make information easily accessible** | **Do more with less water** | **Make the region more resilient to climate variability** | **Share water differently to address critical needs of Border Rivers and downstream users** |
| Page 52 | Page 58 | Page 64 | Page 72 |
| Actions 1.1–1.5 | Actions 2.1–2.4 | Actions 3.1–3.7 | Actions 4.1–4.5 |

**Figure 23. Summary of Border Rivers Regional Water Strategy actions**



# Priority 1

## Address knowledge gaps and make information easily accessible

To support the Border Rivers communities and businesses prepare for and adapt to future climatic conditions, the NSW Government will focus on making climate information more easily available and ensuring key knowledge gaps are filled so local communities, industries and environmental water managers are better placed to make water-related decisions and are resilient to water availability risks.

### Our starting point

The NSW and Australian governments have been progressively publishing more climate information over recent years in ways that are more accessible and easier to understand.

The actions in this strategy will build upon this existing information, which includes:

- the WaterNSW Water Insights portal, which provides easy access to data on water use and water management in NSW. This portal will be updated continuously
- water allocation statements, which include information on how much water is available in dams and how that is being distributed across different users
- modelling of the Border Rivers River system within the Source modelling platform, developed by the department in collaboration with the Queensland Government
- a commitment in the Future Ready Regions Strategy to upgrade the Enhanced Drought Information System to provide farms with world-leading weather and climate data so they can make better business decisions.

Image courtesy of Department of Planning and Environment. Cotton harvesting, Moree Plains Shire.

**Figure 24. Priority 1: Action summary**

| Legend | | | | |
|---|---|---|---|---|
|  Increased surface water security risks for towns in the region |  Risk of reduced water availability will impact the regional economy |  Addressing barriers to Aboriginal water rights |  Sustaining the health and resilience of aquatic and floodplain ecosystems |  Improving connectivity to support downstream needs |

| Action number | Action name | Challenges addressed |
|---|---|---|
| **Action 1.1:** | Improve public access to climate information and water availability forecasts |  |
| **Action 1.2:** | Foster ongoing arrangements for participation of local Aboriginal people in water management |  |
| **Action 1.3:** | Improve understanding of river flows, water use and water quality at priority locations in the Border Rivers |  |
| **Action 1.4:** | Invest in continuous improvement to water modelling in the Border Rivers region |  |
| **Action 1.5:** | Improve cross-border collaboration and information sharing |  |

# Action 1.1: Improve public access to climate information and water availability forecasts

This action commits to improving the availability of climate and water management information. All parts of the community and government need access to reliable and timely information to make informed decisions and be effectively involved in water planning and decision making.

The NSW Government is committed to supporting better planning for droughts. This includes providing more information and data to enable businesses to make the right decisions for their circumstances. Access to good climate information ahead of time, sound risk management and business planning are significant determining factors in the ability of businesses to withstand prolonged droughts.

While the delivery of climate and water availability information by government has improved in recent years, more can be done to ensure water-related information products meet the expectations of water users and help new industries entering the region.

The new climate data published in the regional water strategies is the first step in providing more information to water users on the future risks to water availability. This data will be progressively published online. The next step will be tailoring the application of this data for industry and communities to deliver the greatest benefits.

Improving short- and long-term water availability forecasts will help the region's businesses plan with greater certainty and make informed decisions on managing their allocations. It will also support farm-level climate adaptation decisions. Improving understanding of the vulnerability of primary industries to climate change is critical for managing risks and making sound adaptation decisions.

Giving new and diversified businesses a better understanding of water licensing products and climate risks will help new industries to establish in the Border Rivers region and ensure they can remain in the region over the long term.

Building upon existing state and national information platforms and products, including the Water Insights and Water Information Dashboards, the NSW Government will deliver suitable training, information products and platforms that:

- deliver upfront education and clarity to industry and government on potential water sources, given that the region's surface water sources, and some groundwater sources, are already fully allocated and there is potential for reduced water availability in the future
- provide education on how continuous accounting and water markets can help individual water users create the mix of water products needed to support their businesses and risk appetites
- encourage new industries to have comprehensive drought management plans as they set up in the region
- improve forecasting and better understand the movement of water across floodplains and within river channels during higher flow events. This requires continuous and ongoing investment
- communicate the potential implications of long-term climate data on:
  - surface water availability and water quality
  - the likelihood of consecutive years of low or no water availability
  - periods where access to water allocations may be restricted by delivery problems in the regulated river system
  - groundwater availability
  - how future use may affect the condition of groundwater resources
  - the decision framework for how available water determinations are made based on use, compliance triggers and carryover.
- develop a Drought and Flood Risk Index to provide early warning to water users on whether a regulated valley is at a higher risk of heading into drought or floods. The index will be made available on the Water Insights portal.

## Action 1.2: Foster ongoing arrangements for participation of local Aboriginal people in water management

An effective governance, engagement and knowledge sharing process is the first step in fundamentally improving Aboriginal people's involvement in water management and supporting cultural, environmental, social and economic outcomes. For this process to be successful, the makeup and function of groups need to be led by local communities. Experience has shown that government dictated governance models for Aboriginal communities do not work.

This action will fund existing or new Aboriginal groups that have developed a governance approach for involvement in water management processes. The success of this action will be driven by the extent to which it enables self-determination and provides an adequate level of support for these groups.

This action supports Priority Reform 1 in the National Agreement on Closing the Gap – to enter formal partnerships and decision-making arrangements and develop place-based partnerships to respond to local priorities.

Local Aboriginal groups in the Border Rivers region could be involved in:

- developing programs and initiatives to improve cultural competency within the water sector
- developing culturally appropriate water knowledge programs
- outlining a process that the NSW Government can follow to ensure water decisions have appropriately been considered by the community
- progressing on-ground water-related initiatives.

## Action 1.3: Improve understanding of river flows, water use and water quality at priority locations in the Border Rivers

Water management across regional NSW is impaired by gaps in real-time and long-term stream flow, water extraction and water quality information. Telemetered river gauges are limited in the region because of operational costs, and water taken from many unregulated rivers is poorly metered. However, there is an increasing need to install gauges in the headwaters of the Border Rivers catchment where floods come in fast and with little warning.

Under the NSW Non-Urban Water Metering Policy, the extraction of water will begin to be accurately measured and reported on all unregulated rivers in the northern Basin from December 2021, which will start to build a better understanding of water use over the next few years. Accurate and near real-time measurement of floodplain harvesting will also be introduced and enforced as a result of licences in the Border Rivers coming into effect from September 2022.

Water quality is important for ecological processes, recreation, amenity and industry use. Changes to water quality occur due to a combination of factors including changes to river flows and land use. For example, high flows from rainfall and runoff often result in higher turbidity, while low flow and cease-to-flow events increase the risk of algal blooms in reservoirs and weirs. Rainfall following extended dry periods can also increase the risk of blackwater events, which can result in fish deaths.

Improved information about water quality and water flows at priority locations is important to inform future modelling, planning and management for these systems, including development of environmental water requirements, access and trade rules, identifying flow components for protection and preventing environmental harm.

This action will review existing monitoring programs and data to identify key information gaps and investigate how they could be addressed. Targeting known gaps will include:

- installing a river gauge at Bluff River and/or other strategic locations in the upper catchment for better local flood risk information and better water management further down the system
- improving river flow monitoring and metering in the Boomi River, downstream of Whalan Creek, to better monitor the level of take in a region with high ecological values that provides flows to the Barwon River
- improving telemetered monitoring of water quality parameters, such as dissolved oxygen, turbidity and conductivity, on regulated and unregulated systems to inform management of water quality during regulated releases and extreme events such as droughts, floods and bushfires.

## Action 1.4: Invest in continuous improvement in water modelling to the Border Rivers region

The NSW Government uses river system models to inform many decisions in regional water management. These models can produce detailed information on how changes to policy, water sharing rules or infrastructure would impact the amount of water that flows in the river at different times and locations, and the water available to different users, including the environment.

Recent improvements to the Border Rivers river system model include representing water taken by floodplain harvesting and how environmental water managers use licensed water. The incorporation of new climate datasets also gives us a better understanding of how climate variability and climate change could impact catchment inflows and water availability in the region. The NSW Government is also investing in the development of river system models for the region's unregulated river catchments.

This action will continue to enhance the capability of the Border Rivers system model to support analysis of future operation, policy and planning decisions and their impacts on all water users, including the environment. This, combined with improved communication and engagement approaches, will give stakeholders and the broader community greater confidence that water sharing and management decisions are made using the latest scientific knowledge and a strong and credible evidence base.

This action will:

- continue to invest in science and modelling approaches that enable us to better understand the movement of water across the floodplain, including:
  - floodplain inundation extent and duration and consequent environmental outcomes
  - the return of floodwater from the floodplain back into the river, which is a first step to developing within-flood event forecasting capabilities.
- improve how river models represent river operations, particularly as the region goes into and recovers from drought. Being able to simulate drought contingency measures and better represent evaporation and groundwater seepage can improve our assessment of the impacts and benefits of different actions during droughts
- collaborate across different disciplines to explore how river models could be linked or combined with other models, such as economic and ecological models, to better understand ecological vulnerability to future conditions, including climatic variation
- update how different components of water take are represented once sufficient floodplain harvesting and unregulated river water take measurement data are available.

## Action 1.5: Improve cross-border collaboration and information sharing

This action involves a continued focus on improving collaboration and information sharing across Queensland and NSW in relation to the Border Rivers catchment.

Towns, water users and communities often access water from both sides of the border. Cross-border water management arrangements can be challenging due to the differences in legislation and rules between NSW and Queensland. This makes these arrangements complex to navigate and at times results in gaps in strategic planning or operational decision-making. Each state is responsible for managing water on its own side of the border, through its own legislation but alongside agreed guidelines under the Border Rivers Agreement. It also means that towns relying on shared infrastructure to provide water supplies may not have control over when water is released.

This action will continue to improve and implement effective governance frameworks and collaboration forums to improve cross-border water planning and cooperation between NSW and Queensland.

Image courtesy of Jane Humphries, Commonwealth Environmental Water Office. River Red Gum, Dumaresq River.

# Priority 2

## Do more with less water

Our new climate data and river system modelling for the Border Rivers region indicates a potential future climate with greater rainfall variability, particularly in summer and winter, and more variable catchment inflows. The trend is for warmer and drier conditions with more extreme droughts and floods.

While these changes may reduce the amount of water available for the region, the needs of the environment, communities, Aboriginal people and industries are unlikely to reduce. We will focus on actions that do more with less water and that maximise social, cultural, economic and environmental outcomes when water is used.

### Our starting point

This strategy builds on the existing evidence base and programs being implemented across government that can guide how to achieve multiple outcomes with the water we have. These include:

- The Border Rivers Long Term Water Plan has been developed to describe the flow regimes that are required to maintain or improve environmental outcomes in the region.
- The Water Quality Management Plan developed for the Border Rivers surface water resource plan and the Border Rivers Alluvial water resource plan provide a framework to protect, enhance and restore water quality for the region.
- The Department of Primary Industries Climate Vulnerability Assessment project is analysing the risks and opportunities presented by a changing climate to support resilience and adaptation in the broadacre cropping, horticulture, extensive livestock and forestry industries.
- The $48 million expanded Farms of the Future project, will support on-farm digital connectivity and encourage farmers to adopt agtech[27] to boost productivity, including water efficiency and drought preparedness.
- The Australian Government's Off-farm Efficiency Program will provide over $1 billion for on- and off-farm measures that improve the efficiency of water delivery infrastructure and increase the volume of water available for irrigators and communities.
- The NSW Government has prepared an Extreme Events Policy and valley-specific incident response guides that help manage extreme events in each of major water source in the NSW Murray–Darling Basin. The Extreme Events Policy is currently being reviewed given the severe drought conditions in 2017–2020 across NSW.
- The NSW Government responded in a range of ways to manage limited water supplies, support rural communities and minimise ecological impacts during the last drought (2017–2020). Individual valley 'drought snapshots' have been prepared that include sections on 'lesson learnt' and changes that are being implemented in response to the last drought (2017–2020).
- The NSW Government is running a suite of Natural Capital Programs to assist the primary industries sector to undertake sustainable actions to enable improved productivity, drought and climate resilience, regenerate local landscapes, and facilitate new/diversified income streams.

27. Agtech is the collective term for the tools and technologies – sensors, farm management software, imagery and smart farm equipment – that enables best practice agriculture.

**Figure 25. Priority 2: Action summary**

| Legend | | | | |
|---|---|---|---|---|
| Increased surface water security risks for towns in the region | Risk of reduced water availability will impact the regional economy | Addressing barriers to Aboriginal water rights | Sustaining the health and resilience of aquatic and floodplain ecosystems | Improving connectivity to support downstream needs |

| Action number | Action name | Challenges addressed |
|---|---|---|
| **Action 2.1:** | Support farm climate adaptation and water efficiency measures | |
| **Action 2.2:** | Coordinate the management of irrigation water releases and water for the environment to improve ecological outcomes | |
| **Action 2.3:** | Identify and address physical barriers to the delivery of water for the environment | |
| **Action 2.4:** | Provide clarity and certainty for water users, landholders and environmental water managers during drought operations | |

Image courtesy of Neil Fenelon, Department of Planning and Environment. Landscape outside of Glen Innes, NSW.

# Action 2.1: Support farm climate adaptation and water efficiency measures

Industry associations, research institutions and government have worked together for decades to support industry to adapt to the variable climate in the Border Rivers region. This has included improving the water use efficiency and productivity of traditional crop and livestock production systems. Grower-led irrigation research has been underway in the region for more than a decade and new land use activities, including carbon and biodiversity farming, are increasing in some areas of the region.

Farm businesses in the Border Rivers region are considered early adopters of best practice management and new technology. Continuing critical research and development will set the agricultural sector up for the future and may go a significant way towards mitigating future climate risks and adapting to climate change.

Understanding the vulnerability of primary industries to climate change is critical for managing risks and making sound adaptation decisions. The Department of Primary Industries Climate Vulnerability Assessment project is assessing the vulnerability to climate change for 29 primary industries and 14 related biosecurity risks. The project includes an assessment of risks for cotton and extensive livestock – industries that are important mainstays of the Border Rivers regional economy.

The climate vulnerability assessment will provide information on what types of adaptation strategies and industries could be best suited to the region within the context of a changing climate. With respect to irrigated crops like cotton, the vulnerability assessment has focused on how plant water demand is likely to shift under future climate change. Combining an understanding of changing plant water demand with a better understanding of future water availability, made possible by our new climate modelling, will give a more comprehensive understanding of the risks industries face. This work could help fast-track research and development into new practices and enterprises that are best suited to the future climate conditions projected for NSW.

Opportunities for improving industry water use efficiency remain. These improvements could help farmers produce more from the water they have. Options that reduce evaporation from on-farm storages appear to offer the greatest potential in the Border Rivers catchment but would ideally form one component of a whole farm water efficiency program.

This action will build on behaviour change and efficiency gains by continuing to support research, trials and demonstration projects for climate adaptation and water use efficiency. This could include:

- integrating water data from the regional water strategies into the climate vulnerability assessment analysis for selected agriculture industries and investigating adaptation responses
- exploring ways to reduce evaporation from on-farm storages, including evaporation mitigation technology or reducing surface area-to-volume ratios
- improving water use efficiency through use of smart sensors and automated irrigation systems
- limiting deep drainage by increasing the soil water holding capacity using novel compounds such as hydrophilic polymers.

In addition, research and development into new practices and enterprises that are best suited to warmer and drier conditions could be fast-tracked. This research will build on the Department of Primary Industries Climate Vulnerability Assessment to provide farm businesses with information on what types of crops could be best suited to the region in the context of a changing climate.

# Action 2.2: Coordinate the management of irrigation water releases and water for the environment to improve ecological outcomes

All water, including from natural events and the provision of irrigation water, has the potential to contribute to the ecological condition of rivers, wetlands and floodplains. The way the river is operated to deliver irrigation water can either enhance environmental outcomes or exacerbate environmental impacts.

Reduced water availability in a changing climate will mean fewer opportunities to use environmental water licences to support environmental outcomes in the region during extended dry periods. We need to make sure that mechanisms are in place to allow water for the environment to go as far as possible towards achieving necessary environmental outcomes.

In the NSW Border Rivers, 1% of the licences are held by the Commonwealth Environmental Water Holder. While the Commonwealth holds nearly 40 GL of water entitlements across the entire Border Rivers catchment, only 4.2 GL are NSW entitlements; the remaining 35.5 GL are Queensland entitlements. A further 5.1 GL needs to be recovered from the NSW Border Rivers to meet the Murray–Darling Basin Plan obligations.

These small amounts of environmental water mean that we need to rely on how water is released from Pindari and Glenlyon dams for irrigation use to maximise environmental watering requirements and minimise water quality impacts.

This action will investigate opportunities to achieve more natural flow patterns, provide flexibility to manage environmental flows in changing climate conditions and better coordinate the management of irrigation flows and water for the environment.

In addition, this action will assess the flow regime in the Border Rivers catchment to identify gaps in the frequency and adequacy of different flow types, including baseflow, low flows and freshes, under the current climate and under future climate change scenarios and determine how to fill those flow gaps without impacts on water users.

Potential changes include:

- investigating limitations and barriers to achieving environmental watering requirements with irrigation flows
- working with water users to protect important flows down the system without having major impacts on water users
- coordinated releases of irrigation water and held environmental water
- refinement of water releases from dams and weir pools to mimic more natural rates of rise and fall and minimise water quality impacts
- coordinating dam releases with unregulated tributary flows to promote higher flow events, within system constraints
- amending relevant water sharing plan rules or supplementary water announcements to allow flows down the system at ecologically important times, without having impacts on water users
- the control of water releases from water storages to minimise or avoid relevant environmental impacts, damage to riverbanks, public safety and operational efficiency.

These and other changes could be set out in guidance developed by the Department of Planning and Environment for the coordinated management of water for the environment and consumptive (irrigation) flows.

# Action 2.3: Identify and address physical barriers to the delivery of water for the environment

The Murray–Darling Basin Authority's 2016 Northern Basin Review recognised that complementary measures such as removing physical and operational barriers (constraints) that inhibit the delivery of water for the environment can help to improve the ecological outcomes of water management in the northern Basin and support environmental objectives.

During consultation, we heard that physical constraints may exacerbate the impacts of climate change on the ability to deliver water for the environment, and that we should identify and address key constraints in the Border Rivers catchment.

This action will investigate physical constraints that impact on the ability of water to move through rivers and across floodplains. Initial focus areas include:

- the Morella Watercourse/Boobera Lagoon/Pungbougal Lagoon complex – this is listed as a nationally significant wetland and is highly significant to local Aboriginal communities. This wetland complex is located on the Macintyre River floodplain south of Boggabilla and is fed by groundwater springs and periodic floodplain inundation. A reduced level of overbank flows is likely to make it more difficult to deliver water to these priority assets
- the Dumaresq and Severn rivers downstream of the major storages – these are the reaches in the upper part of the catchment where environmental water managers are most able to influence the flow regime with the release of environmental water to target in-channel features such as benches and woody debris. Instream constraints to delivery are expected to be some public and private low-level road crossings.

Image courtesy of Department of Primary Industries – Fisheries. Holdfast Crossing, Macintyre River.

# Action 2.4: Provide clarity and certainty for water users, landholders and environmental water managers during drought operations

During the 2017 to 2020 drought, the NSW Government altered normal regulated river operations in the Border Rivers from February 2019 to April 2021 to adapt to the extreme dry conditions.

The operational measures that were implemented included releasing water over shorter periods (block releases) to maximise delivery efficiency. Block water deliveries can have undesirable environmental consequences by reducing hydrological connectivity and water quality within refuge habitat. These short flows often don't meet the durations required for environmental watering and cause unnatural rates of rise and fall. They therefore lack the cues for ecological responses such as spawning.

Another drought operation measure used was to stop providing regulated releases to certain points to preserve water for critical needs. In 2017–18, regulated releases were not made past Boomi; during 2019, releases were not made past Boggabilla. This meant that sections of the river below these points did not receive any flows from dam releases. The only flows came from local rainfall events, which provided small flows in the river and helped top up drought refuge pools. Providing greater certainty about when these measures will occur can help all water users, landholders and environmental water managers to be prepared for dry periods.

A more variable or changing climate will increase the times that some of these drought operations are used. Greater transparency and information about when these drought responses will be triggered and what they are based on will help to maintain confidence that these events are managed appropriately and will support water users, landholders and environmental water managers to plan for and manage their water use during these periods.

This action will improve transparency and certainty about how water will be managed during drought by:

- clarifying the measures that could be applied during increasing stages of drought by updating the Incident Response Guide and developing a drought management plan for the Border Rivers
- developing hydrological drought risk indicators
- defining triggers for protecting natural flows for critical needs during and after prolonged droughts
- identifying critical triggers and potential actions in relation to water quality events
- developing procedures to manage block releases and other operational measures
- developing guidance on how to 'restart' the river after dry times or cease-to-flow events to minimise the risk of fish deaths occurring from hypoxic blackwater events or the destratification of pools
- investigating the impact of drought management responses on alluvial groundwater sources and designing responses address these.

# Priority 3

## Make the region more resilient to climate variability

More extreme wet and dry periods and longer droughts will place at risk the health of ecosystems, the ability for Aboriginal communities to practice culture and the sustainability of the industries in the Border Rivers region. We will invest in actions that support the resilience of the Border Rivers region so it can withstand periods of drought and shock, recover quickly after droughts and prosper.

### Our starting point

A range of existing government strategies and programs have been developed to support the resilience of regions, communities and industries to climate change. Alongside the NSW Government's investment in updated climate information, this includes:

- The NSW Water Strategy includes a commitment to reviewing water allocation frameworks and water sharing plan provisions in response to the last drought. This review will need to determine the most appropriate dataset to use in assessing whether essential needs reserves in dams need to be amended through a risk framework. Analysis undertaken for the Border Rivers Regional Water Strategy will be considered in this review.
- The Future Ready Regions Strategy includes a commitment to upgrade the Enhanced Drought Information System to provide farms with world-leading weather and climate data so they can make better business decisions and develop drought resilience plans.
- The NSW Government is working with other jurisdictions to finalise a target for ownership of water entitlements by Aboriginal people and organisations under the National Agreement on Closing the Gap.
- The NSW Government Climate Change Research Strategy is supporting projects that help primary industry sectors adapt to climate change.
- The NSW Government is partnering with First Nations/Aboriginal people to co-design a state-wide Aboriginal Water Strategy that will identify a program of measures to deliver on First Nations' water rights and interests in water management and address state-wide systemic issues to better enable the exercise of First Nations/Aboriginal people's rights and access to water.
- The 20-Year Economic Vision for Regional NSW is the NSW Government's plan to drive sustainable, long-term economic growth in regional NSW. It guides transformative, once-in-a-generation investment in the state's regions through the $4.2 billion Snowy Hydro Legacy Fund to create jobs now and into the future.

**Figure 26. Priority 3: Action summary**

| Legend | | | | |
|---|---|---|---|---|
|  |  |  |  |  |
| Increased surface water security risks for towns in the region | Risk of reduced water availability will impact the regional economy | Addressing barriers to Aboriginal water rights | Sustaining the health and resilience of aquatic and floodplain ecosystems | Improving connectivity to support downstream needs |

| Action number | Action name | Challenges addressed |
|---|---|---|
| **Action 3.1:** | Modernise the water management framework so it can continue to support sustainable economic diversification |  |
| **Action 3.2:** | Support place-based initiatives to deliver cultural outcomes for Aboriginal people |  |
| **Action 3.3:** | Support Aboriginal business opportunities in the Border Rivers region |  |
| **Action 3.4:** | Mitigate the impact of infrastructure on native fish through infrastructure changes |  |
| **Action 3.5:** | Fully implement the NSW Floodplain Harvesting Policy |  |
| **Action 3.6:** | Remediate unapproved floodplain structures |  |
| **Action 3.7:** | Rehabilitate regionally significant riparian, wetland or floodplain reaches |  |

# Action 3.1: Modernise the water management framework so it can continue to support sustainable economic diversification

Councils within the Border Rivers region want to expand and diversify their local economies, moving away from a heavy reliance on agriculture to provide more stable employment and support growing communities. Encouraging investment in sectors that are less reliant on water and that capitalise on the strengths of the region will be critical in promoting economic diversification and supporting the long-term economic development of the region.

The Border Rivers and adjoining regions have a number of emerging and potential future industries with lower water dependence. Investments to help diversify the economy focus on leveraging the region's agricultural base through the Moree Special Activation Precinct, as well as encouraging investment in industries less dependent on water such as the New England Renewable Energy Zone, Inland Rail and the visitor economy. These investments have the potential to provide more stable employment, attract investment and maintain liveability, particularly in the face of more extended droughts.

However, existing and new industries will still require access to water, which will need to come from trading of existing water entitlements, groundwater sources that are not fully allocated or recycled and re-used water sources. We need to make sure our water entitlement and access framework can cater to these new industries.

To support changing water needs, this action involves:

- taking a proactive approach to understanding the water quality and quantity requirements of emerging industries to inform policy development, planning and investment decisions
- addressing water-related policy and regulatory barriers around using new and innovative water sources, such as town stormwater harvesting and re-use of water
- investigating community and industry interest in alternative and more flexible water products, and the level of risk that different industries are willing to take
- encouraging new industries to have comprehensive drought management plans as they set up in the region
- consider the findings of the Border Rivers Regional Water Strategy in the update of the Regional Economic Development Strategy for the Upper North-West region.

Image courtesy of CWP Renewables. Sapphire Wind Farm, Northern Tablelands.

## More flexible water products

A range of options could be investigated to alter the types of water licences or water products offered in the market.

### Converting general security licences to high security licences

The Border Rivers Regional Water Strategy: Shortlisted Actions – Consultation Paper included a proposed action around converting a small amount of general security licences to high security licences to enable more higher reliability products to be secured by businesses needing higher water security. While there was some support for this option in the eastern part of the catchment, significant concerns were raised about the potential of the proposal to reduce the reliability of remaining licences and have negative impacts on the environment. Progressing this in the long term would need further modelling and consultation, as well as an impact assessment to confirm conversion factors and any rules needed to mitigate impacts on other licences, basic landholder rights and environmental outcomes.

### Capacity sharing

Some states in Australia have moved towards greater capacity sharing as a tool to allow water users to choose their own level of supply security. Under these arrangements, instead of issuing water users with an annual licensed volume that receives water allocations, water users instead own a share of the capacity in a dam and a share of any inflow. They can store their share of inflow in the dam or release it and extract water from the river equivalent to their remaining share of water once it has travelled to their pump site.

This arrangement significantly changes the management of water as it becomes up to each water user to manage their water, along with what water they should put aside to cover loss in delivery and loss from storage. While this becomes a complex arrangement for individuals and government, it provides greater flexibility for individual water users to tailor their water use strategy to suit particular needs.

Image courtesy of Department of Planning and Environment. Irrigation works, Moree Plains Shire.

## Action 3.2: Support place-based initiatives to deliver cultural outcomes for Aboriginal people

This action will fund and support Aboriginal organisations and communities to develop tailored projects for their communities. It will aim to move away from central decision making and develop a flexible program that can be adapted and is driven by the principle of self-determination – local communities 'speaking with their voice' to make decisions about the programs needed for their community and their region.

In the Border Rivers, this could include Aboriginal communities and organisations:

- developing a cultural watering program that identifies the specific sites or locations where water should be delivered at certain times. This could involve working with the Department of Planning and Environment Water, WaterNSW and environmental water holders to identify whether co-benefits could arise from water for the environment
- working with government to improve access to Country, including identifying locations that have local significance and opening up local parcels of land that access waterways but are gated or locked, such as travelling stock reserves or Crown roads
- establishing a restoration reach that uses cultural knowledge and science to rehabilitate riparian land, planting native species and caring for Country
- developing and delivering programs that engage Aboriginal youth in water and landscape management, with an objective to build cultural awareness and give a sense of ownership and cultural connectivity.

To receive government funding or support, these initiatives will need to have local champions, effective local governance arrangements and a strong capacity building component, such as activities that focus on water legislation and literacy, licensing of water structures, landscape management or knowledge activities for schools and youth programs.

## Action 3.3: Support Aboriginal business opportunities in the Border Rivers region

Investing in regional Aboriginal businesses can help diversify incomes in the region, create employment for local Aboriginal youth and improve social and economic outcomes for Aboriginal people. Realising some of these opportunities may require access to surface water or groundwater resources.

This action will support Aboriginal business development opportunities in the Border Rivers. The action will be led by the Department of Planning and Environment with support from the Department of Regional NSW. Through the Aboriginal Partnership Program, a dedicated Partnership Manager will work with Aboriginal organisations, businesses, and individuals to:

- identify and develop new business opportunities
- better manage existing ones
- access support or grant funding.

Other support is also available through the Department of Aboriginal Affairs, the NSW Aboriginal Lands Council, and the National Indigenous Australians Agency.

# Action 3.4: Mitigate the impact of infrastructure on native fish through infrastructure changes

Many native fish species that are native to the Border Rivers region need to move freely within and between rivers to breed, migrate and at times escape the impacts of drought. Enabling native fish to move freely within the Border Rivers region will help the resilience of fish species in a changing climate and will help to maintain and replenish native fish stocks across the northern Basin.

## Improve fish passage at priority sites in the Border Rivers region guided by the NSW Fish Passage Strategy

Physical barriers to fish passage such as weirs and dams can limit fish movement, leading to a decline in the health and viability of native fish populations. Currently, native fish can only move through the Border Rivers system during high flow conditions when water overflows weirs and other instream barriers, and regulator gates are lifted.

This action supports the staged remediation of fish passage at 9 priority sites within the Border Rivers region:

- Macintyre Blockbank A
- Boomi Weir
- Goondiwindi Weir
- Boggabilla Weir
- Toomelah Weir
- Glenarbon Weir
- Cunningham Weir
- Bonshaw Weir
- Holdfast Crossing.

## Progress cold water pollution measures for Pindari Dam

Cold water pollution has damaging impacts on riverine ecological function, particularly in summer where biological cues such as fish spawning are disrupted. This water is typically 10°C colder than the ambient river temperature, causing cold water pollution that affects the river for over 100 km downstream of the dam.

In warmer months, the presence of blue-green algae blooms in Pindari Dam means that water needs to be released into the Severn River from lower levels in the dam. Pindari Dam has a variable level offtake (bulkhead gate and trash rack system) to assist in mitigating cold water pollution. However, the presence of potentially toxic surface algae often prevents the ability to release warmer surface water during summer. This results in cold water from lower in the dam being released into the river. As it is not currently possible to remove the risk of algal blooms in Pindari Dam, cold water pollution management actions need to be taken.

WaterNSW and Department of Primary Industries – Fisheries are currently undertaking preliminary investigations into cold water pollution mitigation options for Pindari Dam.

This action will involve:

- development of a cold water pollution monitoring plan within and below Pindari Dam. This will include completion of pre-feasibility assessments and demonstration aeration trials
- completion of investigations to understand the improvements in fish populations that can be achieved by addressing cold water pollution at Pindari Dam
- progressing investigations into infrastructure improvements, new technologies and operational changes to arrive at a preferred solution for Pindari Dam, and developing a strategic business case for the related infrastructure.

## Implement fish diversion screens at priority pump sites in the Border Rivers to protect native fish

Every year, large numbers of native fish are extracted from rivers by unscreened pumps in the Border Rivers region. Adult fish as well as juveniles, larvae and eggs are extracted by pumps and diverted into irrigation channels, along with debris such as sticks and leave. This impacts the sustainability of native fish populations and can also cause damage to irrigation infrastructure.

Installation of screens at pump sites and diversion regulators can reduce fish losses by over 90%, helping more fish survive to maturity and boosting fish numbers. The protection extends to other aquatic species such as crayfish and turtles. Screening infrastructure also improves pump operation, water delivery and extraction efficiency for asset owners through fewer blockages caused by debris.

The Australian Government has funded the first phase of works to implement screening activities under the Northern Basin Toolkit – Fish Friendly Water Extraction project, which will install fish diversion screens at priority sites in the Barwon–Darling and Gwydir valleys in NSW and the Condamine–Balonne and Queensland component of the Border Rivers. The sites selected will complement other fish passage works and diversion screening activities being undertaken in NSW and Queensland.

Through this action, the NSW Government will work with the Australian and Queensland governments to prioritise sites for the installation of diversion screens across the target valleys based on their capacity to provide ecological and economic returns.

## Action 3.5: Fully implement the NSW Floodplain Harvesting Policy

Floodplain harvesting happens when water is collected from floodplains during a flood or after a major or significant rain event (overland flows).

Floodplain harvesting is accounted for in the legal limits on surface water extractions as set out in the Murray–Darling Basin Agreement (the Cap), NSW water sharing plans (long-term average annual extraction limits) and the Basin Plan (sustainable diversion limits).

Floodplain harvesting is a significant farm management practice in the Border Rivers. More than 20% of all surface water used in the region comes from water diverted from the floodplain and intercepted before it enters rivers and creeks.

There has been growth in floodplain harvesting across the NSW northern Basin. Where this growth has resulted in total diversions in a water resource exceeding the legal limits, the licensing of floodplain harvesting will enable this form of take to be reduced so that total diversions from the Border Rivers Regulated and Unregulated water sources do not exceed legal limits.

Licensing and managing floodplain harvesting within legal limits is a 'game changer' for the Border Rivers. It will deliver environmental and downstream benefits by reducing floodplain harvesting take to within the water source legal limits and is expected to deliver up to a 5.5 GL increase in average annual flood volume across the Border Rivers valley floodplain in years when floods occur.

It will deliver significant in-valley benefits to native vegetation, native fish and waterbirds in the Border Rivers floodplain and more flows into the Barwon–Darling during floods. This will provide greater resilience for the diverse habitats and species in the Border Rivers Valley and the northern Murray–Darling Basin more broadly.[28]

Implementing the NSW Healthy Floodplain Policy provides certainty for water users, the regulator and communities about floodplain harvesting limits, requirements and the means for applying and enforcing these. These reforms now ensure that we can measure and monitor floodplain harvesting and that other licence categories are not penalised in order to meet legal limits for the Border Rivers water sources.

This action will support compliance and reporting actions within the region, enabling fair and transparent regulation of this historically legitimate water management practice in compliance with NSW Water Sharing Plan and Murray–Darling Basin Plan extraction limits.

## Action 3.6: Remediate unapproved floodplain structures

Extensive floodplain development exists on the Border Rivers floodplain, including levee banks, earthworks, on-farm storages, raised roads and water supply channels. Structures in the floodplain can block or significantly alter the natural flow of water across the floodplain. Disconnection of these natural flow paths within and between valleys has negative impacts on ecological and cultural assets.

Some ecological assets in the Border Rivers region, such as river red gum and coolabah vegetation communities, rely on floodplain flows for their maintenance and survival. If water cannot naturally move through the floodplain to these assets, then this water will need to be provided from other sources such as Pindari Dam.

This action, delivered through the Improving Floodplain Connections program which is jointly funded by the Australian and NSW governments, will remediate or remove unapproved works in up to 18 priority areas in the Border Rivers floodplain that are altering the flow of floodwaters in the region and potentially impeding the delivery of water to ecological assets and floodplain areas, including Ottley's Creek and Turkey Lagoon. Over 55,800 ha of wetland and floodplain ecosystems in the Border Rivers region will benefit from this action.

The program also has the potential to enhance cultural sites and values held by local Aboriginal people. This action will explore how Aboriginal cultural heritage values and ecological balance can be restored in partnership with Aboriginal communities.

28. See technical reports developed to inform the development of the floodplain harvesting licensing rules at www.industry.nsw.gov.au/water/plans-programs/healthy-floodplains-project/water-sharing-plan-rules/border-rivers

# Action 3.7: Rehabilitate regionally significant riparian, wetland or floodplain reaches

The health and resilience of rivers and the ecosystems they support are directly linked to the condition of waterways and their floodplains. Conserving remnant biodiversity and restoring degraded riverine and wetland ecosystems can strengthen their long-term resilience and improve ecological responses and benefits from environmental watering.

Land use changes have impacted the health of the rivers throughout the region. Water now moves more quickly and with more energy through the catchment, eroding land and waterways, reducing water quality and leading to less water being stored in the landscape. The degradation of native riparian vegetation along water courses is recognised as a key threatening process under the *Fisheries Management Act 1994*.

Blue-green algae causes significant water quality issues in the region, particularly for Pindari Dam and Lake Inverell. The algal blooms are caused by consistent hot days, high nutrients in the water and low flows. Blue-green algae pose significant risks to human health, recreation activities and ecosystem function.

During consultation we received considerable support for on-ground river rehabilitation and restoration works and were encouraged to design projects in partnership with Aboriginal land managers, landholders and councils.

The quality of surface water and groundwater systems is directly affected by the land uses and land management practices in surrounding catchments. Broadscale, long-term catchment management is also likely to be the most effective long-term solution to minimising blue-green algae outbreaks and improving water quality in the Border Rivers catchment.

This action will build on existing land management programs and other local initiatives to support a whole-of-catchment program of works to improve river health, connectivity and ecosystem resilience. Works could include instream structures such as appropriately designed and approved large woody habitat structures. It could also include improvements to instream vegetation, which slows and filters water flow and improves water quality by removing sediments and nutrients. Improved riparian management, including controlled stock access, would improve bank stability, protecting banks from erosion and sediment loss during floods.

Implementation of this action will involve:

- developing a system to prioritise areas to protect or rehabilitate – based on, for example, detailed habitat mapping data, native fish conditions, threatened species distribution or the River Styles framework, severity of land degradation and environmental management outcomes
- establishing a phased and prioritised program of management measures for the life of the Border Rivers Regional Water Strategy
- identifying funding models, including consideration of landholder incentives
- developing a clear decision making and program delivery governance framework
- understanding and including local Aboriginal knowledge and expertise in delivering river improvement works – for example, through a River Ranger program
- developing a monitoring and evaluation framework.

# Priority 4

## Share water differently to address critical needs of Border Rivers and downstream users

The biggest challenge that the region and inland NSW will face in the context of a drier future is the ability to protect critical needs during extended droughts that could be significantly worse than anything experienced since European settlement.

We will focus on actions to secure water sources for towns, build knowledge of critical needs of the region and investigate ways to improve connectivity with the Barwon–Darling River.

### Our starting point

Investments have been made in recent years to help secure water supplies for towns across the Border Rivers regions, and to support critical needs during drought periods.

#### Supporting town water security

Every local water utility faces unique challenges and risks. In the Border Rivers region, the costs associated with implementing water security infrastructure solutions across a small and dispersed ratepayer base, attracting and retaining skilled staff, and working through regulatory requirements can make it challenging for local water utilities to operate.

The NSW Government's Town Water Risk Reduction Program is working in partnership with councils, local water utilities, government agencies and the broader water sector to address these issues and improve management of town water risks. In addition, around $12 million has been invested in water security upgrades in the region through the Safe and Secure Water Program.

#### Supporting critical needs during drought

The NSW government responded in a range of ways to manage limited water supplies, support rural communities and minimise ecological impacts during the last drought (2017–2020):

- Individual valley 'drought snapshots' have been prepared that include sections on 'lessons learnt' and changes that are being implemented.[29]
- The NSW Government has prepared an Extreme Events Policy and valley-specific incident response guides that support the management of extreme events in each of major water sources in the NSW Murray–Darling Basin. The Extreme Events Policy is currently being reviewed, given the severe drought conditions in 2017–2020 across NSW.

29. www.industry.nsw.gov.au/water/allocations-availability/droughts-floods/drought-update/previous-valleys-in-drought

## Providing connectivity flows across the northern Basin

Three connectivity events from 2018 to 2021 are examples of how carryover and water for the environment in the Border Rivers can be used to meet environmental demands during dry periods and provide connectivity across the northern Basin. The ability to access carryover is critical to meeting environmental demands in a variable climate, particularly in dry years where environmental damage can occur. Without these flows from environmental water accounts, refuge pools would have dried up.

- Northern Connectivity Event – From April 2018, Commonwealth and NSW environmental water holders released water from Glenlyon Dam in the Border Rivers (4.3 GL) and Copeton Dam in the Gwydir (18.9 GL). The releases aimed to support the environmental health of aquatic ecosystems, including the Gwydir Wetlands, and provide connecting flows into the Barwon–Darling River. The release flowed down the Gwydir and Mehi rivers and into the Barwon–Darling River and combined with some small natural inflows, reached Wilcannia, with a small volume entering Menindee Lakes by June 2018.
- Northern Fish Flow Event – In April 2019 another release of environmental water was made – 26 GL from Copeton and 7.4 GL from Glenlyon. However, flows only reached just upstream of Bourke along the Barwon–Darling River because of the dry conditions.
- Northern Water Hole Top-up Event – In late December 2020, 5.1 GL of Commonwealth environmental water in the Gwydir and 2.9 GL from the Border Rivers was released from Copeton and Pindari dams to top up in-channel refugia to help native fish survive by improving water quality in drying waterholes. The flow started to reach the Barwon–Darling in early 2021.

Water monitoring was undertaken by the University of New England prior to and during the Northern Waterhole Top-up. It showed overall improvements to water quality, including increased dissolved oxygen levels as water levels rose.

In addition to these, in 2020 the NSW Government restricted commercial access to water to protect the first flow after the extended drought (Northern Basin first flush event).

The First Flush event involved protecting the significant amount of rainfall and inflows in early 2020 along the length of the northern Basin and into Menindee Lakes. By the end of June 2020, more than 583 GL of inflows reached Menindee Lakes, which enabled flows into the Lower Darling River.

Image courtesy of Bron Powell, Department of Primary Industries – Fisheries. Macintyre River.

**Figure 27. Priority 4: Action summary**

| Legend | | | | |
|---|---|---|---|---|
| Increased surface water security risks for towns in the region | Risk of reduced water availability will impact the regional economy | Addressing barriers to Aboriginal water rights | Sustaining the health and resilience of aquatic and floodplain ecosystems | Improving connectivity to support downstream needs |

| Action number | Action name | Challenges addressed |
|---|---|---|
| **Action 4.1:** | Map critical drought refugia | |
| **Action 4.2:** | Support towns to understand if groundwater can provide a reliable water supply when surface water availability is limited | |
| **Action 4.3:** | Investigate innovative water projects to support town water supplies | |
| **Action 4.4:** | Investigate sustainable levels of groundwater extraction in the Border Rivers Alluvial aquifers | |
| **Action 4.5:** | Investigate ways to improve connectivity with the Barwon–Darling River on a multi-valley scale | |

Image courtesy of Brown Powell, Department of Primary Industries – Fisheries.
Department of Primary Industries – Fisheries Officer measuring the depth of a refuge pool, Macintyre River.

# Action 4.1: Map critical drought refugia

For the environment, drought refugia (small habitats and deep waterholes that naturally retain water during extended dry periods) are critical to the survival of many aquatic species. Refugia can occur within river channels, as instream pools, or in off-channel habitat where water persists after disconnection from the channel. Instream refuge pools are replenished by freshes, while the main replenishment of off-channel drought refugia occurs from larger connecting and overbank flows.

Climate change could influence the future extent, availability and condition of drought refugia – making it important that we take action now to protect and sustain them across all resource availability scenarios.

Improved information about the location of key drought refugia and the flow volumes needed to maintain them will assist environmental water managers to protect critical river flows and deliver water that maintains their health and condition.

This action will complete the detailed identification of critical drought refugia in the Border Rivers region by building on the preliminary mapping undertaken by Department of Primary Industries Fisheries during the 2019 to 2020 drought.

The action will:

- complete the detailed identification and mapping of critical drought refugia in the Border Rivers, including through different technologies
- pilot the use of remote sensing technology to map the location, size and persistence of instream and floodplain refuge locations. Existing mapping could be used to validate this approach
- undertake mapping of refuge pool persistence in reaches that are identified as priorities
- identify the water requirements needed to protect and maintain the refugia.

# Action 4.2: Support towns to understand if groundwater can provide a reliable water supply when surface water availability is limited

Analysis undertaken for the Borders River Regional Water Strategy found there are no cost-effective water supply options to address water security for towns at a regional level. This means that towns that do not have reliable surface water supplies will need to look to develop local water supply solutions, such as groundwater. However, as groundwater availability and quality vary across the catchment there is a need to improve our understanding of groundwater sources so we can assess the long-term viability of groundwater as an alternate supply source.

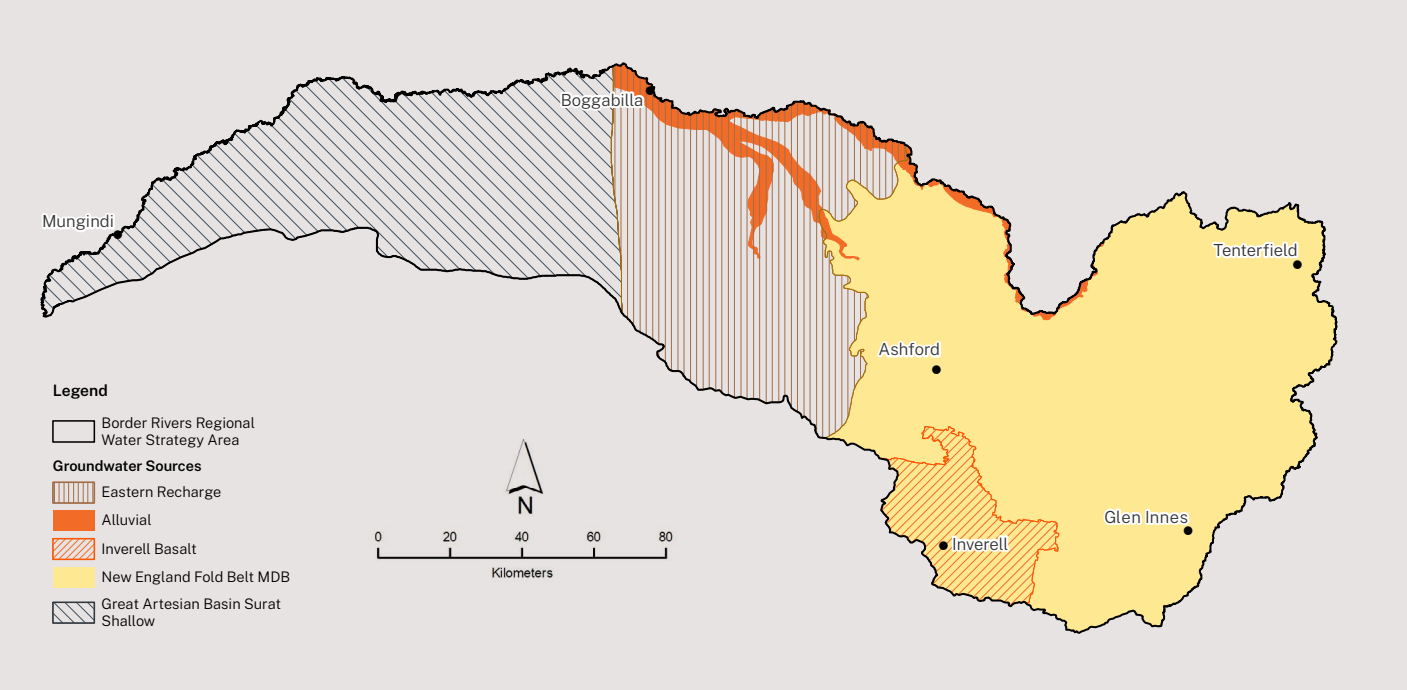
## Eastern catchment

The towns in the east of the catchment rely on unregulated rivers for water. Our new climate data shows that the water security risks for these towns could be higher than previously expected. Tenterfield and Glenn Innes councils have now installed groundwater bores that are likely to support a large portion of town water demands during droughts.

However, the eastern part of the Border Rivers catchment overlies the New England Fold Belt Murray–Darling Basin Groundwater Source (fractured rock aquifer) and the Inverell Basalt (Figure 28). The non-homogenous nature of the underlying fractured rock aquifers means yields and quality vary substantially over relatively short distances and further studies need to be undertaken to assess the long-term viability of this as an alternate water source. The Inverell Basalt source could be a potential water supply in the future, but we have limited knowledge about this resource. Given the unpredictable yield, the risk of drilling an expensive bore for no benefit is high.

To address this, the NSW Government will seek to obtain and publish more information that could assist households and communities in deciding whether the cost of drilling for groundwater is worth the benefit. The Geological Survey of NSW undertakes mineral, energy and water exploration and this action will be a joint project between the survey and the Department of Planning and Environment for the exploration of fractured rock systems. The project will include regional and locally targeted geophysics to identify potential resources followed by drilling, testing and water quality analysis to assess the resource's suitability as supply.

**Figure 28. Groundwater resources in the Border Rivers**




## Western catchment

There are also risks, albeit small, for the western towns of Boggabilla and Mungindi to run out of surface water. The towns in the western part of the catchment overlie the Great Artesian Basin, which can supply long-term high yielding bores for towns. Water quality in the Great Artesian Basin can vary and must be managed on a case-by-case basis. Common issues that need to be assessed and managed can include taste, odour, salinity and temperature. Mungindi already has a Great Artesian Basin water supply in place, but we have heard from residents that there is a preference for drinking surface water over groundwater. Moree Council is currently investigating adjustments that need to be made to Mungindi's water treatment processes when groundwater is used as the primary water source. Boggabilla has some old alluvial groundwater bores that are not connected to the water treatment plant.

In addition, Gwydir Shire Council provides groundwater supplies for the small communities of Croppa Creek and North Star; however, this ground water is accessed through a general security groundwater licence meaning high priority needs are relying on low priority licences. Gwydir Shire Council is investigating options to provide more secure water supply to North Star and Croppa Creek, including ensuring the towns have local water utility licences.

This action will help towns across the Border Rivers develop local solutions to address surface water shortfall risk by:

- obtaining and publishing more information about the fractured rock groundwater sources in the east of the catchment
- through the Safe and Secure Water Program, supporting towns to complete strategic plans to develop sustainable solutions to meet future water needs, including:
  - developing local water supply solutions to assess if surface water shortfalls can be reduced or eliminated by groundwater, and ensuring councils have the appropriate licences to access the required groundwater
  - identifying and implementing additional water quality treatment processes required to make groundwater suitable for use as drinking water, as well as progress actions to address skills gaps and support councils to attract and retain skilled staff to operate water treatment plants
  - delivering community engagement and education programs about a future where groundwater will need to become a greater proportion of drinking water
  - adopting a continued focus on demand management and water efficiency measures. Using water more efficiently means we make the best use of all our available water, improve water security and support the growth of towns in ways that have little or no impact on other water users or the environment.

## Action 4.3: Investigate innovative water projects to support town water supplies

The compounding risks of droughts and bushfires will continue to place stress on town water supplies, particularly as the risk of extreme bushfires is likely to coincide with extreme droughts. During the last drought, Glen Innes Severn Council implemented innovative and flexible strategies to treat wastewater to support bushfire efforts, which diversified their water supplies and enabled the town to support bushfire efforts as well as retain potable water for town needs. Tenterfield Council also supplied water for fire-fighting, including wastewater from potable treatment. This water was also used to water roads and parks. Additionally, Tenterfield Council dedicated a livestock bore free for residents.

This action will keep a focus on efforts to use treated water for non-potable uses in the region and factor bushfire risks into individual town demand and emergency management plans.

## Action 4.4: Investigate sustainable levels of groundwater extraction in the Border Rivers Alluvial aquifer

The Border Rivers Alluvial aquifer and Great Artesian Basin are important water sources for businesses, towns, households and communities across the central and western part of the region.

There is uncertainty about the long-term behaviour of groundwater systems and how they will respond to climate change. Lower rainfall could mean that the amount of water seeping into the ground and replenishing groundwater sources is reduced.

Better understanding of how groundwater recharge rates may be impacted by climate change is needed to ensure these resources are managed appropriately, so they can remain a reliable supply source during droughts.

If the recharge rate is overestimated, it could mean that the extraction limit is too high, which could result in unsustainable extraction of the groundwater source. Alternatively, if the recharge rate is underestimated, the extraction limit could be lower than necessary, which means there is a missed opportunity to extract water that could provide greater security for water users and support economic development. Additionally, a better understanding about the interaction between surface water and groundwater from scientific studies is needed to inform what the sustainable limit should be.

The Murray–Darling Basin Plan will be revised in 2026 and a solid evidence base will be needed to support any suggested changes to the Plan, such as increasing or decreasing the extraction limits. Concerns have been raised by stakeholders that extraction limits for the Border Rivers are too low. Other stakeholders have raised concerns that increasing the use of groundwater would impact on groundwater-dependent ecosystems, particularly with the risks posed by climate change.

This action will:

- review existing groundwater resource extraction limits and the current and future pressures on groundwater
- undertake field investigations combined with modelling analyses to ensure up-to-date information on groundwater connectivity (with surface water and between groundwater systems) and climate change are incorporated in the sustainable extraction limits.

## Action 4.5: Investigate ways to improve connectivity with the Barwon–Darling River on a multi-valley scale

The Border Rivers catchment is one of several NSW and Queensland catchments that play a critical role in providing water to the Barwon–Darling River.

We have heard that many stakeholders outside of the Border Rivers region expect additional actions in the Border Rivers to help meet needs downstream and improve connectivity. We have also heard that it may not be possible to improve connectivity when the river dries up naturally from time to time.

The NSW Government is reviewing whether rules should be amended to improve the flows of water between catchments at certain times. Importantly, this needs to consider whether we have the tools to deliver the intended outcomes without significant adverse impacts. This work is being covered through a more coordinated system scale approach as part of the Western Regional Water Strategy.[30]

Rule changes that significantly affect the amount of water available to water licence holders may trigger compensation under the *Water Management Act 2000*.

30. www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/public-exhibition/western-regional-water-strategy

# Implementing the strategy

# 6

Image courtesy of Destination NSW. Australian Standing Stones in Glen Innes.

# Getting our timing right

A critical feature of developing the Border Rivers Regional Water Strategy has been deciding which actions and investments are needed now, and which ones will be needed further into the future. The strategy has a 20-year timeframe. The timing of various actions is aimed to meet existing challenges, identify and prepare for foreseeable coming challenges, and lay the groundwork for adapting to future uncertainties and changed circumstances.

The water security actions in this strategy have a strong focus on drought security following the experience of the 2017–2020 drought. However, this drought has been closely followed by major flood events from 2020–2022.

Some of these actions may have the capability to mitigate low to moderate flooding events. Analysing the flood benefits of many of the actions in this strategy will require enhanced investment by governments in flood modelling and mitigation works.

The floodplain management plans being developed for the northern NSW valleys are the cornerstone for whole-of-catchment floodplain management in western NSW and will be extended into the southern NSW valleys over the coming years. Local councils, the Office of Local Government and the Department of Planning and Environment – Environment and Heritage take specific lead roles in flood risk management for towns and regional centres across the state.

The strategy has a separate implementation plan that prioritises the delivery of actions over the life of the strategy. The implementation plan also outlines responsibilities and timeframes for delivery, so that we can monitor the progress of the actions, assess the effectiveness of the strategy and identify areas where we need to adapt.

Not all actions will be commenced at once, and funding will be a key consideration in planning when and how the actions will be implemented. The regional water strategies will be a key tool in seeking funding as future opportunities arise.

The implementation plan sets out priorities over the next 3 years and is located at www.dpie.nsw.gov.au/border-rivers-regional-water-strategy

The implementation plan also identifies the key partners involved.

- NSW Government agencies will lead the implementation of actions that will develop and review policies and regulatory arrangements in consultation with the community. They will also undertake research, deliver regional programs and take action where there is a market failure or other need for government intervention.
- Local councils will be involved in actions that influence town water supply at the local level and will lead actions directly related to local level strategic planning.
- State owned corporations, such as WaterNSW, will be involved in actions that result in changes to the design, operation and management of major infrastructure and the way water is delivered in regulated rivers.
- Community and industry groups and research organisations will be engaged in the implementation process and may partner with different levels of government to progress or deliver certain actions.

We will report every year against actions in the implementation plan, so that the community can track our progress and we can demonstrate which actions have been delivered, or continue to be delivered, in that year.

**Figure 29. Regional water strategy process**

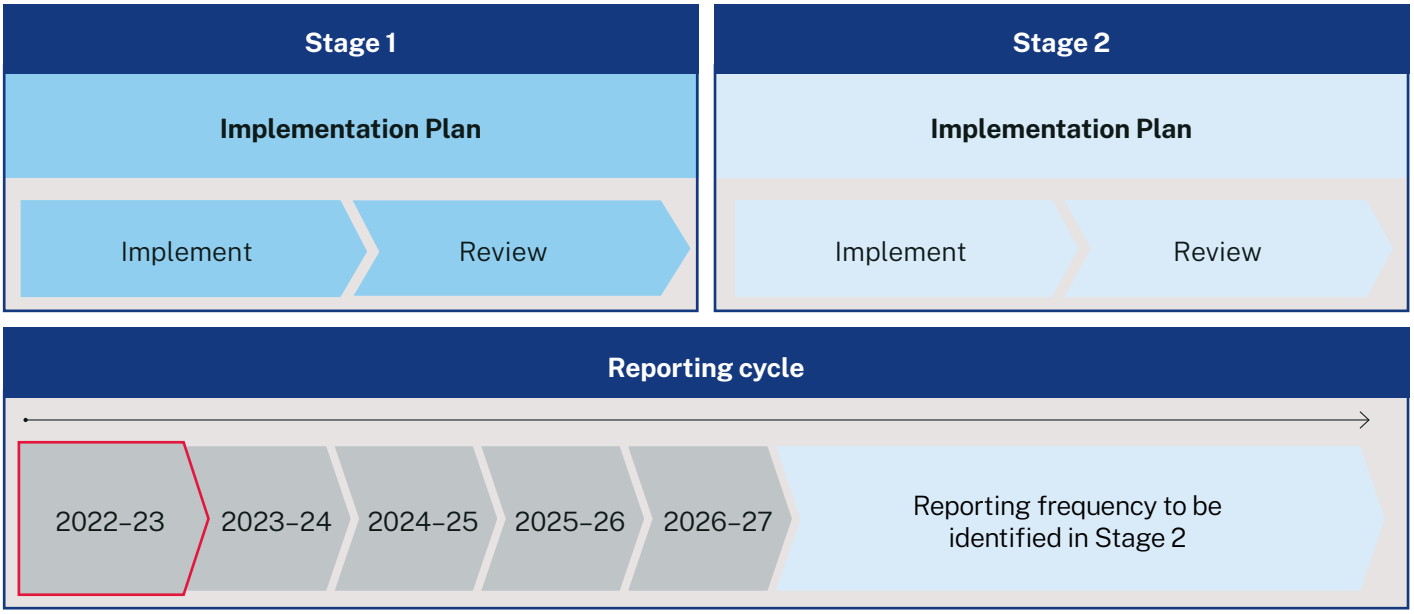



Image courtesy of Floodplain Harvesting Team, Department of Planning and Environment. Barwon River at Mungindi, NSW.

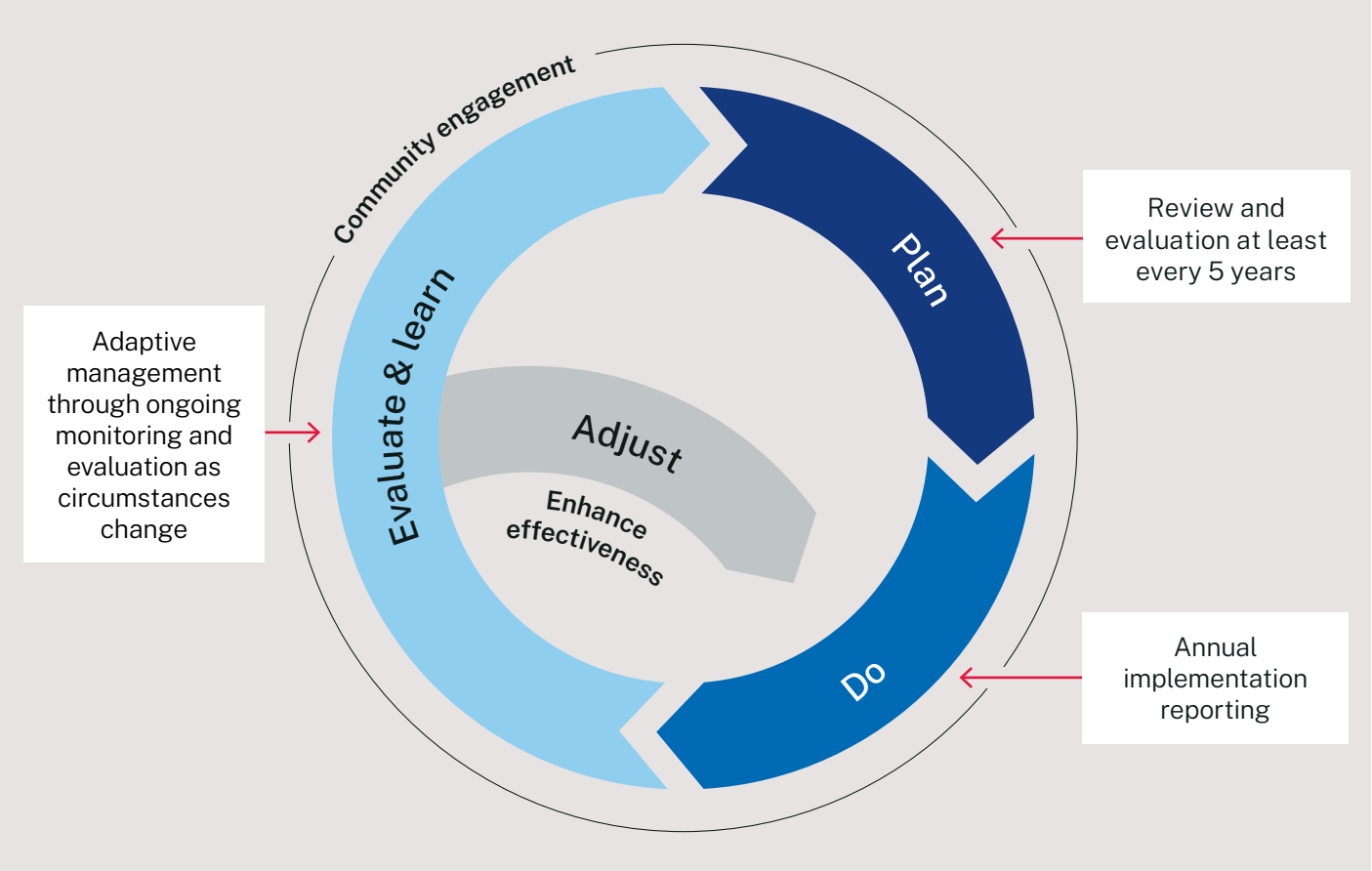
# Ongoing monitoring, adaptation and reporting

The Border Rivers Regional Water Strategy is designed to respond to changing circumstances. We will undertake a formal review of the strategy at least every 5 years, or in response to significant changing circumstances. The formal review will ensure that the key assumptions, such as population and demographics, have not significantly changed.

Amendments may also be made in response to key changes in water demand, social preferences, science and technology, economic conditions or other events, including how climate change assumptions and responses evolve. These amendments may result in a shift in priorities, and the implementation plan will be updated to reflect this.

We will report every year against actions in the implementation plan, so that the community can track our progress and we can demonstrate which actions have commenced, been delivered or progressed in that year.

**Figure 30. Regional water strategy process**



# Attachment 1

7

Image courtesy of Bron Powell, Department of Primary Industries – Fisheries.
Boobera Lagoon, NSW.

# Gomeroi and Kamilaroi water challenge statement

In 2021, the Gomeroi/Kamilaroi water committee developed the following water challenge statement.

## Aboriginal people have lost access to water and country

> We can't sing our song no more, we can't live on the river no more to look after her, for you all.' (Gomeroi)
>
> 'Yaama Nginda Gomeroi Wunnungulda. We are Gomeroi, we have our way of doing business. You have to be invited to sit around our fire. We share language and we engage together. You are asked to identify who you are and what you represent and be clear in your intent. Then, and only then can we do business together.'

Gomeroi and Kamilaroi people have occupied the Border Rivers Valley for at least 60,000 years. They have always been closely linked to rivers, groundwater, billabongs and wetlands, and this relationship is essential to culture, community and connection to Country.

The historical dispossession of land and the effect of colonial era settler laws continue to impact Aboriginal people's rights and access to water. Since European settlement, large areas of land have been converted to private property, and Aboriginal people forced onto Missions and Reserves. Private land, fences and locked gates prevent Gomeroi and Kamilaroi people from accessing country and water, carrying out cultural practices and using traditional knowledge to care for and manage waterways. Access to waterways and springs is critical to providing a purpose and pathway for young people to learn and connect to culture and provide a space for healing, as well as for food, medicine and teaching.

We heard during consultation that access to waterways is critical to providing a purpose and pathway for young people to connect to culture and provide a space for healing, as well as for food, medicine and teaching.

In addition, access water entitlements now require Gomeroi and Kamilaroi people to buy it from the fully or overallocated market.

We know from consultation undertaken regionally and for the NSW Water Strategy that there is strong community support for Aboriginal water rights and access, with the small amount of water in Aboriginal ownership frequently identified as a key area for improvement.

Department of Planning and Environment