Regional Water Strategy

North Coast

November 2022

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

Title Regional Water Strategy

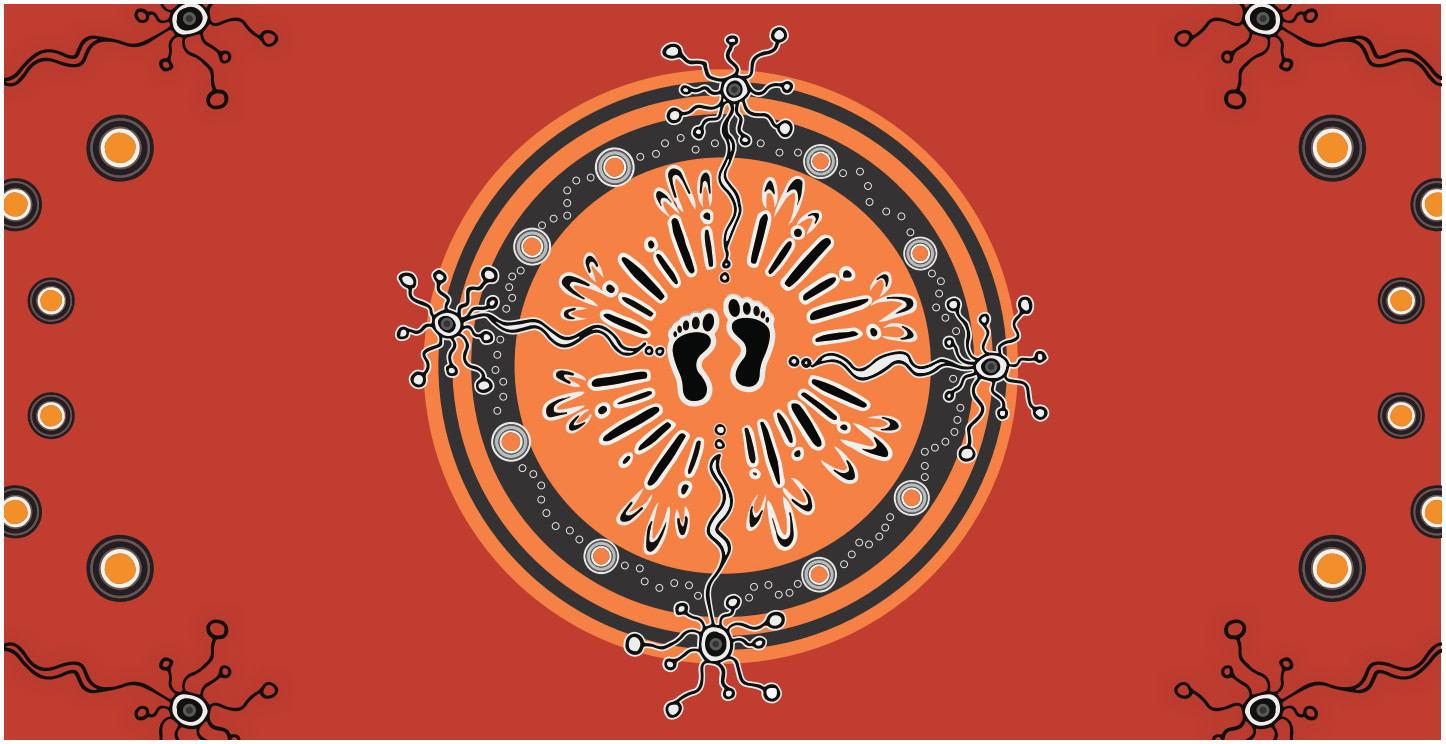
Sub-title North Coast

First published November 2022

Department reference number PUB22/1007

Cover image Image courtesy of Destination NSW. Scenic aerial overlooking the Bellingen River, Fernmount.

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



Acknowledging First Nations people

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

Today, they practice the oldest living culture on earth.

The NSW Government acknowledges the First Nations people/Traditional Owners from the North Coast region as having an intrinsic connection with the lands and waters of the North Coast Regional Water Strategy area. The landscape and its waters provide the First Nations people with essential links to their history and help them to maintain and practice their traditional culture and lifestyle.

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

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

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

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

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

Artwork courtesy of Nikita Ridgeway.

Minister's foreword

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

Water is the most precious resource we have. Everyone and everything relies on water. It supports our towns and regional cities, the rich cultural heritage of our Aboriginal communities, our industries and our natural environment. We need healthy rivers, healthy farms and healthy communities. The way we manage water deeply affects the livelihoods of people in NSW. Water underpins the North Coast region's health and prosperity.

The North Coast faces many water challenges. This has led the NSW Government to develop a long-term strategic vision for water. Our vision sets the direction and lays a path to improve water security, river health and cultural outcomes in NSW. Central to this vision is taking a holistic approach to water management. This will help us ensure that water is used sustainably and fairly, and it will help us prepare for a more variable and changing climate.

The North Coast region is located within the traditional lands of the Biripi (Birpai), Githabul, Bundjalung, Dunghutti, Gumbaynggirr, Yaegl and Anaiwan nation's. These traditional custodians have cared for the North Coast region's rivers and catchments for over 60,000 years. The region is home to 302,000 people and a number of thriving towns that drive the region's strong economy.

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

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

The climate modelling showed that extreme dry and wet periods worse than what has been recorded in the last 130 years have happened in the past. These events are likely to become more frequent and severe in the future. Understanding these possible climate risks lets us plan and make sure we are prepared if they do eventuate.

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

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

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

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

Image courtesy of Destination NSW. Dorrigo Crystal Shower Falls, Dorrigo National Park.

Contents

1.	**About the North Coast Regional Water Strategy**	**8**
	The regional water strategies	10
	Objectives of regional water strategies	11
	Fitting regional water strategies with other plans and policies	12
	Developing the North Coast Regional Water Strategy	15
2.	**The North Coast region**	**20**
	Water sources in the region	25
	Water use in the North Coast region	27
3.	**What the future climate could look like in the North Coast region**	**30**
	Climate snapshot	32
	Future climate impacts on water supplies	34
4.	**Key challenges in the North Coast region – what we will focus on first**	**36**
	Challenge: Declining catchment and river health	38
	Challenge: Competition for low flows	43
	Challenge: Saltwater intrusion into freshwater sources	45
	Challenge: Aboriginal people's rights and access to water	48
	Challenge: Water security for industries in the North Coast	50
	Challenge: Water security for towns and communities in the North Coast	53
5.	**Responding to the challenges**	**56**
	Priority 1: Take a holistic approach to land and water management	60
	Priority 2: Ensure water resource development and use is sustainable and equitable	70
	Priority 3: Prepare for future climatic extremes	80
6.	**Implementing the strategy**	**88**
	Getting our timing right	89
	Ongoing monitoring, adaptation, and reporting	91
7.	**Glossary**	**92**

Image courtesy of Destination NSW. Woodford Island, NSW.

About the North Coast Regional Water Strategy

1

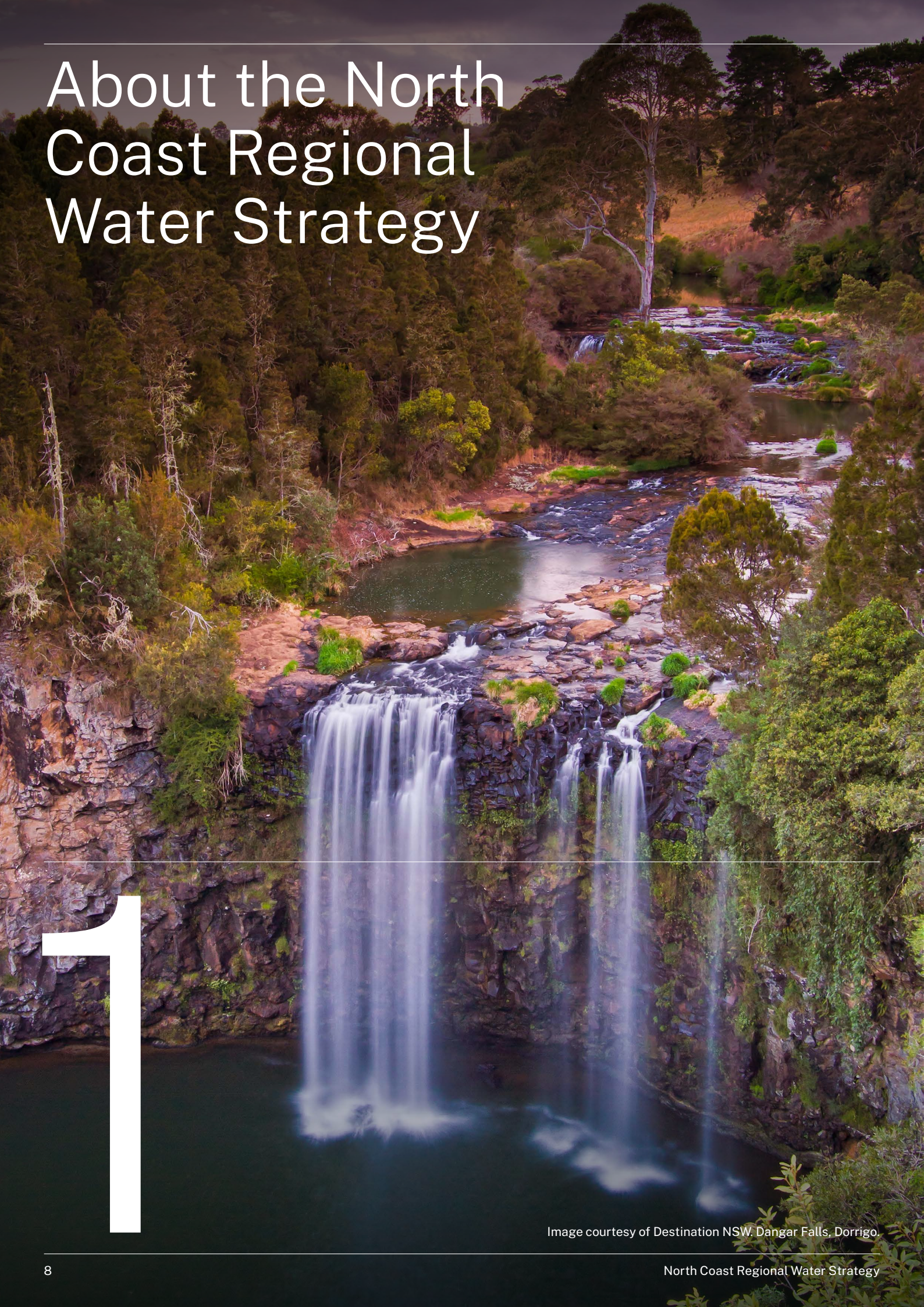


Image courtesy of Destination NSW. Dangar Falls, Dorrigo.

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

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

Image courtesy of iStock. Urunga, NSW.

The regional water strategies

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

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

The aim is each regional water strategy will have a comprehensive, balanced package of options that delivers on objectives. There is a natural synergy between these objectives, which we understood more fully after engaging with primary producers, local communities, Aboriginal people and environmental stakeholders. The strategy actions aim to deliver benefits and complementary actions across all stakeholder groups.

Figure 1. Map of NSW regional water strategy regions

Objectives of regional water strategies

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

Figure 2. Regional water strategy objectives

Deliver and manage water for local communities

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

Enable economic prosperity

Improve water access reliability for regional industries.

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

Including Aboriginal heritage assets.

Protect and enhance the environment

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

Affordability

Identify most cost-effective policy and infrastructure options.

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

When formulating plans to share water, the NSW Government must take all reasonable steps to prioritise the protection of water sources and their dependent ecosystems. During extreme events such as drought, our focus is on securing water for critical human needs. At these times, under section 60 of the *Water Management Act 2000*, critical human needs are the first priority, and the environment is the second priority. Outside of these extreme events, we have greater flexibility to deliver across all the objectives.[1]

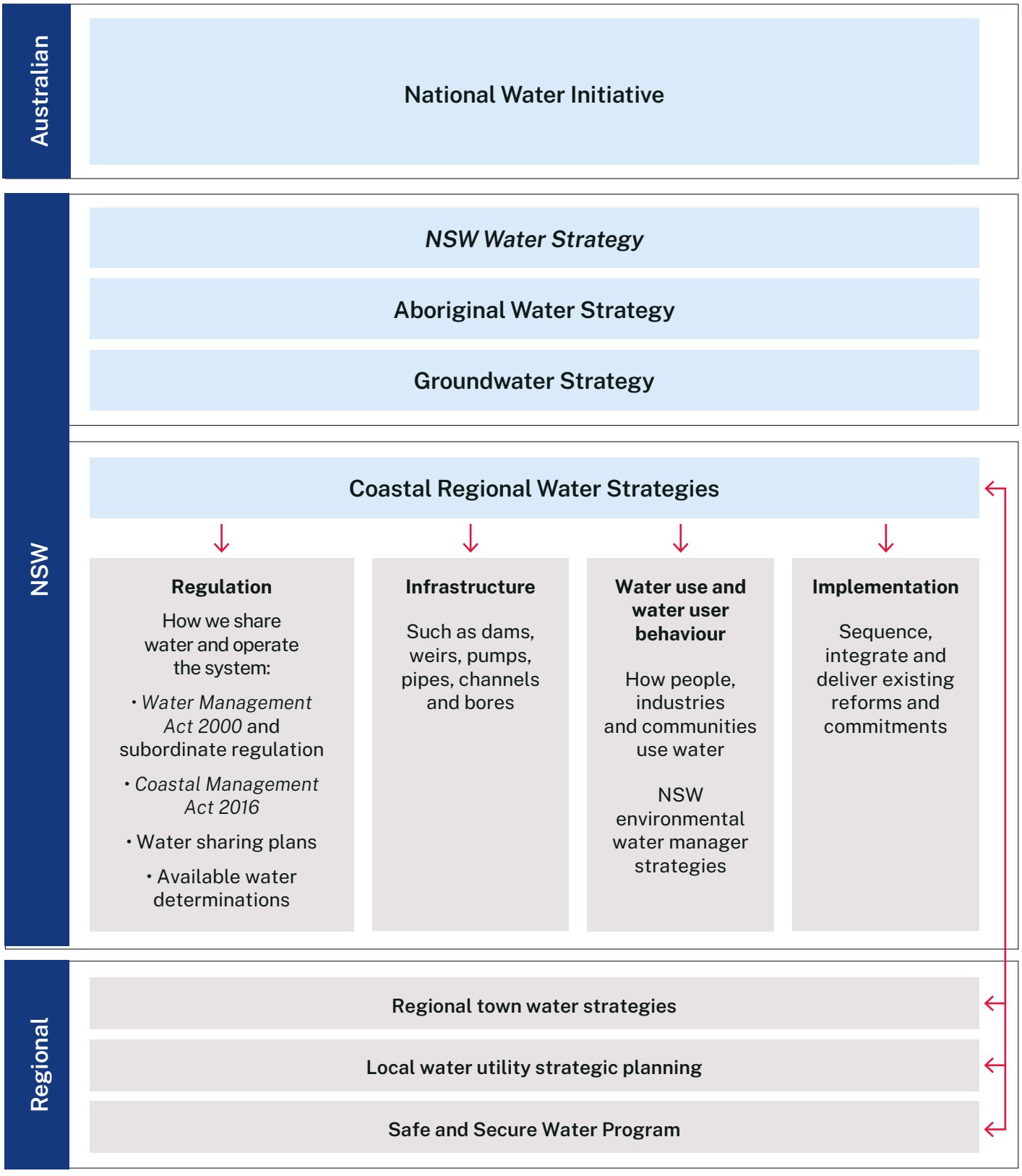
1. Subsections 9(1)(b), 5(3)(a) and 5(3)(b) of the *Water Management Act 2000*.

Fitting regional water strategies with other plans and policies

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

Image courtesy of iStock. Clarence River, NSW.

Figure 3. NSW water policy and planning context



The strategic planning framework for water management in NSW includes the *NSW Water Strategy*,[2] which is underpinned by the regional and metropolitan water strategies. The *NSW Water Strategy* was developed in parallel with the regional and metropolitan strategies and guides the strategic, state-level actions that we need to take. The regional water strategies prioritise how those statewide actions, as well as other region-specific, place-based solutions, are to be staged and implemented in each region.

As part of delivering the *NSW Water Strategy*, the NSW Government is delivering other 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[3]
- the Town Water Risk Reduction Program – to identify long-term solutions to challenges and risks to providing water supply and sewerage in regional towns in collaboration with local councils[4]
- a new statewide Water Efficiency Framework and Program – to reinvigorate water use efficiency programs in cities, towns and regional centres.[5]

The *NSW Water Strategy* and the North Coast Regional Water Strategy also complement other whole-of-government strategies, including:

- *20-Year Economic Vision for Regional NSW*[6]
- *State Infrastructure Strategy*[7]
- *New England North West Regional Plan*[8]
- *North Coast Regional Plan 2041*.[9]

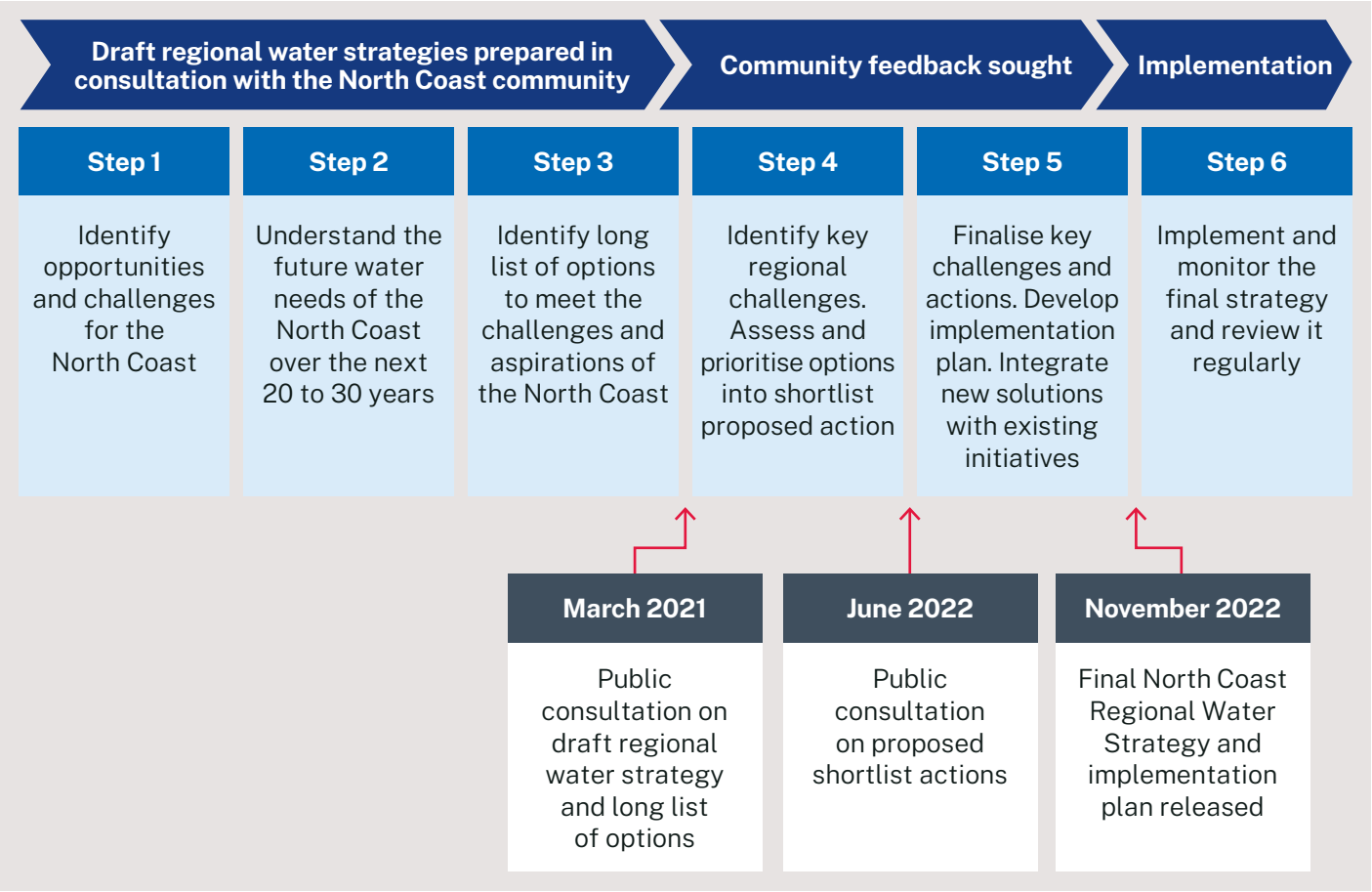
Image courtesy of Jaime Plaza Van Roon, Department of Planning and Environment. Jetty, Port Macquarie.

2. Department of Planning, Industry and Environment 2021, *NSW Water Strategy*, dpie.nsw.gov.au/water/plans-and-programs/nsw-water-strategy/the-strategy
3. Department of Planning and Environment 2022, *Draft NSW Groundwater Strategy*, dpie.nsw.gov.au/water/plans-and-programs/nsw-groundwater-strategy
4. More information is available at: dpie.nsw.gov.au/water/plans-and-programs/town-water-risk-reduction-program
5. More information is available at: dpie.nsw.gov.au/water/plans-and-programs/water-efficiency/framework
6. NSW Government 2021, *A 20-Year Economic Vision for Regional NSW*, nsw.gov.au/a-20-year-economic-vision-for-regional-nsw-refresh
7. Infrastructure NSW 2022, *Staying Ahead: State Infrastructure Strategy* 2022–2042, infrastructure.nsw.gov.au/expert-advice/state-infrastructure-strategy
8. More information on the *New England North West Regional Plan* is available at: planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/New-England-North-West-Regional-Plan-2041
9. More information on the *North Coast Regional Plan* is available at: planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/North-Coast/North-Coast-Regional-Plan

Developing the North Coast Regional Water Strategy

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

Figure 4. Process for developing regional water strategies



What informed the North Coast Regional Water Strategy

We have used feedback from the community, and the best evidence and most recent data from a wide range of sources, to inform the North Coast Regional Water Strategy and ensure it is based on evidence.[10] This information has been used to help identify the challenges that need to be tackled first, and the measures that will best support the region over the next 20 years. Information we used to develop the strategy included:

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

10. The outputs and outcomes of the consultation process have been compiled into reports titled 'What We Heard'. These reports and the draft strategy documents are available at: water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies/what-we-heard/south-coast-regional-water-strategy

Climate data in the regional water strategies

The regional water strategies are underpinned by groundbreaking new climate science. Our new climate datasets and modelling give us a more sophisticated understanding of past and future climatic conditions. This new approach integrates recorded historical data with paleoclimate data[11] to generate 10,000 years of synthetic climate data. This information provides a better understanding of natural climate variability under current climate conditions. When combined with climate change projections, we can better understand how this natural variability will be influenced by human-induced climate change.

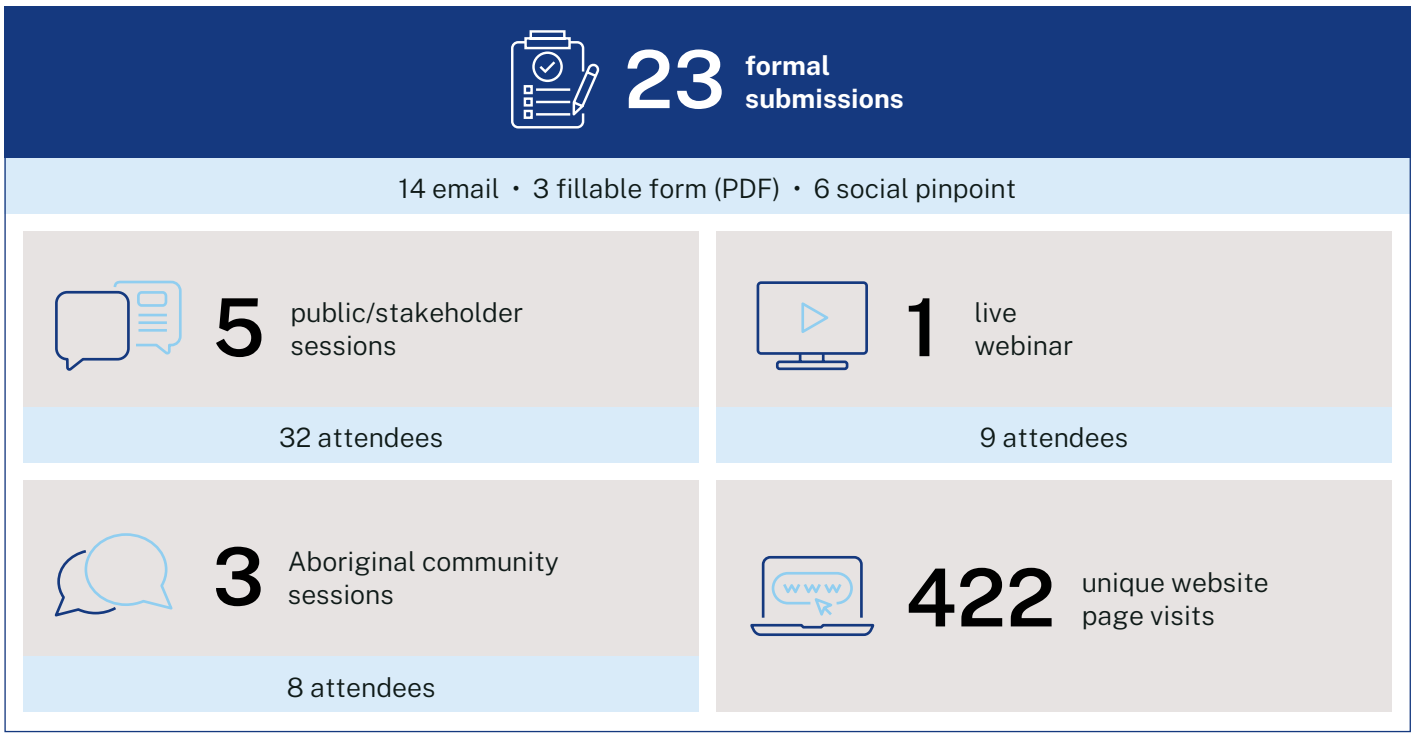
The section of this report *What the future climate could look like in the North Coast region* summarises what the new climate data and modelling tells us about future climate risks. We will continue to use the best and latest evidence about the future climate to develop solutions for water challenges in the region. This approach will also support all water users to make more informed decisions and to better plan and prepare for climate risks.[12]

Extensive community consultation

Developing an effective and lasting regional water strategy requires input from the community that lives there. This includes Aboriginal people, landholders, community members, local councils, and industry and environmental groups across the region. We would like to acknowledge and thank all these groups and individuals for the time and effort they gave to providing input into the development of the strategy.

We sought feedback on the Draft North Coast Regional Water Strategy through 2 public exhibition periods and a range of targeted engagement sessions. Community feedback was very important in shaping the final regional water strategy and implementation plan.[13] Figure 5 summarises the consultation activities undertaken for the development of the North Coast Regional Water Strategy.

Figure 5. Summary of consultation on development of the North Coast Regional Water Strategy



11. Data reconstructed from before instrumental records began, using sources such as tree rings, cave deposits and coral growth.
12. More information about these new climate datasets and how they are being used in our river system models is in the Regional Water Strategies Guide, available at water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies
13. What We Heard reports and draft strategy documents are available here: www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/what-we-heard/north-coast-regional-water-strategy

Feedback received during our consultation with primary producers, local councils, Aboriginal communities and the general public created key insights, shown in Figure 6, which fed into the development of the regional water strategy.

Figure 6. Key insights from consultation on the Draft North Coast Regional Water Strategy

Theme	Feedback summary
Use a holistic and integrated approach to support water quality, healthy rivers and ecosystems	River and system health continued to be identified as a key consideration. Taking a more integrated and holistic approach to align local, regional and state plans and strategies was also identified as important. This can help achieve a consistent catchment-level approach.
Support inclusion of First nations/ Aboriginal peoples' interests and expertise in water management, and the achievement of cultural outcomes, including access to water	There continued to be widespread support in the draft strategy for actions that increase Aboriginal peoples' involvement in land and water management and strengthening programs, employment opportunities, and cultural outcomes such as water access.
Understand, plan and prepare for climate change	There were mixed views about climate change and the specifics of the modelling used to inform the draft strategy. However, there was support for a better understanding of the likely impacts, including publicising modelling assumptions, and for planning and preparing for climate impacts.
Promote water conservation, reuse and recycling	There was continued broad support for treating water as a scarce resource requiring efficient use, and exploring options for reuse. Some environmental and other concerns and challenges were raised about water recycling.
Address challenges and explore opportunities of existing and new infrastructure	The issue of infrastructure generated mixed views, with both support and opposition for water infrastructure. There was more consistent support for on-farm dams as an alternative to catchment dams. There was also debate about including infrastructure in the strategy given responsibility generally lies with local councils or other state and federal agencies.
Managing increasing demand from different users in a sustainable and equitable way	There was support for water security, balanced with the understanding that water is a scarce resource that needs to be used efficiently, and competing demands should be managed in a way that is both equitable and ecologically sustainable.
Improve data adequacy, collection and sharing to achieve an evidence-based approach to improved planning, management responses and compliance	There was strong support for actions that improve data development and availability, and a desire to see those actions resourced adequately so that stronger data can help improve water planning and management over time.
Implement, review and update the strategy	Issues were raised about how the final strategy would be implemented, with support for it to be delivered, updated and evaluated based on the further development of data and evidence, monitoring and measurement, and effective consultation.

Economic, environmental and hydrological analyses

A range of assessments were used to prioritise the actions in the regional water strategy, including:

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

More detail on the approach and results of these analyses is available on the Department of Planning and Environment's website.[14]

The analyses in the regional water strategies are based on the best information available at the time they were completed. We had to make a range of assumptions to complete the analyses. Significant changes to the key assumptions used in the strategy may trigger the need to review or amend the strategy.

Key assumptions used for the analyses include:

- Town water supply risks: The analyses focused on surface water availability and do not include any existing alternative supply sources such as groundwater or desalination plants.
- Population changes: Population increases have been included in accordance with the NSW Government's Common Planning Assumptions medium population growth forecasts.
- Water use and industry mix: The types of industry and water use were assumed to be constant over the model periods. Significant changes to the nature of the crops produced, or to the industry mix in the North Coast region, will change the amount of water used. This may trigger a review of the strategy.
- Climate data: Climate variability outside the bounds of the variability of the climate data sets used to inform this strategy may also necessitate a review of the North Coast Regional Water Strategy.

Image courtesy of Jaime Plaza Van Roon, Department of Planning and Environment. Jetty, Port Macquarie.

14. More information is available at: water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies/what-we-heard/north-coast-regional-water-strategy

Existing studies

A significant amount of work was undertaken to understand the risks to water resource management in regional NSW.[15]

In the North Coast region, we have considered catchment studies, water security reports and existing water allocation and drought planning. We have also considered other NSW Government strategies for regional development, infrastructure and the environment. The following studies were critical for informing the North Coast Regional Water Strategy:

- Department of Land, Water and Conservation 1998, *Stressed Rivers Assessment Report: NSW State Summary*
- WaterNSW 2018, *20 Year Infrastructure Options Study, Rural Valleys: Summary Report*[16]
- NSW Government's *NSW Marine Estate Management Strategy 2018–2028*[17] and *NSW Marine Estate Threat and Risk Assessment*[18]
- Department of Environment, Climate Change and Water 2006, *NSW Water Quality and River Flow Objectives*[19]
- Department of Planning, Industry and Environment 2017, *NSW Government water reform action plan*.[20]

Building on existing commitments and reforms

The NSW Government has made significant commitments to address the water management risks in regional NSW and to prepare our regions for the future. Some of the statewide water reforms include:

- improving water and sewerage services for Aboriginal communities
- improving compliance and transparency around water use and access
- implementing metering laws to make sure that 95% of the potential water taken in NSW is accurately measured and monitored.[21]

In 2020, the NSW Government also commenced implementation of the environmental water reforms that arose from the Water Reform Taskforce.[22]

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

15. More information is in the *Regional Water Strategies Guide*, available at: water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies
16. More information is available at: waternsw.com.au/projects/infrastructure-studies/20-year-infrastructure-options-study
17. NSW Government 2018, *Marine Estate Management Strategy 2018–2028*, marine.nsw.gov.au/marine-estate-programs/marine-estate-management-strategy
18. NSW Government 2017, *NSW Marine Estate Threat and Risk Assessment*, marine.nsw.gov.au/marine-estate-programs/threat-and-riskassessment
19. NSW Government 2006, *NSW Water Quality and River Flow Objectives*, environment.nsw.gov.au/ieo/index.htm
20. More information is available at: industry.nsw.gov.au/water/what-we-do/water-reform-action-plan
21. The NSW Government and the Australian Government have committed $23.6 million and $12.5 million respectively to the metering program to ensure that meters are upgraded effectively. This funding commitment includes rebates for water users who switch to telemetry-based systems.
22. The Water Reform Taskforce was set up following the independent investigation into NSW water management and compliance.

The North Coast region

2

Image courtesy of Destination NSW. Clarence River, Iluka.

Figure 7. Snapshot of the North Coast region

302,000
population

42,000
km² area

Aboriginal Nations:
Biripi (Birpai), Githabul, Bundjalung, Dunghutti, Gumbaynggirr, Yaegl and Anaiwan nations.

Regional centres include:
Grafton, Armidale, Coffs Harbour, Kempsey and Port Macquarie.

Smaller towns and localities include:
Guyra, Bellingen, Maclean, Yamba, Wauchope, Macksville and Nambucca Heads.

Main rivers:
Clarence, Macleay, Bellinger, Nambucca, Hastings, Camden Haven as well as adjoining coastal catchments and many unregulated rivers.

Major town water storages:
Shannon Creek Dam with a storage capacity of 30 GL.
Karangi Dam with a storage capacity of 5.6 GL.
Malpas Dam with a storage capacity of 13 GL.
Cowarra Dam with a storage capacity of 10 GL.
No state-owned dams.

Critical State Significant Infrastructure:
Oven Mountain Pumped Hydro Energy Storage Project.

Groundwater sources:
Alluvial, coastal sands, porous and fractured rock
Key sources: Comboyne Basalt Groundwater Source, Stuarts Point Groundwater Source and Macleay Coastal Sands.

Key environmental assets:
Nearly 16,000 km² of national park and wilderness area, including the Gondwana Rainforest World Heritage Area and Oxley Wild Rivers National Park as well as nationally important wetlands.

Threatened native species including the endangered eastern freshwater cod, the green-thighed frog and the vulnerable Bellinger River snapping turtle.

Gross Regional Product: **$16.8 billion**

The North Coast region is located east of the Great Dividing Range and includes the catchments of the Clarence, Macleay, Bellinger, Nambucca, Hastings and Camden Haven rivers, as the waterways of the Coffs Harbour area (Figure 8).

The region is located on the traditional lands of the Biripi (Birpai), Githabul, Bundjalung, Dunghutti, Gumbaynggirr, Yaegl and Anaiwan nations who have been caretakers of this Country for over 60,000 years. Water is the lifeblood of Aboriginal people. It allows kinship, connection, stories, songlines and healing through medicine and food. Healthy waterways and groundwater systems are critical to Aboriginal people for wellbeing and culture.

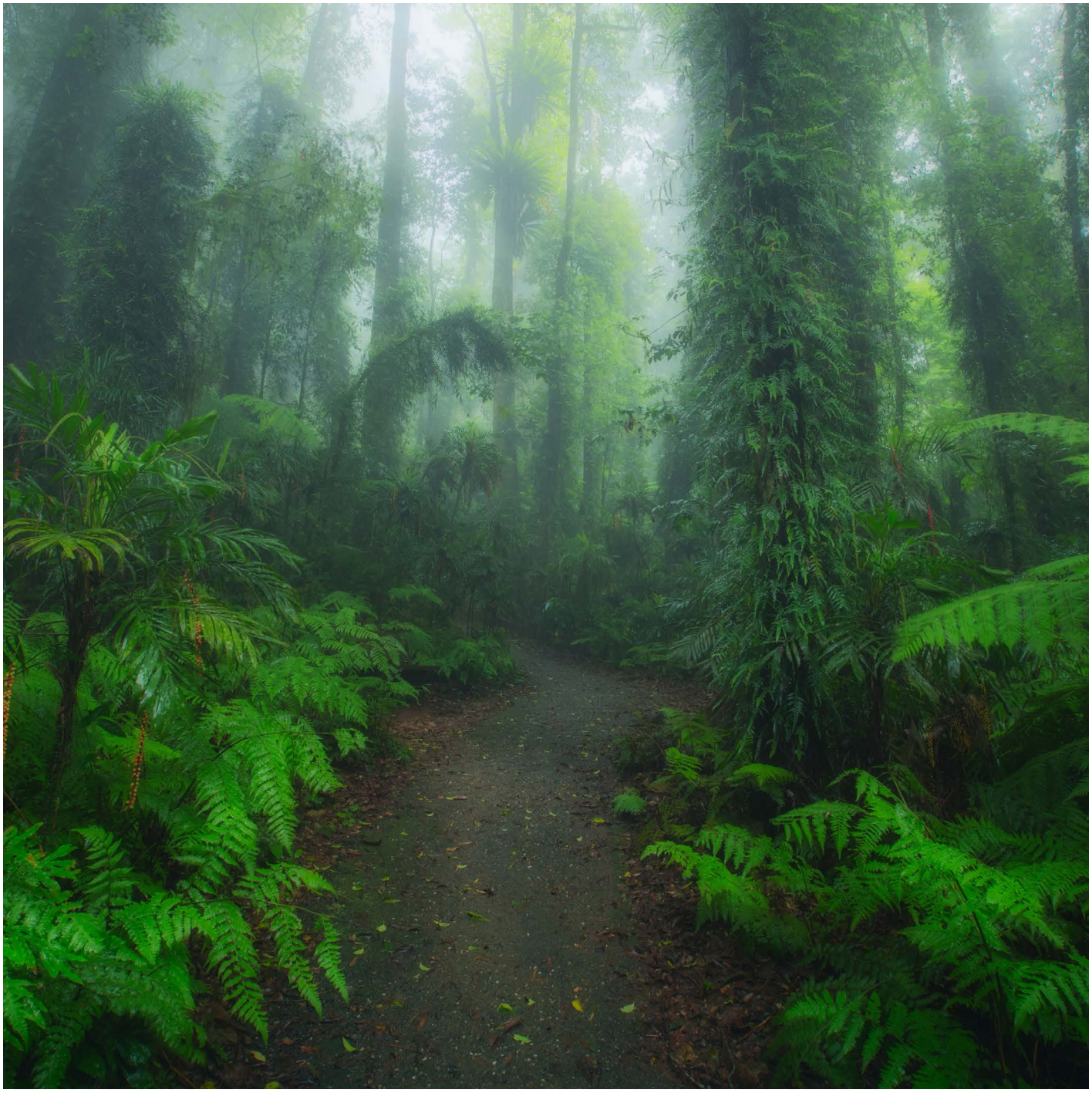
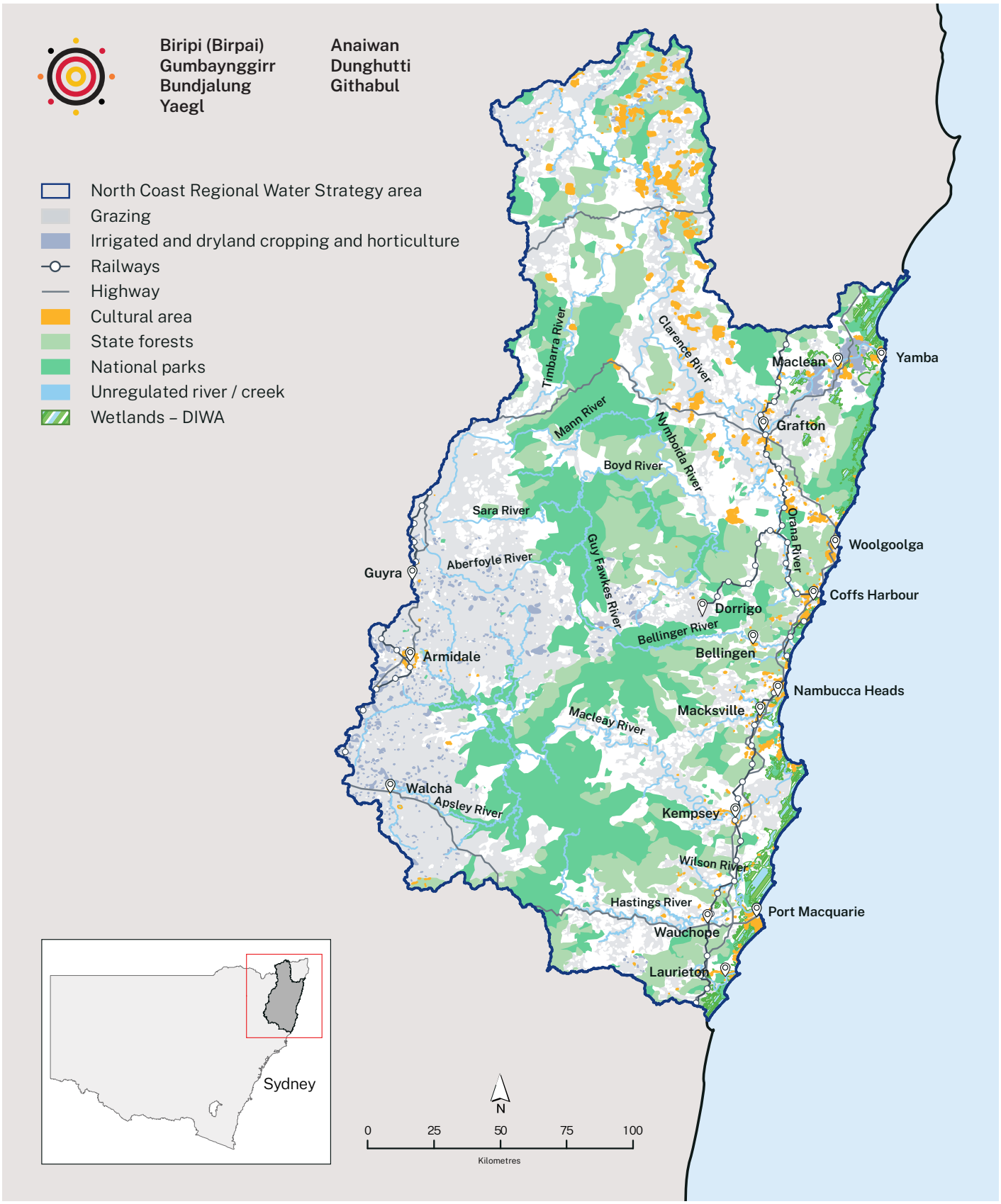


Image courtesy of Destination NSW. Crystal Shower Falls Walk, Dorrigo National Park.

Figure 8. Map of the North Coast region



The region's landscape transitions from the high areas of the New England Tablelands in the west and descends the slopes through rugged gorges. It passes through undulating foothills and floodplains before reaching the lagoons, wetlands, estuaries and beaches of the coast. In contrast to NSW's inland rivers, the rivers of the North Coast region generally have small catchments, are fast flowing and have many tributaries.

Water is critical to the North Coast region – to the health of its environment, its social fabric and liveability of towns and communities, and to its economic prosperity. The *North Coast Regional Plan 2036*[23] identifies Coffs Harbour, Grafton and Port Macquarie as key growth anchors for the region, delivering new jobs, more diverse housing, as well as high quality essential services. Similarly, the *New England North West Plan 2041*[24] identifies Armidale as a centre of population growth that provides the region with key health and education services, and supports critical jobs growth. These cities and towns throughout the North Coast region are the vibrant social and economic hubs of their surrounding communities.

The North Coast region is continuing to develop a thriving, interconnected economy. The economy is grounded in strong cities and centres that have inter-regional links, growing farming and tourism sectors, high-quality infrastructure and a unique environment.

The region's thriving economy is supported by highly productive and diverse riverine, coastal and rural landscapes, and relatively high and reliable annual rainfall. The Regional Economic Development Strategies identify a number of key specialisations for the region, including:

- health care
- agriculture (particularly horticulture in the coastal areas, and livestock farming and vegetable production in the tablelands)
- fishing
- aquaculture
- tourism
- education and construction.[25]

The unique natural assets of the region bring over 5 million visitors each year. This generates $1,800 million annually,[26] making tourism the second-highest valued industry in the region. Tourism is focused on both nature-based experiences and locally-produced products. The focus for the future is to capitalise on the region's natural endowments to make the region the 'best place to live, work and play' in Australia.[27]

Water is a critical enabler of many businesses in the region. The region's water supplies support important service industries that include food manufacturing, retail trade and agricultural needs. Farmers in the North Coast region have traditionally grown mostly rain-fed crops. However, agriculture in the region is shifting towards more intensive horticulture that needs secure water supplies.

23. Department of Planning and Environment 2017, *North Coast Regional Plan 2036*, www.planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/North-Coast/North-Coast-Regional-Plan
24. Department of Planning and Environment 2022, *New England North West Regional Plan 2041,* www.planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/New-England-North-West-Regional-Plan-2041
25. There are 5 Regional Economic Development Strategies relevant to the North Coast region: the Hastings Macleay, the Southern New England High Country, Nambucca, Coffs Coast and Clarence Valley
26. Based on 2019 data.
27. Department of Planning and Environment 2017, *North Coast Regional Plan 2036*, www.planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/North-Coast/North-Coast-Regional-Plan

Water sources in the region

Surface water sources

The region has a total area of almost 42,000 km^2. Its catchments include the:

- Clarence River
- Macleay River
- Bellinger River
- Nambucca River
- Hastings River
- Camden Haven River
- waterways of the Coffs Harbour area.

Clarence River

The Clarence River is the longest river in the region. The river's catchment transitions from high tableland areas in its western extremities, falling away to a large and relatively flat coastal floodplain. Around a third of the river's catchment lies within national parks and nature reserves. The Clarence River's frequent high flows are critical to the diverse and unique ecosystems of the North Coast region. About 2,340,000 ML water flows through the Clarence River each year. However, this amount can be anywhere between about 1,500,000 ML and 7,500,000 ML.

Macleay River

The Macleay River starts between Guyra and Armidale on the New England Tablelands. From its source at the confluence of the Gara River, Bakers Creek and Salisbury Waters, it travels about 300 km to the sea. The Macleay River runs mainly through tableland areas and rugged gorge country. Like the Clarence River, annual flows can be highly variable from year to year.

Bellinger River

The Bellinger River catchment includes both the Bellinger and Kalang rivers. The Bellinger River flows 109 km from the Dorrigo Plateau before entering the ocean at Urunga. The Kalang River joins the Bellinger River just upstream of Urunga. The river system has one of the smallest catchments of the region's major rivers. At around 450,000 ML per year, the flows in the Bellinger River are still large. High flows typically occur between January and April. The tidal limit is just upstream of the township of Bellingen.

Nambucca River

The Nambucca River headwaters are within the Gumbaynggirr National Park on the border of the New England Tablelands. The river traverses through mainly cleared floodplain and terminates at the Nambucca River estuary. The Nambucca River estuary covers about 20% of the catchment area. The average annual flow is about 88,000 ML, with approximately half of this amount flowing between January and March.

Hastings and Camden Haven Rivers

The southern extent of the region includes the catchments of the Hastings River and the Camden Haven River. The Camden Haven River is much smaller than the Hastings River. It meets the sea at North Haven and supports extensive floodplains, wetlands and coastal lakes, including Watson Taylors Lake and Queens Lake.

Coffs Harbour waterways

The Coffs Harbour waterways are all short catchments. The upper parts of each catchment have steep, dramatic topography that flattens out where the creeks become estuaries. Like the Nambucca River and Bellinger River catchments, a significant amount of the catchment is state forests.

Groundwater sources

The region has many groundwater sources, including coastal alluvial floodplains, coastal sands, porous and fractured rocks, and many smaller alluvial aquifers next to rivers and creeks.

The coastal sands groundwater sources in the region are highly connected to surface water. Many areas are so connected that groundwater levels can increase rapidly during rainfall events.

Water storages

The North Coast region has no state-owned water storages. The major storages in the region are owned and operated by local councils and are generally located off-river. The 3 biggest storages are Malpas Dam, Karangi Dam, and Shannon Creek Dam.

Farm dams are common in the North Coast region. There are over 450 licensed farm dams. The Clarence River catchment has the most dams in the region. Farm dams are increasingly being constructed to meet the water demands of intensive horticulture. This is particularly true around Coffs Harbour, and in the Clarence Valley and Nambucca areas.

Recycled water is widely used in the region for non-potable demands such as:

- sportsground and golf course irrigation
- fodder crop irrigation
- horticultural crop irrigation
- toilet flushing
- vehicle washdown.

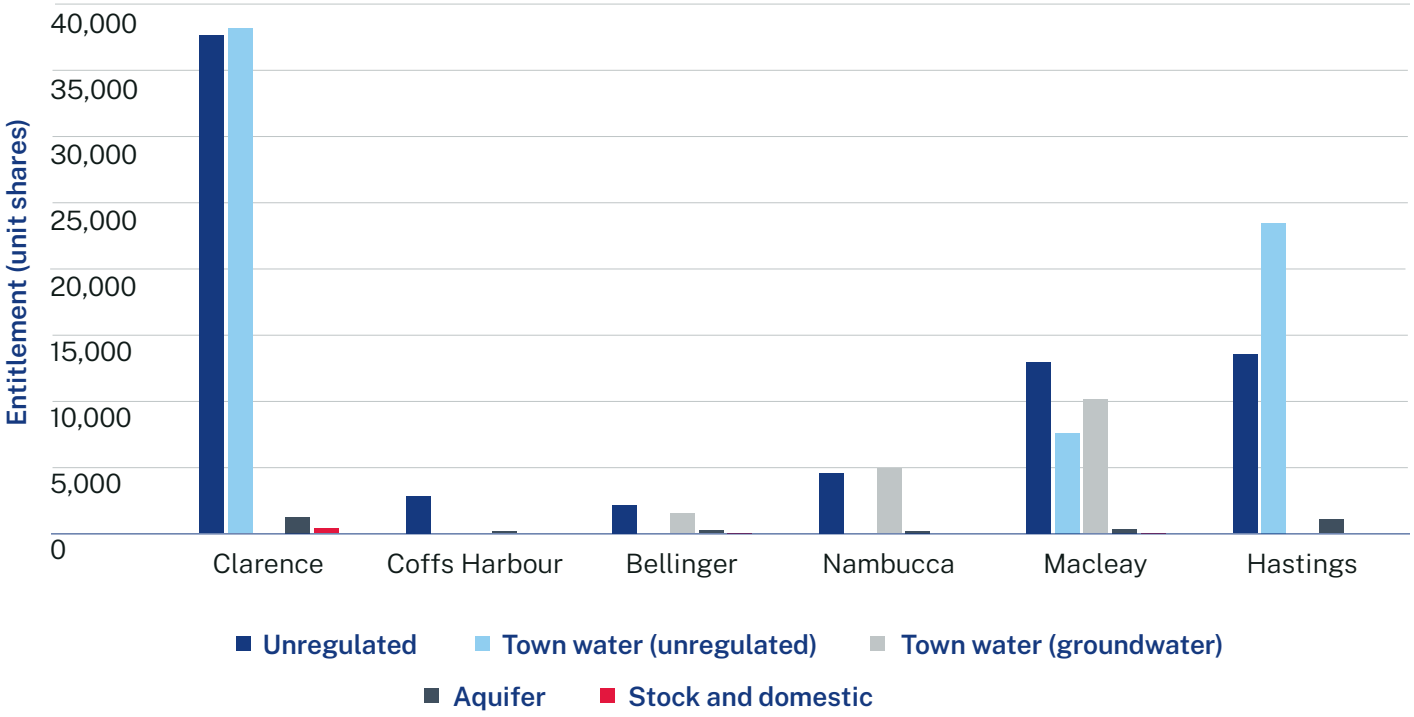
Recycled water use varies across the region's local government areas, ranging from less than 10% to nearly 50% of wastewater produced.

Image courtesy of Clarence Valley Council. Shannon Creek Dam, NSW.

Water use in the North Coast region

There is limited data on water use in the North Coast region. Water extraction from both surface water and groundwater sources is often unmetered. For this reason, water planning is largely based on the volumes of water licenses and entitlements. Figure 9 shows the licensed entitlement from unregulated surface water and associated alluvial water sources by licence category and catchment.

Figure 9. Licenced entitlement from unregulated surface water and associated alluvial water sources by licence category and catchment



The region's local councils account for approximately half of all licensed water entitlements in the North Coast region. This is approximately 69,000 ML of surface water and 21,600 ML of groundwater entitlements per year. As well as providing water for residents, local councils also provide water for commercial and industrial uses such as food manufacturing and rural businesses. This commercial and industrial demand for water is significant for some councils. For example, almost half of Guyra's[28] potable water supply is used to grow tomatoes at one of Australia's largest greenhouse facilities. In contrast, in both Port Macquarie Hastings Council and Bellingen Shire Council areas only 3% of the potable water demand is from large food manufacturers.

Irrigation is fairly limited in the North Coast region. Rainfall has generally been fairly reliable, and traditionally rain-fed crops have dominated. About 38% of the North Coast region (1,500,000 ha) is used for agriculture, but less than 1% is irrigated. Irrigation from farm dams, unregulated creeks and shallow aquifers generally only happens during dry months or extended dry periods. However, the region is susceptible to drought because there are very few storages to manage water shortages.

Many landholders in the North Coast region have harvestable rights dams. Harvestable rights dams allow landholders to collect a proportion of runoff from their property and to store it for later use.

Pasture and cereal crops (mainly for grazing) and fruit trees (including blueberries and avocados) are the crops with the greatest demand for irrigation water in the region. In the North Coast region, farmers generally irrigate in the spring and summer months when crops flower and the climate is hotter and drier.

28. Guyra is located in the Armidale Regional Council area.

Oven Mountain Pumped Hydro Energy Storage

The Oven Mountain Pumped Hydro Energy Storage is a 600 MW energy storage project planned for the North Coast and will contribute to a combined capacity of almost 1.75 GW as part of 5 new hydro-electric energy projects across NSW. The project will be located next to the Macleay River between Armidale and Kempsey.

The NSW Government has identified this project as critical state significant infrastructure under the State Environmental Planning Policy (State and Regional Development) 2011. It will be situated in the New England Renewable Energy Zone. It will support a reliable and resilient energy supply for NSW by providing clean energy generation and storage and will create more infrastructure jobs in regional NSW.

The Oven Mountain Project will be constructed on private land. It will not require significant additional water once the storage has been filled. Because it is an off-river scheme, it will not significantly impact hydrology and river health. Water for the initial storage fill will be extracted from the Macleay River during high-flow periods. This will further limit the impacts of the project on river health.

The project will also include:

- construction of a new electricity transmission network from the generation site to the Lower Creek area
- upgrades to existing local and regional roads to provide safe access during construction and operation.

Image courtesy of iStock. Macleay River, NSW.

Image courtesy of Destination NSW. Clarence River, Grafton.

What the future climate could look like in the North Coast region

3

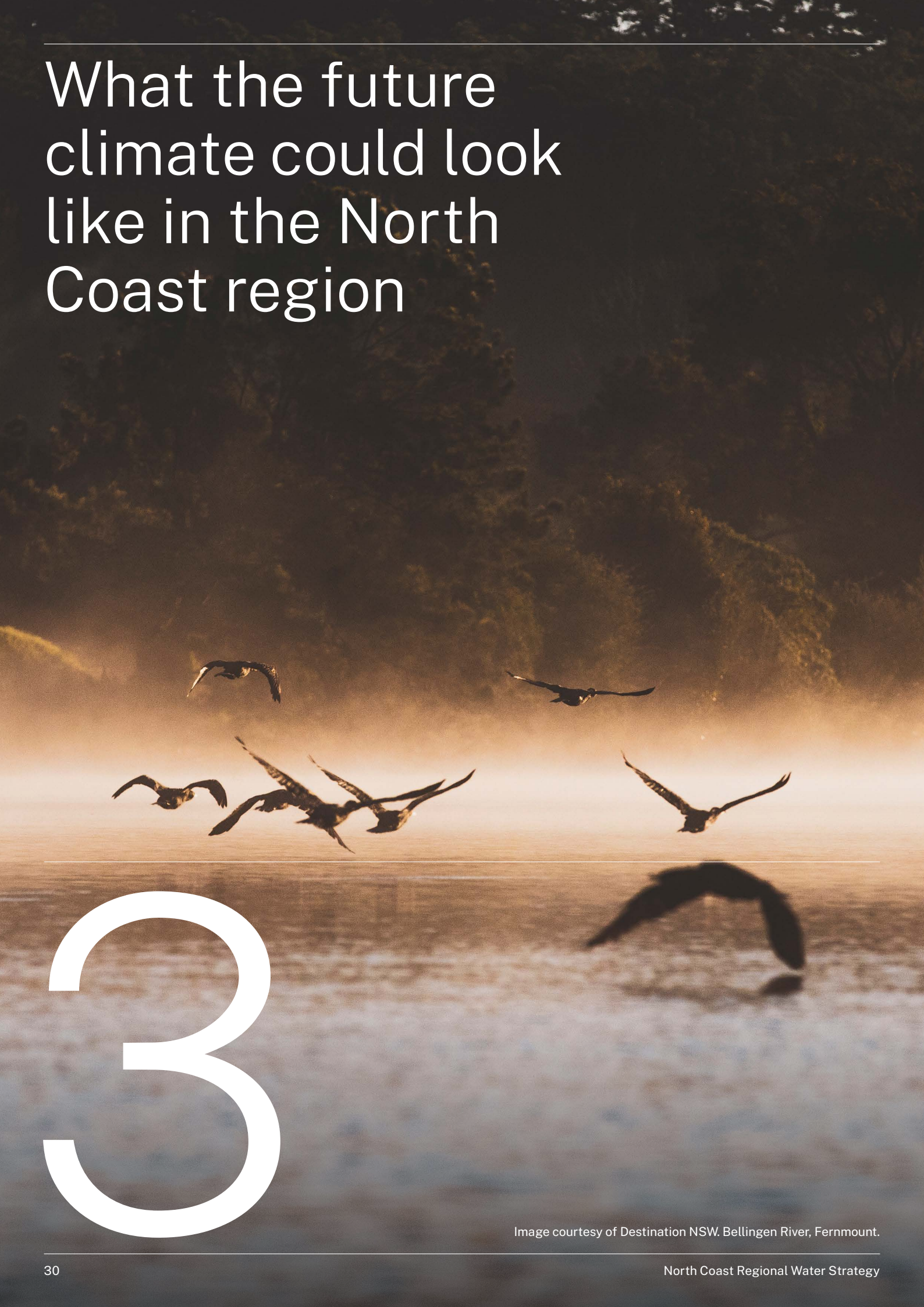


Image courtesy of Destination NSW. Bellingen River, Fernmount.

Climate data and modelling used to develop the North Coast Regional Water Strategy

We have used 3 climate data sets to understand the key regional challenges and to assess options for this strategy:

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

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

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

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

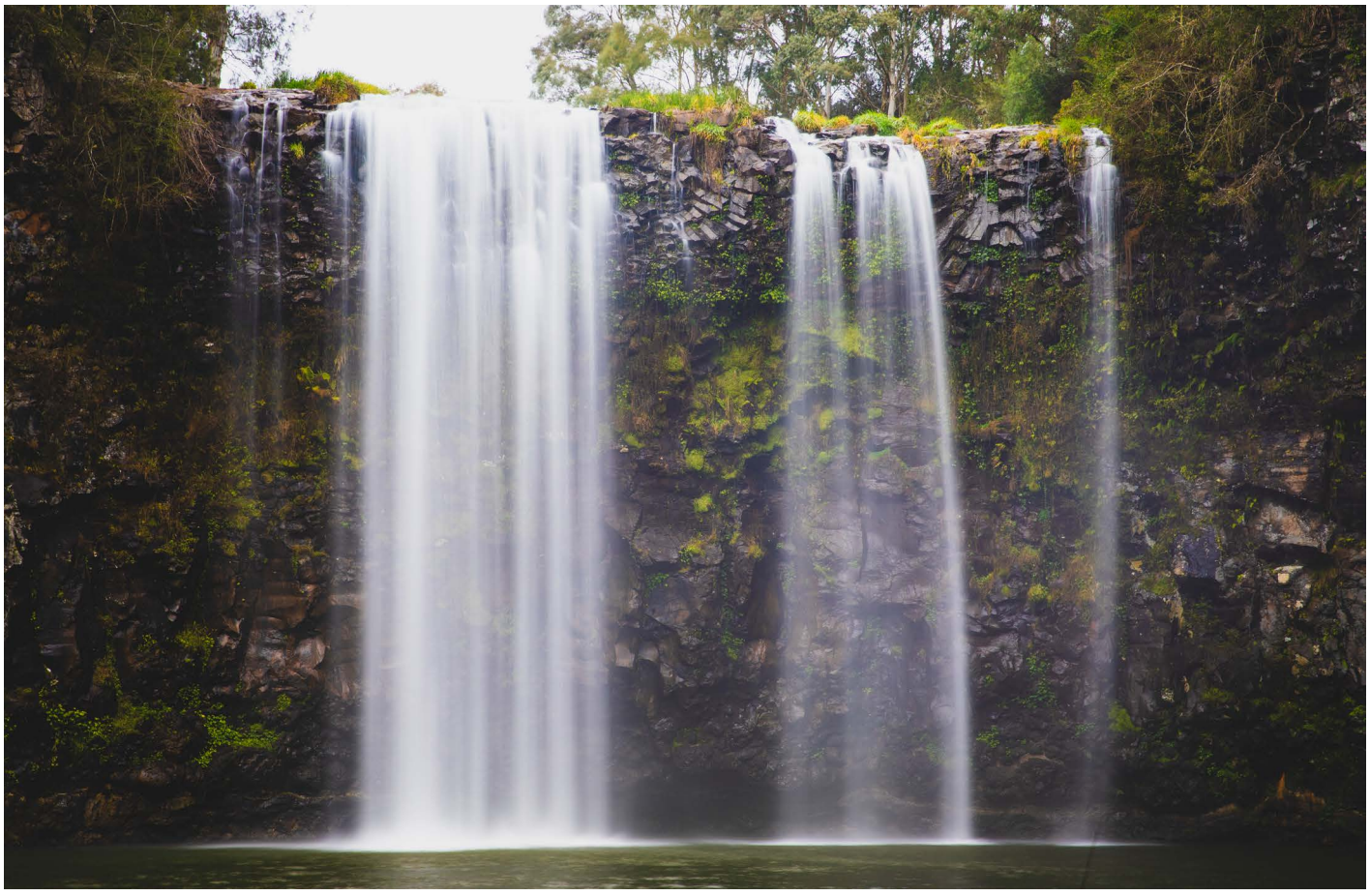


Image courtesy of Destination NSW. Dangar Falls, Dorrigo.

Climate snapshot

The North Coast region has a naturally variable climate

Over the past 130 years the North Coast region has experienced extreme droughts as well as floods.

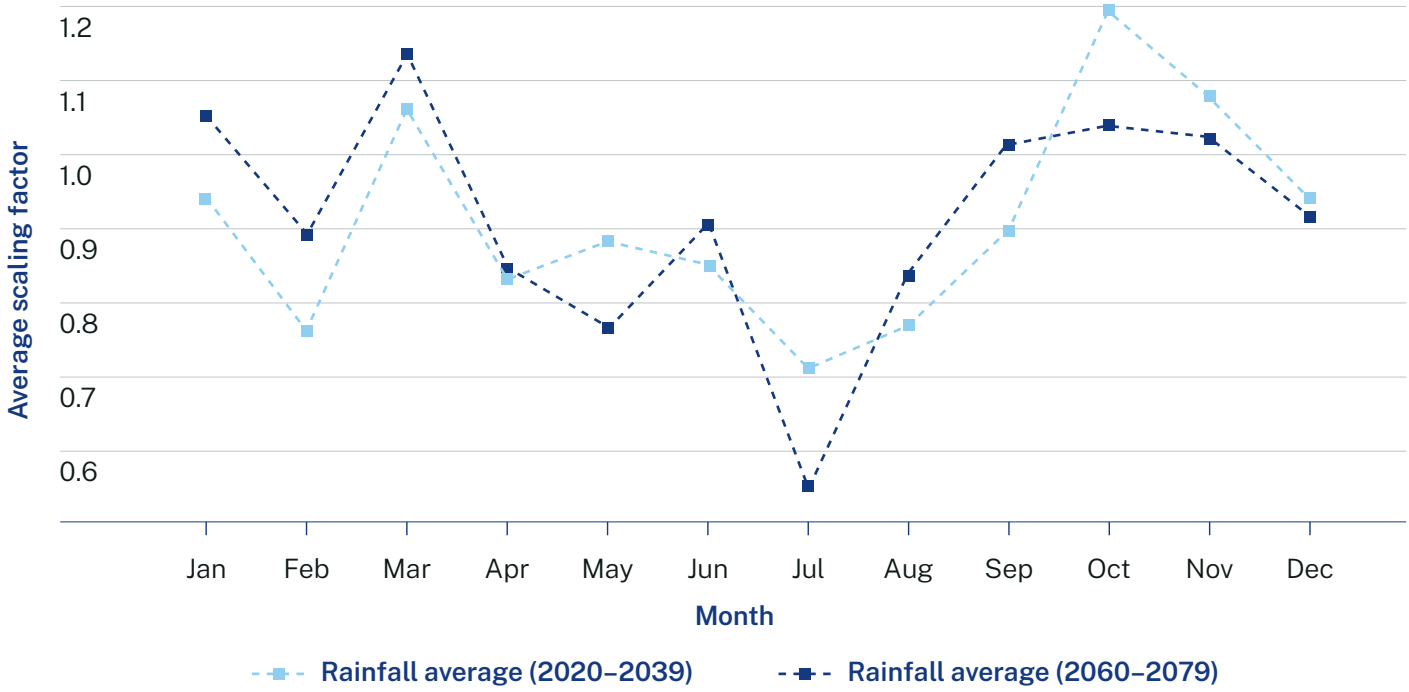
The most well-known droughts are the:

- Federation Drought (1895–1903)
- World War II Drought (1939–1945)
- Millennium Drought (1997–2009)
- most recent drought (2017–2020).

Flooding in the region typically happens in the summer and autumn, which tend to be wetter. The most significant floods are:

- Northern NSW Flood (March 2012)
- Northern NSW Flood (January 2013)
- Northern NSW Cyclone Debbie (March 2017)
- Northern NSW Flood (December 2020 – March 2021)
- Northern Rivers Flood (February – March 2022).

Figure 10. Possible future changes to rainfall in the North Coast region compared to the 1990–2009 average[29]



29. Based on NARCliM climate change modelling. More information on the NARCliM project is available at: www.climatechange.environment.nsw.gov.au/climate-projections-used-adaptnsw

The North Coast region's climate could become more variable

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

Our modelling suggests that the past 130 years has seen some of the worst conditions that are likely to occur for very short dry periods. For example, in the Macleay catchment, the lowest 1-year rainfall total in the historical record is around 360 mm. This is very close to the lowest 1-year rainfall in the long-term climate variability data-set.

However, for longer droughts (2–10 years), the long-term climate variability data shows that more intense conditions with significantly less rainfall are possible. For example, the lowest 5-year rainfall total on the historical record for the Clarence catchment is about 4,450 mm. The long-term climate variability data set shows that for 5-year droughts, rainfall is more likely to be between 3,700 mm and 4,300 mm. It also shows 5-year periods with as little as 3,200 mm rain. These conditions have not been seen in the past 130 years, but they are likely to occur in the future.

The long-term climate variability data shows a potential for:

- more frequent prolonged droughts with less rainfall than droughts in the historical record
- more frequent short, sharp droughts like the 2017–2020 drought.

Climate change will probably cause more extreme weather in the future

The future climate is uncertain. Our analysis of different climate projections shows there could be more extreme wet and dry periods than what has been previously observed. There is also the potential for:

- a reduction in the total annual volume of water flowing down the major rivers
- changes to different types of river flows (low flows, high flows and overbank flows)
- a decrease in rainfall by up to 5% per year
- a rise in sea levels of around 0.42 m by 2070.

We need to plan for this uncertainty and fully understand the future risks we face. A dry scenario, like what we have modelled, may not occur. However, analysing these extreme dry scenarios helps us to understand how to prepare for a more variable and changing future climate.

Future climate impacts on water supplies

Future climate change

Climate change will likely cause a reduction in average rainfall in the North Coast region, with river flows in the future also likely to decrease. These changes could affect water users and the environment.

Table 1 shows a summary of what current conditions and conditions under climate change could look like, on average. It shows the annual average river flows that we have modelled using the 3 data sets:[30] historical data; long-term climate variability data (stochastic data); and dry climate change scenarios.

The effects of climate change on flows are expected to vary across the region. The Hastings River is likely to be the river least affected by climate change and the Macleay River is likely to be the most affected by climate change. The right-hand side column in Table 2 shows the average decrease in flows due to climate change. It compares the historical data and the dry climate change scenarios.

Table 1. Average future water availability: annual flows in the major North Coast region rivers

River	Annual Average Flow (GL/year)			
	Historical data	**Long-term climate variability data**	**Dry climate change scenario**	**Historical compared to climate change (% difference)**
Bellinger	209	220	175	16%
Hastings	510	508	443	13%
Nymboida	605	611	491	19%
Macleay (Georges River Junction)	672	690	437	35%
Macleay (Turners Flat)	1,063	1,100	796	25%
Clarence	2,341	2,397	1,776	24%

30. All the values in the 2 water availability tables are modelled flows. The 'historical data' columns are not based on measurements – they are outputs from our hydrologic models run using historic climate data.

Future climate variability

The long-term climate variability data does not reveal a lot about average conditions. But it does show that, in the past, extreme conditions were likely to have been worse than what the historical record shows.

Table 2 shows the worst 1 per cent of river flows modelled using the 3 climate data-sets. It shows that more severe droughts are likely to have occurred in all the catchments of the North Coast region, except the Bellinger and Hastings catchments. Climate change will further increase the likelihood of these events occurring in the future.

Table 2. Extreme dry conditions water availability: lowest 1% flows in the major North Coast region rivers

River	Extreme dry conditions, 1% probability (GL/year)			
	Historical data	Long-term climate variability data	Dry climate change scenario	Historical compared to long-term climate variability (% difference)
Bellinger	27	31	26	-13%
Hastings	61	69	59	-13%
Nymboida	114	96	74	16%
Macleay (Georges River Junction)	97	83	55	14%
Macleay (Turners Flat)	107	96	62	10%
Clarence	392	254	186	35%

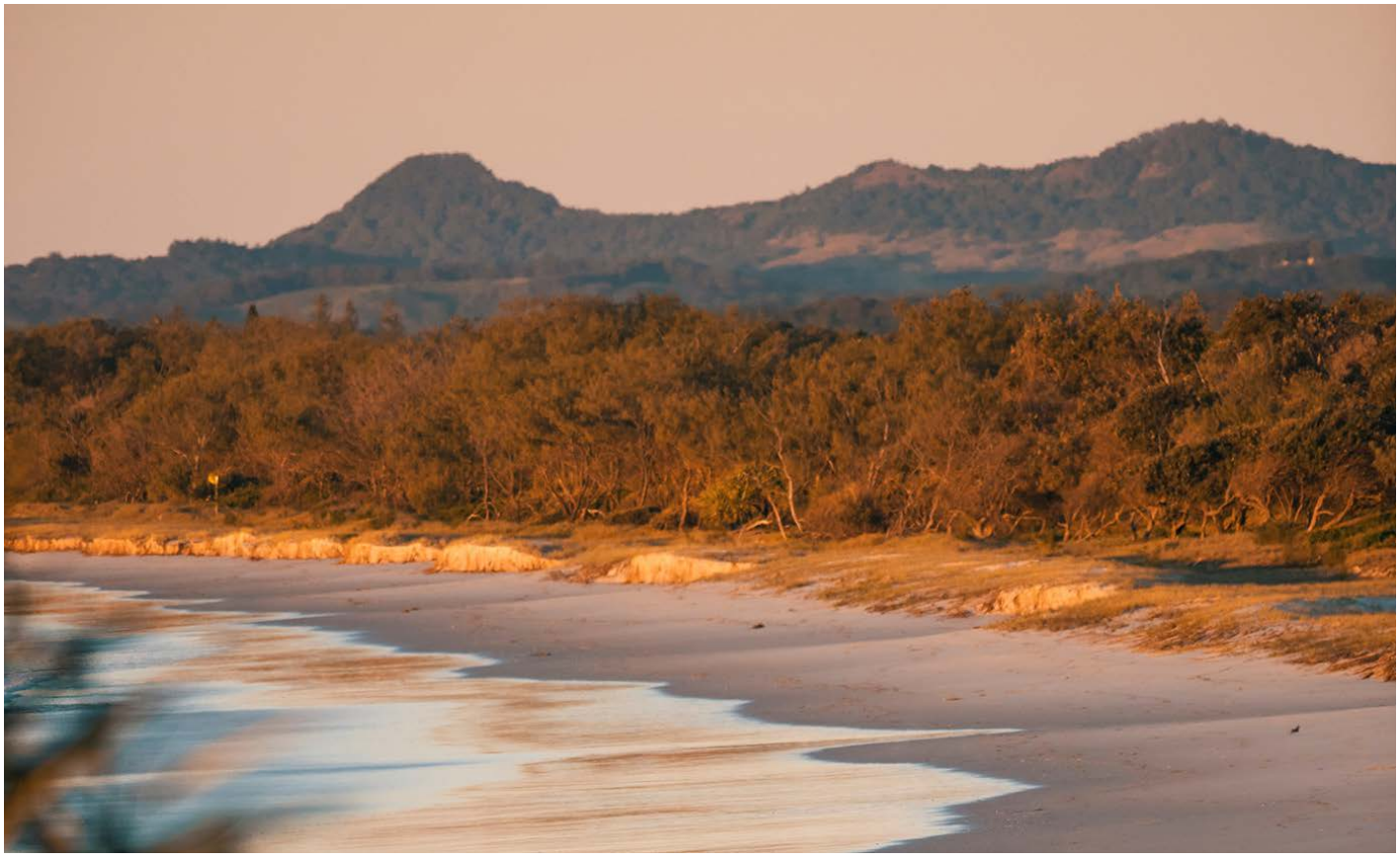


Image courtesy of Destination NSW. Sunrise, Hastings Point.

Key challenges in the North Coast region – what we will focus on first

4

Image courtesy of Destination NSW. Dorrigo Skywalk, Dorrigo.

The North Coast region is located within the traditional lands of the Biripi (Birpai), Githabul, Bundjalung, Dunghutti, Gumbaynggirr, Yaegl and Anaiwan nations. These traditional owners have been the custodians and caretakers of the region for many tens of thousands of years. The region is home to a wide variety of aquatic ecosystems and is a productive agricultural area of NSW.

Like all regions across Australia, the North Coast region faces a warmer and more variable climate. We need to prepare now to protect our most critical water needs and to do more with less water. We need to make water management decisions with better knowledge and information.

We have identified 6 challenges that are the immediate priorities for the region:

- Declining catchment and river health
- Competition for low flows
- Saltwater intrusion into freshwater sources
- Aboriginal people's rights and access to water
- Water security for industries in the North Coast
- Water security for towns and communities in the North Coast.

Addressing these challenges will help us meet the vision and objectives we have set for the North Coast Regional Water Strategy.

Image courtesy of My Clarence Valley. Mann River, Cangai.

Challenge: Declining catchment and river health

Poor catchment and riparian management, and changes in catchment and river hydrology, are affecting river health, hydrologic connectivity and raw water quality.

The North Coast region supports a rich and diverse range of water-dependent plants, animals and ecosystems. They form an important part of our shared biodiversity resources, have cultural value for local Aboriginal communities and support the economic value, liveability and wellbeing of the region. Preserving these values will continue to support the communities of the North Coast region.

Land management practices are impacting riverine health

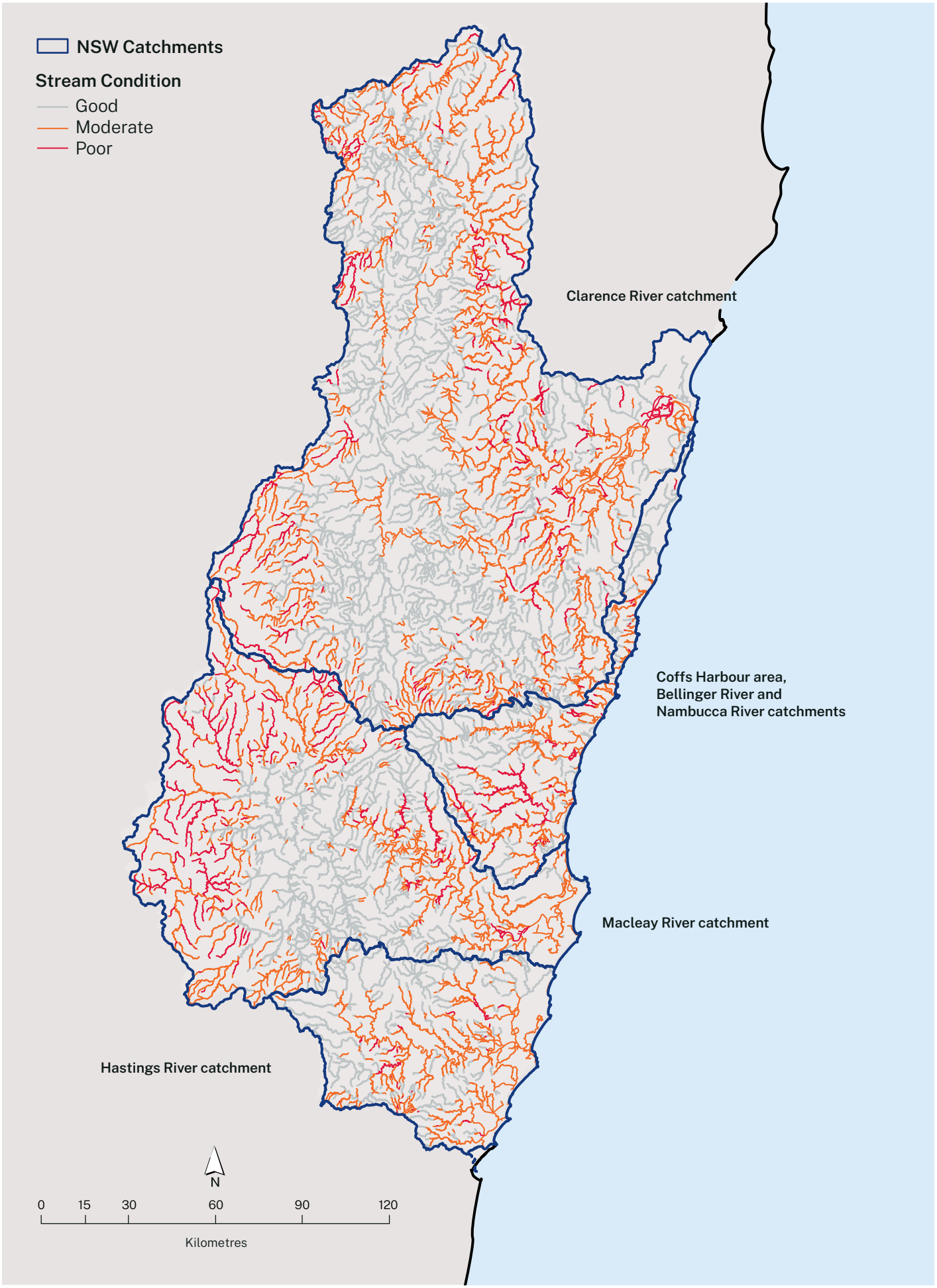
The decline in catchment and river health threatens aquatic and riparian ecosystems, as well as downstream estuarine health. This decline negatively affects Aboriginal peoples' connection to Country and cultural sites associated with waterways. Communities and towns have an increased need to treat poor quality water for consumption, and there are reduced opportunities for recreation. Industries are also directly impacted by poor water quality, particularly those operating in estuaries, such as aquaculture. Other sectors such as tourism, are indirectly impacted through loss of amenity.

Clearing forests and native vegetation allows water to flow through the landscape much more quickly. Although the North Coast region's agricultural industry has been important for the region's development, it has also lead to land clearing and a reduction in soil carbon levels. Clearing forests and native vegetation allows water to flow through the landscape much more quickly while reduced carbon in soil affects its capacity to take in water. Other land management practices, such as providing stock access to riverbanks and creeks, also causes erosion and decreases bank stability.

Water now worsens land and waterway erosion because it moves faster and more forcefully than in its natural state. This is of particular concern in the region because erosion increases sediment inputs to waterways and reduces water quality.

Image courtesy of Annette Harrison, Department of Planning and Environment. Port Macquarie, NSW.

Figure 11. Distribution of poor and moderate condition river reaches across the North Coast region



Current geomorphic and riparian condition

Just under half of the North Coast region's river reaches are in good geomorphic condition. About 16% of river reaches are in poor geomorphic condition. These poor-condition reaches are mainly located on the New England Tablelands and on the central-to-lowland plains, including the area between Walcha and Guyra/Llangothlin, as well as the Lower Macleay, the Nambucca River, Taylors Arm and the Bellinger River.

The condition of riparian vegetation is generally low across the region, except in protected or forested areas. This is often due to weed infestations and vegetation clearing, which leads to large areas devoid of native vegetation or with poor vegetation diversity. Infestations and clearing also lead to reduced leaf area and tree canopy height, and small, poorly connected patches of native vegetation. Most estuarine reaches are in poor condition, and are mostly characterised as riverbanks with little or no vegetation.

Effects of increased sediment loads

The impacts of land clearing and development are heightened during extreme rainfall events – a climatic feature of the North Coast region. Runoff from these events is typically high in nutrients and sediment. This causes elevated nutrient loads, smothered vegetation, and subsequent deoxygenation and further release of nutrients. These impacts are particularly acute during rainfall events that occur after a bushfire and can lead to increased river toxicity and fish deaths.

Many of the region's local councils cannot treat water when turbidity is high. This restricts the availability of water for town water supply and becomes a critical issue when rainfall follows extended dry periods. In the last round of community consultation, we heard that the public and Aboriginal communities have significant concerns about the continued impact of catchment land use on the quality of the region's highly valued waterways.

Poor management of fertiliser contributes to high nutrient loads in the region's waterways

Many of the region's rivers, creeks and estuaries are suffering from poor water quality, particularly due to increased sediment and nutrient loads. Catchment health monitoring programs conducted across the region note exceptionally high nutrient concentrations for many rivers and creeks in the Clarence, Macleay, Hastings, Coffs Harbour and Nambucca river catchments. Modelling also shows that the average annual load of sediment generated from the Clarence River catchment is 700 kt/year, or about 200 times more than before European settlement.

Landholders, as stewards of the land, are engaged in natural resource management and play a key role in generating natural capital value and improving ecosystems and habitats through best practice land management. Natural capital refers to the world's stocks of natural assets and the services that flow from them, which include geology, soil, air, water, and all living things.

Natural capital investment, by both government and the private sector, can support active land stewardship among and alongside productive land activities. The NSW Government is running a suite of natural capital programs that can benefit farmers who voluntarily want to manage biodiversity and carbon while enhancing their land for productive use. Farmers can achieve accreditation through agreed sustainability actions including using best practice feed and fertiliser practices.

Recent shifts in agriculture to intensive horticulture are exacerbating water quality issues in the region. Blueberry plantations, particularly around Coffs Harbour and Woolgoolga, are replacing banana crops on steep land. These steep slopes can create challenges in managing crop fertilisation and irrigation. Consequently, some farmers over-fertilise crops, which can cause elevated nutrient levels (particularly nitrate and nitrite) in downstream waterways, and deterioration of soil health and productivity.

Best practice land management helps to improve the infiltration and quality of water. The strategy will build on existing programs to support private landholder to adopt these best practices in priority waterways across the region, including drainage and fertiliser use management. Support will largely be provided through natural resource management, sustainable agriculture advisory services and on-ground projects delivered by Local Land Services. This aims to collaboratively build on the good work farmers are already doing to care for their land.

Studies conducted for Coffs Harbour City Council have detected increased nitrate and nitrite loads downstream of farming areas around Coffs Harbour. These concentrations were well above the Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines and suggested nitrogen leaching from fertilised soils. These impacts may continue to worsen. This could impact waterway heath, recreational values, the Solitary Islands Marine Park and other important coastal lagoons.

The NSW Government has started to address some of the key challenges of the expanding intensive horticulture industry. The 2021 report by the NSW Agriculture Commissioner[31] recommended improving planning definitions around horticultural practices. This would enable local councils to make more informed environmental planning decisions and mitigate the risk of potentially environmentally harmful practices.

31. NSW Agriculture Commissioner 2021, *Improving the Prospects for Agriculture and Regional Australia in the NSW Planning System*, www.dpi.nsw.gov.au/agriculture/lup/nsw-agriculture-commissioner

Current governance arrangements are inhibiting catchment-scale decision-making, planning and project delivery

Responsibility for managing water quality impacts is shared across several state and local government agencies. We lack an overarching framework for managing water quality and waterway impacts. This impedes planning, collaboration, coordination and reconciliation of state and local priorities. It also:

- negatively affects the development and delivery of environmental catchment programs at different scales
- makes it difficult to ensure that environmental water quality and quantity needs are met throughout the catchment.

During consultation we heard that a reduction in the uptake of best practice is being driven primarily by:

- a lack of social willingness among users and landholders
- complicated natural resources regulation.

Instream structures are impacting natural flow regimes, aquatic health and fish movement

Although all rivers in the North Coast region are unregulated, there are still many instream structures that control and modify flows. These structures alter the natural flows of rivers and streams and their associated floodplains and wetlands. They also contribute to the loss of biodiversity and ecological function of waterways.

Instream structures can be significant barriers to native fish migration. Many species are directly affected by instream structures and their operation, including:

- the endangered eastern freshwater cod (*Maccullochella ikea*)
- oxleyan pygmy perch (*Nannoperca oxleyana*)
- southern purple spotted gudgeon (*Mogurnda adspersa*).

Other coastal fish species potentially impacted by barriers to fish passage include:

- freshwater catfish (*Tandanus tandanus*)
- diadromous species[32] such as freshwater herring (*Potamalosa richmondia*) and short-finned eel (*Anguilla australis*)
- high recreational value species such as Australian bass (*Macquaria novemaculeata*) and estuary perch (*Percalates colonorum*).

Many other protected or unlisted species of invertebrates and mammals can also be negatively affected by instream structures. Government programs have been addressing this through fish restocking programs and actions to progress fish passages on weirs.

32. Diadromous fish migrate between fresh and salt water.

Declining quality and quantity of freshwater inflows to coastal systems is affecting estuarine health

Freshwater inflows are critical to the health and function of the region's estuaries. These inflows help maintain low salinity levels in tidal pools and mobilise the nutrients, sediment and pathogens needed to support habitat diversity and productivity. High quality freshwater inflows are important both to estuarine health and to the communities and industries they support.

Effects of declining quantity of freshwater inflows

Projected reductions of estuary inflows may alter salinity gradients, water circulation patterns, and fish movement, which could negatively affect estuarine ecology, particularly in the tidal pools at the upper limits of the estuaries. These reductions can also increase salinity further upstream where water is used for agriculture and town water supplies.

Intermittently closed and open lakes and lagoons are particularly sensitive to changes in freshwater flows. These changes can have a large effect on water quality, geomorphology and entrance opening regimes. They can also affect the health of mangroves, saltmarsh and seagrass, which are important fish habitats.

The *Marine Estate Management Strategy*[33] has highlighted the regulation and extraction of freshwater flows as a priority threat to help address these issues.

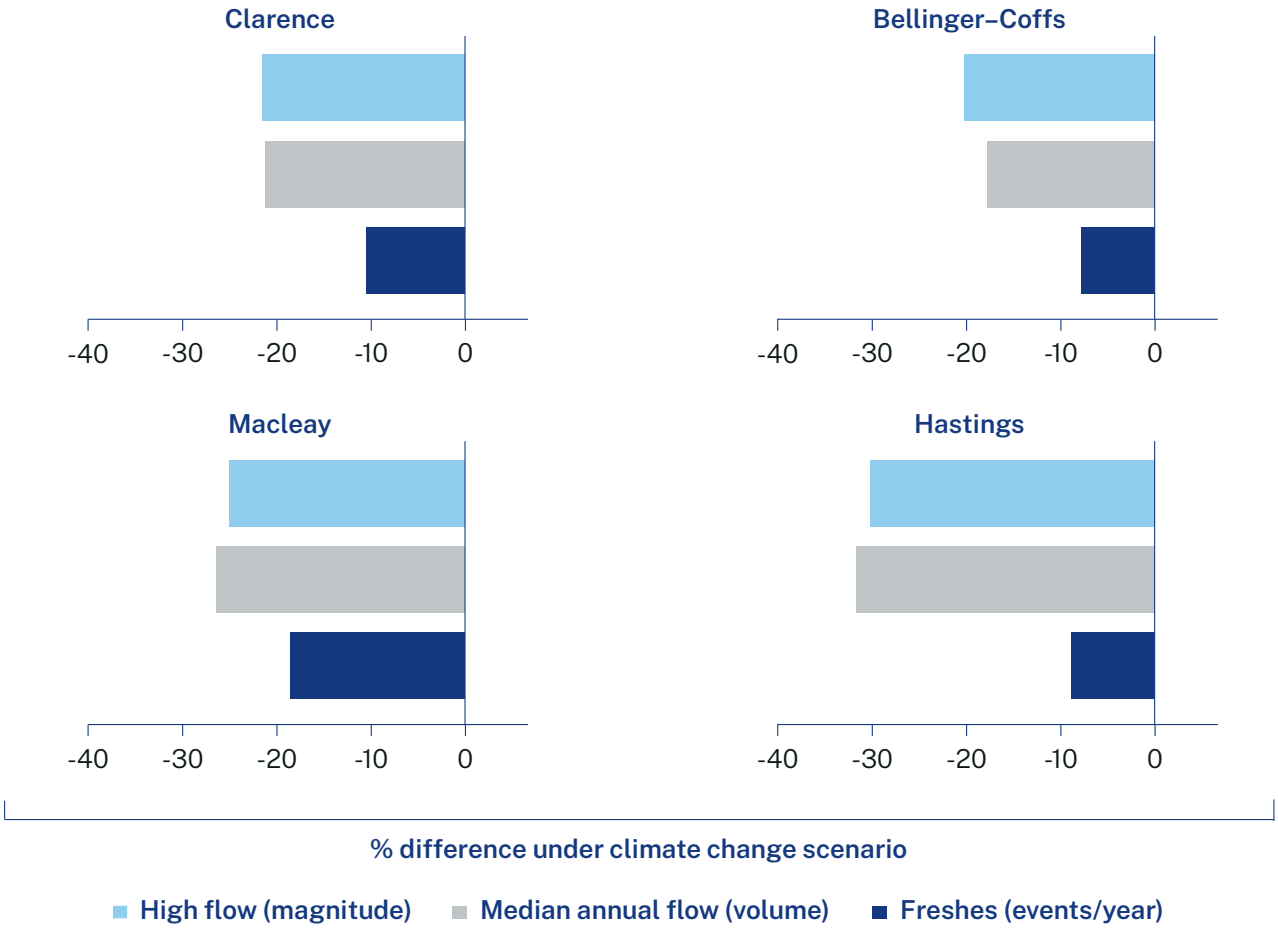
Our new climate data and hydrologic modelling show that the annual volume of flows in the North Coast region catchments may decrease by about 24% under a dry climate change scenario, and that all parts of the flow regime may be affected (Figure 12). Reductions in medium- to high-flow events would affect sediment and nutrient transport that stimulate riverine productivity, system flushing, and limit the number of events that trigger fish movement and spawning.

Effects of declining quality of freshwater inflows

Examples of where poor-quality water is affecting estuarine health are in the Macleay River and South West Rocks Creek. In these locations, high nutrient levels, turbidity and siltation have led to significant seagrass loss.

Bacterial contamination has negatively affected oyster growers and the health of fish, shellfish and crustaceans in the Nambucca, Bellinger, Hastings and Macleay rivers.

Figure 12. Projected impacts of climate change on inflows to North Coast estuaries



33. NSW Marine Estate Management Authority 2018, *NSW Marine Estate Management Strategy 2018–2028*, www.marine.nsw.gov.au/marine-estate-programs/marine-estate-management-strategy

Challenge: Competition for low flows

Competition for water during low-flow periods is restricting access for landholders and industries and placing many of the region's waterways under stress.

There is generally enough water across the North Coast region to meet urban and rural water demands each year, on average. However, competition for low flows during the drier spring months places many of the region's rivers and creeks under increased hydrologic stress.

Over the last 20–30 years, there has been a major shift away from rain-fed crops to high-value horticulture crops that have increased irrigation demands. This has placed a great stress on rivers. Pressure on low flows is likely to increase in the future because the climate change will likely reduce flows while increasing water demands for irrigation.

Low flows maintain connectivity between river pools, provide riffle flow and aeration, and provide freshwater inputs to sensitive estuaries and intermittently closed and open lakes and lagoons. These river functions are critical for river and ecosystem health, and to support water-dependent industries such as commercial fishing and the significant wild harvest oyster industry within the estuaries of the Clarence, Macleay, Bellinger, Hastings, and Nambucca rivers.

Competition for low flows also affects groundwater systems. Many of the region's alluvial and coastal sand groundwater systems are highly connected to surface water flows so reductions in surface flows can reduce recharge rates. This impacts both the health of groundwater-dependent ecosystems and consumptive users of groundwater.

Competition for water also negatively affects the reliability of water for irrigated agriculture. Unreliable water supplies can seriously threaten the long-term viability of existing industries and can discourage future investment in emerging industries.

Catchment conditions and limited data are constraining the ability to set effective rules to manage competing demands for low flows

Protecting low flows reduces the stress on the region's rivers and protects water for downstream users. Implementing these protections relies on cease-to-pump rules. These rules require licenced water users to stop taking water under low flow conditions and are based either on gauged flow rates or visible flow conditions and daily extraction limits.

A lack of stream gauging has made it difficult to effectively implement cease-to-pump rules. Sand-dominated coastal streams are not suited to conventional stream gauges and identifying reliable long-term gauging sites is difficult. Gauging stations are also expensive to install and maintain, and many new gauges would be required to cover all streams where extraction occurs. Consequently, augmenting the coastal gauging network would come at a considerable cost to water users. This may be difficult to justify given the low level of extraction compared to inland regions.

Visible flow rules were adopted in many of the small unregulated coastal catchments in the region to manage these challenges. However, visible flows have been criticised for being subjective. They are also generally so low that they do not provide sufficient protection for environmental assets.

Daily extraction limits are another tool for addressing competition for water. They permit water users to take a proportion of the daily flow at a particular site, leaving enough water for the environment and downstream users. However, implementing daily extraction limits takes considerable resources, including stream flow gauges, water meters and coordinated rostering among users.

Low numbers of metered pumps makes it difficult to understand the extent of low flow competition and to manage water sharing among users

Protecting low flows requires water users to comply with the rules. However, very few pumps for surface water or groundwater are metered. This makes it difficult to ensure water is extracted legally and shared equitably during low flow periods. In some parts of the region, water sharing arrangements and compliance with cease-to-pump rules is managed through community-operated water user associations. However, management is difficult without meters or adequate gauging.

Growth in harvestable rights dams and water extraction under basic landholder rights may place additional pressure on low flows

The protection of low flows can be compromised by water take that does not require licensing and approvals, particularly where there is significant take-up of harvestable rights and basic landholder rights within a catchment.

Harvestable rights allow landholders to intercept a percentage of average regional rainfall-runoff from their property and store it in one or more farm dams without a water access licence, water supply work approval or water use approval. Many landholders in coastal areas have sought the right to take and store more water during wet periods to improve their preparedness for dry periods. However, a range of stakeholders are also concerned about the impact this may have on freshes and low flows in downstream rivers and creeks.

Harvestable rights dams do not require a licence, so there is a limited understanding of their current level of water take, and their impacts on the environment and licensed water users. Additionally, many harvestable rights dams in the region have been found to be significantly larger than the permissible size. This could negatively affect baseflows to downstream waterways. Changes to harvestable rights in coastal-draining catchments announced in October 2021 will allow an increase in the proportion of average regional rainfall-runoff that may be harvested from 10% to 30%, subject to limitations and mitigation measures intended to reduce the effects on low flows. Further detailed catchment analysis in 2022 will confirm the suitability of these changes to harvestable rights.

Growth in water extraction for domestic and stock purposes under basic landholder rights is also increasing competition for water at low flows. This is particularly true for rural residential sub-divisions with waterway frontage. Water extraction for basic landholder rights is not regulated. There is no limit on the volume of water that may be taken and there are no guidelines about how the right can be used, although basic landholder rights cannot be traded. Increases in these rights could compromise the effectiveness of any cease-to-pump conditions aimed at protecting the environment and downstream users. Under the *NSW Water Strategy*,[34] we will review how domestic and stock basic landholder rights are regulated. This review will include estimating the quantity of water extracted under these rights.

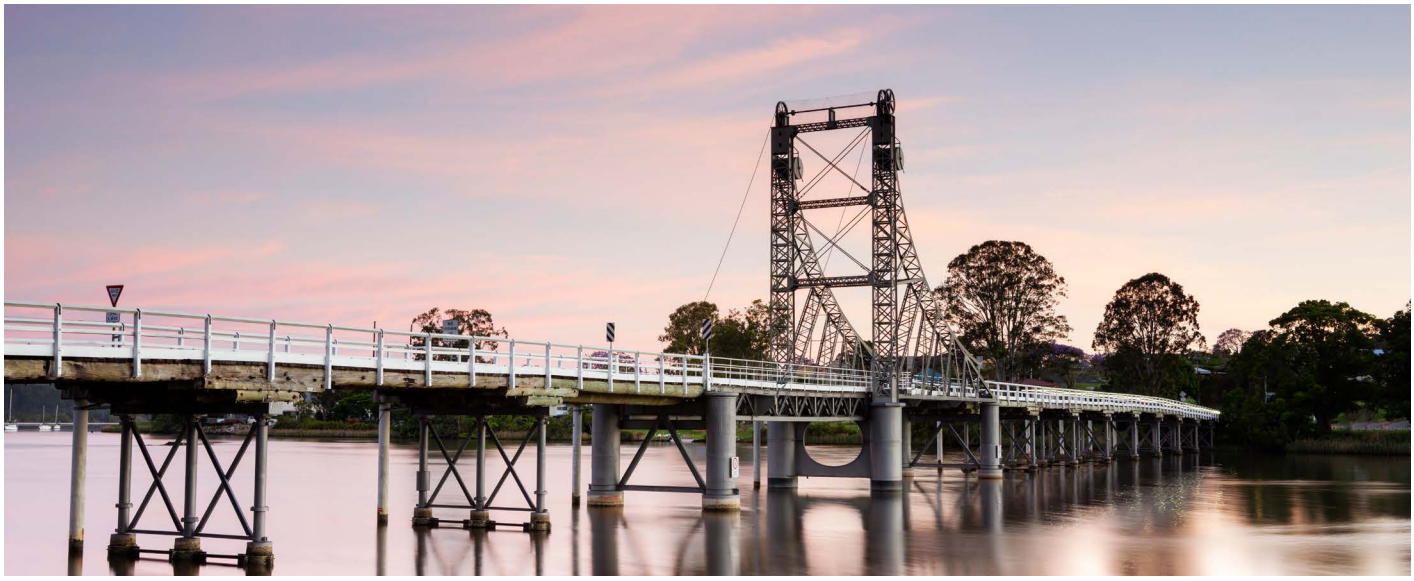


Image courtesy of My Clarence Valley. McFarlane Bridge, Maclean.

34. Department of Planning, Industry and Environment 2021, *NSW Water Strategy*, water.dpie.nsw.gov.au/plans-and-programs/nsw-water-strategy

Challenge: Saltwater intrusion into freshwater sources

Sea level rise, groundwater extraction and changes in catchment hydrology are projected to seriously affect coastal waterways and aquifers. We need to better understand the magnitude of this threat and how best to manage it.

Global sea levels are rising, mostly from increasing greenhouse gas concentrations in the atmosphere and associated glacial and ice sheet melt.[35] Between 1966 and 2009, sea levels around the coastline of Australia have risen at an average rate of 1.6 mm/year,[36] which equates to approximately 7 cm over the past 50 years. Rising sea levels will result in saline water migrating upstream and saltwater intrusion in many of the region's groundwater and low-lying water sources. Increased water salinity may negatively affect:

- coastal wetlands, and freshwater and estuarine habitats such as mangroves that are critical for fauna breeding and recruitment
- town water security and water users who currently access and rely on freshwater close to, or within, current tidal limits
- Aboriginal communities' abilities to practice culture and protect important cultural sites and assets.

The magnitude of sea level rise and its impacts will vary by location due to geological factors, ocean currents and localised thermal expansion or contraction of oceans. The extent to which sea level rises will also depend on how much greenhouse gas emissions are reduced in the coming years.

The average projection for sea level rise along coastal NSW is between 0.30 m and 0.45 m by 2070.[37] For the North Coast region, the average projection is between 0.19 m and 0.59 m by 2070 (Table 4).

Larger sea level rises are possible beyond these scenarios. The Intergovernmental Panel on Climate Change states that sea level rise will continue for centuries to millennia due to continuing deep ocean warming and ice sheet melt. It projects that the global mean sea level rise by 2100 could be up to nearly 2 m (for a very high greenhouse gas emission scenario). Storm surges may also contribute to higher sea levels during the more frequent and intense low-pressure systems caused by climate change.

The severity of impacts from sea level rise, saltwater intrusion and altered catchment hydrology is likely to worsen as growing populations and industries increase the demand for freshwater in coastal areas.

35. Oppenheimer et al. 2019, *Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities*. In Pörtner et al. (Eds.), *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*, Intergovernmental Panel on Climate Change.
36. Siebentritt, M. 2016, *Understanding sea-level rise and climate change,* and *associated impacts on the coastal zone: CoastAdapt Information Manual 2, National Climate Change Adaptation Research Facility,* coastadapt.com.au/information-manuals
37. CoastAdapt 2017, *Sea-level rise and future climate information for coastal councils,* www.coastadapt.com.au/sea-level-rise-information-all-australian-coastal-councils

Table 3. Sea level rise projections for the North Coast region

Year	Low emissions scenario (RCP4.5) [m]	Very high emissions scenario (RCP8.5) [m]
2030	0.13 (0.09–0.18)	0.14 (0.09–0.18)
2050	0.22 (0.14–0.29)	0.27 (0.19–0.36)
2070	0.30 (0.19–0.42)	0.45 (0.31–0.59)

Table notes:
Values are averaged, with the likely range provided in brackets.
Projections are relative to an average calculated between 1986 and 2005.
RCP = representative concentration pathway.

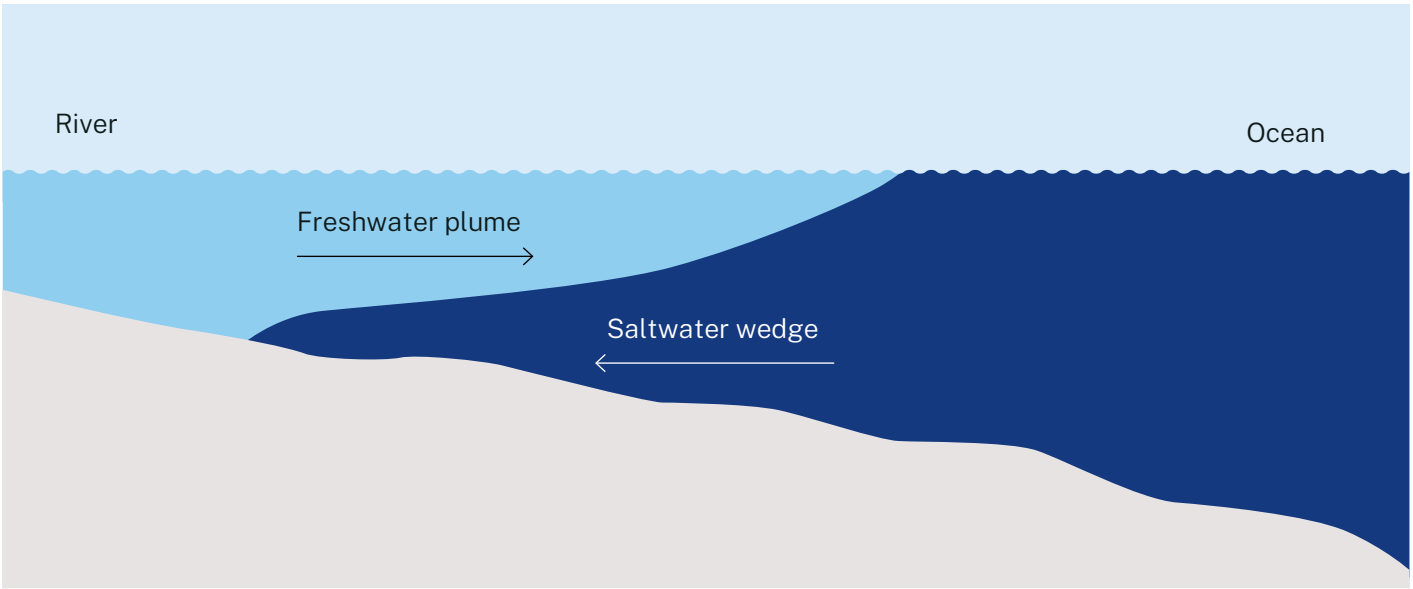
Possible reductions in river flows are likely to worsen the effects of sea level rise

Many of the North Coast region's rivers have a maximum high-tide footprint that extends at least 20 km upstream. Sea level rise is likely to cause estuarine zones to move further upstream. Climate change will also reduce the size of freshwater inflows and increase the frequency of cease-to-flow events, which is expected to have other negative effects.

During low-flow and cease-to-flow events, salinity gradients in tidal pools change as freshwater entering estuaries is either reduced or stops (Figure 13). This change allows the salt wedge that usually sits below the freshwater in tidal pools to move further upstream.

Our modelling shows that low flows may be 36% smaller under a worst-case climate change scenario. The frequency of cease-to-flow events could increase by between 2% and 8%. The most significant reductions in low-flow and cease-to-flow events are likely to occur in the Macleay River catchment. The frequency of cease-to-flow events there could increase by 24%

Figure 13. Concept of a tidal saltwater wedge for a permanently opened estuary[38]



38. Adapted from Hurdle, J. 2020, *As Sea Levels Rise, Will Drinking Water Supplies Be at Risk?*, Yale School of the Environment e360.yale.edu/features/as-sea-levels-rise-will-drinking-water-supplies-be-at-risk

Saltwater intrusion in freshwater and estuarine systems – and the associated increase in salinity levels – is a significant risk to water users in low-lying areas across the region. Freshwater extraction from below the tidal limit currently occurs in the Bellinger, Clarence, Hastings and Macleay river tidal pools. Many towns also extract water from rivers and alluvial groundwater immediately upstream of the existing high-tide limit. This means that even a small rise in sea level may reduce the suitability of water sources for a number of important uses, including:

- local town water supplies
- irrigation
- dairy washdown
- stock and domestic supplies.

Saltwater intrusion may also compromise water and wastewater treatment plant infrastructure.

Sea level rise is likely to negatively affect coastal environments such as low-lying coastal wetlands that could become inundated for longer. At the most extreme, some low-lying coastal wetlands could be permanently inundated. The *Marine Estate Management Strategy* recognises sea level rise as a key threat to the NSW coastal, estuarine and marine environment and has identified several actions to prepare the region to manage this risk. These actions include on-ground activities that provide habitat protection and rehabilitation to help mitigate the impacts of climate change. They also include tools that will help industry and the community better understand future impacts.

Plans and strategies for water resources in the region will need to incorporate more up-to-date information on climate change to better manage the future impacts of sea level rise. For example, the hydraulic models developed for the Hastings, Clarence and Macleay river catchments for the *Marine Estate Management Strategy* considered sea level rise and saltwater intrusion, but did not consider the impacts from changes in freshwater inflows due to climate change.

Water sharing plans for major tidal pools in the Clarence and Macleay river catchments have cease-to-pump rules that try to prevent the unnatural progression of saltwater into the tidal pools. At this stage, however, it is unclear if these rules are enough to protect downstream users and environments in the future.

It is critical to form a clearer regional picture of the combined effects of changes to catchment hydrology and sea level rise. This will help us develop appropriate local management responses.

Sea level rise is likely to increase the risk of saltwater intrusion into groundwater, particularly for low-lying areas with high volumes of extraction

Saltwater intrusion into groundwater is caused by sea level rise and over-extraction of groundwater and freshwater. Areas where groundwater and surface water systems are highly connected are particularly vulnerable. The intrusion of saltwater into groundwater affects ecosystems and town water security by significantly degrading water quality and reducing freshwater availability.

Groundwater sources that are vulnerable to saltwater intrusion include coastal sands, floodplain alluvials and some upriver alluvial groundwater sources. These groundwater sources are important to the region's towns, tourism and industries, particularly the major centres of Kempsey, Bellingen and Nambucca. Saltwater intrusion is already occurring in the Stuarts Point coastal sands.

We currently manage the impacts of saltwater intrusion by ensuring coastal aquifers are not over-extracted. This is done mainly by controlling licensed extraction and managing water levels in areas of high extraction.

Challenge: Aboriginal people's rights and access to water

Historical dispossession of land, effects of colonisation and government water management processes continue to impact Aboriginal people's access to water and their ability to care for Country.

Aboriginal people have lost access to waterways

The historical dispossession of land and the effect of colonial-era settler laws continue to impact the Aboriginal people's access to water and ability to care for Country. Fences and locked gates on public land such as Crown land and state conservation areas prevent Aboriginal people from accessing Country, carrying out cultural practices and using traditional cultural knowledge to care for and manage waterways.

Water infrastructure, modifications made to waterways, and poor land management and land use practices impact important cultural sites and traditional water and food sources.

Access to Country and waterways and the important sites they hold is critical to providing a purpose and pathway for young people to connect to culture. These sites provide spaces for healing, as well as for food, medicine, and teaching.

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

Image courtesy of Destination NSW. Unkya Cultural Eco Tours, Scotts Head.

North Coast region's Aboriginal people want a 'seat at the table' when it comes to decision-making

Current water legislation and water management processes do not adequately bring the North Coast region's Aboriginal people into decision-making, nor do they fully reflect Aboriginal people's perspectives, approaches and values. These processes also do not draw on the knowledge that the North Coast region's Aboriginal people have of their traditional lands, water bodies and the flora and fauna that inhabit them. This is compounded by the limited involvement of the North Coast region's Aboriginal people in water consultation processes. Most often this lack of involvement has been because:

- There is a lack of trust in governments. Historically, governments have not engaged thoroughly in water and natural resource management in the region, nor have they followed through on previous commitments.
- Consultation timeframes and processes around water policy changes do not allow the time needed for Aboriginal cultural governance processes.
- The state and federal laws and systems around water and natural resource management are complex. They do not match well with Aboriginal perspectives and are often not clearly explained.
- Aboriginal groups lack resources and support to drive their engagement in water management.

The North Coast region's Aboriginal people want a 'seat at the table' when it comes to decision-making, both at the state and local levels. Government needs to develop a collaborative, culturally-sensitive approach that is appropriate for Aboriginal communities. This means working with Aboriginal communities to develop governance structures that are familiar to them, and setting aside adequate time to engage, consult and genuinely listen to Aboriginal people. These investments in time and resources will help build respect and trust between all parties. They will also help identify the different needs, challenges and interests of each Aboriginal community.

This model can benefit both Aboriginal communities and government by:

- offering the North Coast region's Aboriginal people the opportunity to improve outcomes for Country and for their communities
- improving natural resources management with the rich and holistic approach to water and land management that Aboriginal people have been practicing for thousands of years.

Challenge: Water security for industries in the North Coast

The viability and growth of regional industries is constrained by the uncertainty of future access to secure water supplies.

Water-dependent industries are facing an uncertain future in the region due to climate variability and climate change. New modelling shows that the reliability of existing water access licences is likely to be less than originally thought and may reduce in the future. Saltwater intrusion also threatens existing supplies of high-quality surface water in low-lying areas close to the coast and coastal groundwater systems.

Existing and prospective North Coast region businesses find it hard to gain access to additional water to mitigate these risks or to support new or expanding industries.

To respond to these issues, local industries are already innovating towards diversification of water sources to increase production and reliability. This diversification has complementary benefits to other stakeholders. It means more water is available to relieve the stresses of future droughts. Increased diversification, productivity and efficiency are complementary, not contradictory, across the strategy's objectives.

Limited stored water or alternative sources of water to meet irrigation demands, particularly during drought

Historically, large volumes of water have not needed to be stored for irrigation across the North Coast region. Traditional crops were rain-fed and only required irrigation during the drier spring months. For most landholders, the costs of constructing, maintaining and operating farm dams and the additional pumping infrastructure was not economically viable.

The 2018–20 drought highlighted the need to shift from a reactive to a proactive management approach to weather extremes. The drought showed that the crops currently grown in the North Coast region are vulnerable to extended dry periods, particularly the more recent horticultural crops. During the recent drought, farm dams dried up, many farmers carted water, crops were severely cut back, and stocks were reduced. At one point, the blueberry industry at Woolgoolga even tried to access water from a decommissioned local council dam.

The 2020 bushfires in the North Coast region's hinterland affected farm infrastructure, such as troughs, further reducing local water supplies. Water quality was also badly affected by the fires (see challenge 1).

Our modelling shows that dry periods are likely to increase in frequency and intensity, and traditional surface water sources may be less reliable than previously thought. Currently, there are few alternative water sources available in the region that are readily accessible and able to mitigate the water security risks of drought.

Groundwater is often considered an emergency supply of water during drought. For the North Coast region, the interconnectivity between surface water and many of the region's groundwater sources means that reductions in surface water flows – from changes to rainfall during periods of drought as well as from over-extraction – can reduce groundwater yields. Some of the region's coastal sands and alluvial groundwater sources have come close to failing during extended dry periods, even with only the current licensed extraction levels.

The only climate-independent water source in the region is the recycled water scheme operated by Coffs Harbour City Council. This scheme supplies water to 30 agricultural properties, mainly for growing blueberries, tomatoes, cucumbers, and bananas. It also supplies municipal and sporting facilities. However, using this water has presented several problems around administration and downstream water quality.

Water extraction limits are restricting development opportunities in some unregulated catchments

Water sharing plans set limits on how much water can be extracted annually from the region's water sources through long-term average annual extraction limits (LTAAELs). LTAAELs aim to balance long-term reliable access to water with protecting the environment.

Surface water and alluvial groundwater LTAAELs in the North Coast region reflect the sum of licensed volumes and estimated basic landholder rights at the time the water sharing plan was made. As such, no new water access licences can be issued to surface water sources, even if they would not cause water extractions to exceed long-term sustainable limits.

The region's groundwater LTAAELs vary by aquifer and are based on the calculation of several key components, including groundwater recharge, risk assessments, planned environmental water, and current and future water requirements. Unassigned water exists in these sources because the LTAAELs still exceed the total volume of water access licences and basic landholder rights. Acknowledging this, the NSW Government has made shares available in these groundwater sources through a controlled allocation process each year since 2017. Future controlled allocations will be made in accordance with the *Strategy for the controlled allocation of groundwater*.[39]

However, opportunities for industry to use groundwater are constrained. Current usage is low, mainly due to the limited availability of agricultural land along the coast, large areas of national parks and nature reserves, the presence of groundwater-dependent ecosystems and the presence of potential acid sulfate soils. Additionally, the quality of the available groundwater is not suitable for crops such as cucumbers.

Agricultural production in the North Coast region is constrained by existing harvestable rights limits. Harvestable rights apply to coastal-draining catchments and allow landholders to collect a proportion of the average regional rainfall-runoff from their property in one or more dams on non-permanent, mapped minor streams, or unmapped streams.

This collection is allowed without a water access licence, water supply work approval or water use approval. Some water users have advocated for increases in harvestable rights to support commercial enterprises and believe that this could be achieved while still maintaining a sustainable level of access for downstream users. The recently announced increase in the harvestable rights limit in coastal-draining catchments recognises the strong interest received from some water users for the need to improve water security for stock and domestic and basic farming use during extended dry periods and to ensure water for firefighting. The increase in the harvestable rights limit in coastal-draining catchments excludes the use of this water for intensive agricultural uses such as horticulture and aquaculture.

Water users are not taking up opportunities in water sharing plans to access more water

For water sources where no additional licences can be allocated, additional water can be accessed through permanent or temporary trade of existing water access licences, in line with water sharing rules. The rules aim to maximise flexibility for water users without adversely impacting the environment or the reliability of other water access licences.

Very little trade occurs in the region's catchments, despite trade being allowed and annual water usage in most areas generally being well below LTAAELs. There are no examples of temporary trades and only a few examples of permanent trades. Water users have noted many barriers to trade, including lack of meters, restrictive trade rules and limited market information.

Water sharing plan rules allow for low-flow to high-flow conversions in many North Coast region water sources. Although the main intent of this rule is to protect low flows, it also allows landholders to access a greater volume of water during high-flow periods to store for later use. In theory, this approach could also provide landholders with more water to support expanded operations. However, there are currently no high-flow conversion licences in the region.

39. Department of Primary Industries Water 2017, *Strategy for the controlled allocation of groundwater*, www.industry.nsw.gov.au/water/allocations-availability/controlled

Landholders who have shifted to irrigated crops do not fully understand their water requirements or how to maximise irrigation efficiencies

Irrigated industries in the North Coast region, such as intensive horticulture, have generally been established based on an expectation that there is plenty of water available. However, the evidence to support this belief has been lacking. Our new modelling that considers long-term climate variability and climate change suggests that water availability may be lower than previously thought.

Some farmers who have shifted to more water-dependent crops do not have the knowledge or experience of irrigation. However, simple changes to farm infrastructure and processes can provide significant water savings. To support these industries in the future, capacity and knowledge gaps need to be addressed. A good understanding of irrigation demands is also needed.

Image courtesy of Jaime Plaza Van Roon, Department of Planning and Environment. Coffs Harbour, NSW.

Challenge: Water security for towns and communities in the North Coast

The reliability of town water supply sources is likely to decrease with projected climate change.

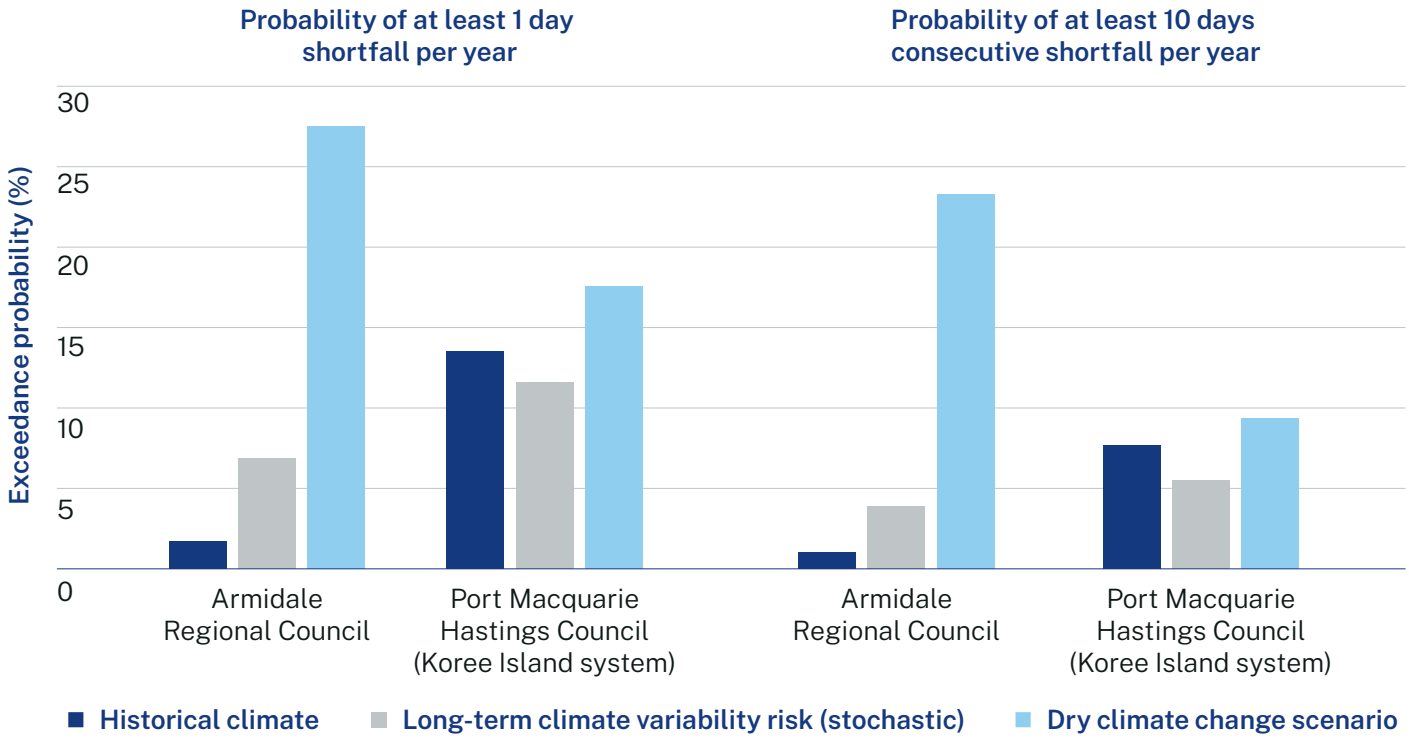
Most major centres in the North Coast region rely exclusively on surface water flows for town water supply. Alluvial groundwater is also an important water source for Kempsey Shire Council, Nambucca Valley Council and Bellingen Shire Council.

Our long-term climate variability data shows that risks to some town water supplies in the region are higher than previously thought. This is particularly true for surface water sources. These risks are likely to increase with climate change. However, the magnitude of these risks varies across the region. Our new modelling suggests that the western parts of the North Coast region may be worse affected than the eastern parts.

Figure 14 shows the likelihood of supply shortfalls modelled using the 3 climate data sets. The figure shows that the increases in supply risk from climate variability and climate change are likely to be more significant for the Armidale Regional Council system than for the Port Macquarie Hastings Council system.

Alluvial groundwater sources are highly connected to rivers, so they are affected by low stream flows. Our new modelling shows that cease-to-pump orders and periods of low flow could occur more often, which could affect the reliability of town water supplies that use groundwater.

Figure 14. Probabilities of modelled supply shortfalls for different parts of the North Coast region



Many local councils in the region have already taken steps to protect town water supplies against dry periods

Over the last 20 years, many of the North Coast region's local councils, have invested in infrastructure to manage shortfalls in water availability, prompted by impacts from historic extended dry periods and population growth. This is particularly true for the larger centres of Grafton, Coffs Harbour and Port Macquarie. These measures have mainly included local water storages. The only example of a regional town water supply solution in the North Coast region is the Clarence–Coffs Harbour Regional Water Supply Scheme. Our modelling indicates a low water availability risk for this scheme to supply town water to Grafton and Coffs Harbour based on both instrumental and future climate change data.

The 2018–20 drought highlighted that many of the region's local town water supply systems are still vulnerable to drought. Several local storages were affected by algal blooms and, for some councils, water security issues continued even when rain arrived. The combination of bushfires, drought and, eventually, heavy rainfall increased turbidity in the region's rivers. This subsequently impacted the ability of the town water treatment facilities to effectively treat water.

Regional solutions for improving access to water for towns are limited

As a result of these climate conditions, councils across the region are investigating improvements to existing measures or additional local opportunities to secure town water supplies. Much of this work is being informed by local water utility strategic planning. Consideration of our new climate modelling data and future water availability risk will be critical to understanding the capability of existing town water supply systems to reduce supply risks and in assessing the performance of local supply opportunities.

Councils are mostly investigating local opportunities to improve town water security. The major centres are spread across 5 of the 6 main catchments. Regional opportunities are limited due to the size and topography of the region, except for potentially connecting Bellingen to Coffs Harbour's town water supply. Comments on the Draft North Coast Regional Water Strategy showed significant community concern with connecting neighbouring town water networks and emphasised the importance of managing water locally. There was also significant opposition to inland catchment diversions due to the economic and environmental costs involved.

Several options that included diverting water from NSW coastal regions to the Border Rivers region were investigated to inform the Border Rivers Regional Water Strategy. Our analyses show that the costs of such a scheme could be between $4 billion and $5 billion. This is larger than the economic value provided by some of NSW's biggest inland centres. The economic value that could be created from this water is significantly less than the project costs. Additionally, these options would have serious negative effects on the environment, Aboriginal people and communities on the coast.

Image courtesy of Destination NSW. Hastings River, Port Macquarie.

Image courtesy of Destination NSW. Grafton Jacaranda Festival 2018, Northern Rivers.

Responding to the challenges

5

Image courtesy of iStock. Clarence River, Grafton.

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

There is no single solution that can address the challenges ahead, and it is important that this strategy does not preference one interest group over another. Although sometimes interests compete, harnessing the synergies of various objectives will deliver maximum possible benefit for the whole region.

To help us achieve this vision and address the challenges in the North Coast region, we have set 3 priorities and identified actions under each (Figure 15 and Figure 16). The regional priorities are:

- take a holistic approach to land and water management
- ensure water resource development and use is sustainable and equitable
- prepare for future climatic extremes.

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

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

Image courtesy of My Clarence Valley. Scenic country views of the Mann River, Cangai.

Figure 15. North Coast Regional Water Strategy: overview of strategy vision, objectives, water security challenges and priorities

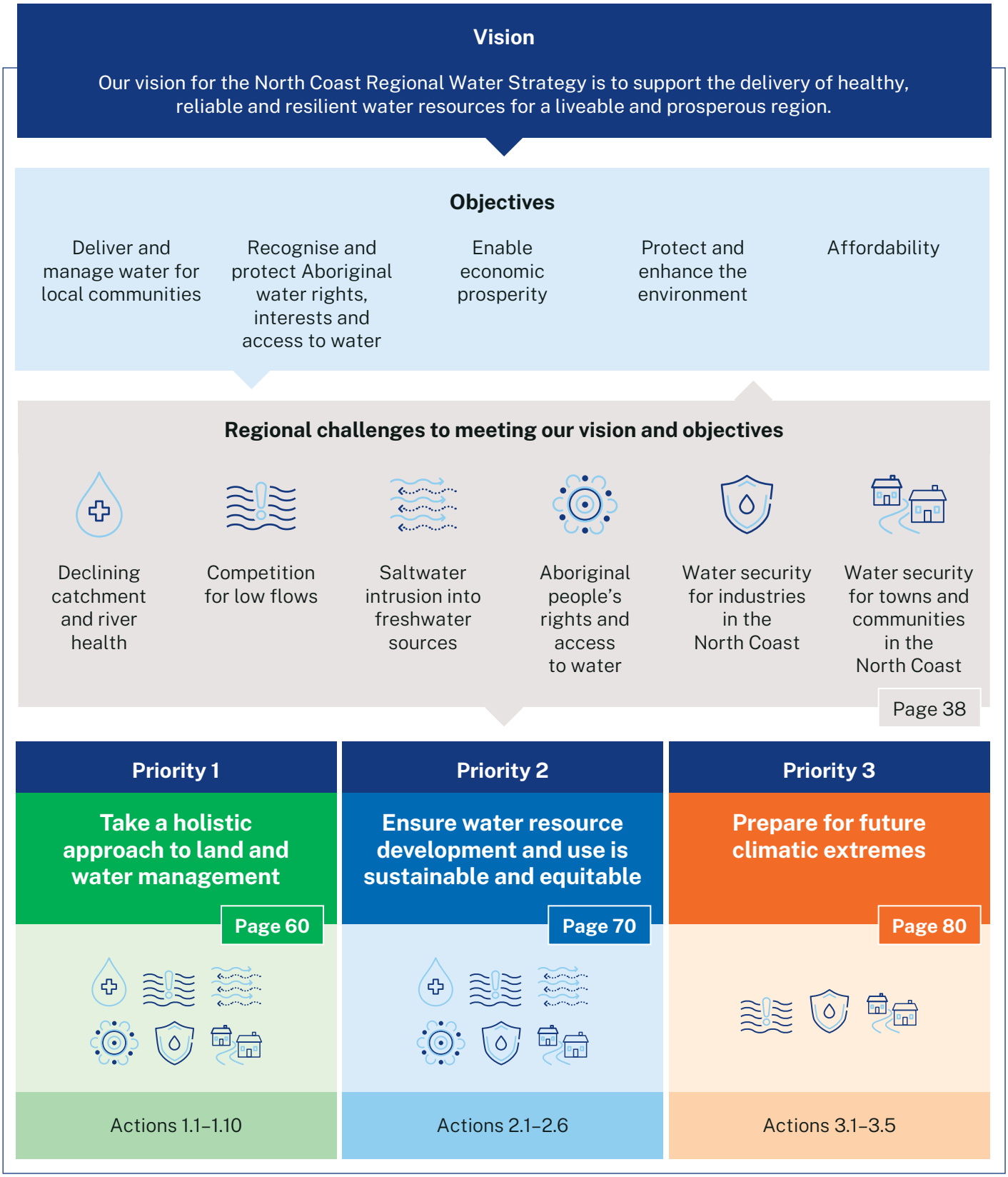
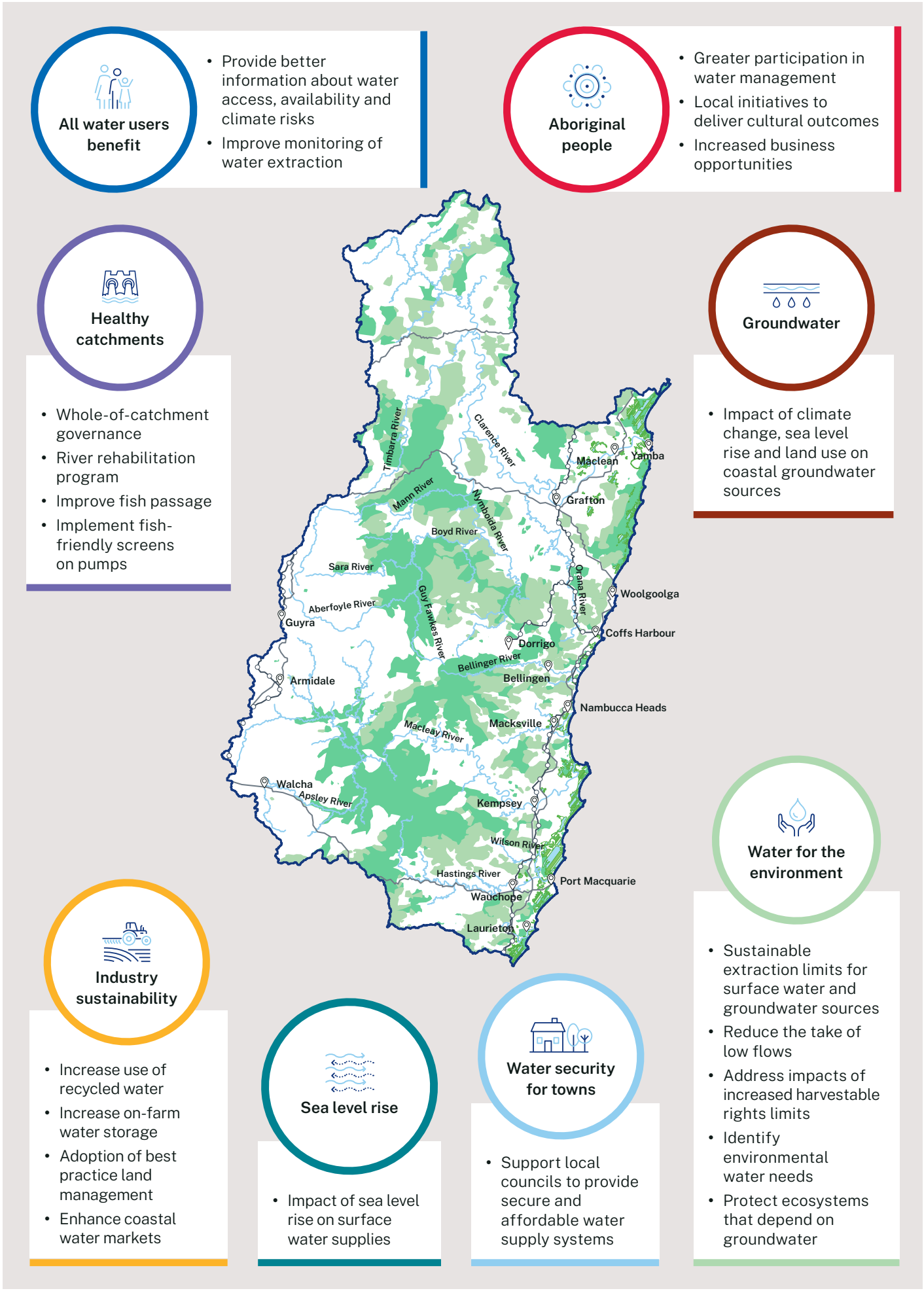


Figure 16. Summary of North Coast Regional Water Strategy actions



Priority 1

Take a holistic approach to land and water management

To continue to protect and enhance the region's waterways, groundwater systems and the ecosystems they support, we need to ensure management systems and decision-making processes use a holistic, whole-of-catchment approach. This approach includes coordinating efforts across stakeholder groups and supporting landholders to build awareness and capacity for best practice natural resource management and sustainable agriculture. Adopting best practice land and water management that considers Aboriginal knowledge and culture together with western science will be critical to ensuring efforts that protect waterway health are targeted and benefit users at a local, whole-of-catchment and regional scale.

Our starting point

The ***NSW Water Strategy***[40] commits to actions to improve river, floodplain and aquifer ecosystem health and system connectivity (Priority 3 of the *NSW Water Strategy*). For example by taking landscape-scale action to improve river and catchment health and adopting a more intense, statewide focus on improving water quality.

The NSW Government will partner with First nations/Aboriginal people to co-design a statewide **Aboriginal Water Strategy** that will identify a program of measures to deliver on First nations' water rights and interests in water management and help address systemic issues to better enable the exercise of Aboriginal people's rights and access to water.

The ***Marine Estate Management Strategy***[41] is progressing actions that address the cumulative impact of agricultural runoff, urban stormwater, sediment contamination and other threats to the water quality of NSW estuaries (Initiative 1). Actions such as on-ground activities to provide habitat protection and rehabilitation are being designed to help mitigate the impacts of climate change on estuarine and coastal habitats, particularly from sea level rise.

Coastal management programs,[42] developed by local councils with the assistance of the Department of Planning and Environment, provide strategic direction and funding support for local councils to address key coastal management issues, including impacts that originate from higher in the catchment.

The NSW Government is developing the **NSW Groundwater Strategy**[43] that identifies the key risks to our groundwater resources and the associated management challenges for NSW. The strategy sets out the actions required to respond to these challenges and provide a framework for funding of groundwater management reform work over the next 20 years.

The NSW Government is implementing the new **non-urban metering framework**[44] through the *NSW Government water reform action plan*. Under the framework, all surface water and groundwater works covered by the rules in the North Coast region will need to be fitted with compliant metering equipment by 1 December 2024.

The **Protecting Our Places Grants Program**[45] is a contestable grants program for Aboriginal community organisations and groups, seeking to achieve long-term beneficial outcomes for the environment.

The NSW Government is running a suite of natural capital programs[46] that can benefit farmers who voluntarily want to manage biodiversity and carbon while enhancing their land for productive use.

40. Department of Planning, Industry and Environment 2021, *NSW Water Strategy*, water.dpie.nsw.gov.au/plans-and-programs/nsw-water-strategy
41. NSW Government 2018, *Marine Estate Management Strategy 2018–2028*, www.marine.nsw.gov.au/marine-estate-programs/marine-estate-management-strategy
42. More information on coastal management programs is available at: www.environment.nsw.gov.au/topics/water/coasts/coastal-management/programs
43. Department of Planning and Environment 2022, *Draft NSW Groundwater Strategy,* www.dpie.nsw.gov.au/water/plans-and-programs/nsw-groundwater-strategy
44. More information on the non-urban metering framework is available at: dpie.nsw.gov.au/water/nsw-non-urban-water-metering
45. More information on the Protecting Our Places Grants Program is available at: environment.nsw.gov.au/funding-and-support/nsw-environmental-trust/grants-available/protecting-our-places
46. More information on natural capital programs is available at: www.environment.nsw.gov.au/research-and-publications/our-science-and-research/our-research/social-and-economic/natural-capital

Legend

Declining catchment and river health

Competition for low flows

Saltwater intrusion into freshwater sources

Aboriginal people's rights and access to water

Water security for industries in the North Coast

Water security for towns and communities in the North Coast

Figure 17. Actions to address Priority 1: Take a holistic approach to land and water management

Action number	Action name	Challenges addressed
Incorporate Aboriginal knowledge and culture into land and water management		
Action 1.1	Foster ongoing collaboration with local Aboriginal people in water management	
Action 1.2	Support place-based initiatives to deliver cultural outcomes for Aboriginal people	
Undertake whole-of-catchment planning, decision-making and project delivery		
Action 1.3	Support whole-of-catchment governance	
Action 1.4	Deliver a river rehabilitation program	
Support local landholders to adopt best practice land use and water management		
Action 1.5	Support landholder adoption of best practice land management	
Improve our understanding and management of the region's water resources		
Action 1.6	Assess the vulnerability of surface water supplies to sea level rise and saltwater intrusion	
Action 1.7	Identify environmental water needs to support healthy coastal waterways	
Action 1.8	Characterise and plan for climate change and land use impacts on coastal groundwater sources	
Action 1.9	Protect ecosystems that depend on coastal groundwater	
Action 1.10	Improve monitoring of water extraction	

Incorporate Aboriginal knowledge and culture into land and water management

As custodians of Australia's land and water for tens of thousands of years, Aboriginal people have developed a rich spiritual connection to Country and have a large body of knowledge and culture. Healthy waterways are critical for Aboriginal people's health, wellbeing and culture.

Aboriginal people do not consider land and water as separate. A more holistic approach to land and water management involves working collaboratively with Aboriginal people, drawing on their knowledge and experience, and integrating their perspectives, approaches and values into water legislation and management frameworks. We will develop whole-of-system governance structures that are understood and supported by Aboriginal people and give them direct input to water management decision-making. We will also provide Aboriginal people with opportunities to manage water using their culture and knowledge and create improved economic opportunities and environmental outcomes. Restoring degraded spiritual and cultural sites are important acts of reconciliation.

Action 1.1: Foster ongoing collaboration with local Aboriginal people in water management

Aboriginal people have told us 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 following this are never seen again. During consultation in the North Coast region, Aboriginal groups told us that government has to earn the trust of the community as the first step in building strong, lasting relationships with them.

To address this issue 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 incorporated into decision-making.

An effective governance, engagement and knowledge-sharing arrangement is the first step in improving Aboriginal people's involvement in water management. The makeup and function of groups need to be led by local communities to be successful. Experience has shown that governance models for Aboriginal communities do not work when they are set by government. This action will include supporting new or existing Aboriginal groups to develop a model for involvement in water management processes. One example of a model supported by some Aboriginal people in the North Coast is establishing Aboriginal catchment management boards. 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.

Action 1.1 supports Priority Reform 1 in the *National Agreement on Closing the Gap*[47] to enter formal partnerships and shared decision-making arrangements and to develop place-based partnerships that respond to local priorities.

Local Aboriginal groups in the North Coast region could be involved in:

- developing culturally appropriate water knowledge programs
- identifying culturally appropriate methods for how and when communities should be consulted and how their feedback should be considered in decision-making processes
- outlining a process that the NSW Government can follow to ensure water-related decisions have been appropriately considered by the community.

47. Various parties 2020, *National Agreement on Closing the Gap*, available at: closingthegap.gov.au/national-agreement

Action 1.2: Support place-based initiatives to deliver cultural outcomes for Aboriginal people

The Australian Government's *Closing the Gap*[48] report and the Local and Indigenous Voice program have highlighted that Aboriginal people want strong and inclusive partnerships in which local communities set their own priorities and tailor services and projects to their unique situations. Successful programs are often those that are tailored to local circumstances, are place-based, well resourced and locally-driven.

Action 1.2 will fund and support Aboriginal organisations and communities to develop tailored projects for their communities. It will move away from centralised decision-making and develop a flexible program that is driven by the principle of self-determination – local communities 'speaking with their voices' to make decisions about which programs are needed for their community and their region.

There are already some examples of local Aboriginal groups in the North Coast leading the way in delivering on-ground river restoration and education programs. One example is the Darrunda Wajaarr Rangers. This group of Gumbaynggirr people has been operating since 2006 in the Coffs Harbour area. They combine their traditional knowledge with western practices to restore and look after the land. They also inform and empower local Aboriginal people – especially young people – to take a more active interest in the environment and language of their Country.

In the North Coast region, this action will build on the work already started by local Aboriginal groups by:

- *Identifying cultural water needs for specific sites or locations where water may support cultural practices*: This could involve working with the Department of Planning and Environment and WaterNSW to understand if cultural water access licences or water for the environment could help deliver water to these locations.
- *Improving access to Country*: This could be done by opening up gated or locked parcels of land that have access to waterways. These could be locations of significance and could include travelling stock reserves or Crown roads.
- *Piloting a restoration reach*: This would use cultural knowledge and science to rehabilitate riparian land, plant native species and care for Country.
- *Supporting Aboriginal communities to develop 'Caring for Country' programs*: These engage young Aboriginal people in water and landscape management. Their objectives include building cultural awareness and giving 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, licensing structures, land management or knowledge activities for schools and youth programs.

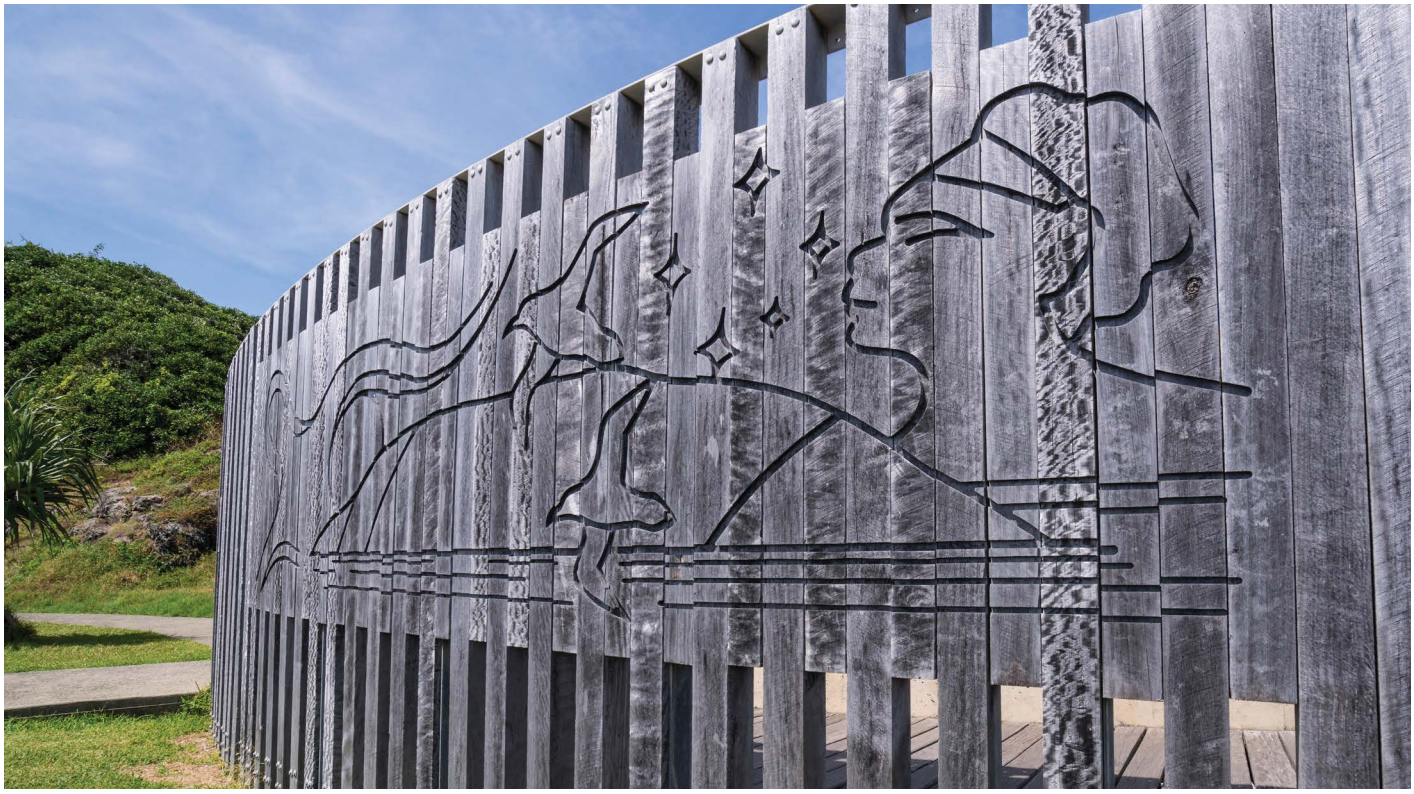


Image courtesy of Jaime Plaza Van Roon, Department of Planning and Environment. Muttonbird Island Nature Reserve, Coffs Harbour.

48. Australian Government 2020, *Closing the Gap* report, available at: ctgreport.niaa.gov.au/

Undertake whole-of-catchment planning, decision-making and project delivery

Many strategies, programs and on-the-ground projects have tried to improve the health of the region's aquatic environment. These strategies, programs and on-ground projects have mainly focused on managing the impact of diffuse pollutants from urban and rural land on the coastal, estuarine and marine environments. These initiatives include:

- the NSW Government's *Marine Estate Management Strategy*[49]
- *NSW Coastal management framework*[50] and supporting coastal management programs
- different on-ground works administered by the Department of Planning and Environment, Local Land Services, Department of Regional NSW, Department of Primary Industries, local councils, community groups, private landholders, and local Aboriginal organisations.

The following actions aim to build on existing programs that focus on managing the impact of diffuse pollutants from urban and rural land on the coastal, estuarine and marine environments. They will apply a whole-of-catchment approach to planning, decision-making and project delivery. Catchment planning will help target and coordinate these programs under one framework. It will also help highlight and address gaps in the current range of programs being delivered, particularly those related to river and geomorphic health.

Action 1.3: Support whole-of-catchment governance

Current governance arrangements have been criticised as being fragmented, which affects decision-making, investment prioritisation, monitoring and reporting. Delivering effective governance is a key initiative of the *Marine Estate Management Strategy* to help address threats and improve health outcomes to the NSW coastal, estuarine, and marine environments.

The *Marine Estate Management Strategy* recognises the need to improve collaboration and integration across government agencies and is supporting a pilot program for improved governance in the Richmond River catchment in the Far North Coast region. These issues are not unique to the Far North Coast region or the coastal environment. Rather, they impact the delivery of good environmental management outcomes across all coastal and riverine environments.

The NSW Government will review learnings from the Richmond River pilot program to support whole-of-catchment planning, coordination, decision-making and project delivery for North Coast region river catchments (Actions 1.4 and 1.5).

Action 1.4: Deliver a river rehabilitation program

The health and resilience of rivers and the ecosystems they support depends on their geomorphic condition and the condition of surrounding floodplains.

This action will develop a whole-of-catchment program for improving the health and water quality of the region's rivers and the ecosystems they support, including native and threatened aquatic species. It will ensure that future river rehabilitation efforts:

- are coordinated and effective at a catchment scale
- support broader ecological, social, cultural and economic outcomes.

Developing a framework to prioritise the type and location of rehabilitation works will be important for the success of this action. The framework will support evidence-based prioritisation by using important river health metrics such as:

- the River Styles classification system, which provides information on condition and recovery potential, and allows us to focus on reaches classified as conservation, strategic or rapid recovery
- severity of land degradation
- mapped high ecological value aquatic ecosystems
- local Aboriginal knowledge and cultural water needs.

49. NSW Marine Estate Management Authority 2018, *NSW Marine Estate Management Strategy 2018–2028*, www.marine.nsw.gov.au/marine-estate-programs/marine-estate-management-strategy
50. More information on the coastal management framework is available at: www.environment.nsw.gov.au/topics/water/coasts/coastal-management/framework

Support local landholders to adopt best practice land use and water management

The Department of Planning and Environment, Local Land Services, and Department of Regional NSW deliver programs that support local landholders to adopt best practice land management by improving productivity and reducing land and water degradation. These programs include:

- irrigation audits
- guidelines for fertiliser application
- improved management of farm runoff and water quality
- improved capacity to prepare and recover from droughts and bushfires.

Many landholders have adopted best practice land and water management. However, some landholders need support to recognise potential improvements to their land and water management. Feedback received through engagement with local landholders showed that some are frustrated with the lack of extension services available to help them understand the rules and their obligations, and the opportunities for accessing and managing farm water needs.

Action 1.5: Support landholder adoption of best practice land management

Best practice land management helps to improve the infiltration capacity and quality of water. This action will build on existing programs to support private landholders to adopt best practice land management in priority waterways across the region.

Support will largely be provided through natural resource management, sustainable agriculture advisory services and on-ground projects, with a focus on:

- stock grazing management
- raising soil carbon levels
- soil disturbance and erosion management
- soil condition and ground cover management
- native vegetation and biodiversity management
- streambank and riparian vegetation protection and restoration
- structural instream habitat restoration works
- drainage and fertiliser use management.

A suite of fit-for-purpose tools will be used to build landholder capacity in knowledge and skills, and to access networks and resources. The tools could include:

- one-on-one consultation
- advice and referrals
- webinars and podcasts
- targeted social media campaigns
- field days and demonstrations
- incentives to deliver on-the-ground projects.

Program delivery will align with the framework developed in Action 1.4 and the environmental water requirements we will establish under Action 1.7. This approach will ensure that improvements in private landholder land and water management practice are directed to catchments where either river reaches have a high recovery potential, or improvements are critical to achieving key environmental objectives.

Landholders – as stewards of the land – are engaged in natural resource management and play a key role in generating natural capital value and improving ecosystems and habitats through best practice land management. Natural capital refers to the world's stocks of natural assets, and the services that flow from them, which include geology, soil, air, water, and all living things.

Natural capital investment, by both government and the private sector, can support active land stewardship among and alongside productive land activities.

The NSW Government is running a suite of natural capital programs[51] that can benefit farmers who voluntarily want to manage biodiversity and carbon while enhancing their land for productive use. Farmers can achieve accreditation through agreed sustainability actions including using best practice feed and fertiliser practices. This action will be implemented collaboratively with other government agencies, established research groups, local Aboriginal and community groups, and universities.

51. More information is available at: www.environment.nsw.gov.au/research-and-publications/our-science-and-research/our-research/social-and-economic/natural-capital

Improve our understanding and management of the region's water resources

The NSW Government has a key role to play in helping coastal regions prepare and adapt to future climate-related challenges.

Filling critical gaps in our understanding of the impacts of climate change is key to fulfilling this role. Investment in new climate datasets, the development of new hydrological models and the roll-out of the NSW Government's non-urban metering framework are all good first steps. However, more targeted investigations are needed to properly understand the cumulative effects of population growth, climate change, water extraction, and sea level rise on the North Coast region's water resources. We also need more flexibility in how we share and manage those water resources.

The following actions are important first steps to improving our understanding and future management of the region's water resources. These actions will build on the initiatives of other strategies, particularly the *NSW Water Strategy*,[52] the *Marine Estate Management Strategy*[53] and the NSW Groundwater Strategy.[54]

Action 1.6: Assess the vulnerability of surface water supplies to sea level rise and saltwater intrusion

This action will investigate how future changes to hydrology and water extraction could affect salinity in estuaries in the North Coast region. This action will also consider how intermittently closed and open lakes and lagoons will be affected.

We need to better understand how changes to salinity will affect water users and the environment. The department has recently studied the effect that sea level rise will have on floodplain drainage and low-lying land along the NSW coast. However, these studies did not consider the effects that sea level rise will have on water resources. Action 1.6 will build on these existing studies to:

- improve existing models and build new models, where needed
- develop a method to assess the impacts of sea level rise on water supplies using these models.

This action will improve understanding of the risks that sea level rise and saltwater intrusion pose to water supplies. It will allow us to:

- provide information to water users so they are fully informed about the risks to their water supplies
- develop the planning and policy settings required to address the risks that saltwater intrusion presents.

This action provides 3 key benefits:

- *Reduces cost to government and water users in the long-term*: Formulating policy for sea level rise challenges is complex due to the uncertainty involved. While this uncertainty cannot be removed entirely, taking early action can significantly reduce the future costs of damages. It can also mitigate the economic impacts from sea level rise and saltwater intrusion.
- *Supports tidal pool water users to manage their business risks into the future*: Previous studies have considered the impacts of projected sea level increases on coastal properties, infrastructure and future development. However, little has been done in NSW to assess the risks to water users and water resources from increasing salinity.
- *Supports Aboriginal communities to manage cultural assets that may be affected by sea level rise*: This support includes identifying cultural assets that could be impacted by future sea level rise and saltwater intrusion, for example changes to ecology in important fishing sites.

This action will also inform our assessment of sea level rise and saltwater intrusion on groundwater resources. We will assess how sea level rise will affect groundwater sources through Action 1.8 of this strategy. The outputs from Action 1.6 will be important inputs to the groundwater models developed for Action 1.8.

52. Department of Planning, Industry and Environment 2021, *NSW Water Strategy*, water.dpie.nsw.gov.au/plans-and-programs/nsw-water-strategy
53. NSW Marine Estate Management Authority 2018, *NSW Marine Estate Management Strategy 2018–2028,* www.marine.nsw.gov.au/marine-estate-programs/marine-estate-management-strategy
54. Department of Planning and Environment 2022, *Draft NSW Groundwater Strategy,* www.dpie.nsw.gov.au/water/plans-and-programs/nsw-groundwater-strategy

Action 1.7: Identify environmental water needs to support healthy coastal waterways

This action will establish the objectives and water requirements to protect important species, ecological communities, and aquatic ecosystems in the region.

Environmental water requirements define a suite of flow strategies to maintain and improve aquatic health. They are a key tool for linking ecological objectives to management actions and water sharing plan rules. However, many species and aquatic ecosystems in the North Coast region have not been studied enough to describe these requirements and target them through management actions.

Environmental water requirements often include information about the volume, frequency, timing and duration of different types of flows, and water quality. They may also define the ecological risks and constraints, and complementary non-water measures.

Coastal water sharing plans currently define ecological objectives. However, it is difficult to evaluate their effectiveness for 2 reasons:

- the links between objectives and water management activities in water sharing plans are unclear
- the data needed to undertake effective evaluation is insufficient or missing.

To address these difficulties, this action will provide a framework to identify and prioritise data and monitoring gaps. It will also develop methods to address these gaps. These methods could include using data from information-rich areas to represent the water needs of a broader river reach or valley. Current initiatives such as WaterNSW's review of the existing hydrometric gauging network[55] may support this framework. We will also consider alternative management approaches that can protect important flows without relying on flow gauges. The recently announced increase to the harvestable rights limit in coastal-draining catchments will also help inform this action.

Action 1.8: Characterise and plan for climate change and land use impacts on coastal groundwater sources

There is currently a lack of data and information about groundwater sources across the coastal regions. Data is essential to ensure future management decisions effectively mitigate the potential impacts of climate change, particularly saltwater intrusion, and associated changes to catchment hydrology, sea level rise, and over-extraction.

This action proposes to characterise key groundwater resources across the region. We will start with the 3 highest priority groundwater sources: the Stuarts Point Coastal Sands; Comboyne Basalt Plateau; and New England Fold Belt. These 3 groundwater resources have been chosen because:

- there is a high level of dependency on licensed entitlement (mainly for industries such as avocado and blueberry growing)
- they are vulnerable to contamination
- there is already evidence of saltwater intrusion.

Data sources for this action will include initial satellite imagery and field investigations[56] to help characterise the groundwater resources. The investigations will focus on factors known to be affected by climate change and land use pressures. These investigations will be supported by a review and potential expansion of the bore monitoring and metering network.

The major output of this work will be a conceptual model of key groundwater resources across the North Coast region. This will provide decision-makers with a better idea of how much groundwater is available, how it recharges, where it discharges, and how extraction impacts on the resource. More detailed modelling may be needed depending on what is learnt from the conceptual model.

This action will also consider how we can make this information available to water users. Access to this information is important because it can inform individual decision-making, and can support co-design of projects that aim to reduce the impacts of climate change with stakeholders and researchers.

55. More information is available at: water.dpie.nsw.gov.au/science-data-and-modelling/data/hydrometric-network-review
56. Such as geological, geophysical, geochemical, ecological and hydrogeological studies.

Action 1.9: Protect ecosystems that depend on coastal groundwater

Groundwater dependent ecosystems are classified broadly as terrestrial (vegetation communities), aquatic (wetlands and springs) or subterranean (aquifers). However, there are many knowledge gaps and knowledge of these ecosystems is still developing.

This action would improve knowledge and management of groundwater dependent ecosystems in the North Coast region. This can inform and guide sustainable water sharing arrangements that protect the environmental values of these ecosystems.

Our knowledge of these communities is still developing. Supported by the NSW Groundwater Strategy,[57] this action will support knowledge-based management and protection of these communities by:

- developing a method for identifying groundwater dependent ecosystems across the North Coast region that are reliant on surface water flows (i.e. baseflows)
- monitoring the condition and extent of the associated vegetation community.

The success of this action depends on the adequacy of the monitoring bore network and metering coverage across the North Coast region, both of which are being assessed through other actions (Action 1.10 and Action 2.3).

This action will inform the environmental water requirements for the region's waterways (Action 1.7). It will also inform future reviews of water sharing plan rules.

Image courtesy of Jaime Plaza Van Roon, Department of Planning and Environment. Macadamia plantation, Bellingen.

57. Department of Planning and Environment 2022, *Draft NSW Groundwater Strategy*, www.dpie.nsw.gov.au/water/plans-and-programs/nsw-groundwater-strategy

Action 1.10: Improve monitoring of water extraction

Water extraction, water storage and increases in access to basic landholder rights can negatively affect water sources. Monitoring and data collection are important to understanding these effects. Current monitoring and data collection in the North Coast region's water sources is not sufficient to provide this understanding.

Several recent studies have identified the lack of water data in the North Coast region as a problem. These studies include the recent audits of the Coffs Harbour[58] and Bellinger[59] surface water and alluvial water sharing plans by the Natural Resources Commission.

This action aims to improve the way we monitor water extraction in the North Coast region. It will provide several important benefits, including:

- improving our understanding of how well water sharing plan objectives are being met
- improving future water sharing decisions and natural resource planning
- supporting landholders to identify where they can reduce water use.

Considerations and links to other programs

Non-urban metering framework

The non-urban metering framework will ensure around 19% of surface water supply works will be metered in the North Coast region by 2024. This metering will provide a good starting point to better understand the effects of water extraction in the region. However, increasing metering in coastal catchments is challenging because:

- the flashy nature of coastal floods can damage or wash meters downstream[60]
- the metering reforms target large water users, but the combined impacts of smaller water users in smaller waterways can be large.

This action will build on the NSW Government's non-urban metering reforms by investigating other opportunities for improving water extraction monitoring across the region. This includes improving:

- awareness of current exemptions
- financial support
- the availability of compliant metering solutions, such as specifications for metering moveable pumps.

Coastal harvestable rights

Increases in water extraction under basic landholder rights may increase unmetered water take across the North Coast region. This is due to:

- growth in rural subdivisions and smaller properties
- the recently announced increase to the harvestable rights limit in coastal-draining catchments.

As part of the changes to the harvestable rights limit there are 2 important initiatives that can support and inform this action:

- the NSW Government has purchased high resolution satellite imagery to better understand the current levels of uptake of harvestable rights dams.
- landholders who build new dams or enlarge dams above their existing harvestable right dam capacity will need to notify the Natural Resources Access Regulator.

Other initiatives

A number of other initiatives will inform and support implementation of this action. These initiatives include work funded through the Commonwealth's Hydrometric Networks and Remote Sensing Funding Program.

This action will complement and link to the Draft NSW Groundwater Strategy[61] Action 3.1 (Develop a groundwater knowledge plan to improve how we use groundwater information to make decisions).

58. Natural Resources Commission 2020, *Final Report Review of the Water Sharing Plan for the Coffs Harbour Area Unregulated and Alluvial Water Sources 2009,* www.nrc.nsw.gov.au/water/wsp-reviews/completed-2020
59. Natural Resources Commission 2018, *Review of the water sharing plan for the Bellinger River Area Unregulated and Alluvial Water Sources 2008,* www.nrc.nsw.gov.au/water/wsp-reviews/completed-2018
60. Coastal floods can peak dramatically within hours of heavy rain and usually return to medium flows within a few days.
61. Department of Planning and Environment 2022, *Draft NSW Groundwater Strategy,* dpie.nsw.gov.au/water/plans-and-programs/nsw-groundwater-strategy

Priority 2

Ensure water resource development and use is sustainable and equitable

Sustainable water management means that the water needs of the present are met without compromising the ability of future generations to do the same. Ensuring sustainable water management for the North Coast region will require improving management of water use between users and reducing the impact of infrastructure on waterway health.

Image courtesy of Destination NSW. Nambucca River, Nambucca Heads.

Our starting point

The ***NSW Water Strategy*** has committed to the sustainable management of surface water and groundwater systems. These initiatives include better integrating land use planning and water management, reviewing water allocation and water sharing in response to new climate information, and developing the **NSW Groundwater Strategy**.[62]

The NSW Government is currently updating the **North Coast**[63] and **New England North West regional plans**.[64] The objectives of these plans recognise the need to think holistically about water management and to encourage innovation in water efficiency and whole-of-water-cycle management.

The Department of Planning and Environment is applying a **new risk-based assessment process** to help understand the relative impact of water sharing plan rules on key environmental functions, such as the effects that reduced inflows can have on low flows, freshes and water quality. This new approach is being considered as part of the review or remake of coastal water sharing plans.

The **NSW Fish Passage Strategy** provides a coordinated 20-year plan to proactively restore unimpeded fish passage and improve native fish access to main-stem rivers and key off-channel habitats across NSW. Under the ***Marine Estate Management Strategy***,[65] the action Reconnecting Fish Habitats aims to address high priority fish passage barriers along the NSW coast. Both strategies are led by the Department of Regional NSW, and provide a framework for prioritising restoration work across the state and North Coast region.

The NSW Government has assisted local councils to develop **Regional Economic Development Strategies**[66] based on the concept of a Functional Economic Region. The Regional Economic Development Strategies provide a clear economic development strategy for the region and are currently under review.

The NSW Government has also committed $3.9 million under **Future Ready Communities** to promote resilience and develop drought resilience plans which will assess drought impacts and responses. Individual plans can focus on intra- or inter-industry diversification, leadership and building social capital, and planning council works counter-cyclicality.

The ***20-Year Economic Vision for Regional NSW***[67] is the NSW Government's plan to drive sustainable, long-term economic growth in regional NSW. It is the roadmap to unlock significant economic potential in regional NSW. It guides transformative, once-in-a-generation investment in our regions through the $4.2 billion Snowy Hydro Legacy Fund, to create jobs now and into the future.

The NSW Government's $48 million expanded **Farms of the Future program** 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 NSW Government ***Climate Change Research Strategy***[68] is supporting projects that help primary industry sectors adapt to climate change. Under this strategy, the Department of Primary Industries is undertaking a detailed analysis of the risks and opportunities of a changing climate to support resilience and adaptation in the broadacre cropping sector.

62. Department of Planning and Environment 2022, *Draft NSW Groundwater Strategy*, www.dpie.nsw.gov.au/water/plans-and-programs/nsw-groundwater-strategy
63. More information on the *North Coast Regional Plan* is available at: planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/North-Coast/North-Coast-Regional-Plan
64. More information on the *New England North West Regional Plan* is available at: planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/New-England-North-West-Regional-Plan-2041
65. NSW Marine Estate Management Authority 2018, *NSW Marine Estate Management Strategy 2018–2028,* www.marine.nsw.gov.au/marine-estate-programs/marine-estate-management-strategy
66. More information on the Regional Economic Development Strategies is available at: nsw.gov.au/regional-nsw/regional-economic-development-strategies
67. More information on the *20-Year Economic Vision for Regional NSW* is available at: nsw.gov.au/a-20-year-economic-vision-for-regional-nsw-refresh
68. More information on the *Climate Change Research Strategy* is available at: www.dpi.nsw.gov.au/dpi/climate/about-dpi-climate/climate-change-research-strategy

Review of Harvestable Rights

From May 2022, landholders in the North Coast region are able to capture a maximum of 30% of the average regional rainfall-runoff from their property in harvestable right dams. This applies to dams that are built on non-permanent flowing minor streams, hillsides and gullies. The remaining runoff will continue to flow downstream into licensed dams and the local river systems, where it is shared between the environment and other water users.

This increase from 10% up to a maximum 30% limit follows a review and community consultation of harvestable right limits in coastal-draining areas of NSW. It provides landholders in these regions better access to water storage for domestic and stock puposes, and extensive agriculture such as stock grazing and pasture irrigation. However, the increase excludes use for intensive livestock and plant agriculture, such as horticulture and feedlots. Water taken under the existing 10% harvestable right can continue to be used for any purpose.

A number of critical steps have been completed to support these new arrangements. These include:

- consultation with Native Title holders
- determining a method for setting a landholder's revised maximum harvestable right dam capacity
- working with other agencies, including the Natural Resources Access Regulator, on monitoring and enforcement issues
- replacing the Harvestable Rights Order applying to the Central and Eastern Division with 2 separate new Orders.

The North Coast Regional Water Strategy will provide a path for supporting the implementation of these changes. This will help to manage future impacts on downstream water needs, including those of the environment, from uptake of the higher limit. Commencing in 2022, the Department of Planning and Environment Water will assess whether the increase to a 30% harvestable right limit is appropriate at the water source scale while considering, the limitations and mitigation measures announced as part of these changes.

The department will include an amendment provision in upcoming water sharing plans to review the uptake of harvestable rights by either year 3 or year 5 of the plan. The provision will require a review of access, trade and water supply work approval rules if the uptake of harvestable rights has increased above the 10% limit in the original Harvestable Right Order. Updated plans will include an estimate of the current uptake in harvestable rights within the long-term average annual extraction limit.

The North Coast Regional Water Strategy can help ensure these changes not only improve water security for rural landholders but also consider the impacts on the downstream environment and licenced users.

Image courtesy of iStock. Dorrigo, NSW.

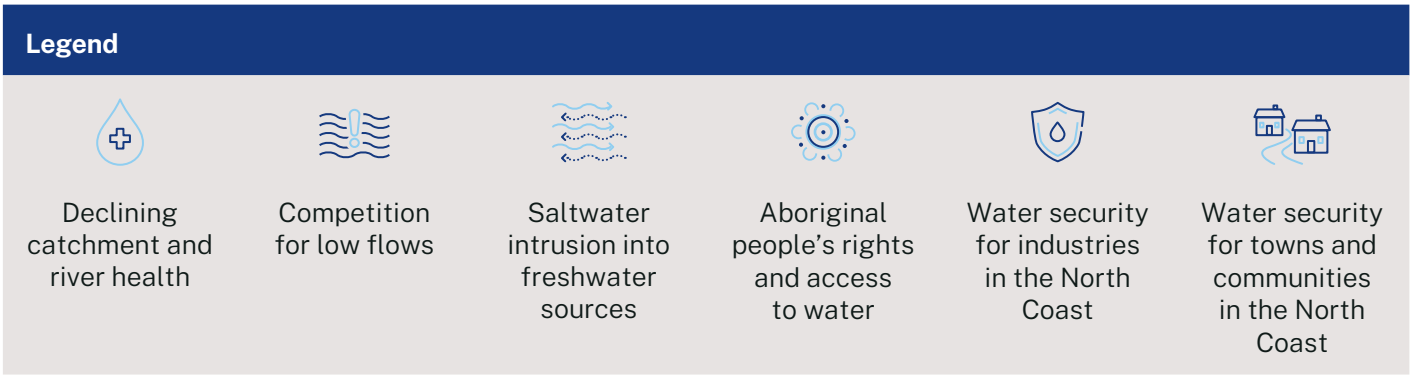


Figure 18. Actions to address Priority 2: Ensure water resource development and use is sustainable and equitable

Action number	Action name	Challenges addressed
Reduce the impact of water infrastructure on native fish populations		
Action 2.1	Improve fish passage	
Action 2.2	Implement fish-friendly water extraction	
Better manage competing demands for water		
Action 2.3	Establish sustainable extraction limits for surface water and groundwater sources	
Action 2.4	Reduce the take of low flows	
Action 2.5	Address catchment-based impacts of increased harvestable rights limits	
Action 2.6	Support Aboriginal business opportunities	

Reduce the impact of water infrastructure on native fish populations

Many native fish species in the North Coast region require free passage up and down the region's rivers to access food, avoid predators and find shelter. They also need seasonal passage to spawn, migrate and reproduce. Removing high-priority barriers to fish movement will help the resilience of fish species, particularly those that are threatened or endangered.

Action 2.1: Improve fish passage

Physical barriers to fish passage such as weirs, floodgates, causeways and culverts can limit fish movement, leading to a decline in the health and viability of native fish populations. Removing barriers to fish movement and allowing fish to move to breed, find food and locate ideal habitat is critical to supporting native fish populations in the North Coast region.

The NSW Fish Passage Strategy provides a coordinated 20-year plan to proactively restore unimpeded fish passage and improve native fish access to main-stem rivers and key off-channel habitats across NSW. Under the *Marine Estate Management Strategy*,[69] the action Reconnecting Fish Habitats aims to address high priority fish passage barriers along the NSW coast. Both strategies are led by the Department of Regional NSW. Together, they provide a framework for prioritising restoration work across the state and North Coast region.

The 4 high-priority barriers identified by these strategies in the North Coast region are:

- the Nymboida Weir
- a causeway on Timbarra River, off Rocky Creek Road
- a pipe culvert on Dowlings Falls Road
- a box culvert on Ewingar Road.

Improving fish passage can lead to changes in current flow patterns near instream structures. The effects that improving fish passage could have on flows near town water supply extraction points will be considered to ensure they do not compromise local councils' access to drinking water.

Action 2.2: Implement fish-friendly water extraction

Modern fish-protection screens offer significant benefits for biodiversity and businesses. Self-cleaning, retractable designs are available to suit all types of water pumps and channels, at any size. The technology represents a new best practice for water users, protecting up to 90% of native fish and excluding virtually all debris. Installation of screens represents an opportunity to reduce fish losses at water diversions, improve recovery of threatened species, and reduce energy costs and downtime for water users.

This action proposes to promote the installation of modern fish-protection screens on pumps across the North Coast region. This action includes building awareness among water users of the benefits of modern screening technology. The NSW Government's non-urban metering framework will collect valuable information on the locations and sizes of pumps in the region. This will support implementation of this action by helping to prioritise locations for screen installation.

69. NSW Marine Estate Management Authority 2018, *NSW Marine Estate Management Strategy 2018–2028*, www.marine.nsw.gov.au/marine-estate-programs/marine-estate-management-strategy

Better manage competing demands for water

Governments have a legal responsibility to ensure that water is allocated and used to achieve beneficial environmental, social and economic outcomes. We need to review how extraction is regulated across the region to ensure that we appropriately meet this responsibility, particularly in managing competing demands for water during dry and low flow periods. We also need to provide greater opportunities for the North Coast region's Aboriginal people to access water.

The following actions will help provide confidence that the rules that determine water sharing arrangements are equitable and sustainable, while also providing opportunities to shift water demand and extraction out of critical low flow periods.

Action 2.3: Establish sustainable extraction limits for surface water and groundwater sources

Extraction limits

The *Water Management Act 2000* (WMA)[70] outlines the principles that guide water sharing. These principles oblige the government to ensure the ecological sustainability of the state's water sources and to maximise the economic and community benefits from water.

The water sharing plans prepared under the WMA regulate the diversion, extraction, and development of water resources in NSW. Putting limits on extracting water from rivers and aquifers is a key tool that can help meet the obligations of the WMA.

Water sharing plans can define different types of extraction limits, including the total volume of water that can be extracted from a river or aquifer in a year. These annual limits are called the long-term average annual extraction limits (LTAAELs). Other types of limits aim to protect specific parts of river flows by governing when water users can take water from a river. An example of this type of limit is daily extraction limits.

Water sharing plans in the North Coast region do include LTAAELs. However, the current LTAAELs were set as the sum of existing water entitlements at the time the water sharing plans were first developed. It is not known if the current LTAAELs can meet the requirements of the environment and the community.

The Natural Resources Commission has recommended that the Department of Planning and Environment review coastal LTAAELs. It has also recommended that the department develops extraction limits that better meet water sharing principles.

What establishing sustainable extraction limits will do

This action will transition water sharing to a regime that is based on science and evidence. It will establish the extraction capacity of the region's surface water and groundwater systems and use this new knowledge as the starting point for water sharing. This approach will allow water extraction to be best managed to improve outcomes for the environment and the community by:

- understanding different methods for setting extraction limits
- testing one or more methods on a pilot water source
- establishing the appropriate extraction limits for water sources across the region
- investigating the feasibility of implementing and setting daily extraction limits.

70. Available at: legislation.nsw.gov.au/view/html/inforce/current/act-2000-092

Benefits of sustainable long-term average annual extraction limits (LTAAELs)

Defining sustainable LTAAELs in water sharing plans across the region would provide a number of benefits:

- allow water users to maximise water resource development within ecological limits
- ensure that water is shared equitably among users
- provide water users with greater certainty in their share of the resource
- identify if and where additional water entitlements could be made available.

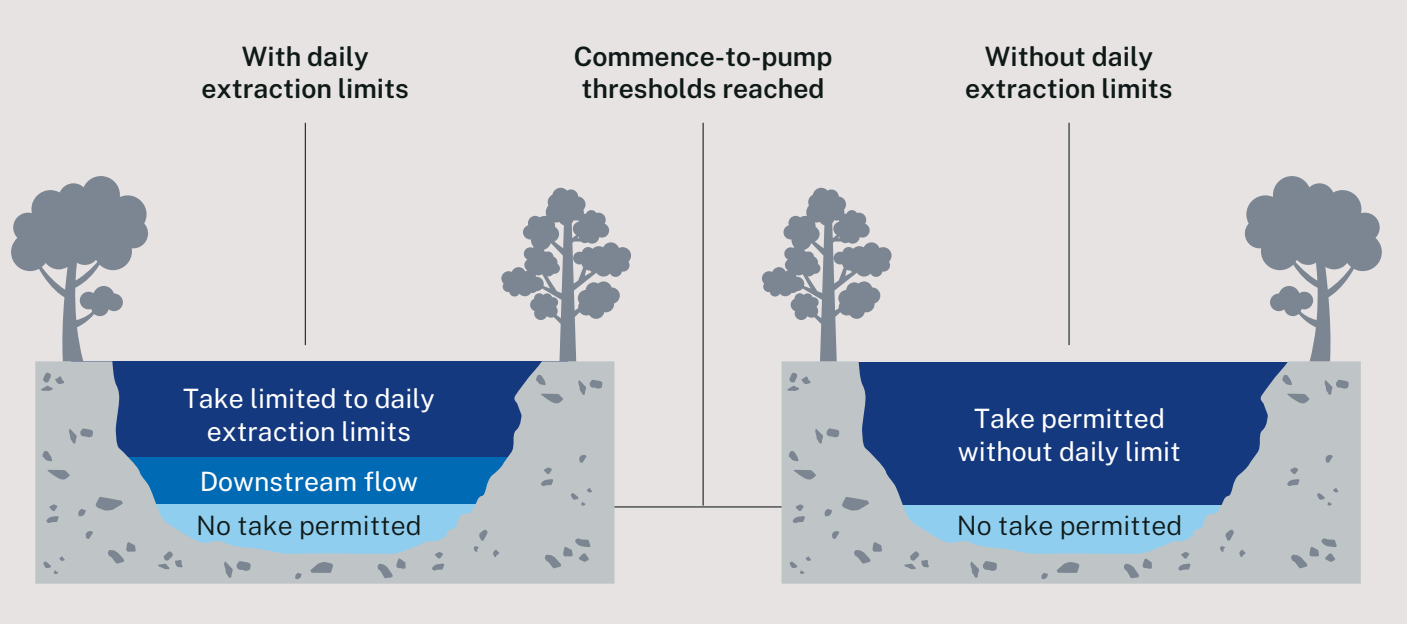
Benefits of daily extraction limits

Daily extraction limits restrict the rapid removal of water during peak irrigation periods (Figure 19). They are included in water sharing plans to protect low and medium flows, which reduces the impact of water extraction at certain times of the year. This reduction ensures there is enough water in a river system for the environment, non-extractive users (aquaculture, cultural and recreation) and downstream extractive water users.

There are a number of requirements for implementing daily extraction limits:

- stream gauging and monitoring
- daily measurements of water extraction, or estimates of water extraction
- a mechanism to co-ordinate water extraction between water users.

Figure 19. Daily extraction limit concept



Action 2.4: Reduce the take of low flows

Reducing water extraction from rivers during periods of low flow will improve both river connectivity and natural flow variability. It will also complement other actions aimed at improving river health.

This action will investigate and assess options for reducing water extraction during low flows. We will focus on the effectiveness of high-flow conversions; low-flow bypasses for farm dams; and options for landholders to store water extracted from streams under basic landholder rights.

High-flow conversions

In some water sources in the North Coast region, water users can apply to convert their existing water access licence to a high-flow access licence. This allows water users to extract more water but only under high-flow conditions. The high-flow conversion rule only applies in catchments that are gauged and are experiencing hydrologic stress in periods of low flow. Widespread adoption across a catchment would increase the protection of low flows and improve river connectivity during dry times, while increasing the water available for extraction during wetter times.

No licence-holders in the North Coast region have yet converted their entitlement to a high-flow access licence because:

- the current conversion rates do not provide enough water security benefits to counter the extra costs of irrigating from on-farm storages
- the frequency and intensity of droughts historically in the North Coast region have not been severe enough for water users to consider licence conversion
- there is limited space for off-stream storages
- pump equipment is susceptible to being washed downstream during high-flow events.

Any modification to the current conversion rate would need to consider the effect on all parts of the flow regime, including the ecological effects of changing high flow patterns and the associated effects on river health, reliability of downstream licences, and social and cultural values.

Overcoming constraints to on-farm storages (Action 3.4) and an improved understanding of climate risks to surface water availability may make high-flow licence conversions more feasible in the future.

Low-flow bypasses

Farm dams increase water security for landholders but can reduce the volume of runoff that flows into downstream waterways. During extended dry periods, the effect that farm dams have on waterways can worsen. Because they are usually partially empty during dry periods, they capture most of the rainfall-runoff that falls on the land. Low-flow bypass devices can allow some of this runoff to bypass dams and to flow into waterways.

Low-flow bypass devices change the timing that a dam captures water. At the beginning of a rainfall event it allows flows to pass through to downstream waterways. As the rainfall event continues or becomes more intense, it allows the higher flows to enter the dam. This can reduce the negative effects of dams on low flows while still providing water security benefits to landholders.

The department will commission a desktop review of the use of low-flow bypasses in other jurisdictions. This will inform other potential measures for mitigating downstream impacts from an increase in extraction from coastal harvestable rights dams. Subject to the findings of this review, field trials will be conducted to test their design efficacy under a range of NSW coastal conditions, and to assess their cost effectiveness. The outputs of these investigations will be a key input to understanding the benefits and constraints of low-flow bypasses more broadly.

Storage of water extracted under basic landholder rights

Landholders with river frontage are permitted to extract water under basic landholder rights, including during very low-flow conditions, regardless of the cease-to-pump rules in water sharing plans. Extracting water under these rights during higher-flow periods and storing it in tanks or turkey nest dams[71] can reduce the volume of water extracted from stressed rivers and delay the need to draw water from town water supply networks.

State and local government rebates on rainwater tanks have assisted in addressing this problem. However, there is a need to better understand the extent of current and future growth of water extraction under basic landholder rights.

71. A dam with a completely enclosed earth embankment that is filled by pumping water from alternative water sources.

Action 2.5: Address catchment-based impacts of increased harvestable rights limits

This action will ensure potential impacts on downstream licence holders, communities and the environment, resulting from the increase in harvestable rights limits, are understood at a more localised scale and are considered and managed in future water sharing plan arrangements.

The NSW Government's decision in October 2021 to increase the harvestable rights limit in coastal-draining catchments from 10% to 30% of average annual regional rainfall runoff included a range of mitigation measures to manage the potential impact of the change on downstream users, communities and the environment.[72]

Action 2.5 supports these mitigation measures through the following initiatives:

- undertake further assessment to confirm the appropriateness of the 30% limit in each water-source scale, taking into account the specific characteristics of the water source
- introduce a mechanism to manage potential future impacts from an increase in the uptake of harvestable rights on existing water sharing plan arrangements
- include an estimate of annual extractions under the 10% of rainfall runoff harvestable rights limit in the updated coastal water sharing plans to assist in establishing the long-term average annual extraction limits.

Action 2.6: Support Aboriginal business opportunities

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

During our consultation on the Draft North Coast Regional Water Strategy we heard that Aboriginal communities in the North Coast need and support business opportunities that are led by Aboriginal communities. An example of a current Aboriginal-led water-dependent businesses in the North Coast is a native garden nursery that focuses on edible, endemic plants that have a low water demand. We also heard strong support for a river ranger program. River ranger programs deliver environmental and social benefits. They integrate traditional Aboriginal knowledge into waterway management while also creating ongoing employment for Aboriginal people.

The Department of Planning and Environment will lead Aboriginal business development opportunities in the North Coast region and will be supported by the Department of Regional NSW. Through the Aboriginal Partnership Program, a dedicated Aboriginal Partnership Manager 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 the Department of Aboriginal Affairs, the Aboriginal Lands Council and the National Indigenous Australians Agency.

Image courtesy of Melinda Simpson, Department of Primary Industries. Blueberries, NSW.

72. More information on harvestable rights in coastal-draining catchments is available at: dpie.nsw.gov.au/water/licensing-and-trade/basic-landholder-rights/harvestable-rights/coastal-draining-catchments

Image courtesy of Destination NSW. Iluka Bay, Iluka.

Priority 3

Prepare for future climatic extremes

We need to prepare for future climate variability, particularly extended dry periods, to help build a stronger and more resilient region. Providing better information on the impacts of climate change on water resources will allow the community to plan better for the future, particularly local councils and businesses that are highly dependent on water. The resilience of local industries will be strengthened by having the tools and infrastructure at hand to make the most of existing water supplies and manage risks of increased climate variability and change.

Our starting point

The ***NSW Water Strategy***[73] has committed to increasing the resilience of the region's water users to changes in water availability. This includes supporting more efficient water use by industry and improving drought planning, preparation and resilience.

The $1 billion **Safe and Secure Water Program**[74] supports councils to implement infrastructure and non-infrastructure solutions to address key risks to regional water safety and security.

The **Town Water Risk Reduction Program** is currently underway. Its aim is to work with local councils to develop a new framework that will better support them to manage safe, secure and sustainable water supply and sewerage services to regional communities across NSW.

The Government will support water utilities to **diversify sources of water** including groundwater, stormwater harvesting and recycling. This will include progressing relevant regulatory reform and community acceptance campaigns to help increase the uptake of diverse water sources with the potential to increase water security and resilience for towns and communities.

The ***Future Ready Regions*** **Strategy**[75] includes a commitment to upgrade the Enhanced Drought Information System to provide farms with world-leading weather and climate data so they can make better business decisions.

The NSW Government's ***Climate Change Research Strategy***[76] is supporting projects that help primary industry sectors adapt to climate change. Under this strategy, the Department of Primary Industries is undertaking a detailed analysis of the risks and opportunities of a changing climate to support resilience and adaptation in the broadacre cropping sector.

The NSW Government has recently **published the long-term climate variability risk data** that supports the regional water strategies. This is the first step in providing water users with better access to information on the future risks to water availability. The stochastic datasets for rainfall and potential evapotranspiration for the North Coast region and a number of other NSW regions are available on the **SEED**[77] portal.

The NSW Government is working towards a policy of more open and easily accessible data. The **open data framework**[78] recently published by the Department of Planning and Environment Water outlines how we will manage and drive open data to improve transparency and data sharing.

73. Department of Planning, Industry and Environment 2021, *NSW Water Strategy*, water.dpie.nsw.gov.au/plans-and-programs/nsw-water-strategy
74. More information on the Safe and Secure Water Program is available at: industry.nsw.gov.au/water/plans-programs/infrastructure-programs/safe-and-secure-water-program
75. More information on *Future Ready Regions* is available at: nsw.gov.au/regional-nsw/future-ready-regions
76. More information on the *Climate Change Research Strategy* is available at: www.dpi.nsw.gov.au/dpi/climate/about-dpi-climate/climate-change-research-strategy
77. The long-term climate variability risk data is available at: datasets.seed.nsw.gov.au/dataset/water-modelling-stochastic-climate-data
78. More information on the open data framework is available at: water.dpie.nsw.gov.au/science-data-and-modelling/data/open-data-framework

Legend					
Declining catchment and river health	Competition for low flows	Saltwater intrusion into freshwater sources	Aboriginal people's rights and access to water	Water security for industries in the North Coast	Water security for towns and communities in the North Coast

Figure 20. Actions to address Priority 3: Prepare for future climatic extremes

Action number	Action name	Challenges addressed
Support local councils and water users to manage risks		
Action 3.1	Support local councils to provide a secure and affordable water supply for towns	
Action 3.2	Provide better information about water access, availability and climate risks	
Optimise use of existing water supplies		
Action 3.3	Enhance coastal water markets	
Action 3.4	Investigate increased on-farm water storage	
Investigate alternative water supplies		
Action 3.5	Investigate increased use of tertiary-treated and on-farm recycled water for intensive horticulture	

Image courtesy of Destination NSW. Bellbrook, Macleay Valley Coast.

Support local councils and water users to manage risks

The NSW Government supports local councils to manage town water supply and security risks through the Safe and Secure Water Program.[79] The Safe and Secure Water Program has funded around $38 million of projects in the North Coast region over the past 3 years, including funding support for the preparation of local water utility strategic plans. The Safe and Secure Water Program has generally prioritised funding for sewage discharges and sewer overflows that pose risks to water quality, water security and the environment.

NSW Auditor General's report Support for regional town water infrastructure[80] recognises that more needs to be done to properly support local councils with issues such as affordability and project delivery.

Councils continue to be active in this space to meet their obligations. Port Macquarie Hastings Council is preparing to expand its distribution network of recycled water.[81] Armidale Regional Council has supported a water security package that proposes a 6.5m raising of the Malpas Dam, acquisition and commissioning of Oaky River Dam and the construction of a pipeline from Oaky River Dam to Armidale.[82]

Local industries also need support. Sustainable and drought-resilient industries are underpinned by good business planning, which includes understanding future water availability.

Action 3.1: Support local councils to provide a secure and affordable water supply for towns

Supporting local councils with water system planning and building skills and capacity for implementation will focus on the Department of Planning and Environment's new regulatory and assurance framework for local water utilities.

The new regulatory and assurance framework sets the expectations the department has for local water utilities, including:

- establishing the outcomes required to meet customer needs and to manage key risks
- undertaking evidence-based strategic planning to meet these outcomes
- assessing the standard to which the outcomes are met.

The regulatory and assurance framework highlights the key outcomes for understanding and addressing water security and water quality risks.

The current approach to managing water security for towns relies on defining an 'acceptable risk' of running out of water. Existing NSW Government guidelines suggest town water supplies should meet a minimum service level. This roughly correlates to town water supplies being able to withstand a drought that has the probability of occurring 1 in 1,000 years.[83] This level of risk may be too high for large towns in extreme droughts where there are no last resort options such as water carting.

The NSW Government aims to provide the right mix of tools to support local councils in the North Coast region to address their key town water security challenges. This includes assisting councils to explore options to reduce demands on surface and groundwater sources. For example, water use efficiency programs and accessing other water sources such as desalinated water and purified recycled water. The department will provide guidance and support to local water utilities to help them undertake their strategic planning under the framework. The department will also monitor this work to ensure it sufficiently manages the key risks.

Other actions in the North Coast Regional Water Strategy aim to improve river health and land management. These actions will also benefit councils by improving access to high-quality water for town water supplies.

79. More information on the Safe and Secure Water Program is available at: industry.nsw.gov.au/water/plans-programs/infrastructure-programs/safe-and-secure-water-program
80. New South Wales Auditor-General 2020, *Support for regional town water infrastructure, Audit Office of New South Wales*, www.audit.nsw.gov.au/our-work/reports/support-for-regional-town-water-infrastructure
81. More information is available at: pmhc.nsw.gov.au/Residents/Water/Recycled-water
82. More information is available at: armidaleregional.nsw.gov.au/news/news-2022/water-security-package-key-to-region-s-prosperity
83. This does not mean that a drought will only occur once in 1,000 years. Rather, it means there is a 0.1% probability that this severity of drought could occur in any given year.

Action 3.2: Provide better information about water access, availability and climate risks

Reliable and timely information helps both the community and government make informed decisions, particularly when preparing for droughts and floods. However, this information can often be difficult to access or use. This affects landholders' abilities to make business decisions and for all residents' capacities to plan for natural disasters, including drought. These issues were an important theme during recent consultation on several NSW Government water initiatives.

The NSW Government has recently improved how it provides climate and water availability information. However, there is still room to improve how information is provided to ensure it meets the needs of the North Coast region's communities and industry.

What this action will do

This action will build on existing state and national information platforms, including:

- WaterNSW's WaterInsights portal[84]
- NSW Government's Water Usage Dashboard[85]
- Bureau of Meteorology's Water Information Dashboard.[86]

Stakeholders in the North Coast region will be consulted widely to ensure the Department of Planning and Environment provides the training and information products that the region needs.

As part of this action, we will also:

- develop a website that brings together information on coastal areas, estuaries and climate change, and provides access to associated data and reports
- review the ways water information is made available so we can improve usability and accessibility
- educate industry and local government on water access options including about the recent changes to the coastal harvestable rights limit
- educate water users on how water markets can help them diversify their water supply options
- encourage new industries to develop drought management plans as they set up in the region.

We will also support water users to understand what the long-term climate variability data tells us about:

- surface water availability and water quality
- the likelihood of consecutive years of low or no water availability
- groundwater availability.

Benefits of improved data and forecasts

Improving forecasts and data about short-term and long-term water availability can offer several benefits:

- helps water-dependent businesses in the region to make informed decisions on how to manage their water entitlements
- supports farms to make informed climate-adaptation decisions
- ensures new industries can remain in the region over the long-term.

84. Available at: waternsw.com.au/waterinsights/water-insights
85. Available at: industry.nsw.gov.au/water/allocations-availability/water-accounting/utilisation-dashboard
86. Available at: bom.gov.au/water/dashboards

Optimise use of existing water supplies

Water resources are finite. By using water wisely today, we can support thriving and resilient communities in a drier future. Current rules and regulations aim for flexibility in how and when water is extracted, while protecting the environment and other water users. The following actions propose to review these rules to ensure they provide the flexibility needed for local businesses to prepare for and manage drought.

Action 3.3: Enhance coastal water markets

Our climate modelling shows the North Coast region is likely to experience drier conditions and more frequent and severe droughts in the future. Active and effective water markets are important for maintaining a thriving regional economy. They enable industries, especially those reliant on unregulated water, to adapt to change, increase their water security and prepare for drier conditions. Trade is also a key tool in shifting water demands from low flows to high flows in the region's unregulated rivers, consistent with the regional priority to better manage competing demands for water.

This action would:

- investigate the barriers to trade and seek to understand why so little trade has occurred in the region's unregulated and groundwater sources
- identify the improvements that can be made to the North Coast region's water markets.

The Australian Consumer and Competition Commission identified common elements of effective water markets in its *Murray–Darling Basin Water Markets Inquiry*.[87] This action will assess how well the North Coast region's water markets are set up to deliver these key elements, and will identify and explore barriers for participation.

Recommendations arising from this investigation will be informed by forecast behaviour change and more detailed hydrologic and economic analysis of benefits and costs. They would also be informed by recommendations from the department's review of trade rules in unregulated catchments, the Australian Consumer and Competition Commission's water market inquiry and the establishment of sustainable extraction limits for surface water sources (Action 2.3).

Image courtesy of Destination NSW. Gaagal Wanggaan (South Beach), Scotts Head.

87. Australian Competition and Consumer Commission 2021, *Murray–Darling Basin water markets inquiry, Australian Competition and Consumer Commission*, www.accc.gov.au/publications/murray-darling-basin-water-markets-inquiry-final-report

Action 3.4: Investigate increased on-farm storage

This action considers water harvested and stored on-farm under a water access licence. It will investigate:

- current levels of on-farm storage and usage, and barriers to constructing farm dams
- options to mitigate downstream environmental and water security impacts of increased storage capacity
- impacts on catchment hydrology, particularly the potential to reduce take of low flows
- the value of on-farm storages to various North Coast region industries and as a local water supply to fight bushfires
- options for incentivising the uptake of on-farm storage.

Increasing the volume of water stored on farms will help landholders in unregulated catchments manage the impacts of climate change on water security. Capturing runoff high in the catchment and applying it to irrigation in drier times will assist retaining water in the catchment for longer periods. Water stored on-farm has the potential to provide vital water supplies to help fight bushfires. However, relying on this water is dependent on a large volume of water being stored and available.

As on-farm storage can increase how much licensed water is taken, this action may risk placing further pressure on rivers and streams already under hydrologic stress. This action will have the greatest benefits to extractive users and have the least impact on river ecology if considered in conjunction with actions that shift water extraction away from low flows which is where the greatest pressure from extraction occurs (Action 2.4) or through increased trade (Action 3.3).

Any proposal to increase on-farm storage will need to be considered and implemented alongside the investigations to address catchment-based impacts of increased harvestable rights limits (Action 2.5) and establish sustainable extraction limits for surface water and groundwater sources (Action 2.3).

Image courtesy of Destination NSW. Countryside, Grafton.

Investigate alternative water supplies

The projected effects of climate change on the North Coast region will put water supplies under pressure. We need to ensure that water supply is resilient and that users have feasible access to alternative water supplies.

As part of their local water utility strategic planning, local councils are already considering options and alternative water sources that meet future water security challenges.

Action 3.5: Investigate increased use of tertiary-treated and on-farm recycled water for intensive horticulture

Investigating increased use of tertiary-treated and on-farm recycled water will improve our understanding of using recycled wastewater as an alternative water source for intensive horticulture across the region.

Intensive horticulture is a rapidly expanding industry that provides high-value crops in the North Coast region. Intensive horticulture has much greater water demands than crops that have historically been grown in the region. The 2017–2020 drought showed how vulnerable these operations are to extended dry periods. During this time, blueberry farmers had to slash production bushes to the ground to reduce water demand and to save the bushes from dying.

Recycled water is already being provided to rural users in some parts of the North Coast region. The largest scheme is managed by Coffs Harbour City Council. The North Coast region's horticultural industry is aware that growers may need to use recycled water in the future.

What this action will do

This action will assess the demand, costs, benefits and challenges of using recycled tertiary-treated and on-farm recycled water for intensive horticulture in the North Coast region. It will consider both the environmental impacts of using recycled water and the key barriers to uptake. It will also consider the costs of recycling excess irrigation water on-farm. We will collaborate and consult with local councils, landholders and the community. We will draw on the local experience of Coffs Harbour City Council and other schemes that have been implemented across the state.

Key considerations

Recycled water can have a higher nutrient profile than freshwater sources which can negatively affect downstream water quality. Changes to water quality from recycled water have already been observed in the Coffs Harbour area. Recycled water users may need to change how they fertilise crops and to reduce excess runoff.

Key barriers to widespread uptake of recycled water for irrigation include:

- public perception
- water quality impacts
- community acceptance of recycled water
- regulatory and administrative barriers.

Benefits

Using recycled water for intensive horticulture can:

- reduce demand for river extractions including demand for low flows
- provide an alternative to increasing on-farm dam storage
- increase reliability by providing a climate-independent water source for industry
- potentially reduce runoff pollution through a circular economy on farms.

Image courtesy of Department of Planning and Environment. Nambucca River, Nambucca.

Implementing the strategy

6

Image courtesy of iStock. Bellinger, Dorrigo Mountain.

Getting our timing right

A critical feature of developing the North Coast Regional Water Strategy was deciding which actions and investments are needed now, and which ones will be needed further into the future. The strategy has a 20-year timeframe. The timing of actions aims to meet existing challenges, identify and prepare for future challenges, and lay the groundwork for adapting to future uncertainties and changing circumstances.

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

Some of the actions in the strategy may be able to reduce the effects of small-to-moderate flood events. Analysing the flood benefits of many of the proposed actions in this strategy will require more investment by governments in flood modelling and mitigation works. A better understanding of the flood mitigation benefits of some of the water security options presented in this strategy will help to implement the strategy actions.

The *Floodplain Development Manual*[88] and the Flood Prone Land Policy guide local government in managing flood risk in their communities. The Office of Local Government and the Department of Planning and Environment Environment and Heritage Group also lead flood-risk reduction for towns and regional centres across the state.

The North Coast Regional Water Strategy is accompanied by a separate implementation plan[89] that prioritises the delivery of actions over the life of the strategy. The implementation plan also outlines responsibilities and timeframes for delivery. This plan will allow us to monitor progress of the actions to assess the effectiveness of the strategy, and to identify areas where we need to adapt. The current implementation plan sets our priorities over the next 3 years.

We cannot start implementing all the actions at once. Funding will be a key consideration in planning when and how actions will be implemented. Because regional water strategies set the government's priorities for water management, they will be a key tool for seeking future funding.

The implementation plan identifies the key partners who will be involved in implementing the strategy:

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

Each year, we will report on our progress in implementing the strategy actions. This will provide transparency to the community, and allow us to show what we have achieved and what we will deliver in the future.

88. Available at: www.environment.nsw.gov.au/topics/water/floodplains/floodplain-manual
89. Available at: www.dpie.nsw.gov.au/north-coast-regional-water-strategy

Figure 21. North Coast Regional Water Strategy implementation timeline

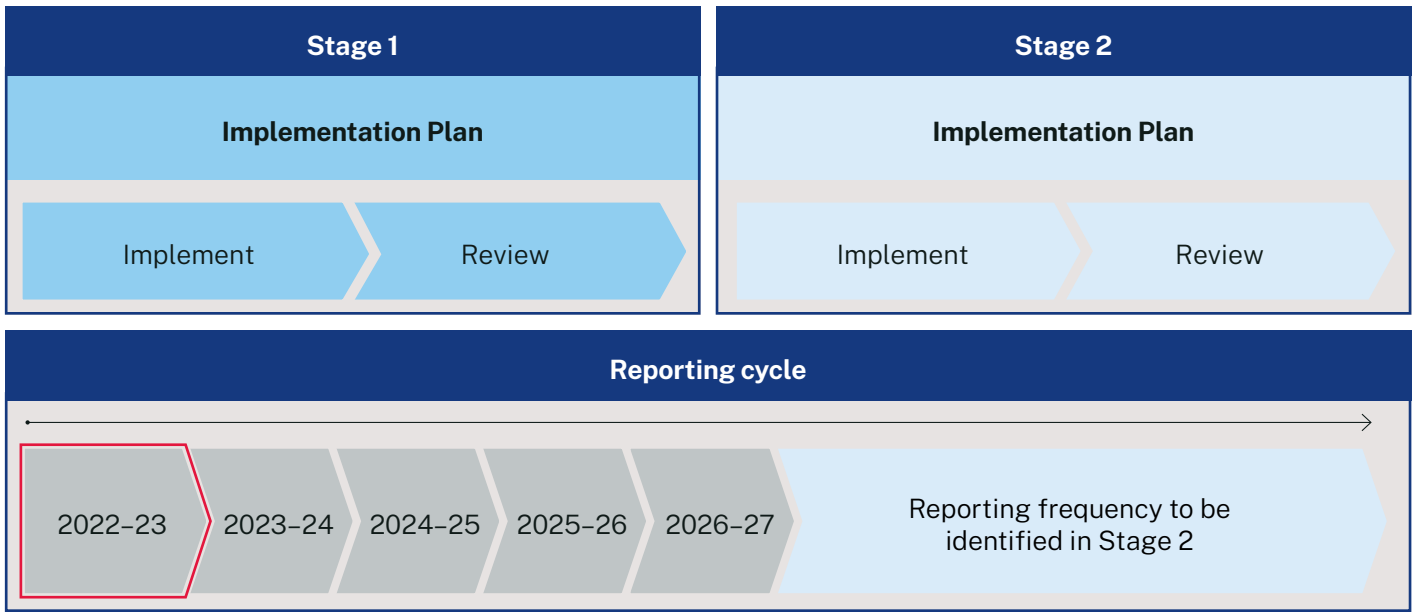
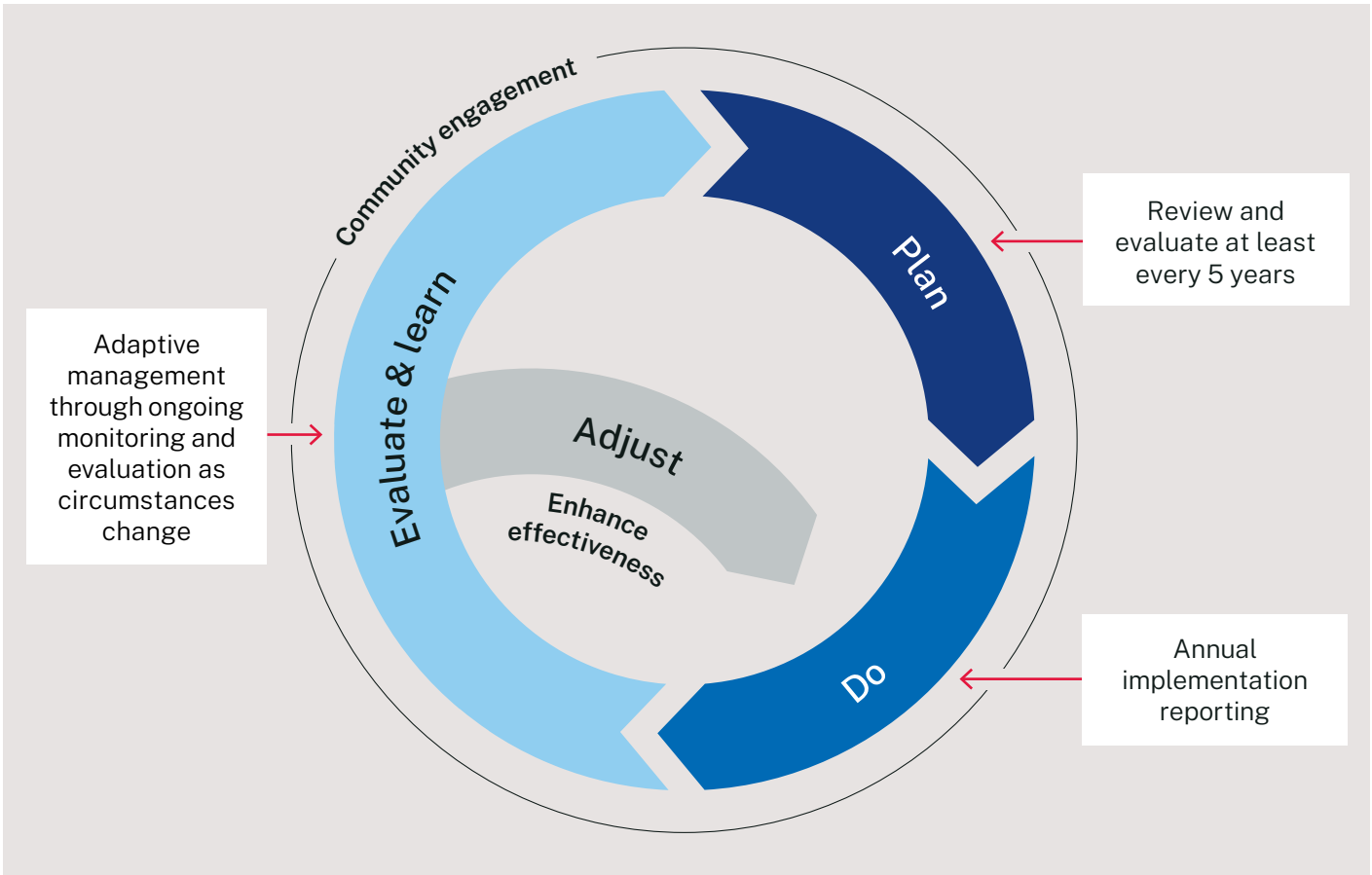


Image courtesy of Clarence Valley Council. Clarence River, NSW.

Ongoing monitoring, adaptation and reporting

The North Coast Regional Water Strategy is designed to respond to changing circumstances. We will undertake a formal review of the strategy at least every 5 years, or in response to changing circumstances. The formal review will ensure that the key assumptions, such as population and demographics, have not significantly changed. We may make amendments in response to key changes in water demand, social preferences, climate, science and technology, economic conditions, or other events. These amendments may result in a shift in priorities, and the implementation plan will be updated to reflect this.

Figure 22. Regional water strategies process



Glossary

7

Image courtesy of iStock. Crystal Shower Falls, Dorrigo.

Glossary

Name	Description
Action	A description of the on-the-ground next step required to achieve the priorities of the regional water strategy. These are expanded on in the Implementation Plan.
Consultation paper	A document developed in response to feedback on the first round of public exhibition of the draft regional water strategies. It includes shortlisted options and additional analysis.
Draft regional water strategy	A document released including a long list of options as part of the first round of public exhibition.
Instrumental data	The available historic record in the region, referred to as the instrumental record of approximately 130 years (1890 to 2020).
Option	One of the water management options listed in the draft regional water strategies long list of options. Options were taken through an assessment process. Options that progressed to the regional water strategies have been called actions.
Projection	A plausible estimate of future population or climatic conditions.
Recurrence interval	The probability that a climatic event will occur in a given time period. This generally refers to river flows or droughts. For example, an annual recurrence interval, or 5-year recurrence interval.
Scenario	A model run with a particular set of model conditions. These conditions are usually made from a particular climate projection and may also include a particular population projection. A scenario represents a plausible future condition for the region.
Longlist options	Potential options released in the draft regional water strategy.
Short-list of options	A refined list of potential options in the Consultation Paper.
Rapid CBA	A cost benefit analysis undertaken with the instrumental database.
Sensitivity analysis	Used to identify the extent to which changes to the key assumptions influence the outcomes of the detailed analysis. The sensitivity analysis was carried out across: • the discount rate (3% and 10%) • capital and operational expenditure (+30% / -30%) • the value of water assigned to each economic activity • reactive infrastructure solutions.
Distributional impact	Looked at how the option impacts different water users and classes of licences.
Breakeven analysis	Determines at what price a megalitre of water would result in the costs being equivalent to the benefits. This analysis assumes the proposed option is viable on the balance of outcomes within the economic analysis framework presented and determines what price for a megalitre of water would make the benefits equal the cost of the option.
Economic base case	An assumption of existing infrastructure and policy settings but including central planning assumptions on projections of future population in each region.

Department of Planning and Environment