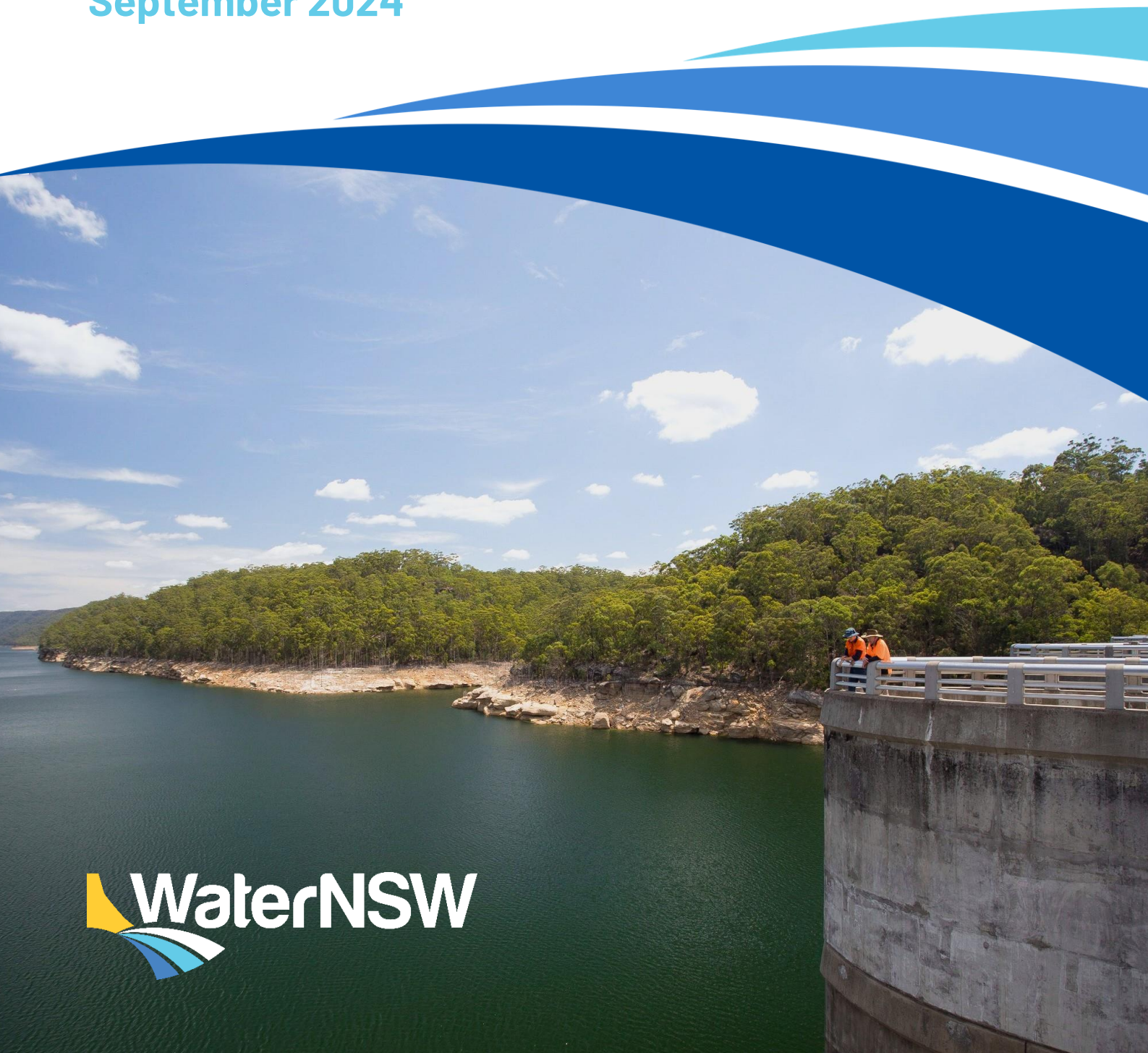
Attachment 24

Greater Sydney long-term capital and operational plan

30 September 2024

Greater Sydney Long-term capital and operational plan (LTCOP)

September 2024

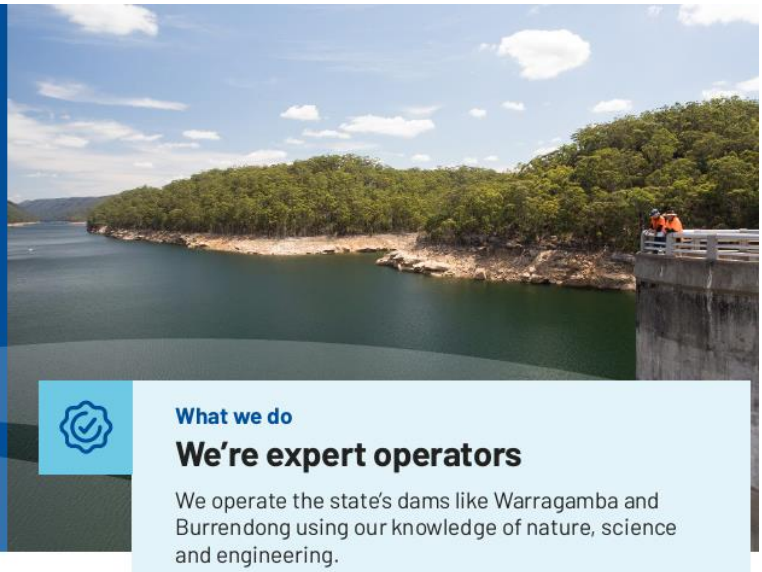


WaterNSW

About WaterNSW

WaterNSW
We're at the source

We're the people taking care of the state's water at the source – capturing, storing, delivering.



Our story

We're vital

We use our expertise to carefully capture and store our most vital natural resource. We then supply that water ready for distribution, for the environment, agriculture, industry and the community.

- We manage **41 major dams** and hundreds of waterways across the state, delivering **two thirds of all water used in NSW**
- We're at the source of the state's water, we're not at the taps
- WaterNSW is a State-Owned Corporation and one of the main government agencies tasked with managing water in NSW
- We follow the rules, we don't make the rules
- We're also the source of vital information, like river and dam storage levels

What we do

We're expert operators

We operate the state's dams like Warragamba and Burrendong using our knowledge of nature, science and engineering.

Our why

We're proud custodians

We are driven to use our knowledge, passion and expertise to manage water responsibly and support the resilience of NSW.

How we work

We're local partners

We live and work side-by-side with our customers and communities across NSW, and our work with First Nations people is important to us.

We acknowledge the Traditional Custodians of the land and water on which we work and recognise the continuing cultural and spiritual connections that Aboriginal and Torres Strait Islander People have to Country. We pay our respects to Elders past and present.

Table of contents

Executive Summary

An investment plan supporting the long-term vision for Greater Sydney's water supply

The Long-term Capital and Operational Plan (LTCOP) for Greater Sydney outlines WaterNSW's investment drivers and projected expenditure over a 20-year horizon. It describes our approach and requirements to sustain our future operations and service delivery, recognising the challenges ahead and changing expectations from government, our customers, and the community.

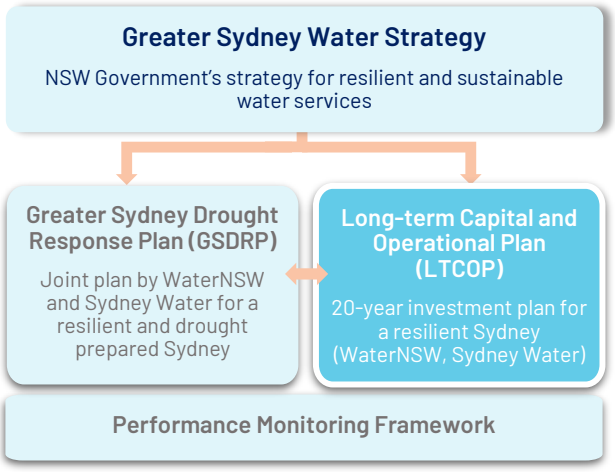
The LTCOP supports the NSW Government's long-term approach to managing Greater Sydney's water services to enable a sustainable, liveable, and prosperous city. The Greater Sydney Water Strategy (GSWS) outlined the direction and priority actions to ensure the resilience of our water supply, as well as the protection of our natural environment in the face of a growing population and changing climate.

We worked collaboratively with Sydney Water, our major customer in Greater Sydney, during the development of this plan to ensure that our respective LTCOPs and future servicing directions are aligned.

This plan is intended to inform our internal budgeting processes and WaterNSW (Greater Sydney) pricing submissions to IPART, and to provide the context for pricing and affordability discussions with Sydney Water and the NSW Government.

WaterNSW is Greater Sydney's raw water service provider. We have obligations to our regulators, customers, and the wider community for

- the delivery and management of supplied water quantity and quality
- catchment protection and management
- the operation and management of dams and bulk water delivery infrastructure.



Ensuring surface water continues to do the heavy lifting in a changing environment

We currently provide about 85% of Greater Sydney's raw water supply.
We capture, store, and deliver water to Sydney Water's water filtration plants, and to other customers, including councils and private landholders.
Greater Sydney's bulk water system comprises 21 prescribed dams, linked by a system of rivers, canals, tunnels, pipelines, weirs and pumping stations that enable water to be moved across the network.

The GSWS has established a clear priority for rainfall-independent sources of water for Greater Sydney in the future and Sydney Water's supply augmentation plans and LTCOP have maintained that focus. Nevertheless, Greater Sydney will remain heavily reliant on surface water sources throughout the period of the LTCOP and beyond.

Most of our assets are over 50 years old, some over 100 years. While they have, and continue to serve us well, ongoing investments are essential to maintain a safe and reliable water services in a changing climate and regulatory requirements. Thus, our LTCOP focuses on programs and initiatives we need to undertake to renew, enhance, and optimise the existing bulk water delivery infrastructure and its supporting systems, including for the protection of drinking water catchments.

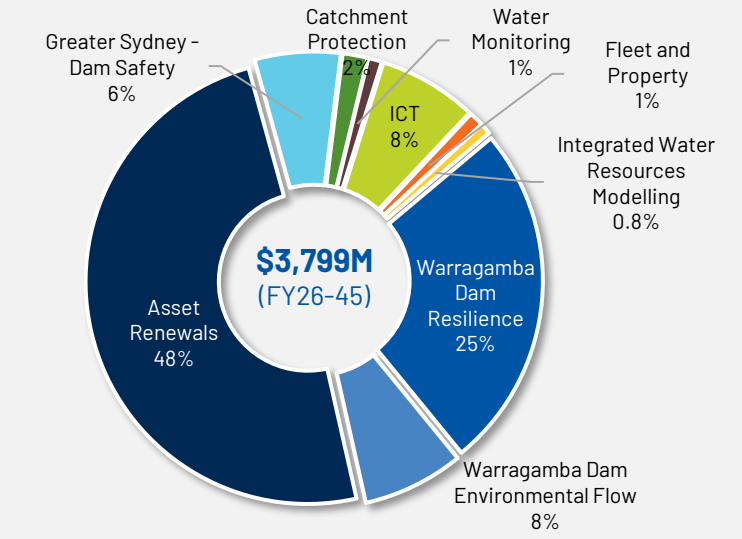
What drives our future expenditure

As a water utility providing an essential service, we have obligations to operate and manage our assets according to the relevant standards and meet the expectations of our customers. We also need to plan for how we should respond to the challenges and potential risks to our future operations and service delivery in a prudent and efficient manner to minimise customer bill impacts.

Our regulatory and societal obligations	We need to align our investments with the requirements of new risk-based dam safety management standards and water quality and catchment protection.
Our corporate strategic priorities	We set strategic priorities to achieve our purpose – *water delivered when and where it matters* – and our vision to support the resilience of NSW communities through our leadership in delivering water services, for generations to come.
Ageing infrastructure	We need to ensure our assets and systems can continue to meet the needs of a modern water supply system and keep pace with the changing customer and government expectations around service reliability and resilience.
Maintenance and operational efficiency	Delivering operational excellence is one of our strategic goals and drives our ongoing focus on becoming ever more efficient in how we operate and maintain our water delivery assets and systems.
Greater Sydney's changing water context Population growth and urbanisation I Climate change and extreme events I Water quality risks I Catchment health risks I Emerging technologies	Our catchments and assets are increasingly at risk from the intensification of development and more frequent and intense events, such as droughts, bushfires, floods and heatwaves. Additionally, technologies that enhance our service delivery are rapidly changing, and the threat of cyber risks are increasing. We need to adapt and manage these risks to become a more resilient and responsive water utility.

An investment plan reflecting our approach to servicing Greater Sydney into the future

Our projected baseline capital expenditure (capex) over the next 20 years is in the order of **$3,799M**. This includes major investment in two key projects at Warragamba Dam and funding for various programs that focus on the renewal and enhancement of our existing assets and supporting systems.



Our capital expenditure plan has gone through a detailed evaluation process, utilising a prioritisation approach that considers the risks to our service delivery and operations, benefits, and cost to determine the overall value.

Our forecast average annual operating expenditure (opex) over the next 10 years is in the order of $134M/yr and is expected to increase in line with inflation in the long-term. Our opex is driven by several factors, including ageing assets and higher input costs driven by increase in labour, utilities, services, and insurance costs, as well as taxes. We will manage the impact of future cost increases through our continued effort to introduce efficiencies in our operations, better management of risks, and enhanced prioritisation of maintenance activities.

Program	Key investment drivers	Cost ($M, $2024-25)
Warragamba Dam Resilience	Regulatory & societal obligations I Changing water context I Ageing infrastructure	$966
Warragamba Dam Environmental Flow	Regulatory & societal obligations I Changing water context	$302
Asset Renewals	Ageing infrastructure I Regulatory obligations I Maintenance and operational efficiency I Our strategic priorities I Changing water context	$1,823
Greater Sydney - Dam Safety	Regulatory obligations I Changing water context I Ageing infrastructure	$240
Catchment Protection	Regulatory obligations I Changing water context I Our strategic priorities	$70
Water Monitoring	Maintenance and operational efficiency I Ageing infrastructure I Our strategic priorities I Changing water context	$39
ICT	Regulatory compliance I Maintenance and operational efficiency I Our strategic priorities I Changing water context	$287
Fleet and Property	Regulatory compliance I Maintenance and operational efficiency I Our strategic priorities	$41
Integrated Water Resources Modelling	Maintenance and operational efficiency I Our strategic priorities I Changing water context	$31
	20-Year Total Projected Capex (FY26-45)	**$3,799**

Key investments over the next 10 years

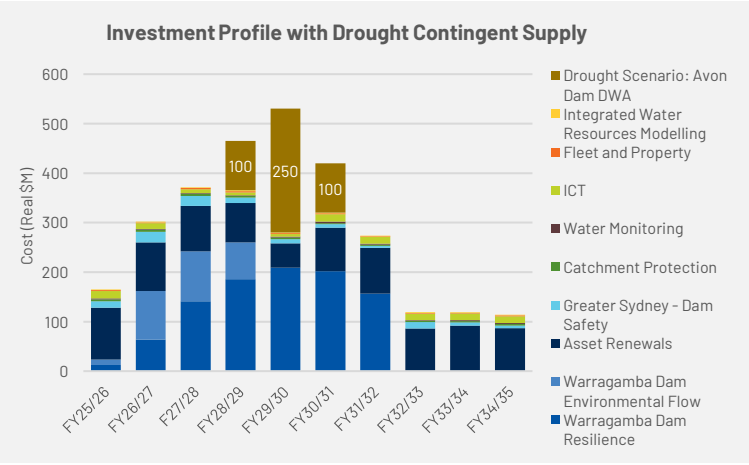
Our capex program assumes the delivery of two significant projects at Warragamba Dam and critical asset renewal and dam safety works in the next 10 years.

Warragamba Dam Resilience Project $966M (FY26-32)	In line with current regulatory requirements, WaterNSW completed a comprehensive risk assessment (CRA) of Warragamba Dam in mid-2021. Based on the information available for this assessment, the CRA concluded the dam exceeded the prescribed safety threshold as determined by the Dams Safety NSW (DSNSW) regulations. We have been undertaking extensive investigations and studies to assess both non-infrastructure and infrastructure measures to reduce the risks. Currently, the infrastructure options under consideration include construction of a concrete buttress on the downstream face and/or installing post tensioned anchors with no change to the full supply level or gate operations. Considerations for addressing the overtopping risk include a large channel constructed at the downstream toe to direct flows into the main/central spillway. At this stage, the estimated costs are based on a scope of work that is not yet well defined and informed by preliminary engineering assessment and thus subject to change.

Warragamba Dam Environmental Flow (eflow) $302M (FY26-29)	The Greater Sydney Water Strategy has maintained the NSW Government's commitment to introduce variable eflow releases from Warragamba Dam to improve the health of the Hawkesbury-Nepean River. This change is intended to mimic the natural flow of the river prior to the construction of the dam. Under the GSWS implementation plan, WaterNSW is responsible for finalising the Warragamba Dam eflow business case and implementing the new eflow regime. We completed the final business case and will be the delivery agency for the required dam wall modifications. This project will provide the necessary infrastructure to enable the new eflow regime to be released from Warragamba Dam.
Asset Renewal Program $1,823M	There is a wide range of project types within our asset renewal program to address the risks associated with ageing assets and to maintain or improve service levels and performance. These include projects that focus on personnel and infrastructure safety and on improving infrastructure reliability and resilience. Some of the key projects in the next 10 years include: • Warragamba pipelines and corridor renewal • Upper Canal repairs • Warragamba deepwater pumping station operational readiness
Greater Sydney Dam Safety Program $240 M	Our Portfolio-wide Risk Assessment (PRA) was completed in 2019, including the consequences assessment review of Greater Sydney Dams in-line with the industry best-practice. To reduce the identified dam safety risks, we apply a "So Far As Is Reasonably Practicable" (SFAIRP) approach, in line with the Dams Safety Act and Regulations. We also apply a prioritisation framework to the SFAIRP outputs to determine the priority and programming of the risk control measures to achieve our risk management objectives. This information has been used to develop our Dam Safety Investment Strategy. Some of the key projects in the next 10 years include: • Warragamba and Prospect Dams instrument enhancement • Cataract Dam safety upgrade: a staged approach to lower a risk rating to SFAIRP

Drought investments

Our baseline investment plan does not feature the delivery of new surface water supplies based on GSWS direction and Sydney Water's current planning advice. However, the LTCOP has included an investment scenario with drought contingent supply - Avon Dam deepwater access (DWA) - should it be required in the next drought for mitigating water security risks in the Illawarra. The need to implement the Avon DWA will be dependent on the severity of the drought, storage levels in the Upper Nepean and Tallowa, and risk appetite of government around severe water restrictions and system failure.



Additionally, the Greater Sydney Drought Response Plan identified assets that are critical for maintaining supply continuity in drought operations and included action plans for addressing known constraints and issues with these assets. The costs associated with delivering these projects are captured in the Asset Renewal Program.

Bill impact

Our bill impact analysis indicates that, for the baseline LTCOP investment profile, annualised increases of about 14 per cent and 12 per cent from current bills is expected for FY26-30 and FY30-35 regulatory periods, respectively. Our LTCOP also canvasses other scenarios, as shown below.

Scenario	FY26-30 Annualised Increase vs 2024-25	FY30-35 Annualised Increase vs 2024-25
Baseline LTCOP	14%	12%
Warragamba Dam Resilience and Eflows excluded from pass-through cost	12%	6%
Baseline LTCOP with drought contingency (Avon DWA)	14%	14%

Funding for our proposed programs

We will ensure the LTCOP investment is financially sustainable, meeting the needs of the community and enabling us to continue investing in services and assets. As projects progress to business case phase, a range of funding and delivery options will be investigated as part of the process of assessing whether projects are economically viable and will deliver value for money. The LTCOP seeks to align the investment drivers with funding sources within the IPART Pricing Determination as much as possible, to provide clarity and transparency in our approach with customers.

Our current assumption is that we can fund the entire LTCOP program without any need for equity or other NSW Government contribution, assuming the costs associated with the entire program are fully funded by Sydney Water (and its customers).

Progressing the LTCOP

Our LTCOP is an adaptive plan that will continue to be updated as Greater Sydney's water context changes, new water policy direction is set, and new opportunities or threats emerge. We will continue to engage closely with stakeholders including the NSW Government and IPART and work closely with Sydney Water.

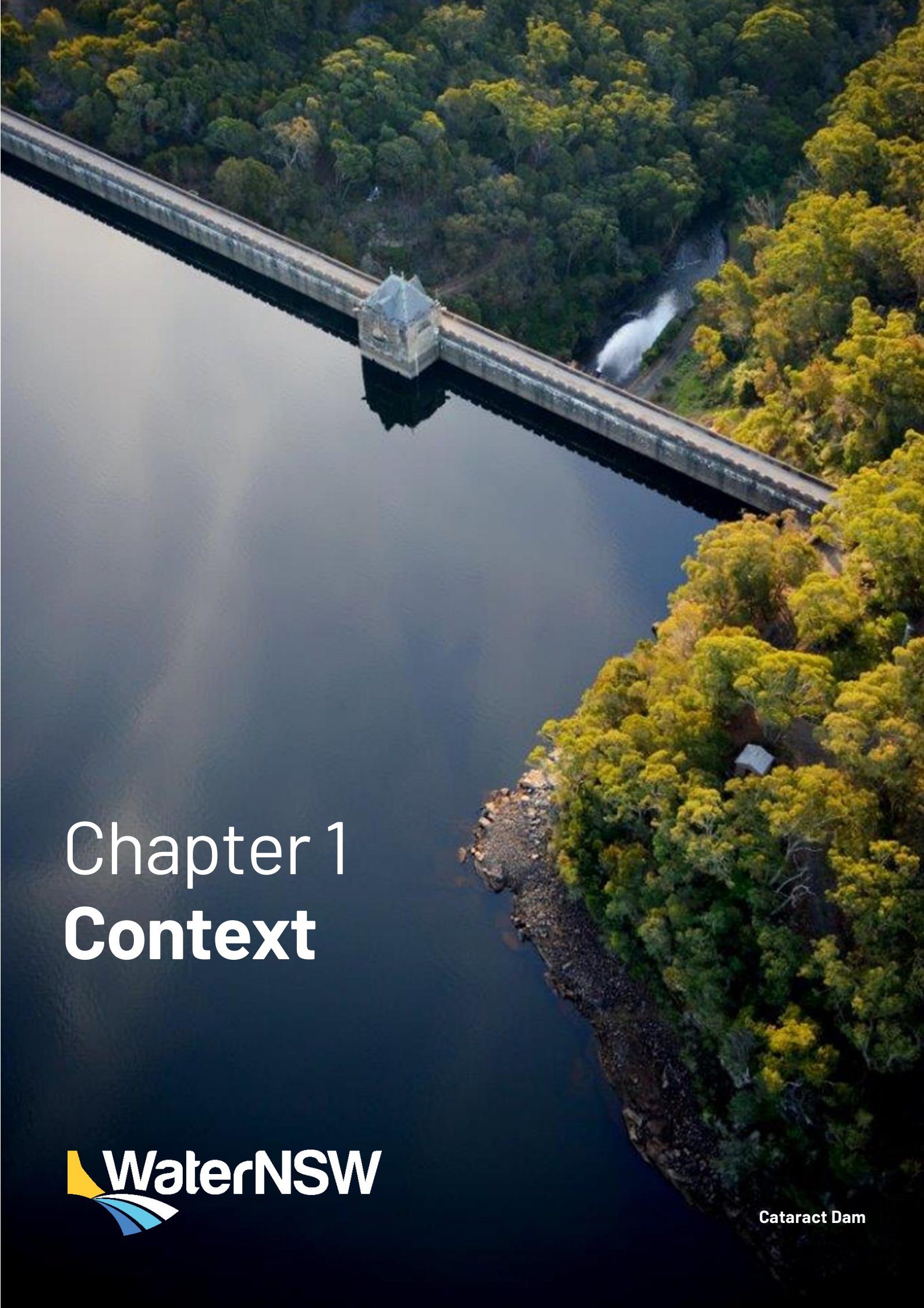
We will progress to detailed assessments of specific investments as part of the WaterNSW Investment governance process. Business cases supporting each major investment decision will ensure projects that are progressed will deliver value for money for the people of Greater Sydney.

Additionally, the LTCOP requires a review and update at least once every five years (an Operating Licence requirement). However, it may also need updating if any of the following changes:

- GSWS water servicing direction and its implementation plan, including any changes to our core functions and responsibilities in Greater Sydney
- Warragamba Dam Resilience Project or Warragamba Dam Environmental Flows Project scope and implementation plan
- new regulations, requiring our compliance via capital investments or major operational change
- Warragamba Dam flood mitigation function, especially if it has implications for our dam safety.

Our future LTCOPs will also include any required investments associated with the following:

- Our corporate Environment, Social and Governance (ESG) and climate change adaptation strategies
- Catchment audit recommendations
- Upper Canal long-term strategy
- Warragamba Full Supply Level lowering for flood mitigation (if becomes policy)
- Purified recycled water to Prospect Reservoir
- Initiatives to ease cost pressures



Chapter 1
Context

WaterNSW

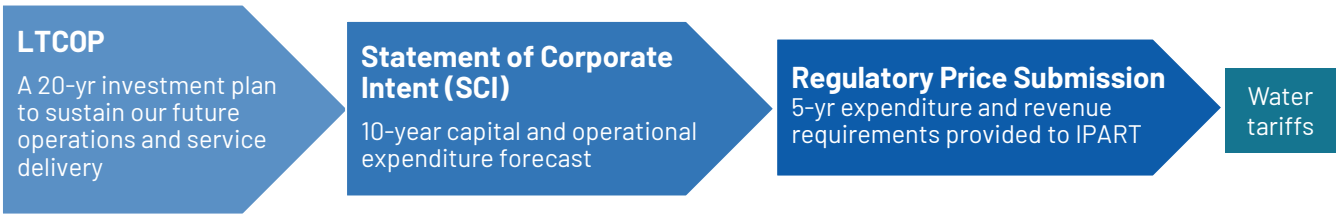
Cataract Dam

1.1 Purpose of this document

This document describes our Long-term Capital and Operational Plan (LTCOP, this Plan) for Greater Sydney's bulk water system, reflecting our current thinking and view on future investment needs. The LTCOP outlines our key investment drivers and projected expenditure over a 20-year horizon to achieve our customer service goals, comply with our regulatory obligations, and support the NSW Government's strategic directions to provide sustainable and resilient water services for generations to come.

While several specific projects are included in this LTCOP, it is not intended to be a comprehensive list of all infrastructure projects that will proceed over the next 20 years. Rather, it presents the strategic drivers, priorities, and intended outcomes that underpin our expenditure plan. The details of specific projects, their costs and timelines will be determined through the IPART economic regulation and other various NSW Government approval processes. Our LTCOP endeavours to ensure that our investments occur in an optimised order and are prudent and efficient to minimise cost impacts to customers.

The LTCOP is intended to inform our internal budgeting processes and WaterNSW (Greater Sydney) pricing submissions to IPART, and to provide the context for pricing and affordability discussions with Sydney Water, our major customer in Greater Sydney, and the NSW Government.



1.2 Supporting Government's strategic priorities

The LTCOP supports the NSW Government's long-term approach to managing Greater Sydney's water services to enable a sustainable, liveable, and prosperous city. The Greater Sydney Water Strategy (GSWS) outlined the direction and priority actions to ensure the resilience of our water supply, as well as the protection of our natural environment in the face of a growing population and changing climate.

WaterNSW and Sydney Water worked collaboratively to develop our respective LTCOPs, as well as the Greater Sydney Drought Response Plan (GSDRP). The development of these plans forms part of our responsibilities in delivering the GSWS objectives. This obligation is also reflected in our Operating Licence.

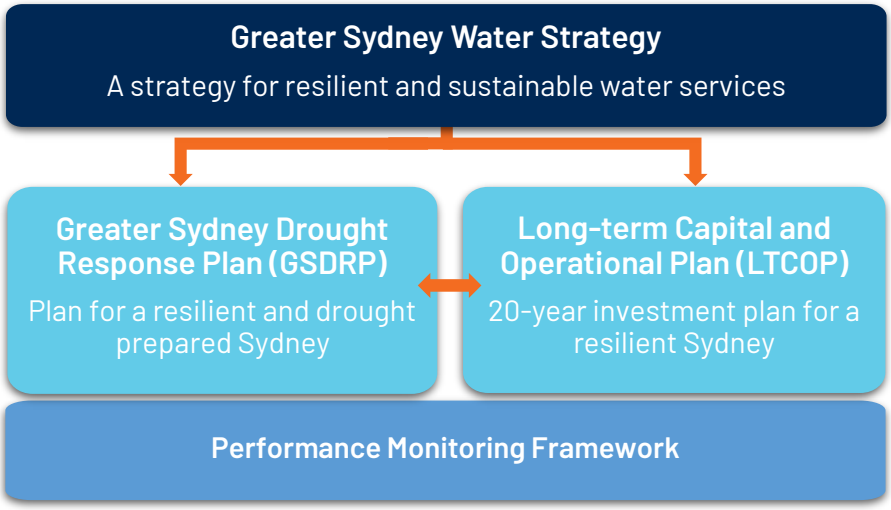


Figure 1: LTCOP strategic context

Our proposed investments over the next 20 years will contribute to achieving the key outcomes under each priority area identified in the GSWS. These include:

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

The LTCOP is also in line with the Statement of Expectation for WaterNSW by NSW Government, including:

- alignment with Government's strategic planning
- strive for excellence in customer expectation and experience
- focus on environmental outcomes
- minimise cost of living pressure
- ensure the Government's investment of its capital is used efficiently.

1.3 A collaborative approach to develop the LTCOP

WaterNSW and Sydney Water are responsible for different aspects of delivering water services to Greater Sydney, along with several government agencies, such as the NSW Department of Climate Change, Energy, the Environment, and Water (DCCEEW). This means a close collaboration between the agencies is required to deliver water services in a cost-effective and efficient manner.

We developed our LTCOP in consultation with DCCEEW and Sydney Water, our major customer in Greater Sydney, to ensure that their future needs and service expectations are considered and there is alignment between our respective LTCOPs. This involved developing a joint planning approach and investment drivers, and sharing our strategic plans, models, inputs, and key planning assumptions.

Our collaboration with Sydney Water focused on:

- clarifying accountability for planning and delivery of the different projects
- identifying current and future assets and system requirements, assumptions, and dependencies
- establishing our respective investments and actions for the next 20 years
- aligning assumptions, inputs, and outcomes (e.g., reviewing each other's LTCOPs)
- optimising the staging, timing, and costs of different servicing pathways, to understand the impact on pricing and customer bills, and our ability to meet our regulatory requirements and service delivery objectives.

1.4 Key assumptions

This LTCOP is based on the following assumptions.

Bulk water asset augmentation	Supply augmentation	Geographical scope
No augmentation is required to our major bulk water transfer assets such as the Upper Canal and Warragamba pipeline; only renewal costs are reflected. This aligns with Sydney Water's current planning advice.	No investment in new surface water options such the Burrawang to Avon Tunnel (BAT), based on GSWS direction and Sydney Water's current planning advice. Although, an additional investment scenario with drought contingent supply (Avon Dam deepwater access) has been included.	The same geographical scope as the GSWS, i.e. areas serviced by Sydney Water. Nevertheless, this LTCOP includes renewal programs covering the assets that also supply our other customers in the Greater Sydney system (Wingecarribee, Shoalhaven and Goulburn-Mulwaree Councils).

Design drought	Climate change scenario	Current policy around Warragamba Dam's operation
1:100,000 design drought was used for storage depletion forecasts and drought response planning.	Representative Concentration Pathway (RCP) 4.5 scenario (NARCliM 1.5) was used to assess potential impacts on system yield.	Warragamba Dam's FSL will not be reduced for flood mitigation. WaterNSW will deliver the required dam wall modifications to enable variable eflow releases from Warragamba Dam.

Water market	Weighted Average Cost of Capital (WACC)	Pass through costs
No change to current WaterNSW operating model, responsibilities, regulatory obligations, or asset ownership.	3.6% (consistent with WaterNSW's Statement of Corporate Intent)	The costs associated with our entire LTCOP 20-year program, including for the Warragamba Dam Resilience and Environmental Flows are fully funded by Sydney Water (and its customers). A scenario where the two major Warragamba projects are funded by other means has been included.

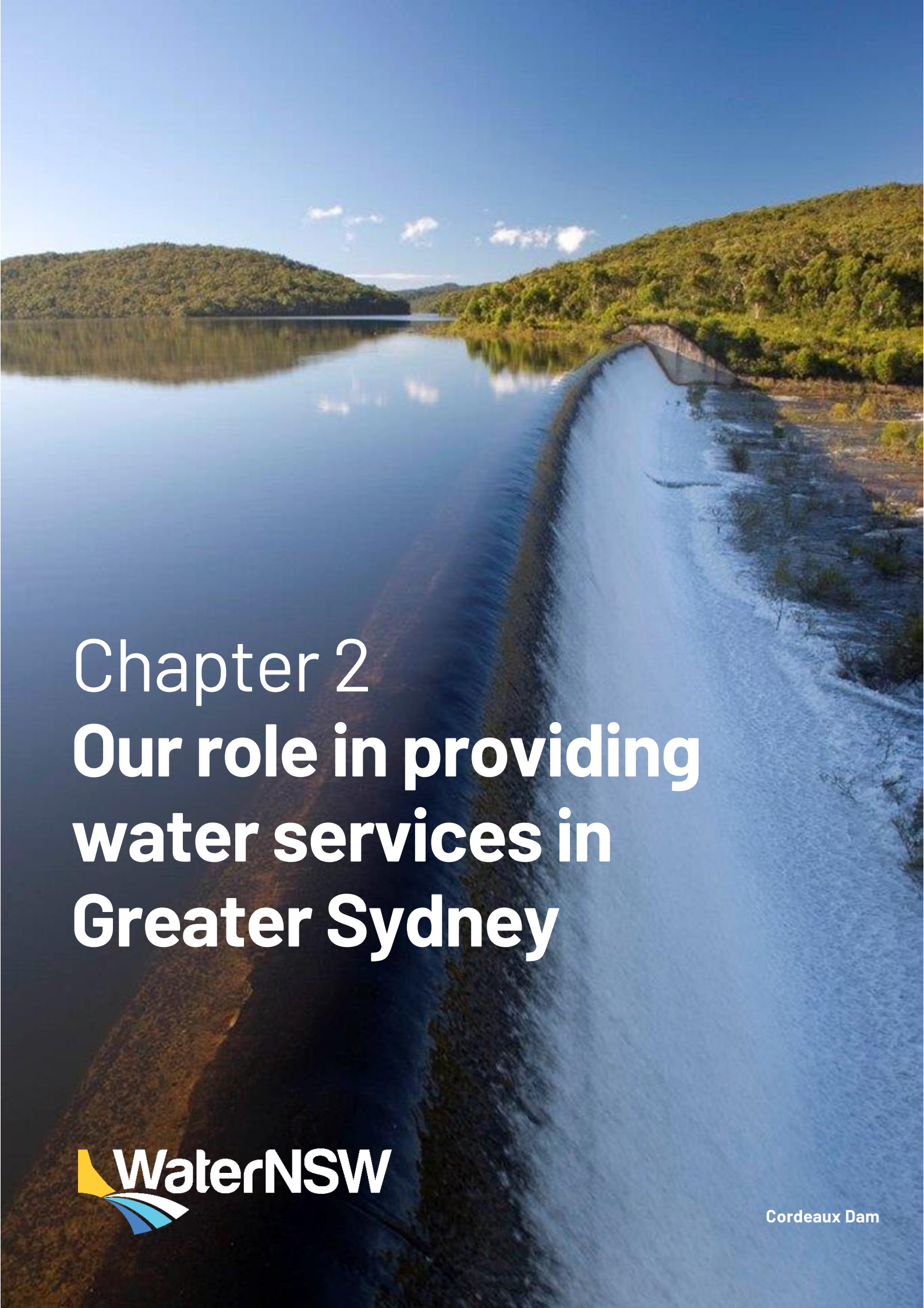
1.5 Scope of our LTCOP for Greater Sydney

Our LTCOP focuses on our existing bulk water infrastructure and supporting systems, comprising:

- water delivery assets consisting of dams, tunnels, pipelines, weirs, pumping stations, and water monitoring network, including their associated civil works and facilities
- the Declared Catchments in Greater Sydney
- soft infrastructure, such as our Information and Communication Technology (ICT), modelling software and other tools that support our day-to-day operations, forecasting, and planning
- assets that support our people and those that provide recreational amenity for the community.

Our current 20-year investment plan does not include new supply infrastructure, such as new dams and rainfall-independent supplies, however, provision is made for the progression of drought contingent supplies should they be required in the next drought for mitigating nodal water security risks (details in Chapter 5.2).

Sydney Water is responsible for water supply augmentation planning in Greater Sydney and for identifying the need for major augmentations to our bulk water delivery infrastructure, such as the Upper Canal and Warragamba pipelines. At the time of writing, Sydney Water was in the process of developing its Master Plan for Greater Sydney which will outline the infrastructure required and staging to achieve the supply and network resilience objectives. Our future LTCOPs will capture any required investment by WaterNSW for major augmentation of the bulk water assets based on Sydney Water's Master Plan recommendations.



Chapter 2
Our role in providing water services in Greater Sydney

WaterNSW

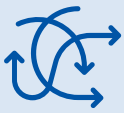
Cordeaux Dam

2.1 We're at the source

We protect
16,000km²
of Greater Sydney's drinking water catchment

We provide
~85%
of Greater Sydney's raw water supply from our dams

We maintain
~200km
of transfer pipelines, tunnels, and canals



We collect data from
380+
water monitoring sites across Greater Sydney

WaterNSW is Greater Sydney's raw water service provider. We also protect the health of Sydney's drinking water catchments and source water to enable delivery of high-quality raw water to our customers.

Figure 2 shows the schematic diagram of the existing raw water supply network and supply nodes, i.e., interface with water filtration plants.

Greater Sydney's bulk water system is an integrated network that captures, stores, and delivers raw water to Sydney, the Illawarra, Blue Mountains, Shoalhaven and Southern Highlands. The system comprises 21 prescribed dams and a transfer system that delivers water to Sydney Water's water filtration plants, and to other customers in WaterNSW's service area, including Wingecarribee Shire Council, Shoalhaven City Council, Goulburn-Mulwaree Council, and private landholders.

The system can collectively store approximately 2,750 GL of water, of which approximately 2,600 GL is currently accessible. The dams are interconnected by a system of rivers, diversion weirs, canals, tunnels, (e.g., Nepean, Nepean-Avon, Upper Canal), pipelines, and pumping stations that enable water to be moved throughout the network.

The system draws water from four river basins – the Shoalhaven, Hawkesbury-Nepean, Grose, and Georges (Southern Sydney Rivers) – and the Fish River Water Scheme (FRWS). WaterNSW has water Access Licences and associated Work Approvals to extract water from these sources.

The system is supported by a diverse and sophisticated monitoring, data collection, and modelling network which is integral to operational decision making and implementation, risk assessments, and planning. All decisions are made based on a range of dynamic system constraints, and customer and stakeholder requirements to ensure a continuous supply of the highest quality raw water.

What we do

Source water protection to ensure safe water is supplied to our customers

Bulk water supply from our storages to customers in Greater Sydney

System operator of the river systems and bulk water supply systems,

Infrastructure planning, delivery and operations to meet customer levels of service consistent with government policy and priorities

Information services, giving customers and communities access to bulk water supply information

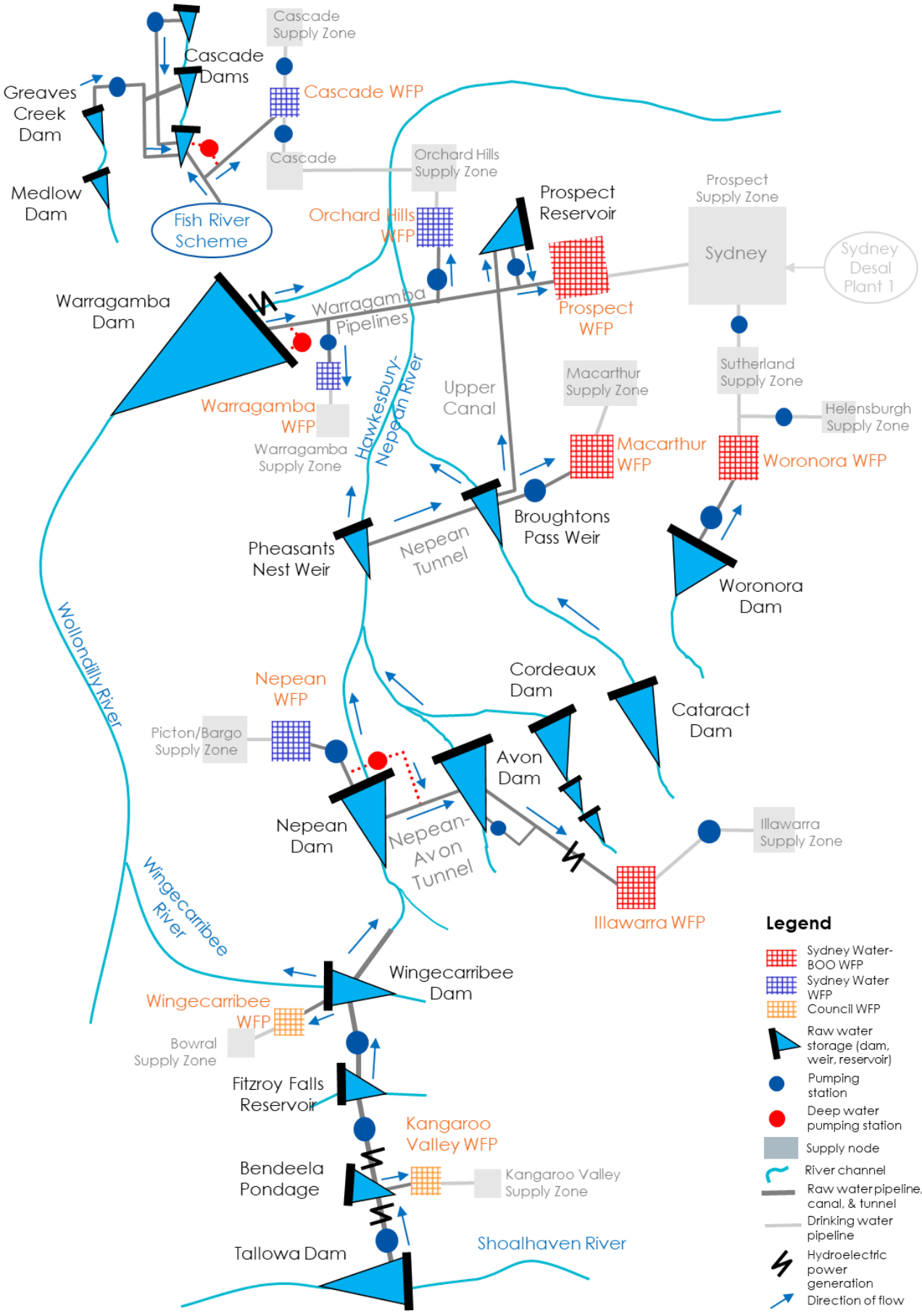


Figure 2: Schematic of WaterNSW's bulk water system

2.2 Operational philosophy and delivery objectives

WaterNSW configures and operates the Greater Sydney system with the principal objective of supplying the best possible quality of water at the agreed quantities to our customers. Within this principal objective, there is a series of other objectives that govern the management and configuration of the system, including:

- ensuring safety for staff, customers, contractors, and the public at all times
- protecting and enhancing water quality and the health of the Declared Catchments
- maximising the long-term yield by making strategic choices about where water is supplied, optimising water quantity and quality outcomes
- maintaining continuity of supply to all customer supply points, particularly during drought or abnormal circumstances
- implementing sound asset management, including inspections, outages, maintenance, repairs, and replacements
- minimising the impact on the environment and
- optimising operating and investment costs.

2.3 Protecting our drinking water catchments

We manage and protect Declared Catchment areas in Greater Sydney to enhance the quality and quantity of raw water for our customers. To achieve this, we:

- manage and monitor all developments in the Declared Catchments
- develop management standards and plans of management for our lands
- develop and implement land and asset management programs
- ensure lands are managed consistently with WaterNSW Asset Management Systems, including bushfire management, biosecurity, and recreational use
- actively patrol and manage Special Area and Controlled Area access to ensure compliance with WaterNSW Act, regulation, and other environmental legislations
- provide input and advice to mining related activities such as exploration and development applications, especially within Special Areas.

2.4 Meeting water quality objectives

Our extensive catchment protection and ongoing management activities minimise the risk to the quality of raw water supply. Also, our network of storages and transfer systems enable optimisation of supply to deliver raw water to our customers at the required standard. Flood events, algal blooms or stratification of a reservoir may cause changes in quality water quality for a period, and during these events water will be drawn selectively from sources that have better quality to ensure that the best possible quality water is delivered to meet demand at each water filtration plant.

Changes in climatic condition or significant events, such as large rainfall and inflow events, can rapidly impact water quality. To mitigate the potential risks, we work closely with our customers, such as Sydney Water, to optimise raw water supply. This process is supported by our extensive water monitoring network that includes on-line instrumentation, providing real-time data, combined with extensive water quality expertise and modelling capabilities.

2.5 Protecting river health

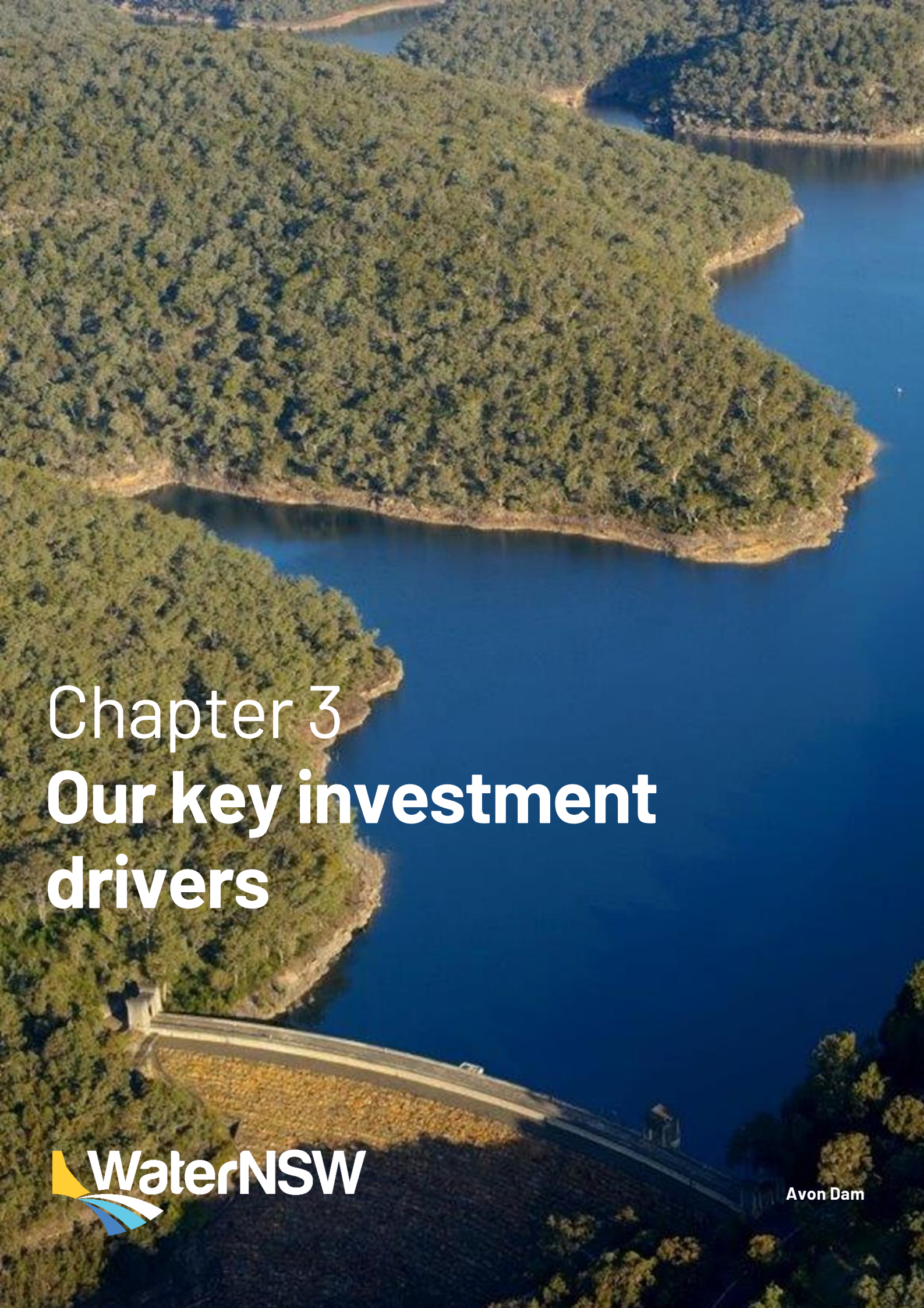
Releases from our dams to meet environmental watering needs are critical in maintaining downstream river health and mitigating environmental impacts. Our operations and management of environmental flows (eflows) comply with the rules and requirements of the Water Sharing Plan (WSP) for the Greater Metropolitan Region Unregulated River Water Sources.

There are a variety of environmental release regimes in place across Greater Sydney ranging from a fixed daily flow to a daily variable flow regime. These include:

- Fixed daily flow requirements are currently in place at Warragamba and Wingecarribee Dams.
- A variable eflow regime will be implemented at Warragamba Dam to improve river health outcomes along the Hawkesbury-Nepean between Wallacia and Richmond. To enable this, Warragamba Dam will require major modifications to install infrastructure that allows variable releases to occur. This is discussed in more detail in Chapter 5.1.2.
- Daily variable releases are implemented at Fitzroy Falls Reservoir.
- An 80/20 transparent/translucent[1] flow regime is implemented Pheasants Nest, Broughtons Pass and Woronora.
- A scaled 80/20 transparent/translucent flow regime will soon be implemented at Tallowa, Nepean, Avon, Cordeaux, and Cataract dams as per the Greater Sydney WSP 2023 scaled eflow regime.

Variable release 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, fish passage, and reduce floating weeds. Variability in flow is a natural part of Australian rivers, with ecosystems evolved to cope with our variable climate. No flows, steady flows, or low flows below our dams contribute to poor water quality, invasive floating weed outbreaks, and toxic algal blooms. These conditions also adversely impact the native fish population. Thus, we carefully manage environmental flows in the Greater Sydney system to optimise the trade-off between water supply security and environmental benefits.

[1] The intent of this regime is to pass through inflows at or below the 80th percentile as the transparent portion of flows. This ensures stream connectivity during low flow conditions and ensures some water is available for downstream irrigators who draw water from various weir pools along the Nepean River. The translucent portion is made up of 20% of any inflows above the 80th percentile. This is to allow for the release of higher flows outside of spills conditions which are considered essential for maintaining a healthy downstream river system.



Chapter 3
Our key investment drivers

WaterNSW

Avon Dam

3.1 Our regulatory and societal obligations

We have obligations to our regulators, customers, and the wider community for the delivery of water and management of supplied water quality, catchment protection and management, and the operation of dams and other infrastructure in Greater Sydney. Our activities are guided and regulated by the following.

3.1.1 Water NSW Act 2014

The Water NSW Act 2014 defines the objectives of WaterNSW as:

- to capture, store and release water in an efficient, effective, safe, and financially responsible manner, and
- to supply water in compliance with appropriate standards of quality, and
- to ensure that declared catchment areas and water management works in such areas are managed and protected to promote water quality, the protection of public health and public safety, and the protection of the environment, and
- to provide for the planning, design, modelling and construction of water storages and other water management works, and
- to maintain and operate the works of WaterNSW efficiently and economically and in accordance with sound commercial principles.

Our Operating Licence, set by the Independent Pricing and Regulatory Tribunal (IPART), is an enforceable regulatory instrument that authorises us to exercise our functions under the Water NSW Act 2014. Those functions include:

- capture and store water and to release water
- supply water to Sydney Water and other water supply authorities, local councils or county councils
- construct, maintain and operate Water Management Works
- manage, protect and enhance the declared catchments and the water quality and quantity within them
- undertake flood mitigation in all areas of NSW except the Sydney Catchment area
- undertake research on catchments
- undertake an educative role within the community.

3.1.2 Water NSW Regulation 2020

One of our key responsibilities is identifying and managing impacts on water quality in the Declared Catchment areas. To protect water quality, the Water NSW Regulation 2020 restricts access to lands immediately adjacent to the storages used for drinking water supplies. It also provides for regulatory powers to manage pollution activities that impact water quality.

In Special Areas, (those lands adjacent to water storages in the Greater Sydney drinking water catchment) access may be prohibited or certain activities restricted to protect water quality and ecological health.

The Water NSW Regulation 2020, which operates under the Water NSW Act 2014, provides WaterNSW with the power to legally enforce access restrictions. We have enforcement powers under the Protection of the Environment Operations Act 1997 to penalise polluting activities in the catchment that may impact on water quality.

3.1.3 Water Management Act 2000

The objects of the Water Management Act (the Act) are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations.

Water Sharing Plan (WSP) for the Greater Metropolitan Region Unregulated River Water sources 2023

The Water Sharing Plan (WSP) establishes the bulk access regime for the extraction and movement of water within the bounds of the Greater Metropolitan region. The plan specifies operating rules for the Shoalhaven transfer system, as well as setting out environmental flow requirements. The WSP sits below the Water Management Act and provides a greater level of detail. We ensure that our operations comply with the rules and requirements of the WSP.

Operating Protocol to implement WaterNSW's works approvals under the water sharing plan

The works approvals package sits below the Water Sharing Plan and defines:

- the infrastructure used to capture, store, supply, release and transfer water
- our water access rights and obligations including the releases for environmental and other purposes in accordance with the provisions of the Water Sharing Plan
- the monitoring and reporting requirements to enable assessment of environmental flows on river health.
- the requirements for measurement and accounting of water releases and extractions.

3.1.4 Dams Safety Act 2015

Our dams capture and store a significant volume of water and form an essential component of the bulk delivery system. Failure of any dam structure could have a devastating impact on human life, water supply and downstream communities, as well as the environment. To secure our water supply and for public safety, we regularly assess the risks and mitigate those risks to ensure our dams are structurally sound and capable of surviving extreme flood and earthquake conditions.

As a responsible dam owner and manager, we comply with the requirements of the NSW Dams Safety Act 2015 and NSW Dams Safety Regulation 2019 and follow appropriate industry good practice guidelines. Dams Safety NSW (DSNSW) is the State's regulator for dam safety. It is responsible for developing and implementing policies for effective dam safety management.

In line with the Dams Safety Act and Regulations, we apply a "So Far As Is Reasonably Practicable" (SFAIRP) approach to reduce dam safety risks. The updated Dam Safety Regulations require dam owners to utilise a range of risk informed methods, processes, and information management systems appropriate for the dams to discharge their compliance obligations and their operation.

In response to the change in regulations, WaterNSW established a dam safety management system (DSMS) to manage the safety of its dams. The DSMS is supported by a robust technical assurance and governance framework that includes independent review of dam safety decisions. The dam safety management practices are regularly reviewed and audited (including by DSNSW) to ensure it remains appropriate and in line with good practice.

We also developed the SFAIRP Framework and methodology, which is a foundational element to the evaluation of risks for our portfolio of dams. In addition, to evaluate adequacy of existing controls, it identifies and assesses control measures that could be implemented to control the risk of dam failure. Where insufficient information is available to make this assessment, it also identifies associated studies, investigations or concepts required.

We applied a prioritisation framework to the SFAIRP outputs to determine the priority and ultimately the programming of the implementation of the risk control measures to achieve WaterNSW risk management objectives. This information has been used to develop WaterNSW Dam Safety Investment Strategy.

We are committed to ensuring our dams meet the highest safety standards to protect life, property, and the environment from dam failures. Our capital investment in Dam Safety Management supports a systematic approach to managing dam safety risks, including organisational structures, roles, responsibilities, accountabilities, codes, policies, standards, communications, tools, data, processes, procedures, and documentation.

As part of the ongoing dam safety investment, Warragamba Dam has had significant upgrades over the years, with wall strengthening and raising by 5 m in the 1980s, and construction of the Auxiliary Spillway in the early 2000s. We have recently undertaken a comprehensive review of the dam safety risks at Warragamba, which has identified there may be the need for significant upgrades and associated investments to ensure the dam complies with the latest regulatory requirements. Details of this project and investment program are provided in Chapter 5.1.1.

Upgrade works are also required at Cataract Dam as detailed in Chapter 5.1.4. The Upper Nepean Risk Review Project identified dam safety risks at Cataract dam that plot above the 'Safety Threshold'. We commissioned the Cataract Dam Safety Upgrade project to assess dam safety upgrade options for the key 'Potential Failure Modes' that were dominating the dam safety risks. Preferred options have been selected, and preliminary concept designs and cost estimates developed. The complete list of risk control measures was subsequently assessed under the SFAIRP framework.

3.2 WaterNSW Corporate Strategy

The LTCOP supports our strategic priorities over the next 5 years to realise our purpose – *water delivered when and where it matters* – and our vision to support the resilience of NSW communities through our leadership in delivering water services, for generations to come.

Our strategic priorities (2021-2026)

Delivering operational excellence	Safe, reliable, affordable water services through technical and operational excellence	Working together in partnership	Committed to working in partnership with stakeholders to manage sustainable, secure and healthy waterways
Developing our people and capabilities	Diverse, high performing workforce responsive to customer and community needs	Building a sustainable future	Our part in creating a more resilient water system to enable thriving communities while reducing our environmental footprint
Respected by the customers and communities that we serve	Trusted to support social, cultural and economic prosperity of customers and community through transparency and community presence		

3.3 Ageing infrastructure

Many of our major water supply assets in Greater Sydney have been in service for many decades (some for over 100 years). The Upper Canal, which is used to transfer raw water from the Upper Nepean dams to Prospect Water Filtration Plant (WFP), is one such example. It has been in operation since 1888, providing supply resilience to the Prospect system which supplies up to 80% of Sydney's potable water.

Our ageing infrastructure requires ongoing maintenance, renewal, and upgrades to ensure they can continue to meet the needs of a modern water supply system and keep pace with the changing community and regulatory expectations.

Despite plans to build more rainfall independent supply sources of water, our surface water supply infrastructure will continue to supply the vast majority of Sydney's water well into the future. Ongoing investment therefore is critical to make our bulk water supply infrastructure more resilient to changes and potential threats in a changing climate and growing population.

3.4 Maintenance and operational efficiency

Delivering operational excellence is one of our strategic goals and drives our ongoing focus on becoming ever more efficient in how we operate and maintain our assets. Our Asset Management System (AMS) supports an efficient process for enabling timely decision making to improve the management of service, cost and risk. It enables delivery of a safe, reliable and affordable water service through our technical and operational excellence.

Our AMS ensures the assets deliver on customer commitments, through a structured, planned, and corrective maintenance strategy and in driving operational safety performance. Delivery of the capital works program, and supporting functions such as reliability engineering, analysis of work history and the delivery of continual improvement tasks help ensure we drive performance and ongoing efficiencies in the assets, project delivery, and operations.

3.5 Greater Sydney's changing water context

3.5.1 Population growth and urbanisation

Greater Sydney's population will continue to grow, with anticipation of an average yearly increase of 100,000 people, to between 6 and 7 million by 2036 (GSWS). For the Greater Sydney water supply system this means:

- additional drinking water supply capacity and sources
- new and extended service networks
- upgrades, renewals, and augmentation of existing water infrastructure assets.

Sydney's West is projected to double in size by 2056. The Southwest corridor has been considered as the major area for new housing and development. Until recently, the land adjacent to the Upper Canal was largely rural with a low population density and few major road crossings.

By 2036 the population in the four major Local Government areas through which the Upper Canal passes will more than double, exceeding 870,000. For WaterNSW, this means additional safety and water quality risks to manage to protect the Upper Canal and Warragamba pipelines.

3.5.2 Changes in temperature, rainfall and inflows to dams

Greater Sydney's water supply system gets most of its inflows from the Warragamba catchment. Climate monitoring shows an increasing trend in temperature (0.2deg/year daily maximum) in the period since 2005. While annual average rainfall for the Warragamba catchment for the period since 1885 does not show any trends at a catchment scale, there is significant annual and muti decadal variability. WaterNSW has undertaken an extensive study to identify such changes and a summary of the findings are as follows:

- Climate model simulation results for the catchments into the future generally show rainfall reductions across all catchments, although some models show a slight increase in the near future. There is considerable variability in the changes shown by different climate models. Changes were similar across catchments except for some smaller reductions in rainfall in the Upper Nepean dam catchments.
- Overall, modelling indicates a 1.3% median increase (range -10% to +17%) of annual catchment average rainfall for "Near future' and 6.4% reduction (range -10% to +11%) for 'Far' future under the RCP4.5[2] scenario for the Warragamba Catchment. For the RCP8.5 scenario, modelling indicates a 2.2% median reduction of annual catchment average rainfall for "Near future' and 8.3% reduction for 'Far'.
- Annual average evaporation for all catchments increased due to future temperature rises. Overall, there was a 4.5 % increase of annual average potential evapotranspiration for "Near future' and 9.4% increase for 'Far' future in the Warragamba catchment.
- New rainfall-runoff models were developed to estimate inflows using rainfall from climate change modelling. Generally, inflows derived for historical climate model simulations matched reasonably well with observed inflows on a statistical basis. However simulated inflows using rainfall from climate models did not reflect the known pattern multiyear droughts which occur in Greater Sydney and are important in water supply planning. In response to this, WaterNSW used climate models to provide simulated datasets in terms of inflows, lake evaporation and water demand that can be used for supply system modelling. These simulated datasets were used to modify historical datasets in the water supply models, producing results which reflected future climates, yet preserved the known pattern of multi-year droughts in Sydney.

3.5.3 Impact of climate change on yield

We undertook extensive modelling and analysis of a range of scenarios to provide inputs into Sydney Water's Resilient and Reliable Water Supply Business Case, which in turn provided input for their LTCOP. This included input for investigating risk, cost, and benefits of future bulk water supply options. This included carrying out yield modelling based on manipulation of NarCLiM 1.5 datasets, time series modelling, and drought depletion modelling using a design drought framework that we developed (details of this work are presented in Appendix B).

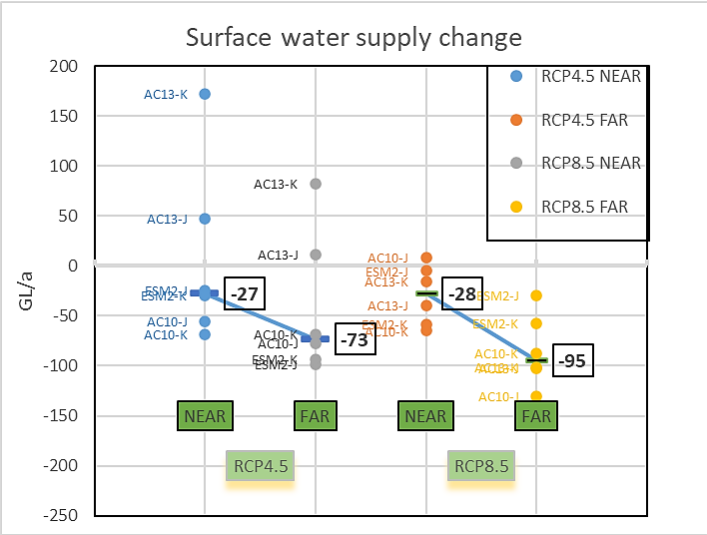
Regardless of the emission scenario, the analysis indicated that a median yield loss of about 30 GL/a could occur in the near future. The maximum loss could be up to 65GL/a.

While there is significant uncertainty regarding the future climate and there are limitations of current datasets to forecast future changes, it is recognised that continuing to use datasets based on historical information to inform future planning is not appropriate given the changing climate. Both WaterNSW and Sydney Water's water supply planning analysis adopted the RCP4.5 scenario as the baseline requirement,

[2] A Representative Concentration Pathway (RCP) is a greenhouse gas concentration trajectory adopted by the Intergovernmental Panel on Climate Change (IPCC). RCP 4.5 is described by the IPCC as an intermediate scenario. RCP8.5 is the high-emissions scenario.

with the RCP 8.5 scenario used as a pathway to demonstrate extreme climate impacts. WaterNSW will continue to undertake extensive programs of research and analysis to update and improve:

- Climate change projections with respect to yield and drought, utilising NarCLiM 2.0 datasets and other emerging datasets and techniques for this analysis
- Best-practice for understanding streamflow impacts of future climate effects on evapotranspiration
- Assessments of hydrological trends and climate stationarity to determine most suitable approach to utilising historical datasets to estimate current yield
- Research into advanced forecasting techniques to inform timing of water transfers and system balancing options.



Potential climate change scenarios considered in the LTCOP

- RCP4.5 median scenario - **30 GL/a** of loss of surface water yield for near future
- RCP4.5 worst-case scenario - **65GL/a** of current surface water yield for near future
- RCP8.5 for stress testing the LTCOP - indicative yield loss of -125 GL/a. A zero-inflow scenario would result in greater reductions, but it is an unforeseeable climate scenario which is not appropriate for infrastructure investment planning such as the LTCOP.

Figure 3: Climate change scenarios – projected yield change (GL/a)

3.5.4 Extreme droughts, floods, and bushfires

To support our joint drought planning work with Sydney Water, we analysed the statistics of historical droughts and developed a design drought methodology. The aim was to produce synthetic droughts that are more severe than what have been seen in historical records in alignment with predictions of potentially more frequent and severe droughts due to climate change (details are presented in Appendix B).

Recent droughts have highlighted the vulnerability of Greater Sydney water supply system in severe droughts, showing that:

- storage levels can deplete more rapidly in extreme dry conditions
- some water delivery nodes can be impacted much faster than others
- timely delivery of new supplies to avoid system failure will be more challenging than previously thought.

Climate change models indicate that in the future, extreme rainfalls and long droughts will threaten the Greater Sydney Water supply system and pose serious water quality and bushfire risks. Large rain events after long droughts, or consecutive floods, can bring large amounts of sediment and organic material into the storages and affect water quality.

Climate change is also driving more extreme floods, including larger (but rarer) Probable Maximum Floods, especially for large catchments. This could also trigger significant investment to ensure safety of dams and other assets.

3.5.5 Water quality risks

The quality of Greater Sydney's drinking water supply is managed by following a multiple barrier approach, in line with the Australian Drinking Water Guidelines. The protection of our Drinking Water Catchments is the first barrier for the management of drinking water quality. Despite ongoing improvements to catchment management, the impacts of climate change, especially the increased frequency and intensity of significant climatic events in close succession, such as droughts, bushfires and flood events, pose a significant risk to water quality. Increased erosion, increased pressure on native vegetation, swamps and riparian corridors and increased stress on waterways can result in adverse water quality outcomes. These include higher occurrence of nuisance and harmful algal blooms and elevated levels of natural organic constituents that can hinder water treatment plant performance.

To meet a growing water demand and respond to potential decreased rainfall, the need to expand drinking water supply capacity drives the need for alternative rainfall independent drinking water sources which require additional controls to ensure the provision of safe drinking water and mitigate any risks to lake ecology and long-term water quality. Therefore, the ability to predict and mitigate the impacts of climate change by enhancing catchment resilience and undertaking an integrated water management approach are essential to ensure supply of optimum quality water for the protection of public health, now and into the future.

In addition to increasing pressure on our water resources due to environmental changes and rising demand, advances in testing and health research on the potential impacts of emerging contaminants also pose ongoing challenge to the management of drinking water quality. The development of monitoring strategies, risk assessment processes, new or more stringent standards with associated mitigation options may require significant investment from water utilities and a need for innovation to manage potential risk to environmental and human health.

We have a dedicated and highly specialised research program focusing on catchment health and water quality, but we need to continually invest in improving our integrated catchment, water quality, and water quantity modelling, extensive monitoring programs and technical capability to identify and assess emerging risk. This enables the development and implementation of the most appropriate mitigation strategies.

3.5.6 Catchment health risks

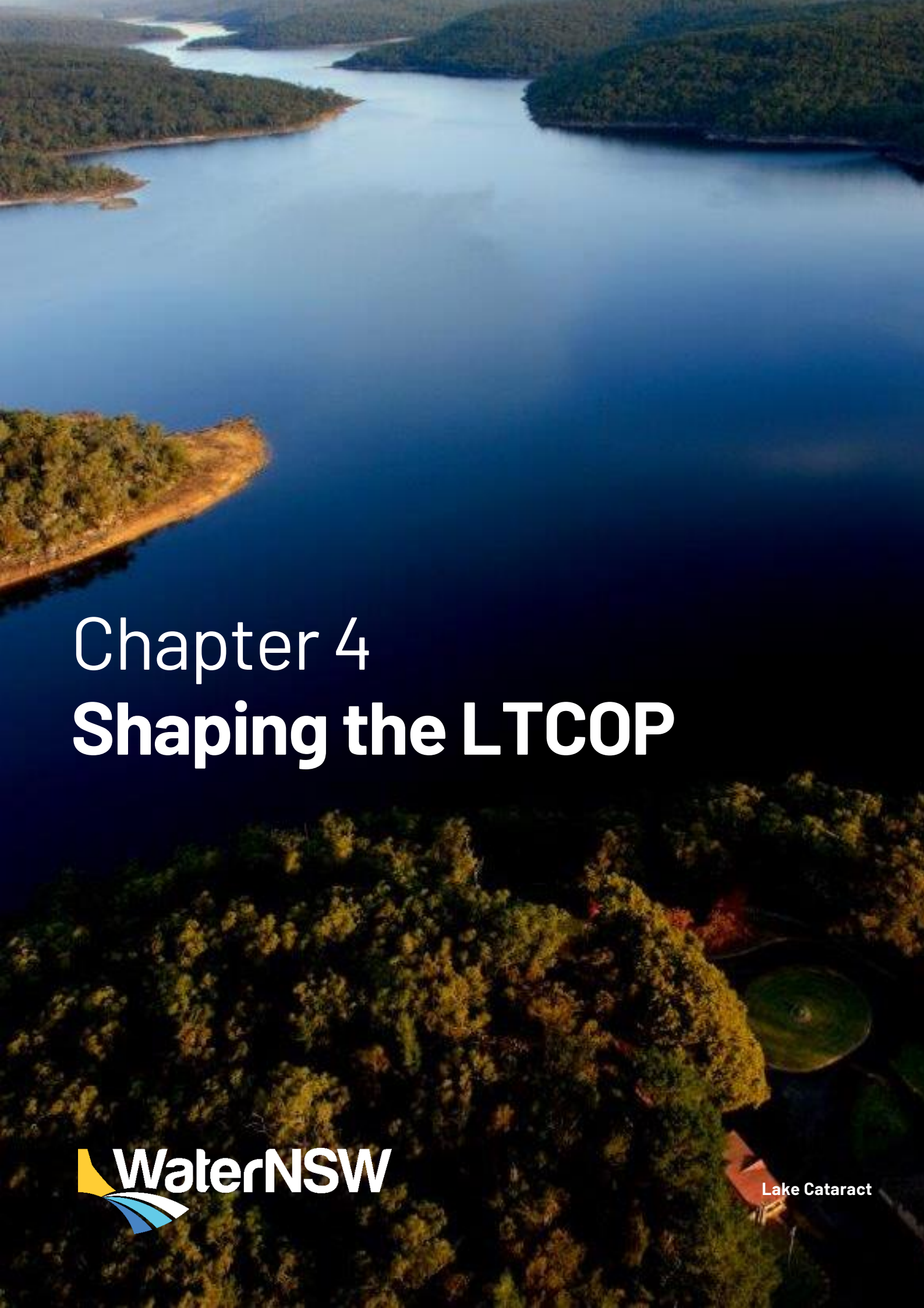
Our catchments and assets across Greater Sydney are increasingly at risk from the intensification of development, mining activities, natural disasters, and human disturbance. The Australian Drinking Water Guidelines recognise that source water protection is an essential part of the multi-barrier approach to providing drinking water. It is also firmly established in the regulatory framework governing Sydney's drinking water catchments. We are legislatively required "to protect and enhance the quality and quantity of water in declared catchment areas" under the WaterNSW Act 2014.

We have a Source Water Protection Strategy which sets the vision, the priorities, and the goals for source water protection in Sydney's drinking water catchment over the next 20 years. It is critical that the planned programs are funded to respond to future challenges and mitigate the risks.

3.5.7 Emerging technologies

Due to rapid changes in technologies, we will need to operate in a significantly different technological environment in the future. We also need to keep evolving to become a more resilient and responsive water utility in response to shifting external landscape in which we operate and customer expectations.

Our ongoing digital transformation program aims to modernise our systems and streamline processes to empower us to make better decisions, operate more efficiently as business, improve our customer and stakeholder experience, and redirect our time towards value-add work by leveraging modern technology and improved processes.



Chapter 4
Shaping the LTCOP

WaterNSW

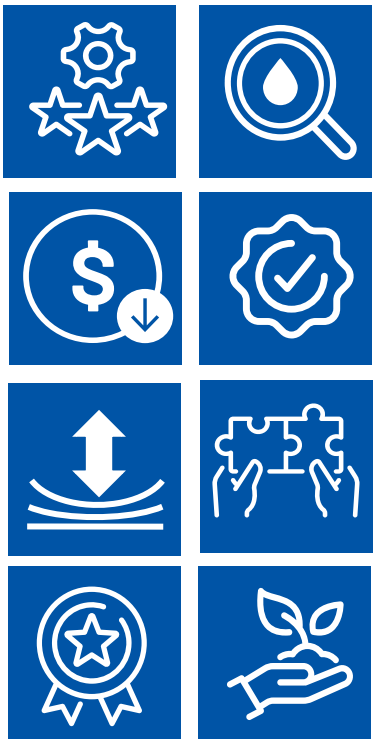
Lake Cataract

4.1 Principles and investment goals

We have been working closely with Sydney Water and NSW Government to deliver the GSWS actions and outcomes. In developing our LTCOP, we considered the following principles, in alignment with the GSWS.

Use what we have better	Increase integration and interconnection	Diversify supply sources	Plan ahead	Review and adapt
Our approach: *Optimise the performance of our existing infrastructure and supporting systems in a cost-effective manner*	Our approach: *Address issues with drought-critical assets to mitigate supply continuity or nodal supply security risks in a drought (in line with the Greater Sydney Drought Response Plan)*	Our approach: *Identify what investments are required to support Sydney Water's supply augmentation plan*	Our approach: *Work with Sydney Water to identify required investments to progress our drought response measures*	Our approach: *Collaborate with Sydney Water on the review and update of the LTCOP. GSDRP, and other relevant plans*

Additionally, our LTCOP sets the following investment goals that contribute to the provision of safe, reliable, and resilient water supply across Greater Sydney in the years to come. These goals support the GSWS priority actions (Chapter 1.2) as well as our current corporate strategic priorities (Chapter 3.2).



Safe and secure supply
Contributes to the safety of Greater Sydney's water supply and infrastructure; reduces incidents and risks to the community.

Water Quality
Maintains the outstanding status of source water quality which contributes to the health of the Greater Sydney community.

Cost Effectiveness
Contributes to the reduction in costs through improved efficiencies across the water supply chain.

Reliable services
Contributes to the ability of Greater Sydney's system to function properly and reduce the uncertainty and risk of inability to provide services.

Resilient infrastructure
Helps Greater Sydney's system adapt and respond to changes and recover quickly from unexpected incidences or breakdowns.

System Integration
Contributes to the Integrated Water Management, bringing together all facets of water cycle to achieve the best outcome.

Regulatory Compliance
Enables compliance with regulations, guidelines, and specifications relevant to the assets and area of operation.

Sustainable future
Reduces impact on the environment and contributes to the improvement in wellbeing of the community.

Figure 4: Our key investment goals

4.2 Our approach to prioritising investments

Our capital expenditure plan has undergone a detailed evaluation process, utilising a ranking method that considers risk, benefit and cost to determine the overall value. This involves a multi-stage process involving validation, prioritisation, and subsequent integration into the capital works program. This structured approach enabled a comprehensive examination of each project's potential impact, identifying those that offer the highest benefit while still proving to be cost-effective. Each potential project was categorised according to a scoring system that ranges from 'Very Low' to 'Extreme' benefits. This scoring framework ensures that projects classified with 'Extreme benefits' truly reflect significant, measurable impacts, justifying their prioritisation in the capital works program.

- 'Extreme' benefits reflect projects that are transformative, delivering substantial, measurable advantages that directly align with our strategic objectives and have a significant positive impact on customers and communities. These projects are prioritised due to their potential to drastically improve operational performance, safety, service delivery, and sustainability outcomes.
- 'High' scoring projects significantly advance our strategic goals, demonstrating a strong alignment with customer needs, regulatory requirements, and operational improvements. These projects are likely to enhance system resilience, improve safety and compliance, and foster stakeholder and community trust.
- 'Moderate' scoring projects are those that have a noticeable impact on strategic objectives, offering improvements across several key areas such as stakeholder relationships, operational performance, and sustainability. These projects are important for maintaining service standards and regulatory compliance.
- 'Low' scoring projects contribute slightly more towards strategic objectives than 'Very Low' projects but still offer limited benefits. These projects may provide some improvements in operational efficiency or customer service but are not critical.
- Very Low' scoring projects are those expected to have minimal impact on achieving WaterNSW's strategic objectives and customer outcomes. These projects might only marginally enhance operational performance, stakeholder partnerships, or sustainability goals.

In preparation for the FY26-30 IPART Pricing Submission, we engaged service providers specialising in asset management and engineering assessments to undertake a combination of on-site condition assessments, options assessments, and subsequent estimate development by external parties. The field validation of candidates with engineering service providers, followed by prioritisation by asset management specialists in line with the benefit scoring methodology above, has provided WaterNSW with an appropriately prioritised program of works in FY26-30 and beyond.

4.3 Project categories

Our projects and initiatives can be broadly grouped into three main categories (Figure 5), based on the type and scale of required works and intended outcomes. Our baseline LTCOP consists of programs that fall under the Renewal and Enhancement categories. This reflects the GSWS long-term direction for future supplies (being rainfall-independent), and the supply augmentation planning and delivery now being Sydney Water's responsibility.

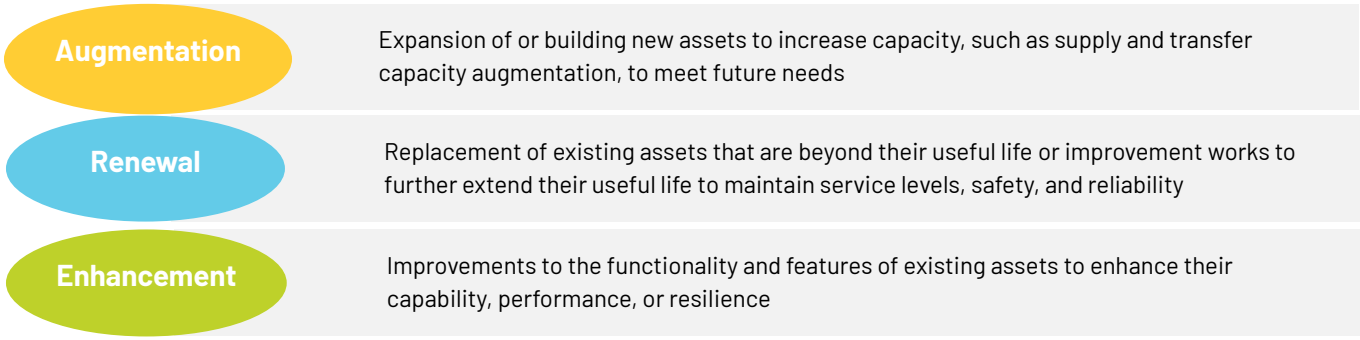
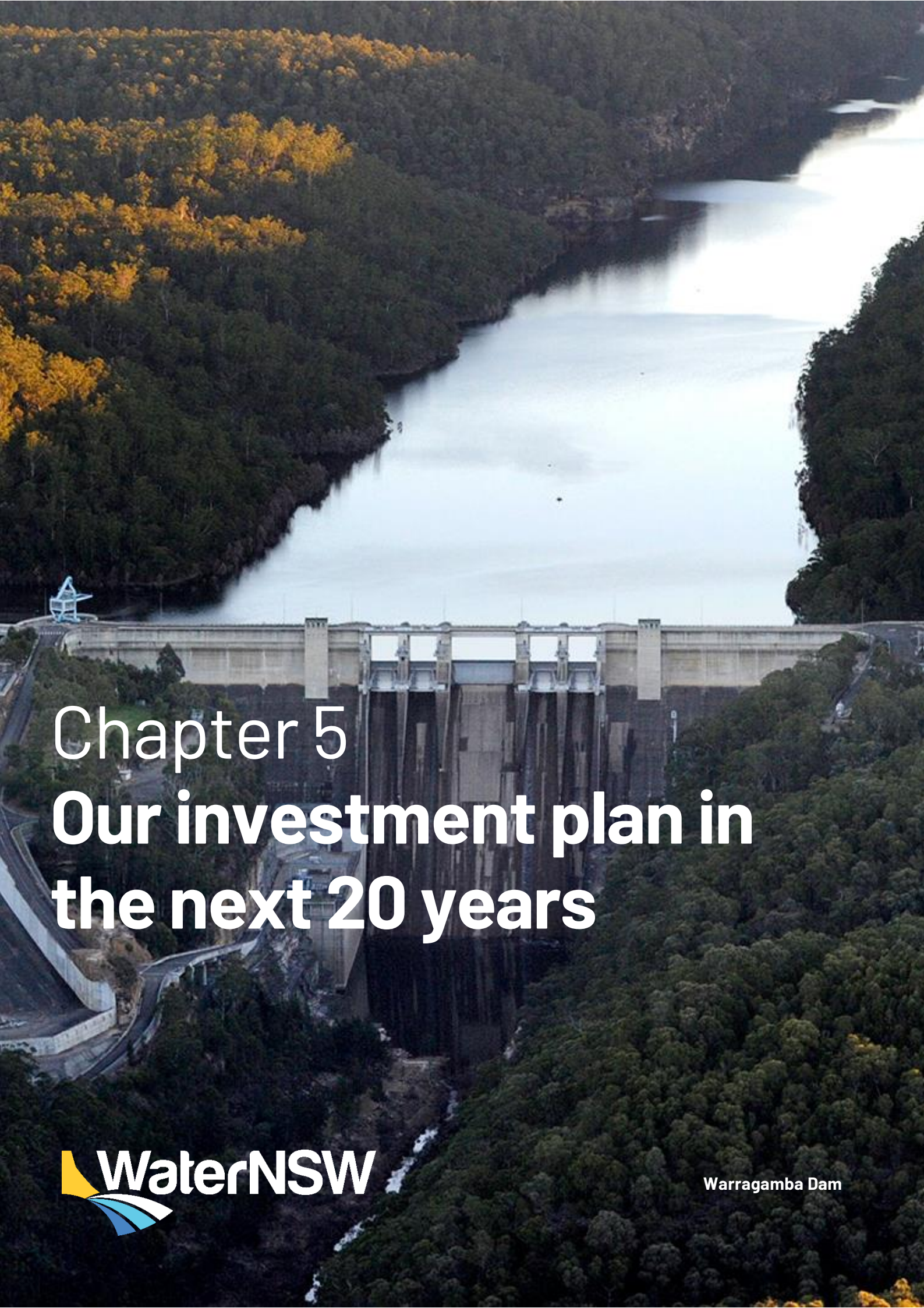


Figure 5: LTCOP project categories



Chapter 5

Our investment plan in the next 20 years

WaterNSW

Warragamba Dam

5.1 A capital investment plan to sustain our future operations and service delivery

Greater Sydney is dependent on surface water resources for its water supply, which may become less reliable in the future due to climate change. For this reason, the GSWS has identified that future investments on supply augmentation should focus on rainfall-independent sources. Nevertheless, the Greater Sydney system will remain heavily reliant on surface water sources throughout the period of the LTCOP, and our assets will continue to play a critical role in reliability and security of supply. On this basis, our LTCOP includes several programs over the next twenty years to sustain our future operations and service delivery, recognising the challenges ahead and expectations from government, our customers, and the community. These programs will ensure that:

- all elements of our bulk water supply infrastructure can continue meeting future service requirements safely and reliably, and comply with the relevant regulatory standards,
- our drinking water catchments and source water can be protected while providing some recreational facilities to the community,
- we can continue supporting our people by providing them with comfortable, safe, and secure premises that empower the effective and efficient delivery of work and customer service, and
- we can keep pace with changing technology and continue developing tools and systems that can help optimise our operations, inform our decisions, enhance our forecasting and planning capabilities, and improve our data management.

Our projected baseline capital investment over the next 20 years is in the order of **$3,799M** ($24-25) and features major capital expenditure for Warragamba (Dam Resilience and Environmental Flows Projects) and programs for the ongoing renewal and enhancement of our existing infrastructure and supporting systems (refer to Table 1 and Figure 6). Each program is described in more in detail in Chapters 5.1.1 to 5.1.9.

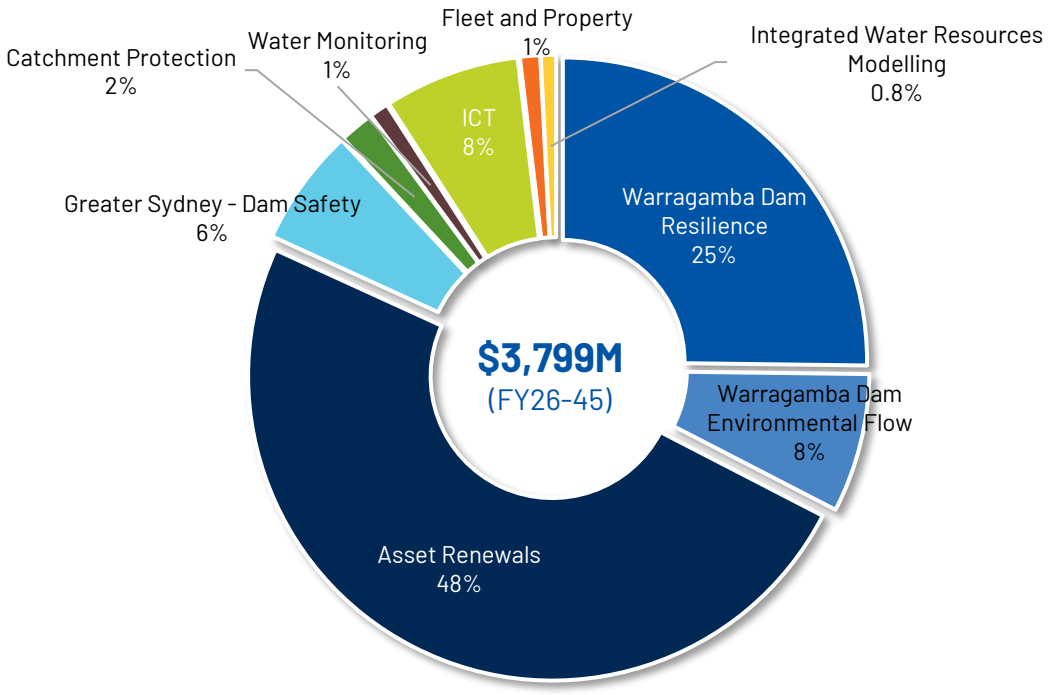


Table 1 – Summary of baseline capital expenditure (Capex) to FY45

Program	Key investment outcomes	Cost ($M, $2024-25)
Warragamba Dam Resilience	Regulatory compliance I Safe & secure supply I Reliable services I Resilient infrastructure	$966
Warragamba Dam Environmental Flow	Sustainable future I Reliable services I Regulatory compliance	$302
Asset Renewals	Safe & secure supply I Reliable services I Resilient infrastructure I Regulatory compliance I Cost effectiveness I Water quality I Sustainable future	$1,823
Greater Sydney - Dam Safety	Regulatory compliance I Safe & secure supply I Reliable services I Resilient infrastructure	$240
Catchment Protection	Regulatory compliance I Sustainable future I Water quality I Safe & secure supply I Resilient infrastructure I Reliable services I System integration	$70
Water Monitoring	Safe & secure supply I Reliable services I Resilient infrastructure I Cost effectiveness I Water quality	$39
ICT	Safe & secure supply I Reliable services I Resilient infrastructure I Regulatory compliance I Cost effectiveness	$287
Fleet and Property	Safe & secure supply I Reliable services I Regulatory compliance I Cost effectiveness I Sustainable future	$41
Integrated Water Resources Modelling	Safe & secure supply I Reliable services I Resilient infrastructure I Cost effectiveness I System integration	$31
	20-Year Total Projected Capex FY26-45	**$3,799**

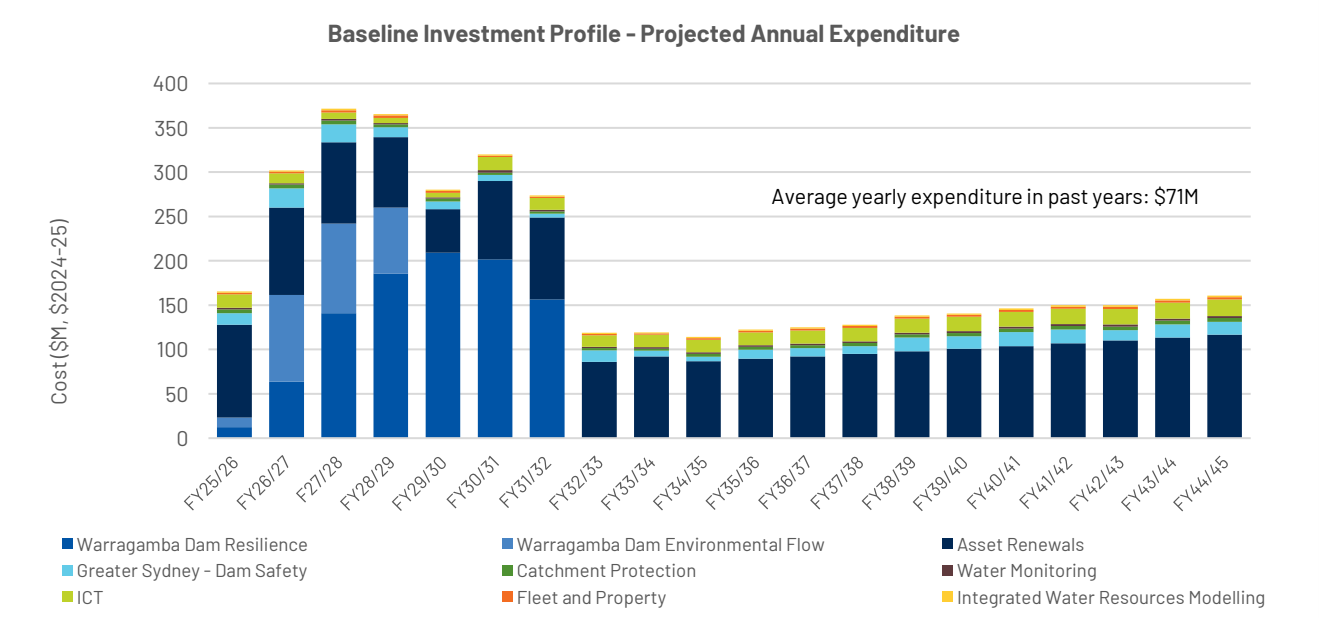


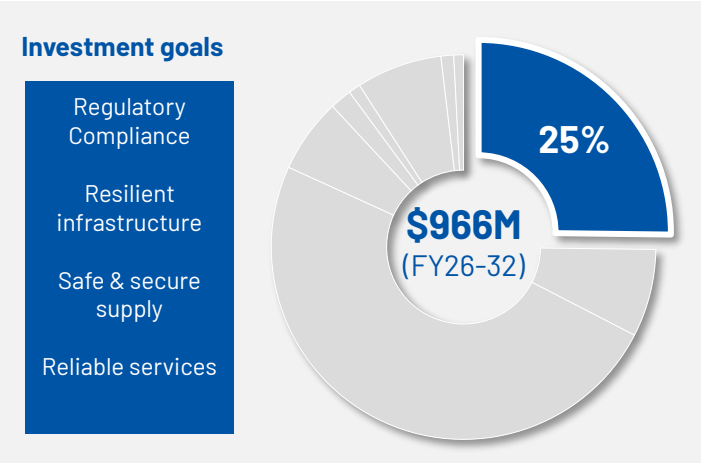
Figure 6: LTCOP baseline capital expenditure profile

5.1.1 Warragamba Dam Resilience Project

WaterNSW is committed to ensuring we understand the risk profile of our dams and have risk mitigation measures in place to secure our source water and reduce societal risk.

WaterNSW as owner of Warragamba Dam must ensure the dam complies with contemporary dam safety regulatory standards. The Regulation requires us to ensure that public safety from the operation of our Declared Dams is reduced so far as is reasonably practicable.

The comprehensive safety risk assessments undertaken for Warragamba Dam have found that the dam has a high societal risk rating from potential dam failure that does not meet the dam safety standard set by the Dams Safety NSW (DSNSW).

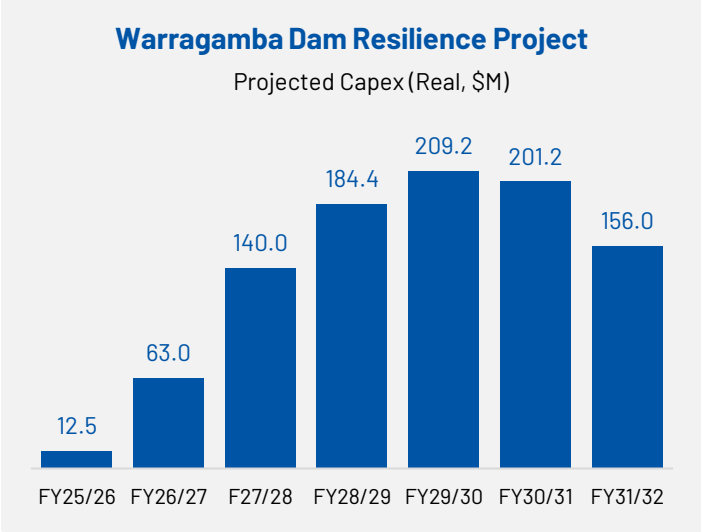


The consequence of dam failure resulting from a rare rainfall event would be catastrophic both in terms of the potential for loss of life and the impact on Sydney's water supply system and economy.

Our program

In mid-2021, we initiated a comprehensive risk assessment (CRA) of Warragamba Dam to understand the risks posed to the safety of the dam structure. The CRA concluded the dam exceeded the prescribed safety threshold as determined by DSNSW regulations.

Hydrological modelling indicates that when the lake rises above the full supply level, from large rainfall events feeding into the catchment, significant loads are applied against the dam. The structural modelling from these loads shows that the dam's structural integrity is compromised from dam instability and then from water overtopping at levels above the road deck.



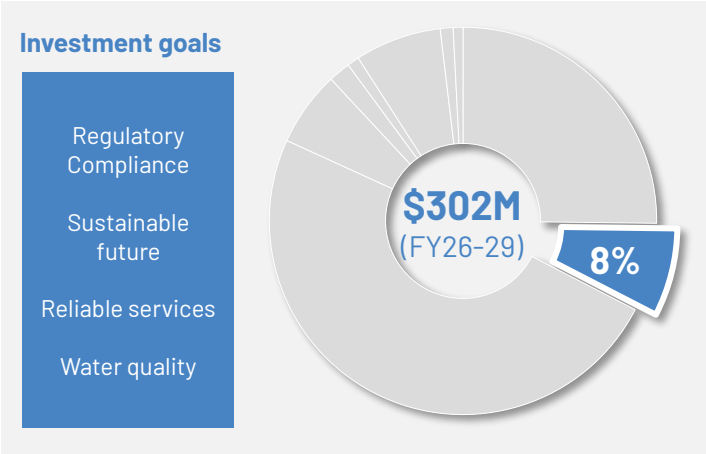
WaterNSW must consider how to reduce the risk to within acceptable safety limits which is likely to require modification to strengthen the dam. Extensive investigations and studies have been undertaken to address the options for both non-infrastructure and infrastructure measures to reduce the risk of dam failure. The infrastructure solutions under consideration include options that do not require a raising of the dam. The options include the construction of a concrete buttress on the downstream face and/or installing post tensioned anchors with no change to the full supply level or gate operations. Considerations for addressing the overtopping risk include a large channel constructed at the downstream toe to direct flows into the main/central spillway.

Recent industry research shows that climate change is likely to drive greater flood variability. This may result in the flood events occurring more intensely and/or frequently than what has been considered in the modelling work to date.

5.1.2 Warragamba Dam Environmental Flows Project

WaterNSW is committed to fulfill its obligations in maintaining downstream river health and mitigating environmental impacts.

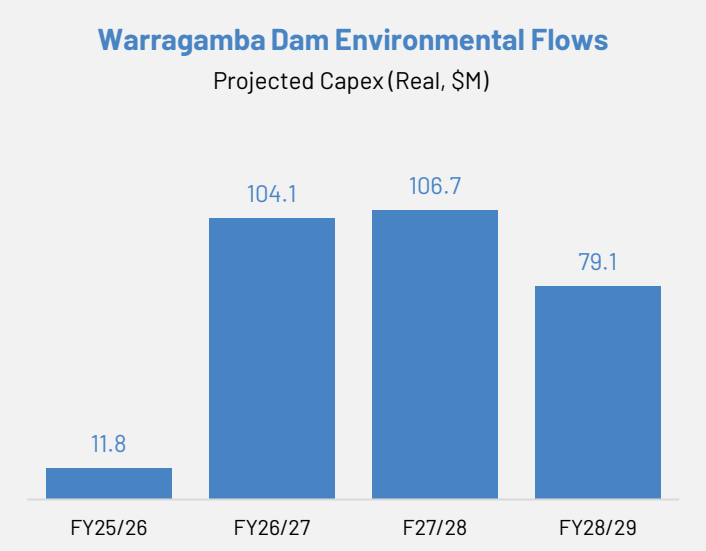
The 2017 Metropolitan Water Plan committed to the introduction of variable environmental flows (eflows) from Warragamba Dam to improve the Hawkesbury-Nepean River health and identified the need for dam wall modifications to enable the optimised eflow regime. The Greater Sydney Water Strategy (GSWS) has reflected this commitment and included a priority action to progress this new eflow regime to protect, maintain, and enhance river health and recreational opportunities downstream of the dam. For WaterNSW, this means progressing the planning and delivery of Warragamba Dam eflow project.



WaterNSW has completed the Warragamba Dam environmental flows final business case and will be the delivery agency for the construction of the infrastructure and the ongoing operation of the eflows regime. The latest Water Sharing Plan for the Greater Metropolitan Regions Unregulated River Water Sources (commenced on 1 July 2023) includes an amendment provision to allow for any changes of infrastructure in the future.

Our program

Our Warragamba Environmental Flows (eflows) Project will provide the necessary infrastructure to enable the new environmental flows regime to be released from Warragamba Dam which is designed to mimic the natural flow of the river prior to the construction of the dam. This enables capability to provide the required releases under the regime.



The eflows infrastructure would include:

- a multi-level offtake tower on the upstream face of the dam to draw suitable water from Lake Burragorang
- modifying the existing large diameter penstock to draw water through the dam and discharging at the downstream end of the hydroelectric power station (HEPS), and
- modifications to the existing HEPS to allow for new pipework and valve configuration for releasing variable flows.

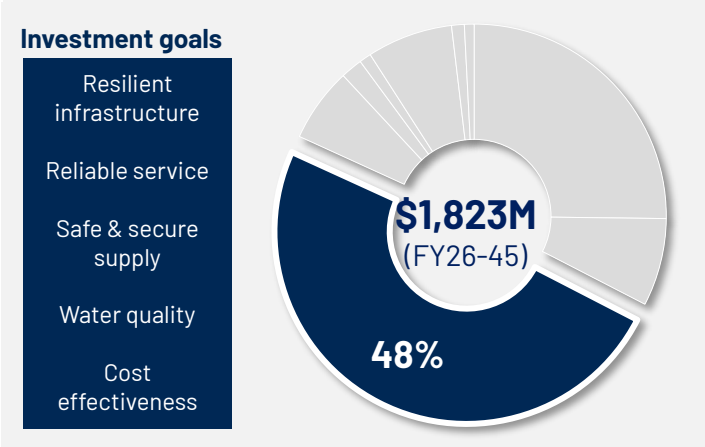
The new eflow regime will improve river health and ecological outcomes, including mitigating cold-water pollution impacts downstream of Warragamba Dam.

5.1.3 Asset Renewal Program

We will continue investing in infrastructure renewals to ensure the ongoing reliability of bulk water supply and to maintain the capability of our assets and the safety of our operators and the wider community.

We operate and maintain a large and diverse range of assets across Greater Sydney, from the simplest of weirs to one of Australia's largest and most critical urban water supply dams (Warragamba Dam).

Many of our assets are large civil structures that have been in service for many decades (some for over 100 years). As these assets age, increasing diligence is required to mitigate the potential for service interruption or failure. We undertake renewal and replacement at regular intervals to maximising the performance and lifespan of every asset while also minimising cost and risk to our customers.



Our program

There is a wide range of project types within our asset renewal program to address the risks associated with ageing assets and improve the performance, reliability and resilience of our bulk water supply infrastructure. These investments are broadly categorised as:

- **Water delivery renewals**. These projects include pipeline upgrades, restoration of pipeline corridors, rehabilitation of canals, remediation of pipe and canal supporting structures, pump station resilience work and upgrades to valves. The Warragamba Pipeline and Corridor Restoration project forms part of this program which involves improving drainage along the pipeline corridor to prevent long term deterioration of pipeline components. Other projects along the pipeline include the provision of pressure monitoring and fault-detection systems. These works are critical to ensure the reliable and efficient operation of the pipelines and provide a resilient and safe water supply to Orchard Hills and Prospect systems.
- **Modernising asset electrical supply, control and automation, and communication links**. These projects will enable capability and operability improvements to the water delivery assets, offering safer and more efficient and flexible operation. Switchboard upgrades, instrumentation, monitoring equipment and SCADA are part of this category. The planned electrical and SCADA renewals at the Metropolitan Dams of Avon, Cordeaux, Woronora, Cataract and Nepean will progressively improve the communications, monitoring, and automation capability at these sites.
- **Overhauling major mechanical components on existing assets**. As asset condition deteriorates over time, regular overhauls of major mechanical components are required to ensure their reliability and capability is maintained. The programmed mechanical overhauls comprise key components of the larger dams, such as Warragamba, Upper Cascade and Greaves Creek in the Blue Mountains, Wingecarribee in the Southern Highlands, Avon, Upper Nepean and Woronora. Examples are large trunnions that control the water intake pipes, lifts that enable access within the dam for goods and staff, valves that enable the release of water into the rivers, pipes or channels, and gates that secure and release the water.

- **Protecting existing assets from damage**. To maintain and extend the life of existing assets, they are progressively provided with added protection. This can include protective surface coating renewals, replacement of aqueduct expansion joints, relining of tunnels and remediation of spillways at dams. Along the Warragamba pipeline this includes the treatment of embankments that abut the pipeline to prevent long term damage.
- **Improving access to assets for operation and maintenance**. Access improvements to assets enables safer routes for both workers and the public and may also improve efficiency and reliability of access required for ongoing operations and maintenance activities. Many access improvements are roads to dams, public access bridges to dams or operational access across spillways and foreshore roads for continued inspection and maintenance. Access improvements also address rockfall risks near assets or roads, improve the functionality of boat ramps and provide steel platforms walkways to monitoring equipment.

In addition, renewals include smaller risk-based asset replacements to maintain asset capabilities in the Greater Sydney region. Most of these projects are personnel and infrastructure safety focused, whilst others improve infrastructure performance and resilience. These are often bundled for delivery, based on location and work type. Examples are placing overhead power supplies underground to reduce bushfire risks, and procurement of new plant and equipment.

Our planned capital investment is a mix of specific asset projects of 1 to 10-year duration and broader renewal programs to progressively address issues with our major assets over time.

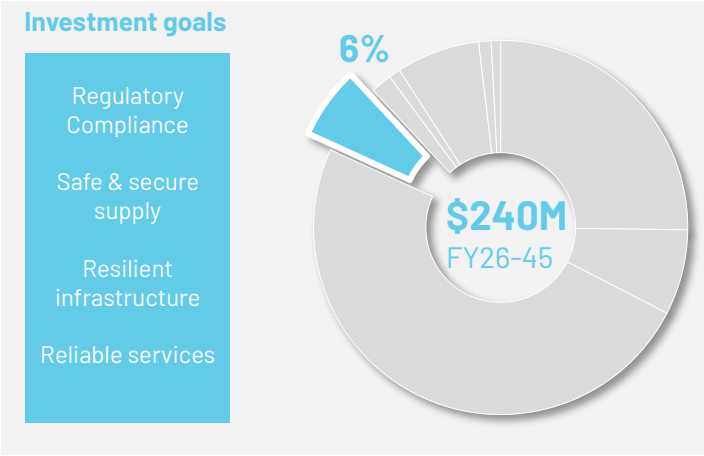
Some of the key projects slated for delivery in the next ten years include:

Warragamba Deepwater Pumping Station Operational Readiness	**Warragamba Pipelines and Corridor Renewal**	**Prospect Raw Water Pumping Station Resilience**
Broughtons Pass Renewal	**Cordeaux Dam Outlet Works**	**Upper Canal Monitor and Respond**
Automation Renewal and Protection System Works (Upper Nepean Dams)	**Cascade Supply Resilience**	**Leura to Upper Cascade Pipeline Renewal**

5.1.4 Greater Sydney Dam Safety Program

WaterNSW is committed to ensuring we understand the risk profile of our dams and have risk mitigation measures in place to secure our source water and reduce societal risk.

Our Portfolio-wide Risk Assessment (PRA) was completed in 2019, including the consequences assessment review of Greater Sydney Dams (except Warragamba) in-line with the industry best-practice. Significant progress on dam safety has been made based on its findings; overall improving the understanding of dam behaviour, risk management and data analysis.



- Cataract, Cordeaux and Woronora Dams had societal risk position higher than the Safety Threshold mandated by the Dam Safety NSW. Detailed engineering studies were undertaken in 2022 for these dams improving the level of confidence in the behaviour of these dams. The outcomes indicated a favourable shift in the risk positions for all three dams. The updated studies indicate that only Cataract dam plots above the Safety Threshold. Consequently, management of risks for Cordeaux and Woronora dams has now transitioned from Risk Management Plans to the SFAIRP framework.
- The instrument enhancement project completed at Cataract and Woronora Dams. The project delivered improved asset capabilities through real-time monitoring with alarm capabilities for early detection of potential dam safety issues. These works enable early detection and intervention, and increase the time required to warn and evacuate the population at risk in the event of potential dam safety incidents. The project at Cordeaux Dam is currently in the data proofing stage and is expected to be online by August 2024.
- Stability and deformation analysis studies are being finalised at Prospect Dam. These studies improved the understanding of the likely performance of Prospect Dam under seismic loading and rapid drawdown. The revised dam risk assessment indicates that the deformation failure modes leading to upstream slope instability are no longer the key risk contributors. The updated risks will now be carried through and managed under a SFAIRP assessment.
- An Operational Risk Assessment Framework was developed and piloted at Warragamba Dam. The Operational Risk Assessment considers system vulnerabilities and failures arising from exposure to hazards and condition states (physical and non-physical) in the context of day-to-day operations, beyond those considered in a dam risk assessment. The recommendations from the assessment are being reviewed and an implementation plan is being developed.
- The automated survey monitoring is near completion at Warragamba Dam and will be completed in early 2025 at Prospect Dam. These projects will enable the effective real-time monitoring with alarm capabilities of the potential failure modes, aiding in early detection of dam safety observations and increase the time available to warn and evacuate the population at risk in the event of potential dam safety incidents.

Works are progressing in line with the Risk Management Plans (RMP) for Cataract and Warragamba Dams. These dams have been identified with an elevated risk profile in accordance with our Dam Safety Management System (DSMS).

Our program

Our program includes:

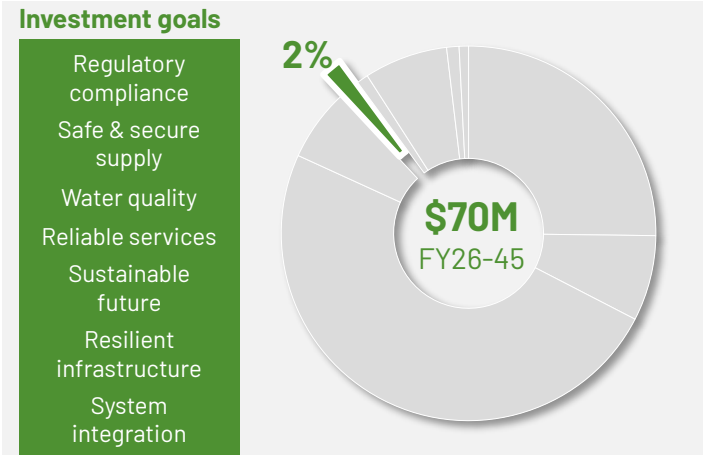
- **Warragamba and Prospect Dams instrument enhancement** (short-term risk control). The design of the instrumentation enhancement at Warragamba and Prospect Dams is significantly progressed. However recent updates to the dam risk assessments and the key failure modes means that the design needs to be revisited to ensure it remains adequate and robust. There is provision for the construction phase funding in FY26 & FY27.
- **Cataract Dam safety upgrade** (long-term risk control). A staged approach is being applied to reduce the risk rating to SFAIRP. The project scope includes development of detailed design and then implementation of effective engineering structural solution to lower the risk position below the Safety Threshold to conform with Dam Safety Regulations. Engineering analysis in parallel will continue to inform controls that require confirmation on their reasonableness.
- **Benefits of reservoir drawdown and Enhanced Warning Program – Flood forecasting, warning dissemination and evacuation.** During the SFAIRP assessment recurring themes for dam safety were identified. It is considered cost effective to carry out these studies at a valley level where efficient rather than individually at dams to evaluate their cost, benefits and parameters from a constructability and implementation perspective. Three Greater Sydney studies have been identified forming the basis to assess the impact of these themes.
- **Greater Sydney PRA 2029 –Risk Assessment & Associated Engineering studies – Seismic and Hydrology.** Methodologies to assess Seismic Hazards and Hydrologic hazards in Australia are continually evolving. To prepare for and to have pre-requisite information ready for the Greater Sydney PRA in 2029, Seismic hazard and hydrologic hazard are required to be updated. Early outputs from these studies are necessary at early phases of the project to aid effective decision making at a project level and to ensure investment is prioritised towards appropriate engineering studies.
- **Operational Risk Assessments – treatment of existing and identifying/analysing additional at Prospect.** The Operational Risk Assessment Framework (piloted at Warragamba Dam) will be applied at Prospect Dam to understand the system vulnerabilities and develop an emergency drawdown procedure based on the results from the recent stability and deformation analysis.

5.1.5 Catchment Protection Program

We will continually improve our approach to managing risks from urbanisation, mining activities, natural disasters, and human disturbance to protect our Declared Catchment areas and source water quality.

We have a responsibility to manage and protect Greater Sydney's Declared Catchment areas, as well as the ecological integrity of the Special Areas, covering 360,000 ha of land (of which 70,000 ha is owned by WaterNSW). Our extensive catchment protection and management activities are critical to minimise the risk to the quality of raw water supply to Greater Sydney customers.

Our approach to land management is guided by the Source Water Protection Framework and the Special Area Strategic Plan of Management (SASPOM).



Our program

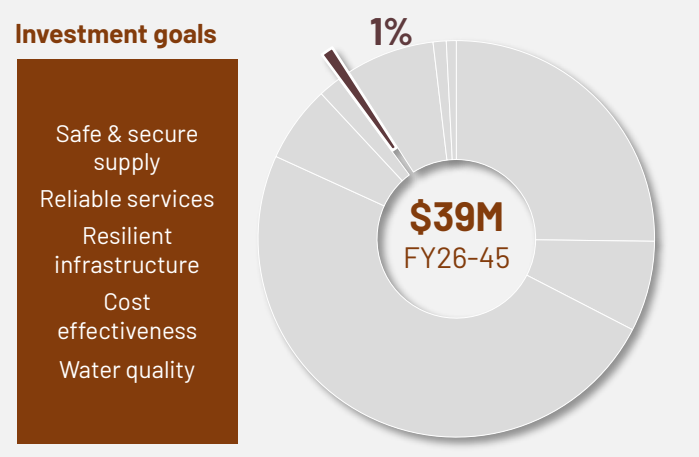
The catchment protection program is a key component in managing the quality of water entering the Greater Sydney dams. It comprises

- renewal of catchment protection infrastructure that enables diversion or capture of debris or polluted flows and guides overland flows to enter catchments with minimal environmental sediment loading
- upgrades and replacement of the plant and equipment used in the catchment protection work
- maintenance of fences, barriers, gates and signs to protect the Special Areas and other freehold land to meet our obligations under the WaterNSW act and regulation, to prevent unauthorised access, and to prevent stock access to our land
- maintenance of approximately 500 km of fire trails that provide access for maintenance, monitoring, fire protection, and land management
- provision of serviced picnic or camping areas at 14 locations for the community, including the redesign and renewal of some sites to improve recreational amenity, and
- building new infrastructure, such as early fire detection consisting of fire observation towers and camera technology to assist with rapid detection and response.

5.1.6 Water Monitoring Program

Our water monitoring network is critical in achieving our commitment to deliver water when and where it matters.

The Greater Sydney bulk water system requires a fit-for-purpose monitoring network that provide accurate and reliable data in near real-time. Water quantity and quality data capture is critical to our day-to-day operations, incident response and management, decision-making, and forecasts.



Our water monitoring network consists of automatic monitoring stations comprising sensing equipment, data logging and telemetry devices, and supporting infrastructure such as shelters and enclosures, visual reference gauges, power supplies, and mobile plant and equipment. These assets have a finite life and need regular maintenance and renewal to continue meeting intended outcomes.

Our program

Ongoing investment is required to maintain the reliability and accuracy of data being collected, and to enhance the resilience of our monitoring infrastructure. Our planned investment program provides a sustainable approach to asset lifecycle management.

Additionally, advancements in technology, when used appropriately, can improve data provision to inform decisions more reliably, and increase automation to improve the safety of staff performing manual activities and reduce operational costs. There is an increasing trend towards automation of water quality and flow monitoring activities to provide 24/7 monitoring capability during incidents.

A summary of water monitoring sites in Greater Sydney, categorised by site type and catchment is presented in Appendix A. This program includes:

- asset renewals program
- improvement projects
- condition assessment program
- criticality assessment.

5.1.7 Information and Communication Technology (ICT)

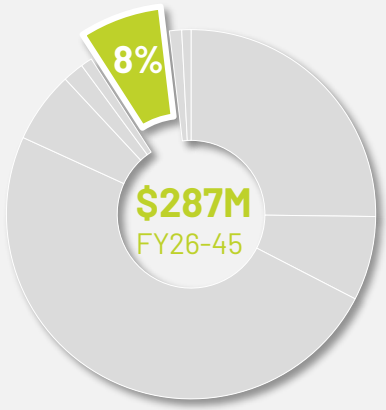
We will continue enhancing our ICT infrastructure to ensure our staff have access to contemporary and appropriate systems for data management, analytics, remote operation, and communications.

Our Information and Communication Technology (ICT) infrastructure plays a critical role in enhancing the business' overall effectiveness and efficiency. It comprises software programs, software platforms, and the electronic system's architecture that enable the efficient storage and retrieval of data, as well as maintaining their integrity. It supports our:

- extensive data collection
- storage and analysis of collected data
- monitoring
- reporting and
- communications capability.

Investment goals

- Safe & secure supply
- Reliable services
- Resilient infrastructure
- Regulatory Compliance
- Cost effectiveness



Our program

We have a rolling program of expenditure to regularly renew and upgrade our ICT infrastructure to either augment its existing performance or enhance its capability. This is required to keep pace with rapid changes in technologies, improve the remote operation of our water infrastructure assets in Greater Sydney, and enhance the telecommunication network. This ensures delivery of remote visual monitoring technologies, modernised data acquisition and automated control systems, and enabling real-time data collection and remote monitoring capability with increased accuracy, reliability, as well as reduced cost and time for delivery.

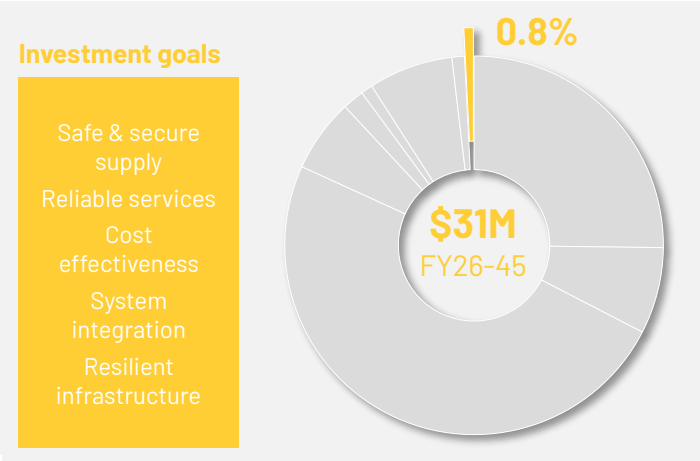
A complementary analytics program of works will extract patterns, trends, and actionable information from large sets of water, corporate and retail data with beneficial outcomes in water quality, billing and water operations. Similarly, communications projects will target a minimum telecommunication standard across our sites to enable staff to access corporate systems, resulting in workplace health and safety risk reduction, as remote and isolated sites are provided with telephone services.

Finally, our cyber security program will deliver and embed the tools, processes and information to reach the appropriate industry security maturity that complies with the regulatory cyber security requirements.

5.1.8 Integrated Water Resources Modelling Program

Ongoing investment in modelling capacity building enables us to deliver reliable performance, better understand the impacts of climate change on water supply and develop appropriate mitigation strategies in a changing environment.

Our customers expect us to deliver the required quantity and best available quality of water. To do this efficiently and reliably, we need to continually improve the systems and tools that help us understand the likely water availability and water quality and be well informed about future risks to supply quantity and quality in the face of a changing climate and operational environment.



We have well-established capabilities in the areas of water supply and water security assessments, quantity and quality management, risk assessment, and catchment protection in Greater Sydney. Developing tools and models that continue to improve our ability to understand and quantify the magnitude of risk will enable WaterNSW to better manage our water supplies as our climate and catchment conditions change. Improving our ability to analyse and communicate risk will better inform our operational, financial, asset, and strategic business planning processes and enable us to more efficiently and effectively manage risks to our service delivery.

Our program

The foundations of our integrated water resources modelling investment over the next 20 years will include the development, utilisation and upgrade of a series of climate change and integrated quantity-quality models. The workplan includes their ongoing development, utilisation and subsequent upgrade for both log-term 'strategic' and short-term 'event' modelling and forecasting.

Climate change science and modelling approaches with respect to water supply are constantly evolving and improving. Security of supply and drought risk is the primary driver of large-scale investment for augmentation of the Greater Sydney water supply system (as well as key policy changes with economic and ecological impacts). We will continue to invest and work to incorporate the most accurate state of the science and industry practice in our approach to yield and drought modelling. This will allow us to advise Government and Sydney Water with a robust, risk-based approach to decision-making and investment.

Improving our understanding of likely future water quality in our storages via series of linked catchment, reservoir, and delivery system models will improve our capability to model the impact of droughts, rainfall events and catchment interventions (e.g. development, recycled water interventions, changes in management practices) on water quality and quantity at a whole-of-system level.

Additionally, it will enable us to better understand the potential range of water quality variations at each point of supply to Sydney Water to inform investment decision-making and enable optimisation of both investments and operational decisions. We intend to utilise these models to increase our ability to understand impacts of climate change on water supply within our lakes and inform mitigation strategies under different climate scenarios.

An integrated approach to whole-of-cycle water quality and quantity management in the Greater Sydney system is critical in improving the long-term resilience of our water supply in a cost-effective manner.

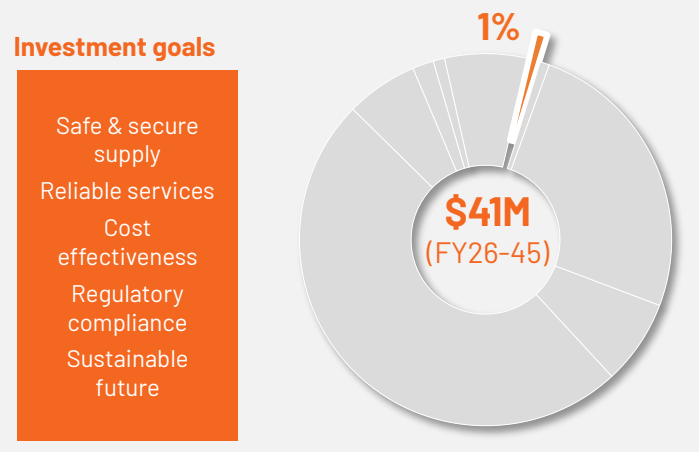
5.1.9 Facilities and Fleet

Our investments are designed to ensure our facilities and fleet across Greater Sydney and its catchment areas are fit for purpose, safe, and available to meet the needs of the business.

We are committed to support our staff by giving them access to safe and adequate facilities to enable the effective and efficient operation of our systems, delivery of services, and customer service.

Additionally, to achieve and deliver the requirements of our business, we regularly review and assess the state of our fleet to identify

- safety risks and how to manage them
- changes we need to make to meet operational business needs and comply with the relevant legislative and regulatory requirements to ensure the safety of WaterNSW employees
- improvements that enable efficient and reliable operation of the fleet.



Our program

Our investment in facilities will see the completion of several office and depot refurbishment projects, one key site being the Southwest Corridor facility. These refurbishments will

- improve the amenity of the offices, depots, vehicle, plant, and storage facilities
- maintain modern, technology-capable, comfortable, safe, and secure premises
- create a single office and depot in the Southwestern Region of Greater Sydney for a variety of operational teams across the business.

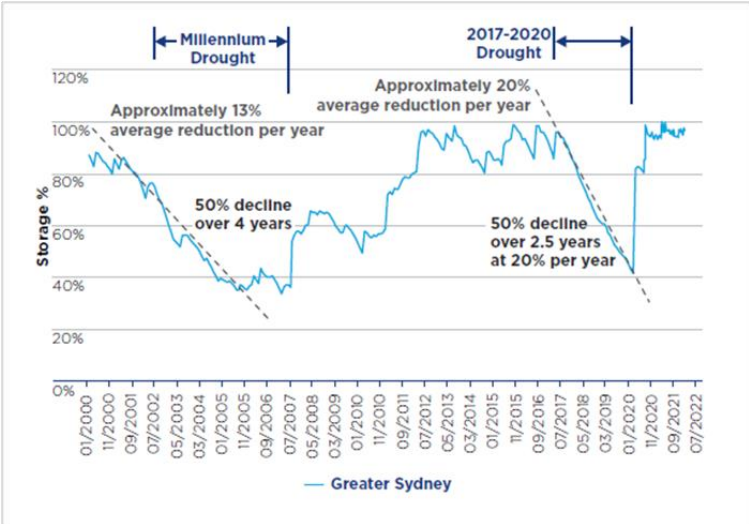
Our fleet renewal program covers the following initiatives

- In-vehicle monitoring systems telemetry
- Domestic commercial vessels and safety management system
- Electric vehicle and target zero emissions roadmap and strategy
- CoR (Chain of Responsibility) – mass load requirements.
- Renewal of vehicles that have exceeded the recommended mileage or age

5.2 Drought investments

5.2.1 Enabling an improved drought response

Our experience from the last drought (2017-2020) tells us that in a prolonged dry period, there can be a requirement to quickly deploy projects to mitigate the risk of Greater Sydney entering severe water restrictions or running out of water. The GSWS recognised this need, and the Greater Sydney Drought Response Plan (GSDRP), a plan we developed jointly with Sydney Water, outlined a drought governance framework and action plans to ensure drought response measures can be enabled in a timely manner.



Supporting the GSDRP is an interim Drought Asset Response Plan (DARP) that Sydney Water has developed with input from WaterNSW. The DARP focuses on drought-critical assets and drought-triggered staging plan for new rainfall independent supplies alongside contingent supply measures, such as Avon Dam Deep Water Access, to address nodal water security risks, especially in the Illawarra.

The following sections describe how our drought-related investments are captured in this LTCOP.

5.2.2 Drought-critical assets

In a drought, our operational flexibility is gradually eroded as dam levels decline due to hydraulic constraints at low storage levels. This makes source water selection and transfers to Sydney Water's water filtration plants and between distribution nodes more challenging, posing a risk to supply continuity.

The GSDRP identified assets that are critical for maintaining supply continuity during drought operations, i.e., when storage levels drop to low levels, and included action plans for addressing known constraints and issues with these assets. This is to ensure that we maintain appropriate supply delivery capability at low dam levels to mitigate supply interruption or failure risks. These action plans are also included in the DARP.

WaterNSW and Sydney Water committed to progress these action plans regardless of drought. The following have been identified as priority projects and the costs associated with delivering these projects are captured in the Asset Renewal Program (refer to Chapter 5.1.3).

- Warragamba deep-water pumping station (DWPS) operational readiness
- Broughton Pass and Pheasants Nest Weirs improvements to improve delivery efficiency
- Fish River to Cascade transfer resilience
- Cordeaux Dam low-level outlet augmentation

5.2.3 Drought-triggered supply augmentation capital investment

The DARP has identified key drought contingent projects, one of which is Avon Dam Deep Water Access (DWA) that require investment by WaterNSW.

Avon Dam supplies the Illawarra Region, providing water to over 310,000 residents and businesses. It contains 214 GL of total storage volume, of which about 70 GL is considered as 'dead storage' for the Illawarra as the existing supply offtake cannot access this water. New infrastructure will be required to enable access to this deep storage. Avon Dam DWA could extend supply to the Illawarra for up to two years. It would also provide a modest yield benefit (approximately 5 GL per year).

In the last drought, we progressed the Avon Dam DWA project through the conceptual design and business case phases. The project was suspended following the drought-breaking event in early 2020 and no further work has been undertaken since then.

The need to implement the Avon DWA will be dependent on the nature and severity of the drought, storage levels in the Upper Nepean and Tallowa, and risk appetite of government. The DARP recommends some elements of the project be progressed outside of drought to reduce its delivery time to about 3 years. Current estimate to reactivate and deliver the Avon Dam DWA project is between 4 and 5 years.

The Avon Dam DWA may no longer be considered as a contingent drought supply in the event rainfall independent supplies are built in the Upper Nepean, such as the Illawarra Desalination Plant.

Expenditure associated with delivery of Avon Dam DWA (estimated at $450M) does not form part of our baseline investment plan, but it has been included in our bill impact assessment (Chapter 5.4) as a scenario to estimate the potential increase to Sydney Water's bill should it be required in the next drought.

Figure 7 shows the projected cash flow, assuming drought occurs in 2026, and a decision to proceed with Avon DWA construction occurs in 2028.

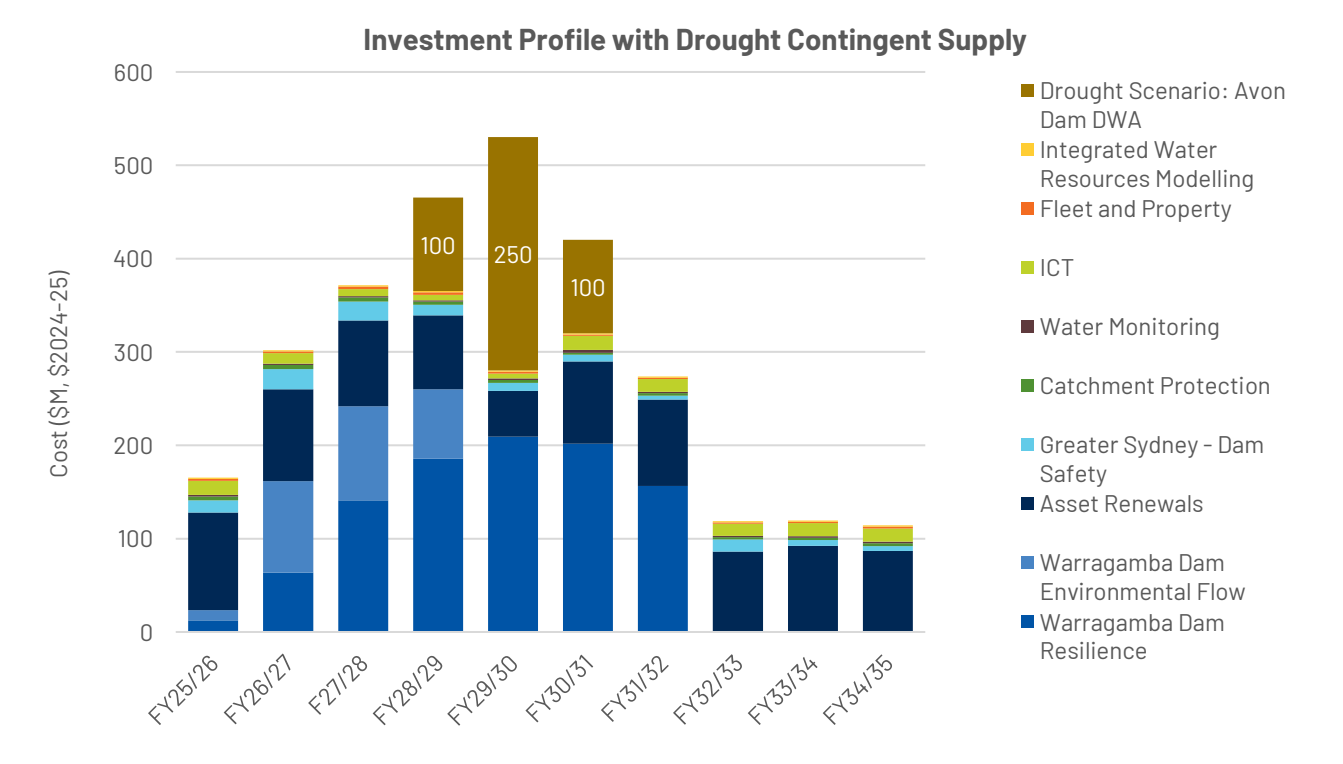


Figure 7: Projected capital expenditure profile with Avon Dam DWA delivery included

5.3 Operational expenditure forecast

We are expecting our operating expenditure (opex) to increase over the next 20 years due to several factors, including ageing assets and higher input costs driven by increase in labour, utilities, services, and insurance costs, as well as taxes. Some of these cost increases will be offset by our continued effort to introduce efficiencies in our operations, deliver our cost transformation (reduction) targets, better management of risks, and enhanced prioritisation of maintenance and operational activities.

Figure 8 shows our forecast opex profile, and the key cost drivers are presented in the following chapters.

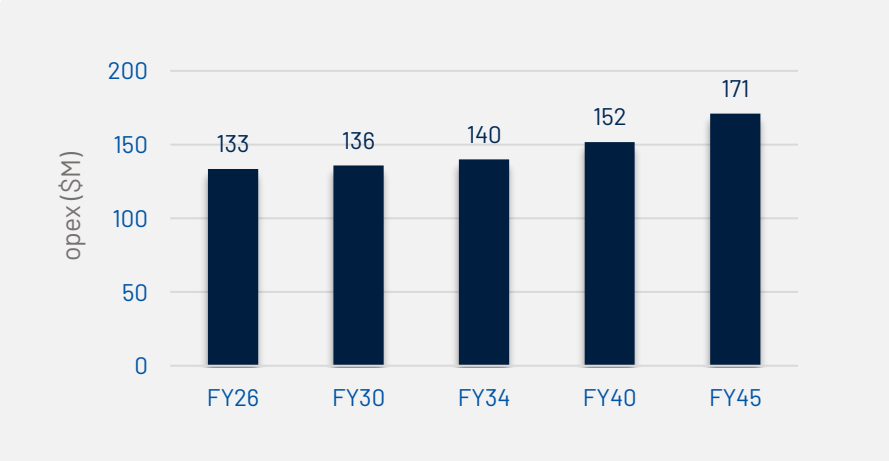


Figure 8: LTCOP operational expenditure profile

5.3.1 Maintenance cost

Maintenance activities are tasks that we undertake to ensure that assets continue to function efficiently and safely for their intended service life and function at lowest total life cost. Our maintenance program is driven by a reliability centred maintenance strategy, supported by an ISO55001 certified Asset Management System (AMS), and which is regularly subjected to multiple annual audits (IPART and ISO).

In Greater Sydney, the areas with the largest operational requirements include:

- water delivery and other operations – managing and overseeing water delivery operations and other essential functions to ensure the efficient operation of assets
- routine maintenance – conducting routine inspections and maintenance activities to keep the assets in safe working condition
- corrective maintenance – performing corrective inspections and maintenance activities to restore assets to full service or reduce the risk to failure.

5.3.2 Corporate costs

Our corporate costs are expenditure that we incur as part of our operations in the Greater Sydney region, ranging from fixed expenses to variable expenses. These include:

- staff salary and superannuation
- contract and professional services
- digital/ICT
- insurance
- land tax
- licence fees
- fuel costs
- utility costs

Most of these costs are subject to external factors, such as economic conditions and regulations, that will drive up our opex over time. To put downward pressure on the cost we can control, we continue to change the way we operate to become a leaner, more efficient, more agile, and higher performing business.

5.4 Bill impact estimates

In Greater Sydney, our revenue requirements are determined by IPART, with the resulting revenue predominantly provided by Sydney Water, which reflect the cost of the provision of raw water for subsequent treatment and distribution. Historically, the cost of purchasing raw water from WaterNSW has represented approximately 8% of Sydney Water's overall revenue requirement.

An analysis of the potential impacts of the WaterNSW LTCOP investments has been undertaken, as presented in Table 2, considering following assumptions.

- Analysis is presented in 2024-25 real dollars, under the following scenarios:
    - Scenario 1: Baseline capex plan. The costs associated with our entire LTCOP 20-year program, including for the Warragamba Dam Resilience and Environmental Flows are fully funded by Sydney Water (and its customers).
    - Scenario 2: Scenario 1, but excluding Warragamba Dam Resilience and Environmental Flows projects, i.e., not included in pass-through costs to Sydney Water
    - Scenario 3: Scenario 1 plus Avon deep-water access (DWA), assuming an extreme drought occurs in the next 5 years, and a contingent drought supply is required to protect the Illawarra node.
- Operating expenditure is in line with the 2025 WaterNSW Statement of Corporate Intent (SCI).
- Baseline bills are sourced from the 2020-24 (extended to 2025) IPART Greater Sydney final determination. The baseline bill is the expected price in the final year of the current period (2024-25) with forecast expected demand of 488 gigalitres per annum (non-drought) from Sydney Water.
- Forecast bills assume a 5-year determination period commencing 2026 to 2030 and a subsequent 5-year determination period commencing 2030 to 2035. The bill impact is presented as an average per annum bill impact to Sydney Water for the 2026-30 / 2030-35 period, with expected demand of 488 gigalitres per annum (non-drought).
- A weighted average cost of capital (WACC) of 3.6% real post tax for the 2026-30 and 2030-35 period.
- Projected capital costs are assumed to be recovered over an average economic life of approximately 29-30 years using the straight-line depreciation methodology as advised by the WaterNSW assets team and consistent with the IPART methodology (using asset specific RABs). The customer bill impacts are quite sensitive to this assumption and are subject to Board endorsement and IPART approval.
- Calculation of tax depreciation is consistent with the approach in the final determination (i.e., accelerated depreciation).
- Shoalhaven transfer costs are excluded from the analysis as they are subject to a separate IPART charging mechanism.
- Customer prices are subject to IPART approval.
- WaterNSW IPART Greater Sydney Pricing Proposal for prices commencing in 2026 are subject to relevant Board Approvals and may differ to the assumptions used in this bill impact analysis. This includes but is not limited to updated cost estimates, asset lives, WACC assumptions and other regulatory inputs in line with relevant Board Approvals, customer consultation, updated IPART methodologies, and updated WACC market parameters / data.
- Any nominal bill impacts faced by customers by definition include inflation which would be on top of the percentages noted above.

- The cost estimates for the Warragamba Dam Resilience works are:
    - very preliminary and subject to change. It should be considered a class 5 estimate which is prepared based on limited information and used for preliminary project screening, determination of feasibility and forward strategic planning purposes
    - based on a scope of work that is not yet well defined and informed by a very preliminary engineering assessment only
    - based on a what would be expected conditions associated with Planning Approvals. Final Planning Approval may result in increased time and costs
    - subject to obtaining investment and planning approvals, which may be delayed due to the sensitive nature of the works and requirements to obtain both State and Australian Government approval. The phasing of costs is considered 'best case', and therefore conservative from a cashflow and bill impact perspective.
    - not considering unknown existing site conditions.
    - not considering the costs of replacement water.
    - not considering any imposed restrictions related to pandemics and other uncontrolled events (force majeure) that impact delivery costs including construction activities and supply chain impacts both domestically and internationally

Our bill impact analysis indicates that, for the baseline LTCOP investment profile, annualised increases of about 14 per cent and 12 per cent from current bills is expected for FY26-30 and FY30-35, respectively.

Table 2 Bill Impact Estimate

Scenarios For Sydney Water's bill impact estimate	2024-25	2025-30	Change to 2025-30	FY26-30 Annualised Increase vs 2024-25	2030-35	Change to 2030-35	FY30-35 Annualised Increase vs 2024-25
	Average per annum ($M, $2024-25)						
Scenario 1: Baseline LTCOP program	227.6	340.8	113.3	14%	418.9	191.3	12%
Scenario 2: Warragamba Dam Resilience and Eflows excluded	227.6	323.7	96.1	12%	347.2	119.7	6%
Scenario 3: Baseline LTCOP with drought contingency (Avon DWA)	227.6	342.6	115	14%	439.0	211.4	14%

Note: Forecast bill increase is influenced by:

- higher levels of proposed capital investment and depreciation (capex on shorter lived assets) to 2035 compared to the 2020-25 regulatory period
- higher funding costs driven by higher WACC, estimated to increase from 3.4 per cent to 3.6 per cent real WACC, and
- impact on unit price from lower demand compared to the 2020-25 regulatory forecast.

5.5 Funding for our proposed programs

We will ensure the LTCOP investment is financially sustainable, meeting the needs of the community and enabling us to continue investing in services and assets. As projects progress to business case phase, a range of funding and delivery options will be investigated as part of the process of assessing whether projects are economically viable and will deliver value for money. The LTCOP seeks to align the investment drivers with funding sources within the IPART Price Determination process as much as possible, to provide clarity and transparency in our approach with customers.

Given the substantial level of expenditure with the concurrent delivery of several large projects expected throughout the next 20-years, we will consider funding and financing arrangements for the LTCOP. Based on the current baseline investment profile, our assumption is that we can fund the entire program, without any need for equity or other NSW Government contribution, based on the assumption that the costs associated with the entire program, including for the Warragamba Dam Resilience and Environmental Flows Projects, are fully funded by Sydney Water (and its customers).

As per NSW Treasury policy and guideline TPG21-10, we have undertaken a review of our capital structure. The following principles have been adopted:

- ensuring a stable dividend profile over the forecast period
- ensuring retained earnings are not depleted over the forecast period
- ensuring a minimum credit rating of BBB is maintained.

Baseline projects and drought contingent scenario are deliverable subject to the following considerations:

- timing of Avon Deep Water Pumping station is drought dependent and funding requirements may not line up with Price Determinations.
- ongoing work will continue to inform the detailed scope and preliminary cost estimate of Warragamba Dam Resilience project.

5.6 Future LTCOP inclusions

5.6.1 ESG and climate change adaptation

The focus of our Environmental, Social and Governance (ESG) initiative is on emissions reduction, climate change mitigation and adaptation actions, waste management, and the circular economy and land management to determine optimal use of land from an economic, environmental, and social perspective. Social initiatives centre around inclusion and diversity, RAP and employees and public safety. In addition, there will be some work to develop a broad ESG reporting and disclosure framework that incorporates all of these and other related activities.

The initial focus of activities is centred around the following:

- Assessment of potential land use through site-by-site assessment of potential additional use based on location, soil type, existing use, suitable for alternative use etc.
- Empirical assessment of fugitive emissions from dams to understand the full scale of our greenhouse gas emissions. It is worth noting that the scale of these emissions could be significant, and reduction of those emissions is likely to be difficult. As such, to reach Government targets of net zero emissions is likely to require investment in offsets.
- Exploration of options for reducing fugitive emissions from our dams, as well as assessment of alternative options to offset these. (Investment in generation of renewable energy through solar panels at sites to reduce reliability of fossil fuel generated energy. Planting of native trees and plants as part of a carbon sequestration program and to improve biodiversity.

- Detailed risk and gap analysis to determine potential actions to be taken to reduce impacts of climate change on our assets and water quality.
- Following the above - implementation of projects to reduce impact on our assets or water quality.
- Investment in renewable energy over and above the current program for opening assets to third parties. This could include investment in solar or wind generated energy and batteries on some sites.

The cost and feasibility of these options have not yet been determined. This will be undertaken over the next five years with some pilot schemes and/or small-scale investments also being made. Future revisions to the LTCOP will include a more comprehensive breakdown of costs and benefits associated with these programs particularly around carbon management and further climate change considerations and natural capital.

5.6.2 Catchment audits

The Water NSW Act 2014 requires there to be an audit of the catchment health of the declared catchment to be undertaken every three years. The audit considers the responses by all public authorities with a role in managing the catchment. We must incorporate the findings of the audit, to the extent to which they relate to our activities and water quality, into our risk framework and programs and activities relating to catchment management. Some of the recommendations of the latest catchment audits that could lead to future capital investments are as follows:

- develop and implement an erosion management decision support tool for the Special Areas
- audit high risk Neutral or Beneficial Effect (NorBE) developments that are in maintenance phase to determine if stormwater controls are being adequately maintained.
- investigate causes of poor water quality at priority sites so that management can be targeted to the root cause.

5.6.3 Future use of the Upper Canal

The Upper Canal is part of the Upper Nepean Transfer System and is the only means of transferring water from the four Upper Nepean Dams (Cataract, Cordeaux, Avon and Nepean) to Sydney Water's Prospect system. It provides system flexibility by optimising raw water quality supplied to Prospect Water Filtration Plant (WFP) and supplementing supply to Prospect WFP when Warragamba pipelines and Prospect Reservoir are taken offline for routine maintenance. The Upper Canal operates entirely under gravity, incurring no energy costs and producing no greenhouse gas emissions.

During refurbishment works completed in 2019, 13% of the canal wall was either rebuilt or relined to enable reliable operations in the short to medium term. The capital and operating expenditures for continuing to operate the Upper Canal over the next 20 years have been included as part of this LTCOP. These include improved drainage along the Upper Canal as well as condition-assessment of the tunnels and various other assets within the Canal to better inform our investment strategy over the asset lifecycle.

The ongoing supply augmentation and network resilience planning (by Sydney Water), condition assessment, and water quality and safety drivers will inform future investment decisions with respect to the Upper Canal. It will continue to remain an important source of network resilience to the Prospect supply node over the medium-term, which will allow ongoing maintainability of Warragamba Pipelines. Additionally, the flows from the Shoalhaven River and Upper Nepean Dams will continue to supplement the Prospect supply node.

Our ongoing planning processes with Sydney Water will consider the impact of rainfall independent water supply sources and population growth patterns on the long-term role of Upper Canal, in addition to deteriorating asset condition over the coming decades, and the associated need for large scale capital investment.

5.6.4 Potential change to Warragamba Dam's flood mitigation function

The NSW Government has committed to not progress the proposal to raise Warragamba Dam wall by 14 m for flood mitigation. The NSW Reconstruction Authority is now leading a work across the NSW Government to develop the Hawkesbury-Nepean Valley Disaster Adaptation Plan (HNV DAP) by 2025. Recognising that there is no single solution to flood risk in the Valley, the HNV DAP is considering a range of measures consisting of:

- mitigation in infrastructure, such as levees, lowering the full supply level (FSL) at Warragamba Dam, and allowing for pre-releases ahead of a flood
- improvements to evacuation roads
- ways to better the prepare the community.

Preliminary desktop analysis for the HNV DAP has identified lowering the FSL at Warragamba Dam by 5, 12 and 25 metres as flood mitigation options for further analysis and modelling based on their potential to reduce loss of life and property in a flood. However, the magnitude of these benefits is likely to be outweighed by heightened risks to Sydney's water security and quality.

Reducing the FSL of Warragamba Dam by any amount would further reduce Sydney's water security, especially in a drought, and may have implications for our dam safety and environmental flow infrastructure. It would also significantly reduce our operational flexibility to manage water quality events in the dam.

A decision to lower Warragamba Dam's FSL permanently will require a major update of both Sydney Water and WaterNSW LTCOPs to include investments that may be needed to address dam safety risks, measures to offset the decline in yield, water quality risks, and impacts on our assets and operation.

5.6.5 Purified recycled water to Prospect Reservoir

Sydney Water is currently planning for a full-scale purified recycled water (PRW) scheme at its existing Quakers Hill Water Resource Recovery Facility (WRRF). Sydney Water is aiming for the scheme to be operational in 2031 at an initial production rate of 36ML/d with future expansions in the range of 150-250M/d. This is part of its Reliable and Resilient Water Supply program, supporting the Greater Sydney Water Strategy's commitment to build new rainfall-independent supplies.

Prospect Reservoir has been identified as a critical part of the Quakers Hill PRW Scheme as it will enable PRW at the scale needed to achieve a reasonable level of improved supply resiliency. The reservoir will be used as an environmental buffer (from a hydrodynamic perspective) between the recently produced PRW and the Prospect Water Filtration Plant.

Any investments that may be required by WaterNSW to support this scheme, such as modifications and upgrades to Prospect Reservoir including baffles in the lake to improve detention time, potential modifications to the Raw Water Pumping Station, major modifications to the destratification system and other assets in the vicinity will be captured in future LTCOPs.

5.6.6 Initiatives to ease cost pressures

As part of our current strategic initiatives, we are exploring various opportunities to supplement our revenue streams to minimise bill increases or even reduce customer bills over time. These include:

- Developing New Revenue Streams. We will continue to examine, assess and create new sources of income for WaterNSW, leveraging existing resources and expertise where we can.
- Renewable Energy Program. By partnering with the private sector, we will continue to explore the potential for using WaterNSW land and assets for renewable energy assets, including pumped hydro, wind, solar, and batteries.
- Alternative Funding Strategy. We will investigate alternative funding avenues for business initiatives that are not funded through the IPART determination process.

Chapter 6
Next steps

Lake Avon

6.1 Continue to engage and work with stakeholders

Our LTCOP is an adaptive plan that will continue to be updated as Greater Sydney's water context changes, new water policy is set, new hydrological and climate change data become available and new opportunities or threats emerge. The LTCOP needs to adapt to reflect stakeholder insights, long-term direction for water supply services and expectations from us as bulk water supply provider. This means we will continue to engage closely with stakeholders including the NSW Government and IPART and work closely with our primary customer in Greater Sydney (Sydney Water).

As an important component of water planning framework, the LTCOP will require collaboration in closely related areas such as:

- a shared vision for water servicing in Greater Sydney
- emerging and future challenges and opportunities
- projects and initiatives to meet water servicing outcomes and our corporate goals such as ESG and Net Zero strategies.

6.2 Progressing the plan

Preparing the LTCOP and establishing its goals and expected outcomes are just the first steps. Identifying investments to deliver on these is the starting point for planning for future programs and initiatives that will deliver the desired outcomes.

We will progress to detailed assessments of specific investments as part of the WaterNSW Investment governance process. Business cases supporting each investment decision will ensure projects that are progressed will deliver value for money for the people of Greater Sydney.

6.3 Updating the plan

As per our operating license requirement, the LTCOP requires a review and update at least once every five years. However, it may also need updating if:

- the GSWS or its implementation plan is revised to incorporate a new water servicing direction or priority actions
- major new regulations are introduced that require our compliance through capital investments or significant change in our operations
- any decision that changes the role of Warragamba Dam, especially if the decision has implications for our dam safety or eflow works
- Warragamba Dam Resilience Project or Warragamba Dam Environmental Flows Project scope and implementation plan changes
- any changes to our core functions and responsibilities in Greater Sydney, and any major investments to achieve our business goals and strategic priorities
- any major change to the assumptions outlined in Chapter 1.4.

Appendix A: Greater Sydney Bulk Water Assets

Table A-1 Major Greater Sydney Storages

Dam	Operating Storage Capacity (ML)
Avon	146,700
Blue Mountains	2,890
Cataract	97,190
Cordeaux	93,640
Fitzroy Falls	9,950
Nepean	67,730
Prospect	33,330
Tallowa	7,500
Warragamba	2,064,680
Wingecarribee	24,130
Woronora	71,790
Total	2,596,150

Note: The table combines the storages of the five Blue Mountains dams under one banner as all water is transferred to Upper Cascade Dam before it is supplied to Sydney Water.

Table A-2 Water Transfer Conduits

Supply Conduit	From/To	Capacity (ML/d)	Length (km)
Glenquarry Cut, Creek, Control Structure and Pipeline	Wingecarribee Reservoir to Nepean Reservoir	600 winter[1] 400 summer[1]	20
Wingecarribee and Wollondilly Rivers	Wingecarribee Reservoir to Lake Burragorang	600 winter[1] 400 summer[1]	90
Nepean-Avon Tunnel	Nepean Reservoir to Avon Reservoir	1,000	2
Nepean DPWS Rising Main	Nepean Dam to Nepean-Avon Tunnel	190	2
Nepean River	Nepean Dam to Pheasants Nest Weir	1,300[2]	10
Avon River	Avon Dam to Cordeaux River	900[2]	3
Cordeaux River	Cordeaux Dam to Nepean River	1,000[2]	10
Cataract River	Cataract Dam to Broughtons Pass Weir	700[2]	10
Nepean Tunnel	Pheasants Nest Weir to Broughtons Pass Weir	410	7.2
Cataract Tunnel	Broughtons Pass Weir to Brooks Point	500[1]	3
Upper Canal	Brooks Point to Prospect WFP / Reservoir	500[1]	54
Warragamba Pipelines	Warragamba Dam to	2,600 at FSL	

Supply Conduit	From/To	Capacity (ML/d)	Length (km)
No.1 (2650-2100mm) No.2 (2650-3000mm)	- Warragamba WFP - Orchard Hills WFP - Prospect WFP - Prospect Reservoir		27.49 27.56
Woronora Pipeline	Woronora Dam to Woronora WFP	800	0.2
Fish River Water Supply Main (dia. 375 mm)	Leura to Upper Cascade Dam	9.5 gravity 14.5 boosted	8.4
Greaves Creek – Upper Cascade Pipeline	Greaves Creek Dam to Upper Cascade Dam	7	5.4
Shoalhaven Scheme[3] Bendeela Pipeline Kangaroo Tunnel Kangaroo Shaft Kangaroo Pipeline and Control Structure Fitzroy Canal Wildes Meadow Canal Burrawang Tunnel, Canal and Control Structure	Lake Yarrunga to Wingecarribee Reservoir (via various conduits and including Bendeela Pondage and Fitzroy Falls Reservoir)	2,400[4] 1,581[5]	16 0.8 1.5 0.3 2.5 4.1 3.0 2.8 1.0

Notes:

1. Current environmentally sustainable capacity
2. Maximum controlled discharge available from dam infrastructure
3. Also includes Bendeela and Kangaroo Valley Pumping Stations owned and operated by Origin Energy; Glenquarry Cut, Creek and Control Structure accounted for elsewhere
4. Based on capacity of infrastructure
5. Based on O&M agreement, Max entitlement of 140 Hours a week per Burrawang pump unit

Table A-3 Pump Stations

Pump Station	Delivery: Min (ML/d)	Delivery: Max (ML/d)	Delivery Head (m)	Purpose
Warragamba DPWS	250	1,000	70	Access lower levels of Warragamba Dam for supply via Warragamba Pipelines to Prospect
Nepean DPWS	80	190	120	Access lower levels of Nepean Dam for supply to Avon Dam via Avon-Nepean Tunnel
Burrawang PS	2,445	2,445	10	Transfer from Fitzroy Falls Dam via Wildes Meadow Canal to Wingecarribee Dam via Burrawang Tunnel
Prospect RWPS	150	1,400	20	Transfer water from Prospect Reservoir to Prospect WFP via Channel 2
Upper Cascade RWPS	10	29	15	Access lower levels of Upper Cascade Dam for supply to Cascades WFP
Lower Cascade PS	5	5	50	Transfer water from Lower Cascade Dam to Upper Cascade Dam
Greaves Creek PS	6	6	90	Transfer water from Greaves Creek Dam to Upper Cascade Dam

Table A-4 Number of water monitoring sites in Greater Sydney

Groundwater	**150**
Hawkesbury-Nepean	40
Shoalhaven	1
Upper Nepean	109
Stream level/water quality	**112**
Hawkesbury-Nepean	51
Prospect	1
Shoalhaven	26
Upper Nepean	29
Woronora	5
Rainfall/weather station	**96**
Hawkesbury-Nepean	44
Prospect	1
Shoalhaven	32
Upper Nepean	17
Woronora	2
Storage level/water quality	**27**
Blue Mountains	6
Hawkesbury-Nepean	8
Prospect	1
Shoalhaven	4
Upper Nepean	5
Woronora	3
Total	**385**

Appendix B: WaterNSW Climate Change and Drought Modelling

B2 – Climate Change

The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment report shows trends for Australia that include further warming and sea level rise, with more hot days and heatwaves, less snow, more rainfall in the north, less April–October rainfall in the southwest and southeast and more extreme fire weather days in the south and east.

Climate models provide projections of climate under different input emission pathways. The input projections are referred to as representative concentration pathways (RCPs) with RCP4.5 representing an intermediate scenario and RCP8.5 representing a worst-case scenario.

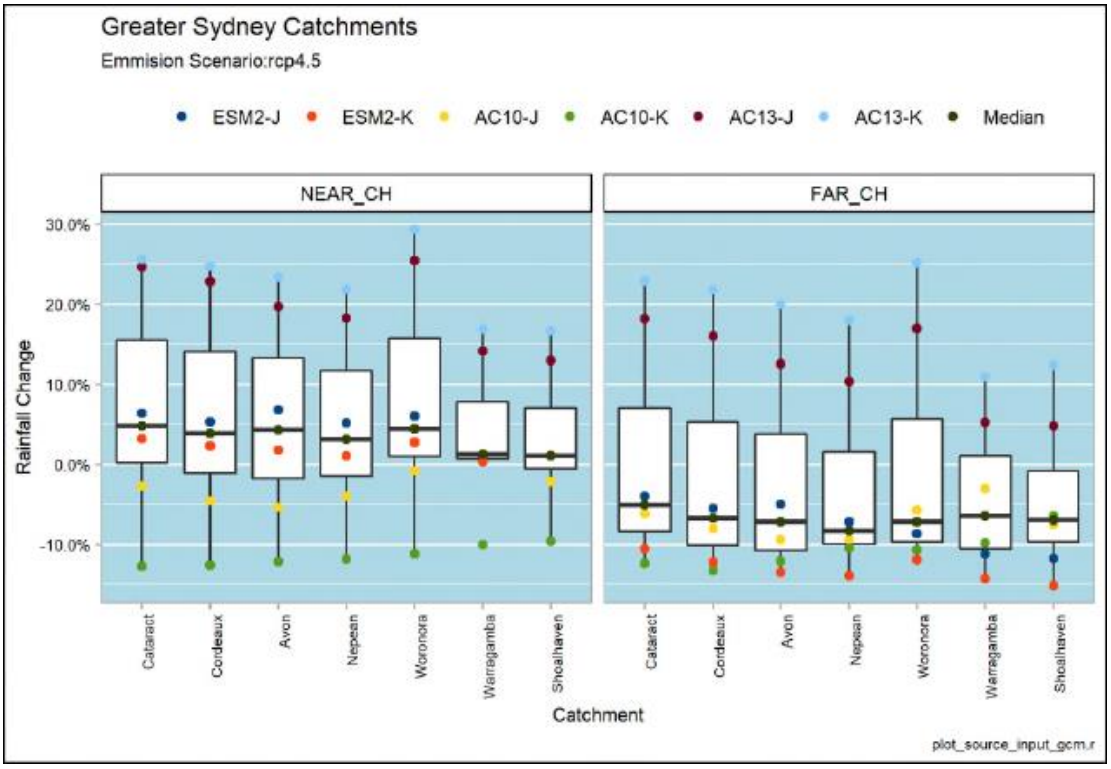
The NARCLiM model project provides down scaled datasets for NSW suitable for climate impact assessment for various future planning projects. This summary report presents the use of NARCLiM1.5 data for the assessment of Climate Change impact on water security for Greater Sydney Water Supply System.

Future changes in rainfall

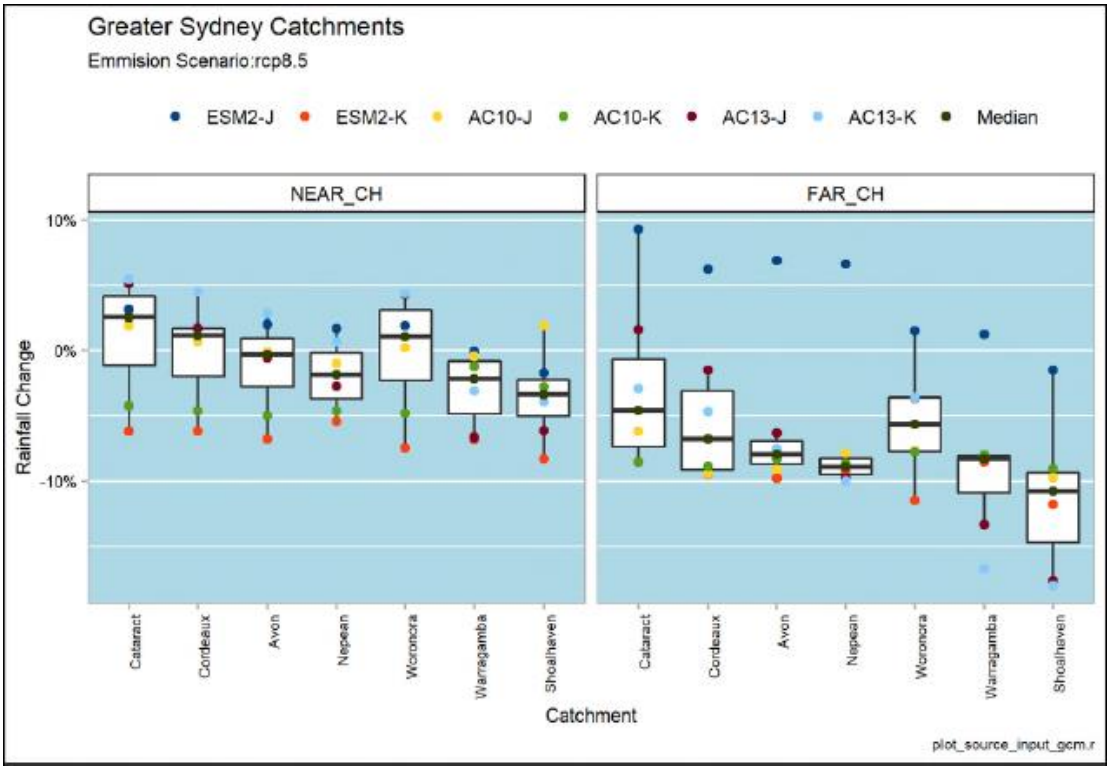
Climate Model outputs are available from 1951 to 2100. Current climate simulation covers the period of 1951-2005. Future climate simulations are available for period 2006-2100. Two 40-year time slices were considered for "Near" and "Far" future periods. "Near future" period is considered as 2020-2059 and "Far Future" is considered as 2060-2099. The rainfall and temperature results were bias corrected using (Australian Water Availability Project) AWAP gridded data. Climate model results are not representative of observations over time but considered as a statistical representation only.

Rainfall reductions were seen across the majority of catchments except for near future under RCP4.5 scenario. There is considerable variability on the range of changes shown in the different climate models.

Overall, a 1.3% median increase across all models (range -10% to +17%) in annual catchment average rainfall is shown for "Near future', and 6.4% reduction (range -10% to +11%) is shown for 'Far' future under RCP4.5 scenario for the Warragamba Catchment.

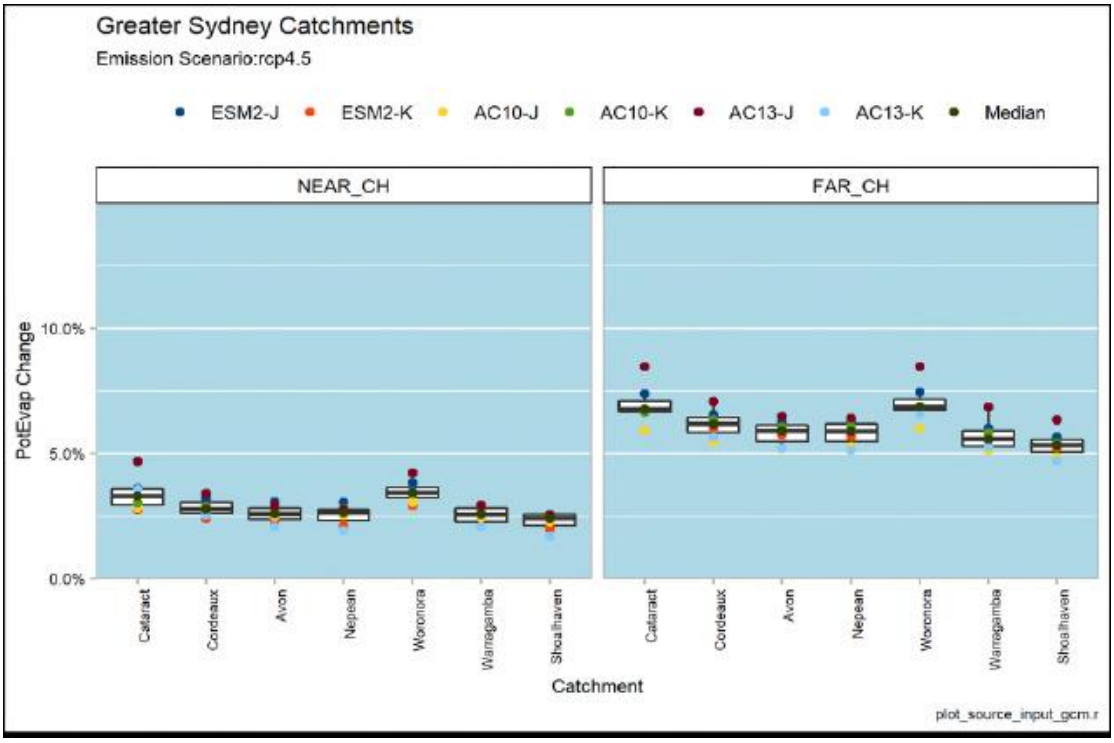


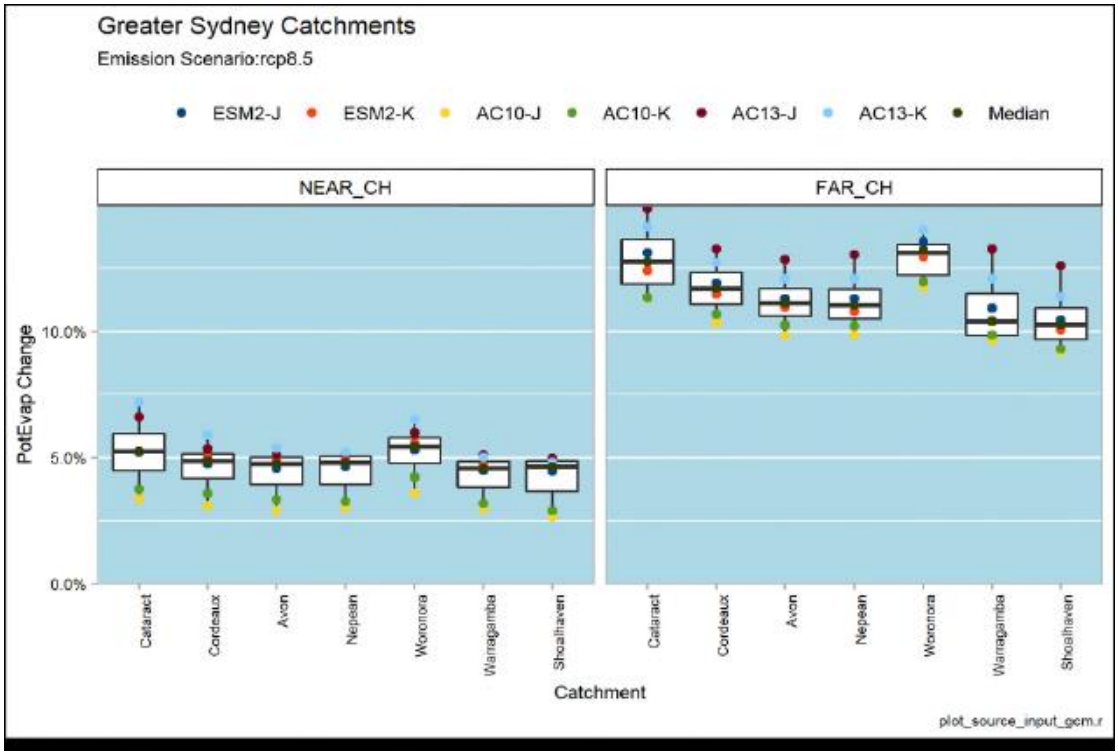
Under the RCP8.5 scenario for Warragamba Catchment a 2.2% median reduction of annual catchment average rainfall is shown for 'Near future' and 8.3% reduction is shown for 'Far' future.



Future changes on Potential Evapotranspiration

Annual average evaporation is shown to increase for all catchments due to future temperature rises. The annual average potential evapotranspiration increase for near and far future period for RCP 4.5 & RCP 8.5 is shown below. Annual average potential evapotranspiration for Warragamba catchment is shown to increase by 2.6 % for "Near future' and 5.6% for 'Far' future for RCP4.5. For the RCP8.5 Near and Far Future, evaporation is estimated to increase by 4.6 % and 10.4% respectively.





B3 – Design Drought Analysis

The primary objectives of the design drought analysis are to:

- investigate the statistics of historical droughts, including likelihood and severity characteristics,
- develop a consistent approach to developing and adopting synthetic droughts to ensure reliable and robust drought planning.
- estimate the potential impact of future climate change to drought characteristics.

Historical inflow analysis

Two characteristics predominantly determine the impact of droughts: severity, which describes how bad a drought is, and duration, which describes how long a drought lasts.

To understand the length and severity of historical droughts, the minimum inflow volume from 1909-2020 over a range of time periods from 1 to 7 years is calculated using a moving total method. The analysis shows the driest observed 2-year (24 month) period was experienced during the recent drought from January 2018 to December 2019. The driest 5,6- and 7-year periods all occurred during the 2000-2007 Millennium Drought.

The Greater Sydney drinking water catchment is made up of five water catchments- Warragamba, Shoalhaven, Upper Nepean, Woronora and Blue Mountains. Because the Greater Sydney can only access a portion of the water from Shoalhaven system under certain conditions, drought analysis does not include the Shoalhaven system.

Table B-1 Historical n-year Moving Average minimum inflow to Sydney supply dams from 1909 Jan to Dec 2019

n-year period	1 year	2 years	3 years	4 years	5 years	6 years	7 years
Minimum inflow (GL/a)	33	123	216	299	328	368	418
Historical period	1939 Dec -> 1940 Nov	2018 Jan -> 2019 Dec	1939 Jun -> 1942 May	1938 Oct -> 1942 Sep	2002 May -> 2007 Apr	2001 Jun -> 2007 May	2000 Jun -> 2007 May

Synthetic inflow analysis

WaterNSW currently uses the historical flow record to synthetically generate streamflow replicates (or timeseries) for the assessment of yield and extreme drought depletion. Ten Thousand (10,000) 111-year synthetic replicate time series are generated by WATHNET to give a total of 1,100,000 years of streamflow. These synthetic replicates, while having the same statistics as the observed data, contain drought sequences more severe that the observed record.

Table B-2 shows the probabilities of a range of synthetic drought inflow volumes and durations, with historical inflows as a reference. The analysis shows as expected the worst historical droughts on record, which are based on 111-years of flow data have a probability of approximately 1 in 100.

Table B-2 n-year overlapping inflow analysis to Sydney supply dams from 10,000 synthetic replicates calibrated to historical record 1909 to 2019

		n-year overlapping average inflow (GL/a)									
	Likelihood of n-year overlapping average occurs	**1-yr**	**2-yr**	**3-yr**	**4-yr**	**5-yr**	**6-yr**	**7-yr**	**8-yr**	**9-yr**	**10-yr**
Historical synthetic replicate	1/1,000,000	5	24	39	56	70	95	118	153	174	175
	1/100,000	15	40	62	90	114	133	166	194	220	245
	1/10,000	26	60	94	126	155	185	217	242	267	286
	1/1,000	**51**	**102**	**147**	**188**	**225**	**259**	**291**	**318**	**345**	**370**
	1/100	**114**	**190**	**251**	**303**	**348**	**387**	**422**	**455**	**485**	**512**
	1/50	150	237	303	358	405	446	484	516	546	573
	1/20	224	325	399	458	509	552	589	623	652	678
	1/10	316	429	508	571	622	665	702	734	762	788
Historical data (1909 - 2019)	**minimum flow**	**33**	**123**	**216**	**299**	**328**	**368**	**418**	**446**	**466**	**490**

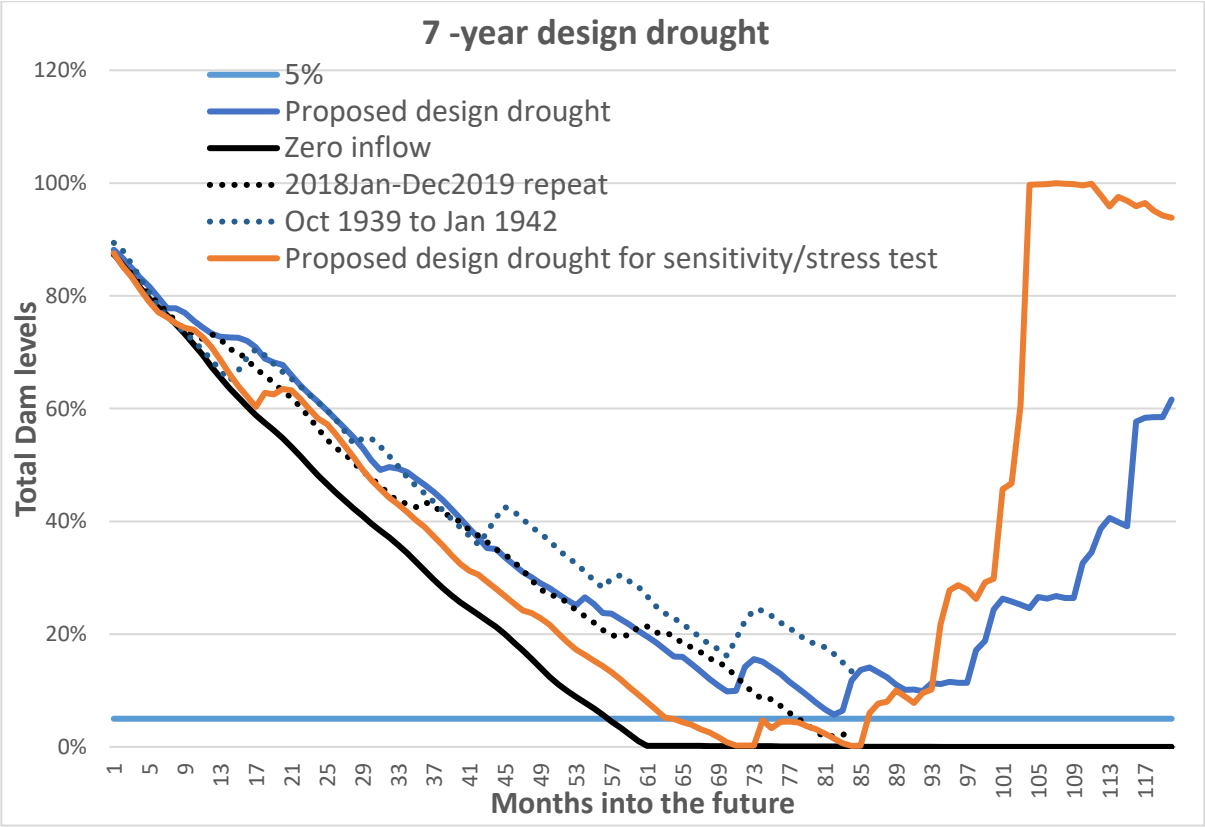
For the Greater Sydney water supply system, given the large storage capacity and starting with full storages, an extreme drought that lasts for less than 3 years would pose less risk to water security than a slightly less extreme drought that lasts for 7 years. Therefore, the Design Drought methodologies for Greater Sydney adopts two major components for its inflow: frequency/likelihood and duration.

The Greater Sydney water supply system has storage capacity and SDP1 output that can meet up to 5 years' supply (from 90% supply level), even under a zero-inflow scenario. The zero-inflow scenario statistically has a zero chance of occurring but does represent the worst possible drought. As a result there is minimal risk for 5-year and 6-year droughts that have a probability of 1/100,000 or higher to deplete the system to below 5%, but there is significant risk for storages to drop below 5% dam levels with 7-year droughts with probability of occurring of 1/100,000 or higher. If however a 15% minimum operating level (MOL) is adopted, then there is a risk that 5-year, 1/100,000 probability droughts will result in storage levels dropping below 15%. This demonstrates that the critical duration of design droughts is related to the adopted minimum operating level.

Two types of design droughts are developed in this study. This first type of design droughts is intended to be used in assisting developing drought portfolios (what drought contingency options to build and when). The second proposed design drought is intended to be used to adjust drought portfolios when storage depletion is steeper than the first design drought, to avoid the water security risk for any potential droughts that are worse than the first design drought. The design drought for contingency planning has a lower probability of occurring but is more severe.

For drought planning purposes it is proposed to adopt two design droughts to reflect the corresponding critical duration droughts required to deplete the system to the respective MOLs.

- For a 5% MOL, adopt the 7-year 1/100,000 drought that corresponds to 166 GL/a over 7 years. The plot below shows the modelled depletion of the 7-year design drought in comparison with repeated sequences of historical droughts and the zero-inflow scenario. To deplete the system to 5% with a drought corresponding to a 1 in 100,000 probability, it takes a minimum of approximately 80 months or close to 7 years. For comparison, the worst 7-year historical drought has an average inflow of 418 GL/a.
- For a 15% MOL, adopt the 5 year 1/100,000 drought that corresponds to 114 GL/a over 5 years. For comparison, the worst 5-year historical drought has an average inflow of 328 GL/a.



The worst drought in the synthetic replicates sequence correspond to a probability of 1/1,000,000. For sensitivity and stress testing, zero-inflow scenario and 1/1,000,000 design droughts are recommended.

B1 – Supply augmentation planning

The following summaries the analysis undertaken for the Strategic Option Business Case (SOBC) project led by Sydney Water, in investigating risk, cost and benefit of future bulk water supply options using the design drought framework.

Base case yield

Base case yield estimate for the project SBC is 525 GL/a. Main assumptions around base case yield are:

- Demand Run 60 restriction trigger levels and savings
- SDP1 continuous operation with ramp up/ramp down arrangement
- No storage triggered drought supply options available (installed capacity of the System).
- Warragamba variable eflow in effect (for planning purposes).

The yield adopted in the SBC is lower than what WaterNSW reported recently (540 GL/a). This is mainly due to the assumption around the Warragamba Dam eflow releases.

Base case time series for drought risk

There are three base cases for time series runs with different variation around availability and construction of SDP1 expansion (also referred to as SDP2). These base cases are:

1. SBC_BC_1 does not have SDP1 expansion,
2. SBC_BC_2 in which SDP1 expansion will commence construction at 80%,
3. SBC_BC_3 in which SDP1 expansion will commence construction at 60%.

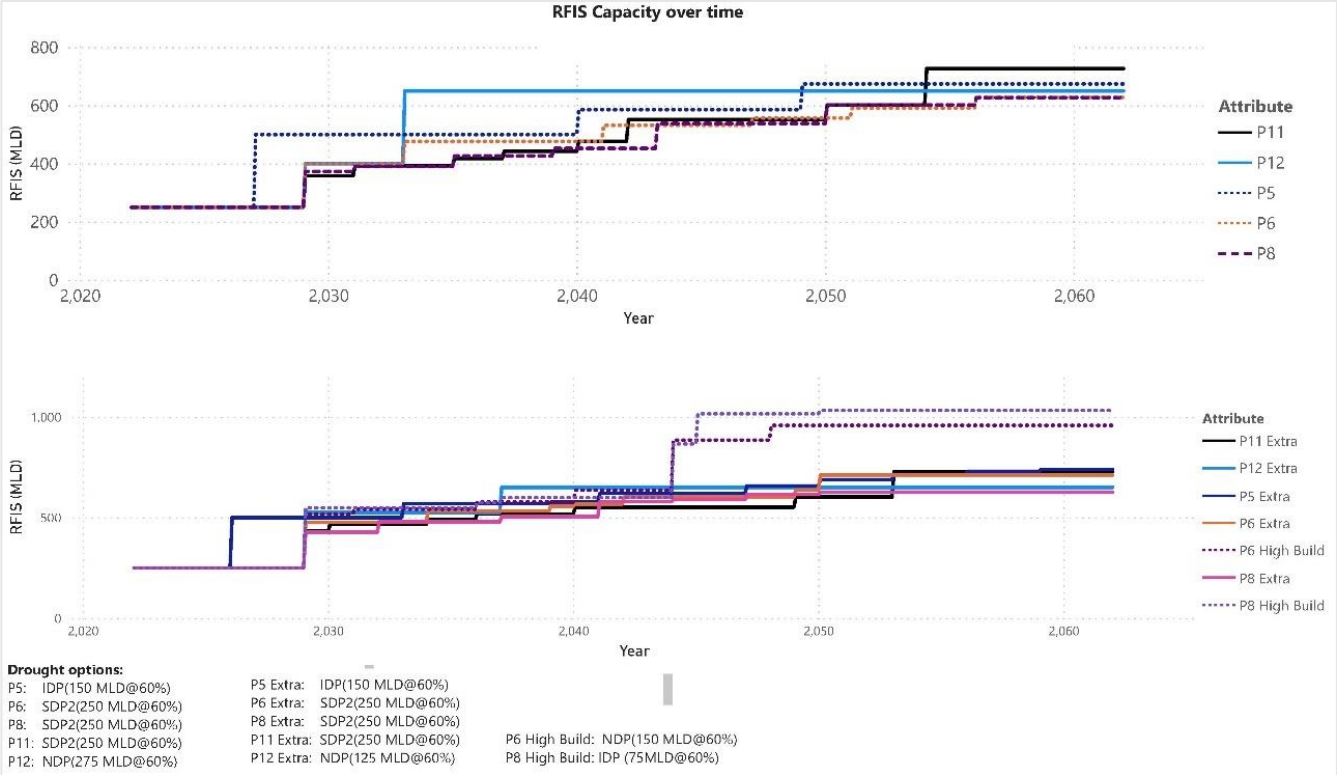
Drought risk analysis for SOBC is based on design drought framework. 1 in 100,000 droughts are selected as design droughts and 1 in 1,000,000 droughts are used as sensitivity analysis. A zero-inflow scenario is also modelled as a reference. 30-drought ensembles are used instead of one single drought to capture the temporal and spatial variation of droughts.

Rainfall independent supply

5 investment or infrastructure portfolios were assessed for a number of investment levels that result in different level of Rainfall Independent Supply (RFIS) capacity over time. These investment levels are:

- Minimum build: a subset of options was selected to meet "minimum build", that is the minimum yield required to meet demand increase. This level of service is designed to match demand and yield over time.
- Minimum build + Extra: a subset of options to selected to meet "minimum build", as well as additional build requirements to ensure yield stay approximately 30GL/a above demand.
- High build: a subset of options selected with the aim to supply Level 5 restricted demand only by RFIS at 2056.

The figure below shows the RFIS capacity and timing for when the options become available for production for the various portfolios for "Minimum Build" (top) and the "Extra" and "High Build" options.



Rainfall Independent Supply (RFIS) capacity over time for different portfolios and level of investment

Appendix C: 20-year capital expenditure forecast

PROJECTED CAPITAL EXPENDITURE ($M, $24-25)

Project/Program	Totals	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	FY41	FY42	FY43	FY44	FY45
Warragamba Dam Resilience	**966.4**	12.5	63.0	140.0	184.4	209.2	201.2	156.0													
Warragamba Dam Environmental Flow	**301.8**	11.8	104.1	106.7	79.1																
Asset Renewals	**1,823.3**	102.3	89.0	83.4	78.2	48.7	87.0	90.1	82.2	91.7	83.6	86.1	88.7	91.4	94.1	96.9	99.8	102.8	105.9	109.1	112.4
Greater Sydney - Dam Safety	**240.3**	12.9	21.4	20.2	11.3	8.5	7.0	4.1	13.0	6.5	5.0	10.1	9.3	8.8	15.6	14.2	15.9	15.7	11.7	14.8	14.3
Catchment Protection	**70.3**	4.3	4.4	4.4	3.1	3.3	2.2	2.7	2.3	2.3	3.2	3.3	3.4	3.5	3.6	3.7	3.9	4.0	4.1	4.2	4.3
Water Monitoring	**38.5**	1.6	1.6	1.5	1.5	1.6	3.1	1.6	1.5	1.8	1.8	1.8	1.9	1.9	2.0	2.0	2.1	2.2	2.2	2.3	2.4
ICT	**286.7**	15.6	14.1	10.5	6.2	7.0	15.0	13.5	13.1	13.7	13.9	14.3	14.7	15.2	15.6	16.1	16.6	17.1	17.6	18.1	18.7
Fleet and Property	**40.9**	1.9	1.8	2.7	2.7	2.1	1.4	1.4	1.5	1.5	1.9	1.9	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5
Integrated Water Resources Modelling	**31.0**	1.4	1.5	1.4	1.5	1.5	1.4	1.3	1.4	1.4	1.4	1.5	1.5	1.6	1.6	1.7	1.7	1.8	1.8	1.9	1.9
Drought Scenario: Avon Dam DWA	**450.0**				100	250	100														
TOTAL - BASELINE	**3,799.3**	**164.3**	**300.9**	**370.8**	**367.9**	**281.9**	**318.4**	**270.9**	**115.0**	**118.8**	**110.8**	**119.1**	**121.5**	**124.4**	**134.7**	**136.8**	**142.2**	**145.8**	**145.7**	**152.9**	**156.5**
TOTAL WITH DROUGHT INVESTMENT	4,249.3	164.3	300.9	370.8	467.9	531.9	418.4	270.9													

Appendix D: Acronyms

Acronym	Definition
ADWG	Australian Drinking Water Guidelines
AMS	Asset Management System
CoR	Chain of Responsibility
CRA	Comprehensive Risk Assessment
DARP	Drought Assets Response Plan
DSMS	Dam Safety Management System
DSNSW	Dams Safety NSW
DWS	Deep Water Access
DWPS	Deep Water Pumping Station
eflows	Environmental flows
ESG	Environmental, Social and Governance
FRWS	Fish River Water Scheme
FSL	Full Supply Level
FY	Financial year
GL	Giga Litres
GSDRP	Greater Sydney Drought Response Plan
GSWS	Greater Sydney Water Strategy
HEPS	Hydroelectric Power Station
ICT	Information and Communication Technology
INSW	Infrastructure New South Wales
IPART	Independent Pricing and Regulatory Tribunal
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organisation for Standardisation
LTCOP	Long Term Capital and Operational Plan
ML	Mega Litres

Acronym	Definition
NARCliM	NSW and Australian Regional Climate Modelling
NorBE	Neutral or Beneficial Effect
NSW DCCEEW	New South Wales Department of Climate Change, Energy, the Environment and Water
PMF	Probable Maximum Flood
PRA	Portfolio Risk Assessment
PRW	Purified Recycled Water
RBA	Reserve Bank of Australia
RCP	Representative Concentration Pathway
RFIS	Rainfall independent supply
RMP	Risk Management Plans
SASPOM	Source Water Protection Framework and the Special Area Strategic Plan of Management
SCADA	Supervisory Control and Data Acquisition
SFAIRP	So Far As Is Reasonably Practicable
WACC	Weighted average cost of capital
WFP	Water Filtration Plant
WRRF	Water Resource Recovery Facility
WSP	Water Sharing Plan

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Version no.	Version date	Author/s	Description
1.0	June 2023	P Amies L Castro G Begg	WaterNSW Board-endorsed Greater Sydney LTCOP; submitted to the Minster for Water
1.1	September 2024	L Castro	Minor updates to Version 1.0 to align cost forecasts (year 1 to 10) to the latest SCI and incorporate the latest information on major capital projects and programs

Approvals

Version no.	Name	Date
1.0	Fiona Smith – Executive Manager, Strategy and Performance	24 May 2023
	WaterNSW Board	30 May 2023
	Andrew George – Chief Executive Officer	31 May 2023
1.1	Fiona Smith – Executive Manager, Strategy and Performance	10 September 2024
	Ronan Magaharan – Executive Manager, Operations	15 September 2024