Draft Regional Water Strategy

North Coast: Shortlisted Actions – Consultation Paper

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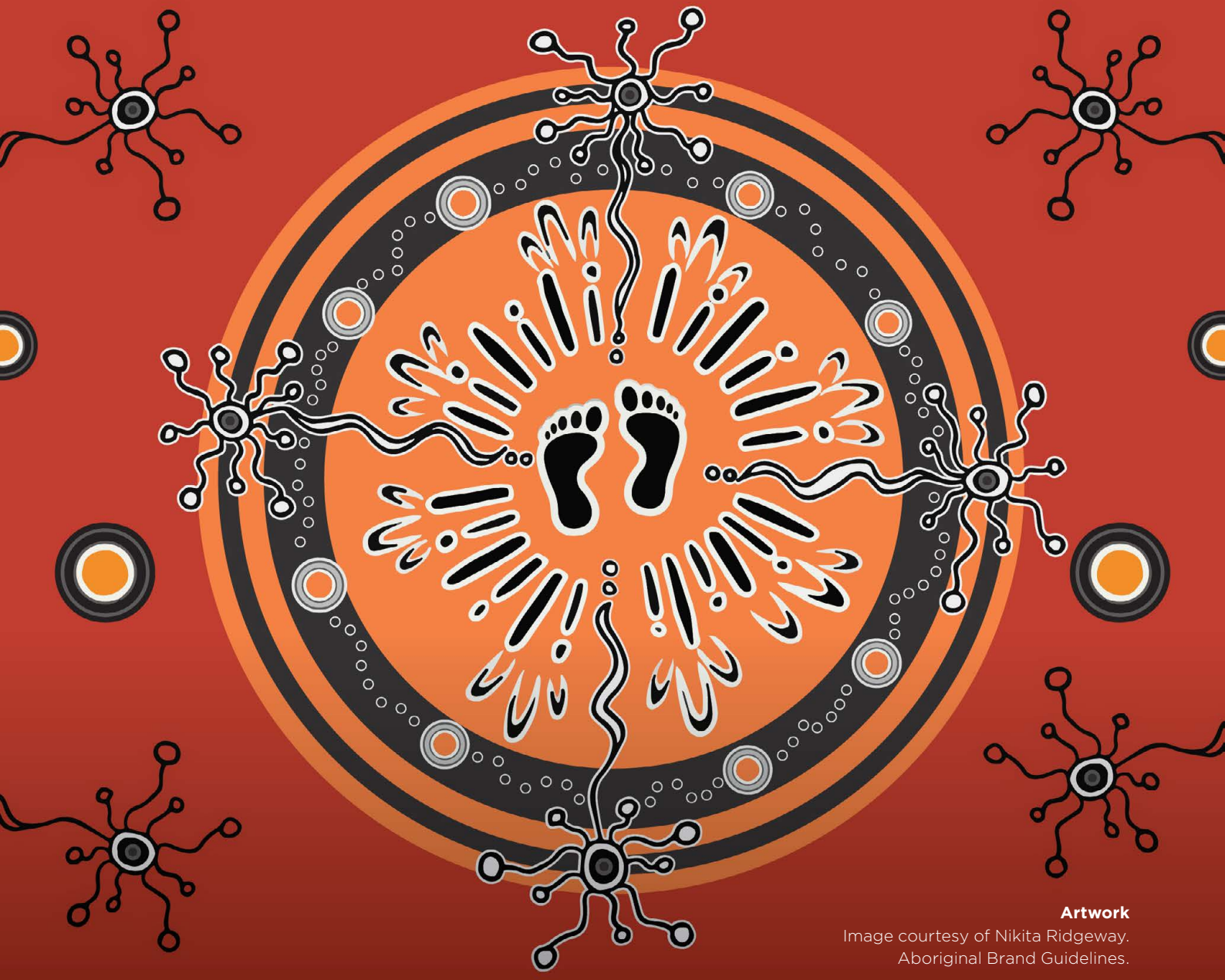
Cover image: Image courtesy of Destination NSW. Scenic aerial overlooking the Belligen River, Fernmount.

Acknowledging Aboriginal people

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

The NSW Government acknowledges the Anaiwan, Biripi, Bundjalung, Dunghutti, Githabul, Gumbaynggirr and Yaegl people 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 Anaiwan, Biripi, Bundjalung, Dunghutti, Githabul, Gumbaynggirr and Yaegl people with essential links to their history and help them to maintain and practise their culture and lifestyle.

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



Artwork
Image courtesy of Nikita Ridgeway.
Aboriginal Brand Guidelines.

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

Minister's foreword

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

When it comes to managing water in NSW my view is healthy rivers, healthy farms and healthy communities. Not one or the other.

The North Coast region is located within the traditional lands of the Anaiwan, Biripi, Bundjalung, Dunghutti, Githabul, Gumbaynggirr and Yaegl nations. The region is home to 300,000 people and the major centres of Port Macquarie, Coffs Harbour, Armidale and Kempsey, which drive the region's $16.8 billion average annual economy.

Water helps drive the local economy, including local businesses, and supports towns and communities. It is also critical for maintaining a healthy environment, which on the North Coast includes 6 river catchments – the Clarence, Macleay, Hastings, Bellinger, Nambucca and Wilson rivers, and the waterways surrounding Coffs Harbour.

Our state is no stranger to extremes – we have always had to manage our water resources through floods and prolonged droughts. In the face of an increasingly variable climate future, we must prepare for even longer and more severe wet and dry periods. Data shows that the North Coast region will experience hotter days and more extreme conditions in future. The devastation caused in the region over the last 5 years – the extended drought of 2018 to 2020, followed by catastrophic bushfires and extensive flooding – are a stark reminder of the type of natural disasters which could increasingly play out in the future.

This strategy, alongside 11 other regional and 2 metropolitan strategies across the state, are being developed using the best and latest scientific evidence. This helps ensure that we can understand and mitigate potential risks to water users, even in the most extreme climactic circumstances.

We engaged leading academics from the University of Adelaide to develop new climate data for the region. This new data supplements our historical record of climate conditions with new paleoclimate data, providing us with over 500 years of climate data to better understand historic climate variability. We have also applied the NSW Government's climate projections to this new data to understand the impacts of a worst-case 'dry' scenario. These scenarios may not necessarily eventuate, but they give us an idea of the possible climate risks and allow us to plan for them should they arise.

Through the development of this strategy, we have gained significant understanding of the region's unique water needs and the considerations needed for meeting future demands. Local government has contributed greatly to the development of the draft strategy and this consultation paper, and I thank councils for their engagement and support. We will continue to partner with them, and to work closely with the community, to ensure the strategy aligns with their needs.

We now know the North Coast region faces significant challenges going forward. River and catchment health is declining; there is more demand for water when rivers are running low; there is saltwater intruding into freshwater sources; there are barriers to Aboriginal people's rights and access to water; and we need to improve future water security for regional industries, towns and communities.

The key priorities for addressing the challenges in the North Coast region include taking a holistic approach to water management, ensuring water resources are used sustainably and fairly, and preparing for a more variable climate.

We now need to continue our conversations with the community. We are looking for your feedback on the proposed suite of actions that have been identified to meet these priorities. Your feedback will help us ensure that our decisions around future investments in the North Coast will safeguard our water resources for the decades to come.

We will continue to engage with the local Aboriginal communities across the region. This is vital given water is an essential part of their connection to Country and culture. Ensuring that these communities have access to water and cultural water holdings will be crucial to creating local jobs into the future.

To complement the regional water strategies, the NSW Government is delivering the Future Ready Regions Strategy, which aims to improve resilience and drought preparedness in regional NSW by drawing on lessons learnt from previous droughts. The NSW Government is also delivering the Marine Estate Management Strategy 2018-2028, which outlines how we plan to protect and enhance our coastal waterways, coastline, and estuaries.

In short, the evidence and information we now have means we can better plan for the future – to ensure this precious shared resource can continue to sustain regional lifestyles and cultural connections, support industry and protect our precious natural environment. The final North Coast Regional Water Strategy will put forward the best mix of solutions to address these challenges and support environmental, social and economic outcomes.

There is no 'one size fits all' policy to manage water in our regions. I encourage all members of the community on the North Coast to get involved and contribute to the strategy. Water is for everyone, and we are ensuring our water management policies support the future of the North Coast and all of NSW.

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

Contents

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

Snapshot: The North Coast region

302,000
population

42,000
km² area

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

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

Smaller towns 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.

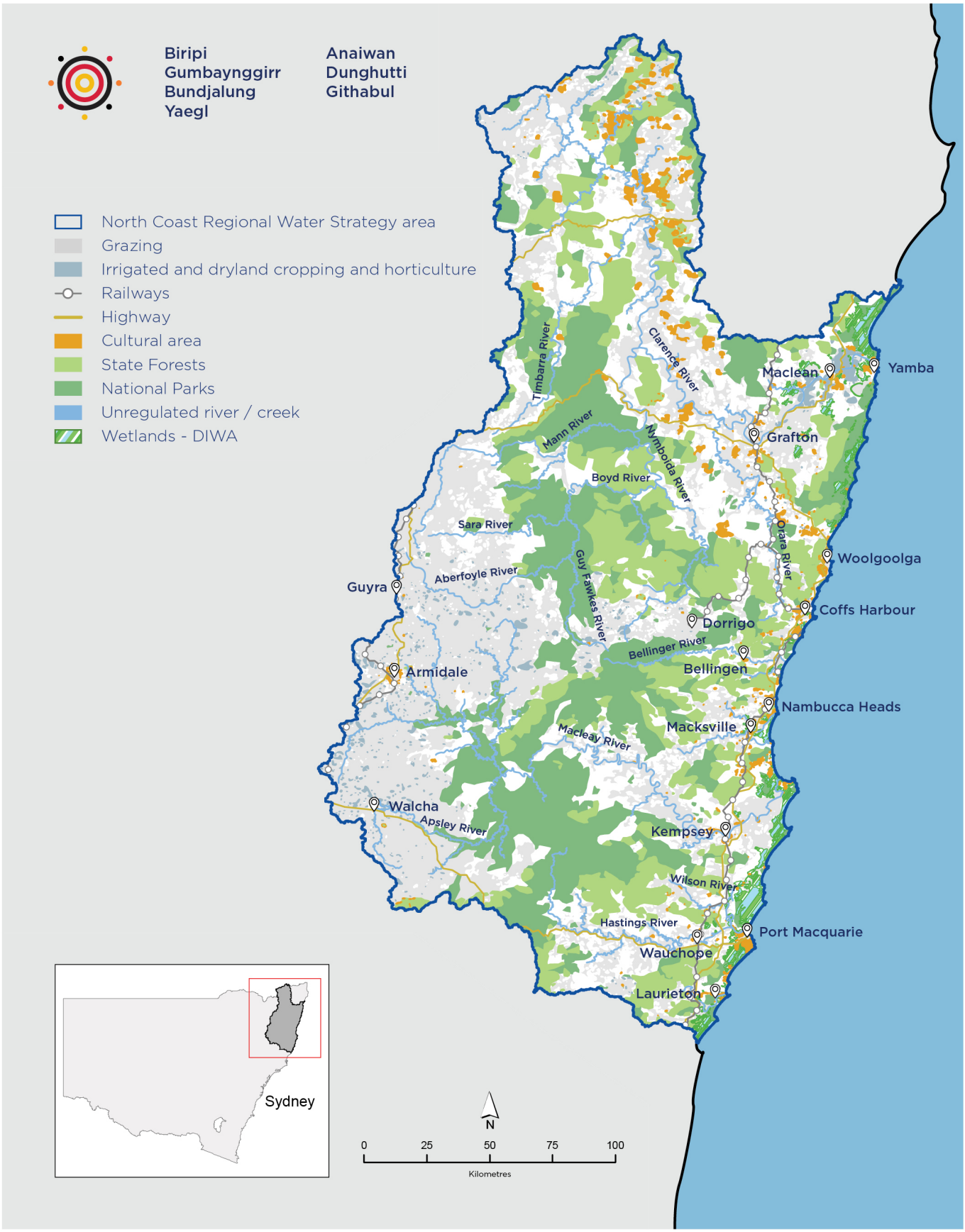
Critical State Significant Infrastructure:
Oven Mountain Pumped Hydro Energy Storage project.

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.

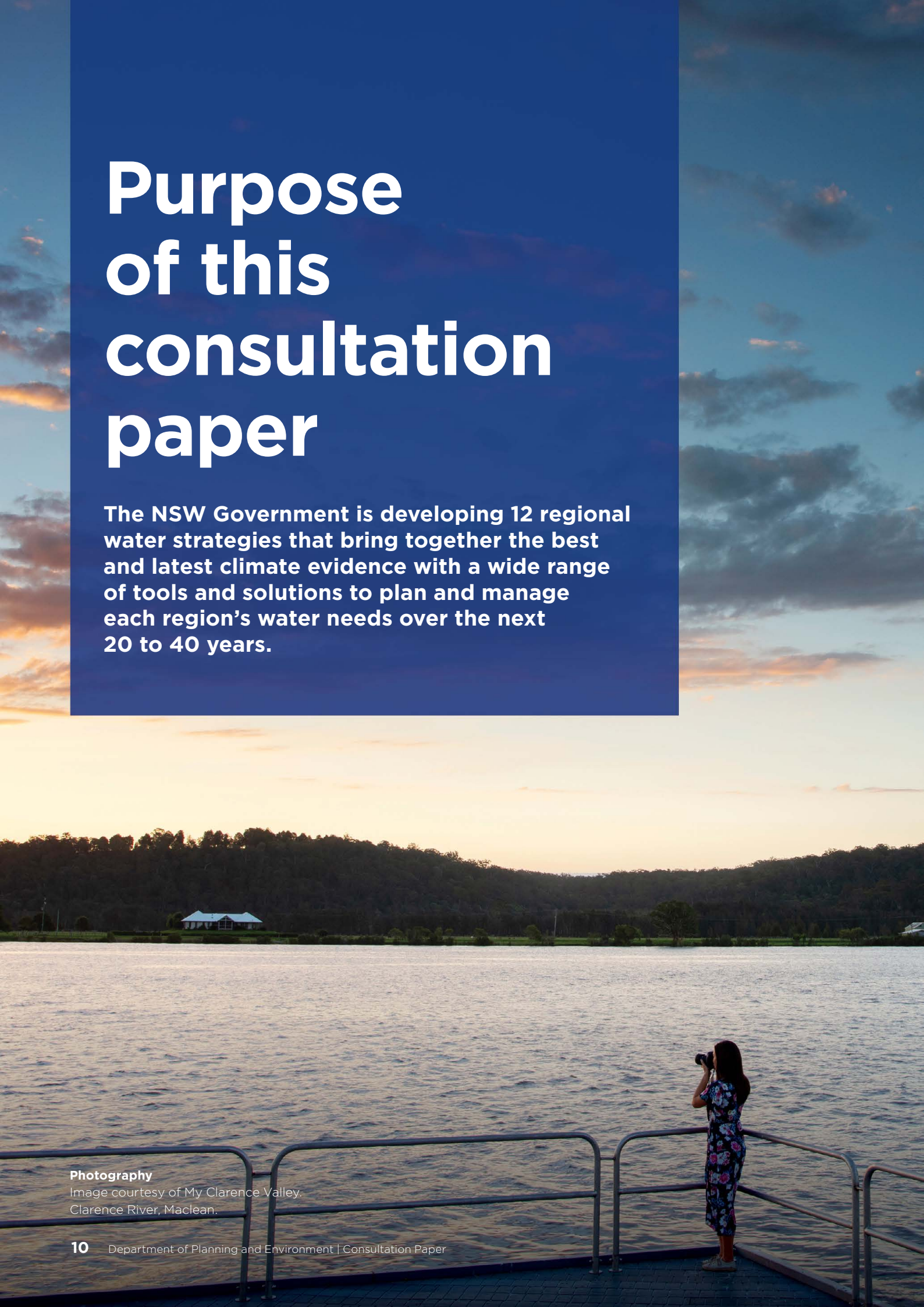
Gross Regional Product: **$16.8 billion**

Figure 1. Map of the North Coast region



Purpose of this consultation paper

The NSW Government is developing 12 regional water strategies that bring together the best and latest climate evidence with a wide range of tools and solutions to plan and manage each region's water needs over the next 20 to 40 years.



Photography
Image courtesy of My Clarence Valley.
Clarence River, Maclean.

The Draft North Coast Regional Water Strategy, including a long list of options, was released in March 2021.[1]

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

This consultation paper seeks your feedback on the challenges, priorities and proposed actions to help us finalise the North Coast Regional Water Strategy and implementation plan.

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

Additional background information can be found in:

- Draft North Coast Regional Water Strategy: What we heard
- Options assessment process: Overview[2]
- Economic base case.

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

1. Full descriptions of the region, its water resources and water needs are provided in the draft strategy, which can be viewed and downloaded at water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies/upcoming-public-exhibition/north-coast-regional-water-strategy
2 water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies/identifying-and-assessing

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

Figure 2. Proposed water security challenges and priorities for the North Coast

Vision

Our vision for the North Coast Regional Water Strategy is to support the delivery of healthy, reliable and resilient water resources for a liveable and prosperous region.

Page 20

Objectives

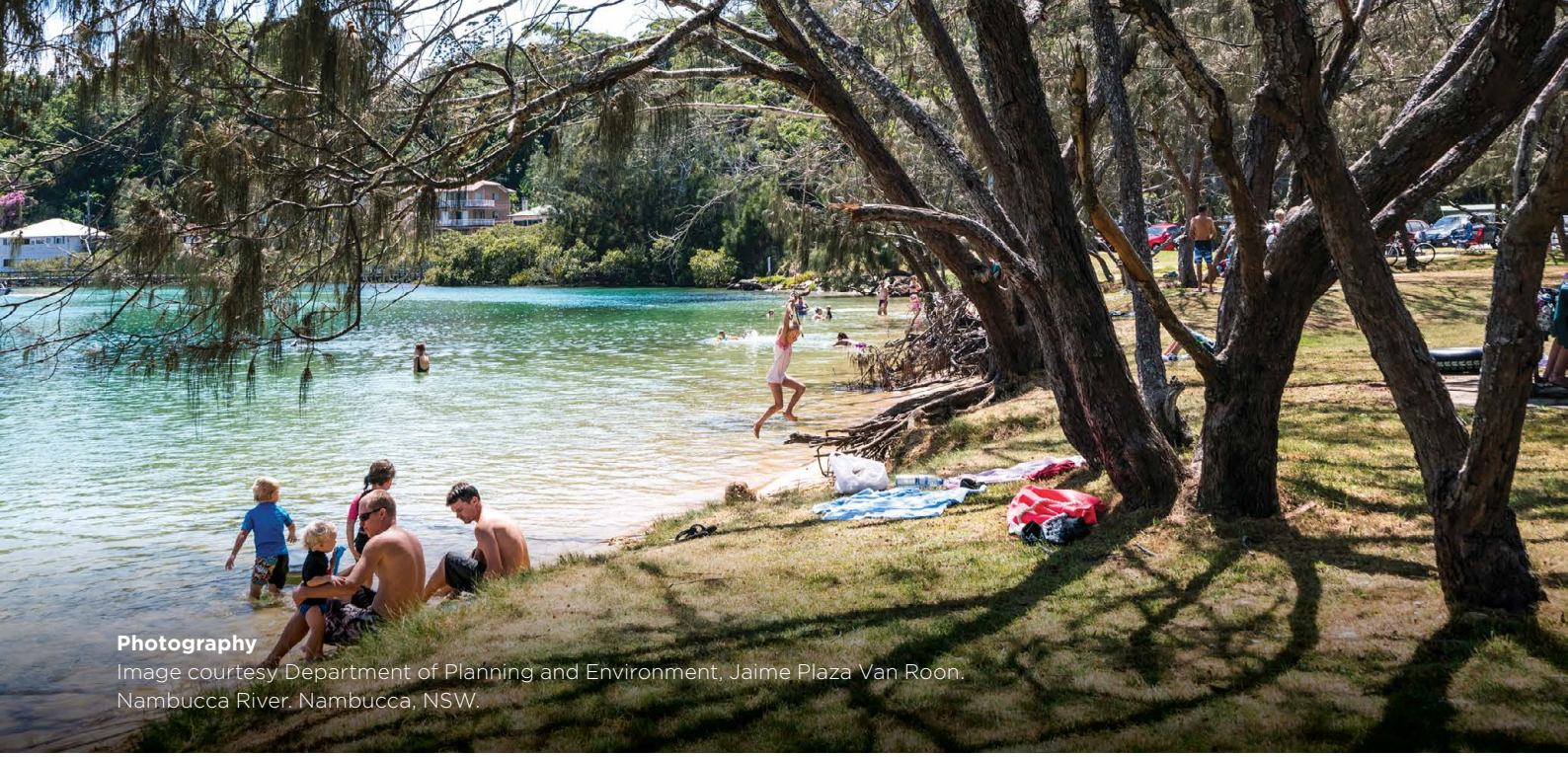
- Deliver and manage water for local communities
- Recognise and protect Aboriginal water rights, interests and access to water
- Enable economic prosperity
- Protect and enhance the environment
- Affordability

Regional challenges to meeting our vision and objectives

- 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 North Coast region industries
- Water availability for North Coast towns and communities

Page 22

Priority 1	Priority 2	Priority 3
Take a holistic approach to land and water management	**Ensure water resource development and use is sustainable and equitable**	**Prepare for future climatic extremes**
Page 44	Page 60	Page 72
		
Actions 1.1-1.10	Actions 2.1-2.7	Actions 3.1-3.5



Photography
Image courtesy Department of Planning and Environment, Jaime Plaza Van Roon. Nambucca River. Nambucca, NSW.

Why we are developing regional water strategies

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

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

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

How do regional water strategies fit with other water strategies?

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

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

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

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

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

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

Affordability – identify least cost policy and infrastructure options

We want to hear from you

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

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

The feedback we receive from you will help us finalise the North Coast Regional Water Strategy and implementation plan.

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

- based on the best evidence
- designed to respond to the North Coast region's water needs
- directed towards creating new opportunities for the region
- focused on delivering the objectives of the regional water strategies and the NSW Water Strategy.

Assessing benefits and impacts of actions on Aboriginal people and communities

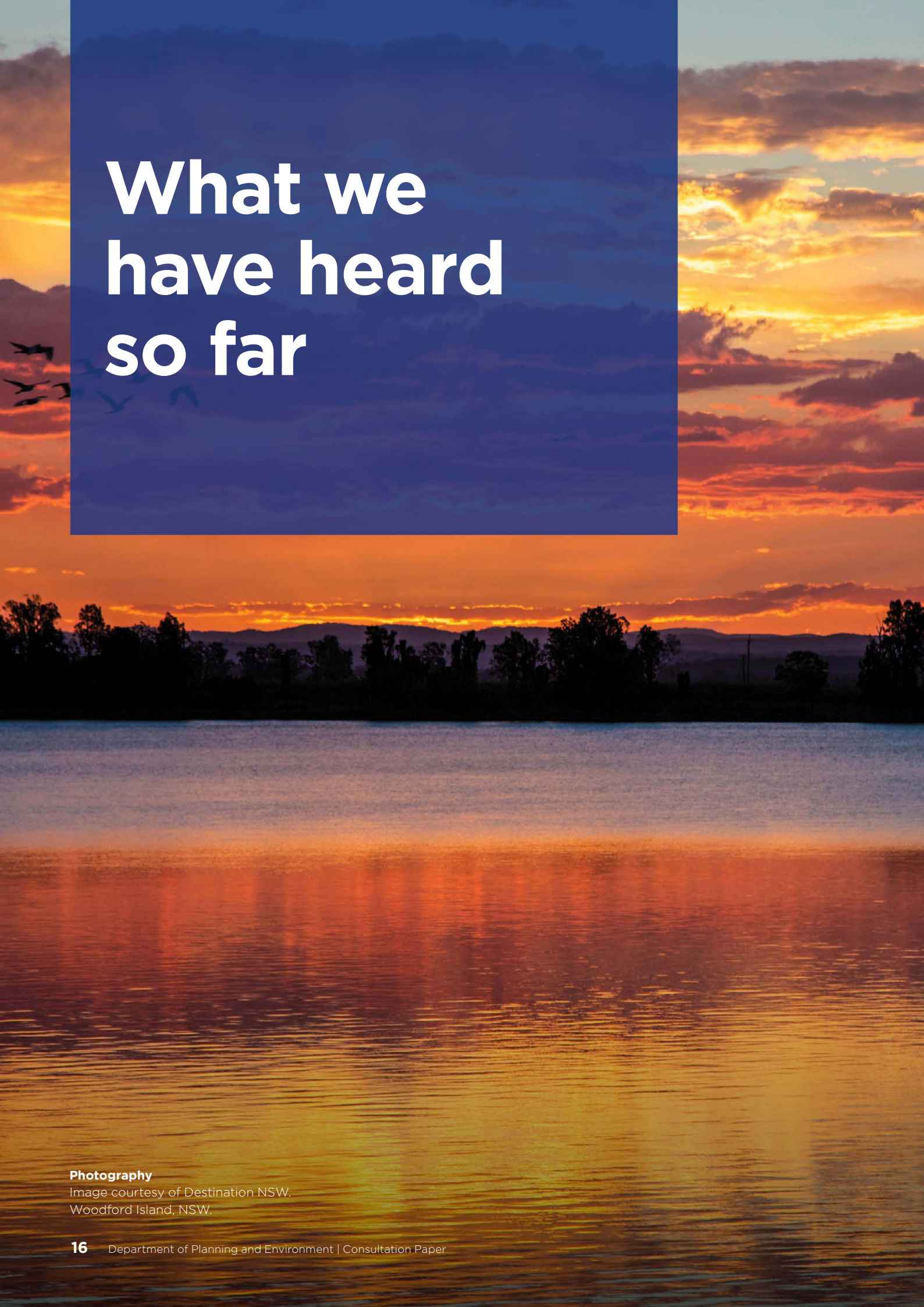
Aboriginal communities in the North Coast region have told us that they need specific information on how the proposed actions will affect them.

We know that several of the proposed actions will have potential impacts on, or provide benefits to, Aboriginal people and Aboriginal communities. Currently, we do not have enough evidence about these potential impacts and benefits to provide a full assessment of the proposed actions. Our preliminary engagement with some Aboriginal communities in the North Coast region has identified that communities need specific information on how the proposed actions will affect them. Some of this information will not be available until we begin to do more detailed analyses of specific options that remain in the final regional water strategy shortlist. Some of this additional analysis may be identified for early action in the strategy's implementation plan.

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

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

What we have heard so far



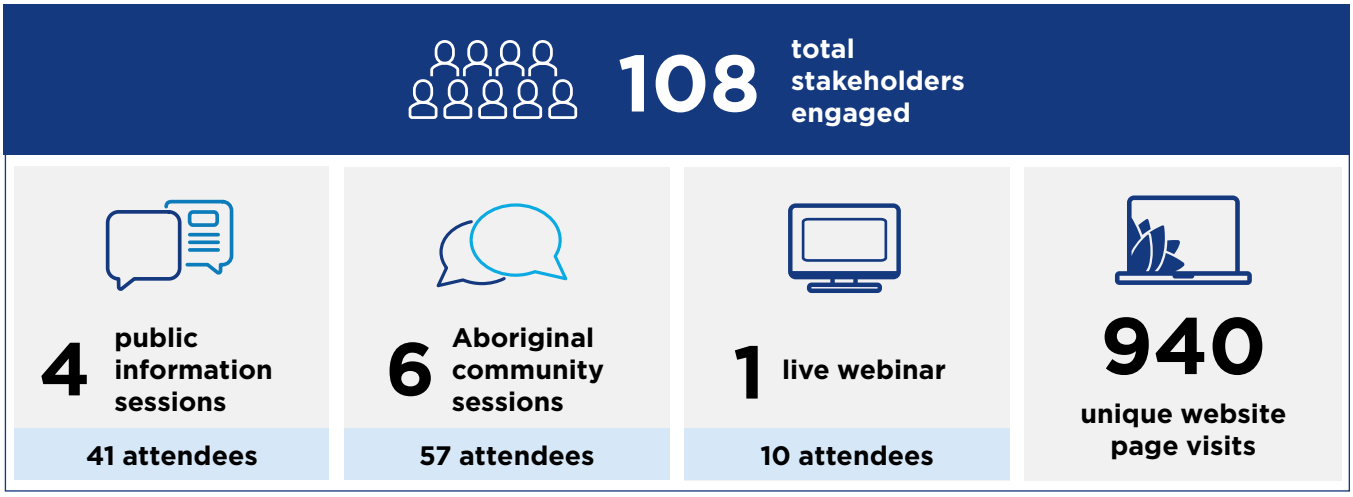
Photography
Image courtesy of Destination NSW.
Woodford Island, NSW.

In 2021 we engaged with the general public and Aboriginal communities on the Draft North Coast Regional Water Strategy and the long list of options. The What We Heard report[3] for the draft strategy summarises the key issues we heard during the first round of public exhibition and highlights how all feedback received during this period has informed the next steps in the development of the North Coast Regional Water Strategy.

There was general support for the regional water strategies program and the development of the North Coast Regional Water Strategy. Stakeholders asked the Department of Planning and Environment to progress the development of the NSW Water Strategy to provide an overarching framework and objectives that would guide the 12 regional water strategies and the associated implementation plans. Since that time, the NSW Water Strategy has been released for public consultation and finalised.

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

Figure 4. Stakeholder engagement



3. water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies/upcoming-public-exhibition/north-coast-regional-water-strategy

During consultation we also heard:

Water quality, river health and ecosystems

- Confirmation of the importance of the region's environment to its community and the expectation that river health be protected and water quality issues addressed.
- Support for options that help waterways cope with future projected impacts from climate change.
- Concerns about the impacts of catchment agricultural land use on water quality.
- Suggestions that options need to support farmers to change and adapt how they manage their land and water use.

Aboriginal people's water rights, interests and access to water

- Support for improving the recognition of Aboriginal people's water rights, interests and access to water.
- Suggestions to involve Aboriginal people in the development and implementation of this strategy.
- Provided examples of initiatives developed and led by local Aboriginal people that improve river health, build awareness and interest in the local environment and its cultural significance, and provide employment opportunities for local Aboriginal people.

Water conservation, re-use and recycling

- Support for options that conserve water.
- Suggestions that water recycling is critical to meeting future water needs, noting that there are several challenges that need to be addressed first.

New and existing infrastructure

- Concern about the impacts of new infrastructure and the diversion of flows on the environment.

Managing increasing demand from different users

- Concern that growth in demand for water from new industries, particularly horticulture, is unsustainable.
- Support for policy development and implementation that would assist the community during extended dry periods.

Compliance and monitoring

- Concern about the lack of compliance across the region and users not adhering to any proposed changes in policy or regulation.
- Landholders do not have access to the right extension services to help them understand the rules and their obligations.

Data collection and sharing

- Information and knowledge is critical to long-term water management.

Photography
Image courtesy of Destination NSW.
Ebor Falls, NSW.

Where should we focus first?

To achieve our vision for the North Coast region, we need to support the delivery of healthy, reliable and resilient water resources that will sustain a liveable and prosperous region.

Photography
Image courtesy of My Clarence Valley.
Clarence River, NSW.

The North Coast region lies within the traditional lands of the Anaiwan, Biripi, Bundjalung, Dunghutti, Githabul, Gumbaynggirr and Yaegl nations. It is located east of the Great Dividing Range and includes the catchments of the Clarence, Macleay, Bellinger, Nambucca, Hastings and Camden Haven rivers, as well as the waterways of the Coffs Harbour area. The landscape transitions from the New England Tablelands in the west, through rugged gorges to undulating foothills and floodplains before reaching the coast and its lagoons, wetlands, estuaries and beaches.

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

We have identified 6 key challenges that are immediate priorities for the region. Addressing these will help us meet the vision and objectives we have set for the North Coast Regional Water Strategy.

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

Declining catchment and river health

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

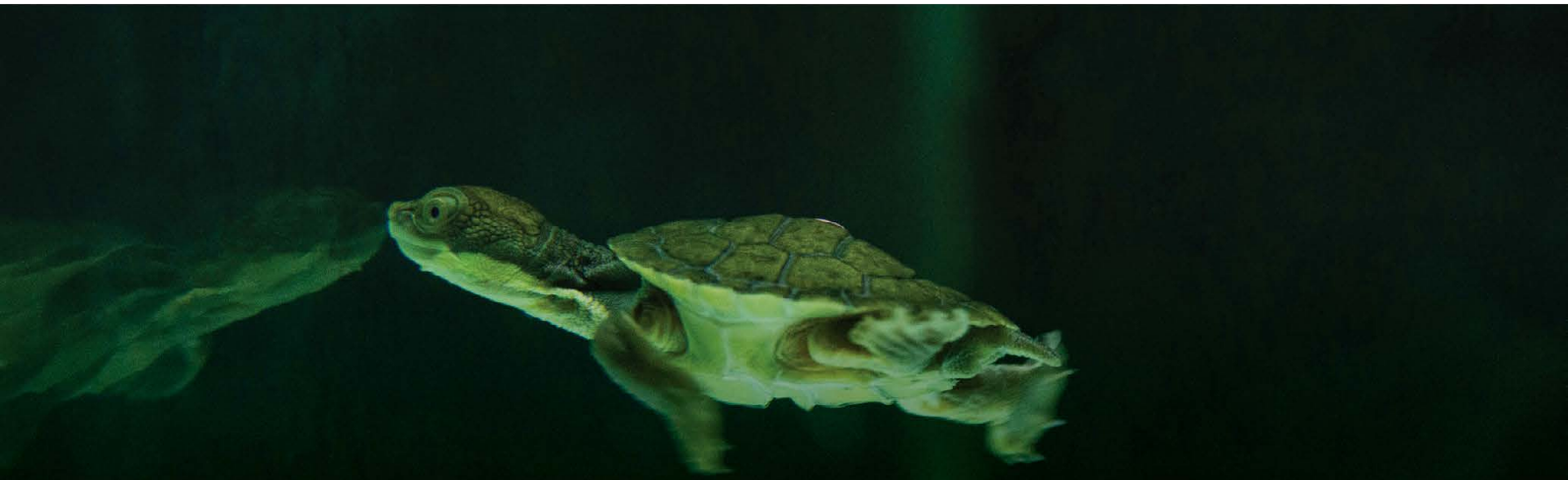
The decline in catchment and river health threatens aquatic and riparian ecosystems, as well as downstream estuarine health. This decline impacts Aboriginal people's connection to Country and cultural sites associated with waterways. Communities and towns have an increased need to treat poor quality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

Land management practices are impacting riverine health

Land clearing, poor riparian management and uncontrolled stock access has led to riverbank and riverbed erosion, and the mobilisation of sediment, nutrients, pathogens and debris during rainfall events. These impacts are particularly acute during rainfall events following bushfire.

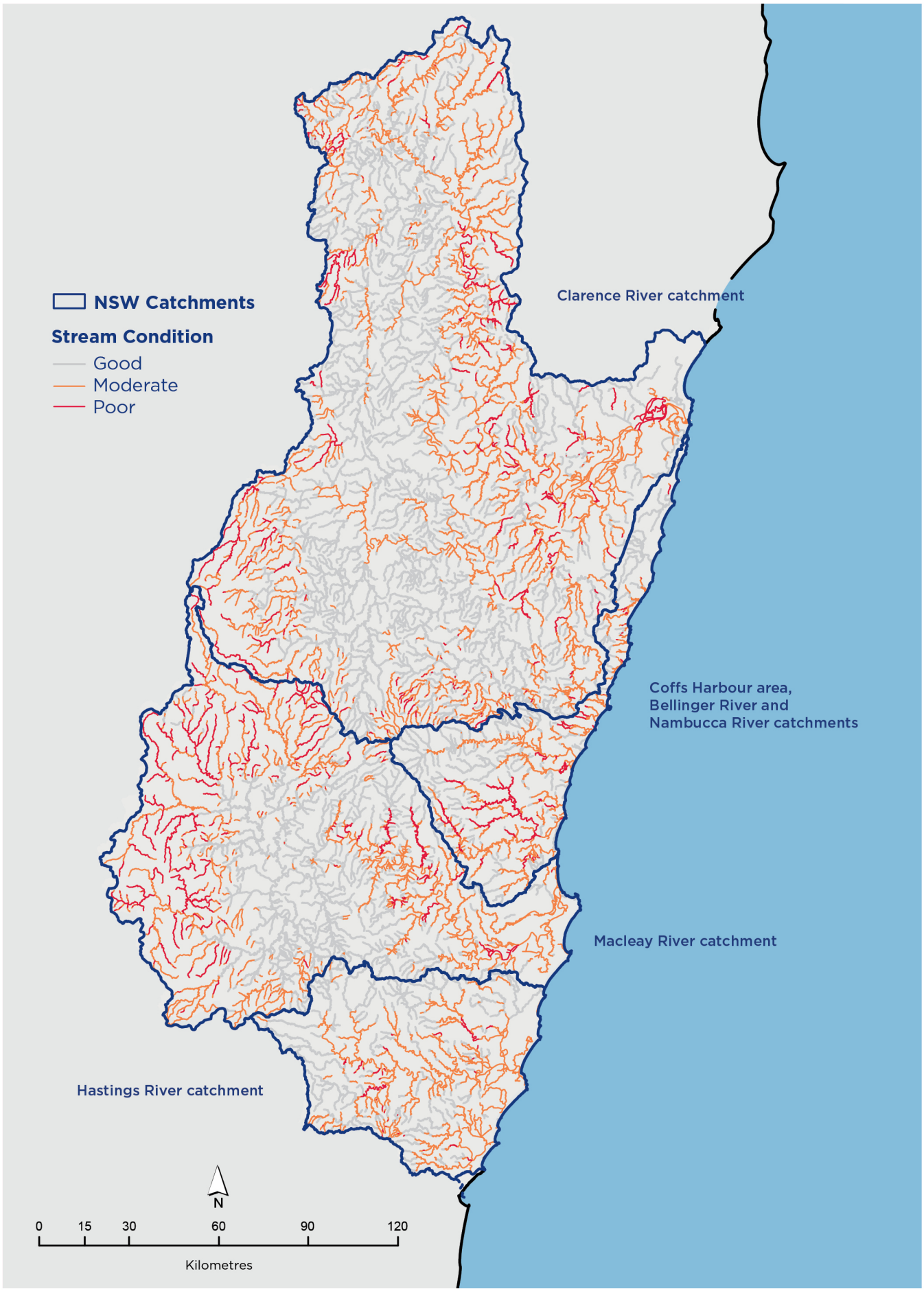
Across the North Coast region, 10,600 km (or just less than 50%) of the region's rivers are in good geomorphic condition. River sections in poor geomorphic condition account for 16.7% of the total length of all rivers across the region and are mainly located within reaches on the New England Tablelands (for example, the zone between Walcha and Guyra/Llangothlin) and on the central to lowland plains (for example, the Lower Macleay, the Nambucca River, Taylors Arm and the Bellinger River).[4]

4. Alluvium 2012. *River Styles assessment and mapping in the Northern Rivers CMA area*. Report by Alluvium for the NSW Office of Water and Northern Rivers Catchment Management Authority, January 2012.



Photography
Image courtesy of Taronga Zoo.
Bellinger River turtle hatchling, NSW.

Figure 5. Distribution of poor and moderate condition river reaches across the North Coast region



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 has also shown 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.[5]

The condition of riparian (streambank) vegetation is generally low across the region, except in protected or forested areas. This is due to weed infestations and vegetation clearing, which leads to large areas devoid of native vegetation or with poor vegetation diversity. It also leads to reduced structure – such as leaf area and canopy height – and small, isolated and poorly connected patches of native vegetation. Most estuarine reaches are in poor condition and are dominated by riverbanks with little or no vegetation.

As a result of land clearing, water now moves more quickly and with more energy through the region's catchments than in its natural state. This fast-moving water further erodes land and waterways, reduces water quality and leads to less water stored in the landscape. Stock access to the region's rivers and creeks also contributes to bank erosion, water pollution and increased sediment inputs.

The impacts of land clearing and development are heightened during the extreme rainfall events which is characteristic of the North Coast region. Runoff generated during these events is typically high in nutrients and sediment, causing elevated nutrient loads and smothering vegetation, and subsequent deoxygenation and further release of nutrients. These impacts are particularly acute during rainfall events after 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. During consultation for the draft strategy, 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.

5. www.bioregionalassessments.gov.au/assessments/11-context-statement-clarence-moreton-bioregion/1152-surface-water-quality

Photography
Image courtesy of Kempsey Shire Council.
Men canoeing in Bellbrook, Macleay Valley Coast.

Poor management of fertiliser is a key contributor to high nutrient loads in the region's waterways

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 make it challenging to manage crop fertilisation and irrigation. Consequently, crops are being over-fertilised, which causes elevated nutrient levels (particularly nitrate and nitrite) in downstream waterways, and deterioration of soil health and productivity.

Studies conducted for Coffs Harbour City Council have detected significant 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 were consistent with nitrogen leaching from fertilised soils (as well as greywater usage). These impacts could continue to worsen as more intensive industries establish across the region, impacting waterway health, recreational values, the Solitary Island Marine Park as well as other important coastal lagoons.[6]

Current governance arrangements for catchment-scale decision-making, planning and project delivery are confusing, complicated and disconnected

Responsibility for managing water quality impacts is shared across several state and local government agencies. We lack an overarching framework for managing water quality. This impedes planning, multi-actor collaboration, coordination and reconciliation of state and local priorities. It also impacts the development and delivery of environmental catchment programs at different scales and makes it difficult to ensure that environmental water quality and quantity needs are met throughout the catchment.

We have heard that a lack of social willingness amongst users and landholders, together with complicated natural resources regulation, is also reducing uptake of best practice.

6. White, S. et. al., 2020, *Nutrient transport and sources in headwater streams surrounded by intensive horticulture*. Prepared for Coffs Harbour City Council by Southern Cross University, July, available at: www.coffsharbour.nsw.gov.au/files/sharedassets/public/environment/compliance-and-reporting/monitoring-our-waterways/nutrient-transport-and-sources-in-headwater-streams-final-report.pdf

Photography
Image courtesy of iStock.
Nambucca Heads, NSW.

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

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%, and that all parts of the flow regime may be impacted (Figure 6). 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.

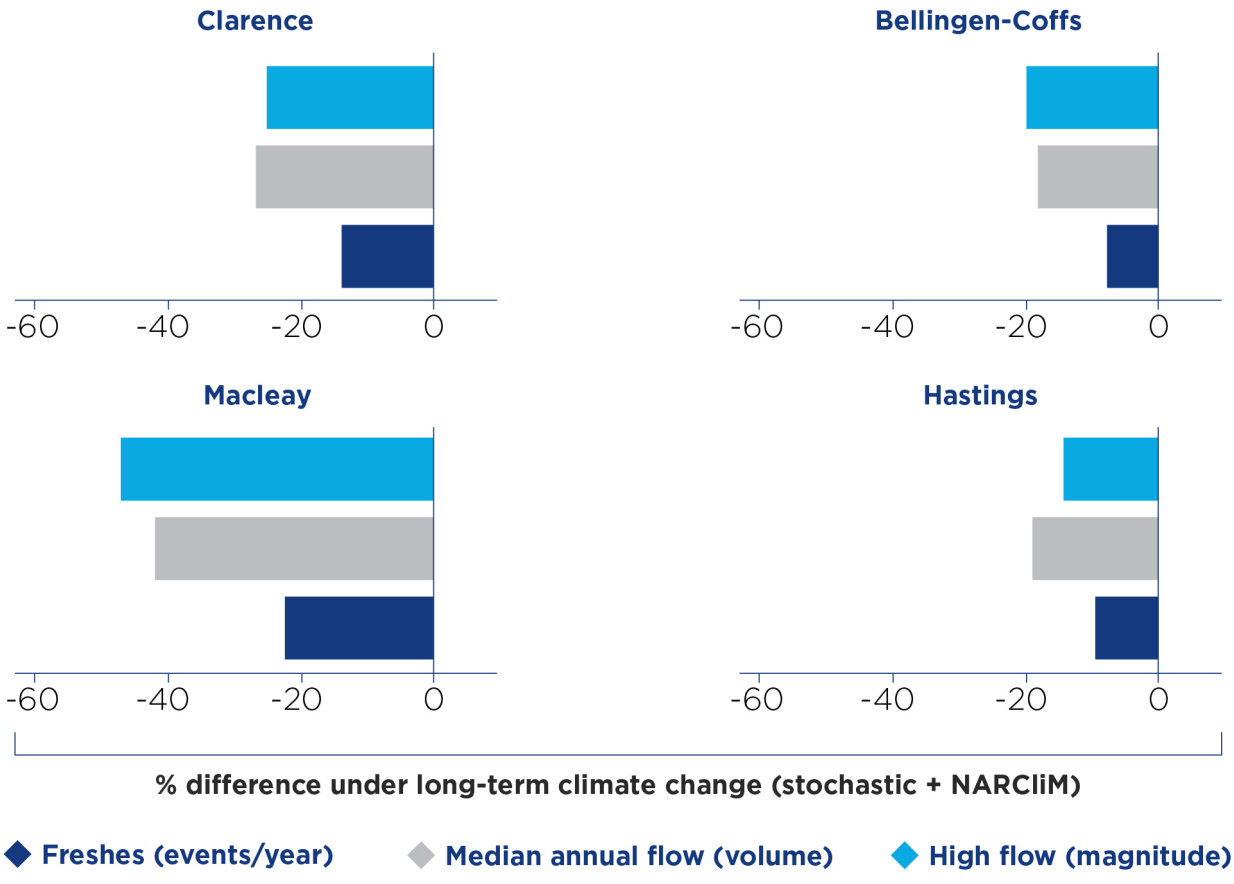
Freshwater inflows are critical to the health and function of the region's estuaries. These inflows help maintain low salinity levels and mobilise the nutrients, sediment and pathogens needed to support habitat diversity and productivity. Reductions in inflows may affect salinity gradients, circulation patterns, and fish movement. This would detrimentally impact estuarine ecology, particularly in the tidal pools at the upper limits of the estuaries.

Intermittently closed and open lakes and lagoons are particularly sensitive to modified freshwater flows, which can significantly impact water quality, geomorphology and entrance opening regimes. It can also impact the health and extent of mangroves, saltmarsh and seagrass, which are important fish habitat.

To help address these issues, the Marine Estate Management Strategy has flagged the regulation and extraction of freshwater flows as a priority threat.

The quality of freshwater inflows is also important to estuarine health and the communities and industries they support. For example, elevated nutrient levels, excessive turbidity and siltation are key factors that have led to the significant loss of seagrass in the Macleay River and South West Rocks Creek. Additionally, bacterial contamination in the estuary and lower floodplains impacts the health of fish, shellfish and crustaceans and impacts oyster growers in the Nambucca, Bellinger, Hastings and Macleay rivers.

Figure 6. Projected impacts of climate change on the flow regime in North Coast rivers[7]



7. Similar trends are also likely for estuary inflows. These trends are presented in the Draft North Coast Regional Water Strategy.

Structures that alter natural flow regimes are impacting 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 flow of rivers and streams and their associated floodplains and wetlands, and contribute to the loss of biodiversity and ecological function of waterways.

Instream structures – such as dams, weirs, culverts, navigation locks and floodgates – can be significant barriers to native fish migration. Species known to be directly affected by instream structures and their operation include the endangered eastern freshwater cod (*Maccullochella ikea*), oxleyan pygmy perch (*Nannoperca oxleyana*) and the southern purple spotted gudgeon (*Mogurnda adspersa*). Other coastal fish species potentially impacted by barriers to fish passage include freshwater catfish (*Tandanus tandanus*), diadromous species[8] such as freshwater herring (*Potamalosa richmondia*) and short-finned eel (*Anguilla australis*), and 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 adversely affected.

8. Diadromous fish migrate between fresh and salt water.

Photography
Image courtesy of iStock.
Macleay River, NSW.

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[9] during the drier spring months places many of the region's rivers and creeks under increased hydrologic stress.

Over the last 20 to 30 years, there has been a major shift away from rain-fed crops to high-value horticulture crops with increased irrigation demands. This has placed a great stress on rivers. With projected climate change, the modelled reduction in low flows and the subsequent increase in demand for irrigation, this pressure on low flows is likely to increase in the future.

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

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

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

9. Flows in the 95th percentile on a flow duration curve. Upper percentiles, such as the 95th percentile, typically represent low or very low flows, while lower percentiles, such as the 5th percentile, represent high flows or flooding.

Setting effective rules to manage competition for low flows is constrained by catchment conditions and limited data

Protecting low flows – to reduce the stress on the region's rivers and to protect water for downstream users – relies on cease-to-pump rules. These 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, which may be difficult to justify given the low level of extraction compared to inland regions.

In many of the small unregulated coastal catchments in the region, visible flow rules were adopted primarily as a result of these challenges. However, visible flows have been criticised for being subjective and 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.

Very few pumps are metered, making it difficult to understand the extent of the problem and to properly 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-take 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 we have 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 impact 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 ameliorate low flow impacts. Further detailed catchment analysis in 2022 will confirm the suitability of these changes to harvestable rights.

Anecdotally, growth in water extraction for domestic and stock purposes under basic landholder rights – particularly resulting from the sub-division of rural residential land with waterway frontage – is also increasing competition for water at low flows. Water extraction for basic landholder rights is not regulated. There is no limit on the volume of water that may be taken nor guidelines about how the right can be used, although basic landholder rights cannot be traded. Consequently, 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, we will review how domestic and stock basic landholder rights are regulated. This will include estimating the quantity of water extracted under these rights.

Photography
Image courtesy of Melinda Simpson.
Blueberries, NSW.

Saltwater intrusion into freshwater sources

Changes in catchment hydrology and sea level rise are projected to significantly impact 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.[10] 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 impact:

- coastal wetlands, 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 it 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.[11] For the North Coast region, the average projection is between 0.19 m and 0.59 m by 2070 (Table 1).

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, and the likely global mean sea level rise by 2100 is 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 frequency and severity of impacts from sea level rise, saltwater intrusion and altered catchment hydrology is likely to be worsened as growing populations and industries increase the demand for freshwater in coastal areas.

Table 1. 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)

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

10. 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.*
11. CoastAdapt 2017, *Sea-level rise and future climate information for coastal councils*, accessed 14 July 2020 from coastadapt.com.au/sea-level-rise-information-all-australian-coastal-councils

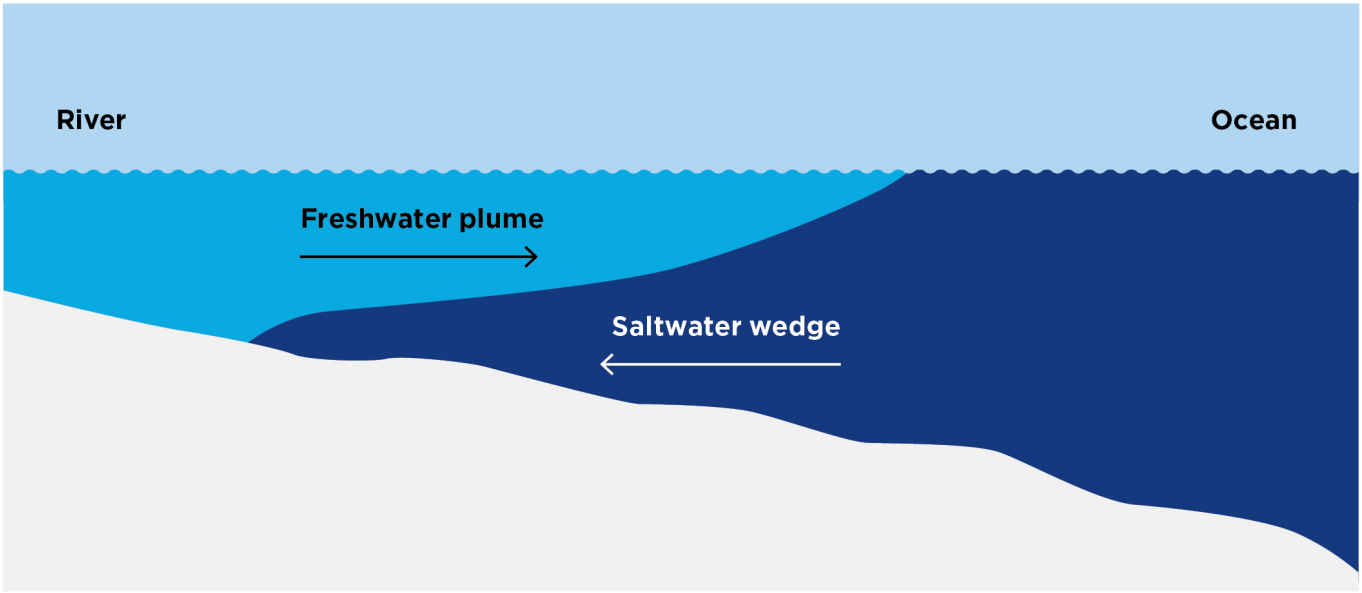
Possible reductions in river flows are likely to amplify the impacts from sea level rise

Many of the North Coast region's rivers have a maximum high-tide footprint that extends at least 20 km upstream, with sea level rise likely to cause estuarine zones to migrate upstream. Other climate change impacts on coastal estuaries are expected, mainly due to the reduction in the magnitude of freshwater inflows and increased frequency of cease-to-flow events.

During low flow and cease-to-flow events, salinity gradients in tidal pools change as freshwater entering estuaries is either reduced or stops (as illustrated in Figure 7). This change allows the salt wedge that usually sits below the freshwater in tidal pools to move further upstream.

Our modelling shows that the magnitude of low flows may decrease by 36% under a worst-case climate change scenario, with the frequency of cease-to-flow events increasing 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, with the frequency of cease-to-flow events potentially increasing by 24%.

Figure 7. Concept of a tidal saltwater wedge for a permanently opened estuary[12]



Note: Salt fronts form when freshwater moving downstream meets tidal water moving inland.

12. Adapted from 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. Thus, even a small rise in sea level may reduce the suitability of water sources for local town water supplies, irrigation, dairy washdown, and stock and domestic supplies as well as potentially compromise water and wastewater treatment plant infrastructure.

Sea level rise is likely to impact on coastal environments such as low-lying coastal wetlands which could become inundated for longer, or at the most extreme, inundated permanently. The Marine Estate Management Strategy recognises this as a key threat to the NSW coastal, estuarine and marine environment and has identified several actions that 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 need 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, Macleay and Wilson river catchments for the Marine Estate Management Strategy included sea level rise and saltwater intrusion, but did not consider the impacts from changes in freshwater inflows due to climate change. Additionally, water sharing plans for major tidal pools in the Clarence and Macleay river catchments have cease-to-pump rules aimed at preventing the unnatural progression of the salt wedge into the tidal pool areas. However, at this stage, it is unclear if these rules will be effective given both the potential future changes in sea level rise and catchment hydrology.

Forming a clearer regional picture of the combined impacts from changes in catchment hydrology and sea level rise is critical to developing 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, particularly where groundwater and surface water systems are highly connected. The intrusion of saltwater into groundwater affects ecosystems and town water security by significantly degrading water quality and reducing freshwater availability over the medium-to-long term.

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 – particularly the major centres of Kempsey, Bellingen and Nambucca – and industries. Saltwater intrusion is already occurring in the Stuarts Point coastal sands.

The impacts of saltwater intrusion are currently managed by ensuring coastal aquifers are not over-extracted through limiting licensed extraction and managing water levels in areas of high extraction.

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.

The Anaiwan, Biripi, Bundjalung, Dunghutti, Githabul, Gumbaynggirr and Yaegl nations people have been the custodians of the lands and waterways in the North Coast region for tens of thousands of years. Water is deeply entwined with Aboriginal culture. Healthy waterways are essential to the culture and wellbeing of Aboriginal communities across the North Coast region, providing food, kinship, connection, recreation, stories, songlines and healing.

Aboriginal people have lost access to waterways

The historical dispossession of land and the effect of colonial era settler laws continue to impact the North Coast region's Aboriginal people's access to water and ability to care for Country. Private land, fences and locked gates – often on Crown land – prevent Aboriginal people from accessing Country, carrying out cultural practices and using traditional knowledge to care for and manage land and 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. It also provides spaces for healing, as well as for food, medicine, and teaching.

Aboriginal communities in the North Coast region 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 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 made worse 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. Often, Aboriginal people need to give up personal time and resources to have a say in water consultation processes.

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 a rich and holistic approach to water and land management that Aboriginal people have been practicing for thousands of years.

The actions that have been proposed in the North Coast Regional Water Strategy target both state-level and local-level solutions through:

- ongoing arrangements for the participation of local Aboriginal people in water management
- place-based initiatives to deliver cultural outcomes for local Aboriginal people
- support Aboriginal business opportunities
- removing barriers through a statewide Aboriginal Water Strategy.

Photography
Image courtesy of Destination NSW.
Wajaana Vaam Gumhavnanirr Adventure Tours, Coffs Harbour.

Water security for North Coast region industries

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 we 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.

We have also heard that gaining access to additional water to mitigate these risks or support new or expanding industries is a challenge for existing and prospective North Coast region businesses.

There is limited stored water or alternative sources of water to meet irrigation demands, particularly during drought

Historically, the need to store large volumes of water for irrigation across the North Coast region has been largely unnecessary. 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 to 2020 drought highlighted a need to shift from a reactive to a proactive management approach to weather extremes. It showed that the crops currently grown in the North Coast region, particularly the more recent horticultural crops, are vulnerable to extended dry periods. During the recent drought, farm dams dried up, many farmers carted water, crops were severely cut back, and stocks were reduced. Efforts were made by the blueberry industry at Woolgoolga to access water from a decommissioned local council dam.

The 2020 bushfires in the North Coast hinterland impacted farm infrastructure such as troughs, further reducing local water supplies. Water quality, as discussed in Challenge 1, was also severely impacted.

Our modelling shows that dry periods are likely to increase in frequency and intensity and traditional surface water sources may be less reliable than we 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 deplete groundwater yields. The region's coastal sand and alluvial groundwater sources have come close to failing during extended dry periods, even with only the current licenced extraction levels.

Currently, the only drought-proof water source in the region is the recycled water scheme operated by Coffs Harbour City Council. This scheme supplies water to 30 agricultural properties (as well as to municipal and sporting facilities), mainly for growing blueberries, tomatoes, cucumbers, and bananas. However, the use of this water has presented several administrative and downstream water quality problems.

Water extraction limits are restricting development opportunities in 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*.[13]

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.

We have also heard that 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 run-off from their property in one or more dams on non-permanent, mapped minor streams, or unmapped streams. This 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 done 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. It excludes the use of this water for intensive agricultural uses such as horticulture and aquaculture.

13. www.industry.nsw.gov.au/water/allocations-availability/controlled

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, access to additional water can occur 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.

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

Industries in the North Coast region, such as intensive horticulture, have generally been established based on an expectation that there is plenty of water. However, the long-term data to support this belief has been lacking, particularly considering recent modelling on long term climate scenarios and climate change projections.

We have heard that some farmers who have shifted to more water-dependent crops do not have the knowledge or experience of irrigation, and there is scope to provide significant water savings through simple changes to farm infrastructure and processes. To support these industries in the future, capacity and knowledge gaps need to be addressed. Likewise, a good understanding of irrigation demands is needed.

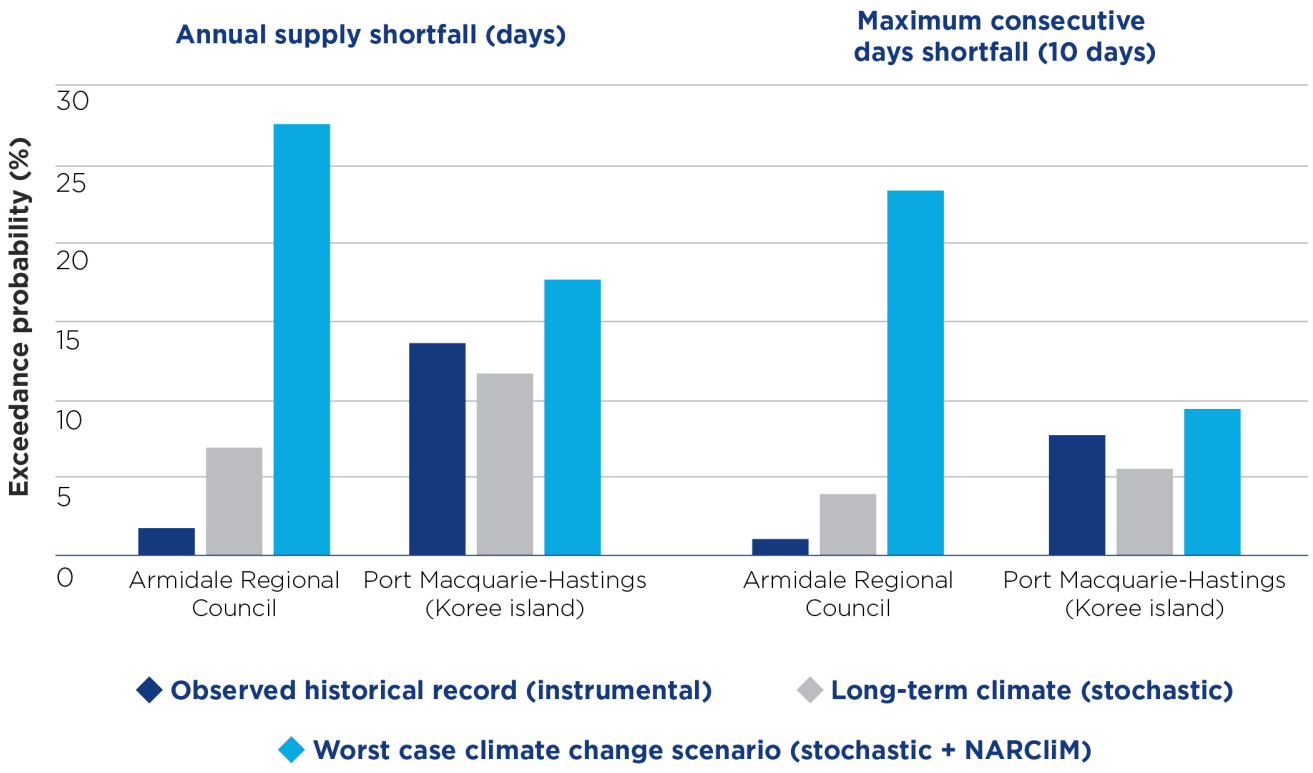
Water availability for North Coast towns and communities

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

Most major centres in the North Coast region rely exclusively on surface water flows for town water supply.

Our new modelling and climate data suggests that shortfalls in the extraction[14] of surface water do occur and could increase with climate change. Additionally, the models show that the probability of these shortfalls will differ across the region. For example, based on current population, the number of days with a shortfall in extraction for Armidale Regional Council is projected to increase from less than 2% (based on instrumental data) to around 27% (worst-case climate change projections). In contrast, the new model predicts the probability of shortfalls in Port Macquarie–Hastings Council extractions to increase from 14% to 18% based on instrumental and worst-case climate change projections (Figure 8).

Figure 8. Shortfalls in extraction for Armidale Regional Council (Malpas Dam) and Port Macquarie–Hastings Council (based on data collected at Koree Island)



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

Local alluvial groundwater is also an important source of town water for Kempsey Shire Council, Nambucca Valley Council and Bellingen Shire Council. These sources are highly connected to river flows and water availability is impacted by reduced surface water flows. Our new modelling shows that low flow periods and associated cease-to-pump conditions could occur more often, affecting extraction of groundwater for these councils.

Most local councils have already taken steps to protect town water supplies against dry periods; however, the conditions of 2018 to 2020 highlighted that many of these systems are still vulnerable

Over the last 20 years many of the region's local councils, prompted by impacts from historic extended dry periods and population growth (particularly for the larger centres of Grafton, Coffs Harbour and Port Macquarie) have invested in infrastructure to manage shortfalls in water availability.

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 to 2020 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 – with one reason being the extraction of poorer quality water – and, for some councils, water security issues continued even when rain arrived. The combination of bushfires, the drought and finally heavy rainfall, meant that when the rivers did begin to flow the water was highly turbid and could not be effectively treated through the town's water treatment facilities.

Photography
Image courtesy of Clarence Valley Council.
Shannon Creek Dam, Shannondale.

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 integrated water cycle management 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 meet shortfall risks in extraction and assessing the performance of local based 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 the Coffs Harbour's town water supply. Comments on the Draft North Coast Regional Water Strategy also note significant community concern in connecting neighbouring town water networks, emphasising the importance of managing water locally. There was also significant opposition to inland catchment diversions given the perceived economic and environmental costs.

Photography
Image courtesy of Destination NSW.
Muttonbird Island Nature Reserve, NSW.

Addressing the challenges

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

The regional priorities are:

1. **Take a holistic approach to land and water management**
2. **Ensure water resource development and use is sustainable and equitable**
3. **Prepare for future climatic extremes.**

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

Photography
Image courtesy of iStock.
Clarence River, Near Grafton.

Figure 9. Summary of North Coast proposed actions

Actions not shown on the map are not location specific.

Priority 1: Take a holistic approach to land and water management

- Action 1.1: Develop ongoing collaboration with local Aboriginal people in water management
- Action 1.2: Support place-based initiatives to deliver cultural outcomes for Aboriginal people
- Action 1.3: Support improved governance
- Action 1.4: Deliver a river recovery program
- Action 1.5: Support landholder adoption of best practice land management
- 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

Priority 2: Ensure water resource development and use is sustainable and equitable

- Action 2.1: Improve fish passage
- Action 2.2: Implement fish-friendly water extraction
- Action 2.3: Establish sustainable extraction limits for surface water and groundwater sources
- Action 2.4: Implement daily extraction limits
- Action 2.5: Reduce the take of low flows
- Action 2.6: Support Aboriginal business opportunities
- Action 2.7: Address catchment-based impacts of increased harvestable rights limits

Priority 3: Prepare for future climatic extremes

- 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
- Action 3.3: Review water markets
- Action 3.4: Investigate increased on-farm water storage
- Action 3.5: Increase use of recycled water for intensive horticulture

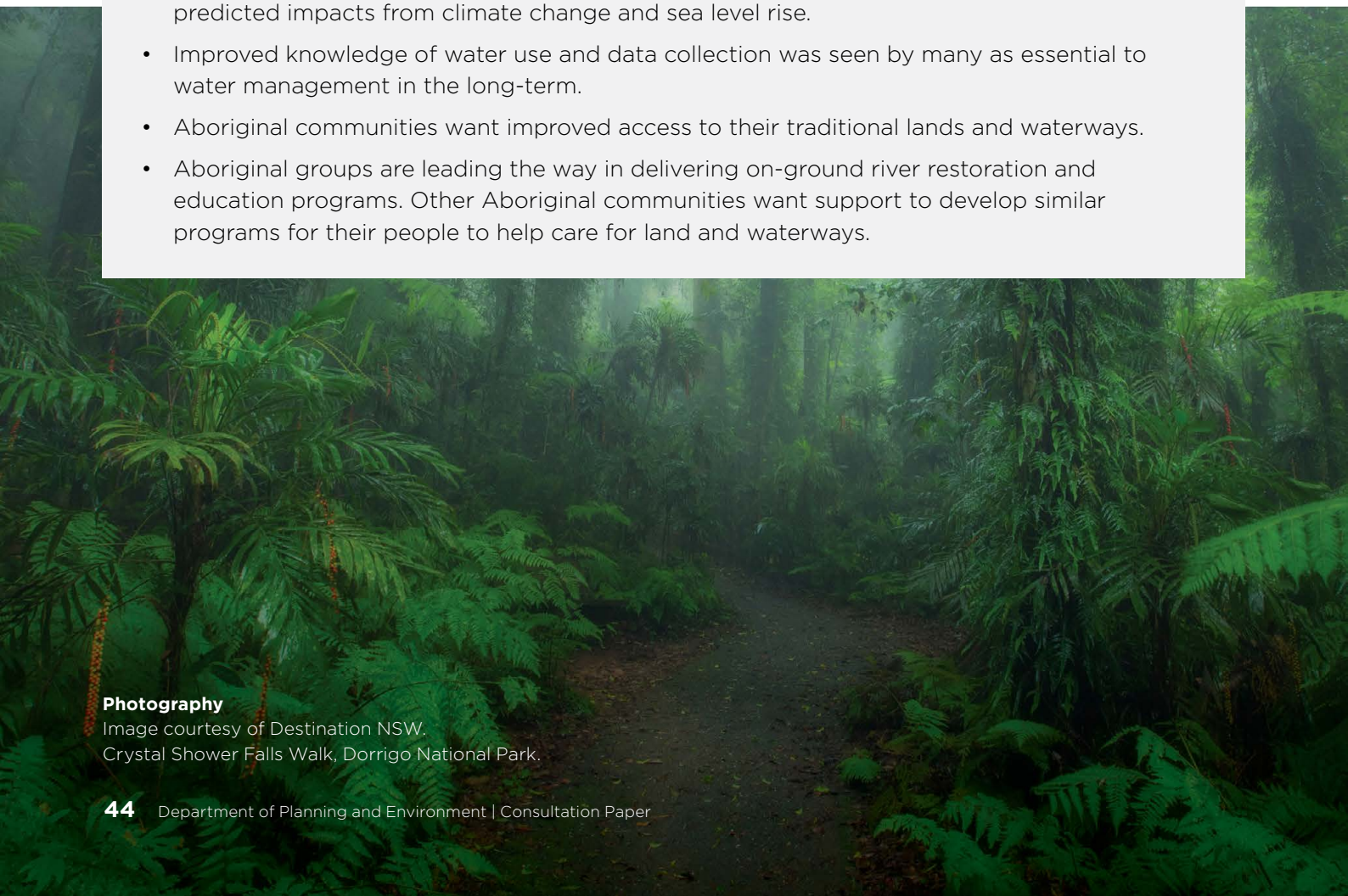
PRIORITY 1

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 our 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.

What we have heard so far

- Protecting and enhancing the health of the region's waterways, for example by maintaining natural flows and water quality, is a priority.
- We need to better manage what we do on the land and how we use water to protect what we value in rivers, creeks, and groundwater systems.
- Future priorities and actions should ensure the needs of the region's waterways and groundwater systems (environmental as well as town and economic) can cope with predicted impacts from climate change and sea level rise.
- Improved knowledge of water use and data collection was seen by many as essential to water management in the long-term.
- Aboriginal communities want improved access to their traditional lands and waterways.
- Aboriginal groups are leading the way in delivering on-ground river restoration and education programs. Other Aboriginal communities want support to develop similar programs for their people to help care for land and waterways.



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

What we are already doing

- The Marine Estate Management Strategy 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, developed by local councils with the support 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 high up in the catchment.
- North Coast Local Land Services delivers a significant number of natural resource management and sustainable agriculture projects across the region that support private landholders to adopt best practice land and water management practices. These projects contribute to improvements in soil, vegetation and riparian condition, and ultimately water quality and landscape health. Funding for these projects has been provided through a variety of sources including the Marine Estate Management Strategy, the *NSW Government Bushfire Stimulus* and Catchment Action NSW.
- The NSW Water Strategy has committed to improving river, floodplain and aquifer ecosystem health and system connectivity (Priority 3), for example by taking landscape scale action to improve river and catchment health and adopting a more intense, state-wide focus on improving water quality.
- Many of the region's coastal councils have already completed, or are in the process of commencing, remediation works for acid sulfate soils areas of high concern. Examples include 230 drains (with a total length of 100 km) in the lower Clarence and Gumma Swamp in the Nambucca. In addition, the NSW Government is investigating options for better managing the issues caused by coastal drains through a review of coastal drainage management in NSW. This is being delivered through the Marine Estate Management Strategy.
- The NSW Government is implementing the new non-urban metering framework through the 2017 *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 2023.

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 North Coast region industries	 Water availability for North Coast towns and communities

Proposed actions	Description	Challenges addressed
Incorporate Aboriginal knowledge and culture into land and water management		
Action 1.1 **Develop ongoing arrangements for participation of local Aboriginal people in water management**	Fund existing or new Aboriginal groups to participate in water management processes. These groups will help facilitate culturally appropriate: • water knowledge programs • engagement and consultation.	
Action 1.2 **Support place-based initiatives to deliver cultural outcomes for Aboriginal people**	Fund and support Aboriginal organisations and communities to develop tailored projects for their communities. This action would aim to move away from central decision making and develop a flexible program that can be adapted and is driven by the principles of self-determination and collaboration.	
Undertake whole-of-catchment planning, decision making and project delivery		
Action 1.3 **Support improved governance**	Develop a new governance approach that recognises stakeholder roles and responsibilities and supports whole-of-catchment planning, coordination, decision making, and project delivery.	
Action 1.4 **Deliver a river recovery program**	Deliver a whole-of-catchment program that prioritises and guides works to improve the health of the region's rivers and the ecosystems they support (including native and threatened aquatic species).	

Proposed actions	Description	Challenges addressed
Support local landholders to adopt best practice land use and water management		
Action 1.5 **Support landholder adoption of best practice land management**	Build on existing programs to support private landholders to adopt best practice farm management. This will help improve the health of priority waterways by reducing the discharge of sediment and nutrients from agricultural land.	
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**	Improve our understanding of the risks of saltwater intrusion from sea level rise, changes in catchment hydrology, and extraction to local council water supplies and industries, by developing an integrated catchment model for high priority sites.	
Action 1.7 **Identify environmental water needs to support healthy coastal waterways**	Define objectives and the amount and quality of water necessary to sustain key, priority surface water and groundwater aquatic ecosystems across the region.	
Action 1.8 **Characterise and plan for climate change and land use impacts on coastal groundwater sources**	Increase investment in accurately determining the availability and vulnerability of groundwater sources from climate change. Ensure the NSW Government and the community have the necessary information to inform management frameworks, including considering protecting water resources in land use planning decisions.	
Action 1.9 **Protect ecosystems that depend on coastal groundwater**	Better understand groundwater dependent ecosystems and incorporate knowledge and monitoring programs into current and future water quality and water sharing plans.	
Action 1.10 **Improve monitoring of water extraction**	Expand on recent NSW Government metering reforms by investigating opportunities to further improve how we monitor water extraction – particularly in managing competition during low flow periods and assessing the impact of extraction limits on water sharing plan objectives.	

Photography
Image courtesy of iStock.
Crystal Shower Falls, Dorrigo.

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 culture and knowledge. Land and water are not considered as separate to Aboriginal people, and healthy waterways are critical for their health, wellbeing and culture.

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 need to develop whole-of-system governance structures that are supported and understood by Aboriginal people and to give Aboriginal people direct input to water management decision making. We also need to provide Aboriginal people with opportunities to manage water using their culture and knowledge and to create improved economic opportunities and environmental outcomes. Restoring degraded spiritual and cultural sites are also important acts of reconciliation.

Proposed action 1.1: Develop 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 after they have got what they want, they 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 a strong, lasting relationship 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 would include supporting new or existing Aboriginal groups to develop a model for involvement in water management processes. The success of this action will be driven by the extent to which it enables self-determination and provides an adequate level of support for the groups.

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

Local Aboriginal groups in the 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 decisions have been appropriately considered by the community.

Have your say

- What level of government support do you think is needed to successfully implement this action?

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

The Australian Government's Closing the Gap report and 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, place-based, well resourced, and locally driven.

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

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

In the North Coast region, this action would 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 – Water, Department of Planning and Environment – Environment, Energy and Science 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, including locations of significance, **by opening up local parcels of land** that have access to waterways but are otherwise gated or locked. These include travelling stock reserves or Crown roads that provide access to waterways
- developing a **demonstration reach** within the River Recovery Program (action 1.4), where cultural knowledge and science is used to rehabilitate riparian land, plant native species and care for Country (this could use existing examples from the Armidale, Nambucca or Coffs Harbour area)
- supporting other local Aboriginal communities to develop 'Caring for Country' programs that **engage young Aboriginal people** in water and landscape management, with the objectives of 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, landscape management or knowledge activities for schools and youth programs.

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

Various strategies, programs and on-ground projects have been implemented to improve the health of the region's aquatic environment. These 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, the *NSW Coastal Management Framework* and supporting coastal management programs, and on-ground works administered by the Department of Planning and Environment – Water, Local Land Services, Department of Regional NSW (Department of Primary Industries – Fisheries and Agriculture), local councils, community groups, private landholders, and local Aboriginal groups.

The following actions aim to build on these programs by applying 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.

Proposed action 1.3: Support improved governance

Current governance arrangements have been criticised as 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 has proposed to try a new governance framework, starting with a pilot program for 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. They impact the delivery of good environmental management outcomes across all coastal and riverine environments.

This action proposes to use the Richmond River pilot program to guide the development and implementation of a new governance approach to support whole-of-catchment planning, coordination, decision making and project delivery for North Coast region river catchments. The action will adapt the Richmond River governance model to the North Coast region based on existing programs, key stakeholders, current funding sources and capacity needs. The action will also map out how this process of adaption will occur, including identifying anything that can be done before the Richmond River governance model is finalised.

The new framework will help to improve river and estuarine health by clarifying roles and responsibilities, synchronising projects, building collaborative networks, avoiding duplication, coordinating funding and highlighting gaps in knowledge. This action would underpin planning and delivery of the river recovery program (action 1.4). The framework will also benefit the region's commercial, social and cultural values, which all place a high priority on the local natural environment.

Proposed action 1.4: Deliver a river recovery program

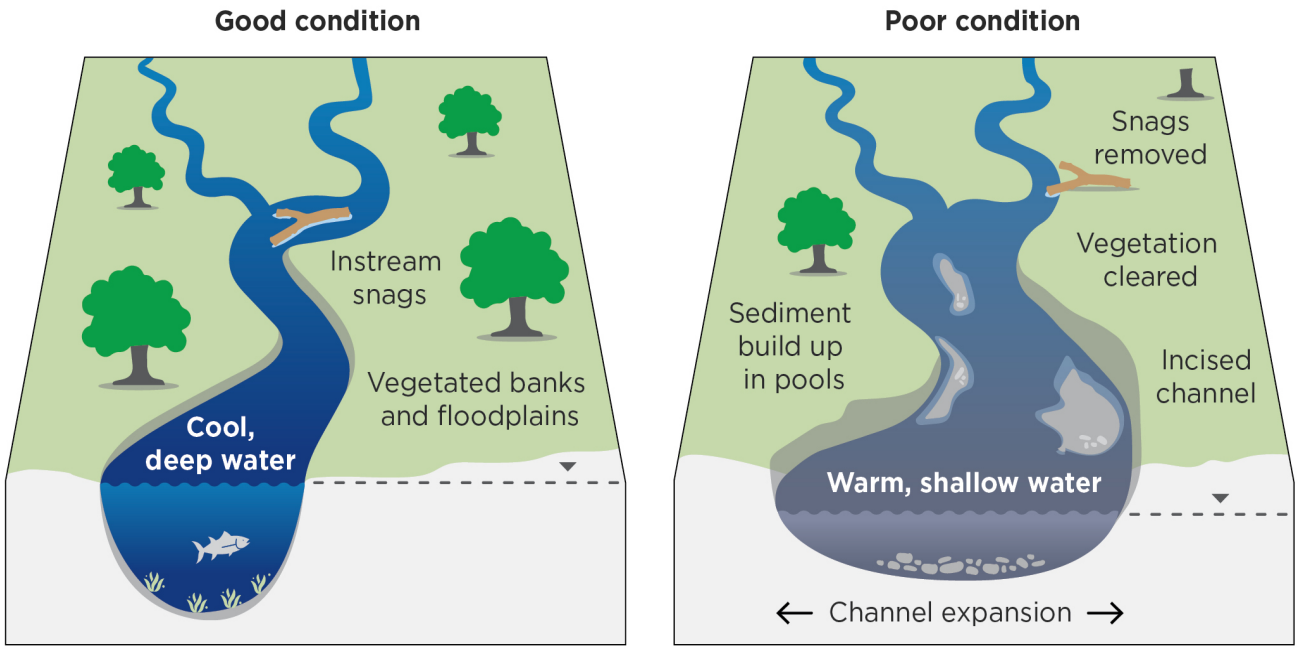
The health and resilience of rivers and the ecosystems they support is directly linked to their geomorphic condition and that of the surrounding floodplains. This is illustrated in Figure 10.

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. A key part of the program will be the development of a framework to prioritise the works required and where they should be implemented. The framework will use the condition and recovery potential classes from the River Styles classification system and will mainly focus on reaches classified as conservation, strategic or rapid recovery. It will also consider severity of land degradation, high ecological value aquatic ecosystems, and local Aboriginal knowledge and cultural water needs.

Other key steps for implementing this action are:

- addressing any overlaps with similar programs – particularly coastal management programs – to ensure efforts are complementary and not duplicated
- establishing a program of potential recovery and management measures such as increased riparian vegetation, spawning boxes for the recovery of threatened species, and measures that address bed erosion and improve river system function (for example, rock chutes and log jams, and creating pool and riffle systems)
- identifying funding models, which may include landholder incentives
- developing a clear decision-making and program delivery framework that brings together relevant government agencies with responsibilities in these areas. It would also consider how to involve local community and Aboriginal groups
- developing a monitoring and evaluation framework.

Figure 10. Conceptual models underpinning river health and resilience[15]



Strong connections between healthy floodplain, channel and groundwater.

Loss of groundwater and floodplain connections as channel incises into its bed.

15. Adapted from water.dpie.nsw.gov.au/science-data-and-modelling/surface-water/monitoring-changes/nsw-river-condition-index

This action is important to ensure that future river recovery efforts are coordinated and effective at a catchment scale and that they support broader ecological, social, cultural and economic outcomes. When planned and implemented well, these works can achieve multiple benefits. For example, measures that slow and filter water – such as increasing channel roughness, re-introducing large woody debris in pool and riffle systems, and improving instream native vegetation – improve water quality by removing sediment and nutrients, and can provide flood mitigation benefits downstream. This benefits Aboriginal people's connection to Country, improves water security, asset protection and amenity for local towns and enhances local industries – particularly aquaculture.

Riparian revegetation improves bank stability and helps retain water in the landscape. This improves soil health and can make crops more resilient to extended dry periods.

The impact of this action is tightly linked to the effectiveness of the governance framework established under action 1.3 and to the capacity of landholders to implement best practice land and water management practices (action 1.5).

Proposed actions that seek to reduce the impact of extraction on flows, such as establishing sustainable extraction limits (action 2.3) and reducing take from low flows (action 2.5), will complement the efforts sought through this action. Future reviews of water sharing plans will also consider and manage future changes in flow.

Photography
Image courtesy of Kempsey Shire Council.
Fishing in Bellbrook, Macleay Valley Coast.

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

The Department of Planning and Environment, North Coast region's Local Land Services, and Regional NSW (Department of Primary Industries – Fisheries and Agriculture) already deliver programs that support the adoption of best practice land management by local landholders to improve productivity and reduce land and water degradation. These programs include irrigation audits, guidelines for fertiliser application, improved management of farm runoff and water quality and improved capacity to prepare and recover from droughts and bushfires. Complementary extension services are also provided by the Natural Resource Access Regulator.

While many landholders have adopted best practice land and water management, there is still a lack of willingness among some to change land management practices that negatively impact water quality and river health. We have also heard that landholders need support in recognising potential improvements in managing their land and water requirements, even relatively simple ones. Furthermore, feedback received through recent engagement with local landholders indicates some are frustrated with the lack of extension services available to help them understand the rules, obligations and opportunities for accessing and managing farm water needs.

Proposed action 1.5: Support landholder adoption of best practice land management

This action will build on existing programs to support private landholders to adopt best practice land management to improve water quality of priority waterways by reducing the discharge of sediment and nutrients from agricultural land across the region.

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

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

A suite of fit-for-purpose tools would be used to build landholder capacity in knowledge, skills, access to networks and resources; including one-on-one consultation, advice and referrals, webinars and podcasts, YouTube videos, regular social media, field days, demonstration sites, farm planning training and incentives to deliver on-ground projects.

The delivery of this program will align with the framework developed in action 1.4 and the environmental water requirements established under action 1.7. This will ensure that improvements in private landholder land and water management practices are directed to catchments where either river reaches have a high recovery potential or improvements are critical to achieving key environmental objectives.

Implementation of this action will be delivered in partnership with other government agencies, as well as local Aboriginal and community groups.

Have your say

- What are the constraints to landholders adopting measures that reduce farm runoff and fertiliser use? What support is needed to encourage widespread improvements?

Photography
Image courtesy of Annette Harrison, Sugarcane, Maclean.

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 us fulfilling this role. Our 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, further targeted investigations are required to properly understand the cumulative impacts of population growth, climate change, water extraction, and sea level rise on the region's water resources and to allow more flexibility in how we share and manage them.

The following actions have been shortlisted (or adapted) from the draft long list of options as they 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, the Marine Estate Management Strategy and the NSW Groundwater Strategy.

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

This action proposes to improve our understanding of the risks of saltwater intrusion from sea level rise. It will consider the impacts of changes to future hydrology and water extraction on salinity dynamics, and estuary closure in the case of intermittently closed and open lakes and lagoons, in key tidal pools and estuaries of the North Coast region. High-priority sites include the Macleay River and Nambucca River tidal pool.

The action will require the development of integrated models that will identify possible changes to salinity by considering several important variables: surface water flows, local-scale runoff, water extraction and estuary hydrodynamics. These models will use the new hydrologic modelling completed for the North Coast Regional Water Strategy and the hydrodynamic models developed for the Marine Estate Management Strategy. Similar work that assesses the impacts of water extraction on salinity dynamics is underway in the Richmond River and Shoalhaven tidal pools, providing important insights for progressing this action.

As part of this action, we would develop a framework to assess the economic and social impacts of sea level rise and saltwater intrusion to water users, local council water management infrastructure, and Aboriginal cultural assets identified as being at risk. The outputs of the modelling may also inform our understanding of future environmental water requirements.

This action provides 3 key benefits:

- **Reduced 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 possible future costs of damages.
- **Tidal pool water users supported in managing 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 risks to water users and water resources, particularly regarding increasing tidal pool salinity.
- **Aboriginal communities supported in managing cultural assets that may be impacted by sea level rise:** Includes identifying cultural assets that may be impacted by future sea level rise.

Proposed action 1.7: Identify environmental water needs to support healthy coastal waterways

This action will establish objectives and water requirements for priority environmental assets – species, communities, and aquatic ecosystem functions – across the region.

Coastal water sharing plans have ecological objectives however they are difficult to evaluate. This is for 2 reasons: the links between objectives and water management activities that are used in water sharing plans are unclear and the data required to undertake effective evaluation is insufficient or missing.

As well as measurable ecological objectives, we also need to know more about the environmental water requirements – both in terms of flow and quality – for species and aquatic ecosystems in the North Coast region. Environmental water requirements define a suite of flow strategies to maintain and improve aquatic health. This includes information related to the volume, frequency, timing, and duration of flows for various flow classes, the impacts from changes in baseline water quality, as well as the risks, constraints, and complementary non-water measures. Environmental water requirements are a key tool for linking environmental objectives to management strategies and water sharing plan rules. Despite this, many species and aquatic ecosystems in the North Coast region have not been studied sufficiently to reliably describe these requirements and target them through management actions.

The key steps for this action are:

- developing a method to prioritise key environmental assets (for example, based on high ecological value aquatic ecosystems) and the subsequent data and monitoring needs for defining their environmental water requirements
- establishing objectives for the recommended environmental flow and water quality requirements, including upper and lower threshold limits that are adaptive to predicted climate variability
- testing the proposed environmental water requirements (for example, through hydrological modelling) to ensure they are achievable
- agreeing to an initial set of environmental water requirements
- investing in research required for developing and monitoring environmental water requirements.

This action will also provide a framework to identify and prioritise data and monitoring gaps, and will 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, as appropriate. The framework will also consider existing initiatives to address monitoring gaps, such as WaterNSW's review of the existing hydrometric gauging network. This information will be integrated with existing data platforms, where possible, in a readily accessible format.

The delivery of ecological objectives and environmental water requirements would be coordinated with the review of water sharing plans across the region. The proposed objectives will be tested against water sharing plan levers – such as long-term average annual extraction limits and cease to take conditions – to ensure they are feasible and can be met within the required timeframe. The Clarence River Unregulated and Alluvial Water Sources and the Macleay River Unregulated and Alluvial Water Sources are the next 2 water sharing plans due for review in 2026.

Proposed 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 potential impacts from climate change and land use impacts. These impacts include changes to groundwater recharge and movement, contamination from diffuse sources (e.g. pesticides and fertilisers), and saltwater intrusion.

This action proposes to characterise key groundwater resources across the region, beginning with 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 licenced entitlement (mainly for industries such as avocado and blueberry growing), they are vulnerable to contamination, and evidence of saltwater intrusion has already been observed.

The action would require initial satellite imagery, field investigations (such as geological, geophysical, geochemical, ecological and hydrogeological studies) to help characterise the groundwater resource based on factors known to be affected by climate change and land use pressures. These investigations would be supported by a review and potential expansion of the bore monitoring and metering network.

The outcome of this work would be the development of a conceptual model of key groundwater resources across the North Coast region that would 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. Depending on what this conceptual model tells us about the risk of climate change and land use to these resources, further, more detailed modelling may be conducted.

This action will also consider how this information is made available to water users to inform individual decision making, and co-design potential projects with local stakeholders and universities to mitigate the key impacts of climate change and land use identified.

Proposed action 1.9: Protect ecosystems that depend on coastal groundwater

This action would advance our knowledge and management of groundwater dependent ecosystems in the North Coast region to guide sustainable water sharing arrangements that protect the inherent environmental values of these ecosystems.

Groundwater dependent ecosystems are classified broadly as terrestrial (vegetation communities), aquatic (wetlands and springs) or subterranean (aquifers). In the North Coast, vegetation communities include red gum/swamp turpentine, turpentine/grey gum, river oak, swamp oak, paperbark/swamp mahogany, coastal wetlands and lowland subtropical rainforest communities.

Our knowledge of these communities is still developing. To support the future protection of these communities, this action will develop a method for identifying groundwater dependent ecosystems across the North Coast region that are reliant on surface water flows (i.e. baseflows) and monitoring the condition and extent of the associated vegetation community.

The ability to implement this action will be conditioned on the adequacy of the monitoring bore network and metering coverage across the North Coast, both of which are being considered as part of other actions (see action 1.10 and action 2.3).

Outputs from this action will be critical to informing environmental water requirements for the region's catchments (see action 1.7) and reviewing the effectiveness of associated water sharing plan rules in protecting these groundwater dependent communities.

Proposed action 1.10: Improve monitoring of water extraction

A lack of monitoring and data is impacting our understanding of the effects of extraction, on-farm storage and growth in basic landholders rights on water sources across the North Coast. This scarcity of data has been noted in several reports and reviews, including the recent audit reports by the Natural Resources Commission of the Coffs Harbour and Bellinger surface water and alluvial water sharing plans. Obtaining this data is important for effective natural resource planning, as well as irrigation management and planning.

Implementation of the NSW Government's non-urban metering framework will ensure around 31% of water (surface and groundwater) supply works will be metered in the North Coast region by 2023. This metering will provide a good starting point to better understand the impact of water extraction in the region.

While the current metering reforms target larger water users, smaller water users can also have a large impact on water resources during low flow events. Additionally, increases in water extraction under basic landholder rights, particularly from the recently announced increase in the harvestable rights limits in coastal-draining catchments, may increase unmetered water take across the North Coast region.

This action aims to give us a better understanding of the impact of extraction limits on water sharing plan objectives and may allow us to better manage competition during low flows. It will expand on the current metering reforms by investigating opportunities to further improve how we monitor water extraction across the region. These investigations would consider alternative, innovative methods for collecting data (such as satellite imagery or GIS databases) to estimate water use, or calibrating electricity meters to track pump rates and use. This action may also include incentives for voluntary uptake of metering and telemetry, or a review of thresholds for pump sizes requiring metering.

These types of initiatives have already been flagged through the recent announcement of changes to the harvestable rights limit in coastal areas. The NSW Government has purchased high resolution satellite imagery to better understand the current levels of uptake of harvestable rights dams. Further, landholders who build new or enlarged dams – above their existing maximum harvestable right dam capacity – will also need to notify the change with the relevant water agency. These initiatives will provide important information to both planners and regulators.

Improving how we monitor water take is critical to guiding future water sharing decisions. It also provides a useful tool for landholders to identify where water use can be reduced to help build resilience against extended dry periods.

Have your say

- What other options are available to improve how water extraction is monitored in the region?

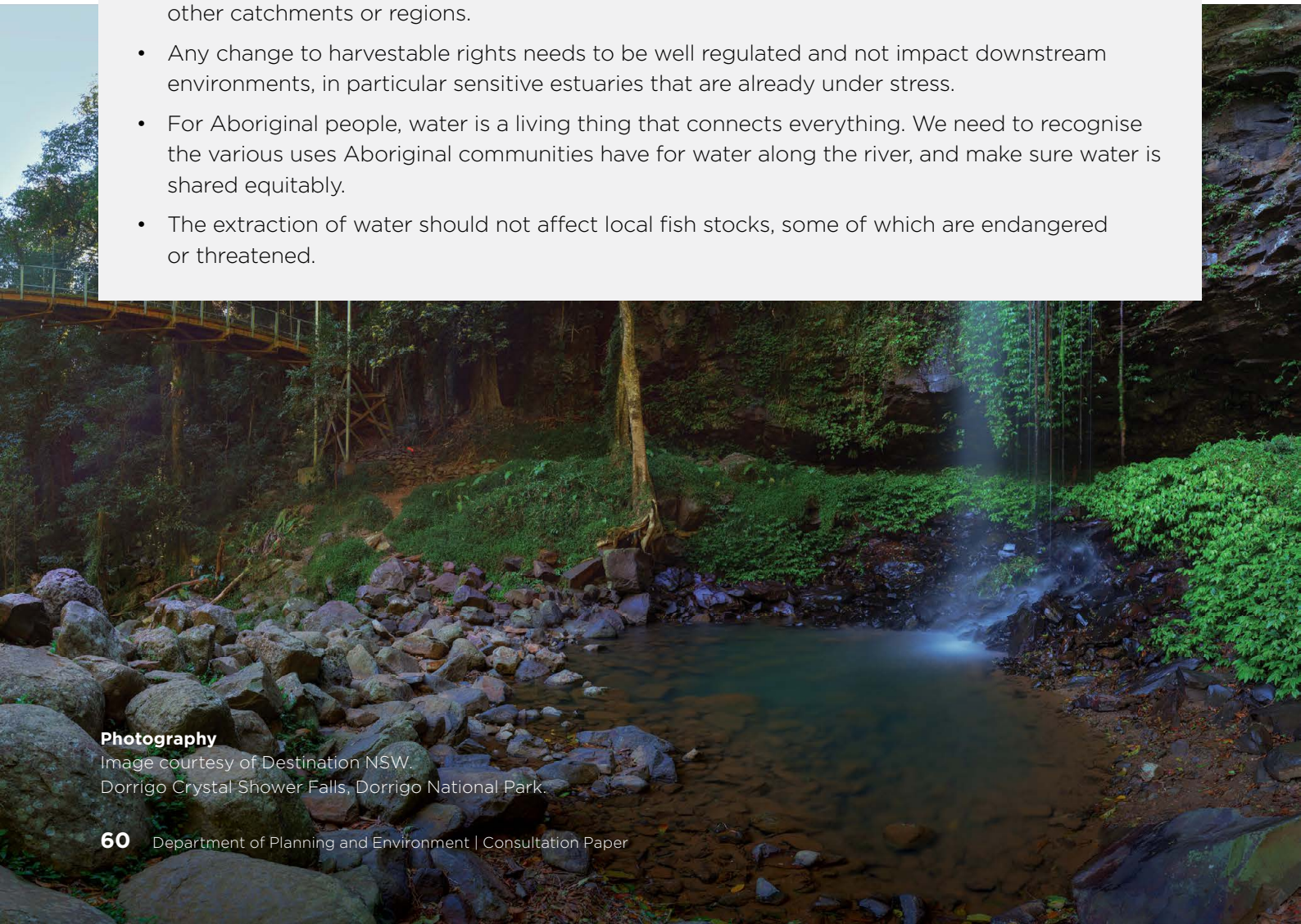
PRIORITY 2

Ensure water resource development and use is sustainable and equitable

Sustainable water management means that we meet the water needs of the present without compromising the ability of future generations to do the same. Ensuring this for the North Coast region will require improved management of water use between various users, as well as reducing the impact of infrastructure on waterway health.

What we have heard so far

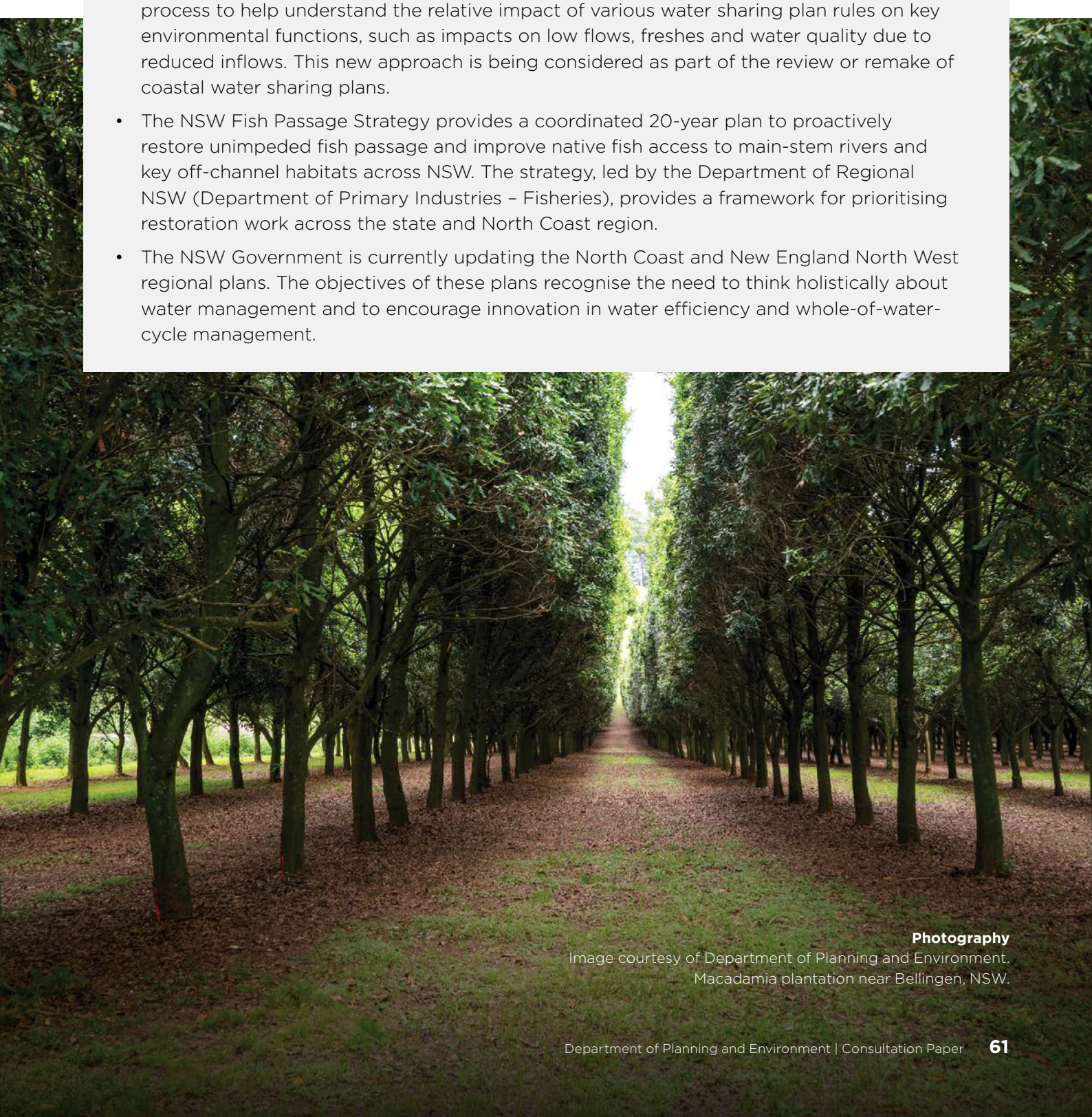
- There are concerns that recent growth in demand for water from intensive horticulture and from population growth is not sustainable.
- We need to consider options that reduce the competition for water when flows in the region's rivers are low, and be more efficient with how we use the water we extract.
- Our management of the region's rivers and creeks needs to focus on supporting local environmental, social and economic needs – it is not ecologically sustainable to divert water to other catchments or regions.
- Any change to harvestable rights needs to be well regulated and not impact downstream environments, in particular sensitive estuaries that are already under stress.
- For Aboriginal people, water is a living thing that connects everything. We need to recognise the various uses Aboriginal communities have for water along the river, and make sure water is shared equitably.
- The extraction of water should not affect local fish stocks, some of which are endangered or threatened.



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

What we are already doing

- 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 the development of the NSW Groundwater Strategy.
- The Department of Planning and Environment is applying a new risk-based assessment process to help understand the relative impact of various water sharing plan rules on key environmental functions, such as impacts on low flows, freshes and water quality due to reduced inflows. 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. The strategy, led by the Department of Regional NSW (Department of Primary Industries – Fisheries), provides a framework for prioritising restoration work across the state and North Coast region.
- The NSW Government is currently updating the North Coast and New England North West regional plans. 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.



Photography
Image courtesy of Department of Planning and Environment.
Macadamia plantation near Bellingen, NSW.

Review of Harvestable Rights

From early 2022, landholders in the North Coast region will be able to capture up to a maximum of 30% of the average regional rainfall runoff from their property in harvestable right dams built on non-permanent flowing minor streams, hillsides and gullies. The remaining runoff will continue to flow into licensed dams and the local river systems, where it is shared among the environment and other downstream 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.[16] It will provide landholders in these regions better access to water storage for domestic and stock and extensive agriculture, such as stock grazing and pasture irrigation. It excludes 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:

- further 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 (NRAR), on monitoring and enforcement issues
- supporting landholders and the public to understand the changes.

The North Coast Regional Water Strategy will provide a path for supporting the implementation of these changes while effectively managing future impacts from an increased uptake in the higher limit on downstream water needs, including those of the environment. During 2022 the department will assess whether the increase to a 30% harvestable rights limit is appropriate at the water source scale, noting the limitations and mitigation measures announced as part of the 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 Rights Order. Updated plans will include an estimate of the current uptake in harvestable rights within the long-term average annual extraction limit.

Through such action, 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 downstream environment and licensed users.

16. www.industry.nsw.gov.au/water/licensing-trade/landholder-rights/harvestable-rights-dams/review

Photography
Image courtesy of My Clarence Valley.
Clarence River, NSW.

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 North Coast region industries	 Water availability for North Coast towns and communities

Proposed actions	Description	Challenges addressed
Reduce the impact of water infrastructure on native fish populations		
Action 2.1 **Improve fish passage**	Implement the NSW Fish Passage Strategy to replace or remediate 4 high-priority fish barriers in the North Coast region: Nymboida Weir, off Upper Rocky River Road, Dowlings Falls Road and Ewingar Road.	
Action 2.2 **Implement fish-friendly water extraction**	Promote and implement the strategic installation of diversion screens on irrigation pumps and diversion offtakes, across priority waterways and irrigation channels.	
Better manage competing demands for water		
Action 2.3 **Establish sustainable extraction limits for surface water and groundwater sources**	Review the existing long-term average annual extraction limits for surface water and groundwater sources to ensure they are sustainable; are based on best available science; and protect ecological, economic, social and cultural water needs.	
Action 2.4 **Implement daily extraction limits**	Investigate and assess options for implementing daily extraction limits and determine an approach that would cost-effectively ensure the protection of low and medium flows in streams where there is high competition for water.	

Proposed actions	Description	Challenges addressed
Action 2.5 **Reduce the take of low flows**	Investigate and assess options for reducing water extraction during low flows, focusing on the effectiveness of high-flow conversions, adopting low flow bypasses for on-farm dams, and options for landholders to store water extracted from the region's streams under basic landholder rights.	
Action 2.6 **Support Aboriginal business opportunities**	Support Aboriginal people to develop business opportunities in the North Coast region, some of which may require access to water.	
Action 2.7 **Address catchment-based impacts of increased harvestable rights limits**	Ensure that any impacts on downstream licence holders and the environment resulting from the uptake of increased harvestable rights are understood at the local scale and potential impacts from any increase are considered (and managed where necessary) in future water sharing plan arrangements.	

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

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; and seasonally to spawn, migrate and reproduce. Removing high-risk barriers to fish movement will help the resilience of fish species, particularly those that are threatened or endangered.

Proposed action 2.1: Improve fish passage

Physical barriers to fish passage such as weirs, floodgates, causeways and bridges 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 breed, find food and locate ideal habitat is critical to supporting native fish populations in the North Coast region.

The NSW Fish Passage Strategy aims to address the highest priority fish barriers remaining in NSW. This action would remediate fish passage at 4 priority barriers in the North Coast region: the Nymboida Weir, a bridge on Timbarra River off Upper Rocky Creek Road, a bridge/box culvert on Dowlings Falls Road, and a bridge on Ewingar Road.

Proposed action 2.2: Implement fish-friendly water extraction

Every year, large numbers of native fish are removed from rivers. Adult fish as well as juveniles, larvae and eggs are extracted by pumps, along with debris such as sticks and leaves. This impacts the sustainability of native fish populations and can also damage irrigation infrastructure.

Installation of screens at pump sites can reduce fish losses at these sites by over 90%, helping more fish survive to maturity and boosting fish numbers. This protection also extends to other aquatic species such as crayfish and turtles.

As well as benefiting fish, the screens will help prevent blockages caused by debris. This will avoid damage to irrigation infrastructure and improve pump operation, water delivery and extraction efficiency for asset owners.

This action proposes to support the installation of screens on pumps at key sites across the North Coast region. The action will confirm the location of diversion pumps and prioritise where the installation of screens will have the largest impact – for example in protecting threatened or susceptible species. The project will include high-level costing and an implementation plan to support landholders install screens in priority locations.

Have your say

- What support do irrigators require to implement screens on pumps?

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 we regulate extraction 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 gain access to water.

The following proposed actions would 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.

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

Setting long-term average annual extraction limits (LTAAELs) in water sharing plans across the North Coast region would maximise water resource development within ecological boundaries and ensure water is shared equitably among users. Moving to a regime that is based on science and the capacity of the region's surface water and groundwater systems would better protect the region's environmental assets. It would also provide water users with a greater level of certainty in their share of the resource, from which they can confidently make business investment decisions. In some areas, calculating LTAAELs may help identify where additional entitlements or extractions may occur.

There are different steps for establishing sustainable surface water and groundwater LTAAELs:

Surface water LTAAELs

1. Review how other jurisdictions define and calculate sustainable extraction limits.
2. Develop methods for determining sustainable LTAAELs, considering legislative requirements, available data and resources, potential changes to catchment hydrology from climate change, ecological needs (including marine park values) and water extraction under basic landholder rights, including water taken in harvestable rights dams.
3. Apply, consult and assess methods in trial catchments to understand environmental, social, economic and cultural impacts.
4. Adopt preferred method and develop supporting implementation policy.
5. Prioritise implementation of sustainable LTAAELs for water sharing plans.
6. Quantify sustainable extraction limits and amend water sharing plans.
7. Where the revised sustainable LTAAEL is larger than the existing limit, develop and implement a controlled allocation strategy to issue new water access licences.
8. Monitor, evaluate and review.

Groundwater LTAAELs

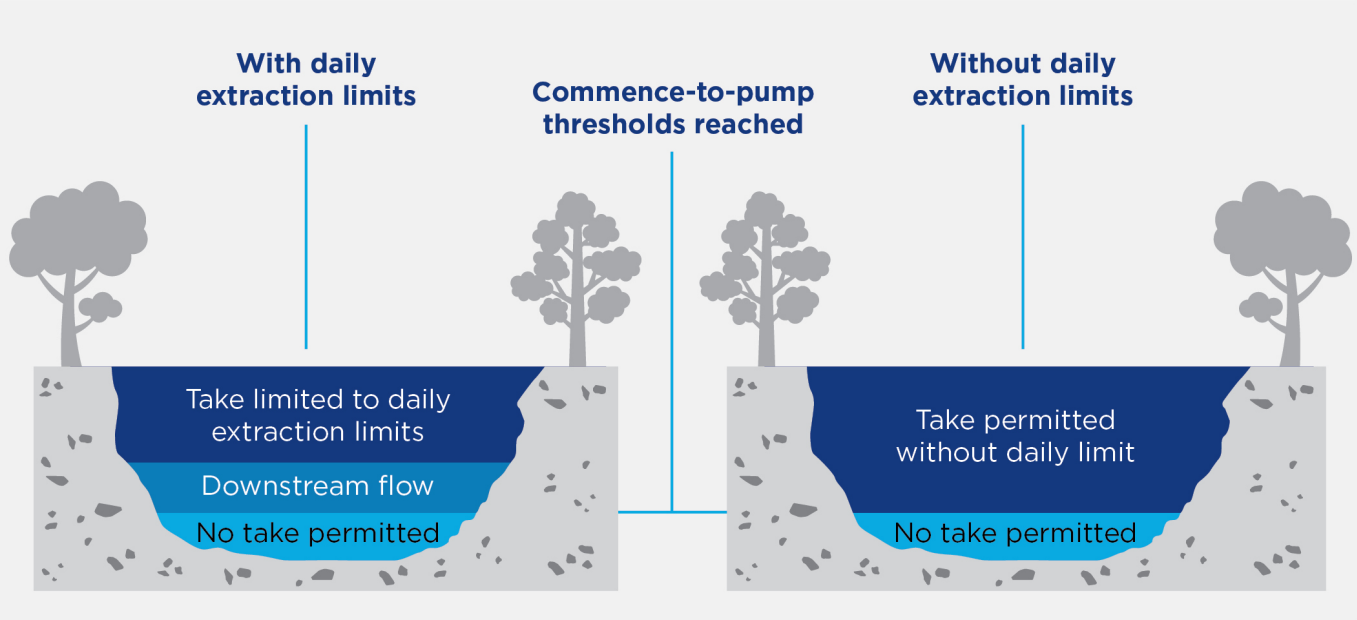
1. Based on new data and information, review and update the current method to calculate sustainable extraction.
2. Prioritise implementation of sustainable LTAAELs for water sharing plans.
3. Quantify sustainable extraction limits and amend water sharing plans.
4. Where the revised sustainable extraction limit is larger than the current limit, update and implement the controlled allocation strategy to issue new water access licences.
5. Monitor, evaluate and review.

Proposed action 2.4: Implement daily extraction limits

This action proposes to investigate and assess options for implementing daily extraction limits and determine an approach that would cost-effectively ensure the protection of low and medium flows in streams with high competition for water.

Daily extraction limits restrict the impact of rapid removal of water during peak irrigation periods (Figure 11). They have been written into water sharing plans to protect low and medium flows so that there is enough water in a system at any one time for the environment, non-extractive users (aquaculture, cultural, recreation) and downstream water users. Implementing daily extraction limits requires stream gauging and monitoring, daily measurements (or estimates) of water extraction, and someone to co-ordinate extractions among water users.

Figure 11. Daily extraction limit concept



The NSW Government previously supported the implementation of daily extraction limits in some catchments by providing field officers to coordinate extractions among water users. However, the government ceased carrying out this role about a decade ago, with the expectation that water user groups would implement daily extraction limits in line with water sharing plan rules. In most cases, this has not eventuated because water user groups lack established infrastructure, systems and incentives. Consequently, daily extraction limits are not being implemented and the environment, downstream water users and non-extractive water users risk not receiving their designated share of low and medium flows.

Proposed action 2.5: Reduce the take of low flows

This action would investigate and assess options for reducing water extraction during low flows. The assessments will focus on:

- the effectiveness of high-flow conversions
- adopting low flow bypasses across catchments
- options for landholders to store water extracted from the region's streams under basic landholder rights.

Reducing the take of low flows would improve river connectivity and natural flow variability in the region's rivers and complement other actions proposed in the North Coast Regional Water Strategy aimed at improving river health.

High-flow conversions

In some water sources in the North Coast region, water users can apply to have their existing water access licence converted to allow extraction of a greater volume of water under high-flow conditions. The high-flow conversion rule applies in catchments that are gauged and experiencing hydrologic stress.

As described above in 'Where should we focus first?', no licence-holders on the North Coast region have taken up the opportunity to convert their entitlement, mainly because the proposed conversion rates do not provide enough water security benefits to offset the additional costs of irrigating from on-farm storages. 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. Any modification to the current conversion rate would also need to consider the impact on all parts of the flow regime, particularly high flows, and subsequent changes to river health, the reliability of downstream licences, and social and cultural values.

Overcoming constraints in constructing and operating on-farm storages (action 3.4) and an improved understanding of climate risks to surface water availability in the region, may make high-flow conversions more viable in the future.

Low flow bypasses

On-farm dams offer increased water security for landholders but reduce the volume of runoff that makes its way into downstream waterways. The impacts are greater during extended dry periods when the volumes of water stored in farm dams are typically low, and the dams are configured in a way that prevents all runoff from passing downstream. On-farm dams fitted with devices that allow some runoff to bypass or flow through the dam (Figure 12) reduce their impact on low flows, while still offering water security benefits for landholders.

A targeted, catchment-wide program investing in low flow bypasses on existing dams has the potential to restore more natural stream flows in the region's stressed waterways. The Department of Planning and Environment will commission a desktop review of the use of low flow bypasses in other jurisdictions to inform further 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 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.

Low flow bypasses may also be necessary to mitigate the environmental impacts of infrastructure options being proposed through the North Coast Regional Water Strategy, such as increased on-farm storage (action 3.4). The effectiveness of low flow bypasses is also being considered as part of the mitigation measures proposed in the recent decision to increase the harvestable rights limit for coastal draining catchments.

Have your say

- What barriers do we need to overcome for irrigators to convert to high-flow licences?

Figure 12. Low flow bypass technology[17]

Source: Diagram copied from Flows For the Future – Factsheet #1, South Australian Government Department of Environment and Water.

17. Adapted from Flows For the Future – Factsheet #1, South Australian Department of Environment and Water.

Storage of water extracted under basic landholder rights

Landholders with river frontage are allowed to extract water under very low flow conditions under their basic landholder rights, regardless of water sharing plan cease-to-pump rules. Extracting water under these rights during higher-flow periods and storing in tanks or turkey nest dams[18] can reduce the volume of water extracted from stressed rivers and delay the need to cart water from town water supply networks.

State and local government rebates on rainwater tanks have assisted in addressing this problem. We need to better understand the extent to which current and future growth of water extraction under basic landholder rights threaten environmental assets.

Proposed action 2.6: Support Aboriginal business opportunities

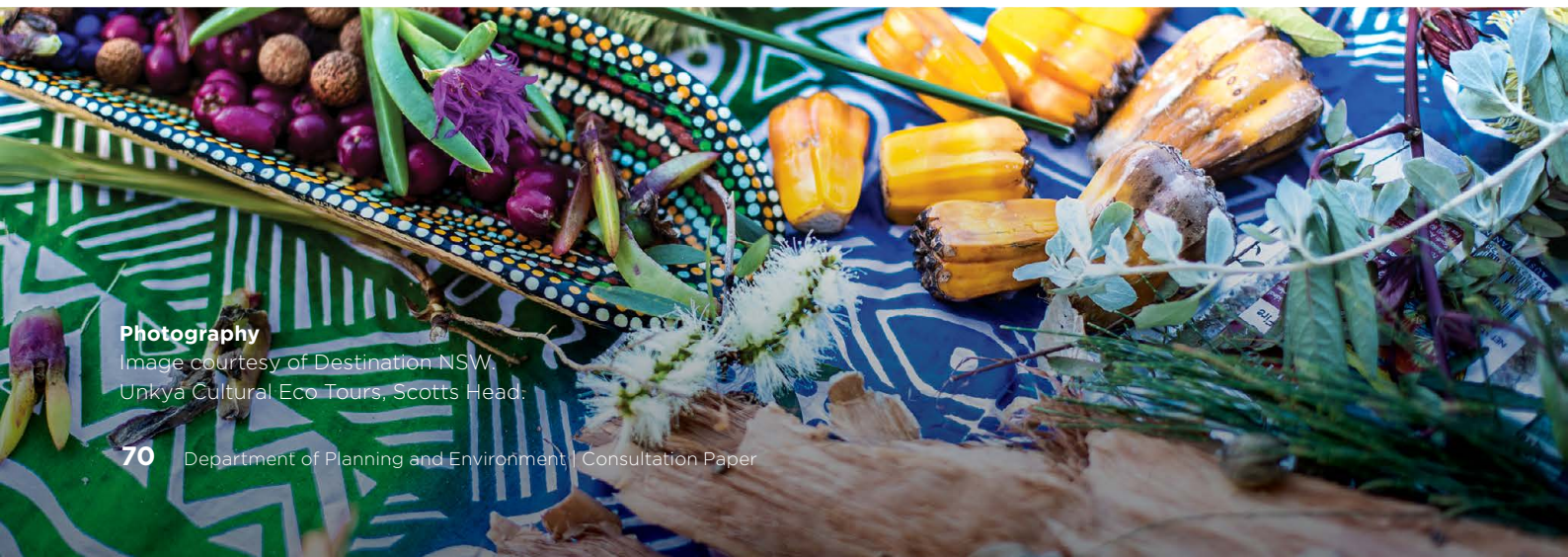
During our consultation on the Draft North Coast Regional Water Strategy we heard of a need for, and support of, business opportunities in the region that are led by Aboriginal communities. We also heard of business plans already being pursued by local Aboriginal people. One of these businesses is a native garden nursery, with a focus on edible, endemic plants that, unlike many of the crops now being grown in the region, have a low demand for water.

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.

This action will focus on supporting Aboriginal business development opportunities in the North Coast region and will be led by the Department of Regional NSW. Through the Aboriginal Partnership Program, a dedicated Aboriginal Senior Regional Coordination Officer will work with Aboriginal organisations, businesses, and individuals to identify and develop new business opportunities (or better manage existing ones) and access support or grant funding. Other support is also available through NSW Department of Aboriginal Affairs, NSW Aboriginal Lands Council and National Indigenous Australians Agency. The Aboriginal Partnerships Program within the Department of Regional NSW works in collaboration with local Aboriginal community representatives to co-design solutions and use NSW Government programs to increase economic participation, grow employment, improve skills and employability, and enhance services for Aboriginal people in regional NSW. There are 9 Senior Regional Coordination Officers who work in communities across NSW to deliver the program.

A dedicated Senior Regional Coordination Officer – Aboriginal Partnerships will be available to work with the Local Aboriginal Land Councils to progress their project ideas.

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



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

Proposed action 2.7: Address catchment-based impacts of increased harvestable rights limits

The recent decision to increase the current harvestable rights limit from 10% to 30% in coastal-draining areas includes a range of mitigation measures to manage the impact of these changes on downstream users.

This action supports the implementation of these mitigation measures through the following 2 measures:

- Further analysis to confirm the appropriateness of the 30% limit at a local level. An assessment will be conducted at the water-source scale to determine whether a higher or lower limit – including reverting to the previous 10% limit – is more appropriate in the longer term. The action would prioritise catchments (or water sources) across the North Coast region based on the sensitivity of the downstream environment or the likely uptake of the new limit. Landholders will be required to adjust any works at their own cost to ensure they comply with the new limit.
- Introduce levers to manage future impacts from an increase in the uptake of harvestable rights on existing water sharing plan arrangements: An amendment provision will be included in upcoming water sharing plans to review the uptake of harvestable rights by either year 3 or year 5 of the plan. The provisions will require a review of access, trade and water supply work approval rules if the harvestable rights uptake has increased above the 10% limit in the original Harvestable Rights Order. The review will occur within the first 3 years for all areas where there is a high possibility of uptake of increased harvestable rights.

Revised coastal water sharing plans will also include an estimate of annual extractions under harvestable rights in establishing the long-term average annual extraction limits. This is an important first step in ensuring harvestable rights take is included when establishing sustainable long-term average annual extraction limits into the future (see Proposed action 2.3).

PRIORITY 3

Prepare for future climatic extremes

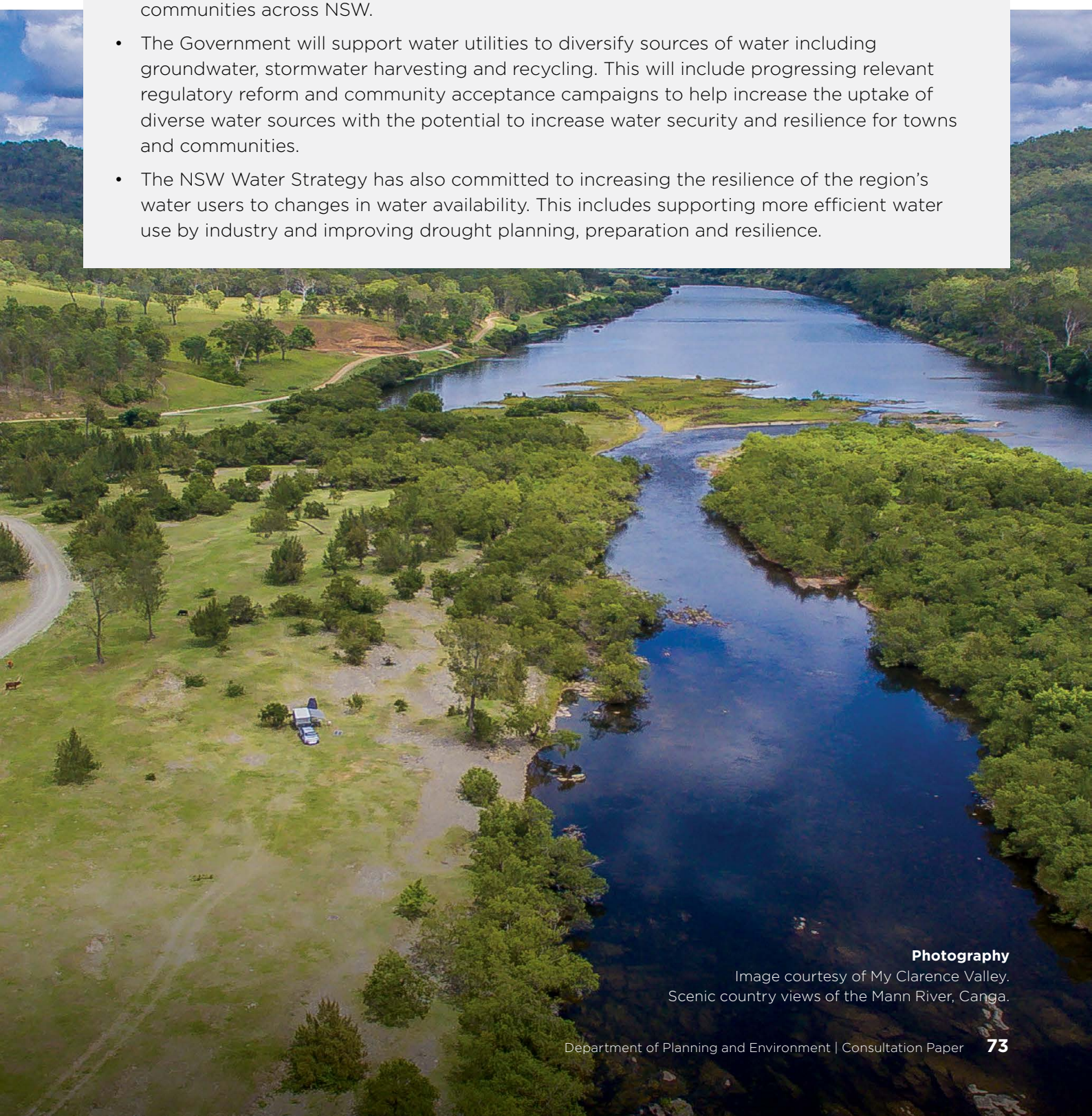
We need to prepare for future climate variability, particularly extended dry periods, to help build a stronger and more resilient region. Providing more and better information on the impacts of climate change on water resources will allow the community to plan better for the future, particularly local 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.

What we have heard so far

- We want to understand how climate change will impact water availability for the region's industries and towns.
- Councils across the region are investigating improvements to existing measures or additional local opportunities, such as local storages and desalination, to secure town water supplies.
- There is growing support for potable reuse in some communities, with some local councils already pursuing third pipe systems for new residential developments. However, for some councils, indirect or direct reuse of purified water would be difficult because of the location of their local town water storage relative to their wastewater treatment plant.
- After the conditions experienced in 2018 to 2020, the region's agricultural businesses want to ensure they have a secure water supply for droughts, noting that this will require innovative approaches to water use and conservation.
- Increased water security for industry will need to consider alternative water sources that are droughtproof and can alleviate stress on the region's rivers and groundwater systems. For some industries, purified recycled water is considered the best option.

What we are already doing

- The $1 billion Safe and Secure Water Program 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 councils to develop a new framework to better support local water utilities and councils to manage safe, secure and sustainable water supply and sewerage services to regional to 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 NSW Water Strategy has also 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.



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

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 North Coast region industries	 Water availability for North Coast towns and communities

Proposed actions	Description	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**	The NSW Government will continue to support local councils across the region, both in integrated water cycle management planning and co-funding infrastructure options to address key risks. This support will include addressing the recommendations of the NSW Government's Town Water Risk Reduction Program.	
Action 3.2 **Provide better information about water access, availability and climate risks**	Improve existing platforms and products to provide information about water availability and climate change in forms that are suitable to stakeholders and allow better business planning.	
Optimise use of existing water supplies		
Action 3.3 **Review water markets**	Review water markets to ensure water security, encourage trade efficiencies and allow transparency of information.	
Action 3.4 **Investigate increased on-farm water storage**	Assess the barriers to constructing on-farm storages, and the value of on-farm storages to landholders, industry and local fire-fighting.	
Investigate alternative water supplies		
Action 3.5 **Increase use of recycled water for intensive horticulture**	Understand the potential for and barriers to using recycled water for intensive horticulture across the region.	

Support local councils and water users to manage risks

The NSW Government already supports local councils in managing town water supply and security risks through the Safe and Secure Water Program. The Safe and Secure Water Program has funded around $38 million of investigations and works in the North Coast region over the past three years, including funding support for the preparation of integrated water cycle management strategies. Under this program, funding priorities have been for sewage discharges and sewer overflows, that pose risks to water quality, water security and the environment.

However, as recognised in the NSW Auditor-General's report *Support for regional town water infrastructure*, more needs to be done to properly support local councils. For example, some councils, despite the funding available through the Safe and Secure Water Program, may still find affordability and, therefore, project delivery an issue.

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

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

This action proposes that the NSW Government continue to support local councils across the region, both in planning as well as helping build skills and capacity for implementation. The first key step is to support councils to complete their integrated water cycle management planning and water security investigations. This will enable us to better understand if proposed local measures are sufficient to manage shortfalls in extraction.

Future support provided by the NSW Government will be guided by the outcomes of the NSW Government's Town Water Risk Reduction Program. This two-year program is aimed at working with councils (and other stakeholders) to develop a new framework to better manage safe, secure and sustainable water supply and sewerage services to regional communities across NSW. Three key components of this program that will benefit local councils in the North Coast region are:

- the review of the integrated water cycle management framework and improving the secure yield analysis guidelines, methods and data access arrangements
- a commitment to provide a clear timeframe for when the new climate data developed for the regional water strategies will be available to local water utilities and councils
- investigating how to set clear minimum service levels for water security, water quality and environmental outcomes and the funding arrangements needed to support this.

The program aims to provide the right mix of tools to support local councils in the North Coast region to address their key future town water security challenges. For example, this includes assisting councils to explore options to reduce the demand on surface and groundwater sources through water use efficiency programs, and where appropriate, decentralised desalination and direct or indirect potable reuse.

NSW Government support for local councils through catchment-based actions that improve river health and land management (see action 1.4) will also help improve the quality of water being extracted to meet town water needs.

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

The NSW Government's Future Ready Regions Strategy recognises that providing clear and accessible information on surface water and groundwater availability allows industries to forward-plan with certainty. However, this data is often not accessible or available to water users in a format that is useful to their needs or preferences. Recent consultation on the coastal regional water strategies and the review of the coastal harvestable rights limit echoed this concern, with stakeholders stating they did not know who to contact for advice on their options for accessing water. This ultimately affects landholders' ability to make optimal business decisions – particularly when considering the impacts of extended dry periods.

The NSW Government is committed to supporting better planning and decision making for normal and dry times by providing more information and data to enable businesses to make the right decisions for their circumstances. For example, access to good climate information ahead of time, and sound risk management and business planning are significant determining factors in the ability of farming businesses to weather prolonged droughts.

The new climate data that has been published as part of the regional water strategies is a key step in providing more information to water users and managers on the risks of different climate scenarios on the reliability of water access licences over the long term.

The NSW Government can design and deliver suitable training and information products for:

- medium-term climate outlooks over the next 12 months. This will look at how climate outlooks will influence water availability to help water users make informed decisions on managing their allocations or trading water on the market
- implications of the long-term climate data on surface water availability and the likelihood of periods of low or no water availability
- implications of the long-term climate data on groundwater availability from different aquifers
- understanding water access options in coastal areas, including the implications of the recent changes in the coastal harvestable rights limit.

The NSW Government will consult with stakeholders and review the ways water information is made available to users to improve usability and accessibility. Where appropriate, this work would build on existing information platforms and products to provide data in forms that are suitable to stakeholders.

Have your say

- What water information would you like made available?

Optimise use of existing water supplies

Water resources are finite, and 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.

Proposed action 3.3: Review water markets

Climate modelling indicates that the North Coast region is likely to experience more frequent droughts and drier conditions in future. Active and effective water markets are important for maintaining a thriving regional economy by enabling industries, especially those reliant on unregulated water, to prepare for drier conditions. Trade could also be used as 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 why so little trade has occurred in region's unregulated and groundwater sources, and identify what improvements can be made to its water markets.

The Australian Consumer and Competition Commission (ACCC) identified common elements of effective water markets in its *Murray–Darling Basin Water Markets Inquiry*. This action would assess how well North Coast region's water markets are set up to deliver these key elements, by identifying and exploring barriers for participation in the markets. This action would also consider the extent to which the issues and barriers identified in the *Murray–Darling Basin Water Markets Inquiry* would apply to a more developed water market in the North Coast region.

Recommended actions arising from this investigation would 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, action 2.3 (Establish sustainable extraction limits for surface water and groundwater sources) and the ACCC's water markets inquiry.

Proposed action 3.4: Investigate increased on-farm water storage

This action considers water harvested and stored in farm dams under a water access licence, and would investigate:

- current levels of on-farm storage and usage as well as barriers to constructing them
- options to mitigate downstream environmental and water security impacts of on-farm storages, such as the provision of low flow bypasses
- 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.

On-farm dams can be either catchment dams constructed in a drainage line or gully, or turkey-nest dams, which do not harvest surface flows and must be filled by pumping. Landholders usually prefer catchment dams because they are cheaper to construct and operate. They can be sited in less productive gully country and they naturally fill after rainfall. Conversely, turkey-nest dams need to be sited on flat land, which are often productive alluvial flats, and require pumping to be filled. Turkey-nest dams have less environmental impact.

Increasing the volume of water stored on farms will help landholders in unregulated catchments manage the impacts of climate change on water security. Furthermore, capturing runoff high in the catchment and applying it for irrigation in drier times will assist in retaining water in the catchment for longer periods. Water in on-farm dams also provides vital supplies to help fight bushfires.

As farm dams 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 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 2.5) or through increased trade (action 3.3).

Further, any proposal to increase on-farm storage will need to be considered and implemented alongside the increase in harvestable rights limits for coastal-draining catchments and implementation of sustainable extraction limits (action 2.3).

Have your say

- Do farm dams (including dams with low flow bypasses as discussed in action 2.5) offer a realistic, environmentally acceptable option for improving water security for landholders and industry?

Photography
Image courtesy of Destination NSW.
Milly Hill Farm, Armidale.

Investigate alternative water supplies

Projected climate change impacts in the North Coast region means that we are under additional pressure to ensure that water supply is resilient to changes, and that users have access to alternative water supplies.

Local councils, as part of their integrated water cycle management planning, are already considering local options and alternative water sources to meet future water security challenges. The following action considers opportunities to provide industry with an alternative, relatively drought-proof source of water for irrigation.

Proposed action 3.5: Increase use of recycled water for intensive horticulture

This action will improve the understanding of the potential for and barriers to using recycled water from sewage treatment plants or sewer mining as an alternative water source for intensive horticulture across the region. This includes the water quality impacts that have been observed in the Coffs Harbour area.

Intensive horticulture is a rapidly expanding industry in the North Coast region, with significantly greater irrigation demands than the more traditional crops grown in the region. The 2018 to 2020 drought showed how vulnerable these operations are to extended dry periods, as blueberry farmers slashed production bushes to the ground to try to reduce water demand and save the bushes from dying.

Recycled water is already being provided to rural users in some parts of the North Coast region, with the largest scheme managed by Coffs Harbour City Council.

This action will assess the likely demand, costs, benefits and challenges of introducing or upscaling recycled water schemes for intensive horticulture within the North Coast region. It will draw on the experience of Coffs Harbour City Council and other schemes implemented across the state. Collaboration with councils, local landholders and the community will also be a key component.

Public perceptions, water quality impacts and community acceptance of recycled water are recognised as key barriers to widespread uptake, irrespective of the strength of technical information supporting adoption. However, there is already an awareness among the North Coast region's horticultural industry that growers may need to use recycled water as part of future water security planning.

If this action finds that recycled water for intensive horticulture is feasible, then the following outcomes could be achieved:

- reduction in demand for river extractions
- reduction in on-farm dam storage
- greater reliability through a climate independent source of water for industry
- potentially less runoff pollution through a circular economy on farms.

Recycled water has a higher nutrient profile than freshwater sources and can have significant downstream water quality impacts. As such, this action would need to be managed appropriately to avoid impacting the success of other actions aimed at improving river health (see action 1.4). The use of recycled water is likely to require landholders to adjust how they fertilise crops and adopt measures that reduce excess runoff. Stakeholders have also told us of the regulatory and administrative barriers in delivering the Coffs Harbour recycled water scheme. The additional support provided for landholders under action 1.5, as well as initiatives of the NSW Water Strategy and the Town Risk Reduction Program, will complement this action by addressing some of these capacity needs.

Have your say

- Would you be interested in accessing recycled water to secure your water supplies?
- How much would you need and what would you be willing to pay to access it?

How to have your say

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Countryside, Grafton.

When will the actions be implemented?

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

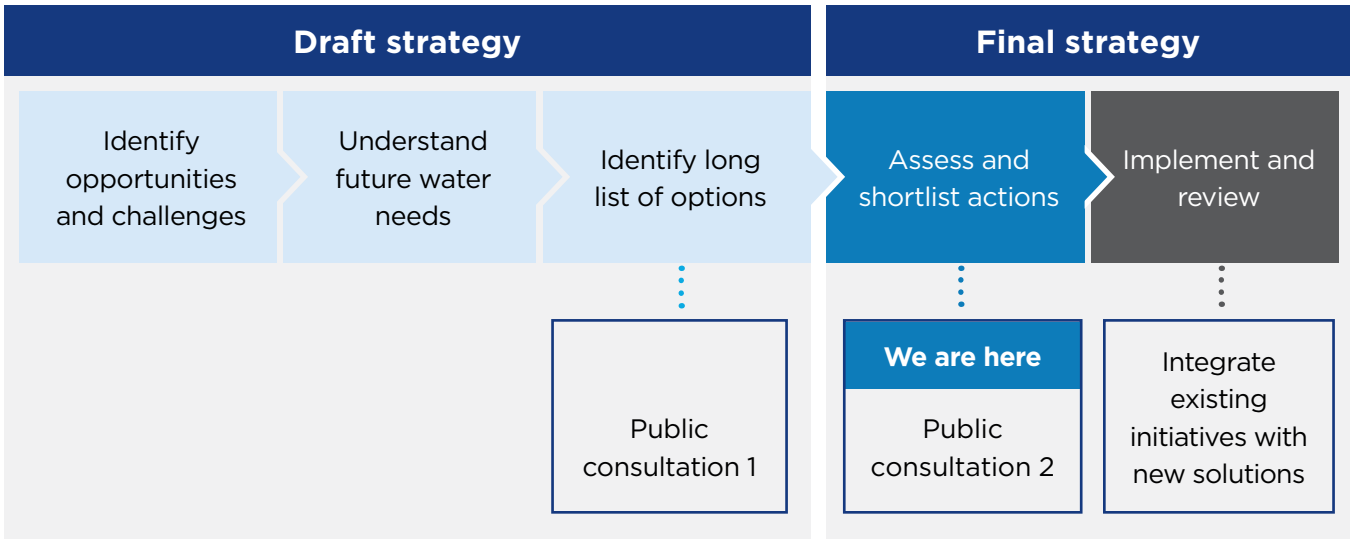
Following public consultation, we will develop an implementation plan that will set out when we plan to commence each action and what we plan to achieve by when.

The implementation plan will also identify key partners in effectively delivering these actions, including local councils, government agencies, local community groups and local Aboriginal communities.

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

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

Figure 13. Regional water strategy delivery timeline



Your voice is important. This consultation paper is on public exhibition from 23 May to 19 June. Supporting information is available at www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/upcoming-public-exhibition/north-coast-regional-water-strategy

You can also have your say on the shortlisted actions by providing written feedback to the Department of Planning and Environment by midnight on 19 June 2022 via:

Web: www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/upcoming-public-exhibition/north-coast-regional-water-strategy

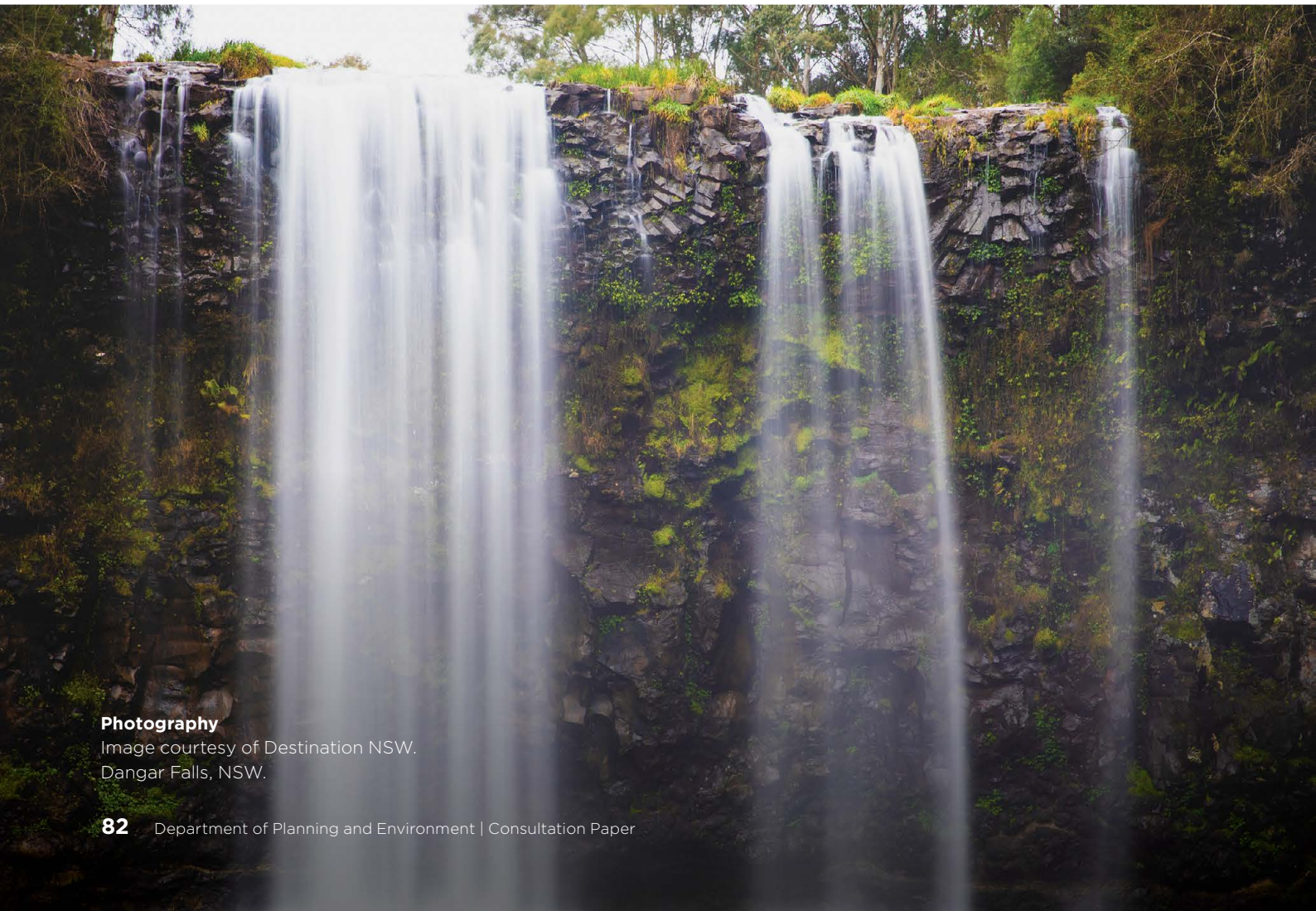
Email: regionalwater.strategies@dpie.nsw.gov.au

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

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

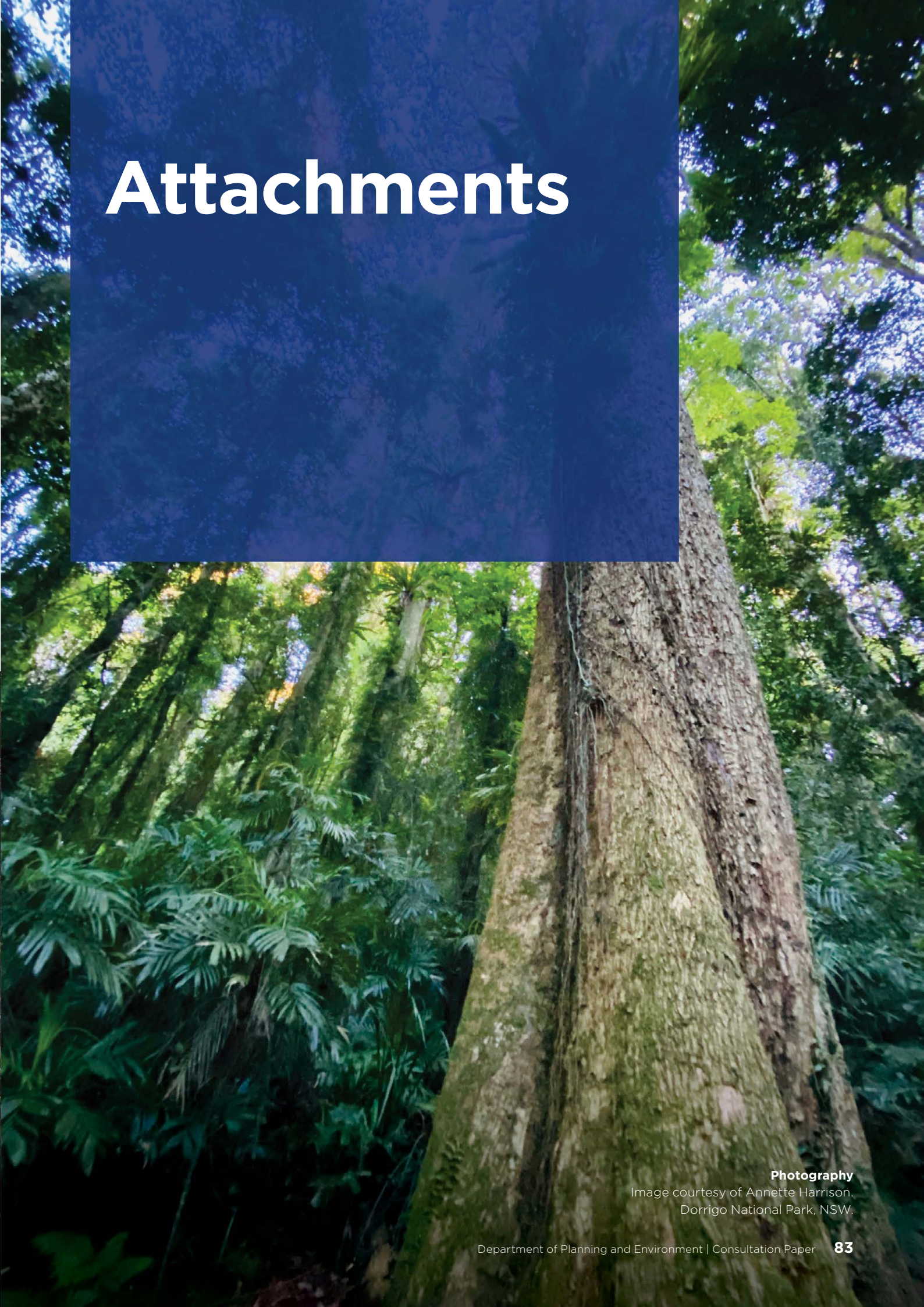
Please note that all submissions will be published on the Department of Planning and Environment's website, unless you let us know in your submission that you do not wish the content to be released.

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



Photography
Image courtesy of Destination NSW.
Dangar Falls, NSW.

Attachments



Photography
Image courtesy of Annette Harrison.
Dorrigo National Park, NSW.

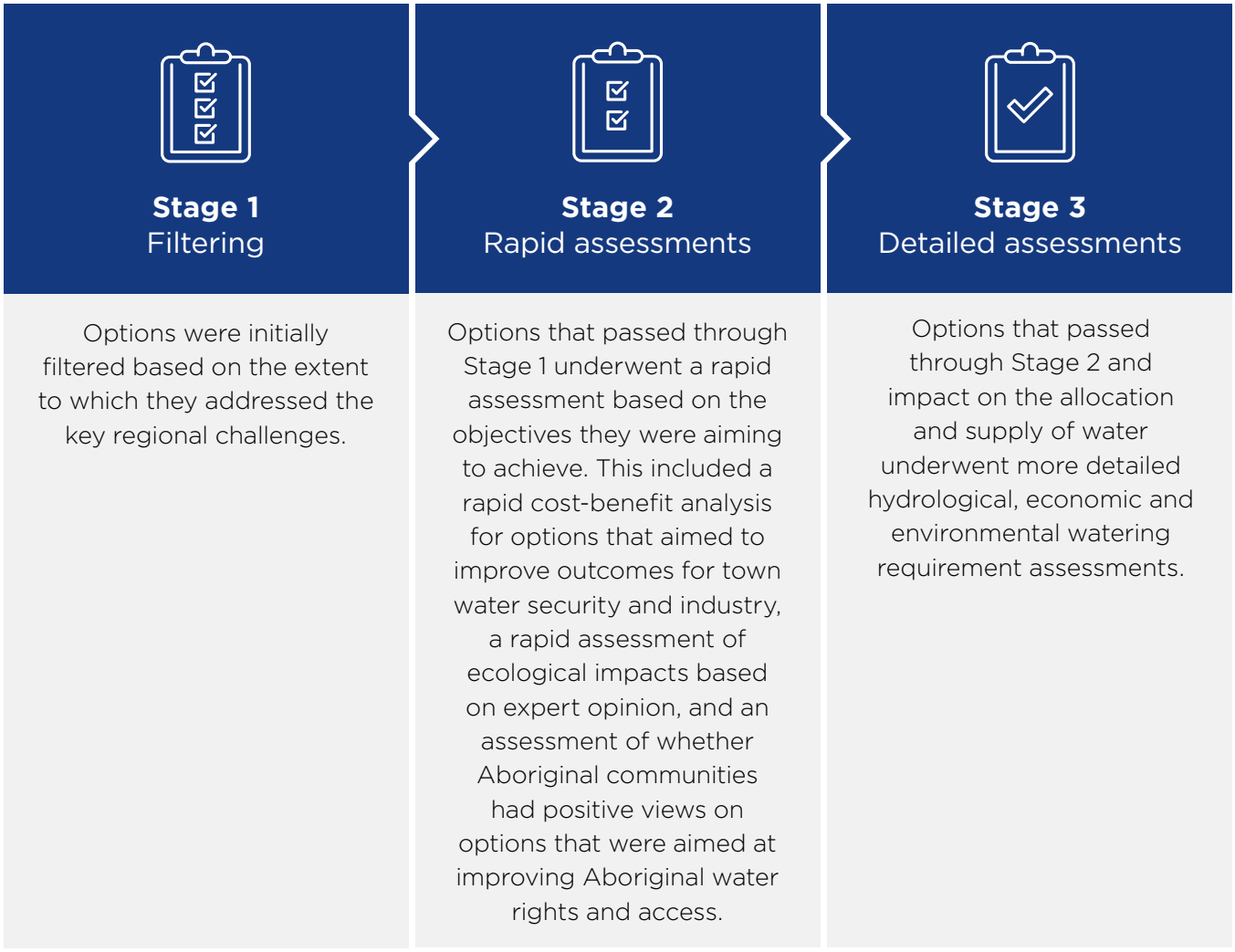
Attachment 1

Summary of the options assessment

The Draft North Coast Regional Water Strategy identified 36 draft options. An additional 5 were identified during the public consultation process.

The process we followed to move from the long list to the short list is summarised in Figure 14 and described in the *Options assessment process: Overview.*[19]

Figure 14. Going from a long list to a final strategy of actions



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

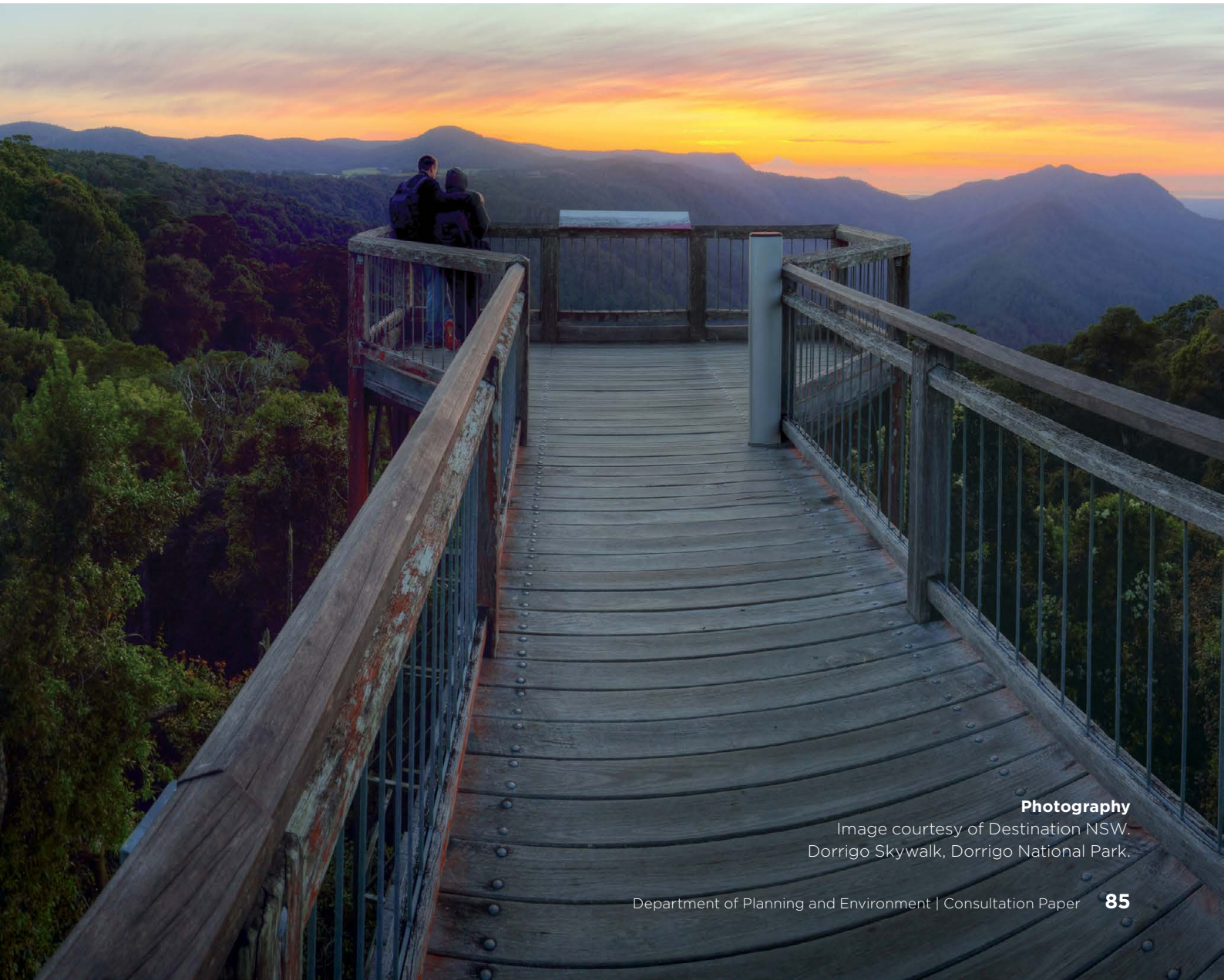
At each step of the assessment, we narrowed down and filtered out the long list of options from the Draft North Coast Regional Water Strategy, based on the evidence we gathered and the analysis we undertook. Based on our analysis, several options were consolidated, refined, or not progressed and converted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

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

The analysis we have undertaken is a high-level assessment process, appropriate for a strategic document, and is not designed to consider all possible impacts on the environment, water users or Aboriginal people in detail.

However, it does provide enough detail to understand if an option is likely to make a net positive contribution to the regional water strategy's objectives. More detailed environmental, economic and cultural assessments are required and will be undertaken in any subsequent business case development or planning processes for actions that proceed to the implementation stage.

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



Photography
Image courtesy of Destination NSW.
Dorrigo Skywalk, Dorrigo National Park.

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

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

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

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid ecological assessment		
1. Expand the Clarence-Coffs Harbour Regional Water Supply Scheme	✓	Not assessed	Minor/moderate impact	✗	Detailed cost–benefit analysis showed that costs outweighed benefits for this option.
2. Portable desalination	✓	Not assessed	No/little change	›	Individual councils may consider portable desalination as part of their integrated water cycle management planning supported through the Safe and Secure Town Water Program.
3. Emergency water supply provided by new pumped hydro storage projects	✓	Not assessed	Minor/moderate impact	›	There is insufficient information to progress this action at this stage. Kempsey Shire Council may consider this as part of their integrated water cycle management planning.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid ecological assessment		
4. Augment Shannon Creek Dam	⊗	Not assessed	Major/extreme impact	⊗	Does not effectively address a key challenge for the region. The Clarence-Coffs Harbour Regional Water Supply Scheme does not require augmentation because the water security risk is currently low.
5. Upgrade major town water treatment facilities	✓	Not assessed	No/little change	›	Individual councils may consider upgrades to town water treatment facilities as part of their integrated water cycle management planning supported through the Safe and Secure Water Program.
6. Repurpose existing assets to provide emergency storage for local industries	⊗	Not assessed	Minor/moderate impact	⊗	Does not effectively address a key challenge for the region. A review of the existing works approvals owned by local councils across the region found limited opportunity for this option.
7. Vulnerability of surface water supplies to sea level rise and saline intrusion	✓	Not assessed	No/little change	✓	Incorporated into: • Proposed action 1.6: Assess the vulnerability of surface water supplies to sea level rise and saltwater intrusion. • Proposed action 1.8: Characterise and plan for climate change and land use impacts on coastal groundwater sources.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid ecological assessment		
8. New industry and rural licence category within major council storages	✓	Not assessed	Minor/moderate impact	✗	There was significant community opposition to this option.
9. Protecting coastal groundwater resources for town water supplies and rural water users	✓	Not assessed	Minor/moderate improvement	›	Investigations are already being progressed by local council as part of their integrated water cycle management planning.
10. Remove impediments to water reuse projects	✓	Not assessed	No/little change	›	This option is being progressed through Action 6.7 of the NSW Water Strategy – Proactive support for water utilities to diversify sources of water.
11. Increase use of recycled wastewater for intensive horticulture	✓	Not assessed	Minor/moderate impact	✓	See Proposed action 3.5: Increase use of recycled wastewater for intensive horticulture.
12. Indirect potable reuse of purified recycled water	✓	Not assessed	Minor/moderate improvement	›	Individual councils may consider purified recycled water as part of their integrated water cycle management planning supported through the Safe and Secure Water Program.
13. Direct potable reuse of purified recycled water	✓	Not assessed	Minor/moderate improvement	›	Individual councils may consider purified recycled water as part of their integrated water cycle management planning supported through the Safe and Secure Water Program.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid ecological assessment		
14. Increased harvestable rights	✓	Not assessed	Major/Extreme impact	✓	See proposed action 2.7: Address catchment-based impacts of increased harvestable rights limits. The environmental assessment of this option recognises the risk of new dams being constructed to the 30% limit prior to: a) local scale assessments having been undertaken; and b) the setting of sustainable extraction limits (see proposed action 2.3). The intent of this option has been changed to address these issues. Stakeholders have requested that the recent changes to harvestable rights be supported by further detailed assessments at the local scale to understand the impact of the change and that provision is made to adjust the limit depending on the outcome of the assessments. The revised action also describes management levers to ensure current and future uptake in harvestable rights is considered in updated coastal water sharing arrangements and plans, including long term average annual extraction limits, trade and water supply approval works. Provided these measures are put in place, it is expected risk ratings for the original option would be reduced to an acceptable level.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid ecological assessment		
15. Increased on-farm water storage	✓	Not assessed	Minor/moderate impact	✓	See Proposed action 3.4: Investigate increased on-farm water storage.
16. Establish sustainable extraction limits for North Coast surface water and groundwater sources	✓	Not assessed	Major/ extreme improvement	✓	See Proposed action 2.3: Establish sustainable extraction limits for surface water and groundwater sources.
17. Convert low flow water access licences to high-flow water access licences	✓	Not assessed	Major/ extreme improvement	✓	See Proposed action 2.5: Reduce the take on low flows.
18. Long-term water plans to support healthy coastal waterways	✓	Not assessed	Major/ extreme improvement	✓	See Proposed action 1.7: Identify environmental water needs to support healthy coastal waterways.
19. Characterising coastal groundwater resources	✓	Not assessed	Minor/ moderate improvement	✓	See Proposed action 1.8: Characterise and plan for climate change and land use impacts on coastal groundwater sources.
20. Protecting ecosystems that depend on coastal groundwater resources	✓	Not assessed	Major/ extreme improvement	✓	See Proposed action 1.9: Protect ecosystems that depend on coastal groundwater resources.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid ecological assessment		
21. Improve stormwater management	✓	Not assessed	Minor/ moderate improvement	→	This option will be considered as part of Management Initiative 1 of the NSW Marine Estate Management Strategy.
22. Bringing back riverine habitat and threatened species	✓	Not assessed	Major/ extreme improvement	✓	Incorporated with Proposed action 1.4: Deliver a river recovery program.
23. Fish-friendly water extraction	✓	Not assessed	Major/ extreme improvement	✓	See Proposed action 2.2: Implement fish-friendly water extraction.
24. Improve fish passage in the North Coast region	✓	Not assessed	Major/ extreme improvement	✓	See Proposed action 2.1: Improve fish passage.
25. Addressing cold water pollution	✗	Not assessed	Minor/ moderate improvement	✗	Does not address a key challenge for the region.
26. Coastal, regional focused water reference groups	✗	Not assessed	No/little change	→	The Department of Planning and Environment is currently consulting with water users on the North Coast of NSW to determine the best way to engage the community in regional water management.
27. Planning for climate change impacts on coastal groundwater resources	✓	Not assessed	No/little change	✓	Incorporated with Proposed action 1.8: Characterise and plan for climate change and land use impacts on coastal groundwater sources.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid ecological assessment		
28. River Recovery Program for the North Coast: a region-wide program of instream works, riparian vegetation and sediment control	✓	Not assessed	Major/ extreme improvement	✓	See Proposed action 1.4: Deliver a river recovery program.
29. Improved data collection on water use and patterns	✓	Not assessed	Minor/ moderate improvement	✓	See Proposed action 1.10: Improve monitoring of water extraction.
30. Active and effective water markets	✓	Not assessed	Minor/ moderate impact	✓	See Proposed action 3.3: Review water markets.
31. Apply the NSW Extreme Events Policy to the North Coast region	✓	Not assessed	No/little change	›	This option will be considered through Action 4.3 of the NSW Water Strategy – Improve drought planning, preparation and resilience.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid ecological assessment		
32. Regional demand management program	✓	Not assessed	No/little change	→	Regional demand management will be considered through the NSW Water Strategy, specifically: • Action 4.3: Improve drought planning, preparation and resilience. • Action 6.3: Deliver a new Town Water Risk Reduction Program. • Action 6.6: A new state-wide Water Efficiency Framework and Program.
33. Regional network efficiency audit	✓	Not assessed	No/little change	→	This option will be considered through Action 6.6 of the NSW Water Strategy – a new state-wide Water Efficiency Framework and Program.
34. Regional capacity building program and skills hub	✓	Not assessed	No/little change	✓	Incorporated with Proposed action 1.5: Support landholder adoption of best practice land management.
35. Support for local councils to lift performance standards	✓	Not assessed	No/little change	→	This option will be supported through Action 6.3 of the NSW Water Strategy – Deliver a new Town Water Risk Reduction Program.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid ecological assessment		
36. Regional framework to manage restrictions for non-urban water users of town water	✓	Not assessed	Minor/ moderate improvement	›	This option will be supported through Action 6.3 of the NSW Water Strategy – Deliver a new Town Water Risk Reduction Program.
37. Cancelling mining licences or leases within the Clarence River catchment	✗	Not assessed	Not assessed	✗	The regulation of mining exploration is managed under the *Mining Act 1992*, and any new mining leases require that a development consent under the *Environmental Planning and Assessment Act 1979* be in place before any title is granted. Statutory requirements, which may include community consultation and an Environmental Impact Statement, would also apply during the development consent process.
38. A new dam above The Gorge on the Clarence River to provide an alternative water source and flood mitigation for the valley	✗	Not assessed	Not assessed	✗	Does not effectively address a key challenge for the region.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid ecological assessment		
39. New local storages in the Bellinger and Nambucca Valleys	✓	Not assessed	Not assessed	›	Bellingen Shire Council and Nambucca Valley Council may consider additional local storages as part of their integrated water cycle management planning supported through the Safe and Secure Water Program.
40. Review BASIX requirements on existing urban dwellings	✓	Not assessed	Not assessed	›	This option will be considered through Action 6.6 of the NSW Water Strategy – A new state-wide Water Efficiency Framework and Program.
41. Support opportunities that retain water within the landscape	✓	Not assessed	Not assessed	✓	This option will be supported through Proposed action 1.4: Deliver a river recovery program and Proposed action 1.5: Support landholder adoption of best practice land management.

Draft strategy option	Stage 1: Filtering	Stage 2: Rapid assessments		Shortlisted	Comment
	Meets key regional challenge	Passes rapid cost-benefit analysis	Rapid ecological assessment		
42. Implement planning controls in drinking water catchments	✓	Not assessed	Not assessed	›	It is noted that zoning and planning controls are managed under the *Environmental Planning and Assessment Act 1979*. However, this option will be broadly supported through the NSW Water Strategy (see Priority 6). The revision of regional plans also provides an opportunity to integrate land use and strategic water planning, particularly in ensuring future growth protect the reliability, quality and security of the region's water resources. In the interim, Proposed action 1.4 and 1.5 have been designed to support measures that reduce the impact of land use on waterway health and town water security.

Photography
Image courtesy of iStock.
Urunga, NSW.

Photography
Image courtesy of NSW Farmers.
Crops, NSW.

Attachment 2

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

This attachment summarises the results of the assessment of 1 option in the Draft North Coast Regional Water Strategy that was able to be assessed for hydrologic and economic impact and benefit - Option 1: Expand the Clarence Coffs Harbour Regional Water Supply Scheme. This option only directly impacted the behaviour of the Clarence River catchment.

The key assumptions and processes used were:

- Hydrologic assessment was done by introducing the option into the Department's Clarence River system model and observing the changes that occurred to extraction of water and flows compared to the base case of current situation.
- Economic assessment used results from the modelled option and estimated the value of changes in town water supply shortfalls and agricultural production. All unregulated water licences were assumed to be used for sorghum, given it is the primary crop grown in the region.
- Ecological assessment using modelled results was also conducted.

High level results of these assessments are presented below. These results are a subset of the more comprehensive and technical outcomes contained in the Detailed economic and ecological analysis report for the North Coast.

Rapid cost benefit analysis results

The option was subjected to a hydrologic and economic assessment using long term (10,000 years) stochastic and worst-case climate data accompanied by an ecological assessment of changes in flows.

The ecological assessment determined whether the changes in flows at five representative flow gauging points in the unregulated river systems were an improvement or a detrimental impact to achieving flow targets.

Table 2 below lists the results for this proposed option. A detailed explanation for this scenario follows.

Table 2. Results of modelling Option 1: Expand the Clarence–Coffs Harbour Regional Water Supply Scheme

Scenario	Present value capital cost ($m)	Stochastic net present value ($m)	NARCliM net present value ($m)	Stochastic benefit–cost ratio	NARCliM benefit–cost ratio
1	36.7	-36.2	-35.9	0.01	0.02

Note: The benefit-cost ratio shows the relationship between the costs and benefits of a project. A ratio that is more than 1.0 for a project is considered acceptable. A smaller ratio would provide less return for each dollar spent. For example a ratio of 1.0 would provide an economic benefit of $1 for every $1 of cost, while a ratio of 0.1 would provide an economic benefit of 10c for each $1 of cost.

Expansion of the Clarence–Coffs Harbour Regional Water Supply Scheme

Purpose	This action is for the expansion of the Clarence-Coffs Harbour Regional Water Supply Scheme to connect to Bellingen Shire Council's town water supply system. Towards the end of 2019, the levels in the Bellinger River continued to drop and Bellingen Shire Council had concerns about the volume of water in the aquifer, and how long this would last if the Bellinger River stopped flowing. Bellingen Shire Council are considering alternative water supply options that could supplement the alluvial water source and secure water supply during a repeat of the dry conditions experienced in 2019, or worse.
Description	This action proposes to construct a pipeline between Coffs Harbour City Council's treated water supply network in the suburb of Boambee East and Bellingen Shire Council's main town water supply network that supplies water to Toormina Reservoir. The proposed option included four different pipeline routes, all of which have been costed.
Results	It is not recommended that this option is progressed any further through the North Coast Regional Water Strategy. The assessment demonstrates that this option is not economically viable in its current form or under current population and climate forecasts. Even with favourably discount rates of 3% or a reduction in the capital cost of 30%, the option does not provide an economic benefit to the region due to the extremely high capital cost of the project relative to the number of people who would benefit from it, and the relatively small amount of shortfalls under these modelling constraints.
Limitations	The Bellingen town water supply demand is 2.5 ML/d during cease-to-pump periods at Gauge 205002. The cease-to-pump rules used in the modelling are from the Bellinger Unregulated Water Sharing Plan. No water losses have been included. The extraction depends on water availability at Karangi and Shannon Creek dams. No water account assessment has been set up for this demand.

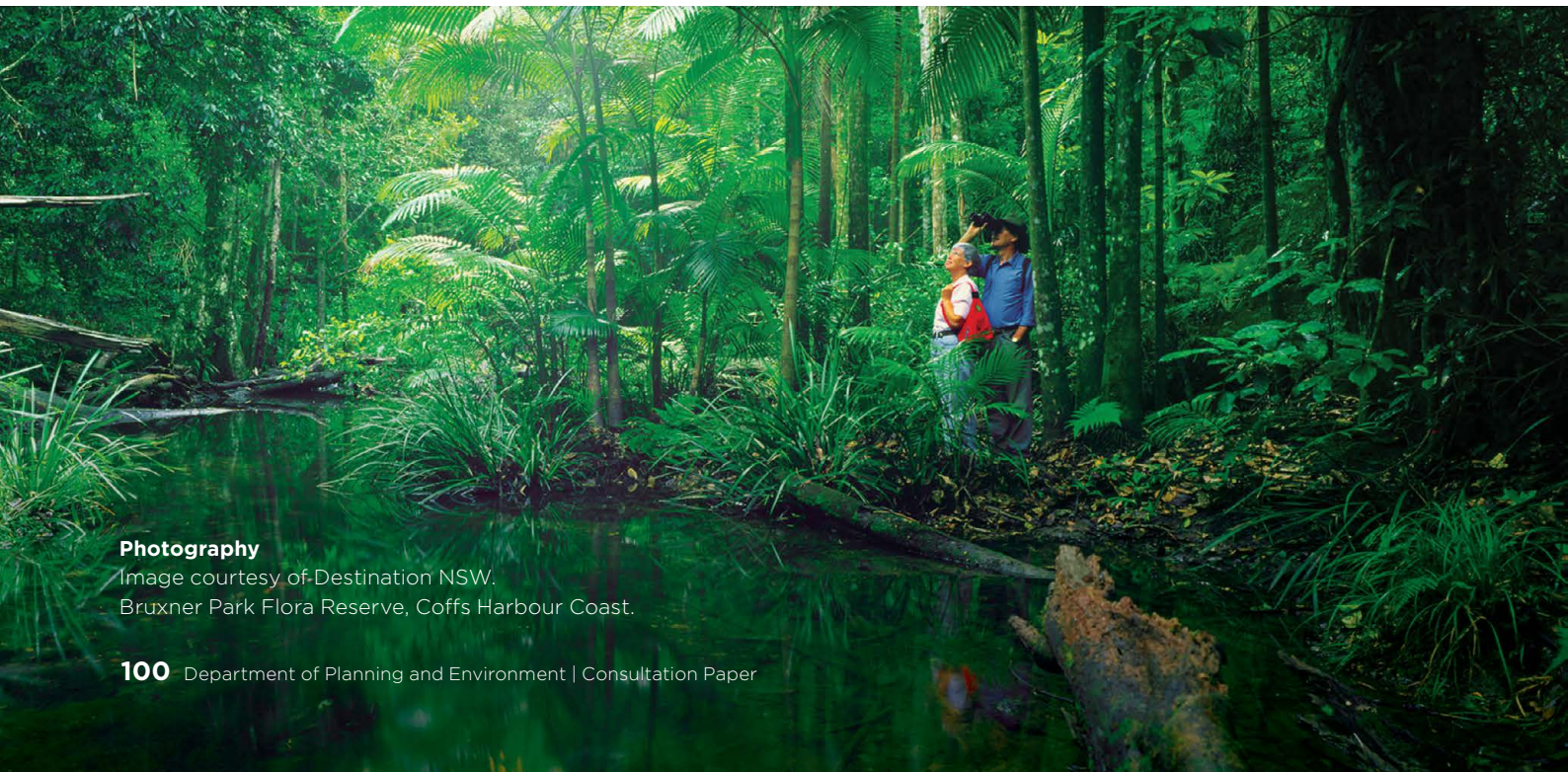
Effects of Option 1: 'Expansion of the Clarence–Coffs Harbour Regional Water Supply Scheme' on river ecology

The ecological effects of this scenario were assessed using 20 measures across 24 representative sites relating to the likely or potential ecological requirements of aquatic flora and fauna. Metrics applied included the frequency and duration of cease-to-flow events and base flows, the frequency of freshes, large and infrequent bankful and overbank flows, low flows (90th and 95th percentile) and the annual volume of flows.

These measures were applied for both the long-term historical climate projections (stochastic) and under a 'worst-case' dry climate change scenario referred to as the NARCliM climate scenario in this document. An effect was generally only considered significant if there was a change in the metric at 3% or higher, in either a positive or negative direction. Descriptions of the extent of impact or improvement follow those categories shown in Table 3.

The results indicate if there are any impacts of the pipeline, they are below the pre-determined 3% significance level (Table 4). The 5 most significant results (all within about a 1-2% effect) suggest a very small change in flow regime towards lower flows, including a very slightly increased tendency to periodically cycle to even lower or higher flows within that low flow range. That is, about a 1% increase in low flow standard deviation at Orara River at Karangi under both the Stochastic and NARCliM scenarios, as well as about a 1 and 2% decrease in size of 95th percentile flows under the Stochastic and NARCliM scenarios respectively. There was also a 1% increase in the number of years with a cease to flow event at Orara River at Glenreagh under the Stochastic scenario.

Although the Karangi Dam within the proposed pipeline scheme does draw from the Orara River there was no expectation that the proposed action would have a significant effect on Orara River flows. The lack of a significant (3% or greater) impact of this option can be attributed to 3 factors. The proposed pipeline from Coffs Harbour to Bellingen will be connected to the existing regional water supply scheme and its impact will be constrained by the capacity of the current infrastructure. Second, the regional water supply scheme draws water from a variety of sources, including the Clarence, Orara and Nymboida Rivers, thereby distributing its impact and reducing the impact on any one source. Third, the proposed additional water delivered to Bellingen will represent a small demand compared to that of Coffs Harbour.



Photography
Image courtesy of Destination NSW.
Bruxner Park Flora Reserve, Coffs Harbour Coast.

Table 3. Explanation of categories used in ecological assessment

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

It is important to note that the ecological assessments presented below are based on generic flow metrics that describe typical components of the flow regimes upon which flow-dependent species and communities rely. However, flow-dependent species and communities often have different and more complex environmental water requirements that cannot be represented with simple or generic metrics. There are also many external factors and long-term hydrological and ecological effects associated with river management that the models used for these assessments cannot capture which could affect the viability of aquatic species and populations. The metrics used for these assessments are designed to help eliminate unviable management options and to support identification of a shorter list of options that can undergo more detailed analysis at future stages of development if required. While brief summaries of the analyses are presented below, more comprehensive and technical analyses are presented in the Detailed economic and ecological analysis report for the North Coast.

Table 4. Predicted effects of Option 1 on ecological flow requirements under Stochastic and NARCliM scenarios*

Metric	% change under the stochastic base case	% change under the NARCliM base case
Number of years with greater or equal to one zero flow spell per 130 years	0 (0 - 1.1)	0 (0 - 0.2)
Average duration of zero flow spells (number of days)	0 (-0.5 - 0)	0 (-0.1 - 0.1)
Number of zero events per 130 years	0 (0 - 0.6)	0 (0 - 0.1)
Very low flow rate (ML/d), measured as the 95th percentile discharge of daily flows	0 (-0.9 - 0)	-0.1 (-1.8 - 0)
Low flow rate (ML/d), measured as the 90th percentile discharge of daily flows	0 (-0.5 - 0)	0 (-0.4 - 0)
Median annual low flow days	0 (0 - 0)	0 (0 - 0)
Median days below low flow	0 (0 - 0)	0 (0 - 0)
Low flow standard deviation	0 (0 - 0.7)	0.1 (0 - 0.9)
Low flow days below the 75 percentile	0 (0 - 0)	0 (0 - 0)
Base flow rate (ML/d), measured as the 80th percentile discharge of daily flows	0 (0 - 0)	0 (-0.2 - 0)
Mean annual discharge (ML/y)	0 (0 - 0)	0 (0 - 0)
Fresh flow rate (ML/d), measured as the 20th percentile discharge of daily flows	0 (0 - 0)	0 (0 - 0)
Average number of freshes per year	0 (0 - 0)	0 (0 - 0)
Average duration of freshes (number of days)	0 (0 - 0)	0 (0 - 0)
High flows - 40% Annual Exceedance Probability (AEP), or the 2.5 year Annual Return Interval (ARI) flow rate (ML/d)	0 (0 - 0)	0 (0 - 0)
High flows - 20% AEP, or the 5 year ARI flow rate (ML/d)	0 (0 - 0)	0 (0 - 0)
Very high flows - 10% AEP, or the 10 year ARI flow rate (ML/d)	0 (0 - 0)	0 (0 - 0)
Monthly flow coefficient of variation	0 (0 - 0.1)	0 (0 - 0.1)
Daily flow coefficient of variation	0 (0 - 0.1)	0 (0 - 0.2)
Weekly flow coefficient of variation	0 (0 - 0.1)	0 (0 - 0.2)

*Notes: (i) the numbers in the bracket represent the minimum and maximum; (ii) All results are from averaged effects over time for each site, and so the ranges represent the range of time-averaged values across sites, not the entire variability represented over time at the site, or regional level; and (iii) The changes within little impact to little improvement corresponds to changes at or less than 3% and are not considered significant. Changes greater than 3 up to 10, 10 to 20, 20 to 30, and greater than 30 percent are categorised as minor, moderate, major and extreme respectively.

A summary of the assessment results is provided in Table 5. The results (including minimums and maximums) are derived from site-based averages and do not provide information on time-specific events. The timing of these reductions is particularly important to fish migration, condition and survival, and could impact species such as Cox's gudgeon, Australian Bass and the long-finned eel. These time-specific impacts will need to be considered if this option is pursued further. Such ecological impacts were raised as possibilities by an expert panel, along with associated societal impacts.

Table 5. Summary of the ecological assessments of the proposed action in the North Coast region.

Proposed action	Quantitative modelling results	Most relevant expert assessments
Proposed action 1 - Pipeline from Coffs Harbour to Bellingen	No significant results, but the models did predict 1-2 % size impacts on low flow hydrology in Orara River. These will require further assessment if this option is pursued.	'Expand the Clarence-Coffs Harbour Regional Water Supply Scheme' included this proposed pipeline, but without the currently available detail. Potential impacts were predicted across the range from minor to extreme, with a median prediction of minor/moderate (Table 2, p. 70). Concerns were raised about possible reduction of base flows from upland streams from which the scheme extracts, especially during drought and associated ecological, geomorphological, water quality, cultural, recreational, amenity and social implications. Detail of operations was required to assess further.

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