

Department of Planning and Environment

Greater Sydney Water Strategy

Water for a thriving, sustainable and
resilient Sydney

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Acknowledgment of Country

The NSW Government acknowledges Aboriginal people as Australia's first people practicing the oldest living culture on earth and as the Traditional Owners and Custodians of the lands and waters. We pay our respects to their Elders past, present and future.

We recognise the intrinsic connection of Traditional Owners to Country and acknowledge their contribution to the management of landscapes, water and other natural resources across NSW.

NSW Department of Planning and Environment understands the need for consultation and inclusion of Traditional Owner knowledge, values and uses in water planning to ensure we are working towards equality in objectives and outcomes. The department is committed to continuing future relationships and building strong partnerships with Aboriginal people.



Photography

Image courtesy of Yvonne Kaiser-Glass, Sydney Water © Sydney Water 2021.
Aboriginal cultural site, Manly Vale (Gayamaygal Country) NSW.

Contents

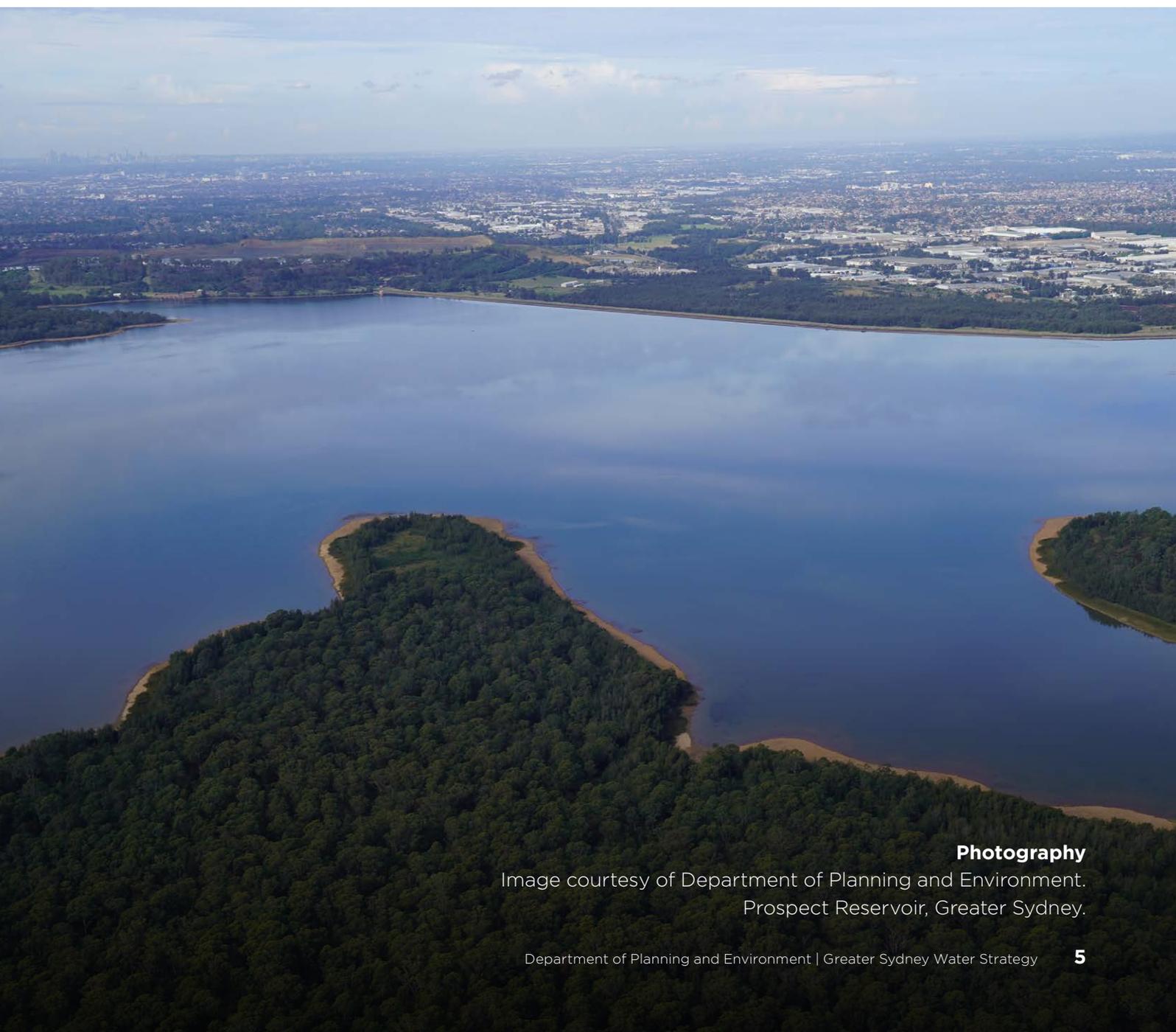
Minister's foreword	6
<hr/>	
Executive summary	8
<hr/>	
Key challenges	10
Responding to these challenges	12
What we heard	15
Snapshot	18
About the Greater Sydney Water Strategy	20
<hr/>	
Setting the direction for water management in Greater Sydney to meet our needs now and for the future	21
A comprehensive set of integrated water strategies for NSW	24
Water in Greater Sydney	26
<hr/>	
Where does Greater Sydney's water come from?	27
Most of our water comes from dams	27
Sydney Desalination Plant is an important part of our water supply	30
Water conservation and recycling are critical to securing our water supply	30
Who provides our water?	31
What happens to our water after we use it?	32
We need new approaches to the big water challenges facing Greater Sydney	34
<hr/>	
Greater Sydney's water challenges	35
Servicing a growing population	35
Building resilience to drought and a changing climate	36
Supporting the economy and jobs	39
Putting water at the heart of our city and communities	39
Improving water rights, interests and access for Aboriginal people	40
We need to invest in our water system and services	41
What we've learned from recent droughts	42
<hr/>	
Water for a thriving, sustainable and resilient Greater Sydney	46
<hr/>	
Our vision	47
Developing a more resilient system	47
Delivering for the community	50

What we need to achieve **52**

Priority 1: We understand how much water we need and when	56
Priority 2: Our water systems are sustainable for the long term and resilient to extreme events	64
Priority 3: Our city is green and liveable	84
Priority 4: Our waterways and landscapes are healthy	102
Priority 5: Water management and services meet community needs	122

How the strategy will be implemented **128**

Getting our timing right	129
Ongoing monitoring and adaptation	129



Photography

Image courtesy of Department of Planning and Environment.
Prospect Reservoir, Greater Sydney.



The Hon Kevin Anderson MP
Minister for Lands and Water

Minister's foreword

The Greater Sydney Water Strategy charts the long-term vision and direction for ensuring the region's sustainable and resilient water services for the next 20 years.

Sydney's liveability and status as a great global city, the region's continuing economic success, our iconic landscapes and unique wildlife all rely on maintaining a sustainable water supply in the face of growing communities and an increasing demand for water and a variable climate.

A key concept underpinning the Greater Sydney Water Strategy is 'enduring supply'. The strategy identifies the need for a pathway to deliver a level of demand that we can be confident of supplying indefinitely, irrespective of the intensity and duration of a drought. Sustainable water supply services are essential to support growth, jobs and a strong economy, to deliver the NSW Government's vision for Sydney as outlined in the *Greater Sydney Region Plan—A Metropolis of Three Cities* and the Premier's Six Cities vision.

With Greater Sydney's population forecast to grow from 5 million to 8 million over the next 40 years, the Greater Sydney Water Strategy outlines how we are managing our water today. The strategy details what actions we need to take to sustain our high quality water and wastewater systems and to build resilience within these systems for Sydney's future prosperity.

The challenges we are facing are not unique to Greater Sydney. We have looked beyond our borders for solutions to issues that are common to many other regions and cities worldwide. We are working even more closely in partnership with all levels of government, industry and communities to be innovative, focused on solutions and planning for our future with confidence.

The strategy recognises that new approaches are needed to secure the region's water supply as our population and economy grow, especially in times of drought. It outlines the challenges facing water management in Greater Sydney, identifies principles and priorities to guide our decisions around water, and considers all available options in determining the best way forward.

The Greater Sydney Water Strategy places a strong emphasis on conserving water and using water more efficiently, while exploring options to make Sydney less dependent on rainfall for our future water supply. Indeed, our future prosperity and growth is inseparable from how well we plan, manage and use our water resources. It also explores how we can create a cooler and greener city, protect our waterways and coastal environments, and support the water interests of Aboriginal communities.

Sydney's growing population and economy mean that, without action, we are almost certain to face a growing gap between our demand for drinking water and the available supply. Our forecast sustainable supply level is up to 540 gigalitres (GL) per year (a bit less than the volume of water in Sydney Harbour) and modelling suggests this may be about 40 to 70 GL/year less than we need under a moderate growth scenario. Increasing climate variability means that, without action, we could face a shortage of drinking water with more and longer periods of severe drought.

This strategy proposes a range of solutions aimed at ensuring there is sufficient water for population growth, industry and jobs, and to support green space and tree canopy even in times of drought. In short, we will:

- **Increase our focus on water conservation and efficiency** as an immediate and cost-effective response.
- **Make better use of our existing assets**, such as how we operate the Sydney Desalination Plant.
- **Continue planning for new rainfall-independent supply sources to support growth** and to reduce the risk of reaching low dam levels during drought. This includes options such as desalination and investigating recycled water where appropriate.
- **Make much greater use of stormwater and recycled water** to cool and green the city and support recreational activities.
- **Invest in upgrades, new connections and leak management** to address the risks posed by ageing water and wastewater systems and infrastructure.

- **Integrate our water and land use planning more effectively** to incorporate sustainable water use into building and landscaping design.

Importantly, this strategy provides the basis for effective forward-planning now while dam levels are high, so that we have a range of fit-for-purpose options available to choose from when they are needed, staged over time so the impacts for customers and for the NSW Government are reasonable.

To inform the final Greater Sydney Water Strategy, we asked for your input about what would work best for your household, business and community, and you provided your views on how much water you can save and what water-using and water saving activities are most important to you. Key themes of water conservation, recycled water use, waterways health, greening and cooling, climate resilience and First Nations access rights came through loud and clear.

We also understand that the options that we plan for and implement must balance the environmental, social and economic impacts of drought with what we can afford and what the community expects and wants from us.

We are taking action now. We have created an implementation plan that outlines how we will deliver the Greater Sydney Water Strategy over the immediate term to 2025. This time horizon aligns with the IPART price determination period and therefore provides clarity about our forward workplan. The strategies we put in place now will affect future generations who want to continue to enjoy the many benefits of living in this wonderful region and great city.

This strategy is a call to action and a guide for our work together across government, industry and communities so that we can greatly improve our capacity to adapt and respond effectively to enhance our water security and resilience now and into the future.



Executive summary

Photography

Image courtesy of Department of Planning and Environment.
Prospect Reservoir, Greater Sydney.

Water is essential for Greater Sydney to grow and prosper. As well as meeting the daily needs of households and businesses, water is vital for maintaining Greater Sydney's amenity and liveability, and for protecting and enjoying the region's unique natural environment. Water supports and sustains Greater Sydney as a highly successful global city, the nation's largest economic centre and the powerhouse of the Australian economy.

The NSW Government is committed to ensuring that the Greater Sydney region—including the Illawarra, Blue Mountains and Sydney—has the resilient and sustainable water supply it needs to thrive, now and for future generations.

The drought experienced from 2017 to February 2020 brought water security in Greater Sydney into sharp focus. Storage levels dropped by 50% of full dam capacity in two and a half years, which was a much faster rate of depletion than in previous droughts. We need to learn from this experience and apply the knowledge we have gained to how we plan for future drought.

We know that, while there are uncertainties, the variability in our climate, and climate change will affect the amount of water we can expect to have stored in our dams. We also know that our water system is reaching its limits as demand grows and we need more water supply for the long term. We know that to stay resilient to future droughts, we need to get much better at conserving, recycling and reusing water, harvesting more of our stormwater and creating cooler and greener places across the city. Given the needs of our growing city, we will also need to invest in more water supply capacity. The NSW Government is also improving water management outcomes for Aboriginal people across NSW, including in our metropolitan areas, and ensuring that Aboriginal people and their wisdom and knowledge have a greater influence in water planning and management.

The challenges we face are not unique to Greater Sydney. Around the world, other cities and regions are grappling with how to maintain a secure supply of water for growing populations as the climate changes and the demand for limited water resources increases. The Australian Government's Productivity Commission has recently highlighted the urgency of using water more productively and efficiently across the nation, while also building our capacity to adapt to a changing climate.

The Commission also stressed the importance of integrating land use planning with managing water supply, wastewater and stormwater services in Australia's major cities and highlighted the need to promote cost-effective water reuse, encourage more efficient water use and adopt water-sensitive urban design. The NSW Productivity Commission has made similar findings.

For Greater Sydney, accommodating over 1 million extra people by 2036 while also contending with climate variability and climate change will require new approaches to securing the region's water supply. In addition, the Greater Sydney Region Plan—A Metropolis of Three Cities outlines a vision for how Sydney could develop as it grows from around 5 million people now to 8 million over the next 40 years. Addressing these challenges and managing a growing population mean that we need to plan now to ensure reliable and affordable water for households, businesses and industry, and to support a healthy environment and quality of life for the people of Greater Sydney.

Key challenges

The Greater Sydney Water Strategy (the strategy) charts the direction for government, utilities, industry and the community to work together to ensure the resilience and sustainability of the region's water and wastewater systems. Sustainable water supply services are essential to support growth, jobs and a strong economy, to deliver the NSW Government's vision for Sydney as outlined in the Greater Sydney Region Plan—A Metropolis of Three Cities, and to realise the Premier's priority for cooling and greening Greater Sydney with increased tree canopy and green spaces.

The strategy seeks to address five significant and inter-related issues:

1. Service a growing population

Our water and wastewater systems are operating at their sustainable limits and our current demand for water exceeds our forecast sustainable supply

While we have a very substantial network of dams that supply water to Greater Sydney, meeting the demand for water from a growing population means that we can't rely solely on these dams and the Sydney Desalination Plant to meet all our future water needs. We face a supply gap that we will need to address by making more efficient use of our existing water resources and investing in additional rainfall-independent supply sources. We also need to upgrade or renew ageing wastewater assets and to recycle more wastewater and harvest more stormwater.

2. Build resilience to drought and a changing climate

Future climate risks and extreme events mean we cannot meet our water needs by only using traditional water supply approaches

We need to plan and build a water supply system that is resilient to extreme events—including droughts and floods—that may be more extreme than we have experienced in

recent history. This was highlighted in the 2017-2020 drought where water storage levels depleted at a much faster rate than in previous droughts. Our preliminary analysis shows that over the past 30 years, average inflows to Sydney's dams have been half the long-term average since records began in 1910, while significant flooding events have also occurred.

Compared to other Australian cities, Sydney has a low level of rainfall-independent water supply, making our city vulnerable to rapid onset and prolonged drought. Increasing our rainfall-independent supply means we can enter periods of drought with higher storage levels in our dams, slow down storage depletion rates in times of drought and improve our response to shocks in the system, such as when bushfires or floods pose water treatment challenges.

3. Support the economy and jobs

We have to use water more productively and efficiently and meet our water needs at a reasonable cost

Water is a critical input to all parts of the NSW economy. Reliable and affordable water services play a vital role in almost all production processes and contribute to jobs, exports, international and domestic competitiveness, and vital sectors such as agriculture, manufacturing and tourism. The *NSW 2040 Economic Blueprint—Investing in the state's future* (prepared by NSW Treasury) recognises that effective water management and secure water supplies are critical to underpin the state's future prosperity, jobs and economic growth. The health benefits of safe and secure water supplies—such as disease prevention, recreation and wellbeing—also underpin a strong and productive economy. We need to make decisions now about how best to invest in our water and wastewater systems to maintain and enhance service levels at a reasonable cost into the future.

4. Put water at the heart of our city and communities

We need to make our city cooler and greener, and maintain healthy waterways and ecosystems

Water needs to be at the heart of planning for Greater Sydney's future. We need to get better at integrating land use and development planning with how we manage water in the landscape to improve liveability and amenity. This includes having water available to create green open space and increase tree canopy across the city, and to help keep places cool as the urban heat effect intensifies. We need to support future growth while maintaining and improving the water quality of the harbour, beaches, lagoons, rivers and creeks that characterise the region—and protecting the wildlife and plants that depend on healthy water-based ecosystems.

5. Improve water management outcomes for Aboriginal people

We need to plan for and manage water to support Aboriginal rights, interests and access

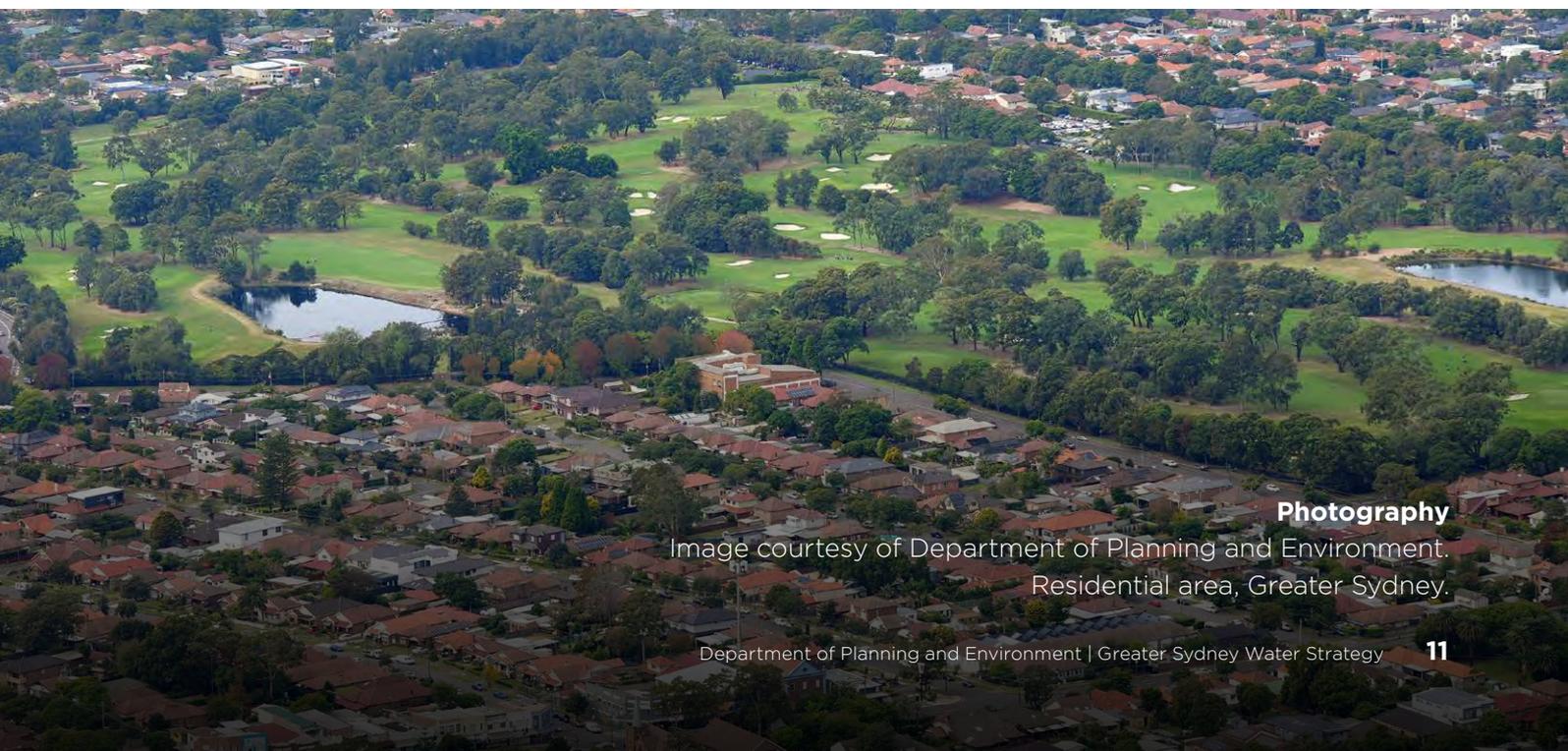
Water is deeply entwined with Aboriginal culture, health and wellbeing. While engagement with Aboriginal people around water management is improving, communities

still lack access to water for cultural, social and economic purposes, and the complex water management framework in NSW can be difficult to understand and engage with. We need to work with Aboriginal people in Greater Sydney to improve their access to water and learn from their knowledge and experience in water management.

The strategy also considers the potential impact of Government decisions about reducing flood risk in Western Sydney.

The Hawkesbury–Nepean Valley has one of the nation's highest flood risk exposures and is home to a large and growing population. It is also one of Australia's most significant and diverse economies. Decisions about reducing flood risk could have an impact on the broader water supply system, and the strategy has considered those potential impacts and can be amended to respond as required.

These issues cannot be addressed in isolation—they require an integrated and coordinated approach that encompasses not only how we plan and manage our water resources, but also how we plan for land use, urban development and infrastructure. Successfully managing these issues over the coming decades will require major additional investment in our water network as our population, jobs and housing development continue to grow.



Photography

Image courtesy of Department of Planning and Environment.
Residential area, Greater Sydney.

Responding to these challenges

To chart a way forward in responding to these challenges, the Department of Planning and Environment, Sydney Water and WaterNSW have worked together to:

- apply systems thinking and integrated water cycle management principles to examine options that consider a range of plausible future scenarios
- undertake risk assessments, engineering feasibility and economic analysis to determine the likely effectiveness, costs and benefits of different portfolios of options
- identify decision pathways that will enable appropriate decisions to be taken at the right time
- consider the need for policy and regulatory changes.

We need to develop strategies to ensure that our water systems can respond to growth, while also being resilient to drought conditions that could be more frequent and severe in the future than we have seen in recent history. This means that we need to continue to investigate and talk to the community about a range of options including:

- **Increasing our focus on water conservation and efficiency** as an immediate and cost-effective response
- **Planning for new rainfall-independent supply sources** to support growth and amenity and to slow storage depletion rates and reduce the risk of reaching extremely low dam levels during drought
- **Investing in transfers, connections and upgrades** to address the risks posed by a lack of system connectivity and ageing assets.

Surface water options such as new dams and dam augmentations. We considered a number of surface water options, however, these potential options depend on rainfall so their contribution to the system may not be reliable depending on changes that may occur in our climate. While our existing dam network serves us very well and provides over 80% of our water supply, the risk of climate change means that, building new surface water storages is not the best option to meet Greater Sydney's future needs. Instead, we need to increase our rainfall-independent supply to provide greater security for our system, particularly in times of drought.

The strategy also outlines pathways towards meeting the NSW Government's **priorities for greening and cooling our city** by prioritising use of recycled water and stormwater to meet these objectives, **integrating water more effectively in our urban environment**, and improving our policies and programs for **protecting waterways and the natural environment**.

All of this will be underpinned by understanding and responding to community preferences. As we move along these pathways, we will continue to engage and consult with the community on options for future water management approaches and services. This includes increasing our focus on water efficiency and working together to understand attitudes towards different supply augmentation options, such as desalination and purified recycled water. We will engage with Aboriginal people across the Greater Sydney region to understand how the strategy can support Aboriginal water rights and values.

Importantly, this strategy provides the basis for effective forward-planning now while dam levels are high, so that we have a range of fit-for-purpose options available to choose from when they are needed, staged over time so the impacts for customers and for the NSW Government are reasonable.

The objectives that the strategy supports all point to the importance of making the most of our existing water supplies and adding to these as we need to. Population growth in Greater Sydney means that the city's water supply system is now at its sustainable limit. Without the actions proposed in this strategy, our supply will be insufficient to meet demand over the long term.

Our forecast sustainable supply level is between 515 and 540 gigalitres per year (GL/year—for reference Sydney Harbour holds about 500 GL of water) and modelling suggests this may be about 40 to 70 GL/year less than we need under a mid-case demand forecast in the short-term. This is equivalent to a half to three-quarters of the capacity of the Sydney Desalination Plan. While this does not create an immediate risk for Greater Sydney because dams are currently full and we have time to plan and act, we need to progress a range of responses in the short term to support growth and enhance resilience. These include:

- conserving more water and using it more efficiently, **so we can save up to 49 GL/year by 2040 at a relatively low cost**

- changing the approach to operation of the Sydney Desalination Plant to enable flexible and continuous operation. This would enable us to operate at full capacity before the onset of drought conditions, **which would result in higher storage levels at the start of a drought and slow the rate of dam depletion during a drought.** It would increase water supply by approximately 20 GL/year under average conditions, although more water supply would be available if needed due to a change in circumstances, such as an increase in demand or a return to drought conditions.
- planning for a range of rainfall-independent supply options such as desalination and purified recycled water so we can deliver the additional water supplies we need, when we need them and in the locations we need them across Greater Sydney. Our analysis shows that we will need to invest in additional water supply in the next 5-10 years, then again by 2040 and once more by 2060.

Figure 1 summarises the objectives, principles and key priorities underpinning the Greater Sydney Water Strategy.

Figure 1. Greater Sydney Water Strategy: Objectives, principles and priorities

<p>Objectives</p>	<p>Support economic growth and community wellbeing by providing confidence in the sustainability of Greater Sydney’s water supply to meet growth and adapt to a changing climate to 2040 and beyond</p>	<p>Support delivery of the Greater Sydney Region Plan—A Metropolis of Three Cities and the Premier’s Priorities for greening the city</p>	<p>Identify the strategic pathways to ensure the right investment decisions are made at the right time in consultation with customers and the community</p>	<p>Set the pathways to identify highest economic value and most affordable investment portfolios for water infrastructure</p>	
<p>Resilience principles</p>	 <p>Use what we have better</p>	 <p>Increase integration and interconnection</p>	 <p>Diversify supply sources</p>	 <p>Plan ahead</p>	 <p>Review and adapt</p>
<p>Priorities and actions</p>	<p>Priority 1 We understand how much water we need and when</p>	<p>1.1 Change the way we think about future water needs (enduring supply) 1.2 Consider future drought and climate risks</p>			
<p>Priority 2 Our water systems are sustainable for the long term and resilient to extreme events</p>	<p>2.1 A concentrated focus on water conservation and efficiency 2.2 Make best use of the assets we have by optimising use of the Sydney Desalination Plant 2.3 Plan for new infrastructure with a focus on rainfall-independent supply 2.4 Managing drought 2.5 Manage location-specific or asset-specific risks 2.6 Respond to the impacts of flood mitigation decisions on the system</p>				
<p>Priority 3 Our city is green and liveable</p>	<p>3.1 Integrate water cycle and land use planning 3.2 Support the design principles for Greater Sydney 3.3 Prioritise alternative water sources for greening and cooling 3.4 Progress a circular economy approach for water services</p>				
<p>Priority 4 Our waterways and landscapes are healthy</p>	<p>4.1 Maintain and improve ecosystem health 4.2 Invest in wastewater management 4.3 Improve stormwater management 4.4 Protect water for recreation</p>				
<p>Priority 5 Water management and services meet community needs</p>	<p>5.1 Recognise and protect Aboriginal rights, interests and access to water 5.2 Enhance community confidence through engagement and transparency 5.3 Manage price impacts for customers</p>				

What we heard

The Draft Greater Sydney Water Strategy was on public exhibition in September 2021 and was accompanied by a comprehensive consultation program. This is a summary of the *What we heard* report that outlines feedback from community and stakeholders and explains how this feedback will inform the next steps for the strategy.

Engagement outcomes at a glance:



700+ direct interactions with community members across six weeks

We received a range of feedback on the draft strategy and the proposed options for water supply and security. The following themes emerged from the feedback.

Water conservation



Water conservation and water efficiency are overwhelmingly supported in the feedback received. We heard a wide range of views on how best to conserve water and those views are strongly held and supported by stakeholders particularly around saving drinking water and using water more efficiently.

Recycled water uses



Recycled water uses including stormwater reuse and purified recycled water for drinking are overwhelmingly supported in the feedback received.

Feedback emphasised the importance of driving demand management and water efficiency options, as well as enabling training and information sharing to assist communities in responding to climate change.

Water quality and waterway health



Water quality and waterway health are well supported in the feedback received. We heard just how important and valued water quality is to prioritise for the community.

Our focus will be improving water treatment measures, better reuse of stormwater, improving monitoring and reporting and better catchment protection.

Greening and cooling



Measures to promote greening and cooling are overwhelmingly supported in the feedback received. We need to improve how we plan for and manage land use, stormwater and water in the landscape to improve liveability. This includes addressing threats such as intensifying urban heat and urban flood risk and having water available for additional greening, cooling and amenity.

Climate resilience



From the feedback we received, we heard there is an urgency to build in greater resilience measures in Greater Sydney's water supply, including improvements to enable greater water efficiency. After the severe 2017-2020 drought, there is more of an understanding and acceptance in the community of the need for much earlier planning for additional supply options including desalination and recycled water.

Water supply options and willingness to pay



Your feedback told us that rainfall-independent options must be explored to better diversify water supply options in Greater Sydney. We heard that a number of supply options are supported, including desalination and recycled water.

Feedback also supported a willingness to pay extra for the rainfall-independent water supply options.

Water restrictions



Water restrictions are overwhelmingly supported by the community and stakeholders.

We heard a wide range of views on how best to implement water restrictions for households and businesses, including more water saving measures being installed and more longer-term planning.

People understood that we need to make sure we are using the water we have more efficiently.

Managing growth through better approaches



From the feedback we received, we heard we should continue moving to a circular economy approach to encompass reuse and recovery of resources across water, materials, energy, food production, ecological health and jobs. We heard a broad range of views on how best to move into this type of economy including recovering energy from wastewater treatment and water supply options.

Access rights, Aboriginal ownership and management of water across Greater Sydney



We heard Aboriginal stakeholders want to work in partnership with government on water management more broadly in Greater Sydney, and there was strong support for improving the recognition of Aboriginal water rights, interests and access.

We heard a strong need for improving the recognition of Aboriginal water rights, interests and access to water and sites for Aboriginal people to maintain a strong cultural connection to Country.

There is support for the strategy to be built on recognising the Aboriginal community's deep and lasting connection to Country: beginning, ending and being accountable to Country and for the need for robust frameworks for access to water.

Cultural significance around water and protection of cultural sites



Water is deeply entwined with Aboriginal culture. Water provides food, kinship, connection, recreation, stories, songlines and healing. Caring for Country is culturally significant for Aboriginal people in practicing their custodial responsibilities.

There is strong support for protecting cultural sites around water for Aboriginal people and this should be further incorporated into the strategy.

We heard concern that cultural sites have been degraded and more robust measures are needed to protect sites.

There is support for the Greater Sydney Water Strategy to recognise the spiritual significance of water to Aboriginal people.

Snapshot

Greater Sydney's water supply challenge

How much water does Greater Sydney need by when?



Sydney is growing—
we expect over

1 million

extra people by 2036 and a growing economy supporting more jobs and businesses.



Greater Sydney's drinking water system provides a **long-term supply of**

515 to 540 GL/year

(GL/year—one GL equals one billion litres).
To put this in perspective, Sydney Harbour holds about 500 GL.



If population growth is low,
we will need an additional

120 GL/year
by 2060.



If the population growth reflects a 'mid-case' scenario,
the projected **gap between what can be supplied sustainably now and the demand for water increases to about**

250 GL/year by 2060

(equivalent to about half the volume of Sydney Harbour).



Most of **Sydney's water supply comes from dams**
and therefore relies on rainfall.

But between July 2017 and February 2020,
inflows reduced dramatically, and Sydney's
storages declined rapidly by

50% of full dam capacity
in two and a half years.



We need to

look at a range of options

to use our available water resources more wisely,
while also planning for new rainfall-independent water supply options.

What are our options to respond?



New supply options can take at least 4-6 years to plan, build and commission.

We have examined a range of options

that can be staged over time to meet our long-term needs for water to support Sydney's future growth, while improving our resilience to drought.



By conserving more water and using it more efficiently,

we can save up to 49 GL/year by 2040 at a relatively low cost.



By changing the approach to operation of the Sydney Desalination Plant,

we can produce an additional 20 GL/year which would result in higher storage levels at the start of a drought and slow the rate of dam depletion during a drought.



By investing in a Demonstration Plant for purified recycled water

and engaging with customers we can highlight the safety of this proven technology and the range of beneficial uses for purified recycled water, including for supporting greening and cooling across our city. The plant does not form part of Sydney's drinking water supply and any future decision to include purified recycled water would be subject to community consultation and require stringent Government approvals.



By investigating portfolios of options for new sources of rainfall-independent supply, we can explore

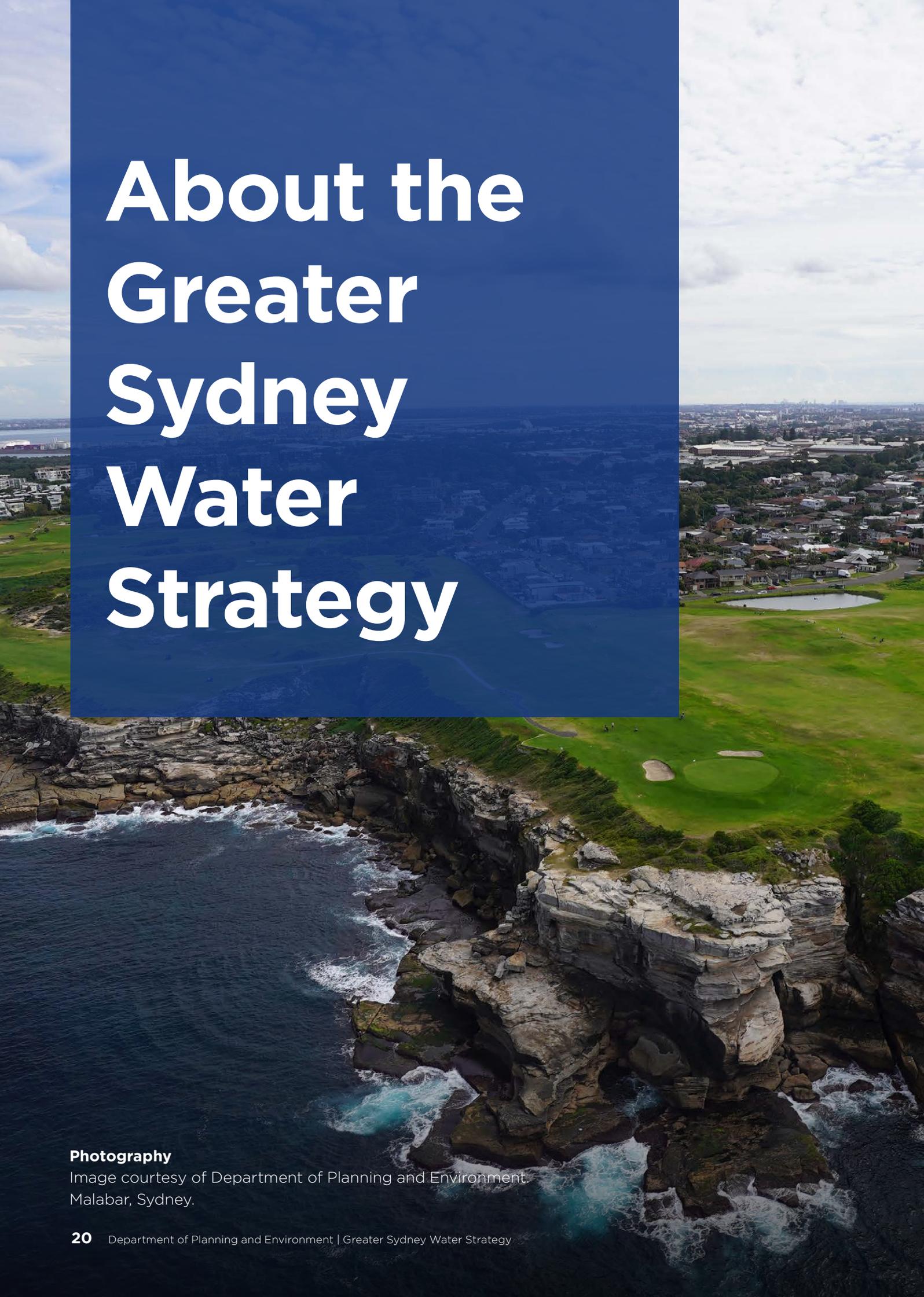
various combinations of desalination and recycling options, including purified recycled water, that can provide up to 140 GL/year over the next twenty years. Any new water supply option, including desalination and purified recycled water, would only be introduced to Sydney's water supply system following community consultation and stringent Government approvals. Investigations into new rainfall-independent sources is targeted at increasing overall supply for potable and non-potable uses.



Building over time a level of enduring supply

capable of meeting the communities' minimum needs during periods of prolonged and extreme drought, irrespective of how long the drought lasts and the impact of climate change.

The options that we plan for and implement must balance the economic, social and economic impacts of drought with what we can afford and what the community expects and wants from us.

An aerial photograph of a coastal cliffside. The foreground shows dark, layered rock formations meeting the ocean, with white waves crashing against the base. A vibrant green golf course is situated on the cliffside, featuring a prominent green and sand trap. In the background, a residential neighborhood with houses and a small pond is visible, followed by a city skyline under a cloudy sky. A large blue semi-transparent rectangle is overlaid on the left side of the image, containing the title text.

About the Greater Sydney Water Strategy

Photography

Image courtesy of Department of Planning and Environment.
Malabar, Sydney.

Setting the direction for water management in Greater Sydney to meet our needs now and for the future

The Greater Sydney Water Strategy charts a direction for delivering sustainable and integrated water services to Greater Sydney for the next 20 to 40 years, servicing a growing Greater Sydney even through periods of severe and prolonged drought and other extreme events, including floods. This includes the delivery of drinking water, wastewater, recycled water and stormwater services in a way that is integrated with land use planning. A core focus of the strategy is better integration of water planning with how we plan for development so that Greater Sydney's waterways, natural environment and biodiversity are protected and our use of water supports recreation activities, cooling and greening initiatives, and urban places with high levels of amenity and liveability.

While we have a very substantial network of dams that supply water to Sydney, our current and future demand for water means that we can't solely rely on the existing dams and the existing desalination plant to meet all our future water needs. Our climate is changing and we need to be prepared for more extremes in weather than we have experienced up until now. Our water system needs to be more resilient to droughts and floods, as well as to bushfires, which can affect water quality in Sydney's catchment areas.

These challenges were highlighted in the 2017–2020 drought where water storage levels depleted at a much faster rate than in previous droughts. In the summer of 2019/20, bushfires devastated drinking water catchment areas, posing water treatment challenges, while the early 2021 floods in the Hawkesbury–Nepean refocused attention on the flood risk from Greater Sydney's major water sources, including the Warragamba and Upper Nepean catchments.

As well as meeting our basic needs and building resilience to future challenges, this strategy considers the role that water plays in enabling a productive, sustainable and liveable Sydney.

The strategy looks at how water can contribute to making Sydney more liveable as the city continues to grow, and to supporting the region's economic recovery following the COVID-19 pandemic. The strategy puts in place the policy settings and directions identified in the NSW 2040 Economic Blueprint to take a longer-term approach to addressing drought by enhancing water resilience and security and providing clarity on investment in water recycling and desalination.

The strategy reflects the vision of the Greater Sydney Region Plan—A Metropolis of Three Cities by recognising that we need to adopt more sustainable approaches in how we use water to have a cooler, greener city and to ensure we can all enjoy the benefits of healthier waterways. This will require more water conservation, water supply options that include more water recycling, and a commitment to reducing the impacts of land use and pollution on our waterways and catchments.

The strategy also reflects feedback from Aboriginal people and communities that they require better access to water for cultural purposes and economic opportunities, and wish to have a greater role in environmental stewardship and decisions about water planning and management. The NSW Government is working closely with Aboriginal communities to develop a state-wide Aboriginal Water Strategy. Relevant outcomes and actions from that strategy will be incorporated into the implementation plan for the Greater Sydney Water Strategy.

This strategy cannot provide all the answers because we can't be sure of what the future holds. We can't predict all the changes, problems and opportunities that may emerge over time. But we can improve our capacity to adapt and respond effectively to a range of different futures and take steps to improve our understanding of likely futures and uncertainties.

Objectives of the Greater Sydney Water Strategy

The strategy will:



Support economic growth and community wellbeing by providing confidence in the security and sustainability of Greater Sydney's water supply to meet growth and adapt to a changing climate by 2040 and beyond



Support delivery of the **Greater Sydney Region Plan—A Metropolis of Three Cities** and the Premier's Priorities for greening the city



Identify the **strategic pathways to ensure the right investment decisions are made at the right time** in consultation with customers and the community



Set the pathways to **identify highest economic value and most affordable** investment portfolios for water infrastructure.

Photography

Image courtesy of Department of Planning and Environment.
IronBark Ridge Rouse Hill Regional Park.



Photography

Image courtesy of Department of Planning and Environment.
Point Piper, Sydney.

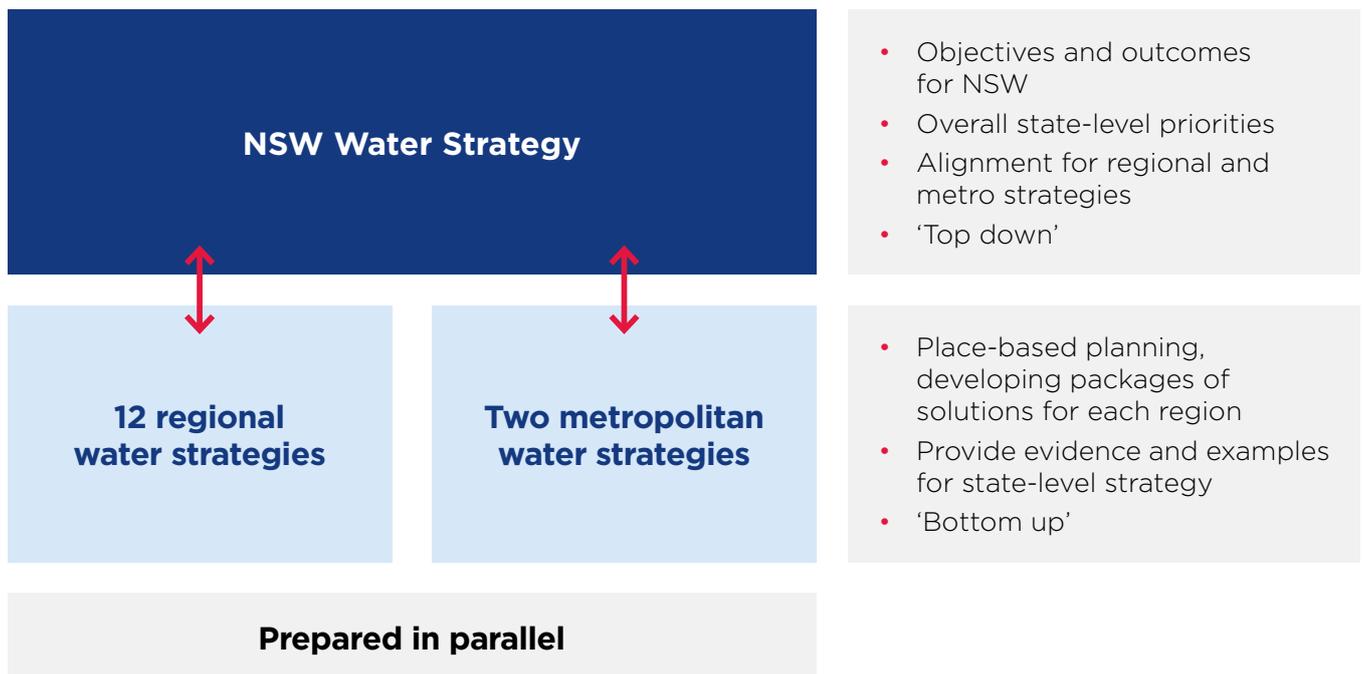
A comprehensive set of integrated water strategies for NSW

The Greater Sydney Water Strategy is part of a suite of long-term strategies being developed by the NSW Government to address the resilience of the state’s water security, services and resources over the coming decades. The Greater Sydney Water Strategy has been developed alongside a state-wide, high-level NSW Water Strategy and Implementation Plan, 12 regional water strategies and the Lower Hunter Water Security Plan (see Figure 2).

These strategies will set the direction for and inform the best mix of water-related policy,

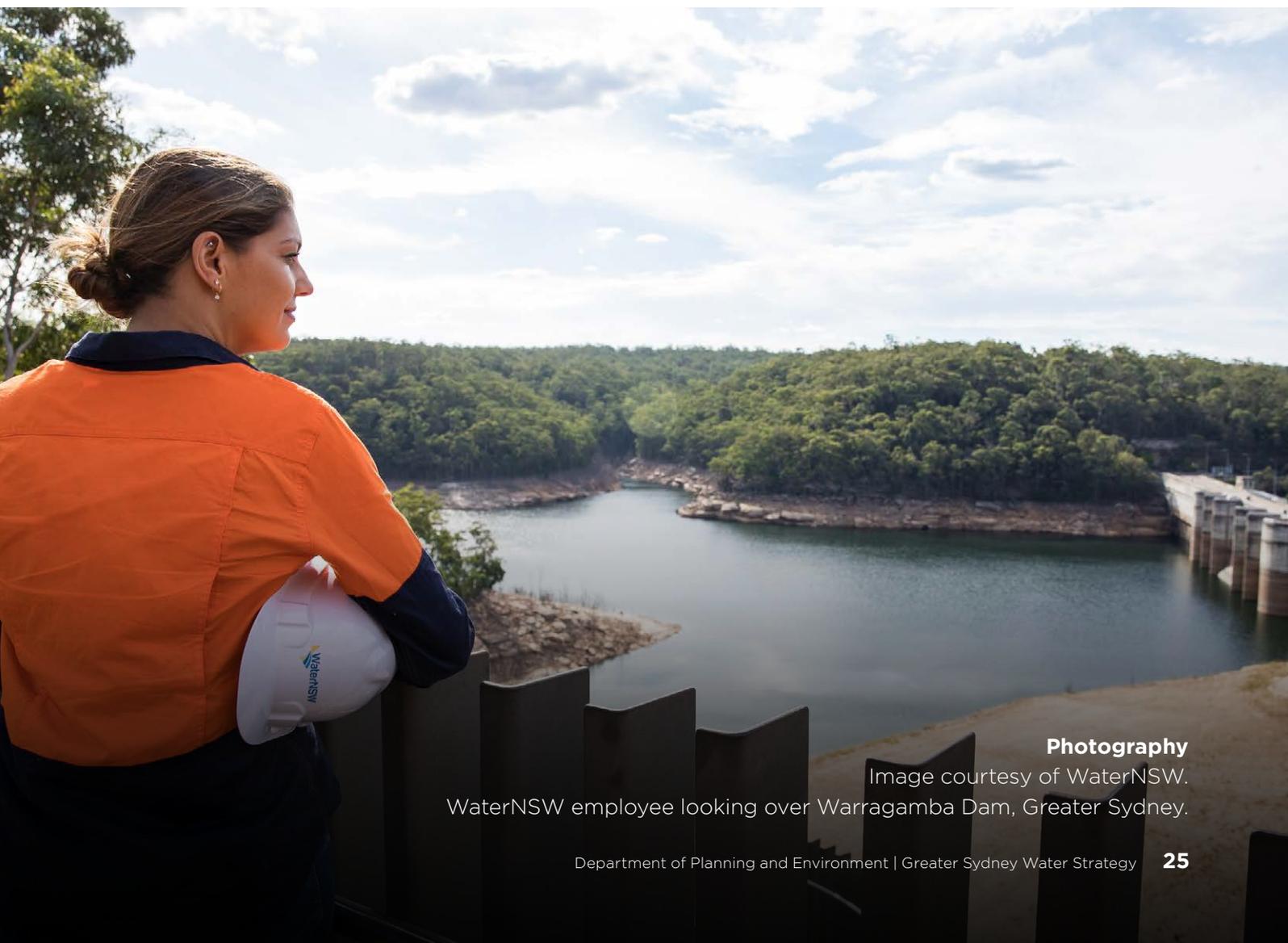
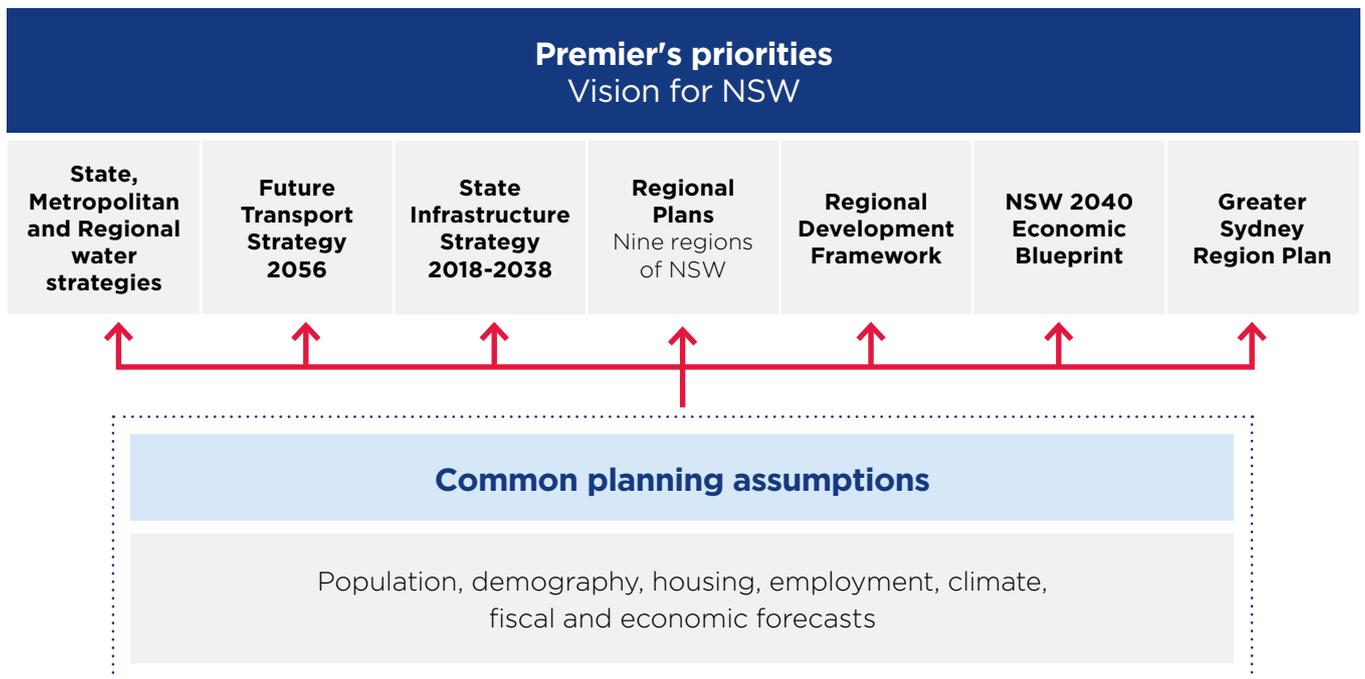
planning and infrastructure investment decisions over the next 20 to 40 years. They aim to balance different and changing water needs and make sure that households, businesses, towns and cities, communities and the environment have access to the right amount of water for the right purpose at the right times. Building on the NSW Government’s record of action and reform in water management, these strategies bring together all the knowledge, tools, experience and solutions we have—and apply the best and latest evidence—to use and share our water wisely, responsibly and sustainably into the future.

Figure 2. An integrated suite of water strategies for NSW



The Greater Sydney Water Strategy also aligns with other plans and strategies and supports delivery of the NSW Government’s vision for Greater Sydney: the Greater Sydney Region Plan—A Metropolis of Three Cities (see Figure 3).

Figure 3. Alignment of the Greater Sydney Water Strategy with other plans and strategies

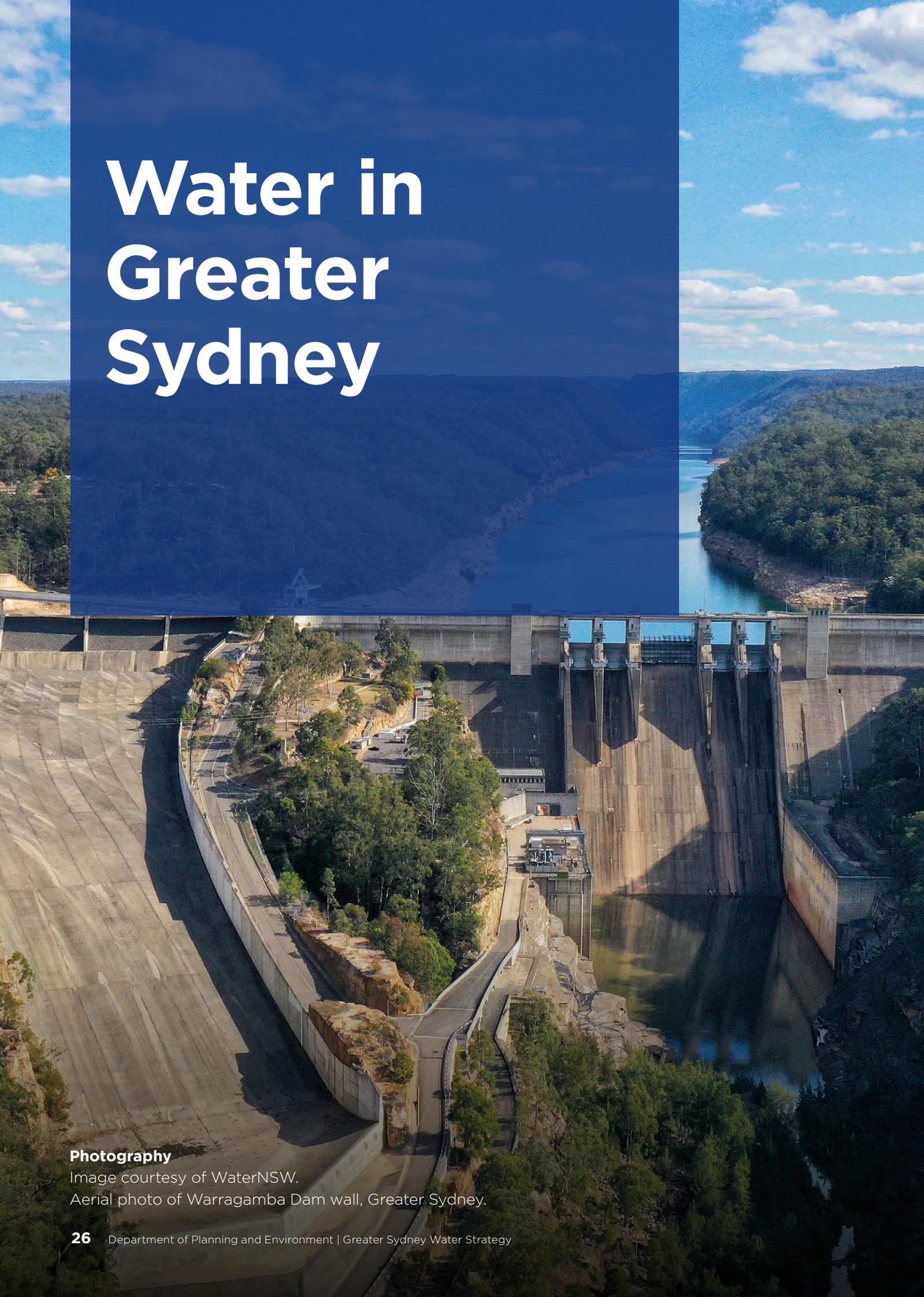


Photography

Image courtesy of WaterNSW.

WaterNSW employee looking over Warragamba Dam, Greater Sydney.

Water in Greater Sydney



Photography

Image courtesy of WaterNSW.
Aerial photo of Warragamba Dam wall, Greater Sydney.

Where does Greater Sydney's water come from?

Most of our water comes from dams

Greater Sydney's water supply catchment area covers 16,000 km² to the west and south of Sydney, extending from Lithgow to Goulburn. It encompasses two major river systems, the Hawkesbury—Nepean and the Shoalhaven, as well as the Woronora River, and incorporates 11 major dams.

- **Warragamba Dam** is by far our largest dam, supplying around 80% of Greater Sydney's water. The dam receives flows from the Coxs and Wollondilly rivers and forms Lake Burrangong.
- **Nepean, Avon, Cordeaux and Cataract dams** capture and store water from the Upper Nepean River catchment. Water from these dams is transferred into the Sydney water supply system at Prospect via the Upper Canal, a 64 km long combination of open canals, tunnels and aqueducts. These dams also provide water to the Macarthur and Wollondilly regions.
- **The Shoalhaven Scheme** is a dual system in that it provides both water transfer to Greater Sydney and for releases to Shoalhaven, Goulburn and Wingecarribee water supplies. It also provides water for the peak generation of hydro-electricity.
- **Tallowa Dam** stores inflows from the Shoalhaven River, which can be transferred to Warragamba Dam or the Upper Nepean dams via pumping from Kangaroo Valley hydroelectric infrastructure to the Wingecarribee River or to Nepean Dam, when needed, to boost supplies to Sydney and the Illawarra. This system has operated since the 1970s and can provide a significant portion of supply when storage levels in the Warragamba and Upper Nepean dams are declining. It has

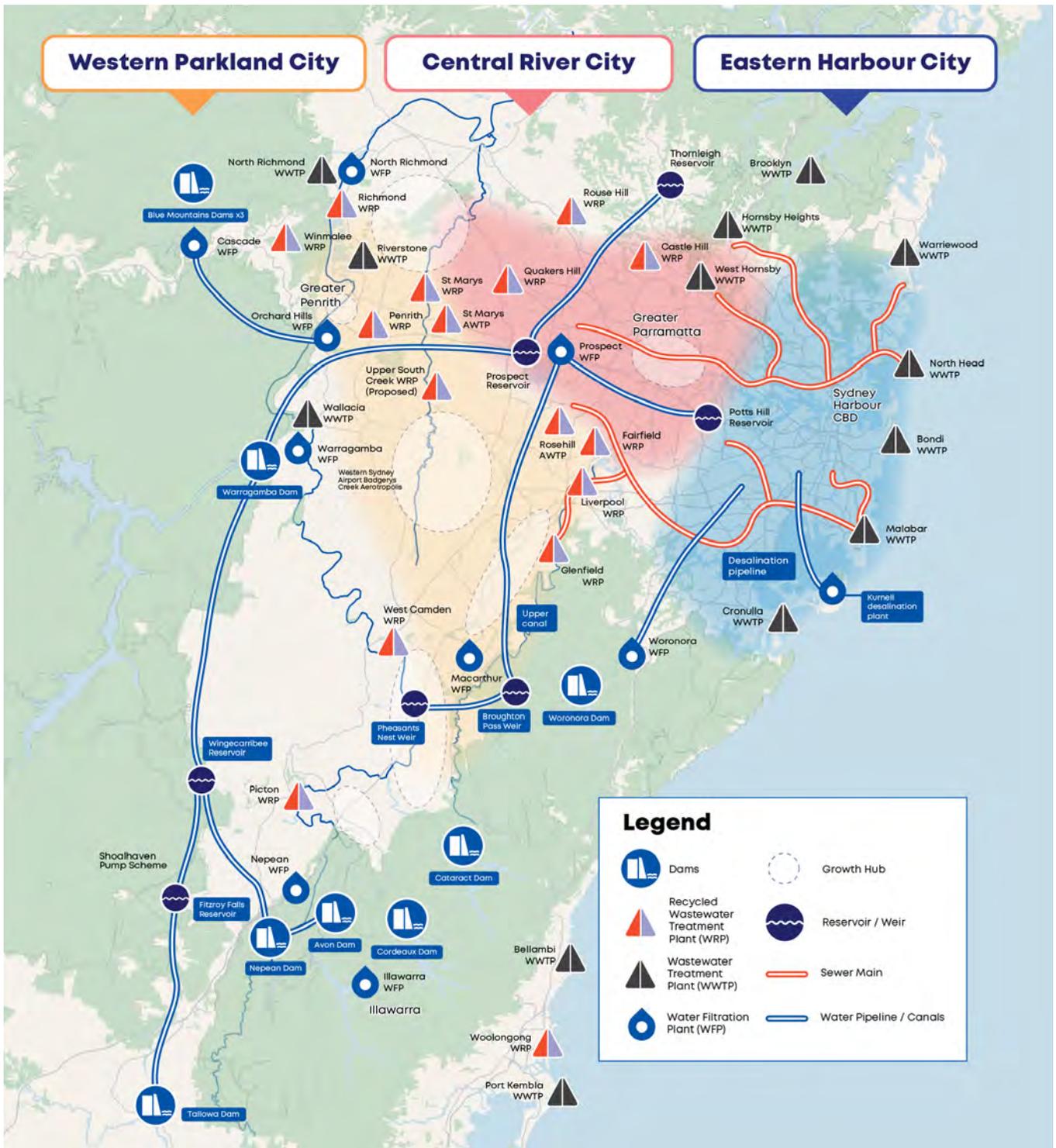
been designed to serve this purpose without posing risks to other water supplies within the Shoalhaven system.

- **Woronora Dam** supplies water to communities in Sutherland Shire and the northern suburbs of Wollongong.
- **The Blue Mountains system** sources water from within and outside the Blue Mountains catchments, a small group of bushland valleys that feed water to Lake Medlow, Greaves Creek and the three Cascade dams. The lower Blue Mountains are typically serviced by pumping Warragamba-sourced water from Orchard Hills filtration plant. When water levels are low, some water can also be transferred from the Fish River water supply scheme to top up supply for the Upper Blue Mountains community.

Water from the dams is treated at nine filtration plants and then supplied to businesses and households across Greater Sydney through a vast network of water pipes, reservoirs and pumping stations. Water is treated to the high standards set by the Australian Drinking Water Guidelines, which means it is safe to drink straight from the tap.

The dams that supply water to the Greater Sydney region also provide water to council areas that include Goulburn and the Shoalhaven. Water supplies for Lithgow also have the potential to supply parts of the Greater Sydney network in the Upper Blue Mountains. Water needs are evolving, including the need for greater water security and the transitioning of power stations over the coming decades. More detailed water strategies will be developed in 2022 and 2023 for these areas and the Macquarie region, through detailed engagement with stakeholders. These strategies will consider the interfaces with supply to the Greater Sydney region.

Figure 4. Greater Sydney's water and wastewater network map



Source: Used with permission of Sydney Water. ©Sydney Water 2021



Photography

Image courtesy of WaterNSW.
Warragamba Dam viewing platform, Greater Sydney.

Sydney Desalination Plant is an important part of our water supply

Sydney Desalination Plant at Kurnell turns seawater into fresh water, which is treated to standards set by the Australian Drinking Water Guidelines, making it safe to drink from the tap. Water is then pumped from Kurnell to Sydney's drinking water network at Erskineville.

The plant can produce up to 250 million litres per day of drinking water—equivalent to about 15% of Sydney's current water demand. The plant was designed with the future in mind, which means its capacity can be doubled more quickly than the time it would take to build a new plant.

Water conservation and recycling are critical to securing our water supply

Water conservation (which includes leakage management, water restrictions in drought and programs to improve water efficiency) makes our drinking water supply go further at relatively low cost and can delay the timing of investment in new large-scale supply infrastructure.

Water recycling involves treating and reusing wastewater, greywater and stormwater for use in and outside the home, in industry and for irrigation and agriculture. Recycled water systems in Greater Sydney are a mix of residential third pipe systems (such as Rouse Hill), industrial schemes (such as BlueScope Steel), agricultural irrigation schemes (such as Picton Farm), golf courses and an environmental flow replacement scheme based at St Marys.

Recycled water is mainly used to water gardens, golf courses and parks, flush toilets, wash cars, fight fires and support industrial processes. It is also used to supplement river flow in the

Hawkesbury-Nepean River. Use of recycled water helps to preserve water stored in dams for drinking, reduces the impact of stormwater run-off on waterways and helps to cool and green urban environments. Water sourced from recycling projects is treated according to the Australian Guidelines for Water Recycling, which means it is safe for its intended use, such as watering gardens or flushing toilets.

Sydney Water is working with the NSW government to engage with the community to gather their input and feedback on a range of water supply augmentation options including purified recycled water and desalination for Greater Sydney to meet future demands.

Stormwater is runoff from rain that falls on hard surfaces such as roofs, roads, footpaths and car parks. This runoff flows from property drains into street drains owned by local councils. It then flows into much larger channels and pipes that run to waterways and the ocean. Stormwater is a highly valuable resource and greater efforts have been made in recent years to collect, clean and re-use urban stormwater. In 2020, there were more than 70 stormwater harvesting projects across Greater Sydney providing water for parks and gardens, irrigating sporting fields and golf courses, and flushing public toilets.

Over 60 GL of recycled water was used by the city in 2019/20, of which approximately 27 GL was used to reduce the demand for drinking water and the rest provided to support irrigation, amenity and environmental flows. Of the 27 GL of reduced drinking water demand, 13 GL came from Sydney Water's recycled water schemes and 14 GL came from localised private residential alternative supplies such as rainwater capture.

Who provides our water?

Storing, treating and distributing water, as well as managing disposal of stormwater and wastewater, requires specialised skills and technical knowledge. In Greater Sydney, these functions are managed and coordinated by NSW Government agencies and public and private water utilities and service providers.

- **The Department of Planning and Environment's Water Group** leads and coordinates metropolitan water strategy for Greater Sydney.
- **WaterNSW** manages and operates the dams that collect rainwater runoff from river catchments to the south and west of Sydney. The water is stored and transported via a network of rivers, pipes and canals to Sydney Water's filtration plants. WaterNSW is also responsible for protecting the health of Greater Sydney's drinking water catchments. Water from these dams also supplies water to the Shoalhaven, Wingecarribee, and Goulburn areas.
- **Sydney Water** operates the nine water filtration plants—directly or by private contract—that treat the raw water provided by WaterNSW. Sydney Water takes the treated drinking water and distributes it to customers. Its area of operation stretches from Palm Beach in the north to Gerringong and Gerroa in the south and to the Blue Mountains in the west. Sydney Water also collects and treats wastewater, provides recycled water services to some areas and manages some major stormwater infrastructure. It is also responsible for planning and incurring the costs of water supply options. Sydney Water recovers its costs through customer charges.
- **Sydney Desalination Plant** is operated by a private consortium under a 50-year lease with the NSW Government. The plant supplements water supplies from the dams when needed and enhances water security for all water customers in Greater Sydney.
- **Local councils** manage most stormwater infrastructure across Greater Sydney. Some councils harvest and treat stormwater for use on their parks and ovals.
- **Private water utilities** licensed under the *Water Industry Competition Act 2006* provide water services to a number of communities in Greater Sydney, often using supply solutions that include recycled water.
- The **NSW Independent Pricing and Regulatory Tribunal (IPART)** reviews and determines the prices that can be charged for bulk and retail water by major water utilities including WaterNSW, Sydney Water and the Sydney Desalination Plant Pty Ltd. IPART administers the licensing of private water utilities in NSW. It also reviews public utilities' operating licences and monitors the utilities' compliance with their licences.
- The **Environment Protection Authority (EPA)** regulates water pollution from major point sources and public authorities and contributes to enhancing the water quality of our waterways and groundwater systems.
- The **Natural Resources Access Regulator (NRAR)** is an independent regulator with responsibility for the compliance and enforcement of water management legislation. It also oversees water access licences and associated approvals for certain organisations, including government agencies and state-owned corporations, licensed operators under the *Water Management Act 2000* and the *Water Industry Competition Act 2006*, public schools and public hospitals, and entities undertaking major developments.
- **NSW Health** regulates drinking and (in some cases) recycled water quality in NSW. Sydney Water's operating licence allows for NSW Health to specify water quality requirements and requires that Sydney Water maintain, implement and operate according to management systems for drinking water and recycled water that are consistent with relevant guidelines and to the satisfaction of NSW Health.

What happens to our water after we use it?

Wastewater is the used water that goes down our drains from baths and showers, sinks, toilets, washing machines and dishwashers. Every day, Sydney Water collects more than 1.3 billion litres of wastewater from homes and businesses across the region.

Sydney's wastewater systems are relatively decentralised by comparison to other large global cities. There are 31 wastewater treatment plants (WWTPs) serving Greater Sydney; 28 are managed by Sydney Water, one is operated under contract to Sydney Water (Gerringong Gerroa) and two are owned and managed by Hawkesbury City Council (McGraths Hill and Windsor).

After it leaves our homes or businesses, wastewater is pumped to a treatment or recycling plant where it is 'cleaned' to remove or break down impurities such as food scraps, coffee grounds, cooking fats and oils, soaps and detergents, excrement, toilet paper and chemicals. Once treated, the wastewater can be safely re-used or discharged to rivers or the ocean depending on the level of treatment applied.

Approximately 80% of Sydney's wastewater is managed by three large coastal sewer systems—Northern Suburbs Ocean Outfall System (NSOOS) to North Head WWTP, Bondi Ocean Outfall System (BOOS) to Bondi WWTP and South Western Suburbs Ocean Outfall System (SWSOOS) to Malabar WWTP. These WWTPs provide partial treatment (sub-primary¹ treatment level) and discharge to the ocean via deep water ocean outfalls that discharge effluent 2 to 3 km offshore through a series of diffusers that achieve very high levels of dilution. The deep-water ocean outfalls have been successful in protecting nearshore water and beach quality. These systems were originally intended to serve inner city areas, but over time have extended 30 km or so, reaching areas as far west as Prospect, as far south west as Glenfield and as far north west as Blacktown.

Most of the inland WWTPs discharge to the Hawkesbury Nepean River catchment under very stringent environment protection licences.

1. 35%-45% total suspended solids removal compared with 60%-80% removal in full primary treatment.



Photography

Image courtesy of Don Fuchs, Department of Planning and Environment.
Prospect Water Treatment Plant, Greater Sydney.

A photograph of a desalination plant, showing various pipes, valves, and machinery. A large blue rectangular overlay is positioned in the center, containing white text. The background image shows a complex network of white and grey pipes, some with circular openings, and a blue metal structure. The lighting is somewhat dim, highlighting the industrial nature of the scene.

We need new approaches to the big water challenges facing Greater Sydney

Photography

Image courtesy of Department of Primary Industries.
Desalination plant equipment.

The 2021 NSW Productivity Commission White Paper—Rebooting the economy—highlights many of the key challenges facing the water sector. It notes the risk that traditional rainfall-dependent water supply will become less reliable as demand pressures grow, and that the combination of population growth, a changing climate and ageing infrastructure will test the water sector’s ability to meet evolving water needs across NSW.

We must respond to these challenges to ensure water services continue to support productivity growth and that NSW and Greater Sydney continue to be attractive places to live and do business.

Greater Sydney’s water challenges

Servicing a growing population

Our water and wastewater systems are operating at their sustainable limits and our current demand for water exceeds our forecast sustainable supply.

- **The system needs to service a growing population**

Greater Sydney’s population will continue to grow. Current (2019) population projections anticipate an average yearly increase of 100,000 people in Greater Sydney, and that Sydney’s population could grow to between 6 and 7 million by 2036. The 2021-22 NSW Intergenerational Report identified that 86 per cent of New South Wales’ population growth over the next 20 years will be in Greater Sydney.

- **Our forecast demand for water exceeds our estimate of current sustainable supply**

Sydney is at a tipping point for its water supply system, with the forecast annual demand exceeding our system’s existing sustainable supply capacity. However, there is time to take action to balance the system as dams are currently full.

- **Our assets are ageing and some need to be renewed and replaced**

Our water supply, wastewater and stormwater systems have served us well over the last 100 or so years, but now these assets are ageing and some need upgrading or replacement to

meet the needs of a modern growing city. We will need to make significant investment in the water system in the short-term and into the future not just to respond to growth, but to make our water system more resilient to climate change and events such as droughts, floods and bushfires.

- **Our wastewater system is nearing capacity**

A growing population in Sydney is placing significant pressure on an ageing wastewater network as it reaches capacity, particularly in the Eastern Harbour and Central River cities. There is a need to invest in new assets and renew old ones, and an opportunity to intercept and recycle more of Sydney’s wastewater. Approximately 90% of Sydney’s wastewater is used once, treated and discharged to the ocean. There are opportunities to use water more than once on a broader scale and continue to protect our precious waterways and beaches for the future.

- **Some areas are at more risk than others and there are high-risk potential points of failure in the system**

Some parts of the system are more vulnerable to drought than others during long and severe drought conditions. This includes the Illawarra region and the fast-growing Macarthur region.

Building resilience to drought and a changing climate

Future climate risks and extreme events mean we cannot meet our water needs by only using traditional water supply approaches.

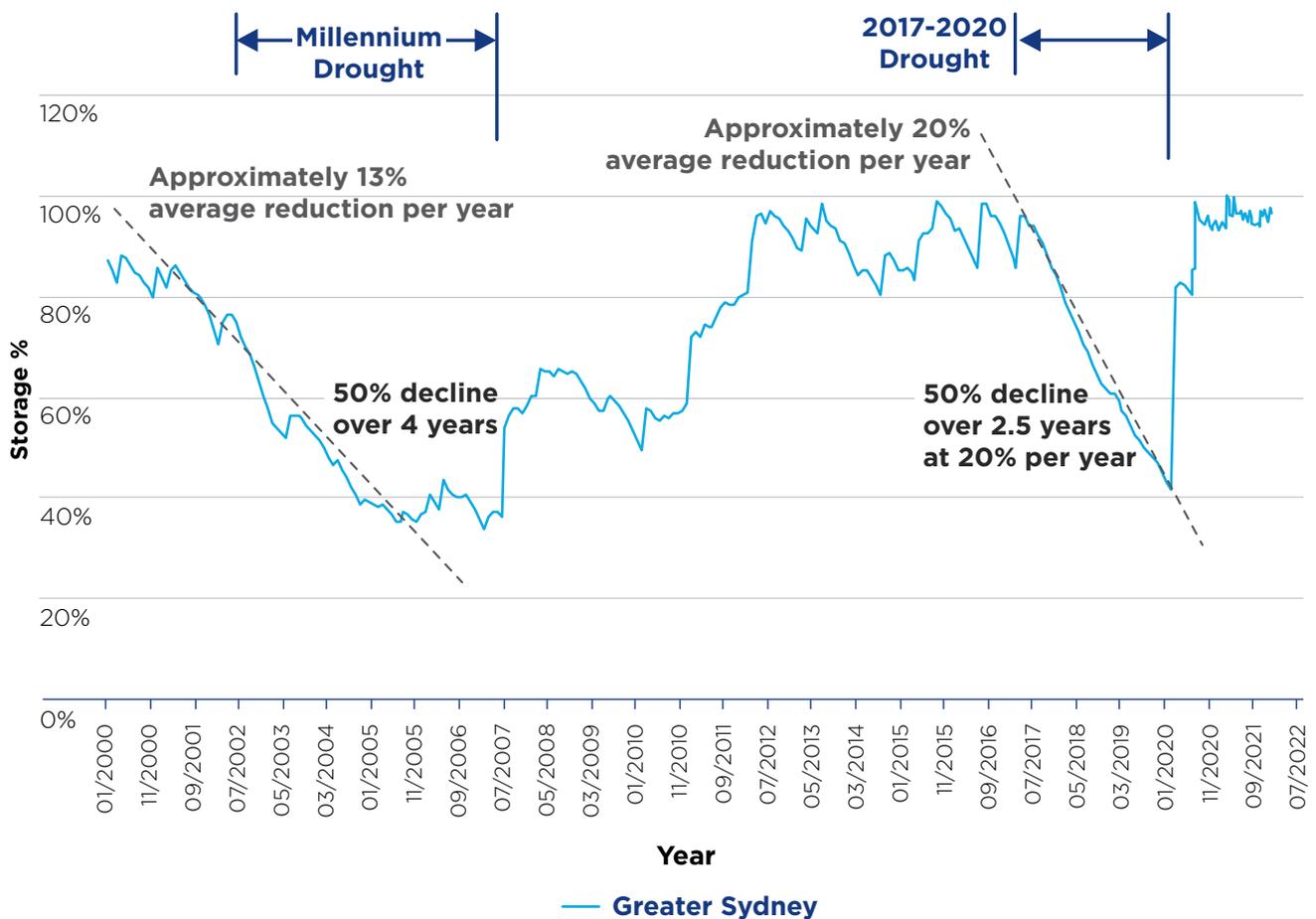
- **Greater Sydney is vulnerable to drought and other extreme events**

When developing this strategy, Sydney had just recovered from one of the most intense droughts on record, with storages declining by 50% of full dam capacity in two and a half years. Inflows were significantly lower than in

the Millennium Drought, which contributed to storages depleting at a much faster rate (see Figure 5). If these conditions had persisted, this rapid rate of depletion would have presented challenges to our ability to respond by delivering additional water supply solutions, as most projects typically require 4-6 years to deliver.

Figure 5 also highlights that each drought can have different characteristics. The Millennium Drought had lower depletion rates and it took longer for storages to rebound, whereas the most recent drought saw steep depletion rates and a very steep rebound of water into our storages.

Figure 5. Greater Sydney storage level profile 2000-2020



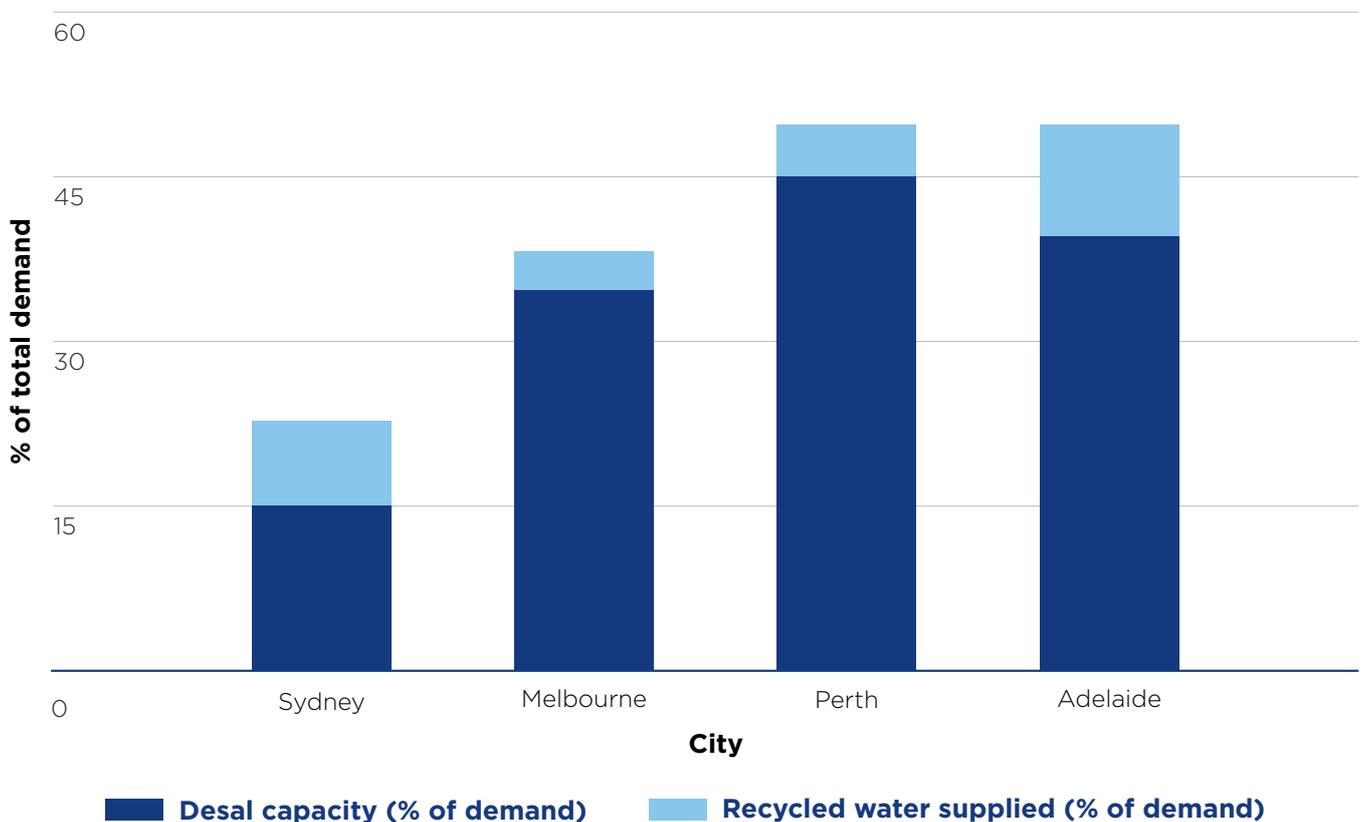
Source: WaterNSW, May 2020

- Greater Sydney has a low proportion of rainfall-independent supply**

Compared to other Australian cities, Sydney has a low level of rainfall-independent water supply (see Figure 6). Only the Sydney Desalination Plant (which provides around 15% of daily demand when operating at full capacity) and water recycling plants (providing up to only 8% of daily demand in Sydney) are rainfall-independent. By comparison, Melbourne (which has the next lowest level of rainfall independence) can meet 34% of

its water supply from rainfall-independent sources. This low level of rainfall-independent supply makes Greater Sydney vulnerable to rapid onset and prolonged drought. Increasing our proportion of rainfall-independent supplies would allow us to enter a future drought with higher water levels in our dams, slow down depletion rates during future droughts and enhance our ability to respond to other shocks in the system such as challenges to water treatment or network outages.

Figure 6. Rainfall-independent water supply: Sydney versus other cities



Sources: Australian Water Association, Desalination Fact Sheet, Bureau of Meteorology 2021, National performance report 2019/20, urban water utilities, part A.

- **Sydney's water systems are vulnerable to flood**

Climate change may not only result in more extreme droughts, there could also be an increase in extreme wet weather events. East coast lows (similar to the one that ended the drought in February 2020) play a key role in maintaining Greater Sydney's water supplies but can also result in hundreds of millimetres of rain falling into the catchment in a period of a few days, creating a significant flooding risk. An increase in the frequency of such events not only increases the risk of flooding, it can also impact on the performance of the water supply and wastewater treatment systems.

The Hawkesbury–Nepean Valley in western Sydney has one of the nation's highest unmitigated flood risk exposures and is home to a large and growing population, and one of Australia's most significant and diverse economies. In addition to the devastation of flooding for households and communities, flooding also creates risks to water supply through poor water quality.

An increase in flooding will also increase the frequency and volume of wet weather overflows from the sewage system, driving further investment to maintain the capacity of the pipe network and to reduce the environmental impacts of sewage overflows.

- **Water quality risks are present within the system**

In addition to the risks imposed by drought, inflows after storms and bushfires escalate water quality risks in dams and create treatment risks, particularly during periods of high demand.

The ability of the system to maintain water quality was tested by the bushfires that ravaged some of Sydney's major water supply catchment areas in 2019/20, and the heavy rainfall that followed. Events such as these pose an additional potential challenge to the capacity of the city's water treatment plants and the quality of drinking water, highlighting the system's vulnerability.



Photography

Image courtesy of John Yurasek, Department of Planning and Environment.
Second Ponds Creek walking track, Rouse Hill Regional Park.

Supporting the economy and jobs

We have to use water more productively and efficiently and meet our water needs at a reasonable cost.

- **Water underpins the economy**

Water is a critical input to all parts of the NSW economy. The NSW Productivity Commission's *Continuing the Productivity Conversation Green Paper* notes that reliable and affordable water services play a vital role in almost all production processes and contribute to jobs, exports, international and domestic competitiveness, and vital sectors such as agriculture and tourism. The health benefits of safe and secure water supplies—such as hygiene, disease prevention, recreation and wellbeing—also underpin a strong and productive economy. This means that the efficient delivery of drinking water and management of wastewater and stormwater have a direct impact on economic activity and productivity growth in NSW. Water services are also key to supporting population growth. The NSW and Australian economies will suffer if the delivery of water and wastewater services to Greater Sydney is not maintained at current service levels, or better.

- **We need to meet our water needs at a reasonable cost and the burden should be shared equitably**

Investments to improve the resilience of our water and wastewater systems will benefit future generations but will result in cost and therefore price increases in the medium and long-term. Today, Sydney benefits from historical investment in dams and, more recently, in the Sydney Desalination Plant. Customers have paid for these investments, which have supported the growth of our city, however, additional future investments will need to be paid for, and we will consult with the community to understand people's preferences and priorities, as well as the level of restriction on water availability during drought that the community is willing to bear.

Putting water at the heart of our city and communities

We need to make our city cooler and greener and maintain healthy waterways and ecosystems.

- **Urbanisation and the new Western Parklands City**

By 2036 Greater Sydney's population is forecast to grow by over 1 million to 6 to 7 million. Much of this growth will be in the Western Parkland City. Centred on Wianamatta South Creek and its tributaries, planning in the Western Parklands City is taking an integrated land use and water cycle management approach to ensure there is enough water to achieve urban cooling, provide open space and sustain about two million trees. Options for recycling and stormwater harvesting to support the amenity provided by the parkland have been identified.

- **We need to make our city green and keep it cool**

We must put water at the heart of planning for Greater Sydney. We need to improve how we plan for and manage land use, stormwater and water in the landscape to improve liveability. This includes addressing threats such as intensifying urban heat and urban flood risk and having water available for additional greening, cooling and amenity.

- **We need to improve waterway health**

Healthy waterways are a priority for the community. Our cities are built around the stunning coastline, harbours, lagoons, rivers, and creeks that characterise the Greater Sydney region. However, urbanisation and development create many challenges for waterway health and biodiversity. We need to support future growth while maintaining and improving the health and value of our waterways, as well as working within existing urban landscapes and communities to better protect our waterways.

Improving water rights, interests and access for Aboriginal people

We need to plan for and manage water to support Aboriginal rights, interests and access.

- **We need to recognise and protect Aboriginal rights, interests and access to water**

Water is deeply entwined with Aboriginal culture, health and wellbeing.

While engagement with Aboriginal people around water management is improving, communities still lack sufficient access to water for cultural, social and economic purposes. We need to work with Aboriginal people in Greater Sydney to improve their access to water and learn from their knowledge and experience.

Greening Greater Sydney—Premier’s priority

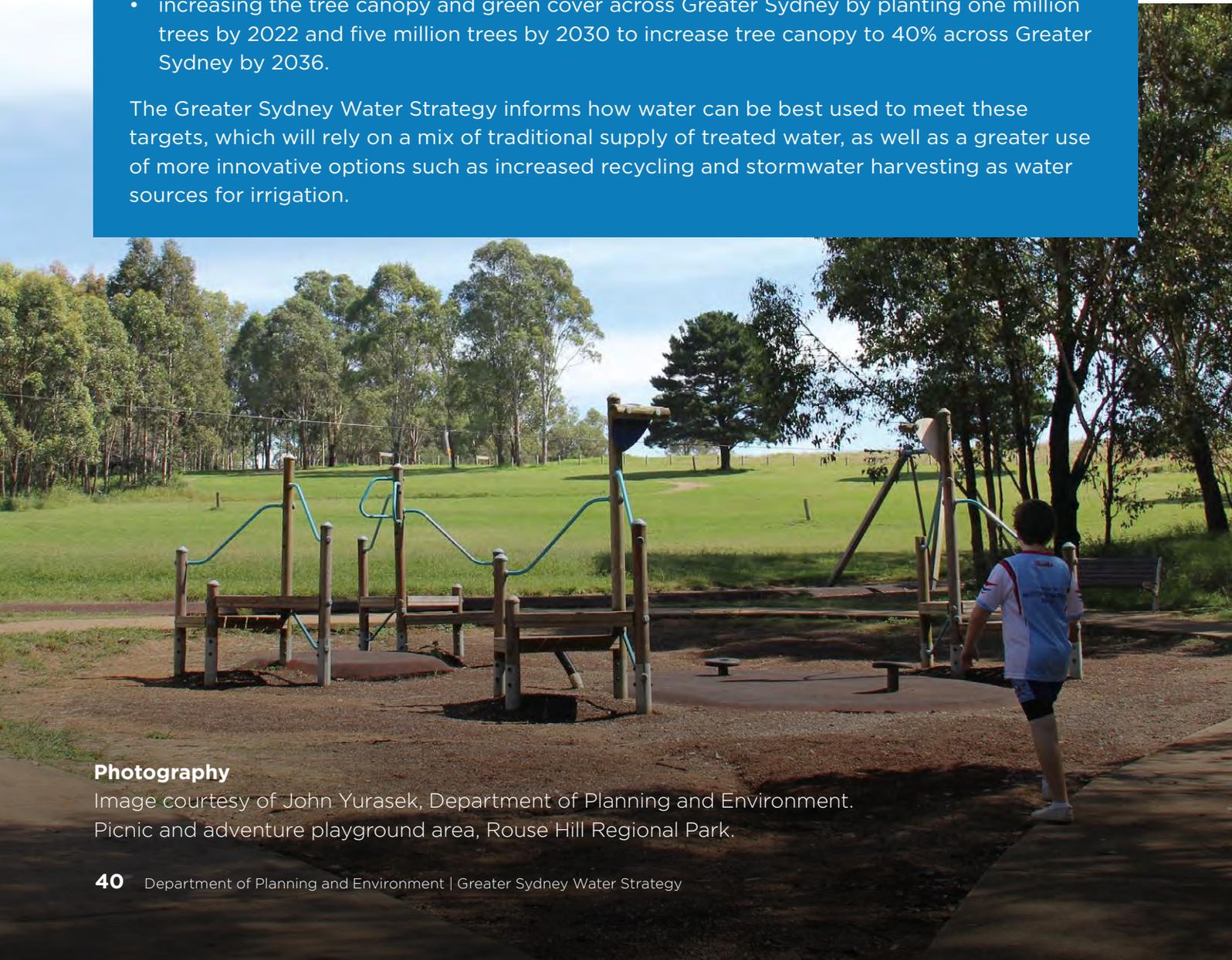
One of the NSW Premier’s central commitments is to create a greener Greater Sydney. Two key priorities will increase demand for water:

- increasing the proportion of homes in urban areas within a 10-minute walk of quality green, open and public space by 10% by 2023
- increasing the tree canopy and green cover across Greater Sydney by planting one million trees by 2022 and five million trees by 2030 to increase tree canopy to 40% across Greater Sydney by 2036.

The Greater Sydney Water Strategy informs how water can be best used to meet these targets, which will rely on a mix of traditional supply of treated water, as well as a greater use of more innovative options such as increased recycling and stormwater harvesting as water sources for irrigation.

Photography

Image courtesy of John Yurasek, Department of Planning and Environment.
Picnic and adventure playground area, Rouse Hill Regional Park.



We need to invest in our water system and services

Meeting the big water challenges facing Greater Sydney will require major additional investments.

- **Improved efficiency and investment in rainfall-independent water supply will be critical**

As Greater Sydney's population grows, tackling the increasing supply/demand gap will require making the best use of all our water sources, including desalination, recycling and stormwater. In addition to becoming more efficient in how we use water, new investment to increase the city's proportion of rainfall-independent water supply will be critical to address the supply/demand gap while also improving the liveability of our city, meeting greening objectives, and building the water system's resilience to drought and other extreme events.

- **Significant investment is needed to improve Sydney's resilience to drought**

Meeting current and future water service challenges—while also strengthening our capacity to adapt to a changing climate—will require significant investment in Greater Sydney's water network. Investment will need to be directed towards improving Sydney's

resilience to drought and to shocks and stresses such as storms, heatwaves and floods. The capacity, condition and performance of some key water assets will need to be improved. New investment will also be required to meet community expectations about water for cooling and greening, and for healthier waterways and landscapes that are more resilient to increased storm severity, erosion and waterway damage.

- **We need to understand what customers and communities want**

These necessary investments will result in Sydney Water and WaterNSW incurring more costs to provide a secure and resilient water system. The Independent Pricing and Regulatory Tribunal then determines how these costs are passed on to Sydney Water customers. However, if we plan well over time (and integrate water planning with land use planning), we can reduce or minimise the cost impacts for customers and government. Building a better understanding of the water priorities of customers and communities across Greater Sydney will help us to make the right investments in the right places at the right time.

An aerial photograph of a residential development in Western Sydney, Australia. The image shows a dense cluster of new residential lots, many with solar panels on their roofs. The development is situated next to a large industrial area with several large white warehouse-like buildings. In the background, a city skyline is visible under a cloudy sky. A dark blue semi-transparent box is overlaid on the top left portion of the image, containing the title text in white.

What we've learned from recent droughts

Photography

Image courtesy of Department of Planning and Environment.
New residential lots, Western Sydney.

Recent droughts have taught us that our water strategy and drought planning for the future needs to be much more adaptive. Our approach needs to consider a range of factors including how fast the dams are depleting, existing levels of water demand, the likely effectiveness of water restrictions and how long it will take to plan and deliver our various drought responses.

The drought from 2017 to early 2020 and the previous Millennium Drought from 2003 to 2009 highlighted that Sydney's existing water supply system is vulnerable to prolonged and severe drought and there is a risk, albeit low, of severe restrictions and even the possibility of supply failure unless we act to improve our preparedness for future droughts.

Some areas of the Greater Sydney region, such as Macarthur, Illawarra, Nepean and the Blue Mountains, can be more vulnerable to supply failure during drought than the rest of Sydney—largely because they have limited interconnections to Sydney's largest water storage (Warragamba Dam) and rainfall-independent supply sources.

The *2017 Metropolitan Water Plan* proposed a set of drought measures based on planning or providing infrastructure that would be triggered at specific dam levels. However, the 2017-2020 drought was more intense than anticipated in the plan. We now know that had the drought conditions persisted for another two years, it is unlikely we could have built the required infrastructure in time to avoid severe restrictions or even running out of water.

If we return to the same drought conditions that we experienced in 2017-2020, we know that Sydney can go from full dams to 15% dam levels in around four to five years. The rate of dam depletion experienced during the most recent drought and the time required to augment supplies (which could be up to six years depending on the option) means that if we wait until drought conditions return before we augment supply, there may not be sufficient time to respond.

We also learned that water conservation efforts are important before a drought starts. This is because it puts us in a better position at the start of a drought with higher dam levels, and helps make sure we can achieve the maximum benefit during droughts by scaling up existing programs and initiatives and maintaining our efficient water use behaviours.

Water quality is also an important consideration in drought planning. Poor raw water quality can reduce the amount of water that can be treated to required health standards for distribution to customers. When the drought broke in February 2020, high levels of inflow to the dams and runoff from bushfire-affected catchments had adverse impacts on water quality in the dams. Despite these water quality challenges, our treatment plants performed well.

Even though dam levels have not fallen below 30% historically, expert analysis indicates that water quality is likely to deteriorate as dams approach very low levels. Therefore, our drought response planning needs to reduce the risks of reaching and operating at very low dam levels.

Key lessons from the 2017-20 drought have informed this strategy

The Greater Sydney Water Strategy ensures that we:

- Plan for drought before the next drought starts
- Maintain water conservation efforts at all times to help us when droughts occur
- Recognise uncertainty about whether dams can be operated at very low levels due to potential water quality and hydraulic risks, and that we have no historical experience of operating Sydney dams below 30%
- Recognise that some parts of the system may deplete faster than others
- Increase the diversity of water supply sources, including more rainfall-independent supply
- Have options at-the-ready to respond quickly when drought conditions return
- Have an adaptive approach that gives us the flexibility to adjust our policies, plans and investment decisions as circumstances change—including changes to the climate, rates of population growth and where and how people choose to live and work.

Photography

Image courtesy of Department of Planning and Environment.
Bardwell Park, Southern Sydney.



Photography

Image courtesy of Department of Primary Industries.
Residential use of rainwater tank.

A scenic view of a river shoreline with a blue overlay containing text. The background shows a calm river reflecting the surrounding greenery and trees. The foreground features a sandy and rocky bank. The blue overlay is a semi-transparent rectangle that covers the upper portion of the image, providing a clear background for the white text.

Water for a thriving, sustainable and resilient Greater Sydney

Photography

Image courtesy of Salty Dingo, Department of Planning and Environment.
Georges River shoreline, Georges River National Park.

Our vision

The Greater Sydney Water Strategy has a vision of water to support a thriving, sustainable and resilient Greater Sydney.

The Greater Sydney Water Strategy considers the whole water cycle—how and where we get our water, how we use our water and how we treat and dispose of and/or recycle wastewater. We can't look at water services and supply in isolation—we need to think about what future development (residential, commercial, industrial) should look like at a local scale and more broadly across Sydney, and how we use water to support the community's desired liveability and amenity outcomes in a way that is sustainable and that aligns with what customers can afford and are willing to pay.

Developing a more resilient system

The Greater Sydney Water Strategy is centred around improving the resilience of Greater Sydney's urban water cycle, including water supply, wastewater and stormwater systems.

A resilient water and wastewater system is one that can respond and adapt to stresses and shocks that pose risks to the delivery of water and wastewater services.

We know that Sydney's water supply system is at risk from rapid onset and prolonged drought, flood and bushfire, and other risks to water quality that put pressure on supply. The configuration of the system also means that there is some high risk 'points of failure' that if compromised would have significant consequences.

However, this strategy also recognises that we cannot completely 'drought proof' or 'flood proof' the system through new investment and infrastructure—that is not technically feasible and would be prohibitively expensive. Rather, we have to make prudent decisions to mitigate risks, taking into account the likelihood, potential costs and impacts of these risks, our ability to mitigate them and the costs associated with mitigation. Accordingly, this strategy reinforces the need to make better use of our existing assets and use our available water resources more efficiently, while establishing investment alternatives and pathways that can be followed to make the right decisions when and where they are needed. This means ensuring that all of the appropriate pre-planning has been done so that when action is needed, it can proceed without unacceptable delay and risk to water supply. These pathways should be suited to taking effective action under most future, foreseeable conditions but be flexible enough so we can change the timing, nature or location of investments as circumstances change.

Figure 7 outlines the proposed key principles for improving resilience that underpin this strategy.

Figure 7. Principles for improving the resilience of Greater Sydney’s water system

 <p>Use what we have better</p>	<ul style="list-style-type: none"> • Recognise the value of water to Greater Sydney. • Use water as efficiently as possible and continue to reduce leakage. • Leverage our water supply and wastewater assets and maximise recycling (reducing discharge to the ocean). • Reinvest to maintain the performance of our system and ensure that services remain affordable and deliver value.
 <p>Increase integration and interconnection</p>	<ul style="list-style-type: none"> • Increase system interconnection and decrease potential points of failure. • Ensure that we are not overly dependent on any one group of assets. • Integrate land use and development planning with water planning and management.
 <p>Diversify supply sources</p>	<ul style="list-style-type: none"> • Understand future climate risks to water availability (consider worst-case scenarios). • Increase the amount of rainfall-independent supply that can continue to be provided reliably during extreme drought, and provide time to respond by slowing dam depletion. • Make more use of local water sources such as stormwater and recycling.
 <p>Plan ahead</p>	<ul style="list-style-type: none"> • Plan for the next drought now while the dams are full. • Plan ahead so solutions and contingency measures are ready to implement when needed. • Anticipate and plan for potential future changes to environmental standards and community values.
 <p>Review and adapt</p>	<ul style="list-style-type: none"> • Don’t rely on one approach or infrastructure solution—ensure diversity of approach and action. • Enable flexible operations to adapt to changing circumstances—for example, through flexible operating rules for desalination plants, water restrictions and other operational measures. • Monitor, evaluate and report to inform adaptive responses.



Photography

Image courtesy of Salty Dingo, Department of Planning and Environment.
Footbridge at Western Sydney Parklands, NSW.

Delivering for the community

Sydney Water engages with the community in Greater Sydney to understand people's views about using and sharing water, how it should be managed in the future and their expectations of government in providing water services.

Five key themes have emerged from this engagement over the last few years that have informed this strategy:

- **Transparency and involvement in long-term water planning**

The community wants visibility about future water planning, and they want to have an ongoing and active role in being consulted about plans for the future.

- **A more resilient water supply**

The community is aware of the challenges to Sydney's water supply presented by climate change, urban growth and ageing infrastructure and recognises the importance of a sustainable and resilient water supply for the region.

- **Openness to new approaches**

The community understands the need to diversify water supplies and there is growing support for considering new options such as using purified recycled water as part of the drinking supply.

- **Water makes places liveable**

The community values the role of water in making Greater Sydney a great place to live (see Figure 8). They describe a vision for communities with:

- tree lined streets for urban cooling
- access to attractive spaces around water, parks and green spaces
- clean and swimmable waterways
- public water stations
- rainwater capture and recycling.

- **Shared responsibility between the community, government and business**

The community accepts that water restrictions are sometimes necessary in times of drought but wants to see long-term planning that increases the available supply, while also making sure we use the water we have more efficiently.

Figure 8. The community's future vision



Source: Used with permission of Sydney Water. ©Sydney Water 2021

An aerial photograph of a coastal area. The top half shows a dark blue ocean with white-capped waves breaking onto a wide, sandy beach. The bottom half shows the beach extending towards a city skyline with various buildings and a road. The sky is clear and blue.

What we need to achieve

Photography

Image courtesy of Department of Planning and Environment.
Northern Beaches, Sydney.

The priorities in the Greater Sydney Water Strategy are designed to respond to the water challenges facing our city in a way that is not ‘business as usual’ and that reflects the lessons we’ve learned during recent droughts.

As described throughout this strategy, water is essential to support a growing city and prosperous economy and demand is increasing. However, Greater Sydney is primarily reliant on surface water resources (rainwater runoff captured in dams) for its water supply, which is highly variable and may be less reliable in the future due to climate change. Sydney has limited rainfall-independent supplies that can sustain its needs when inflows and dam levels are low, which means that Greater Sydney is vulnerable to drought. Combined with the risks posed by a lack of system interconnectivity and diversity in water supply sources, this means that we need to take new approaches.

As well as responding to the challenges of growth and improving resilience to extreme events, we must also rise to the challenges of making Greater Sydney greener and cooler as it continues to grow—and improving the health of our waterways and ecosystems by managing land and water resources in a more integrated way. We must also work closely with Aboriginal people across Greater Sydney to improve their rights and access to water and ensure that Aboriginal knowledge informs our water management approaches in a culturally appropriate way.

Figure 9 summarises the proposed objectives, resilience principles and priorities for the Greater Sydney Water Strategy.



Photography

Image courtesy of Department of Planning and Environment.
Nepean River, NSW.

Figure 9. Greater Sydney Water Strategy: Objectives, principles and priorities

<p>Objectives</p>	<p>Support economic growth and community wellbeing by providing confidence in the sustainability of Greater Sydney’s water supply to meet growth and adapt to a changing climate to 2040 and beyond</p>	<p>Support delivery of the Greater Sydney Region Plan—A Metropolis of Three Cities and the Premier’s Priorities for greening the city</p>	<p>Identify the strategic pathways to ensure the right investment decisions are made at the right time in consultation with customers and the community</p>	<p>Set the pathways to identify highest economic value and most affordable investment portfolios for water infrastructure</p>	
<p>Resilience principles</p>	 <p>Use what we have better</p>	 <p>Increase integration and interconnection</p>	 <p>Diversify supply sources</p>	 <p>Plan ahead</p>	 <p>Review and adapt</p>
<p>Priorities and actions</p>	<p>Priority 1 We understand how much water we need and when</p>	<p>1.1 Change the way we think about future water needs (enduring supply) 1.2 Consider future drought and climate risks</p>			
<p>Priority 2 Our water systems are sustainable for the long term and resilient to extreme events</p>	<p>2.1 A concentrated focus on water conservation and efficiency 2.2 Make best use of the assets we have by optimising use of the Sydney Desalination Plant 2.3 Plan for new infrastructure with a focus on rainfall-independent supply 2.4 Managing drought 2.5 Manage location-specific or asset-specific risks 2.6 Respond to the impacts of flood mitigation decisions on the system</p>				
<p>Priority 3 Our city is green and liveable</p>	<p>3.1 Integrate water cycle and land use planning 3.2 Support the design principles for Greater Sydney 3.3 Prioritise alternative water sources for greening and cooling 3.4 Progress a circular economy approach for water services</p>				
<p>Priority 4 Our waterways and landscapes are healthy</p>	<p>4.1 Maintain and improve ecosystem health 4.2 Invest in wastewater management 4.3 Improve stormwater management 4.4 Protect water for recreation</p>				
<p>Priority 5 Water management and services meet community needs</p>	<p>5.1 Recognise and protect Aboriginal rights, interests and access to water 5.2 Enhance community confidence through engagement and transparency 5.3 Manage price impacts for customers</p>				



Photography

Image courtesy of Yvonne Kaiser-Glass, Sydney Water © Sydney Water 2021.
Aboriginal cultural site, Manly Vale (Gayamaygal Country) NSW.

We understand how much water we need and when

One of the fundamental questions for the Greater Sydney Water Strategy is how to make sure there is enough water to meet the needs of the global city and all customers over the long-term, while recognising that water restrictions may still be necessary in times of drought. This means we need to understand historical and current patterns of water use, how these might change in the future and how much water we will need and when. We also need a more sophisticated understanding of the likely impacts of climate change on our water supply and future demand for water.

The 2017-2020 drought highlighted that we need to change the way we think about and plan for

our future water needs. We not only need to understand the demand that will need to be supplied over the long-term to accommodate future growth and liveability goals; we also need to understand the minimum amount of water supply the community can tolerate during a severe and prolonged drought. We need to know these requirements to inform our supply planning and to make sure that we have enough rainfall-independent supply in the system to continue to service customers during severe and prolonged drought conditions.

This requires a new approach to how we think about future demand requirements and supply planning.

Strategic pathway: Priority 1

Examine **a range of possible future scenarios** for water demand

Understand **minimum water needs** that could be supplied reliably during prolonged drought (enduring supply).

Test assumptions with the community to understand minimum water needs.

Use the results of **new climate risk modelling** and data to assess future supply and demand.

Identify an **enduring level of supply** and plan our water supply system accordingly.

Photography

Image courtesy of Department of Primary Industries. Golf course sprinklers.



1.1 Change the way we think about future water needs (enduring supply)

How much water do we use?

In 2019/20, Sydney Water supplied around 535 gigalitres (GL) of drinking water to over 5 million people and businesses across Greater Sydney.

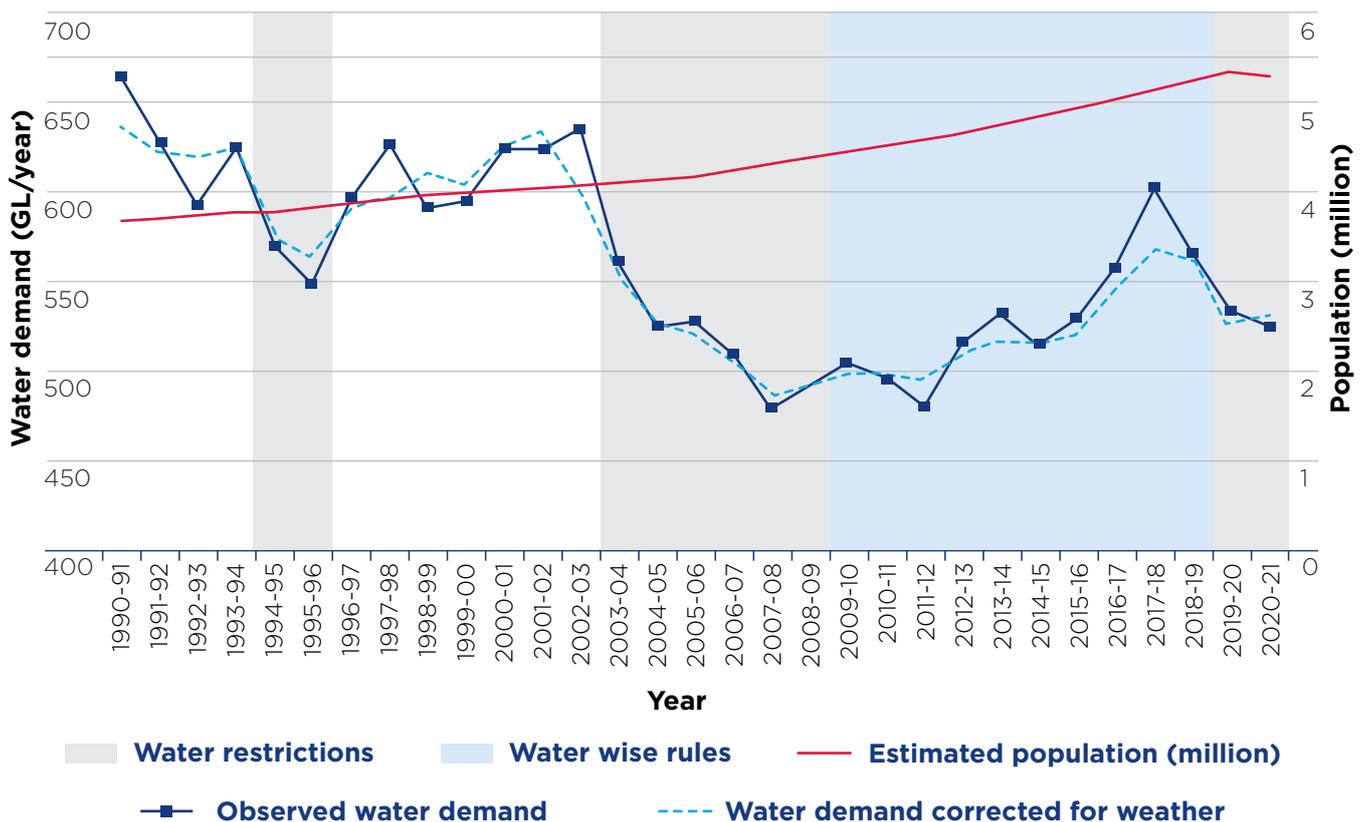
Water use per person has declined from relatively high levels in the 1990s, but has remained relatively stable since the early 2000s. Per capita use of drinking quality water in Greater Sydney is now around 280 litres per day (L/day).

This reduction in water use is due to a combination of higher density in urban areas, new water rules and policies, improvements in leak detection and prevention, advances in water-efficient appliances, successful water conservation campaigns and greater consumer awareness about not wasting water. In addition, less water is being used by industry as NSW shifts away from water-intensive industries such as manufacturing to a more technological- and services-driven economy.

While per capita demand for water has decreased, particularly since the end of the Millennium Drought, overall demand for water has generally increased due largely to Greater Sydney's growing population and increased urbanisation (see Figure 10). The overall trend of increasing total consumption has not been observed during the last couple of years. This is due to the effects of water restrictions (towards the end and after the 2017-2020 drought), changed customer behaviour towards more efficient water use, and wetter weather conditions.

Historically, the demand for drinking water in Greater Sydney has varied in response to changes in population, economy, regulation, policy, technology, urban form and customer behaviour. In the coming decades, changes to the nature of the city, social attitudes and customer behaviour will continue to influence the demand for water. Other known changes likely to affect the future demand for water include adapting to climate change by mitigating urban heat and meeting the NSW Government's objectives of place-based planning and cooling and greening the city.

Figure 10. Historical demand for drinking water



How much water will we need in the future?

Projected population growth in Greater Sydney means that the city's water supply is now at its sustainable limits and will be insufficient to meet demand over the long-term. We have prepared a range of demand forecasts to understand the potential range of long-term water demand for the next 40 years.

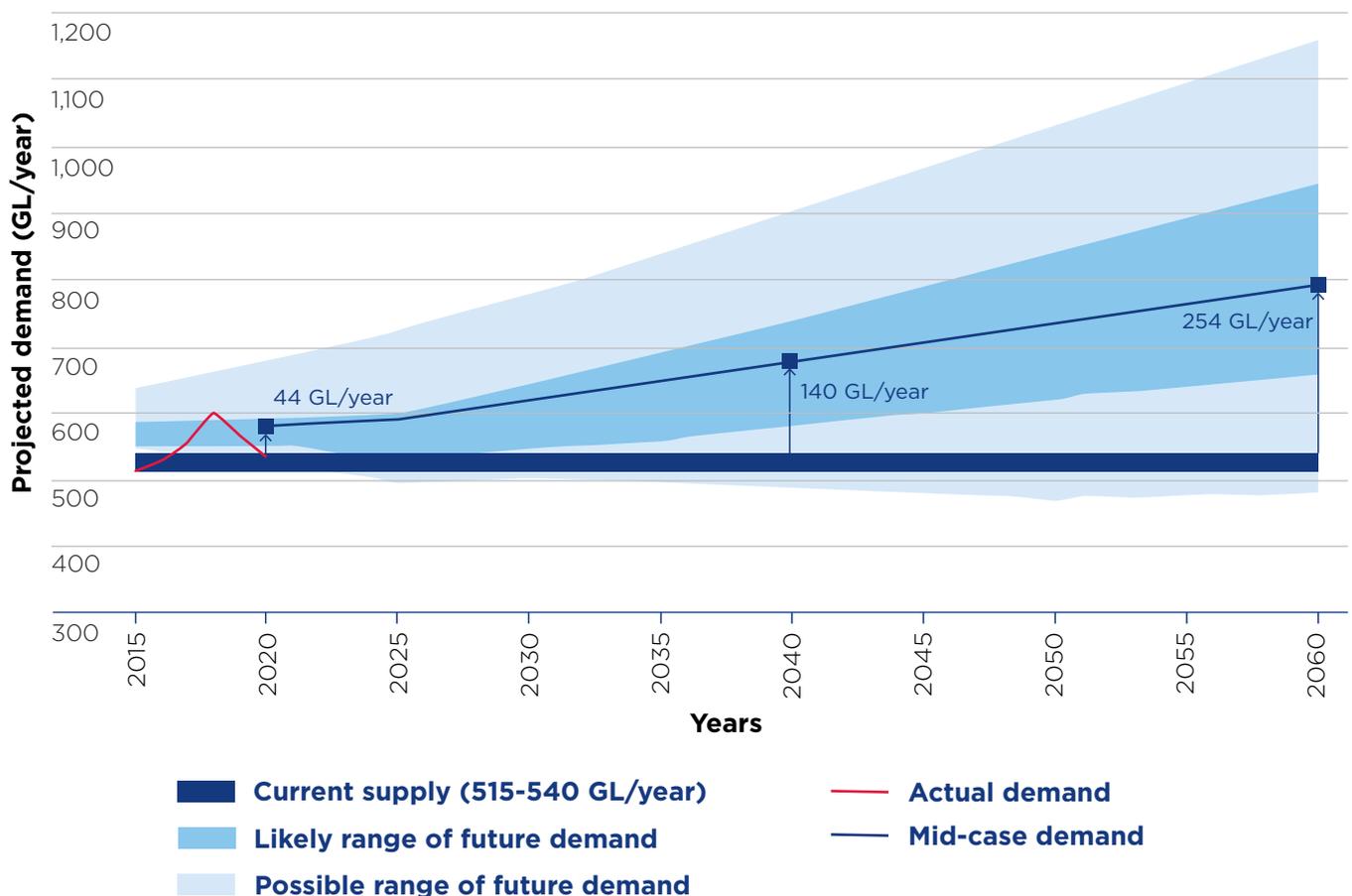
Greater Sydney's drinking water system can provide a long-term supply of 515 to 540 GL/year. This is less than we will need under a mid-case demand forecast (see Figure 11). While this does not create an immediate risk for Greater Sydney because dams are full and we have time to plan and act, Greater Sydney's water supply will be exposed to risk should we experience another severe drought before we enhance the resilience of the system. We have examined a range of potential population growth scenarios to understand how demand will change in the future. If population growth is low, we will need an additional 120 GL/year by 2060. Under our mid-case

demand forecast, where the population projections reflect a 'middle-range' growth scenario, the projected gap between what can be supplied sustainably and the demand for water increases to about 250 GL/year by 2060 (equivalent to about half the volume of Sydney Harbour).

The range of potential demand is wide, but the message is consistent—that the gap between demand and sustainable supply will increase over time. This means that we need to immediately look at options to reduce demand and increase supply to bring the system back into balance.

In addition to the projected demand shown in Figure 11, additional water to support cooling and greening goals for Sydney will require an estimated 68 GL/year by 2035. Of the total volume required, our analysis has identified that 48 GL/year would be met through stormwater and recycled water, and 20 GL/year will need to be drawn from the drinking water supplies. This will support maintaining tree canopy and green space during droughts.

Figure 11. Projected demand for water to 2060



A new approach to thinking about future water needs

The Millennium Drought and the 2017-2020 drought taught us that we need to think differently about how we plan for future supply. These droughts demonstrated that the conventional approach of balancing demand to the sustainable long-term average supply may not accurately reflect our system's ability to respond to potential future severe droughts and flooding. Even if demand and sustainable supply are balanced, the water supply system is still vulnerable to complete exhaustion in a severe and prolonged drought (albeit with a low probability). In the drought of 2017-2020, inflows to Greater Sydney's water storages were very low and the storages depleted rapidly. While the probability of these rapid depletion rates occurring again is low, the consequences would be extremely severe and potentially catastrophic.

We need a new approach to considering how much water we need and by when. In addition to thinking about the long-term average supply and making sure it is greater than demand over the long-term, we need to consider the minimum amount of water the community and industry would need to sustain them for a long period during a severe drought, until storages refill.

This concept is referred to as 'enduring supply'—basically, the amount of water that we can be confident of supplying indefinitely, irrespective of the intensity and duration of drought. Ideally, the 'enduring level of supply' should match the minimum level of demand that the community needs—including for business needs and maintaining greening space—for a long period of time after water restrictions have reduced demand as much as possible and until our storages refill. This level of supply needs to consider the needs of all segments of the economy to ensure we can maintain the right level of economic, social, environmental and health outcomes. We also need to make sure we can maintain the city's green spaces during drought.

To inform our water supply planning, we will discuss and test these assumptions with the community to understand—at a practical household and business level—the minimum water use that customers would need in an extended drought.

Initial analysis for the Greater Sydney Water Strategy estimates that we could reduce demand, under the tightest water restrictions, by around 40% for residential use and 55% for businesses.

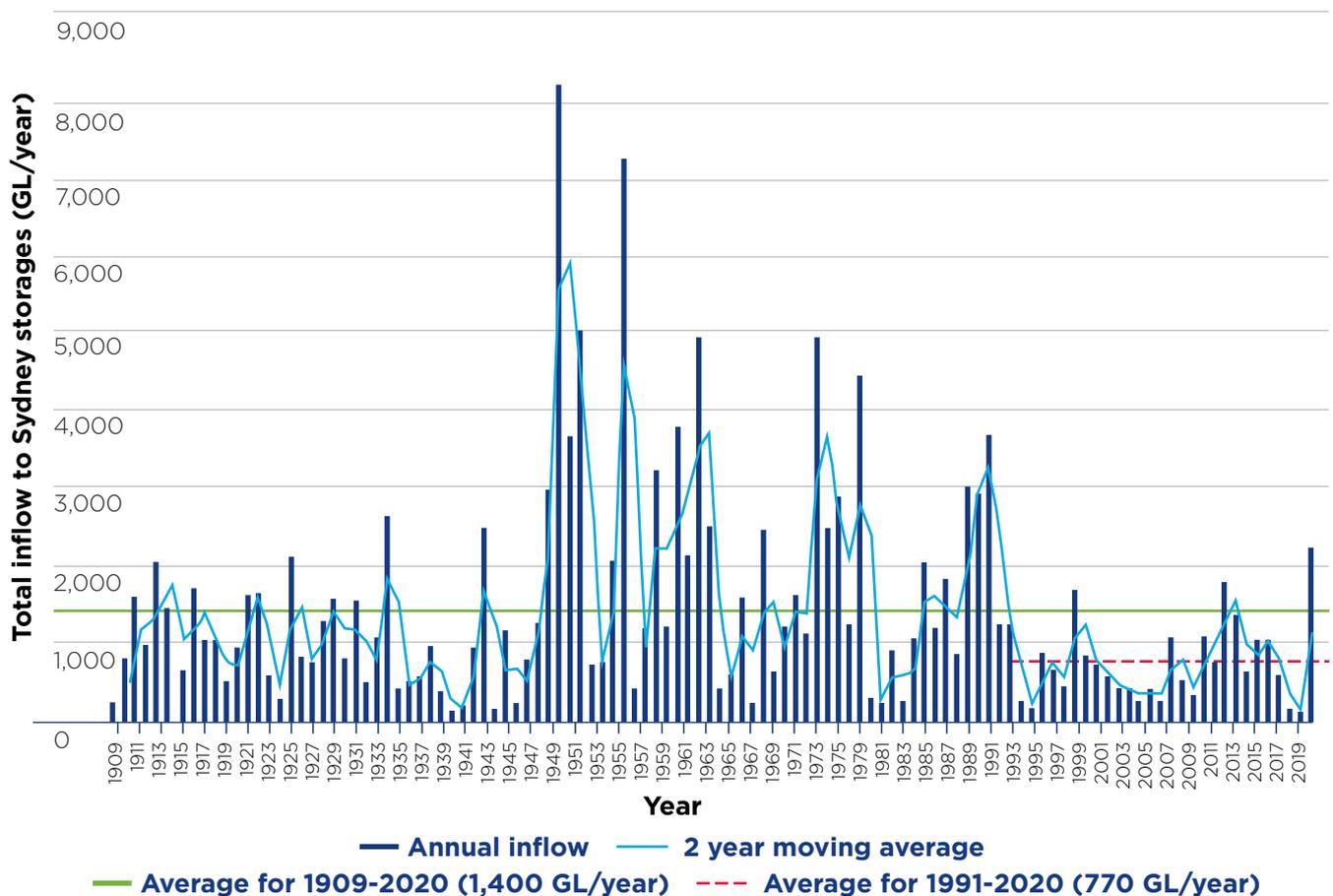
1.2 Consider future drought and climate risks

Analysis undertaken to support the Greater Sydney Water Strategy has identified a significant range of uncertainty around the future gap between supply and demand. Future demand will be influenced by a range of factors including population growth, urban typologies, and customer behaviours. In addition, the amount of water that can be supplied sustainably from the water system is subject to significant uncertainty.

One of the major areas of uncertainty relates to our understanding of past climate conditions, and how the climate might change in the future.

Historical records indicate that average inflows to Greater Sydney’s storages over the last 30 years are lower when compared with 110 years of records (Figure 12).

Figure 12. Average inflows to Sydney storages since 1909



A new approach to climate risk modelling

While there has been significant variation in inflows over the last 130 years, numerous studies now exist that demonstrate that recorded climate data (which we have traditionally used to estimate what the water system can sustainably supply) may not reflect the full range of climate conditions and extremes that we have experienced in the past or the full range of variability we could experience in the future.

The Greater Sydney Water Strategy uses a new climate data and modelling approach that improves our understanding of past climate conditions and plausible climate futures and provides a more accurate picture of extreme climate events. This approach greatly improves our ability to identify potential climate impacts and risks, and it represents a significant and important advance in water planning in NSW.

The message from this work so far is that our water supplies in NSW could be less secure than we thought, and we are taking actions now while our dams are full, to address this risk. This is because we now understand that droughts longer

than those experienced in the last 130 years are likely at some point, and that we could also see higher temperatures and less rainfall. Projected changes in rainfall patterns, warmer conditions and increased evaporation will impact future water availability. The frequency, intensity and duration of droughts are also expected to increase, which may affect water quality and the ecology of our rivers.

Through this new approach, we have estimated Greater Sydney's sustainable water supply under a 'base case' (using the 130 years of historical record) and two scenarios: a scenario that uses the paleoclimate data to supplement the historical record and a worst-case climate change scenario.

The purpose of undertaking this modelling is to stress-test our planning work against challenging scenarios to ensure we can make the necessary interventions and respond in the necessary timeframes if, and when, we need to. As our dams are currently full, we have the time to plan and take actions to enhance our resilience to future climate change risks.

Table 1 summarises the impact on water supply of these different scenarios.

Table 1. Estimate of sustainable supply for different modelling scenarios

Modelling scenarios	Sustainable supply
Base case: 130 years of historical record	540 GL/year
Scenario 1: incorporating paleoclimate data	460 GL/year
Scenario 2: worst-case (maximum impact) climate change	Reducing to 275 GL/year by 2050

We then considered the potential impact of these scenarios on the timing and need to augment Greater Sydney's water supply over the next 20-40 years.

Our analysis indicates that,

- using paleoclimate data, the timing of several new sources of rainfall independent supply would need to be brought forward if a worst case drought scenario were to eventuate in the near term
- using the worst-case climate change scenario, about 3 new large sources of rainfall independent supply could need to be brought online from about 2040 onwards, as well as bringing forward the timing of other supply augmentations.

These are worst-case and low probability scenarios but ones that we need to be prepared for.

It is also acknowledged that there may be an increase in the frequency of extreme wet weather events. If these were to occur there would be a limited increase in the available supply, but the largest impacts would be an increase in flooding risks and impacts on water quality, and the wastewater and stormwater systems.

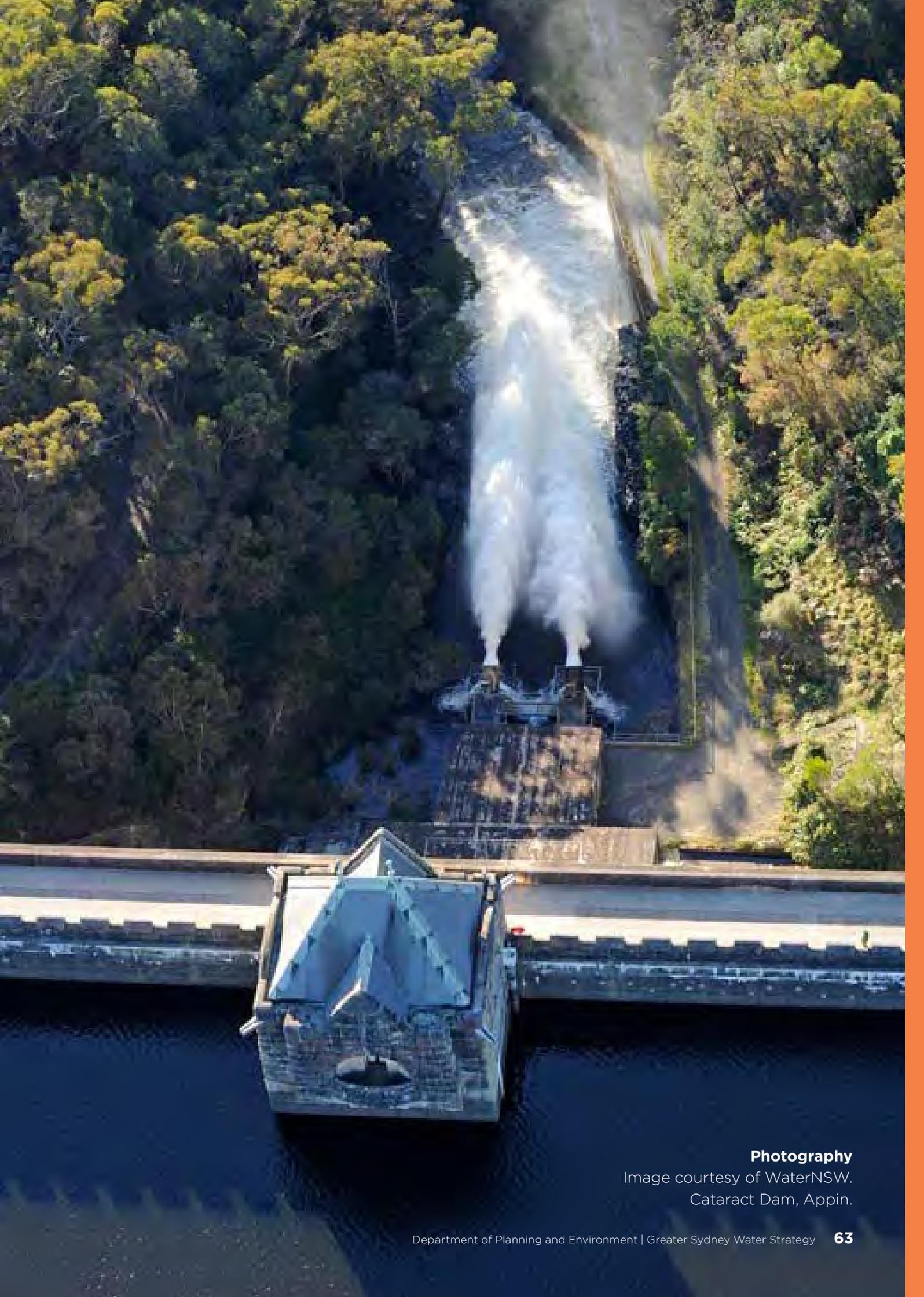
While the above climate conditions may not eventuate over the next few decades, this new data and modelling considers the broader range of potential future conditions to support long term planning and the options, capacity and adaptability to respond in the coming decades.

Actions in the Greater Sydney Water Strategy include moving towards an enduring supply (that is, increasing the amount of climate-independent supply in the system), a strong water conservation program and short-term actions, such as changing the operation of the Sydney Desalination Plant, to increase our drought resilience and reduce the risk of being in severe water restrictions.

Implementing these elements of the strategy ahead of severe drought and/or other climate change impacts reduces our risk exposure should these extreme events eventuate.

The strategy does not recommend investing now to completely mitigate all potential extreme events that may not occur. The key is to take the necessary precautionary actions in anticipation of potential extreme events so we have adequate adaptive capacity should these occur, while we continue to monitor for changes in climate that might be occurring. This adaptive planning approach is a central pillar of the Greater Sydney Water Strategy.

Detailed planning of augmentation portfolios in line with the directions established in the Greater Sydney Water Strategy will be undertaken by Sydney Water. In addition to responding to growth, this planning will consider how we maintain an adaptive approach to respond to severe drought and other climate change scenarios, and in a manner that keeps bills affordable and in line with community values and preferences.



Photography

Image courtesy of WaterNSW.
Cataract Dam, Appin.

Our water systems are sustainable for the long term and resilient to extreme events

There are several big issues to tackle to ensure that our water system is sustainable and resilient to extreme events, including severe and prolonged drought. We need to consider a combination of solutions—from changing our behaviour to investing in new assets—to build resilience and flexibility, support a growing population, manage system risks and use our water more efficiently and sustainably.

The Greater Sydney Water Strategy is exploring how to best develop a more resilient system by:

- Developing the right mix of solutions to accommodate growth and liveability goals and bridge the supply-demand gap, as well as increasing the amount of rainfall-independent supply in the system that can provide water services in severe, prolonged drought
- Taking an approach grounded in system resilience, which has options and adaptability built in so decisions can be made at the right time
- Improving system integration and interconnection to manage system risks and ageing infrastructure and asset capability

The following sections outline a range of options being considered in combination to build resilience and adaptability, including:

- **Increasing our focus on water conservation and efficiency** as an immediate and cost-effective response.
- **Leveraging existing assets** through more flexible operation of the Sydney Desalination Plant.
- **Planning for new infrastructure with a focus on rainfall-independent supply**, enabling an ‘enduring supply’ during drought and managing storage depletion to reduce the risk of reaching extremely low dam levels
- **Investing in transfers, connections and upgrades** to address system risks and risks posed by ageing assets.

Some options can be progressed immediately to reduce or address the existing supply-demand gap—for example, the options to change the operation of the Sydney Desalination Plant, improve water efficiency and encourage water wise behaviours.

For other options, such as new or augmented desalination or purified recycled water plants, we need to invest first in progressing the next stages of planning so that these options are ready to deploy when conditions indicate they will be needed.

Strategic pathway: Priority 2

Invest in water conservation and efficiency

in drought and non-drought conditions to reduce demand and system leakage.

Optimise operation of the Sydney Desalination Plant

as an ongoing source of rainfall-independent supply (not just a drought response measure).

Detailed planning for portfolios of supply augmentation options

that focus on rainfall-independent supply.

Community engagement

on purified recycled water and desalination.

Assess the water supply system

to understand risks to resilience and security.

Construct new rainfall-independent supply assets when needed

(with construction triggers based on the time required to deliver first water to the network prior to dam levels reaching critical levels in drought).

Planning and approvals for **system upgrades and interconnections**.

Bring additional water supply on-line.

Optimise the operation of the system.

Continue to investigate and select further rainfall-independent options to ensure we have the best options available to meet Greater Sydney's growth and enduring level of supply.

2.1 A concentrated focus on water conservation and efficiency

Using water more efficiently—and wasting less water—means we make the best use of all our available water. It also means we can potentially reduce or defer investment in costly new supply infrastructure. We can save greater volumes of drinking quality water in ways that have little or no impact on water users, such as:

- Supporting households to save water, including buy-back programs for inefficient appliances, installation incentives and maintenance services for rainwater tanks, free repairs to leaky taps and fittings, and helping people to use water more wisely (and make better use of stormwater) in their gardens.
- Encouraging businesses to save water, including water saving action plans and audits, replacement programs for inefficient commercial appliances and help to find and fix leaks.

- Setting best practice water efficiency and sustainability standards for buildings and appliances, and providing ratings and labels to help consumers choose water efficient products.
- Conducting campaigns to make people more aware of ways to save water in their everyday lives and the benefits to the wider community of water conservation.

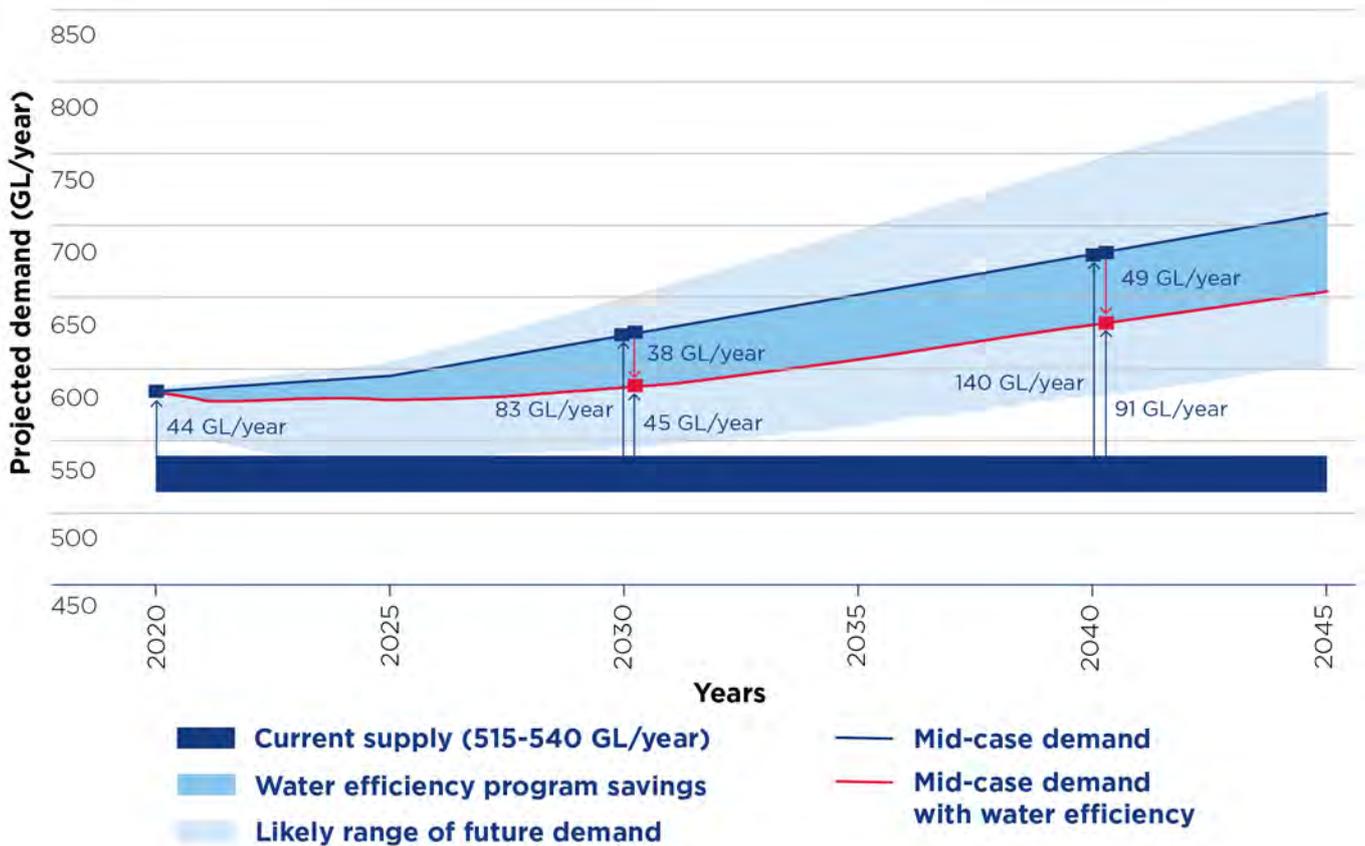
Analysis undertaken for this strategy indicates that an additional 49 GL/year of drinking water could be saved by 2040 through a concentrated focus on water efficiency, with an average annual investment of around \$23 million per year. Water conservation and efficiency measures are relatively inexpensive to deliver, have better environmental outcomes than other options, and they do not increase carbon emissions.

Figure 13 illustrates the potential reduction in overall demand that could be achieved over time from adopting a comprehensive water efficiency program for Greater Sydney. By 2030, a cumulative 38 GL/year could be saved each year; by 2040, 49 GL/year of drinking water could be saved each year, which is equivalent to 55% of the

annual water production of Sydney's Desalination Plant (90 GL/year).

Economic analysis conducted for the strategy shows that this is a cost-effective option for residents and business in Sydney, and is lower cost than supply-side options such as water recycling and desalination.

Figure 13. Potential impact of an increased focus on water efficiency across Greater Sydney



Water conservation is strongly supported by communities and businesses, and across government. The NSW Government is enhancing its investment in water conservation and IPART has recently increased the level of expenditure allowed for Sydney Water to deliver its water conservation program.

As part of the NSW Water Strategy, the Government is developing a state-wide Water Efficiency Framework and Program that will focus on building water efficiency capacity, gaining a greater understanding of water use, improving the evaluation of water efficiency initiatives and increasing private sector involvement. The framework will also provide a clear statement of NSW Government policy in relation to supporting and investing in water efficiency across all sectors.

The Building Sustainability Index (BASIX), introduced in 2004, is a key regulatory tool for driving and sustaining water efficiency in new residential and other new developments in NSW. Existing data indicates that BASIX has not maintained its effectiveness over time and that more needs to be done to improve water efficiency performance in new building developments. The NSW Government will undertake a review of the water efficiency requirements of BASIX and look at what improvements are needed to continue to drive improvements in water efficiency at the property level, and whether there are opportunities to expand the scope of the tool to drive water efficiency for new or re-developed precincts.

2.2 Make best use of the assets we have by optimising use of the Sydney Desalination Plant

The Sydney Desalination Plant is the city's only significant rainfall-independent asset that can assist the NSW Government in managing water security for Sydney. The plant uses reverse osmosis membrane technology to turn seawater into drinking water and can produce 90 GL/year of drinking quality water to supplement water drawn from the storage dams.

The plant was originally built by Sydney Water as an 'insurance policy' to provide an additional source of drinking water during the Millennium Drought when the dams supplying Sydney dropped to 33.7% of their storage capacity.

The first drinking water was provided to the Sydney Water network in February 2010. The plant then operated successfully for two years before being placed in Water Security Mode (mothballed) in July 2012. The desalination plant was leased to a private consortium in 2012 under a 50-year lease. Its current operating rules are set in its operating licence that requires it to be switched on when dams reach 60% and switched off when dams recover to 70%.

An immediate option is to change the operating rules for the plant so that it runs flexibly and its operations can be optimised.

We have identified a more flexible operating regime. If the Sydney Desalination Plant was online and always available it would:

- increase water supply by approximately 20 GL/year under average conditions, although more water supply would be available if needed due to a change in circumstances, such as an increase in water demand or a return to drought conditions
- extend supply for up to four months of water during a severe drought like the 2017-2020 event, giving more time to implement drought supply measures
- assist in managing water quality and other asset risks (the plant has been operating since the drought broke in February 2020 due to water quality and treatability risks caused by bushfires and flooding)
- have a relatively small financial impact on customer bills, with an estimated increase of less than 2% on an average annual water and wastewater bill.

2.3 Plan for new infrastructure with a focus on rainfall-independent supply

Augmenting our water supply

We need to plan and deliver our water investments in a way that reduces the risk of Greater Sydney running out of water. As already described, the conventional approach to balancing supply and demand over the long term does not guarantee that we will not experience severe water restrictions or run out of water during extreme drought. Our future planning should simultaneously address the gap between supply and demand while increasing the amount of rainfall-independent supply available in the system—reducing our risks to tolerable levels and increasing our capacity to respond to extreme drought.

We have undertaken risk assessment and options analysis to:

- Identify the portfolios of options for supply augmentation that need further planning and investigation.
- Manage the transition to a greater rainfall-independent supply, noting that some initial investment will be needed in this supply before the next drought to slow dam depletion rates, while developing longer term plans for drought-triggered rainfall-independent supply options that help us move along the pathway to an enduring level of supply.
- Enable forward planning for supply augmentation options so that the impacts on customer bills can be minimised as much as possible.

Strategic planning studies have identified a wide range of water supply options that could contribute to future water security. These can be summarised as:

- **Surface and groundwater options**
These options include traditional water sources such as dams and dam augmentations and groundwater extraction. Surface water

augmentations will not increase our level of rainfall-independent supply, however, groundwater may still continue to play a limited but meaningful role in drought management, providing up to 30 GL/year.

- **Desalination options**

There are a number of possible desalination options that are relatively flexible in terms of how much water they can provide. These options are rainfall-independent and also have a comparatively lower environmental impact compared with large surface water storages. Identified options could contribute additional supply from between 35 to 250 GL/year.

- **Purified recycled water options**

Purified recycled water options are rainfall-independent and can provide multiple staged increases to available supply (starting from as little as 30 GL/year and growing to up to 200 GL/year) for a range of uses. In many instances, these schemes offer the potential to support planned new infrastructure for growth. They may also contribute to avoiding some planned wastewater investment in the major coastal systems. Their supply contribution during drought will be lower because water restrictions mean there will be less wastewater produced and available for treatment. While communities have indicated an openness to new supply options, engagement and consultation with customers and communities will be needed around the idea of using purified recycled water for drinking purposes. Other uses for the water include enhancing the health of our rivers by replacing environmental flows from our dams and meeting the water demand for green space and tree canopy, which is anticipated to be around 68 GL/year by 2035—20 GL/year of which is expected to come from the drinking water supply.

- **Transfer options**

Additional transfer infrastructure, such as pipelines, can move water around the Greater Sydney system from one area or source to another (such as between dams/storages or between drinking water systems), improving nodal security and system flexibility.

Types of water recycling

Non-potable reuse schemes involve treating wastewater and distributing it for uses, such as flushing the toilet or watering the garden. This requires a separate pipe network.

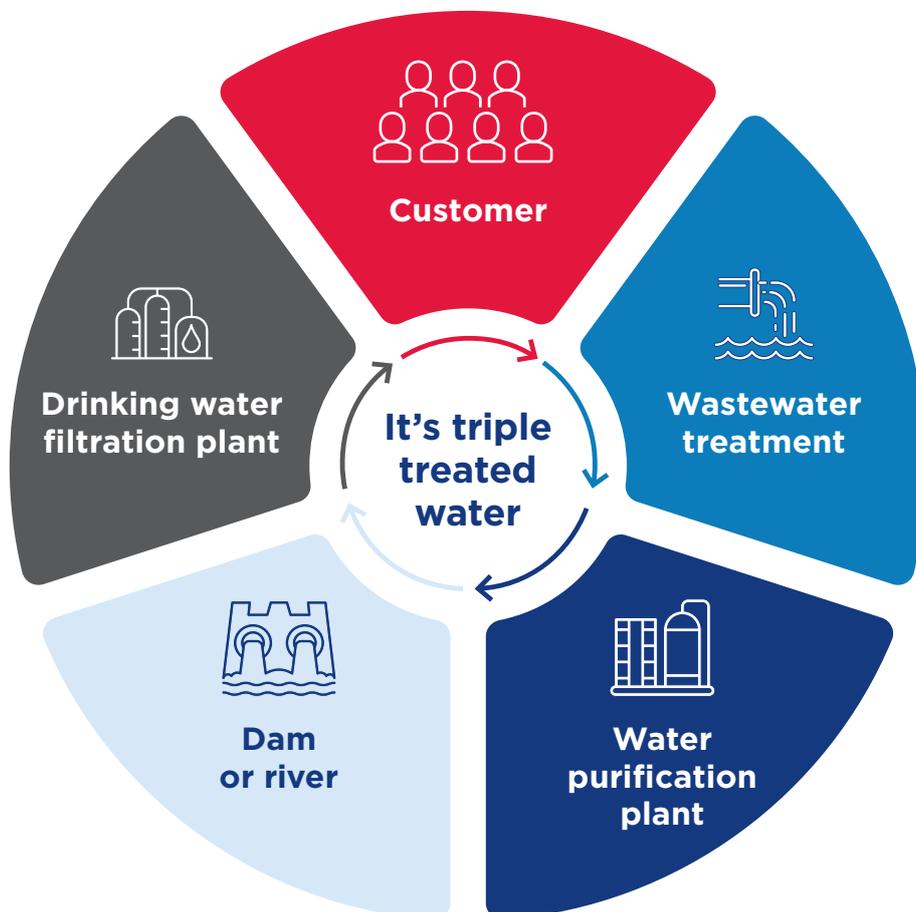
Purified recycled water involves releasing highly purified wastewater into an ‘environmental buffer’, such as a river or underground aquifer, before re-extracting and treating the water for drinking. Currently there are no indirect potable schemes in NSW. Unplanned reuse of purified recycled water does occur when treated wastewater is released into river systems that feed other water supplies.

Water can be recycled through **centralised** infrastructure (large-scale treatment and purification plants), or through **decentralised** infrastructure to service a smaller community (such as a large apartment building).

Two main purification processes have been used in other jurisdictions. **Reverse osmosis trains** (using membranes) have historically been the most common choice for purified recycled water and use the same technology as desalination plants. **Carbon trains** (using ozone and activated carbon filters) are increasingly being used due to their lower cost and environmental benefits—unlike reverse osmosis they do not produce a concentrated ‘brine’ of salt and residual organic substances, which can be hard to dispose of.

Snapshot

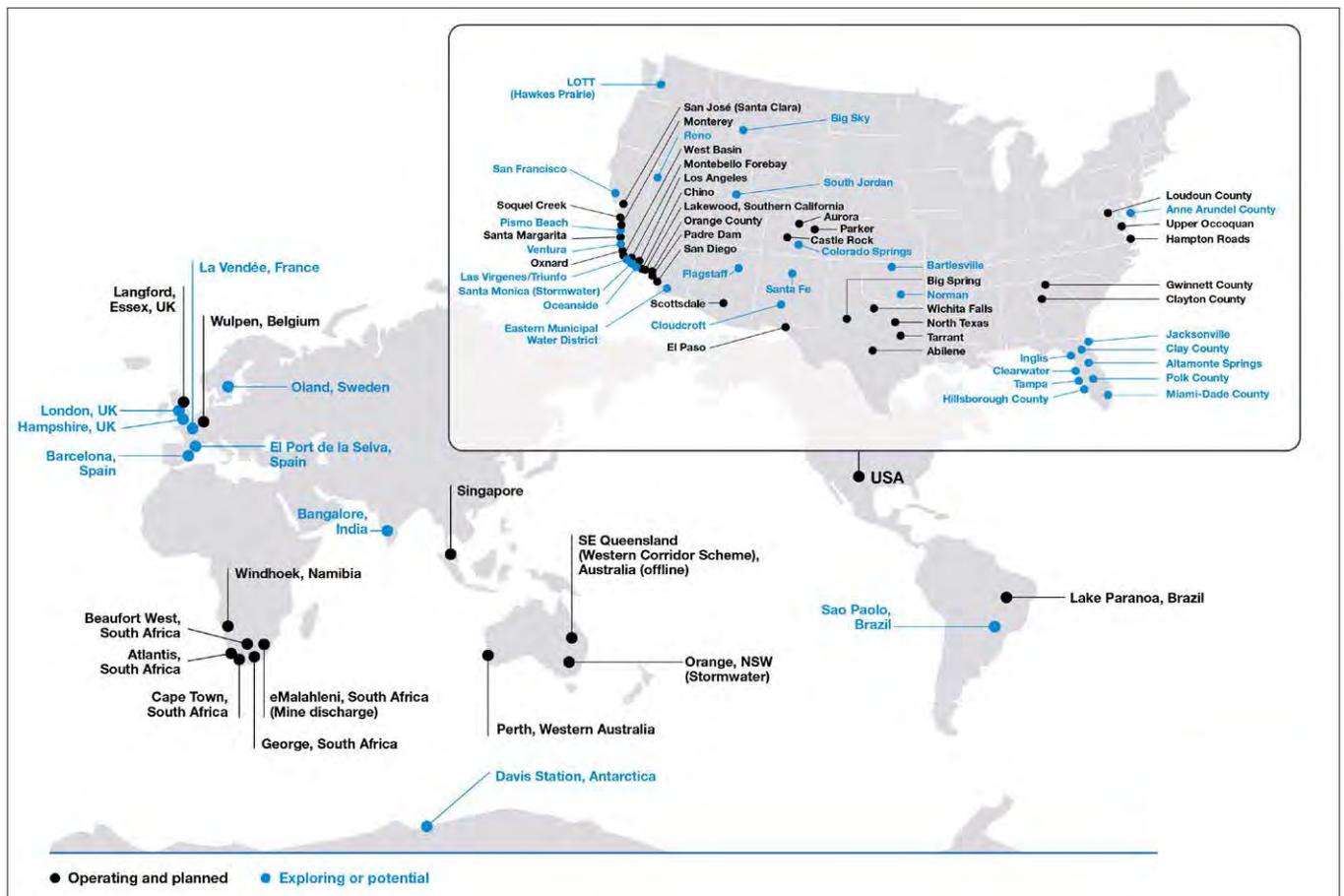
How does purified recycled water work?



Unplanned reuse of wastewater is common throughout the world, particularly on large river systems where there are many major cities or industrial or agricultural developments that extract water along the river. For example, a city or town will extract water from the river and treat it to an appropriate level for drinking water consumption. Once used, any wastewater that cannot be recycled is treated and discharged downstream of the extraction point. This treated wastewater mixes with other flows in the river and is then part of the water supply for towns that extract water further downstream. When it is extracted downstream the water is treated to appropriate drinking water standards before being used for water supply. This is referred to as 'unplanned reuse'.

Snapshot

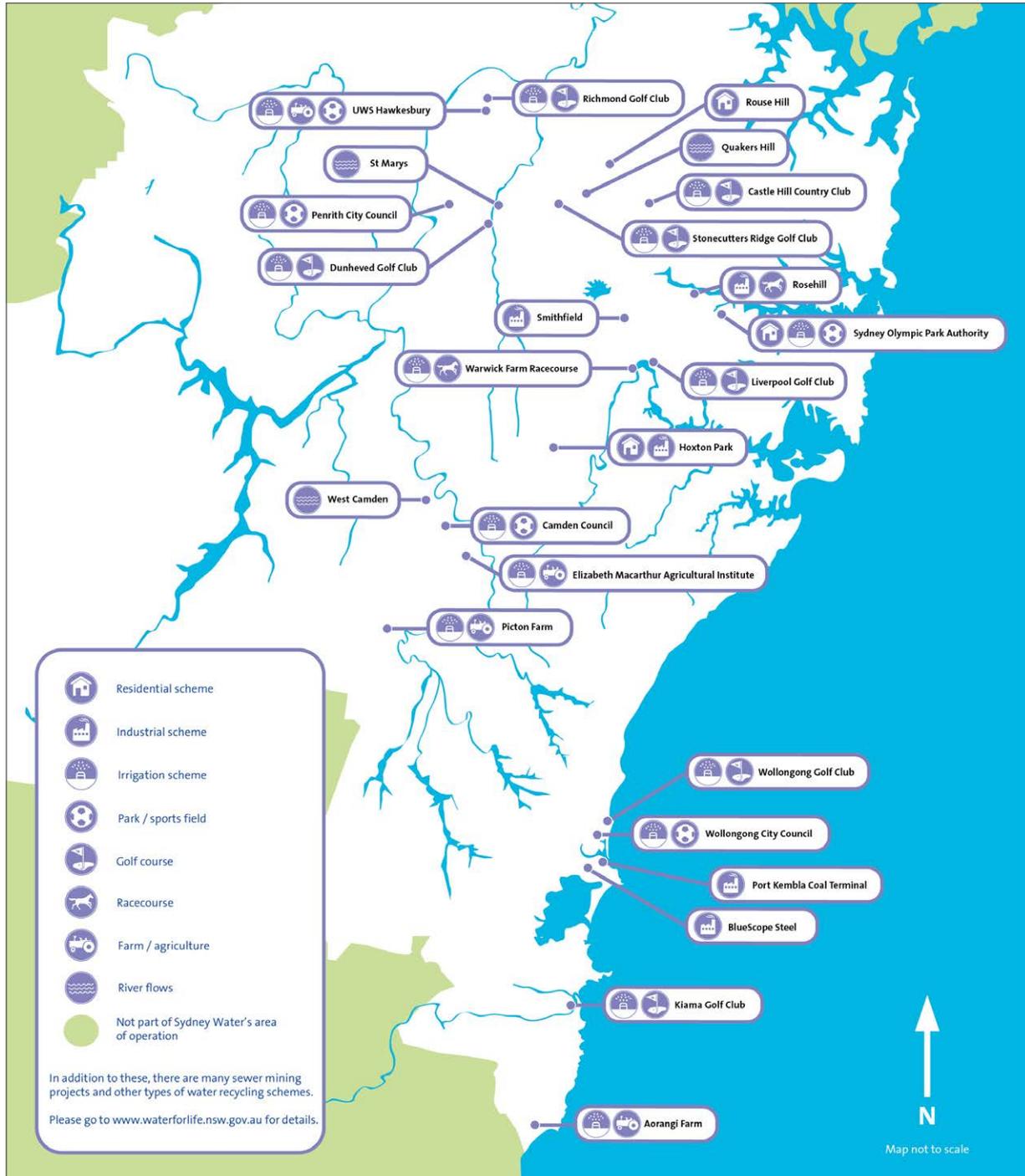
Global locations using purified recycled water for drinking water supply



Source: Water Services Association of Australia

Snapshot

Water recycling in Sydney region



Source: Used with permission of Sydney Water. ©Sydney Water 2021

Increasing rainfall-independent supply

Our analysis shows that **Sydney could need new additional rainfall-independent water supply as early as 2026/27** to help restore the water demand/supply balance. Modelling indicates that even with low growth and an increased focus on reducing drinking water demand, there will still be a need to augment the existing supply system to bring demand and supply into balance—within the next 5-10 years, before 2040 and again prior to 2060.

In addition, to be able to respond to drought effectively, we need to:

- increase rainfall-independent supply to have higher dam levels at the start of a drought and provide more time to respond, and to slow dam depletion rates
- have a plan that will enable commissioning of sufficient contingent supplies in an orderly

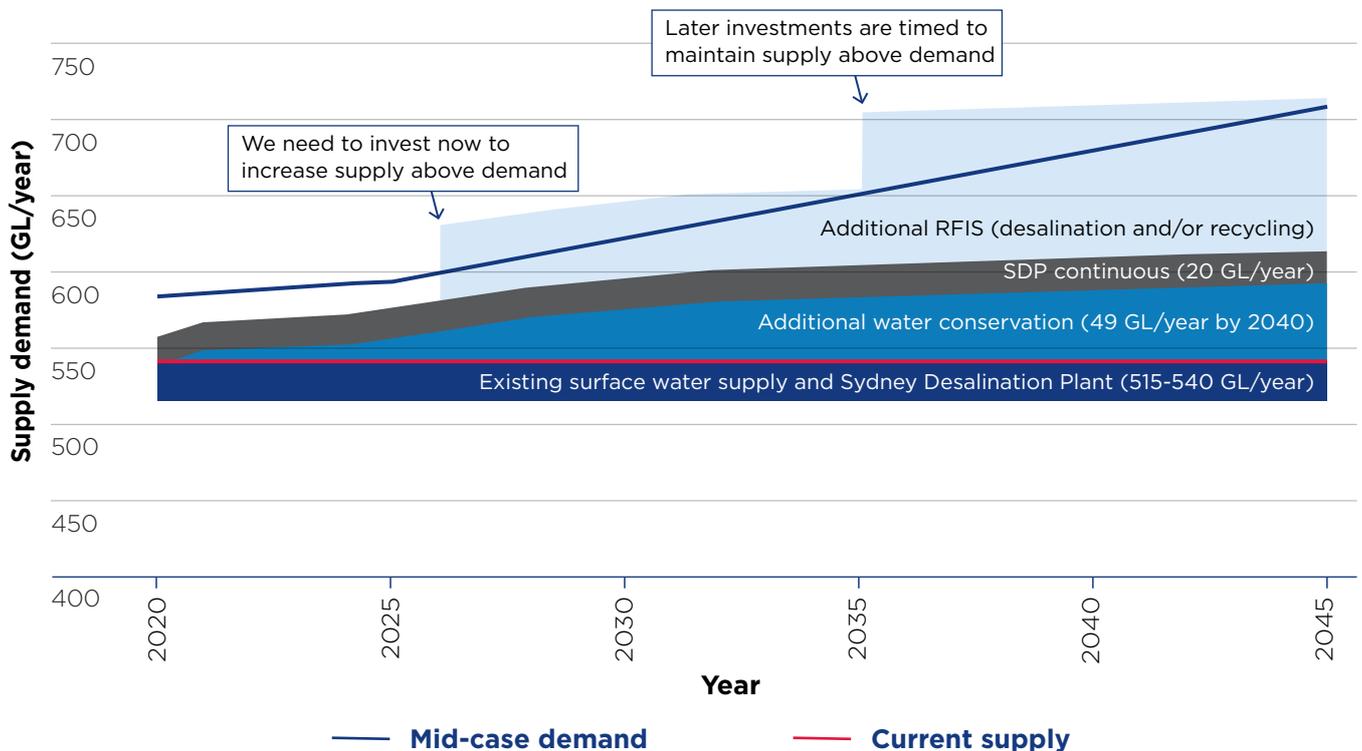
manner when extreme drought next occurs, before storage levels fall to critically low levels

- in the longer term, have a level of enduring supply that meets the level of water use to support the community's priority needs during a prolonged drought.

A combination of water efficiency, the flexible operation of the Sydney Desalination Plant (as described earlier), and new rainfall-independent supply will serve the dual purposes of supporting the growth in Sydney's water demand and becoming part of a comprehensive response to future droughts.

Figure 14 shows how an indicative portfolio of actions can be staged over time to meet water demand requirements and ensure we have sufficient rainfall-independent supplies to respond to drought.

Figure 14. Portfolio of actions to support growth



An engineering analysis conducted for the strategy indicates that the likely best mix of actions to increase rainfall-independent supply capacity is to:

1. Undertake planning investigations and business cases for the expansion of the Sydney Desalination Plant (providing an additional 90 GL/year), an Illawarra Desalination Plant (up to 90 GL/year) and purified recycled water schemes capable of providing up to 140 GL/year. The demonstration plant will assist in understanding purified recycled water, but is not connected to Sydney's water supply. Any new water supply option, including desalination and purified recycled water, would only be introduced to Sydney's water supply system following community consultation and stringent Government approvals.
2. Build a purified recycled water Demonstration Plant, accompanied by an extensive community engagement program, to demonstrate that the technology is available to purify water to drinking level standard and to allow the public

to see it for themselves. This is consistent with the recommendations of the NSW Productivity Commission White Paper 2021, *Rebooting the economy*. The plant does not form part of Sydney's drinking water supply and any future decision to include purified recycled water would be subject to community consultation and require stringent Government approvals.

3. Provide for enhanced stormwater management and harvesting and recycled water schemes to supply water for greening and cooling in new growth areas, reducing the demand on the drinking water system for these activities to 20 GL/year (this is discussed further in Priority 3), and potentially for release to rivers as environmental flows rather than releasing water from dams.

As part of delivering any of these rainfall-independent water supply projects, we will undertake specific consultation activities to ensure we continue to deliver to the community's and customer's expectations.

Table 2. Options for increased rainfall-independent supply capacity

Option	Benefit	Status
Sydney Desalination Plant Expansion	<ul style="list-style-type: none"> • Additional 90 GL/year. • Can be delivered in the shortest time (~4 years). 	<ul style="list-style-type: none"> • During the 2017-2020 drought, preliminary expansion plans were completed, with the detailed expansion plan put 'on-hold' in March 2020 when the drought ended, so that further analysis could be undertaken as part of this strategy.
Illawarra Desalination Plant	<ul style="list-style-type: none"> • Variable size options are available. • Provides improved resilience to the Illawarra and Macarthur areas. • Offers access to 67 GL of currently inaccessible storage in Lake Avon for the Macarthur and Prospect areas. 	<ul style="list-style-type: none"> • Although some planning work has been undertaken identifying a site, further investigations and approvals are required prior to site acquisition.
Purified recycled water schemes	<ul style="list-style-type: none"> • Could add significant rainfall-independent capacity to Greater Sydney during both drought and non-drought times. • Lower capital and operating costs than desalination. • Addresses some wastewater system risks. • Has a lower carbon footprint. 	<ul style="list-style-type: none"> • Sydney Water has identified eight possible schemes capable of delivering up to 140 GL/year in drought conditions. • These are in addition to a proposed Demonstration Plant that demonstrates the technology and ultimately forms part of the water supply network. • Proceeding with these schemes requires ongoing community engagement to support implementation.

As already described, modelling indicates that Sydney could go from full dams to 15% dam levels in around four to five years, and that if we wait until drought starts to plan new augmentations there may not be sufficient time to respond. We also know that our drought response planning needs to reduce the risks of reaching and operating at extremely low dam levels.

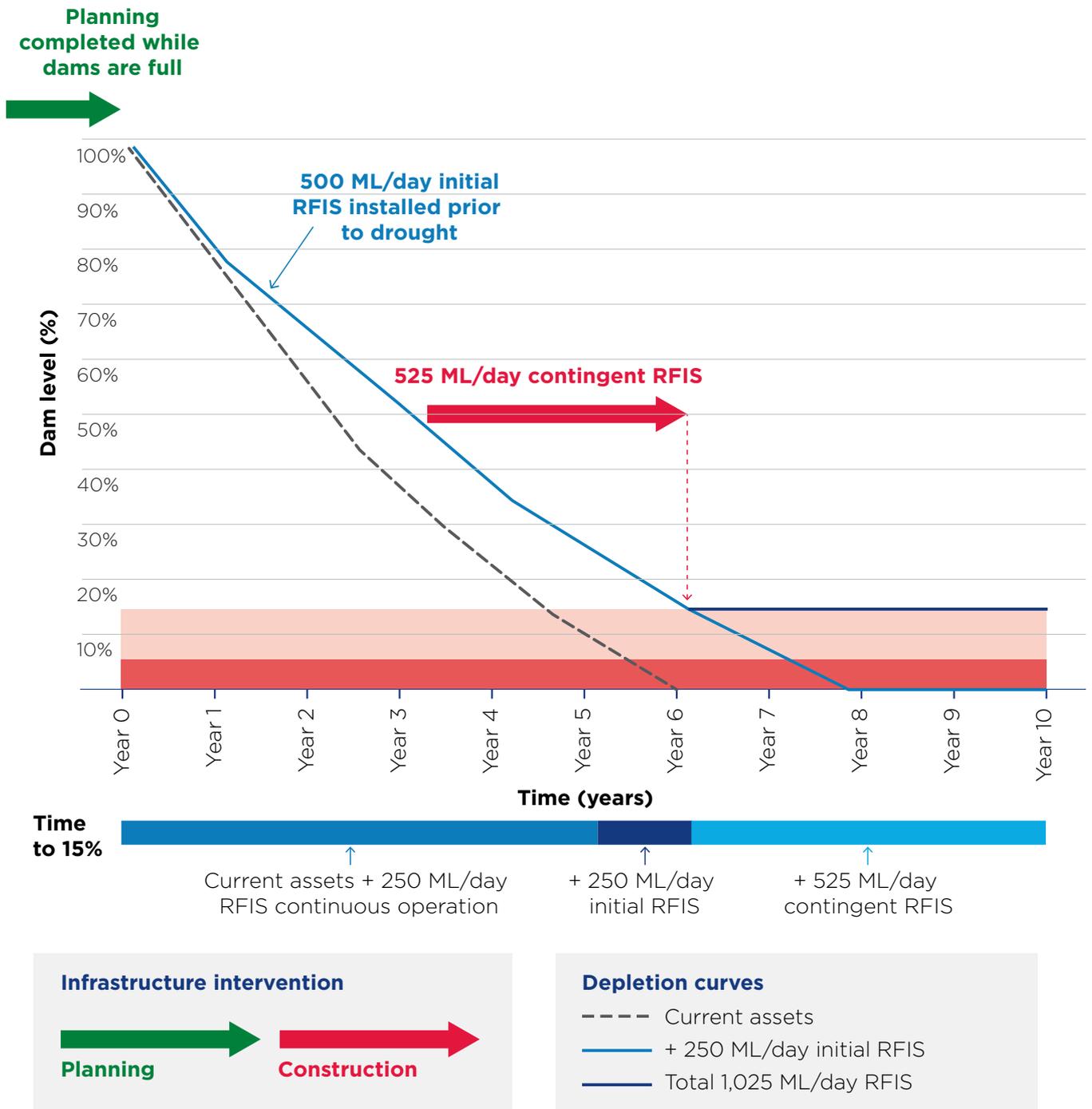
We can't predict when we will next go into drought, the severity of the drought or its duration. The long lead times needed to build new infrastructure mean that we need to start detailed planning now—while Sydney's dams are full—for new water supply capacity that is not rainfall dependent.

We need a portfolio of options for a comprehensive and adaptive drought response. It is clear that some initial investment will be needed in rainfall-independent supply before the next drought to support growth. At the same time, we need to plan for additional water supply options so that decisions can be made during drought within the time required to construct, commission and deliver additional water to the network before dam storages fall to extremely low levels.

Alternatively, if we do not have additional rainfall-independent supply in the system before returning to drought conditions, it could be necessary to start construction of large-scale rainfall-independent water supplies at relatively high dam levels to give enough time for these supplies to be ready before dams reach critically low levels if the drought persisted.

Figure 15 shows the effect on dam depletion rates of adding additional rainfall-independent supply in the system before the next drought and indicative timeframes for construction of contingent rainfall-independent supply that would be needed in drought. Having additional rainfall-independent supply before drought starts will delay the construction decision for contingent supplies, and is likely to reduce the scale of these investments. Figure 15 also highlights the need for augmentation planning to be complete prior to the return of severe drought conditions.

Figure 15. Impact of additional rainfall-independent supply (RFIS) on dam depletion rates (planning completed when dams are full)



Notes: This figure shows how the depletion rate is slowed and the time to reach critically low dam levels is extended by installing an additional 250 ML/day of rainfall-independent supply before drought conditions start, to achieve a total of 500 ML/day of rainfall-independent supplies (the existing desalination plant already provides 250ML/day). The additional measures that can be put in place during the drought are called 'contingent' rainfall-independent supply, which will further slow the rate of depletion.

2.4 Managing drought

Greater Sydney Drought Response Plan

As described earlier in the strategy, Greater Sydney is vulnerable to drought. While we expect drought to be a normal part of Sydney's climatic cycle, we do not know when the next drought will occur or how severe it will be.

Given this uncertainty, it is essential that Greater Sydney has a ready-made plan for dealing with drought whenever it may occur.

Learning from our experience of the Millennium Drought and the 2017-2020 droughts, Sydney Water and WaterNSW in collaboration with the NSW Government has developed the *Greater Sydney Drought Response Plan* to provide water authorities and the Government with a plan that can be activated quickly when drought occurs. This Plan is part of the framework that sits alongside the Greater Sydney Water Strategy and is consistent with, and responds to, the directions of the strategy. The plan focuses on:

- continuous monitoring of a range of indicators that suggest a drought may be developing
- identifying when actions need to be taken to respond to drought as it develops
- how decisions are made to manage our drought response
- the range of actions we can take to reduce demand for water in preparation for and during a drought

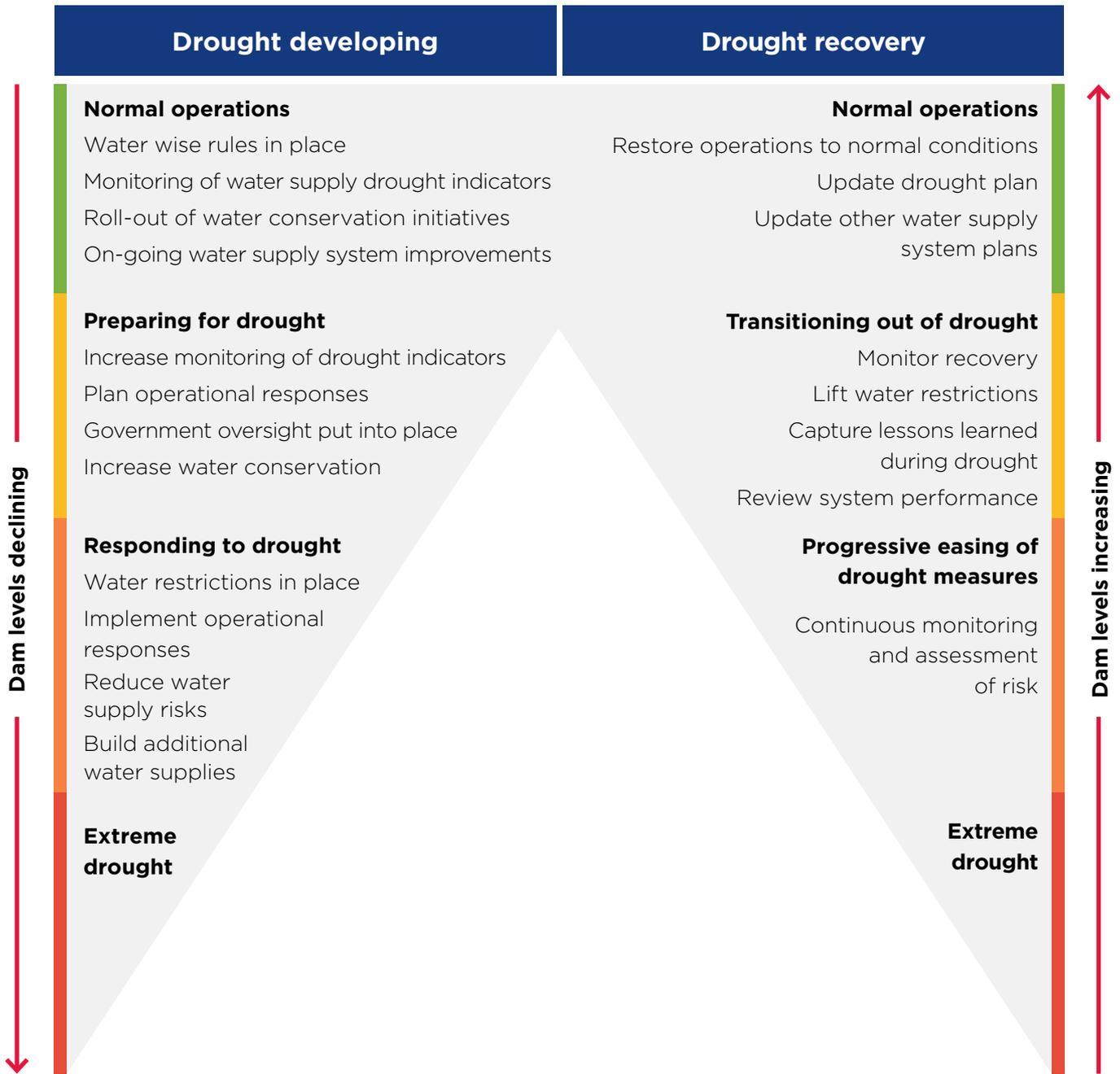
- the range of actions we can take to maximise existing water supplies
- additional water supply requirements to ensure additional rainfall independent supply is deliverable before or in the next drought.

The *Greater Sydney Drought Response Plan* takes into account that new rainfall-independent water supplies are being planned as part of this strategy. Once built, these new supplies will increase our level of enduring supply, reducing Sydney's exposure to future droughts, and reducing our dependence on drought response actions to get through severe drought. The plan will be reviewed annually to ensure it remains up to date with the latest information and revised to reflect the new water supply infrastructure once they are completed. A summary of the *Greater Sydney Drought Response Plan* can be found on the department's website at www.dpie.nsw.gov.au/our-work/water

Drought phases and indicators

To manage drought effectively, response actions such as public communication campaigns to reduce water consumption, water restrictions, or constructing new water supplies, need to be initiated with sufficient lead time. Figure 16 indicates the key stages of drought and when different types of responses need to be taken as water levels in water storages decline.

Figure 16. Phases of drought



Sydney Water and WaterNSW have developed a range of indicators to monitor and track the emergence of dry conditions in the water catchments of Sydney’s dams. Continuous monitoring of these indicators allows these water authorities to make decisions about when and how quickly they need to activate the drought response measures for which they are responsible.

Primary indicators include:

1. Recorded rainfall in catchments
2. Recorded inflows to storages

3. Time-based supply forecast (for example, time to reach critical storage level).

A range of secondary indicators will also be used to track the emergence or easing of drought conditions. These include:

1. Bureau of Meteorology’s (BOM) short-term rainfall outlook
2. BOMs El Nino/La Nina outlook.



Photography

Image courtesy of Department of Planning and Environment.
Tumbalong/Darling Harbour, Sydney.

Changing the triggers for water restrictions in drought

The *2017 Metropolitan Water Plan* set a framework for water restrictions for Greater Sydney. The plan set triggers for introducing water restrictions but did not include triggers for lifting them, noting that restrictions would be eased as dam levels rise, based on circumstances at the time.

The experience of the 2017-2020 drought provided several important lessons:

- We need more flexibility around when restrictions are implemented and lifted depending on the conditions.
- When in drought, the optimal timing for introducing restrictions is before warmer months when seasonal water use will be higher. Flexibility is needed so that restrictions

can be used when the greatest savings can be made while minimising unnecessary impacts on businesses and the community.

- Water restrictions were successful in helping to lower demand and reduce the load on water treatment plants when the raw water quality from the dams was affected by high rainfall in February 2020, including run off from bushfire-affected catchments.

In light of these lessons—and informed by Sydney Water’s customer feedback and community research—changes to the previous approach to water restrictions will be implemented as part of the Greater Sydney Water Strategy. These changes will allow water restrictions to be applied in a more flexible way and as appropriate to the context at the time.

Table 3. Changes to the approach for introducing water restrictions

Restriction level	Previous 2017 Metropolitan Water Plan restriction triggers	Proposed decision-making considerations
1	50%	A flexible approach based on depletion rates, inflows to our dams, volume of demand, and weather forecasts.
2	40%	
3	30%	

Other options to support Sydney’s drinking water supplies

We have also investigated two other options to support Greater Sydney’s drinking water supplies during drought

- The first option was whether water transfers from the Shoalhaven River to the Sydney system could commence when the Sydney dam levels are higher than the current rules allow—that is, at 85% dam capacity instead of the current 75% trigger. Our investigation has shown this change would not provide significant additional water supplies and there would likely be impacts on recreational activities for downstream users. Accordingly, this change will not be implemented.

- The second option was whether water releases from the Upper Nepean dams and Tallowa Dam for environmental purposes could be reduced in line with declining dam levels. Our investigation has shown that this could provide substantial additional water supplies for Sydney, particularly during a drought, while maintaining positive environmental outcomes for the river and its ecosystems. These changes will be considered further, and consulted upon, as part of the review of the *Water Sharing Plan for the Greater Metropolitan Region Unregulated Rivers Water Sources 2011*, due to be completed by December 2022.

2.5 Manage location-specific or asset-specific risks

There are a number of system risks and issues with Greater Sydney's water, wastewater and stormwater systems. These include the risks posed by ageing infrastructure, over-reliance on specific assets or groups of assets, and lack of connectivity between different systems.

Any short- or long-term disruption of supply from our major water filtration facilities would pose significant social and economic risks to Sydney. Some parts of the system such as Macarthur and Illawarra are dependent on one source of supply, increasing their vulnerability to asset failure and during times of drought.

In the wastewater system, the majority of Sydney's wastewater is collected and discharged to the ocean through three major wastewater collection networks and treatment systems, with ocean outfalls at Bondi, Malabar and North Head. The lack of capacity in these systems to support growth and the concentration of risks should major asset failure occur, together with the need to maximise rainfall-independent water supply options, requires a new approach for future network planning.

Risks are increased for water and wastewater systems by some of the key assets being more than 100 years old, and many parts of the networks being more than 50 years old.

It is important to note that our existing assets have served Greater Sydney very well; however, the spare capacity in our water and wastewater systems has largely been used up and we now need further investment so these systems can respond to growth and deliver other outcomes, including green space and tree canopy.

Strategies for managing these risks include minimising or reducing future loads on key assets and having more connections between systems for increased flexibility. For example, we are already examining connection options to improve resilience such as a proposed Prospect to Macarthur water transfer pipeline and a possible connection between Prospect—Orchard Hills—Macarthur, which will partly reduce the system's reliance on the Upper Canal and Warragamba pipelines.

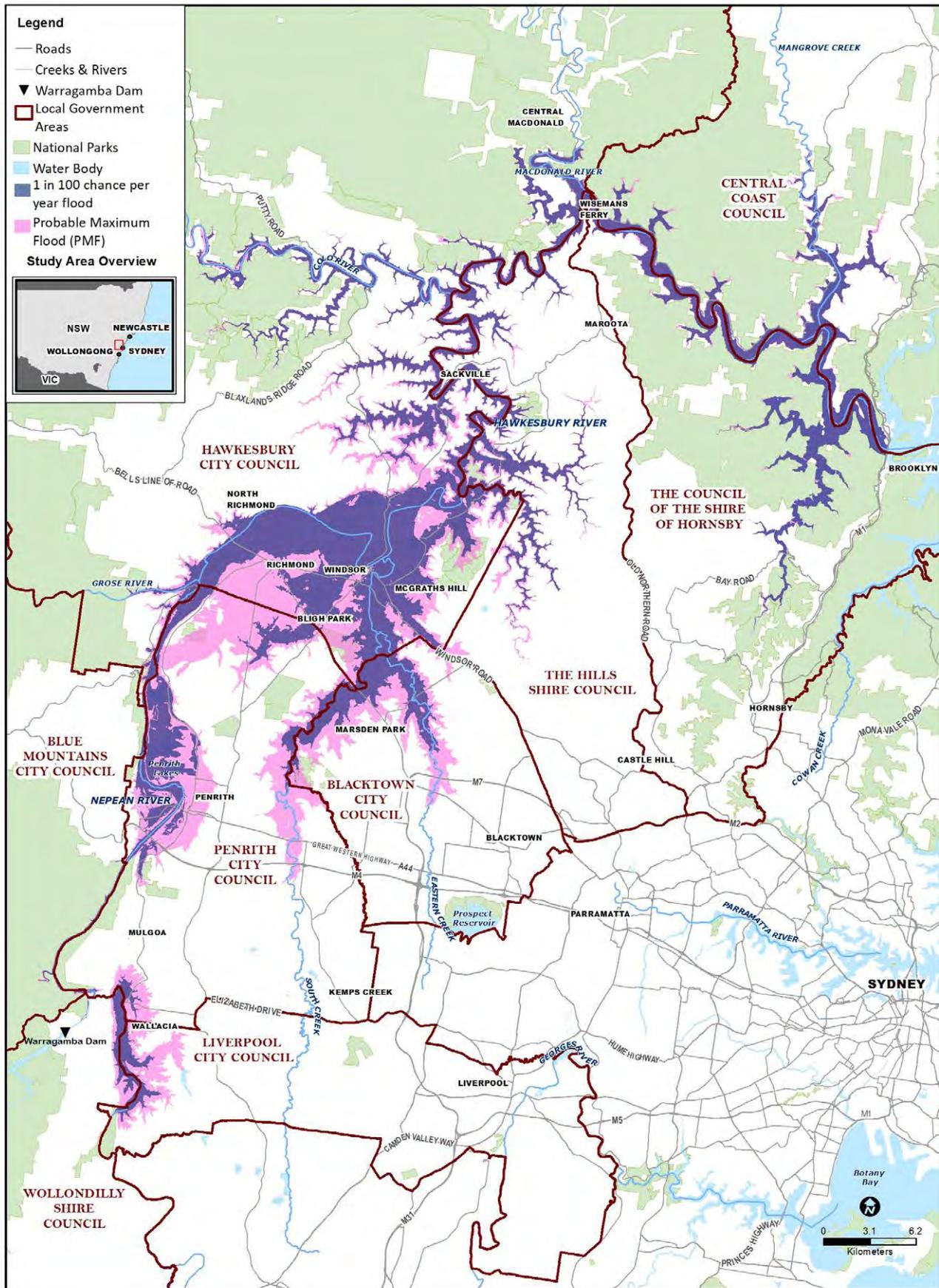
Detailed planning will be undertaken for Greater Sydney's wastewater and water systems that considers options for, and the value in, addressing these risks, including potential climate change impacts.

2.6 Respond to the impacts of flood mitigation decisions on the system

Increasing climate variability means that we will need to balance Greater Sydney's water network in such a way as to keep storage levels as high as possible while minimising flood risk. Measures such as improved water conservation and efficiency, water restrictions, reducing leaks and changing the operating rules for the Sydney Desalination Plant will be critical to achieving this balance.

Ongoing consideration is also being given to how best to mitigate flood risk in the Hawkesbury—Nepean Valley and Western Sydney—one of the nation's most flood-prone regions, home to a large and growing population, and one of Australia's most significant and diverse economies.

Figure 17. The Hawkesbury-Nepean Valley floodplain



Courtesy of Infrastructure NSW.

The proposal to raise Warragamba Dam for flood mitigation is one of nine elements of the NSW Government's Hawkesbury–Nepean Valley Flood Risk Management Strategy, released in 2017. By raising the dam wall, a dedicated flood mitigation zone (or airspace) would be created 14 metres above the current full water supply level. This zone would capture and temporarily hold back floodwaters coming from the large Warragamba catchment. After the flood peak, the floodwaters would be released in a controlled way. The zone would only be used during floods and the current full water supply level would not change.

Following investigation of all feasible options, the Hawkesbury–Nepean Valley Flood Management Taskforce found that raising the dam wall would lower potentially devastating flood levels downstream, give people more certainty of time to evacuate and decrease flood damage to urban and rural properties by more than 70% on average. In a flood similar to the worst on record in the valley, the number of homes impacted by floodwaters would reduce from around 15,500 to 5,000, the number of people requiring evacuation would decrease from around 90,000 to around 14,000, and damages would lessen by between \$8 billion to \$2 billion.

WaterNSW (the owner and operator of the dam) is finalising an environmental impact statement (EIS) and concept designs for the proposal, including detailed modelling, technical studies, flora and fauna surveys, and Aboriginal cultural heritage impact assessments. Consultation with traditional owners, local communities and other stakeholders is ongoing.

The NSW Government has identified the project as state significant infrastructure under NSW legislation, making it subject to comprehensive assessment requirements. Impacts on the Greater Blue Mountains World Heritage Area and threatened species and communities are also being assessed under Commonwealth laws.

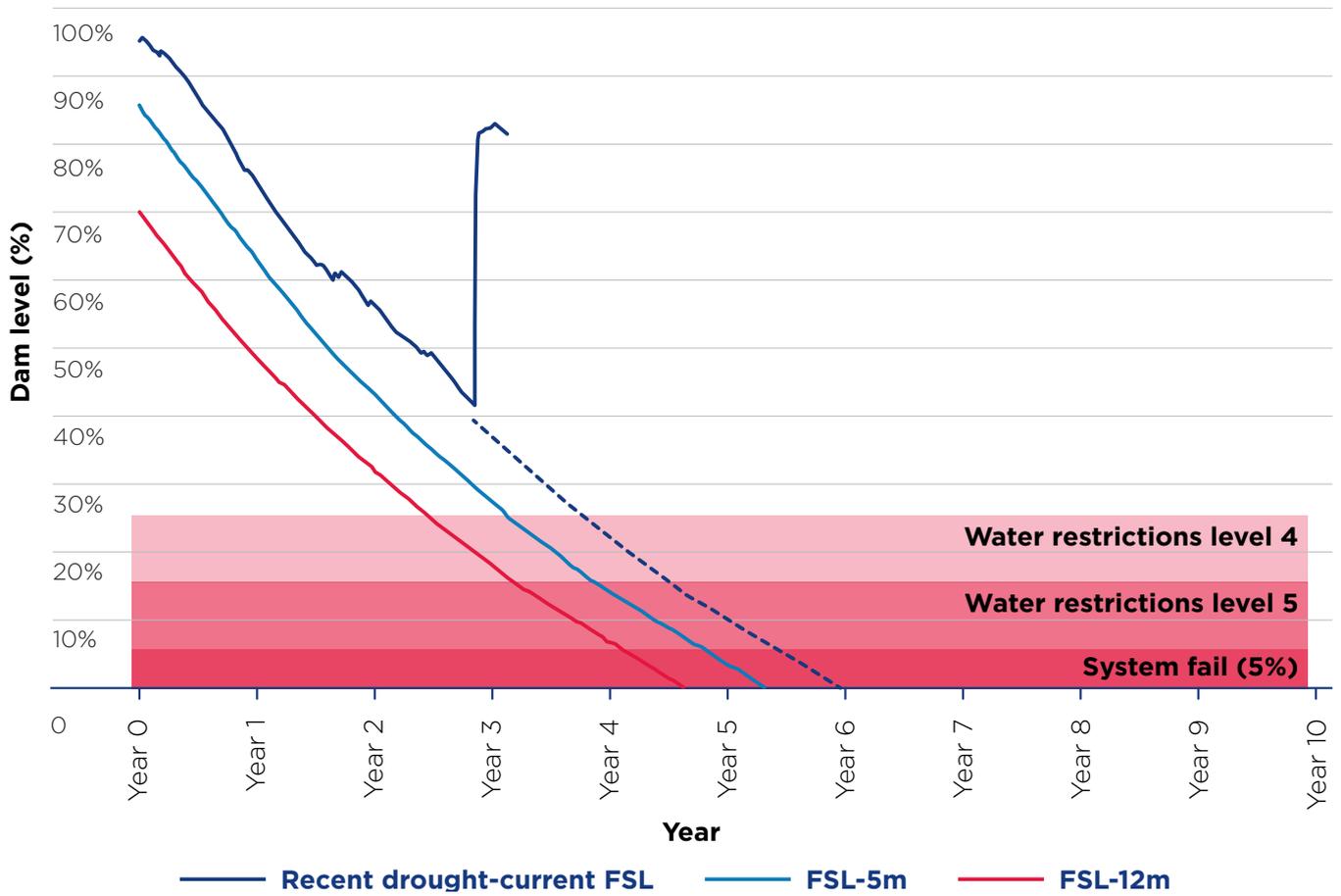
The EIS for the Warragamba Wall raising was on public exhibition from 29 September to 19 December 2021. A final decision about whether to proceed with the project will be made after all the environmental, cultural, financial and planning assessments are complete.

The impacts on water supply of the dam wall raising and the impacts of alternative flood mitigation options have been considered as part of the Greater Sydney Water Strategy to understand their potential effects on water security and drought risk. These alternative options include permanently lowering the full water supply level of the existing Warragamba Dam by 12 metres for flood mitigation, and accelerating plans for rainfall-independent supplies to make up the water supply shortfall. While raising the dam wall to create airspace for flood mitigation would not affect future water supply options, lowering the storage level for flood mitigation would mean that additional rainfall-independent supplies would be needed to address the reduction in water security. For example, if the dam supply levels were lowered by 12 metres, this would reduce dam storage by around 39% and overall system storage by around 30%. This would also reduce the long-term sustainable supply by 80 GL/year, equivalent to one new desalination plant.

Figure 18 illustrates how lowering the storage level of Warragamba Dam by different amounts reduces the time that it would take for dam levels to reach critically low levels under very low inflow conditions similar to those experienced during the 2017-2020 drought.

This analysis provides guidance about how water supply and security planning for the volumes and timing of new supply sources will need to adjust in response to the NSW Government's decision to proceed with raising the dam wall or to pursue alternative options.

Figure 18. Impact of reducing the full supply level (FSL) of Warragamba Dam on time to reach critical dam levels



Our city is green and liveable

We need water to create an attractive, green and liveable city. Water sustains trees, parks and bushland, supports outdoor recreation and improves the amenity of local neighbourhoods. Using water in urban design improves air quality, reduces ambient temperatures and boosts resilience to a changing climate. Cooler, greener places also provide habitat for animals and birds. We know that we can't rely on the drinking water system alone to meet these needs. We need to get much better at using recycled water and stormwater to support a highly liveable city by retaining water in the local landscape, particularly in Western Sydney where it is hotter and drier.

Making Sydney green and liveable also supports the city's global economic competitiveness, making it an attractive destination for international investment, businesses and skilled workers.

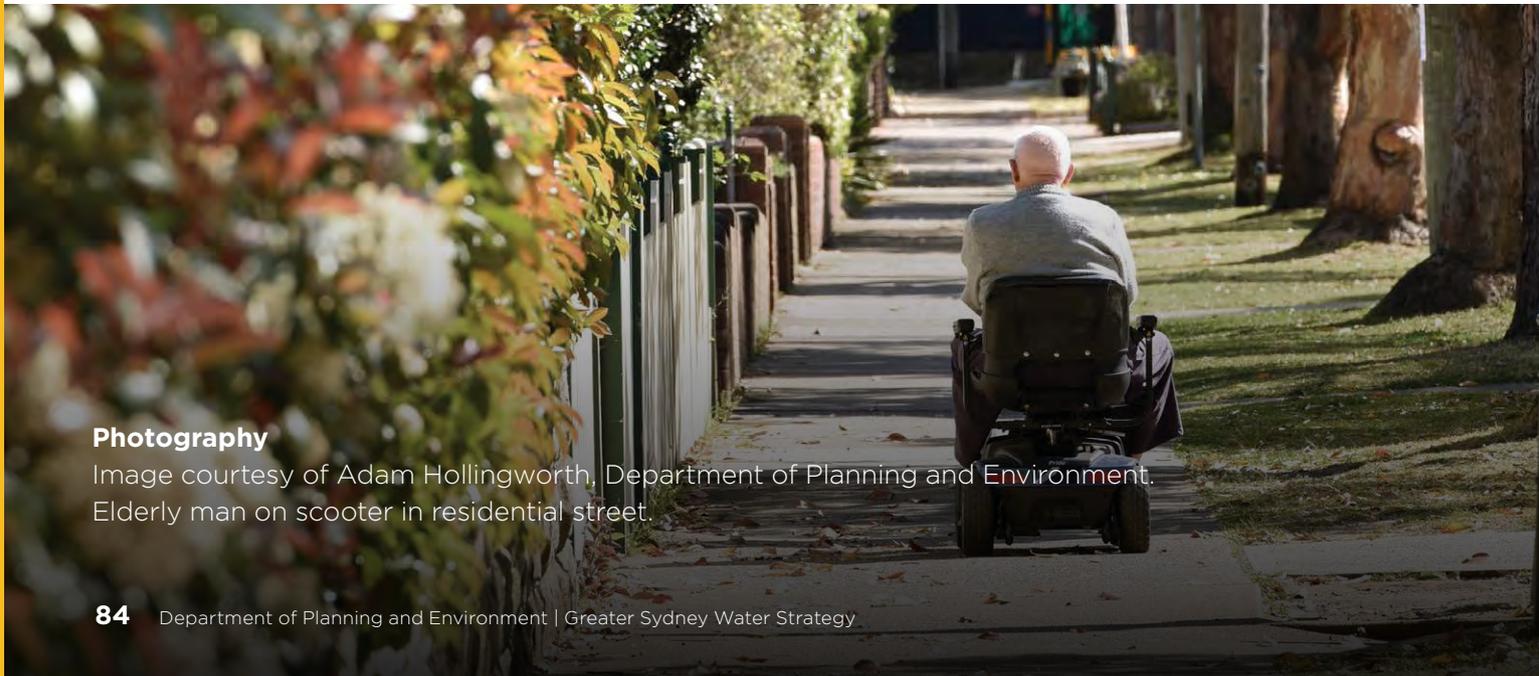
Greening Greater Sydney is one of the Premier's priorities. This includes increasing tree canopy and green cover throughout the region and making sure that homes in urban areas are within walking distance of quality green, open and public space.

This strategy considers a range of approaches to cool and green Greater Sydney:

- **Integrate water cycle and land use planning**—We need to provide the full range of water services (drinking water, wastewater and stormwater management) in an integrated way that responds to the needs of communities and improves liveability. Integrated water cycle management treats all water services in an interconnected way. By combining this whole-of-system, multidisciplinary approach with place-based planning, we can identify local solutions to manage and use water in ways that achieve the specific outcomes sought by communities.
- **Support the design principles for Greater Sydney**—Water and waterways are critical to delivering the green and blue places and infrastructure that are increasingly essential to good urban design. Water-sensitive urban design can be as simple as providing watering systems for landscaping along cycle paths through to large-scale stormwater harvesting and recycling projects that are integrated into parks and precincts. We need to make sure that we are using water innovatively and sustainably as a core element in high quality urban design throughout Greater Sydney.

Photography

Image courtesy of Adam Hollingworth, Department of Planning and Environment. Elderly man on scooter in residential street.



- Water for green public and private spaces—**
 To support growing communities and deliver a greener Sydney, we will need to maximise and use alternate water sources such as stormwater and recycled water to meet demands for cooling, greening and amenity. Actions to help keep private and public spaces green and cool, while minimising additional demand on drinking water supplies could include promoting smart irrigation technology, encouraging greater use of stormwater harvesting and recycled water, and conducting information campaigns to make households and businesses aware of actions they can take to manage their water use.
- Progress a circular economy approach—**
 A circular economy is one that values resources by keeping products and materials in use for as long as possible and recovering energy and other resources. The Greater Sydney Water Strategy has provided an opportunity to re-think our view of water management beyond the narrow focus of water services. By moving to a circular economy framework that encompasses water, materials, energy, food production, ecological health and jobs, water services in NSW can reduce their own carbon and ecological footprints and provide resources for other uses. This includes recovering energy from wastewater treatment and water supply systems and establishing regional bioresource hubs that co-locate and integrate energy, water and organic waste management.

Strategic pathway: Priority 3

Review current practice, planning mechanisms and development controls to **overcome barriers to integrated water cycle management (IWCM).**

Identify ways to make **more extensive use of water-sensitive urban design.**

Develop an implementation **plan to accelerate transition of the water sector to a circular economy.**

Develop a **Net Zero Carbon Plan** for water services delivered to Greater Sydney.

Set targets and introduce a governance framework for IWCM.

Develop a **new model for stormwater governance.**

Develop technical guidance and regulatory tools to support the Design and Place State Environmental Planning Policy to prioritise the use of rainwater, stormwater and use of recycled wastewater for cooling and greening.

Implement the Wianamatta South Creek Delivery Strategy for Western Sydney.

Embed specific place-based IWCM, urban design and smart water technology opportunities and **start planning to put these into practice.**

Establish a **regional scale food, energy, water and waste hub in Western Sydney**, in partnership with local government and industry.

Mature and consistent systems are in place for the management and use of water in urban areas.

Premier's greening priorities have been achieved.

Identify additional cooling and greening initiatives that can be delivered before 2040.

3.1 Integrate water cycle and land use planning

Integrated Water Cycle Management (IWCM) is a key element of urban water reform in the National Water Initiative. IWCM captures opportunities to improve all aspects of water management and provide urban amenity as part of the design and establishment of new urban communities, urban infill and urban redevelopment. It is also relevant to the replacement and renewal of existing urban infrastructure, including water and wastewater systems, channels and drainage lines, as well as footpaths and roadways.

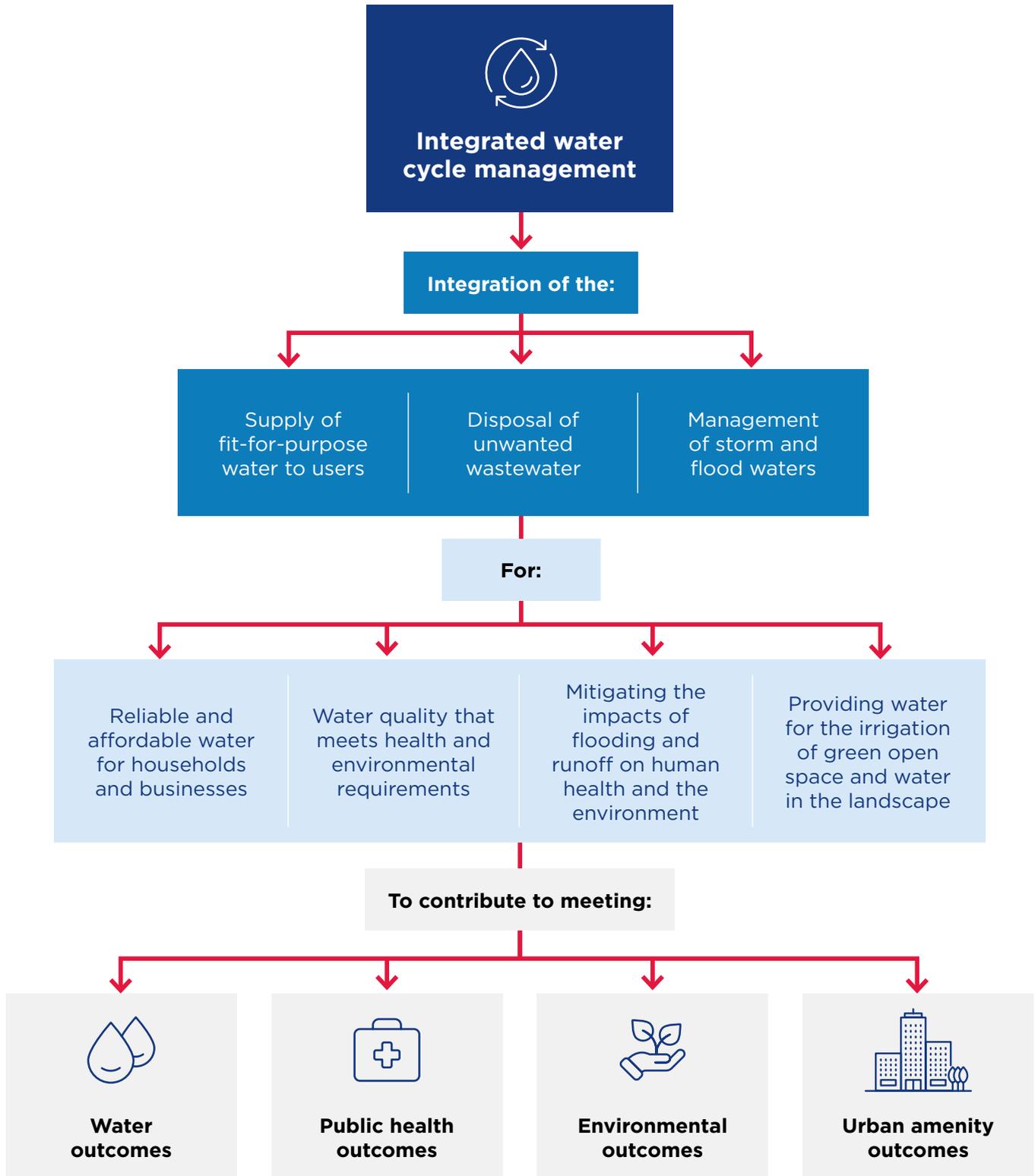
An IWCM approach promotes the coordinated development and management of water with land, urban infrastructure and related resources to better protect our water resources and vital ecosystems, and deliver place-based, community-centred outcomes that maximise the resilience and liveability of cities and towns. Adopting this integrated approach means that a greater range of options can be identified and evaluated at the outset of planning for urban water services, which can be designed to meet a broad range of community expectations, leading to better decisions and lower cost solutions.

In 2018, the NSW Government accepted Infrastructure NSW's advice that improvements need to be made in integrated water resource planning to prioritise major water infrastructure investment decisions needed to meet the challenges facing a rapidly growing Sydney. The South Creek Sector Review by Infrastructure NSW identified that a more integrated approach to water cycle and land use planning could generate significant economic benefit (~\$6.6 billion NPV* by 2056) for the Western Parkland City. Part of the economic value is in health benefits for the community.

The combination of IWCM and a place-based approach to land use and water planning will be critical to meeting the Premier's greening priorities and the objectives of the Greater Sydney Region Plan.

* Net present value (or NPV) is the difference between the current value of a stream of benefits and costs over a period of time. NPV identifies today's value of future benefits, and a positive NPV means a project or investment is delivering benefits or profits over time.

Figure 19. Integrated water cycle management aims for several outcomes



A place-based approach

A place-based approach refers to understanding the local context in which land use and water services are being planned, managed and balanced—taking into consideration factors such as community demographics, topography, housing densities and climate. One benefit of a place-based approach is that it can identify and develop local opportunities to achieve the specific outcomes a community wants to achieve. This can be contrasted with a network-oriented approach, which seeks to deliver a common level of service to all places.

Photography

Image courtesy of Adam Hollingworth, Department of Planning and Environment.
Footpath through Bardwell Park, Sydney.

A more integrated approach to land use and water cycle planning would result in:

- applying different solutions at various scales that suit the unique characteristics, needs and aspirations of communities
- retaining and integrating waterways and waterbodies into design of the urban landscape
- increasing stormwater retention by maximising previous land surface area, diverting roadway runoff into raingardens and using stormwater to support increased vegetation coverage
- enhanced urban canopy cover
- protected and enhanced riparian vegetation and habitat
- prioritising rainwater and stormwater harvesting and recycled water for irrigation and cooling to offset the additional water required by a greater canopy cover
- increasing the use of recycled water to support cooling and greening initiatives
- improving the quality and reduce the quantity of stormwater discharge to waterways.

A range of approaches will be needed to ensure that land use planning and urban design and development incorporate IWCM from the outset. Sydney Water has been exploring the different ways in which new developments (especially in Western Sydney) can integrate water smart solutions into buildings, streetscapes, precincts and open spaces. This work has identified a best practice approach to IWCM that includes clear targets, planning and development controls, and closer collaboration between all levels of government, developers, the water sector and the Greater Sydney Commission.

As new developments occur or existing areas are redeveloped across Greater Sydney, there are many opportunities for increasing stormwater harvesting and using decentralised forms of wastewater treatment and recycling, such as sewer mining schemes. There are many examples of decentralised wastewater treatment approaches in Sydney that vary in size—from

property scale systems (such as greywater systems, rainwater tanks and septic tank systems) to larger scale systems servicing buildings and precinct scale solutions. The NSW Government and Sydney Water will work with local councils to encourage these types of schemes in new developments where they are economically viable, and we will develop an approach for how to service these types of schemes and ensure no adverse impacts on waterway health.

The BASIX review being undertaken by the Government in 2022 will consider water use targets for different types of development and how the use of local water sources such as rainwater and stormwater can support achieving these targets.

The NSW Government continues to encourage innovation and competition in Sydney's water sector through the participation of private companies by licensing private water utilities under the *Water Industry Competition Act 2006* (WIC Act). These utilities have brought new ideas and pioneered innovative water recycling schemes in Sydney, such as those servicing award-winning developments at Central Park and Barangaroo. The water for these schemes is drawn from the same bulk water system as the rest of customers across Greater Sydney.

NSW was the first State to license private operators in 2006 and since then, water recycling schemes have been established across the state servicing a range of industrial, commercial and residential developments. The Government has been reviewing the operation of the WIC Act and will introduce reforms to streamline the licensing system and reduce red tape, while remaining focused on the protection of consumers, public health, and the environment.

We have considered the potential focus and direction for IWCM across the different 'cities' of Sydney based on development, climate and other factors (illustrated in Figure 20). The differences in focus and direction highlight the importance of considering integrated water management within a 'place' and the need to align land use planning with water planning. These are preliminary concepts that will continue to be refined as planning continues across the different cities.

Figure 20. Potential integrated water cycle management (IWCM) opportunities for Greater Sydney

Central River City

- Prioritise implementation of better practice typologies for industrial and commercial developments as these offer the strongest areas of opportunity from an immediate development focus perspective.
- The Greater Parramatta and Olympic Peninsula Growth Impact Corridor also provides a significant opportunity to implement IWCM (currently underway).
- Access to recycled water is needed to supplement stormwater use for irrigation, and appropriate infrastructure to supply recycled water needs to be confirmed.
- Better practice low and medium density typologies do not meet canopy or stormwater retention targets when optimised at the street block scale. Precinct scale IWCM interventions are likely required to ensure low and medium density developments meet liveability outcomes.
- Significant decreases in mean land surface temperature can be seen across all better practice typologies, where the greatest decrease is a result of substantial increases in canopy.

Western Parkland City

- An IWCM approach to planning Western City is crucial to meeting the Premier's Priorities and the Greater Sydney Region Plan.
- Four key technical solutions will be needed to retain stormwater in the urban environment:
 - Bioretention sponges, e.g. rain gardens
 - Water Smart Wianamatta street trees
 - Permeable pavements
 - Rainwater harvesting and reuse.
- Precinct scale IWCM interventions are required to meet better practice targets, mainly changing the development footprints to meet a 50% permeability and 40% permeability outcome for residential and employment lands respectively.
- Typologies developed by Sydney Water for Western Sydney should be implemented for future developments.
- The Western Sydney Street Design Guidelines provide best practice targets to encourage street tree planting that optimises enhanced canopy and cooling outcomes.

Illawarra Region

- Growth of current practice low density typologies is at risk of impacting the quality of waterway health due to decreased permeability (~50%) and limited canopy cover.
- Planning controls should align with the Western City better practice typologies for low density developments.
- Low density typologies are also likely to have an increased demand for potable water under better practice scenarios, as there are limited options of water harvesting at the lot scale.
- Although the scale of growth is less significant than the other cities, there are likely longer-term impacts if not appropriately managed in the next 20 years which may place strain on Sydney's water supply for the Illawarra.

Eastern Harbour City

- Prioritise implementation of better practice typologies for growth corridor typologies (generally high or very high-density residential typologies).
- Better practice industrial typologies have significant increases in performance, however there is little opportunity for new industrial development in Eastern City.
- The projected change of industrial and medium density land to mixed use commercial and high to very high density offers an opportunity to naturalise and enhance urban waterways.
- Changes in land use also offer an opportunity to modernise the water network and implement possible decentralised recycled water systems.

Challenges for integrated urban water management

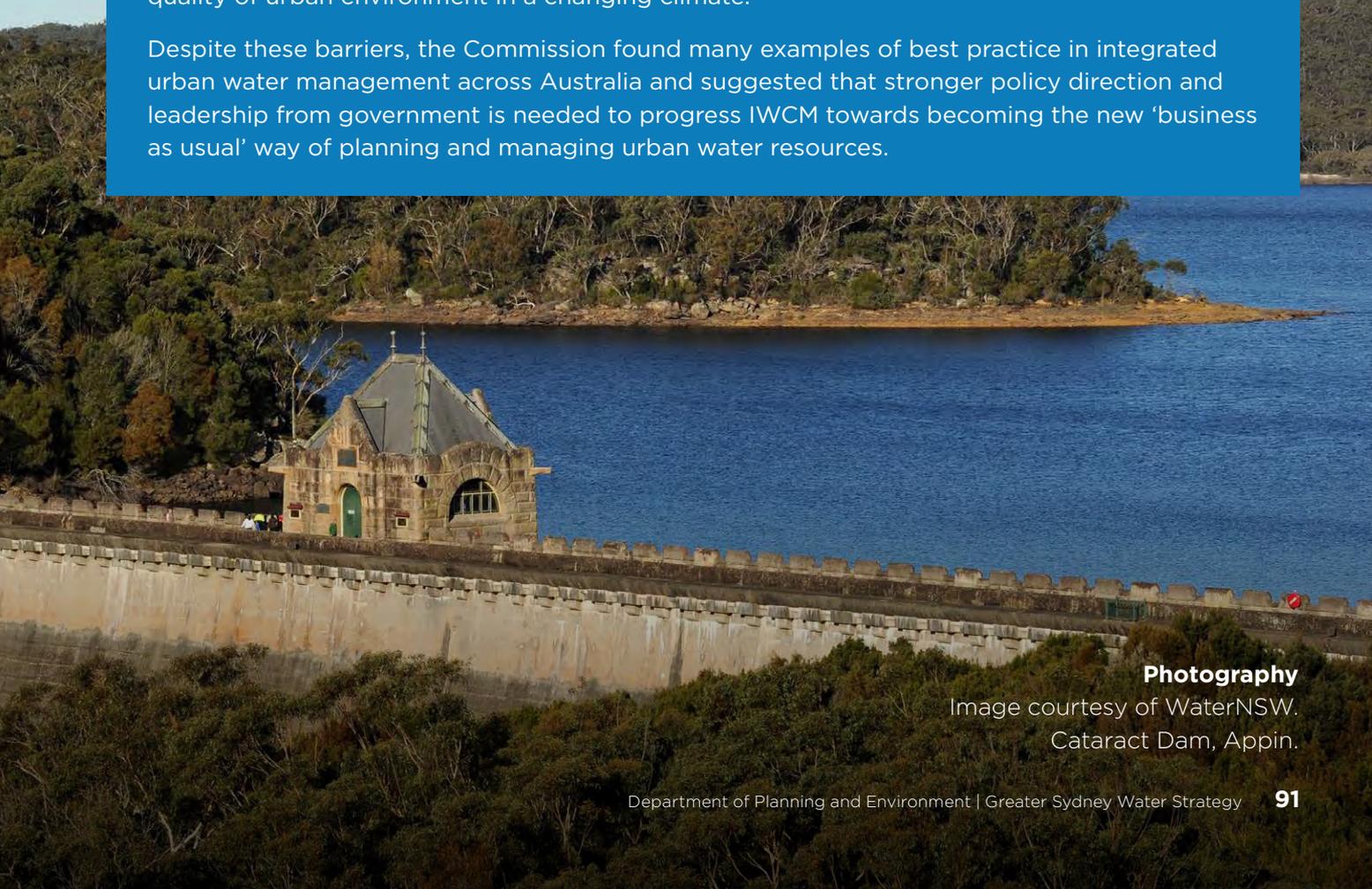
The National Water Initiative (NWI) is a shared commitment by Australian governments to increase the efficiency of water use nationwide, leading to greater certainty for investment and increased productivity. The NWI includes outcomes and objectives related to the integrated management of water for environmental and other public benefit outcomes.

As part of its review of the NWI, the Productivity Commission has conducted research into integrated urban water management across Australia. The Commission's Research Paper *Integrated Urban Water Management—Why a good idea seems hard to implement* (March 2020) identified key impediments to implementing IWCM, including:

- A lack of clear objectives, policy frameworks and well-defined roles and responsibilities for water-related aspects of enhanced urban amenity.
- Poor links between statutory land use and water planning.
- Stormwater planning and management is not integrated into general water planning.
- Local scale and system wide water planning are not well integrated.
- Limited capabilities to rigorously and transparently assess the costs and benefits of IWCM projects.
- Complex regulatory regimes, additional administrative hurdles and excessive transaction costs restrict the range of options considered.

The Commission also observed that there are complex policy issues involved in shifting to an IWCM approach, including trade offs between the quality and type of urban amenity and environmental outcomes being sought, questions of equity (including the impact on house prices), who should bear the costs of improving liveability and amenity, the issue of 'intergenerational equity' and the long-term opportunity costs of not providing an appropriate quality of urban environment in a changing climate.

Despite these barriers, the Commission found many examples of best practice in integrated urban water management across Australia and suggested that stronger policy direction and leadership from government is needed to progress IWCM towards becoming the new 'business as usual' way of planning and managing urban water resources.



Photography

Image courtesy of WaterNSW.
Cataract Dam, Appin.

Case study: Wianamatta South Creek Delivery Strategy

Wianamatta South Creek is a major tributary of the Hawkesbury—Nepean River in the Western Sydney Basin that runs 80 km from Narellan to Windsor. A large part (80%) of the 63,000 ha catchment falls within the Western Parkland City urbanised area, covering 6,000 km² and eight local government areas. The catchment is experiencing rapid change from rural to predominantly urban land use, including development of the Western Sydney Aerotropolis precinct.

Wianamatta South Creek and its catchment has a critical role to play in realising the vision for the Western Parkland City to create cool, green and attractive urban communities by retaining water in the landscape, integrating water cycle planning in the design of new neighbourhoods and supporting the health and management of waterways.

This vision has been captured in several strategic land use planning frameworks, including the Greater Sydney Region Plan and Western Sydney District Plan, with links to the proposed Design and Place State Environmental Planning Policy. Premier's Priorities for open space and greening are also key requirements, with about two million trees to be planted in the area.

New integrated land use and water cycle management approaches and major policy reforms are required to achieve the economic, amenity and environmental objectives of the Western Parkland City. Reflecting this, the South Creek Catchment Sector Review identified changes to land use controls and major water-related infrastructure investment decisions:

- **Stage 1 of the South Creek Sector Review** identified significant economic value in taking an integrated approach to land use, water cycle management and investment in advanced recycling water infrastructure in developing the Western Parkland City. This value was estimated at around \$6.6 billion (NPV), compared to a business-as-usual approach.
- **Stage 2 of the South Creek Sector Review** included a strategic economic analysis of stormwater and waterways governance, which found that a catchment-wide approach to planning and delivery of stormwater infrastructure and waterways management could deliver a significant economic benefit (which is being investigated further).

To achieve these changes, a Delivery Strategy is being developed to provide an adaptive 40-year framework and the tools needed for integrated land use and water cycle management for the Wianamatta South Creek catchment. The strategy focuses initially on actions aligned with planning for the Western Sydney Aerotropolis.

The Delivery Strategy will cover green and blue infrastructure, land use outcomes, catchment health and flooding, connected spaces and the interfaces and relationships with future development, utilities and transport. It will also address current and future land controls and ownership, and is being developed collaboratively with Aboriginal communities, landholders, local government, Sydney Water and other stakeholders. A key first step is Sydney Water's planning for the Upper South Creek Advanced Water Recycling Centre which is planned to be operational in 2025.

3.2 Support the design principles for Greater Sydney

The Greater Sydney Region Plan—A Metropolis of Three Cities² describes a vision of three cities (the Western Parkland City, Central River City and Eastern Harbour City) where most residents live within 30 minutes of their jobs, education and health facilities, services and great places. It describes priorities for green and blue infrastructure such as urban tree canopy, green ground cover, bushland, waterways, parks and open spaces.

As the region's population grows, the design quality of the urban environment across Greater Sydney is more important than ever. Urban design frameworks provide direction for the policies and actions that shape our open spaces, buildings, and landscapes. These frameworks, which are an important part of the planning system in NSW, bring together designers (building, engineering and landscape) with planners (strategic, cultural and social), heritage and environment advisors, economists and other specialists.

Four design principles identified by the Government Architect NSW are helping to deliver green infrastructure in Greater Sydney:

- **Integration**—combining green infrastructure with urban development and grey infrastructure
- **Connectivity**—creating an interconnected network of open space
- **Multifunctionality**—delivering multiple ecosystem services simultaneously
- **Participation**—involving stakeholders in development and implementation.

Water is critical in supporting these principles and to delivering the green places and infrastructure that are increasingly essential to high quality urban design. Water can enliven existing and new public open spaces and civic infrastructure, rehabilitate degraded and neglected places, and support diverse recreational activities—while also performing important environmental functions such as improving water quality, reducing pollution and runoff, restoring highly modified urban waterways, mitigating flood risk and providing animal habitat.

Innovative, water sensitive urban design can be as simple as providing watering systems for tree planting and landscaping along walking and cycling paths through to large-scale stormwater harvesting and recycling projects that are integrated or retrofitted into major parks and precincts.

Across Greater Sydney, there are opportunities to use water more effectively to address our needs for both more efficient water use and high quality urban design. The Greater Sydney Water Strategy includes actions that:

- **Formally incorporate the consideration of water use and management within urban design frameworks and land use planning instruments** as part of the NSW planning system
- **Promote the greater use of stormwater harvesting and retention, and use of recycled water** as core urban design elements throughout Greater Sydney
- **Provide guidance through the Government Architect NSW** for planners, architects, engineers and other specialists on how water can be incorporated to deliver green infrastructure and public open space
- **And demonstration projects** that show the benefits of integrating or retrofitting multifunction water use at a precinct-scale.

2. Greater Sydney Commission 2018, *Greater Sydney Region Plan—A Metropolis of Three Cities*

Case study: Sydney Park Water Re-use Project

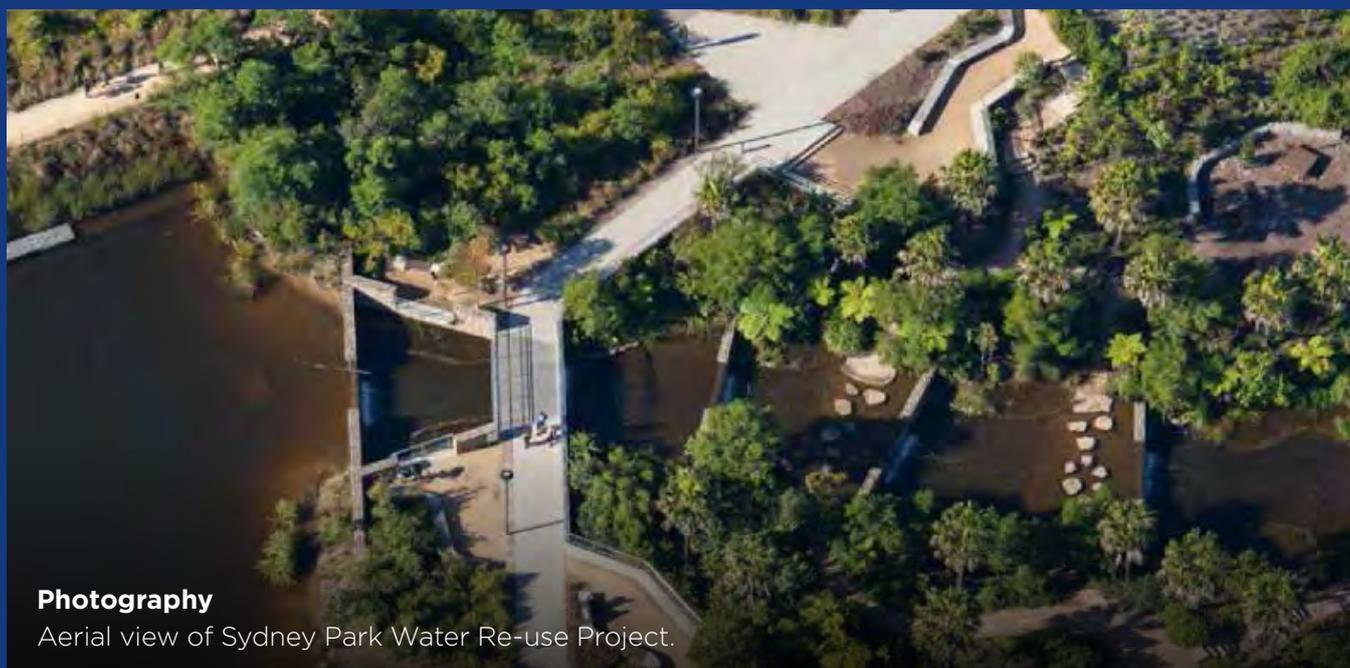
A naturalised stormwater treatment system, integrated into Sydney Park at St Peters, is the City of Sydney's largest environmental project to date—successfully fusing design, science, art and ecology to create new recreational park uses and native wildlife habitat.

The project was ambitious from the outset, with the goal of capturing and cleaning 850 million litres of stormwater each year for recycling and reuse. The project retrofitted Sydney Park as a precinct-scale stormwater harvesting asset—maintaining and enhancing the park as a major green open space for the inner city through a collaborative urban design effort that incorporated water sensitive urban design, new connecting infrastructure, environmental bio-retention and a local urban water re-use system.

Instead of constructing traditional grey water treatment systems, the project uses connected wetlands, cascades, spillway and sculptural elements within the park to filter and treat the equivalent of 340 Olympic-sized swimming pools.

Stormwater is fed into the naturalised system from a main drainage pipe that captures runoff from the adjacent suburb of Newtown. Footbridges, informal paths and stepping stones encourage people to explore the park's new water features. The park's wetlands have the highest population of native birds in the local area, including 22 wetland species. Public art is integrated directly into the filtering process in the form of raised terracotta troughs that release, reticulate and aerate the water via cascades.

The project has won several Australian and international awards for landscape architecture and environmental design.



Photography

Aerial view of Sydney Park Water Re-use Project.

Case study: Rosemeadow Demonstration Project

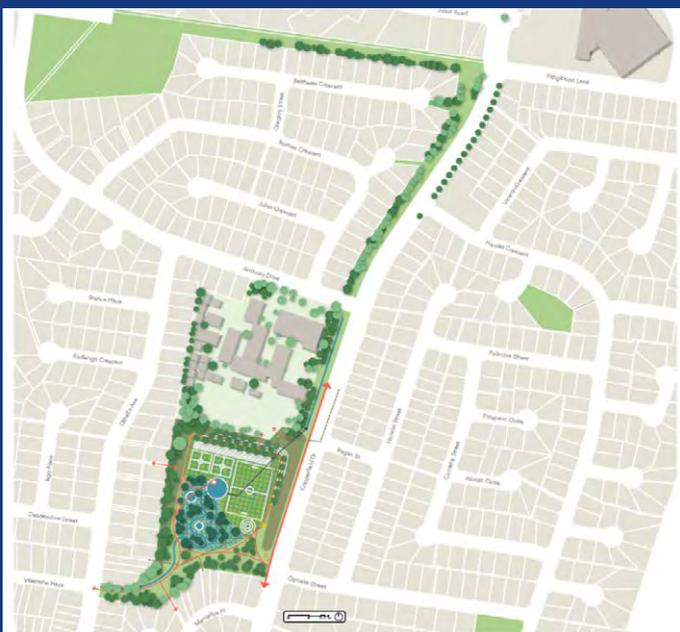
Rosemeadow is a residential suburb within Campbelltown City Council, Western City District of Greater Sydney. It was subdivided in the 1980s as a residential estate, including roads and stormwater infrastructure. Urban drainage systems became a dominant function in public open space as the natural watercourses across the suburb were replaced with stormwater management systems such as pipes, grass lined channels and retarding basins. These stormwater management practices caused several issues, such as spatially constrained urban drainage systems, downstream flooding, transfer of polluted stormwater to downstream waterways and loss of the social, cultural and environmental benefits that natural waterways provide.

The Rosemeadow Demonstration Project shows how tree planting and integrated stormwater management solutions in an established residential suburb can increase both the performance of stormwater systems and the quality of public open space, and improve liveability through better social and biodiversity outcomes.

The project draws attention to the vital role water plays in supporting the local environment, healthy landscapes and resilient communities. It provides design guidance on how to integrate stormwater management systems with natural systems to help capture, treat and show stormwater runoff, help store flood water, improve soil moisture levels, increase tree health, cool residential streets, and provide better quality public open spaces.

Working in collaboration with Campbelltown City Council, multiple state government agencies, universities, a local Aboriginal group and the local community, the Department of Planning and Environment has developed technical case studies and design guides to support greater tree planting in public spaces, including streets and stormwater systems replication across Greater Sydney.

The demonstration component of the project (Copperfield Drive, as illustrated below) commenced in June 2021. The project will be supported by ongoing monitoring to evaluate the success of the interventions.





Photography

Image courtesy of Department of Planning and Environment.
Sydney Harbour, Sydney.

3.3 Prioritise alternative water sources for greening and cooling

To support growing communities and deliver a greener Sydney, we will need to maximise our use of alternate water sources such as stormwater and recycled water to meet demands for cooling, greening and amenity and reduce additional demands on the drinking water supplies.

There is considerable scope to improve how we irrigate public open space, trees and vegetation to conserve our drinking water supply while still enjoying the benefits of parks, gardens and shady streets. A recent study commissioned in Western Sydney by Sydney Water (*Mosaic Insights, 2020*) found that incorporating irrigated urban greening in new developments could reduce extreme heat day maximum temperatures in residential areas and planned employment precincts by approximately 3.5°C under current climatic conditions. Modelling showed that this cooling effect increases under hotter temperatures—a significant effect that will become more important as urban areas experience hotter conditions due to a changing climate.

Households play an active part in Greater Sydney's ability to provide cool and green spaces. While there is often an emphasis on public open space to deliver community benefits and improve the city's liveability and amenity, most open space in many urban precincts and neighbourhoods is privately owned. This means that we also need to make sure that private open space (our front and back yards) stays green and cool, even during times of drought. This is an important role that water plays in creating an environment that supports the community's enjoyment of green space for physical and mental well-being.

One of the main issues associated with private space outdoor water use is for households to know when and how much water to use and the impact this has on things such as electricity use. We can increase this knowledge through information and awareness campaigns and the use of smart technology and real time data.

Initiatives that may be delivered through the Greater Sydney Water Strategy include:

- **Greater use of stormwater harvesting and recycled water** to create and maintain green open space and tree canopy, including integrating these water services into the early stages of planning and designing new urban developments
- **Reviewing and addressing regulatory, policy and pricing barriers to the reuse of recycled water** and ensuring that we have sound and easily applicable economic frameworks for valuing the outcomes of improved water cycle management
- **Promoting smart irrigation technology**, such as supporting research and development into prototypes that can recommend the most appropriate time to irrigate by using a combination of air temperature sensors, moisture readings in the soil and weather and climate information
- **Identifying innovative urban forms** that provide cool and green features without compromising drinking water supply and embedding templates for these forms in planning, policy and legislation. This could include locating large irrigation areas such as sports fields, recreational parks and public gardens together to maximise the value of using recycled water services to activate these green 'hubs'
- **Conducting information campaigns** to make households aware of actions they can take, and products they can use, to cool and green private open space.

3.4 Progress a circular economy approach for water services

Underpinned by a transition to renewable energy sources, the circular economy keeps resources in use at their highest value, designs waste out of the system and restores and enhances natural capital. It contributes to innovation and job creation and brings major economic and social benefits while reducing our impact on the environment. It will be an essential contributor to limiting global warming.

Water consumption requires the use of energy, chemicals and materials, and can alter river flows and generate organic waste that can affect the ecological health of our waterways and oceans. Circular economy frameworks provide the opportunity to re-think how we manage the complex interconnections between water services, carbon emissions, ecological health and economic productivity.

NSW and the circular economy

The *NSW Circular Economy Policy Statement—Too Good to Waste* sets out principles, actions and opportunities to help NSW make the shift to a best practice circular economy. The statement includes support for innovative approaches and reducing market, regulatory and governance barriers to the adoption of circular economy principles.

The NSW Government published the *NSW Waste and Sustainable Materials Strategy 2041* in June. This strategy sets the future direction of the state's waste and resource recovery system, including contributing towards a circular economy by keeping products and materials in use for as long as possible. The strategy also includes a plan to address the pressing need to reduce plastic waste and manage plastic pollution.

As part of its commitment to reach net zero emissions by 2050, the Government has set a target of net zero emissions from organic waste by 2030.

Photography

Image courtesy of Department of Planning and Environment, Bicentennial Park, Sydney.

There is significant scope to provide strong support for water utilities—many of which have been at the forefront of circular resource management—to become leaders in the circular economy and management of water services. The Greater Sydney Water Strategy opens up possibilities to expand our view of water management and move to a circular economy framework that encompasses water, materials, energy, food production, resource protection and jobs.

The water sector’s transition to a circular economy will align with the NSW Government’s goal of reaching net zero carbon emissions by 2050. However, it is possible for the transition to occur much sooner, depending on customer, stakeholder and community preferences and willingness to pay.

Circular economy and net zero emissions initiatives that will be explored over the life of the strategy include:

- **Working with the community and customers to build confidence in and acceptance of purified recycled water for drinking**, with the circular economy objective of ‘closing the loop’ and supplying purified recycled water to the potable system. Purified recycled water would only be introduced to Sydney’s water supply system following community consultation and stringent Government approvals. There are no plans to introduce purified recycled water into the potable system at this time.
- **Bioresource hubs** that integrate food production, energy, water, and organic waste management. This could include establishing an organic waste processing hub in Western Sydney as part of the planned Upper South Creek Advanced Water Recycling Plant to produce recycled water, bioenergy (as electricity, heat, biomethane or green hydrogen), fertiliser products and purified carbon dioxide.
- **Resource recovery at Sydney Water’s coastal wastewater treatment plants (WWTPs)** to capture organics for bio-energy production at Malabar and North Head.
- **Food waste co-digestion**—establishing capacity to receive and digest food waste at a network of WWTPs to enhance bioenergy production.
- **Expanded non-potable recycled water services**, particularly in greenfield development in Western Sydney to support urban greening and cooling.
- **Improved nutrient recovery**, including investigating the increased capture of nutrients and value adding for local industry.
- **Increasing use of recycled materials in the supply chain**, such as investigating the use of recycled and low carbon materials for use in new infrastructure, to reduce carbon footprint and decrease pressure on landfill and virgin resources.
- **Further action to ‘level the playing field’** for circular economy projects and businesses.
- **Improving economic valuation models** to capture environmental benefits and the value of natural capital.
- **Sydney Water** is working with customers, partners and stakeholders to understand the aspirations and willingness to pay in order to achieve the goal of net zero emissions from its operations by 2030 and within its supply chain by 2040.

Case study: Green gas from wastewater— an Australian-first for Sydney

In a first for Australia, Sydney's Malabar Biomethane Injection Project will upgrade biogas produced from wastewater and inject it into the NSW gas distribution network, giving thousands of homes and businesses access to renewable green gas for cooking, heating and hot water.

Sydney Water and Jemena are partnering on the demonstration project to convert raw biogas (derived from the anaerobic digestion process used at Sydney Water's Malabar water treatment plant) into biomethane—turning waste into clean, green energy. The project is supported by the Australian Renewable Energy Agency (ARENA).

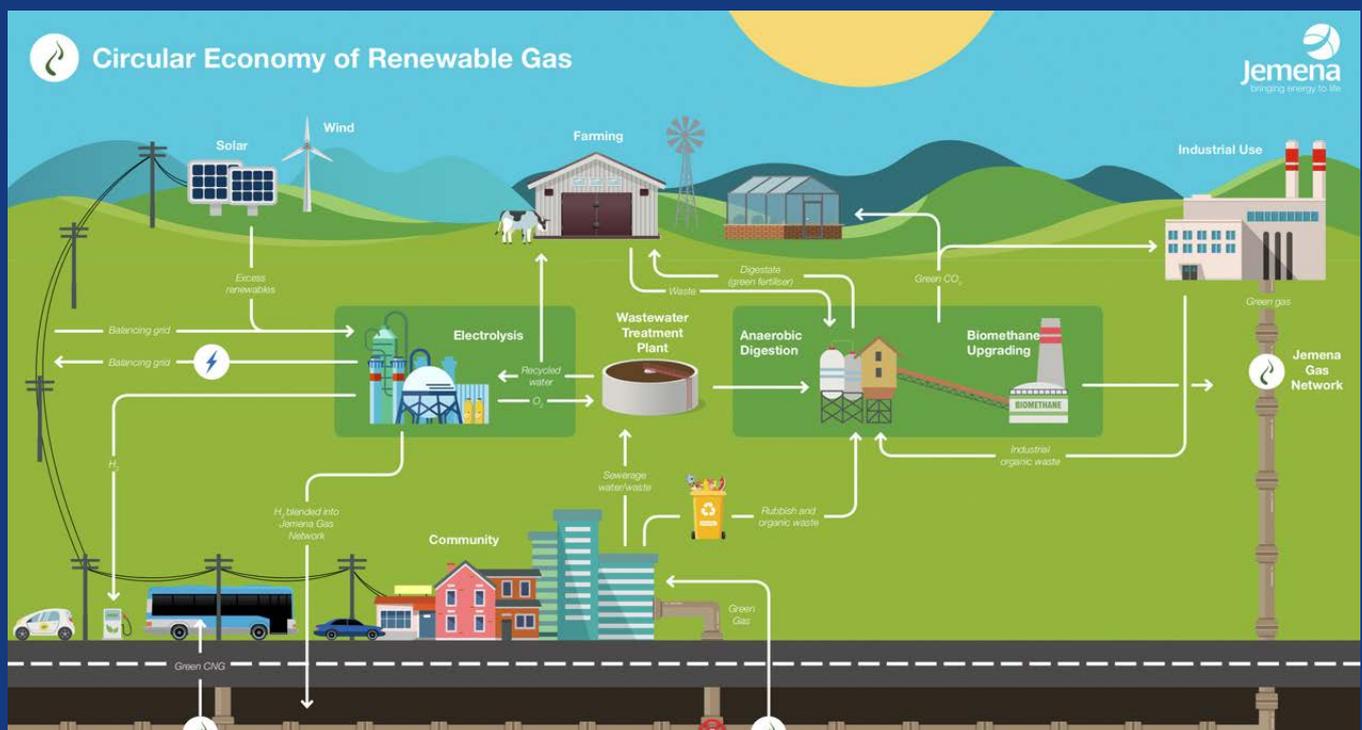
The project is accompanied by a Renewable Gas Certification Pilot through which gas customers can buy renewable gas to help reduce their carbon emissions. The scheme—which is also an Australian-first—will establish a voluntary market for gas users to buy biogases, such as biomethane, which can be produced from wastewater, food and garden waste.

The pilot is a partnership with Green Power, Jemena and Energy Networks Australia (ENA).

Unlocking a renewable gas market is also expected to help the NSW industrial and manufacturing sectors to decarbonise and meet zero emissions targets by giving them more clean energy choices.

From 2022, approximately 95,000 gigajoules of biomethane will be generated each year through the Malabar project, enough to meet the gas demand of 6,300 homes. The project is expected to remove 56,000 tonnes of carbon emissions, potentially 11,000 tonnes if scaled up to its full potential, making it an important contributor to the NSW Government's plan to cut emissions by 35% by 2030 compared to 2005 levels.

Bioenergy and waste-to-energy projects are widespread in the United States and Europe. Bioenergy Australia has estimated that the biofuels industry could provide 250,000 jobs across Australia, mostly in regional areas, and has the potential to avoid up to 9 million tonnes of CO₂ emissions.



Circular economy of renewable gas. Illustration courtesy of Jemena.



Photography

Image courtesy of Department of Planning and Environment.
Aerial view of Sydney Harbour from plane.

Our waterways and landscapes are healthy

Greater Sydney has a rich diversity of aquatic and marine environments, from the sandstone gorges of our drinking water catchments and the majestic Hawkesbury–Nepean River to coastal lagoons, beautiful beaches and the stunning Sydney Harbour and Illawarra escarpment. Within the city, waterways and estuary foreshores provide nature refuges and habitat for wildlife and are highly valued by urban communities. As we explore our future water options, we must also find the right mix of solutions to better protect, maintain and improve these environments.

Aquatic and marine environments provide important ecosystem services but also sustain our health and wellbeing by supporting recreational activities, outdoor relaxation and a connection

with nature. These diverse places have a wide range of ecological needs and values, all of which are underpinned by water quality and availability.

The restoration, maintenance or re-discovery of local ecosystem services within the city is essential for a productive, sustainable, liveable and ultimately successful Sydney. The challenge we face is not simply working out how we grow without further degrading the remaining health and value of our waterways, but in reshaping the past 100 years of urban development to a form and system that works with the natural water cycle and enhances the region's natural ecosystems and biodiversity.

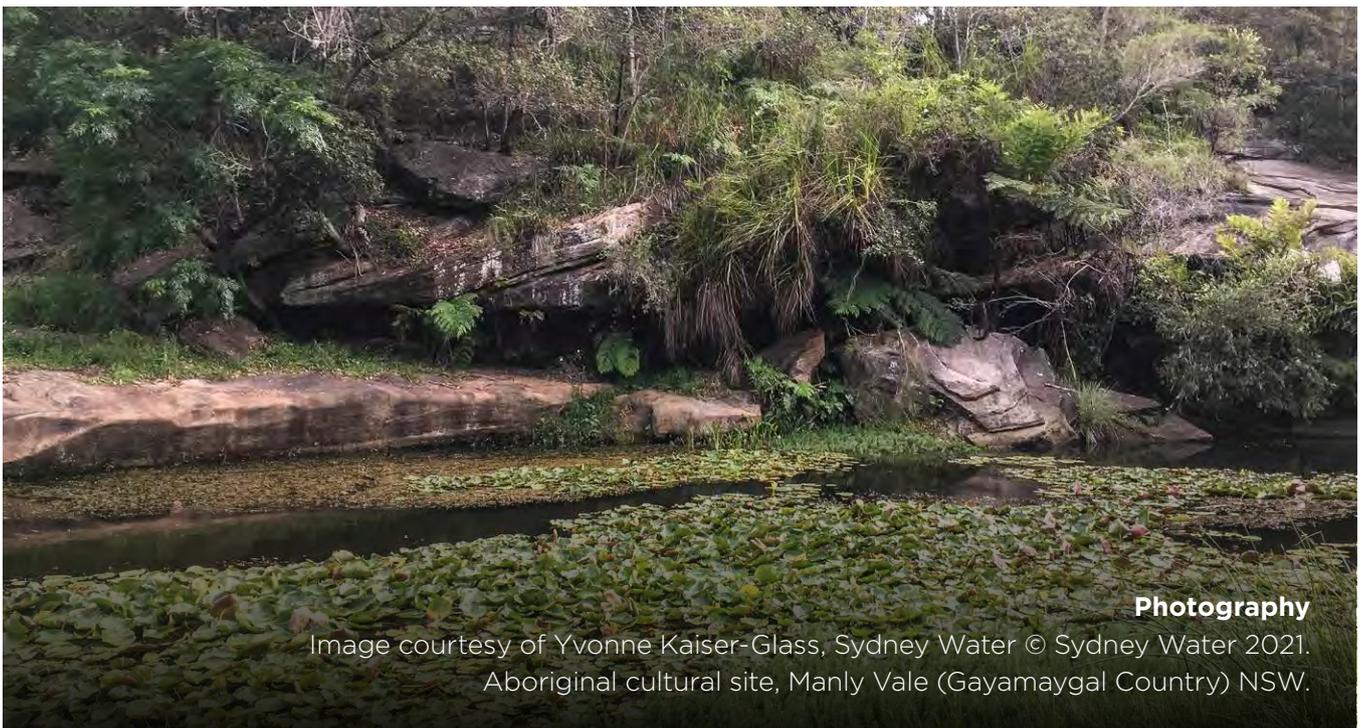
Challenges for waterway health

We face some significant challenges in improving the health of our urban waterways. These include:

- A growing population, which is driving the demand for water and leading to increased wastewater and stormwater production, and greater pressures on waterway health.
- Continuing urban sprawl into greenfield catchments with ecologically sensitive waterways.
- Complex contamination management issues with urban infill development in industrial legacy sites.
- Complex and fragmented governance, with no single government entity responsible for urban waterways, multiple (and often overlapping) plans, and processes and policies that impede progress.
- A lack of public reporting and data on performance against waterway objectives.
- Ageing infrastructure that is reaching capacity and often fails to protect the natural environment.
- Highly modified runoff and flow regimes that can degrade rivers and streams.
- Limited monitoring and management of groundwater systems and water dependent ecosystems.

We are looking for better ways to:

- **Maintain and improve ecosystem health**— We want to build on existing strategies, laws and plans to maintain a consistent focus on enhancing water quality, with a particular focus on high priority causes of diffuse source urban water pollution and management of contaminating industrial legacies. We can also explore ways to better manage and protect waterway and marine values and uses and improve how we monitor and report on water quality and waterway health.
- **Improve wastewater management**— Wastewater is a valuable resource that can reduce reliance on surface water supplies and help to manage water flows in rivers and streams. There are solutions we can adopt to make better use of this resource while, at the same time, decreasing the amount of wastewater we generate, reducing contaminants in wastewater and upgrading our ageing wastewater network to bring it into line with national and global best practice.
- **Improve stormwater management**—Like other wastewater, stormwater can be a problem and a valuable resource. While we have made some advances in managing stormwater over the last 20 years, there is significant room to improve through actions such as more effective planning controls and governance, raising awareness about how households and businesses can reduce stormwater runoff, and making better use of stormwater to create green and cool urban places.
- **Ensure water for recreation**—Water is highly valued in Greater Sydney as a recreational asset that underpins the city’s liveability and amenity. People use the region’s water resources for a variety of recreational activities: from boating, fishing, surfing, swimming and water-skiing to simply enjoying being outdoors in the natural environment. Water sports and water-based activities are also among the city’s major visitor attractions and part of Sydney’s global brand. We need to ensure our water management practices sustain these activities and that iconic water-based destinations (including our beaches and coastal environments) stay clean and healthy.



Photography

Image courtesy of Yvonne Kaiser-Glass, Sydney Water © Sydney Water 2021.
Aboriginal cultural site, Manly Vale (Gayamaygal Country) NSW.

Strategic pathway: Priority 4

Review **waterway and marine values** and their associated water quality objectives.

Prepare a **wastewater management strategic plan**.

Develop a better understanding of the risks and future resilience of our wastewater infrastructure, including how we **monitor and report discharges through Sydney's wastewater ocean outfalls**.

Support councils to prepare **Coastal Management Plans**.

New **framework for monitoring and reporting waterway health** against water quality objectives.

Improve **statutory planning tools to manage and protect waterway and marine values and uses**.

New, more streamlined and better coordinated model for **stormwater governance and stormwater management controls**.

Deliver **initiatives to reduce microplastics and other contaminants**.

Upgrade ageing assets and make new network interconnections (see Priority 2).

Support councils to deliver community-led initiatives for recreational activities including **swimming**.

Comprehensive **monitoring and reporting of water quality and waterway health**.

Recycled water and stormwater harvesting are widely used across Greater Sydney **to support recreational activities and waterway health**.

4.1 Maintain and improve waterway health

Supporting community values for waterways

In NSW, the community's environmental values and uses for waterways are reflected across a range of national and state-based strategies, policies,³ plans and laws.⁴ These cover water quality, water flow and water pollution, as well as identifying waterway objectives for major fresh and estuarine surface water catchments across the state.

The NSW Water Quality Objectives (the Objectives) were developed around 2006 and are the long-term goals for water quality across NSW. The Objectives are based on existing principles and guidelines recommended in the National Water Quality Management Strategy (NWQMS).

The Objectives are currently being reviewed for all coastal catchments within NSW. Recent online community engagement confirmed that the current values and objectives are still relevant today. However, further work is needed to better describe and formally map cultural values, the community's aspirational waterway uses and

3. These include State Environment Planning Policies (SEPPs), Regional Plans and the Secretary's Environmental Assessment Requirements (SEARs) that apply to State Significant Development (SSD) and State Significant Infrastructure (SSI).

4. Protection of the Environment Operations Act 1997, Water Management Act (2000), Environmental Planning and Assessment Act 1979

agricultural and drinking water values that need a greater focus in the Objectives. The Risk-based Framework for Waterway Health Outcomes in Strategic Land-use Planning Decisions is a tool to assist decision makers with this work. This framework brings together existing principles and guidelines recommended in the National Water Quality Management Strategy, which the federal and all state and territory governments have adopted for managing water quality. It allows decision-makers to determine management responses that meet waterway health outcomes and reflect the community's environmental values and uses of waterways.

To help achieve the Objectives, Coastal Management Programs⁵ are being developed for catchments across Greater Sydney. These plans are designed to coordinate efforts across state and local governments to implement priority management actions, including waterway health objectives.

To be effective, waterway management needs local-level guidelines for effective stormwater management at a precinct or sub-catchment level. The NSW Government and local governments have been working together on developing this approach, with successful pilots established for the Northern Beaches Lagoons and Lake Illawarra. These pilots demonstrate how specific local guidelines can drive best practice stormwater management and better water quality outcomes.

While a range of initiatives to improve how the NSW Water Quality Objectives are set and implemented, better outcomes can be achieved through improved coordination across government and clearer roles and responsibilities for implementing actions and monitoring whether the Objectives are being achieved. This is a significant opportunity for improvement.

Effective governance and reporting frameworks are also an essential foundation for ensuring waterway and ecosystem values are achieved.

Reforms being implemented as part of the Greater Sydney Water Strategy include:

- **Water quality**—Through the NSW Water Strategy, the Government is adopting a more intense, state-wide focus on improving water quality. This includes reviewing water quality objectives to make sure they reflect contemporary community and environmental values and uses, and defining clear roles, accountabilities and frameworks for monitoring, assessing and addressing water quality risks across the state. This will include a sharper focus on high priority causes of diffuse source urban water pollution in Greater Sydney.
- **Values and objectives**—In addition to the renewed state-wide focus on water quality objectives, there are opportunities to review waterway and marine values and objectives in Greater Sydney and to develop new planning tools to manage and protect waterway and marine values and uses in the region.
- **Performance, monitoring and reporting**—Comprehensive water quality and wastewater monitoring programs are in place for waterways, estuaries and marine waters. But much of this current reporting is highly technical and directed towards government and regulatory audiences—there is very little reporting that reflects community values or that uses terms and metrics the general public can understand. There is also no catchment scale, holistic reporting against waterway values and objectives. This means that we cannot measure (or report on) what has been achieved against these objectives.
- **Aboriginal cultural values**—Water is deeply entwined with Aboriginal culture and decisions that affect the health of waterways need to protect Aboriginal cultural values. We need to improve the way we manage our urban water resources in partnership with Aboriginal communities and empower Aboriginal people in water governance and management.

5. This program is being run under the Coastal Management Act and in line with the Marine Estate Management Strategy.

Managing water for the environment

The Hawkesbury–Nepean, Shoalhaven and Woronora are the major waterway catchments around Sydney providing most of the city's drinking water. The Hawkesbury–Nepean River is also critical for recreational opportunities and the provision of water for agriculture, seafood, and tourism. The health of our rivers has been in decline for years due in part to the impact of pollutants in discharges and runoff from urban and rural areas.

Healthy rivers need flows that retain or mimic natural conditions. Improved river flows benefit recreation and river health (including improved fish populations) by reducing the severity and persistence of aquatic weed and blue-green algal outbreaks.

Environmental flows are an important part of enhancing the health of our rivers. Environmental flows are managed releases of water from dams that mimic natural inflows to support the health of our rivers, particularly downstream of those dams that interrupt the natural river flow (illustrated in Figure 21). Environmental flow rules are set in the statutory water sharing plan for the Greater Sydney region.

The first Metropolitan Water Plan (2004) identified that water releases from dams to help the downstream river environment (known as environmental flows) would be released from Sydney's major water supply dams to maintain and enhance river health. Variable environmental flows from the Upper Nepean Dams and Woronora Dam were introduced in 2009-10. More detailed studies were needed before environmental flows could be implemented for Warragamba Dam. Following completion of those studies, the *2017 Metropolitan Water Plan* committed to the introduction of environmental flows from Warragamba Dam by 2024. Environmental flows from this dam will require modifications to the dam wall to install infrastructure that allows the water releases to occur, and therefore the exact timing of their introduction may be affected by the Government's decision on whether to raise the Warragamba Dam wall for flood mitigation purposes (see Priority 2.6).

Environmental flows mimic natural flows

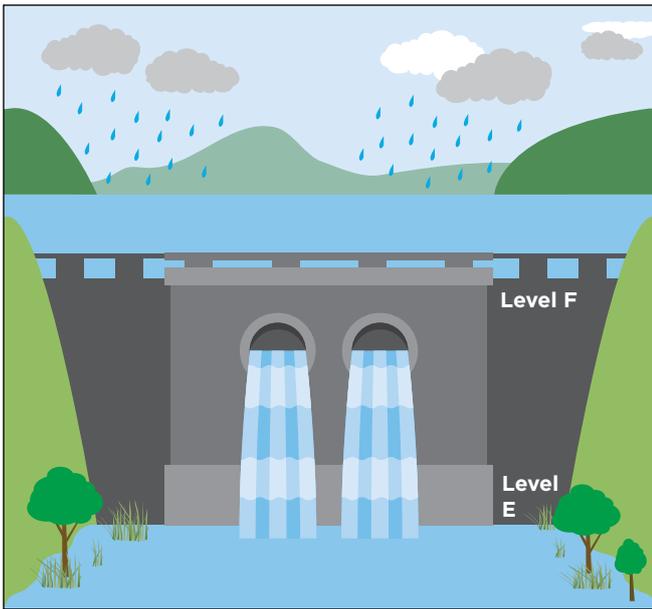
Environmental flows are designed to mimic the patterns of a natural flow regime and support a river's ecology. They are released to help improve water quality, support fish passage and reduce floating weeds.

Variability in flow is a natural part of Australian rivers and ecosystems have evolved to cope with our variable climate. In dry weather or during drought there will be little water many rivers.

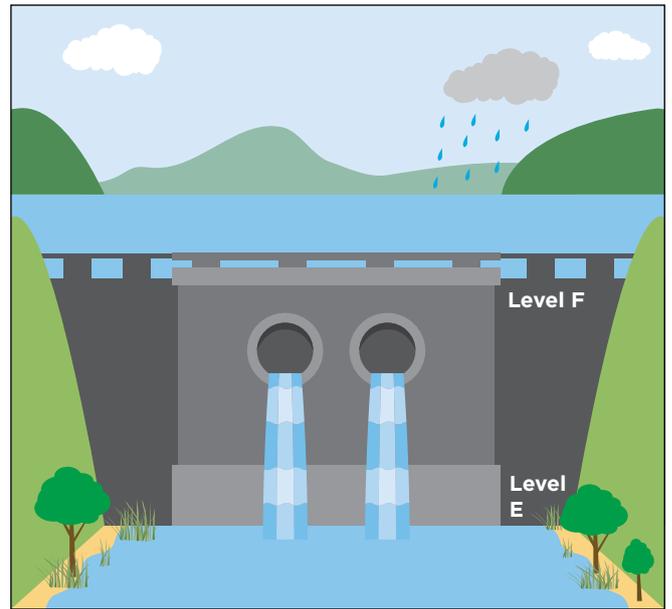
In wet weather, river flows are much higher. Plants and animals in and around the river have evolved with this pattern of dry and wet.

No flows or steady, low flows below dams contribute to poor water quality, invasive floating weed outbreaks and toxic algal blooms, as well as having adverse impacts on the native fish populations.

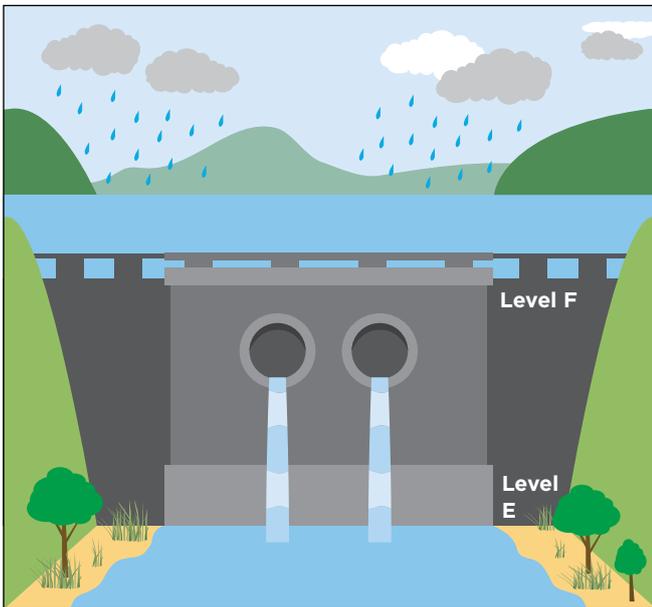
Figure 21. Dam storage levels relative to rainfall, demonstrating environmental flow levels



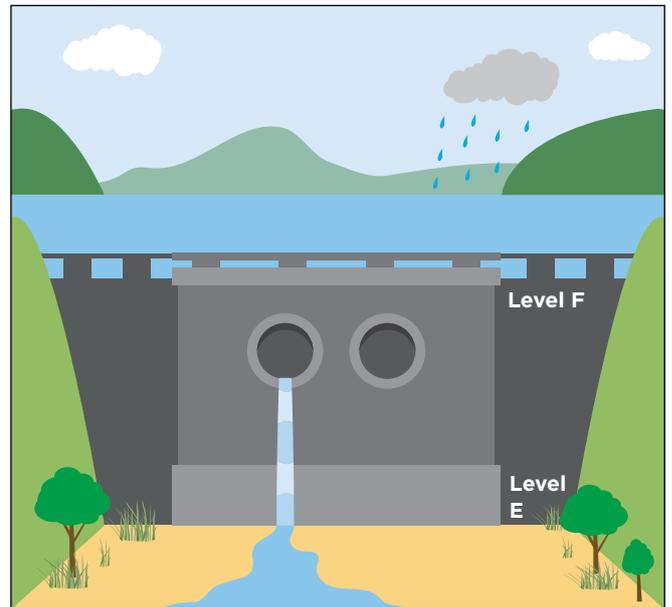
A: High dam storage levels, high rainfall - high environmental flow release



B: High dam storage levels, low rainfall - moderate environmental flow release



C: Low dam storage levels, high rainfall - moderate environmental flow release



D: Low dam storage levels, low rainfall - low environmental flow release

As discussed in Priority 2, options to further support Greater Sydney's drinking water supplies have been examined through the development of this strategy. Those investigations have shown that reducing environmental flows from the Upper Nepean and Tallowa dams in line with falling dam levels (known as scaled environmental flows), could provide substantial additional water supplies for Sydney, while maintaining environmental benefits to the river and its ecosystems. This change to the environmental flow regime will be considered further, and consulted upon as part of the review of the *Water Sharing Plan for the Greater Metropolitan Region Unregulated Rivers Water Sources 2011*, due to

be completed by December 2022. A monitoring and assessment program will ensure that environmental impacts are maintained while implementing the scaled environmental flows.

We are also examining the potential for replacing some environmental flows with highly treated recycled water, as currently occurs at Penrith to compensate for environmental flows that cannot yet be discharged from Warragamba Dam. The energy and resource implications of this will need to be examined alongside river health and social outcomes.

Review of the Greater Sydney Water Sharing Plan

The *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011* is currently being reviewed and will be replaced before it expires in July 2023. The water sharing plan establishes long-term extraction limits for the take of surface water in the area, environmental flow rules and operational, access and trade rules that share the resource between the environment and other uses, protecting a portion for the environment.

The Natural Resources Commission (NRC) has recently completed its review of the plan and made recommendations, including the need to align the rules in the water sharing plan to the Greater Sydney Water Strategy.

The remake of the water sharing plan will consider recommendations made by the NRC and new information that may better inform environmental flow rules and operational, access and trade rules. Some rules in the water sharing plan will reflect the implementation of the Greater Sydney Water Strategy; for example, the changed requirements for delivery and management of environmental flows from the Upper Nepean and Tallowa dams. Any potential options to further support Greater Sydney's drinking water supplies need to be explored in the context of the water sharing arrangements set out in the water sharing plan, including ensuring they maintain provision of water for the environment, basic landholder rights and other uses.

A draft replacement water sharing plan is scheduled to be on public exhibition in mid-2022, seeking public comment and input.

Mining in the Sydney catchment

An extensive review of mining in the Sydney catchment by an independent expert panel found that better protections, stronger assessment and more environmental offsets will ensure Sydney's drinking water supply is safeguarded. The NSW Government has accepted all 50 recommendations of the expert panel led by the office of the NSW Chief Scientist and Engineer and is implementing an action plan that includes:

- Ensuring there is a net gain for the metropolitan water supply by requiring more offsetting from mining companies.
- Establishing a new independent expert panel to advise on future mining applications in the catchment.
- Strengthening surface and groundwater monitoring.
- Improving access to and transparency of environmental data.
- Adopting a more stringent approach to the assessment and conditioning of future mining proposals to minimise subsidence impacts.
- Reviewing and updating current and potential future water losses from mining in line with the best available science.
- Introducing a licensing regime to properly account for any water losses.
- Undertaking further research into mine closure planning to reduce potential long-term impacts.

Photography

Image courtesy of Adam Hollingworth, Department of Planning and Environment.
Parramatta Park, Parramatta NSW.

Groundwater in Greater Sydney

Groundwater in the Greater Sydney region is used for commercial purposes, agriculture and mining. It also sustains groundwater dependent ecosystems (GDEs) and Aboriginal cultural sites. Groundwater has the potential to supplement surface water as a safe and secure water source.

However, this valuable resource faces challenges:

- Urban development can cause dewatering, contamination, increased salinity and interrupt groundwater flow.
- Early identification and improved ongoing management is needed of known and not yet recognised contaminants.
- Mining activities can have long-term impacts on GDEs, surface water flows and groundwater levels.
- Salinity from rising water tables in urban areas can cause damage to buildings, roads and pipe systems.
- Significant groundwater seepage can occur from unsealed road tunnels and mines.
- Climate change may bring increased demand for groundwater as surface water becomes scarcer; less rainfall may mean less water to recharge groundwater levels; and rising sea levels may cause saltwater to intrude into freshwater groundwater sources.
- Groundwater dependant cultural sites and practices need to be understood and protected.
- More information is needed to better understand groundwater processes, use and impacts.

Although Greater Sydney relies heavily on surface water for its water supply, it is important that we also manage our groundwater sustainably. That means using groundwater efficiently, managing groundwater levels so they don't drop to a point beyond which they can't recover, and protecting groundwater from contamination. We can improve our management of this vital resource by increasing monitoring activities, managing extraction demands and rising salinity levels, better managing dewatering and contamination at construction and mining sites, and identifying and protecting GDEs.

Groundwater is managed under the *Water Management Act 2000* and specific rules for the management of groundwater resources across the metropolitan area are set out in the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011. This plan is currently being reviewed and will be remade before it expires in July 2023. A draft replacement groundwater sharing plan is scheduled to be on public exhibition mid-2022, seeking public comment and input.

The groundwater sharing plan establishes long-term extraction limits for groundwater to share the resource between the environment and other uses, protecting a portion for the environment. The plan also sets rules for how groundwater can be accessed and traded. The remake of this water sharing plan will consider recommendations made by the NRC in its review of the plan, new information that may better inform setting extraction limits and access and trade rules.

The NSW Government is also developing a NSW Groundwater Strategy to address the challenges facing groundwater sources across the state and improve how we protect and manage this vital resource.

4.2 Invest in wastewater management

As with water supply, we are reaching the capacity of Greater Sydney's wastewater systems and are facing a steep increase in the level of investment required compared with previous years.

The Greater Sydney Water Strategy recognises that wastewater management plays a vitally important role in achieving a variety of outcomes for the region. It protects public health and contributes to healthy waterways and, as technology advances and our needs change, wastewater is also becoming an increasingly important part of our water supply and the circular economy. Recycling wastewater provides a rainfall-independent source of water that reduces impacts on waterways and contributes to a more resilient water supply. We will need to do more recycling of highly treated wastewater and stormwater to support the growing need for amenity, cooling and greening across Greater Sydney.

Wastewater also contains valuable resources that can be transformed into products that support a more productive and sustainable economy, such as renewable energy, fertilisers and bioplastics.

Despite the success of major recycled water schemes in some suburbs such as Rouse Hill, only about 7% of wastewater in Greater Sydney is recycled. Most of it is used once by households and industry and discharged directly to the ocean with only partial treatment. As the Greater Sydney region becomes denser and extends into new areas, and our infrastructure continues to age, the pressures on waterway health will grow. Urban growth and redevelopment provide both the need and the opportunity to invest in new approaches to managing wastewater such as large-scale recycling, repairing networks to prevent rainwater overloading sewer capacity and building more system interconnections to manage risks when pipes break. With 60% of Sydney's 2050 housing stock already established, innovative programs to retrofit and renew existing infrastructure and established suburbs will also be required to achieve wastewater performance and urban amenity outcomes that are comparable with those expected for our newer suburbs.

Challenges for wastewater management

The main challenges to improving our wastewater management in Greater Sydney are:

- Population growth is generating more wastewater, driving up nutrient loads and increasing the need for more stringent, more advanced and more costly treatment to meet discharge standards.
- Increasing demands on the Hawkesbury–Nepean River to supply water and wastewater services to Sydney are leading to elevated nutrient levels and reduced river flows, contributing to ongoing risks of algal blooms and excessive aquatic weed growth.
- Development is pushing into ephemeral sub-catchments, such as Upper Wianamatta South Creek and parts of the Greater Macarthur Growth Area, requiring more recycling and pipeline infrastructure to move wastewater to suitable receiving waterways.
- Sydney's three major deep ocean outfall treatment plants at Bondi, Malabar and North Head are having increasing difficulty complying with discharge limits for oil and grease, and there are significant challenges in managing infrastructure.
- Discharging sub-primary treated effluent to the ocean is out of step with accepted national and global practice, and although current testing has not identified risks, we need to guard against future long-term risks associated with emerging concerns about microplastics and other contaminants.
- Wet weather overflows from the sewerage system continue to be a problem for waterway health, recreational uses and amenity.
- The trunk wastewater network is exposed to single points of failure.
- Fixing these problems and upgrading infrastructure, especially the large coastal systems, will be complex and costly.

Photography

Image courtesy of Department of Planning and Environment.
Ironbark Ridge, Rouse Hill Regional Park.

Across Greater Sydney, ongoing action to improve wastewater management has significantly improved the health of the Hawkesbury–Nepean River from previous decades, when blue green algal outbreaks turned toxic and aquatic weeds prevented some recreational uses of the river. This includes a new regulatory framework enforced by the Environment Protection Authority (EPA) to cap and manage nutrient loads to the Hawkesbury–Nepean River from wastewater treatment plants. A pilot nutrient offset program will research and test the effectiveness of trading and offsetting nutrient loads between point and diffuse nutrient sources (due to be applied in July 2024). Sydney Water also plans to invest about \$2.2 billion on wastewater management across the Hawkesbury–Nepean catchment between 2020 and 2024.

The EPA applies a risk based approach to regulating Sydney Water’s Bondi, North Head, Malabar and Cronulla systems. This allows Sydney Water to target investment to areas with the greatest risks to public health and waterway ecosystem health and that deliver the greatest economic benefits. Upgrades to the three major wastewater systems leading to the deep ocean outfall systems are planned over the next 10 years to abate wet weather overflows, upgrade treatment facilities and cater for population growth.

More broadly, Sydney Water has forecast approximately \$13 billion of investment for wastewater management up to 2030, increasing to \$24 billion by 2050. This level of investment is a significant increase on the level of investment seen over the past two decades and is being directed towards wet weather flow abatement, critical maintenance and renewal, odour and corrosion management, and growth in the network and treatment plants.

Sydney Water is also testing and implementing new technologies and approaches that will help to reduce escalating costs.

The Greater Sydney Water Strategy will build on these actions and investments, and support:

- **Increasing our understanding of emerging pollutants** such as microplastics, pharmaceuticals and other contaminants and identifying initiatives to reduce their impact on our waterways including through programs targeting households and industry
- **Considering responses to potential higher environmental standards**, including programs targeting households and industry
- **Support for community- and household-based actions to reduce wastewater**, such as creating raingardens, installing greywater systems, reusing water used for cooking and using fewer chemicals and more natural cleaning products
- **Building a purified recycled water Demonstration Plant**, accompanied by an extensive community engagement program, to demonstrate that the technology is available to purify water to drinking level standard and to allow the public to see it for themselves. The plant does not form part of Sydney’s drinking water supply and any future decision to include purified recycled water would be subject to community consultation and require stringent Government approvals
- **Improving the resilience of the wastewater network**, such as replacing and renewing ageing assets and making strategically placed network interconnections that can provide redundancy for critical maintenance or flow diversions in the event of asset failures
- **Reducing wastewater impacts on the Hawkesbury–Nepean River** by increasing environmental flows through our dams or through discharges of purified recycled water into our rivers.

Servicing new growth around Western Sydney (Nancy-Bird Walton) Airport

Greater Sydney's population is forecast to grow by about 3 million people in the next 40 years, with about half of those people expected to live west of Parramatta in the Western Parkland City. This area of Sydney has very limited water infrastructure and new wastewater collection, treatment and recycling infrastructure is critical to supporting population and economic growth.

At the centre of this growing region of Sydney is the Nancy-Bird Walton International Airport and the surrounding economic growth areas of the Western Sydney Aerotropolis and the South West Growth Area. The entire region sits within the upper reaches of the Wianamatta South Creek catchment, which flows into the Hawkesbury Nepean River at Windsor.

Sydney Water is currently planning new wastewater systems to service the Aerotropolis Growth Area. At the centre of this planning is the Upper South Creek Advanced Water Recycling Centre (AWRC)—Sydney Water's largest investment in wastewater management and water resilience in a decade. The facility will be built in stages to service and support population and economic growth across the Aerotropolis and South Western Sydney. The first stage will be completed in 2025 in time for commissioning of the Nancy-Bird Walton International Airport.

At full scale, the AWRC will treat up to 100 million litres of wastewater per day, capacity for approximately half a million people. The Centre will use industry-leading technology to harness renewable energy, making this one of the greenest infrastructure investments in NSW. The project will include a diversified approach to water recycling that includes the potential for purified water to be used for environmental flows, supply to third pipe systems for urban greening, cooling and industry.

However, the use of purified recycled water from this advanced treatment facility for drinking purposes would not be implemented as a supply option until there was community consultation about this option and it had been subject to a stringent Government approval process.

4.3 Improve stormwater management

Without careful management, stormwater has major impacts on the ecological health and recreational quality of waterways and marine environments. However, if managed well, stormwater can be a valuable resource that contributes to ecological health and to making green, cool and attractive urban places.

Challenges for stormwater management

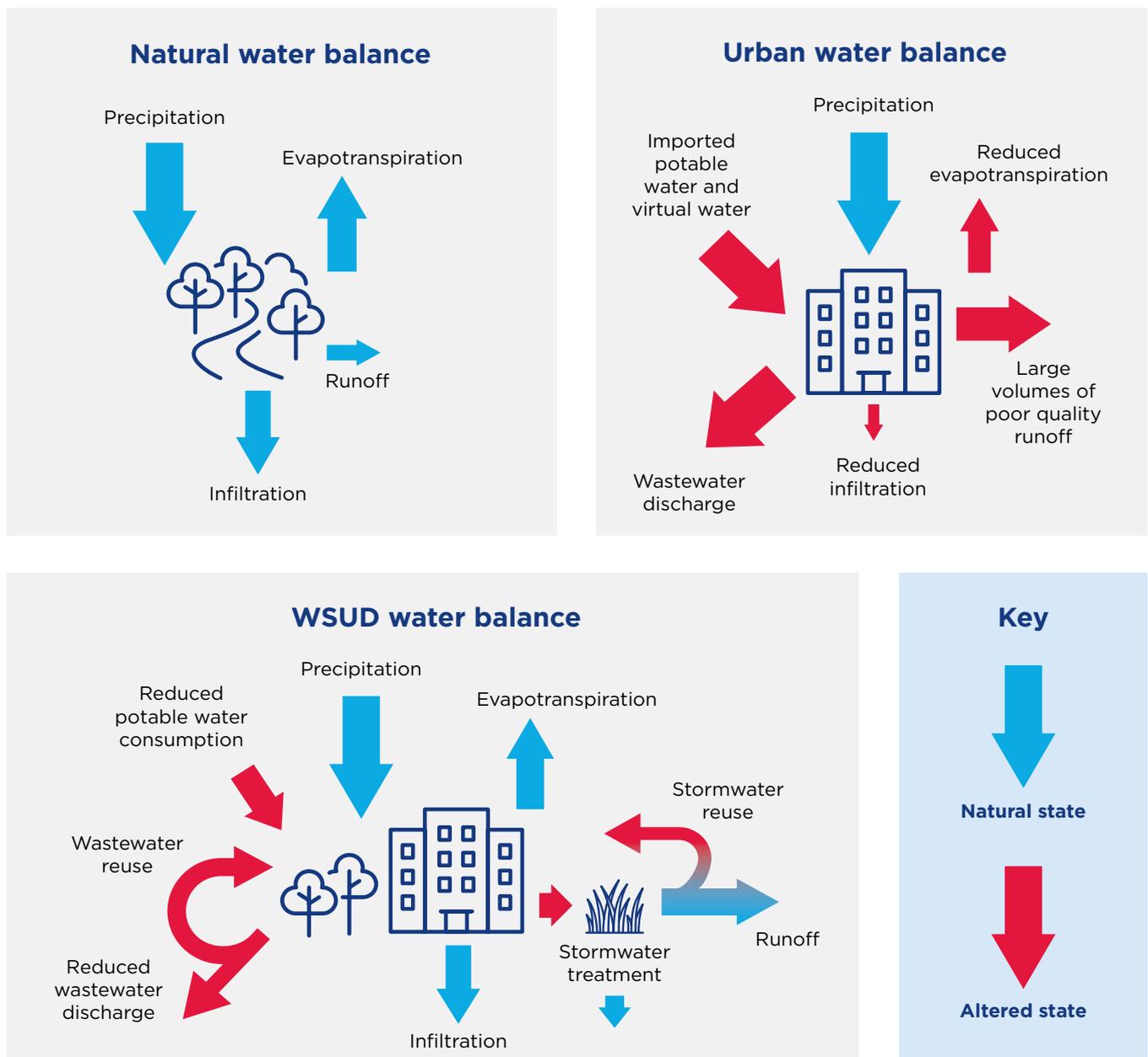
Our management of urban stormwater is improving, but a number of issues need to be addressed:

- Population growth and urban development are generating more stormwater runoff from hard surfaces.
- Stormwater continues to be a major source of litter, plastics, sediment, nutrients, chemicals and metals that pollute our waterways, harbour and ocean.
- Waterway health objectives are not well-defined in planning policy and there are no required levels of service for stormwater management.
- Responsibilities for stormwater management are not assigned appropriately—for example, organisational capabilities are not aligned with regional or local waterway health objectives.
- Community awareness about how households and businesses can contribute to reducing stormwater runoff remains relatively low.
- The stormwater drainage network typically does not meet contemporary standards throughout most of Sydney's established suburbs.
- There are inconsistencies in the design standards, performance and monitoring of stormwater drainage and water sensitive urban design across Greater Sydney.
- Most local councils have limited access to advice and expertise regarding the application of water sensitive urban design.

Over the last 20 years, there have been substantial advances in Water Sensitive Urban Design (WSUD) and stormwater quality controls. However, these have been applied to different extents in different parts of Greater Sydney and there are opportunities to achieve a more consistent approach. Integrated Water Cycle Management is essential to achieving WSUD as it brings together urban stormwater management, waterway management and urban design to complement broader urban water and wastewater management services.

Figure 22 shows a simplified view of how a WSUD approach can shift the water balance closer to a natural system—one that benefits ecosystems while reducing dependence on surface water supplies and providing a more resilient water supply. This transition is only possible through the integration of land use and water planning.

Figure 22. Difference in water cycle flows between natural, urban and water sensitive forms



Source: Alan Hoban, Bligh Tanner.

Embedding WSUD requirements in urban planning and development controls is now seen as an important mechanism to deliver waterway and ecosystem objectives.

The Greater Sydney Water Strategy will include actions to better manage stormwater through the application of WSUD, including:

- **Developing a new, more streamlined and better coordinated model for stormwater governance**
- **A more coordinated and transparent approach to managing urban stormwater**, including a mechanism to deliver water objectives and defining levels of service for stormwater management

- **Improving the resilience of the stormwater network**, such as replacing ageing drainage assets
- **Achieving maturity and consistency in WSUD across the region**, such as new planning controls for urban development, support for local councils to apply WSUD and community awareness initiatives.



Image courtesy of Bob Peters, Department of Planning and Environment.
Water tank and garden.

Photography

Case study: Integrated land and water management for the Western Sydney Aerotropolis

The Aerotropolis covers over 11,000 ha with a large portion of the catchment draining to Wianamatta South Creek, a significant and largely ephemeral waterway in Western Sydney with considerable ecological and community value.

A new government collaborative planning agency, the Western Sydney Planning Partnership Office partnered with Sydney Water to undertake water cycle planning for the initial urban precincts. Under the concept of 'landscape led planning' and driven by tangible waterway health outcomes, the management of the water cycle is integrated with land use planning to meet key government objectives for the Western Parkland City including healthy waterways, urban greening and cooling, and a resilient water supply.

To demonstrate the potential for urban development to meet such objectives, Sydney Water developed typologies for a variety of development styles, with runoff reduction as a key objective. These typologies reduce impervious areas and identify opportunities to harvest stormwater and promote water being used in the urban landscape. This has the added benefit of providing a ready supply of non-potable water to support the vegetation vision of the Greater Sydney Region Plan, offering improved evapotranspiration and assisting in cooling the heat island effect caused by urbanisation. It also reduces the volume of stormwater runoff and can

replenish the general soil moisture content and groundwater.

Controls have been prepared that limit the volume of stormwater runoff leaving sites. This prevents excessive volumes of stormwater runoff entering streams in the catchment and protects the ecology and geomorphology of the streams. Other advantages can be gained through innovation, which could be as simple as an industrial site harvesting its roof water and then misting it over the roof to assist in cooling the building and surrounding environment. Reduced volumes of stormwater runoff will also reduce pollutants washed into the streams and allow treatment closer to the source.

These stormwater harvesting options will assist in reducing the demand for drinking water. There are also options to use recycled water from the water treatment plants for suitable industrial uses or where needed to augment irrigation needs. With smart technology, it is possible to use stormwater runoff within these treatment plants to add to the recycled water or even provide drinking water. This would reduce the number and size of basins required for stormwater detention/retention and reduce the reliance on drinking water supplies.

4.4 Protect water for recreation

Water is highly valued in Greater Sydney as a recreational asset that underpins the city's liveability and amenity. People and communities use the region's water resources for a variety of recreational activities—from boating, fishing, surfing, swimming and water-skiing to simply enjoying being outdoors in the natural environment.

The city's coastline and beaches are deeply ingrained in our history and identity, and more than 36 million visits⁶ are made to Sydney's beaches each year. Public swimming pools are also part of our culture and lifestyle—providing community meeting places and opportunities for exercise, as well as offering respite on hot days. Water is also essential to maintaining our sporting fields, golf courses and passive recreation areas.

As well as contributing to the city's liveability and quality of life, the benefits of outdoor water-based recreation include improvements in physical and mental health. This translates into substantial economic value—a 2016 study by Sydney Water valued beach access for Sydney residents at about \$1.3 billion per year.

Beaches, water sports and water-based activities are among the city's major attractions for domestic and international visitors. Ferry trips and cruises on Sydney Harbour and the Parramatta River, wakeboarding on the Hawkesbury River, water-skiing, kayaking tours, snorkelling and

diving, white-water rafting at Penrith's Olympic course, surfing, sailing and fishing—these and other aquatic activities are enjoyed by large numbers of tourists. These activities, and a reputation for spectacular and pristine beaches, contribute to Sydney's iconic brand.

Environmental flow releases from storages to improve the health of downstream river environments has the additional benefit of supporting these activities. As our drinking water supply comes under greater pressure, we may need to find alternative reliable supply options to sustain ecological health and water-based recreational facilities and activities.

In its 2020 report on the impediments to integrated urban water management, the Productivity Commission noted the contribution of water-based recreational activities to urban amenity and observed that greater collaboration between land use planners and water planners is needed to:

- improve stormwater management and harvesting to create and sustain recreational lakes and wetlands
- make use of water easements and natural waterways as corridors for recreation
- provide fit-for-purpose water to support recreational activities in urban areas.

6. From 2016 Sydney Water report, *Economic and social value of improved water quality at Sydney's coastal beaches*

Challenges for coastal management

Greater Sydney residents place a very high value on clean ocean water at our beaches and on protecting our unique coastal environments. As noted earlier under this priority, Coastal Management Programs (CMPs) are currently being prepared for Greater Sydney. These programs will set out the issues facing the region's coastal areas and outline actions to tackle them. Preliminary work for the CMPs has identified a range of challenges that we will need to address:

- Urban stormwater pollution in Sydney Harbour, which is becoming a significant threat to community values and expectations.
- Beach erosion due to rising sea levels and more frequent extreme weather events.
- Poor water quality in urban streams and rivers that run into estuaries and the ocean.
- Degraded coastal ecosystems and biodiversity.
- Impacts of sporadic wet weather overflows from the sewerage system.
- Discharge of treated wastewater to the ocean which is out of step with global standards.

The Greater Sydney Water Strategy provides an opportunity to:

- **Make better use of recycled water and stormwater harvesting to sustain recreational activities, greening and protect waterways** while reducing pressure on our drinking water supply (this is discussed in the previous section)
- **Reduce the causes of diffuse source urban water pollution** (discussed earlier under Priority 4) that bring litter, plastics and other contaminants to our rivers and coast, and contribute nutrients and sediments that cause excessive weed growth and algal blooms, which affect water-based recreational activities and tourism
- **Better manage the discharge of urban stormwater to our urban rivers, bays and harbours including Sydney Harbour**, by strengthening oversight, coordination, compliance and enforcement activities
- **Incorporate values and objectives for water-based recreational use** within integrated water cycle management approaches (see Priority 3) and planning controls
- **Support local councils to identify and deliver solutions** to increase recreational use of waterways, including for swimming, and that can sustain water-based community facilities such as public swimming pools, aquatic recreation centres and passive recreation spaces centred on water features.

Case study: Ten Steps to a Living River—the Parramatta River Masterplan

Sydney deserves a world class river, one that the millions of people who live and work within 20 minutes of the Parramatta River can swim in again—like they once did. The Parramatta River is one of Australia’s most iconic waterways and it is set for another period of change with burgeoning growth predicted for the Central River City.

The Parramatta River Catchment Group (PRCG) is an alliance of councils, government agencies and community groups working together to improve the river. The PRCG has involved the community and consulted widely to develop ‘DUBA, BUDU, BARRA: Ten Steps to a Living River—the Parramatta River Masterplan’. The Masterplan sets out the actions required to achieve the PRCG’s mission of making the Parramatta River swimmable again by 2025 and to deliver the ‘our living river’ campaign that encourages industry, government and community to collaborate to make a world class river for Sydney.

The Masterplan uses swimming in the river as a ‘people focused’ outcome to drive broader improvements in catchment management and waterway health. The Masterplan steps work towards realising the vision of creating a ‘living river’, recognising that this will require reforms to land use planning controls and the integration of WSUD principles along with reducing wet weather overflows from Sydney Water’s

wastewater network, protecting and improving habitat for plants and animals, and working with the community through targeted education and regulatory programs.

The success of the Masterplan can be attributed to three key elements:

- Setting a clear vision based on community values. Swimming is a clearly understood outcome of improved water quality that everyone can endorse
- Taking a whole of catchment approach, recognising that what happens in the upper catchment is as important as what happens directly next to the river. The Masterplan also takes into consideration that successful management needs to be a combination of regulation, education and targeted intervention
- Establishing the right governance framework to ensure all decision makers and the community are ‘at the table’.

The collaborative model applied across the Parramatta River Catchment recognises the complexities involved in waterway management and the varying roles and responsibilities held across councils, government agencies and the community. As a result, partners have been able to come together around a single vision and align their programs of work to deliver results.

Water management and services meet community needs

Water planning and management is not just about filling the supply gap. It also has to ensure that the needs of customers and the community are met in affordable and fair ways. The community has to have confidence in the water sector and understand the implications of water supply and management decisions. We also need to recognise Aboriginal knowledge and science around water and identify actions to support First Nations' water rights and access in Greater Sydney.

The Greater Sydney Water Strategy includes actions that:

- Support Aboriginal water rights, interests and access**—While engagement with Aboriginal people around water management is improving, communities still lack sufficient access to water for cultural, social and economic purposes. The strategy provides an opportunity to work with Aboriginal people in Greater Sydney to recognise, understand and support their priorities.
- Enhance community confidence through engagement and transparency**—Community confidence in the water sector is critical to delivering the best water solutions for Greater Sydney. Our water sector needs to be transparent and accountable and provide more and better information to customers and communities. Public trust is especially important for building community support for alternative water supplies, and the strategy marks the start of an important conversation with communities about their expectations around the use of purified recycled water.
- Manage price impacts for customers**—Over the last decade, Sydney's water bills have been some of the lowest in Australia. But we can't defer the cost of investing in our water and wastewater networks any longer. While new investments will secure Greater Sydney's water supply for generations, they are expected to lead to higher water servicing costs in the next 10 years. These costs will be passed on to customers through water bills. The Greater Sydney Water Strategy will include a number of different approaches to lessen price increases.

Strategic pathway: Priority 5

Consult with Aboriginal people and communities across Greater Sydney regarding this strategy.

Commence a **community-wide conversation about purified recycled water.**

Deliver actions through the NSW Water Strategy to **achieve greater outcomes for Aboriginal communities.**

Understand **community preferences for securing Greater Sydney's water supplies, including** desalination and the potential uses for purified recycled water.

Improve and expand water modelling capabilities and give the public access to these models.

Work with Sydney Water and IPART to **identify mechanisms that can lessen price increases.**

Review and refine hardship policies, concessions and other measures.

Aboriginal water values, knowledge and science are **embedded in water planning and management,** supported by data sovereignty and intellectual property protections.

Investment in water infrastructure is supported by a **fair and reasonable pricing structure.**

Photography

Image courtesy of Yvonne Kaiser-Glass, Sydney Water © Sydney Water 2021.
Aboriginal cultural site, Manly Vale (Gayamaygal Country) NSW.

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

Greater Sydney is built around the stunning coastline, harbours, lagoons, rivers, and creeks that characterise our region. These places make up the ancestral lands and waters of the Eora, Dharug, Gundungurra, Tharawal, Darkinjung, Wiradjuri, Ngarigo and Yuin Nations. Despite European settlement disrupting and usurping Aboriginal peoples' traditional land and water custodianship, these nations have an ongoing connection with and obligation to care for Country.

More than 16,000 Aboriginal heritage sites and 34 Aboriginal places have been registered across Greater Sydney, documenting economic, artistic and ceremonial activities. Many of these places reflect the high value given by Aboriginal Nations to rivers, creeks, estuaries and wetlands and the land adjacent to waterways (both prior to and after European settlement). There are also many dreaming stories that explain the creation of waterways in the region, including the rivers and caves of the Burratorang Valley (where most of Sydney's water is sourced).

While engagement with Aboriginal people around water policy and management is improving, communities continue to have limited access to water for cultural, social and economic purposes.

Aboriginal people have told us that they want to be more involved in water management decision-making. Through the state-wide NSW Water Strategy, the NSW Government is proposing a number of initiatives to achieve greater outcomes for Aboriginal people, including:

- **Strengthening the role of Aboriginal communities** in water planning, management governance and decision-making.
- **Developing a state-wide Aboriginal Water Strategy** in partnership with First Nations that will identify a program of measures to deliver on First Nations' water rights and interests in water management.

These approaches will provide a foundation for actions taken through the Greater Sydney Water Strategy. We will work with Aboriginal people, communities and organisations across the region to understand their priorities and how to incorporate these priorities into the state-wide Aboriginal Water Strategy and in the review of the Greater Sydney Water Sharing Plan. We will develop options for how to best manage Greater Sydney's water resources to support Aboriginal rights, interests and access to water, and we will report on progress through the implementation reports for the Greater Sydney Water Strategy.

Photography

Image courtesy of Yvonne Kaiser-Glass, Sydney Water © Sydney Water 2021.
Aboriginal cultural site, Manly Vale (Gayamaygal Country) NSW.



5.2 Enhance community confidence through engagement and transparency

A high degree of public trust in the water sector is essential if we are to select, plan and deliver the best water solutions for Greater Sydney into the future. Recent reviews of water management in NSW have identified a strong desire for the water sector to be more transparent and accountable, and for more and better information to be provided to customers and communities. Reviews have also highlighted the need for 'a single source of truth' about water management.

The Greater Sydney Water Strategy acknowledges the importance of better communication with all stakeholders and their more effective involvement in water management decisions and water resource planning. This includes Aboriginal communities, environmental groups, industry, local councils and the broader community.

The aim of community engagement is to empower the community to make informed choices about the future of their water supply. We will engage with the community on Greater Sydney's water cycle—this will include information about how our urban water cycle works as well as the opportunities and challenges facing our city and our water resources now and into the future.

To support this engagement Sydney Water will build a purified recycled water Demonstration Plant and visitor centre in Sydney that will allow the community to see how the purified water recycling process works. This will help the community to understand and to be part of the conversation on planning for the future of water management in Sydney. Once the technology is proven to produce consistent high quality recycled water, the recycled water from the demonstration plant may be used for non-drinking purposes, including indoor uses such as flushing toilets and outdoor uses including watering lawns and parks.

The plant does not form part of Sydney's drinking water supply and any future decision to include

purified recycled water would be subject to community consultation and require stringent Government approvals.

The NSW Water Strategy incorporates several new state-wide approaches that will also improve public trust in Greater Sydney's water management:

- **Improving how the water sector engages with communities**, including using plain English to explain complex technical and regulatory concepts, and exploring ways to build the community's capacity to participate in water management processes and decisions
- **Making water information open, transparent and easy to find**, including through a new WaterInsights portal that provides easy access to information about how water is used, managed, shared and traded in NSW.
- **Improving and expanding our water modelling capabilities** and giving the public access to these models and the data generated by them.

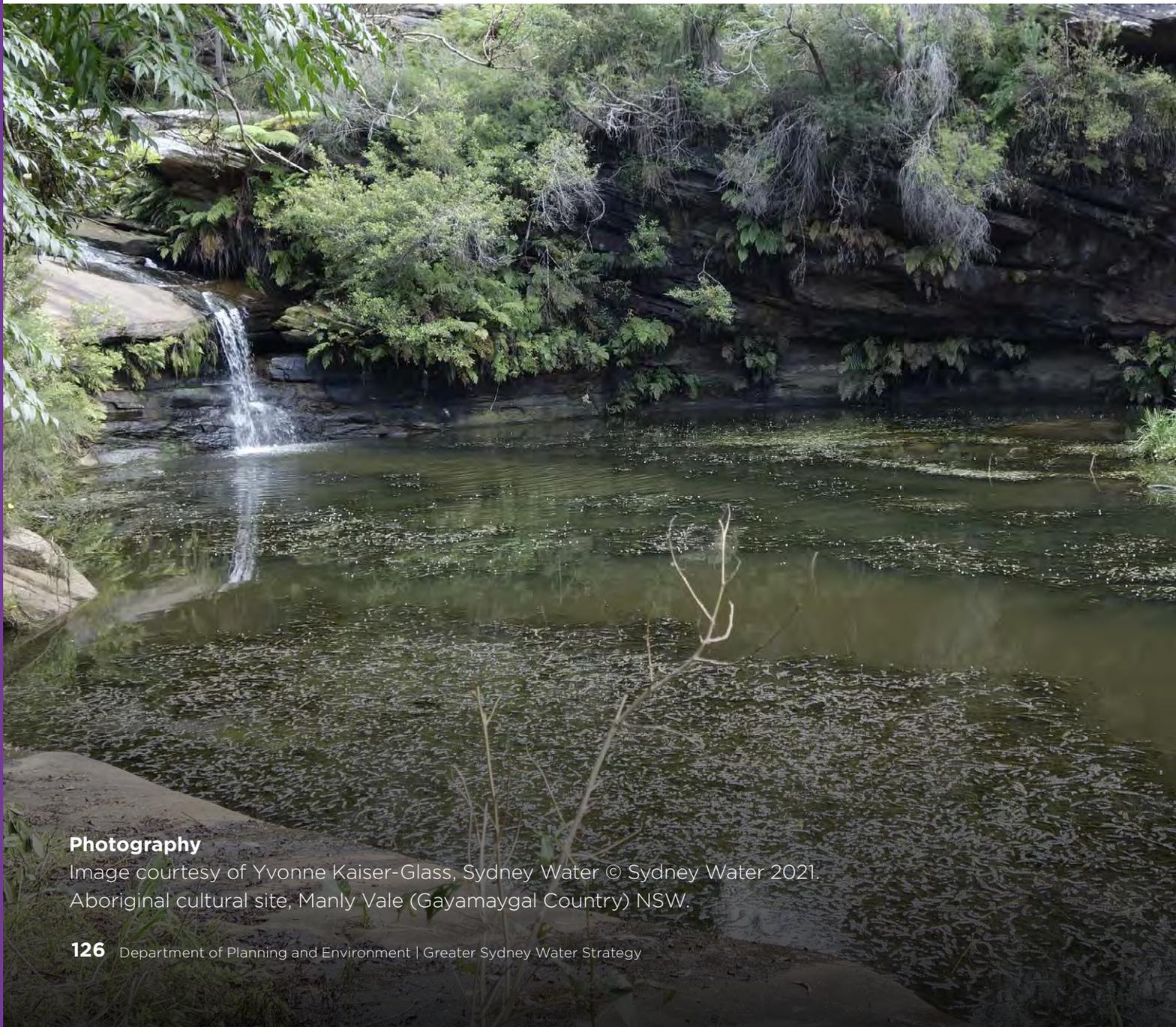
Community confidence in the design, development and distribution of water from alternative supply sources, such as desalination and purified recycled water, is critical to meeting our future water needs. Households and businesses across Greater Sydney will need to be satisfied that there is strong evidence for increasing our use of these sources and that the water provided is of the highest quality.

As discussed earlier in this strategy, the community is aware of the challenges facing Sydney's water supply, understands the need to diversify water supplies and is open to considering new options. The Greater Sydney Water Strategy provides an opportunity to talk further with customers, councils, communities and other groups about all options for water supply augmentation and understand their expectations around the greater use of recycled water for garden watering and other non-potable uses.

Any new water supply option, including desalination and purified recycled water, would only be introduced to Sydney's water supply system following community consultation and stringent Government approvals.

As part of the ongoing implementation of this strategy, there will be opportunities to:

- **Provide precise, easy to understand information** about the science and technology behind a range of water supply options including desalination and purified recycled water, using a range of different media and methods
- **Highlight examples of leading technologies for rainfall-independent supply options** operating in other major cities and **deliver demonstration projects** that increase community familiarity with and acceptance of those
- **Clearly articulate the environmental benefits of different rainfall-independent supply options**
- **Research customer and community perceptions** about where and when rainfall-independent supply options would be accepted, under what conditions and at what price.



Photography

Image courtesy of Yvonne Kaiser-Glass, Sydney Water © Sydney Water 2021.
Aboriginal cultural site, Manly Vale (Gayamaygal Country) NSW.

5.3 Manage price impacts for customers

While Sydney's water bills have been among the lowest in Australia, this strategy highlights the need to invest soon to service Greater Sydney's growing population and manage the risks and impacts of a changing and more variable climate. In particular, we will need to invest in new rainfall-independent sources of supply.

Sydney Water also faces potentially higher costs in the future, over and above maintenance of the existing network. For example, some ageing assets will need to be replaced and others will need to be upgraded to meet the environmental and water quality standards required by regulators and expected by the community. There are also likely to be significant costs associated with mitigating flood risk in Western Sydney.

These investments will secure Greater Sydney's water supply and maintain the high level of service and water quality enjoyed by water customers in the region. However, they are expected to lead to higher water bills in the future as the costs of those investments will be incurred by Sydney Water but ultimately paid for by customers.

The NSW Government will identify a number of approaches to smooth price increases, working together with Sydney Water and IPART. This includes improving long-term planning in the water sector, implementing lower-cost operational changes as quickly as possible and spreading larger-scale investment over a longer period (to avoid any sharp increases in bills).

As recommended by the NSW Productivity Commission in its White Paper, *Rebooting the Economy*, we will explore the role that price signals and innovative pricing models might play in demand management. It will also be important to recognise opportunities for alternative funding sources and partnering with the private sector where appropriate.

The Government's reintroduction of developer charges for providing water services to new developments means that the cost of building water and wastewater infrastructure in new growth areas will be partly funded by developers in the medium term. This is expected to significantly reduce the extent of bill increases by the 2030s.

Some measures adopted in the Greater Sydney Water Strategy may lead to economic savings, offsetting the cost of new investment. For example, producing extra water at the Sydney Desalination Plant would reduce the amount of water that needs to be treated at the Prospect water filtration plant and lessen the amount of time spent under water restrictions.

Hardship policies, concessions and special measures will continue to help customers having difficulty managing their water use or paying their water bills.

It is also important to appreciate that unplanned supply outages or regular water quality problems due to infrastructure failures will have economic impacts. Running out of water would be a catastrophic event that would impose very substantial financial costs on households, businesses and the broader economy.



How the strategy will be implemented

Photography

Image courtesy of Department of Planning and Environment.
Figtree Bay Reserve, Sydney.

Getting our timing right

A critical feature of the Greater Sydney 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 40-year timeframe from now until 2060, 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.

Ongoing monitoring and adaptation

The events of the last few years (drought, bushfires, floods, COVID-19) have highlighted that we live in a complex, changing and unpredictable world.

To develop this strategy, we have considered a wide range of future scenarios, the role of water in delivering the future vision for Greater Sydney, the aspirations of communities and the options for infrastructure and other policy responses needed to ensure that we have enough water to meet our water needs now and into the future.

However, there remains a degree of uncertainty around what our future will look like and the scale and nature of water services that best meet those needs. Even though we have a view of what needs to be done to deliver the outcomes for Greater Sydney over the next 20 years, the strategy sets out a pathway for adaptive decision making.

Critical to the success of such an adaptive approach is to monitor for key changes in water demand, customer behaviours, social preferences, economic conditions, affordability, science and technology, climate change, the nature of urban form, potential changes to standards and so on.

We also need to look back to see what is working well, what we need to keep and what we need to change. This adaptive approach will ensure that the strategy remains relevant and that we are doing the right things to continue to improve water services into the future.

We will establish an integrated framework for monitoring, reviewing and reporting against the Greater Sydney Water Strategy. Informed by feedback on the draft strategy, this final strategy includes an implementation plan outlining the delivery of actions, with a focus on the short-term planning horizon through to 2025. We will report every year against actions in the strategy so that customers and the community can track progress. We will formally evaluate, review and update the strategy at least every five years, or in response to changing circumstances.



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