Draft Regional Water Strategy

Gwydir:
Shortlisted Actions – Consultation Paper

June 2022

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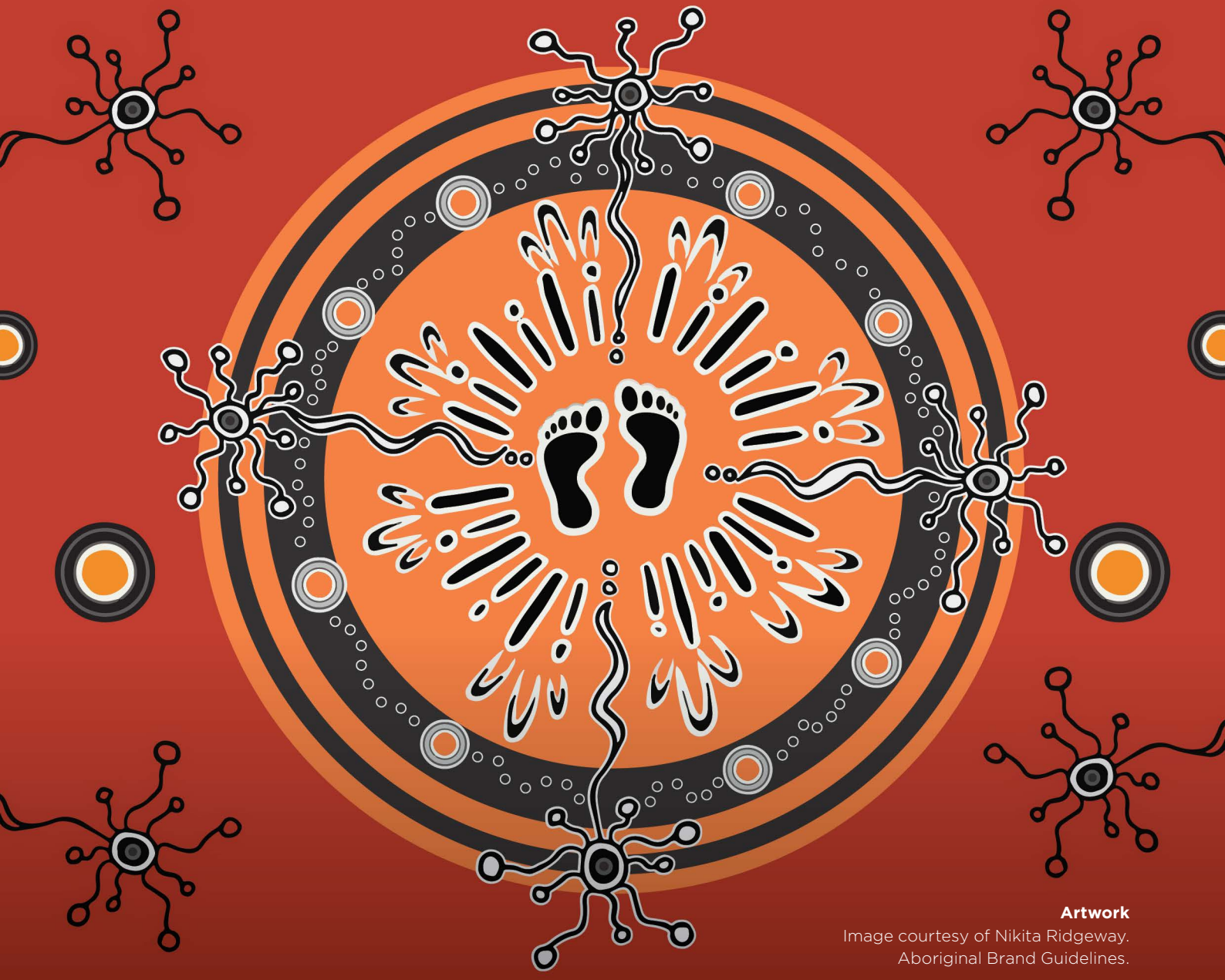
Cover image: Image courtesy of Belinda Collingburn, Department of Planning and Environment. Gwydir River upstream of Bingara, NSW.

Acknowledging Aboriginal people

The NSW Government acknowledges Aboriginal people as Australia's first people and the traditional owners and custodians of the country's lands and water. Aboriginal people have lived in NSW for over 60,000 years and have formed significant spiritual, cultural, and economic connections with its lands and waters. Today, they practice the oldest living culture on earth.

The NSW Government acknowledges Gomeroi/Kamilaroi people as having an intrinsic connection with the lands and waters of the Gwydir Regional Water Strategy area. The landscape and its waters provide the Gomeroi/Kamilaroi people with essential links to their history and help them to maintain and practice their culture and lifestyle.

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



Artwork
Image courtesy of Nikita Ridgeway.
Aboriginal Brand Guidelines.

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

Minister's foreword

The NSW Government is committed to managing our state's water, improving water security and better preparing our communities for future droughts. Our towns, industries, and natural and cultural assets all rely on water, and the way we manage it deeply affects the lives and livelihoods of the people of NSW. Water is our most precious resource.

That is why we have invested in cutting-edge scientific modelling to bolster our knowledge and understanding of our waterways and enhance our policies and long-term planning, so we can manage water for the benefit of everyone.

The Gwydir is home to 24,800 people and the growing country towns of Moree, Uralla, Bingara and Warialda. The region is located within the traditional lands of Gomeroi Nation and is home to internationally recognised Gwydir Wetlands, and rare, endangered and threatened animal and plant species.

Farms and the agriculture industry are the engine of the regional economy. Agriculture creates half of the region's employment and drives the Gwydir's $1.34 billion a year economy, while producing food and fibre for our state. But we know that future droughts will place the regional economy at risk.

Our state is no stranger to extremes; we have always had to manage our water resources through floods and prolonged droughts. In the face of an increasingly variable climate future, we must prepare for even longer and more severe wet and dry periods, particularly in the Gwydir region. During 2017 to 2020, the region experienced the worst drought on record. This experience 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.

We need to start the conversation now with the community on how to support and structure the future economic growth of the region. This strategy is the start of that conversation.

Working closely with the community, we are now making decisions around future investments that will set the region up for the future, support the new industries coming in through the renewable energy zone and special activation precincts, and support the health of the environment.

Engaging with our Aboriginal communities is vital, given water is an essential part of their connection to Country and culture. Ensuring that these communities have access to water and cultural water holdings will be crucial to creating local jobs into the future.

Local government has contributed greatly to this strategy, and I thank councils for their engagement and support. We will continue to partner with them to ensure the strategy addresses the needs of all communities across the Gwydir.

This strategy, alongside 11 other regional and 2 metropolitan strategies across the state, has been developed using the best and latest scientific evidence to ensure we can understand and mitigate risk even in the most extreme climactic circumstances.

We engaged leading academics, including experts from the University of Adelaide, to undertake paleoclimate-informed rainfall and evaporation modelling. This climate modelling is based on a deliberately conservative scenario that is intended to 'pressure test' the effectiveness of the strategy in a worst-case scenario. 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 should they arise.

The Gwydir Regional Water Strategy will put forward the best mix of solutions to address these challenges and support environmental, social and economic outcomes. After widespread community consultation, we have shortlisted proposed actions to ensure water for critical human and environmental needs, underpin sustainable water resources for new and existing businesses, and best use existing water to support a healthy environment.

To complement the regional water strategies, the NSW Government is delivering the Future Ready Regions Strategy, which aims to improve resilience and drought preparedness in regional NSW by drawing on lessons learnt from previous droughts.

In short, the evidence and information we now have means we can better plan for the future to ensure this precious shared resource is managed to sustain secure 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. I encourage all members of the community and stakeholders in the Gwydir to get involved and contribute to the strategy. Water is for everyone, and we are ensuring our water management policies support the future of the Gwydir and all of NSW.

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

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Photography
Image courtesy of iStock.
Gwydir River, NSW.

Snapshot: The Gwydir region

Gomeroi

24,800
population

Key towns include:
Moree, Uralla, Bingara and Warialda.
Councils include:
Uralla, Gwydir and Moree Plains.

Main rivers:
Gwydir River, Horton River, Warialda Creek, Mehi River, Mallowa Creek and Carole Creek.

Region supports the Gwydir Wetlands:
Also provides habitat for rare, endangered and threatened animal and plant species.

Major water storages:
Copeton Dam with a storage capacity of 1,364 GL and supported by a series of weirs and re-regulators.

The region's economy is **highly dependent on agriculture, especially cotton** in the west, with production influenced by water availability. Approximately 80% of available licensed water is used for agriculture.

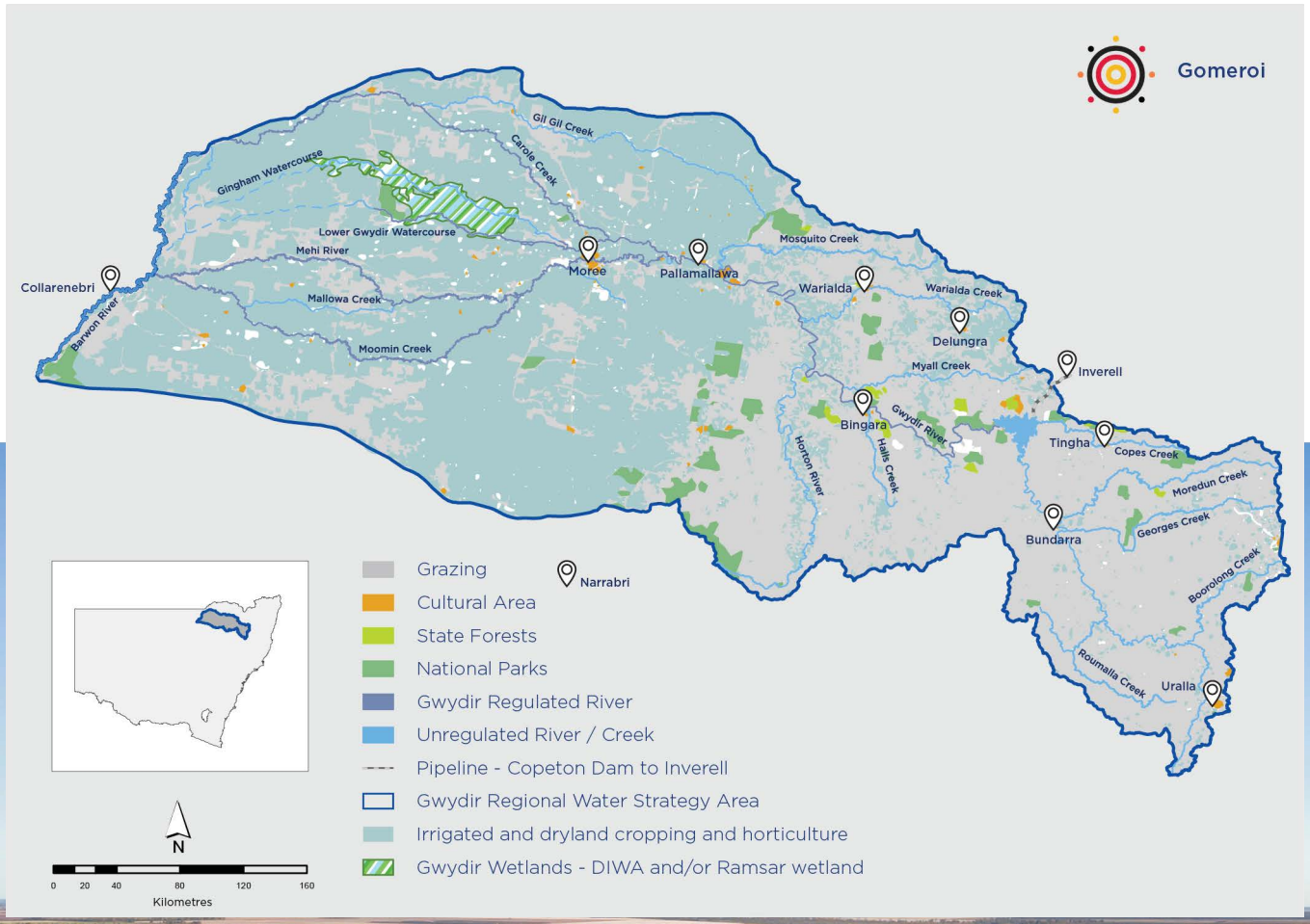
Water for the environment:
Approximately 19% of licences in the regulated Gwydir River, or 135,700 ML of water entitlements are managed by state and federal environmental water holders.

The majority of these are general security licences.

Groundwater:
Groundwater is an important source of water for towns. Alluvial groundwater aquifers located in the lower Gwydir have high yields and are in high demand for agriculture and town water supply.

Groundwater resources in the upper catchment have lower reliability and yield.

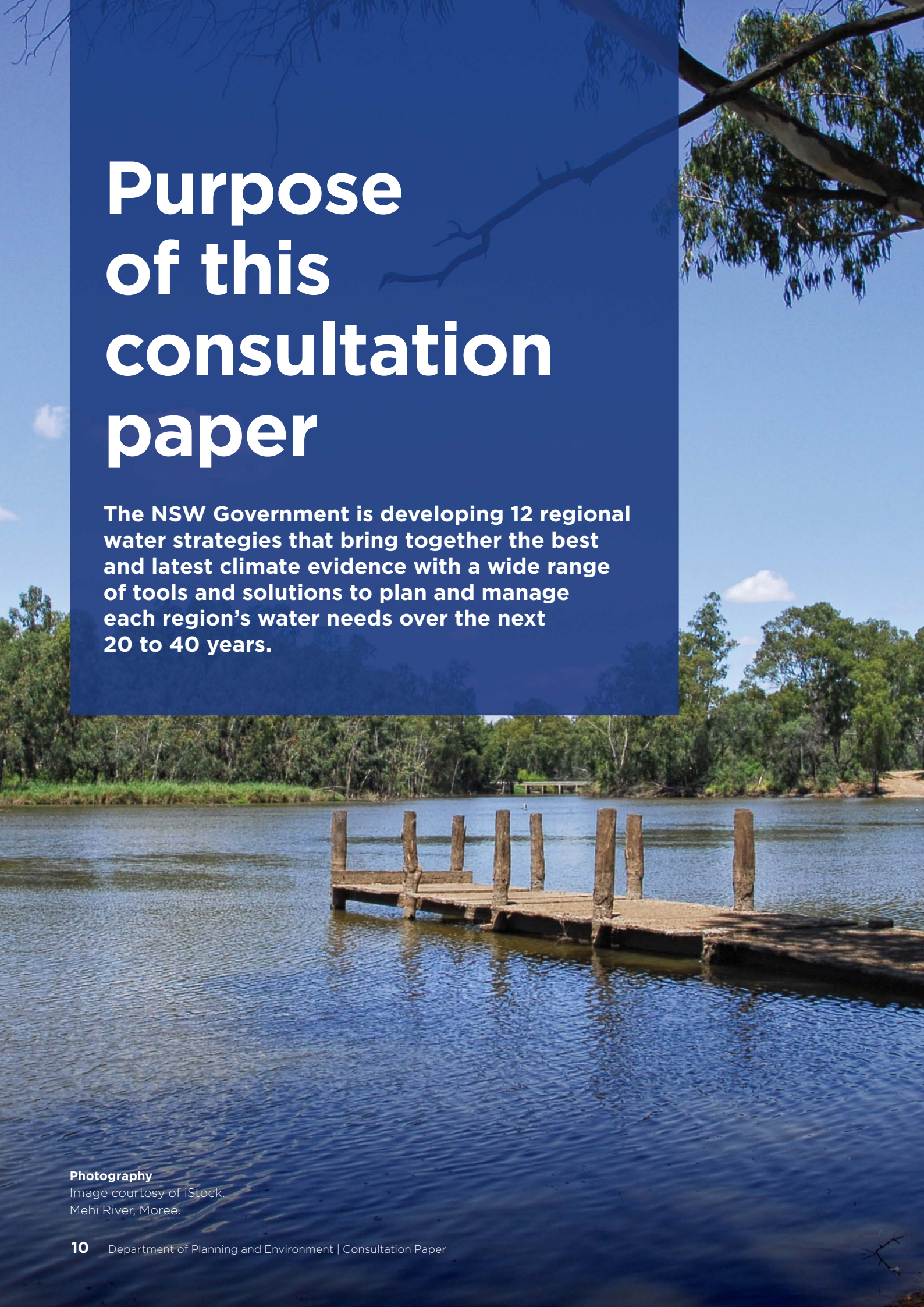
Figure 1. Map of the Gwydir region



Photography
Image courtesy of iStock.
Gwydir River, Moree.

Purpose of this consultation paper

The NSW Government is developing 12 regional water strategies that 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.



Photography
Image courtesy of iStock.
Mehi River, Moree.

The Draft Gwydir Regional Water Strategy, including a long list of options, was released in September 2020.[1]

Since public consultation on the Draft Gwydir Regional Water Strategy, we have taken on-board what we heard, undertaken additional analyses to prioritise the key challenges in the region that need to be tackled first and have shortlisted the options into proposed actions that will help address these challenges. This consultation paper presents the outcomes of this work, summarised in Figure 2.

No decisions have been made on the shortlist of proposed actions. This consultation paper seeks your views on what the best actions are to set the Gwydir region up for the future before a final strategy and implementation plan are developed.

Additional background information can be found in:

- Gwydir Region: Draft Regional Water Strategy: What we heard[2]
- Options assessment process: Overview.[3]

Other regional water challenges previously described in the Draft Gwydir Regional Water Strategy are important and will be revisited during future ongoing reviews of the final strategy, planned to be every 3 to 4 years.

1. The Draft Gwydir Regional Water Strategy and long list of options can be viewed at, www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/upcoming-public-exhibition/gwydir-regional-water-strategy
2. Gwydir Region: Draft Regional Water Strategy: What we heard can be viewed at, www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/what-we-heard/gwydir-regional-water-strategy
3. water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies/identifying-and-assessing

Photography
Image courtesy of James Faris, Department of Planning and Environment.
Bunnor Waterhole, Gwydir Wetlands.

Figure 2. Water security challenges and priorities for the Gwydir region

Vision

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

Objectives

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

Regional challenges to meeting our vision and objectives

Reducing water service risks and improving water supply resilience for the region's towns and villages

Supporting licence holders in the face of declining water availability

Delivering water to the end of the river system and connected valleys

Dismantling barriers to Aboriginal water rights

Improving the health and resilience of the region's aquatic ecosystems

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Priority 1	Priority 2	Priority 3
Water for critical human and environmental needs	**Sustainable water resources for new and existing users**	**Best use of existing water for the environment**
Page 46	Page 56	Page 78
		
Actions 1.1-1.4	Actions 2.1-2.9	Actions 3.1-3.9

Photography
Image courtesy of iStock.
Gwydir River, Narrabri Shire.

Why we are developing regional water strategies

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

The regional water strategy process is identifying these risks and understanding how we can manage and be best prepared for these future uncertainties and challenges, and capitialise on the region's opportunities.

The regional water strategies will include a wide range of tools and solutions to help us better use, share, store and deliver water to ride the highs and lows of water availability and change how we manage water into the future.

How do regional water strategies fit with other water strategies?

The NSW Water Strategy, together with the 12 regional water strategies, and 2 metropolitan water strategies that will underpin it, will form the strategic planning framework for water management in NSW. The NSW Water Strategy was developed in parallel with the draft regional water strategies. The NSW Water Strategy guides the strategic, state-level actions that we need to take, while the regional water strategies will prioritise how those state-wide actions, as well as other region-specific, place-based solutions, should be staged and implemented in each region (Figure 3).

As part of delivering the NSW Water Strategy, the NSW Government will deliver other statewide strategies including:

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

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

Figure 3. State and regional water strategies: priorities and objectives

NSW Water Strategy core objectives	NSW Water Strategy strategic priorities	Regional water strategy objectives
Protecting public health and safety	**Priority 1** Build community confidence and capacity through engagement, transparency and accountability	**Aligned with all** regional water strategy objectives.
Liveable and vibrant towns and cities	**Priority 2** Recognise First Nations/ Aboriginal people's rights and values and increase access to and ownership of water for cultural and economic purposes	**Recognise and protect Aboriginal water rights, interests and access to water –** including Aboriginal heritage assets.
Water sources, floodplains and ecosystems protected	**Priority 3** Improve river, floodplain and aquifer ecosystem health, and system connectivity	**Protect and enhance the environment –** improve the health and integrity of environmental systems and assets, including by improving water quality.
Cultural values respected and protected	**Priority 4** Increase resilience to changes in water availability (variability and climate change)	**Aligned with all** regional water strategy objectives.
Orderly fair and equitable sharing of water	**Priority 5** Support economic growth and resilient industries within a capped system	**Enable economic prosperity –** improve water access reliability for regional industries.
	Priority 6 Support resilient, prosperous and liveable cities and towns	**Deliver and manage water for local communities –** improve water security, water quality and flood management for regional towns and communities.
Contribute to a strong economy	**Priority 7** Enable a future focused, capable and innovative water sector	**Aligned with all** regional water strategy objectives.

Affordability—identify least cost policy and infrastructure options

We want to hear from you

Developing an effective and lasting strategy requires input from communities, towns and industries across the Gwydir region.

We are seeking your feedback on the prioritised regional water security challenges and proposed actions in this document, including the focus questions under each priority.

The feedback we receive on the consultation paper will feed into the final Gwydir Regional Water Strategy and implementation plan.

The final strategy will identify a range of solutions – from policies, plans and regulation through to new technology and infrastructure – that could mitigate water-related impacts across the region and support thriving regional communities. The strategy will bring together these solutions in an integrated package that:

- is based on the best evidence
- is designed to respond to the Gwydir region's water needs
- creates new opportunities for the region
- delivers on the objectives of the regional water strategies and the NSW Water Strategy.

Accessing benefits and impacts of actions on Aboriginal people and communities

Aboriginal communities in Gwydir region have told us that they need specific information on how the proposed actions will affect them.

We know that several of the shortlisted actions will have an impact on, or provide benefits to, Aboriginal people and Aboriginal communities. Currently, we do not have enough information to be able to include evidence about these potential impacts and benefits to provide a full assessment of the shortlisted actions. Our preliminary engagement with some Aboriginal communities in the Gwydir region has identified that communities need specific information on how the shortlisted actions will affect them. Some of this information will not be available until we begin to do more detailed analyses of specific options that remain in the final regional water strategy shortlist. Some of this additional analysis may be identified for early action in the strategy's implementation plan, while other work would progress as part of the strategic business case for specific options.

At this stage of the regional water strategies process, we are identifying and recording the types of questions that Aboriginal communities are likely to have about each of the proposed actions and working out what information communities will need to make informed decisions about how specific actions will affect them.

Once we have undertaken the detailed analysis required to progress preferred actions, we will share that information with Aboriginal communities and seek their feedback on how those actions may impact them. That evidence may help to refine a proposed action or identify risks in progressing with an action.

What we have heard so far

Photography
Image courtesy of Belinda Collingburn, Department of Planning and Environment.
Copeton Dam, NSW.

We sought input from the general public and Aboriginal communities on the Draft Gwydir Regional Water Strategy and the long list of options. The What We Heard report[4] for the draft strategy summarises the key issues we heard during the first round of public exhibition and highlights how all feedback received during this period has informed the next steps in the development of the Gwydir Regional Water Strategy.

There was general support for the regional water strategies program and the development of the Gwydir Regional Water Strategy.

Stakeholders asked the Department of Planning and Environment to progress the development of the NSW Water Strategy to provide an overarching framework and objectives that would guide the 12 regional water strategies and the associated implementation plans. Since that time, the NSW Water Strategy has been released.

The department also heard that the next phase of the Gwydir Regional Water Strategy should be accompanied by an open and transparent consultation process to ensure all stakeholder voices are heard and a broad cross-section of the community is represented in the discussion. This consultation paper has been developed to deliver on this recommendation.

Figure 4. Stakeholder engagement during public exhibition period

4. Gwydir Region: Draft Regional Water Strategy: What we heard can be viewed at, www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/what-we-heard/gwydir-regional-water-strategy

During consultation we also heard:

Climate and modelling

- There was strong support for the strategy's long-term vision and its consideration of future climate risks.
- The inclusion of new climate data and modelling was praised, but there were mixed views on how it should be used. We heard:
  - worst-case dry scenario should not be used to set licence allocations policy
  - alternatively, dry climate change predictions may not be the 'worst-case scenario', but a potential likely future.

Aboriginal knowledge and connection to Country

- There was broad support for improving the recognition of Aboriginal people's water rights, interests and access to water.
- Many stakeholders think that local Aboriginal people have a valuable role to play in long-term water management and emphasised the importance of involving Aboriginal people in the development of the strategy and its implementation.
- All options aimed at delivering Aboriginal water rights received strong support from Aboriginal groups and other stakeholders.

Water security and infrastructure

- There was strong opposition to the proposed Gravesend Dam, which has now been removed from the options list. Concerns included:
  - the belief that the stated benefits would not be realised
  - impacts on communities, including displaced households and businesses.
- There was mixed feedback about enlarging Tareelaroi Weir.

Environment and ecosystem health

- Protecting and maintaining healthy rivers and ecosystems was important for many stakeholders.
- Some stakeholders supported options that improve river system connectivity.
- Improving aquatic ecosystem health through improved land management in addition to water management was considered important.

Water entitlement reliability and risk management

- Existing high-value industries across the region are important, but industry diversification is needed for ongoing economic sustainability.
- Many stakeholders want the strategy to focus on changing water use habits and using available water in a sustainable way.
- The development and adoption of efficiency initiatives by industry and the region's towns was supported.

Groundwater

- There was support for more research and improved knowledge of the relationship between surface water and groundwater.
- Stakeholders were concerned about potential damage to aquifers and wariness of an over reliance on groundwater as a water source, especially in times of drought.

Photography
Image courtesy of Destination NSW.
Streetscape, Tingha.

Where should we focus first?

Our vision for the Gwydir 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.

Photography
Image courtesy of Department of Planning and Environment.
Perseverance through droughts sheep mustering for sale day.

The Gwydir region is a productive agricultural region of NSW and home to a wide variety of aquatic ecosystems including internationally and culturally significant wetland complexes.

The region is located within the traditional lands of Gomeroi Nation. Gomeroi/Kamilaroi people have been caretakers of the Gwydir region for over 60,000 years.

Like all regions across Australia, the Gwydir region faces a warmer and more variable climate. We need to prepare now for the transition to a scenario where we do more with less water, make wise decisions about our water use and management armed with better knowledge and information, and protect our most critical water needs.

We have identified 5 key challenges that are the immediate priority for the region. Addressing these will help us meet the vision and objectives we have set for the Gwydir Regional Water Strategy.

Photography
Image courtesy of Department of Planning and Environment.
People swimming in Warialda Creek, Warialda.

Reducing water service risks and improving water supply resilience for the region's towns and villages

Less reliable flows in unregulated rivers and creeks are increasing water security and water quality risks for the towns, rural landholders and industries that rely on them. A drier future climate could also reduce the reliability of groundwater resources.

Towns supplied from unregulated rivers are more at risk than others

Residents of towns and villages in the Gwydir region expect safe and reliable water services to their homes and businesses. Providing sufficient water for domestic needs and essential services is the NSW Government's highest priority during drought. Communities also value water for recreation and amenity.

Our analysis has shown that supplies from Copeton Dam to the towns of Bingara, Gravesend and Inverell – in the Border Rivers catchment – are very secure and have a very low likelihood of supply shortfalls under a dry climate change scenario (Table 1). This is because town water entitlements represent less than 1% of the total regulated river entitlement in the Gwydir region, meaning that essential town water supplies can be more readily secured.

Table 1. Town water supply: Hydrologic base case outcomes – stochastic and NARCliM

Town	Average annual shortfall (ML)*	Average annual demand (ML)	Shortfall as a % of demand	Average % of year with shortfall
Stochastic (long-term climate record)				
Bingara	0.0	654	0.0	0.0
Inverell	0.0	3,046	0.0	0.0
Gravesend	0.0	118	0.0	0.0
NARCliM (dry climate change scenario)				
Bingara	0.8	654	0.1	0.2
Inverell	0.0	3,046	0.0	0.0
Gravesend	0.3	118	0.2	0.2

* A shortfall occurs when daily town water supply demands exceed the volume of water that can be extracted from the water source by more than 1 ML/day. Most town water supply systems include storages (e.g. dams, weirs) to manage variability in water availability. Thus, a shortfall in extraction does not directly result in a shortfall in supply to customers.

The NSW Government has invested in new modelling methods and datasets to develop a better understanding of both historical climate variability and likely future climate conditions. We are using new scientific methods that augment the observed historical record (about 130 years of rainfall, temperature and evaporation data) with paleoclimate data (data reconstructed from before instrumental records began, using sources such as tree rings, cave deposits and coral growth) and the latest regional climate change projections from NARCliM (the NSW and ACT Regional Climate Modelling project). This greatly improves our ability to identify plausible climate impacts and risks, and it represents a significant and important advance in water planning for NSW.[5] We have used the driest climate change scenario in our analysis to stress test the system. This scenario may not occur.

Additional work to investigate the secure yield of individual town water supply systems in the Gwydir Shire, which includes Bingara, is currently being progressed through a regional town water strategy led by the Namoi Joint Organisation of Councils. The outcome of this work will be considered when finalising this strategy.

Water security risks for towns, such as Uralla, which are supplied by unregulated surface water and do not have backup groundwater supplies, are of greater concern. Uralla came close to running out of water during the 2017 to early 2020 drought. It's town water supply dam fell to 29% in February 2020[6] and at the same time, the water supply was also compromised from levels of arsenic above those recommended under the Australian Drinking Water Guidelines. This led to a 4-month 'do not drink alert' with residents using about 40 kL of bottled water per day for their domestic needs at an average cost of $4,000 per day.[7] The Council has since received an additional $1.5 million to investigate and develop a groundwater supply to improve water security under the Emergency Drought Fund.[8] These investigations are continuing.

The region's rural properties that supply their own domestic needs from rivers and creeks, groundwater bores or rainwater tanks are also at risk and often place further strain on town water supplies during drought conditions by purchasing carted water for their household needs. We have also heard that during extreme droughts and bushfires, towns in the region experience a significant increase in demand for water to support fire-fighting efforts. These risks may increase in the future.

Towns in the Gwydir region's tablelands and slopes, like Uralla, are supporting emerging boutique food and tourism-based retail enterprises. Failure to address water supply risks presents a threat to business and investor confidence and the region's tourism appeal.

Groundwater could become harder to access

Some towns in the Gwydir region rely on groundwater. Moree's primary source of water supply is alluvial groundwater from the Lower Gwydir Groundwater Source. There are approximately 1,500 registered bores in this groundwater source, the majority of which are used for stock and domestic purposes. There are also approximately 400 production bores that are largely along the Gwydir and Mehi rivers between Moree and Ashley (Figure 5).[9]

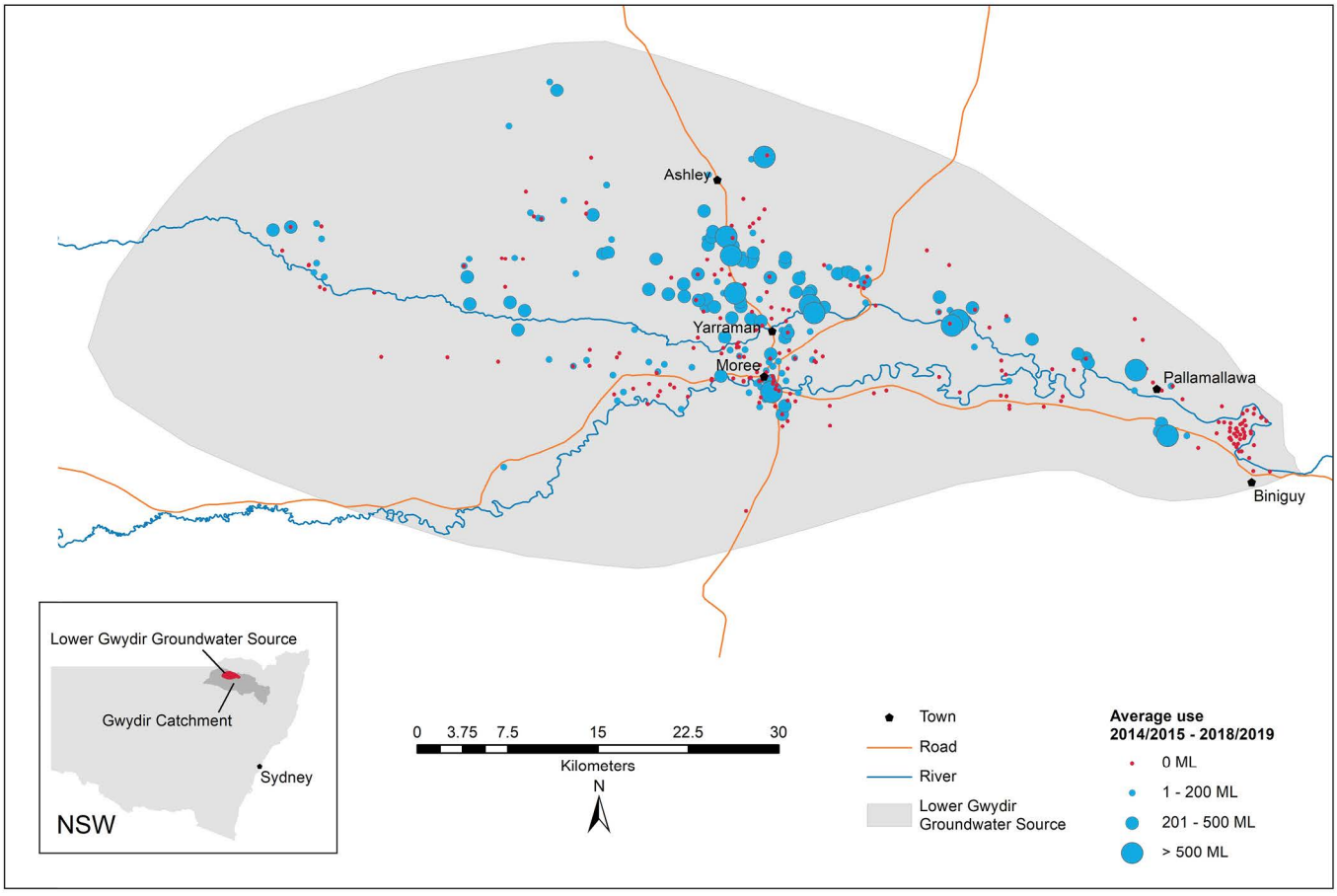
5. A detailed explanation of the new climate data and modelling being used for the regional water strategies is provided at www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/climate-data-and-modelling
6. www.uralla.nsw.gov.au/Council-Services/Water-and-Sewer-Services/Water-Production-and-Storage-Volumes-Uralla
7. Department of Planning and Environment—Water data
8. Department of Planning, Industry and Environment 2021, *Gwydir Valley snapshot: 2017-2020 Drought*, retrieved on 11 October 2021 from www.industry.nsw.gov.au/water/allocations-availability/droughts-floods/drought-update/critical-valleys-in-drought
9. Department of Planning, Industry and Environment 2021, *Groundwater Annual Report: Lower Gwydir Groundwater Source—2021*, retrieved 11 March 2022 from www.industry.nsw.gov.au/water/science/groundwater/document-library

Water use from the Lower Gwydir Groundwater Source is close to the extraction limit each year (Figure 6) and water levels have declined by between 5 to 10 metres in some areas.[10] This means that any increased groundwater use for high priority town needs would potentially lead to reduced access for existing users.

Under a drying climate the amount of water seeping into the ground and replenishing groundwater could reduce. Under this scenario, it would be harder to meet current demand for groundwater use. It also means that if other users continue to turn to groundwater in extreme droughts, there may be increased risks for towns that rely solely on this resource. This risk will not have a significant impact in the short term, but we need to prepare now.

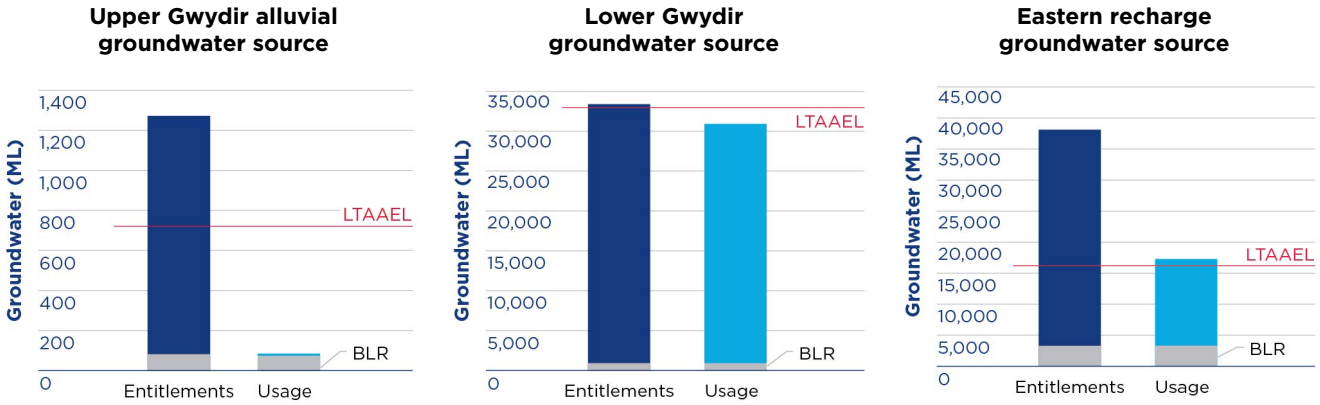
In addition, Gwydir Shire Council provides groundwater supplies for Warialda, however this groundwater is accessed through a general security groundwater licence meaning high priority needs are relying on low priority licences. Gwydir Shire Council is in investigating options to provide more secure water supply to Warialda, including ensuring the towns have access to high security water licences.

Figure 5. Average groundwater use in the Lower Gwydir Groundwater Source from 2014 to 2019



10. Department of Planning and Environment 2022, *Lower Gwydir Groundwater Source: Water level review*, retrieved on 11 March 2022 from www.industry.nsw.gov.au/water/allocations-availability/managing-decline-in-groundwater-levels

Figure 6. Volume of groundwater for long-term average annual extraction limits (LTAAELs), basic landholder rights (BLR), total share component and average annual metered use from 2015 to 2020



Photography
Image courtesy of Belinda Collingburn, Department of Planning and Environment.
Gwydir River, Bingara.

Supporting licence holders in the face of declining water availability

Aquatic ecosystems, including the Gwydir Wetlands, and the region's main industry of agriculture rely heavily on general security licences, which have low reliability and often receive zero or low water allocations during drought. Droughts that last multiple years impact the region's economy and the health of its natural ecosystems. Ongoing changes to climate could increase drought frequency and severity.

Water underpins the regional economy

The Gwydir region prides itself as a productive agricultural area. Long-established mixed family farms and grazing enterprises are a feature of the region's slopes and tablelands, while the expansive black soil floodplain, which stretches from west of Biniguy near Moree to the Barwon River, primarily supports dryland and irrigated cropping.

Agriculture drives the Gwydir region's economy. It is the largest employer – directly and indirectly employing nearly 50% of all workers in the region. Towns in the region and surrounding area rely on the economic performance of the agricultural industry to support businesses, such as real estate, retail, road transport and construction, plus sustainable provision of community services.

Surface water and most groundwater sources in the region are fully allocated. Agriculture accounts for approximately 80% of all licensed water use in the region, much of which is used to grow irrigated cotton during summer and wheat in winter. Other agricultural land uses include grazing of prime beef and lamb and production of chickpeas, oil seeds, pecans, oranges, olives and walnuts.

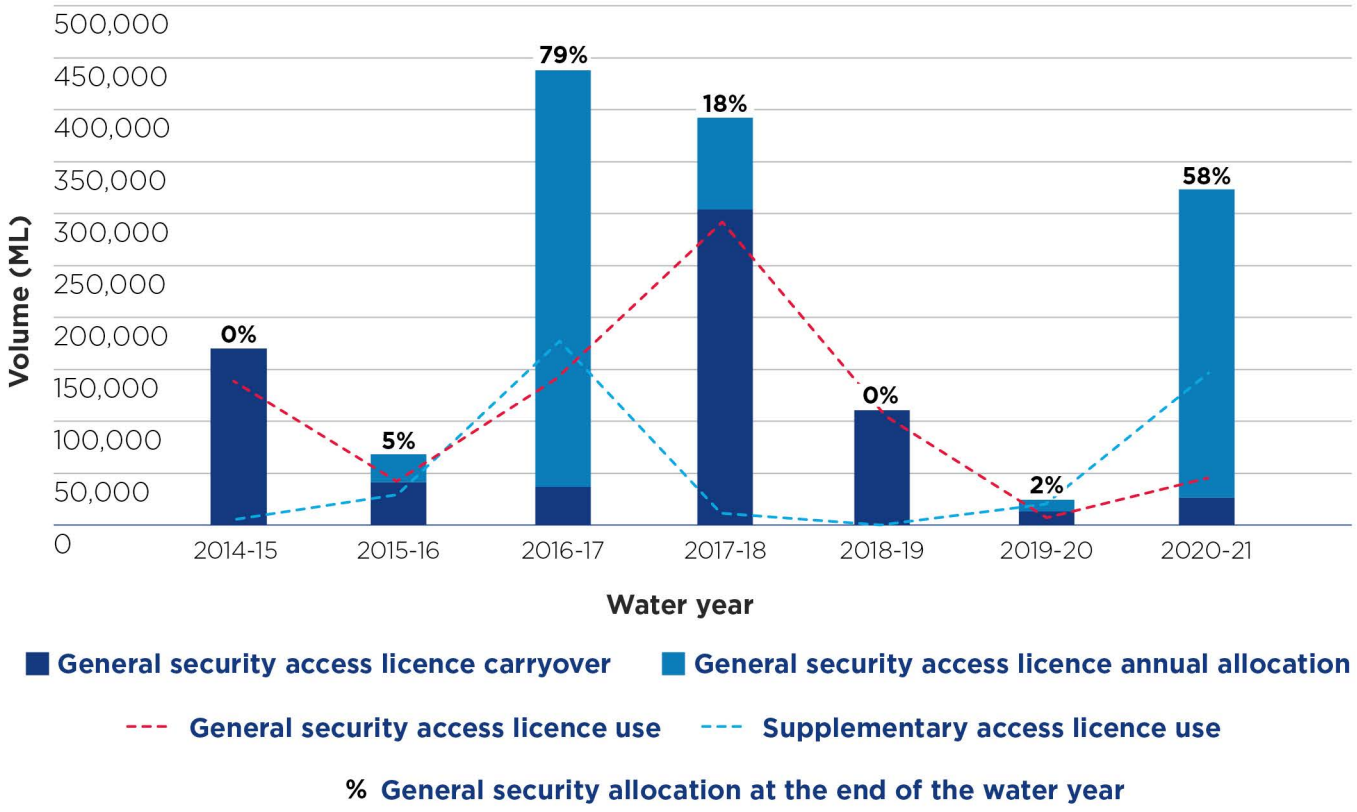
The region is vulnerable to drought and many farm businesses have adapted to the region's variable climate by producing annual or seasonal crops and investing in technology and improved management practices. The cotton industry has improved whole farm irrigation efficiency and producers now achieve almost twice as much cotton from the same amount of water as 25 years ago.[11] Other improvements by farm businesses include the adoption of no-till and conservation farming methods.

For irrigated agriculture, water sharing arrangements negotiated over the past 20 years and access to multiple sources of water also allow production to continue during dry spells. If irrigators have access to supplementary or floodplain flows in the lead up to or during the summer cropping season, they use this and carry over their general security allocation into the following year.

Due to this water use behaviour, droughts that extend beyond 2 years often lead to water users having low volumes of carryover and general security allocations (Figure 7). These droughts can have a significant impact on industry and impose hardship on the region's communities as the impacts of reduced agricultural production extends to other parts of the economy. For example, general security water available in 2019–20 was the lowest since 2004 when water sharing plan management conditions started. It contributed to the Moree Local Government Area experiencing the largest fall in gross regional product of any local government area in NSW in 2019–20.[12]

11. Australian Cotton 2020, *Cotton with a Conscience: Social Report*, retrieved 20 September 2020 from www.cottonaustralia.com.au/cottons-water-use
12. Department of Planning, Industry and Environment 2021, *General Purpose Water Accounting Report 2019-20: Gwydir Catchment*, retrieved 20 September 2021 from www.industry.nsw.gov.au/water/allocations-availability/water-accounting/gpwar

Figure 7. General security and supplementary availability and use in the Gwydir valley from 2014 to 2021



Note: The general security annual allocation shown in this figure (light blue area of column and percentage) is the cumulative allocation at the end of the water year (30 June).

Source: Department of Planning and Environment—Water Group, *General Purpose Water Accounting* reports, www.industry.nsw.gov.au/water/allocations-availability/water-accounting/gpwar

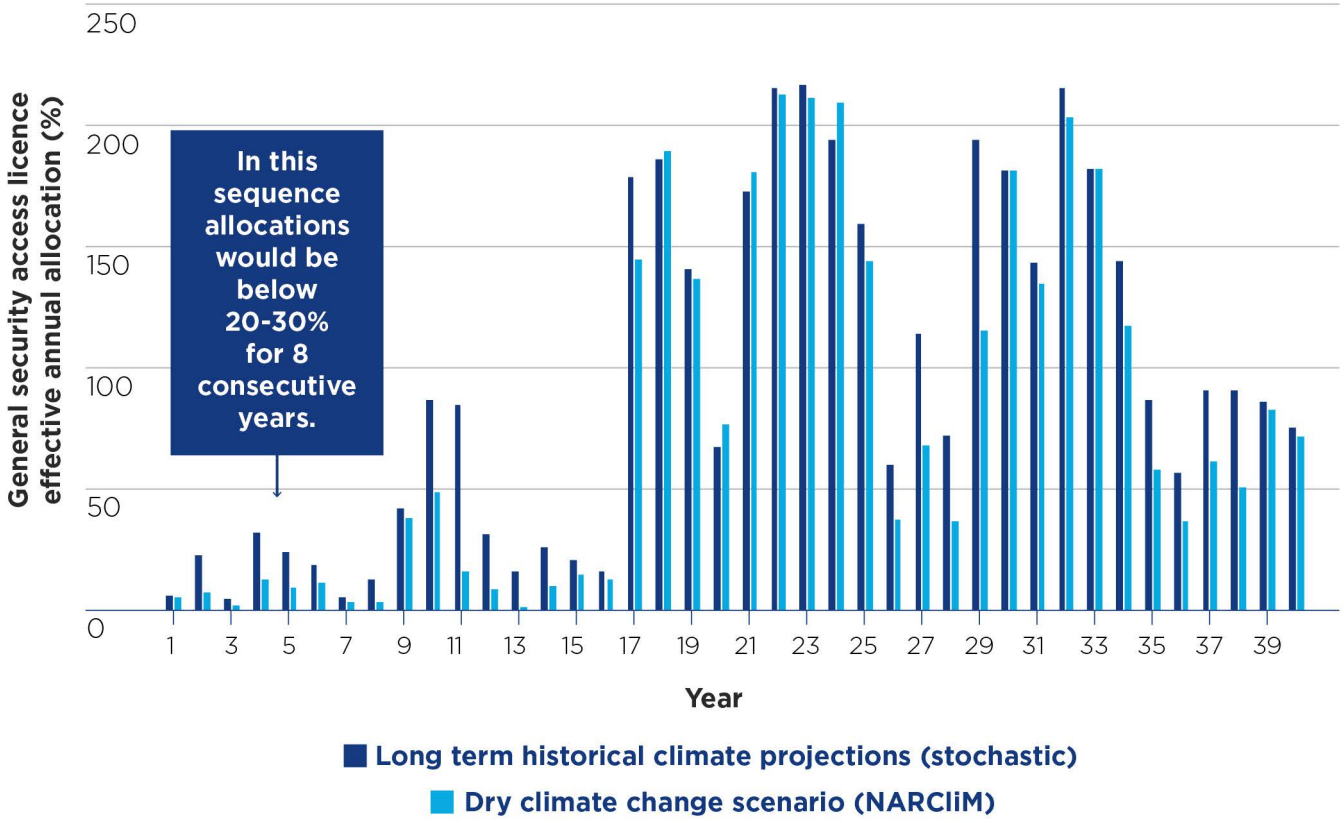
Recent improvements in our understanding of the region's climate suggest that droughts may occur more often and last longer. While the impacts of a changing climate are uncertain, there could be reductions in the amount of water flowing into rivers because of less overall rainfall and high evapotranspiration. In the Gwydir region. This could result in:

- an increase in consecutive years of low water availability for general security licence holders (see Figure 8)
- a 6% reduction in annual extraction by general security water access licence holders based on the long-term historic climate (stochastic) and 26% reduction under a dry climate change scenario over the long term compared to the observed record
- the potential for flow-on reductions in agricultural profit by 20% over a 40-year period under a dry climate change scenario, relative to the long-term historic climate (Table 2).

A more variable or changing climate would also impact water supply reliability in the region's unregulated rivers and creeks, which support many of the region's mixed farming and grazing enterprises.

Figure 8. Effective annual allocations for general security licences under different climate scenarios

This graph shows one potential 40-year sequence from the 10,000-year dataset we have developed. It shows the end of year effective annual allocations in the regulated Gwydir River could be low for extended periods of time under long-term historic and long-term climate projections. In this 40-year sequence, general security allocations would be less than 30% over an 8-year period. In the 2017 to 2020 drought, effective annual allocation was below 30% for 2 consecutive years.



Source: Department of Planning and Environment—Water 2022, catchment hydrologic and climate data.

Table 2. Average yearly water provided to different water user groups in the Gwydir valley and average total (40 years) economic outcomes

Water user group (Regulated Gwydir River)	(b) Long-term historical climate projections (stochastic)	(c) Dry climate change scenario (NARCliM)	Difference between (b) and (c)	Difference (%) between (b) and (c)
Annual crops*				
Water supplied, GL/year	391	301	-90	-23
Economic value, $ million	1,995	1,532	-463	-23
Permanent crops*				
Water supplied, GL/year	12	12	0	-0.1
Economic value, $ million	137	136	-1	-1

* The annual water for annual crops is calculated using regulated Gwydir River general security entitlement, floodplain harvesting and rainfall runoff availability. The annual water for permanent crops is calculated based on the availability of the regulated Gwydir River high security entitlement.

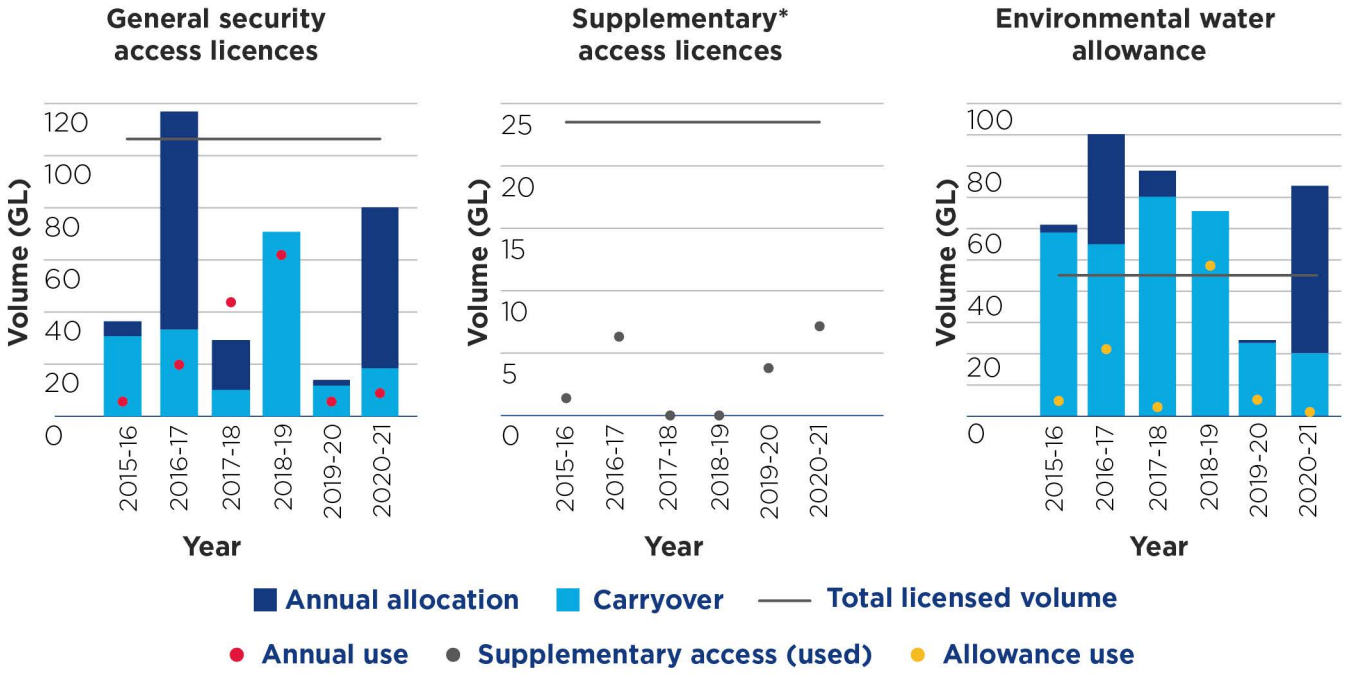
Photography
Image courtesy of the Department of Planning and Environment.
Windmill, Warialda.

It could become increasingly difficult to meet environmental needs

The NSW and Commonwealth environmental water holders own and manage a total of 135.7 GL of water entitlement in the Gwydir region—19% of total regulated Gwydir River entitlement. Most of this entitlement is held as general security licences. 5.7 GL is high security entitlement and 23.4 GL is supplementary entitlement. An environmental water allowance of 45 GL per year is also set aside in Copeton Dam, which can accrue up to 90 GL in any water year. The allowance can be used for a wide range of purposes related to wetland or river health, or for the direct benefit of birds, native fish or other fauna. The water sharing plan also provides minimum flow rules to protect the Gwydir Wetlands.[13]

The amount of licensed water and environmental water allowance that is available for use varies year by year depending on water allocations and how much water has been carried over, in the same way that it does for other users (see Figure 9). This variability is considered as part of the annual planning process by environmental water managers. However, it can mean that during dry periods, there may be less water available to release for the environment and, in some instances, limited opportunities to maintain critical environmental needs such as refuge river pools, core wetland areas and seed banks in the soil. Ongoing dry conditions would also reduce the reliability of these licences.

Figure 9. Environmental water volumes available for use in the Gwydir valley from 2015 to 2021



Note: Supplementary flow events occur in the Gwydir regulated system at any time and therefore access is purely opportunistic. Supplementary events depend on the amount and location of rainfall and ensuing streamflow, the catchment conditions at the time and whether the flows are needed to meet higher priority requirements, including environmental flow rules in the water sharing plan. A maximum of 50% of available supplementary flows can be extracted in any announced event. No supplementary access events occurred in 2018–19.

*The supplementary graph shows the volume of water used by the environmental water holders.

Source: Department of Planning, Industry and Environment—Water 2021, compiled from data available on the Allocations Dashboard, www.industry.nsw.gov.au/water/environmental-water-hub/public-register/dashboard

13. See Part 3, Environmental Water Provisions in the *Water Sharing Plan for the Gwydir Regulated River Water Source 2016* from www.legislation.nsw.gov.au/view/html/inforce/current/sl-2015-0629

New industries in the region will help diversify the economy but these need secure water

The NSW Government has invested in a Special Activation Precinct in Moree. The precinct will stimulate investment, employment and new industries in the region that capitalise on the region's existing strengths in agriculture as well as its road and rail infrastructure.

The Special Activation Precinct will help diversify the region's economy by attracting intensive and value-add agricultural products:

- aquaculture, including a potential barramundi facility
- indoor or polytunnel horticulture – medicinal cannabis, aquaponics, organic tomatoes, vegetables and fruit
- tree crops and non-narcotic hemp
- storing, handling and early-stage processing of flour, chickpea milling and canning.

The precinct will also provide opportunities for solar energy generation and intermodal transport facilities.

These new industries will need secure water to operate. Water from Moree Plains Shire Council's town water supply will go some way to supporting these industries but is unlikely to be enough long term to fully meet the Special Activation Precinct.

In addition, the New England Renewable Energy Zone will help create employment opportunities and new income streams for landholders, particularly in the eastern part of the catchment. As of August 2021, the Zone has attracted substantial private sector investment interest, with 6 distinct renewable energy projects within or in immediate proximity to the Gwydir region that are either approved or progressing through the NSW planning system. These projects have a combined generation capacity of around 1.39 GW and represent about $2.34 billion in investment. The renewable energy zone could also support the establishment of new, energy-intensive industries in the region, which may also require access to water.[14]

We will need to identify innovative ways to provide water to support the precinct and future industries that enter the region and ensure the industries are capable of operating in times of reduced water availability.

14. www.energy.nsw.gov.au/renewables/renewable-energy-zones#-new-england-renewable-energy-zone

Photography
Image courtesy of Destination NSW.
Merilba Estate Wines, Uralla.

Delivering water to the end of the river system and connected valleys

High evaporation rates and smaller river channels make it difficult to deliver water efficiently from Copeton Dam to industry and environmental assets at the end of the catchment and connected valleys. Large on-farm storages – where regulated river water is often stored before use – also experience high evaporation losses.

Delivery and on-farm storage of water experiences large evaporation losses

The Gwydir River extends from Uralla through Copeton Dam and downstream to Pallamallawa, where it branches into 4 main systems:

- the Carole/Gil Gil systems
- the Gingham watercourse
- the lower Gwydir (Big Leather) watercourses
- the Mehi, Mallowa and Moomin systems.

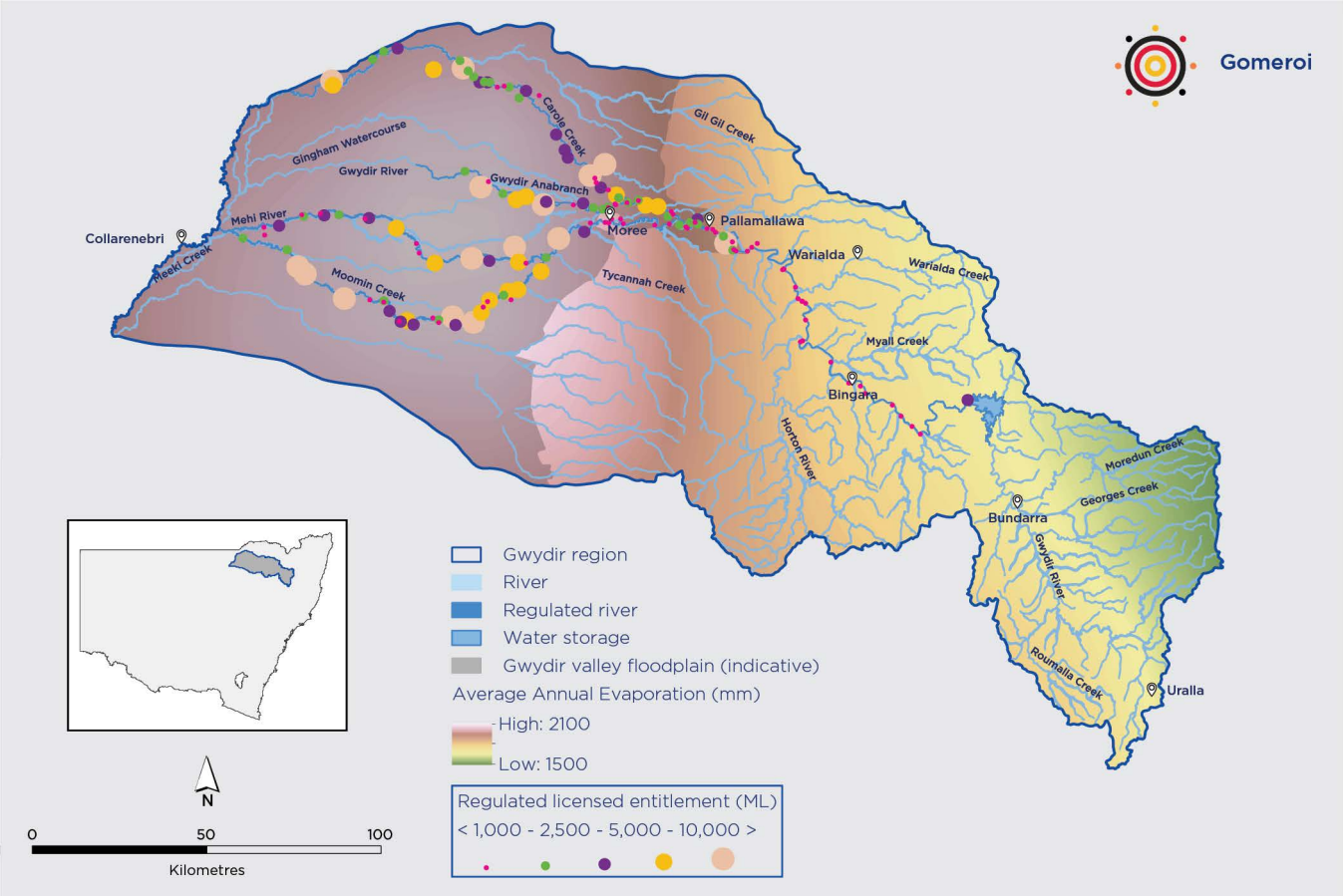
Water is released from Copeton Dam and delivered to water users along each of these 4 river systems. The region's largest water users and some of the most important environmental assets and processes, including connectivity with the Barwon–Darling, are towards the end of the catchment (Figure 10). The ability to control and deliver water to these water users and environmental assets can be challenging due to the long transmission distances and the small river channels. Evaporation can be up to 30-35% of the total volume released from Copeton Dam in dry years.[15]

The system also experiences high annual average evaporation from large, relatively shallow private on-farm storages located west of Moree[16] where, in summer, evaporation is more than 3 times rainfall. On-farm storage of water is primarily used to meet the water needs of summer cotton production, including at critical times of its growth and maturity. There can be sharp peaks in crop water demands that the regulated river system cannot meet, as travel time for flows released from Copeton Dam is up to 2 weeks.

Being able to deliver water more efficiently and effectively to the end of the system for ecological, industry and community needs, and reducing evaporation losses will be an important strategy for the region over the next 20 years.

15. Based on data from the Department of Planning and Environment's general purpose water accounting reports found at www.industry.nsw.gov.au/water/allocations-availability/water-accounting/gpwar
16. Department of Planning and Environment internal data

Figure 10. Regulated river water licences and the Gwydir valley floodplain



Connectivity to the Barwon–Darling River

The Gwydir catchment is part of a connected system. On average approximately 21% of the inflows in the Gwydir flow downstream to the Barwon-Darling.[17] This makes up approximately 6% of water into the Barwon–Darling river system.[18] There are ecological, industry and community needs, including, critical human and environmental needs in the Barwon–Darling system that rely on surface water flowing in from the Gwydir catchment and other catchments in the northern Basin. These needs include:

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

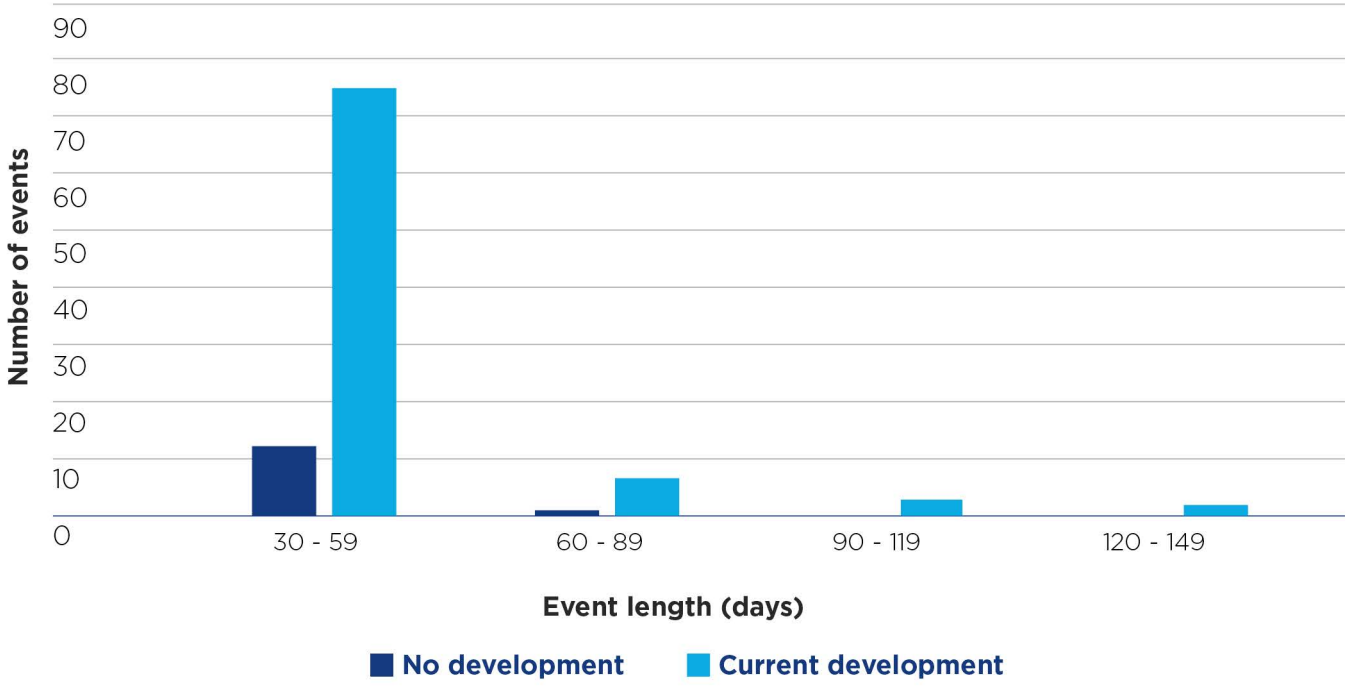
We have also heard there are cultural needs that need to be met.

There have been changes to the flow regime. Both the Gwydir and Barwon–Darling river systems stop flowing naturally from time to time. Dams have helped the rivers keep running when they may have stopped running naturally. However, development and changes to how water is used and targeted to different parts of the system has likely increased the number of cease-to-flow events at the end of the Gwydir catchment (Figure 11). These changes impact ecological, industry and community needs across connected systems.

17. This is the proportion of the average inflow from the Gwydir into the Barwon-Darling as a proportion of long-term average modelled mid system flows in the Gwydir. Further information is available in the report *Stocktake of northern basin connectivity rules—analysis of implementation and effectiveness* available at www.industry.nsw.gov.au/water/environmental-water-hub/outcomes
18. This figure is based on pre-development conditions under the historical climate

Figure 11. Modelled number and length of cease-to-flow periods (<10 ML/day) in the Mehi River near Collarenebri

This graph illustrates what would have occurred with no development compared to what would have occurred if the current development was in place over the last 130 years.



The Gwydir valley often connects with the Barwon–Darling River during high-flow periods via the Mehi River, Gil Gil Creek and Gwydir River. Connectivity during high flows supports a range of ecosystem functions including providing habitat; cycling nutrients and carbon; and providing natural cues for native fish feeding, breeding and movement both within the Gwydir and Barwon Darling valleys, and between the 2 valleys.

Dismantling barriers to Aboriginal water rights[19]

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

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

Aboriginal people have lost access to water and country

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

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

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

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

19. This challenge statement was developed by the Gomeroi/Kamilaroi Water Engagement Committee in 2021

Aboriginal water values are not well-supported by water management

Current water legislation and water management frameworks have evolved over the last 130 years but have never reflected Gomeroi and Kamilaroi water values. This is exacerbated by poor employment strategies and the limited involvement of Gomeroi and Kamilaroi people in water policy and planning processes because of:

- changes to Aboriginal water programs
- consultation timeframes and processes around water policy changes not allowing the time needed for Gomeroi and Kamilaroi cultural governance processes or shared management, which erodes trust
- Gomeroi and Kamilaroi people not being informed to make a decision on water policy and planning or have a say in when and where environmental/cultural water is delivered
- the complex set of state and federal laws and systems around water management that is often not explained in a plain English or visual manner
- inadequate resources and support for Gomeroi and Kamilaroi people to engage in water management. Often, Aboriginal people need to give up personal time and resources to have a say in water consultation processes.

Changing this and empowering Aboriginal communities to make decisions on water requires the NSW Government to 'flip the model on its head' and develop an approach to engagement that is of benefit to Gomeroi and Kamilaroi people's communities.

For many years, government has committed to models around committees and advisory bodies that are not made up of local Aboriginal people with cultural connection to or authority to speak about their Country. We need an innovative approach that enables Gomeroi and Kamilaroi people in their Nation area/region to get the right people involved or appointed to seats at the table where decisions about water are being made.

Gomeroi and Kamilaroi people would like to have a direct line of contact with regional water managers, compliance officers and decision makers and have their knowledge and science be actively sought, respected and heeded. To do this, water policy makers, planners and managers need to 'sit at the fire', listen to the knowledge holders and develop a cultural governance structure that is familiar to Gomeroi and Kamilaroi people, supported by the time that is needed to engage, consult and listen genuinely.

Improving the health and resilience of the region's aquatic ecosystems

River regulation, extraction and water infrastructure operations have resulted in changes in flow variability, water quantity and water quality. This has impacted the health of water-dependent ecosystems and assets in the region and connected valleys. There are challenges in being able to use water for the environment effectively during dry and wet periods to protect and enhance the region's natural systems and assets.

Minimising the impacts of altered flows on rivers and wetlands will be critical to achieving ecological outcomes

Over the last 40 years, landuse change and water extraction has resulted in less water in rivers and wetlands, and modifications to how water moves through the region's landscape and connected systems. Changes to the natural river flows and floods have impacted on the health of floodplains and downstream waterways and disrupted the lifecycle of the plants and animals that depend on them. One consequence of the changes has been the substantial decline in the size and health of the Gwydir Wetlands.[20]

Changes to river flows in the Gwydir valley have included:

- longer and more frequent cease-to-flow events in some unregulated rivers and creeks
- constant low flow and increased small freshes in summer months because of the timing of irrigation deliveries, but an overall reduction of flows in the Gwydir River downstream of Moree (refer Figures 13, 15 and 17)
- fewer large freshes and overbank flows below Copeton Dam (refer Figures 12–17).

20. Department of Planning, Industry and Environment 2020, *Gwydir Long Term Water Plan Part A: Gwydir catchment*, retrieved 20 September 2021 from www.environment.nsw.gov.au/topics/water/water-for-the-environment/planning-and-reporting/long-term-water-plans/gwydir

Figure 12. Modelled change in the total number of different flow events[21] in the Gwydir River at Gravesend (Stream gauge 418013) over the last 130 years

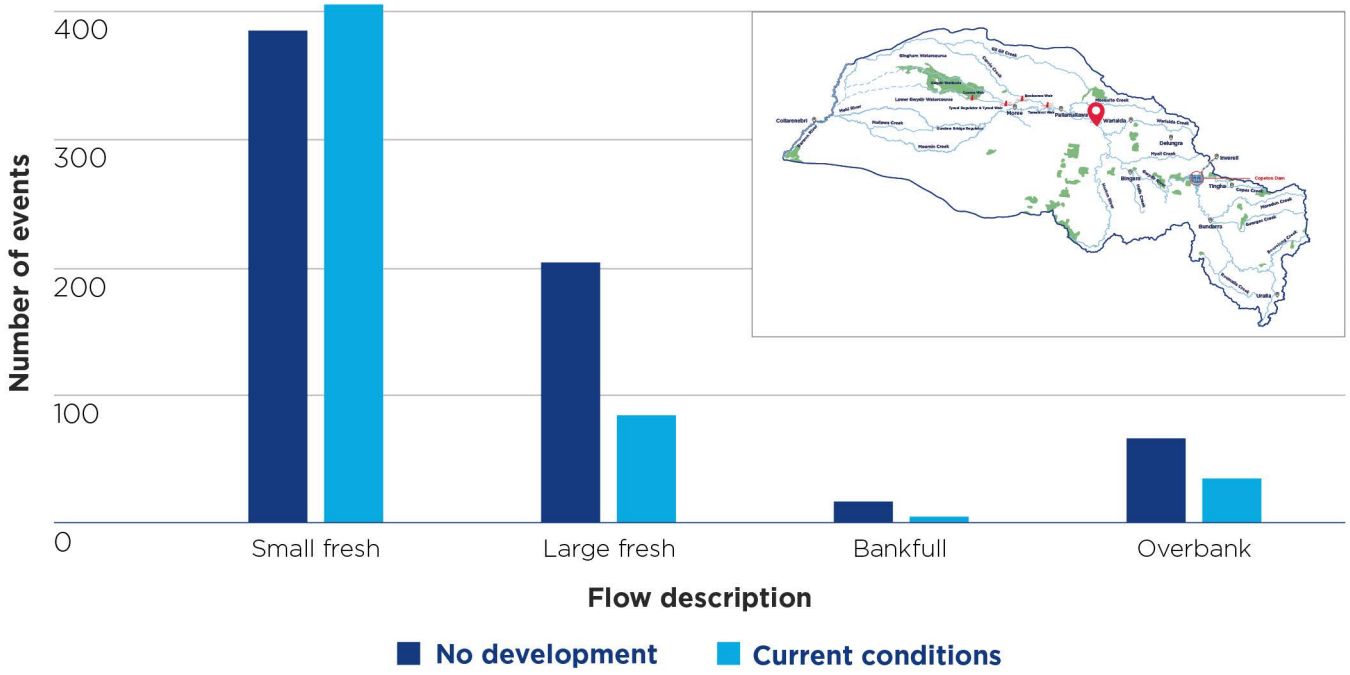
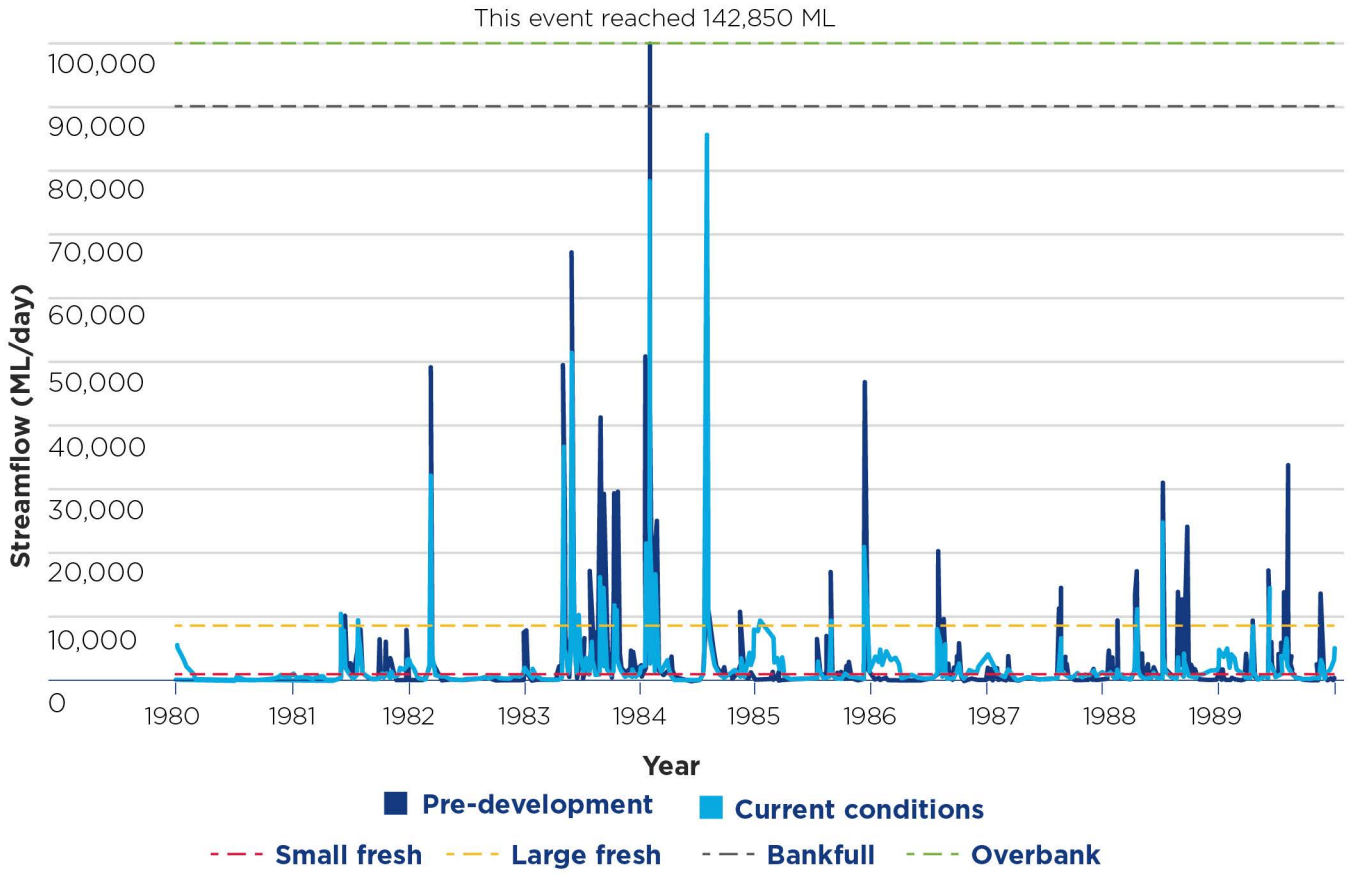


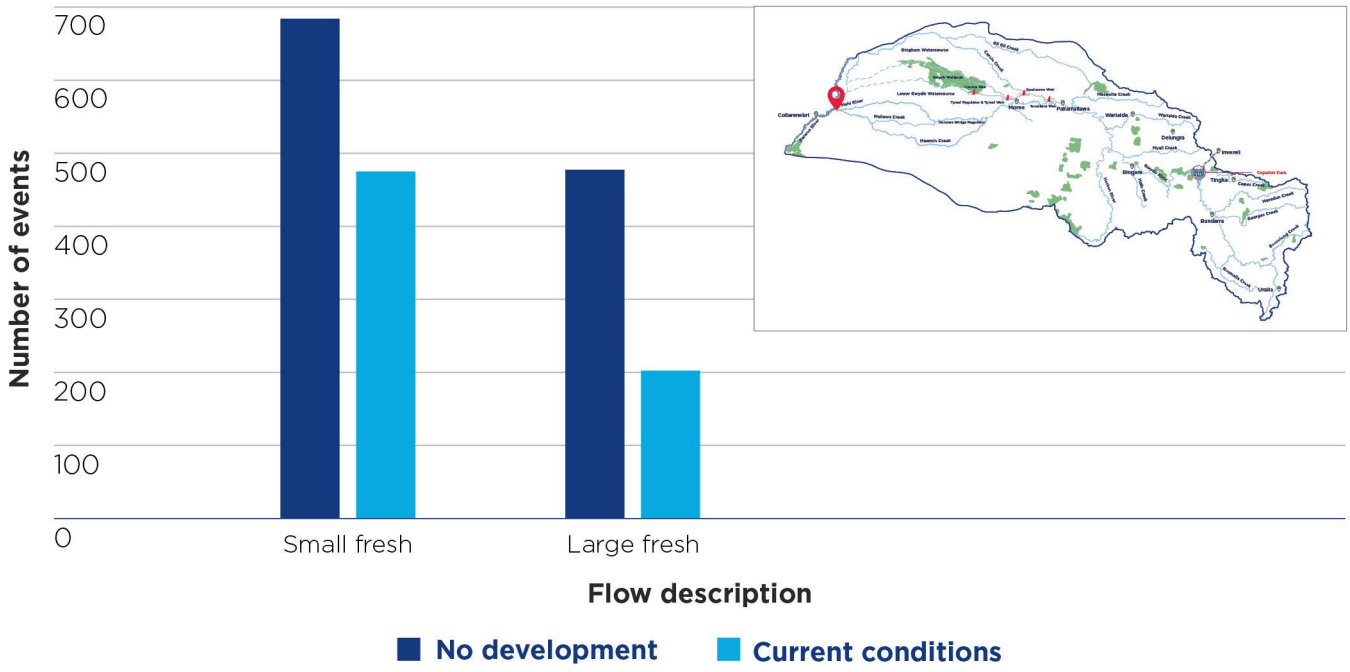
Figure 13. Modelled flows in the Gwydir River at Gravesend (Stream gauge 418013) with and without development over an 'average' 10-year period



Note: This graph uses natural and current conditions model runs.

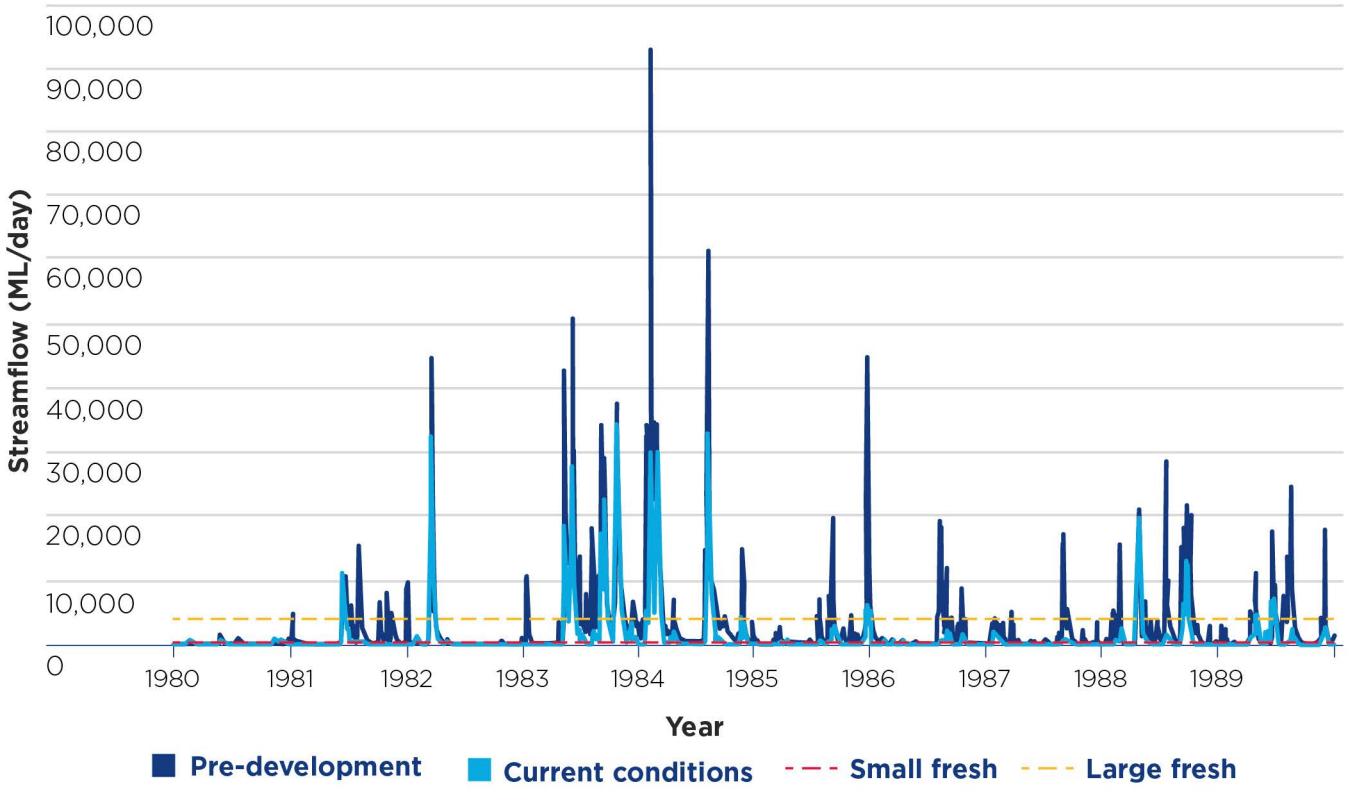
21. The categorisation of flow events in Figures 12 to 17 has been adopted from the environmental watering requirements at the relevant location as identified in the Gwydir Long Term Water Plan. Categorisation of events was only based on the volume of the flow over the specified number of days being met and not time of the year it occurred. The duration and timing of these events is important in maximising ecological outcomes of these events. For more information one environmental watering requirements see NSW Office of Environment and Heritage 2018, *Gwydir Long Term Water Plan–Parts A and B–Gwydir catchment*, retrieved 20 September 2021 from www.environment.nsw.gov.au/topics/water/water-for-the-environment/planning-and-reporting/long-term-water-plans/gwydir

Figure 14. Modelled change in the total number of different flow events in the Mehi River near Collarenebri (Stream gauge 418055) over the last 130 years



Note: The Gwydir Long Term Water Plan does not define bankfull and overbank flow thresholds for the Mehi River near Collarenebri (418055).

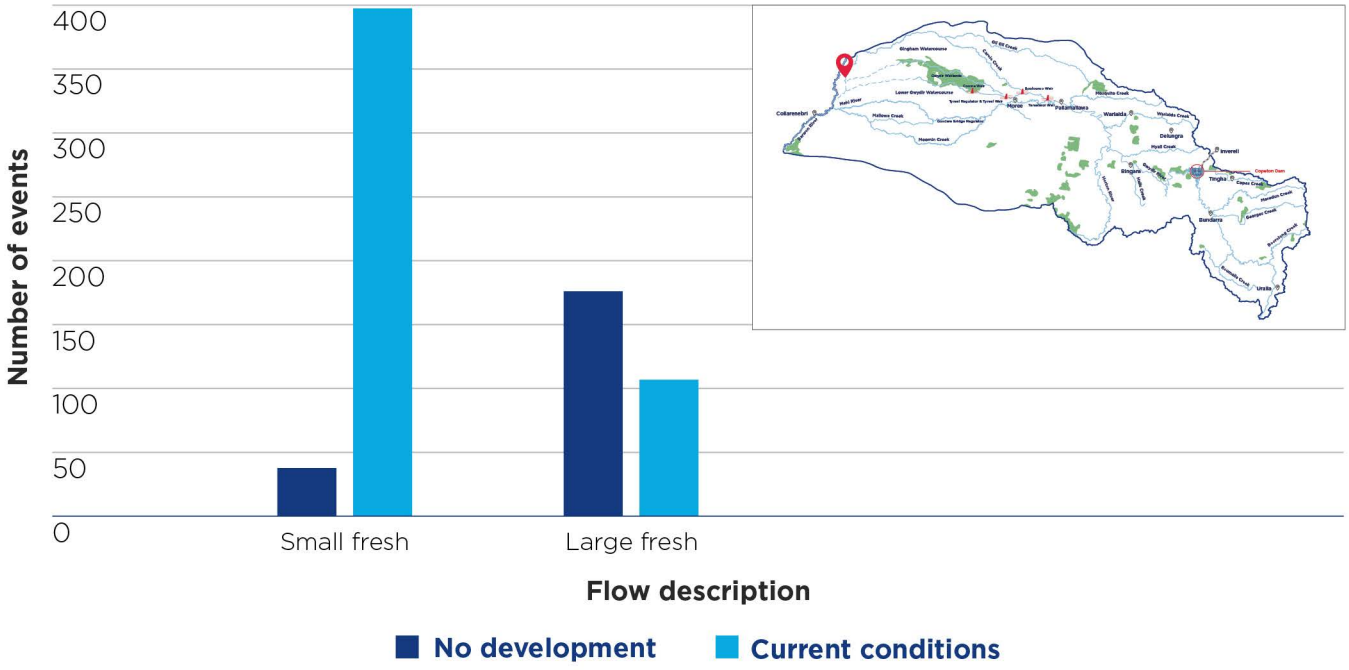
Figure 15. Flows at Mehi River near Collarenebri (Stream gauge 418055) with and without development over an 'average' 10-year period



Note 1: This graph uses natural and current conditions model runs.

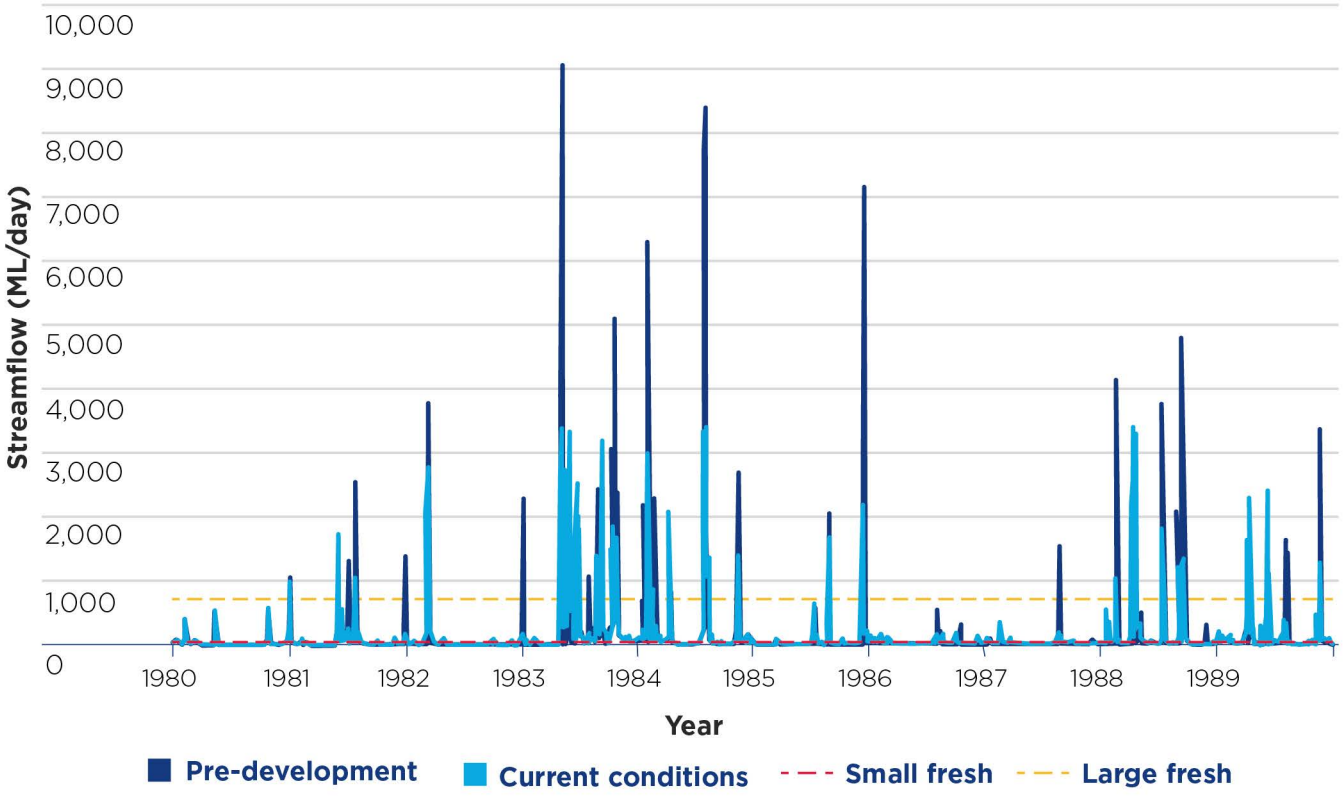
Note 2: The Gwydir Long Term Water Plan does not define bankfull and overbank flow thresholds for the Mehi River near Collarenebri (418055).

Figure 16. Modelled change in the total number of different flow events in Gil Gil Creek at Galloway (Stream gauge 416052) over the last 130 years



Note: The Gwydir Long Term Water Plan does not define bankfull and overbank flow thresholds for Gil Gil Creek at Galloway (416052).

Figure 17. Flows at Carole Creek at Galloway (Stream gauge 416052) with and without development over an 'average' 10-year period



Note 1: This graph uses natural and current conditions model runs.
Note 2: The Gwydir Long Term Water Plan does not define bankfull and overbank flow thresholds for Gil Gil Creek at Galloway (416052).

Australian Government and NSW Government water reforms and water sharing planning over the past 2 decades have recovered 136 GL of water for the environment (in addition to an environmental water allowance held in Copeton Dam) to protect and enhance environmental assets and try to help reduce risks from these flow impacts on the environment. The water is managed according to locally developed management principles and flow triggers to maintain the health of the region's rivers and wetlands by supporting:

- priority river reaches, during extended dry periods
- restoration of natural river flows to downstream rivers and wetland communities
- breeding habitat for colonial nesting waterbirds, as well as habitat for migratory bird species listed under international agreements
- unplanned contingencies that require water for the environment.[22]

Planning and management of water for the environment is relatively mature in the Gwydir region and actions taken to deliver meaningful environmental outcomes in a variable climate are becoming increasingly sophisticated. But there are challenges in using this water for the environment during dry and wet periods, in addition to the risks posed by potential future reductions to streamflow as a result of a drier climate.

We need to reduce the impact of drought operation measures on the environment

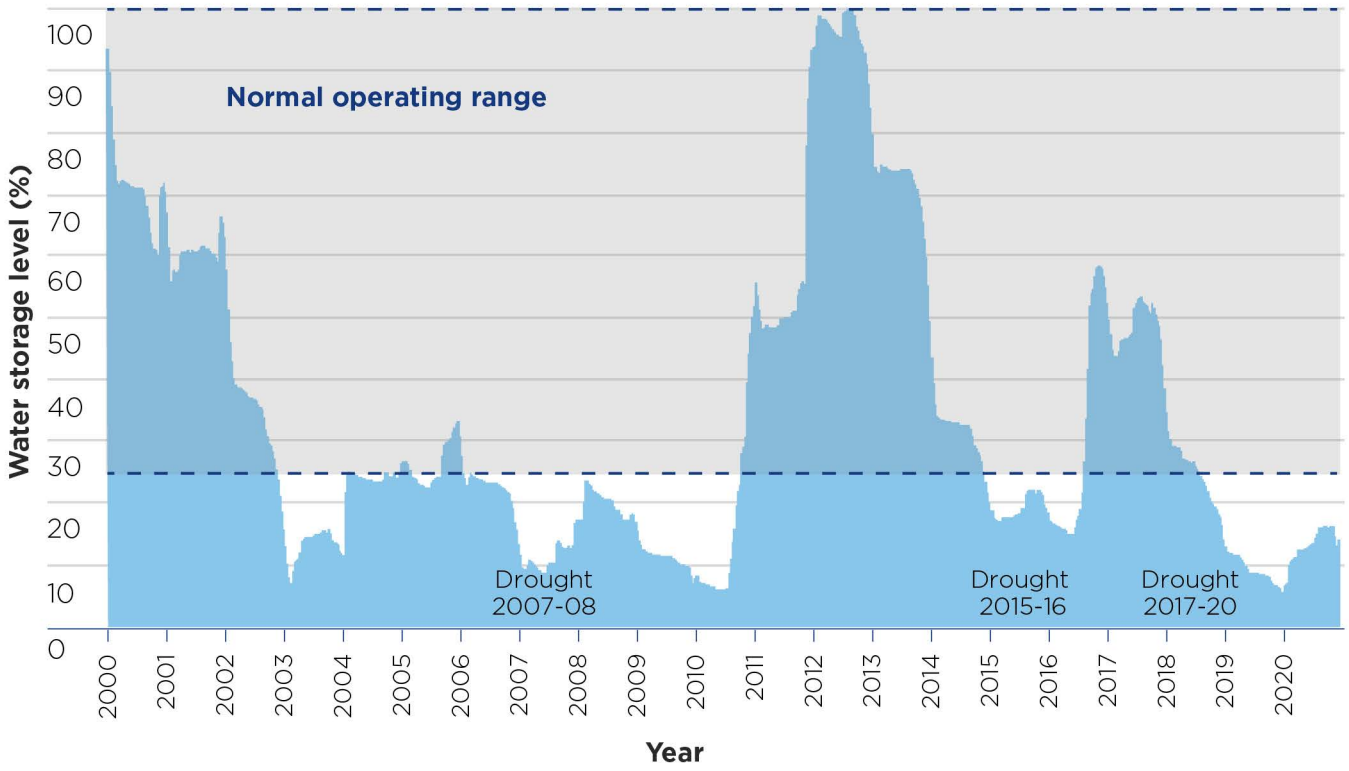
Despite the volume of water that has been recovered for the environment in the Gwydir region, it is not always possible to use this water as required to meet environmental needs during dry periods, particularly when the river is being managed using drought operation measures to extend the available water supply.

This is primarily because block releases are used in dry times and deliver water to water users in a larger grouped release pattern to minimise the amount of water lost in transmission. While this saves water in the dam, it reduces the times there is water flowing in the river and limits the amount of water that seeps into the riverbed and connected aquifers. These higher but shorter release periods, while timed to suit irrigation watering, may not be the best times for deliveries to meet environmental needs or basic landholder rights.[23]

We heard during public consultation that the continuing practice of block water releases for water orders is impacting river flows, accompanied by genuine concern that in a drier climate, they could be used even more often. We also heard that operating the river using drought measures on a consistent basis undermines the wellbeing of communities if there are increased periods of no or low flows in the river.

22. Department of Planning, Industry and Environment 2021, *Gwydir catchment—Water for the environment: Annual priorities 2021-22*, retrieved 29 September 2021 from www.environment.nsw.gov.au/research-and-publications/publications-search/annual-environmental-watering-priorities-2020-21-gwydir
23. Subsection 61 of the *Gwydir Regulated River Water Sharing Plan 2016*

Figure 18. Water storage levels in Copeton Dam from 2000 to 2020



Our new climate risk modelling shows that Copeton Dam may sit at or below 25% capacity more often in the future (see Table 3) which is typically the level of the dam when drought measures such as block releases commence (Figure 18). This lower storage volume would increase the use of drought operations.

Table 3. Copeton Dam storage volumes

Copeton Dam effective storage volume (%)	Historic (% time)	Long-term historical climate projections (stochastic) (% time)	Dry climate change scenario (Stochastic + NARCliM) (% time)
Time below 25%	28.7	34.2	55.3
Time below 20%	16.2	24.0	45.2
Time below 10%	0.2	2.0	8.9

System constraints and floodplain harvesting are limiting the achievement of environmental outcomes

System constraints limit how and when water for the environment can be delivered in the Gwydir region. These include:

- **the capacity of the river channel in the lower Gwydir,** which reduces from around 100,000 ML/day bankfull discharge in the Gwydir River upstream of Moree to approximately 250 ML/day in the Gingham and Gwydir watercourse channel networks. This impacts on the ability to deliver enough water downstream for both irrigation and environmental needs
- **the proximity of cropping to the rivers and creeks –** environmental deliveries aim to mimic natural flow patterns that, for the region, involve inundation during summer. This inundation coincides with crop harvest periods and delivering large amounts of water during that time has the potential to flood crops. This situation requires environmental water managers to work in partnership with landholders to manage the timing of water delivery to maintain landholder property access and minimise losses during harvesting
- **floodplain structures on private property** limit the ability of water to flow down the system in some locations and can also impact river flows into the Barwon–Darling River.

In some instances, despite the volumes of environmental water holdings, water is not reaching the extremities of environmental assets such as the Gwydir Wetlands, nor can it be delivered at critical times to allow wetland-dependent species to complete their lifecycles.

Unconstrained floodplain harvesting[24] has impacted the health of the floodplain and downstream waterways by reducing the volume, frequency and duration of floods. Implementing the *NSW Floodplain Harvesting Policy* in the Gwydir valley is expected to deliver significant environmental outcomes by returning water from the floodplain into the river system.

24. Floodplain harvesting is the capture and storage by irrigators of water that flows across the Gwydir floodplain

Native fish remain under stress from river regulation and degraded habitats

The Gwydir valley supports 15 native fish species, including threatened species, populations and part of the Lowland Darling River endangered aquatic ecological community.

Monitoring conducted by the Australian Government and the NSW Government has found that the fish population in the Gwydir River system is under stress, with many native species and endangered species in low abundance. While some species appear to be breeding and recruiting, others, especially some of the more iconic species such as Golden Perch, Freshwater Catfish and Murray Cod, are not recruiting sufficiently to improve their populations.[25]

The ability to sustain the native fish community of the Gwydir and support native fish populations in the rest of the Murray–Darling Basin is impaired by river regulation, and the physical structures such as dams, weirs and floodplain infrastructure that impact the flow regime and restrict the ability of native fish to move to breed, find food and ideal habitat.

In addition to modified flow patterns, there are other threats that contribute to the stressors affecting native fish in the Gwydir catchment. These include:

- substantial modification of riparian vegetation, river channelization and bank erosion in parts of the Gwydir River system has impacted the quantity and quality of key habitat features
- the creation of ideal habitat for introduced species, such as carp, by the series of weirs and regulators that assist in diversion of water to various watercourses of the lower Gwydir.

Along with adjusting operations to better support environmental flows, complementary measures such as habitat rehabilitation, mitigating cold water pollution, remediating fish passage, conservation stocking and undertaking diversion screening, restocking and barrier remediation will help to improve fish community condition and improve overall waterway health.

25. Commonwealth Environmental Water Office 2021, Monitoring, Evaluation and Research Program that can be found at www.awe.gov.au/water/cewo/publications/mer-plan-gwydir-2019

Addressing the challenges

To address the challenges in the Gwydir region, we have set 3 priorities and proposed actions under each.

The regional priorities are:

1. **Water for critical human and environmental needs**
2. **Sustainable water resources for new and existing users**
3. **Best use of existing water for the environment.**

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

Photography
Image courtesy of Sally Anderson-Day, Department of Planning and Environment.
Gwydir River, Bingara.

PRIORITY 1

Water for critical human and environmental needs

Record drought conditions in the northern Murray–Darling Basin from 2017 to early 2020 highlighted that we need to change the way we think about and plan for our future water needs. We now understand that the drought was not unusual when compared to the region's longer historical climate record and that potential changes in rainfall patterns, warmer conditions and increased evaporation may impact future water availability.

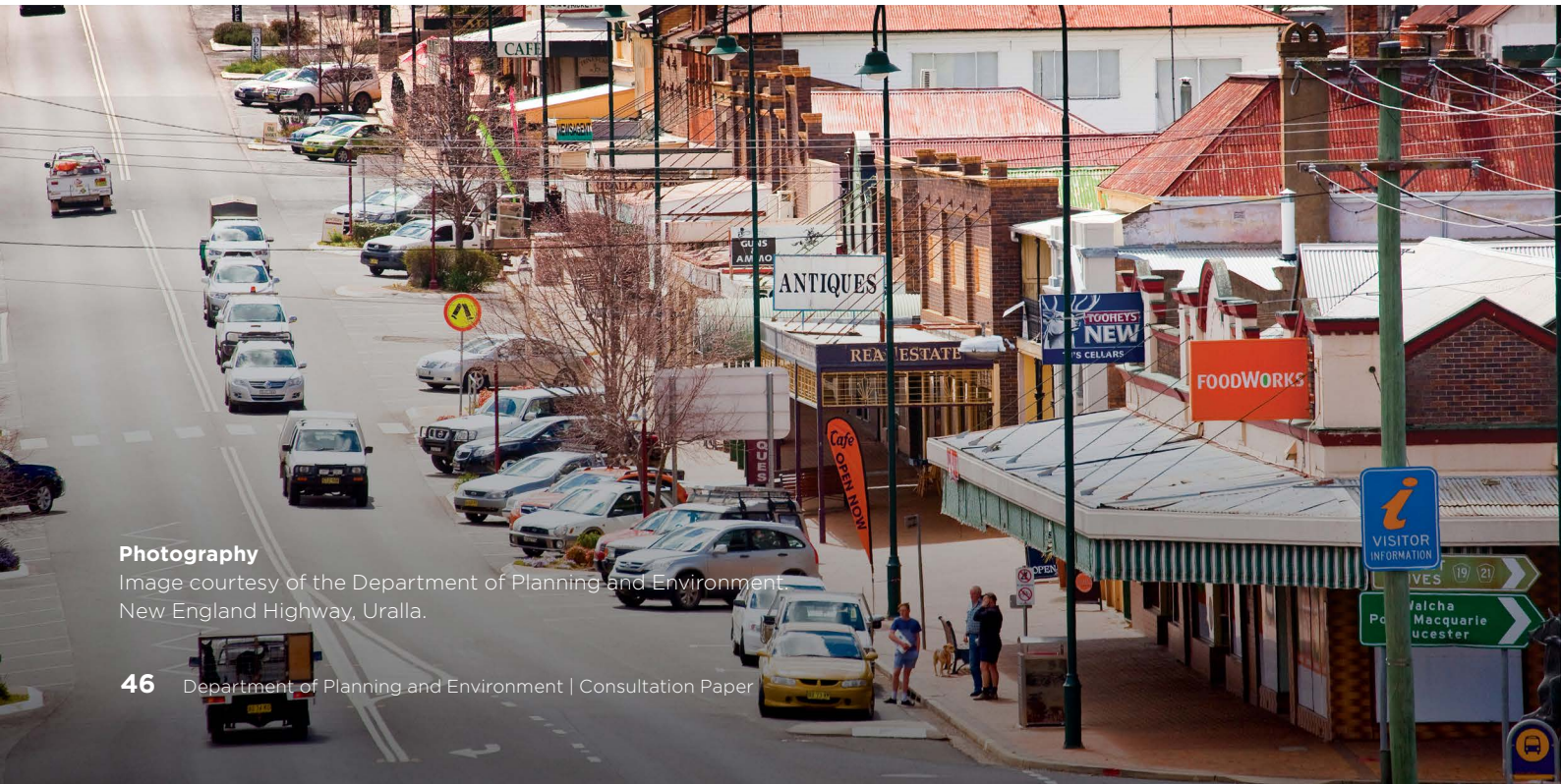
We need to understand the minimum amount of water supply the community and environment needs during a severe and prolonged drought. We also need decision-making arrangements and tools for managing water resources during climate extremes.

We need to ensure that we can secure water to contribute to these needs downstream of the valley at important times. It may not be possible to always meet all needs from river flows given that the rivers in the Gwydir and Barwon–Darling catchments naturally stop flowing from time to time in dry years. However, it is important that when flows resume after a prolonged drought that they are initially protected from commercial extraction to ensure that can flow through the system.

The actions shortlisted under this priority will:

- secure water sources for towns and manage water demand
- investigate ways to improve connectivity through the system and with the Barwon–Darling River.

During the public consultation process we also heard varied views about whether the drought of record informing water sharing plans needs to be changed and whether the water allocation process should be amended to consider our new climate information. This regional water strategy analysed one option, with the results presented in Attachment 2. Further work around the drought of record and assessing it through a risk framework will be considered as part of the implementation of the NSW Water Strategy.



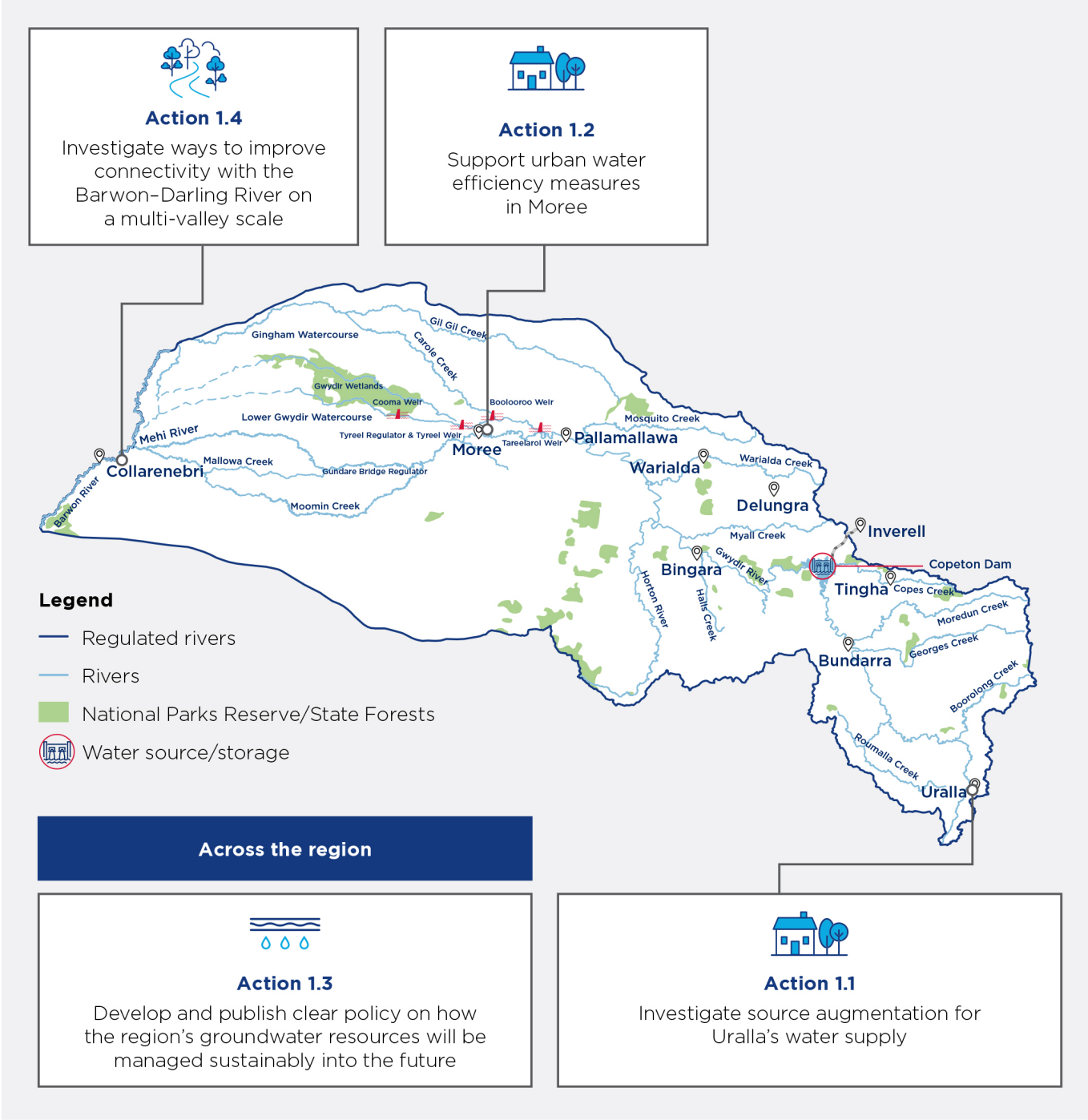
Photography
Image courtesy of the Department of Planning and Environment.
New England Highway, Uralla.

What we are already doing

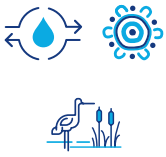
- The $1 billion Safe and Secure Water Program and Town Water Risk Reduction Program support councils to implement infrastructure and non-infrastructure solutions to address key risks to regional water safety and security.
- The NSW Water Strategy has committed to delivering a state-wide campaign to address community concerns about the risks of purified recycled water, including providing information about technologies, safeguards and benefits.
- The NSW Government is identifying triggers in the Gwydir valley and downstream catchments to guide when to apply and lift temporary water restrictions on commercial access to flows during and after prolonged dry periods. This was a recommendation of the Independent Assessment Panel's Assessment of the Management of the 2020 Northern Basin First Flush Event.

Photography
Image courtesy of Belinda Collingburn, Department of Planning and Environment.
Mehi River downstream of Combadello Weir, NSW.

Figure 19. Priority 1: Water for critical human and environmental needs



Legend				
 Reducing water service risks and improving water supply resilience for the region's towns and villages	 Supporting licence holders in the face of declining water availability	 Delivering water to the end of the river system and connected valleys	 Dismantling barriers to Aboriginal water rights	 Improving the health and resilience of region's aquatic ecosystems

Proposed actions	Description	Challenges addressed
Action 1.1 **Investigate source augmentation for Uralla's water supply**	Support Uralla Council to investigate and develop an additional water source for town water supply and identify opportunities to reduce town water demand.	
Action 1.2 **Support urban water efficiency measures in Moree**	Support Moree Plains Shire Council to implement the NSW Government's new state-wide Water Efficiency Framework.	
Action 1.3 **Develop and publish clear policy on how the region's groundwater resources will be managed sustainably into the future**	Determine how to prioritise groundwater for critical needs, provide water users greater clarity and certainty about how declining groundwater levels will be managed, and develop options to best manage fully committed groundwater systems.	
Action 1.4 **Investigate ways to improve connectivity with the Barwon–Darling River on a multi-valley scale**	Develop the most effective coordinated options to improve connectivity across all Barwon–Darling tributaries through the Western Regional Water Strategy.	

Proposed action 1.1: Investigate source augmentation for Uralla's water supply

The town with the greatest water security risk in the Gwydir region is likely to be Uralla, which relies on unregulated river flow for its water supply. In 2015, the Uralla Shire Council's secure yield assessment found there is a risk of water shortfalls in dry years and in the last drought, the town nearly ran out of water.

The Council is investigating groundwater. However, the shire lies over the New England Fold Belt Murray–Darling Basin Groundwater Source, which does not consistently produce high yielding or good quality supplies. If these groundwater investigations reveal that groundwater is not a viable long-term back-up supply for the town, Uralla Shire Council will need to consider other ways to diversify water sources and buffer water availability impacts of drought.

With support from the NSW Government's Increasing Resilience to Climate Change community grants, ZNET Uralla, in partnership with Uralla Shire Council, has facilitated community discussions on how to best achieve water sustainability for the area. The project has documented public sentiment around 9 solutions: put down supplementary bores, install more rainwater tanks, clean the silt out of the dam, 2 options for recycling water (just for roadworks and maintaining sports fields or to recycle back into the dam for general use), harvest storm water, raise the dam wall or build an additional dam, link up with a regional water line or do nothing about extra water supplies.

Uralla Shire Council could be supported to investigate preferred alternative supply strategies in addition to groundwater if it is found to be required. This could include investigating the feasibility of supply augmentation and town water demand measures, which had received strong community support.

Proposed action 1.2: Support urban water efficiency measures in Moree

Domestic water use in Moree Plains Shire Council is currently one of the highest in NSW. To address this, the Council has recently adopted a 400 kL/connection target for annual average consumption, which is close to a 33% reduction compared to current figures. The Council is undertaking demand management initiatives to help meet this target, which include:

- a customer meter replacement program, including the installation of smart meters that enable continuous data logging and communications integrated with a web-based monitoring platform
- addressing and repairing leaks.

These measures are expected to reduce demand by 15–20%, so additional measures will be required to meet the Council's annual average target of 400 kL/connection.

The NSW Government is enhancing its investment in water conservation. This action will support Moree Shire Plains Shire Council implement the Government's new state-wide Water Efficiency Framework, which is designed to increase the capacity and capability of local water utilities to plan and implement water efficiency measures and programs. The framework focuses on building water efficiency capacity, gaining a greater understanding of water use, improving the evaluation of water efficiency initiatives and increasing private sector involvement.

Proposed action 1.3: Develop and publish clear policy on how the region's groundwater resources will be managed sustainably into the future

The Lower Gwydir Groundwater Source (Lower Gwydir Alluvium) is the primary source of town water for Moree. The volume of extraction, the number of existing irrigation bores, the high reliance on domestic bores, and areas of water level decline all mean the groundwater system is under pressure. This can constrain the availability of water for high priority needs such as the proposed new town water supply for nearby Ashley, which is currently unserviced and largely reliant on stock and domestic bores.

In addition to this, additional groundwater from the Great Artesian Basin is likely to be needed to support industries entering into the Moree Special Activation Precinct.

We also heard in consultation feedback that the current condition of the region's main productive aquifer indicates it is under stress. More frequent and extended droughts may exacerbate this threat. While we do not expect this risk to materialise in the short term, we do need to act now to provide clear guidance around how high-priority groundwater needs will be managed in the Gwydir region.

This action involves:

- Determining how to ensure critical needs and high priority uses such as local water utility licenses are prioritised when considering impacts on the aquifer and other users. For example, if/how can a local water utility extract water from a new bore where that extraction has the potential to have an impact on existing bores. This sensitive issue has the potential for community conflict and is currently being managed on a case-by-case basis.
- Preparing a guideline with a series of escalating management actions corresponding to stages of groundwater level decline. For example, providing clear guidance on what levels of groundwater decline we would restrict trade, additional bores and lower priority users of water. This policy would provide certainty to all water users about what actions the NSW Government will take and when, in areas where groundwater extraction is causing declines in water levels, such as the Lower Gwydir Groundwater Source, and help towns, stock and domestic and industry users plan for more extreme droughts when groundwater may not be a viable backup.
- Looking at ways to proactively manage groundwater systems where the entitlements plus basic landholder rights exceed the extraction limit, particularly where usage is high, such as in the Eastern Recharge Groundwater Source. This could include investigating and managing risks associated with inactive licences. It would give clarity to water users about how fully committed groundwater systems will be managed if licence activation and use further increases.
- Investigating the degree of connectedness between groundwater and surface water and the influence that each has on the successful management of the other, and exploring a joint trigger arrangement in areas where it would be effective.

Have your say

Do you support changing the groundwater assessment framework so that towns are given priority over other water users?

Proposed action 1.4: Investigate ways to improve connectivity with the Barwon–Darling River on a multi-valley scale

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

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

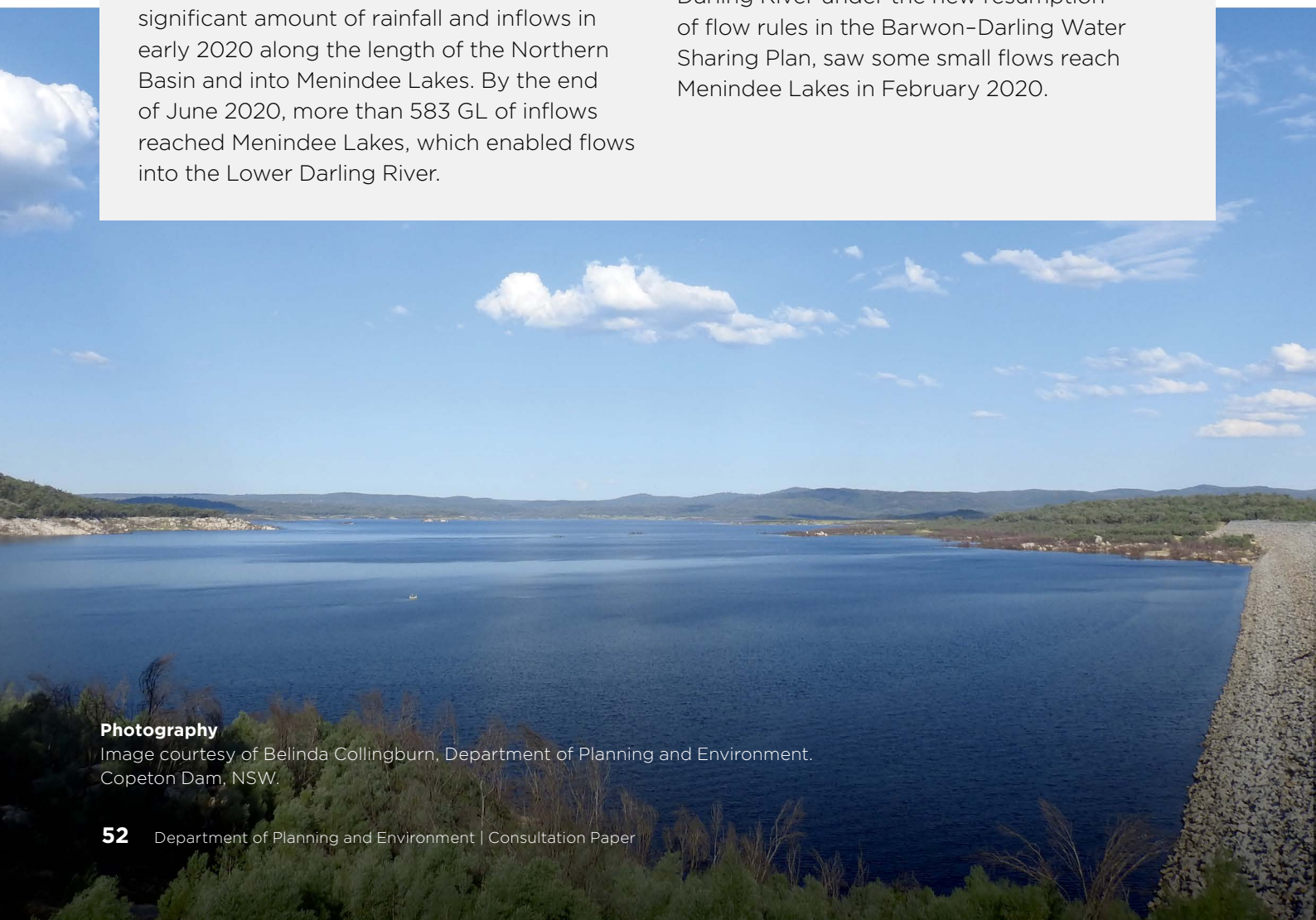
The NSW Government is reviewing whether rules should be amended to improve the flows of water between catchments at certain times. Importantly, this needs to consider whether we have the tools to deliver the intended outcomes without significant impacts. This work will be covered through a more coordinated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

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

The 2020 Northern Basin First Flush Event

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

The releases, combined with further natural inflows into the Barwon–Darling River and restrictions on access along the Barwon–Darling River under the new resumption of flow rules in the Barwon–Darling Water Sharing Plan, saw some small flows reach Menindee Lakes in February 2020.



Photography
Image courtesy of Belinda Collingburn, Department of Planning and Environment.
Copeton Dam, NSW.

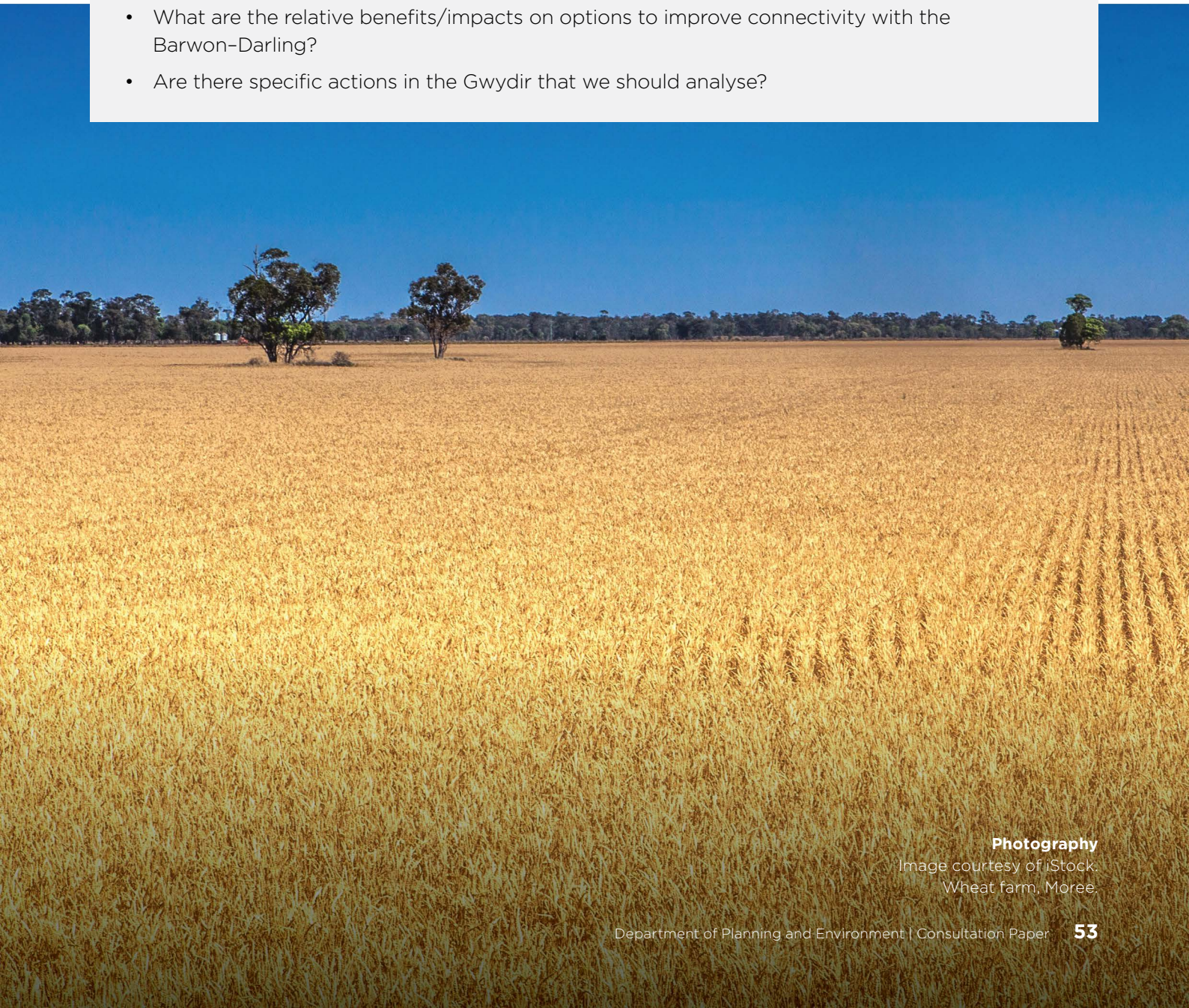
What we have heard so far

Feedback provided in earlier consultation showed support for:

- Restoration of river health and a commitment to reversing historic ecological damage, with connectivity considered a key component in the resilience of water-dependent ecosystems.
- Additional actions in the Gwydir catchment to help meet downstream water needs.
- Consideration for what connectivity actions can feasibly be achieved.

Have your say

- What are the relative benefits/impacts on options to improve connectivity with the Barwon–Darling?
- Are there specific actions in the Gwydir that we should analyse?



Photography
Image courtesy of iStock.
Wheat farm, Moree.

Photography
Image courtesy of iStock.
Gwydir River, Moree.

Providing connectivity flows across the northern Basin

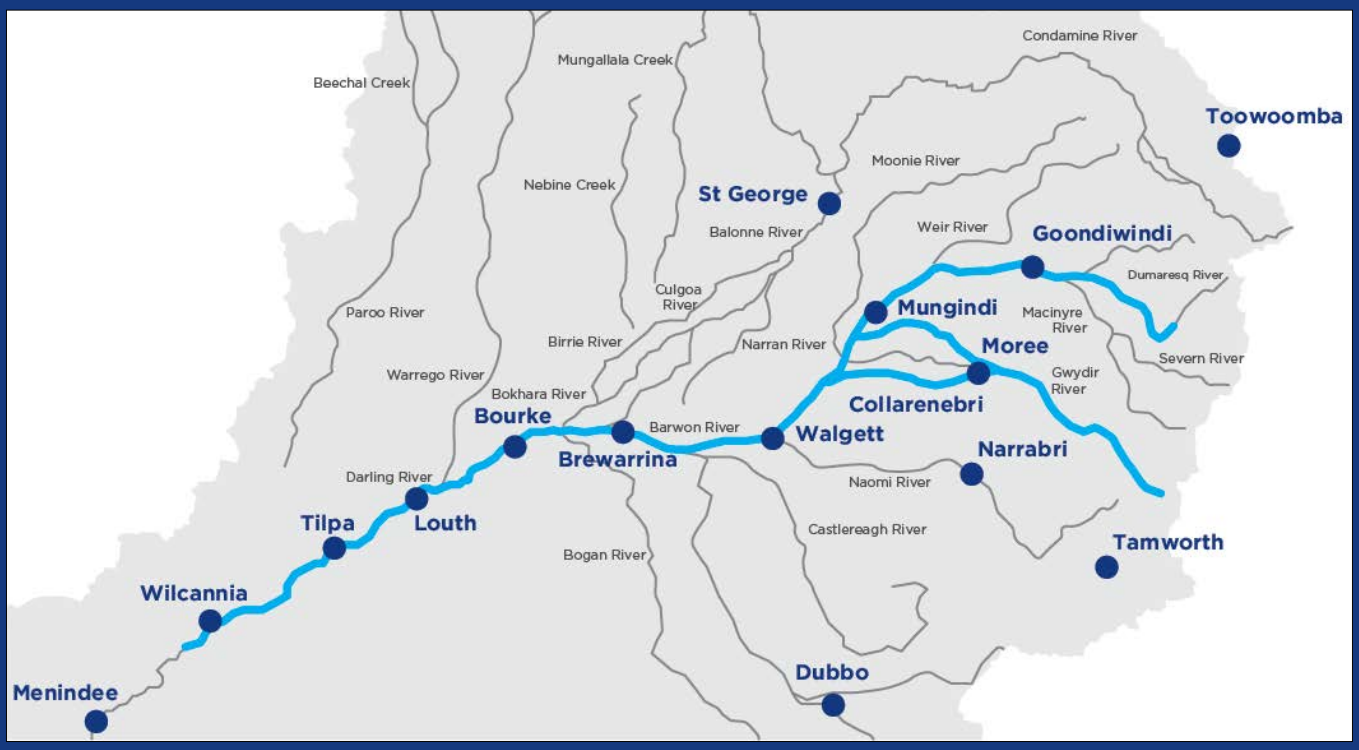
Three connectivity events from 2018 to 2021 are examples of how carryover and water for the environment in the Gwydir can be used to meet environmental demands during dry periods and provide connectivity across the northern Basin. The ability to access carryover is critical to meeting environmental demands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

Northern Connectivity Event – From April 2018, Commonwealth and NSW environmental water holders released water from Copeton Dam (18.9 GL) and Glenlyon Dam in the Border Rivers (4.3 GL). The releases aimed to support the environmental health of aquatic ecosystems, including the Gwydir Wetlands, and provide connecting flows into the Barwon–Darling River. The release flowed down the Gwydir and Mehi rivers and into the Barwon–Darling River and combined with some small natural inflows, reached Wilcannia, with a small volume entering Menindee Lakes by June 2018.

Northern Fish Flow Event – in April 2019 another release of environmental water was made—26 GL from Copeton and 7.4 GL from Glenlyon. However, flows only reached just upstream of Bourke along the Barwon–Darling River because of the dry conditions.

Northern Water Hole Top-Up Event – In late December 2020, 5.1 GL of Commonwealth environmental water in the Gwydir and 2.9 GL from the Border Rivers was released from Copeton and Pindari dams to top up in-channel refugia to help native fish survive by improving water quality in drying waterholes. The flow started to reach the Barwon–Darling in early 2021.

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



PRIORITY 2

Sustainable water resources for new and existing users

The Gwydir region is one of the most productive agricultural regions in Australia. Agriculture will continue to underpin the regional economy in coming decades; however, our new climate data indicates potential for longer droughts, which could reduce farm productivity and have flow on impacts on the regional economy.

The actions shortlisted under this priority aim to strengthen the resilience of the regional economy to climate-relate challenges by supporting community and industry adaptation efforts, and research and applied activities that will drive continued improvement in water use efficiency by the agricultural sector.

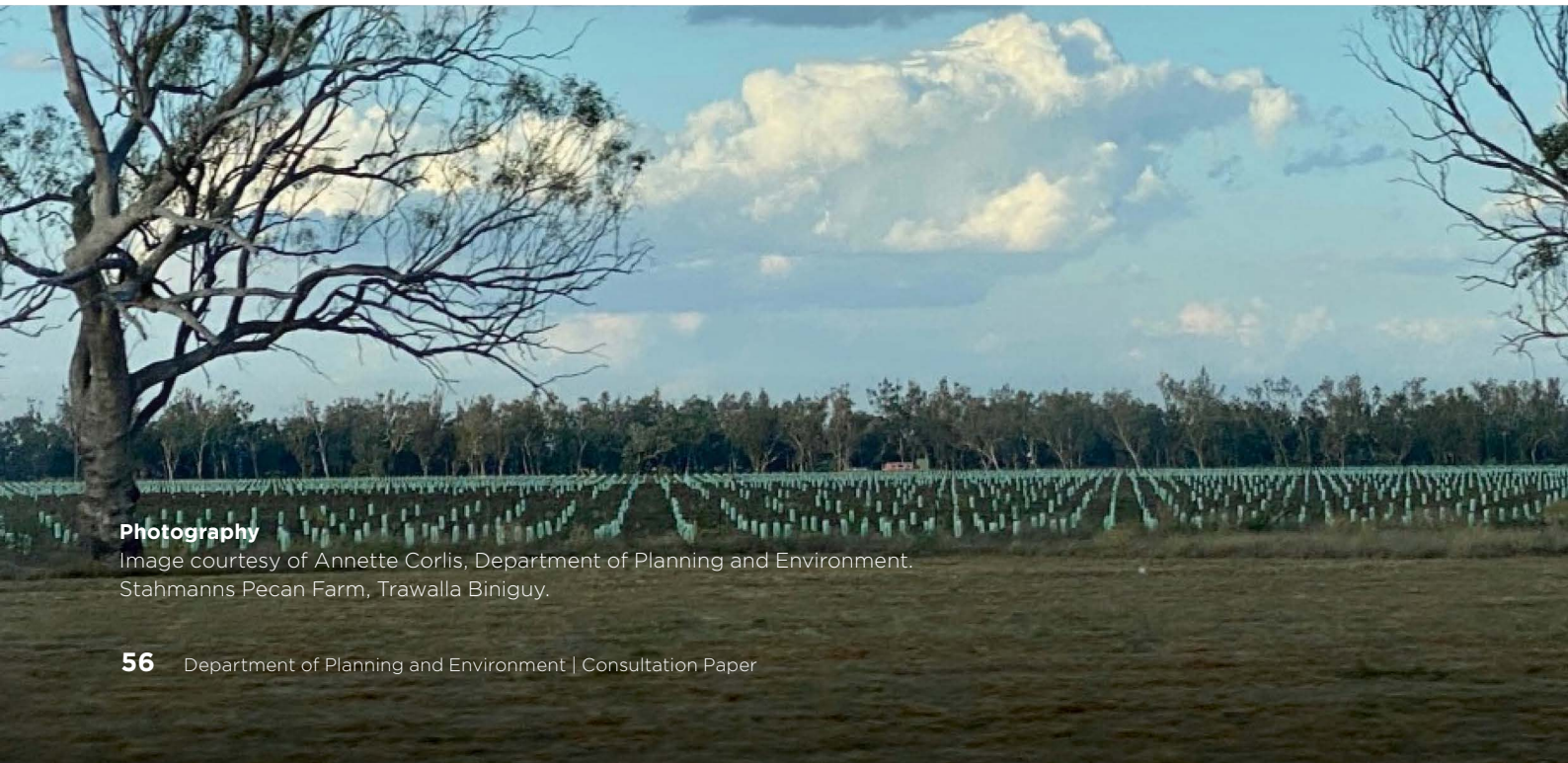
In addition to supporting existing industries and businesses, the NSW Government is taking steps to help diversify the Gwydir's economy and reduce the vulnerability of communities to changing economic and climate conditions.

Investments to help diversify the economy focus on leveraging and value-adding to the region's agricultural base through the Moree Special Activation Precinct, as well as encouraging investment in industries less dependent on water such as the New England Renewable Energy Zone, Inland Rail and the visitor economy.

These investments have the potential to provide more stable employment, attract investment and maintain liveability, particularly in the face of more extended droughts.

To support these future industries, the actions shortlisted under this priority will:

- facilitate access to higher security, or alternative sources of water, while observing legislated limits to take
- explore opportunities to make sure the water entitlement and access framework can cater to the development of emerging industries
- support Aboriginal people to be more involved in water management, by both sharing their traditional knowledge and contributing to decision making.



Photography
Image courtesy of Annette Corlis, Department of Planning and Environment.
Stahmanns Pecan Farm, Trawalla Biniguy.

What we are already doing

The NSW Government has committed $3.9 million under Future Ready Communities to promote resilience and develop drought resilience plans.

Drought resilience plans will assess drought impacts and responses and engage the community to prepare a triple-bottom line strategy. Individual plans can focus on intra- or inter-industry diversification, leadership and social capital building, and planning council works counter-cyclically.

Photography
Image courtesy of Daryl Albertson, Department of Planning and Environment.
Black winged stilt Gwydir Wetlands, Moree.

Supporting economic prosperity in a capped system

The Basin Plan and NSW rules limit how much water can be taken from river and groundwater systems in the Gwydir region. The long-term average annual water use in the regulated river system exceeds extraction limits. This means we cannot progress any action that may increase the total amount of water extracted. Any measures that increase the reliability of regulated water supply or encourages an increase in water use by one class of licence holder will mean we need to reduce the amount of water available to other users to reduce total water use back within the allowable limit.

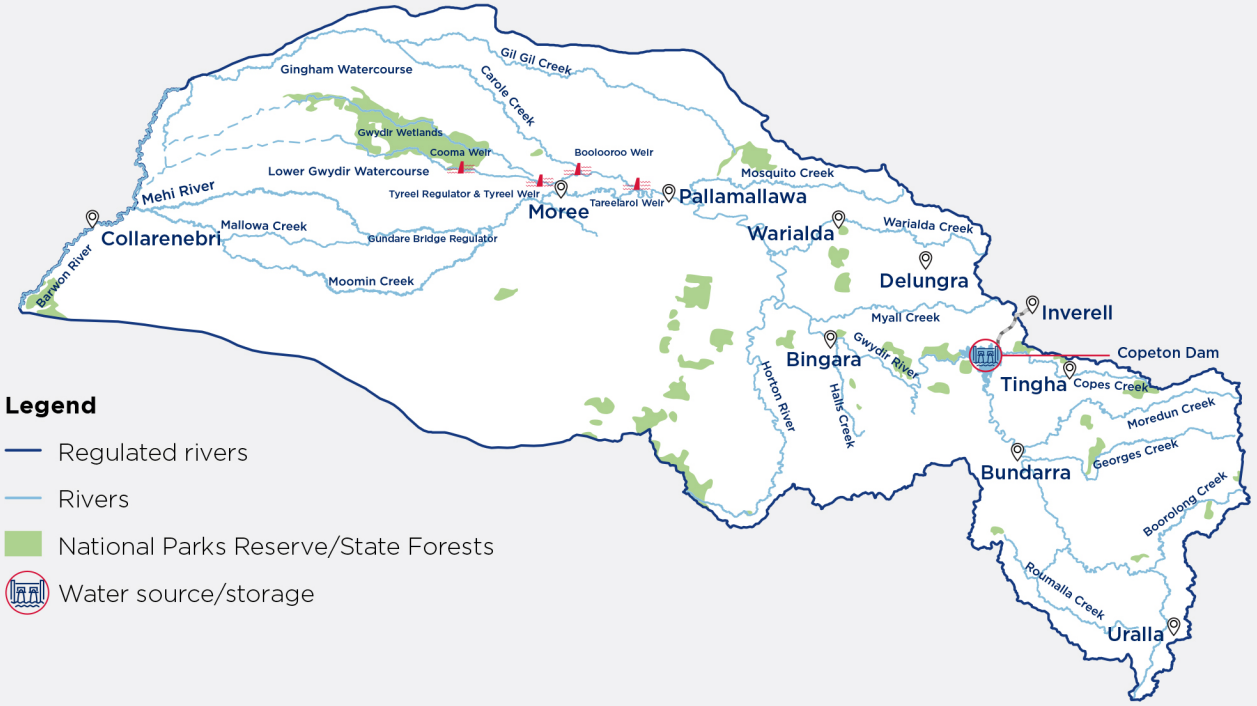
Photography
Image courtesy of the Department of Planning and Environment.
Irrigation channel, Stahmanns Pecan Farm.

Figure 20. Priority 2: Sustainable water resources for new and existing users

Action 2.3
Assess the potential costs and benefits of event-based trade of supplementary flows

Action 2.4
Increase the availability of high security water access licences

Action 2.5
Investigate managed aquifer recharge in the Gwydir region



Legend

- Regulated rivers
- Rivers
- National Parks Reserve/State Forests
- Water source/storage

Across the region

Action 2.1
Improve public access to climate information and water availability forecasts

Action 2.2
Support adoption of on-farm water efficiency measures

Action 2.6
Develop ongoing arrangements for participation of local Aboriginal people in water management

Action 2.7
Support place-based initiatives to deliver cultural outcomes for Aboriginal people

Action 2.8
Support Aboriginal business opportunities in the Gwydir region

Action 2.9
Ensure the water management framework can support sustainable economic diversification

Legend

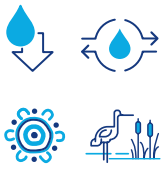
Reducing water service risks and improving water supply resilience for the region's towns and villages

Supporting licence holders in the face of declining water availability

Delivering water to the end of the river system and connected valleys

Dismantling barriers to Aboriginal water rights

Improving the health and resilience of region's aquatic ecosystems

Proposed actions	Description	Challenges addressed
Action 2.1 **Improve public access to climate information and water availability forecasts**	Improve existing platforms and products to provide information about water availability and climate change in forms that are suitable for water users and their business planning needs.	
Action 2.2 **Support adoption of on-farm water efficiency measures**	Continue to support industry to invest in ways to improve water efficiency.	
Action 2.3 **Assess the potential costs and benefits of event-based trade of supplementary flows**	Investigate and review methods to enable trading to operate as supplementary events occur. Supplementary events are an important source of water for industry, the environment and downstrean needs.	
Action 2.4 **Increase the availability of high security water access licences**	Investigate conversion of a small portion of general security licences to high security access licences in the region to encourage different industries into the region and support the Moree Special Activation Precinct.	
Action 2.5 **Investigate managed aquifer recharge in the Gwydir region**	Investigate possible sites for temporary storage of stormwater and river flows in aquifers, known as managed aquifer recharge. This action would also develop supporting policy to regulate the storage and recovery of this water and could support industries in the Moree Special Activation Precinct.	

Proposed actions	Description	Challenges addressed
Action 2.6 **Develop ongoing arrangements for participation of local Aboriginal people in water management**	Support existing or new Aboriginal groups develop governance arrangements for involvement in water management activities and decision making.	
Action 2.7 **Support place-based initiatives to deliver cultural outcomes for Aboriginal people**	Support Aboriginal organisations and communities to develop tailored projects for their communities with the aim of moving away from central decision-making and developing a flexible program that can be adapted and driven by the principle of self-determination.	
Action 2.8 **Support Aboriginal business opportunities in the Gwydir region**	Support Aboriginal business development opportunities in the Gwydir region, some of which may require access to water resources.	
Action 2.9 **Ensure the water management framework can support sustainable economic diversification**	Work across government to understand the water supply and demand needs of emerging industries, including opportunities created by the renewable energy industry and special activation precincts.	

Proposed action 2.1: Improve public access to climate information and water availability forecasts

While the delivery of climate and water availability information has improved in recent years, more can be done to ensure it meets the expectations of water users. Increasing the amount of publicly available climate-related information, including short- and long-term water availability forecasts, will help the region's businesses plan with greater certainty. It will also support farm-level climate adaptation decisions.

The new climate data that has been published in the regional water strategies is the first step in providing more information to water users on the future risks to water availability; however, tailoring the application of this data for industry and communities is likely to deliver the greatest benefits. Improving understanding of the vulnerability of primary industries to climate change is critical for managing risks and making sound adaptation decisions.

This action will design and deliver suitable training and information products and platforms that communicate:

- 12-month water storage outlooks and how this could influence water allocation decisions and other operational water sharing decisions, which could help water users make informed decisions on managing their allocations using carryover or trading water on the market
- implications of long-term climate data on:
  - surface water availability and water quality
  - the likelihood of consecutive years of low or no water availability
  - periods where access to water allocations may be restricted by delivery problems in the regulated river system
  - groundwater availability.
- how future use may affect the condition of groundwater resources
- a decision framework for how available water determinations are made based on use, compliance triggers, and carryover.

The work will build on or complement existing state and national information platforms and products, including the Water Insights and Water Information Dashboards.

What we have heard so far

Feedback provided in earlier consultation showed support for:

- Climate data and modelling being made available to assist communities and councils in their planning.
- Helping communities to understand what long-term climate assessments can tell us about future water availability. They also need an enhanced understanding of how water allocation decisions are made.
- Giving local industries better information on forecast water availability over the next 12 months to inform planning decisions about cropping and business management. Water allocation announcements should be more timely, predictable and transparent.

Have your say

What water availability information and information products do you need to make decisions for your business?

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

Proposed action 2.2: Support adoption of on-farm water efficiency measures

Industry associations, research institutions and government have worked together for decades to improve traditional crop and livestock production systems, including their water use efficiency and productivity. Grower-led irrigation research has been underway in the region for more than a decade and we heard during earlier consultation that new land use activities, including carbon and biodiversity farming are increasing in some areas of the region.

Farm businesses in the Gwydir region are considered early adopters of best practice management and new technology. Continuing critical research and development will set the industry up for the future and may go a significant way to mitigating future climate risks. Opportunities for on-farm water use efficiency improvements remain. This includes the mixed and small farms in the region's east.

This action would build on behaviour change and efficiency gains by continuing to support research, trials and demonstration projects for:

- evaporation mitigation technology
- smart sensors and automated irrigation systems
- reconfiguration of on-farm storages to reduce the surface area-to-volume ratio
- limiting deep drainage by increasing the soil water holding capacity using novel compounds such as hydrophilic polymers.

This work will be progressed through:

- the NSW Government's $48 million expanded Farms of the Future program, which will support on-farm connectivity and encourage farmers to adopt agtech to boost productivity including water efficiency and drought preparedness. In 2022, a grants program will be delivered to help farmers purchase agtech devices and applications
- the Department of Primary Industries – Agriculture's research programs, which will lead efforts to translate world-leading research into practical improvements, including drawing on research to develop and coordinate local pilots, and information and training programs.

In addition to these programs, there is an opportunity to fast-track research and development into new practices and enterprises that are best suited to warmer and drier conditions projected for regional NSW. This would build on the climate vulnerability assessment being undertaken by the Department of Primary Industries and help the agricultural sector diversify incomes and ensure long-term sustainability.

Helping primary producers adapt farming systems to climate change

The NSW Government's Climate Change Research Strategy is supporting projects that help primary industry sectors adapt to climate change. For example, the NSW Department of Primary Industries – Agriculture's Vulnerability Assessment Project is assessing the vulnerability of 28 primary industries and 14 related biosecurity risks to climate change.

The assessment is being conducted in 2 stages:

- an impact assessment looking at how current production might vary under future climate conditions in 2050
- an adaptation assessment looking at how we might respond to negative impacts and provide direction for industry research and development; for example, developing crop varieties more suited to a drier climate.

The impact assessment for cotton, which is nearing completion, suggests that warmer temperatures could benefit cotton production and quality. The next steps are to assess water-related risks and possible responses to negative impacts. This could include developing new cotton varieties or other farming systems that are more suited to a drier climate.

The rangeland component of the vulnerability assessment project is looking at the impact of existing livestock production systems. The project will focus on the suitability of adaptation options, including changing management systems, shifting the focus of livestock enterprises to include carbon farming or adopting an increased focus on goat production.

What we have heard so far

Feedback provided in earlier consultation showed support for:

- The regional water strategy to focus on reducing and managing water demand and prioritising suitable efficiency measures to improve or maintain water reliability and deliverability.
- Managing land within the catchment to increase soil carbon and absorb more of the rain that falls allowing it to be released more gradually to sustain streamflows as well as enabling better production from those soils.

Have your say

What should be the focus of future water use efficiency research and investment?

Proposed action 2.3: Assess the potential costs and benefits of event-based trade of supplementary flows

There is a total of 181 GL of supplementary water entitlement in the regulated Gwydir River; 23.5 GL of which is held as environmental water. Supplementary licences, together with floodplain and rainfall-runoff harvesting, are an important source of water for irrigators that significantly supplements general security allocations. Water users have been given access to supplementary water in 9 out of the past 10 years. Use has ranged from a total of 5 GL in 2009/10 to 177 GL in 2016/17.

Accessing supplementary water is 'opportunistic' and is announced on an event-by-event basis when there is more water in a regulated river than is needed to fulfil water sharing plan requirements and other licensed demands. Supplementary water access licence holders can only pump water against these licences during announced periods.

For each flow event, irrigators can access 50% of the supplementary flow volume with the other 50% remaining in the river for the environment as part of planned environmental water provisions. These natural flow events are critical for protecting and enhancing environmental outcomes, providing natural cues and opportunities for aquatic biota to complete important life history stages.

Event-based trading of supplementary allocation would give individual licence holders, including environmental water holders, the opportunity to obtain an increased share of an individual flow event by purchasing another licence holder's allocation.

This option would explore the feasibility, and potential benefits and risks associated with a framework for trading supplementary allocation between water users in any individual event. This would include identifying the size of the potential market, and the systems needed to ensure compliance with water allocation account rules and support trade approvals as well as any environmental implications that may affect the effectiveness of supplementary flows contributing to environmental outcomes.

Proposed action 2.4: Increase the availability of high security water access licences

General security water licences make up 71% of all water licences and are used by industry and to deliver water to the environment in the regulated Gwydir River. Only 2% of licences are high security. In drought, general security licences typically receive no or very low allocations. For high security licences, enough water is reserved to receive their full allocation through a possible repeat of the worst droughts in 120 years of historic climate data records. During the recent drought, high security licence holders in the Gwydir continued to receive 100% allocations.

This action proposes to convert some general security licences to high security licences. This will reduce the overall volume of licensed water but increase the availability of entitlement that can be allocated with high reliability each year. As we are working in a capped system, this option becomes a trade-off between volume and security.

Increasing the availability of more reliable water licences may help high value businesses to expand or enter the region, with significant potential for expansion into horticulture. We received feedback that some existing licence holders would like to access a higher security licence. The potential area and extent of expansion are partially limited by the availability of high security water.

Converting a small amount of general security licences to high security licences could support industries setting up in the Moree Special Activation Precinct and surrounds. Intensive agricultural industries entering the Namoi Regional Job Precinct, which extends into the Gwydir Local Government Area, may also have appetite to purchase high security licences. It could also allow environmental water holders to convert some of their general security holdings to high security to change their portfolio mix, which could improve the volume of water available for environmental needs during times of shortage.

To determine the capacity of Copeton Dam to support high security licences, we have undertaken preliminary analysis of a partial conversion of licences. Three constraints were considered when creating additional high security volumes:

- end of year allocation reliability for any remaining licence holders must not decrease on average below current conditions
- total diversions must not exceed the base case diversion limit
- end of system flows must not decrease below the current conditions.

Our analysis has shown that converting 41 GL of general security licences – 10% of all general security licences, excluding those held as environmental water – would:

- create 18 GL of new high security entitlement with high reliability across all climate scenarios
- increase end-of-year effective annual allocation for remaining general security licences by approximately 2% under the historic and long-term climate, and remain unchanged under a dry climate scenario under average conditions
- reduce the time that Copeton Dam sits at or below 25%, from 29% to 23% of the time based on the long-term historic record; and from 55% to 50% under a dry climate change scenario. The 25% volume is typically when drought operation measures commence in this valley
- come at a moderate cost for some environmental outcomes. This option has no extreme or major impacts. It does include moderate impacts on very low, base and fresh flows in the Mehi River (see Attachment 2).

The storage drawdowns for Copeton Dam are generally slightly less severe during drought periods under this option. When Copeton Dam is drawn down to low levels, operational measures are usually taken to ensure that remaining general security account water and supplies to higher priority licence categories can be maintained. It could be expected that operational contingency measures such as limiting storage releases to specific periods – block releases – would be slightly less frequent and less severe.

The environmental metrics included with the hydrological models we have used for our analysis indicate mostly minor impacts for the freshes and floodplain flows, but with some local impacts on freshes in the Gwydir River downstream of the Tyreel offtake under the long-term climate change scenario. These flows are required for wetland inundation, fish movement and other key processes that allow the movement of nutrients and other biota along and across river landscapes. Wetland flows were also mostly unaffected. The exception to this pattern were minor impacts on Mallowa Creek wetlands under the long-term climate change model.

The largest impacts were on the duration, and especially the frequency of no flow events which vary widely depending on location. For example under the long-term climate scenarios with this high security licence conversion, the Gwydir River at Gravesend would never experience a cease-to-flow day. However, cease-to-flow events could increase in frequency in some locations, shifting from:

- a once in 4-year (0.24) event to an every year event at Gwydir at Yarraman
- a once in 5-year event (0.2) to most years (0.8) for the Mehi downstream of Combadello.

Progressing this proposed action

More detailed analyses and consultation would involve:

- assessing demand for high security licences and level of interest in licence conversion
- detailed modelling, consultation and impact assessment to confirm the conversion factor and any rules needed to mitigate impacts on other licences, basic landholder rights, effectiveness of environmental outcomes and environmental outcomes
- consultation with the Murray–Darling Basin Authority and Australian Competition Consumer Commission, who currently do not endorse conversion of licences if the licence conversions impact on the reliability of remaining licence holders
- adjustments to statutory instruments to allow applications for licence conversion to occur.

Have your say

Do you see there being appetite for conversion of general security licences to high security licences?

Licence conversions and Aboriginal people

Our initial discussions with Aboriginal communities and environmental agencies have indicated that we also need to provide more specific, detailed information on how licence conversions will impact the amount of water in the river at different locations, for them to assess whether this action will have positive, neutral or negative impacts on their communities and environmental outcomes. Better understanding of the benefits or impacts of the policy change on the environment and Aboriginal communities is a critical step before these changes can be implemented. This relies on a better understanding of how water users and industry would behave or change their operations.

Proposed action 2.5: Investigate managed aquifer recharge in the Gwydir region

Managed aquifer recharge, or water banking, stores water in an aquifer or underground storage for future use, including during drought. A range of water sources can be used in aquifer recharge, including stormwater, treated wastewater, river or dam water, or industrial water.

Potential benefits from managed aquifer recharge include:

- minimising evaporation, compared to storing water aboveground
- providing additional recharge to groundwater sources to increase water reliability for groundwater dependent users, including ecosystems
- reducing pressure on surface water supplies during drought, which could improve environmental outcomes for riverine environments.

We received support for the investigation of managed aquifer recharge during consultation. It was considered an innovative option with potential to enhance water security.

The deeper part of the Lower Gwydir Groundwater Source could be a potential target for managed aquifer recharge in the Gwydir region because it is sandier and gravellier than the shallow part of the aquifer, which is clayey. This means that injection bores rather than infiltration ponds are likely to be needed to recharge the aquifer. This requires investigation.

Managed aquifer recharge could be used to increase town water security; however, the location of the operation would need to be carefully considered. For example, the productive aquifer at the Moree Special Activation Precinct is limited and an off-site location is likely to be required.

Other groundwater sources in the Gwydir region are most likely unsuitable for managed aquifer recharge, including the Great Artesian Basin, fractured rocks like the Lachlan Fold Belt Murray–Darling Basin and upland alluvial aquifers like the Upper Gwydir Alluvial Groundwater Source.

The regulatory framework for managed aquifer recharge is currently in the early stages of development within the Department of Planning and Environment – Water. Progressing managed aquifer recharge is a priority in the NSW Water Strategy. As it is a new alternative way of managing and storing water in NSW, extensive stakeholder consultation will be needed, especially because existing users could be affected.

Progressing this action will, among other things, involve:

- exploring the feasibility of potential recharge, including its cost effectiveness and how efficiently the stored water can be accessed
- developing the necessary policy and legislative changes
- creating the water licensing and accounting framework for surface water temporarily stored as groundwater
- considering the distribution of benefits – additional water because of reduced evaporation – among consumptive water users and the environment
- determining public acceptance of this option, particularly the impacts on and benefits for Aboriginal cultural heritage and environmental flows – including specific pilot schemes
- assessing biosecurity and water quality risks associated with transferring water from surface water – especially stormwater or recycled water – to groundwater.

Photography
Image courtesy of the, Department of Planning and Environment.
Groundwater bore pump discharge, NSW.

Proposed action 2.6: Develop ongoing arrangements for participation of local Aboriginal people in water management

We heard from Aboriginal people that consultation with their communities on water issues has been infrequent and poorly executed. Community sentiment is that government agencies often come out to 'tick a box' and after they have got what they want, they are never seen again. During consultation in the Gwydir region, Aboriginal groups told us that the government had to earn the trust of the community as the first step in building a strong lasting relationship with them.

To address this now and over the next 20 years, we need an approach that allows Aboriginal people in each local area and region to get the right people involved or appointed to seats where decisions about water are being made. Aboriginal people need to have a direct line of contact with regional water managers, compliance officers and decision makers. Aboriginal knowledge and science should be actively sought, respected and listened to.

An effective governance, engagement and knowledge sharing process is the first step in fundamentally improving Aboriginal people's involvement in water management and supporting cultural, environmental, social and economic outcomes.

For it to be successful, the makeup and function of groups need to be led by local communities – experience has shown that government dictated governance models for Aboriginal communities do not work.

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

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

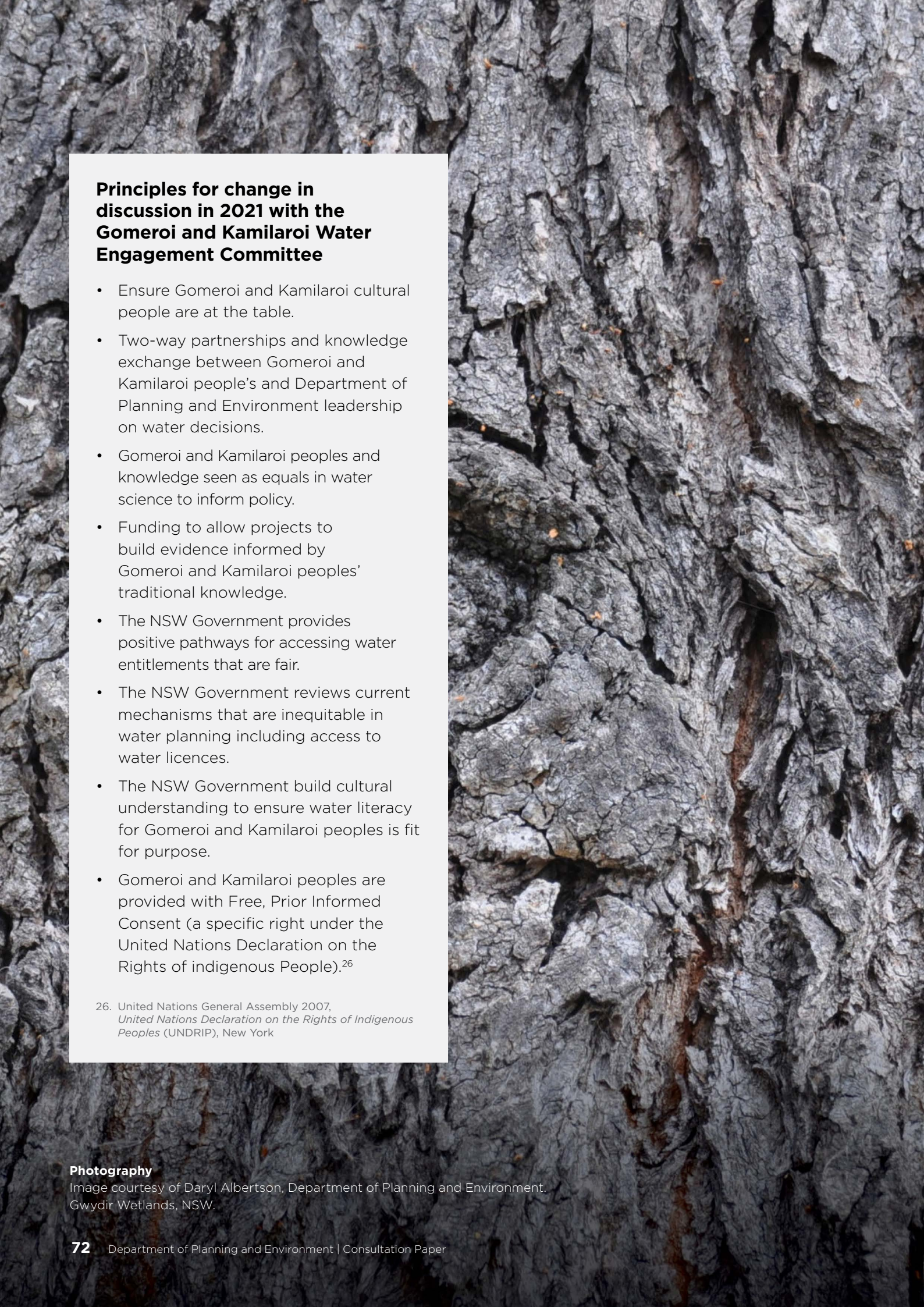
Local Aboriginal groups in the Gwydir region could be involved in:

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

What we have heard so far

Feedback provided in earlier consultation showed support for Aboriginal traditional knowledge and science to support healthy waterways.

We have also heard that ongoing consultative processes require government to provide administrative funding, support and working in partnership with local Aboriginal communities and organisations.



Principles for change in discussion in 2021 with the Gomeroi and Kamilaroi Water Engagement Committee

- Ensure Gomeroi and Kamilaroi cultural people are at the table.
- Two-way partnerships and knowledge exchange between Gomeroi and Kamilaroi people's and Department of Planning and Environment leadership on water decisions.
- Gomeroi and Kamilaroi peoples and knowledge seen as equals in water science to inform policy.
- Funding to allow projects to build evidence informed by Gomeroi and Kamilaroi peoples' traditional knowledge.
- The NSW Government provides positive pathways for accessing water entitlements that are fair.
- The NSW Government reviews current mechanisms that are inequitable in water planning including access to water licences.
- The NSW Government build cultural understanding to ensure water literacy for Gomeroi and Kamilaroi peoples is fit for purpose.
- Gomeroi and Kamilaroi peoples are provided with Free, Prior Informed Consent (a specific right under the United Nations Declaration on the Rights of indigenous People).[26]

26. United Nations General Assembly 2007, *United Nations Declaration on the Rights of Indigenous Peoples* (UNDRIP), New York

Photography
Image courtesy of Daryl Albertson, Department of Planning and Environment.
Gwydir Wetlands, NSW.

Proposed action 2.7: Support place-based initiatives to deliver cultural outcomes for Aboriginal people

The Draft Gwydir Regional Water Strategy identified options to improve Aboriginal people's access to water and water rights. While there was a significant amount of support for these options, preferences on how they should be prioritised or implemented varied across communities. The needs and priorities of Aboriginal communities in different parts of the region were different.

The Australian Government's *Closing the Gap* report and the Local and Indigenous Voice program highlighted that Aboriginal people have expressed the desire for strong and inclusive partnerships in which local communities set their own priorities and tailor services and projects to their unique situations. Programs with demonstrated successful initiatives are often those that are tailored to local circumstances, are place-based, well resourced, locally driven and often cannot be scaled up.

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

In the Gwydir region, this could include:

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

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

Have your say

How can Aboriginal place-based solutions be implemented in a way that creates opportunities for Aboriginal people and communities in the Gwydir region, while also delivering positive outcomes for the broader community?

Improving land and water management for cultural and environmental outcomes on Munwonga

North West Local Land Services is working with the University of Canberra and Mungindi Local Aboriginal Lands Council to improve land and water management for cultural and environmental outcomes on Munwonga, owned by Mungindi Local Aboriginal Land Council and forming part of the Gwydir Wetlands in the Gwydir catchment.

Associate Professor Bradley Moggridge is leading the project to engage with the Mungindi Aboriginal elders to implement water and land management practices to improve ecological and cultural outcomes for the property and wider area. Key principles of Aboriginal peoples' natural resource management will underpin the project. This includes the deeply held belief that historical and cultural perspectives remain critical to contemporary land and water management.

This project is supported by North West Local Land Services through funding from the Australian Government's National Landcare Program.

Photography
Image courtesy of the Department of Planning and Environment.
Munwonga Wetlands, NSW.

Proposed action 2.8: Support Aboriginal business opportunities in the Gwydir region

During our consultation on the Draft Gwydir Regional Water Strategy, we heard about the need for economic development and business opportunities in the region that are led by Aboriginal communities and allow for local Aboriginal people to be employed.

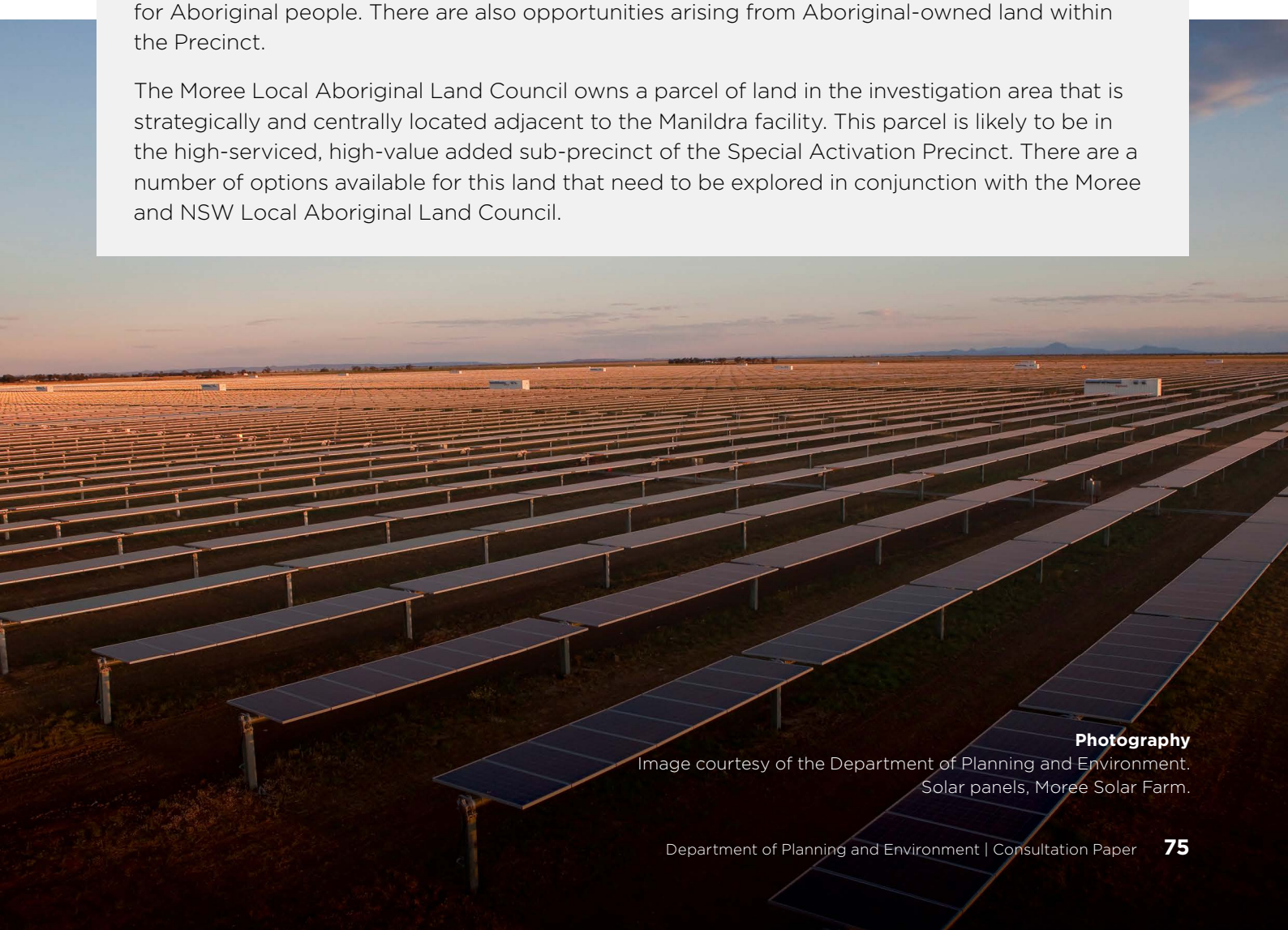
Investing in regional Aboriginal businesses can help diversify incomes in the region, create employment for local Aboriginal youth and help deliver social and economic outcomes for Aboriginal people. Realising some of these opportunities may require access to surface water or groundwater resources.

This action will support Aboriginal business development opportunities in the Gwydir region and will be led by the Department of Regional NSW. Through the Aboriginal Partnership Program, a dedicated Aboriginal Senior Regional Coordination officer will work with Aboriginal organisations, businesses and individuals to identify and develop new business opportunities or better manage existing ones and access support or grant funding. Other support is also available through NSW Department of Aboriginal Affairs, NSW Aboriginal Lands Council and National Indigenous Australians Agency.

Moree Special Activation Precinct

The Master Plan for the Moree Special Activation Precinct provides opportunities for connection to Country by fostering partnerships and opportunities for skills, training and employment for Aboriginal people. There are also opportunities arising from Aboriginal-owned land within the Precinct.

The Moree Local Aboriginal Land Council owns a parcel of land in the investigation area that is strategically and centrally located adjacent to the Manildra facility. This parcel is likely to be in the high-serviced, high-value added sub-precinct of the Special Activation Precinct. There are a number of options available for this land that need to be explored in conjunction with the Moree and NSW Local Aboriginal Land Council.



Photography
Image courtesy of the Department of Planning and Environment.
Solar panels, Moree Solar Farm.

Proposed action 2.9: Ensure the water management framework can support sustainable economic diversification

The NSW Government is making significant place-based investments in the Gwydir region and surrounding areas to build strong communities and diversified economies that thrive. The following emerging opportunities and industries will support this goal and deliver new income streams that will be important in helping to build regional resilience and spread financial risk for individuals:

- The New England Renewable Energy Zone covers parts of the Gwydir region and could create employment opportunities and new income streams for landholders, particularly in the eastern part of the catchment. The Zone could also support the establishment of new energy-intensive industries in the region. We have heard that companies setting up in this Zone are likely to require a significant amount of water during the construction phase and may seek to rely on town water for these needs.
- The Moree Special Activation Precinct will enable the establishment of agribusiness, logistics and food processing businesses. The Namoi Regional Jobs Precinct also extends into the Gwydir Local Government Area and will encourage similar opportunities.
- Participation in carbon farming (carbon sequestration or emissions reduction) and biodiversity offsets could create new income streams, which can improve the resilience of farming systems and Aboriginal communities.
- Moree, Gwydir and Uralla councils are each working to expand nature-based adventure and cultural tourism places, leverage the area's environmental and iconic assets and enhance visitor experiences, and recreation and cultural facilities. Tourism—including eco-tourism, Aboriginal cultural tourism and agri-tourism—could generate year-round cash flow and reduce the impacts of seasonal and cyclical activities.

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

This action will:

- take a proactive approach to understanding the water quality and quantity requirements of emerging industries in order to inform policy development and planning decisions
- address water-related policy and regulatory barriers around supporting new and diverse industries setting up in the region
- deliver upfront education and clarity to industry and government on potential water sources, given that the surface water sources, and some groundwater sources are already fully allocated and there is potential for reduced water availability in the future
- encourage new industries to have comprehensive drought management plans as they set up in the region.

What we are already doing

Primary Industries Productivity and Abatement Program

As part of the Net Zero Plan, the NSW Government is developing a Primary Industries Productivity and Abatement Program (PIPAP) to help producers and landowners commercialise low-emissions technologies and maximise their revenue from carbon offset programs. The program will help farmers meet the growing demand for sustainable products and ensure the productivity of primary industries in NSW is not tied to emissions intensity in the global transition to a net zero economy. Some abatement opportunities, such as soil carbon sequestration, can also enhance the sustainability of farming systems and reduce their susceptibility to dry periods.

Identifying and mapping important agricultural lands

The Department of Primary Industries—Agriculture has been undertaking a 3-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.

Have your say

- What are the key barriers to unlocking industries with low water reliance in the Gwydir?
- Are there other industries that could generate sustainable employment in the region?

PRIORITY 3

Best use of existing water for the environment

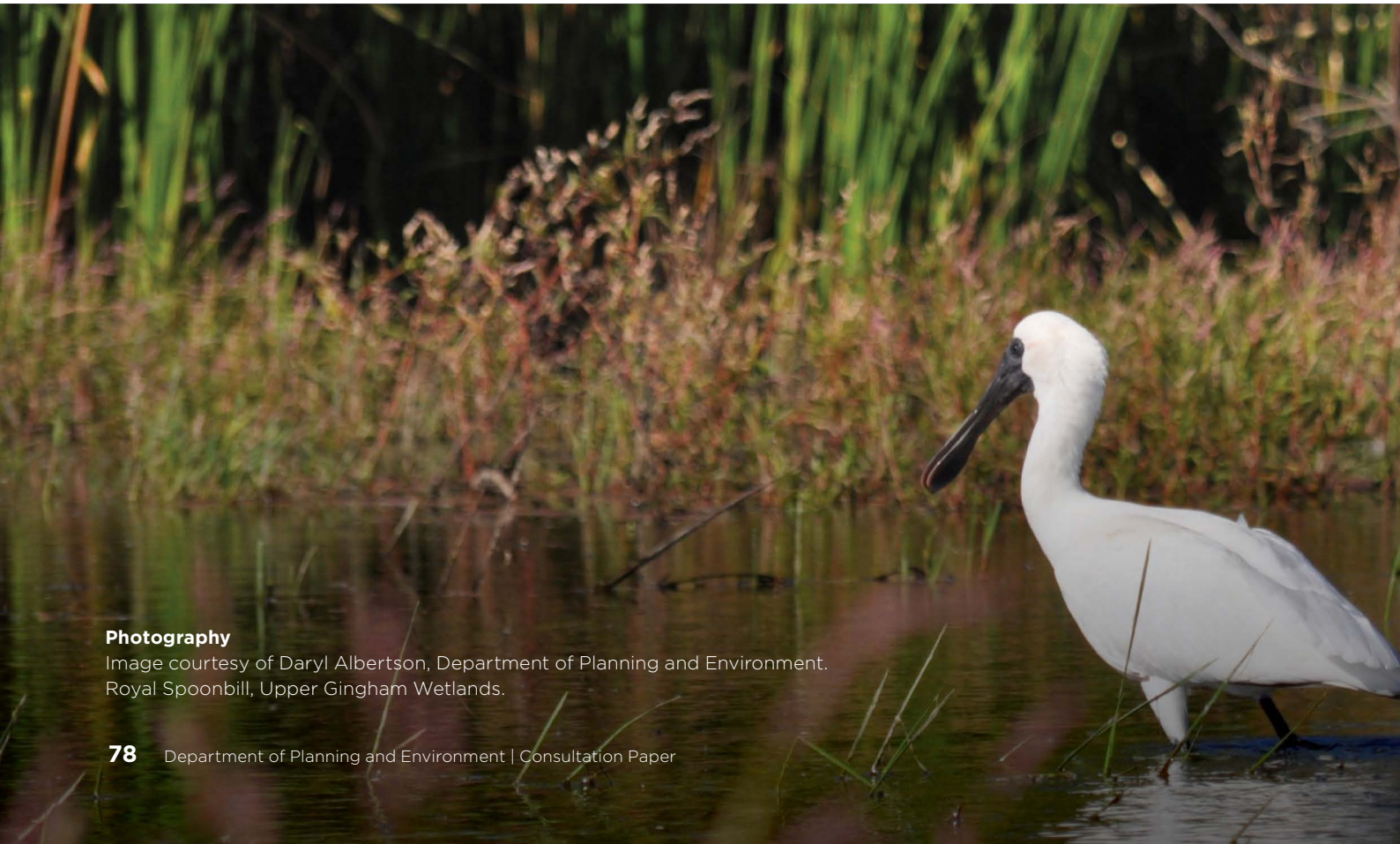
Approximately 19% of the surface water licences in the regulated Gwydir River are held by environmental water holders—providing significant opportunities for delivering water to support environmental outcomes.

Environmental water managers adapt to the Gwydir region's variable climate by using responsive strategies to manage the needs of its aquatic ecosystems. Watering activities range from building resilience and promoting ecological restoration by maximising environmental outcomes from flow events when water is abundant; to minimising losses or damage by maintaining drought refuges when resources become scarce.

Despite this, water for the environment cannot always be used when it is needed or delivered to its best effect during dry and wet periods, which limits the ability to build resilience in the system.

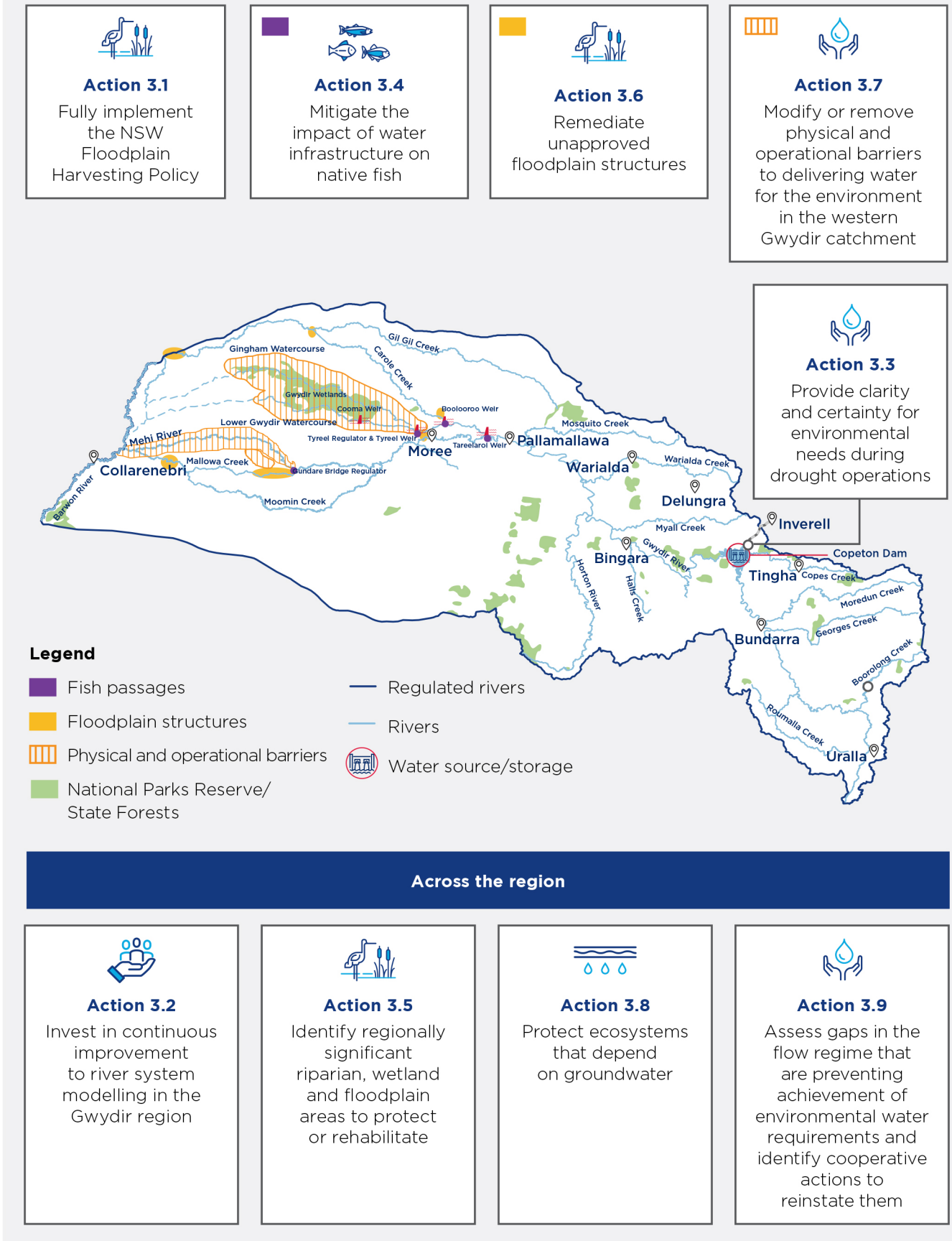
The actions shortlisted under this priority will:

- build knowledge and understanding of the region's water dependent ecosystems and assets and the impacts of climate change on their health and resilience
- achieve shared benefits from water delivery and maximise social, cultural, economic and environmental outcomes when water is used
- limit or remove pressures and impacts directly related to water infrastructure. The options recognise that complementary catchment management activities are often needed to achieve environmental watering outcomes
- improve water resource health through better land management.



Photography
Image courtesy of Daryl Albertson, Department of Planning and Environment.
Royal Spoonbill, Upper Gingham Wetlands.

Figure 21. Priority 3: Best use of existing water for the environment



Across the region

Action 3.2
Invest in continuous improvement to river system modelling in the Gwydir region

Action 3.5
Identify regionally significant riparian, wetland and floodplain areas to protect or rehabilitate

Action 3.8
Protect ecosystems that depend on groundwater

Action 3.9
Assess gaps in the flow regime that are preventing achievement of environmental water requirements and identify cooperative actions to reinstate them

Legend

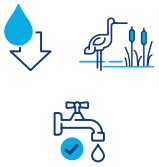
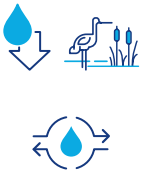
Reducing water service risks and improving water supply resilience for the region's towns and villages

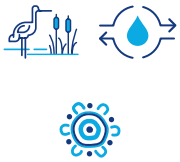
Supporting licence holders in the face of declining water availability

Delivering water to the end of the river system and connected valleys

Dismantling barriers to Aboriginal water rights

Improving the health and resilience of region's aquatic ecosystems

Proposed actions	Description	Challenges addressed
Action 3.1 **Fully implement the NSW Floodplain Harvesting Policy**	Finalise licences and work approvals to measure and regulate floodplain harvesting take within legal limits in the Gwydir valley floodplain.	
Action 3.2 **Invest in continuous improvement to water modelling in the Gwydir region**	Update the Gwydir river system model so it better represents drought operations and flood behaviour, which can help support future operation, policy and planning decisions. This action could also explore how water models can link with other models (e.g. ecological and economic) to better understand vulnerability to future conditions, including climate variability.	
Action 3.3 **Provide clarity and certainty for environmental needs during drought operations**	Clarify when, how and why drought operations are triggered. This will allow more accurate planning of environmental releases and more informed environmental management of the system.	
Action 3.4 **Mitigate the impact of water infrastructure on native fish**	Mitigate the impact of water infrastructure on native fish by: • installing fish passages at 5 priority barriers in the Gwydir region • progressing cold water pollution mitigation measures for Copeton Dam • implementing diversion screens at priority pump sites in the Gwydir to protect native fish.	

Proposed actions	Description	Challenges addressed
Action 3.5 **Identify regionally significant riparian, wetland and floodplain areas to protect or rehabilitate**	Strategically target on-ground activities at high-priority locations to restore, conserve and protect critical riparian, wetland and floodplain habitat and species, or areas of high cultural value in the Gwydir region.	
Action 3.6 **Remediate unapproved floodplain structures**	Undertake an accelerated compliance program for unapproved floodplain structures for high-risk areas of the Gwydir valley floodplain.	
Action 3.7 **Modify or remove physical and operational barriers to delivering water for the environment in the western Gwydir catchment**	Implement the Gwydir Constraints Measures Project in the Gingham, lower Gwydir and Mehi watercourses. In areas outside of the Gwydir Constraints Measures Project, implement identified measures (modification or removal of physical and operational barriers) in the Ballin Boora and Mallowa watercourses.	
Action 3.8 **Protect ecosystems that depend on groundwater**	Progress work on understanding and protecting different types of groundwater dependent ecosystems.	
Action 3.9 **Assess gaps in the flow regime that are preventing achievement of environmental water requirements and identify cooperative actions to reinstate them**	Identify gaps in the frequency and adequacy of different flow types under the current climate and future climate change scenarios and determine how to fill these flow gaps without significant impacts on water users.	

Proposed action 3.1: Fully implement the NSW Floodplain Harvesting Policy

Floodplain harvesting happens when water spills from a river during a flood or on the way to the river after a rain event. It is a historically legitimate form of water take that has not been fully transitioned into the licensing framework provided by the *Water Management Act 2000*. Floodplain harvesting is a significant farm management practice in the Gwydir region. More than one third of all surface water used in the region comes from water diverted from the floodplain and intercepted before it enters rivers and creeks.

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

There has been growth in floodplain harvesting across the NSW northern Basin. Where this growth has caused total diversions in a water resource to exceed the legal limits, the floodplain harvesting reform will reduce take such that total diversions within each valley will not exceed legal limits.

Licensing, measuring and managing floodplain harvesting within legal limits will be a game changer for the Gwydir valley. It will decrease floodplain harvesting by 30%[27] and is expected to deliver up to 58.5 GL increase in average annual flood volume across the floodplain in years when floods occur.[28]

A quantity of the foregone diversions in the Gwydir (proposed at approximately 9.7 GL/year) would remain in the terminal Gwydir Wetlands, providing localised environmental benefits.[29] Other predicted benefits are expected to provide greater resilience for the diverse habitats and species it supports in the Gwydir valley and the northern Murray–Darling Basin more broadly.

Not implementing the NSW Healthy Floodplain Policy would mean continuing uncertainty for water users, the regulator and communities. Without implementing these reforms, we cannot measure or monitor floodplain harvesting and it may mean other licence categories are penalised in order to meet legal limits.

This action will ensure a regulatory framework is in place to manage floodplain harvesting in the Gwydir valley.

27. Department of Planning, Industry and Environment 2021, *Floodplain harvesting entitlements for the Gwydir Valley regulated river system: Model scenarios*, retrieved on 28 September 2021 from www.industry.nsw.gov.au/water/plans-programs/healthy-floodplains-project/water-sharing-plan-rules/gwydir-valley
28. Department of Planning, Industry and Environment 2021, *NSW Floodplain Harvesting Policy: Predicted environmental outcomes*, retrieved on 28 September 2021 from www.industry.nsw.gov.au/water/plans-programs/healthy-floodplains-project/water-sharing-plan-rules/gwydir-valley
29. Department of Planning, Industry and Environment 2021, *Environmental outcomes of implementing the Floodplain Harvesting policy in the Gwydir Valley: Report,* retrieved on 28 September 2021 from www.industry.nsw.gov.au/water/plans-programs/healthy-floodplains-project/water-sharing-plan-rules/gwydir-valley

Proposed action 3.2: Invest in continuous improvement to water modelling in the Gwydir region

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

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

This action enhances the capability of the Gwydir river system model to support analysis of future operation, policy and planning decisions and their impacts on all water users, including the environment. This action would work with Proposed action 2.1 to make this information more readily available in a format that can be understood by users.

Areas of focus could include:

- Investigating ways to represent how we change river operations as we go into and recover from drought. Being able to simulate drought contingency measures and better representation of evaporation and groundwater seepage can help us better assess the impacts and benefits of different actions during droughts.
- Reducing model uncertainty to better account for different components of water take once sufficient floodplain harvesting and unregulated river non-urban water take measurement data is available.
- Combining our models with analysis from hydraulic models and remote sensing to better estimate floodplain inundation extent and duration and consequent environmental outcomes, as well as improving our representation of floodplain return flows under different floodplain harvesting rules.
- Collaborating across different disciplines to explore how hydrologic models could be linked or combined with other models, such as economic and ecological models, to better understand ecological vulnerability to future conditions including climatic variation.

This action would significantly improve understanding of the Gwydir region's water resources and give stakeholders and the broader community greater confidence that water sharing and management decisions are made using the latest scientific knowledge and a strong and credible evidence base.

Collecting more data and better data

The NSW Government is undertaking a range of programs aimed at improving our understanding of water flows and water use in the Gwydir region. The data collected by these programs will improve our modelling capabilities and knowledge, and support better water management decisions.

Non-urban water metering reforms

Introduced in 2018, the non-urban water metering policy requires licensed water users to monitor their take. Water supply works in the Gwydir region (other than those works used to take water for basic landholder rights) will be subject to the new metering rules, which require the installation of meters on pumps. Large surface pumps (500 mm and above) in the region were required to be fitted with compliant metering and telemetry equipment by 1 December 2020. All remaining surface and groundwater works covered by the rules will need to be fitted with compliant metering equipment by 1 December 2021 in the northern inland and 1 December 2022 in the southern inland.

The non-urban water metering framework will be able to better collect and store data, through its cloud-based data acquisition service, to assist the Natural Resources Access Regulator, WaterNSW and the Department of Planning and Environment to undertake compliance and enforcement, billing, and other water management activities. Water users will also be able to access their water usage data via a private online dashboard.

Enhanced Water Monitoring and Information aprogram

Twenty new or upgraded water monitoring gauging stations will be installed across the northern Murray–Darling Basin in the Border Rivers, Gwydir, Darling, Culgoa, Namoi and Macquarie catchments, as part of a joint Australian–NSW Government-funded project to improve water information.

Five new or upgraded stations are expected to be operational by June 2022, and the remaining 15 by the end of 2023. These additional sites were identified through a review of the hydrometric network undertaken as part of the Murray–Darling Basin Compliance Compact. The review looked at the coverage and data quality obtained from the existing hydrometric (river gauge) network and identified ways to improve the information collected.

Photography
Image courtesy of Destination NSW.
Aerial of Moree Town, Moree.

Proposed action 3.3: Provide clarity and certainty for environmental needs during drought operations

During the most recent drought, the NSW Government altered normal regulated river operations in the Gwydir from February 2019 to April 2021 to adapt to the extreme dry conditions.

The operational measures that were implemented included releasing water over shorter periods (block releases) to maximise delivery efficiencies; and applying dam wall debiting to deliveries of general security and environmental contingency allowance water.[30] Towards the end of 2019, the NSW Government and high security licence holders also discussed the need to provide survival water only for permanent plantings in the Gwydir if drought conditions continued.

During consultation we heard concerns about the number and frequency of block releases from Copeton Dam and delivery to ecological assets such as the Mallowa Wetlands, which supports threatened and migratory waterbird species. We also heard that greater transparency and information about when drought responses will be triggered and what they are based on will help to maintain confidence that the events are managed appropriately.

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

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

Have your say

- Do you support adjustments to the management of the regulated river to optimise outcomes for the environment as well as consumptive users?
- Is this likely to impact on business operations?

30. Dam wall debiting means these account holders had additional amounts extracted from their accounts to cover the water required to deliver the water ordered (normally water is debited from the pump site, not at Copeton Dam wall).

Proposed action 3.4: Mitigate the impact of water infrastructure on native fish

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

Improve fish passage at priority sites in the Gwydir region as guided by the NSW Fish Passage Strategy

Physical barriers to fish passage such as weirs and dams can limit fish movement, leading to a decline in the health and viability of native fish populations. Currently native fish can only move through the Gwydir system during high flow conditions when water overflows weirs and other instream barriers. Removing barriers to fish movement and allowing fish to breed, and to find food and ideal habitat is critical to supporting native fish populations in the Gwydir region.

This action would improve fish passage at priority sites within the Gwydir region including Tier 1 sites:

- Tyreel Weir
- Tyreel Regulator
- Tareelaroi Weir
- Boolooroo Weir
- Gundare Bridge Regulator.

Four of these fish passages are existing legislative requirements under the *NSW Fisheries Management Act 1994* for the Copeton Dam Safety Upgrade Project. Additional Tier 2 sites could also be pursued for remediation during the life of the regional water strategy as funding and opportunities arise.

Progress cold water pollution mitigation measures for Copeton Dam

The NSW Government has identified Copeton Dam as a high-priority dam in the *NSW Cold Water Pollution Strategy*.

Water releases from Copeton Dam can display temperature decreases of 10°C or more in summer that extend more than 200 km downstream. Cold water pollution has significant damaging impacts on riverine ecological function, particularly in summer when biological cues such as fish spawning are disrupted. It also has social and tourism impacts, with recreational use of the Gwydir River downstream of Copeton Dam constrained due to cold summertime water temperatures.

IPART has determined funding for WaterNSW to:

- install and maintain temperature monitoring equipment for Copeton Dam
- progress investigations to implement a preferred infrastructure solution for Copeton Dam.

Funding implementation of cold water pollution mitigation and progressing to investment may create challenges associated with aligning future prices and customer and regulator expectations. Infrastructure options may require additional State or Commonwealth Governments contribution in funding.

Implementing diversion screens at priority pump sites in the Gwydir to protect native fish

Every year, large numbers of native fish are extracted by pumps and diverted into irrigation channels, never to return to the Gwydir system. There are over 300 pump offtakes with a diameter greater than 200 mm on the Gwydir River, Moomin Creek, Mehi River and Carole Creek. Up to 12,000 native fish per day can be extracted from the river by a single pump.

Installation of screens at pump sites and diversion regulators can reduce fish losses at these sites by over 90%, helping more fish survive to maturity and boosting fish numbers. The protection extends to other aquatic species such as crayfish and turtles. Screening infrastructure also improves pump operation, water delivery and extraction efficiency for asset owners through fewer blockages caused by debris.[31]

The Australian Government has funded the first phase of works to implement screening activities under the Northern Basin Toolkit—Fish Friendly Water Extraction project, which will install fish diversion screens at priority sites in the Barwon–Darling and Gwydir valleys in NSW and the Condamine–Balonne and Queensland component of the Border Rivers. The sites to be selected will complement other fish passage works and diversion screening activities being undertaken in NSW and Queensland.[32]

This option would build on existing government commitments and continue the rollout of diversion screens at other priority sites in the Gwydir valley over time to maximise environmental and water user benefits.

Have your say

Do you agree that the actions around limiting impact of infrastructure on fish, enabling flows to move across floodplains more easily and rehabilitating high-priority locations will help support the long-term resilience of the environment?

31. Boys C, Baumgartner L, Rampano B, Robinson W, Alexander T, Roswell M, Fowler T, Lowry M 2012, *Development of fish screening criteria for water diversions in the Murray–Darling Basin*, Fisheries Final Report Series 13
32. www.mdba.gov.au/basin-plan/northern-basin-projects/northern-basin-toolkit-measures

Proposed action 3.5: Identify regionally significant riparian, wetland and floodplain areas to protect or rehabilitate

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

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

We heard during consultation that habitat restoration undertaken with local involvement should be combined with actions to improve native fish health. Many landholders in the eastern part of the Gwydir catchment are already investing in ways to rehabilitate riparian land and manage land in a way that supports healthy waterways.

This action proposes to build on existing land management programs and other local initiatives to support a whole-of-catchment program of works to improve river health, connectivity and ecosystem resilience. Works could include instream structures such as appropriately designed and approved large woody habitat structures, as well as improved instream vegetation, that slow and filter water flow, thus improving water quality by removing sediments and nutrients. Improved riparian management, including controlled stock access, would provide bank stability, protecting banks from erosion and sediment loss during floods.

Implementation of this action would require:

- mapping existing programs and potential overlaps
- developing a system to prioritise where work is required based on, for example detailed habitat mapping data, native fish conditions, threatened species distribution or the River Styles framework, severity of land degradation and environmental management outcomes
- establishing a program of management measures for the life of the strategy
- identifying funding models including landholder incentives
- developing a clear decision making and program delivery governance framework
- understanding and integrating local Aboriginal knowledge and expertise in delivering river improvement works—for example, through a River Ranger Program
- developing a monitoring and evaluation framework based on the outcomes and targets developed through the Long Term Water Plans.

What we are already doing

Taking landscape-scale action

Taking landscape scale action to improve river and catchment health is an identified action in the NSW Water Strategy.

The Gwydir Regional Water Strategy is an opportunity to identify specific priorities and target programs to improve land use and land management practices in catchments that are major contributors to a decline in river and catchment health.

To support these actions, the NSW Water Strategy has also identified the importance of continuing to improve knowledge and information about water resources and catchments.

Fencing Northern Basin Riverbanks Program

The NSW Government is supporting improved land management through the Fencing Northern Basin Riverbanks Program, which supports landholders to protect valuable ecological sites and improve native fish habitat across the northern Basin. This includes off-stream stock watering points, control of exotic woody weeds, minor erosion control works, revegetation and river re-snagging to protect native fish, and stock-proof fencing along riverbanks.

What we have heard so far

Feedback provided in earlier consultation showed support for conservation and restoration of riparian, wetland and floodplain vegetation to protect native fish and threatened species habitats.

Have your say

What do you see as the key challenges that need to be addressed to improve the management of the rivers?

Proposed action 3.6: Remediate unapproved floodplain structures

Extensive floodplain development exists on the Gwydir valley floodplain, including levee banks, earthworks, on-farm storages, raised roads and water supply channels. Larger uncontrolled floods that make it to the floodplain can be constrained by these structures, which are referred to as flood works.

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

This action, through the Improving Floodplain Connections program (which commenced in January 2022), will remediate or remove unapproved works in up to 3 priority areas in the Gwydir valley floodplain that are altering the flow of floodwaters in the region and potentially impeding the delivery of water to ecological assets. Over 4,695 ha of wetland and floodplain ecosystems in the Gwydir region would benefit from this option.

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

Photography
Image courtesy of Destination NSW.
Farmer picking cotton on a farm, Moree.

Photography
Image courtesy of the Department of Planning and Environment.
Groundwater monitoring metering station, NSW.

Proposed action 3.7: Modify or remove physical and operational barriers to delivering water for the environment in the western Gwydir catchment

A major challenge in being able to get the best outcomes from water recovered for the environment is the physical constraints in getting water to environmental assets in the western portion of the Gwydir catchment.

The Murray–Darling Basin Authority's 2016 *Northern Basin Review* recognised that complementary measures such as removing constraints that inhibit the delivery of water for the environment can help improve the ecological outcomes of water management in the northern Basin and support environmental objectives of the *Basin Plan* by:

- enhancing habitat for aquatic organisms
- building ecological resilience
- protecting or enhancing the delivery of environmental water by addressing constraints.

This action will implement the Gwydir Constraints Measures Project, which has been identified to address physical and operational barriers to flow delivery in the western Gwydir catchment by establishing environmental water corridors in partnership with landholders.

The project will improve the passage, flow and distribution of moderate-sized flow events in the lower Gwydir and Gingham watercourses, meaning that:

- flow duration and timing will better match wetland requirements
- greater volumes of water will reach downstream Ramsar-listed wetlands
- watercourses and rivers will be reconnected with dominant flow paths.

The project will also improve baseflows in the Ballin Boora Creek and Mehi River. This will improve the effectiveness of environmental water deliveries reaching water-dependent environmental assets in these systems, as well as improving the connectivity and capacity to deliver water from the Gwydir catchment to the Barwon–Darling River.

What we have heard so far

Feedback provided in earlier consultation showed support for the Gwydir Constraints Measures in the Northern Basin Toolkit.

Proposed action 3.8: Protect ecosystems that depend on groundwater

A critical but often overlooked element of the water cycle is groundwater and groundwater dependent ecosystems. Groundwater dependent ecosystems support a range of species and provide important ecosystem services, such as habitats. They also have inherent environmental value. Groundwater dependent ecosystems are classified broadly as terrestrial (vegetation communities), aquatic (wetlands and springs) or subterranean (aquifers).

In the Gwydir region, these ecosystems support a variety of fauna and flora communities, including river red gum in both the Upper and Lower Gwydir Alluvium. Groundwater dependent ecosystems in parts of the Lower and Upper Gwydir Alluvium are at medium to high risk because the amount of water being taken from the groundwater sources is causing a decline in the level of groundwater.

The Gwydir River is also supported by groundwater levels. The losses experienced by river operators during recent dry periods are related to the low levels of alluvial groundwater in the region. The connected nature of the surface and groundwater systems in the Gwydir requires a formalised understanding, rather than separate treatment and management.

However, our knowledge of groundwater dependent ecosystems and how to protect them is still a developing area of science. This action would advance our knowledge and management of these ecosystems in the Upper and Lower Gwydir Alluvium by:

- establishing drawdown thresholds that are specific for each type of groundwater dependent ecosystem and species requirements, across different geology and vegetation types. This will progress current work being undertaken by the Department of Planning and Environment – Water to assess drawdown impacts on subterranean groundwater dependent ecosystems by expanding the scope to a wider range of groundwater dependent ecosystems
- implementing a groundwater health index monitoring program to collect data required for the reporting of the health index for Basin Plan Matter 8 reporting. This will enable changes in groundwater health to be detected by comparing new monitoring data with baseline data collected in 2019 for water resource planning
- implementing a method for rapid assessment of whether groundwater is being used by vegetation. This could be particularly important in the western part of the Lower Gwydir Alluvium where there is limited understanding about whether deep-rooted trees, like river red gum and black box, are accessing deep groundwater
- implementing a method for monitoring the condition and extent of groundwater dependent vegetation communities of river red gum, black box, coolibah, river cooba, lignum and mixed marsh using field condition data and remote sensing methods. The results from ongoing monitoring would be used to compare against baseline conditions established in 2019 for Basin Plan Matter 8 reporting and water sharing plan evaluations
- identifying which ecosystems are dependent on groundwater flows to creeks and streams (i.e. baseflows). This will also require understanding where surface water and groundwater are connected in the region and how this changes over time
- establishing the watering requirements (e.g. timing and duration, quality) for each type of groundwater dependent ecosystem (e.g. critical life cycle stages such as flowering and fruiting, and recruitment of juveniles)
- developing educational materials to inform water users and the wider community on the research being undertaken to increase our knowledge of them and how they are managed under water regulation.

Proposed action 3.9: Assess gaps in the flow regime that are preventing achievement of environmental watering objectives and identify cooperative actions to improve ecological outcomes

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

The potential for reduced water availability may mean there will be fewer opportunities to use environmental water licences to support environmental outcomes in the region during extended dry periods. We need to make sure the mechanisms are in place to allow water for the environment to go as far as possible.

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

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

Potential changes as part of this action that would improve outcomes include:

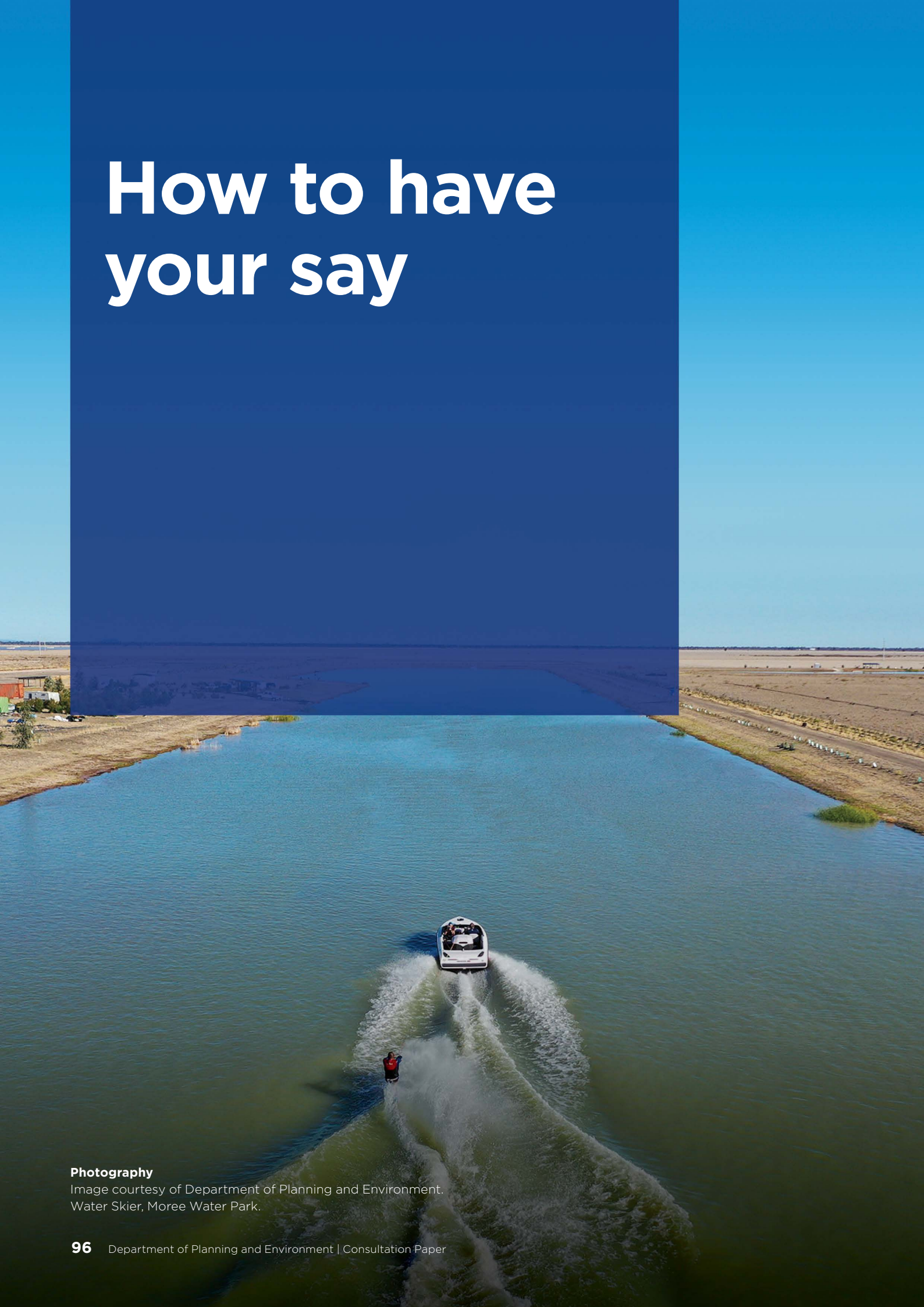
- working with water users to protect important flows down the system without having major impacts on water use. This could include expanding the protection of water for the environment by continuously improving active management through investment in monitoring and flow gauging
- amending relevant water sharing plan rules or supplementary water announcements to allow flows down the system at ecologically important times, without having impacts on water users
- coordinating releases of consumptive water and held environmental water
- investigating limitations and barriers to achieving environmental watering requirements with consumptive flows
- refining water releases from dams and weir pools to mimic more natural rates of rise and fall and minimise water quality impacts
- coordinating dam releases with unregulated tributary flows to promote higher flow events, within system constraints
- water releases from water storages giving consideration to relevant environmental impacts, damage to riverbanks, public safety, and operational efficiency.

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

Photography

Image courtesy of Sharon Bowen, Department of Planning and Environment.
Gingham Watercourse Starfruit, Gwydir Wetlands.

How to have your say



Photography
Image courtesy of Department of Planning and Environment.
Water Skier, Moree Water Park.

When will the actions be implemented?

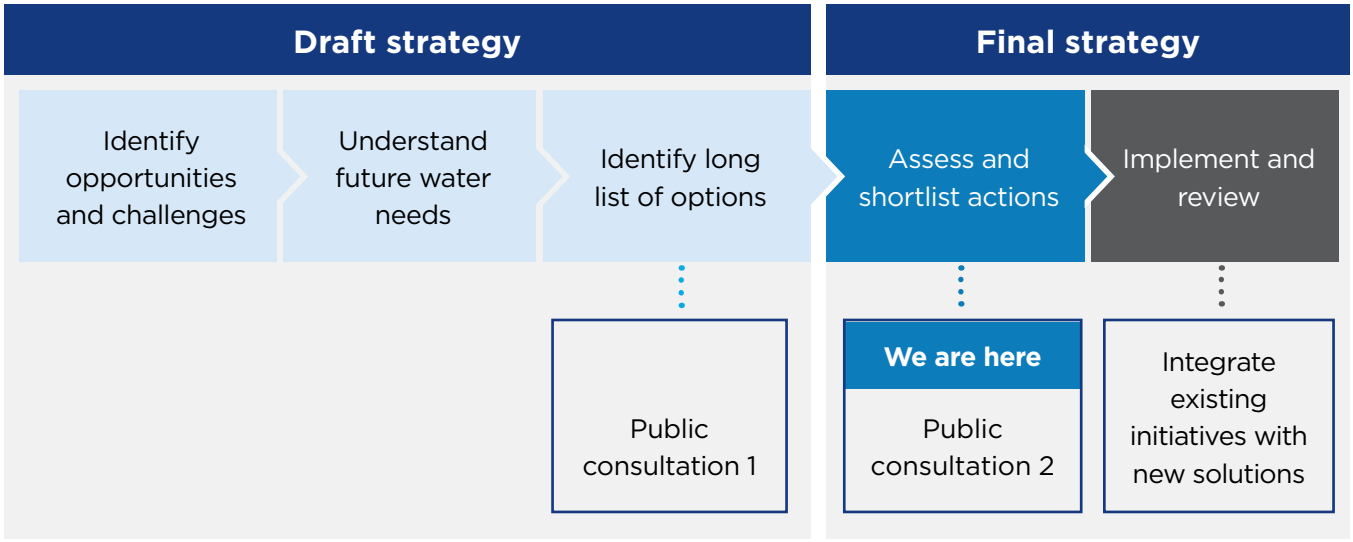
A critical feature of the final Gwydir Regional Water Strategy is making sure we identify clearly what actions and investments are needed now and those that will or may be needed further into the future. The strategy considers a 20-year timeframe aiming to chart a progressive journey that enables us to meet existing challenges, identify and prepare for foreseeable coming challenges and lay the groundwork for adapting to future uncertainties and changed circumstances.

Following public consultation, we will develop an implementation plan that will set out when we plan to commence each action and what we plan to achieve by when. The implementation plan will also identify key partners in effectively delivering these actions, including local councils, government agencies, local community groups and local Aboriginal communities.

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

We want your feedback on which actions should be prioritised for implementation over the next 3 to 5 years, and which ones should be implemented in the medium or longer term.

Figure 22. Regional water strategy delivery timeline



Your voice is important. This consultation paper is on public exhibition from 1 June 2022 to 26 June 2022. Supporting information is available at www.dpie.nsw.gov.au/gwydir-regional-water-strategy

You can also have your say by providing written feedback to the Department of Planning and Environment by midnight on 26 June 2022 via:

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

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

We have included focus questions throughout this consultation paper that we'd like to hear your thoughts on. We would also be interested in your thoughts on:

- whether any of the actions in this consultation paper should not be shortlisted and why?
- how actions should be staged and which actions should be implemented first?

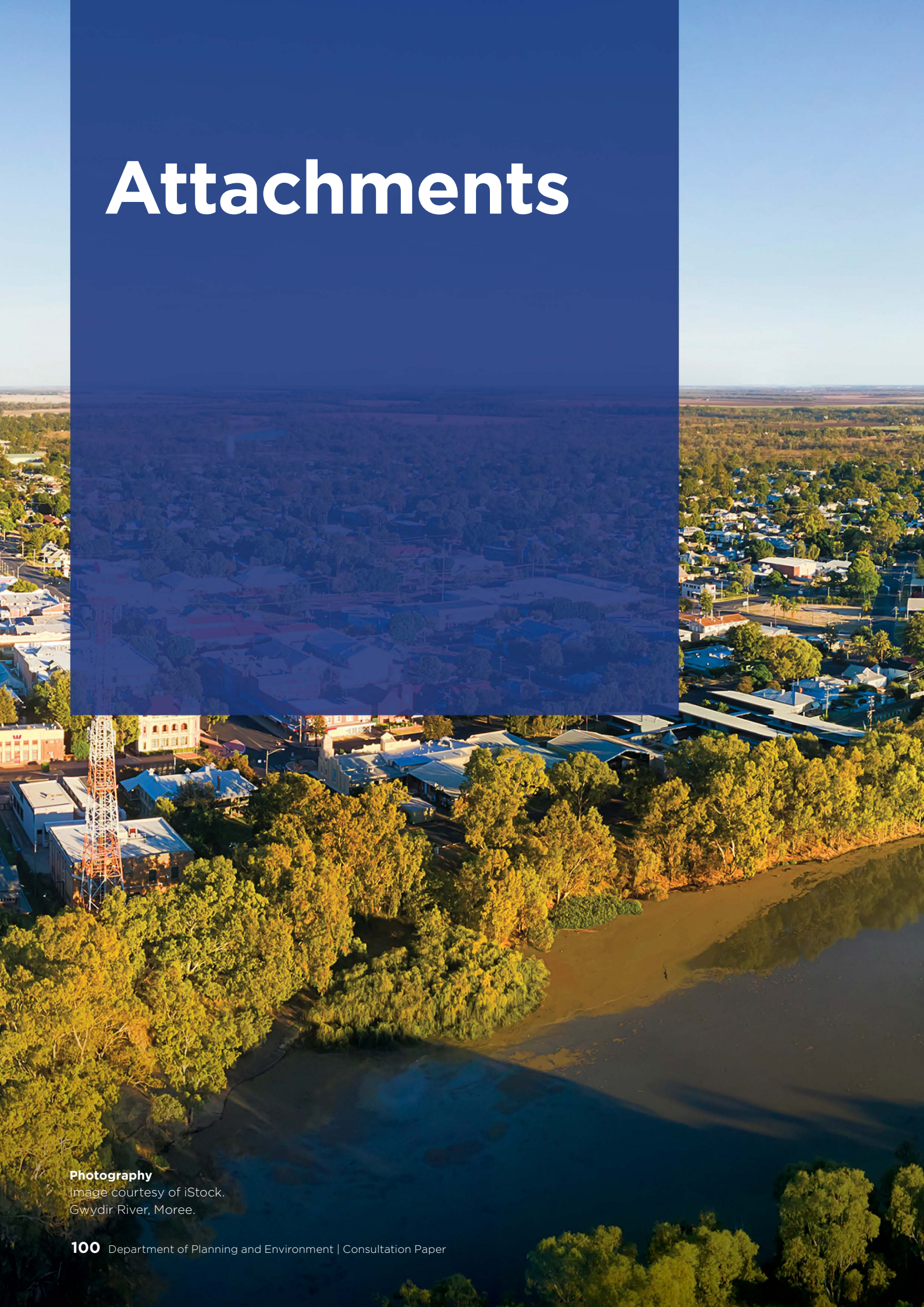
Please note that all submissions will be published on the Department of Planning and Environment's website, unless you let us know in your submission that you do not wish the content to be released.

We will be holding community engagement sessions to give participants an understanding of the context for the regional water strategy and an overview of the key proposed priorities and actions. Face-to-face sessions will be held subject to COVID-19 restrictions and risks; otherwise they will be held online. Details of these sessions can be found at the website listed above.

Photography
Image courtesy of iStock.
Gum Flat Reserve, Moree.

Photography
Image courtesy of Destination NSW.
Mary Brand Park along the Mehi River, Moree.

Attachments



Photography
Image courtesy of iStock.
Gwydir River, Moree.

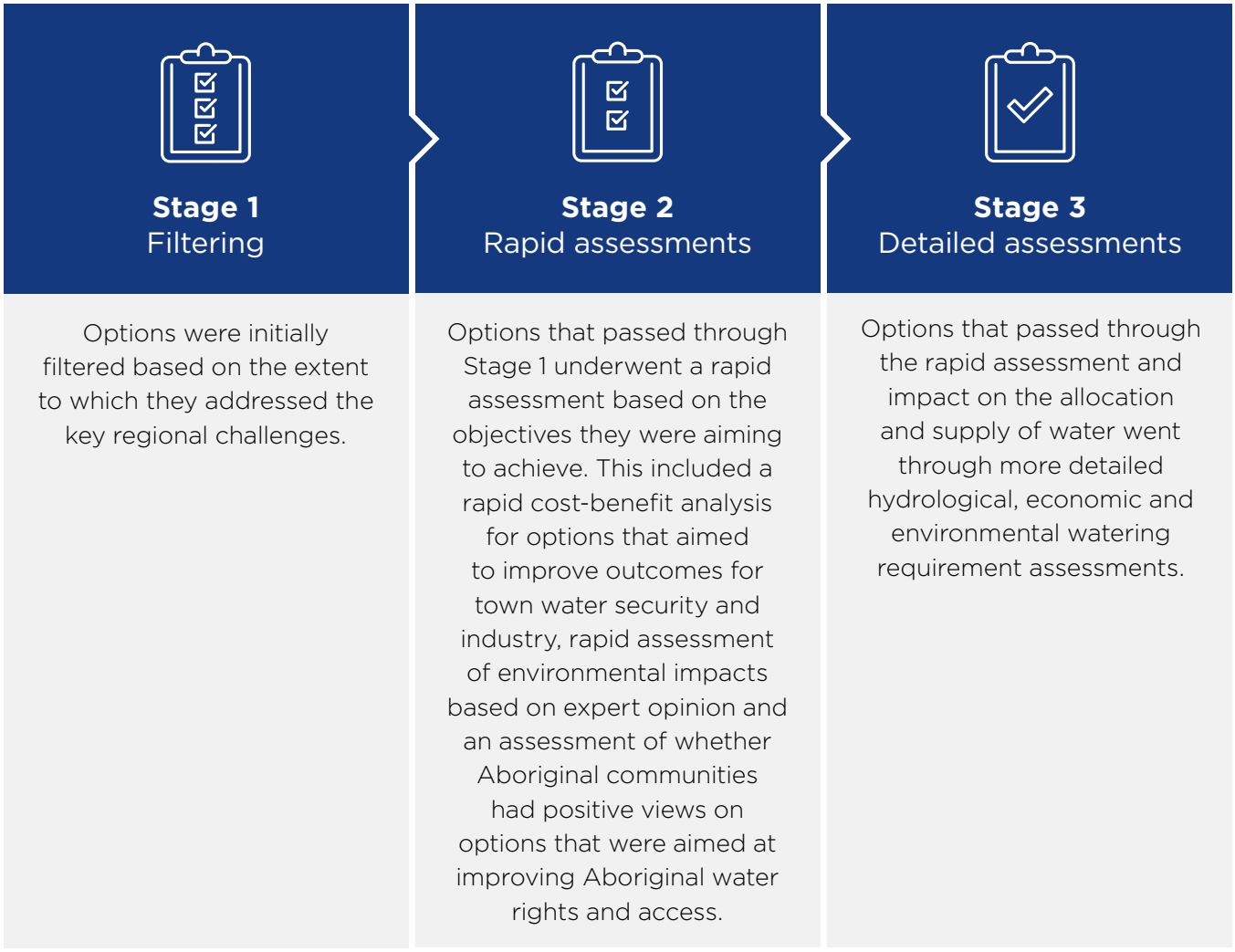
Attachment 1

Summary of the options assessment

The Draft Gwydir Regional Water Strategy identified 40 draft options. An additional 4 were identified during the public consultation process.

The process we followed to move from the long list to the short list is summarised in Figure 23 and described in the *Options assessment process: Overview*.[33]

Figure 23. Going from a long list to a final strategy of actions



33. water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies/identifying-and-assessing

At each step of the assessment, we narrowed down and filtered out the long list of options from the Draft Gwydir Regional Water Strategy, based on the evidence we gathered and the analysis we undertook. Based on our analysis, several options were consolidated, refined, not progressed or converted into proposed actions.

This attachment summarises the outcomes of our options assessment. Results from the cost-benefit and environmental watering requirement analyses is presented in Attachment 2.

The analysis we have undertaken is a high-level assessment process, appropriate for a strategic document, and is not designed to consider all possible impacts on the environment, water users or Aboriginal people in detail. However, it does provide enough detail to understand if an option is likely to make a net positive contribution to the regional water strategy's objectives. More detailed environmental, economic and cultural assessments are required and will be undertaken in any subsequent business case development or planning processes for options that proceed to implementation stage.

After community consultation, the recommended options for the regional water strategy will be sequenced, meaning, they will not all be progressed or implemented at the same time.

Photography
Image courtesy of the Department of Planning and Environment.
Watertank in outback backyard, NSW.

Assessment results – Long list of options to proposed shortlist of options

This section summarises how each of the options in the Draft Gwydir Regional Water Strategy were shortlisted or filtered out at different assessment stages.

- ✓ Options progressed to next step
- → To be considered in other NSW processes
- ✗ Option not progressed

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
1. Enlargement of Tareelaroi Weir	✓	✗	Major impact	✗	Rapid and detailed cost-benefit analyses showed that costs outweighed benefits. Refer to Attachment 2 for details.
2. New Lower Gravesend Dam on the Gwydir River downstream of Warialda Creek	✓	✗	Major impact	✗	Rapid cost-benefit analysis showed that costs outweighed benefits. There was also significant community opposition to this option. Refer to Attachment 2 for details.
3. Reuse, recycling and stormwater projects	✓	Not assessed	Little change	✓	Incorporated into Proposed action 1.1: Investigate innovative water projects for Uralla.
4. Managed aquifer recharge investigations and policy	✓	Not assessed	Minor impact	✓	See Proposed action 2.5: Investigate managed aquifer recharge in the Gwydir region.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
5. Reliable access to groundwater by towns	✓	Not assessed	Little change	✓	Incorporated into Proposed action 1.3: Develop and publish clear policy on how the region's groundwater resources will be managed sustainably into the future.
6. Town water security planning and investment for Gwydir Shire	✗	Not assessed	Minor impact	✗	It does not address a key challenge for the region.
7. Town water security planning and investment for Uralla Shire	✓	Not assessed	Minor impact	✓	See Proposed action 1.1: Investigate innovative water projects for Uralla.
8. Reliable access to groundwater for the Moree Special Activation Precinct	✓	Not assessed	Minor impact	✓	Staged water supply solutions have been identified for the Moree Special Activation Precinct through technical studies undertaken as part of the Precinct's master planning.
9. Removal of system constraints in the Gwydir catchment to improve flows reaching the Gwydir wetlands	✓	Not assessed	Major improvement	✓	See Proposed action 3.7: Modify or remove physical and operational barriers to delivering water for the environment in the western Gwydir catchment.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
10. NSW Fish Passage Strategy	✓	Not assessed	Major improvement	✓	Incorporated into Proposed action 3.4: Mitigate the impact of water infrastructure on native fish. This action contains a sub-action to install fish passages at 5 priority barriers in the Gwydir region identified in the NSW Fish Passage Strategy.
11. Ability to directly access supplementary flows	N/A	Not assessed	Minor improvement	✗	This option has been implemented by the NSW Government since release of the Draft Gwydir Regional Water Strategy.
12. Cold water pollution mitigation measures	✓	Not assessed	Major improvement	✓	Incorporated into Proposed action 3.4: Mitigate the impact of water infrastructure on native fish. This action contains a sub-action to progress cold water pollution measurement and mitigation for Copeton Dam.
13. Diversion screens to prevent fish extraction at pump offtakes	✓	Not assessed	Major improvement	✓	Incorporated into Proposed action 3.4: Mitigate the impact of water infrastructure on native fish. The Australian Government is funding a project to screen the intakes of small to large water extraction pumps in the Mehi River within the Gwydir Region as part of a $90 million package to accelerate projects from the Northern Basin Toolkit.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
14. Improved understanding of groundwater processes	✓	Not assessed	Little change	→	This will be considered as part of the NSW Groundwater Strategy and may recommend actions that will require implementation in the Gwydir Region.
15. Sustainable access to groundwater by all users	✓	Not assessed	Minor impact	→	This will be considered as part of the NSW Groundwater Strategy and may recommend actions that will require implementation in the Gwydir region.
16. Improved clarity in managing groundwater resources sustainability	✓	Not assessed	Little change	✓	See Proposed action 1.3: Develop and publish clear policy on how the region's groundwater resources will be managed sustainably into the future.
17. Active management to share flows between consumptive and other uses	✓	Not assessed	Minor improvement	✓	This option has been implemented by the NSW Government since release of the Draft Gwydir Regional Water Strategy. See Proposed action 3.9: Assess gaps in the flow regime that are preventing achievement of environmental water requirements and identify cooperative actions to reinstate them, which proposes to continuously improve the implementation of active management via investment in monitoring and flow gauging.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
18. Modification and/or removal of existing priority flood work structures causing adverse impacts	✓	Not assessed	Major improvement	✓	Incorporated into Proposed action 3.6: Remediate unapproved floodplain structures.
19. River Ranger Program	✓	Not assessed	Little change	✓	Incorporated into Proposed action 2.7: Support place-based initiatives to deliver cultural outcomes for Aboriginal people.
20. Investigation of water quality mitigation measures	✓	Not assessed	Minor improvement	✓	Incorporated into: • Proposed action 3.5: Identify regionally significant riparian, wetland and floodplain areas to protect or rehabilitate. • Incorporated into Proposed action 3.4: Mitigate the impact of water infrastructure on native fish.
21. Secure flows for water-dependent cultural sites	✓	Not assessed	Little change	✓	Incorporated into Proposed action 2.7: Support place-based initiatives to deliver cultural outcomes for Aboriginal people.
22. Water efficiency projects (towns and industries)	✓	Not assessed	Little change	✓	Incorporated into Proposed action 1.2: Support urban water efficiency measures in Moree.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
23. Review of water markets in the Gwydir region	✓	Not assessed	Minor impact	✓	Incorporated into Proposed action 2.3: Assess the potential costs and benefits of event-based trade of supplementary flows.
24. Connectivity with downstream systems	✓	Not assessed	Major improvement	✓	Incorporated into Proposed action 1.4: Investigate ways to improve connectivity with the Barwon–Darling River on a multi-valley scale.
25. Review urban water restriction policy	✓	Not assessed	Little change	›	This will be considered as part of the NSW Water Strategy. A priority action for 2021-22 is to work with local water utilities to bring more consistency to water restrictions.
26. Addressing inefficient delivery system management	✓	✓	Major impact	✓	Incorporated into Proposed action 2.4: Increase the availability of high security water access licences.
27. New drought operational rules (Gwydir River region)	✓	Not assessed	Major impact	✓	Proposed action 3.3: Provide clarity and certainty for environmental needs during drought operations.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
28. Review of surface water accounting and allocation process	✓	✗	Minor impact	→	This will be progressed under the NSW Water Strategy's Action 4.2: Review water allocation and water sharing information in response to new climate information. The assessment undertaken for this regional water strategy will inform work progressed through the NSW Water Strategy. Refer to Attachment 2 for details.
29. Investigation of licence conversions	✓	✓	Major impact	✓	Proposed action 2.4: Increase the availability of high security water access licences. Refer to Attachment 2 for details.
30. Improved data collection and storage	✓	Not assessed	Little change	→	Incorporated into Proposed action 2.1: Improve public access to climate information and water availability forecasts.
31. Training and information sharing programs	✓	Not assessed	Little change	✓	Incorporated into Proposed action 2.1: Improve public access to climate information and water availability forecasts.
32. Land use change impact on water resources	✓	Not assessed	Little change	✓	Incorporated into Proposed action 2.9: Ensure the water management framework can support sustainable economic diversification.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
33. Culturally appropriate water knowledge program	✓	Not assessed	Little change	›	This will be considered as part of the NSW Aboriginal Water Strategy.
34. Water-dependent cultural practices and site identification	✓	Not assessed	Little change	✓	Incorporated into Proposed action 2.7: Support place-based initiatives to deliver cultural outcomes for Aboriginal people.
35. Shared benefit project (environment and cultural outcomes)	✓	Not assessed	Little change	›	This will be considered as part of the NSW Aboriginal Water Strategy.
36. Regional Cultural Water Officer employment program	✓	Not assessed	Little change	›	This will be considered as part of the NSW Aboriginal Water Strategy.
37. Regional Aboriginal Water Advisory Committee	✓	Not assessed	Little change	✓	Incorporated into proposed action 2.6: Develop ongoing arrangements for participation of Aboriginal people in water management.
38. Water portfolio project for Aboriginal communities	✓	Not assessed	Little change	›	This will be considered as part of the NSW Aboriginal Water Strategy.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid environment assessment		
39. Co-management investigation of Travelling Stock Reserves	✓	Not assessed	Little change	✓	Incorporated into Proposed action 2.7: Support place-based initiatives to deliver cultural outcomes for Aboriginal people.
40. Aboriginal cultural water access licence review	✓	Not assessed	Little change	›	This will be considered as part of the NSW Aboriginal Water Strategy.
New option: Water security for discrete communities	✓	Not assessed	Insufficient information to assess	›	This will be progressed through the Aboriginal Water and Sewerage Program.
New option: New and improved farming practices	✓	Not assessed	Insufficient information to assess	✓	See: • Proposed action 2.2: Support adoption of on-farm water efficiency measures. • Proposed action 3.5: Identify regionally significant riparian, wetland and floodplain demonstration reaches to protect or rehabilitate.
New option: Water use efficiency for non-town based industries	✓	Not assessed	Insufficient information to assess	✓	See Proposed action 2.2: Support adoption of on-farm water-efficiency measures.
New option: Take the final steps to implement the Floodplain Harvesting Policy	✓	Not assessed	Minor to moderate improvement	✓	See Proposed action 3.1: Fully implement the Floodplain Harvesting Policy.

Attachment 2

Assessment of options that impact supply, demand or allocation of water

This attachment summarises the results of the assessment of options in the Draft Gwydir Regional Water Strategy that were able to be assessed for hydrologic and economic impact and benefit, as they directly impacted behaviour of the regulated river system. The following options were modelled:

- Option 1: Enlargement of Tareelaroi Weir
- Option 2: New Lower Gravesend Dam on the Gwydir River downstream of Warialda Creek
- Option 28: Review surface water accounting and allocation process (hereafter referred to as Increase the storage reserve in Copeton Dam)
- Option 29: Investigation of licence conversions (hereafter referred to as Increase the availability of high security water access licences [Bulk licence conversion and Partial licence conversion]).

The key assumptions and process used to undertake the modelling were:

- Hydrologic assessment was done by introducing the option into the department's Gwydir river system model and observing the changes that occurred to extraction of water and flows compared to the base case of current situation.
- The rapid environmental assessment was a professional assessment undertaken by government agencies. The detailed ecological assessment used modelled results to assess whether changes to a set of flow parameters at several points were positive or negative relative to targets in the Gwydir Long Term Water Plan. Table 4 describes the impact categories used in the environmental assessments and their associated changes in hydrology.

Importantly, the modelling assumed:

- The diversion limit set by the Basin Plan is not exceeded. This was done by reducing the amount of water for lower priority licences if an option resulted in the diversion limits being increased.
- A rapid cost benefit and hydrologic analysis (using historic data) was undertaken on all the options that could be modelled. Based on the results of this analysis, more detailed hydrologic analysis using historic and long-term climate data and ecological assessment was undertaken on 3 options (Enlargement of Tareelaroi Weir, Increase the storage reserve in Copeton Dam and Bulk licence conversion and Partial licence conversion).

High level results of these assessments are presented below.

Table 4. Explanation of categories used in ecological assessment

Stage 1 category	Stage 2 category	Estimated percentage change in hydrology/ecology
Major/Extreme impact	**Extreme impact**	More than 30% change in a negative direction (< -30%).
	Major impact	More than 20% change in a negative direction (< -20%).
Minor/Moderate impact	**Moderate impact**	More than 10% change in a negative direction (< -10%).
	Minor impact	More than 3% change in negative direction (< -3%).
No/Little change	**Little impact**	Less than 3 % change in a negative direction (< 0%).
	No change	0%, rounded to the nearest whole percentage point.
	Little improvement	Less than 3% change in a positive direction (>0% and <3%).
Minor/Moderate improvement	**Minor improvement**	More than 3% change in a positive direction (> 3%).
	Moderate improvement	More than 10% change in a positive direction (> 10%).
Major/Extreme improvement	**Major improvement**	More than 20% change in a positive direction (> 20%).
	Extreme improvement	More than 30% change in a positive direction (> 30%).

Enlargement of Tareelaroi Weir

Purpose	Reduce evaporative losses from the system and enable greater operating flexibility for delivering flows to the lower reaches of the Gwydir system and the Mehi system. This was Option 1 in the Draft Gwydir Regional Water Strategy.
Description	Tareelaroi Weir is a major re-regulating structure on the Gwydir River approximately 20 km east of Moree. The weir services water users on the Mehi River, Moomin Creek, lower Gwydir and Carole Creek. Enlargement of Tareelaroi Weir (by raising the height by 2.7 m) and modifying the Mehi regulator would increase the weir's storage capacity from 2.5 GL to 6.5 GL.
Results	Not viable due to high negative net present value (> -$100 million) and a very low benefit–cost ratio. The benefit to all water extractive users is negligible because: • the increase in long-term average water take under general security is offset by losses in supplementary water availability • these negligible benefits will not pay for the enlargement of the weir over the timeframe examined. Despite the outcomes of the rapid cost–benefit analysis, this option did progress to the detailed assessment for further examination due to the modelling limitations noted below.
Limitations	The modelling is sufficient to demonstrate the water availability and reliability impact of this option on water users throughout the Gwydir region; however, its operational (water delivery) benefits could not be assessed by the existing hydrologic model and, therefore, could not be valued by the rapid cost–benefit analysis method. Further fine tuning of the modelling could be done to reduce the impact on supplementary access and the additional water could be provided as a general security entitlement to increase its value, but the effect would be small.

Summary model results are shown below. Changes are compared to the base case (i.e. no change).

Change in long-term average water take under licences (GL/year) under the historical model (past 130 years)			Change in town water supply shortfalls	Change in % of time system storage <341 GL (25% Full Supply Level)	Change in average flow into Gwydir Wetlands (GL/year)	Benefit to cost ratio
General security	Supplemen-tary	High security				
+8 (4%)	-8 (-9%)	nil	nil	-6%	+6	<0

	Change in long-term average water take under licences (GL/year)*				Benefit to cost ratio (range)**		
	General security	Supple-mentary	High security	Change in town water supply shortfalls	Less than 0	Between 0 and 1	Greater than 1
Long-term stochastic model (10,000 years)	7.3 (4%)	-7.9 (-9.1%)	nil	nil	70.9%	29.1%	0%
Long-term dry climate change model (10,000 years)	5.5 (4.1%)	-5.4 (-8.3%)	0.0 (0.1%)	nil	48.6%	51.4%	0%

* These figures demonstrate general security usage and not annual reliability. Annual reliability for the remaining general security licences is shown in Figure 25 below.

** The variability in the hydrologic record can result in a wide range of benefit cost ratios. Understanding what portion of the hydrologic dataset results in a positive result, or a poor outcome, is important to appreciating how likely the option will add economic value to the region.

Summary ecological assessment results are shown below.

- Minor to moderate environmental impacts are predicted under this scenario, such as on freshes in the Mehi River, which experiences no effect to a moderate impact depending on the specific fresh flow requirement in the Gwydir Long Term Water Plan.
- Many fresh flow targets were protected under these scenarios, including a general improvement in freshes for the Gwydir River at Tyreel under both climate scenarios.
- Wetland flows were generally unaffected. There would be some minor to moderate loss of wetland flows in the Mallowa wetlands across the two scenarios.
- Cease-to-flow events could occur more frequently, especially under the long-term climate change scenario, and for longer in some locations.

These results summarise the effect of the proposed scenario by impact category, observed within that environmental flow class, and across multiple representative river flow gauges.

Flow range	Long-term stochastic model (10,000 years)	Long-term dry climate change model (10,000 years)
No flows (duration)	No effect – minor impact	No effect – minor impact
All CTFs (CF, events/130-yr)	Moderate improvement – extreme impact	Moderate improvement – extreme impact
Very low flows (frequency of years not met)	Minor impact – minor improvement	Minor impact – minor improvement
Base flows (frequency of years not met)	Minor improvement – moderate impact	Minor improvement – moderate impact
Small freshes (frequency of over-extended time between events)	Major improvement – extreme impact	Extreme improvement – extreme impact
Large freshes (frequency of over-extended time between events)	Minor improvement – major impact	Major improvement – major impact
Bankfull flows (frequency)	Minor impact – no effect	Minor impact – no effect
Overbank flows (frequency of over-extended time between events)	No effect – no effect	No effect – no effect

Note: The changes within little impact to little improvement corresponds to changes at or less than 3% and are not considered significant. Changes greater than 3 up to 10, 10 to 20, 20 to 30, and greater than 30% are categorised as minor, moderate, major and extreme respectively.

New Lower Gravesend Dam on the Gwydir River downstream of Warialda Creek

Purpose	Increase security of supply to general security licences. This was Option 2 in the Draft Gwydir Regional Water Strategy.
Description	Construct a new 175 GL dam on the Gwydir River downstream of Warialda Creek.
Results	Not viable due to extremely high negative net present value (-$1.5 billion) and a very low benefit–cost ratio. The benefit to all water extractive users is negligible because the increase in general security is offset by a similar amount of loss in supplementary access licences. With a capital cost of over $1 billion and annual operating costs of over $10 million, these negligible benefits will not pay for the dam over the timeframe examined. The option did not progress to the detailed assessment for further examination.
Limitations	The modelling is sufficient to demonstrate the impact of this option on water users throughout the Gwydir region. Further fine-tuning of the modelling could be done to reduce the impact on supplementary access licences and the additional water could be provided as a general security entitlement to increase its value, but the effect would be small.

Summary model results are shown below. Changes are compared to the base case (i.e. no change).

Change in long-term average water take under licences (GL/year) under the historical model (past 130 years)			Change in town water supply shortfalls	Change in % of time system storage <341 GL (25% Full Supply Level)	Change in average flow into Gwydir Wetlands (GL/year)	Benefit to cost ratio
General security	Supplementary	High security				
36 (+18%)	-39 (-45%)	nil	nil	-9%	-24.3	<0

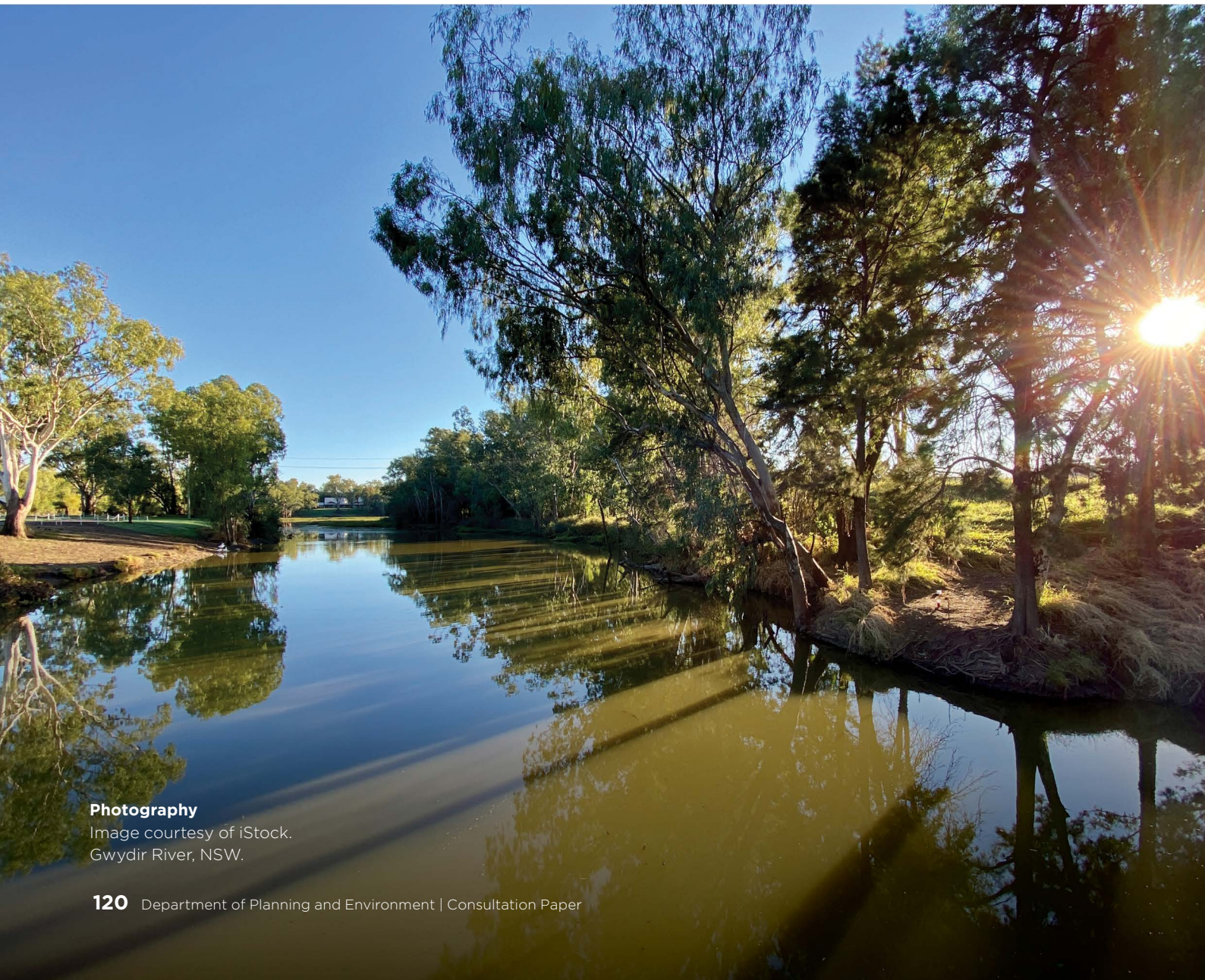
Increase the storage reserve in Copeton Dam

Purpose	Improve security of supply for critical needs in dry periods. This was Option 28 in the Draft Gwydir Regional Water Strategy.
Description	When allocating water to users in the regulated Gwydir River, the NSW Government first ensures, as far as practicable, that two years of essential requirements can be met from Copeton Dam before allocating to lower priority (general security) licence categories. This volume must include the amount of water required for town water supplies, high security licences, minimum dam releases, stock and domestic replenishment needs and water conveyancing volumes, which are based on average transmission and evaporation losses. The allocation set aside for high-priority purposes is called the reserve. Currently, we set aside 111 GL of water in the storages to support essential needs over a 2-year period. We have undertaken a preliminary assessment to understand the benefits and impacts of increasing the reserve volume in Copeton Dam by 55 GL to provide an additional year of essential needs reserve. Most of the extra water is needed to deliver the water down the river. While we know the towns that rely on water from Copeton Dam are unlikely to face substantial water shortfalls in the long term, we know that actual volumes to convey water down the system can be higher during dry times and that the use of drought contingency measures has been driven by higher-than-average river conveyancing volumes. There may be benefits to setting aside more water for transmission losses during droughts for basic landholder rights, environmental needs and replenishment flows to the lower system.

Results	This option has the potential to provide benefits during dry times that are not valued by the rapid economic assessment. For this reason, this option progressed to the detailed assessment for further examination. The detailed assessment found that the option has a negative net present value and low benefit cost ratio under all scenarios which is driven by the reduction in water available to general security licence holders. This was true for all of the sensitivities modelled which included increasing the economic returns by 30% or by using a 3% discount rate. The assessment has also shown that an increase in the reserve would reduce the time that Copeton Dam sits at or below 25%, but it would not eliminate the risk. This is the level at which drought operation measures typically commence in this valley to reduce transmission losses. It would also reduce the time that Copeton Dam would sit at or below 10% volume, from 8.9% to under 1% of the time under long-term climate change. This analysis only looked at one option around changing the essential needs reserve in Copeton Dam. A broader assessment of whether changing the essential needs reserve is an effective way to secure water for critical needs in dry periods compared to alternative options needs to be considered through a risk framework and will be assessed as part of the work program implementing the NSW Water Strategy. Using this analysis as a basis, the NSW Water Strategy work program will consider: • options for redefining the period of lowest inflows to the water source • whether different periods should apply to different categories of access licences • whether the reserve level should be increased during a sequence of dry years and reduced during a sequence of wet years • the impact of any options for change on planned environmental water and each category of access licence. The results of the investigation would help to determine whether a change to water allocation rules in the regulated Gwydir River is warranted in response to new extremes in water availability. Any decision on whether to implement a change in the policy on reserves depends on the level of risk that the community is willing to bear around running out of surface water in droughts and associated impacts on licence holders and the environment.
Limitations	The modelling is sufficient to demonstrate the water availability and reliability impact of this option on water users throughout the Gwydir region; however, its operational (water delivery) benefits to minimising the time the system is in drought operation could not be assessed by the existing hydrologic model and, therefore, could not be valued by the rapid cost–benefit analysis method.

Summary model results are shown below. Changes are compared to the base case (i.e. no change).

Change in long-term average water take under licences (GL/year) under the historical model (past 130 years)			Change in town water supply shortfalls	Change in % of time system storage <341 GL (25% Full Supply Level which is when drought operation measures typically commence from Copeton Dam)	Change in average flow into Gwydir Wetlands (GL/year)	Benefit to cost ratio
General security	Supplemen-tary	High security				
-4 (-2%)	0 (0%)	nil	nil	-10%	+2	<0



Photography
Image courtesy of iStock.
Gwydir River, NSW.

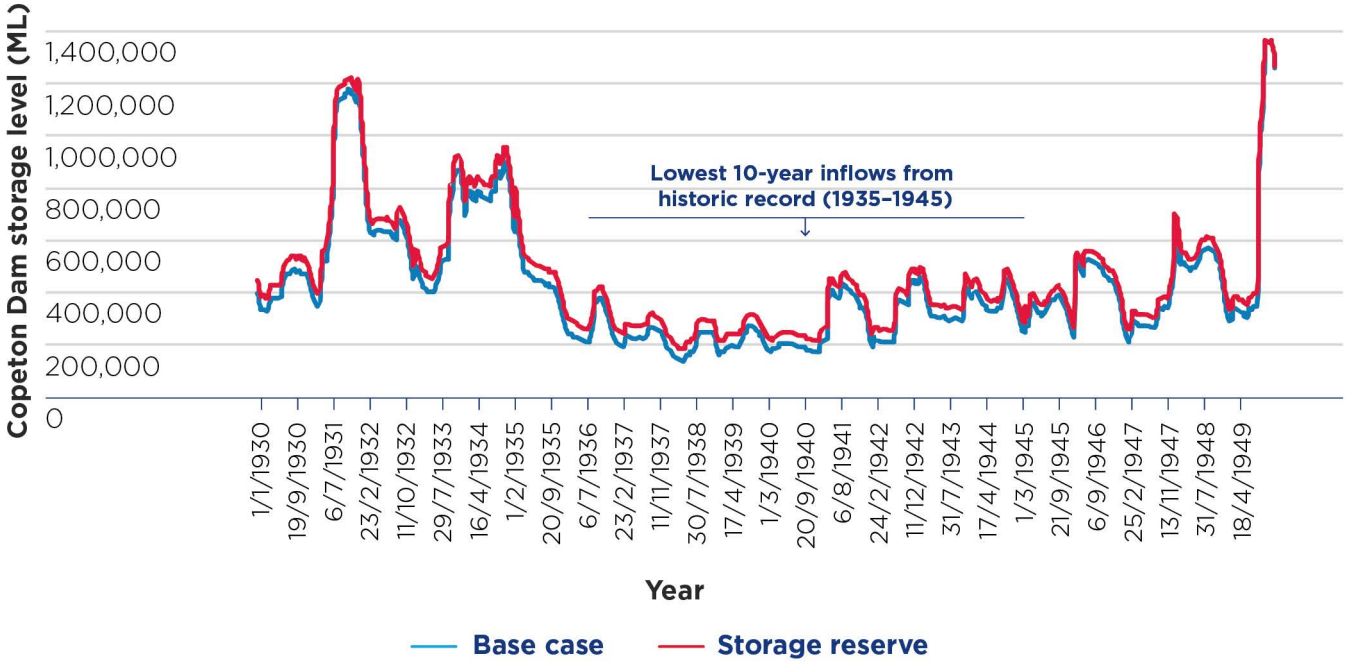
	Change in long-term average water take under licences (GL/year)*				Benefit to cost ratio (range)**		
	General security	Supple-mentary	High security	Change in town water supply shortfalls	Less than 0	Between 0 and 1	Greater than 1
Long-term stochastic model (10,000 years)	-3.4 (-1.8%)	0.1 (0.1%)	0 (0%)	nil	99.7%	0.1%	0.2%
Long-term dry climate change model (10,000 years)	-2.5 (-1.8%)	0.1 (0.03%)	0 (0.1%)	nil	97.2%	0.3%	2.5%

* These figures demonstrate general security usage and not annual reliability. Annual reliability for the remaining general security licences is shown in Figure 25 below.

** The variability in the hydrologic record can result in a wide range of benefit cost ratios. Understanding what portion of the hydrologic dataset results in a positive result, or a poor outcome, is important to appreciating how likely the option will add economic value to the region.

Figure 24. Copeton Dam's modelled storage level profile from 1930 to 1950

Modelling shows that in a dry period of the observed record, increasing the essential needs reserve volume in Copeton Dam would prevent it falling below 25% of its full supply in shorter dry periods, but would not prevent it falling below 25% in multi-year droughts.



Summary ecological assessment results are shown below.

- Little to no impact was observed across the region.
- Some locations had more or fewer cease-to-flow events. The general (average) effect was a minor impact under both climate scenarios, but with extreme impacts at some sites.

These results summarise the effect of the proposed scenario by impact category, observed within that environmental flow class, and across multiple representative river flow gauges.

Flow range	Long-term stochastic model (10,000 years)	Long-term dry climate change model (10,000 years)
No flows (duration)	No effect	No effect
All CTFs (CF, events/130 yr)	Moderate improvement – extreme impact	Minor improvement – exterme impact
Very low flows (frequency of years not met)	No effect – minor impact	No effect – minor impact
Base flows (frequency of years not met)	No effect – minor impact	No effect – minor impact
Small freshes (frequency of over-extended time between events)	No effect – extreme impact	Minor improvement – extreme impact
Large freshes (frequency of over-extended time between events)	No effect – minor impact	No effect – minor impact
Bankfull flows (frequency)	No effect	No effect
Overbank flows (frequency of over-extended time between events)	No effect	No effect

Note: The changes within little impact to little improvement corresponds to changes at or less than 3% and are not considered significant. Changes greater than 3 up to 10, 10 to 20, 20 to 30, and greater than 30% are categorised as minor, moderate, major and extreme respectively.

Increase the availability of high security water access licences (Bulk licence conversion)

Purpose	Make more high-security water entitlements available for higher-value crops and industries by bulk conversion of all general security licences to high security licences. This demonstrates the maximum increase in economic output that could be created using the existing infrastructure. This was Option 29 in the Draft Gwydir Regional Water Strategy.
Description	All of the existing general security entitlements, except for those held as environmental water, are converted in bulk to 178.85 GL of high security entitlements, using the existing Copeton Dam to create additional high security entitlements to the maximum extent possible. The assessment assumes cotton production using the general security water is replaced by higher-value permanent plantings (pecans) using the converted high security entitlements.
Results	Unviable despite a high net present value and benefit–cost ratio. The benefit to high security water extractive users is very high, but at the cost of general security licence holders who would bear this cost. Supplementary licence holders would also be impacted. The assessment demonstrates that the existing infrastructure can support around 178.85 GL/year of high security entitlements that could be used for higher-return crops or industries, assuming the long-term climate is like the historic climate. However, the assessment using worst case dry future climate change scenario shows that the reliability of the created high security entitlements would drop and would result in large losses of investment. This option was progressed to the detailed assessment.
Limitations	The modelling is sufficient to demonstrate the effect of this option. This option was chosen to highlight the maximum benefit that could be achieved under a 100% conversion; it was not designed as a realistic solution for the region. A number of high-level assumptions were used to for this preliminary modelling, which means that we cannot meaningfully understand the impacts on the environment. These assumptions were: • the new high security entitlement is close to fully utilised every year • its use is evenly distributed over the year • all the high security entitlement is in the vicinity of Moree • all the high security entitlement is used to grow pecans. In reality, a transition from cotton to a high-value crop would be incremental over time and the industries might be distributed across the catchment rather than in one section. Significant fine-tuning of the modelling approach could be undertaken to more realistically replicate the actual timeframe it would take to migrate a bulk water licence shift of this magnitude. This would reduce the benefit of this option, but not the overall result. The assessment shows a very high benefit–cost ratio as the costs of making the necessary administrative arrangements are relatively low. However, it does not allow for the impact on industries that would occur in the dry climate change scenario when water becomes unavailable for unacceptably long times.

Summary historic model results are shown below.

Change in long-term average water take under licences (GL/year) under the historical model (past 130 years)			Change in town water supply shortfalls	Change in % of time system storage <341 GL (25% Full Supply Level)	Change in average flow into Gwydir Wetlands (GL/year)	Benefit to cost ratio
General security	Supplementary	High security				
-193 (-100%)	nil	178 (1,426%)	nil	-25%	+4	>100

	Change in long-term average water take under licences (GL/year)*				Benefit to cost ratio (range)**		
	General security	Supplementary	High security	Change in town water supply shortfalls	Less than 0	Between 0 and 1	Greater than 1
Long-term stochastic model (10,000 years)	-185.6 (-100%)	1.3 (1.4%)	175.5 (1,506%)	nil	11.5%	0.2%	88.3%
Long-term dry climate change model (10,000 years)	-135.7 (-100%)	-1 (-1.5%)	161.6 (1,293%)	nil	37.5%	0.2%	62.3%

* These figures demonstrate general security usage and not annual reliability. Annual reliability for the remaining general security licences is shown in Figure 25 below.

** The variability in the hydrologic record can result in a wide range of benefit cost ratios. Understanding what portion of the hydrologic dataset results in a positive result, or a poor outcome, is important to appreciating how likely the option will add economic value to the region.

Summary ecological assessment results are shown below.

- This option had the greatest number of impacts on cease-to-flow events, base flows and very low flows of the 4 modelled options.
- For example, for the Mehi River near Collarenebri (gauge 418055), cease-to-flow events went from almost never (0.04) to rarely (1.1 events per 130 years) under the stochastic model.
- Base flows were extremely impacted. For example, Moomin Creek at Combadello went from 7 to 104 days a year when significant base flow periods (30 or more ML/day, for 150 days or more during September to March, as defined under the Long-Term Watering Plan) did not occur. Similarly, Carole Creek (418011) went from 4 to 59 % years where significant very low-flow periods (20 or more ML/day, for 230 days or more a year) did not occur.
- There was an overall impact on freshes, especially small freshes, but this varied considerably across sites.
- There was no general improvement in wetland flows, and on average a minor impact under the long-term dry climate change model. In particular, the wetlands at Allambie and Millewa (Long Term Water Plan unit 6) were moderately impacted.

These results summarise the effect of the proposed scenario as percentage change, with minimum to maximum effects observed within that environmental class, and across multiple representative river flow gauges.

Flow range	Long-term stochastic model (10,000 years)	Long-term dry climate change model (10,000 years)
No flows (duration)	Extreme impact	Extreme impact
No flows (events/130 years)	No effect – extreme impact	No effect – extreme impact
Very low flows (frequency of years not met)	Extreme impact	Extreme impact
Base flows (frequency of years not met)	Extreme impact – extreme improvement	Extreme impact – extreme improvement
Small freshes (frequency of over-extended time between events)	Extreme impact – extreme improvement	Extreme impact – extreme improvement
Large freshes (frequency of over-extended time between events)	Extreme impact – extreme improvement	Extreme impact – extreme improvement
Bankfull flows (frequency)	Moderate – major improvement	Minor – major improvement
Overbank flows (frequency of over-extended time between events)	Minor improvement – extreme impact	No effect – extreme impact

Note: The changes within little impact to little improvement corresponds to changes at or less than 3% and are not considered significant. Changes greater than 3 up to 10, 10 to 20, 20 to 30, and greater than 30% are categorised as minor, moderate, major and extreme respectively.

Increase the availability of high security water access licences (Partial licence conversion)

Purpose	Make more high security water entitlements available for higher-value crops and industries by enabling voluntary conversion of general security licences to high security licences. A small amount of general security entitlement is converted to assess the benefit and impact on reliability of the remaining water access licence holders. This was Option 29 in the Draft Gwydir Regional Water Strategy.
Description	Convert 40 GL of general security entitlements to 16 GL of high security entitlements at Moree.
Results	Viable due to a high net present value relative to capital outlay and a high benefit–cost ratio. The broader benefit to the region is the result of the shift from general security water access licences (-13 ML) to high security licence (18 ML), allowing farmers to extract a higher economic return for each megalitre of water used. At this conversion rate, the remaining general security has a small improvement in reliability. The results are preliminary, but sufficient to demonstrate viability to proceed. More refined modelling is required to more precisely determine the appropriate conversion ratio and assess whether location constraints or other rules are required. This option was progressed for detailed assessment.
Limitations	For this preliminary modelling, it was assumed that the new high security entitlement is close to fully utilised every year—that its use is evenly distributed over the year, that it is all at one location, and the conversion ratio is 2–3:1. Additional modelling would vary the conversion ratio and other assumptions and would need to ensure compliance with the diversion limit. It is expected the most appropriate conversion rate will be between 2:1 and 3:1. Further discussion with the community on appetite for this option will help refine the modelling assumptions. Detailed assessments of environmental impacts will then be undertaken. This option was chosen to highlight the scale of economic benefits that could be achieved under a 10% partial conversion and it achieves this objective.

Summary model results are shown below.

Change in long-term average water take under licences (GL/year) under the historical model (past 130 years)			Change in town water supply shortfalls	Change in % of time system storage <341 GL (25% Full Supply Level)	Change in average flow into Gwydir Wetlands (GL/year)	Benefit to cost ratio
General security	Supplementary	High security				
-13 (-7%)	nil	+18 (+143%)	nil	-6%	3 GL	>1

	Change in long-term average water take under licences (GL/year)*				Benefit to cost ratio (range)**		
	General security	Supplementary	High security	Change in town water supply shortfalls	Less than 0	Between 0 and 1	Greater than 1
Long-term stochastic model (10,000 years)	-12.6 (-6.8%)	-0.2 (-0.2%)	17.9 (143%)	nil	0.2%	0%	99.8%
Long-term dry climate change model (10,000 years)	-10.9 (-8.1%)	-0.3 (-0.4%)	17.9 (143%)	nil	0.1%	0%	99.9%

* These figures demonstrate general security usage and not annual reliability. Annual reliability for the remaining general security licences is shown in Figure 25 below.

** The variability in the hydrologic record can result in a wide range of benefit cost ratios. Understanding what portion of the hydrologic dataset results in a positive result, or a poor outcome, is important to appreciating how likely the option will add economic value to the region.

Summary ecological assessment results are shown below.

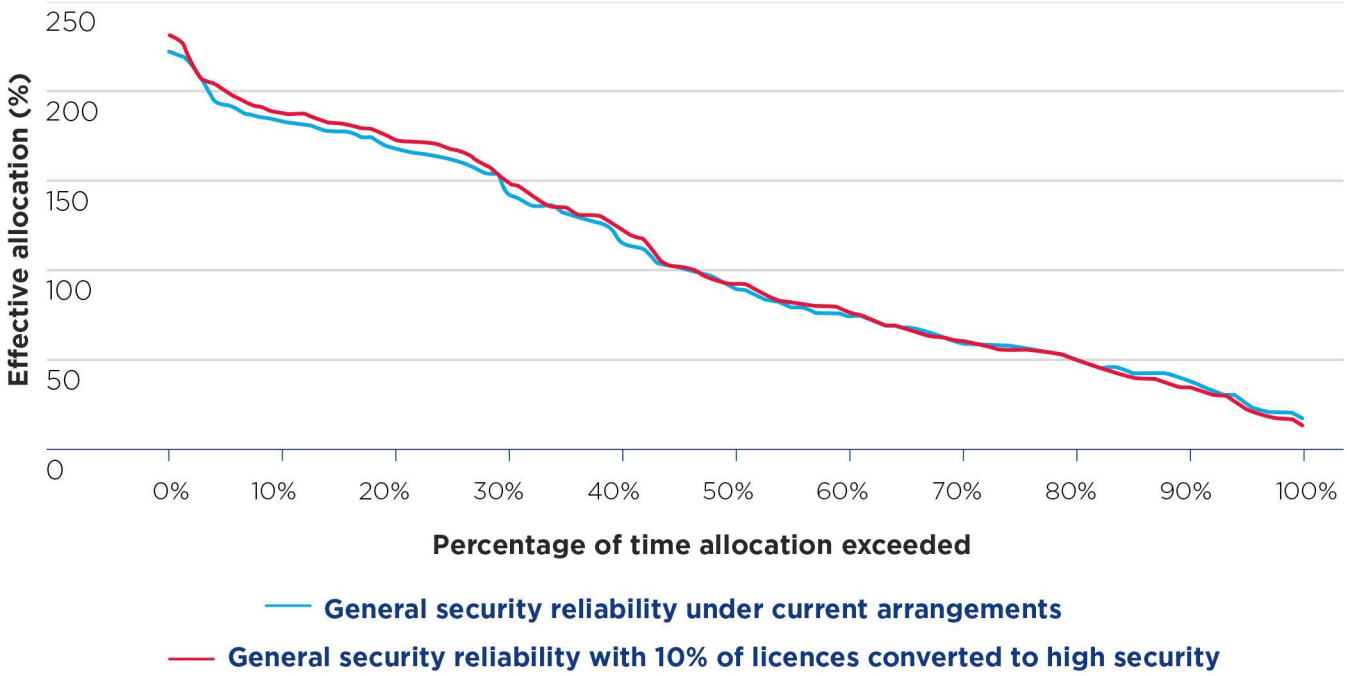
- This scenario showed extreme impacts to extreme improvements for no flow frequency, with the average effect an extreme impact. In the most extreme case, the Gingham Channel at Teralba showed a 60% increase in no flow events under long-term dry climate change. Otherwise, there were many moderate or minor impacts distributed across the region.
- The minor impacts included impacts on very low, base and fresh flows in the Mehi River These changes would likely contribute to the cumulative impacts of flow regulation in the Mehi River.
- Very low flows were impacted. The number of years the very low flow metric was not met increased by approximately 90% for the Mehi River downstream of Combadello (418037) from 3.5 to 6.6 events every 130 years under the long-term stochastic model.

These results summarise the effect of the proposed scenario by impact category, observed within that environmental flow class, and across multiple representative river flow gauges.

Flow range	Long-term stochastic model (10,000 years)	Long-term dry climate change model (10,000 years)
No flows (duration)	No effect – major impact	Minor – major impact
No flows (events/130 years)	Extreme improvement – extreme impact	Extreme improvement – extreme impact
Very low flows (frequency of years without)	Major – extreme impact	Moderate – extreme improvement
Base flows (frequency of years without)	Extreme impact – extreme improvement	Extreme impact – major improvement
Small freshes (frequency of over-extended time between events)	Extreme improvement – major impact	Extreme improvement – major impact
Large freshes (frequency of over-extended time between events)	No effect – major impact	Minor improvement – major impact
Bankfull flows (frequency)	Little impact – little improvement	Little impact – little improvement
Overbank flows (frequency of over-extended time between events)	No effect	No effect

Note: The changes within little impact to little improvement corresponds to changes at or less than 3% and are not considered significant. Changes greater than 3 up to 10, 10 to 20, 20 to 30, and greater than 30% are categorised as minor, moderate, major and extreme respectively.

Figure 25. Impact of converting 10% of general security licences to high security on the reliability of the remaining general security licences (at the 30th of June)



Attachment 3

Groundwater availability and use for all groundwater sources in the Gwydir region (2015–2020)

Groundwater source	LTAAEL (ML)	Basic landholder right estimate	Total share component	Average metered usage over last 5 years plus basic landholder rights
Upper Gwydir Alluvial Groundwater Source	721	73	1,193	83
Lower Gwydir Groundwater Source	33,000	700	32,630	30,854
GAB Surat Shallow Groundwater Source	15,500	978	5,812	2,226
Inverell Basalt MDB	4,150	1,073	3,079	1,355
Eastern Recharge Groundwater Source	16,200	3,200	35,006	17,224
Southern Recharge Groundwater Source	38,700	13,500	27,528	17,611
Surat Groundwater Source	43,446	20,400	8,920	23,582
Lower Namoi Groundwater Source	88,255	2,255	85,993	82,849
Gunnedah–Oxley Basin MDB Groundwater Source	127,500	5,778	24,182	12,873
New England Fold Belt MDB	39,253	14,520	10,958	14,583

Photography
Image courtesy of iStock.
Mehi River, Moree.

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