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Lachlan Valley Water Inc
ABN 38 597 032 631
Sustainable, productive and efficient water use in the Lachlan Valley

Submission to
Department of Planning and Environment

Lachlan Regional Water Strategy Consultation Paper

November 2023

[redacted]

SUBMISSION ON THE DRAFT NSW REGIONAL WATER STRATEGY

Executive Summary

The Strategy Consultation Paper is a very high-level document and doesn't present many tangible activities to mitigate flood and drought effects. It reads as a "plan for a plan". LVW is disappointed that our previous submission representing some 450 water licence holders in the Lachlan Valley wasn't considered to represent a diverse range of stakeholders, or be comprehensive or definitive. Given that the Department received 12 submissions in total, 5 social pinpoint fillable forms and had only 22 attendees to the webinars in round two, its' LVWs opinion that our submission should have been considered to represent a broad cross-section of the community and was both comprehensive and definitive. LVW is further concerned regarding the arbitrary nature in which the Department considers what stakeholder engagement/submissions are included/considered, and what arn't.

LVW questions why only Options 25, 34, 35, 39, and the Belubula Weir were subject to rapid and detailed quantitative assessments, when other options were subjected to the same assessments, such as updating the regulated structures would be far more costly, potentially cost prohibitive, and add little benefit to enhancing water security with the region. It appears that any option that would provide tangible water security or flood mitigation benefits has been purposely costed out. LVW strongly urges the Department to review inclusion of these options, engage with water users in the region to understand the benefit, and provide environmental impact studies of all options not shortlisted.

In relation to the protection of groundwater dependent ecosystems (GDE) it is essential to accurately verify the level of reliance of these ecosystems on groundwater, particularly in relation to deeper aquifers, and to identify whether groundwater extraction poses any risk to GDEs which is not already being managed by the existing WSP rules. Additionally, the Strategy should recognise that while the climate risk is based on a very dry future climate scenario, this may not materialise, and that the management strategy should be guided by actual climate data.

Groundwater management processes to handle compliance with long-term average annual extraction limits have already been implemented through Water Sharing Plans, and there has been good engagement between the Department and licence holders in developing these processes. In addition, we note that while some groundwater sources are 'over-allocated', the actual yearly use can vary significantly, the average annual use in most of these sources remains below the extraction limit, and there are rules already in place in the WSPs to manage compliance with extraction limits.

The previous Strategy recommended investigating the feasibility of managed aquifer recharge as a strategy, and that the technical, economic and environmental limitations must be considered. Managed aquifer recharge is an expensive process so LVW concurs this investigation needs to fully understand the aquifer system, and also factor in the demand for water and the ability of licence holders to pay for it.

1. Introduction

Lachlan Valley Water (LVW) welcomes the opportunity to make a submission on the Lachlan Regional Water Strategy Consultation Paper. Lachlan Valley Water is an industry organisation representing surface water and groundwater licence holders in the Lachlan and Belubula valleys. Membership of LVW is voluntary and our some 450 members represent all categories of licences except for those held by environmental water managers. While this submission is made on behalf of our members, individual members may also make their own submissions.

2. Overview

LVW recommends that Lachlan Regional Water Strategy reviews options that have not been shortlisted, and gauge them against a strategy that considers water security and flood mitigation, and re-list them for inclusion. The current consultation paper is hollow and presents little by way of strategy or tangible actions to provide better water security or flood mitigation. The Department lists its highest priority as building resilience to climate extremes, yet the 9 listed actions present nothing tangible that will have a direct impact on building resilience. The proposed actions are conceptual in nature, and essentially discuss improving relationships, reviewing existing models, and increasing knowledge/understanding. LVW is disappointment in the lack of beneficial actions proposed in the consultation document, and offers to work with the Department to explore beneficial and tangible actions.

LVW recommends that the Lachlan Regional Water Strategy considers the comprehensive groundwater management that is already in place, particularly in groundwater zones where there has been a high level of usage. The strategy needs to recognise that the water level management process must have flexibility appropriate to the different zones, in terms of the type of groundwater system, the actual usage and forecast increase in usage.

We recommend that greater face-to-face engagement with the community, and Water Access Licence holders, would assist with better input on the strategy.

3. Strategic Priorities

Priority 1 – Build community confidence and capacity through engagement, transparency and accountability

Action 1.1: Establish a governance framework to co-ordinate actions under Priority 1.
LVW supports this action but strongly argues that the governance framework must be much wider than simply with local government in order to effectively co-ordinate actions. We therefore recommend that licence holder representatives are also incorporated in this framework.

Action 1.2: Support councils to improve flood risk management in the Lachlan region.
LVW supports improved flood risk management however questions the validity of this action within the Lachlan Regional Water Strategy and requests that further detail on how this will be achieved is provided.

Action 1.3: Upgrade the existing hydrological models for the Lachlan to better represent river operations and drought contingency measures

LVW supports ongoing upgrades to the hydrological models and that the Source model will eventually replace the current IQQM model. However, in terms of factoring in new climate datasets, it must be recognised that the worst possible scenario may not occur, and therefore the management practices and drought contingency measures should be guided by actual climate data as it occurs rather than worst possible forecast data.

Action 1.4: Develop ongoing arrangements for participation of local Aboriginal people in water management.

LVW supports encouraging Aboriginal people being involved in water management, in accordance with the requirements under the Water Management Act 2000.

Action 1.5: Support groundwater use for towns and communities.

LVW supports this requirement. While exploring innovative licensing options for groundwater-based drought resilience, these processes must also recognise the existing long-term average annual extraction limits and avoid breaching them.

Action 1.6: Investigate water security for small and remote communities

Action 1.7: Investigate the need to further expand the regional water supply grid

Action 1.8: Improve the understanding and management of groundwater resources in the Lachlan region

A critical factor to Action 1.8 is that the Department should undertake a verification process to understand the actual level of dependence of ecosystems on groundwater. In many of the areas where there is "high probability to find high priority groundwater dependent ecosystems" are along existing rivers and creeks, especially in the southern half of NSW, so it is anticipated these ecosystems will also have significant dependence on surface water.

Consequently the extent of dependence of ecosystems on groundwater and the depth of the aquifer formations are important factors in assessing the potential impacts of groundwater usage on ecosystems, particularly in regard to deeper aquifers.

The methodology to identify GDE's should explain how the level of dependence on groundwater and the aquifer formations on which the GDEs may be dependent will be identified. LVW is concerned that this is a significant knowledge gap and agrees that Action 1.8 is essential to determine the degree of reliance of ecosystems on groundwater and to identify whether groundwater extraction poses any risk to a GDE which is not managed by the existing WSP rules.

Additionally, it should be recognised that existing Water Sharing Plans already contain rules requiring that a specified distance is maintained between water supply works and groundwater dependent ecosystems, groundwater dependent culturally significant areas and contamination sources.

Regarding managing impacts of extraction at a local level, we note that the assessment of applications for new bores is also more detailed and rigorous now than it was prior to the development of Water Sharing Plans, and the conditions applied on new bores are more stringent in relation to the bores being drilled consistent with bore quality standards, and that there are requirements for grout seals etc.

The previous draft Strategy stated that there were 24 groundwater sources where the number of shares for issued licences is significantly higher than the groundwater extraction limit. This is a result of previous policy implementation. We also note that average annual use in most of these sources remains below the extraction limit. For example, in the Upper Lachlan and Orange Basalt the actual extraction has not reached the compliance trigger, even during the severe drought conditions in 2018/19 and 2019/20. In the Upper Lachlan the average usage since the WSP commenced in 2012/13 has been 61% of the extraction limit. There are already rules in place to manage compliance with the extraction limits and these have been well communicated to licence holders.

Action 1.9: Better integrate strategic land and water planning
The overall approach with Regional Water Strategy has been to use one of the driest future climate scenarios for assessing climate risk. However, it should also be recognised that this worst possible scenario may not occur, and therefore the management strategy should acknowledge this and should also be guided by actual climate data as it occurs rather than worst possible forecast data. LVW considers it is essential that further review of the preliminary modelled results is required to more accurately understand the likely change in recharge.

Priority 2 – Ensure best use of water for the environment

Action 2.1: Reduce salinity and soil erosion in the upper Lachlan and Belubula
LVW concurs that improved land management to reduce sediment and salt transfer to waterways is important to underpin improved water quality.

Action 2.2: Protect and rehabilitate significant riparian and instream habitats in the regulated Lachlan River
LVW suggests that dredging/cleaning creeks systems in mid and lower Lachlan be investigated to more efficiently deliver water to water users, and more effectively deliver environmental water to wetlands in the lower Lachlan.

Action 2.3: Upgrade and automate existing reregulating structures in the mid and lower Lachlan
LVW is concerned over the potential significant cost to water users that upgrading regulating structures may produce. LVW questions why the cost analysis wasn't done as part of the rapid cost-benefit assessment. Our understanding that any upgrades will trigger the requirement to have fish-ladders installed which will add considerably to the costs. It's imperative that these costs be bourn by the Government, and not passed to water users. Torriganny, Woolshed, and Nerathong Weirs are privately owned and are not currently operated by WaterNSW due to safety concerns.

LVW suggests installation of a flow monitoring station at the Kaicatoo Bridge be considered to assist with flow management and efficient river operations.

Action 2.4: Mitigate the impact of water infrastructure and disruption of natural flows on native fish
In addition to this action, there should be additional fish monitoring undertaken to better understand the impacts on native fish. The Sustainable Rivers Audit 2.0 was last undertaken in 2008-2010, and LVW believes it is essential to have better, more up-to-date information on

native fish populations. To this extent LVW continues to fund a fish monitoring project in the mid-Lachlan to provide additional information on fish numbers and breeds.

It should also be acknowledged that raising the Wyangala Dam wall would have enabled a multi-level offtake to be installed which would have significantly mitigated cold water pollution.

Action 2.5: Evaluate the Lake Brewster water efficiency project.

Action 2.6: Support place-based initiatives to deliver cultural outcomes for Aboriginal people

Action 2.7: Support the development and implementation of the Lachlan Floodplain Management Plan and address floodplain structures.

Priority 3 – Support economic prosperity in a capped system

Action 3.1: Improve public access to climate information and water availability forecast

Action 3.2: Investigate water use in the Lachlan region
Action 3.3: Undertake a climate impacts study
Action 3.4: Support employment and business opportunities for Aboriginal people

Action 3.5: Support system water delivery efficiency measures
LVW supports this action, however is concerned by the disparity between this action, and the apparent reluctance to include actions such as the lower Lachlan efficiencies project and the new Weir in the Belubula were not shortlisted, both of which would have made water delivery more efficient and significantly reduce water loss through evaporation etc. LVW strongly believes both these options need to be reconsidered for inclusion.

Additional Comments

LVW supports improving the understanding and management of groundwater resources in the Lachlan region. While exploring innovative licensing options for groundwater-based drought resilience, these processes must also recognise the existing long-term average annual extraction limits and avoid breaching them.

The end strategy should acknowledge that groundwater management processes to handle compliance with long-term average annual extraction limits have already been implemented through Water Sharing Plans, and that this management has been undertaken by the Department through engagement with licence holders and is generally well accepted. These management processes require flexibility appropriate to the different regions in terms of the type of groundwater system and the actual and forecast usage.

In addition, the Department has already undertaken consultation with licence holders in localities where drawdown in some monitoring bores exceeds 30% of total available drawdown, in order to flag the future risk and potential restrictions on access if drawdown continues to increase. Therefore the end strategy should not simply assume that groundwater usage in sources where the issued shares exceed the extraction limit will

continue to increase, and LVW recommends that there must be a better understanding of what degree of risk there is that extraction will actually exceed the extraction limit.

The previous draft strategy recommends investigating the feasibility of managed aquifer recharge as a strategy. LVW agrees that the issues raised in the previous draft strategy regarding the technical, economic and environmental limitations must be considered. Managed aquifer recharge is an expensive process so the investigation will need to understand the aquifer system very well, and also factor in the demand for water and the ability of licence holders to pay for it before going down this track. It will be necessary to fully investigate the aquifer and identify the quality of the water injected, and to be able to ensure that if groundwater is injected into the aquifer it can be pumped out.

The priority for Groundwater actions in the Regional Water Strategy should focus on;

- defining the storage and drawdown characteristics of each aquifer, and then,
- aligning the carryover and annual use limits in each aquifer to these characteristics.
- an initial review of current knowledge of the aquifers may be able to conservatively expand on the current sets of carryover and annual use limits in each aquifer.

Surface water availability is very variable and could become more variable. That is, a future with regular sequences of very restricted or no surface water supply, between years of plenty. The dams moderate this variability to some extent but are unable to guarantee a secure supply.

The opportunity is to use the valley's significant amounts of groundwater storage capacity to build a secure water supply for a climate resilient valley by a Conjunctive use of surface and groundwater. That is, the coordinated use of surface water and ground water to secure long term water supplies for a resilient environment and community. This can be achieved by meeting most of the valley's water demands from surface water when it is available, allowing groundwater to recharge in these wet years, then increasing the proportion of demands supplied by groundwater as surface water is restricted. Some water users in the valley are already applying this strategy to secure water for their enterprises by accessing surface and GW in different years, and using the GW carryover rules to store and then access that groundwater.

This conjunctive use strategy needs to be controlled and supported by the water access rules in the Water Sharing Plans (WSP). The valley's Regulated WSP already has a number of elements to allow for this strategy, eg carryover, account limits and annual use limits, relevant to the size of the dam, water sharing plan limits of the valley and Basin Plan SDLs.

The Valley's Groundwater WSPs should also support these conjunctive use strategies to the extent of the sustainable diversion limits and the characteristics of the various aquifers. That is, the GW WSP limits on carryover and annual use limits should be informed by the various aquifers' ability to recharge in wet years, with reduced extractions (as licence holders carryover their access rights), and be safely drawn down towards sustainable levels in dry sequences. The method of determining the MDBA SDL compliance should also recognise the conjunctive use strategy.

The priority for Groundwater actions in the Lachlan Regional Water Strategy should focus on defining these characteristics of each aquifer (as well as the SDL and GW Dependant ecosystem constraints etc) and aligning the carryover and annual use limits to these

characteristics. An initial review of the current knowledge of the aquifers may be able to conservatively expand on the current sets of carryover and annual use limits. This conjunctive use strategy should also be available to towns and high value industries, so they too can carryover groundwater under-use in wet years by accessing surface water, so there is adequate groundwater in storage to access in dry sequences.

While LVW supports actions to better share and integrate groundwater information, we note that there have been improvements in this over the last few years with tools like the *Tracking groundwater extraction against groundwater limits* on the Department's website. LVW also supports actions to improve the understanding of groundwater resources, and upgrading models as required. We consider these actions will have community-wide benefit for towns, licence holders, Aboriginal communities, environment and industry.

Lower Lachlan Efficiency Measures. LVW supports the reconsideration for inclusion of the Lower Lachlan Efficiency Measures. These measures would provide an alternative water supply to stock and domestic users in the Lower Lachlan, improve water delivery in effluent creeks and reduce transmission losses associated with otherwise replenishment flows in the effluent creeks. This would be achieved through construction of a piped scheme to deliver water more efficiently to landholders (including stock and domestic users) along the Muggabah, Merrimajeel, Merrowie, Booberoi and Willandra Creeks.

LVW believes this option would significantly reduce water losses through evaporation and inefficient water delivery methods, and would significantly contribute to water security from one end of the Lachlan to the to other.

Belabula Weir. LVW supports the reconsideration for inclusion of the Belabula Weir project. The new weir would seek to improve system operations and reliability for water licence holders in the Belubula through the construction of a new 3 GL re-regulating weir on the Belubula River to allow for re-regulation of water released from Carcoar Dam.

Under "Limitations", the document mentions an additional High Security entitlement of 10,000ML. LVW questions where this number comes from and would like to understand if it's a result of Department policy (which can be changed, or exemptions applied for), or whether its an assumption based on the additional water stored as a result of the structure? If its an assumption, additional entitlement requests don't need to be approved. Either way, LVW believes this should be removed as a limitation and all other considerations based on this limitation be removed also.

LVW is also keen to understand what, if any, impacts there are on the available/consumptive pool for water users as a result of the Belubula Water Security Project.

Additional Projects & Strategies. LVW would welcome the opportunity to discuss in detail the additional options included in WaterNSW's '20 Year Infrastructure Options Study Rural Valley's – Summary Report" for inclusion in the Lachlan Regional Water Strategy. This document was produced in 2018. While some of these options have been considered, it is the opinion of LVW that all options need to be considered/reviewed, and we seek engagement with the Department to assist in the review.

Water Supply Infrastructure Options:

LOS Gap/Issue	Preferred Option	Preliminary Capital Cost ($ Million)
Water Availability	Raising Wyangala Dam by about 10 m	650
Delivery Efficiency in Mid Lachlan	Rationalise the Mid Lachlan effluent system by closing inefficient creeks	4
Delivery Efficiency in Lower Lachlan	Lower Lachlan pipe efficiency projects	32
Asset Availability (capacity)	Change size of outlet valves at Wyangala Dam	5.4

Water Security & Reliability Options:

Potential Options to Improve Water Availability	Preliminary Capital Cost* ($ Million)
Raising Wyangala Dam by 10 m	650
Constructing a pipeline between Carcoar Dam and Lake Rowlands	17
Raising the Lake Rowlands Dam on behalf of Central Tablelands Water for urban water supply	58
Constructing a new 700 GL dam at the Abercrombie site	1000
Re-regulating weir on the Belubula River at Cranky Rock	30
Constructing a new 700 GL dam at the Cranky Rock site	1001

Water Delivery Efficiency Improvement:

Potential Options to Improve Delivery Efficiency in Mid Lachlan	Preliminary Capital Cost* ($ Million)
Constructing new regulating stop-board structures at the entrance to Jemalong and Carrawobitty Creeks	42
Building a new weir upstream of the Jemalong and Carrawobitty Creeks	34
Building a new weir on the Lachlan to better control flows into the Island Creek system	44
Building a new pipeline from the Lachlan to service customers in Wallamundry and Wallaroi systems	93
Rationalise the Mid Lachlan effluent system by closing inefficient creeks	21
Rationalise the Mid Lachlan effluent system by closing inefficient creeks	4

Potential Options to Improve Delivery Efficiency in Lower Lachlan	Preliminary Capital Cost* ($ Million)
Divide the main lake at Cargelligo into three lakes	83
Decommissioning and fill the 'Sheet of Water' storage and add a bypass channel	171
Constructing re-regulating storage between Brewster Weir and Booligal	30
Lower Lachlan pipe efficiency projects	32

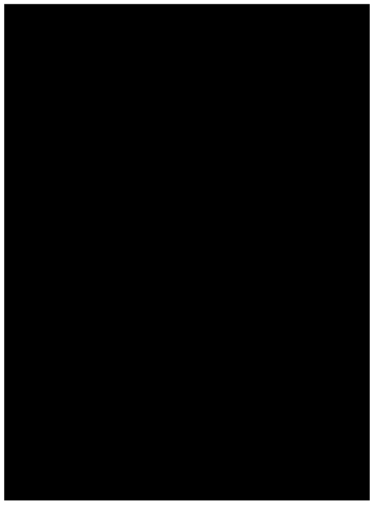
Asset Availability Improvement:

Potential Options to Mitigate Asset Capacity Constraint	Preliminary Capital Cost ($ Million)
Add an additional outlet valve at Wyangala Dam	9.2
Change size of outlet valves at Wyangala Dam	5.4

LVW would welcome the opportunity to review the above potential options with the Department, and understand the drivers for progression/exclusion. LVW would like to see a Regional Water Strategy the proposes tangible actions that provide better water security and flood mitigation.

Please feel free to contact me for further information on any of the issues in this submission.

Yours faithfully,



20 Year Infrastructure Options Study
Rural Valleys

Summary Report

WaterNSW 20 Year Infrastructure Options Study, Rural Valleys
Summary Report

Published by WaterNSW

June 2018

Disclaimer: The information contained in this publication is based on WaterNSW knowledge and understanding at the time of writing (June 2018) and should not be considered to be error free or to include all relevant information.

This options study is focussed on strategic level asset solution options. However, when making investment decisions WaterNSW also plans to consider operational and regulatory options. Cost estimates presented are for strategic level options comparison only. This options study will be further developed with appropriate customer consultation over the next two years.

Message from the CEO

Supplying two-thirds of all the water used in New South Wales (NSW), we are Australia's largest water supplier. From regional towns to Greater Sydney, it's our responsibility to ensure our customers and the communities we serve get the water they need – securely, reliably and efficiently. We also play a vital role during times of crisis, such as droughts or floods, supporting communities and the environment. It's a responsibility we take very seriously.

Our purpose is to improve the availability of water that is essential for water users and the communities throughout NSW. The population of NSW is projected to reach 11.2 million people in 2056* and we must take action to meet the challenges posed by the growing population.

A strategic bulk water supply infrastructure framework has been missing in NSW since the 1970s. This 20 Year Infrastructure Options Study aims to fill a void in long-term strategic planning and provides us with exciting opportunities to identify and address customer needs in rural areas and across town water supply, agriculture and environmental sectors.

This Options Study details the state's existing rural bulk water supply systems and provides a strategic level assessment of infrastructure solutions to mitigate or improve long-term level of service issues in the regulated valleys. This Options Study will continue to evolve over the next two years with appropriate customer consultation to inform future infrastructure planning and pricing submission processes.

We hope this Options Study will start a conversation with our customers and stakeholders about addressing today's opportunities, for the benefit of our future generations. Together, we can ensure we continue to improve upon the level of service we provide across all regions of NSW.

David Harris
Chief Executive Officer

* Source: Future State NSW 2056

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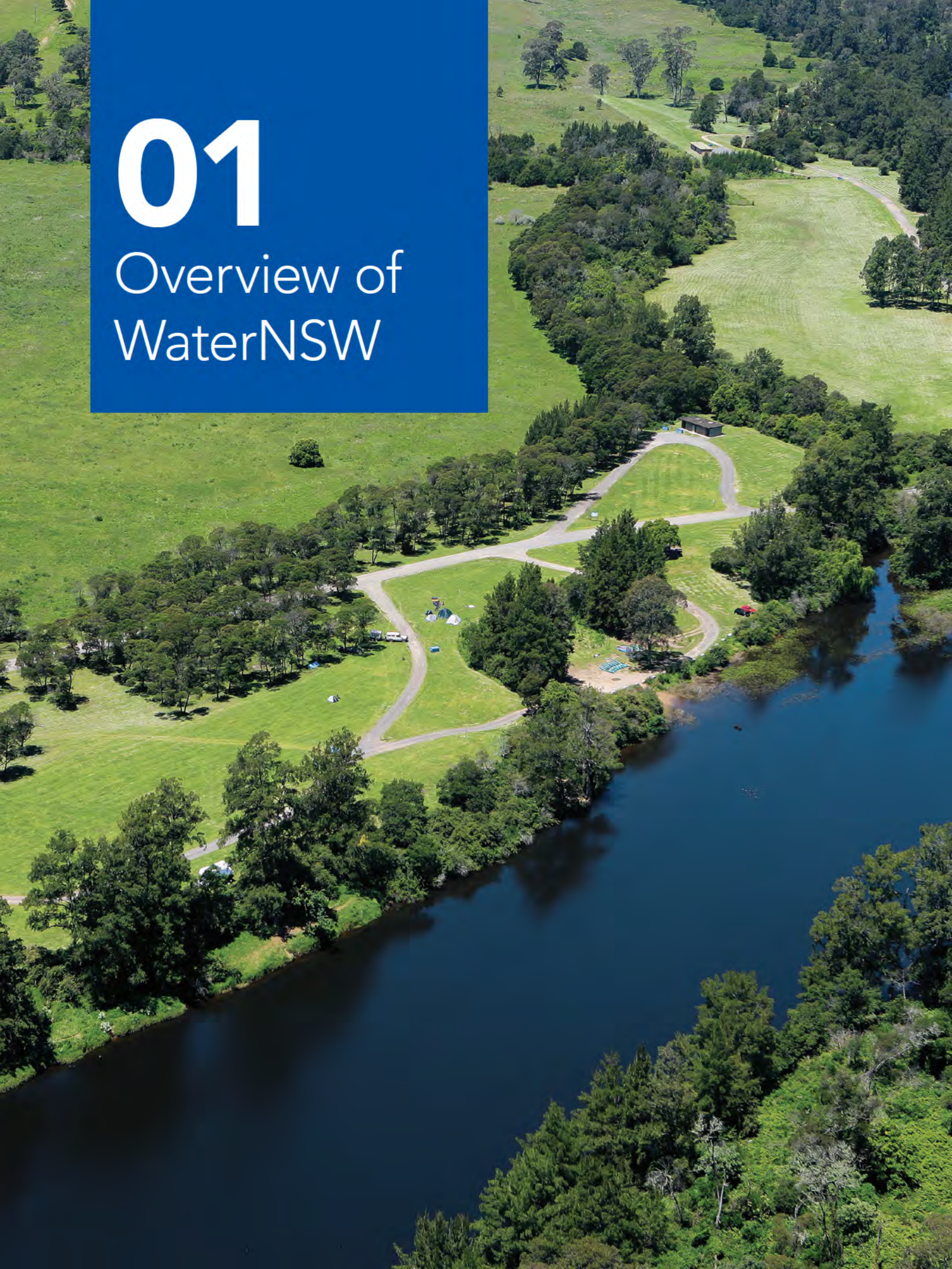


01 Overview of WaterNSW

WaterNSW is a State-Owned Corporation established under the *WaterNSW Act 2014* and operates under an operating licence issued and monitored by the Independent Pricing and Regulatory Tribunal (IPART).

We operate the state's rivers and water supply systems in accordance with the rules set out by regulators.

With more than 40 dams across the state, we supply two-thirds of water used in NSW to regional towns, irrigators, Sydney Water Corporation and local water utilities.

We also own and operate the largest surface and groundwater monitoring network in the southern hemisphere and build, maintain and operate essential infrastructure.

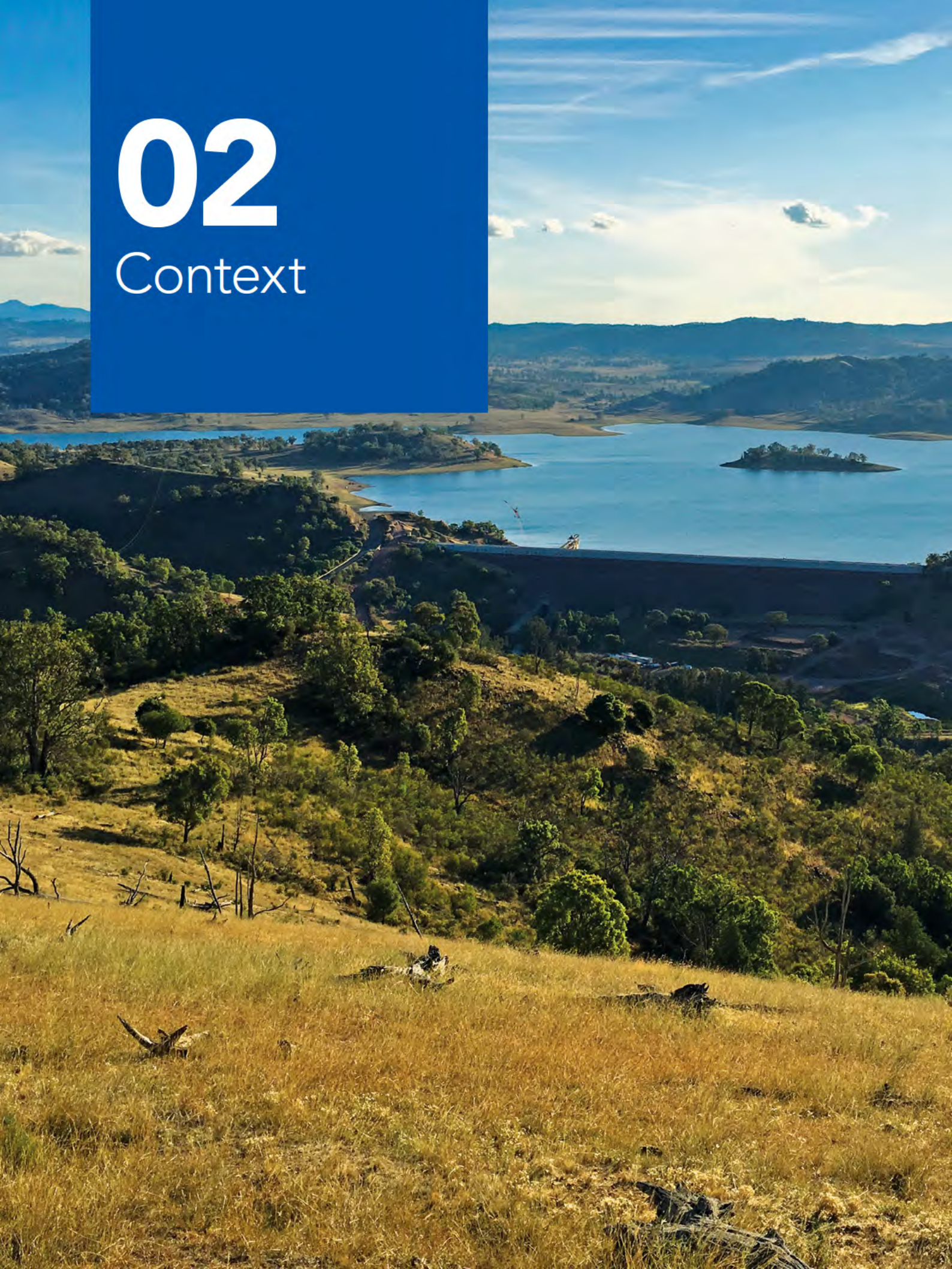
01 Overview of WaterNSW

WaterNSW's regulated valleys operational area are shown in the map below.

General performance of Murray-Darling Basin regulated valleys in relation to reliability of General Security (GS) releases at the end of the water year (% of time entitlement holders received their full allocation)

* Note: this incorporates reliability data collected after the volumetric allocation scheme commenced in Lower Darling.

02
Context



WaterNSW has developed a 20 Year Infrastructure Options Study (rural valleys) which provides a strategic level qualitative assessment of potential infrastructure options to meet long-term level of service (LOS) objectives in regulated river water supply areas across NSW (excluding Greater Sydney).

This Options Study identifies infrastructure options that were considered successful in qualitatively addressing our perceived LOS gaps within a valley. Should customers or government wish to explore the opportunities to close the identified LOS gaps, then we recommend the identified options be investigated in more detail.

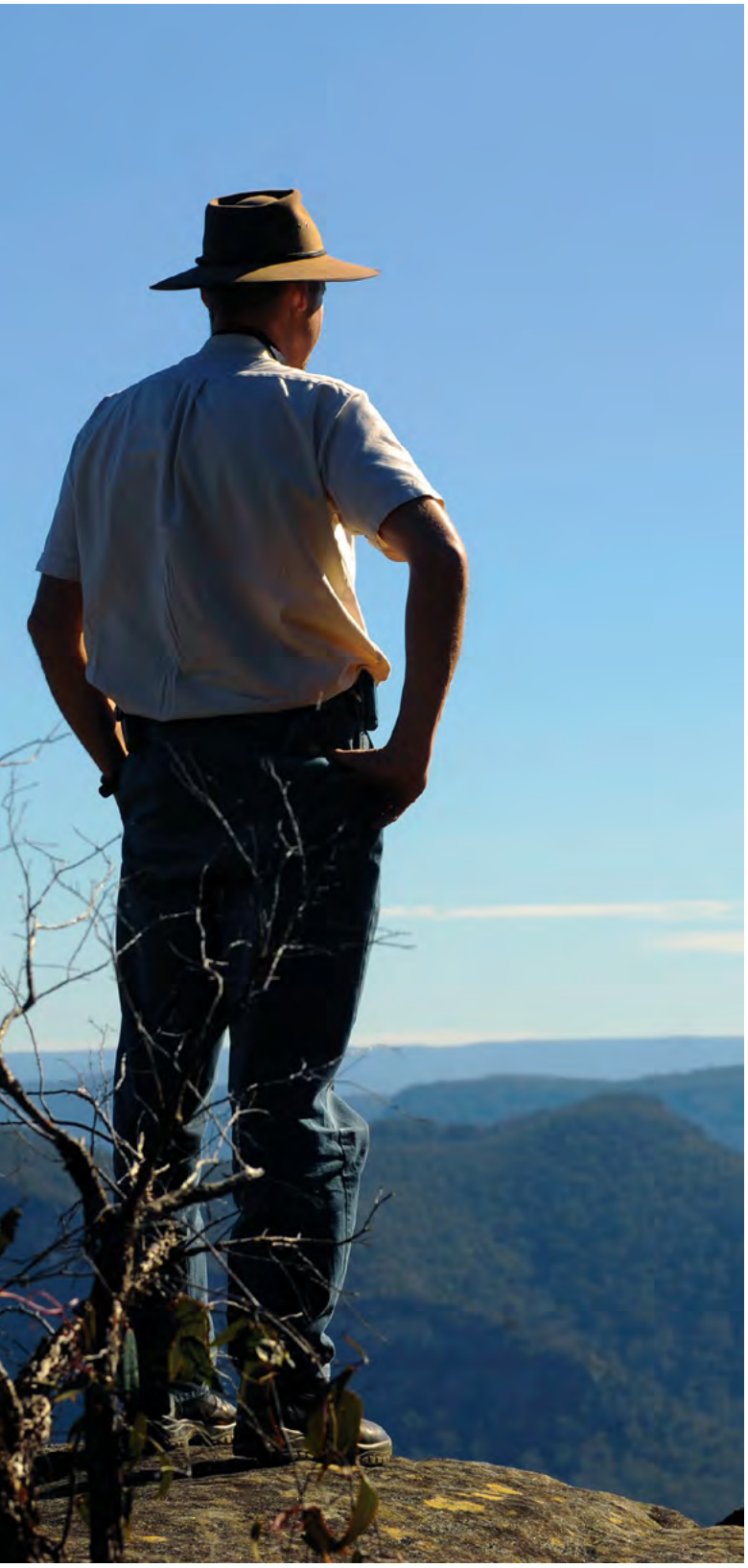
This Options Study will be further developed with appropriate customer input, technical assessment and cost-benefit analysis. Customers will be consulted about their long-term LOS priorities and the infrastructure options they will support to meet those needs.

The cost estimates presented in this document are strategic (pre-feasibility) level estimates, and so carry inherent uncertainty commensurate with the level of detail of this work. The cost estimates were prepared for options comparison only. The infrastructure sizes and costs will be further reviewed in future studies.

This Options Study is not a Capital Investment Plan for WaterNSW, but rather a baseline to guide future decision making and benchmark future investments.

It does not address the potential operational or regulatory options that need to be considered when making investment decisions. These options are being developed by WaterNSW in parallel and will come together prior to WaterNSW's 2021 rural price review.

02 Context



2.1 Overview

We work closely with our customers through a consultative process to inform LOS needs that may lead to the identification of future solutions and investment priorities.

The Infrastructure NSW 2014 State Infrastructure Strategy Update recommended that WaterNSW develop a best practice 20 year capital plan for bulk water supply. The purpose was to provide an evidence base for pricing applications going forward. Completion of this work satisfies the NSW Government's election commitment.

A strategic asset framework for bulk water supply systems in NSW has been missing since the 1970s. To fill this gap, WaterNSW has developed this Options Study to provide planning context for our long-term operation and future development of regulated bulk water supply infrastructure. Existing policies, regulatory requirements, asset capabilities and past and current system performance have been assessed and options developed to meet identified challenges.

The objectives of this Options Study are to:

1. Describe potential issues and opportunities facing our customers in regulated valleys (excluding Greater Sydney).
2. Understand customers' expectations and needs in terms of LOS.
3. Establish a benchmark of WaterNSW's future operational landscape.
4. Develop a robust strategic approach for WaterNSW infrastructure development to meet regulatory and customer LOS needs.
5. Identify strategic level asset options to address identified challenges and capture opportunities to improve service offerings and the long-term support of customers.

This report summarises the findings from more detailed work undertaken across each rural valley.

2.2 Regulatory Requirements

WaterNSW was established under the *WaterNSW Act 2014* as a State-Owned Corporation. WaterNSW operates within a regulatory context that includes key relationships with numerous regulators and organisations such as Department of Industries Water (DoI Water)*, DPI Fisheries, the Dams Safety Committee and the Murray-Darling Basin Authority (MDBA).

2.3 Level of Service (LOS) Framework

WaterNSW has developed a customer LOS framework to provide the basis for customer supported long-term water infrastructure plans. It incorporates nine parameters that will be used to quantify existing LOS and identify customer priorities.

The LOS concept is a way of presenting a customer's water supply as a series of delivery parameters that can be negotiated and adjusted in the broader context of customers' willingness to pay.

Conceptually, customers can dial up or down their desired LOS. Where there is a gap between what is provided and what is desired, WaterNSW will develop solutions to address the root cause or problem.

The LOS concept encourages greater transparency, both in developing a better understanding of customer needs and in quantifying costs to address them.

The identified LOS parameters are:

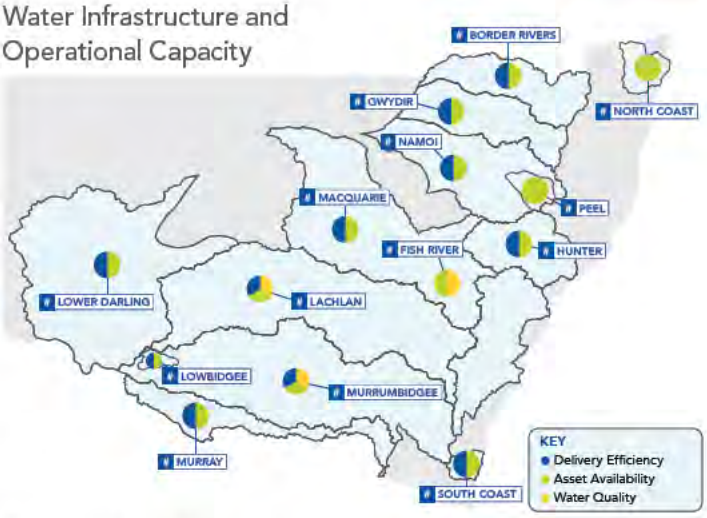
LOS Category	LOS Parameters		
Water Availability	Security of Supply	Reliability	Flow Utilisation
Infrastructure and Operational Capacity	Delivery Efficiency	Asset Availability	Water Quality
Community and Environmental Benefits	Environmental Services	Flood Mitigation	Recreational Amenity

Figure 1 highlights the current LOS issues identified across NSW regulated valleys (excluding Greater Sydney).

Figure 1: LOS Issues Identified in NSW Regulated Valleys

Water Availability

Water Infrastructure and Operational Capacity



Community and Environmental Benefits

* Formerly Department of Primary Industries (DPI) Water

03
Outcome

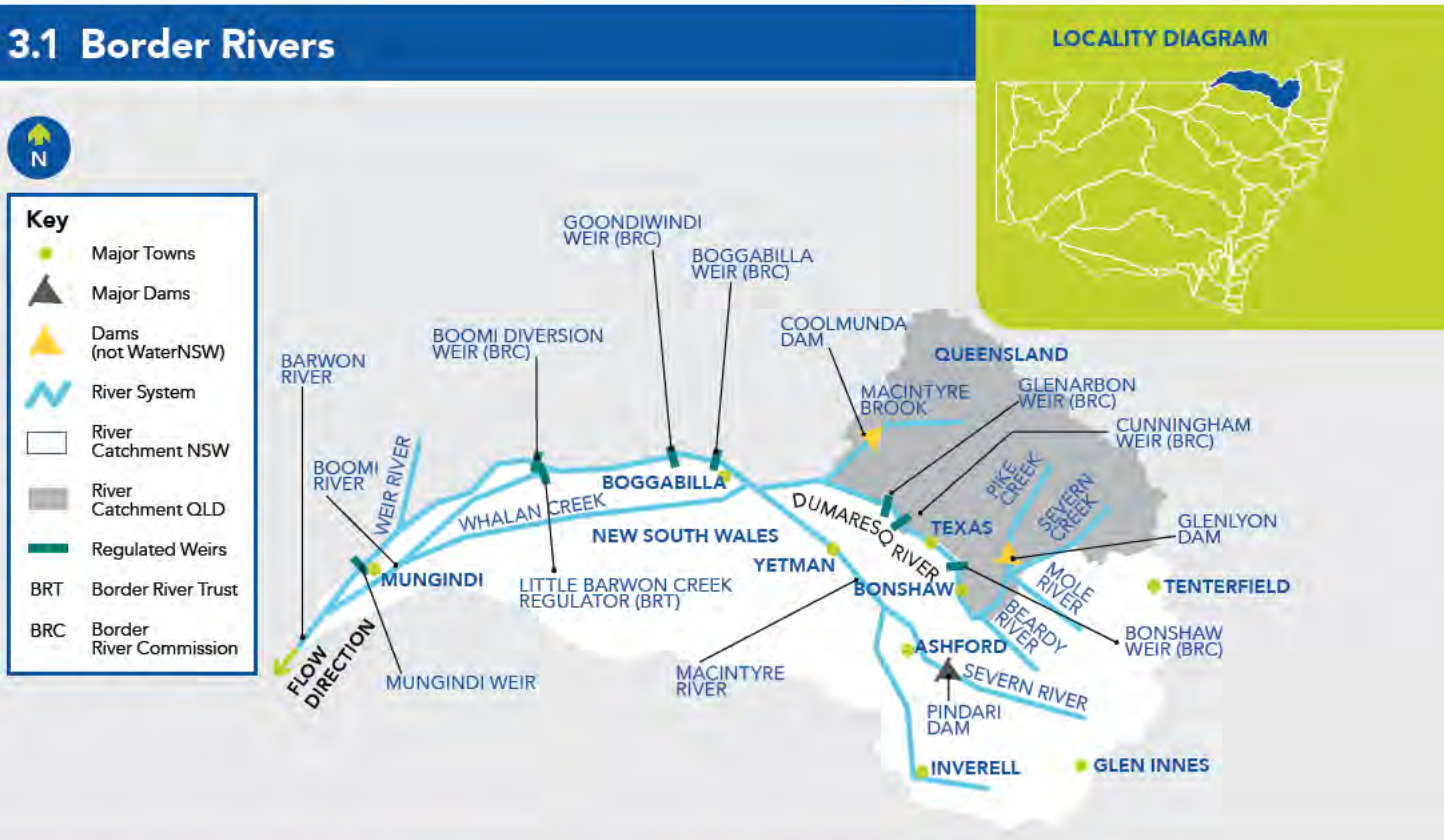
The 20 Year Infrastructure Options Study for rural valleys will:

1. Provide additional context for robust customer engagement, communication and consultation processes to optimise water supply LOS for each supply area.
2. Offer a guide on the long-term infrastructure decision making rationale for WaterNSW and other government agencies.
3. Deliver a rationale for WaterNSW and government decisions to coordinate long-term bulk water supply infrastructure investments that appropriately meet customer service needs.

More in-depth engineering analysis and hydrological modelling are needed to confirm the optimum asset locations, capacities, lifecycle costs and potential impacts (both positive and negative). The next edition of this study will identify the customer supported preferred options to mitigate long-term water supply issues in the valleys.

03 Outcome

3.1 Border Rivers



Water Resource and Catchment

The Border Rivers comprises the Macintyre River, Dumaresq River and part of the Barwon River, which constitute the border between NSW and Queensland (QLD) for approximately 470 km. The Border Rivers catchment covers approximately 49,500 km^2 in southern QLD and northern NSW. Glen Innes, Inverell, Tenterfield and Mungindi are the main town centres in NSW's section of the Border Rivers Catchment.

The Border Rivers are regulated by three dams – Glenlyon Dam on Pike Creek (254 GL*), Coolmunda Dam on Macintyre Brook (69 GL) and Pindari Dam on the Severn River (312 GL). NSW is supplied by Pindari Dam, a share of Glenlyon Dam, and tributary inflows.

The combined volume of on-farm storages in the Border Rivers is relatively high and estimated to be 155 GL and 300 GL in NSW and QLD, respectively.

The Border Rivers contributes about 5 per cent of the Murray-Darling Basin water.

Water Use/Customers

The Border Rivers system supplies water for irrigation, stock and domestic, town water supply and industrial purposes. Land use is predominately for cattle and sheep grazing. Dryland cropping mostly occurs on the slopes. Small-scale crops such as grapes, stone fruit, vegetables and apples are grown in the upland areas. On the western plains, 75 per cent of irrigated crops are cotton.

Water Supply Infrastructure Opportunities

This Options Study has identified a range of options that address the potential LOS gaps in the Border Rivers.

The following table is a summary of the preferred options under consideration.

* Gigaliter

LOS Gap/Issue	Preferred Option	Preliminary Capital Cost ($ Million)
Water Availability	New 100 GL dam on the Mole River	331
Asset Availability (capacity)	Glenlyon and Pindari Dams outlets upgrade – valves replacement	3.9
Delivery Efficiency	Augment end-of-system storage by raising Mungindi Weir (approx. by 5 m)	50

Water availability improvement

The Border Rivers is a large catchment. Its water supply is serviced by three relatively small dams and large on-farm storages that rely on access to unregulated flows (supplementary water access). A significant proportion of water taken by customers evaporates from these on-farm storages.

Long-term water availability is therefore a key issue facing the valley. Unreliable water supply could undermine agricultural productivity, and serve as a barrier to future investments that support the local economy and community.

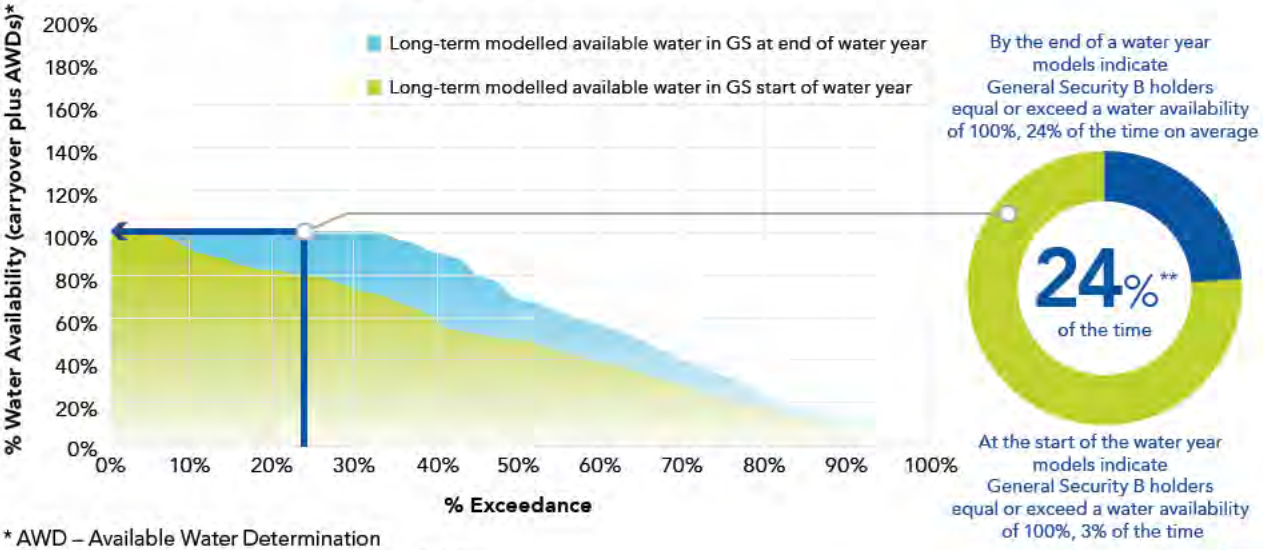
Hydrological data received from DoI Water for the Border Rivers indicates that under the current arrangements, General Security licence holders receive low reliability of supply as shown in Figure 2.

Long-term infrastructure options considered for further investigation to improve security and reliability of supply in the Border Rivers include:

Potential Options to Improve Water Availability	Preliminary Capital Cost ($ Million)
New 100 GL dam on the Mole River	331
Raise Pindari Dam FSL* by 5 m which could increase storage capacity to 450 GL	339
New 500 GL dam on the Severn River	1,342
New dam at Mingoola near the confluence of Mole River and Dumaresq River	183
Glenlyon Dam raising with flow diversion from Severn River to Pike Creek	300
Inland diversions from the east	975

* Full Supply Level

Figure 2: Border Rivers Reliability of General Security B Releases



* AWD – Available Water Determination

** Note: 33% of the time on average, 98% reliability.

03 Outcome

Asset availability (capacity) improvement

In 2013, the MDBA prepared a report outlining the preliminary overview of constraints to environmental water delivery in the Murray-Darling Basin. It identified the release capacities of Pindari and Glenlyon Dams as "second order" constraints to the efficient delivery of environmental flows to the lower Border Rivers during specific flow and climatic conditions. The study indicated that the ability of the dams to satisfy both environmental and irrigation requirements may impede environmental water delivery when the volume of water in storage is relatively low.

Options identified to improve release capacity at Glenlyon and Pindari Dams include:

Potential Options to Mitigate Asset Capacity Constraint	Preliminary Capital Cost ($ Million)
Glenlyon Dam outlet upgrade – valve replacement	2.0
Glenlyon Dam outlet upgrade – installation of additional valve	8.2
Pindari Dam outlet upgrade – valve replacement	1.9
Pindari Dam outlet upgrade – installation of additional valve	8.2
Glenlyon and Pindari Dams outlets upgrade – valves replacement	3.9
Glenlyon and Pindari Dams outlets upgrade – installation of additional valves	15.6

Note: Glenlyon Dam is owned by the Border Rivers Commission

Improvement to delivery efficiency and timeliness of water delivery

There is a potential storage shortage in the middle and bottom sections of the regulated system, impacting overall efficiency and timeliness of delivery. Currently, on average it takes approximately five days to deliver water from Glenlyon Dam to Boggabilla and a further 11 to 13 days to reach Mungindi. Consequently, large volumes of water are released from the dams to account for conveyance losses that occur along the way.

Cross boundary flows through existing breakout structures were also identified as key contributors to in-system losses.

Options considered for further investigation to improve delivery efficiency include:

Potential Options to Improve Delivery Efficiency	Preliminary Capital Cost ($ Million)
New off-stream storage at Boomi	296
New off-stream storage at Mungindi	313
Piped supply to the unregulated Boomi River	591
Raise Mungindi Weir (approx. by 5m)	50
New off-stream storage at Boomi and Mungindi	609

3.2 Gwydir

Water Resource and Catchment

The Gwydir River System is located in northern NSW and is part of the Murray-Darling Basin which covers an area of 26,600 km^2.

The Gwydir River System is regulated by Copeton Dam (1,364 GL). Horton River is the main tributary downstream of Copeton Dam.

The Gwydir River System contributes about 2 per cent of the Murray-Darling Basin water.

Bingara, Gravesend and Moree are the main town centres in this valley.

Water Use/Customers

The Gwydir River System supplies water for irrigation, stock and domestic, town water supply and industrial purposes. The dam also provides environmental flows to the Gwydir Wetlands near Moree and irrigation and environmental flows for hydroelectric power generation (21 MW).

Water Supply Infrastructure Opportunities

This Options Study has identified a range of options that address the LOS gaps for the Gwydir Valley.

The following table is a summary of the preferred options under consideration.

03 Outcome

LOS Gap/Issue	Preferred Option	Preliminary Capital Cost ($ Million)
Water Availability and Delivery Efficiency	A new 350 GL Horton Dam on the Horton River	937
Asset Availability (capacity)	Increase bottom width of Lower Gwydir River from north bank and increase the size of the Tyreel regulator	171

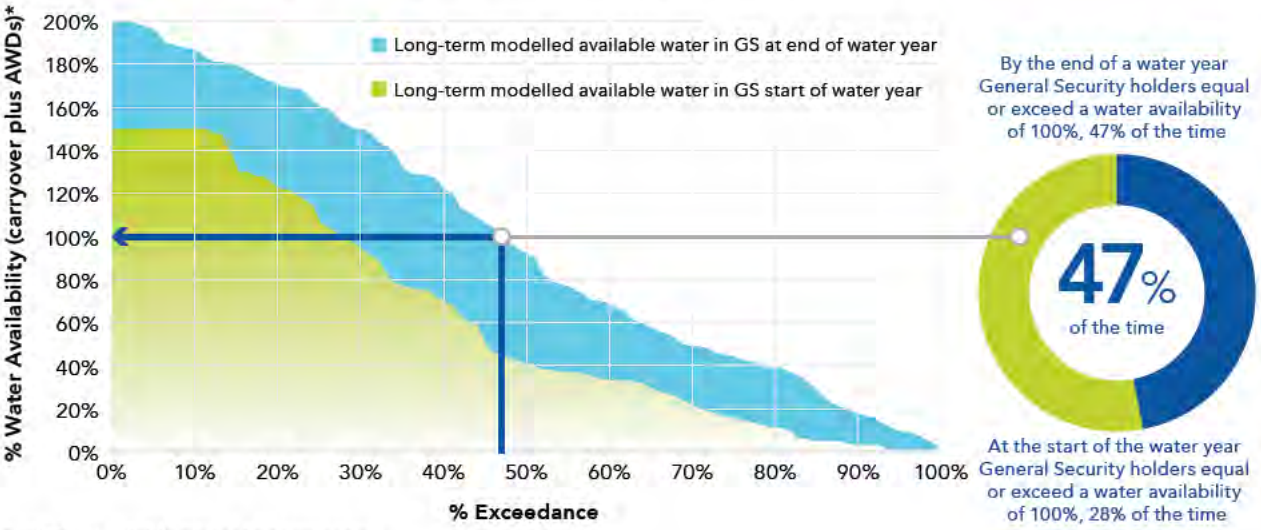
Reliability of supply and delivery efficiency improvement

Irrigation customers downstream of Copeton Dam experience low reliability for general security, due to the limited regulating capacity of the valley. Customers have continued to demand higher water utilisation, which with the current infrastructure, can only be delivered with low reliability.

On-farm storages developed over the last 20 years in the Gwydir Valley produce high evaporative water losses.

Hydrological data received from DoI Water for the Gwydir Valley, confirms that under the current arrangements, Gwydir General Security licence holders receive low reliability of supply (refer Figure 3).

Figure 3: Gwydir Valley Reliability of General Security Releases



* AWD – Available Water Determination

Long-term infrastructure options considered for further investigation to improve reliability of supply and delivery efficiency in Gwydir Valley include:

Potential Options to Improve Reliability of Supply and Delivery Efficiency	Preliminary Capital Cost ($ Million)
A new 500 GL Lower Gravesend Dam on the Gwydir River downstream of Warialda Creek	1,073
A new 500 GL Upper Gravesend Dam on the Gwydir River upstream of Warialda Creek	1,066
A new 350 GL Horton Dam on the Horton River	937
A new 700 GL Bingara Dam on the Gwydir River	1,002
Inland diversion (from Aberfoyle River to Happy Valley Creek in the Gwydir Basin)	1,794
Re-regulating structure at Biniguy with transmission channel to Tareelaroi Weir	388
Biniguy underground dam	79
Biniguy underground dam and transmission conduit to Tareelaroi Weir	1,290
Biniguy underground dam and weir and transmission channel to Tareelaroi Weir	429
A new 250 GL off-stream storage including weir and transmission channel	1,282

Asset availability (capacity) improvement

The limitation to supply for the Lower Gwydir irrigation area is a major issue for the Gwydir Valley system. Supply comes from the Lower Gwydir River and effluent streams, but over the years considerable agricultural land development has occurred at the lower end of the valley. This has led to constraints between Tyreel regulator and Brageen station.

To avoid this asset availability constraint the following infrastructure option has been considered:

Potential Options to Mitigate Asset Capacity Constraint	Preliminary Capital Cost ($ Million)
Increasing bottom width of Lower Gwydir River from north bank and increase the size of the Tyreel regulator	171

DID YOU KNOW?

The construction of Copeton Dam began in 1968 and finished in 1973 with a storage capacity of 863 GL. Construction work on nine radial gates in the spillway was completed in 1976, increasing storage to its current capacity of 1,364 GL.

03 Outcome

3.3 Namoi

Water Resource and Catchment

The Namoi Valley catchment covers a total area of approximately 42,000 km^2. The Namoi is one of the Murray-Darling Basin's major NSW sub-catchments.

The Namoi River System is a major tributary of the Darling River in inland NSW. The headwaters of the Namoi, including the Macdonald River, the Peel River, the Cockburn River and the Manilla River, rise on the western slopes of the Great Dividing Range on the Northern Tablelands of NSW. Other smaller tributaries include Cobrabald River, Coxs Creek, Maules Creek, Mooki River and Bundock Creek.

The Namoi River System is regulated by two major dams: Split Rock Dam (397 GL) and Keepit Dam (423 GL).

This system contributes about 2.6 per cent of the Murray-Darling Basin water.

Water Use/Customers

The Namoi Valley provides water to major industries such as cotton, livestock production, grain and hay, poultry, horticulture and forestry. The region's local councils also depend on the Namoi to meet the water requirements of urban centres such as Gunnedah and Narrabri.

The catchment supports a wide range of aquatic habitats including large areas of wetlands associated with anabranches and billabongs downstream of Narrabri. However, unlike other valleys in the Northern Basin, there are few lakes or expansive wetlands in the Namoi.

Water Supply Infrastructure Opportunities

This Options Study has identified a range of options that address the LOS gaps for the Namoi Valley.

The following is a summary of the preferred options under consideration.

LOS Gap/Issue	Preferred Option	Preliminary Capital Cost ($ Million)
Water Availability	New Blue Hole Weir and pipeline to Split Rock Dam	235
Asset Availability (capacity)	Keepit Dam – increase size of one outlet works valve	2.3
Delivery Efficiency downstream of Keepit Dam	Transfer pipeline to Boggabri/Maules Creek coal mines	178
Delivery Efficiency in Lower Namoi	Mollee Weir raising	77
Delivery Efficiency in Gunidgera Creek	Gunidgera Creek channel desilting	57
Delivery Efficiency in Pian Creek	Dempsey Bridge to the end of Pian Creek (near Walgett Weir) open canal	87
Delivery Efficiency for Environmental Water	Computer Aided River Management (CARM) for Namoi valley	12

03 Outcome

Water availability improvement

Unlike the Southern Basin, the northern parts of the Murray-Darling are characterised by much lower relief topography, a drier climate with irregular summer dominant rainfall and higher levels of evaporation within a region that is relatively less regulated.

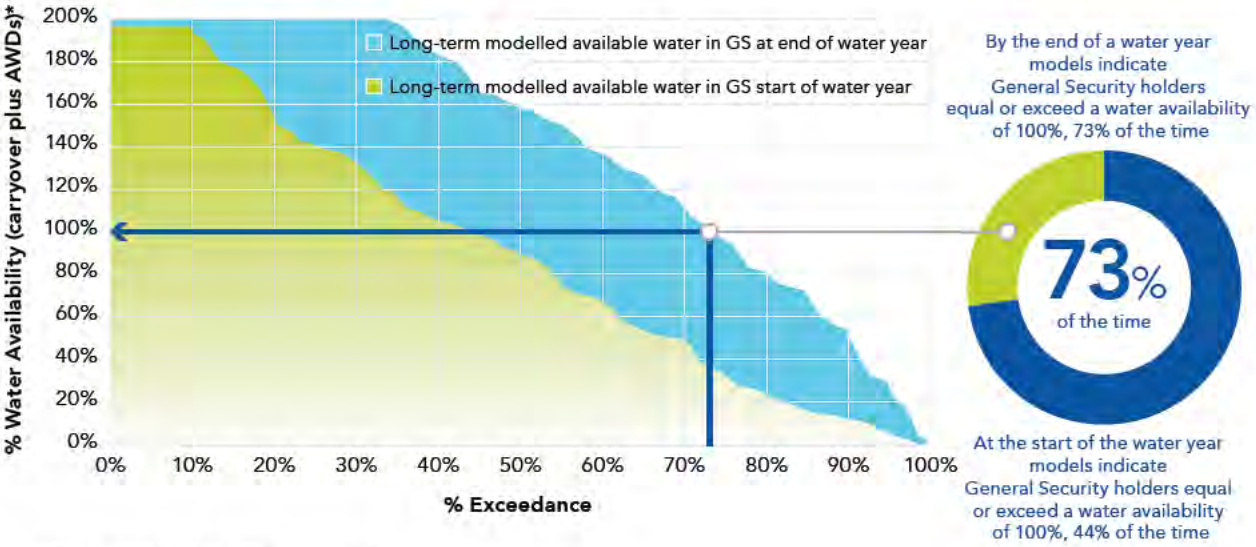
Hydrological data received from DoI Water for the Namoi Valley confirms that under the current arrangements, Namoi Valley General Security licence holders have the opportunity to improve their reliability of supply as shown in Figure 4.

Water availability was considered one of the key issues in the Namoi Valley, as a result options to improve the region's reliability of supply have been developed.

Options considered feasible for improving water availability, including reliability, security of supply, and flow utilisation within the Upper and Lower Namoi system include:

Potential Options to Improve Water Availability	Preliminary Capital Cost ($ Million)
New 360 GL Blue Hole Dam	1,331
New Blue Hole Weir and pipeline to Split Rock Dam	235
Large-scale inland diversion from Macleay River	2,365
Small-scale inland diversion from Macleay River	895

Figure 4: Namoi Valley Water Reliability of General Security Release



* AWD – Available Water Determination

Asset availability (capacity) improvement

In 2013, the MDBA prepared a report outlining the preliminary overview of constraints to environmental water delivery in the Murray-Darling Basin. These were identified as:

- release capacity of Keepit Dam
- bulk water transfer rate from Split Rock to Keepit Dam, and
- the ability to time releases with unregulated inflows from downstream tributaries.

These constraints can impede the delivery of environmental flows at the end of the Namoi system.

Potential infrastructure options include:

Potential Options to Mitigate Asset Capacity Constraints	Preliminary Capital Cost ($ Million)
Keepit Dam – new outlet works valve chamber and one new valve	8.5
Keepit Dam – new outlet works valve chamber and two new valves	9.7
Keepit Dam – increase size of one outlet works valve	2.3
Keepit Dam – new valve system with branch from hydro-power penstock	3.4

Delivery efficiency and reliability improvement

There is a potential shortage of re-regulation storage capacity in the middle of the Lower Namoi regulated system. When combined with the high transmission losses (up to 80 per cent of releases) downstream of Keepit Dam to Boggabri and along the Gunidgera and Pian creek systems, overall efficiency is reduced.

Downstream of Keepit Dam

Large transmission losses are experienced when Keepit Dam releases water to major coal mining customers within the Maules Creek and Boggabri areas of the Lower Namoi. Losses into the highly interactive groundwater system between Keepit and Boggabri Dams can be high relative to dam release volumes.

The following long-term infrastructure options will be investigated to improve delivery efficiency and reliability downstream of Keepit Dam:

Potential Options to Improve Delivery Efficiency in Downstream of Keepit Dam	Preliminary Capital Cost ($ Million)
Transfer pipeline to Boggabri/ Maules Creek coal mines	178
Transfer open channel to Boggabri/ Maules Creek coal mines	354
Two sub-surface dams north of Boggabri to service Boggabri/ Maules Creek coal mine	188
Re-regulation weir north of Boggabri plus two underground dams	236

03 Outcome

Lower Namoi

Some issues have been identified with regard to the Lower Namoi River system's reliability and the ability to capture, store and utilise major tributary flows. Capturing these major downstream tributary flows has the potential to increase system reliability by reducing the reliance on releases from Keepit Dam.

The following long-term potential infrastructure option has been considered for improving delivery efficiency and reliability in Lower Namoi:

Potential Option to Improve Delivery Efficiency in Lower Namoi	Preliminary Capital Cost ($ Million)
Mollee Weir raising	77

Gunidgera Creek

A series of channel capacity constraints exist downstream of Gunidgera regulator which limit the delivery of supplementary and other water demand in years of high Available Water Determinations (AWD).

The following long-term potential infrastructure options have been considered to improve delivery efficiency through Gunidgera Creek:

Potential Options to Improve Delivery Efficiency in Gunidgera Creek	Preliminary Capital Cost ($ Million)
Channel widening downstream of Gunidgera regulator	130
Gunidgera Creek channel desilting	57

Pian Creek

There is a delivery efficiency issue in Pian Creek. High transmission losses are experienced when delivering supplies to both stock and domestic and regulated customers. There is also an unmet requirement for provision of replenishment environmental flows to the unregulated section twice per annum.

The following long-term potential infrastructure options have been considered for improving end of system flow delivery efficiency through Pian Creek:

Potential Options to Improve Delivery Efficiency in Pian Creek	Preliminary Capital Cost ($ Million)
Dempsey Bridge to the end of Pian Creek (near Walgett Weir) transfer pipeline	112
Dempsey Bridge to the end of Pian Creek (near Walgett Weir) open canal	87

Improve environmental water delivery efficiency

Namoi Valley Operational Model is part of a Northern Computer Aided River Management (CARM) project. It will enable more precise and efficient delivery of water for environmental outcomes and to overcome operational and channel constraints.

Northern CARM will assist when scheduling storage releases and customer access, enabling optimal synchronisation with tributary flows for successful environmental water delivery.

Potential Option to Improve Environmental Water Delivery Efficiency	Preliminary Capital Cost ($ Million)
CARM operational efficiency project for Namoi Valley	12

3.4 Peel

Water Resource and Catchment

The Peel River is a major regulated tributary to the Peel Valley with a catchment area of around 4,700 km^2.

The Peel River is regulated by Chaffey Dam (100 GL). The Peel River contributes about 1.2 per cent of the Murray-Darling Basin water.

The valley also includes a small dam (Dungowan Dam (6.3 GL) and pipeline owned and operated by Tamworth Regional Council.

Water Use/Customers

The Peel Valley provides water for irrigation as well as supplementing water supply for the city of Tamworth.

Town bulk water supplied from Chaffey Dam releases down the Peel River in addition to Dungowan Dam and pipeline. Dungowan Dam supplies water directly through the transfer pipeline to Calala Lane water treatment plant for potable supply distribution.

03 Outcome

Water Supply Infrastructure Opportunities

This Options Study has identified a range of options that address the LOS gaps for the Peel Valley.

The following table is a summary of the preferred option under consideration.

LOS Gap/Issue	Preferred Option	Preliminary Capital Cost ($ Million)
Water Availability	New Dungowan Dam (22.5 GL) and augment supply pipeline	484

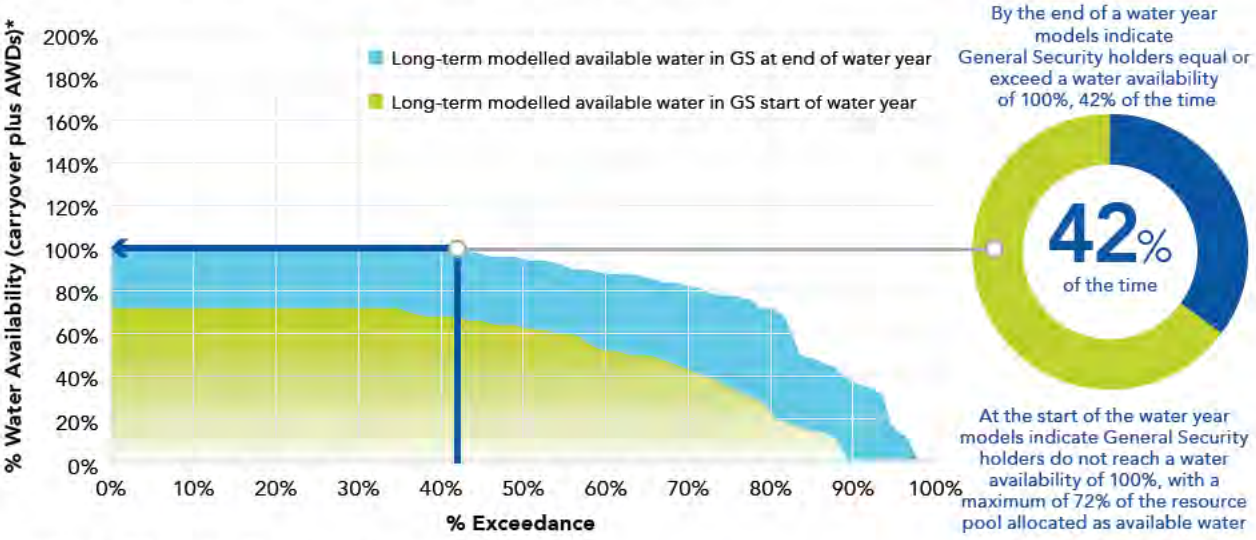
Water availability improvement

The allowable Long Term Annual Average Extraction Limit (LTAAEL) under the Water Sharing Plan is the major issue in the Peel. Of the 15,100 ML/annum allowance, only a maximum of 6,500 ML/annum is available (if storages are full) for general security water users.

Growth in Tamworth's need for water supply will come at the expense of reliability of general security releases in the Peel. This will eventually impact supplementary water availability and general security licences reliability in the Namoi.

Hydrological data received from DoI Water for the Peel Valley confirms that under the current arrangements, Peel Valley General Security licence holders receive low reliability of supply as shown in Figure 5.

Figure 5: Peel Valley Reliability of General Security Releases



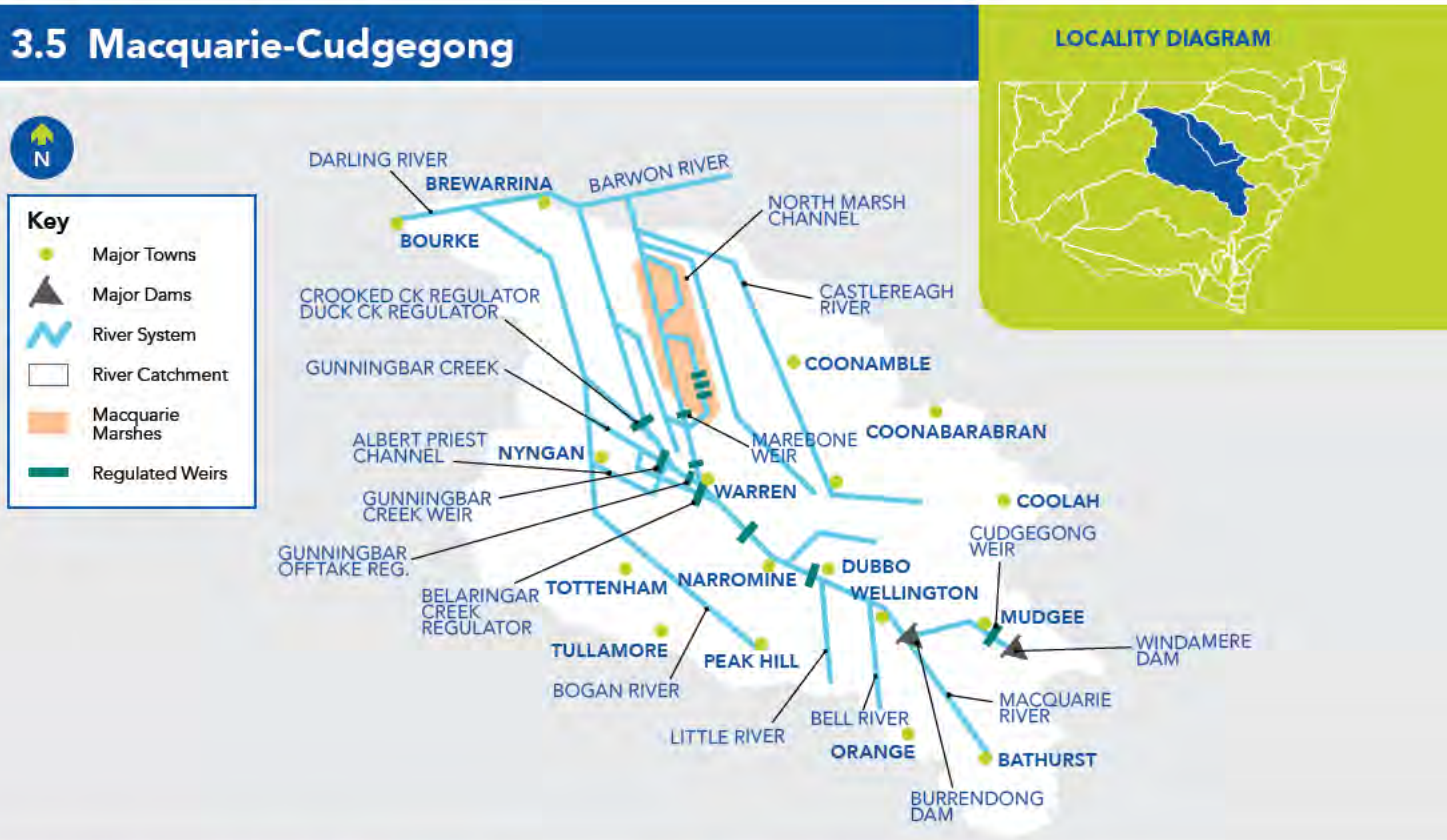
* AWD – Available Water Determination

Potential long-term infrastructure options considered for further investigation to improve water availability in the Peel Valley include:

Potential Options to Improve Water Availability	Preliminary Capital Cost ($ Million)
New Dungowan Dam (22.5 GL) and augment supply pipeline	484
New Dungowan Dam (40 GL) and augment supply pipeline	526
New Dungowan Dam (60 GL) and augment supply pipeline	569
Chaffey networked with new Dungowan Dam (22.5 GL) and augment supply pipeline	567
Chaffey networked with new 40 GL Dungowan Dam and augment supply pipeline	610
Chaffey networked with new 60 GL Dungowan Dam and augment supply pipeline	655
Chaffey Dam second augmentation (180 GL)	215
Chaffey Dam second augmentation (120GL)	143
Keepit to Tamworth pipeline with Keepit Dam [Namoi yield] augmentation	779
Keepit to Tamworth pipeline	128
Inter-Basin Transfer from Barnard river to Peel upstream of Chaffey Dam	756
10 GL off-river storage upstream of Tamworth town	187
Split Rock Dam transfer pipeline	141
Small scale inter-basin transfer from Apsley	3,306

03 Outcome

3.5 Macquarie-Cudgegong



Water Resource and Catchment

The Macquarie-Cudgegong Valley occupies an area of approximately 91,960 km^2.

The Macquarie River is a main tributary of the Darling River in inland NSW. Major tributaries along the Macquarie River include the Cudgegong River, the Talbrager River, the Little River, the Bell River and the Fish River. The Bogan River is an unregulated river that flows parallel to the Macquarie River and joins Barwon River downstream of Brewarrina. In lower areas of the Macquarie River, there are a series of effluent creeks that break away from the Macquarie River and join with the Bogan River.

The system is regulated by two major dams: Windamere Dam (368 GL) and Burrendong Dam(1,190 GL).

The Macquarie-Cudgegong River System contributes about 11 per cent of the Murray-Darling Basin water.

Water Use/Customers

The system supports a variety of industries includingagriculture, tourism and mining. The major agricultural activity in the catchment is cotton production. Other significant crops include wheat, vegetables and oilseed.

Most of the major cities and towns rely on rivers in the catchment for their water supply including:

- Upstream of Burrendong Dam: Bathurst, Orange and Oberon Orange
- Downstream of Burrendong Dam: Wellington, Dubbo, Warren, Nyngan and Cobar
- Downstream of Windamere Dam: Mudgee and Gulgong.

The dams also provide environmental flows to significant sites such as the Macquarie Marshes.

Water Supply Infrastructure Opportunities

This Options Study has identified a range of options that address the LOS gaps for the Macquarie-Cudgegong Valley.

The following table is a summary of the preferred options under consideration.

LOS Gap/Issue	Preferred Option	Preliminary Capital Cost ($ Million)
Water Availability	Change Burrendong Dam full supply level by improving flood mitigation zone management	-
Delivery Efficiency	A new re-regulating weir on the Macquarie River upstream of Gin Gin	36

03 Outcome

Water availability improvement (including supply security and reliability)

Improved security and reliability of the water supply are required to provide greater long-term sustainability in the Macquarie-Cudgegong Valley.

Hydrological data received from DoI Water for the valley confirms that under the current arrangements, Macquarie-Cudgegong Valley General Security licence holders receive low reliability of supply as shown in Figure 6.

Potential long-term infrastructure options considered for further investigation to improve water supply security and reliability include:

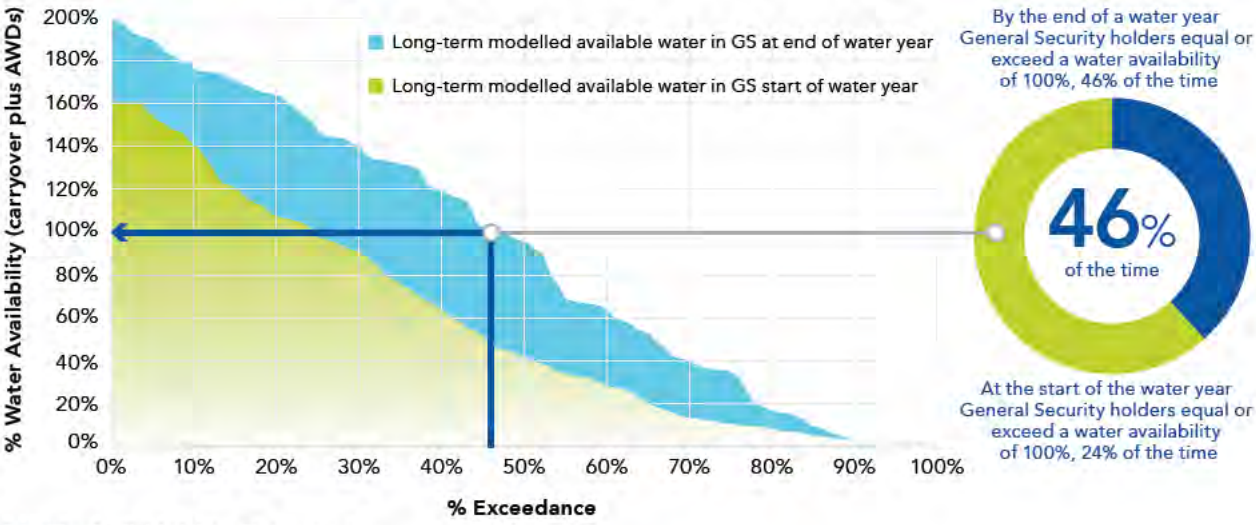
Potential Options to Improve Water Availability	Preliminary Capital Cost ($ Million)
Change Burrendong Dam Full Supply Level by improving Flood Mitigation Zone management	-
Burrendong Dam raising by about 6 m	450
New 308 GL dam on the Bell River	155
New 700 GL Ulmarrah Dam on the Macquarie River	267

Delivery efficiency and flow utilisation

The Macquarie River System does not have any re-regulating structures along the regulated river system. The system experiences high water distribution losses due to the existence of long rivers and creeks. New re-regulating weirs could be built to improve the water delivery efficiency in the valley.

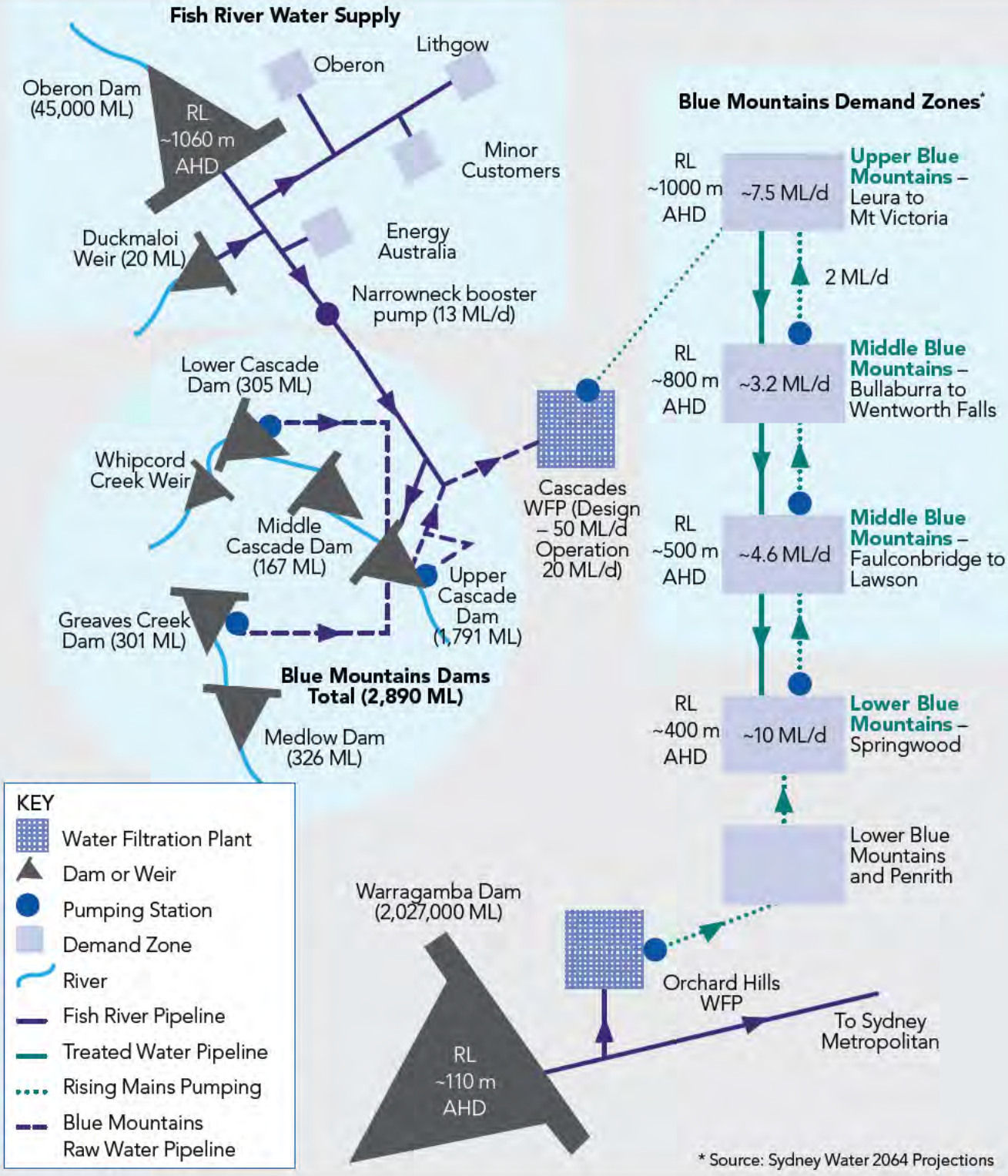
Potential Option to Improve Delivery Efficiency	Preliminary Capital Cost ($ Million)
A new re-regulating weir on the Macquarie River upstream of Gin Gin	36

Figure 6: Macquarie-Cudgegong Valley Reliability of General Security Releases



* AWD – Available Water Determination

3.6 Fish River and Blue Mountains Water Supply System



* Source: Sydney Water 2064 Projections

03 Outcome

Headworks

The Fish River and Blue Mountains Water Supply Scheme is comprised of two interconnected systems:

- Fish River System, and
- Blue Mountains System.

The Fish River System (FRS) headwaters are located on Fish River and Duckmaloi River catchments. The main storages in the system are:

- Oberon Dam (45,000 ML) located on Fish River, and
- Duckmaloi Weir (20 ML) located on Duckmaloi River.

The Blue Mountains system comprises headwaters located on Cascade Creek, Greaves Creek and Adams Creek catchments. The main storages in the Blue Mountains system are:

- Upper (1,791 ML), Middle (167 ML) and Lower Cascade (305 ML) Dams located on Cascade Creek
- Greaves Creek Dam (301 ML) located on Greaves Creek, and
- Lake Medlow Dam (326 ML) located on Adams Creek.

Water Use/Customers

The water supplied from the FRS for potable, stock and domestic or industrial purposes are:

- Chlorinated water: Oberon Council, Cascade Dams/Sydney Water's Cascade Water Filtration Plant (WFP) in the Blue Mountains, Energy Australia and minor customers who are connected to the Fish River chlorinated water pipelines.
- Filtered and chlorinated water: Lithgow City Council and minor customers who are connected to the Fish River filtered water pipeline.

Water from the five Blue Mountains Dams and the FRS are treated at the Cascade WFP. The treated water is then transferred to customers living in Upper, Middle and Lower Blue Mountains. Please note Sydney Water owns and operates the Cascade WFP.

Treated water from Cascade WFP can be supplied down to the Lower Blue Mountains as far as Springwood when the Blue Mountains dams levels are near full capacity. However Springwood is normally supplied from Orchard Hills WFP. Orchard Hills WFP's water can also be pumped to the Upper Mountains demand zones (as shown in the Fish River and Blue Mountains Schematic Map) when the Blue Mountains dams levels are low.

DID YOU KNOW?

Started by the Civil Constructional Corps during WWII and expanded in the 1950s and 1960s, the Fish River System draws water from Oberon Dam and Duckmaloi Weir and includes 236 km of pipelines and a tunnel under the Great Dividing Range.

Water Supply Infrastructure Opportunities

This Options Study has identified a range of options that address the LOS gaps for the Fish River and Blue Mountains Scheme.

The following table is a summary of the preferred options under consideration.

LOS Gap/Issue	Preferred Option	Preliminary Capital Cost ($ Million)
Water Availability	Water quality monitoring instrumentation remote monitoring and control valves at Duckmaloi Weir	0.2
Asset Availability (capacity)	Connect 9 ML Lidsdale Reservoir to treated water supply pipeline	2
Water Quality	Improve telemetry and automate monitoring of the residual chlorine	0.1
Asset Availability (condition)	Replace pipe between Mt Hay and Upper Cascades in a new pipe route	11

03 Outcome

Water availability (drought security and reliability) improvement

Fish River customers resist to use water from Duckmaloi Weir due to water quality concerns. Without Duckmaloi, it is difficult to meet drought security and reliability for Fish River and Blue Mountains customers.

Long-term infrastructure options considered for further investigation to improve drought security and reliability in the Fish River and Blue Mountains regions include:

Potential Options to Improve Water Availability	Preliminary Capital Cost ($ Million)
Decommissioning Duckmaloi Weir and revised water sharing arrangements	0.3
Automating water quality monitoring instrumentation, remote monitoring and control valves at Duckmaloi Weir	0.2
Transferring water from Duckmaloi Weir into Oberon Dam	20.4
Upgrading Duckmaloi WFP to treat Duckmaloi River water	3.1
Construct a larger storage at Duckmaloi River	72.7
Transferring Duckmaloi River water to the Coxs River and improve treated water transfer capacity from Orchard Hills WFP	72.0

Asset availability (capacity) improvement

The system's filtered water storage capacity could be improved to better address water filtration plant outages and pipe breaks.

Infrastructure options considered for further investigation to address system storage capacity include:

Potential Options to Improve Asset Capacity	Preliminary Capital Cost ($ Million)
Build a new clear water tank at the vicinity of the existing tank	26
Build a new balance tank located in the middle of the treated water distribution network	8
Connect 9 ML Lidsdale Reservoir to treated water supply pipeline	2

Treated Water quality improvement

WaterNSW needs to meet Australian Drinking Water Guidelines (ADWG) and NSW Health treated water supply quality requirements when the water is supplied for potable purposes. It is difficult to maintain residual chlorine in the FRS filtered water pipeline due to:

- poor pipe condition, and
- long length of pipeline with high demand variation.

Infrastructure options considered for further investigation to address water quality issues in the system include:

Potential Options to Improve Water Quality	Preliminary Capital Cost ($ Million)
Install baffles in the clear water tank to improve chlorine contact time	1.0
Build a new clear water tank to provide sufficient chlorine contact time	26.0
Improve telemetry and automate monitoring of the residual chlorine	0.1
Replace poor condition pipes (cast iron) in treated water pipeline*	69.0

* This option also improves the asset availability (condition) in FRS

Asset availability (condition) improvement

The FRS was built in three stages from 1948 to 1964. Over the recent years, some assets were renewed or replaced because they were in poor condition and/or had high risk of failure. Previous studies have identified some sections of the Fish River pipelines and Mount Hay road to Upper Cascade Dam pipelines need to be replaced.

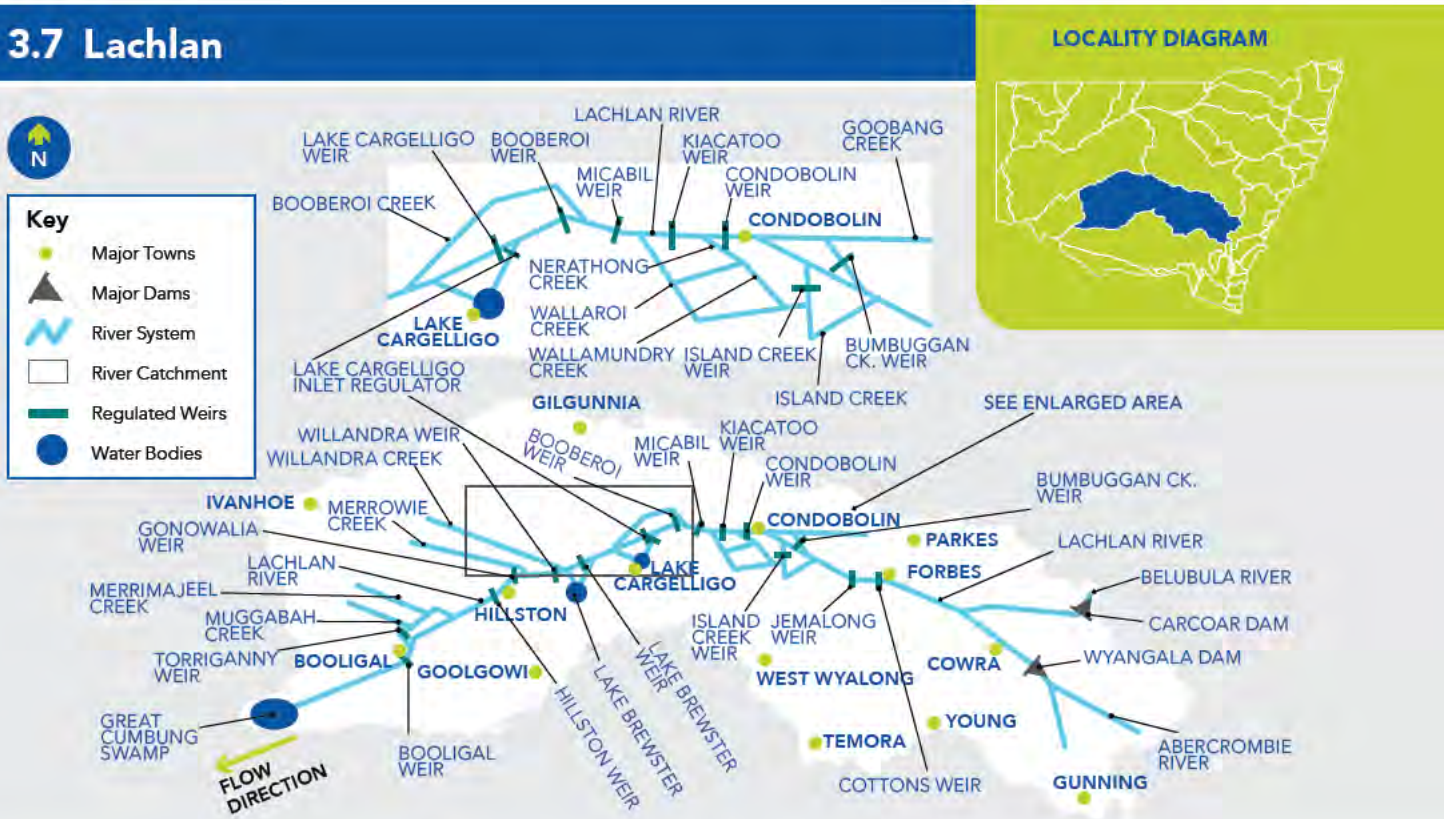
To prioritise Fish River pipe replacement, it is necessary to undertake pipe network hydraulic and failure risk assessment, pipe condition risk assessment and replace poor condition pipes accordingly. Replacement cost varies according to the length of pipes required to be replaced.

Options developed to address pipe condition issues in the Blue Mountains pipeline include:

Potential Options to Improve Asset Availability	Preliminary Capital Cost ($ Million)
Replace the existing pipeline along the existing route (gravity pipeline)	26
Replace existing pipeline in a new route (gravity pipeline)	11
New rising main (pumping required)	14
Supply treated water to Upper Mountains from Orchard Hill WFP	72

03 Outcome

3.7 Lachlan



Water Resource and Catchment

The Lachlan Valley has an area of 90,000 km^2, with its headwaters bounded by the Greater Sydney Catchments (between Goulburn and Yass), to its terminus at the Great Cumbung Swamp. Cowra, Canowindra, Forbes, Condobolin and Lake Cargelligo are the main town centres in this valley.

A notable geomorphic feature of the Lachlan Valley is the number of north-south trending ranges. The Lachlan River cuts these ranges, and the constraints during high flow events are partly responsible for the formation of several wetland areas in the valley. These wetlands are particularly large towards the end of the system (e.g. Great Cumbung Swamp), with the result being that flows from the Lachlan reach the Murrumbidgee/Murray only during very high-flow events. Because of this, the Lachlan is often considered a closed system.

The major tributaries of the valley include the Abercrombie, Boorowa, Belubula, Crookwell, Goobang, Bland, Mandagery and Mirool Rivers.

The Lachlan River is regulated by Wyangala Dam (1,220 GL) and the Belubula River is regulated by Carcoar Dam (35.8 GL).

The Lachlan River accounts for approximately 6.5 per cent of flows in the Murray-Darling Basin. However, during normal flow regimes this system terminates at the Great Cumbung Swamp and does not contribute flows down the Murray-Darling to South Australia.

Water Use/Customers

The Lachlan regulated river system supplies water for irrigation, stock and domestic, town water supply and industrial purposes in the valley.

The storages at Wyangala and Cargelligo are popular recreational lakes, and hold significant value to the general economy and amenity of the nearby townships.

Water Supply Infrastructure Opportunities

This Options Study has identified a range of options that address the LOS gaps for the Lachlan Valley.

The following table is a summary of the preferred options under consideration.

LOS Gap/Issue	Preferred Option	Preliminary Capital Cost ($ Million)
Water Availability	Raising Wyangala Dam by about 10 m	650
Delivery Efficiency in Mid Lachlan	Rationalise the Mid Lachlan effluent system by closing inefficient creeks	4
Delivery Efficiency in Lower Lachlan	Lower Lachlan pipe efficiency projects	32
Asset Availability (capacity)	Change size of outlet valves at Wyangala Dam	5.4

03 Outcome

Water availability (security and reliability) improvement

The Lachlan Valley is believed to have some of the poorest levels of water security and reliability (see Figure 7) in the state in terms of regulated/licensed irrigation and urban water supply. The region was dramatically impacted by the millennium drought.

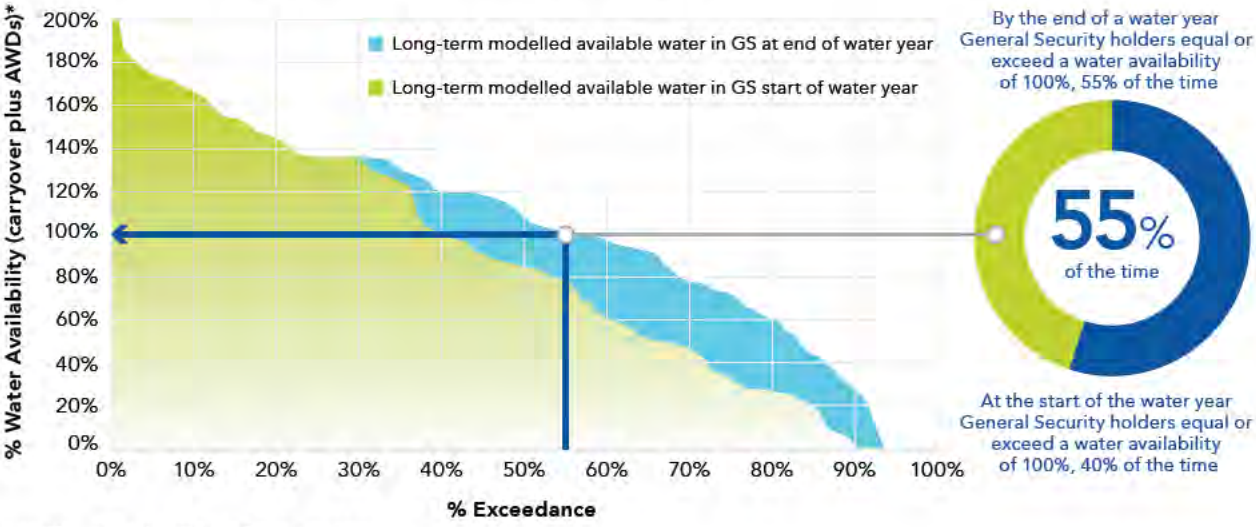
WaterNSW is currently undertaking a detailed study on how to improve water security and reliability in this valley. As part of the development of the Lachlan Valley Water Security Study, WaterNSW has developed a detailed hydrological model of the system. Figure 7 below shows the reliability curve produced by WaterNSW modelling for the Lachlan Valley.

Long-term infrastructure options developed to address water supply security and reliability in the Lachlan Valley include:

Potential Options to Improve Water Availability	Preliminary Capital Cost* ($ Million)
Raising Wyangala Dam by 10 m	650
Constructing a pipeline between Carcoar Dam and Lake Rowlands	17
Raising the Lake Rowlands Dam on behalf of Central Tablelands Water for urban water supply	58
Constructing a new 700 GL dam at the Abercrombie site	1000
Re-regulating weir on the Belubula River at Cranky Rock	30
Constructing a new 700 GL dam at the Cranky Rock site	1001

* The above options will be assessed in detail under the current Lachlan Valley Water Security Study

Figure 7: Lachlan Valley Reliability of General Security Releases



* AWD – Available Water Determination

Water delivery efficiency improvement

There are known issues regarding poor water quality in the Lower Lachlan. Water supplied to customers directly from Lakes Brewster and Cargelligo can be of poor quality. The Lachlan Water Sharing Plan has provisions for 'shandying' type arrangements to accommodate this issue, requiring dilution with releases further upstream. This leads to decreased flexibility and potential increase in end of system unaccounted losses.

The following infrastructure options have been considered for improving the delivery efficiency throughout the Mid Lachlan:

Potential Options to Improve Delivery Efficiency in Mid Lachlan	Preliminary Capital Cost* ($ Million)
Constructing new regulating stop-board structures at the entrance to Jemalong and Carrawobitty Creeks	42
Building a new weir upstream of the Jemalong and Carrawobitty Creeks	34
Building a new weir on the Lachlan to better control flows into the Island Creek system	44
Building a new pipeline from the Lachlan to service customers in Wallamundry and Wallaroi systems	93
Rationalise the Mid Lachlan effluent system by closing inefficient creeks	21
Rationalise the Mid Lachlan effluent system by closing inefficient creeks	4

* The above options will be assessed in detail under the current Lachlan Valley Water Security Study

The following options have been considered to improve the delivery efficiency throughout the Lower Lachlan:

Potential Options to Improve Delivery Efficiency in Lower Lachlan	Preliminary Capital Cost* ($ Million)
Divide the main lake at Cargelligo into three lakes	83
Decommissioning and fill the 'Sheet of Water' storage and add a bypass channel	171
Constructing re-regulating storage between Brewster Weir and Booligal	30
Lower Lachlan pipe efficiency projects	32

* The above options will be assessed in detail under the current Lachlan Valley Water Security Study

Asset availability improvement

Large environmental water licence holders may have issues with the current outlets capacity at Wyangala. An upgrade is not necessary for compliance and regulatory reasons, but a customer LOS framework might be applicable. Similarly, instream assets with insufficient re-regulating flows may impact the flexibility with which WaterNSW is able to operate in the valley.

The following options have been considered to improve asset capacity constraints.

Potential Options to Mitigate Asset Capacity Constraint	Preliminary Capital Cost ($ Million)
Add an additional outlet valve at Wyangala Dam	9.2
Change size of outlet valves at Wyangala Dam	5.4

03 Outcome

3.8 Murrumbidgee

Water Resource and Catchment

The Murrumbidgee River is located in southern NSW. It spans almost 1,600 km in length from its source in the Snowy Mountains to its junction with the Murray River. The Murrumbidgee catchment covers approximately 84,000 km^2 and forms part of the southern Murray-Darling Basin.

The Murrumbidgee River System is regulated by Burrinjuck Dam on the Murrumbidgee River (1,026 GL) and Blowering Dam on the Tumut River (1,628 GL). Burrinjuck Dam receives inflows from the upper catchment while Blowering Dam gets most of its inflow from the Snowy Hydro-Electric Scheme.

The Murrumbidgee River System contributes about 16 per cent of the Murray-Darling Basin water.

A series of weirs between Wagga Wagga and Balranald are operated to provide the head required to deliver water into major irrigation areas and creek systems such as Yanco Creek.

Water Use/Customers

The Murrumbidgee supports a population of over 500,000 people. It provides water for irrigation to various enterprises in the catchment yielding commodities ranging from annual crops such as rice and vegetables to perennial crops such as wine grapes and stone fruit. It also supplies water to towns, stock and domestic users along the river.

Irrigated crops cover around 5 per cent of the catchment area. The irrigation industry in the Murrumbidgee provides roughly 25 per cent of the state's fruit and vegetable production, 42 per cent of the state's grapes and half of the country's rice production.

Water Supply Infrastructure Opportunities

This Options Study has identified a range of options that address potential LOS gaps in the Murrumbidgee Valley.

The following table is a summary of the preferred options under consideration.

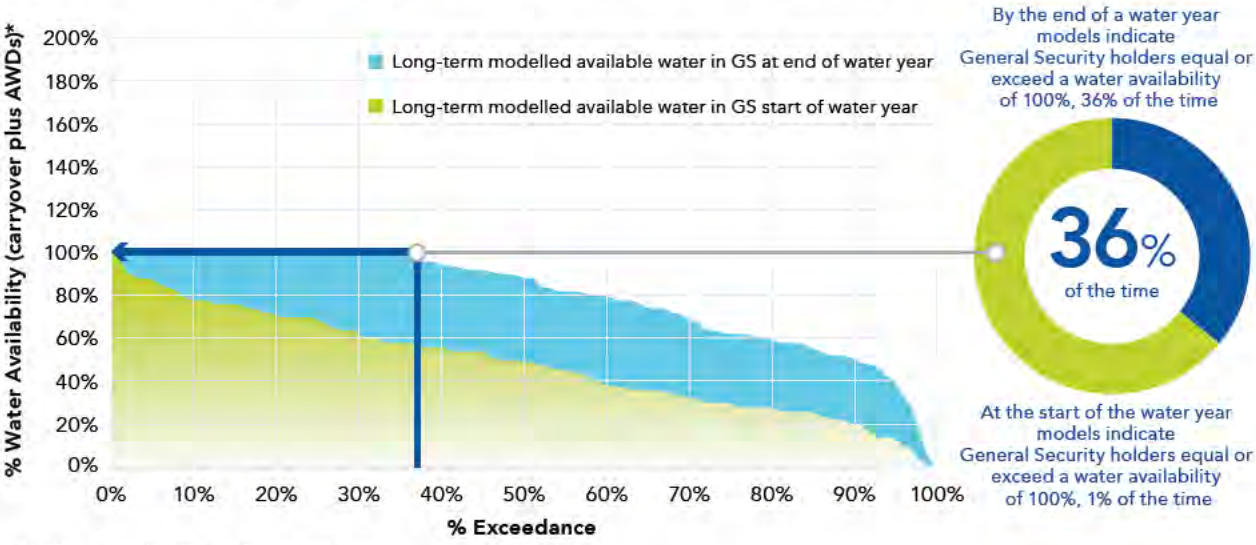
LOS Gap/Issue	Preferred Option	Preliminary Capital Cost ($ Million)
Water Availability	New dam on the Murrumbidgee near Mingay (potentially up to 1000 GL)	1,174
Asset Availability (capacity)	A new Tumut Channel and Blowering Dam outlet upgrade	476
Water Quality	Aerate the storage at Tombullen	Minimal

Water availability improvement

The Murrumbidgee has a relatively reliable water supply. However, this may change following the implementation of the Basin Plan's Sustainable Diversion Limits (SDL), and possible reduction in rainfall due to climate change.

Hydrological data received from DoI Water for the Murrumbidgee indicates that under the current water sharing arrangements, there is an opportunity to improve reliability of supply for general security licence holders, as depicted in Figure 8.

Figure 8: Murrumbidgee Valley Reliability of General Security Releases



* AWD – Available Water Determination

03 Outcome

Long-term infrastructure options considered for further investigation to improve security and reliability of supply in the valley include:

Potential Options to Improve Water Availability	Preliminary Capital Cost ($ Million)
New dam on the Murrumbidgee near Mingay (potentially up to 1000 GL)	1,174
New dam on the Murrumbidgee near Oura (potentially up to 1000 GL)	924
New dam on the Tumut River near Darbalara (potentially up to 1000 GL)	1,624
Burrinjuck Dam raising (up to 1,700 GL potentially)	873
New off-stream storage near Bundidgerry Creek	470

Asset availability improvement

In 2013, the Murray-Darling Basin Authority (MDBA) identified key constraints in the Murrumbidgee related to the operation of Burrinjuck Dam and Blowering Dam and channel capacity of the Tumut River. Currently, releases at Blowering Dam are controlled to ensure flows do not exceed 9,300 ML/d at Tumut, minimising bank erosion and flooding of private land.

These physical constraints could limit WaterNSW's ability to release the required flows for the environment and regulated customers in the future.

Potential options being considered to address possible constraints include:

Potential Options to Mitigate Asset Constraints	Preliminary Capital Cost ($ Million)
A new Tumut Channel and Blowering Dam outlet upgrade	476
Erosion protection along Tumut Channel and Blowering Dam outlet upgrade	642
New mid-catchment storage at Lake Coolah to serve as buffer storage	337
New dam downstream of Blowering Dam on the Tumut River near Gundagai	1,542

System deficiencies improvement

The two key deficiencies identified in the Murrumbidgee include high system losses or poor delivery efficiency, and poor water quality at Tombullen storage.

Options for further investigation to improve delivery efficiency include various SDL adjustment works, complemented with operational changes and modifications to existing assets.

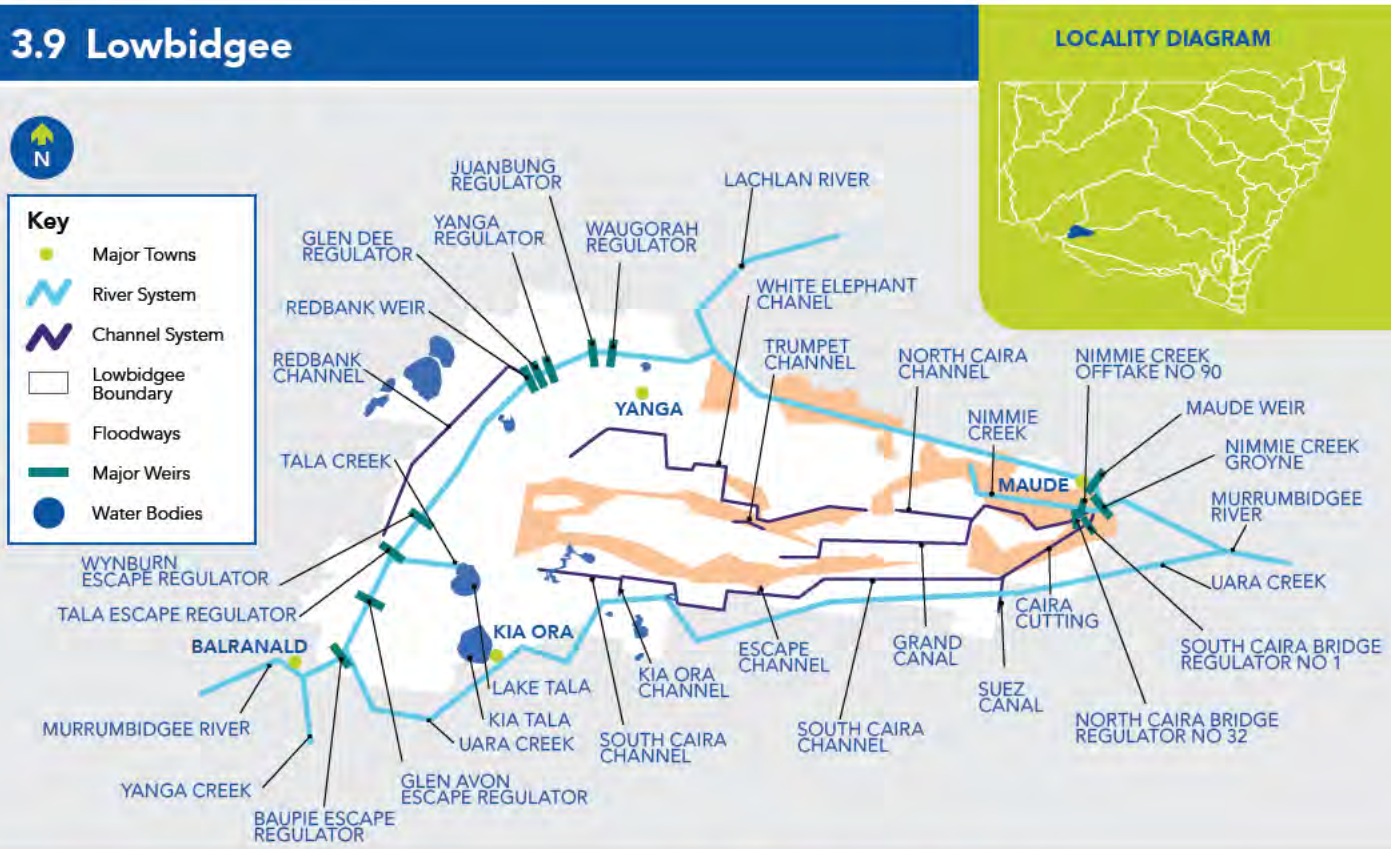
Frequent occurrence of blue-green algae blooms in Tombullen storage is the key risk to water availability during periods of drought and low flows, as water cannot be used due to poor quality. Some options to be explored include:

Potential Options to Improve System Deficiencies	Preliminary Capital Cost ($ Million)
Decommission Tombullen by bypassing channel	202
Aerate the storage at Tombullen	minimal

DID YOU KNOW?

The name Burrinjuck comes from the Aboriginal words "Booren Yiack", meaning precipitous mountain. The dam is appropriately named as it lies between the Barren Jack and Black Andrew Mountains.

3.9 Lowbidgee



Water Resource and Catchment

The Lowbidgee catchment is located in the lower reaches of the Murrumbidgee River Valley between Maude and Balranald and comprises approximately 1,630 km² of land which includes wetlands, red gum forest, Yanga National Park, grazing and agricultural land.

The main tributaries flowing to the Lowbidgee system are the Murrumbidgee River, Lachlan River and Uara Creek. Within the Lowbidgee, water flows through a system of creeks, natural floodways, artificial channels and levee banks.

Water Use/Customers

Approximately 72 per cent of the supplementary water (Lowbidgee) licence allocation is used for environmental water delivery in the Lowbidgee area. This is mainly for Nimmie-Caira and Yanga National Park. Water diversions in the Redbank North area is mainly used for irrigated agriculture and stock and domestic purposes.

Water Supply Infrastructure Opportunities

Opportunities in the Lowbidgee system are divided into the three geographical areas: Nimmie-Caira, Redbank North and Redbank South.

A preliminary study has identified future opportunities to improve service delivery in the valley.

03 Outcome

Water delivery improvement in Nimmie-Caira

The NSW government acquired Nimmie-Caira land and farming operations ceased in 2013–2014. The management of the system has changed radically due to the cessation of irrigated agriculture and livestock grazing. DoI Water is currently working on the Nimmie-Caira Project aimed at balancing environmental and Aboriginal cultural heritage protection with commercial use to create an asset for the local community and the Murray-Darling Basin.

In the future, Nimmie-Caira water infrastructure assets will need to be reconfigured or new assets built with consideration of water delivery efficiency and in accordance with DoI Water's desired outcomes.

Potential options include:

- Keep ownership while optimising, operating and maintaining management of existing assets and the proposal of new assets.
- Transfer asset ownership to DoI Water or new land owner and maintain the asset.
- Optimise WaterNSW asset management responsibility through keeping regulated assets such as weirs, channels and regulators along the river and transferring small levees and on-farm storages to DoI Water or another beneficiary.

Water delivery improvement in Redbank North

Water is distributed to the various licence holders via the Redbank North Channel.

For the long-term sustainability of managing Redbank North assets, the following potential option is being considered:

- Optimise WaterNSW asset management responsibility through keeping regulated assets such as weirs and regulators along the river and transferring Redbank North Channel to DoI Water or other third party.

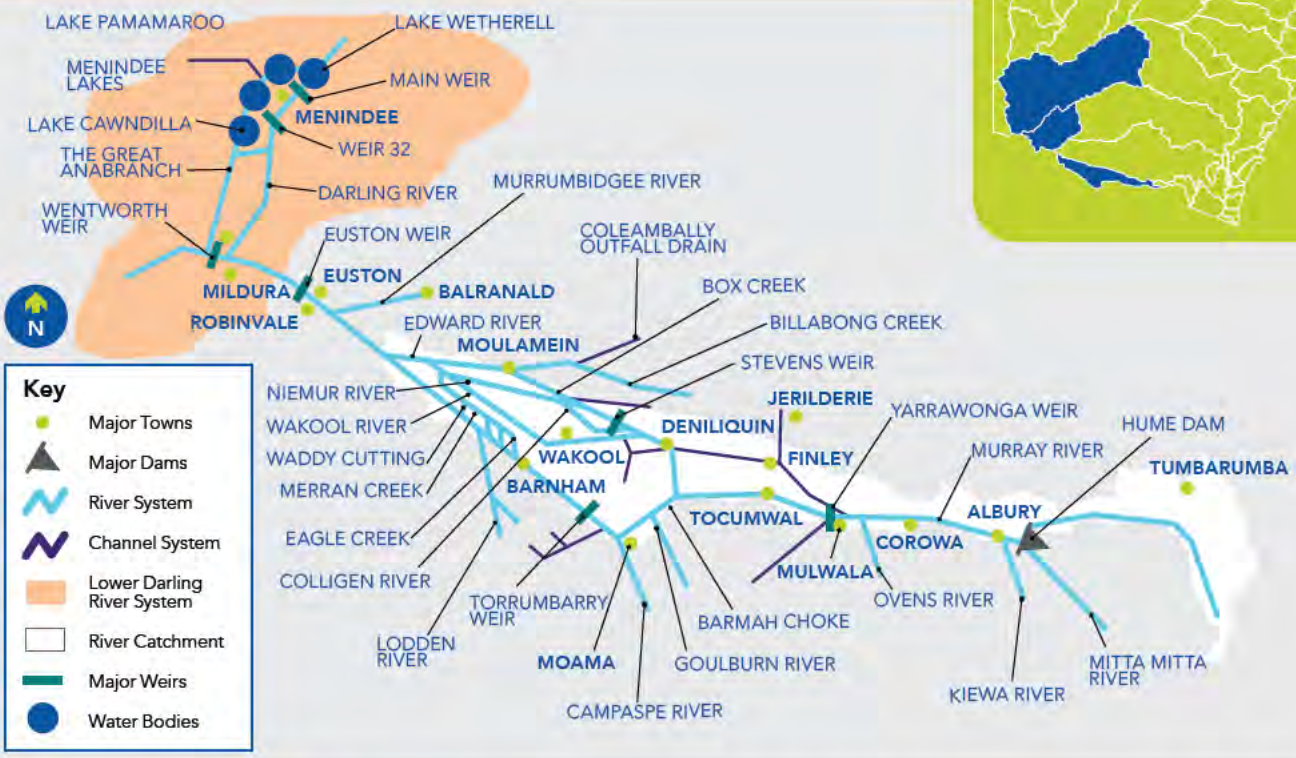
Water delivery improvement in Redbank South

Redbank South mainly covers environmental water delivery to Yanga National Park. The park's major hydrological feature is the long stretch of red gum forest that takes a long time to cover and can only be watered by the two regulators at the northern end. This has led to overwatering of the top sections and under-watering of the lower sections of the forest. Some improvements to water delivery in the southern end are expected to improve through DoI Water's Nimmie-Caira Project.

The following long-term option has been considered appropriate to improve asset operation and improve the delivery efficiency in Redbank South.

- Optimise WaterNSW asset management responsibility through keeping regulated assets such as weirs, channels and regulators along the river and transferring small levees and on-farm storages to the Office of Environment and Heritage (OEH) or other beneficiaries.

3.10 Murray



Water Resource and Catchment

The Murray River System is in southern NSW and demarcates the NSW-Victoria border. The catchment covers 14,950 km² of southern NSW.

The Murray River System's main operational storages include Hume Dam (3,005 GL) and Yarrawonga Weir (118 GL). The major NSW tributaries and anabranches include the Edward River, Wakool River, Niemur River, Billabong Creek, Yallakool Creek and Colligen Creek.

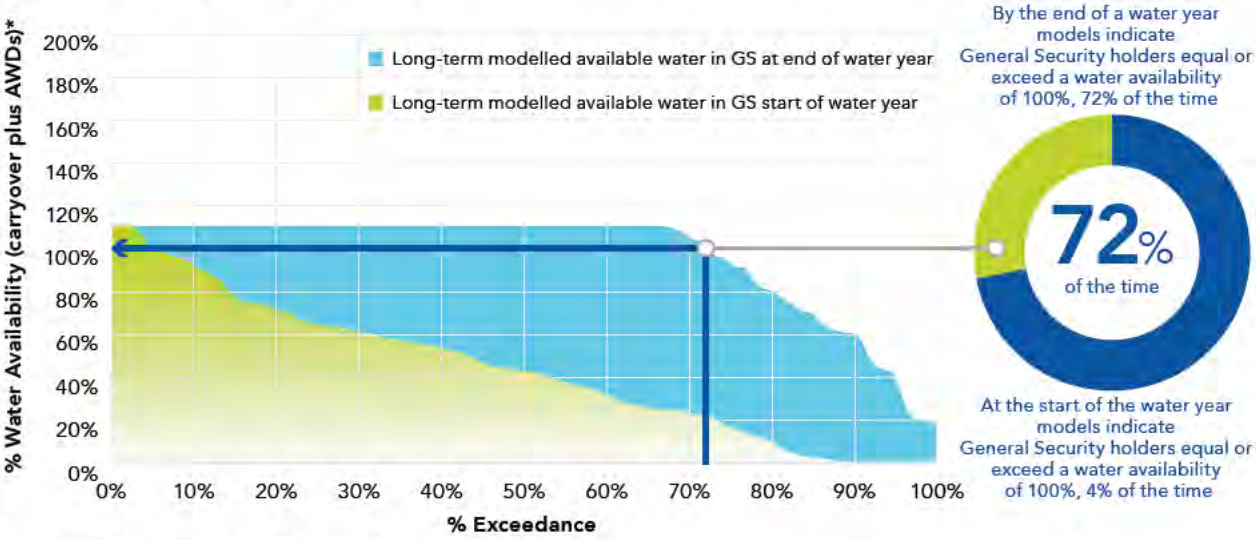
The Murray River System contributes 17 per cent of the Murray-Darling Basin water. It is operated and maintained by WaterNSW under the Murray-Darling Basin Agreement which aims to provide water for the benefit of NSW, Victoria and South Australia.

Water Use/Customers

The Murray River System provides regulated water supply for a wide range of uses including local water utilities, forestry, tourism and agriculture.

03 Outcome

Figure 9: Murray Valley Reliability of General Security Releases



* AWD – Available Water Determination

Water Availability

The Murray Valley has what is possibly the most complex operating environment of all the systems in the Murray-Darling Basin.

The general security water availability in the Murray River is presented in figure 9 based on data provided by DoI Water from 1985 to 2008.

Water Supply Infrastructure Opportunities

This Options Study has identified a range of options that address the LOS gaps for the Murray Valley.

The set of potential options to address these gaps are summarised in the table in the following section.

The potential options carry inherent uncertainties in respect of information available at the time of development of this study.

Water delivery constraints improvement

Delivery constraints exist in the Murray River System resulting from a combination of the following:

- High operational water levels are required to maintain navigation on the Murray River for boats, limiting the operational water level range (re-regulation capacity) of weir structures. An example of the system constraints exists in the works approval for Stevens Weir where a maximum draw-down rule applies to maintain historical water levels for navigation.
- Current asset configuration and river channel capacities are limited for general operation and water delivery.

These constraints reduce operational flexibility in delivering customer water orders, resulting in lower overall delivery efficiency in the system. From an operational perspective, this creates resource impacts at certain 'stress points' within the valley, particularly at peak demand times.

The MDBA has carried out a study on the Barmah Choke to address flow constraint issues and investigate environmental risks. Fifteen options have been identified as suitable for further investigation. The outcomes of the project may address WaterNSW's water delivery efficiency issues. However, further information is not available at this stage.

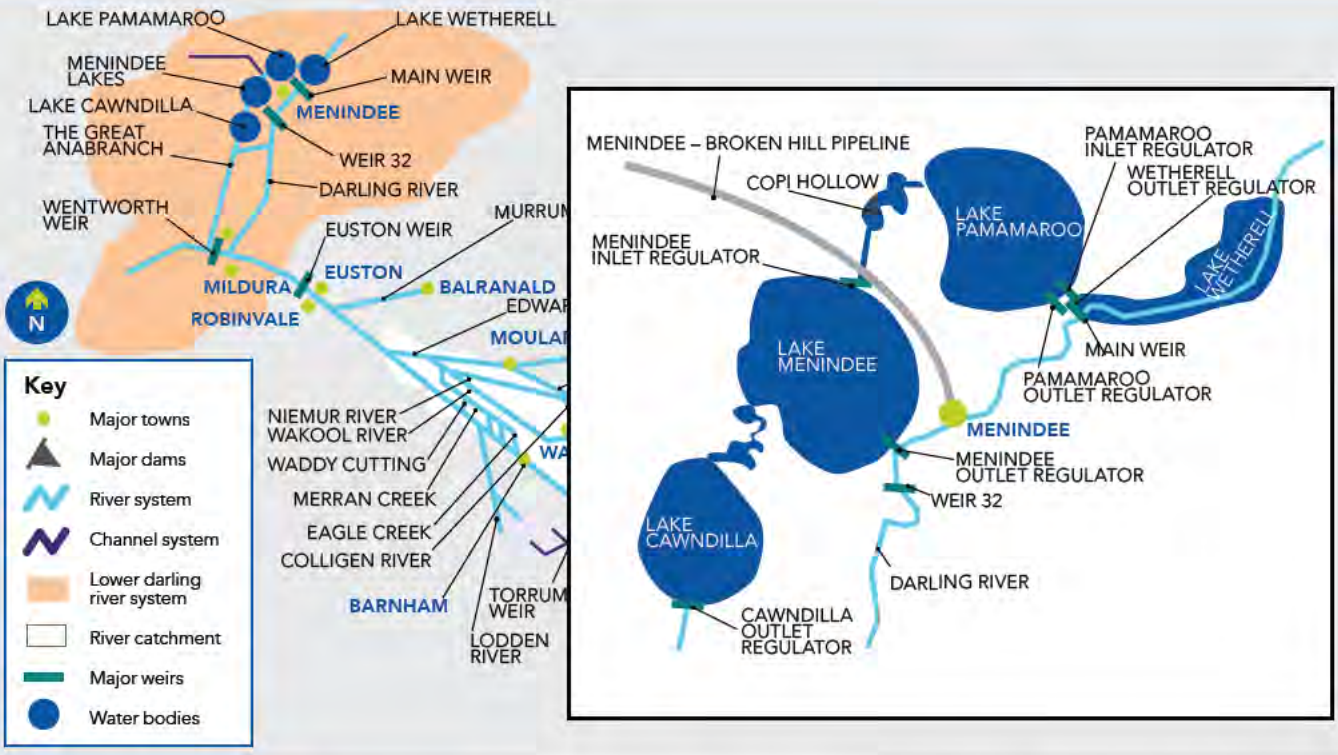
The options identified in the study are outlined in the table.

Potential Options to Improve Delivery Efficiency	Preliminary Capital Cost ($ Million)
Increase re-regulation capacity at Stevens Weir in combination with gate reconfiguration to meet peak demand	27
Enlarge storage capacity at Euston Weir	81
Upgrade Bullatale Creek bypass	697
Increase diversion though Wakool River	1,234
Increase escape capacity to the Edward River	7
Build new Murray–Goulburn Interconnector Channel	1,115

Note: Option details were extracted from DoI Water's Securing NSW's Water Future, NSW Government approach to Menindee Lakes, March 2017 and other publicly available or web accessible reports. Capital costs were estimated by WaterNSW.

03 Outcome

3.11 Lower Darling



Water Resource and Catchment

The Lower Darling River System is located in south-western NSW.

Under regulated conditions, water flows from the Menindee Main Weir through the main channel of the Darling River and then converges with the Murray River at Wentworth.

The Lower Darling River System contributes about 3 per cent to the Murray-Darling Basin water.

The Menindee Lakes Storage Scheme consists of four large lakes and several smaller interconnected lakes. The four major lakes consist of Wetherell, Pamamaroo, Menindee and Cawndilla Lakes, which have a combined storage capacity of 1,731 GL.

Inflows to the Menindee Lakes come from the Barwon-Darling River and its tributaries. A number of weir and regulator structures divert and regulate water to various parts of the scheme.

The Menindee Lakes are owned and operated by WaterNSW. Operation of the lakes is subject to the longstanding Murray-Darling Basin Agreement between NSW, Victoria, South Australia and the Australian Government. The agreement allows the MDBA to use the water in the lakes to meet the Murray River's downstream demand when the lakes' volume rises above 640 GL and until it drops below 480 GL.

Water Use/Customers

The Menindee Lakes are an instrumental part of the Murray-Darling Basin water supply system and are of critical importance for water supply to the Lower Darling River and the people who live and work in this remote part of NSW.

Menindee Lakes Storage Scheme supplies water for agricultural purposes in the Lower Darling system and provides additional flow to the Lower Murray in accordance with the Water Sharing Plan and Murray-Darling Basin Agreement.

For Broken Hill's long-term water security, the River Murray to Broken Hill Pipeline project will be delivered by WaterNSW by December 2018 and will supply 37.4 ML of peak daily demand to Essential Water as the local water utility.

Now that the pipeline project is being delivered, the NSW Government will be working with water users, the community and other governments to finalise a proposal for amendments to the Menindee Lakes management.

The NSW government has explored options that could allow the lakes to be operated in a way that achieves significant water savings.

Water Supply Infrastructure Opportunities

In March 2017, the Murray-Darling Basin Ministerial Council agreed to continue to progress a package of supply measures under the SDL adjustment mechanism.

Further work will be required to refine these projects. Modelling to date has provided approximately 400 GL of offsets, with the balance of additional projects to reach 650 GL of offset, particularly:

- The Structural and Operational Changes at Menindee Lakes, which may include revised sharing arrangements for Menindee with new infrastructure for improved operations.
- Updated operating rules for the Murray River to deliver environmental outcomes and potential flood mitigation through the Hydrological Cues project.
- Complementary Measures and Adaptive Management approaches to maximise outcomes from existing environmental water.

The River Murray to Broken Hill Pipeline is a standalone project and is not dependent on any reconfiguration of the Menindee Lakes System.

The following table is a summary of the preferred options under consideration to address water availability issues in the Lower Darling Valley. The recommended option is in addition to water saving projects proposed by DoI Water.

LOS Gap/Issue	Preferred Option	Preliminary Capital Cost ($ Million)
Water Availability and Delivery Efficiency	Construction of additional weirs downstream of Weir 32 to re-regulate river flow in Lower Darling	>50

Water Availability

The Murray and Lower Darling Valleys have possibly the most complex operating environments of all the systems in the Murray-Darling Basin.

The general security water availability in the Lower Darling is presented in Figure 10 and is based on data provide by DoI Water for the period 1985 to 2008.

03 Outcome

Asset availability improvement

The NSW Government has explored options and operational changes that could allow the lakes to be operated in a way that achieves significant water savings, including:

- new regulators at Morton-Bulka and Cawndilla Creek
- revised trigger levels in relation to shared management arrangements and operational rules
- recognition of additional inflows expected to flow into Menindee Lakes under the operation of the Basin Plan, and
- allowing operation of Lake Menindee independently of Lake Cawndilla and enabling more efficient operations through the creation of a new regulator.

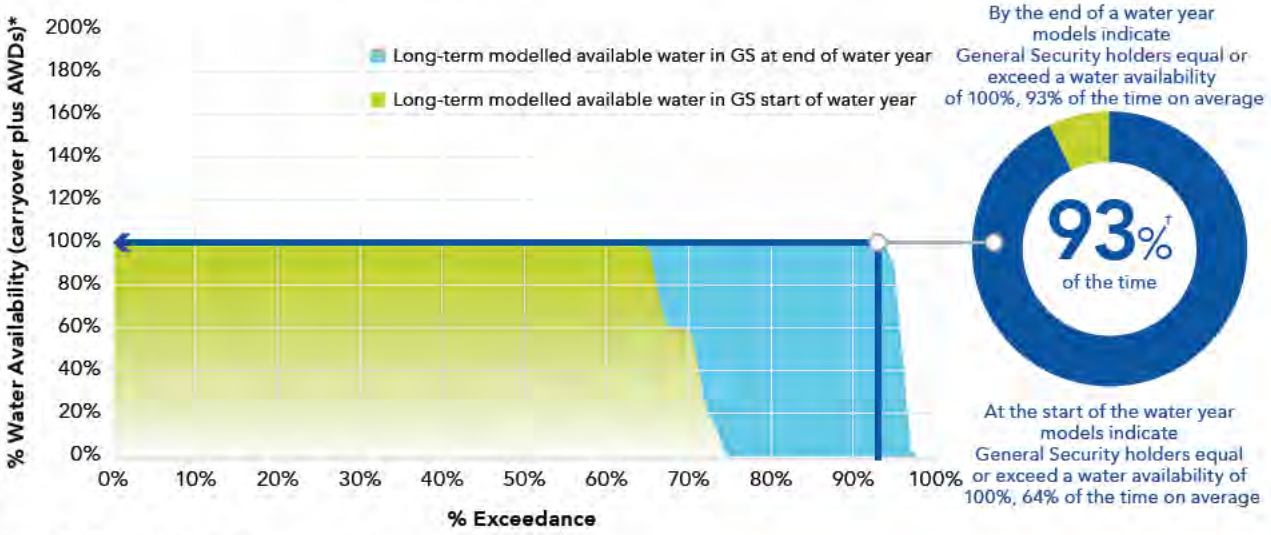
Consultation and ongoing discussions with water users and the community around the Menindee Lakes and Lower Darling, as well as with other state jurisdictions, is required before any proposal for the lakes can be developed.

Options developed in the DoI Water's studies may improve the asset availability in transferring environmental water in Lower Darling. These include:

Potential Options to Improve Asset Availability Developed by DoI Water	Preliminary Capital Cost ($ Million)
Improvements to Menindee outlet capacity	11
Installing an anabranch regulator to prevent water entering the anabranch and allow more flows to pass along the Lower Darling river channel. The regulator could be open at other times to allow water into the anabranch and provide environmental benefits	39
Improving access to Menindee dead storage	41

Note: Option details were extracted from DoI Water's Securing NSW's Water Future, NSW Government approach to Menindee Lakes, March 2017 and other publicly available or web accessible reports. Capital costs were estimated by WaterNSW.

Figure 10: Lower Darling Reliability of General Security Releases



* AWD – Available Water Determination

† Note: Since the 1980s there has been increased development in Northern basin catchments. A review of the last 25 years data shows that, in relation to reliability, Lower Darling GS entitlement holders received their full allocation in 8 out of 10 years (i.e. 80%)

Potential Option to Improve Asset Availability Developed by WaterNSW	Preliminary Capital Cost ($ Million)
Construction of additional weirs downstream of Weir 32 to re-regulate river flow in Lower Darling.	>50

Note: This option will also address water delivery efficiency issue below

Water delivery efficiency improvement

The Menindee Lakes are relatively shallow and the climate is hot, dry and windy. Evaporative loss is very high and reduces available water for consumptive use and for the environment. This creates system capability constraints to meet future environmental flow requirements.

Options developed in the DoI Water studies may improve the water delivery efficiency in Lower Darling. These include:

Potential Options to Improve Delivery Efficiency Developed by DoI Water	Preliminary Capital Cost ($ Million)
Providing additional capacity in northern catchments for release to Lower Darling	1,074
Isolating Lake Cawndilla from Menindee to allow more flows to be diverted from Lake Menindee to Lower Darling	16
Installing an anabranch regulator	39
Constructing a channel from Lake Cawndilla to the Darling River to allow the lake to drain directly to the river	360

Note: Option details were extracted from DoI Water's Securing NSW's Water Future, NSW Government approach to Menindee Lakes, March 2017 and other Publicly available or web accessible reports. Capital costs were estimated by WaterNSW.

03 Outcome

3.12 Hunter

Water Resource and Catchment

The Hunter River rises in the Liverpool Range and generally flows south then east, reaching the Pacific Ocean at Newcastle. The Hunter River catchment covers approximately 22,000 km^2.

The Hunter River System is regulated by Glenbawn (749 GL), Glennies Creek (283 GL) and Lostock (22 GL) Dams. Tributaries of the Hunter River include the Pages, Goulburn, Williams, and Paterson Rivers, and Wollombi Brook. Towns along the Hunter River include Raymond Terrace, Morpeth, Maitland, Singleton, Jerry's Plains, Denman, Muswellbrook and Aberdeen. The Hunter River System has no contribution to the Murray-Darling Basin water.

Water Use/Customers

The Hunter River System supplies water for irrigation, stock and domestic, major utility (power generation), coal mining, town water supply and industrial purposes. The valley contributes significantly to the production of various agricultural commodities, particularly equine, viticulture, milk and beef cattle.

Water Supply Infrastructure Opportunities

This Options Study has identified a range of options that address the LOS gaps for the Hunter Valley.

The following table is a summary of the preferred option under consideration.

LOS Gap/Issue	Preferred Option	Preliminary Capital Cost ($ Million)
Water Availability	Lostock Dam to Glennies Creek Dam transfer pipeline – (transfer capacity considered 7.5 GL/a to 73 GL/a*)	115 to 502 (price varies according to transfer capacity)

*annum

03 Outcome

Water availability (security and reliability) improvement

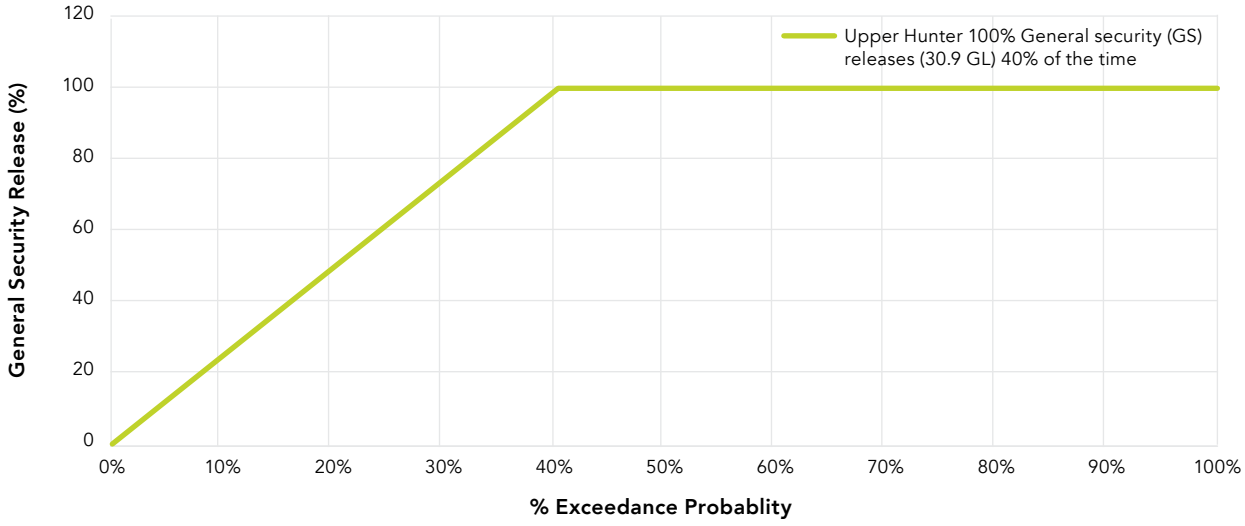
The 2014 State Infrastructure Strategy update (SIS) identified the Upper Hunter as having a low level of 'Irrigation Drought Security'. This was accompanied by an associated low level of flow utilisation, i.e. much less than the available yield was consistently consumed by existing users.

Although Glenbawn and Glennies Creek are relatively large dams they only regulate a small proportion of the valley resulting in low water reliability in the Upper Hunter region. Further, the Lostock catchment has a large potential yield compared to the size of the dam. That means it fills and spills more often than other dams in the region. The eastern catchment is high yielding but largely unregulated and disconnected from the demands for mining and power stations located in the central catchment.

Figure 11 below illustrates reliability and security for the Upper Hunter which is based on the current available information. The water availability graphs will be reviewed and updated by WaterNSW as the studies under the SIS Priority Catchment program progress throughout 2018.

In the future, the Upper Hunter is forecast to have low drought security with an expected transition in demand for water for increased agribusiness. Mining and population growth in the Hunter Valley are also expected to continue as the need for water security for power generation is progressively replaced by new productive enterprise alternatives. The water needs for growth and its distribution in the Upper Hunter over the next 20–30 years are therefore uncertain.

Figure 11: Upper Hunter Reliability of General Security Releases



The following options were developed to improve water availability in the Upper Hunter.

Potential Options to Improve Water Availability	Preliminary Capital Cost ($ Million)
Enlarge Lostock Dam (67 GL)	232
Lostock Dam to Glennies Creek Dam transfer pipeline (transfer capacities considered 7.5 GL/a to 73 GL/a)	115 to 502*
Pipeline Glenbawn Dam to Glennies Creek Dam (transfer capacities considered 7.5 GL/a to 82 GL/a)	123 to 688*
Glenbawn Dam to Glennies Creek Dam transfer pipeline with Rouchel Brook supplementary diversion structures (67 GL/a)	541
A new Camerons Dam (450 GL)	897
Allyn River supplementary diversion to Lostock Dam	298
Williams River supplementary diversion to Lostock Dam	382
Combined Williams River and Allyn River supplementary diversions to Lostock Dam	629

* Cost varies according to the transfer capacity

03 Outcome

3.13 North Coast

Water Resource and Catchment

WaterNSW's major asset in the North Coast region is Toonumbar Dam (11 GL) which regulates a small section of Iron Pot Creek and Eden Creek, tributaries of the Richmond River.

Toonumbar Dam stores water from a 98 km^2 catchment and does not contribute to Murray-Darling Basin water. The river meets the ocean at Ballina.

Water Use/Customers

The North Coast system currently supplies water for irrigation, stock and domestic, and high security grazing. Land use is predominately utilised by dairy farming. Dryland cropping occurs on the slopes. High security water is used for intensive grazing, and intensive meat production.

The irrigation demand drivers include the various irrigated commodities and dairy production.

Water Supply Infrastructure Opportunities

This Options Study has identified a range of options that address the LOS gaps for the North Coast Valley.

The types of options presented to the North Coast customers in early 2017 are included in the following section.

Flow utilisation improvement

Currently, utilisation of water from Toonumbar Dam is low, as existing licence holders do not fully exhaust their entitlements. This is attributed to the availability of unregulated surface water and groundwater sources within the Richmond catchment. These are preferred by the major water users (such as dairy and agricultural farms) due to lower water usage charges. Anecdotal evidence and customer feedback suggests surface water licences are currently used as a drought security measure.

The lack of utilisation has resulted in high water levels in the dam all year round and high operational surplus due to increased frequency of spills. WaterNSW views this as a significant underutilisation of existing assets.

Options are currently being developed that may enable an increase in utilisation. These are likely to require negotiation and consultation with relevant local stakeholders.

The types of options presented to the North Coast customers in early 2017 included:

- introducing new users to the regulated system
- altering pricing strategies and tariff structures to encourage growth in usage
- merging water types within a valley
- extending the length of the regulated river system, and
- augmenting Toonumbar Dam for other industries (e.g. hydro power) or decommissioning the dam.

WaterNSW recognises that any successful strategy to improve the situation on the North Coast is likely to involve a combination of asset, financial and regulatory improvements, and as such, is working towards investigating these options.

03 Outcome

3.14 South Coast

Water Resource and Catchment

Brogo Dam (9 GL) is the main dam located on the Brogo River which regulates Brogo and Bega Rivers downstream. Brogo Dam has an approximate catchment area of 400 km^2.

The catchment has no contribution to the Murray-Darling Basin and the river flows to the ocean near Tathra.

Water Use/Customers

The storage is used to supply town water to Bermagui and Cobargo, and provides water for irrigation, stock and domestic requirements in the Brogo and Bega river valleys on the NSW South Coast.

The dam was built to provide a reliable supply of water for the dairy industry, the main agricultural industry in the area. The dam is also a popular fishing and water sport destination.

Water Supply Infrastructure Opportunities

This Options Study has identified a range of options that address the LOS gaps for the South Coast Valley.

The following table is a summary of the preferred option under consideration.

LOS Gap/Issue	Preferred Option	Preliminary Capital Cost ($ Million)
Water Availability and Flow Utilisation	Augment Brogo Dam and addition of hydro-power plant	201 (excludes power network to the dam site)

Address Flow Utilisation Issue

The current base water demand from Brogo Dam is low and the licence holders do not utilise their full water entitlements. This is attributed to the relatively high yield and availability of unregulated surface water and groundwater sources within the catchment. These are preferred by the major water users (e.g. dairy and agricultural farms) due to the lower water usage charges. Surface water licences are currently used as a drought security measure.

The lack of demand has resulted in high water levels in the dam all year round and high operational surplus due to increased frequency of spills.

WaterNSW recognises the need for a clear strategy that addresses the major issues in both the North and South Coast valleys.

The low extraction of regulated water from Brogo Dam has impacted revenue to a point where it is no longer sufficient to cover operating and maintenance costs. Currently, the dam operation is heavily subsidised by NSW Government funding.

Options developed to address flow utilisation issue in the valley include:

Potential Options to Address Flow Utilisation Issue	Preliminary Capital Cost ($ Million)
Brogo Dam removal	80
Augment Brogo Dam	199
Augment Brogo Dam and adding hydro-power plant	201*
Town water supply to Bermagui	39
Town water supply to Tathra	47
Town water supply to Narooma	92
Town water supply to all three towns (Bermagui, Tathra and Narooma)	160
Augment Brogo Dam and town water supply to all three towns (Bermagui, Tathra and Narooma)	359

* The cost of hydropower plant excludes getting the power network to the dam site

DID YOU KNOW?

Brogo Dam is about 30 km north-west of Bega on the NSW South Coast. Bega is about 430 km south of Sydney via the Princes Highway.

03 Outcome

Reliability of supply improvement

The small capacity of Brogo Dam is not sufficient to supply customer water demand in periods of lower than average rainfall.

To improve drought security, the following options were considered:

Potential Options to Improve Water Availability	Preliminary Capital Cost ($ Million)
Augment Brogo Dam	199
Build pipeline for existing customers	157
Augment Brogo Dam and pipeline for existing customers	356

Eliminate or reduce margin between revenue and operation and maintenance costs

The high cost is driven by the "Minimum Standard Operating Costs" required to manage the dam (i.e. maintenance, dam safety inspections, etc.).

Options developed to eliminate or reduce the margin between revenue and dam operation and maintenance cost include:

Potential Options to Improve Valley Viability	Preliminary Capital Cost ($ Million)
Remote operation	0.2
Brogo Dam removal	80
Augment Brogo Dam	199

03 Outcome

3.15 Other Cross-Valley Strategies

There are a number of specific thematic issues and opportunities that have been dealt with separately to the valley strategies. These are largely regulatory and apply to all valleys, and all WaterNSW assets.

Relevant studies include:

- Portfolio Risk Assessment (PRA) – a key strategy adopted by WaterNSW to meet dam safety obligations for 10-year 'Safety Reviews' of dams
- SDL projects and opportunities
- The Fishway Strategy
- The Cold Water Pollution Strategy, and
- Unregulated Infrastructure Asset Strategy.

A brief summary of the issues surrounding these matters are found below.

Portfolio Risk Assessment (PRA)

In order to meet NSW Dams Safety Committee (DSC) requirements, WaterNSW has adopted an economic 'least cost' risk-based management approach for its entire portfolio.

A staged approach has been adopted in order to achieve the most cost effective overall risk reduction, within the stipulated 20-year timeframe. This commenced with a Phase 1 upgrade program focused on the high-risk rural dams identified in a 2002 Rural Portfolio Risk Assessment. It is now being completed through the 2017–18 Greater Sydney Portfolio Risk Assessment.

Portfolio risk approach for WaterNSW dams

The DSC timeframes for a staged risk reduction approach to dam safety compliance are:

- Short term goal: up to two years, initial easily-attainable risk reduction, e.g. dam break early warning systems, minor interim structural works.
- Medium term goal: three to 10 years, significant risk reduction as soon as reasonably practicable, aim to achieve risk reduction to below the Limit of Tolerability (for Individual & Societal Risk).
- Long term goal: 11 to 20 years, full deterministic compliance (i.e. PMF) or risks below the Limit of Tolerability subject to ALARP (as-low-as-reasonably-practicable) and taking account of the DSC's broadly acceptable objective for risk.

Under the new Dams Safety Act (2015), new regulations are to be developed which are likely to influence WaterNSW's dam safety compliance strategy. The new regulations are not expected until mid-2018.

Dam safety upgrade programs

The Dam Safety Upgrade Program progressively reduces societal risk in two phases:

1. Phase 1 will reduce risk at priority rural dams within the medium term of 10 years to a level approaching an Annual Exceedance Probability of Dam Crest Failure of 1:100,000, subject to what is reasonably practicable in this timeframe.
2. Phase 2 continues to reduce risks across priority rural dams and the remainder of WaterNSW's portfolio towards the long-term compliance goal (subject to any further legislative/regulatory changes). The outputs from the Greater Sydney PRA will be combined with portfolio risks for rural dams when completed in 2019. Any emergent and justifiable risk reduction priorities will inform the Dam Safety Upgrade Program for the next Regulatory Price Submissions due in 2020 and 2021 for Greater Sydney and rural areas respectively.

Sustainable Diversion Limits (SDL)

Murray-Darling Basin jurisdictions have submitted SDL adjustment proposals for consideration as possible supply or constraint measures after DoI Water submitted NSW's projects. These are currently being assessed by the MDBA. WaterNSW is the proponent for three SDL adjustment proposals:

- Computer Aided River Management (CARM) Murrumbidgee
- improved flow management works at the Murrumbidgee River – Yanco Creek offtake, and
- modernising supply systems for effluent creeks – Murrumbidgee River.

Other SDL adjustment proposals, for example the Menindee Lakes Water Savings Project, will also have direct or indirect impacts on customers by involving WaterNSW assets or impacting operations.

With all of the SDL adjustment proposals, WaterNSW's strategy needs to ensure alignment between customers' desired LOS, the 20 Year Infrastructure and Operating Strategies and the overarching objectives of the State and Australian Governments.

Fishway Strategy

Existing fishways' operations

WaterNSW owns and operates fishways throughout NSW. WaterNSW operates and maintains existing fishways to meet their commissioned design requirements.

Existing weirs and fishways

Regulatory requirements under Section 218 of the Fisheries Management Act (1994) states if WaterNSW needs to modify or alter an existing weir/dam/reservoir asset or construct a new structure, then WaterNSW may be required to provide a form of fish passage for the site.

Where existing WaterNSW weirs and fishways are identified as being in poor condition and/or not working effectively, these assets are managed through the asset planning process. These assets fall within two asset groups:

1. Regulated Assets: access to funding for appropriate upgrade projects to address the deficiency identified above is approved under the IPART regulatory pricing review process occurring approximately every four years.
2. Unregulated Assets: funding for appropriate treatment of unregulated assets to address the deficiency outlined above is obtained from a NSW Treasury Community Service Obligation (CSO). Alternatively, it may take the form of grant funding from other agencies e.g. local government or other sources.

There is also potential in the future for SDL adjustment funding of fishways from the Australian Government including:

- to help with structure modifications/weir augmentation projects requiring fish passage, and
- to bolster funding from other sources as part of Northern Basin Toolkit measures at both unregulated and regulated weir sites.

WaterNSW priority fishways strategy

The WaterNSW 2017 Fishways Strategy for the 46 priority fishway sites managed by WaterNSW was developed in consultation with DPI Fisheries. This formed part of a broader fishway strategy addressing the 90 highest priority barriers to fish passage in the state.

The implementation of WaterNSW's high priority sites is anticipated to achieve large environmental benefits. This may open up approximately 8,200 km of rivers and streams to fish migration.

IPART has approved $2 million in funding in its Determination of Rural Prices, to progress the phase of the Fish Passage Strategy over the next three years (FY18 to FY20). This first phase will develop feasibility engineering designs to plan the most cost effective and efficient fishways.

WaterNSW is finalising the principles of the Fishways Strategy with the goal of developing a business case in time for the next rural pricing submission in 2021. It will provide a robust, least-cost approach to strategic fishways implementation across WaterNSW assets in the Murray-Darling Basin.

IPART and the Minister for Primary Industries, Regional Water and Trade and Industry, the Hon Niall Blair MLC, established a Ministerial Taskforce on fishways in mid-2017 that will allow NSW to capitalise on the emerging funding opportunities under the Basin Plan, and maximise the ecological, social, and economic outcomes of restoring fishways in the Murray-Darling Basin in a coordinated and strategic manner.

03 Outcome

Cold Water Pollution

Definition

The DPI website defines cold water pollution as "an artificial decrease in temperature of water in a natural ecosystem". Water released from the lower layers of large dams (deeper than 15 m) has the potential to be colder than the receiving waters. The cold water has a negative impact on the aquatic environment and can have an effect on fish breeding and growth in river reaches significantly downstream of the release point. This is most likely to occur during the warmer months and is a particular problem in rural NSW where large flows are released for irrigation between spring and autumn.

History

The studies highlighting the potential impacts of cold water pollution were used to develop the Cold Water Strategy Below Dams (DIPNR 2004). In NSW, the Cold Water Pollution Inter Agency Group (CWPIAG) was formed in 2006 by the then Department of Environment and Climate Change (DECC). It is working on a coordinated whole of government Cold Water Strategy for the next 20 years, to be implemented in five year stages. The stage 2 report has been completed. The work of this group is ongoing and currently contains representatives from WaterNSW, DoI Water and Snowy Hydro.

Current position

WaterNSW is actively involved in the CWPIAG, working to minimise the frequency and impact of cold water releases on the environment and develop strategies for the future.

WaterNSW has also actively sought funding to address this issue but has been unsuccessful. Without further funding, WaterNSW is restricted to operating existing assets within agreed operational protocols and looking for opportunities to address Cold Water Pollution challenges within existing capital works programs.

Opportunities

WaterNSW is committed to identifying funding opportunities for the improvement of offtake structures to minimise the release of cold water and its impacts. The most likely opportunities are:

1. customer and NSW Government share funding via periodic pricing submissions to IPART, and
2. funding from other sources as part of Northern Basin Toolkit measures.

Customer and government share funding via IPART would result in customers currently funding at least 50 per cent of any cold water mitigation scheme through an increase in water bills. This is unlikely to occur in the near future. WaterNSW anticipates that more robust economic analysis, with willingness to pay studies, would be required to support a submission to regulated customers and IPART, prior to embarking on engineering feasibility studies.

Funding of cold water mitigation schemes as a SDL complementary measure is a far more opportunistic approach. Complimentary measures are defined as schemes that provide an environmental benefit without reducing the volume of water available for irrigation. Money used to fund water buyback could instead be used to finance non-volumetric schemes such as cold water mitigation. This is very attractive to both environmental and industry stakeholders and would provide significant funding opportunities to develop cold water mitigation infrastructure on WaterNSW assets.

Unregulated Asset Strategy

Background

WaterNSW owns and operates a large number of unregulated weir infrastructures. These are used to intercept water flowing downstream of unregulated rivers which are not regulated by WaterNSW's dams. Their primary use is to create a weir pool for town supplies. WaterNSW still applies its ISO55000 certified Asset Management System, despite its operating licence only covering regulated assets.

WaterNSW has identified potential risks and constraints in managing unregulated weir structures and the need for a clear strategy. WaterNSW receives no revenue requirement from IPART associated with water releases on these weirs and has no direct operational requirement for these structures. The services provided by these structures are considered a Community Service Obligation (CSO). These are services the community expects to be provided that fall outside the corporation's core regulated business such as:

- environmental services to protect or control the inundation of land and river bed support
- stock and domestic watering, and
- watering during drought.

Currently, WaterNSW owns and operates 56 unregulated weirs across NSW.

WaterNSW strategy for unregulated weir assets

A strategy is being developed to identify opportunities and constraints from the operation and maintenance of unregulated weir assets over the long term.

Potential constraints

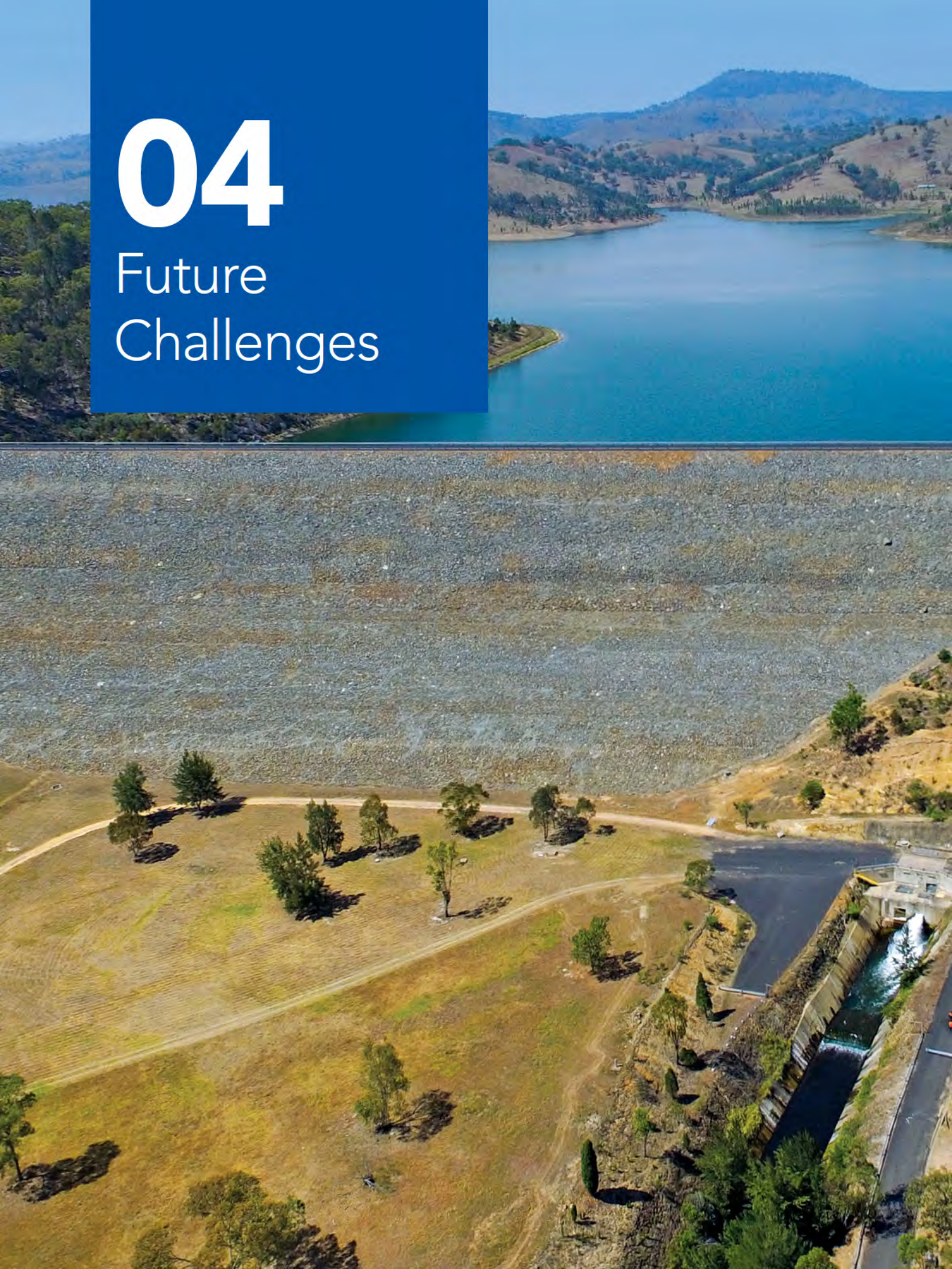
- There are no commercial returns generated through operating and maintaining these unregulated weirs. Operational and maintenance costs are not necessarily recovered.
- 20 per cent of the high priority fish passage sites proposed under the Fishway Strategy are identified on unregulated weir structures. The recovery of the operating and maintenance costs after building fish passages on unregulated weirs remains a significant challenge.
- There is a possibility of transferring the unregulated weirs to local communities or councils (i.e. ownership transfer) for drought security and/or recreational amenity, but success with this approach is uncertain.
- The transfer of ownership for unregulated weirs may require installation of a fishway as part of the works approval conditions by DPI Fisheries.
- Operation and maintenance of some unregulated weirs is challenging due to geographical locations with difficult and/or remote access.
- The poor condition of some structures generates Work, Health and Safety issues.
- $500K per year CSO grant is received for operation and maintenance of unregulated weirs. These funds are not indexed with inflation and so continue to be insufficient to maintain a minimum standard for asset lifecycle requirements, particularly any major asset renewals.
- Decommission of unregulated weirs is difficult due to environmental, heritage and financial constraints.
- Access issues persist if assets are located on private property.

Potential opportunities

The following business opportunities could be generated through an appropriate capital investment on unregulated weirs.

- If the asset is identified as possible to dispose of (i.e. asset removal) then it may also provide the potential to offset an existing fishway requirement elsewhere.
- If an asset is identified as having a high demand for water use then WaterNSW could explore the commercial opportunities to improve LOS with the particular beneficiary.
- Transferring ownership of the asset may be possible to the Regional Council where recreational amenity and/or drought security is particularly valued by a local community.

04
Future Challenges



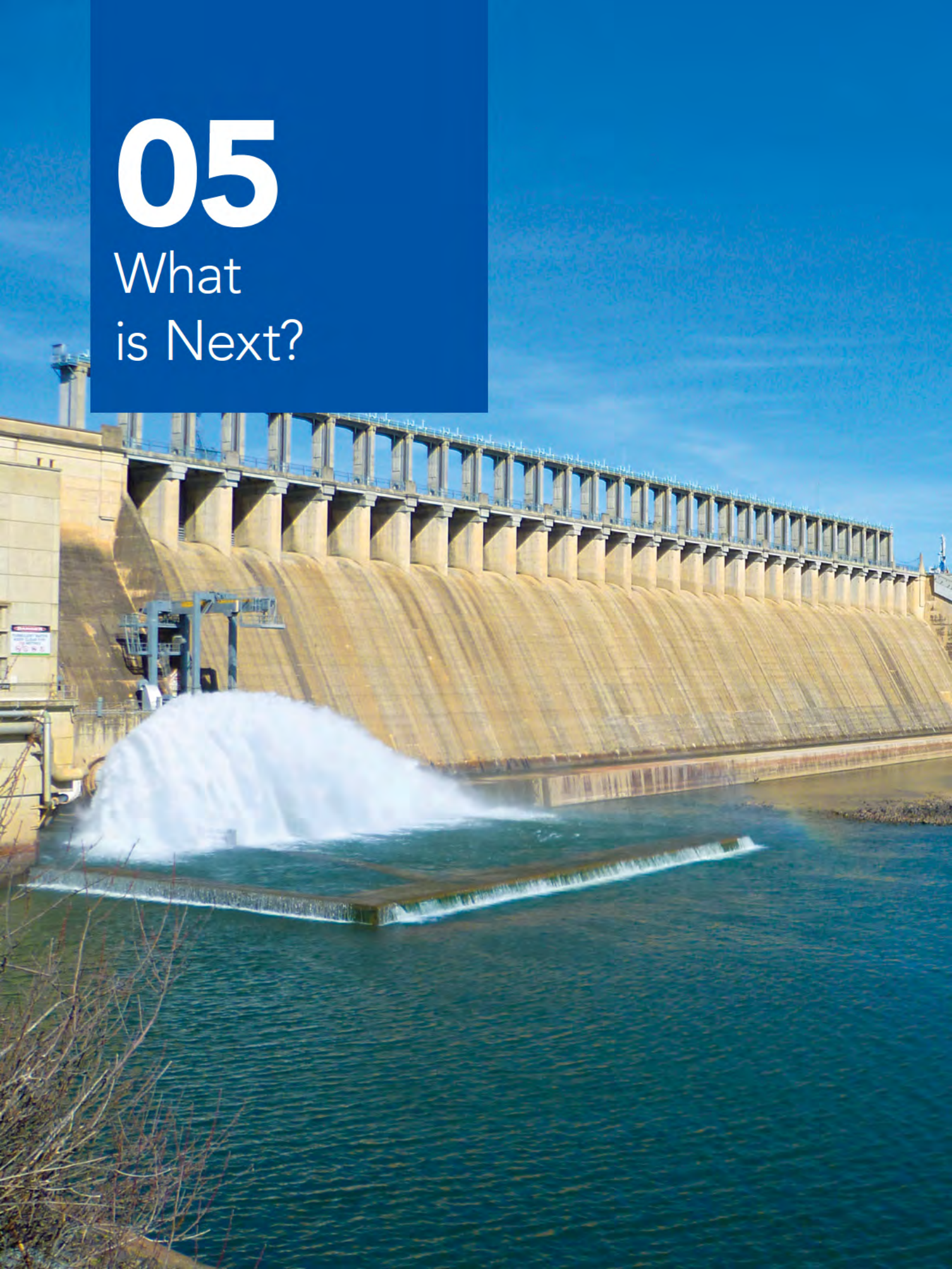
What will the future political, economic, social and technical operating environment be in 20 to 30 years for WaterNSW and our infrastructure assets?

If WaterNSW were to continue operating in the same way, what challenges are likely to be faced in meeting water users' expectations?

WaterNSW faces the following challenges in meeting future water service needs across NSW:

- NSW population forecast to increase by 3.7 M up to 11.2 M by 2056
- greater water market competition driven by technological innovation
- improvements in sub-surface water storage, surface water capture and delivery solutions
- changes in demand and per capita water use
- water accounting improvements
- water quality – greater service delivery expectation
- changes in how environmental water is utilised
- water availability due to climate change
- SDL and environmental water
- agriculture variability
- mining variability
- town water supply and urban demand, and
- carbon constraints.

05
What is Next?



The next steps envisioned for further developing the 20 Year Infrastructure Options Study over the next two years will involve:

- Establishing quantified LOS baseline performance for all rural valleys.
- Engaging with customers to discuss their current and future LOS priorities, and to identify any gaps. The outcomes will either reinforce the infrastructure solutions presented in this document or redefine the suite of options.
- Preparing the sister 20 Year Operating Strategy complete with non-build options and proposed rule changes to address the same LOS priorities and gaps.
- Preparing, analysing and costing a suite of asset and operational options to address the LOS gaps.
- Undertaking a high level economic cost-benefit analysis, and determining the willingness to pay studies to inform WaterNSW's future long-term Capital Investment Plans.
- Exploring and capitalising on opportunities to leverage available government funding where customers are unable to fund the investigations or capital costs of the water supply infrastructure they require.

The outcomes of the above processes will inform the infrastructure planning process for the next edition of the 20 Year Infrastructure Options Study. The next edition will feature a customer shared long-term (seven to 20 year) context for each rural valley that leads to a broader context for WaterNSW's investment decisions.

WaterNSW
169 Macquarie Street
Parramatta 2150
PO Box 398 Parramatta 2124
1300 662 077
waternsw.com.au