



Draft Regional Water Strategy

Border Rivers: Strategy

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The NSW Government acknowledges Aboriginal people as Australia's first people practicing the oldest living culture on earth and as the Traditional Owners and Custodians of the lands and waters.

We acknowledge that the people of the Bigambul, Githabul, Kambuwal, Gomeroi/Kamilaroi/Gamilaroi/Gamilaraay, Kwiambul and Ngarabal Nations hold a significant connection to the lands in which the Border Rivers Regional Water Strategy falls upon. Please note, throughout this document we will refer to Gomeroi/Kamilaroi/Gamilaroi/Gamilaraay as Gomeroi Nation as per consistency with Native Title.

The Border Rivers Region holds areas of great spiritual, cultural and economic importance to Aboriginal people and the NSW Government recognises the connection of the water to the people of these nations.

We recognise the intrinsic connection of Traditional Owners to Country and acknowledge their contribution to the management of the Border Rivers Regional Water Strategy area landscape and natural resources.

Department of Planning, Industry and Environment understands the need for consultation and inclusion of Traditional Owner knowledge, values and uses in water quality planning to ensure we are working towards equality in objectives and outcomes.

Department of Planning, Industry and Environment is committed to continue future relationships and building strong partnerships with Aboriginal people. Due to COVID-19, face-to-face engagement with Aboriginal communities has been put on hold. We are committed to engaging with the Elders, representatives of the Bigambul, Githabul, Kambuwal, Gomeroi, Kwiambul and Ngarabal Nations and Aboriginal community members about the regional water strategy in late 2020.

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Minister's foreword



The NSW Government made a commitment before the last election to undertake comprehensive modelling that would enhance the management of water, to improve water security and better prepare our communities for future droughts.

Water is our most precious resource—for our towns, industries and maintaining our natural and cultural assets.

Our water management and understanding has improved considerably in recent times—if you can't measure it, you can't manage it.

Communities have participated in tough decisions that have returned just over 1000 gigalitres to natural river flows in the past decade through the Murray-Darling Basin.

The knowledge we have garnered in the development of these strategies will underpin future investments through a better understanding of optimum water management.

Engaging with our Aboriginal communities is vital given water is an essential part of their connection to Country and culture, and their cultural water holdings will be vital to creating local jobs into the future. While COVID-19 has impacted our ability to engage with Aboriginal communities in a culturally appropriate way, we are committed to including their voices in the Border Rivers Regional Water Strategy.

I appreciate the engagement by local government in the development of the draft strategies. Their continued partnership is very important to ensure the strategies respond to the needs of catchments that may extend across many local government boundaries.

Australia is no stranger to extremes; we have always had to manage our water resources through floods and prolonged droughts.

In preparing these strategies, we've engaged leading academics at a number of universities. The paleoclimate-informed

rainfall and evaporation modelling was largely undertaken by the University of Newcastle and the University of Adelaide to help understand and mitigate risk in the most extreme circumstances.

The climate modelling in this draft strategy is based on a deliberately conservative scenario which is intended to ‘pressure test’ the effectiveness of these strategies in a worst-case scenario. They do not account for changes in how we operate the system moving forward, where in reality we will respond actively to ongoing drought conditions to prolong the availability of water for critical human needs.

These climate scenarios will not necessarily eventuate, but they give us an idea of the possible climate risks and allow us to begin planning to mitigate these risks if they arise.

The recent drought has taught us a great deal about managing our water resources and we need to put these lessons to good use in preparing for future extreme weather events.

In short, the better evidence and information we now have means we can better plan for the future to ensure this precious shared resource is managed to sustain regional lifestyles, create jobs, support industry and protect our precious natural environment.

There is no one size fits all policy to manage water in our regions, and I encourage all stakeholders to take part in giving us your views on how to improve these draft strategies to ensure our water management policies support the future of NSW.



Melinda Pavey
Minister for Water,
Property and Housing



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Snapshot

The Border Rivers region



32,000
population



24,500
km² area



**Bigambul, Githabul,
Kambuwal, Gomeri,
Kwiambal, and
Ngarabal Nations**



Regional centre:
Inverell



Key towns include:
Glen Innes, Tenterfield,
Goondiwindi (QLD),
Boggabilla, Mungindi
and Ashford



Major water storage:
Pindari Dam (NSW) and
Glenlyon Dam (QLD)



Main rivers:
Dumaresq River, Macintyre River and Severn River



Key environmental assets:
Boobera Lagoon, wetlands in Kwiambal
National Park and lagoons in Lower
Macintyre River

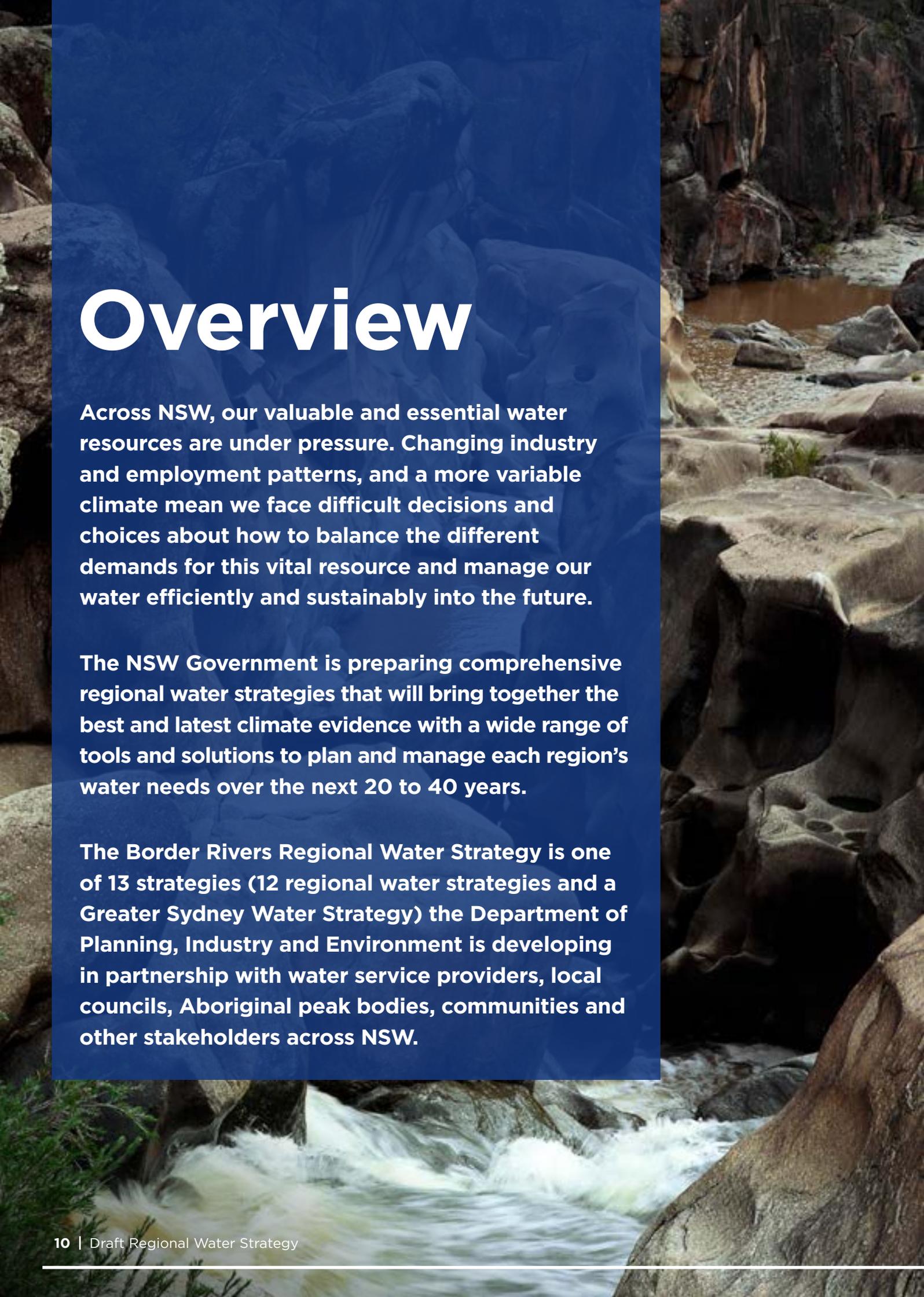


Groundwater sources:
Alluvial sources, Great Artesian Basin,
Inverell Basalt and New England Fold Belt

Gross Regional Product: **\$1.6 billion**







Overview

Across NSW, our valuable and essential water resources are under pressure. Changing industry and employment patterns, and a more variable climate mean we face difficult decisions and choices about how to balance the different demands for this vital resource and manage our water efficiently and sustainably into the future.

The NSW Government is preparing comprehensive regional water strategies that will bring together the best and latest climate evidence with a wide range of tools and solutions to plan and manage each region's water needs over the next 20 to 40 years.

The Border Rivers Regional Water Strategy is one of 13 strategies (12 regional water strategies and a Greater Sydney Water Strategy) the Department of Planning, Industry and Environment is developing in partnership with water service providers, local councils, Aboriginal peak bodies, communities and other stakeholders across NSW.

The Border Rivers region

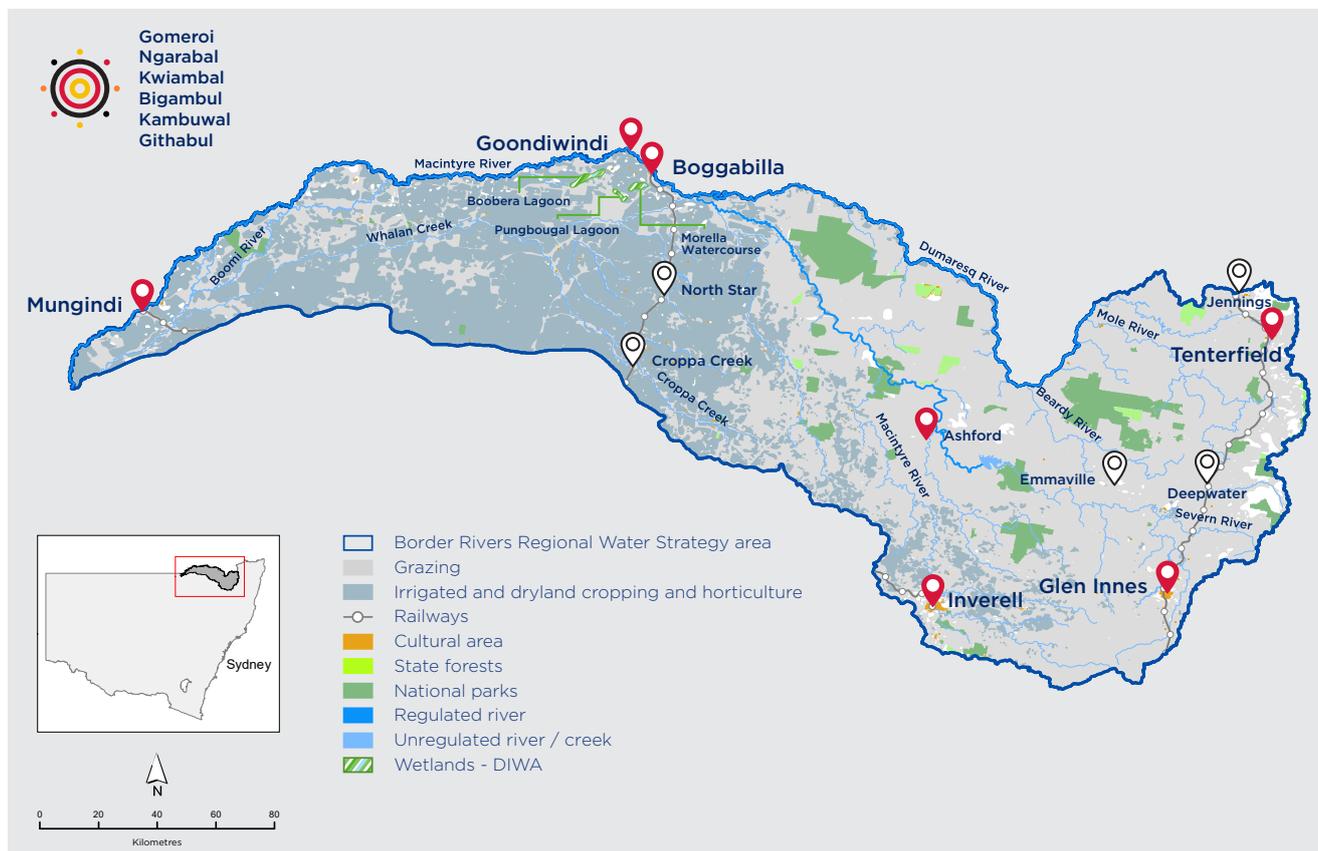
The Border Rivers region (Figure 1) is located in northern NSW, bound by the Queensland border to the north and west, the western slopes of the Great Dividing Range to the east, and the Gwydir catchment to the south. The Border Rivers catchment is located within both NSW and Queensland, with the NSW portion covering 24,500 km², or just under half of the total catchment area. The region is located within the traditional lands of the Bigambul, Githabul, Kambuwal, Gomeroi, Kwiambal, and Ngarabal Nations.

The region's population is around 32,000. Inverell, with 11,660 people, is the largest town and an important employment and services hub for outlying areas. Other key towns in the region include Glen Innes, Tenterfield, Boggabilla, Ashford and Mungindi. Goondiwindi and Stanthorpe are also important regional towns in the Queensland part of the Borders Rivers catchment.

The region is home to the nationally significant Morella Watercourse, Boobera Lagoon and Pungbougul Lagoon, which are located on the Macintyre River floodplain. They are some of the few permanent waterbodies in the northern Murray-Darling Basin.

The Border Rivers region supports various industries, with the most significant economic contribution coming from the agricultural industry, including irrigated agriculture, grazing, food processing, broadacre and small-scale cropping. Tourism also contributes to the regional economy and is expected to continue to expand, as are enabling industries such as transport, freight and logistics. Service industries such as health and education are also growing in importance. The Inland Rail Project and upgrades to the New England and Gwydir Highways is likely to encourage further industry development and regional growth.

Figure 1. Map of the Border Rivers region



Water in the Border Rivers region

Water is a significant feature of the Border Rivers region's environment, with its interconnected systems of rivers, creeks, groundwater aquifers and wetlands. The catchment is part of the Murray-Darling Basin and the water resources of the Border Rivers are shared between NSW and Queensland. Water supports the region's population and its liveability, protects and conserves ecological assets and Aboriginal cultural heritage, and underpins key industries and local employment.

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 to underpin businesses and deliver water to important environmental assets along the river.

Water quality and delivery issues can impact water supply availability in the region. Blue-green algae in the region's major dams can pose health risks and necessitate water being released from lower levels, which can lead to cold water pollution.

Delivering water to the end of the system is a challenge in extreme droughts. Releases from the dams are carefully managed to conserve water for critical human needs with several towns, such as Boggabilla, reliant upon surface water. In the past we were only able to deliver water up to a certain distance on the river (Boggabilla in the recent drought). However, this can impact the environment, communities and Aboriginal cultural needs that rely on flowing rivers.

Since 2017, the region has been experiencing widespread drought conditions. As of September 2020, the combined storage capacity of the region's Pindari and Glenlyon dams was only 17%. These conditions place the region's water resources—and the communities, industries and ecosystems that rely on them—under considerable stress. The drought reinforces the Border Rivers region economy's reliance on access to water and the recognition that water in rural landscapes contributes to mental wellbeing and community cohesion.

Despite these challenges, no towns ran out of water and allocations for towns and domestic users were 100% for the 2019/20 water year. This was due to concerted efforts by the community and government to reduce demand for water, conserve remaining supplies for critical human needs and establish alternative back up sources of groundwater.

Many councils in the region have aspirations for growing and diversifying the economy. A more diversified economy can help manage the shocks from droughts.

The Border Rivers region also plays a crucial role in providing water for critical human and environmental needs downstream, contributing 19% of the Barwon-Darling river flows at Menindee Lakes on average over the long term.

Floodplain harvesting is a significant feature in the Border Rivers region. More than one third of all surface water taken comes from water diverted from the floodplain. Significant growth in floodplain harvesting infrastructure over the last 20 years has meant that the amount of surface water now being taken is estimated to be greater than the limit set under the water sharing plans. Licensing and managing floodplain harvesting within legal limits will provide business security and certainty while aiming to maintain downstream environmental and cultural outcomes.

Private on-farm water storages scattered across the region are used to store water from floodplains in addition to rainfall runoff. These storages help to buffer the region from annual rainfall variability and periods of reduced supply from Pindari and Glenlyon dams. For example, after a flood event, the water captured is often used to support the following growing season, however these storages suffer high evaporative losses.

We have heard in other consultation processes and in regions across the state that Aboriginal people 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. Aboriginal people seek more opportunities to manage water using their cultural knowledge and to create improved economic opportunities and environmental outcomes.

Engagement with Aboriginal people has been impacted by COVID-19. The Department of Planning, Industry and Environment is committed to engaging with Aboriginal Elders, Nation representatives and community members between now and the final strategy.

Definitions

We are using the following definitions in the regional water strategies:

Water security in the context of regional water strategies refers to the acceptable chance of not having town water supplies fail. This requires community and government to have a shared understanding of what is a 'fail event' (for example, no drinking water or unacceptable water quality) and the level of acceptability they will pay for.

Water reliability refers to how often an outcome is achieved. It is often considered to be the likelihood, in percentage of years, of receiving full water allocations by the end of a water year for a licence category.

For example, a 60% reliability means that in 60% of years a licence holder can expect to receive 100% of their licensed entitlement by the end of the water year. Other measures of volumetric reliability could also be used. For example, the percentage allocation a licence holder could expect to receive at a particular time of the year as a long-term average. Reliability may also refer to how often an acceptable water quality is available. A reliable water supply gives some clarity to water users and helps them plan to meet their water needs.

Resilient regional centres means water users are able to withstand extreme events, such as drought and flood, and/or adapt and respond to changes caused by extreme events.

Future climate risks

The NSW Government has invested in new climate datasets and improved modelling that provide a more sophisticated understanding of historic climate variability in the Border Rivers region, as well as likely future climate risks. This means that we have moved from making decisions that are based largely on single 'worst-case' scenarios to a much more comprehensive understanding of natural variability and potential extreme events.

We can now better predict and plan for plausible future climate scenarios (such as the likely frequency, duration and severity of extended droughts), better understand the climate risks faced by water users and the environment across NSW and better manage our water resources over the medium and long-term to mitigate these risks.

This new information is the basis for preparing robust new water strategies for our regions and also offers fresh evidence for examining our existing water policies, operational rules and management plans.

The new climate data and updated hydrological modelling developed for this draft regional water strategy suggest that the Border Rivers region will continue to experience extended periods that are dominated by wet and

dry conditions. Under a worst-case climate change scenario:

- there could be a shift in rainfall seasonality, with lower rainfall in winter and higher rainfall in late summer
- there could be an increased probability of the most recent drought reoccurring
- dams in the region could fall to low levels more frequently, but they are unlikely to reach empty
- potential reductions in the volume of water flowing in the region each year, with a higher number of, and longer cease-to-flow events as well as declining flows from the Border Rivers region to the Barwon-Darling River system
- less frequent, but higher magnitude large flow events.

These changes will be coupled with higher average temperatures in the near and long-term. It also means that our rivers and creeks may not flow as regularly as they do now. Droughts that occur in closer succession and hotter, drier conditions may mean catchments require higher rainfall to generate runoff into rivers and creeks.

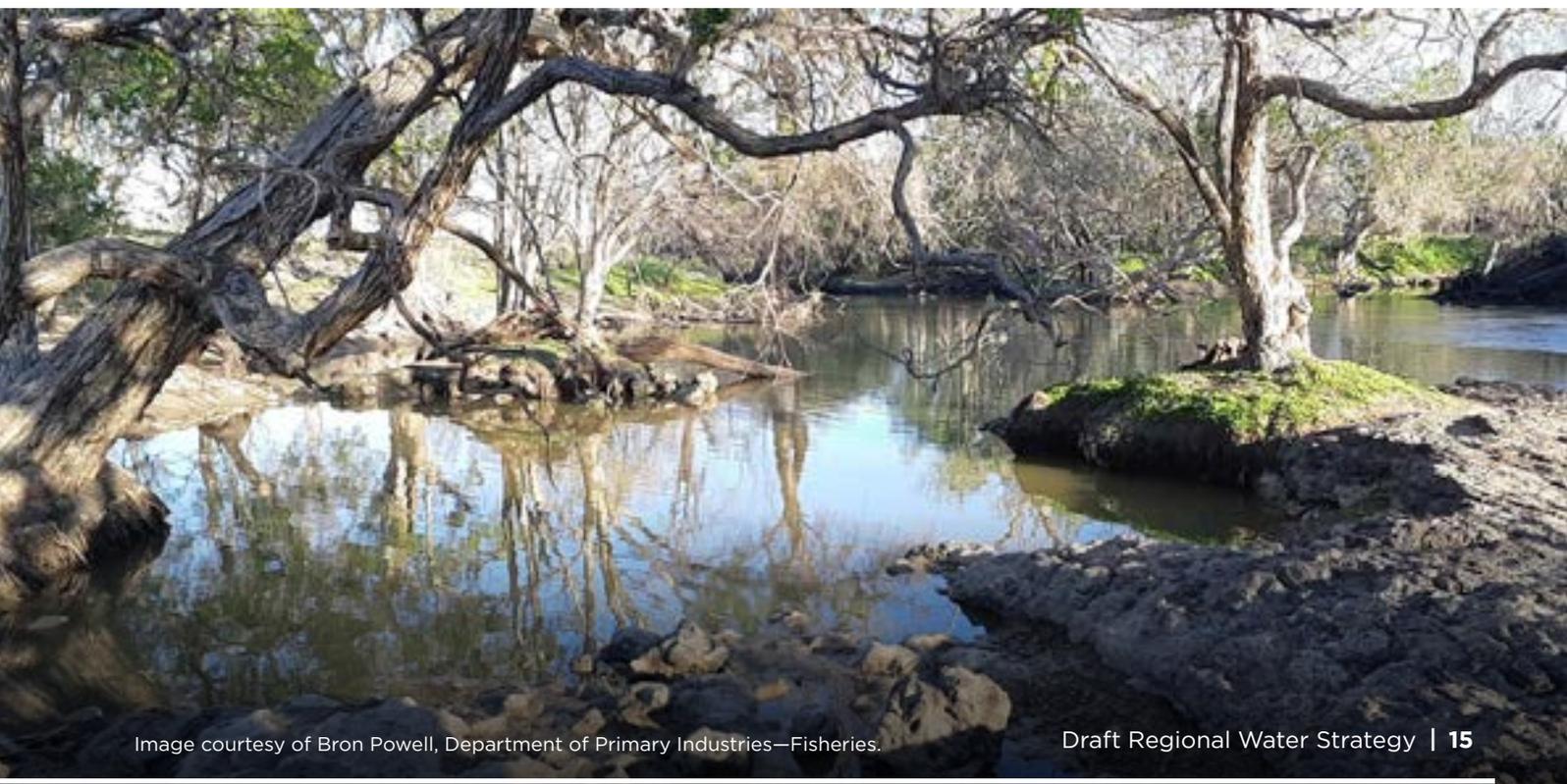
Making choices for the future

Like most regions across Australia, the Border Rivers region faces choices and challenges in balancing different water uses as climatic conditions change. However, the region's communities and primary producers have adjusted to variable annual rainfall and river flows, and past droughts have led to government and industry investment in private and public water storages, groundwater bores and water use efficiency improvements. This has strengthened the Border Rivers region's ability to deal with greater climate variability and tackle future challenges, which include:

- providing reliable and safe water supplies for small towns and Aboriginal communities that rely mainly on unregulated rivers and creeks
- maintaining domestic water availability during extended dry periods for the region's population who source their drinking and domestic water from unregulated rivers, groundwater aquifers, farm dams and rainwater tanks

- sustaining and improving productivity in the region's agricultural industries
- regulating floodplain harvesting and making sure that adequate water reaches downstream users and is available for the environment
- improving waterway connectivity with the Barwon-Darling River system.

To meet these challenges, the types of industries suited to different parts of the region may need to be reconsidered, and we may need to make better use of technology to reduce water demand and use water more efficiently and/or more productively in agriculture and other important industries. We also need to find ways to better manage groundwater and make more use of recycled wastewater and stormwater.



A new, comprehensive water strategy for the Border Rivers region

The Border Rivers Regional Water Strategy will guide how we address future water resource challenges, make the right policy and infrastructure choices and open up new opportunities for the region.

The strategy will bring together all the tools we have—policy, planning, regulatory, educational, technology and infrastructure solutions—in an integrated package that is based on the best evidence, responds to the region’s water needs and delivers the right amount of water for the right purpose at the right times.

The strategy will aim to provide choices to better use, share, store and deliver water to ride the highs and lows of water availability. It will cover the whole Border Rivers region and all water types, and it will change how we manage water in the future.

In line with the objectives we have set for all regional water strategies, the Border Rivers strategy has a strong focus on working closely with communities to provide healthy, reliable and resilient water resources that:

- deliver and manage water for local communities
- enable economic prosperity
- recognise and protect Aboriginal water rights, interests and access to water
- protect and enhance the environment
- are affordable.

The final strategy will set out clear and accountable actions for the NSW Government, local councils and industries to tackle the challenges facing the Border Rivers region and maximise opportunities arising from the growing agricultural sector, other emerging and expanding industries, and new investments in transport and community infrastructure.

To reinforce the significant water reform program undertaken by the NSW Government over the last three years, the final strategy will also help to improve the sequencing and integration of these reforms across the Border Rivers region to ensure they are implemented effectively.

The Department of Planning, Industry and Environment will develop an implementation plan that identifies actions and timeframes.

Our vision for the strategy

Our vision for the Border Rivers Regional Water Strategy 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 available for people, Aboriginal communities, towns, industries and the environment.

The options

A long list of potential options is presented as part of this draft strategy.

These options build on the NSW Government's current and planned investment in water infrastructure in the region, including the preparation of a detailed business case for a new dam on the Mole River. They also complement and build on state-wide reforms to introduce non-urban water metering, improve compliance with water sharing rules and bring floodplain harvesting into the licensing system.

Infrastructure options identified through the strategy will also benefit from the NSW Government's move to streamline the approvals process for drought-related projects. Other options, such as policy solutions, would be designed in partnership with communities.

To identify and develop appropriate options for the draft strategy, we have drawn from a range of sources including previous studies, community engagement, experiences in the Millennium Drought and existing government programs. We have aligned our approach with regional development and land use strategies to ensure that all options can be integrated and sequenced with state-wide and local plans.

The options cover actions, projects, reforms and investments that focus on:

- **maintaining and diversifying water supplies**, including the final business case for building a new dam on the Mole River, increasing the capacity of existing storages, new pipelines and using groundwater sustainably as an alternate source where possible
- **protecting and enhancing natural systems**, including better protection for native and threatened aquatic species, the removal of floodplain structures that impede the delivery of water to priority ecological assets, water quality improvements and improved protection and use of water for the environment
- **supporting water use and delivery efficiency and conservation**, including water efficiency measures, re-use and recycling projects, and water market reviews
- **strengthening community preparedness for climate extremes**, such as reviewing drought operation rules and allocation processes, sustainable management of groundwater resources and improving data collection and education programs
- **improving the recognition of Aboriginal people's water rights, interests and access to water**, such as reviewing cultural water access licences and ensuring greater involvement of Aboriginal people in water management.

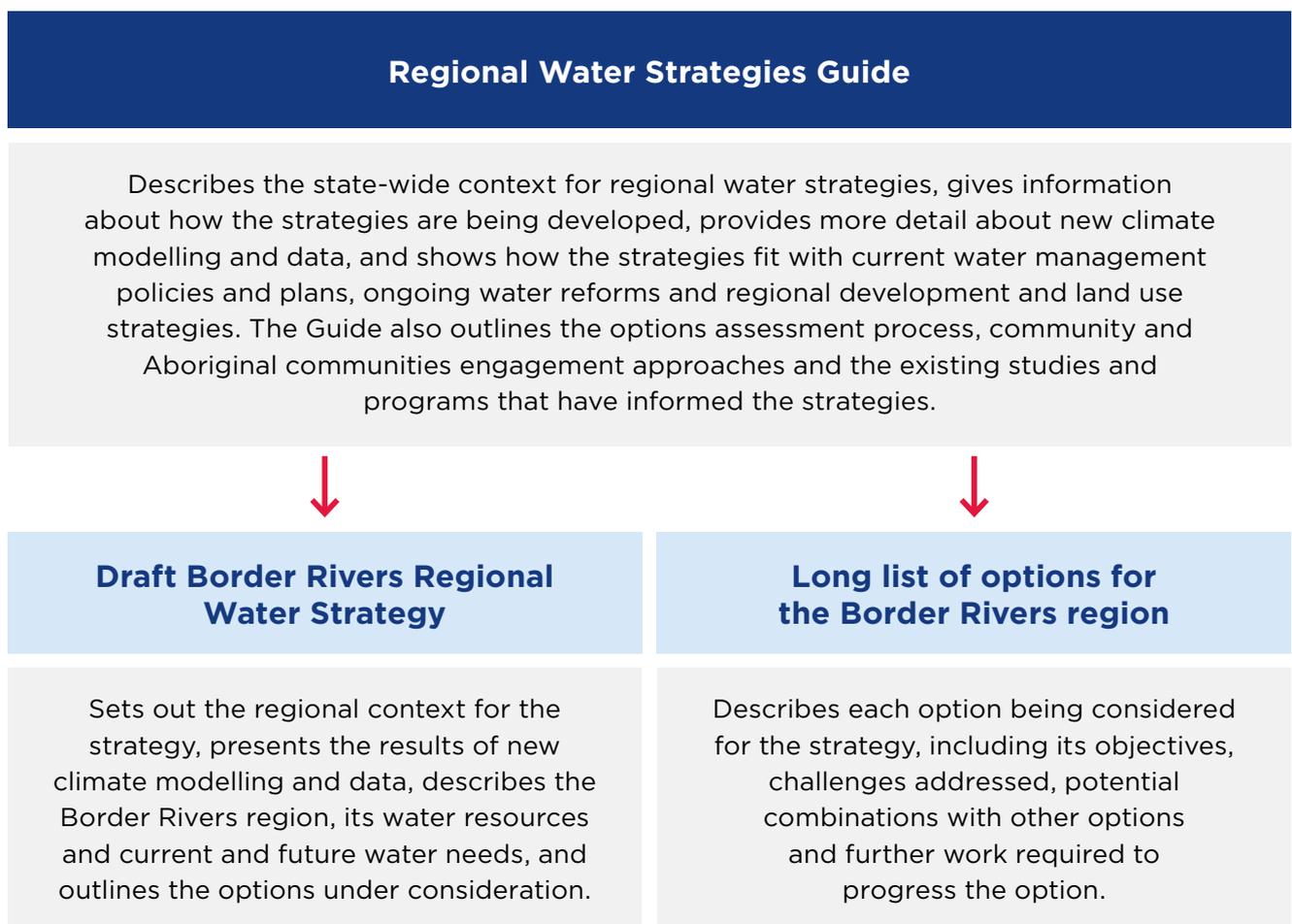
This strategy considers how government and local water utilities can adopt a more integrated approach to managing surface water and groundwater. It also acknowledges that connectivity and end of system flows are important for Aboriginal people, communities and the environment.

Many of the options are interrelated. This means that to get the most benefit out of these options—and make the best use of the region’s water resources—they may need to be combined into portfolios.

Not all options will be progressed, and many have not been costed. Following feedback on the draft strategy, we will conduct an evidence-based assessment to identify the best actions for the Border Rivers region. These will form the final, comprehensive Border Rivers Regional Water Strategy.

The Draft Border Rivers Regional Water Strategy is accompanied by a more detailed description of the long list of options and an overarching explanatory guide that outlines the broader context for the development of regional water strategies across NSW (Figure 2).

Figure 2. Draft Border Rivers Regional Water Strategy





LAD



Chapter 1

Context

Snapshot

We are preparing comprehensive regional water strategies across NSW, bringing together the best and latest climate evidence with a wide range of tools and solutions to plan and manage each region's water needs over the next 20 to 40 years.

- The strategies will aim to understand how much water a region will need to meet future demand, identify the challenges and choices involved in meeting needs and set out the actions we can take to manage risks to water security and reliability.
- Through better strategic planning the NSW Government aims to support safe and secure water for towns and communities, support regional industries, boost economic prosperity and safeguard and enhance the environment. The strategies will also recognise and protect Aboriginal rights, interests and access to water.
- The Border Rivers Regional Water Strategy is one of 13 strategies (12 regional water strategies and a Greater Sydney Water Strategy) the Department of Planning, Industry and Environment is developing in partnership with water service providers, local councils and Aboriginal peak bodies. The final strategies will also be informed by communities and other stakeholders across NSW.

New climate data and modelling, plans, studies and investments have also influenced the direction of the Border Rivers Regional Water Strategy.

- A significant amount of work since the Millennium Drought has improved our understanding of the risks affecting water resource management in the Border Rivers region. Community engagement over the last few years has also given insights into the best way to prepare for future droughts and floods in the region.
- The NSW Government has invested in new climate datasets and improved modelling to provide a more robust and sophisticated understanding of future risks to water availability in the Border Rivers region.
- The regional water strategies will build on existing NSW Government commitments to improve water security, resilience and reliability across regional NSW, including investment in water infrastructure, a range of state-wide water reforms and a new streamlined approval process for drought-related projects.
- The strategy also aligns with existing policies and plans that are improving the management of water resources across NSW, as well as being integrated with strategic and local land use planning.

1.1 Purpose of regional water strategies

Regional water strategies bring together the most up-to-date information and evidence with a wide range of tools and solutions to plan and manage a region’s medium and long-term water needs.

The strategies look out over the next 20 to 40 years and determine the challenges and choices involved in meeting the region’s future water needs and the actions we can take to manage risks to water availability and secure healthier, more resilient water sources.

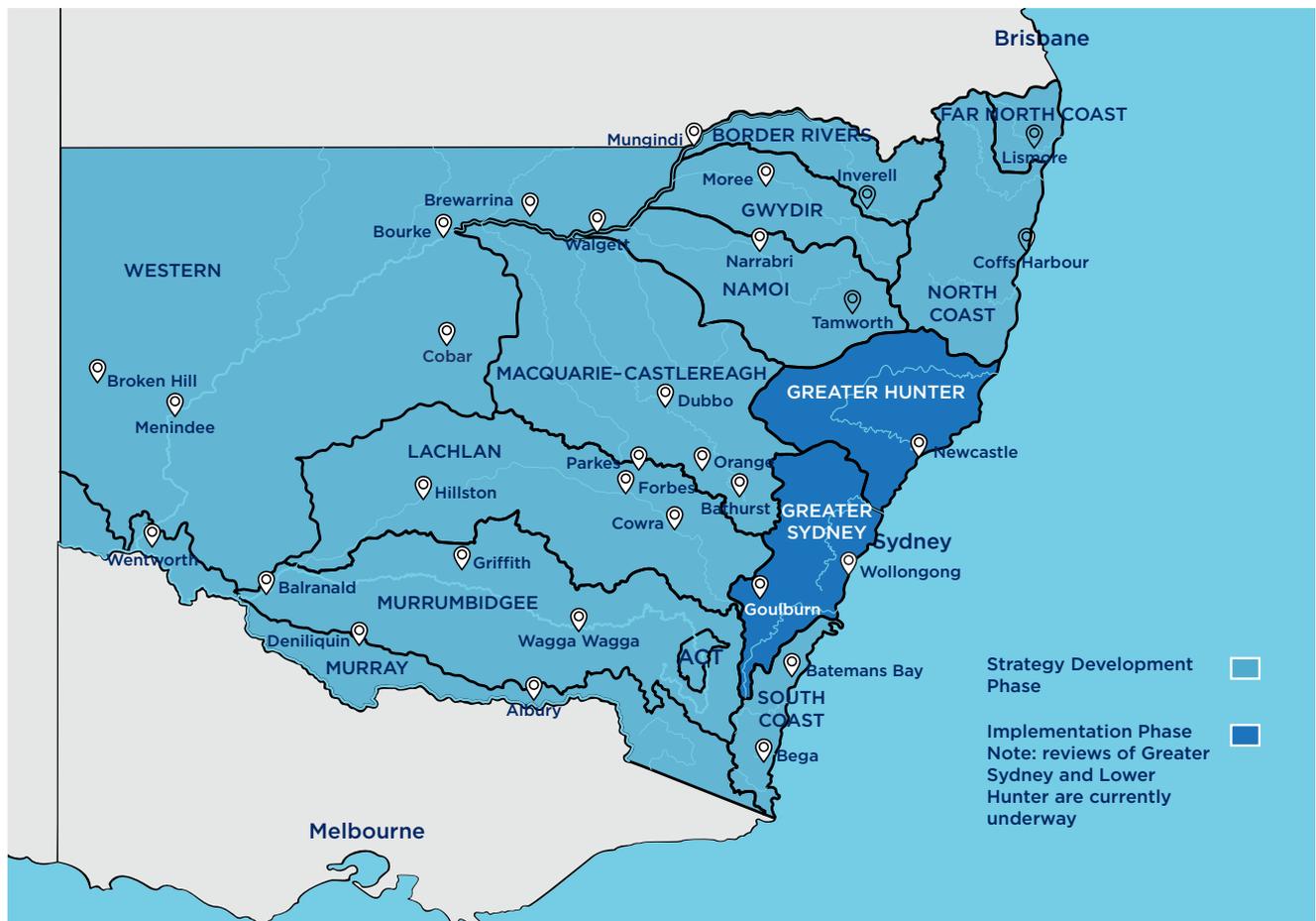
The strategies also explore new solutions to tackling these issues with the potential to add value to the way we manage water, generate greater community-wide and environmental

benefits and create new economic opportunities for each region.

With improved strategic planning around water, the NSW Government aims to achieve more resilient water resources for towns, communities, industries, Aboriginal people and the environment.

The Border Rivers Regional Water Strategy is one of 13 strategies (12 regional water strategies and a Greater Sydney Water Strategy) the Department of Planning, Industry and Environment is developing in partnership with water service providers, local councils, Aboriginal peak bodies, communities and other stakeholders across NSW (Figure 3).

Figure 3. Map of NSW regional water strategy regions





1.2 Objectives of regional water strategies

Regional water strategies will set out a long-term ‘roadmap’ of actions to deliver five key objectives (Figure 4). Options selected for inclusion in the final strategy for each region

will need to address at least one of these objectives. Our aim is for each strategy to have a comprehensive, balanced package of options that delivers on all the objectives.

Figure 4. NSW regional water strategies: objectives



During extreme events, such as drought, our focus is on securing water for critical human needs. In these cases, 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.

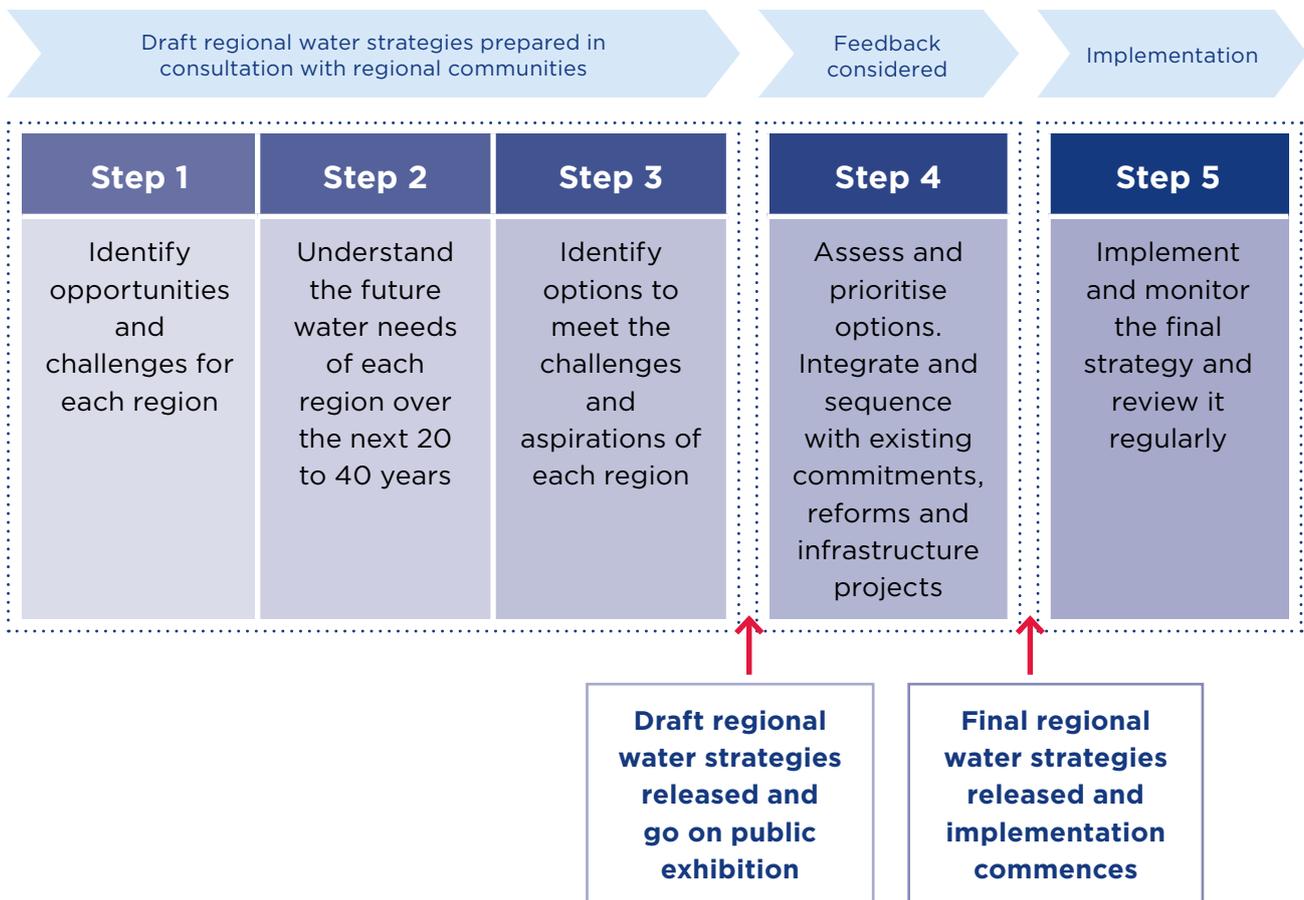
It is also important to note that when formulating water sharing plans, the NSW Government must take all reasonable steps to

prioritise the protection of the water sources and their dependent ecosystems.¹

Through the regional water strategies, we aim to better manage these extreme events for all water users in the future.

The NSW Government is taking a five-step approach to preparing and implementing regional water strategies, as shown in Figure 5 below.

Figure 5. Five step approach to NSW regional water strategies



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

1.3 What has informed the draft regional water strategies?

To ensure we are using the best evidence and most recent data, and fully consider ideas and options from each region, we have used a wide range of sources to inform each strategy.

1.3.1 Improved climate modelling and data

Until now, water management in NSW has been based on historical data and observations going back to the 1890s. This has provided a limited understanding of extreme events. The NSW Government has invested in new climate datasets and modelling to develop a more sophisticated depiction of past and future climatic conditions. These improved datasets integrate recorded historical data with paleoclimate data (data reconstructed from before instrumental records began, using sources such as tree rings, cave deposits and coral growth) to give a modelling tool that generates 10,000 years of synthetic climate data. When combined with other sources of climate data (such as climate change projections), this has helped us to better understand natural climate variability, including the probability of wet and dry periods in each region, and estimate risks to future water availability.

This improved modelling means that we may be able to move from making decisions based heavily on single ‘worst-case’ scenarios drawn from a short climatic record to a much more accurate understanding of the length and frequency of past wet and dry periods.

We can now better understand the probability of future climate characteristics—such as the frequency, length and distribution of droughts in each region—and also better understand how to mitigate these risks and assess the possible benefits of medium and long-term solutions.

This new method is an important advance on previous climate datasets and models. Through this work, we can now assess the impact of changes in flows and water security over a much wider range of climatic conditions than if we had only considered the observed historical records.

This updated climate information has been used in developing the draft regional water strategies and will help to assess and compare the effectiveness of the draft options included in each strategy. It will also support all water users in making more informed decisions and better planning and preparing for climate risks.²

Chapter 2 sets out the results from analysis of the new climate data for the Border Rivers region. We will continue to use the best and latest evidence about the future climate to develop solutions to address the challenges associated with protecting and enhancing environmental assets, regional towns and industries in a more variable climate and during extreme events.

Ongoing analysis will yield more specific and robust results, giving an updated understanding of risks to town water supply, irrigation and environmental water security in the Border Rivers region. The final Border Rivers Regional Water Strategy will use this new data to identify the best ways to share, manage and use water to manage these risks.

2. More information about these new climate datasets and how they are being used in our river system models is provided in the *Regional Water Strategies Guide*.

1.3.2 Existing studies

A significant amount of work has been undertaken to understand the risks affecting water resource management in regional NSW. Development of the Draft Border Rivers Regional Water Strategy and the long list of options identified for the region has been informed by catchment and water security studies, water allocation and drought planning, and regional development, infrastructure and environmental strategies prepared by a range of NSW Government departments and agencies.³

The strategy has also been informed by:

- WaterNSW's Mole River Dam Feasibility Study funded by the National Water Initiative Development Fund (NWIDF) and 20 Year Infrastructure Options Study for Rural Valleys
- the Department of Planning, Industry and Environment's Border Rivers Long Term Water Plan and NSW Border Rivers catchment Annual Environmental Watering Priorities 2019/20
- the Dumaresq-Barwon Border Rivers Commission's annual reports
- the Northern Inland Catchments Bioregional Assessment by the Australian Government Department of the Environment, Bureau of Meteorology, CSIRO and Geoscience Australia

- the independent review of the Northern Murray-Darling Basin First Flush Assessment to provide advice on how to improve management.

We have also taken into account the documentation developed to meet NSW's obligations under the Murray-Darling Basin Plan.

The Australian Government requested an independent panel undertake an assessment of social and economic conditions in communities across the Murray-Darling Basin. The expert panel's final report was released in September 2020.⁴

In August 2019, the Australian Government also announced that it would direct the Australian Competition and Consumer Commission to conduct an inquiry into markets for tradeable water rights in the Murray-Darling Basin. The Australian Competition and Consumer Commission was asked to recommend options to enhance markets for tradeable water rights, including options to enhance their operations, transparency, regulation, competitiveness and efficiency. An interim report was released in July 2020 and a final report to the Federal Treasurer is due in February 2021.⁵

These investigations will be important sources of information as we assess options for the final Border Rivers Regional Water Strategy.

3. More information about this work is provided in the *Regional Water Strategies Guide*.

4. Murray-Darling Basin Authority 2019, *Independent assessment of social and economic conditions in the Basin*, www.mdba.gov.au/publications/independent-reports/independent-assessment-social-economic-conditions-basin

5. Australian Competition and Consumer Commission 2019, *Murray-Darling Basin water markets inquiry*, www.accc.gov.au/focus-areas/inquiries-ongoing/murray-darling-basin-water-markets-inquiry

1.3.3 Community engagement

Over the last few years, the NSW Government has been consulting on water sharing plans, floodplain harvesting, water resource plans, metering reforms, environmental water management and drought. Through these processes, we have heard many ideas about how to be better prepared for future droughts and floods and a more variable climate.

We have also been talking with local councils about their thoughts on what the Border

Rivers Regional Water Strategy could cover. Further information about these discussions is in Attachment 1. Due to COVID-19, face-to-face engagement with Aboriginal communities has been put on hold. We will begin engaging with regional Aboriginal communities in late 2020 and continue this engagement as we progress through the options assessment process and final strategy preparation, and as we develop the NSW State Water Strategy.

What local councils and other groups have told us so far:

- The impact of bushfires and drought on water demand and water quality in the upper catchment has been significant. The strategy needs to consider options to meet additional demands for town water supplies during drought. These options need to include communities outside of reticulated water supply systems and for fighting bushfires.
- Councils are looking at additional sources of water and have increased their use of groundwater as an alternate supply during droughts.
- Economic growth will need water. The region has aspirations for growth in horticulture, including nut production and feedlots in the upper catchment, that will require significant and secure water. The inland rail link may increase or change water demand in the lower catchment if it leads to shifts in the types of agricultural industries.
- The proposed Mole River Dam could help to provide increased security in the upper catchment, and there is community support for an inland diversion scheme.
- Groundwater provides security in the lower catchment although in some areas such as the Great Artesian Basin Eastern Recharge groundwater levels have been declining due to pumping.
- We need to leave enough water in our rivers to allow ecosystems to recover between extreme events such as droughts and bushfires.
- We need to start planning for the next drought now.
- There is a long way to go in getting community acceptance for water recycling and reuse. This should be led at a state-wide level.

These early insights have been considered in developing this draft strategy.



1.4 Building on existing commitments and reforms

The NSW Government has made significant commitments to address the risks associated with water reliability in regional NSW and to set our regions up for the future. This includes investigating dam upgrades, including undertaking a business case for a new dam on the Mole River, investing in water saving infrastructure and preparing for future droughts.

In the Border Rivers region, recent NSW Government funded water infrastructure projects include:

- Glen Innes—additional bores and construction of an off-stream storage
- Mungindi drought emergency—installation of a cooling tower for sourced groundwater
- Boggabilla—construction of the Toomelah pipeline
- Tenterfield—upgrade of Tenterfield Dam during 2017/18, additional groundwater supply and treatment, and replacement of the existing water treatment plant.

We are implementing a range of state-wide water reforms, including improving water and sewage services for Aboriginal communities, improving compliance and transparency around water use and access, and introducing robust new metering laws to make sure that most water taken in NSW is accurately measured and monitored.

We are improving how we protect environmental water in the NSW Northern Murray-Darling Basin by implementing ‘active management’ in some unregulated systems. Along with other states, we are implementing the Murray-Darling Basin Plan, which aims to rebalance water sharing between the environment and other water users. We continue to work with communities on the infrastructure and rule changes needed to implement the Basin Plan.

We have also streamlined the approvals process for drought and major dam projects through the *Water Supply (Critical Needs) Act 2019*.

We continue to work towards a state-wide Aboriginal water policy to better represent the interests of Aboriginal people in water management.

More information about these reforms is in the *Regional Water Strategies Guide*.

The Border Rivers Regional Water Strategy will build on these commitments and reforms, seek to enhance and leverage them where possible, and address any outstanding gaps.

Responding to drought

Up until August 2020, over **\$4.5 billion has been committed to the drought response in NSW**. This commitment to drought relief and water security is providing immediate support to farmers, families, towns and businesses impacted by drought:

- More than \$2 billion has been provided for a support package for primary producers, businesses and communities.
- With the Commonwealth, the NSW Government will deliver over \$1 billion in state significant dam projects, including a business case for the proposed Mole River Dam and upgrades of the Wyangala Dam and Dungowan Dam and pipeline.
- Since 2016, \$1.019 billion has been committed to 189 water projects, including building and upgrading water storages, pipelines and bores across regional NSW through programs like the \$1 billion Safe and Secure Water Program and the NSW drought response.





1.5 Policy and planning context

Each regional water strategy sits within a broader policy and planning context. This includes a range of policies and plans that guide the management of water resources in NSW (Figure 6).

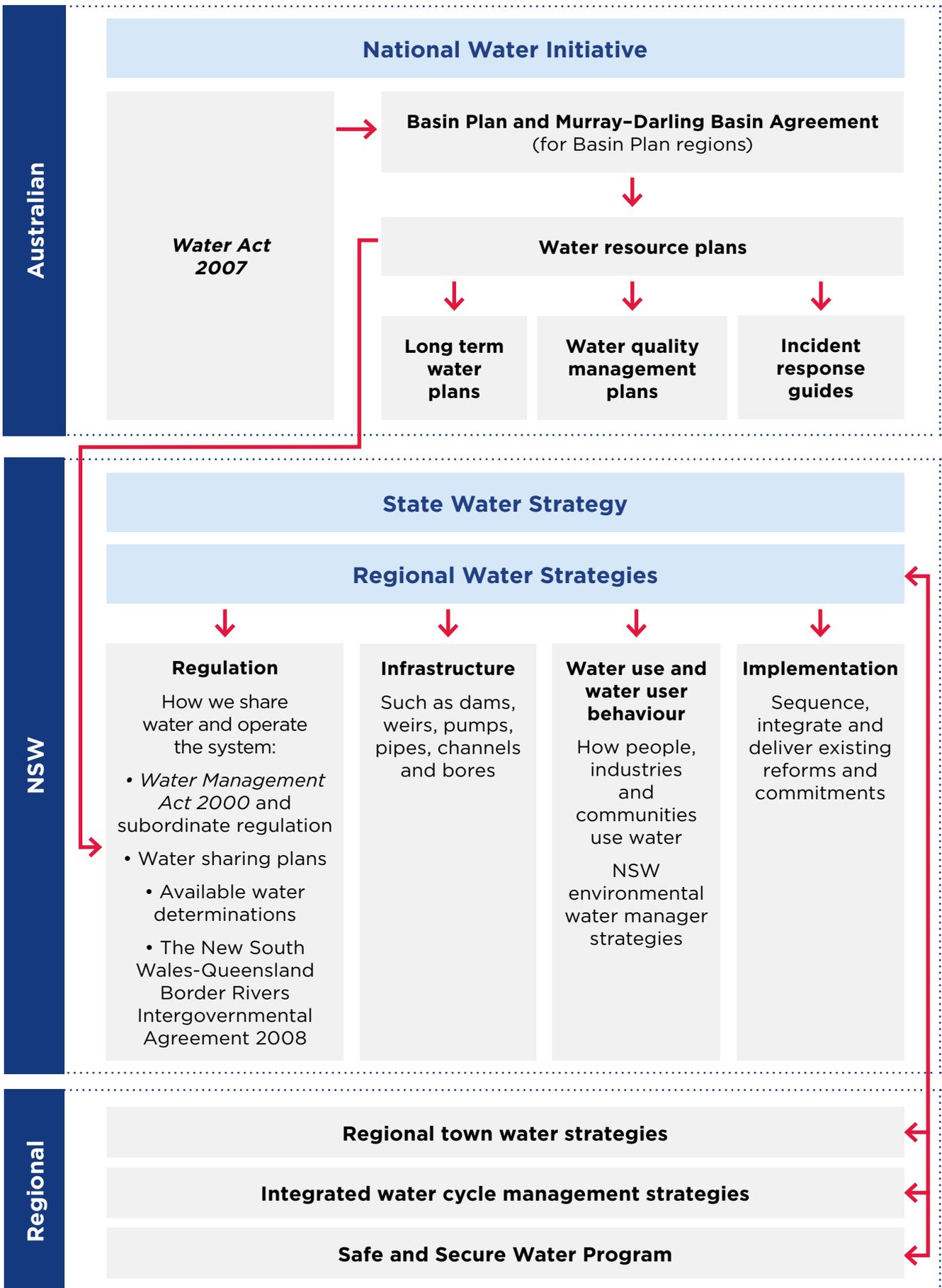
The NSW Government is also developing a 20-year State Water Strategy. This will establish overarching directions for managing water resources and services to ensure future water security, reliability and resilience, and address long-term challenges such as greater climate variability and population changes. The State Water Strategy will set high-level outcomes and actions to achieve these across public and environmental health, service delivery, liveability, economic development and technology, and for Aboriginal people.

Regional water strategies are an opportunity to explore how we can bring together existing commitments and better integrate and shape these plans, policies and investments for improved water outcomes. In particular, the strategies will play a key role in the ordering, sequencing and integration of water reforms in each region.

The strategies also align with the NSW Government's strategic planning hierarchy and will be integrated with current land use and regional plans.⁶

6. More information about how the strategies relate to strategic, regional and water planning is in the *Regional Water Strategies Guide*.

Figure 6. Regional NSW water policy and planning context for coastal catchments



Chapter 2

The Border Rivers region, its opportunities and challenges

Snapshot

Climate conditions, combined with the way we currently manage and share water, are placing the region's water resources under pressure and creating challenges for the towns, communities, industries and ecosystems that rely on them.

- The Border Rivers region has a diverse climate that cycles between wet and dry periods, with long periods of low inflows interspersed by large inflows. The recent drought has been the worst on record. Pindari and Glenlyon dams experienced the lowest 24 and 36-month inflows on record over 2017-2019 and recorded their lowest observed storage levels in January 2020. General security licence holders in the region have received zero or very low allocations for the past two water years.
- Hydrological models updated with more sophisticated climate data for this strategy found that:
 - a future climate could be more variable, with seasonal shifts in rainfall patterns and lower inflows into dams
 - in any 24-month period there is a 0.1-0.2% probability, or a one in 1,000-year event, of experiencing extreme conditions and low inflows similar to the recent drought (2018-2020) based on the long-term historical climate. This changes to a 1-2% probability, or a one in 100-year event, under a worst-case future dry climate scenario.

- Pindari and Glenlyon dams are unlikely to reach empty but there could be longer periods, possibly multiple years, where the dams sit at low levels without significant inflows to top them up
- there will continue to be wet years, and it is possible that, in the future, there could be higher flows than what we have seen previously.
- While large impacts are not expected in the short term, and the likelihood of the worst-case scenario eventuating is small, these new projections show that just relying on observed historical records to make water management decisions is no longer the best course of action. We need to have plans in place to be prepared and resilient if there are future changes in the climate.

There has been pressure on town water supplies across the region.

- Most of the population in the region is located in the upper catchment, in towns relying primarily on unregulated surface water.
- Over the last 12 months, town water supplies have needed to support broader water needs: firefighting, water for regions outside of the Border Rivers region and rural landholders not previously reliant on town water supplies.

- Some towns, such as Tenterfield, faced critical surface water shortages and turned to groundwater as an alternate supply. Delivering water to towns at the end of the system, such as Mungindi, also becomes especially difficult under drought conditions.
- Concerted efforts by the community and government to reduce demand for water, conserve remaining supplies for critical human needs and establish alternative back up sources of groundwater mean that many towns are now much better prepared for future droughts.
- The proposal for the Mole River Dam may help to improve town water security but may have implications for environmental outcomes and water availability downstream of the dam and beyond the Border Rivers region.
- Councils in the upper catchment want to increase horticulture potential to stimulate economic development; however, increased water security is needed to support this type of growth.
- Diversification of industries may provide opportunities to reduce requirements for water and dependence on water supplies. Technology and innovations can also help industry to use water more efficiently, increase productivity without increasing demand for water, and use alternate sources of water such as wastewater recycling.

Increased water security and reliability are essential for industry and economic development.

- The region experiences extreme river flow variability, and agriculture relies on high flow events. There is limited capacity in existing dams to store large flow events. As a result, large private on-farm storages in the region help store water during high flow events, and when water is released down the river from dams in pulses. However, these on-farm storages store water inefficiently with significant evaporative losses, thereby reducing net water supplied to the system for productive use.
- Delivering environmental flows to the end of the system to support fish passage and connectivity to the Barwon-Darling system is a challenge due to upstream demand, instream structures, infiltration along the system and existing small volumes of held environmental water.
- Additional dams, weirs and pipelines—along with operational changes to how rivers are managed during extreme events—will further regulate and alter the natural flow regime of rivers in the valley, impacting native species and ecosystems.
- There has been significant growth in floodplain harvesting infrastructure over the last 20 years. The NSW Floodplain Harvesting Policy will better regulate this activity, but there are still a number of floodwork structures that are causing adverse ecological impacts.

- Future changes to river flows due to greater climate variability may adversely impact riverine, aquatic and floodplain ecosystems. Fish kills will become an increasing risk under future climate scenarios with hotter, drier climates and lower flows. The strategies provide an opportunity to look at ways to mitigate these risks.

We need to better manage groundwater resources.

- Groundwater use varies across the region, with concentrated extraction in the lower catchment. Areas of the Border Rivers Alluvium in the lower catchment have experienced long-term water level declines since the 1990s due to extraction.
- The Border Rivers Alluvium is a shared resource with Queensland and the difference in legislation generates challenges with regards to the assessment of bores and impacts of groundwater use.
- The Eastern Recharge Groundwater Source of the Great Artesian Basin is over-committed and highly used, so licence holders have reduced allocations to ensure total extractions do not exceed the long-term average annual extraction limit.
- We need to use groundwater sustainably and more efficiently to provide a secure supply for towns and industries during dry periods and continue to support vital ecological processes and assets.

Water quality and delivery issues can impact the availability of supplies.

- There are problems with water quality in storages due to blue-green algae, which can impact the availability of water supplies. This is a key issue in warmer months, where blue-green algae blooms in Pindari Dam pose health risks and necessitate water being released from lower levels in the dam causing cold water pollution.
- Delivering water to the end of the system is a challenge in severe droughts. Releases from dams are carefully managed to conserve water for critical human needs with several towns reliant on surface water. In the past we were only able to deliver water up to a certain distance on the river (Boggabilla in the recent drought). However, this can impact the environment, communities and Aboriginal cultural needs that rely on flowing rivers.
- The ongoing dry conditions since the Millennium Drought, along with recent bushfires in 2019/20, have decreased water quality and placed great stress on ecosystems across the region. Bushfires had a significant impact on water quality due to destabilisation of soil, and sediment and burnt organic material entering rivers, causing fish kills.

There are opportunities to improve connectivity to the Barwon-Darling system.

- The Border Rivers region provides water for critical human and environmental needs downstream, contributing 19% of the Barwon-Darling flows at Menindee Lakes on average over the long term. We need to look for more opportunities to support environmental outcomes in the region, including better connectivity within the region and with the Barwon-Darling river system, and improved opportunities for native fish passage.
- Queensland also plays a significant role in managing water flowing through to the Border Rivers, as almost half the catchment is in Queensland. Coordinated action and planning across the region (and cross-border cooperation between NSW and Queensland) should support improved environmental outcomes, including better connectivity with the Barwon-Darling River system, improved movement of native fish species and a focus on drought recovery and meeting ecosystem targets.

Water is essential for Aboriginal people's health, wellbeing and connection to Country.

- The health of waterways impacts the wellbeing of Aboriginal people across the state.
- While there are some provisions for accessing water for cultural purposes, we have heard from Aboriginal stakeholders across the state that these do not currently meet the needs and obligations of Aboriginal people to care for Country, or achieve the cultural water flows and water management aspirations set out in the 2007 Echuca Declaration. Aboriginal people seek ownership of their water.
- Options to improve Aboriginal people's involvement in water management, recognise their water rights and provide dedicated cultural water allocations could protect cultural values and deliver cultural, spiritual, social, environmental and economic benefits.



2.1 What we know about the Border Rivers region's climate

2.1.1 Today's climate

The Border Rivers region has a diverse climate. The climate is temperate in the upper catchment to the east, changing to subtropical and then grassland in the lower catchment to the west. The upper catchment has an average annual rainfall of 1,000 mm, which declines moving west across the lower catchment to 500 mm at Mungindi (Figure 7).

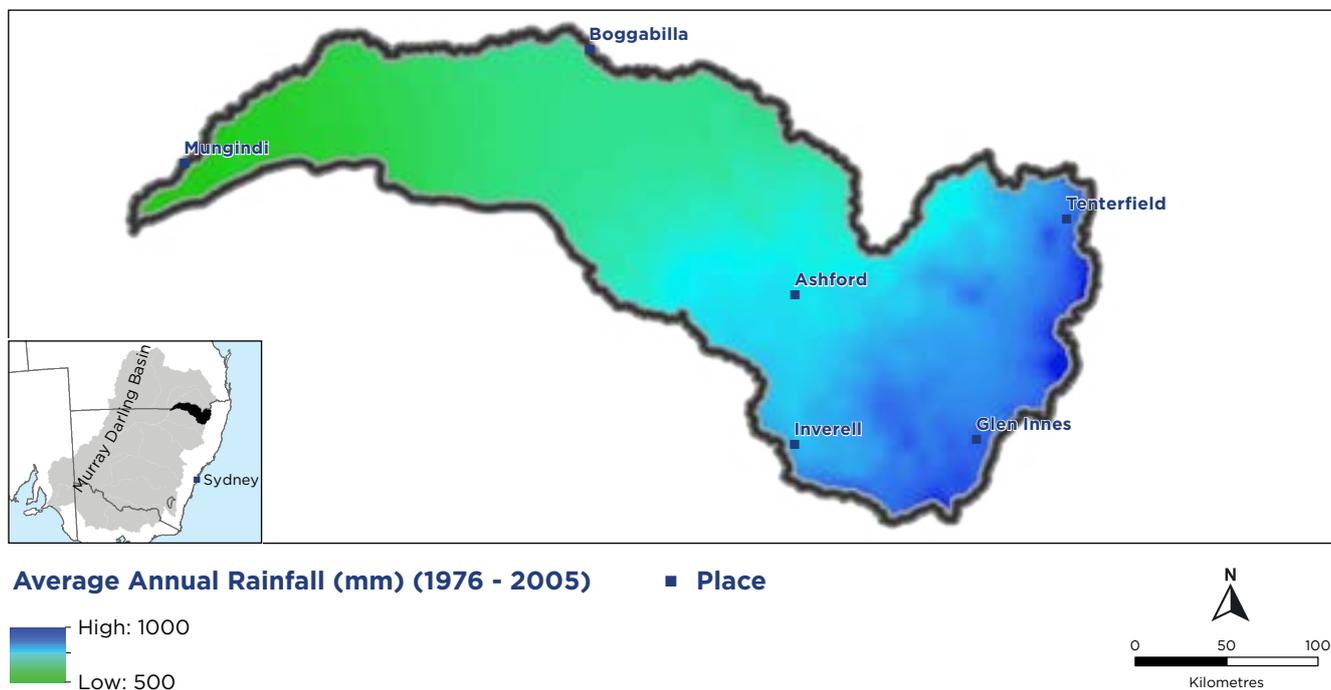
Rainfall is strongly seasonal, with the highest volumes occurring through summer storm activity, which can generate high amounts of run-off and floods. Associated with tropical monsoonal activity, 62% of the annual rainfall

is received between October and March.⁷ Summer storms can cause flooding and erosion, and winter flooding can also occur when soils remain saturated after summer rains.

In the last 30 years, summer rainfall has been reliable, but winter rainfall has decreased in the upper catchment.⁸ Autumn and spring rainfall has decreased in the lower catchment.⁹

Annual evapotranspiration¹⁰ is lower in the upper catchment (1,200 mm) and increases across the lower catchment to 2,000 mm at Mungindi. In the last 30 years, there have been more hot days and more consecutive days above 30°C than the historical average.¹¹

Figure 7. Observed average annual rainfall in the Border Rivers catchment



Source: Department of Planning, Industry and Environment 2018, *NSW Border Rivers Surface Water Resource Plan Area Resource Description: Appendix A*.

7. Thoms, M.C., Southwell, M. and McGinness, H.M 2005, *Floodplain-river ecosystems: fragmentation and water resources development*. *Geomorphology*, 71. p126-138.
 8. Bureau of Meteorology climate guides, www.bom.gov.au/climate/climate-guides/
 9. Bureau of Meteorology climate guides, www.bom.gov.au/climate/climate-guides/
 10. Evapotranspiration is the term used to describe the part of the water cycle that removes liquid water from an area with vegetation and into the atmosphere by the processes of both transpiration and evaporation.
 11. Bureau of Meteorology climate guides, www.bom.gov.au/climate/climate-guides/

The region cycles between wet and dry periods with long periods of low inflows interspersed by large inflows

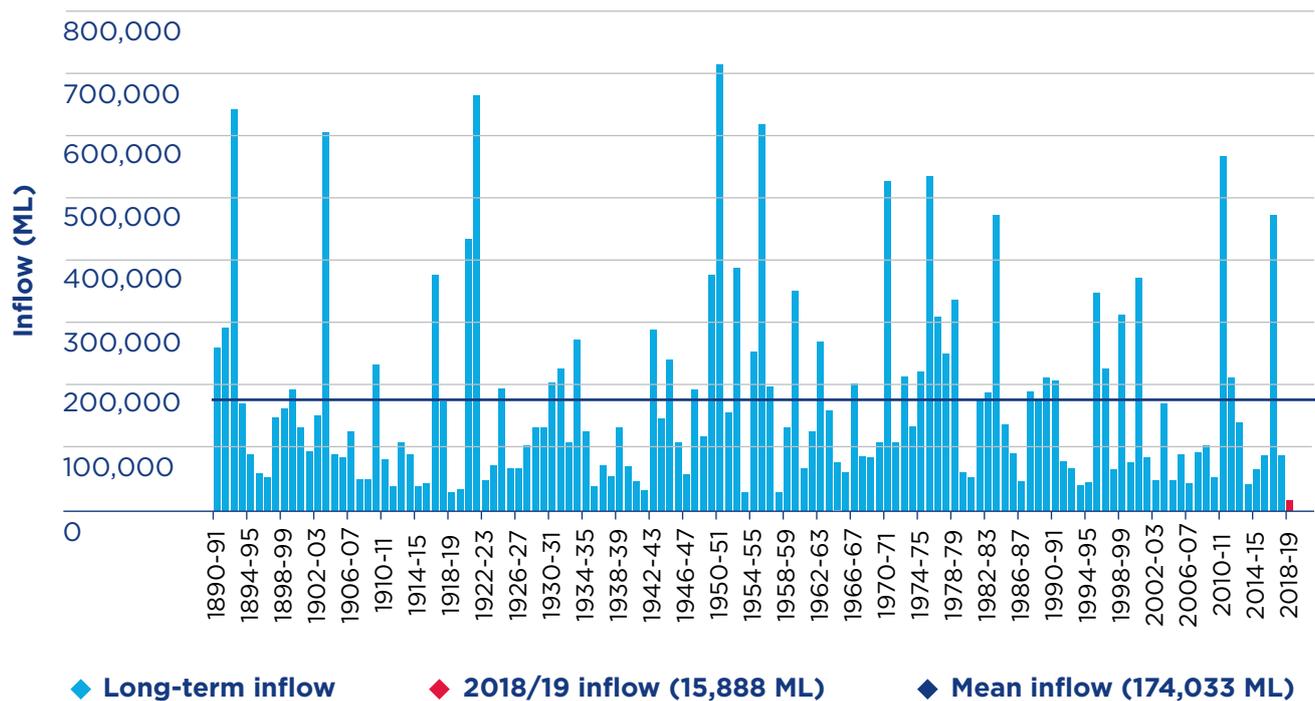
From the observed historic record, we know that the region cycles between dry and wet periods:

- the 1900s to 1940s was a comparatively dry period and most of the recorded short droughts (one to five 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. This variability is illustrated in Figure 8 below, which shows estimated inflows from the catchment above Pindari Dam from 1890 to 2019 based on the observed historic record, and the mean inflows over that period.

The environment relies on periods of large inflows to replenish water bodies and ecosystems, and to support and sustain flora and fauna species. Industries in the region have also adapted to this variability and many rely on these few years of large inflows to underpin their businesses.

Figure 8. Long-term inflows into Pindari Dam against mean and 2018/19 inflows



Source: Department of Planning, Industry and Environment 2019, *General Purpose Water Accounting Statement 2018/19*, Border Rivers Catchment.

The region has experienced persistent droughts as well as intense shorter droughts

The Border Rivers region has experienced extreme droughts over the past 130 years of observed records. The most well-known are:

- the Federation Drought (1895 to 1903)
- the World War II Drought (1939 to 1945)
- the Millennium Drought (1997 to 2009).

Two of the lowest five-year rainfall periods in our historical records all occurred in these periods (Figure 9). Figure 10 shows the region’s lowest 10-year rainfall on record occurred during the World War II Drought. Before the Millennium Drought, the region had been dominated by wetter conditions since the 1950s.



Figure 9. Lowest five-year average rainfall in the Border Rivers region

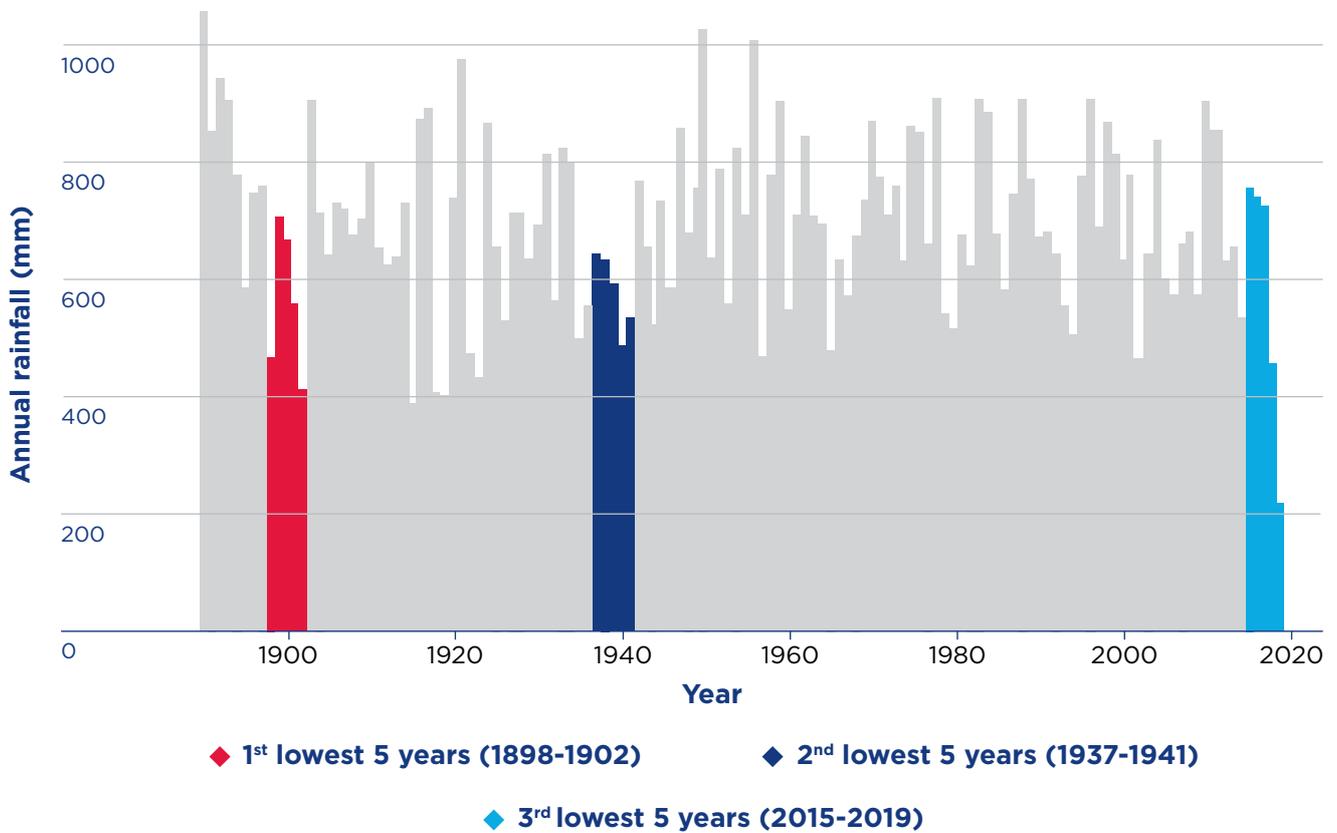
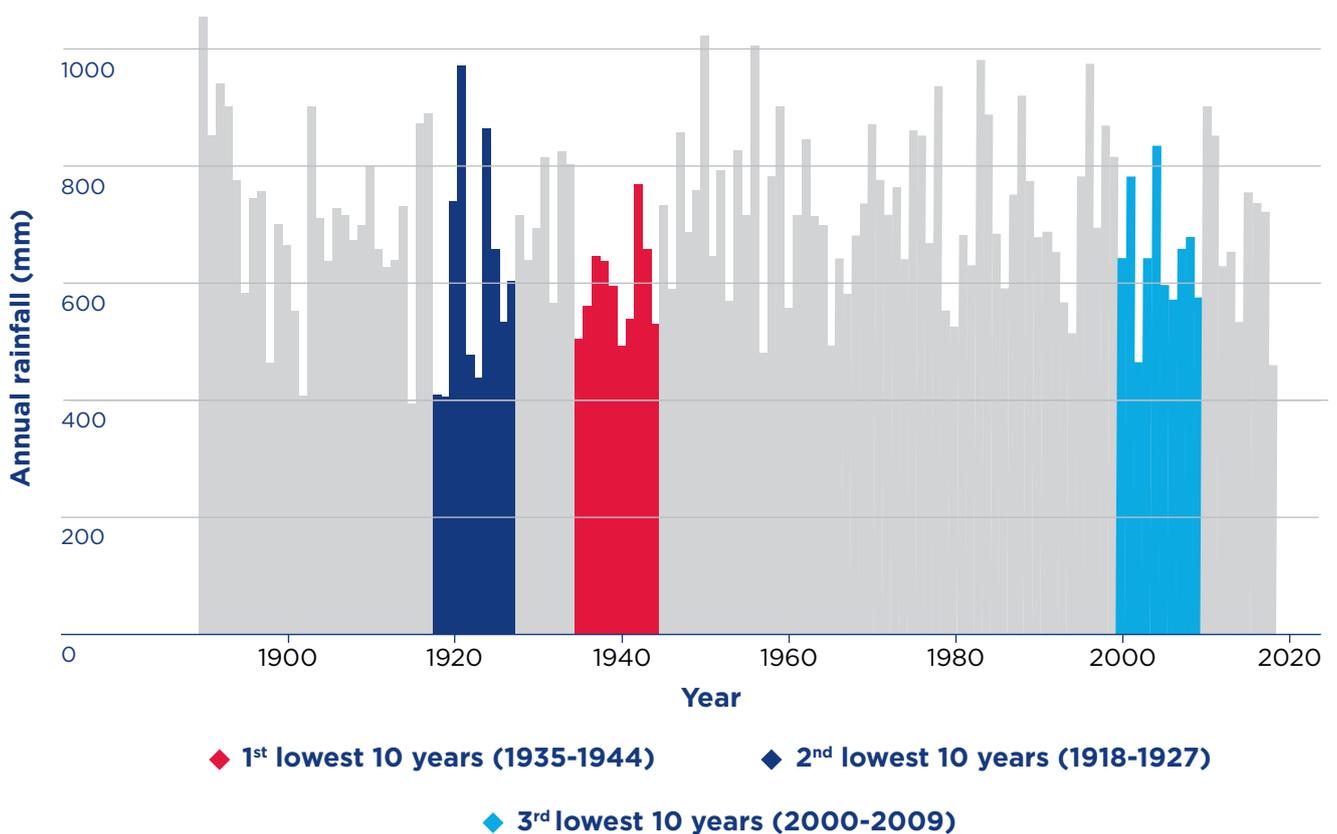


Figure 10. Lowest 10-year average rainfall in the Border Rivers region

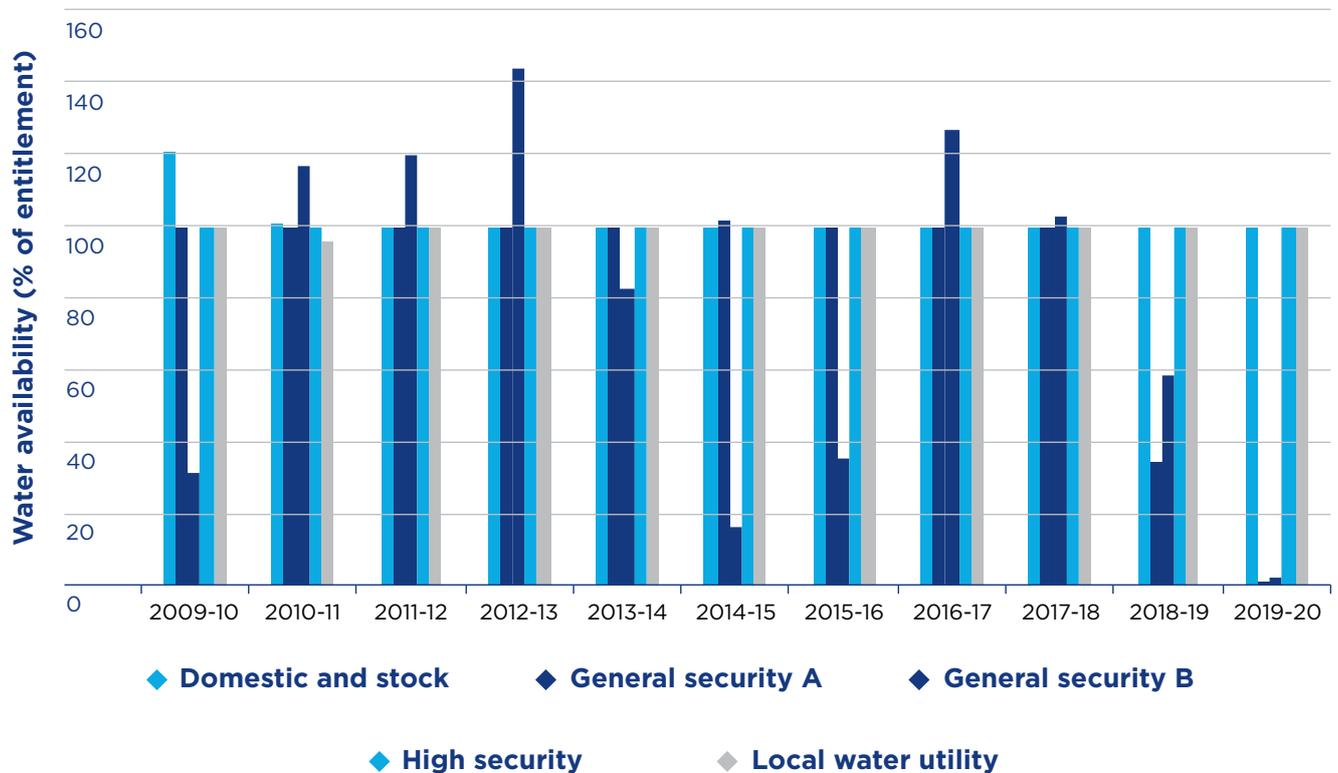


The current drought has been the worst on record

The recent drought had:

- lowest rainfall on record—2019 recorded the lowest rainfall in a 12-month period, which was about 60% of the previous lowest rainfall on record
- lowest inflows on record—Pindari Dam and Glenlyon Dam experienced the lowest 36-month inflows on record over May 2017-April 2020 (receiving 170 GL in total)
- lowest recorded storage levels—Pindari Dam and Glenlyon Dam recorded their lowest observed storage levels in January 2020, which was 3.7% combined. As the management of Pindari Dam and Glenlyon Dam are linked, we have considered their storage volumes together
- zero and low allocations for general security licence holders—General security A class entitlement holders received zero allocations for the 2019/20 water year and 32.8% allocations in the 2018/19 water year (including allocations and carryover). General security B class entitlement holders received zero allocations in 2018/19 and 2019/20—the water available for General security B in 2018/19 was from unused allocations from the previous year (Figure 11).

Figure 11. Total water availability for licence categories in the Border Rivers Regulated River Water Source (2009-2020)



Note: The water sharing plan commenced in 2009.

Source: Department of Planning, Industry and Environment, *General Purpose Water Accounting Statement 2019*, Border Rivers Catchment (to be published).

Significantly, during 2018/19 when water availability was severely reduced, no towns ran out of water and allocations for towns and domestic users were 100% for the 2019/20 water year. This was due to concerted efforts by the community and government to reduce demand for water, conserve remaining

supplies for critical human needs and establish alternative back up sources of groundwater. Local water utilities were also able to provide water carting to rural communities without reticulated supplies. Many towns now have alternative water sources that will make them more resilient to similar droughts in the future.



2.1.2 A better understanding of current climate variability and future climate change

As outlined in section 1.3.1, new climate datasets and improved modelling provide a better understanding and more realistic picture of the natural variability of the Border Rivers region's climate beyond the 130 years of observed historical records.

This allows us to analyse changes to flows and water availability over a much wider range of climate conditions than was possible with only the observed historical record.

A future climate could be more variable, with shifts in rainfall seasonality, higher evaporation and lower inflows into dams

The new analysis shows that the wet and dry cycles we have seen in the last 130 years and the patterns of rainfall are fairly normal when compared to the long-term climate beyond the observed records. Although there have conceivably been more extreme dry and wet conditions in the long-term past than we have seen in the last 130 years.

If the region's future climate is similar to its past climate before observed records began, we could see more variability in rainfall, particularly in summer and winter, and more variability in inflows into our dams.

Our improved modelling also incorporates recognised climate change projections which suggest that, if the worst-case dry climate change scenario eventuates, the Border Rivers region could have:

- **changing rainfall patterns**—shifts in seasonal patterns are expected to cause a decrease in winter and spring rainfall by around 30% by 2079, and an increase in summer and autumn rainfall compared to levels between 1990 and 2009 (Figure 12). The changes in rainfall patterns could impact on the types of crops and agricultural businesses best suited to the region, as well as when environmental water releases may need to be made
- **higher evapotranspiration**—potential evapotranspiration is expected to increase by up to 7% by 2079 compared to levels between 1990 and 2009 (Figure 13)
- **overall lower inflows into Pindari Dam and Glenlyon Dam**—median annual inflows could potentially decline by approximately 45% if the worst-case climate change scenario were to eventuate¹²
- **potential for higher peak flows**—potential for peak flows higher than what we have seen in the observed historical record.

We are not expecting to see impacts of these magnitudes in the short term. However, these results indicate that just relying on observed historical records to make water management decisions no longer represents the best course of action, and that we have an opportunity to put plans in place to make sure we are prepared and resilient if there are future changes in the climate.

12. Based on the median annual flows at three gauges—416032 Mole River at Donaldson, 416201A Macintyre River at Goondiwindi and 4160047 Macintyre River at Terrewah.

Figure 12. Average monthly changes in rainfall for the Border Rivers region from climate change (NARClIM) projections

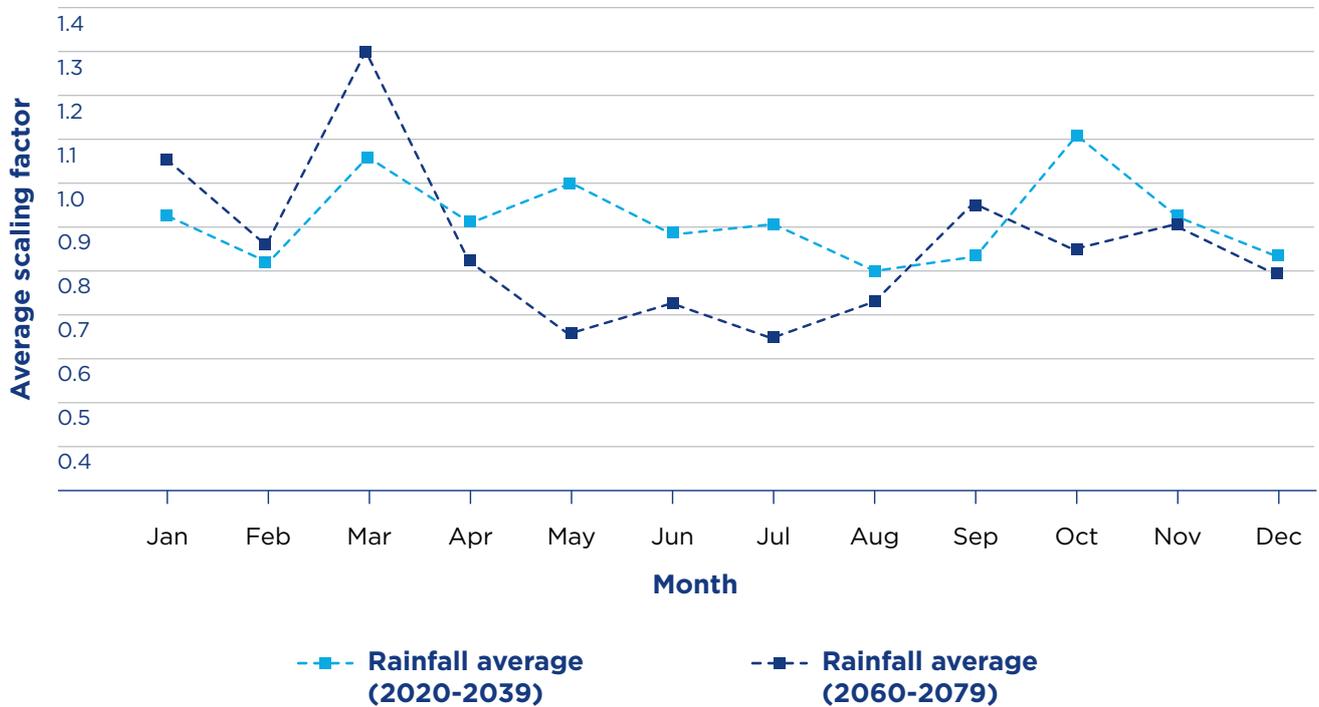
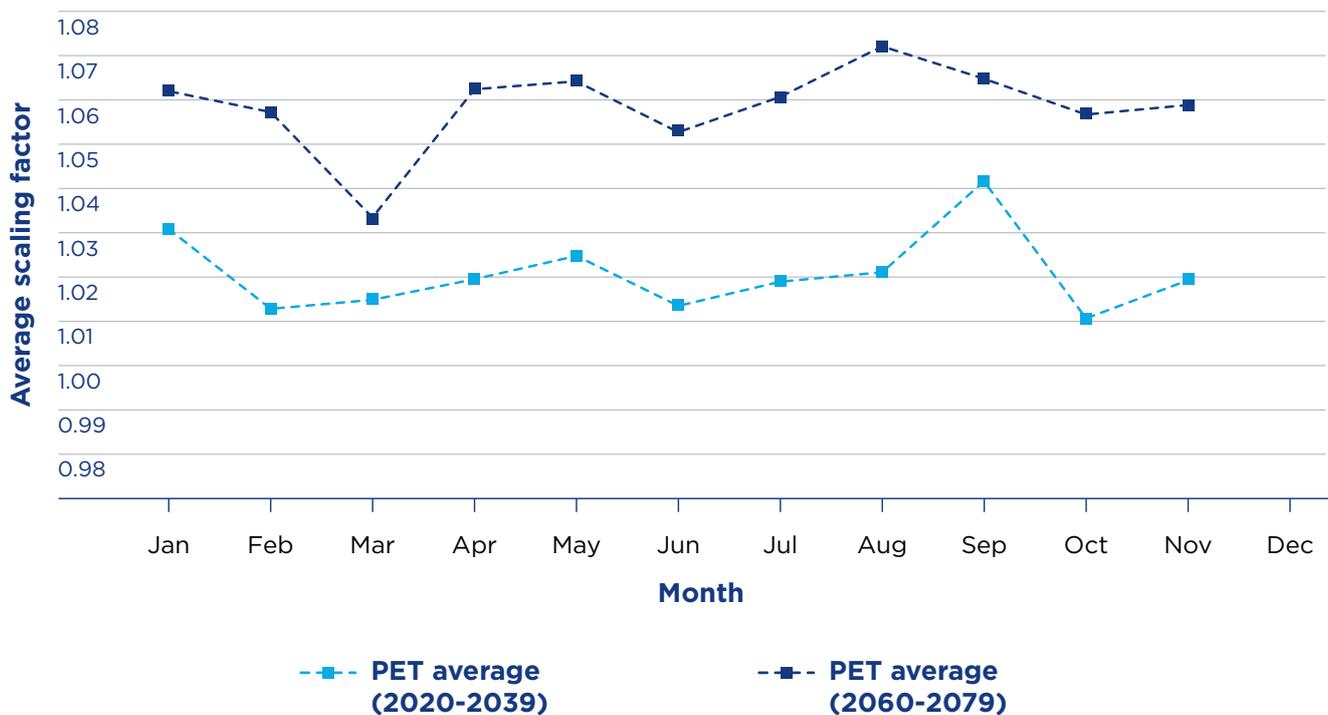


Figure 13. Average monthly changes in potential evapotranspiration (PET) for the Border Rivers region from climate change (NARClIM) projections



Note: Average 2020-2039 and average 2060-2079 figures represent catchment average monthly changes for the periods 2020-2039 and 2060-2079, respectively compared to the baseline period of 1990-2009 based on NARClIM 1.0 future climate change projection.

Using climate change projections in water modelling

The NSW Government's NARClIM (climate change) datasets include a range of different future climate scenarios. We have used the most conservative result from NARClIM 1.0 in our modelling—the scenario which represents the greatest reduction in average monthly rainfall. While the results of the other scenarios in the current version of NARClIM are arguably equally appropriate and probable, we intend to stress test the water system and understand the worst-case climate scenario for strategic water planning. This will test the resilience of options proposed in the regional water strategies, particularly options that go towards securing water for critical human needs.

Our current science indicates that there is an increased probability of the most recent drought reoccurring into the future

The 24-month period from January 2018 to December 2019 was an extremely dry period in the context of the observed historical record, with Pindari and Glenlyon dams receiving only 32.7 GL of inflows.

Our new modelling suggests that the probability of these low inflows (32.7 GL) occurring again over a 24-month period is 0.1-0.2%, or a one in 1,000-year event if the future climate is similar to our long-term historical climate. If the worst-case climate change scenario from our modelling eventuates, the probability of these low inflows occurring again increases to 1-2%, or a one in 100-year event, which is a significant increase in the probability of this extreme event occurring.

To prepare for this we may need to consider alternative water sources for essential needs, or consider changes to the way we allocate water and operate the system.



Storages could sit at lower levels, but they are unlikely to be empty

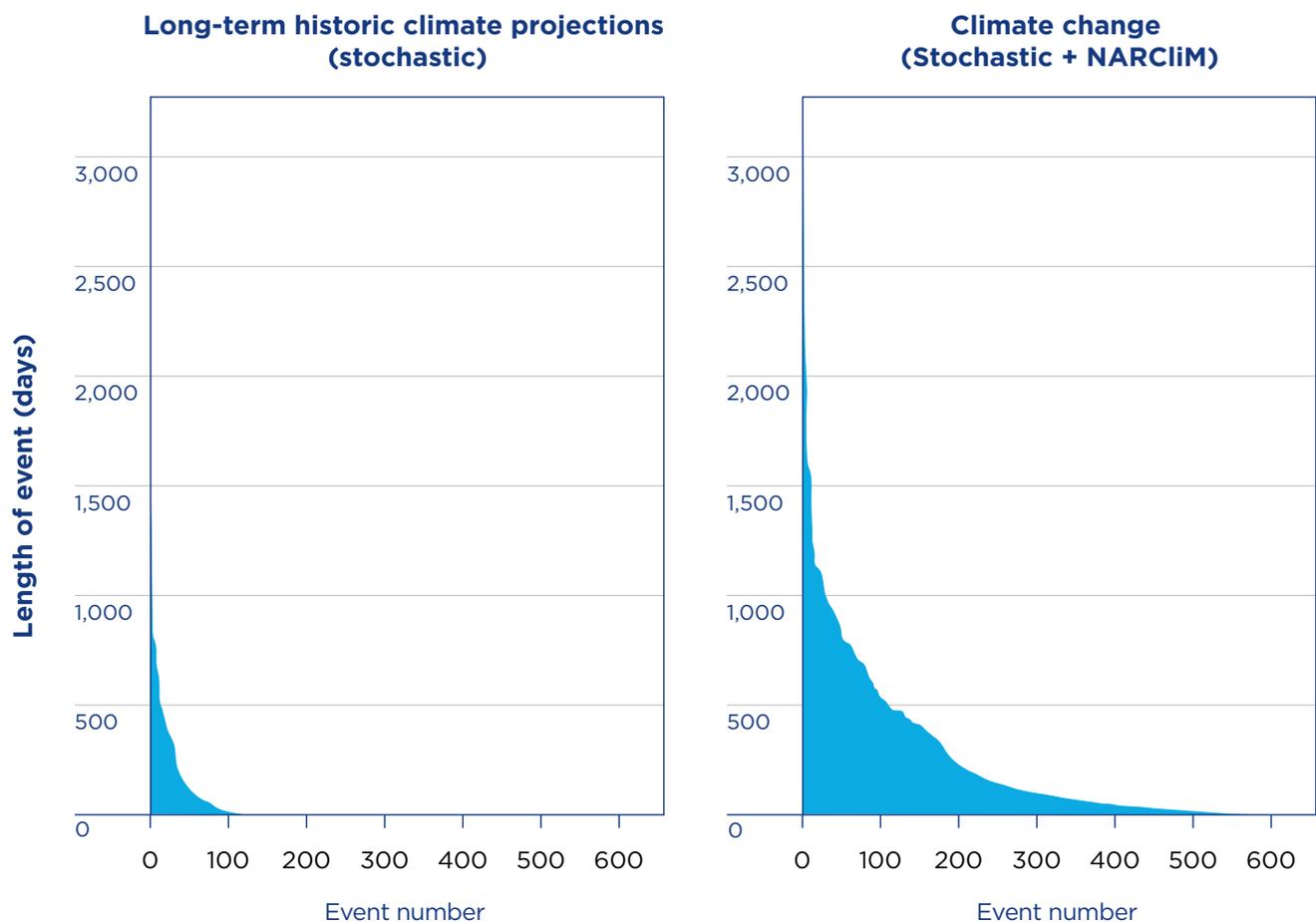
Securing water for critical human needs is the highest priority during extreme events. To help plan for this we have looked at the ‘worst-case’ scenarios and modelled how long Pindari Dam and Glenlyon Dam could have their combined storage volume either below 5% (28,339 ML) or empty¹³ (240 ML) (Figure 14).

As context, the NSW Government operates the system over a 24-month horizon. This means that we need 41,100 ML (or 41 GL) of water in

the storages to support essential needs for two years. If the storages fall below 41 GL, and without additional inflows into the dams, we need to implement drought contingency measures to preserve water for critical needs in the following water year.

Our results show that it is unlikely that the dams will be empty. However, there could be longer periods where the dams sit at low levels without significant inflows to top them up.

Figure 14. Number and length of events when the combined capacity of Pindari and Glenlyon dams could be below 5% full



13. Pindari and Glenlyon dams have a combined small deep storage volume of 240 ML which cannot be released from the dams due to design of the outlet structure. This means that technically the dams may not be empty, but the water remaining cannot be released. Deep storage volume is generally allowed for environmental reasons as they could be a refuge for aquatic species. There could also be water quality issues in the deep storage volume that makes it impractical to access.

At 5% capacity, Pindari and Glenlyon dams can support town water supplies, domestic and stock licence holders and high security licence holders for approximately one year, as these licences are a small proportion of the total pool. However, the longer these dams remain at lower levels, the greater the pressure it puts on the system as we prolong the water in the dams for critical human needs.

In the current drought, the two dams fell to 3.7% (20,970 ML) capacity in January 2020 and remained at that level for about six weeks. During this time, water was not available to be released from Pindari Dam but was available to be released from Glenlyon Dam.

When the dams reach these low levels changes are made to the way the system is operated to help extend supplies. This includes making releases to replenish town weir pools at the end of the system (Boggabilla and Mungindi) during the cooler months when system losses are lower and progressively shortening the point on the regulated river to which water is delivered. When this operational approach is in place, tributary inflows downstream of the dams become very important in helping to maintain the level of supply in town weir pools. Inflows received into the dams and weir pools during cooler months are more effective in prolonging supplies as there are lower losses due to evaporation and water seeping into the river bed.

Our new modelling shows that (Figure 14):

- if our future climate is similar to our past climate before observed records began, the probability of the combined storage volume of the dams falling below 5% is small
- under a dry climate change scenario, the combined storage volume of the dams could fall below 5% capacity approximately 600 times in a 10,000-year period and, in the worst-case scenario, the dams could remain at these levels for multiple years.

It is important to note that while the types of conditions assessed under our climate change scenario represent a possible future, the probability of these outcomes occurring is small. The estimates are based on a deliberately conservative climate-projection scenario in which recent greenhouse gas emission rates and temperature increases are maintained into the future without any mitigation.

These results also assume there is no change in how we operate the system, where in reality we would respond to ongoing drought conditions and operate the system to conserve water for critical human needs. These scenarios will not necessarily eventuate, but they give us an idea of the possible climate risks and allow us to begin planning to make sure we can mitigate these risks if they do arise.

A note of caution: The scenarios in these models will not necessarily eventuate. They are potential scenarios and there is always a level of uncertainty with this type of modelling, which needs to be taken into account as part of any water decision-making and planning.

In some instances, this may mean managing risks to our water security by being prepared and resilient, rather than relying on firm predictions and hard numbers.

As the science develops further, we will be able to reduce or quantify some of these uncertainties.

Floods are a feature of the past, and the future

Flooding is a familiar phenomenon in the Border Rivers. Due to its topography, the region is particularly susceptible to flooding. The floodplain areas of the Macintyre Brook and Dumaresq rivers in the east, and the Macintyre River and Weir rivers in the west, are prone to flooding and significant damage to both public and private infrastructure can occur.

Flooding is also a natural and beneficial process in the Border Rivers. Natural floods support riverine and wetland ecology, as well as enabling fish movement. Flood events also allow water to be captured and used for agriculture (see section 2.2.2).

Flooding can present challenges for towns and rural communities adjacent to rivers. We have heard from councils that floods come in quick and can have significant impacts on the towns in the upper catchment. Tenterfield experiences regular flooding along Tenterfield Creek.

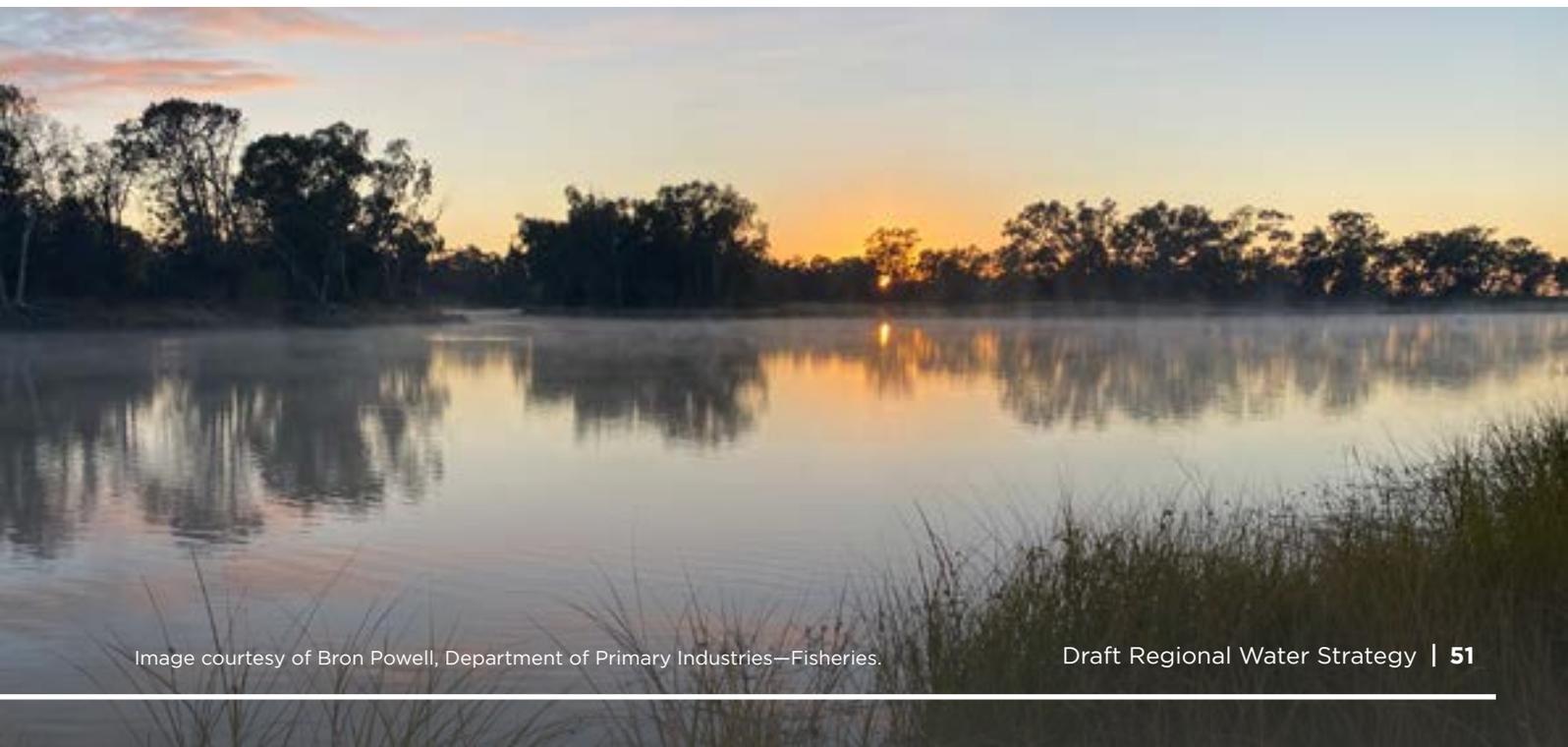
In Inverell, flooding is generally confined to the main river channel and its adjacent alluvial flats. Flood flows in these areas can be fast and dangerous.

In the lower catchment, flooding can affect large areas of farmland, requiring livestock and equipment to be moved before inundation occurs. Numerous minor roads are subject to closure after major floods, which can isolate communities.

During major floods the carrying capacities of the numerous watercourses in the region are not sufficient to confine the flood volume within their banks. The combination of high flows in the Dumaresq, Macintyre and Severn rivers results in extensive, widespread flooding in Boggabilla and the outlying rural area. In Mungindi, flood waters have been reported to remain around the town for four to eight weeks after a major event.¹⁴ Floods can spread over a vast area and even join those in the Gwydir Basin to the south.¹⁵

14. BG&E 2014, *Mungindi Floodplain Risk Management Plan*. Document No.S13162-RPT-002 REV/B, 29/11/2014, www.mpsc.nsw.gov.au/hot-topics/docman/floodplain-management/mungindi-3

15. NSW State Emergency Service 2012, *Moree Plains Shire flood emergency sub plan*, www.ses.nsw.gov.au/local-region-information/nwr/flood-storm-and-tsunami-plans/





2.2 The landscape and its water

The Border Rivers region in northern NSW is a relatively large catchment, covering approximately 24,500 km²¹⁶ and services both NSW and Queensland water users. The region is bounded by Queensland and the Condamine-Balonne and Moonie regions to the north, the western slopes of the Great Dividing Range to the east, the Gwydir catchment to the south and the Barwon River to the west. Major towns include Glen Innes, Tenterfield, Inverell, Boggabilla and Mungindi in NSW, and Goondiwindi in Queensland.

2.2.1 Water resources in the region

Water is critical to the health of the environment, the social fabric and liveability of the Border Rivers region and its economic prosperity.

The region's towns, communities and industries use water from multiple sources (Figure 15):

- **major regulated rivers**—the entire length of the Dumaresq River, the Macintyre River

downstream of the confluence with the Dumaresq and the Barwon River upstream of Mungindi form part of the border with Queensland and so are common to both NSW and Queensland. The Severn River is wholly in NSW and the Weir River and Macintyre Brook are wholly in Queensland¹⁷

- **unregulated rivers and creeks** such as the Mole, Beardy and Weir rivers, and Tenterfield, Bonshaw, Campbells, Camp, Whalan and Croppa creeks in NSW¹⁸
- **floodplain harvesting** during overbank flow events when flood flows are captured in on-farm storages
- **local runoff** from rainfall captured in farm dams
- **groundwater** from alluvial, porous and fractured rock aquifers
- **recycled water** from local water utilities

16. The Border Rivers region spans across the territories of NSW and Queensland. The total surface area is around 49,500 km², of which 24,500 are in Department of Planning, Industry and Environment 2018, *NSW Border Rivers Surface Water Resource Plan Area Resource Description: Appendix A*. www.mdba.gov.au/publications/mdba-reports/nsw-border-rivers-water-resource-plan

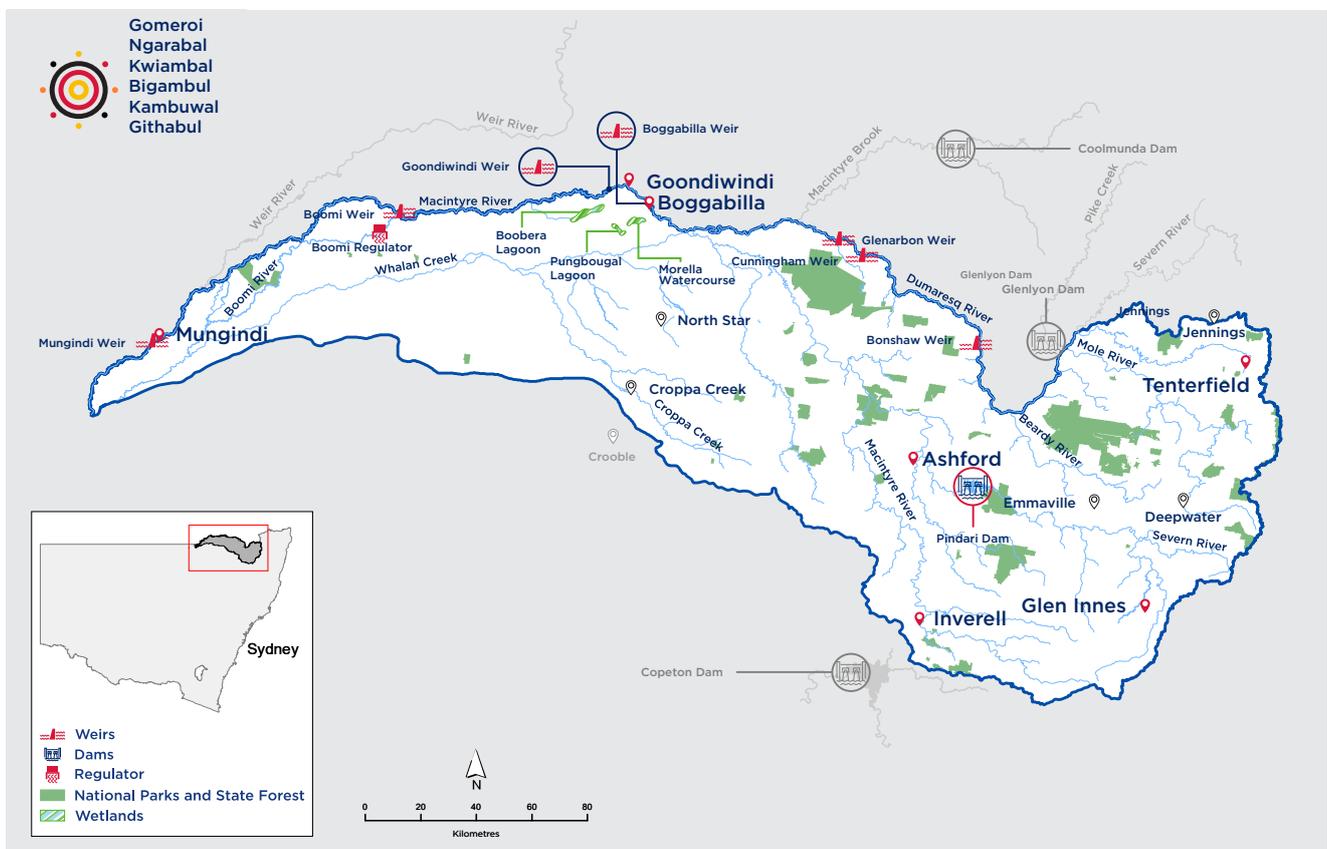
17. A **regulated river** or stream is one where the flow has been modified from its natural state through structures such as dams, weirs or off-takes. Major dams usually control the flow of water down regulated rivers.

18. An **unregulated river** or stream is not controlled by releases from a dam or through the use of weirs or gated structures. Water users are reliant on climatic conditions and rainfall.



Image courtesy of Bron Powell, Department of Primary Industries—Fisheries.

Figure 15. Map of the Border Rivers region: key water resources and infrastructure



The region’s upper and lower catchment have distinct differences:

- The upper catchment is in the narrow valleys of the New England tablelands. This is where the major towns are found and where the unregulated headwaters of most major rivers originate. Groundwater occurs in narrow alluvium associated with the unregulated rivers and in underlying fractured rock.
- The lower catchment further west delivers regulated flows along the plains. Groundwater occurs in wider and deeper alluvium associated with the major rivers and creeks, and in underlying porous rock.

The region is unique in NSW because water sources and infrastructure are regulated and shared jointly between NSW and Queensland.

Major rivers and dams

Major dams and regulating infrastructure have been built in the Border Rivers region since the late 1960s, enabling water to be delivered along the regulated rivers and irrigated agriculture to be developed on the plains of the lower catchment.

Major dams in the Border Rivers region include the Pindari and Tenterfield dams in NSW, and Glenlyon and Coolmunda dams in Queensland (Table 1). These dams provide water for towns, stock watering and domestic consumption, irrigation, industry and environmental flows in both states. Compared to other regions, these storages have small capacities and large service areas.

Pindari Dam on the Severn River is the biggest storage in the region and provides town water supplies for Ashford, Boggabilla, Boomi and Mungindi. A number of weirs further regulate the Severn River. Major in-stream weirs are located at Boggabilla, Boomi, Goondiwindi and Mungindi, and enable water to be directed to the lower reaches of the Macintyre River. Some of these weirs, such as at Boggabilla and Goondiwindi, have fish passages installed. The Border Rivers Commission controls some of the major weirs on behalf of NSW and Queensland.

Boggabilla Weir has a storage capacity of 5,850 ML and is a re-regulating storage that improves water distribution efficiencies by allowing the capture and use of small flows, including re-regulation of releases from upstream dams.

Table 1. Major storages in the Border Rivers region

	New South Wales		Queensland	
Major storage	Pindari	Tenterfield	Glenlyon	Coolmunda
River	Severn	Tenterfield Creek	Pike Creek	Macintyre Brook
Catchment area	1,994 km ²	83 km ²	1,326 km ²	1,760 km ²
Storage capacity (ML)	312,000	1,390	254,000	69,000
Operating authority	WaterNSW	Tenterfield Council	Sunwater on behalf of Border Rivers Commission	Sunwater
Purpose	Town water supply, stock & domestic, irrigation, industrial and environmental flows	Town water supply and stock & domestic	Irrigation, town water supply, stock & domestic and industrial and environmental flows	Town water supply, irrigation, stock intensive industries
Customers	NSW	NSW	NSW and QLD	QLD
Towns supplied	Ashford, Boggabilla, Boomi and Mungindi	Tenterfield	Texas (QLD), Boggabilla, Goondiwindi (QLD) and Mungindi	Inglewood (QLD)

Mole River Dam

The NSW and Commonwealth Governments are investing \$24 million in a business case for a new dam on the Mole River, approximately 20 km southwest of Tenterfield. The proposed project aims to:

- improve water security and reliability and support the development and growth of the regional economy by securing more water in flood sequences for use in drier times
- provide potential benefits for the downstream Barwon-Darling system through increased flow reliability and associated environmental health outcomes.¹⁹

The Macintyre River is the longest river in the catchment at 319 km. It originates around Inverell in the Great Dividing Range along narrow valleys and then flows for most of its length across the dry flat alluvial floodplains of the lower catchment before connecting to the Barwon River upstream of Mungindi. The Severn River is the main tributary from NSW, which enters the Macintyre River 205 km from its source and 20 km north east of Glen Innes.

The junction of Weir River and Macintyre River, approximately 20 km upstream of Mungindi, marks the start of the Barwon River.

Cross-border water management arrangements (see Cross-Border Management box in section 2.2.3) can be challenging at times due to the differences in legislation and rules between NSW and Queensland. It also means that towns relying on particular infrastructure to provide

water supplies may not have control over its operation. We heard from Councils that this was an issue for Boggabilla during the recent drought.

The delivery of water along the length of the Border Rivers system can also be challenging as low storage capacity in the middle and lower sections of the regulated system impacts the overall efficiency and timeliness of delivery of flows to the end of the system. It takes approximately five days to deliver water from Glenlyon Dam to Boggabilla, and a further 11 to 13 days for the water to reach Mungindi.

Large volumes of water are released from the dams to account for evaporation losses and infiltration that occurs as the water flows down the system.²⁰ For example, in 2017/18, 20,901 ML (35%) of the 60,103 ML of water released from Glenlyon Dam was lost through evaporation.²¹

In summer or during dry periods, water is released from the dams in blocks to reduce the proportion of water seeping into the ground. Under drought conditions, significantly more water needs to be released from dams to provide flows along a low or dry river as seepage is greater. This may become unmanageable in an extreme drought and presents significant economic and environmental risks for the region. It also affects groundwater, as surface water is a source of recharge for alluvial groundwater sources. During the recent drought, the operation of the regulated portion of the Macintyre River was shortened to Boggabilla to preserve water security for town water supply. Towns at the end of the system turned to groundwater. However, cutting the river short can impact the environment, communities and Aboriginal cultural needs that rely on flowing rivers.

19. More information is available at www.watnsw.com.au/projects/new-dams-for-nsw/mole-river-dam

20. WaterNSW, 2018. *WaterNSW 20 Year Infrastructure Options Study, Rural Valleys-Summary Report*, www.watnsw.com.au/projects/infrastructure-studies/20-year-infrastructure-options-study

21. Burrell M., Moss P., Petrovic J., Ali A., Nicholls D. and Ching M. 2018, *General Purpose Water Accounting Report 2018/19: Border Rivers Catchment*, Department of Planning, Industry and Environment, www.industry.nsw.gov.au/water/allocations-availability/water-accounting/gpwar

Unregulated rivers and creeks

Most of the Border Rivers unregulated rivers and creeks are located in the upper catchment. These include the Mole River, Beardy River and Glen Innes and Tenterfield creeks.

Most of the population in the region is in the upper catchment, where towns rely on unregulated systems and groundwater for their supply. During the 2017-2020 drought, water security for some towns in the upper catchment was at significant risk due to lack of flows, and groundwater from fractured rock sources was used as an alternate back up supply.

In the lower catchment, the Ottleys, Bonshaw, Camp, Campbell, Yetman, Croppa and Reedy creeks are major unregulated streams that join the regulated system.

Securing water for users of unregulated rivers will become increasingly difficult in a future with even greater climate variability. We heard from Gwydir Shire Council that during the recent drought, council delivered 4 ML of water to rural communities for drought relief, including North Star and Croppa Creek. As well as investigating groundwater, some towns such as Tenterfield are looking to the Mole River Dam proposal to increase security of supply to grow industries.

Connectivity with the Barwon-Darling

In the lower catchment, the confluence of the Macintyre and Weir rivers marks the start of the Barwon River. Extensive floodplains up to 20 km wide with a network of ephemeral channels characterise this part of the catchment. These channels convey water that is extracted for floodplain harvesting and can retain water in pools for several months, providing important habitats for flora and fauna.

The Barwon-Darling River, and the communities along the river, rely on inflows from the Macquarie, Namoi, Gwydir and Border Rivers regions of NSW, and also inflows from Queensland.

The Border Rivers region contributes 19% of the average annual flows to the Barwon-Darling River at Menindee Lakes.²² In a major flood, over 90% of the water flows downstream into the Barwon-Darling system.²³ The water sharing plan for the Border Rivers Regulated River Water Source includes rules to restrict access to uncontrolled flow events to help deliver flows to the Barwon-Darling River system.

In recent years, the NSW and Australian governments have progressed a number of reforms to help improve water flows throughout the catchment and into the Barwon-Darling River. This includes:

- coordinated environmental water releases including the Northern Connectivity²⁴ and Northern Fish Flow²⁵ events
- protecting the first flow (first flush) of water from extraction after the extended drought in early 2020
- changing rules in some water sharing plans to enable environmental water to remain in the system as it moves downstream.

22. Murray-Darling Basin Authority 2018 modelling, as quoted in *NSW Border Rivers Surface Water Resource Plan Area Resource Description: Appendix A*, www.mdba.gov.au/publications/mdba-reports/barwon-darling-watercourse-water-resource-plan

23. www.mdba.gov.au/publications/archived-information/basin-plan-archives/guide-proposed-basin-plan

24. More information available at www.environment.gov.au/water/cewo/northern-rivers

25. More information available at www.environment.gov.au/water/cewo/catchment/northern-fish-flow-2019

However, some communities downstream of the Border Rivers have been requesting additional measures to improve connectivity between water sources. In addition, the independent review of the Northern Murray-Darling Basin First Flush Assessment recommended that the NSW Government:

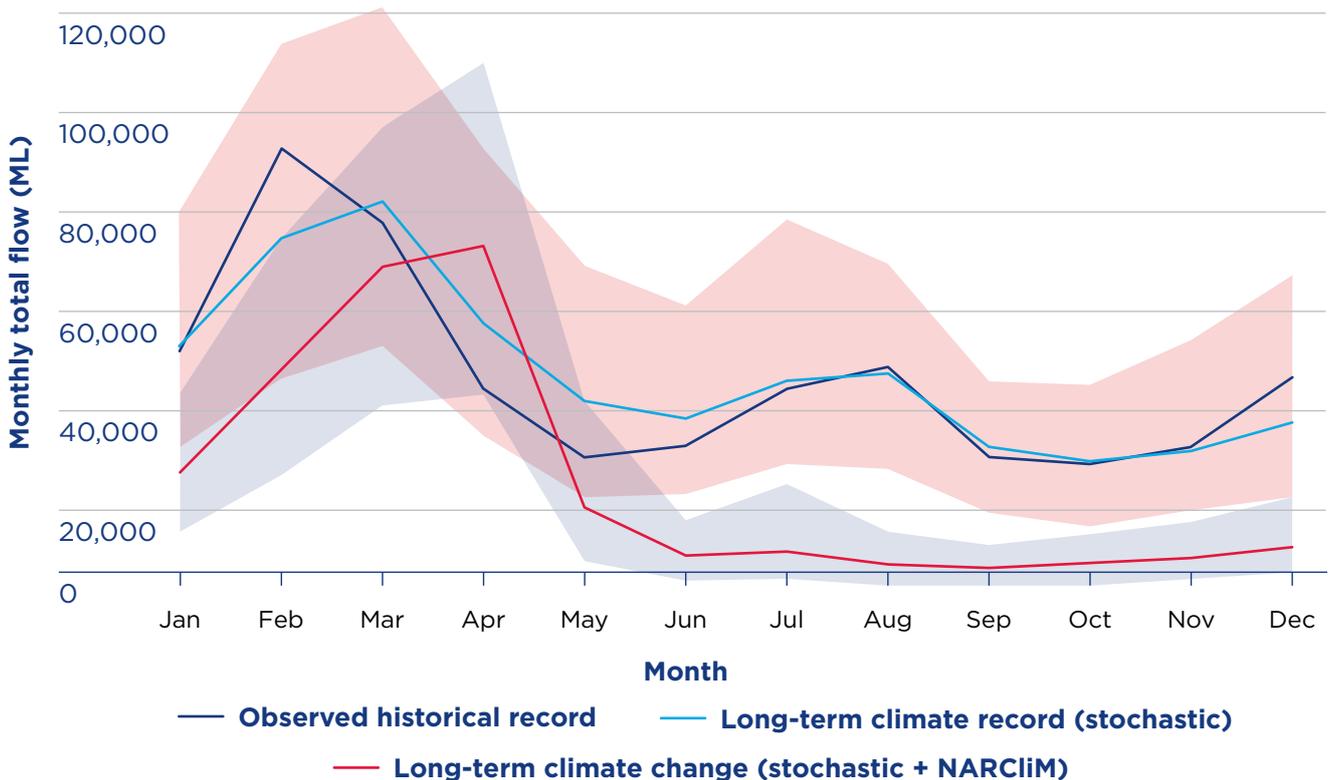
- develop clear arrangements around how decision makers will aim to achieve connectivity within and between water sources after an extended dry period
- engage with water users, Traditional Owners and communities on these arrangements

- embed these arrangements into the regulatory and policy framework for managing drought.

In addition, if the dry climate change scenario from our modelling eventuates, we could see (Figure 16):

- an overall decline in the flows to the Barwon River
- a change in the seasonality of flows to the Barwon River, with a significant reduction in flows in winter, and a delay in peak flows from summer to autumn.

Figure 16. Long-term average of total monthly flows from the Border Rivers region to the Barwon River under different climate scenarios



Given how connected the Border Rivers region is with the Barwon-Darling River system, we may need to look at cross-regional options that improve connectivity and give all communities across NSW fair and equitable access to water. This draft regional water strategy proposes

a number of actions to improve connectivity between the Borders Rivers region and the Barwon-Darling system (see Option 23). The Western Regional Water Strategy may also need to consider options with cross-regional impacts.

On-farm storages and floodplain harvesting

Private on-farm storage structures capture rainfall runoff, or store water extracted from the region's rivers and aquifers, including supplementary water from tributary flows. Water is stored in these private on-farm storages for use on irrigated crops. These storages help to buffer the variability in water availability in the region and periods of reduced supply. Most of these storages are located on the plains adjacent to the Macintyre River.

In addition to the evaporation from rivers and dams, there are large evaporative losses from on farm storages. There are an estimated 111 on-farm storages with a combined capacity of approximately 175,860 ML. The total surface area of on-farm storages in the Border Rivers catchment is estimated to be about 50 km²—similar to the area of Sydney Harbour (55 km²). Hydrologic modelling indicates that combined evaporative and seepage losses from on-farm storages are around 48 GL per annum over a long-term period or 26% of total storage capacity.

On-farm storages on the floodplains may also capture overland flows. Floodplain harvesting is significant in the lower catchment and many agricultural businesses rely on it as a key source of water to support existing and emerging industries.

Floodplain harvesting storages are well distributed along the lower part of the catchment, along the Macintyre River and its tributaries.

The largest concentration of floodplain harvesting storages occurs along the middle section of the Border Rivers catchment between the Goondiwindi and Terrewah gauging stations.

The Floodplain Management Plan for the Border Rivers valley sets clear rules for managing the development of new floodworks and alterations to existing floodworks.

The NSW Government is implementing its Floodplain Harvesting Policy²⁶ (see Better management of floodplain harvesting text on next page) in the Border Rivers region.

The plan seeks to protect the passage of floodwater through the floodplain, while recognising the need to minimise the risk to life and property.

The Healthy Floodplain Project has identified existing floodwork structures (hotspots) that have most significantly altered the flow of floodwaters in the Northern Basin, causing social, economic, ecological and cultural impacts. These have been built on floodplains to support agricultural development and control floodwaters. 33 floodplain hotspots were identified in the Border Rivers region. Options presented in this draft regional water strategy include a proposal to modify or remove unauthorised floodwork structures that are causing adverse impacts, with the aims of protecting vital ecological assets and improving water security (Option 15).

26. Department of Planning, Industry and Environment 2019, *Floodplain Harvesting Action Plan*, www.industry.nsw.gov.au/water/plans-programs/healthy-floodplains-project/harvesting



Better management of floodplain harvesting

The NSW Government introduced a floodplain harvesting policy in 2013 so that it can be better managed within legal limits. The policy brings floodplain harvesting within the current water licensing framework and caps the amount of water that is taken so that water use can return to the statutory limits set by the water sharing plans. Long-term average annual extraction limit estimates are being updated and other amendments made to the water sharing plans to incorporate floodplain harvesting controls.

The *2019 Floodplain Harvesting Action Plan* sets out the NSW Government's commitments to use the best available facts, data and scientific analysis, consult and set clear rules, ensure rules are followed and improve floodplain harvesting management over time.

Groundwater

Groundwater availability and quality varies across the region according to the geology and location. Groundwater in the Border Rivers region is found in different types of formations in layers on top of each other (Figure 17):

- The lowest formations are the New England Fold Belt in the upper catchment, and the Lachlan Fold Belt in the lower catchment.
- The Gunnedah Oxley Basin is an old sedimentary basin overlying the Lachlan Fold Belt in the lower catchment.
- The Great Artesian Basin is a younger sedimentary basin that overlies the Gunnedah Oxley Basin and the fold belts in the lower catchment.
- Inverell Basalt has volcanic origins and overlies the New England Fold Belt around Inverell.
- Alluvial sediments are the topmost formation and are associated with major rivers in the lower catchment.

In the upper catchment, most groundwater sources have low yields and their quality varies due to the local geology. Nonetheless, groundwater is an important water source for town water supplies (such as Tenterfield), domestic consumption and stock watering. Fractured rock groundwater systems are low yielding. Despite this, towns such as Glen Innes are interested in exploring the capacity of local groundwater sources for town water supply, but a lack of knowledge about these sources means some investigation work is initially required.

Significant alluvial aquifers are associated with the Dumaresq River, the Macintyre River and Ottleys Creek.²⁷ Groundwater from the main alluvium along the Macintyre River is used for

irrigating field crops and pastures, domestic consumption and stock watering. The upstream part of the alluvium is highly productive with yields reaching 60 L/s. The downstream part of the alluvium is of poor quality for irrigation. The tributary alluvium sources are shallow and generate low yields.

The Border Rivers Alluvium is fully allocated although use is less than the extraction limit. This presents a potential challenge for licence holders if use increases and water allocations are reduced to prevent the extraction limit being exceeded. Analysis of long-term changes indicates that groundwater levels have declined in response to groundwater extraction upstream of Keetah Bridge.²⁸ A challenge will be to manage these impacts to ensure extraction remains locally sustainable.

The Border Rivers Alluvium in NSW extends into Queensland and is hydraulically connected with the same origin, composition and structure. Each State is responsible for managing groundwater on its own side of the border, through its own legislation but along agreed guidelines under the Border Rivers Commission. A joint management framework, common assessment criteria for bores and the understanding of cumulative impacts across the border would improve cross-border groundwater management.

The Great Artesian Basin underlies a large part of western NSW and is an important source of groundwater in the lower catchment. High yielding bores capable of large-scale irrigation have been developed near Croppa Creek and North Star tapping the Great Artesian Basin Eastern Recharge Groundwater Source, with bores yielding up to 100 L/s in this area. In the Surat Groundwater Source, the high sodium content of the groundwater makes it unsuitable for irrigation but with treatment it is an important source for town water

27. Along the regulated sections of the river, the alluvial systems have been divided into four different sources (all four called the NSW Border Rivers Alluvial Groundwater Sources): 1) the Macintyre Alluvial Groundwater Source; 2) the NSW Border Rivers Upstream Keetah Bridge Alluvial Groundwater Source; 3) the NSW Border Rivers Downstream Keetah Bridge Alluvial Groundwater Source; and 4) the Ottleys Creek Alluvial Groundwater Source.

28. Department of Planning, Industry and Environment 2019, *NSW Border Rivers Alluvium Water Resource Plan Groundwater Resource Description: Appendix A*, www.mdba.gov.au/publications/mdba-reports/nsw-border-rivers-alluvium-water-resource-plan

supplies, such as for Mungindi. Additional uses of the groundwater source include domestic consumption and stock watering. Across the Great Artesian Basin, the Cap and Pipe Program initiated in 1999 has managed to recover artesian pressures in this region, with bores now flowing again.

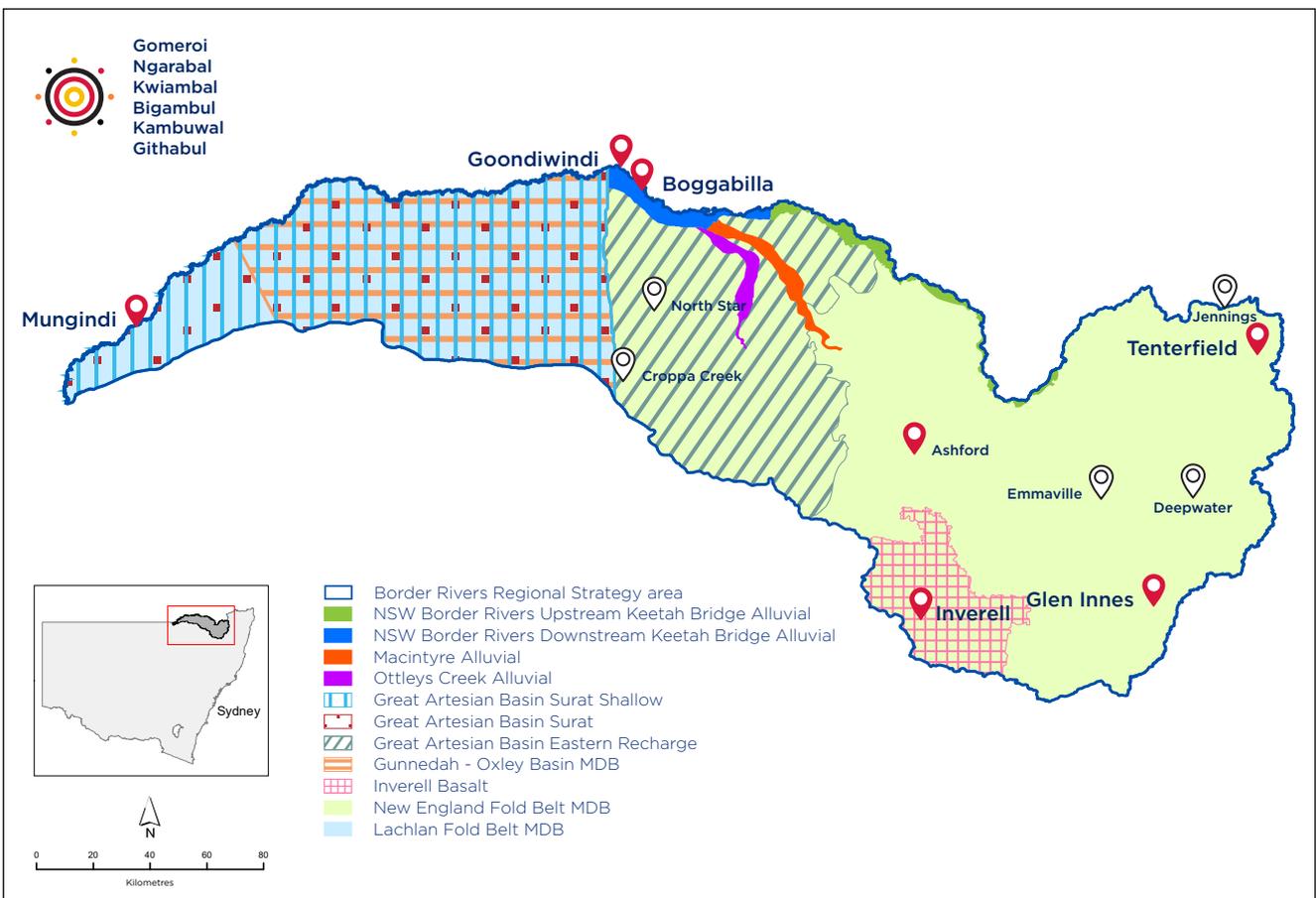
Across the region, groundwater is an important source of town water supply especially in dry years when surface water flows are low. For small communities, such as Boomi and Yetman, groundwater is the only source of water. Intensive extraction is causing declining groundwater levels within the catchment such as in the Great Artesian Basin Eastern Recharge Groundwater Source.

Continuing to improve our understanding of groundwater will enable better informed decisions about its management and use. Gaining knowledge about groundwater availability across the entire Border Rivers

region, not just in areas where it is usually accessible, and providing this information to towns and industries could significantly improve water resource planning and management during drought. It could also help communities to make informed decisions about which water sources to access at different times.

NSW has a robust groundwater management framework that has undergone significant reform. However, opportunities still exist to continue to improve how we manage groundwater resources. Several groundwater-related options are proposed in this draft strategy. These options focus on using groundwater more efficiently, innovatively and sustainably (Options 35 and 36), making sure groundwater of suitable quality is available for critical needs (Option 14), improving our understanding of groundwater processes (Option 37) and better managing risks to the resource (Options 38 and 39).

Figure 17. Groundwater sources in the Border Rivers region



Recycled water

Investing in recycled water presents an opportunity to diversify water sources and buffer water availability from the impacts of droughts. Three of the five local water utilities that source water within the Border Rivers region produce recycled water for reuse. In 2018/19:

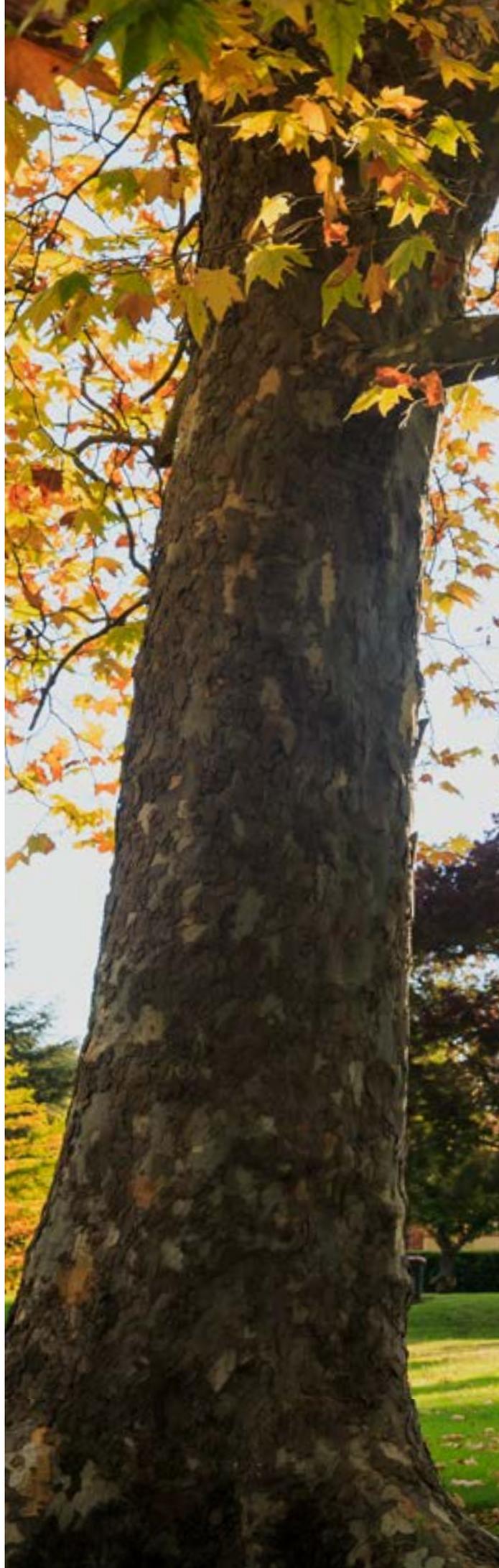
- 101 ML of recycled water was supplied by Tenterfield Shire Council (36% of the total wastewater collected by the local water utility)
- 35.5 ML of recycled water was supplied by Gwydir Shire Council (15% of the total wastewater collected by the local water utility)
- 1,417.5 ML of recycled water was supplied by Moree Plains Shire Council (74% of the total wastewater collected by the local water utility).²⁹

The bulk of water recycled is reused for commercial, industrial, agricultural and municipal purposes. It is not used for drinking water supply. Glenn Innes Severn Council used recycled water to maintain firefighting water supplies over the 2019/20 summer. We have heard from councils that the largest barriers to investing in recycled water is community acceptance, and driving behavioural change could be led through a state-wide approach.

In other regions, we have heard that barriers to investing in recycled water include regulatory requirements around treating recycled water for potable uses and costs associated with treating water.

The regional water strategies provide an opportunity to explore whether highly treated recycled water should be considered for use in drinking water supply, along with other initiatives (such as stormwater harvesting) that could increase town water security (Option 26).

29. www.industry.nsw.gov.au/water/water-utilities/lwu-performance-monitoring-data





Strategic plans to ensure town water security and support emergency firefighting efforts in Glen Innes

The most recent drought, combined with bushfires placed unprecedented pressure on Glenn Innes' water supplies. The innovative and flexible strategies Glen Innes Severn Council implemented helped the region withstand conditions far worse than it had experienced before and included:

- **Treated wastewater to support bushfire efforts** which was stored in a purposefully built pond before delivery—the town hosted a Rural Fire Service base with 200 firefighters as well as an aerial firefighting base for deployment across the New England region during the 2019/2020 bushfire efforts.

- **Building an off-stream storage** in a disused basalt quarry site to provide 500 ML of additional supply to the town—a cost-effective solution to increase town water storage capacity. The council is exploring options for the next stage of the project with the expansion of the existing ponds and a green field site nearby.
- **Applied water restrictions** for a total of 441 days.

The combination of innovative supply options and demand management measures have helped improve the resilience of Glen Innes' water sources during drought.

2.2.2 Water and the regional environment

The Border Rivers region is home to a range of unique ecological and culturally significant sites. Approximately 2% of the broader catchment comprises floodplain wetlands and woodlands, nearly 61,000 ha of which is in NSW.³⁰

The region has many water dependent environmental features, including:

- **Endangered Ecological Communities**—The Macintyre River below Graman Weir, Severn River downstream of Pindari Dam and the Dumaresq River below the junction with the Mole River are listed under the *Fisheries Management Act 1994* as part of the Darling River Endangered Ecological Communities.
- **Significant wetlands**—The Morella Watercourse, Boobera Lagoon and Pungboulal Lagoon complex is a nationally significant wetland located on the Macintyre River floodplain. The Boobera Lagoon is an important Aboriginal cultural site and one of the few permanent waterbodies in the Northern Basin providing critical habitat for wildlife during drought. Wetlands in the Kwiambal National Park and lagoons in the lower Macintyre River provide drought refuges for aquatic flora and fauna, including several freshwater turtle species, and are important breeding grounds for native species.³¹
- **Threatened native flora and fauna species**—The Boomi River, Tenterfield Creek, Mole River and Inverell water source are all important river reaches for threatened

species including diverse native fish, frog and turtle populations. Murray Cod are known to breed on the Boomi River, upstream of Whalan Creek. The Dumaresq River macrophyte beds are a stronghold for the threatened Olive Perchlet. The Macintyre River is categorised as a 'key movement corridor'.³² There are priority drought refuge sites for fish identified in the Border Rivers catchment including the Severn River and Dumaresq River.

- **Connectivity to the Barwon-Darling River**—The Border Rivers system is an important connectivity corridor delivering essential ecosystem flows for the Barwon-Darling system.

Groundwater sources support significant ecosystems of ecological value including wetlands, springs, vegetation and base flow ecosystems. Communities of River Red Gum woodland wetlands, Lignum wetlands and freshwater wetlands are linked to these groundwater sources.

Healthy water sources support these environmental assets and species. Maintaining the lateral connectivity of wetlands, flood runners and billabongs, and supplying sufficient overbank flows, is essential to preserve the health of anabranches, threatened aquatic species and biodiversity. A healthy environment also improves the liveability of the region, contributes to the health and wellbeing of communities and sustains tourism and other industries. For example, healthy fish species support Aboriginal cultural and recreational fishing in the region and provide a stimulus to local economies.

30. Kingsford, R.T., Brandis, K., Thomas, R., Chriton, P., Knowles, E. and Gale, E. 2003, *The distribution of wetlands in New South Wales*, www.environment.nsw.gov.au/topics/water/wetlands/about-wetlands

31. These are the Broad-shelled Turtle (*Macrochelodina expansa*), the Eastern long-necked turtle (*Chelodina longicollis*) and the Macquarie Turtle (*Emydura macquarii*).

www.environment.nsw.gov.au/topics/animals-and-plants/native-animals/native-animal-facts/freshwater-turtles

32. Office of Environment and Heritage 2018, *NSW Border Rivers Long Term Water Plan*, Parts A and B Draft for exhibition, www.environment.nsw.gov.au/research-and-publications/publications-search/nsw-border-rivers-long-term-water-plan-parts-a-and-b

Current environmental challenges

In 2015 the majority of the fish community in the Border Rivers region was assessed to be in a moderate condition, with some rivers such as the Dumaresq, mid-lower Macintyre, Boomi and Upper Barwon and Whalan Creek rated as good.³³ This provides a strong platform for native fish population recovery, provided management actions are developed and implemented appropriately.

However, the impact of the 2019/2020 bushfires and drought on the health and condition of native fish populations in the valley has yet to be assessed. As such, the current condition of listed species is unknown. In February 2020 the Department of Agriculture, Water and the Environment placed the previously unlisted Darling River Hardyhead and Northern River Blackfish (both present in the Border Rivers) on a provisional list of species requiring urgent intervention and assessment for listing under state and national conservation legislation.

There are further constraints that affect the Border Rivers region's ability to meet environmental watering objectives. These constraints also impact the delivery of river flows into the Barwon-Darling Rivers and include the following:

- **Infrastructure, including water storages, weirs and road crossings** impact riparian systems. In-channel infrastructure changes natural river flow patterns and connectivity among and between rivers. Water storage in dams and weirs has decreased the volume and average frequency of flows that connect anabranches and billabongs of the Macintyre River floodplain by about 22%.³⁴ This limits the resilience of fish that rely on this connectivity to move and recruit.³⁵
- **Cold water pollution** is caused by the release of cold water from dams and weirs, which has the potential to alter the natural temperature of aquatic ecosystems and pose a serious threat to the viability and survival of fish populations.³⁶ Cold water pollution affects the Dumaresq, Severn and Macintyre rivers, extending 100 km below Pindari Dam. While Pindari Dam is equipped with a multi-level offtake to enable the warmest water at the surface to be released, blue-green algae blooms on the surface often mean colder water is released from lower levels instead. The risk of cold water pollution can also be reduced by releasing flows over a longer period rather than as a bulk release.
- **Diversions and infiltration along a lengthy system** affect water flows, potentially reduce the availability of water for the environment and adversely impact native fish populations. There is a particular concentration of pumps with a diameter of greater than 200 mm in the mid-lower catchment. These occur primarily on the mainstream Macintyre River from its junction with the Severn River and downstream to Mungindi. There are also concentrations of pumps on the Dumaresq and Boomi Rivers.
- **The channel capacity of some creeks** is limited in some locations which limits the amount of water that can be delivered down those channels.

33. Department of Primary Industries 2015, *Fish and Flows in the Northern Basin: responses of fish to changes in flow in the Northern Murray-Darling Basin—Valley Scale Report*, Final report prepared for the Murray-Darling Basin Authority, www.dpi.nsw.gov.au/fishing/habitat/rehabilitating/fish-and-flows

34. Balcombe, S., Arthington, A.H., Thoms, M.C. and Wilson, G.G. 2011, *Fish assemblage patterns across a gradient of flow regulation in an Australian dryland river system*. *River Research and Applications*, 27, p168-183, onlinelibrary.wiley.com/doi/abs/10.1002/rra.1345

35. Balcombe, S., Arthington, A.H., Thoms, M.C. and Wilson, G.G. 2011, *Fish assemblage patterns across a gradient of flow regulation in an Australian dryland river system*. *River Research and Applications*, 27, p168-183, onlinelibrary.wiley.com/doi/abs/10.1002/rra.1345

36. Department of Infrastructure, Planning, and Natural Resources 2004, *Cold water pollution below dams in New South Wales*. A desktop assessment, www.industry.nsw.gov.au/water/science/surface-water/quality/temperature

- **Floodplain structures on private property** limit the ability of water to flow down the system in some locations and act as a barrier to fish movement. Licensing and removal of these structures is dealt with by the Floodplain Management Plan.

In addition, ongoing dry conditions are particularly damaging to high-value ecosystems and native fish populations, and work to evaluate the impact of the recent drought is underway. During extended dry periods, there are limited opportunities to use environmental water licences to support environmental outcomes. We heard from councils that we need to provide enough water to allow ecosystems to recover between extreme events like droughts and bushfires.



Impacts of future climate variability on the environment

For the environment, higher temperatures, increased evaporation, increased bushfire risk, changes to rainfall patterns and associated flows, and potentially more intense dry and wet periods have the potential to significantly impact ecosystems that have evolved over millennia to thrive in natural cycles that are now changing. These changes are worsened by more recent modifications in flow regimes due to irrigation and water infrastructure.

The effects of climate change in the Border Rivers catchment were determined by comparing metrics calculated on the long-term climate and climate change scenario. These comparisons indicate the potential for significant changes to river flows over the coming 40 years, which could impact on riverine and floodplain ecosystems.

In general, our modelling simulations estimate:

- extreme events could become more extreme—both at the wet and dry ends of the spectrum
- the median volume of water flowing in the Border Rivers region each year could reduce by 45%, impacting all components of the flow regime (Figures 18 and 19)
- the magnitude of high flow events³⁷ (flows with an average recurrence interval of 2.5 years) could decrease by 45% in the regulated Macintyre River and 53% in the Mole River
- the frequency of flows that feed anabranches could decrease by 60% and the period between these flows could increase by 130%
- the number of years in which intermittent environmental flows (known as stimulus flow) from Pindari Dam can be released could be reduced by 43%
- the number of times regulated and unregulated rivers stop flowing could increase by 15-25% (Figure 20), and the duration of these cease-to-flow events could also increase.

If these modelled scenarios came to pass, the impacts could include:

- fewer events that trigger fish movement and spawning
- reduced opportunities for water birds to breed and successfully rear their young
- reduction in overbank flows that stimulate riverine productivity by transporting carbon and nutrients into the system
- drying of flowing water habitats
- impacts on water quality through increased sedimentation, elevated water temperatures and low dissolved oxygen levels
- reduced waterway connectivity throughout the Border Rivers region and connectivity to the Barwon-Darling system
- reduced amenity of the aquatic ecosystem.

37. Measured as 2.5 Average Recurrence Interval. Average Recurrence Interval is the likelihood of occurrence, expressed in terms of the long-term average number of years, between flood events as large as or larger than the design flood event. For example, floods with a discharge as large as or larger than the 2.5-year Average Recurrence Interval flood will occur on average once every 2.5 years.

Figure 18. Impacts of climate risks on the flow regime (high and median flows)

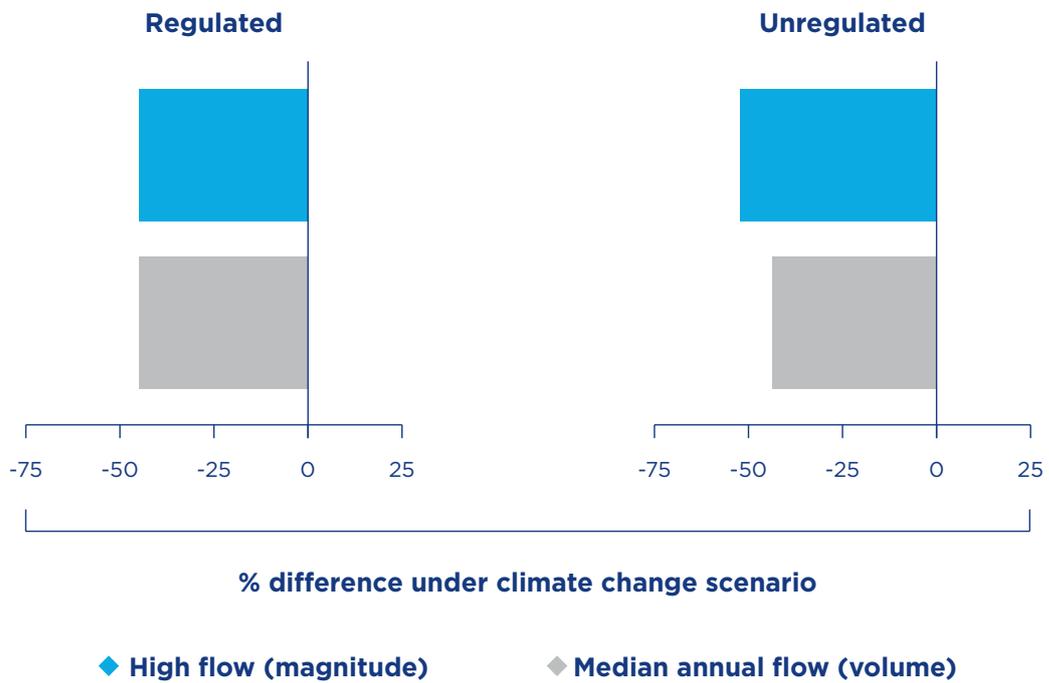


Figure 19. Impacts of climate risks on the flow regime (anabranh flows)

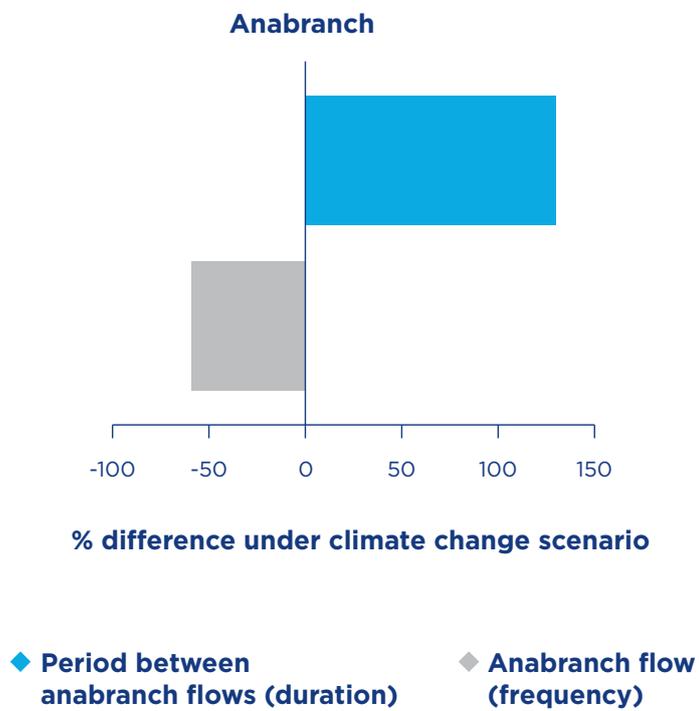
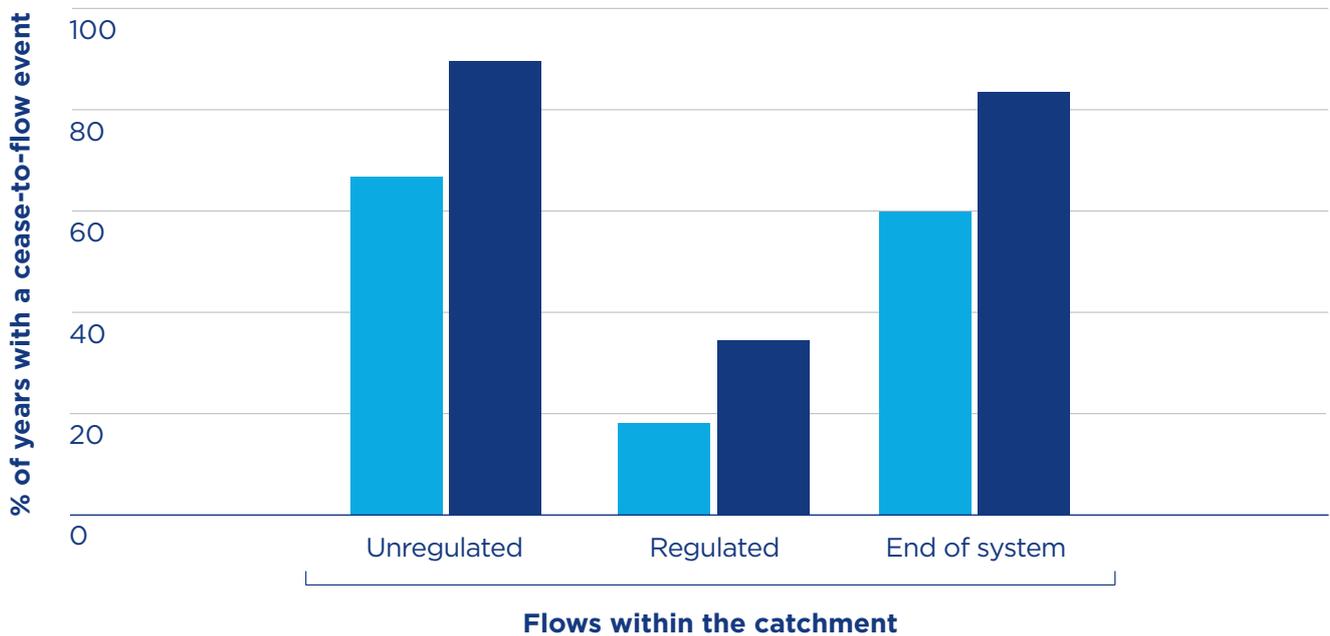


Figure 20. Impacts of climate risks on the flow regime (cease-to-flow events)



- ◆ Long-term historical climate projections (stochastic) record
- ◆ Long-term climate change (stochastic + NARCIIM)

Importantly, these climatic changes will not occur in isolation, but will coincide with potential increases in demand for water resources, market shifts, land use and agriculture. The current environmental water arrangements may not be as effective under a hotter and drier climate with more frequent drought periods based on the existing volume of licensed (held) environmental water and a lack of protection for planned environmental water. Further, the release of planned environmental water, and supplementary access for environmental water are tied to flow thresholds that may not be possible to meet under a hotter and drier climate with prolonged periods of low or no inflow. This presents a long-term risk to river, wetland and floodplain health, making it more difficult to manage our landscapes and ecosystems—and the human activities that depend on and benefit from them. A more variable climate means that concerted and coordinated efforts will be required to protect and enhance the region’s vital environmental, economic, social and cultural assets into the future.

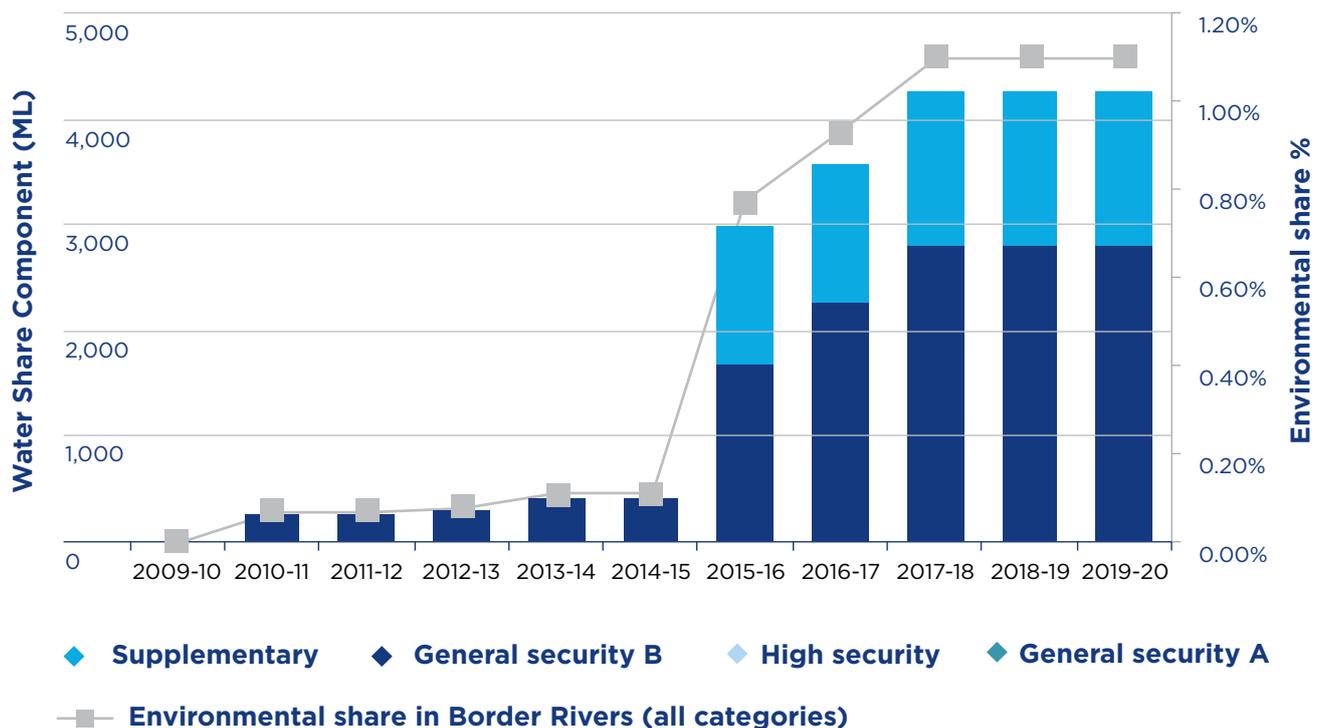
Options presented in this Draft Border Rivers Regional Water Strategy have a strong focus on improving the health and resilience of natural systems and protecting aquatic species. This includes measures to reduce the impact of cold water pollution (Option 12), the modification or removal of floodwork structures that are causing adverse environmental impacts (Option 15) and specific actions to support and increase native fish populations (Options 10 and 11). The strategy also includes options to encourage landholders to conserve and rehabilitate riparian habitats and wetlands, and re-establish threatened species (Options 16 and 17).

Opportunities and existing arrangements to protect and enhance environmental flows

Current environmental water entitlements in the Border Rivers region are shown in Figure 21. A range of existing tools are available to help maintain and improve the environmental flows of rivers. These include:

- minimum daily releases of 10 ML from Pindari Dam to provide a continuous low flow downstream of the dam
- daily releases of inflows into Pindari Dam of 50 ML (from September to May) or 200 ML (from June to August)
- stimulus releases of 4,000 ML of planned environmental water from Pindari Dam between August and December, but only if a daily inflow of 1200 ML or more has occurred on any day between April and August
- 25% of supplementary flow events being reserved for the environment
- 39.7 GL of licensed environmental water held by the Commonwealth Environmental Water Holder.³⁸ The Northern Basin Review recommended that further water should be recovered for the environment: 7 GL from NSW and 26 GL from Queensland.

Figure 21. Environmental water volumes in the Border Rivers region



Source: Department of Planning, Industry and Environment, *General Purpose Water Accounting Statement 2019 Border Rivers Catchment (to be published)*

38. In NSW, the Commonwealth Environmental Water Office holds 4.2 GL of entitlements (2.8 GL general security and 1.4 GL supplementary). In Queensland, the Commonwealth Environmental Water Holder holds 35.5 GL of entitlements, www.environment.gov.au/water/cewo/about/water-holdings

Providing water for a healthy environment can be difficult, particularly during dry conditions when there are reduced inflows into Pindari and Glenlyon dams and fewer floods. As most of the water for environmental assets comes from planned environmental water, the water available for ecological assets and ecosystem functions is related to inflow levels, which are difficult to meet during dry periods and require protection from extraction. Currently, protection for water released from Pindari Dam is limited to the Severn River between Pindari Dam and the junction with Frazers Creek.

In addition, licenced environmental water is subject to the same pressures and availability as for general security, supplementary and unregulated licence holders, including agriculture. This means that licences held for the environment are subject to the same allocations process as are other licences in the same category.

The stimulus flow can also only be used during a specific four-month window, while releases from Pindari Dam are only protected to the confluence of the Severn River and Frazers Creek. Under drought or long-term dry conditions, flexibility in the delivery of environmental water is needed. Long-term

climate changes may require an increase to environmental watering volumes and a more flexible approach in the management of environmental water.

In unregulated rivers, an increase in the volume of environmental water entitlements can lead to an increase in the ability of other water users to take water if environmental water is left in the river and raises river levels. This is because, in the unregulated systems, a water user's ability to take water allocated to their licence is linked to the height of the river and not to a water order. A number of options are proposed to better manage environmental water in unregulated rivers in the region. These include actively managing access to flows to allow held environmental water to remain in-stream for environmental purposes (Option 21), revising water sharing plan provisions for planned environmental water (Option 19) and improving the benefits of planned environmental water (Option 20). Taking these actions would help to ensure that environmental water achieves its intended purpose, provides greater certainty to all water users about how flow events will be managed and improves transparency around when water can or cannot be taken.

Release of environmental flows for fish communities and habitats

Despite the reduction of flows and limited volumes, the release of water for the environment appears to have improved the native fish community in the Border Rivers region, including having a positive effect on recruitment and the maintenance of habitat and fish communities.³⁹ These environmental flows provided increased inundation of key features in all regulated waterways in the region, while also providing greater localised connectivity and movement opportunities

for fish. Additional water for the environment would improve these conditions even further.

Low flow events in the Dumaresq, including water for the environment released in late 2017, inundated a large proportion of key habitat and contributed to improving overall fish condition in the Dumaresq and Macintyre rivers in early 2018.

Similarly, the release of water for the environment in the Severn in late winter 2017 helped lead to an improvement in overall fish condition in late 2017 and early 2018.⁴⁰

39. Commonwealth Environmental Water Office 2018, *Commonwealth Environmental Water Portfolio Management Plan: Border Rivers 2018-19*, www.environment.gov.au/water/cewo/publications/portfolio-mgt-plan-border-rivers-2018-19

40. Commonwealth Environmental Water Office 2018, *Commonwealth Environmental Water Portfolio Management Plan: Border Rivers 2018-19*, www.environment.gov.au/water/cewo/publications/portfolio-mgt-plan-border-rivers-2018-19

Water quality

Water quality in the Border Rivers is strongly correlated with river flow. High flow from rainfall and runoff results in higher suspended solids (turbidity), nutrients and possibly pesticides and pathogens. There is also a general trend towards increasing turbidity and nutrient concentration with distance down the catchment as cumulative impacts increase. Prolonged periods of low flow under hot and dry conditions are associated with poor water quality, increasing treatment costs for drinking water supplies and increasing the risk of fish kills.

Previous analysis to support development of the Border Rivers Water Resource Plan found that:

- **turbidity** is particularly problematic for the region's town water supply operators as it can cause odour problems and reduce the effectiveness of disinfection. Turbidity can also impact the cultural and social uses of water. There are high risks to ecological values from turbidity in the lower sections of the catchment
- there are locations where **nutrients, pH and dissolved oxygen** are outside target ranges. There are high risks to ecological values from total phosphorus, total nitrogen and pH in the Macintyre River around Inverell and Wallangra,⁴¹ and concentrations of dissolved oxygen and elevated levels of nitrogen and phosphorous in water storages and regulating weirs across the region
- **cold water pollution** from Pindari Dam and Glenlyon Dam is a high risk to ecological values downstream of the dams for over 100 km and as far as Glenarbon Weir (downstream of Texas)⁴²
- **blue-green algae** is a recurrent issue in the Border Rivers region. Blue-green algae occurs naturally and can reproduce quickly when there is still or slow-flowing water, abundant sunlight and sufficient levels of nutrients. Blue-green algae is a problem for town water supply, affects cultural and social uses of water, and impacts fauna. Algal warnings have been issued for Pindari Dam and weirs along the Macintyre River. WaterNSW releases water from lower levels in Pindari Dam to avoid releasing blue-green algae at the surface, but this can lead to cold water pollution. During low flows, algal blooms can also develop in Lake Inverell
- the Border Rivers catchment has variable **in-stream salinity and salt load**. High in-stream salinity arises from upper and mid-valley catchments above and below Pindari Dam. Causes of salinity in the Border Rivers include changes in the water balance, redistribution of salt in the landscape, groundwater processes and dry salt scalds that expose salts. Aquatic ecosystems in these tributaries are at medium risk of impacts from salinity during low and cease-to-flow periods
- there are also some point sources of pollution in the upper catchment related to **historic mining activities**. Ottery Arsenic and Tin Mine and Glen Smelting Tailings Emplacement at Tent Hill are point sources of arsenic, and acid and metalliferous drainage. Conrad Mine is a point source of heavy metals. The NSW Government has a program to rehabilitate derelict mines, including these sites, and some rehabilitation works have already been undertaken.⁴³

41. Department of Planning, Industry and Environment 2019, *Water quality management plan for the NSW Border Rivers water resource plan areas SW16: Surface Water 2016: Appendix H*, www.mdba.gov.au/publications/mdba-reports/nsw-border-rivers-water-resource-plan

42. Department of Planning, Industry and Environment 2019, *Water quality management plan for the NSW Border Rivers water resource plan area SW16: Appendix H*, www.mdba.gov.au/publications/mdba-reports/nsw-border-rivers-water-resource-plan

43. Department of Resources and Geoscience, www.resourcesandgeoscience.nsw.gov.au/landholders-and-community/minerals-and-coal/legacy-mines-program/case-studies

These water quality issues can reduce the availability and security of water supplies.

We heard from local councils that the impact of recent bushfires on water quality cannot be understated. The bushfires caused destabilisation of soil and sediment, and burnt organic material washed into rivers causing fish kills. To mitigate these impacts, councils graded sealed roads to remove sediment and cleared multiple pipe blockages caused by sediment. Councils have suggested bringing the management of bushfire risks into the water management framework.

Broader catchment management and land management plans are also needed to improve water quality and stop sediment or ash washing from bushfire-affected land, through actions such as revegetation and establishment of riparian buffer strips.

Water quality is managed through several legislative and regulatory instruments and agencies. For all inland NSW regions, water quality management plans have been prepared to support the development of the water resource plans and meet relevant requirements of the Basin Plan. These plans provide a framework to protect, enhance and restore water quality to achieve the following outcomes:

- provide essential and recreational amenities for rural communities

- protect and improve ecological processes and healthy aquatic ecosystems
- fulfil Aboriginal peoples' spiritual, cultural, customary and economic values
- assist industry to be productive and profitable.

Water sharing plans are a key mechanism to manage water quality in the Border Rivers region. The plans use flow-based rules (like extraction limits, protection of tributary flows and cease-to-pump rules) to help ensure sufficient flow is available to meet water quality objectives and targets. Additional rules are available through the approval and licensing framework, including ensuring set back distances and construction standards are enforced to limit groundwater drawdown and minimise the likelihood of increased salinity.

The regional water strategy process offers an opportunity to consider whether any additional actions are needed to help manage water quality in the Border Rivers region. As well as specific actions to support the region's water quality management plans (Option 13), several options proposed in this draft strategy would improve water quality across the region (Options 9, 12, 14 and 44).



2.2.3 Managing water in the Border Rivers region

Water in the Border Rivers catchment is shared between NSW and Queensland, as the state border bisects the catchment. Within NSW, water is managed and shared under the *Water Management Act 2000*, with specific water sharing rules set out in relevant water sharing plans.⁴⁴

In addition to sharing water, many cross-border communities support each other during droughts.

Water sharing with Queensland

Water sharing arrangements along the Queensland border are managed by the Dumaresq-Barwon Border Rivers Commission (Border Rivers Commission) (see Border Rivers Commission text). The Border Rivers Commission operates and maintains the jointly owned major assets, including Glenlyon Dam, Boggabilla Weir and smaller weirs/regulators, along the main carrier of the Border Rivers. In addition, inflows to the main regulated streams, including into Glenlyon Dam, are shared 57%-43% between NSW and Queensland respectively.

Cross-border water management can be challenging at times due to the differences in legislation and rules between NSW and Queensland. It also means that towns relying on shared infrastructure to provide water supplies may not have control over when water is released. We heard from Gwydir Shire Council that this was an issue for Boggabilla during the most recent drought (2017-2020).

Changes to rules, infrastructure and water flows that are shared between the two states need to be negotiated through the cross-border

Border Rivers Commission

The Border Rivers Commission was created under the provisions of the 1946 New South Wales-Queensland Border Rivers Agreement to implement the agreement in relation to:

1. sharing the waters of the rivers and streams which either form or intersect the boundary between the two states and the associated groundwater resources, and
2. operating and maintaining water infrastructure.

The 2008 Intergovernmental Agreement was established to provide alignment with the Council of Australian Governments, the Murray-Darling Basin Plan and National Water Initiative water reforms. Areas covered include environmental flow management, the delivery of flows to the Darling River downstream of Mungindi, interstate water sharing and access arrangements, and trading of water.

Water sharing:

Regulated river flows, regardless of their state of origin, are shared between NSW and Queensland in the ratio 57:43.

arrangements. We have heard from councils that these cross-border arrangements are complex to navigate. This draft strategy includes options to address cross-border issues and improve cross-border water management. (Options 5 and 40).

44. More information about water policy and planning is provided in the *Regional Water Strategies Guide*.

Areas of operation:

- Glenlyon Dam on Pike Creek in Queensland
- the Border Rivers, which include the parts of the Dumaresq, Macintyre and Barwon Rivers that constitute the boundary between NSW and Queensland from Mingoola to Mungindi
- the intersecting streams, which include the Moonie, Bokhara, Narran, Culgoa, Ballandool, Warrego and Paroo rivers and their effluents and tributaries, and any stream or watercourse which forms part of the Darling River drainage system and crosses the New South Wales-Queensland border west of the town of Mungindi.

Infrastructure controlled:

- Glenlyon Dam
- Boggabilla weir
- Bonshaw weir
- Cunningham weir
- Glenarbon weir
- Goondiwindi weir
- Boomi diversion weir
- Mungindi weir
- Bifurcation weirs
- Newinga Regulator

Functions:

- water quantity assessment and determination of volume available to the states
- arrange for construction, operation and maintenance of
 - storages and weirs
 - gauging stations to record the flow in the Dumaresq River at Mingoola and at such other places as deemed necessary
- coordinated program to monitor water quality in the border rivers and the intersecting streams
- construction, maintenance, operation and control of an effective system of monitoring groundwater
- investigate the practicability of constructing, maintaining and operating additional storages.

Functions outsourced to service providers:

1. River management—WaterNSW
2. Resource assessment—WaterNSW
3. Facility management of jointly owned assets—SunWater (QLD)
4. Hydrography—WaterNSW and DNRME (QLD).

Source: Border Rivers Commission website

Dealing with extraction limits

The Murray-Darling Basin Plan sets the limit on the amount of water that can be extracted from water sources in the Border Rivers region, except for the Great Artesian Basin. Current estimates of the annual limits for the Border Rivers region are 323.6 GL for surface water⁴⁵ and 8.8 GL for groundwater, excluding the Great Artesian Basin⁴⁶ and fractured groundwater sources.

In NSW, these limits are implemented through the long-term average annual extraction limits (LTAAEL) in water sharing plans. Currently, the following plans operate in the Border Rivers region:

- *NSW Border Rivers Regulated River Water Source (2009)*
- *NSW Border Rivers Unregulated Water Sources (2012)*
- *NSW Border Rivers Alluvial Groundwater Sources (2020)*
- *NSW Great Artesian Basin Shallow Groundwater Sources (2020)*
- *NSW Great Artesian Basin Groundwater Sources (2020)*
- *NSW Murray-Darling Basin Fractured Rock Groundwater Sources (2020)*
- *NSW Murray-Darling Basin Porous Rock Groundwater Sources (2020).*

The current rules for allocating surface water and determining extraction limits in NSW are based on rainfall records from the 125 years prior to the development of the first water sharing plan. Based on this historical data, reserves are set aside to operate the river system through extended dry periods. The rules do not anticipate a scenario where the region's climate is likely to be more variable in the future, with more severe droughts occurring more often.

In groundwater sources with low connectivity with surface water, extraction limits are based on the percentage of estimated rainfall recharge that is not reserved as planned environmental water. In groundwater sources with high surface water connectivity, the extraction limit is based on the best estimate of the average level of historic extractions. The Macintyre Alluvial Groundwater Source is also subject to annual management through linked available water determinations to the high security allocations of the regulated river.⁴⁷

Preparation of the regional water strategies offers an opportunity to consider whether our resource assessment and allocation settings are at the right levels, particularly in relation to new climate data, regional trends and other contemporary information.

In addition, as noted in section 2.2.1, there has been growth in floodplain harvesting structures in recent years. This means the potential to extract water above the sustainable diversion limit is high. Restrictions on the use of floodplain harvesting structures will need to apply to bring extraction within the valley back to the limit.

45. Department of Planning, Industry and Environment 2019, *NSW Rivers SW MRP—Modelling—Annual Permitted Take Scenario Report 2018 (update): Attachment B to Schedule F*, www.mdba.gov.au/publications/mdba-reports/nsw-border-rivers-water-resource-plan

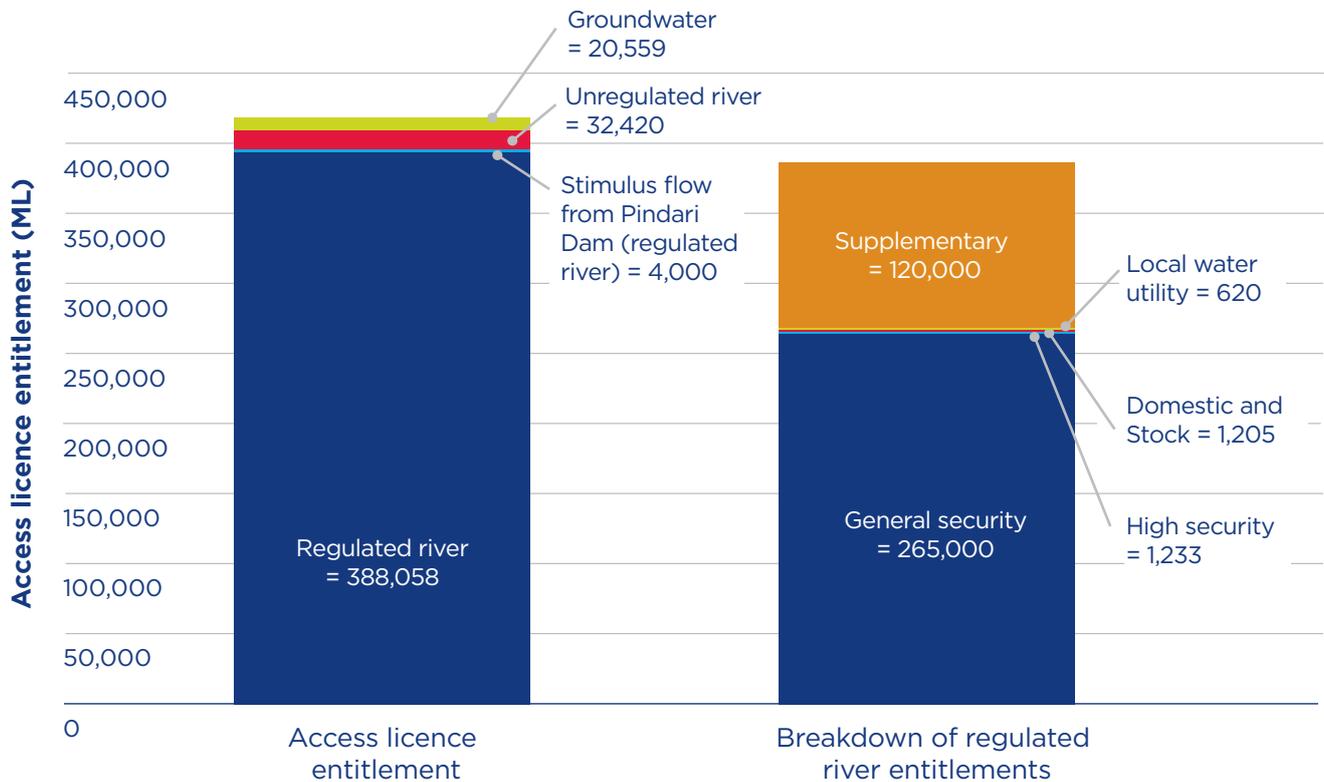
46. This value is the Long-Term Average Annual Extraction Limit (LTAAEL) for the alluvial groundwater sources in the Border Rivers region, excluding porous and fractured rock sources which extend beyond the region. The LTAAEL for all groundwater sources (including the Great Artesian Basin and fractured rock sources) is 508.6 GL.

47. Department of Primary Industries—Water 2015, *Macro water sharing plans—the approach for groundwater*, A report to assist community consultation, Department of Primary Industry Office of Water, www.water.nsw.gov.au/__data/assets/pdf_file/0019/547300/macro-water-sharing-plans-the-approach-for-groundwater.pdf

Water take in the Border Rivers region

Most of the water taken in the Border Rivers region is from regulated river sources (Figure 22).⁴⁸

Figure 22. Water entitlements in the Border Rivers region



Source: Department of Planning, Industry and Environment—Water licencing system 2020

48. Department of Planning, Industry and the Environment 2018, *NSW Border Rivers Surface Water Resource Plan Area Resource Description: Appendix A*, www.mdba.gov.au/publications/mdba-reports/nsw-border-rivers-water-resource-plan

Regulated river licences

In the Border Rivers Regulated River Water Source, there are 433 water access licences with a total of 386,360 shares. Less than 1% of these shares are for town water supplies, domestic consumption and stock watering, and high priority licences. Towns supplied from the regulated system include Ashford, Boggabilla and Mungindi in NSW, and Goondiwindi in Queensland. Most shares are for general security A class licences (6%) and general security B class licences (62%), with the remainder for supplementary access (31%).

Water allocations to these licences are based on the likely inflows and volume of water available in Pindari Dam and Glenlyon Dam.⁴⁹ Significantly, general security B class licences cannot receive a water allocation in any water year until general security A class licences have received a water allocation of 1 ML per share.⁵⁰ This means that general security A class licences have a much greater level of security than general security B class licences, but the water sharing plan allows the unused general security water to be carried over from one year to the next. Water is only permitted to be taken under supplementary licences from uncontrolled flows.⁵¹

The majority of the larger entitlements (licences with shares between 5,000 to 10,000 ML) are located from around Boggabilla and downstream to Mungindi where cotton production is predominant (Figure 23). Re-regulating weirs, such as Boggabilla Weir, help to deliver water from the dams to water users in the lower catchment.

In dry or drought conditions, high evaporation and seepage into groundwater is a major challenge for delivering water, including from the re-regulating weirs, which have long and shallow weir pools. In these conditions, water is released from the dams in blocks to minimise losses and delivery may be restricted to weir pools, which provide town water supplies, to preserve the water remaining for critical human needs. In the summer of 2019/20, transmission losses reached 70% and water was only delivered as far as Boggabilla Weir.

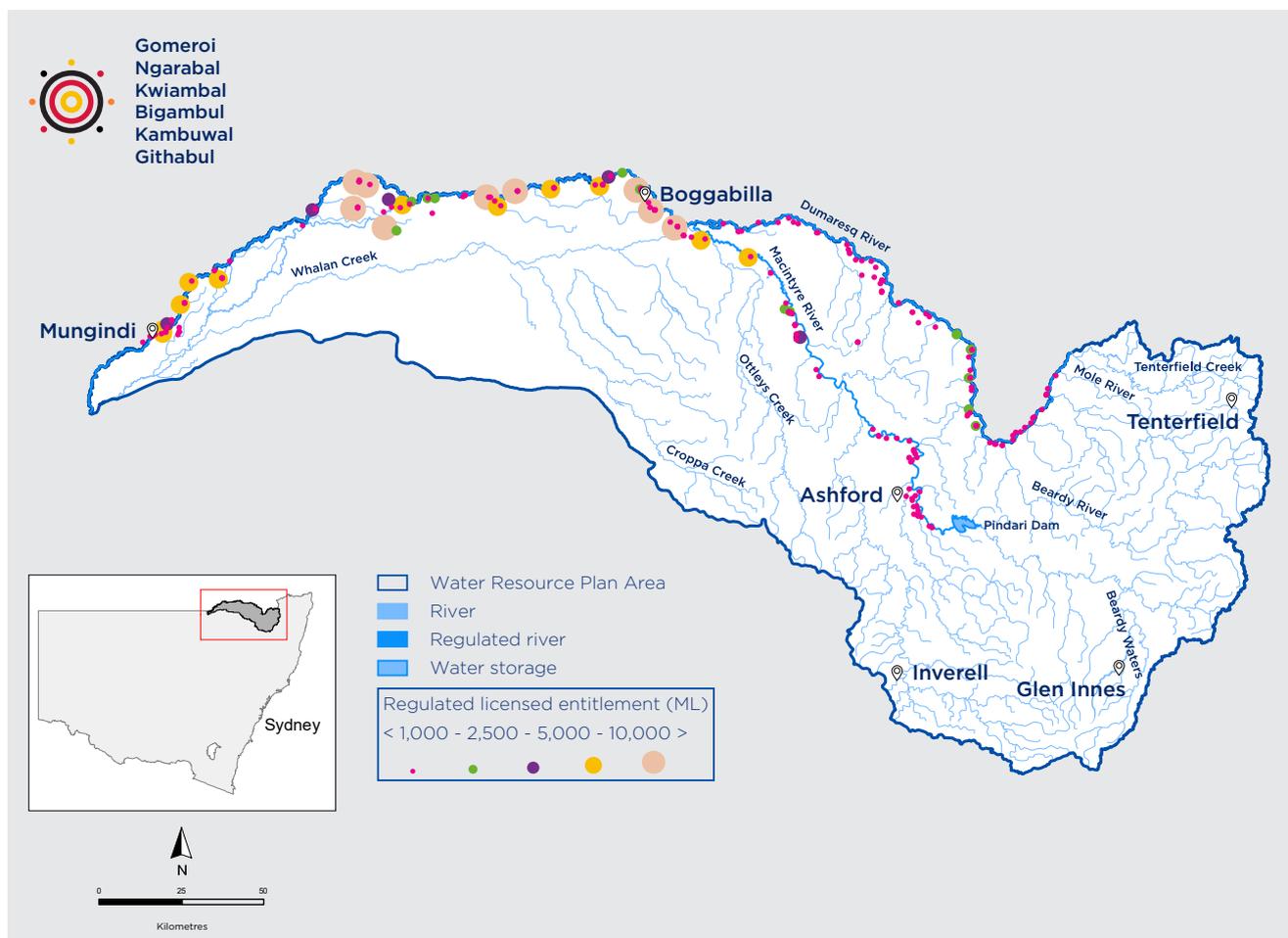
49. *Water Sharing Plan for the NSW Border Rivers Regulated River Water Source 2009*, clauses 32-38, www.industry.nsw.gov.au/water/plans-programs/water-sharing-plans/status/border-rivers-region

50. *Water Sharing Plan for the NSW Border Rivers Regulated River Water Source 2009*, clause 37

51. *Water Sharing Plan for the NSW Border Rivers Regulated River Water Source 2009*, clause 45



Figure 23. Distribution of regulated share components in NSW Border Rivers region



Source: NSW Border Rivers Surface Water Resource Plan Area Resource Description: Appendix A.

Unregulated river licences

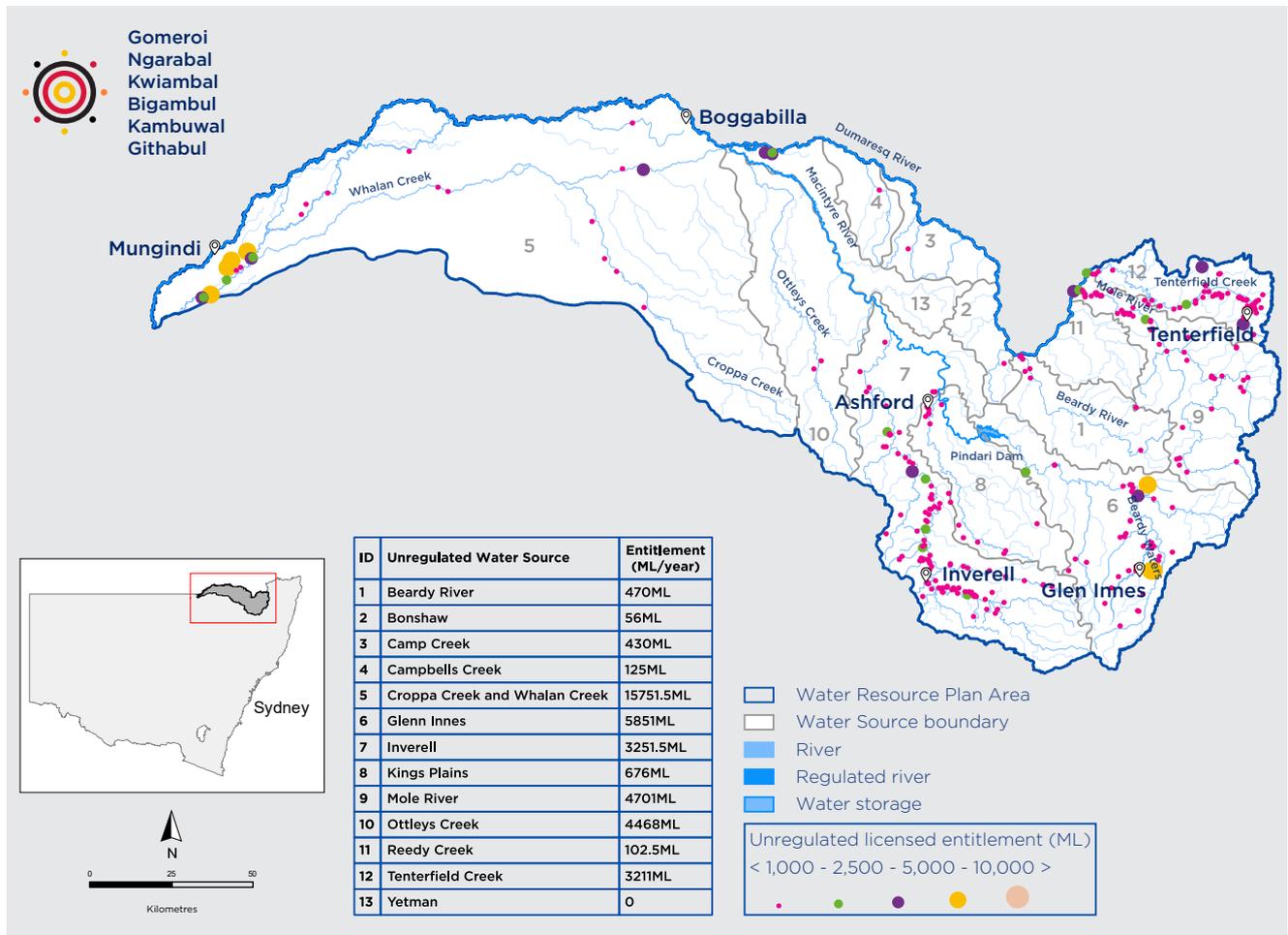
In the unregulated river water sources, there are 378 water access licences with a total of 44,422.5 shares. Only 6% of these shares are for town water supplies, domestic consumption and stock watering. Towns supplied include Glen Innes, Tenterfield, Deepwater, Yetman and Bonshaw.

Most licence shares in the unregulated river water sources are for unregulated river licences (94%) and the majority of the water taken is used for irrigation.⁵²

The majority of licences are located on the upper Macintyre River, Mole River and Tenterfield Creek, with a few are along Croppa Creek and Whalan Creek in the lower catchment (Figure 24).

52. Department of Planning, Industry and Environment 2018, NSW Border Rivers Surface Water Resource Plan Area Resource Description: Appendix A, www.mdba.gov.au/publications/mdba-reports/nsw-border-rivers-water-resource-plan

Figure 24. Distribution of unregulated share components in NSW Border Rivers region



Source: NSW Border Rivers Surface Water Resource Plan Area Resource Description: Appendix A.

Groundwater

There are 32 water access licences in the alluvial water sources with a total of 17,453 shares. The majority of shares are for aquifer access licences (91%) and a small proportion have high security (9%) in recognition of the connection between the Macintyre Alluvial Groundwater Source and the Macintyre Regulated River. There are 193 registered bores in the alluvium, which are mostly used for domestic consumption and stock watering (73%), and irrigation.

Porous and fractured rock groundwater sources in the Murray-Darling Basin are generally very large and cross multiple regions.

Management rules apply at the groundwater source scale and licences can be traded within the groundwater source to different locations and different regions.

In the Eastern Recharge Groundwater Source, 34,974 licence shares have been issued although the long-term average annual extraction limit is estimated to be 16,200 ML⁵³ and extraction rates vary. This means water allocations for licences in the Eastern Recharge Groundwater Source may be reduced below 1 ML per share in some years to ensure the extraction limit is not exceeded. In 2020/21, aquifer access licence holders in this groundwater source received a water allocation of 0.25 ML per share.

53. Water Sharing Plan for the NSW Great Artesian Basin Groundwater Sources 2020, www.industry.nsw.gov.au/water/plans-programs/water-sharing-plans/status/border-rivers-region

Setting priorities for water sharing

The *Water Management Act 2000* sets out how we prioritise water sharing during normal operations, with the highest priority being for the environment, followed by basic landholder rights (Table 2).

During extreme events, such as prolonged droughts, the priority changes. Basic landholder rights and essential town water services (authorised by an access licence) become the highest priority in the Murray-Darling Basin, followed by the environment.

This change in priorities is triggered when a water sharing plan (or part of a plan) is suspended during an extreme event. The aim is to operate within the plan rules for as long as possible, as they provide certainty for all users of these water sources. Preparation of the Border Rivers Regional Water Strategy provides an opportunity to consider whether the trigger needs to be reviewed.

A number of options included for consideration in this draft strategy provide opportunities to review water licensing, allocation, sharing and accounting processes (Options 19, 30, 31 and 48).

Table 2. Priorities for water sharing

Priority	Extreme events	Normal circumstances
Highest	<ul style="list-style-type: none"> Critical human water needs 	<ul style="list-style-type: none"> Needs of the environment
	<ul style="list-style-type: none"> Needs of the environment 	<ul style="list-style-type: none"> Basic landholder rights
	<ul style="list-style-type: none"> Stock High security licences Commercial and industrial activities authorised by local water utility 	<ul style="list-style-type: none"> Local water utility access licences Stock and domestic access licences
	<ul style="list-style-type: none"> General security licences (A Class and B Class) 	<ul style="list-style-type: none"> Regulated river (high security) access licences
	<ul style="list-style-type: none"> Supplementary licences 	<ul style="list-style-type: none"> All other forms of access licences Supplementary access licences

Source: *NSW Border Rivers Surface Water Resource Plan Incident Response Guide: Schedule G.*

Gathering more and better information

Improving the information we have about water use and water needs will help us manage the Border Rivers region's water more efficiently and support our aim to have enough water available at the right time. Improved information can also help water users, future investors and regions make more informed decisions about the industries that are most suited to each region.

The Border Rivers region has a number of unregulated rivers and creeks where streamflow gauges are not installed and water extraction is not measured. This means there is limited data on water extraction and flow patterns, making it difficult to manage equitable sharing during dry conditions. This lack of data will be addressed through the implementation of the new non-urban metering framework announced by the NSW Government as part of its 2017 Water Reform Action Plan.

Under the framework, large surface water works in the Border Rivers will be required to be fitted with compliant metering and telemetry equipment by 1 December 2020. All remaining surface and groundwater works that are captured by the rules will need to be fitted with compliant metering equipment by 1 December 2021. Approximately 570 water supply works in the Border Rivers region will be captured by the metering rules: about 270 in the regulated rivers, 200 in the unregulated rivers and 100 in the alluvium.

Better data and information on floods in the Border Rivers region are also critical to understand how floodplains are connected, how groundwater reserves are replenished and the flood risk of towns and villages.

Flood studies that analyse the characteristics and movements of floods will help to

inform the protection of rural properties and vital infrastructure, while ensuring that environmental and cultural assets are not negatively affected. The NSW Government released the *Draft Border Rivers Floodplain Management Plan* in 2018.

Given the expected continuing demands on groundwater, enhancing our understanding of the interaction between surface water and groundwater resources in the Border Rivers region will help improve our management of connected water sources. We need to understand where a change in groundwater use can influence flows to rivers and vice versa. Given the continuing demands on groundwater in the future, we need to better understand the interaction between surface water and groundwater resources in the Border Rivers.

We also need to understand how a changing climate is impacting the replenishment of groundwater resources. More broadly, we need to ensure ongoing investment in the groundwater monitoring network so we have the water quantity and quality information we need to manage the resource into the future.

Several options considered in this draft strategy focus on gathering and sharing improved knowledge, data and information about water use and needs (Options 22, 32, 33 and 37).

In addition, the Department of Primary Industries—Agriculture is undertaking a three-year program to identify and map important agricultural lands. Knowing where this land is situated and understanding its location, value and contribution will assist in making decisions about current and future agricultural land uses and their water needs. A comprehensive and consistent approach to collecting water statistics information will greatly help this process.

Collecting more and better data

Across the Border Rivers region, there are opportunities to gather more information about:

- the water requirements (when and how much) of communities, the environment and industries and what a reduction in water availability will mean for these users
- what the water is being used for, including crop types and yield values
- the interaction between groundwater and surface water

- quantity of water use and patterns of water use in the unregulated system and groundwater systems
- the characteristics and movements of floods
- water quality.

Gathering and analysing this data will improve our understanding of the water risks in the region for the environment and all water users and support future decisions about water sharing.



2.3 People, industries and water use

2.3.1 Aboriginal people

The Bigambul, Githabul, Kambuwal, Gomeroi, Kwiambul, and Ngarabal people are the original inhabitants of the NSW Border Rivers catchment.

Water is the lifeblood of Aboriginal people. It allows kinship, connection, stories, songlines and healing through medicine and food. Healthy waterways and groundwater systems are critical to Aboriginal communities for culture, and health and wellbeing.

The land and waters of the NSW Border Rivers catchment contain places of deep significance to Aboriginal people that are central to their spiritual and religious belief systems, and are often celebrated in ritual, ceremony, story, dance and artwork.

Due to the impacts of COVID-19 the Department of Planning, Industry and Environment has not been able to engage with Aboriginal people in the Border Rivers region on the draft strategy. We are committed to engaging with Aboriginal people and including their views and voices in the regional water strategies as it develops.

A number of significant Aboriginal sites are located within the region, which are protected from harm or desecration under section 86(4) of the *New South Wales National Parks and Wildlife Act 1974*.

Water used by Aboriginal people

Aboriginal people's legal rights as they apply to water management have been recognised in international human rights treaties and conventions, in Australian and NSW Native Title and land rights laws, and in national and

state-based water plans. These instruments recognise the importance of maintaining the environmental knowledge and practices of Aboriginal people, promoting their full participation in decisions about water resources and acknowledging Aboriginal cultural values and uses in water planning.

In addition, the 2007 Echuca Declaration defines cultural flows as 'water entitlements that are legally and beneficially owned by the Nations of a sufficient and adequate quantity and quality to improve the spiritual, cultural, natural, environmental, social and economic conditions of those Nations'.⁵⁴

While there are some ways of accessing water for cultural purposes, we heard from Aboriginal people across inland NSW that the current provisions in the *Water Management Act 2000* are not meeting their spiritual, cultural, social and economic needs.

Australia's Native Title laws recognise the traditional rights and interests to land and water of Aboriginal people. Anyone who holds Native Title with respect to water can take and use water for personal, domestic and non-commercial communal purposes. Native Title holders often have water-related aspirations: from protecting water to giving advice on water management practices within a determinations area and seeking water allocations.

Aboriginal people can apply for Aboriginal cultural water access licences. If granted, this licence can provide up to 10 ML/year for drinking, food preparation, washing and watering domestic gardens, as well as for Aboriginal cultural uses. Due to COVID-19, face-to-face engagement with Aboriginal communities in the Border Rivers region has

54. Murray Lower Darling Rivers Indigenous Nations, 2007, *Echuca Declaration*, Part 1. The full declaration is available here: www.mdba.gov.au/sites/default/files/pubs/sa-mldrin-echuca-declaration-2009_0.PDF

been put on hold and will occur in late 2020 and 2021. However, during our discussions with Aboriginal peak bodies and consultation with Aboriginal communities in the Macquarie, Lachlan and Gwydir regions, we heard that current cultural water access licences are inadequate to meet the social, spiritual, cultural and economic needs of Aboriginal people. We need to ensure the licences allow for equitable access to water and that the licence assessment framework is culturally appropriate and clearly communicated to Aboriginal people. We will also need to work with Aboriginal communities and state-wide groups to ensure water security for Aboriginal people relying on town water, or discrete communities responsible for providing their own water supplies.

Across the State we have heard that water for Aboriginal people should be licences or water entitlements owned by Aboriginal people and allow for economic benefit. While some Aboriginal businesses, groups and Aboriginal Land Councils own water access licences, which are available on the market for trading, often the cost involved prohibits Aboriginal people from buying these entitlements and allocations.

In various forums across the state we have heard that Aboriginal people want to be more involved in water management decision-making. Increasingly, Aboriginal knowledge is recognised as an essential element of how we manage natural resources in Australia. However, the complexities of water management, legislation and licensing—along with few opportunities to participate in decision-making—are significant barriers to making better use of Aboriginal

people's knowledge and skills. The Border Rivers Regional Water Strategy provides an opportunity to identify ways we can address these challenges and deliver on the aspirations of Aboriginal people in the Border Rivers. We will be engaging with Aboriginal communities to understand what kind of options they would like to see in the Border Rivers Regional Water Strategy.

As a starting point for discussions, this document includes options identified in other regions. This includes options to protect and strengthen water-dependent cultural landscapes, practices, knowledge and traditions, support the economic advancement of Aboriginal people and give them a greater say in water matters that affect their communities (Options 42 to 51). Additional options may be identified during consultation with Aboriginal people in the Border Rivers region. The final regional water strategy could also consider how options will help deliver on commitments under the Closing the Gap Agreement,⁵⁵ including the four reform areas of:

- formal partnerships and shared decision making
- building the community controlled sector
- transforming government organisations
- shared access to data and information at a regional level.

55. www.closingthegap.gov.au/

2.3.2 People and towns

The Border Rivers region is home to around 32,000 people, representing 0.4% of the NSW population. Inverell in the upper catchment is the region's largest centre with over 16,000 inhabitants and there are also smaller towns with populations ranging from 300 people to over 8,000, including Glen Innes and Tenterfield in the upper catchment and Boggabilla and Mungindi in the lower catchment. These and other small towns are located close to productive agricultural lands and are important to the regional economy.

Significant investments in transport, community and digital infrastructure by the NSW Government will continue to support growth in the region and improve liveability and amenity for regional towns and communities. Projects planned or underway in the Border Rivers region include:

- \$2.2 million co-contribution from the NSW Drought Stimulus Package in Inverell local government area for the Gwydir Highway roundabout to facilitate higher productivity and broader economic growth, with flow-on effects for urban infrastructure and services across the region
- over \$1.5 million to replace the Beaury Creek Bridge from the Growing Local Economies Fund, plus \$4.4 million to replace the Boonoo Boonoo and Emu Creek bridges under the Fixing Country Roads program
- a \$400 million package to improve digital connectivity across regional NSW, which will deliver better mobile connectivity and internet access and support technological innovations in agribusiness
- over \$21 million for community and infrastructure projects across Glen Innes, Inverell and Tenterfield.

Crossed by two national road corridors connecting NSW with Queensland, the Border Rivers region will also continue to benefit from the *Regional NSW Services and Infrastructure Plan* and the *Future Transport Strategy 2056*, both of which provide strategic support for the development of infrastructure in regional areas.

Water for people and towns

Providing a secure and resilient water supply to regional centres, towns and outlying areas is vital for the long-term sustainability of the region, particularly in the context of a changing climate.

Secure water supports a growing population and contributes to the amenity, liveability and well-being of residents and visitors. Water in regional towns and communities also provides broader social benefits. This is reflected in the New England North West Regional Plan 2036, which includes a goal to sustain a healthy environment with pristine waterways. Rivers and wetlands, town swimming pools and infrastructure such as Pindari Dam offer social and recreational opportunities. Open spaces and parks connected to water are also important community and recreational assets.

Town water within the Border Rivers region is supplied by local water utilities that are owned and operated by local councils. It is the responsibility of each of these local water utilities to provide water and sewerage services to their communities. This responsibility extends to planning for and delivering secure water supplies.

Towns source their water from a mix of surface water and groundwater, with water carted to smaller villages in the region during droughts.

The majority of the region's population is located in the upper catchment, which relies primarily on unregulated surface water and uses groundwater as a back-up during drought



Image courtesy of Destination NSW.

periods. The groundwater sources in the upper catchment do not provide high yields, but are effective in providing emergency alternative water sources for towns:

- **Tenterfield Shire Council** relies on surface water from Tenterfield Creek Dam (1,390 ML). Additional groundwater sources were accessed during the last drought to secure the community's water supply. The council also provides supplementary water to other users, including rural domestic consumers and stock feed on a fee for service basis via a standpipe.
- **Glen Innes Severn Council** relies on surface water from a weir (650 ML) on the Beardy River, a groundwater license from the Macintyre Alluvium Groundwater Source

(generally not in use with decommissioned infrastructure) and a disused quarry pit as storage capacity, holding around 200 ML. The villages of Glencoe, Red Range, Emmaville and Deepwater are also serviced by the Glen Innes supply system. During the most recent drought, the town relied on groundwater and water carting for two thirds of its supply.⁵⁶

- **Inverell Shire Council** sources its water from Copeton Dam (1,364 GL) located in the Gwydir catchment. The council also provides water to surrounding villages and communities. Based on our new climate data and modelling, water supplied from Copeton Dam is at a low risk of experiencing future supply shortfalls based on current water access licence volumes.

56. Glen Innes Severn Council 2020, *Drought Management Plan*, April 2020, www.gjisc.nsw.gov.au/glen-innes-severn-drought-management-plan

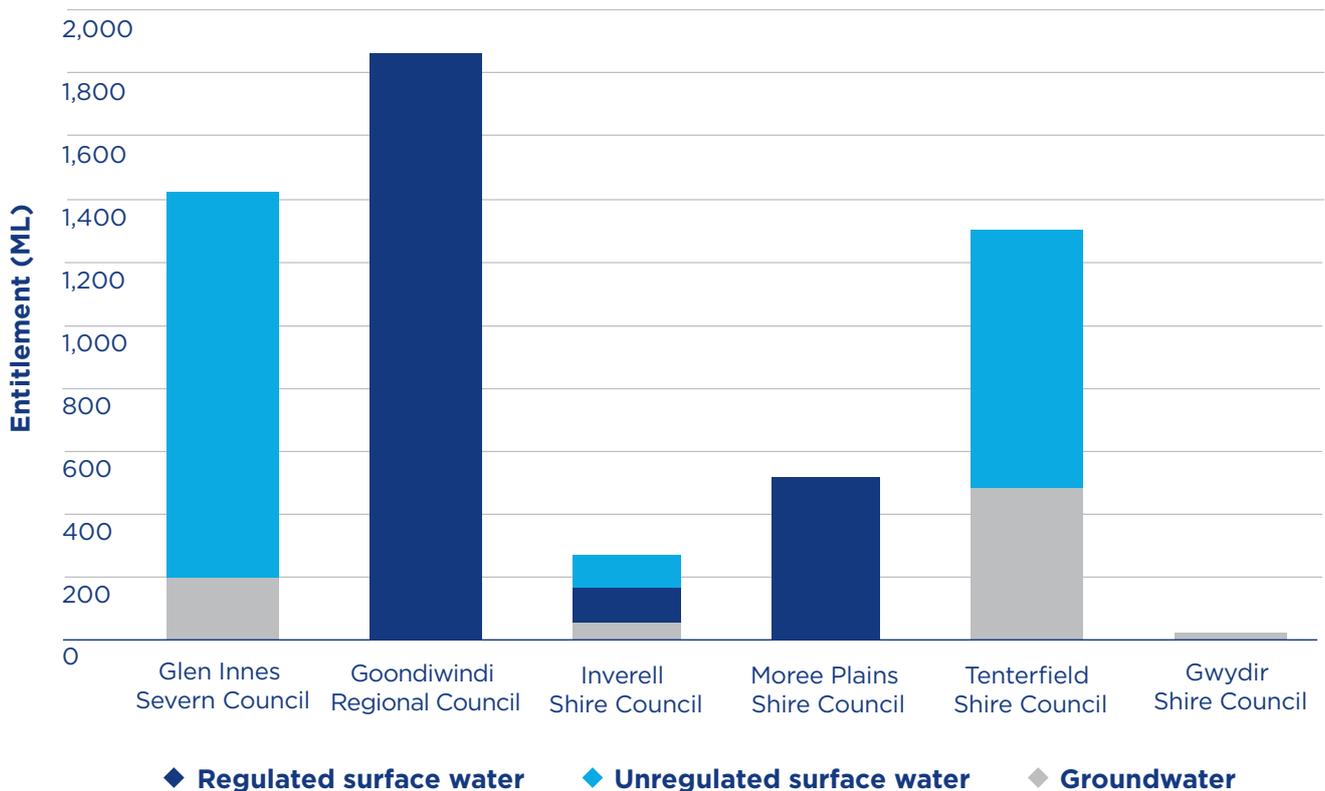
In the lower part of the catchment:

- **Gwydir Shire Council** provides groundwater supplies for Croppa Creek and North Star. Water carting is used in periods of drought to provide additional supply for private residences. We heard that Gwydir Shire Council is investigating options to provide a more secure water supply to North Star and Croppa Creek, including ensuring the towns have access to high security water licences.
- **Moree Plains Shire Council** provides water supplies to towns and villages such as Mungindi, Boomi, Garah, Boggabilla and Toomelah. These communities rely on a combination of surface water from weirs (for example, Boggabilla and Mungindi) and groundwater. Recently during the

drought, groundwater has become an increasingly important resource given the uncertainty surrounding the reduction in surface water flows. We heard that Moree Plains Shire Council is investigating additional opportunities to improve access to groundwater as an alternative back up supply, including using the two-way pipeline between Boggabilla and Toomelah to supply groundwater to both communities.

The region’s local water utilities are permitted to use up to a total of 640 ML each year to supply their connected towns and villages—roughly 0.1% of all licensed water entitlement in the region (Figure 25). Annual water use by the region’s towns has typically been less than this (between 70% and 90% of their total water entitlement used).⁵⁷

Figure 25. Annual town water entitlement volumes and supply sources in the Border Rivers region



Note: Gwydir Shire Council entitlements include Croppa Creek and North Star. Moree Plains Shire Council is licensed to take groundwater for supply to Mungindi but a volumetric entitlement is not available for inclusion in this figure. Surface water entitlement for Inverell Shire Council is not included as it is supplied from Copeton Dam in the Gwydir region.

Source: Department of Planning, Industry and Environment—water licence database

57. Data for 2013 to 2019, based on usage year to date over Total Licensed (data source: WaterNSW Register)



Despite this, there may be security issues in the Border Rivers region in the future due to declining surface water and groundwater levels (Table 3).

About 30% of the population in the Tenterfield, Glen Innes, Inverell and Moree Plains council areas, and 50% of the population in the Gwydir Shire Council area, have a non-reticulated domestic water supply.⁵⁸ This means they depend directly on water from creeks and rivers, aquifers, farm dams and rainwater tanks. These households will face water security challenges from a drier climate.

We heard from councils that in the recent drought they experienced a significant increase in demand for water from outside their service areas and from rural communities not previously reliant on town water supplies. Gwydir Shire Council delivered 4 million litres of water to rural communities over a widespread area including North Star and Croppa Creek. We also heard from councils in the upper catchment that they experienced a significant demand for water for fighting bushfires (for example, Glen Innes).

For towns and Aboriginal communities, the potential for more frequent and longer dry

periods will mean less secure water supplies unless actions are taken now to invest in diversified water sources. This risk will be greatest for towns that rely on water from unregulated rivers.

Our new modelling found that surface water availability for town water supplies could be less secure than we thought due to the greater potential variability in rainfall and inflows. This highlights the importance of diversifying water supplies to improve town water security. Possible alternate supplies include groundwater, which is generally less sensitive to short term climate variability, and climate-independent water sources such as recycled water. Some towns such as Mungindi and Tenterfield already have sources of groundwater developed to provide backup supplies when surface water availability is reduced. However, increased demand for groundwater (especially during drought) can put pressure on groundwater resources due to less recharge from surface water, which can result in declining water tables. To ensure we use our groundwater sources sustainably, it is important to have appropriate groundwater management arrangements in place, particularly during drought.

58. Estimate based on total number of population in local government areas supplied with water (as reported in the Department of Planning Industry and Environment—Water local water utility performance monitoring database for 2017/18) and total population numbers from the Australian Bureau of Statistics Census (Regional population by age and sex, 30 June 2018).

In addition to these modelled risks for surface water reliability, water security access risk analysis undertaken by local water utilities is also available (secure yield analysis undertaken as part of integrated water cycle management strategies). This additional analysis takes into account the following aspects:

- headworks arrangement and capacities of local water utilities
- the physical water delivery system and operational rules under water sharing plans

- local water utility operating protocols and past experiences in delivering water in drought conditions.

This provides a water security access risk specific to each local water utility's town water supply system that is different to the modelled risk for surface water entitlement reliability. The water security access risk for each water utility is shown in Table 3.

Table 3. Water security risk for cities and towns in the Border Rivers region*

Water utility	Drinking water supply system	Population served in 2014 (approx.)	Water security risk
Tenterfield Shire Council	Tenterfield	2,997	Very low
Glenn Innes Severn Council	Glen Innes	5,173	High
Inverell Shire Council	Ashford	495	High
	Inverell + Tingha*	11,205	Very low
Moree Plains Shire Council	Mungindi	485	Medium
	Boggabilla	626	Medium
	Toomelah	226	Low
	Garah	109	Very low
	Boomi	75	Very low
Gwydir Shire Council	North Star	56	Very low

*Inverell town in the Border Rivers region is supplied water from Copeton Dam in the Gwydir region. See Table 3 of the *Gwydir Regional Water Strategy*, which identifies the water security risk for Inverell (and Tingha) as Very low.

Note: These risks represent the (preliminary) water security risks as assessed by the Safe and Secure Water Program as of April 2020 and are subject to change over time based on further investigation, new information from councils and/or delivery of projects/solutions addressing these risks.

Source: NSW Government's Safe and Secure Water Program

To make sure that towns in the Border Rivers region have adequate water security into the future, we need to make decisions and choices now about how and where to direct additional investment. For example, taking action now to diversify town water sources, including climate-independent sources, will increase the resilience of town water supplies to water security risks and water quality issues. More diverse water sources may also open up new economic and employment opportunities in towns and communities.

The regional water strategy process provides an opportunity to improve secure and

reliable water supplies for towns. As well as progressing the business case for a new dam on the Mole River (Option 1), options considered in this Draft Border Rivers Regional Water Strategy include raising Pindari Dam and Mungindi Weir (Options 2 and 3), additional pipeline connections (Options 4 and 7), re-use, recycling and stormwater initiatives (Option 26) and water efficiency projects (Option 27).

A number of initiatives are also proposed to improve reliable access to groundwater by towns, including the removal of regulatory barriers, better policies and processes, and new infrastructure investment (Option 6).





2.3.3 Jobs and industries

The Border Rivers region is a highly productive area in NSW. Its Gross Regional Product grew 3.4% annually over eight years from around \$1.2 billion in 2010/11 to over \$1.6 billion in 2017/18. In 2016, over 11,816 people were employed across the region (Figure 26).⁵⁹

The region is home to the strategic regional centres of Inverell and Glen Innes, which provide service industries to the surrounding regions, with health and education contributing significantly to the region's employment. The NSW Government, through its New England North West Regional Plan 2036, has set out a vision for these centres as the focus for jobs and services.⁶⁰

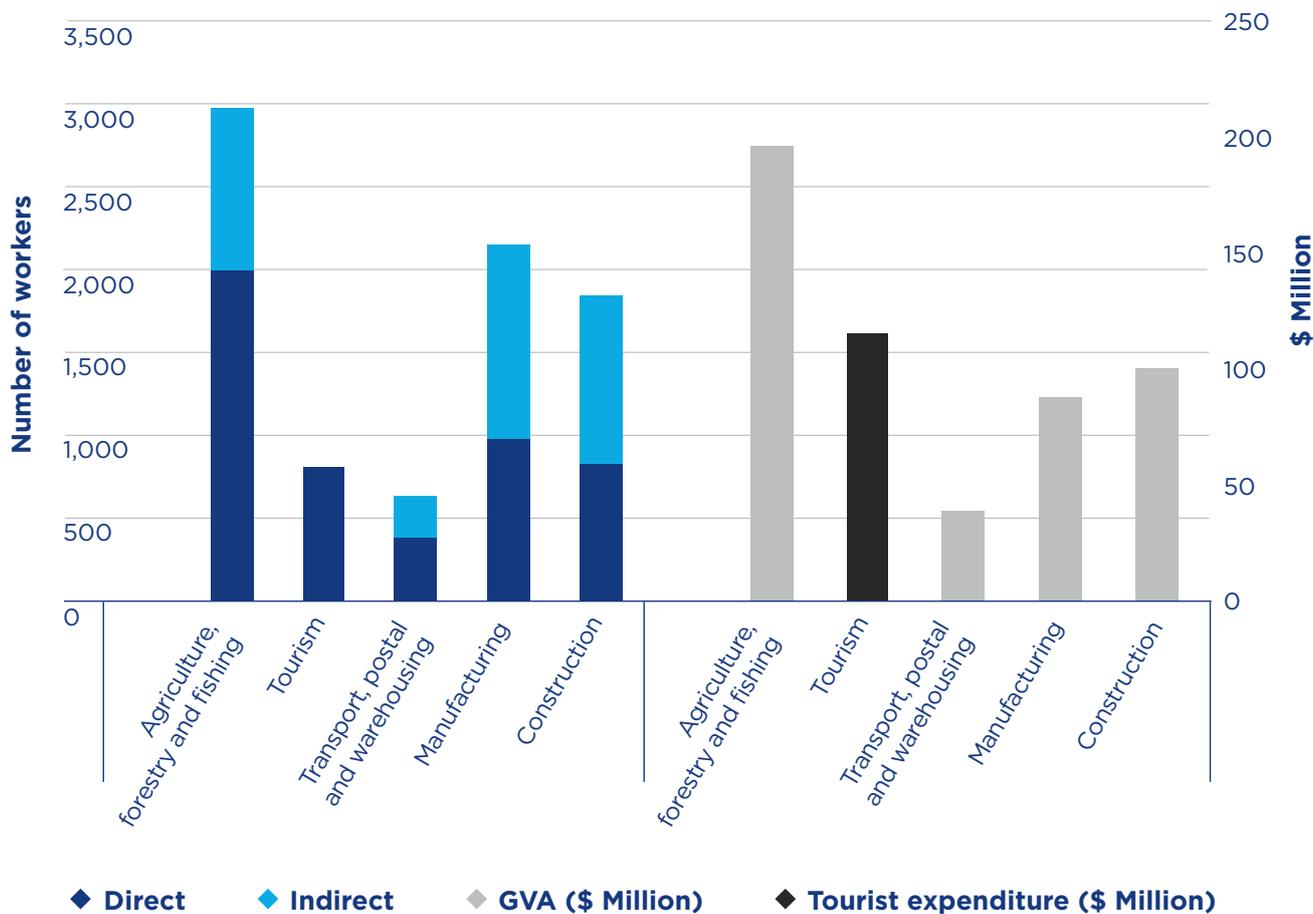
The wider regional economy relies on agriculture and tourism. Innovations in agriculture and renewable energy are capitalising on NSW Government investments to increase economic output in the region. Service industries such as health and education also contribute significantly to the region's employment.

The local economy relies on secure access to surface and groundwater. In particular, groundwater can provide medium to good quality water to agriculture and industrial water users in the lower catchment. Along with floodplain harvesting, this has meant that industry and local businesses have been able to weather times of drought.

59. REMPLAN 2019, *REMPPLAN Economy: Custom data*, www.rempln.com.au/economy

60. NSW Government 2017, *New England North West Regional Plan*, www.planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/New-England-North-West

Figure 26. Employment and economic outputs of key industries in the Border Rivers region



Source: REMPLAN 2019, Economic analysis for Department of Planning, Industry and Environment

Attracting new high value industries and supporting economic diversification is a strong focus for the region. Access to reliable water is important to realising this vision.

The Inland Rail project, upgrades to the Newell Highway and the new Moree Intermodal Project will enable the region to leverage its position along nationally significant rail and road corridors, encouraging further industry development and jobs growth. The *Regional NSW Services and Infrastructure Plan* and the *Future Transport Strategy 2036* are important contributors to the region's future in this regard. Investments made by the NSW Government will also improve the speed, access and reliability of digital connections in the region. In turn, these improvements will support Agricultural Technology (AgTech)

advances that increase water efficiency and drive higher agribusiness productivity.

Emerging industries such as tourism and renewable energy production industries can leverage the region's natural endowments and provide opportunities to diversify the regional economy. These sectors can provide revenue and growth that is not dependent on agriculture, enabling the economy to be more resilient to 'shocks' and droughts.

We know from our discussions with local councils that improved water quality, security and reliability—along with more resilient cities, towns and communities—will help to attract new businesses to the region and maintain existing ones.

Agriculture

The Border Rivers region is one of the most productive areas in NSW for livestock and broadacre agriculture. Agriculture is the main industry in the area, employing directly over 1,995 people and indirectly over 970 workers (2016 data), and contributing 14.7% of the region's economic output (almost \$250 million of the Gross Regional Product for 2017/2018).⁶¹

The region is also home to several large feedlots. Bindaree Beef, a large meat processing plant located in Inverell, drives the region's speciality in meat and meat product manufacturing.⁶²

Agriculture activities vary between the upper and lower catchment. In the upper catchment, land use is dominated by extensive grazing for cattle and sheep production (67% of the catchment), with lucerne and pasture grown for grazing. There are also small-scale irrigation activities such as horticulture. Most agriculture around Glen Innes is rainfed, with pastures and cereal crops used for grazing.⁶³ Glen Innes has some minor irrigation activities, mostly vegetables and fruits. Inverell has some irrigated cotton, pastures and cereals, and a small production of vegetables, fruits and grapes.

We heard that local councils in the upper catchment have aspirations for growth in horticulture and feedlot industries, both of which would require a secure source of water. The Mole River Dam proposal may help to provide additional security for water license holders, depending on how the water captured by the dam is shared between different users. Landowners establishing permanent plantings

(such as pecan or almond trees) are likely to require high security entitlements within the regulated system to ensure a higher reliability of water supply.

In the lower catchment, dryland cropping occurs predominantly on the plains south of Goondiwindi and Boggabilla (18% of the catchment area).⁶⁴ Wheat is the main crop, but a range of other cereals, legumes and oilseeds are also grown. Irrigated agriculture covers 2% of the catchment, mostly west of Boggabilla. Cotton accounts for 85% of all irrigated crops, covering around 40,000 ha of the catchment.⁶⁵ Irrigated agriculture with pressurised pivot systems using groundwater sources (alluvial and Great Artesian Basin Eastern Recharge) is also found along the Macintyre River and around North Star.

Agricultural businesses in the Border Rivers region have learned to adapt to variations in water availability, diversifying their practices and exploring resilient and innovative farming techniques. For example, the cotton industry is particularly advanced in its use of AgTech, including water saving technologies. Cotton growers have been early adopters of new land management practices, production techniques, business models and technology. There are opportunities for AgTech to expand to other types of agribusiness in the region. Non-irrigated agriculture industries also explore ways that they can become more resilient through adoption of new technologies and changes in land use and land management practices that enable them to use the rainfall they receive more effectively.

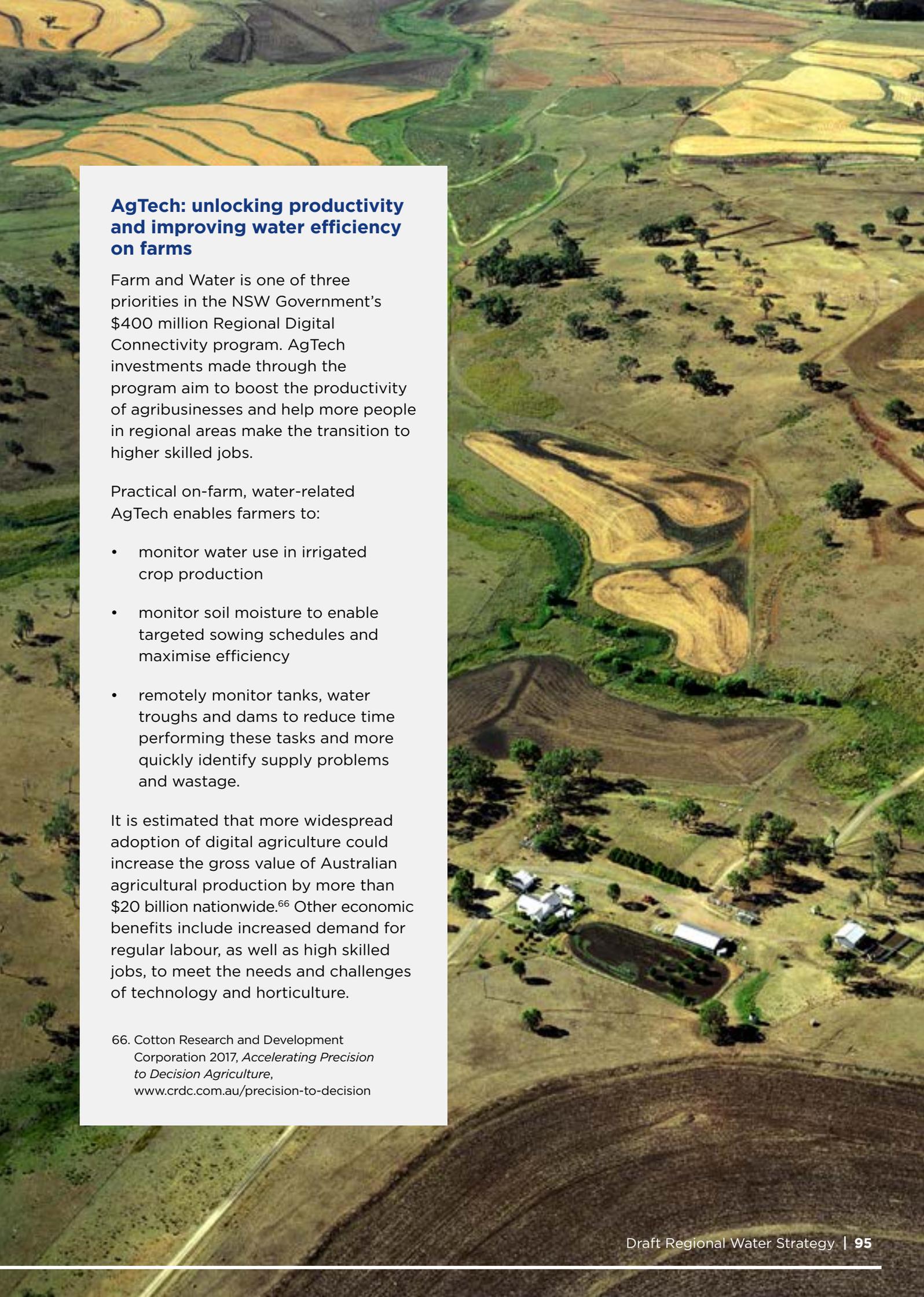
61. REMPLAN 2019, *REMPPLAN Economy: Custom data*, www.rempln.com.au/economy

62. Department of Premier and Cabinet 2018, *Upper North West Regional Economic Development Strategy 2018-2022*, www.dpc.nsw.gov.au/programs-and-services/centre-for-economic-and-regional-development/projects/regional-economic-development-strategies/

63. Department of Planning, Industry and Environment, Internal Data *Water Use on Australian Farms—New South Wales and Local Government Areas—2015-16*

64. Department of Primary Industries—Water 2017, *NSW Border Rivers Water Resource Plan (Surface Water SW16) Status and Issues Paper*, www.industry.nsw.gov.au/water/plans-programs/water-resource-plans/status

65. Department of Primary Industries—Water 2017, *NSW Border Rivers Water Resource Plan (Surface Water SW16) Status and Issues Paper*, www.industry.nsw.gov.au/water/plans-programs/water-resource-plans/status



AgTech: unlocking productivity and improving water efficiency on farms

Farm and Water is one of three priorities in the NSW Government's \$400 million Regional Digital Connectivity program. AgTech investments made through the program aim to boost the productivity of agribusinesses and help more people in regional areas make the transition to higher skilled jobs.

Practical on-farm, water-related AgTech enables farmers to:

- monitor water use in irrigated crop production
- monitor soil moisture to enable targeted sowing schedules and maximise efficiency
- remotely monitor tanks, water troughs and dams to reduce time performing these tasks and more quickly identify supply problems and wastage.

It is estimated that more widespread adoption of digital agriculture could increase the gross value of Australian agricultural production by more than \$20 billion nationwide.⁶⁶ Other economic benefits include increased demand for regular labour, as well as high skilled jobs, to meet the needs and challenges of technology and horticulture.

66. Cotton Research and Development Corporation 2017, *Accelerating Precision to Decision Agriculture*, www.crdc.com.au/precision-to-decision

Agricultural water use

Agriculture is the largest water user in the Border Rivers region, with the majority of water used for cotton production.

Most water used for agriculture is under general security licences (52% of total licences) with over 263,000 shares per year.⁶⁷ Due to the region's highly variable climate, the amount of water allocated each year to general security B class licences has varied widely: from 3,800 ML in 2014/2015 to over 273,000 ML in 2016/2017.

Industries in the region are adapted to a variable water supply. They have invested in technologies and production systems to enable them to use water more efficiently and have the flexibilities to adjust to changes in water availability. For example, cotton is popular because it attracts

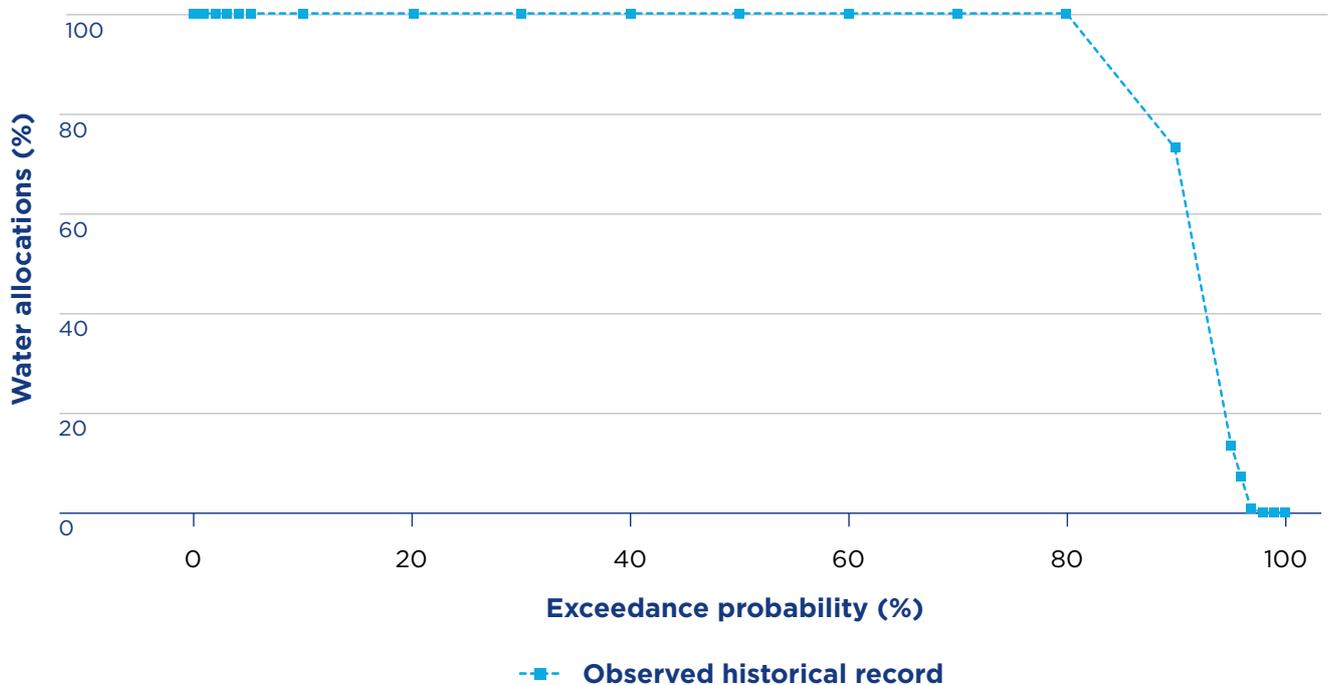
good prices and can be managed as an annual crop in response to variable water supply.

It is not unusual for general security licences to receive low or no water allocations in multiple water years. In the observed historical climate record:

- general security A class licences received 100% water allocations by the end of the water year (30 June) 80% of the time (Figure 27)
- general security B class licences received 100% water allocations by the end of the water year about 35% of the time (Figure 28).

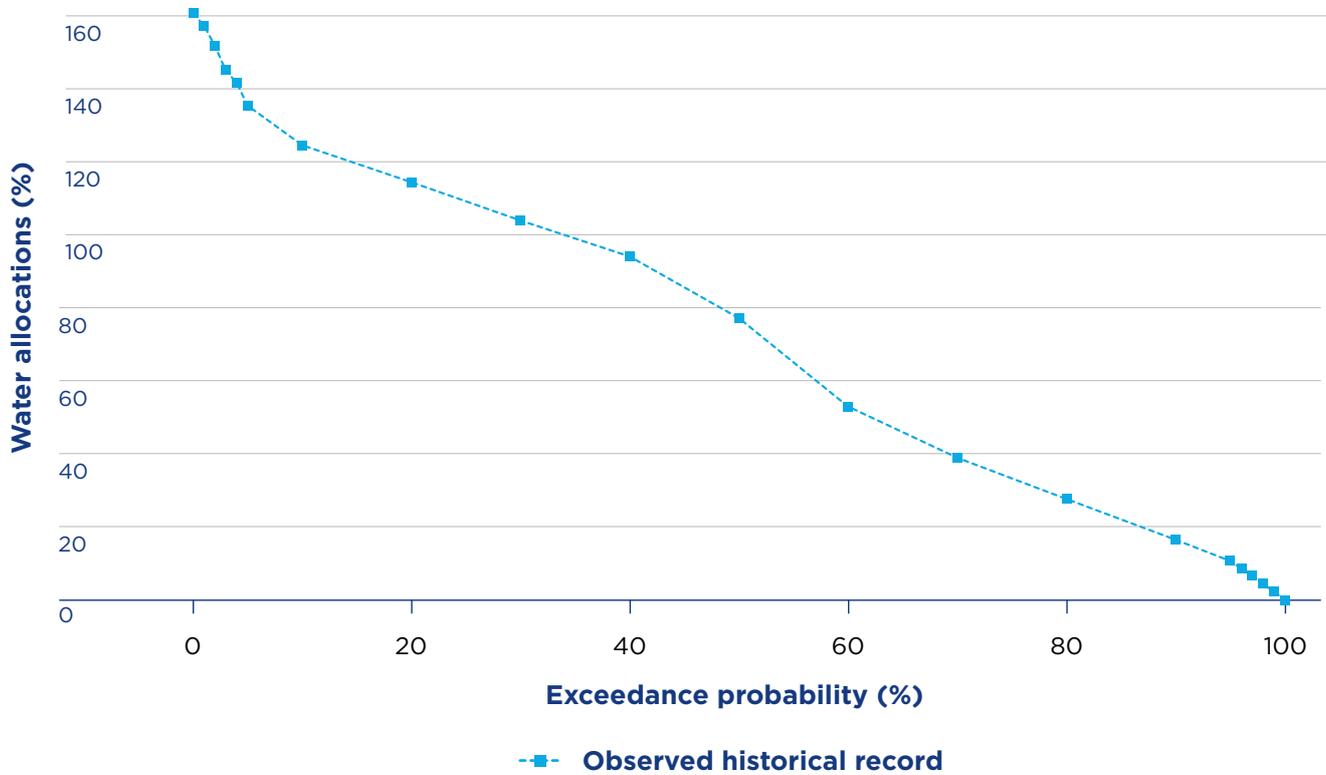
There is also a small number of high security licences (11) with 1,500 ML used for specific industrial and agricultural uses (such as feedlots and a pecan farm).

Figure 27. Exceedance probability for water allocations for general security A class licences at the end of the water year (30 June)



67. This includes both general security A class and B class licenses.

Figure 28. Exceedance probability for water allocations for general security B class licences at the end of the water year (30 June)



Note: In Figures 27 and 28, exceedance probability refers to the probability that the specified volume of water allocations will be credited to the specified category of water access licences in any one year.

There are 120,000 shares for supplementary licences (129 licences). The opportunity for licence holders to access water under these supplementary licences is dependent on uncontrolled flows reaching trigger volumes (as set out in the 2008 Intergovernmental Agreement) to allow announced access to the supplementary flow event. As a result, in drier years there may be very little or zero use under supplementary licences, as was the case in 2014/2015 with 1,843 ML of use, compared to 112,486 ML in 2016/2017 (which was close to full allocations).

Most of the water use in the Border Rivers region is for cotton production in the lower

catchment, grown largely on the alluvial plains downstream of Boggabilla. Average annual water use for cotton in the region is around 400,000 ML—an average of 6.7 ML/ha.⁶⁸ The irrigated area is linked to general security allocations, with cotton production declining in years with low water allocations (33% of total potential water use in 2007/2008 during the Millennium Drought) and increasing in years with higher general security allocations (up to 96% in 2012/2013).⁶⁹ Cotton irrigation has been generally decreasing in the region by 42% since 2004/2005. More than 90% of the water in the region used for irrigation is diverted from regulated surface-water resources.⁷⁰

68. Based on average water use per hectare for years 2011/2012 to 2015/2016 (Source: Australian Bureau of Statistics, *Water Use on Australian Farms*).

69. This data reflects cotton production in the Border Rivers-Gwydir region. Specific data on cotton production for the Border Rivers catchment is not available. (Source: Australian Bureau of Statistics cat no. 4618.0 *Water Use on Australian Farms*).

70. Department of Planning, Industry and the Environment 2018, *NSW Border Rivers Surface Water Resource Plan Area Resource Description: Appendix A*, www.mdba.gov.au/publications/mdba-reports/nsw-border-rivers-water-resource-plan

Agriculture relies heavily on private investment in water infrastructure. Irrigation industries in the region have responded to prevailing dry conditions and drought by improving water efficiency. Changing water availability has led farmers to investing in pressurised systems, centre pivots, on-farm storages or groundwater extraction. It has also led to an increase of on-farm storage and harvesting of flood and overland flows (see section 2.2.1), increasing diversity in enterprise mix and sources of irrigation water, and property consolidation.

Minerals and mining

Glen Innes and Inverell are mining centres in the Border Rivers region. The Kings Plains deposits northeast of Inverell are one of the richest single accumulations of gem-quality sapphires in the State.⁷¹ Mining for sapphires in Inverell started in the 1920s, growing to more than 100 mines in the 1970s. Despite sapphire mining decreasing over the past decades due to the exhaustion of the rich alluvial sources, Inverell remains known as the 'Sapphire City' and continues to attract fossickers.⁷² There is also a small coal basin in the Ashford area in the northern part of Inverell Shire for which a mining lease is being sought.

There is a considerable number of deposits of rare earths in the region, with tin, tungsten and antimony being some of the key minerals of

interest. With growing international demand for tin and other rare earth metals, there is likely to be a resurgence of interest in the region as a metallic mining area. A tin mine and processing plant was approved at Taronga near Emmaville in 2018. However, due to the ongoing drought conditions experienced at the site, operations have been re-assessed and the plant is yet to commence.⁷³

Coal and coal seam gas resources have not been extensively explored in the region and there are currently no proposals for coal seam gas development.⁷⁴

Renewable energy

The renewable energy resource sector is an emerging industry in the region and has the potential to diversify the economy and stimulate economic growth. The region has abundant natural sources of renewable energy, such as solar and wind, that are close to transmission lines and highway access, and has strong investor interest.

The region is an ideal location for solar and wind projects. It receives 19 to 20 megajoules daily of solar exposure, making it the second highest solar generating region in NSW. Existing operations include Sapphire and White Rock hybrid wind and solar farms located along the border of Inverell and Glen Innes.⁷⁵

71. Department of Primary Industries, *Sapphire and Ruby*, www.resourcesandenergy.nsw.gov.au/__data/assets/pdf_file/0019/238204/Sapphire.pdf

72. Mining Link, *Inverell Glen Innes*, mininglink.com.au/site/inverell-glen-innes

73. Aus Tin Mining Ltd 2019, *Quarterly Activities Report – Period Ended 30 September 2019*, www.austinmining.com.au/quarterly-reports

74. Four CSG wells were drilled in the vicinity of Mobbindry Creek drilled by Pangaea PEL 437 Pty Limited. Estimates resulted in a series of bookings for a combined recoverable resource of 991 Petajoules. One petajoule is equivalent to 26.7 mm³ (Source: Pinetown, K., Sander, R. and J. Hodgkinson 2014, *Coal and coal seam gas resource assessment for the Gwydir subregion*, Product 1.2 for the Gwydir subregion from the Northern Inland Catchments Bioregional Assessment, Department of the Environment, Bureau of Meteorology, CSIRO and Geoscience Australia, Australia).

75. Department of Premier and Cabinet 2018, *Upper North West Regional Economic Development Strategy 2018-2022*, www.dpc.nsw.gov.au/programs-and-services/centre-for-economic-and-regional-development/projects/regional-economic-development-strategies/

There are also a range of proposed renewable energy developments in the pipeline including solar farms near Bonshaw in Inverell Shire and a biomass-digester to produce bio-gas to run the plant at Bindaree Beef in Inverell.⁷⁶

The NSW Government has announced that it will prioritise the delivery of an 8,000 MW New England Renewable Energy Zone. The region benefits from some of the State's best pumped hydro potential, as outlined in the NSW Pumped Hydro Roadmap. The Renewable Energy Zone is expected to reduce energy bills for NSW consumers and generate around \$12.7 billion in private sector investment in the region.

Tourism and recreation

The Border Rivers region is a popular tourism destination offering numerous recreational and cultural activities. Tourism provides jobs for about 807 workers in the region (about 6.8% of total employment). In 2018, tourist expenditure amounted to about \$115 million across the local economy.⁷⁷

Important tourist attractions in the region rely on water and nature. Glen Innes is proud of its Celtic heritage and of its World Heritage Washpool and Gibraltar Range National Parks. A rich mineral diversity attracts visitors to this part of the Border Rivers region. Glen Innes offers plenty of outdoor activities such as water sports or fishing for Murray Cod and trout in the Beardy River or around Deepwater.

Inverell attracts visitors wishing to discover picturesque valleys beside the Macintyre River or fossick for gems, and has a proud pioneering

history. Lake Inverell is a wildlife and aquatic sanctuary and its proximity to the town makes it a favourite spot for hiking, birdwatching, picnicking and fishing. Pindari Dam provides additional opportunities for water sports and camping on its shores. Historic drives and hikes along this region's rich mining and farming history are a popular family-friendly activity.

Tenterfield's history attracts visitors as this was the place where Sir Henry Parkes delivered his famous Federation Speech from the Tenterfield School of Arts in 1889. The preservation of many historical buildings gives the township an iconic federation flavour. The various national parks in the New England Tablelands provide visitors with many outdoor activities surrounded by nature. Bald Rock National Park provides bushwalkers and climbers with expansive panoramic views and features the largest exposed granite monolith in Australia.

We heard that councils in the upper catchment have aspirations for the proposed Mole River dam to become a tourist destination with recreational opportunities.

Further west, the Dhinna Dhinawan National Park along the Macintyre River in Yetman contains a wide range of Aboriginal sites that provide evidence of traditional early Aboriginal culture and use by the Gomeroi people.⁷⁸ Near Mungindi and Boomi, artesian water complexes have been operating since 1895. These are a major tourist attraction and provide a significant boost to the economy of Moree Plains Shire. These complexes are highly reliant on water from the Great Artesian Basin.

76. Department of Premier and Cabinet 2018, *Upper North West Regional Economic Development Strategy 2018-2022*, www.dpc.nsw.gov.au/programs-and-services/centre-for-economic-and-regional-development/projects/regional-economic-development-strategies/

77. REMPLAN 2019, *REMPAN Economy: Custom data*, www.rempplan.com.au/economy/, Data for employment linked to Tourism is for 2016

78. National Parks and Wildlife Service 2020, *Dhinna Dhinawan National Park*, www.nationalparks.nsw.gov.au/visit-a-park/parks/dhinna-dhinawan-national-park

Enabling industries

Enabling industries, including transport, freight and logistics, are important in the success of the region's agriculture and tourism industries and also rely on productivity in these industries.

Government investments including the Inland Rail project (which will provide fast, efficient and reliable freight connectivity to meet market demands), upgrades to the Newell Highway (which performs an important role in

road freight and maintaining regional NSW's competitiveness in agriculture and mining) and the Moree Intermodal Project will provide opportunities for economic and job growth.

Inland Rail is expected to bring multiple benefits for the New England and Border regions (see box on next page). The Border Regional Organisation of Councils has endorsed the Moree Intermodal Masterplan as a key element to support the Inland Rail project.

Creating new regional opportunities

Both the *New England North West Regional Plan 2036* and the *Upper North West Regional Economic Development Strategy 2018-2022* prioritise the development of strong and successful communities and regional economies while preserving a healthy environment. A series of new projects aim at boosting the economic profile of the Border Rivers region, as well as providing additional water security for towns and other industrial and business activities.

Inland Rail is a once-in-a-generation project that will become the backbone of freight and supply chain networks connecting regional NSW with Victoria and Queensland. Opportunities for regional NSW include:

- more jobs, with the project expected to create 16,000 new jobs during construction and an additional 700 ongoing jobs across the network
- better connections within the national freight network

- better access to and from NSW regional markets, with farms and mines moving goods via rail to domestic and international markets
- better transit time, reliability and cost savings—less than 24-hour transit time will mean that perishable goods can access markets faster
- transport cost savings, with horticulture and post processed food supply chains estimated to save on average \$76 per tonne when travelling via inland rail (compared to road trips).⁷⁹

The project will also be a catalyst for complementary supply chain investments that exploit the enhanced logistics capability of Inland Rail, including fleet upgrades, new metropolitan and regional terminals and integrated freight precincts.

In terms of water infrastructure, the Mole River Dam project proposal aims to improve storage capacity in the Border Rivers region as well as delivering additional flow security for productive uses inside and outside the catchment.

79. Higgins, A.J., McFallan, S., Bruce, C., Bondarenco, A. and McKeown, A. 2019, *Inland Rail Supply Chain Mapping Pilot Project*, CSIRO, Australia, www.inlandrail.gov.au/regional-development/CSIRO-supply-chain-mapping/CSIRO-supply-chain-mapping-pilot-study

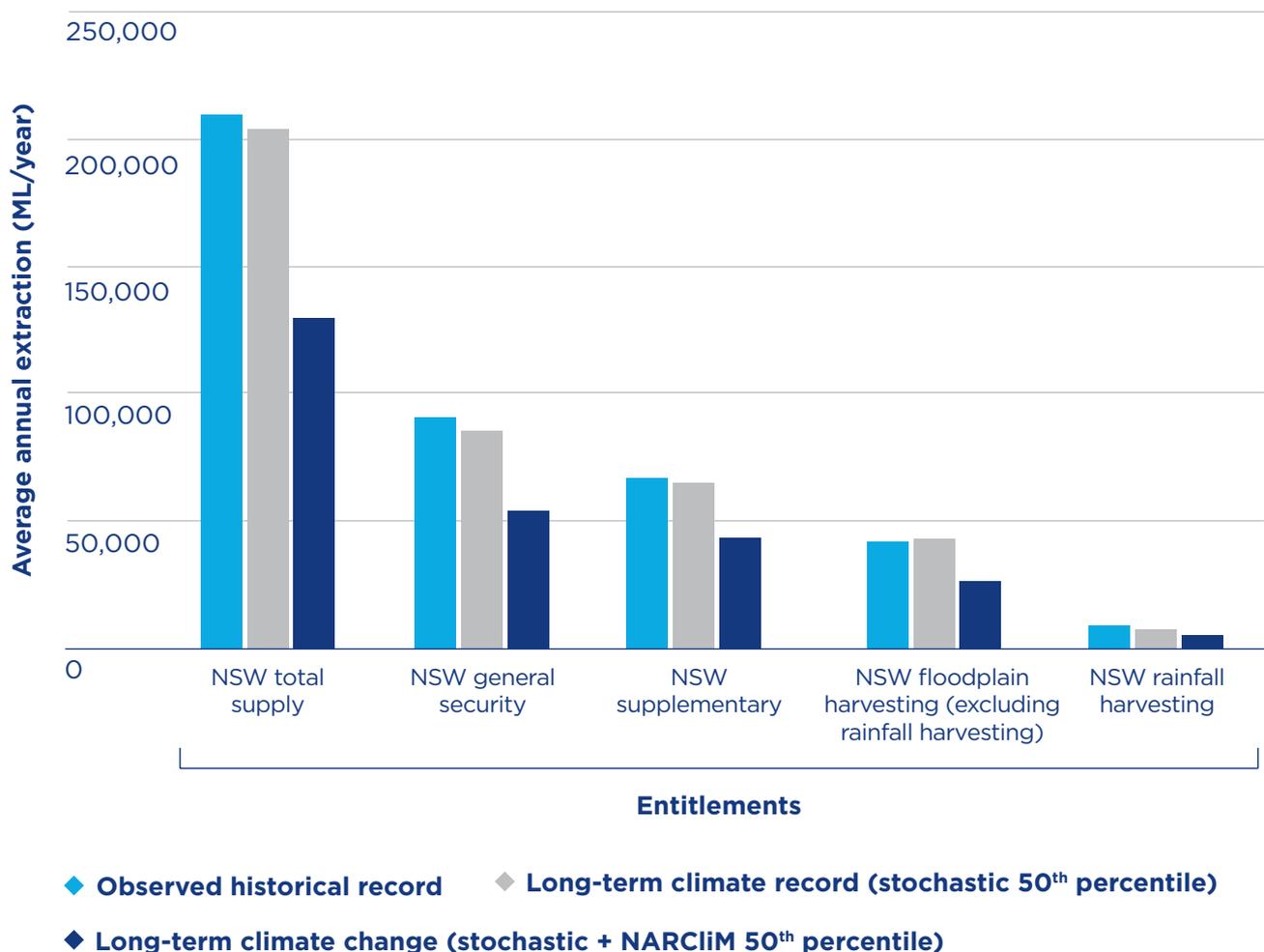


2.4 Water use in a more variable and changing climate

We have modelled a range of plausible climate scenarios to understand how future climate risks may impact on water licences in the NSW Border Rivers regulated rivers. Figure 29 below shows that under a dry climate change

scenario, with lower inflows on average, general security, floodplain harvesting, supplementary licences and rainfall harvesting could be impacted by approximately 40%.

Figure 29. Possible impacts on average annual extractions from the Border Rivers regulated rivers (ML/year)



The potential change in the seasonality of rainfall under the worst-case future dry climate change scenario (with a decrease in winter and spring rainfall and an increase in summer and autumn rainfall) may also have implications for crop types and business planning.

This variability ultimately affects water reliability, which is an increasing risk for the region's agricultural producers and dependent economies. Periods of reduced rainfall and inflows will result in fewer opportunities to plant, which also poses risks to grazing enterprises in the region that rely on as annual pasture production.

However, there will continue to be wet years as well as dry years, and these wet years could see high flows of greater magnitude than we have seen in the historical records.

The regional water strategy provides an opportunity to look at a range of options that would support the region's industries to build resilience and reduce risk in the face of this climate variability (for example, see Options 25 to 37).

In addition, to better understand the effects of climate variability on agriculture, Department of Primary Industries—Agriculture is undertaking a vulnerability assessment to consider potential changes to yield and crop substitution (for example, substituting cotton for high value legume or speciality crops or other cereal crops) and identify adaptation opportunities. These findings will be available in mid-2022 and will inform future water policy and actions.



Chapter 3

Options for the Border Rivers Regional Water Strategy

Snapshot

We have developed a long list of options that could be included in the final Border Rivers Regional Water Strategy.

- To identify these options, we have drawn ideas from previous studies, experience with the Millennium Drought, community consultation and government reforms and programs.
- Each option is expected to address at least one of the objectives set for the regional water strategies.
- The options aim to contribute to achieving our vision of having healthy and resilient water resources for a liveable and prosperous Border Rivers region.
- The options have not been prioritised and not all options have been costed.

The options we are considering aim to tackle the challenges facing the Border Rivers region and maximise opportunities arising from regional change.

Options in the long list focus on:

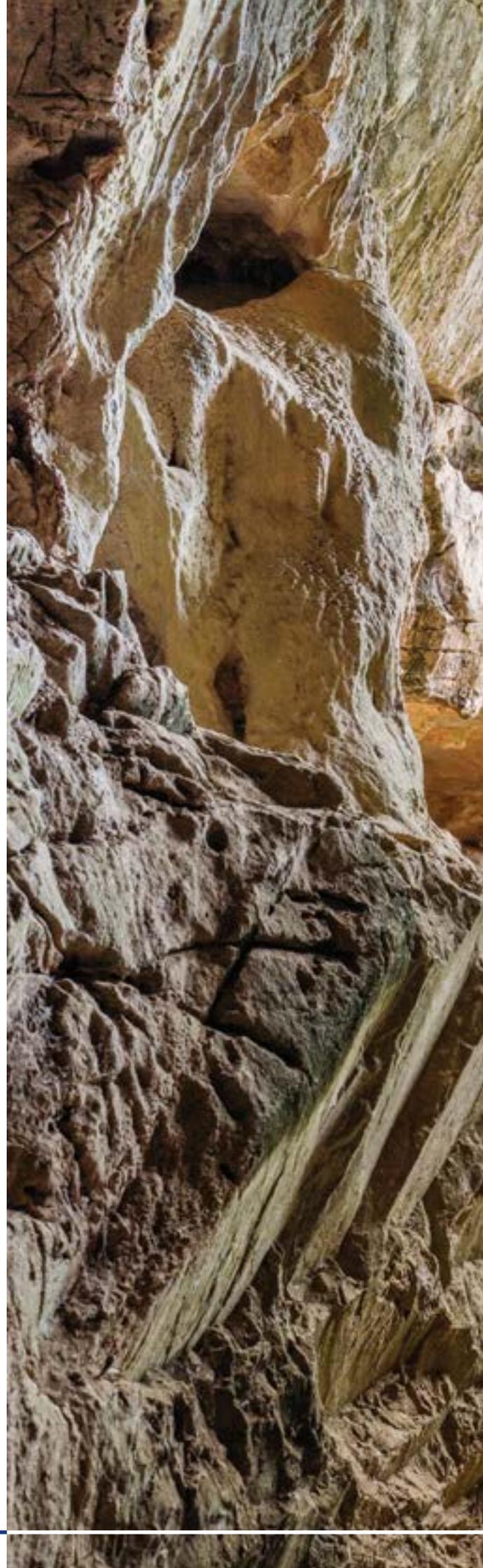
- **maintaining and diversifying water supplies** by establishing alternative water sources and improving existing storages
- **protecting and enhancing natural systems**, including better protection for native and threatened aquatic species, the removal of floodplain structures that impede delivery of water to priority ecological assets and improved protection of water for the environment

- **supporting water use and delivery efficiency and conservation**, including new and upgraded infrastructure, changes to operational rules to reduce evaporative water losses, water efficiency measures, re-use and recycling projects
- **strengthening community preparedness for climate extremes**, such as reviewing existing plans, policies and operational rules to make sure that industries and communities have enough water at the right times to meet their needs
- **Improving the recognition of Aboriginal people's water rights, interests and access to water**, such as reviewing cultural water access licences and ensuring greater involvement of Aboriginal people in water management. These options will be developed following further face-to-face engagement with Aboriginal communities in the Border Rivers region (which has been delayed due to the COVID-19 pandemic).

In each of these areas, we are open to exploring fresh ideas and innovative solutions that will add value to regional industries, leverage new investments and support new economic, employment and environmental opportunities.

Not all options will be progressed.

- Inevitably, these options will involve trade-offs and choices. To fully understand these impacts and trade-offs, we will first seek feedback on these options before undertaking a formal assessment process.
- The assessment process will look at the positive and negative effects of the option, its cost efficiency, how widely its benefits are likely to be distributed and its feasibility. Not all the regional water strategies objectives can be quantified. When the outcome is difficult to assess in a financial context, options will be assessed on how effective they are in terms of achieving objectives, rather than on a cost basis.
- Preferred options, and packages of options delivered together, will be informed by a range of evidence including modelling, expert judgement and Aboriginal and community input. These will form the final, comprehensive Border Rivers Regional Water Strategy.







3.1 Our vision for the Border Rivers Regional Water Strategy

The challenges in the Border Rivers region stem from more variable climatic conditions and increasing water demand. We can't change today's climate or the basic hydrology of our river and groundwater systems. However, we can deliver better outcomes for the region by changing:

- infrastructure in the region, such as dams, weirs, pumps, pipes and channels
- how we operate the water system, such as water sharing arrangements, allocations, environmental flow requirements and flood mitigation
- how water is used and water user behaviour, including demand management measures
- any combination of the above three options.

We have identified policy, planning, regulatory, educational, technology and infrastructure options that address the challenges the region may face and maximise opportunities arising from emerging and expanding industries and new investments in transport and community infrastructure.

Our vision for the strategy

Our vision for the strategy is to support the delivery of healthy, reliable and resilient water resources for a liveable and prosperous Border Rivers 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 people, towns, industries and the environment.

3.2 Identifying and developing the options

We have developed a long list of options that could be included in the final Border Rivers Regional Water Strategy. In preparing this list, we recognise that a great deal of work has been done over the last few years to identify initiatives that could improve water management and water security in the region. We have collated these initiatives and supplemented them with further actions based on feedback from local councils, joint organisations and government agencies. Due to COVID-19, consultation with Aboriginal communities within the Border Rivers region has been put on hold—but this will commence in late 2020. The public consultation process will provide another opportunity to identify options and seek feedback on the long list of options. Bringing all of these options together will help us to align and better sequence the various water reform processes as we develop the strategy.

In developing the long list of options for the Border Rivers region, we have specifically considered the following:

- Each option is expected to address at least one of the regional water strategy objectives (see Figure 4 in Chapter 1). Some options will support multiple objectives. Other options may have positive benefits for one objective while having negative impacts for another objective. We do not have all of the information at the moment to understand these impacts. We will do further work to understand these impacts and seek your views on how each option may impact you and your values.
- As discussed in section 1.3.1, the NSW Government has invested in new climate datasets and improved modelling to gain a more accurate understanding of future climatic conditions in the Border Rivers region. A number of options in the long list propose reviews of existing policy settings,

operational rules and management plans considering this new data.

- As discussed in section 1.3, we have drawn on a range of sources to develop the options, including existing studies, past experience (such as river operations during the Millennium Drought), community engagement and current NSW Government initiatives and programs. This process acknowledges the significant amount of thought and work already directed towards addressing the region's water-related challenges. More information about these sources is in the *Regional Water Strategies Guide*.
- We have had conversations with local councils and local water utilities to understand their views on what options could be considered in the Border Rivers Regional Water Strategy to improve water security and quality for towns and communities (see section 1.3.3).
- Due to COVID-19, face-to-face engagement with Aboriginal communities in the Border Rivers region has been put on hold. The options we have included are based on discussions with Aboriginal peak bodies and what we heard during our consultation with Aboriginal communities in the Macquarie, Lachlan and Gwydir regions. The options will be reviewed following consultation with Aboriginal communities in the Border Rivers region.
- We have sought expert advice from government agencies.

We have not ordered or prioritised the options identified for the *Border Rivers: Long list of options* and many options on the list have not been costed.

3.3 Which options will be progressed?

Not all options in the long list will be progressed. Only feasible options will be progressed following an assessment process.

Inevitably, these options—and their priority in the Border Rivers Regional Water Strategy—will involve trade-offs and choices. To understand the impacts and trade-offs we will first seek your feedback on these options and then use a formal options assessment process which will look at:

- **Effect**
To what extent are the options expected to contribute to or otherwise impact on the objectives over the planning horizon and/or during extreme events?
- **Impacts and magnitudes of impacts**
A risk assessment of the positive or negative impact of the option on the objectives, and the magnitude and frequency of these impacts.
- **Cost efficiency**
To what extent are the options likely to deliver cost-effective outcomes?
- **Distribution of benefit**
Is there likely to be a broader public or regional benefit from the option, or is the benefit concentrated to a small number of users?
- **Feasibility**
To what extent is the option likely to be feasible, including regulatory/policy change, stakeholder acceptance, time to implement, cost, alignment with government policy, both national and international, as well as technical feasibility?

Further information on this process is in the *Regional Water Strategies Guide*.⁸⁰

It is unlikely that a single option will be capable of addressing the identified risks across the objectives we have set for the strategy. The greatest benefits are likely to be realised by combining (or packaging them together) so that they complement each other to improve the efficiency of the system, offset impacts or unlock greater benefits by using the different levers that are available—such as policy and infrastructure levers.

For example, infrastructure options may improve water reliability for industries and water security for towns but could have negative environmental impacts. To mitigate these impacts, and increase the benefit of the projects, infrastructure projects could be combined with:

- environmental options that improve outcomes for fish species and environmental assets such as wetlands, noting that these options may not mitigate the impacts of the infrastructure on native fish species and environmental assets, such as wetlands
- demand management measures to make sure industries are operating as efficiently as possible
- policy and regulatory options that review whether existing water sharing arrangements under altered conditions are appropriate.

However, combining some of the options might mean that other options cannot be pursued. At present, we do not have enough information to understand the trade-offs between options or combinations of options that are described in Table 4.

80. *Regional Water Strategies Guide*, www.industry.nsw.gov.au/water/plans-programs/regional-water-strategies/about



3.4 Border Rivers: Long list of options

Table 4 summarises the long list of options we have identified for the Draft Border Rivers Regional Water Strategy. Detailed information about each option, the challenges it will address, its potential combination with other options and further work required to progress the option is set out in the *Border Rivers: Long list of options*.

The draft long list of options focuses on:

- 1. maintaining and diversifying water supplies**
- 2. protecting and enhancing natural systems**
- 3. supporting water use and delivery efficiency and conservation**
- 4. strengthening community preparedness for climate extremes**
- 5. recognising Aboriginal people's water rights, interests and access to water.**

Concentrating on these five actions enables us to address the challenges facing the Border Rivers region, while maximising opportunities for regional communities and industries, and supporting their aspirations. It will also ensure we preserve our important natural systems and include the extensive knowledge of Aboriginal people in water management decisions.

We have heard from communities that the regional water strategies should not just focus on the risks and challenges of today. This is why our draft long list of options not only focuses on the issues identified in Chapter 2, but also includes a number of options that may become important in future decades.

These options need to be supported by comprehensive and robust data and information and the right tools and infrastructure to implement change in the future.

However, this means that some of our draft long list options are still in a conceptual state. We need to continuously work with communities, environmental managers, Aboriginal peak bodies, Aboriginal people and industries to develop and refine these ideas further.

As noted previously, the options included in Table 4 are not ordered or prioritised and many have not been costed.

Regional water strategies: 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 least cost policy and infrastructure options.

Table 4. Long list of options: summary

Option	Description	Objective
<p>Maintaining and diversifying water supplies—Opportunities to improve town water security, maintain suitable water quality and support growth and jobs in the region</p>		
<p>Government commitment 1 Final business case for building a new dam on the Mole River</p>	<p>Preparation of a detailed business case for the construction of a new dam on the Mole River approximately 20 km southwest of Tenterfield. A new dam has the potential to improve water security and reliability for towns and support the development and growth of the regional economy by securing more water in flood sequences for use in drier times</p>	
<p>2. Raising Pindari Dam’s full supply level</p>	<p>Raise Pindari Dam’s full supply level which could be achieved by increasing the height of the dam embankment. This could increase the dam’s storage capacity improving water availability and flood mitigation in the Border Rivers valley.</p>	
<p>3. Raising Mungindi Weir</p>	<p>Raise Mungindi Weir to increase end-of-system storage capacity. This would result in more water being stored at the end of the regulated river system to meet demand (rather than needing to be released from the dams) and improve delivery efficiency by reducing conveyance losses. This option would also increase the reliability of water supply for Mungindi.</p>	
<p>4. Piping water to stock and domestic water users in the unregulated section of Boomi River</p>	<p>Piped supply to stock and domestic water users in the unregulated section of the Boomi River in lieu of replenishment flow releases from Pindari Dam. This would improve the efficiency of supply and delivery for these water users by reducing conveyance losses.</p>	
<p>5. Improve cross-border management of flows at major breakout points</p>	<p>Improve the monitoring and management of cross-border flows between NSW and Queensland at key breakout structures to recover water for regulated river water users in NSW. Potential projects include upgrading and automating the operation of the Newinga Breakout structure and improvement works at Dingo Creek and Callendoon Creek.</p>	
<p>6. Reliable access to groundwater by towns</p>	<p>Comprehensive strategic review and planning designed to increase the security and resilience of town water supplies by using groundwater resources as an alternative supply. This option would identify towns where future water demands could exceed the capacity of surface water resources and the likelihood and consequences of such exceedances, groundwater resources that could be a complementary water supply, regulatory issues that slow or prevent access to these resources, the infrastructure investments needed and the impact of changing groundwater access on other users.</p>	
<p>7. Intra- and inter-regional connections project investigation</p>	<p>Investigation of potential additional intra-regional pipeline connections in the region’s east and north-east, and inter-regional pipeline connections such as to Stanthorpe in Queensland. Increasing the connections between water supplies would provide access to more than one water source, improving security and reliability of supply for towns and facilitating industry growth.</p>	

Option	Description	Objective
8. Inland diversions from the east	Investigation of potential diversion of flows from the east of the Great Dividing Range or Queensland. A diversion scheme has the potential to increase the region's water security, but will require comprehensive investigation of a number of matters as well as the support of the Commonwealth and other states.	
9. Managing groundwater salinity	A series of projects to prevent further salinisation of groundwater sources and increase the usability of saline groundwater. Projects would include reviewing and updating the definition of groundwater beneficial use categories, a state-wide stocktake of groundwater salinity information, quantitative risk assessment of salinity induced by land management and pumping in all groundwater sources and an investigation into the feasibility of desalination of groundwater in areas where there is high water demand but groundwater sources are too saline.	
Protecting and enhancing natural systems—Opportunities to protect and enhance environmental outcomes and realise broader community benefits through a healthy environment		
10. NSW Fish Passage Strategy	Staged remediation of fish passages at 10 priority weirs and other barriers under the NSW Fish Passage Strategy. Locations are Macintyre Blockbank A and B, Boomi Weir, Goondiwindi Weir, Boggabilla Weir, Toomelah Weir, Glenarbor Weir, Cunningham Weir, Bonshaw Weir and Holdfast Crossing. These works will maintain and improve native fish access to core habitat in the Border Rivers region and to the Barwon-Darling River system and encourage breeding and spawning activities, especially for threatened species. It will also improve recreational fishing and regional tourism opportunities.	
11. Diversion screens to prevent fish extraction at pump offtakes	Every year, large numbers of native fish are extracted by pumps and diverted into irrigation channels, never to return to the Border Rivers system. This option would install screens on major irrigation pumps and diversion channels to prevent entrainment of adult fish, larvae and eggs. It would also improve pump operation, water delivery and extraction efficiency through fewer blockages caused by debris.	
12. Cold water pollution mitigation measures	Cold water is released from lower levels in Pindari Dam to avoid releasing blue-green algae at the surface. Cold water pollution affects over 100 km of the Severn and Macintyre rivers and has damaging impacts on native fish and habitats. It also has social and economic impacts, with recreational use (such as swimming and fishing) around Pindari and Glenlyon dams constrained due to cold summertime water temperatures. This option involves assessing and optimising existing infrastructure, exploring infrastructure improvements and new technologies, and developing effective and feasible plans in conjunction with dam operators to significantly improve water quality.	

Option	Description	Objective
13. Investigation of surface water quality mitigation measures	Investigate opportunities to support the water quality management plans prepared for the Border Rivers surface water and groundwater water resource plans. This could include real time water quality monitors/loggers, investigation of diffuse pollution sources, priority actions to mitigate the risk of algal blooms, an environmental water quality allowance, the reintroduction of wetlands and a strategic plan to improve water quality in surface water sources.	
14. Implement state-wide groundwater quality monitoring program and management program	A range of projects to improve our understanding of water quality in under-allocated groundwater systems to support growth in use of these groundwater sources.	
15. Modification and/or removal of existing priority floodwork structures causing adverse impacts	Some vital ecological assets in the region rely on floodplain connection to replenish and maintain critical elements. Works undertaken on the floodplain can prevent water moving to these areas. This option would modify or remove identified priority floodplain structures and barriers that impede delivery of water to priority ecological assets, specifically in Ottleys Creek and Turkey Lagoon.	
16. Providing incentives to landholders to conserve and rehabilitate riparian, wetland and floodplain vegetation	Complementary measures are needed to ensure the Border Rivers Long Term Water Plan's objectives and targets are achieved. This option would provide incentives for private landholders, councils and other agencies to improve the condition and resilience of habitats and landscapes, mitigate the impact of intensive agriculture and grazing, and adopt low-impact agriculture practices and develop native pastures to increase resilience to future droughts. Funding mechanisms could include grants, BioBanking, Conservation Agreements, Conservation Property Vegetation Plans, Landholder Incentive Agreements and a buy-back program of land for habitat restoration.	
17. Riparian habitat restoration and re-establishing threatened species	A five-year partnership program delivering a package of on-ground activities at targeted high-priority locations, using a catchment management framework. Works could include habitat mapping, identification of high quality drought refugia, riparian restoration, fencing and off stream stock watering points, re-snagging, wetland management, landholder incentives, monitoring and evaluation and threatened species reintroduction and protection.	
18. Investigate land use change impacts on water resources	Review land management practices to improve water quality and reduce salinity impacts. This option aims to provide important information to the NSW Government to help in its decision-making processes regarding current land management practices, future land use applications and the feasibility of land use planning controls.	

Option	Description	Objective
19. Revise water sharing plan provisions for planned environmental water	<p>Reduced rainfall, increased evapotranspiration and any additional regulation and storage of flows will likely lead to longer and more frequent cease-to-flow periods, lower average flows and longer dry periods, increasing the need for environmental water to support ecological outcomes. Under this option, water sharing plan provisions for the release of planned environmental water would be reviewed to accommodate practical considerations in dam operation during periods of low flow. The aim of the review would be to extend the protection of stimulus flows from Pindari Dam and enable a stimulus flow to be available for use all year round.</p>	
20. Improve benefits of planned environmental water	<p>Review water sharing plans to identify, protect and restore the environmental values of pools in unregulated rivers and share water equitably among users. The option would examine the adequacy of existing environmental water rules and access rules to meet environmental water requirements under a more variable and drier climate; enable adaptive adjustments to planned environmental water over time; implement access and trading rules for pools to enable year-round stimulus flows; and formalise channel sharing arrangements.</p>	
21. Active management to protect water for the environment in unregulated rivers	<p>Active management is a new operational tool that ensures water released for the environment remains instream to be used for its intended environmental purpose. Implementing active management in the Border Rivers region will better manage environmental water, maximise environmental outcomes and increase understanding about when water can and cannot be taken.</p>	
22. Improve understanding of water use in unregulated water sources	<p>Better information about water use in unregulated water sources will inform future water planning and management decisions in the region. This option involves understanding how much water is being extracted from these sources through the new metering regulations; improving river flow monitoring systems; monitoring the number and volume of farm dams; and developing hydrologic models of unregulated water sources.</p>	
23. Improve connectivity with downstream systems	<p>Explore options to improve connectivity between the Border Rivers region and the Barwon-Darling River (as recommended by the Independent Assessment of the 2018/19 Fish Deaths in the Lower Darling).</p>	
24. Protecting ecosystems that depend on groundwater resources	<p>A series of projects to advance our knowledge and management of groundwater dependent ecosystems (GDEs) and improve and maintain the health of important GDEs. Projects would include developing new methods to monitor GDEs; formalising water quality guidelines for GDEs; creating a NSW portal for 'one point of truth' for GDEs; and collaborating with universities and other research organisations.</p>	

Option	Description	Objective
Supporting water use and delivery efficiency and conservation — <i>Opportunities to improve the efficiency of existing water delivery systems, increase productivity and address water security challenges through demand management options</i>		
25. Review of water markets in the Border Rivers region	<p>A review of the efficiency and effectiveness of the inter-state and intra-state surface water and groundwater markets in the Border Rivers region, including their ability to contribute to improved water security outcomes in the region. The review would examine the opportunities, challenges and complexities of trade in the Northern Basin with the aim of improving water reliability.</p>	
26. Reuse, recycle and stormwater projects	<p>Investigation of opportunities to maximise the use of surface water and groundwater for potable and non-potable uses through reuse or recycling initiatives, or stormwater harvesting. Options could focus on improving the water security of towns, supporting the establishment of new industry and providing options to maintain 'green' spaces during extended drought.</p>	
27. Water efficiency projects (towns and industries)	<p>Investigation of water efficiency opportunities that can be deployed in regional communities and within businesses. This may require further research and development to identify suitable case studies. As well as improving water security, this option would support industries to maintain and drive regional economic growth and productivity.</p>	
28. Review urban water restrictions policy	<p>Development of a comprehensive policy on water use standards and appropriate temporary water restriction triggers and levels for regional towns. This could complement the Border Rivers Incident Response Guide and assist councils and local water utilities to revise drought management plans.</p>	
Strengthening community preparedness for climate extremes — <i>Opportunities to develop fit-for-purpose policies and regulation to protect town water security, strengthen community health and wellbeing, and better manage risks</i>		
29. New drought operational rules	<p>Review the effectiveness of the NSW Border Rivers Incident Response Guide, including assessing the merit of changing the current system operation rules (for example, limiting the delivery of water to different sections of the regulated river) to minimise delivery losses during extreme events.</p>	
30. Review of regulated river water accounting and allocation process	<p>Review different settings of the current water accounting and water allocation process, including the water allocation process; the effects of updating the 'worse inflow sequence' reference; investigating changes to the volume of water reserved in Pindari Dam; investigating how conveyance 'losses' are estimated and accounted for; and investigating the inclusion of provisions for cultural flows.</p>	
31. Investigation of licence conversions	<p>Consider the potential benefits from voluntary conversion of general security licences to high security licences. This would potentially provide greater flexibility in agricultural production, including the long-term transition to higher value enterprises (such as vegetables and horticulture) that may require high security water. It would also help determine the level of water security achievable in the region.</p>	

Option	Description	Objective
32. Improved data collection	<p>Improve data collection around water use by industry, the environment and towns to better inform future water management decisions. This includes investigating opportunities to refurbish existing monitoring infrastructure and install new infrastructure and technology; harnessing water data collected by industries; reviewing water monitoring programs; and considering how best to publicly share data.</p>	
33. Training and information sharing program	<p>Training and information sessions on new climate data and modelling to build confidence in the new approach and identify opportunities for wider use of the new datasets. The program would also provide training on groundwater resources and how they are managed, and information sessions on NSW and Queensland water market products, systems and processes. Consideration would be given to how best to publicly share data and what information products are needed for different types of water users.</p>	
34. Investigation to maintain amenity for regional towns during drought	<p>Investigate opportunities to maintain town water features, local parks and recreational areas during extended drought and make them less 'climate dependent' so they can be permanent features of regional towns.</p>	
35. Sustainable access to groundwater	<p>Establish a state-wide process to ensure ongoing access to groundwater resources. Existing extraction limits would be reviewed to incorporate up-to-date information, including new climate variation and climate change datasets, ways to improve the integration of surface water and groundwater management, and knowledge about the social and economic impacts under different development scenarios.</p>	
36. Improved clarity in managing groundwater resources sustainably	<p>Review policies to give greater transparency and clarity in managing groundwater extraction within sustainable diversion limits, groundwater systems where the entitlements exceed the extraction limit and areas of concentrated extraction. This option would provide greater transparency and certainty to water users about actions the NSW Government will take to manage groundwater resources.</p>	
37. Improved understanding of groundwater processes	<p>Progress the scientific understanding of five key groundwater processes: recharge rates, dynamics of groundwater levels under stressed and evolving development conditions, connectivity between groundwater and surface water systems, changing patterns in groundwater quality over time and water needs of ecosystems that are partly or wholly dependent on groundwater and the impact on these under different development scenarios.</p>	
38. Extending the Cap and Pipe the Bores Program	<p>The Cap and Pipe the Bores Program was initiated to rehabilitate the Great Artesian Basin and now supports landholders to improve their water security and drought resilience. This option would extend the program after 2024 and define financial and maintenance responsibilities for existing bores.</p>	

Option	Description	Objective
39. Maintaining the Great Artesian Basin for the future	<p>The Great Artesian Basin Strategic Management Plan has guiding principles for economic, environmental, cultural and social outcomes. Under this option, NSW would develop and fund an implementation plan to deliver these outcomes. This would include actions to reduce wastage of groundwater from the Great Artesian Basin; education and compliance programs to promote the shared management of the resource; and design and implementation of water use practices to minimise the amount of groundwater extracted.</p>	
40. Support reforms to simplify and strengthen cross-border groundwater management	<p>This option would support reforms to simplify and strengthen cross-border groundwater management. Potential reforms include agreement on a common management framework with common principles, common management rules and common trade assessment criteria (one resource managed by one set of rules), and reconciling the definition and delineation of joint aquifer management areas across the border.</p>	
41. Improve knowledge of fractured rock groundwater sources in the upper catchment	<p>Opportunities for maximising use of fractured rock groundwater sources depend on increasing our understanding of these resources. This option would expand the groundwater monitoring network; conduct field investigations and exploration to provide baseline information on the availability, likely water quality and vulnerability of fractured rock aquifers; undertake 3D modelling to determine water availability, recharge rates and impacts of extractions; and mapping of groundwater dependent ecosystems.</p>	
<p>Improving the recognition of Aboriginal people’s water rights, interests and access to water— <i>Opportunities to protect and strengthen cultural landscapes, practices, knowledge and traditions. Supporting empowerment, self-determination and economic advancement of Aboriginal people, as well as strengthening community wellbeing</i></p> <p>NOTE: these options have been included as discussion starters and will be amended, replaced, or added to based on advice from Aboriginal communities in the Border Rivers region.</p>		
42. Culturally appropriate water knowledge program	<p>Develop a culturally appropriate water knowledge program that to increase the capacity of Aboriginal people in the Border Rivers region so that they can more effectively negotiate on water management and policy related matters that affect them.</p>	
43. Water-dependent cultural practices and site identification project	<p>Classify and map water-dependent cultural sites. This would include the identification and mapping of cultural sites, places of spiritual significance and places used by Aboriginal communities for traditional and contemporary uses. Intellectual property and cultural knowledge would be protected and retained by Aboriginal people.</p>	
44. Secure flows for water-dependent cultural sites	<p>Aboriginal people have a close spiritual connection with waterways. In the Border Rivers catchment, water-dependent cultural sites are susceptible to dry conditions. This option would investigate opportunities to improve the rate and consistency of flows to places of cultural significance.</p>	

Option	Description	Objective
45. Shared benefit project (environment and cultural outcomes)	Investigate opportunities for shared benefits from using water for the environment to also achieve cultural environmental outcomes, recognising it does not replace the provision of cultural flows. Shared benefits may include fish movement and support for populations of nesting fish species such as Murray Cod.	 
46. Establish a regional Aboriginal Water Advisory Committee	Establish an Aboriginal Water Advisory Committee to improve the ability of Aboriginal groups to have a unified voice on water matters. It could also be responsible for guiding the purchase and management of water entitlements to receive cultural flows; defining cultural water flow needs; and providing broader Aboriginal representation.	 
47. Water portfolio project for Aboriginal communities	Funding to support Aboriginal people to purchase water entitlements and infrastructure (such as pumps) that can be used to improve economic and cultural outcomes across the Border Rivers region. This option would potentially give Aboriginal people more secure access to water for spiritual, cultural, social, environmental and economic purposes, and open up opportunities for investment in water-dependent initiatives and cultural projects.	  
48. Aboriginal cultural water access licence review	Review of water access licences for Aboriginal cultural uses to determine their effectiveness and identify opportunities for improvement.	
49. Co-management investigation of Travelling Stock Reserves	Investigate opportunities to improve the involvement of Aboriginal people in the co-management of Travelling Stock Reserves that connect them to waterways and water-dependent sites of cultural importance.	
50. Regional Cultural Water Officer Employment Program	Investigate models for establishing Cultural Water Officer roles that assist with engaging with Aboriginal people regarding water management. Responsibilities of this role could include increasing knowledge within the Aboriginal community about water management matters and the water licencing framework in a culturally appropriate way; coordinating engagement with local Aboriginal people on water management matters; promoting and supporting self-determination and representation; and channelling information between Aboriginal people and government bodies and key stakeholders.	 
51. River Ranger Program	Investigate options for the establishment of an Aboriginal River Ranger Program. The program would aim to increase the involvement of local Aboriginal people in managing and protecting rivers and wetlands, and use their knowledge to improve water management outcomes in a way that is culturally appropriate and respects cultural knowledge. Rangers could be involved in activities such as pest management; remediation and mitigation of impacts on waterways; restocking native fish and vegetation species; protecting and managing riparian zones; and monitoring, evaluation and research programs.	 



Chapter 4

Where to from here?

We have developed this draft strategy based on the new evidence we have, the latest policies and programs for the region, and feedback from government and councils.

The outcomes, challenges, opportunities and options we have identified in this strategy will be tested, evaluated and refined based on your input.

4.1 Finalising the strategy

Our next steps are to use the feedback you provide to analyse, screen and assess the long list of options, put together a portfolio of options to be progressed and develop a final strategy for release by the end of 2021. Another important step in progressing the strategy is engaging with local Aboriginal people.

We recognise that in getting to the final strategy there will be hard trade-offs, but the only way we can make the best decision possible is to deal with issues proactively and realistically. This will give us the most likely chance of long-term success.

The final Border Rivers Regional Water Strategy will have the flexibility to adapt over time and to new situations and circumstances. It will incorporate regular review processes to ensure the region has an effective strategy in place that remains relevant for future water management.

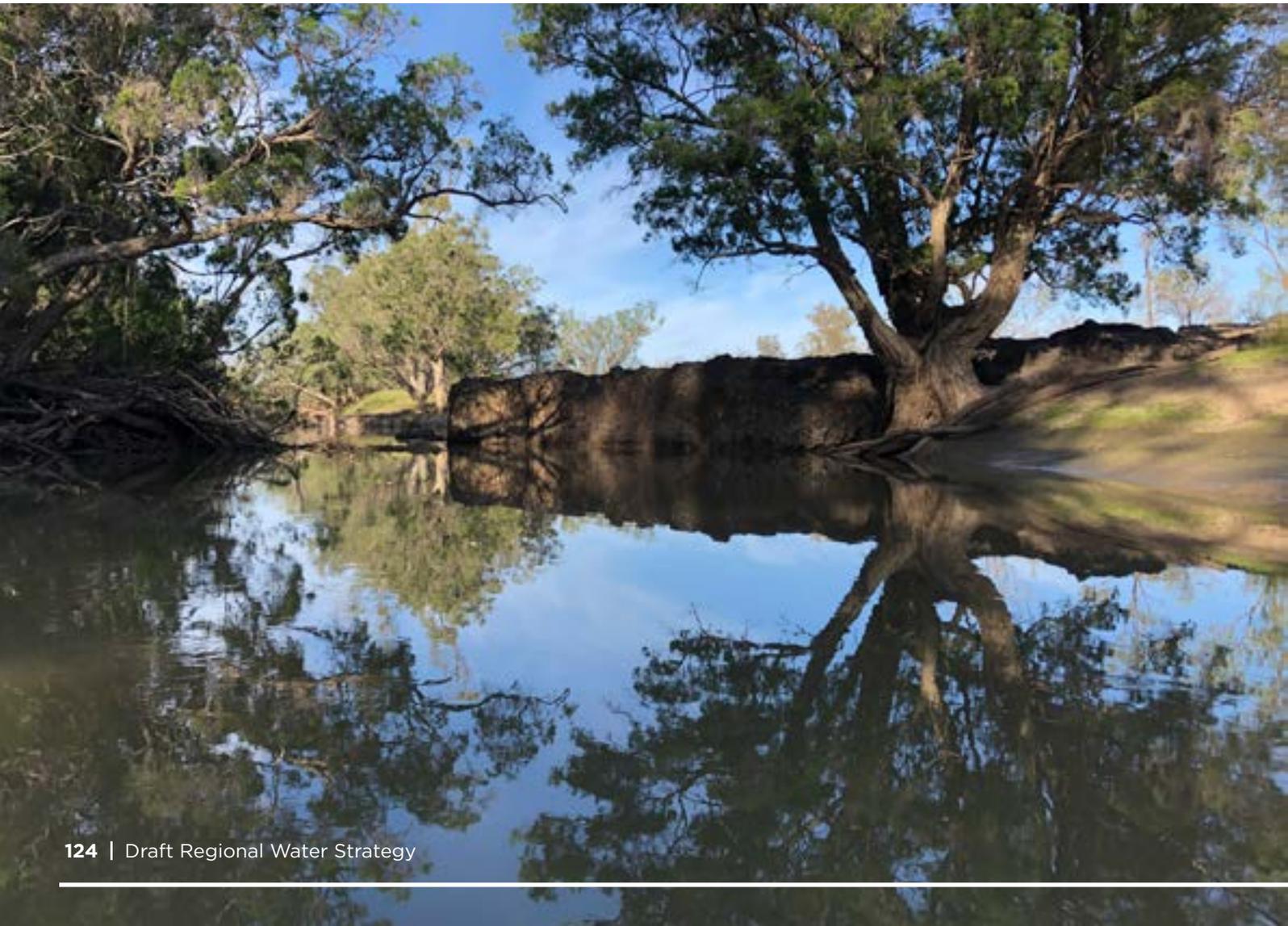
Following completion, each regional water strategy will be reviewed when the equivalent water sharing plans are reviewed.

4.2 Implementing the strategy

Community engagement does not end with consultation; it is a vital part of implementing the regional water strategies. The final Border Rivers Regional Water Strategy will map out our approach to implementation and include an implementation plan. This plan will set out how NSW Government agencies and other organisations with a role in water management and planning will deliver key actions and strategies for maximising water security and availability for all users and the environment. This implementation plan will be clear about timeframes and responsibilities for delivery.

We want to be clear about how we work with communities and regions to ensure:

- We are accountable for what we promise our regions.
- We have the right partnerships in place to drive forward action.
- We are transparent in how we go about those actions.
- We can check with those with on the ground and lived experience that the directions and actions we pursue continue to be the right ones for each region.



Your voice is important

We have prepared this draft strategy to continue our discussions with you about the future management of water in your community. It has been prepared in consultation with local councils. COVID-19 has delayed face-to-face consultation with Aboriginal communities, but this will begin in late 2020. We would like to hear your views on the draft strategy and whether you have any further information that could help us to assess the benefits or disadvantages of any of the options. This may include:

- how your household, business, industry or community currently manages the impacts of a highly variable climate
- the current and future challenges you see in the Border Rivers region and how you think these should be addressed
- how the management of water resources can be improved or leveraged to create and take up new opportunities in the region
- the options presented in this draft strategy
- how we can achieve our aims for accountability and transparency
- the best ways of partnering with communities and regions to implement the strategy.

Your views on the strategy's vision and objectives are also important.

This Draft Border Rivers Regional Water Strategy is on public exhibition from 20 October 2020 for a six-week period. A range of supporting information is available at www.dpie.nsw.gov.au/border-rivers-regional-water-strategy.

We will be meeting with people from the Border Rivers region over the coming months to help shape the final strategy. You can also have your say on the draft strategy by providing written feedback to the Department of Planning, Industry and Environment by midnight 30 November 2020 via:

Web: www.dpie.nsw.gov.au/border-rivers-regional-water-strategy

Email: regionalwater.strategies@dpie.nsw.gov.au

Please note that all submissions will be published on the department's website unless you let us know in your submission that you do not wish the content to be released.

We will be holding online and face-to-face sessions on the draft strategy during the public exhibition period to help shape the final strategy. These sessions will give participants an understanding of the context for the strategy, what the latest modelling is telling us and what the options for better managing water in the Border Rivers region could mean. Times and locations for these sessions can be found at www.dpie.nsw.gov.au/border-rivers-regional-water-strategy

We will also continue to meet with local councils, local water utilities, Aboriginal communities and other stakeholders. Talking with these groups is critical for designing a strategy that builds on their knowledge and capacity, is feasible in terms of implementation and links to their relevant initiatives, plans and strategies.

Attachments

Attachment 1

Targeted stakeholder engagement

Overview

A thorough engagement program supports the development of the regional water strategies. The purpose of engagement is to inform, gain information and feedback, collaborate with key stakeholders on strategy development and build support for the regional water strategy.

Development of the Border Rivers Regional Water Strategy is supported by four engagement phases:

1. Targeted engagement with councils, local water utilities, Aboriginal people and peak bodies⁸¹
2. Public exhibition of the draft regional water strategy and targeted engagement with State and regional peak bodies
3. Further targeted engagement with councils and local water utilities in each region, as well as Aboriginal people and peak bodies
4. Public release of final regional water strategy.

An interagency panel was formed to assist in the development of the Draft Border Rivers Regional Water Strategy. This panel, chaired by Department of Planning, Industry and Environment—Water, included representatives from across the Department of Planning, Industry and Environment cluster including:

- Environment, Energy and Science
- Strategy and Reform.

Members of the panel also included representatives from WaterNSW and the Department of Regional NSW, including the Department of Primary Industries—Fisheries and Department of Primary Industries—Agriculture.

This report documents targeted stakeholder feedback during engagement phase one of the development of the Draft Border Rivers Regional Water Strategy.

81. Targeted engagement with Aboriginal communities is yet to occur due to COVID-19 restrictions

Engagement

Discussions commenced with councils in March 2020. The following organisations or communities participated in discussions. Due to COVID-19, face-to-face engagement with Aboriginal communities has been put on hold, but will commence in November 2020.

Local council/local water utilities/other organisations
Tenterfield Shire Council
Glen Innes Severn Council
Inverell Shire Council
Moree Plains Shire Council
Gwydir Shire Council

The purpose of discussions was to establish a collaborative relationship with local councils, as well as to gain an understanding of key water challenges and risks in the Border Rivers

region. Discussions also focused on gaining feedback on a draft long list of options for the Border Rivers Regional Water Strategy.

Summary

Quick stats and hot topics

A total of four meetings have been held so far, with 18 people external to the Department of Planning, Industry and Environment attending and participating in discussions during the targeted engagement phase. Information about participants and a summary of recurring themes and hot topics are outlined below.

Targeted council/local water utilities/other organisations	
Quick stats	Four targeted meetings
	Eighteen people participated in discussions
	Meetings held via video conference and telephone due to COVID-19
	Over 130 ideas, opportunities, challenges and suggestions identified
Recurring themes	Significant impact of fires and drought on water demand and water quality
	Water security for industry and towns. Strategy needs to consider options to meet additional demands for town water supplies during drought and fires
	Impact of predicted regional growth and climate change predictions on water security for the region in the future
	Conflicting legislation and water sharing rules between NSW and Queensland
Hot topics: Upper catchment—Tenterfield, Glen Innes Severn and Inverell shire councils	Proposed Mole River Dam could help to provide increased security and there is community support for an inland diversion scheme
	Aspirations for growth in horticulture, nut trees and some feedlots that will require significant and secure water
	Drought management compromised by take of water to fight fires
	Retaining enough water in the rivers to allow ecosystems to recover between extreme events such as droughts and bushfires
	Pindari Dam, Mole River Dam and Coffey Scheme
Hot topics: Lower catchment—Gwydir and Moree Plains shire councils	Councils want good quality and consistently available, high security water
	During drought conditions, councils want to have confidence they can supply their towns with water while having some water in reserve
	Councils are looking at additional sources of water and have increased their use of groundwater as an alternate supply during droughts
	Groundwater has helped to provide increased security, although in some areas there is concern about groundwater levels declining
	The Inland Rail link may increase or change water demand if it leads to shifts in the types of agricultural industries

Detailed feedback

The following table summarises the feedback from the targeted engagement phase.

Council engagement

Topic	Comment
Collaboration and engagement	Attendees value ongoing consultation and are keen to see the draft regional water strategy when it is released for comment.
Regional water strategy development	<p>Attendees expressed support for the Regional Water Strategy Program and approve of the process being used to develop the strategy. Attendees advised that:</p> <ul style="list-style-type: none"> • the strategy needs to consider options to meet additional demands for town water supplies during drought • the security of town water supplies will be really relevant to the development of Integrated Water Cycle Management Plans. <p>Climate modelling process and results: Attendees were very interested in hearing about the climate modelling process, and what the results might mean for their shires. For example, during the last drought, one township was only a couple of months away from having to cart water. If the extreme worst case future scenario were to eventuate, this town would have a problem. The need to start considering possible solutions to increase water security was identified.</p>
Regional growth and demand management	<p>Attendees stressed the importance of having a secure water supply in order to facilitate growth—both in terms of population and industry/agriculture:</p> <ul style="list-style-type: none"> • councils in the upper catchment have aspirations for growth in horticulture, nut trees and some feedlots. This will require significant and secure water • the lower catchment could experience growth when the Inland Rail starts operating. Councils would not like to have to turn a business away due to a limited allocation of high security water.

Topic	Comment
<p>Impact of climate change predictions on water security</p>	<p>Attendees stressed the importance of impacts of recurring extreme events such as drought, fire and flooding on water supply and quality.</p> <p>Flooding-related comments:</p> <ul style="list-style-type: none"> • flood events are becoming more extreme. Our temporary bridges were washed out four times before there was relief from the rain. Water flow down the steep mountains is very fast flowing and destructive • Mole River last flooded in 2001 when a monumental amount of water fell and the river was very fast flowing. The flood took out three bridges in the first half day • 2011 flood was less severe for Inverell because Pindari Dam is located above the town. This new modelling shows that flood events are going to be bigger. Does this modelling make the proposed infrastructure works for Pindari Dam and Mole River Dam more relevant? • the NSW Government needs to think about its rules around asset repairs (like for like) versus asset betterment and/or relocation. This is an issue for all upper catchment councils • the Coffey Scheme would help with flooding. <p>Drought impact and water supply comments:</p> <ul style="list-style-type: none"> • the last drought was far worse than previous droughts. We were proactive in securing our water supply ahead of time. We thought we would have way more water than we would need, but it nearly wasn't enough. We had to service rural communities from far afield. This was an unexpected demand we hadn't seen before • recent drought has helped highlight the lack of security of water supplies • lower catchment councils want good quality, consistently available high security water. During drought conditions, we want confidence that we can supply our towns with water, while having some in reserve. <p>Fire impact and water supply comments:</p> <ul style="list-style-type: none"> • the impact of fires on river quality can't be overestimated: it includes destabilisation of soil, sedimentation, burnt organic material in rivers and fish kills. We have been grading sealed roads to get sediment off the road. We have had to fully unblock pipes multiple times from millions and millions of tonnes of sediment and topsoil • demand for water to fight the fires compromised our drought management plan. This was an unexpected need. A key lesson is the need to reuse effluent water to fight fires • we need to enable fish/rivers/biodiversity to recover after fires and droughts without sucking all the water out again. We need to let the Clarence River recover.

Topic	Comment
<p>Comments on draft options</p>	<p>Attendees provided a range of comments on existing draft options and suggested additional draft options:</p> <ul style="list-style-type: none"> • a review of the regulated river water accounting and allocation process is supported, including reserves for town water supply • we need to consider options to meet additional demands for town water supplies during drought and fires • regarding transmission of water downriver: There are high security permanent plantings (such as pecan nut plantings). This is very problematic during droughts. We need to look at long-term high security water • in extreme drought periods, there are delivery losses when getting water to towns. Education and communication about data modelling could help • there should be an option to remove carp. They got into our sewerage treatment ponds and wrecked the walls • chequebook environmental theft hasn't been addressed. A mining company has bought \$5 million of water because they can afford to. But this affects people downstream who don't have money to buy water. We need options that can provide more equity • we would like to see standardisation of water restriction levels; for example, Level 1 restrictions would be the same in every town. This would reduce confusion. However, councils should have flexibility in imposing various levels of restrictions across their region depending on the level of water available in a certain town • water restrictions should depend on reliability of water source. We don't want state government to dictate what each individual community can and can't do • managing bush fire risks needs to be brought into the water engagement framework. <p>Mole River Dam project:</p> <ul style="list-style-type: none"> • the upper catchment councils are in favour of the proposed Mole River Dam project as it could help to provide increased security and help mitigate flooding • these councils submitted the New England Water Grid proposal to the Australian Government on 13 October 2019. The Australian Government has now contributed \$12 million to match the \$12 million provided by WaterNSW • attendees advised they are pleased that WaterNSW is concentrating on the Mole River Dam wall. If the Benefit Cost Ratio is positive, councils will then need to consider the water sharing plans and cross-border issues. <p>Inland diversion scheme:</p> <ul style="list-style-type: none"> • there is community support for an inland diversion scheme. Farmer groups along the north of the shire support the need for the Coffey Scheme to bring water from the coast into inland rivers. The Australian Government has done an initial study • attendees advised the Coffey Scheme could help mitigate flooding. <p>Groundwater:</p> <ul style="list-style-type: none"> • groundwater helped to provide increased security during the recent drought. However, in some areas there is concern about groundwater levels declining • an attendee expressed concern about the recharge of groundwater supply and the lack of knowledge about how much is available • there is a risk that groundwater will not always be a backup supply.

Topic	Comment
Cross-border management	<ul style="list-style-type: none"> • attendees advised conflicting legislation and water sharing rules between NSW and Queensland is an issue that needs addressing • during the drought, weir water that a lower catchment council was relying on was provided to a town in NSW. This halved council's supply of water. Better communication is needed • there is an agreement between states regarding the Murray-Darling. It was suggested that a Memorandum is needed to address cross-border conflicts.
Challenges and opportunities	<p>Attendees identified a number of challenges and opportunities in the region.</p> <p>Challenges:</p> <ul style="list-style-type: none"> • highly variable climate which is more variable and extreme than we expected • pressure on town water supplies during drought • reduced connectivity • delivering environmental flows to the end of the system • declining groundwater levels in the lower catchment • blue-green algae in dams and weirs • salinity in groundwater • cross-border management. <p>Opportunities:</p> <ul style="list-style-type: none"> • improving our management of water resources by improving our understanding of: <ul style="list-style-type: none"> - water extractions through metering framework - flows in unregulated rivers through improved gauging - connectivity between surface water and groundwater - sustainable use of groundwater. • diversification of water sources for towns, such as re-use, groundwater • diversification of industries to reduce requirements for water • we will need to look for more opportunities to support environmental outcomes in the region, including better connectivity within the region and with the Barwon-Darling river system, and improved opportunities for native fish passage.

All feedback has been considered in developing the Draft Border Rivers Regional Water Strategy and stakeholders will continue

to be engaged throughout the public exhibition process and the finalisation and implementation of the regional water strategy.

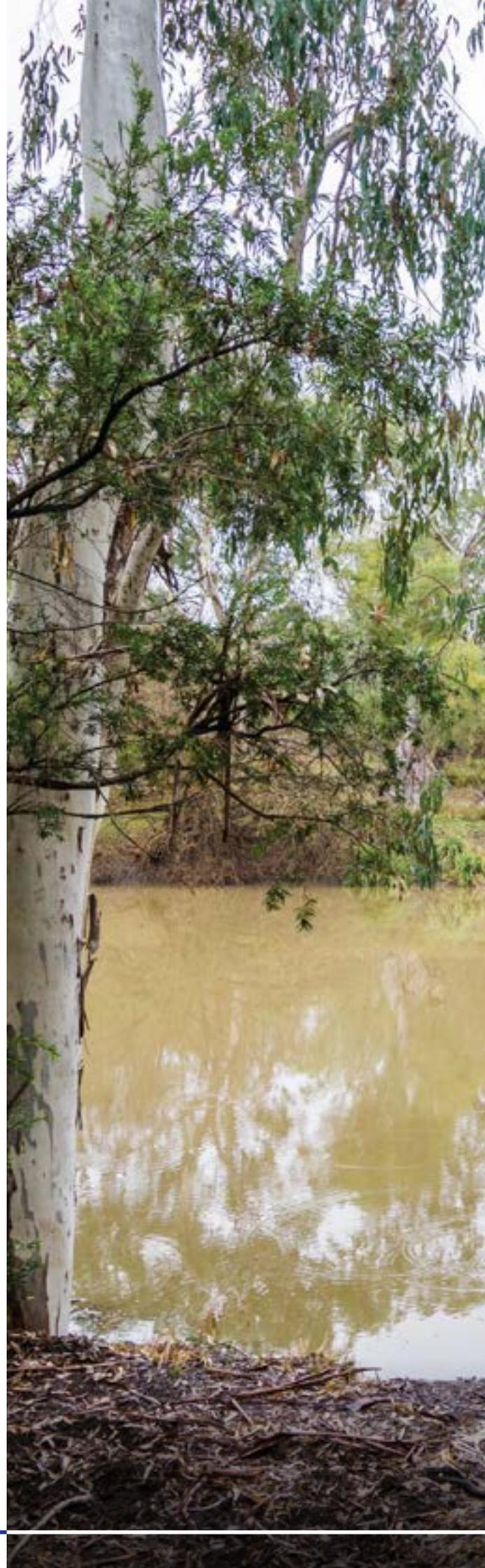
Next steps

In response to the unfolding COVID-19 pandemic, the Department of Planning, Industry and Environment is redesigning its engagement program for the regional water strategies. The pandemic has changed the way we will engage with our stakeholders and communities, replacing some face-to-face consultation with virtual, online and contactless methods.

The department is committed to engage with the Aboriginal communities in the Border Rivers region as soon as possible to ensure the Aboriginal rights, interests and concerns related to water are heard and included in the final strategy. Consultation with Aboriginal communities will commence in late 2020.

The Draft Border Rivers Regional Water Strategy will go on public exhibition from 20 October 2020 for a six-week period. During this period, additional targeted and general public engagement will take place and written submissions will be accepted regarding the strategy.

Following the review of the public exhibition period, further targeted engagement will be undertaken before the final regional water strategy documents are published.





Attachment 2

Glossary

Term	Definition
Access licence	<p>An access licence entitles its holder to take water from a water source in accordance with the licence conditions.</p> <p>Key elements of an access licence are defined in section 56(1) of the NSW <i>Water Management Act 2000</i> as:</p> <ul style="list-style-type: none"> (a) <i>specified shares in the available water within a specified water management area or from a specified water source (the share component), and</i> (b) <i>authorisation to take water:</i> <ul style="list-style-type: none"> (i) <i>at specified times, at specified rates or in specified circumstances, or in any combination of these, and</i> (ii) <i>in specified areas or from specified locations (the extraction component).</i> <p>An access licence may also be referred to as a water access licence or a WAL.</p>
Allocation	The specific volume of water licence holders can access. The amount of water allocated to licence holders varies from year to year based on the type of licence, size of their individual entitlement, dam storage levels, river flows and catchment conditions.
Anabranch	A stream/channel that branches off from a river and re-joins it further downstream.
Aquifer	Geological structure or formation, or landfill, that can hold water.
Basic landholder rights	<p>Where landholders can take water without a water licence or approval under section 52, 53 and 55 of the NSW <i>Water Management Act 2000</i>.</p> <p>There are three types of basic landholder rights under the NSW <i>Water Management Act 2000</i>:</p> <ul style="list-style-type: none"> • domestic and stock rights—where water can be taken for domestic consumption or stock watering if the landholder’s land has river frontage or is overlying an aquifer • harvestable rights—where landholders can store some water from rainfall runoff in dams • Native Title Rights—anyone with a native title right to water, determined under the <i>Commonwealth Native Title Act 1993</i>.
Catchment	A natural drainage area, bounded by sloping ground, hills or mountains from which water flows to a low point. Flows within the catchment contribute to surface water sources as well as to groundwater sources.
Cease-to-pump rule	A requirement in water sharing plans that licence holders stop pumping when the river flow falls below a certain level.
Climate-independent water source	A source of water that does not depend on rainfall or streamflows for replenishment. Includes seawater desalination and recycled water.
Climate variability	Describes the way key climatic elements, such as temperature, rainfall, evaporation and humidity, depart from the average over time. Variability can be caused by natural or man-made processes.

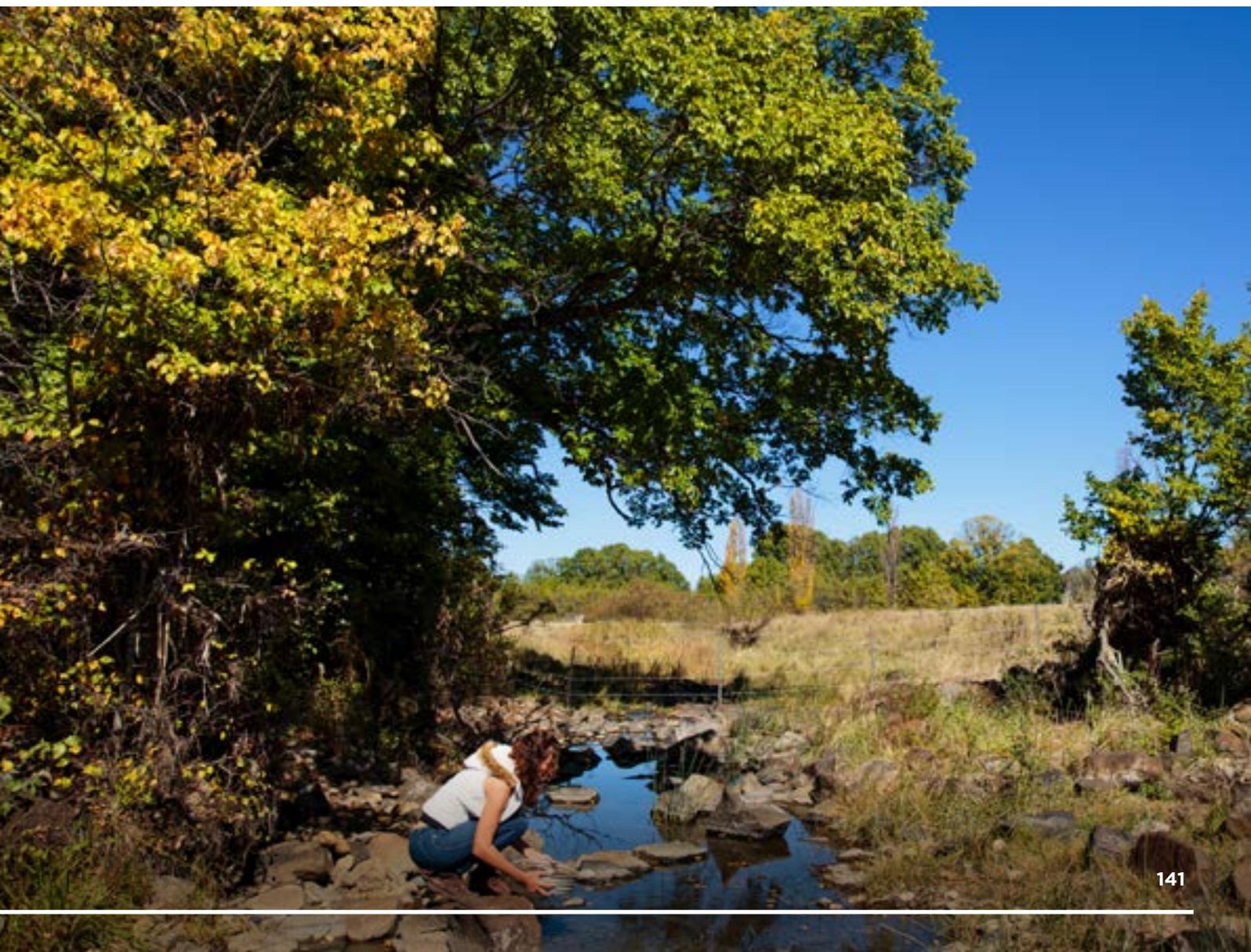
Term	Definition
Cold water pollution	An artificial decrease in the temperature of water in a river. It is usually caused by cold water being released into rivers from large dams during warmer months.
Cultural flows	While the NSW <i>Water Management Act 2000</i> does not define cultural flows, the Murray Lower Darling River Indigenous Nations Echuca Declaration, 2007, defines cultural flows as: 'water entitlements that are legally and beneficially owned by the Nations of a sufficient and adequate quantity and quality to improve the spiritual, cultural, natural, environmental, social and economic conditions of those Nations.'
Direct employment	Refers to employment directly arising from the demand for a specific product or service.
Effluent	Flow leaving a place or process. Sewage effluent refers to the flow leaving a sewage treatment plant. An effluent stream is one that leaves the main river and does not return.
Endangered ecological community	Ecological communities as listed in 'Schedule 1' of the <i>Threatened Species Conservation Act 1995</i> or Schedule 4 of the <i>Fisheries Management Act 1994</i> .
End of system	The last defined point in a catchment where water information can be measured and/or reported.
Entitlement	The exclusive share of the available water that a licence holder can take, subject to allocations.
Environmental asset	Natural features that contribute to the ecosystem of a region. The Murray-Darling Basin Plan defines water-dependent ecosystems with particular characteristics as 'priority environmental assets' for the purposes of environmental watering.
Environmental water	Water allocated to support environmental outcomes and other public benefits. Environmental water provisions recognise the environmental water requirements (planned environmental water) and are based on environmental, social and economic considerations, including existing user rights (held environmental water).
Evapotranspiration	The combined effect of evaporation and transpiration.
Evaporation	The process by which water or another liquid becomes a gas. Water from land areas, bodies of water and all other moist surfaces is absorbed into the atmosphere as a vapour.
Extraction limit	A limit on the long-term average volume of water that can be extracted from a source.
Fish passage	The free movement of fish up and down rivers and streams.
Floodplain	Flat land bordering a river or stream that is naturally subject to flooding and is made up of alluvium (sand, silt and clay) deposited during floods.
Floodplain harvesting	The capture and use of water flowing across a floodplain.
General security licence	A category of water access licence under the NSW <i>Water Management Act 2000</i> . This category of licence forms the bulk of the water access licence entitlement volume in NSW regulated rivers and is a low priority entitlement (i.e. receives water once essential and high security entitlements are met).

Term	Definition
Gross regional product	A measure of the market value of all goods and services produced in a region within a period of time. Gross Regional Product is a similar measure to Gross State Product and Gross Domestic Product.
Gross value added	A measure of the value of goods and services produced in an area, industry or sector of an economy. Gross value added is a similar measure to Gross Regional Product.
Groundwater	Water located beneath the ground in the spaces between sediments and in the fractures of rock formations.
Groundwater-dependent ecosystem	Ecosystems that require access to groundwater to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services.
High flows	Also called bankfull events, these reshape the channel, creating habitats such as pools, bars and benches.
High security licence	A category of water access licenses in regulated rivers implemented under the <i>NSW Water Management Act 2000</i> . Receives a higher priority than general security licences but less priority than essential requirements in the available water determination process. Many high security licences are held by water users that have inflexible water demands, such as those growing permanent plantings and mining companies.
Indirect employment	Jobs that are created by other businesses to support the primary employment sector.
Inflows	The amount of water coming into a surface water source or groundwater source.
Joint organisation	An entity formed under the <i>Local Government Act 1993</i> to perform three principal functions in a region: strategic planning and priority setting, intergovernmental collaboration and shared leadership and advocacy. Each joint organisation comprises at least three member councils and aligns with one of the State's strategic growth planning regions.
Local water utilities	Generally, these are council owned and operated utilities that provide water supply and sewerage services to local communities.
Operational rules	The procedures for managing releases and extractions of water (surface and groundwater) to meet the rules of relevant legislation and policy (e.g. water sharing plans, long-term water plans).
Paleoclimate data	Refers to climate records prior to instrumental records. Various environmental indicators can be used to reconstruct paleoclimate variability extending back hundreds of thousands of years in time. These indicators include marine and terrestrial deposits, tree rings and ice cores.
Permanent plantings	Crops that are not replanted after a growing season. These crops generally require more than one growing season to be productive. Examples include grapes, citrus fruits and almond trees. These are different from annual (or broadacre) crops, which are harvested within 12 months of planting and require replanting to produce a new crop.
Ramsar Convention	The Convention on Wetlands of International Importance (Ramsar Convention) is an international treaty to halt the worldwide loss of wetlands and conserve those that remain. Australia has 66 Wetlands of International Significance listed under the convention.

Term	Definition
Recharge	Groundwater recharge is a hydrologic process where water drains downward from surface water to groundwater. Groundwater is recharged naturally by rain, floods and snow melt and to a smaller extent by drainage directly from surface water (such as rivers and lakes).
Recycled water	Water that has been treated to a 'fit for purpose' standard for a specific application as per the Australian Guidelines for Water Recycling.
Refugia	Ecological refuges (or refugia) are places that naturally provide protection for plants and animals from threats, such as changing climate conditions, extreme events (drought and fire), diseases and invasive species.
Regulated river	A river system where flow is controlled via one or more major man-made structures (e.g. dams and weirs). For the purposes of the NSW <i>Water Management Act 2000</i> , a regulated river is one that is declared by the Minister to be a regulated river. Within a regulated river system, licence holders can order water which is released from the dam and then taken from the river under their water access licence.
Resilience	Resilient water resources as those that are able to withstand extreme events, such as drought and flood, and/or adapt and respond to changes caused by extreme events.
Riparian	The part of the landscape adjoining rivers and streams that has a direct influence on the water and aquatic ecosystems within them.
Salinity	The concentration of sodium chloride or other dissolved minerals in water.
Stochastic climate datasets	Stochastic climate datasets are extended climate sequences that are synthesised using statistical methods applied to observed data of rainfall and evapotranspiration and can include paleoclimatic data. These extended sequences include a more complete sample of climate variability, part of which describes more severe drought sequences.
Storage	A state-owned dam, weir or other structure which is used to regulated and manage river flows in the catchment. There are also a range of storages owned by local water utilities. Also refers to the water bodies impounded by these structures.
Stormwater	Flow generated from rainfall falling on hard (impervious) surfaces.
Supplementary licence	Where a surplus flow from rain events cannot be captured in storages or weirs, and this water is not needed to meet current demands or commitments, then it is considered surplus to requirements and a period of Supplementary Access is announced. Supplementary Water Access Licence holders can only pump water against these licences during these announced periods. Other categories of licence holders may also pump water during these periods.
Surface water	All water that occurs naturally above ground including rivers, lakes, reservoirs, creeks, wetlands and estuaries.
Sustainable diversion limit	Sustainable diversion limits are how much water, on average, can be used in the Murray-Darling Basin by towns, communities, industry and farmers in a particular surface water or groundwater source. The limit is written into law in NSW through water sharing plans.
Synthetic datasets	Data that is artificially created using algorithms and not obtained by direct measurement or generated by actual events.

Term	Definition
Transmission losses	Water, from an accounting perspective, that is considered lost. This water has been lost through surface water seeping into the ground or evaporation.
Transpiration	The process where plants absorb water through their roots and then evaporate the water vapor through pores in their leaves.
Tributary	A smaller river or stream that flows into a larger river or stream. Usually a number of smaller tributaries merge to form a river.
Unregulated river	<p>These are rivers or streams that are not fully controlled by releases from a dam or through the use of weirs and gated structures. However, in some catchments there are town water supply dams that control flows downstream.</p> <p>Water users on unregulated rivers are reliant on climatic conditions and rainfall.</p> <p>For the purpose of the NSW <i>Water Management Act 2000</i>, an unregulated river is one that has not been declared by the Minister to be a regulated river.</p>
Wastewater	<p>Water that is an output of or discharged from a particular activity; for example, from domestic, commercial, industrial or agricultural activities.</p> <p>The chemical composition of the wastewater (compared to the source) will be contaminated.</p>
Water accounting	The systematic process of identifying, recognising, quantifying, reporting, assuring and publishing information about water, the rights or other claims to that water, and the obligations against that water.
Water reliability	Refers to how often an outcome is achieved. It is often considered to be the likelihood, in percentage of years, of receiving full water allocations by the end of a water year for a licence category. For example, a 60% reliability means that in 60% of years a licence holder can expect to receive 100% of their licensed entitlement by the end of the water year. Other measures of volumetric reliability could also be used; for example, the percentage allocation a licence holder could expect to receive at a particular time of the year as a long-term average. Reliability may also refer to how often an acceptable water quality is available. A reliable water supply gives some clarity to water users and helps them plan to meet their water needs.
Water resource plan	A plan made under the <i>Commonwealth Water Act 2007</i> that outlines how a particular area of the Murray-Darling Basin's water resources will be managed to be consistent with the Murray-Darling Basin Plan. These plans set out the water sharing rules and arrangements relating to issues such as annual limits on water take, environmental water, managing water during extreme events and strategies to achieve water quality standards and manage risks.
Water rights	The legal right of a person to take water from a water source such as a river, stream or groundwater source.
Water security	Water security in the context of regional water strategies refers to the acceptable chance of not having town water supplies fail. This requires community and government to have a shared understanding of what is a 'fail event' (for example, no drinking water or unacceptable water quality) and the level of acceptability they will pay for.
Water sharing plan	A plan made under the NSW <i>Water Management Act 2000</i> which sets out the rules for sharing water between the environment and water users, and between different water users, within whole or part of a water management area or water source.

Term	Definition
Water source	Defined under the NSW <i>Water Management Act 2000</i> as ‘The whole or any part of one or more rivers, lakes or estuaries, or one or more places where water occurs naturally on or below the surface of the ground and includes the coastal waters of the State.’ Individual water sources are more specifically defined in water sharing plans.
Water trade	The process of buying and selling water entitlements and water allocations.
Water year	The annual cycle associated with the natural progression of hydrological seasons: starting with soil moisture recharge and ending with maximum evaporation/transpiration. In NSW (as for all of the southern hemisphere), the water year runs from 1 July to 30 June.
Wetland	Wetlands are areas of land where water covers the soil—all year or just at certain times of the year. They include swamps, marshes, billabongs, lakes, and lagoons. Wetlands may be natural or artificial and the water within a wetland may be static or flowing, fresh, brackish or saline.





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