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Urban Water Strategy

MARCH 2017

Barwon Water

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Barwon Water proudly acknowledges the Traditional Owners of the land on which we work and live, and pays respect to their Elders past and present. Barwon Water recognises and values the continuing rich culture and the contribution of Aboriginal people and communities to the Victorian community.

Barwon Water

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Table of contents

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Barwon Water's service area and overview

Our profile

Barwon Water is Victoria's largest regional urban water corporation. Our history dates back to the establishment of the Geelong Municipal Waterworks Trust in 1908.

Our core business

Barwon Water provides high quality water and sewerage services to more than 298,000 permanent residents over 8,100 square kilometres. Over the holiday period, the serviced population can reach up to 510,000 people.

Our people

As a major employer in the region, Barwon Water has more than 300 operational, engineering, strategic planning, financial and administrative employees.

Our region

Our region of responsibility stretches from Little River and the Bellarine Peninsula in the east to Colac in the west, and from Meredith and Cressy in the north to Apollo Bay on Victoria's south-west coast.

The City of Greater Geelong, Borough of Queenscliffe, Surf Coast and Colac Otway shires and part of Golden Plains Shire are incorporated in our service area.

Our assets

- 12 major reservoirs
- 8 water treatment plants
- 2 water pre-treatment plants
- 11 water reclamation plants (WRPs)
- 2 Class A recycled water plants
- 2 groundwater fields
- 49 water pumping stations
- 194 sewerage pumping stations
- 19 water basins
- 40 water tanks
- 6,633 kilometres of pipes

Water customers

Domestic customers comprise 92 per cent of the customer base, with the industrial and commercial sectors accounting for the remaining 8 per cent. Approximately 30 per cent of metered consumption is attributed to non-domestic customers.

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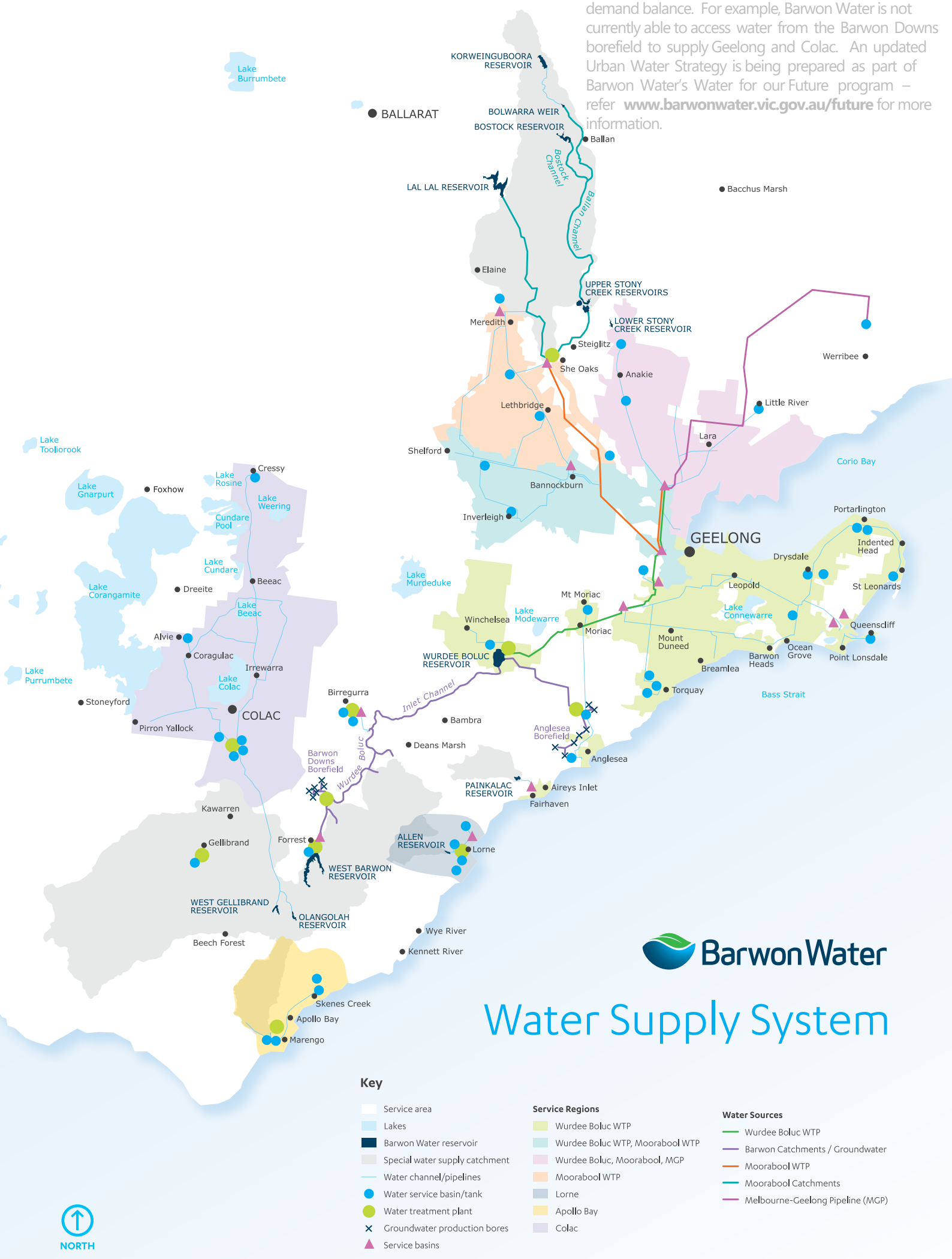

Barwon Water

Water Supply System

Key

- Service area
- Lakes
- Barwon Water reservoir
- Special water supply catchment
- Water channel/pipelines
- Water service basin/tank
- Water treatment plant
- Groundwater production bores
- Service basins

Service Regions

- Wurdee Boluc WTP
- Wurdee Boluc WTP, Moorabool WTP
- Wurdee Boluc, Moorabool, MGP
- Moorabool WTP
- Lorne
- Apollo Bay
- Colac

Water Sources

- Wurdee Boluc WTP
- Barwon Catchments / Groundwater
- Moorabool WTP
- Moorabool Catchments
- Melbourne-Geelong Pipeline (MGP)

NORTH

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Chair's foreword

Barwon Water is proud to play a key role supporting the liveability and prosperity of our region by delivering safe and secure water supplies.

Water supports the agriculture, industry and businesses that drive our region's economy, and sustains our towns and cities as desirable places to live. Our catchments and waterways provide a place of recreation and sanctuary for us today, and have been a source of vitality and spiritual significance for Traditional Owners for millennia.

Victoria has long acknowledged Aboriginal people as the custodians of the land and water on which we rely, but we are yet to fully recognise and benefit from that cultural heritage in the way we manage our water resources. For the first time, we are committing to better incorporating Aboriginal knowledge and values as we plan for the future.

As our population continues to grow demand for water is ever greater, but at the same time we know that a changing climate is likely to reduce the amount of water available from our traditional supplies. We shouldn't underestimate the difficult conditions an uncertain future may present. Under a scenario of high climate change and high population growth, for example, substantial investments to maintain water supply security would be necessary across our region in the coming decades.

The fifty-year outlook of the *Urban Water Strategy* enables – and requires – us to rise boldly to this challenge. We are optimistic about our ability to respond as an organisation and as a community, working together to make best use of the resources we have available to drive the region's continued prosperity and liveability.

With a culture of innovation at our core, being clever about how we use all water sources – including the large volumes of recycled water that we produce – will be critical to meeting our future needs. That is why we have set a path towards a long-term aspiration for zero waste and complete recovery and recycling of water and other resources. More than ever, we understand the need to make the most of what we have.

Our customers should continue to be central to the way our services evolve to best meet future needs, and the *Urban Water Strategy* provides a basis for ongoing engagement. It details the options available to balance supply and demand in each of our systems over the long term, alongside our strategic response to the challenges and opportunities we have identified.

Guided by the state's new Water Plan, *Water for Victoria*, we have prepared a clear blueprint for managing water for the betterment of our customers, communities, Traditional Owners and the environment.

I have pleasure in presenting Barwon Water's *Urban Water Strategy*.

Jo Plummer
Chair

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The Strategy in brief

The Urban Water Strategy describes how Barwon Water will continue to deliver safe, secure and sustainable water and sewerage services over the next fifty years. The strategy updates and replaces the 2012 Water Supply Demand Strategy.

Barwon Water's mission

To deliver quality and affordable water and sewerage services that strengthen the economy, promote liveability and protect the environment.

Urban water strategy goal

To continue to deliver secure water supplies, supporting resilient and liveable communities under a range of climate futures.

A planning horizon of half a century requires visionary thinking. Without losing sight of more immediate needs, this strategy embraces the opportunity to prepare for a future that may look very different to today. A growing population, changing climate, evolving customer needs and a desire to protect and sustain the environment and cultural values are just some of the factors that will shape the decades ahead. Supporting resilient, prosperous and liveable communities through this change requires a clear strategy and strong leadership.

Engaged and empowered customers continue to be central to the direction we take. As our services evolve, we must ensure that they do so to meet the needs and preferences of communities, customers and Traditional Owners across the region. Recognising and supporting Aboriginal values will help underpin sustainable stewardship of our land and water. A commitment to better reflecting Aboriginal values and knowledge in our planning will support a healthy environment, provide economic opportunities for Aboriginal groups, and enhance our region for future generations.

We understand that we are approaching sustainable limits in our consumption of natural resources such as water. We are also committed to addressing the challenge of climate change, with implications for the way we use, source and even produce energy. There is a strong connection between water and energy use, reflecting more broadly the need to continually think about the way we use available resources.

In particular, it emphasises the primary need to make the most productive use of what we have to support our region's ongoing prosperity. This will provide the foundation for a strong economy, a healthy environment and liveable towns and cities.

Our long-term ambition is to achieve optimal use of our resources to the full extent possible – to manage our water and wastewater systems with zero waste, seeking to recover and reuse not only water but other resources, such as energy and nutrients, embodied within waste streams. Beyond reflecting our desire to protect the environment that sustains us, this will underpin a resilience that supports regional growth and prosperity in the face of change.

Productive use of available resources means:

- **reducing** water consumption through efficiency and conservation
- **replacing** drinking water with alternative sources where they are fit-for-purpose
- **recycling** more of the water discharged from our water reclamation plants
- **recovering** other resources, such as energy and nutrients, that are embedded in waste streams.

We already do all of these things to some extent, but we believe we can go further. Aspiring to fully recover or recycle all resources is an ambitious target that is undoubtedly challenging, but we will not achieve such substantial change unless we articulate the vision to do so.

These ambitions are supported by a strong belief in the need to foster innovation and new ideas. The next fifty years will provide many opportunities, including some we can foresee and many we can't yet imagine. We will embed a culture of innovation to seize these opportunities.

Our longer-term aspirations will guide our focus and direction, with the actions in this strategy setting us on a clear path in the short-term.

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Key challenges

The *Urban Water Strategy* provides an opportunity to respond to some of the key challenges and opportunities that are shaping our direction for the future.

The impacts of climate change and variability	
Where we are now	**What we are doing**
Most of our water resources are climate dependent and respond to the natural variability that is a feature of our climate. In the future, the impacts of climate change are expected to result in a drier, hotter climate that will reduce the water available from traditional resources. While evolving climate science informs our planning, there is considerable uncertainty about the climate future we face over the next 50 years and beyond.	The strategy is underpinned by Barwon Water's climate change mitigation and adaptation strategies, as well as best-practice guidance from the Victorian Government. We have undertaken detailed scenario modelling of water availability. An informed and prepared approach to managing all plausible climate futures is the basis of this strategy.
Actions	
6.1 We will continue to use the latest climate science and scenario analysis in water resource modelling 6.2 We will collaborate on further research into the impact of bushfires on yield from the Barwon, Moorabool and Gellibrand catchments 6.3 We will deliver on our *Climate Change Mitigation Plan* targets: achieving 100 per cent renewable energy use by 2025 and zero net greenhouse gas emissions by 2030	

Servicing a growing population	
Where we are now	**What we are doing**
Parts of our region are among the fastest growing in Australia. As demand for water and wastewater services grows, we must be able to maintain service levels while protecting the environment and contributing to sustainable and liveable communities.	Scenario modelling includes considering the potential range of population growth scenarios that will influence future demand. A better understanding of the complex factors contributing to future demand will help us plan more confidently. Making the most of the resources that are available is also critical to managing demand and supporting a prosperous region.
Actions	
6.4 We will participate in industry research and apply emerging approaches to improve the accuracy of demand forecasts	

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Meeting customer expectations	
Where we are now	**What we are doing**
An understanding and awareness about the role of water services in supporting sustainable and liveable communities is driving increasing and more diverse customer expectations.	Barwon Water strives to be recognised as customer-focused and community-minded. Customer engagement has made an important contribution to the development of the Urban Water Strategy. A commitment to ongoing engagement with our customers and the community is a key feature of this strategy.
Actions	
7.1 We will continue to engage with our customers, the community and other stakeholders on issues identified in the Urban Water Strategy	
7.2 We will update the community on Barwon Water's water security status and forecast each year by publishing the *Annual Water Outlook*	
7.3 We will engage with customers to establish whether existing service levels and restrictions are understood and align with customer preferences, or should be revisited as part of the next *Urban Water Strategy*	

Recognising and supporting Aboriginal values	
Where we are now	**What we are doing**
We acknowledge Aboriginal people as the Traditional Owners and custodians of the land and water on which we rely. Traditional Owners have a strong connection to water as a vital part of their life and culture. Water resource planning needs to better acknowledge and support these values.	We have engaged with Aboriginal groups in the course of preparing this Urban Water Strategy. This consultation represents just the first stage in building relationships with Traditional Owners. We understand the enormous value of our region's land and water to Traditional Owners. We recognise the significant opportunity to better engage with Aboriginal groups to reflect their knowledge in water resource planning and ensure Aboriginal values are embraced and protected.
Actions	
7.4 We will engage with Traditional Owner groups to recognise, include and support inclusion of Aboriginal values in water resource management	
7.5 We will explore opportunities as part of the review of the *Central Region Sustainable Water Strategy* to provide access to water to Aboriginal groups for economic development	
7.6 We will work with the Corangamite CMA and Traditional Owners to document the cultural values in the Barwon, Moorabool and Otway Coast river systems to increase understanding of Aboriginal values that can be supported with environmental water	

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Delivering integrated solutions	
Where we are now	**What we are doing**
We recognise the benefits from working collaboratively with the various stakeholders that have a role in delivering water cycle services. As our towns and cities grow and evolve, the integration of land and water planning is critical to ensure we foster places that are sustainable and liveable.	As part of an integrated water management (IWM) approach, we will actively participate in appropriate forums and investigate opportunities for integrated planning and alternative water resources to deliver wider benefits to the community. Making the most of available water resources means a determined focus on water efficiency, as well as embracing the use of recycled water, stormwater and rainwater to underpin regional prosperity. Fostering a culture of innovation that embraces new technology and new ideas will be critical to enable us to achieve more with less.

Actions

8.1 We will continue to lead investigation of integrated water management (IWM) and alternative water opportunities through the Barwon Region Integrated Water Cycle Management (IWCM) Network and IWM Forums

8.2 We will lead the development and implementation of local IWM Plans for Lorne and Apollo Bay

8.3 We will lead the development and implementation of IWM Plans for Geelong's future northern and western growth areas in collaboration with the City of Greater Geelong and other stakeholders

8.4 We will continue to work with local government to ensure that planning for new land development contributes to liveable and resilient communities

8.5 We will determine arrangements for the protection of priority open spaces during drought in consultation with local government and the community

8.6 We will undertake research and development that contributes to ongoing innovation in water efficiency measures

8.7 We will develop, implement and monitor water efficiency programs such as the 'Target Your Water Use' program

8.8 We will facilitate and partner in research and development that contributes to ongoing innovation in the water sector

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Supporting environmental health	
Where we are now	**What we are doing**
Water resource management must balance the needs of competing uses, including the needs of the environment. It is recognised that some waterways, such as the Moorabool River, would benefit from additional environmental flows, particularly as the impacts of climate change potentially reduce streamflows across the region in the future.	We harvest water in accordance with the conditions of our bulk entitlements, which prioritise flows for the environment. We also work with stakeholders to co-ordinate releases from our storages to provide the greatest benefit to the environment with the resources available. Long-term resource assessments and Sustainable Water Strategies planned by the Victorian Government in coming years will identify priorities for environmental water. We are committed to exploring further opportunities to help meet those needs.

Actions	
9.1	We will work with the Victorian Environmental Water Holder and Aboriginal groups to explore further opportunities to operate our headworks systems so that environmental and Aboriginal values are supported
9.2	We will contribute to the review of the Central and Western Region Sustainable Water Strategies and regional long-term water resource assessment
9.3	We will work with stakeholders to explore options to achieve goals for environmental flows in the Barwon and Moorabool Rivers, while continuing to ensure secure and affordable water supply in the Geelong system
9.4	We will collaborate with local government and stakeholders to ensure appropriate domestic wastewater management that supports growth and protects public health, the environment and liveability

Making the most of the Victorian water grid and markets	
Where we are now	**What we are doing**
A pipeline completed in 2012 connecting Melbourne to Geelong is an example of the expanding water grid that links diverse water sources across our region and the state. The water grid creates the opportunity to participate in the trade of those connected resources within an evolving water market.	The water grid and evolving water markets introduce an opportunity to optimise the way resources are used, including for the environment – but there is inherent complexity and governance challenges that must be understood and overcome. We will work with the Victorian Government to make the most of the opportunities provided by the grid and markets.

Actions	
10.1	We will actively participate in the south central market trial being initiated by the Victorian Government in 2017
10.2	We will, in parallel with the south central market trial, investigate the opportunities and risks specific to Barwon Water and develop a decision-making framework for water trading
10.3	We will explore opportunities for the evolving water grid and markets to help contribute to meeting environmental water recovery targets in the Barwon and Moorabool Rivers

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An aerial view of Geelong Waterfront

Adaptive planning

This five-year strategy has an outlook of fifty years. In an uncertain future, one of the key challenges we face is ensuring we make the right decisions at the right time.

We adopt an adaptive planning framework to ensure we are prepared to act decisively when conditions require. This is underpinned by detailed modelling of a wide range of future scenarios, which help us understand potential outcomes for our systems from a changing climate and growing population.

We then actively monitor conditions in order to respond accordingly, based on the actions we have identified to maintain service levels into the future across each of our water supply systems.

Water supply system strategies

Each of our water supply systems is described below, including the outlook over the planning horizon and the actions proposed to ensure that we continue to maintain levels of service.

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Water supply in Geelong

The existing population of the Greater Geelong region is approximately 280,000. Parts of the region are experiencing rapid population growth, with the total number of residents projected to grow to beyond 600,000 by 2065 under a high growth scenario.

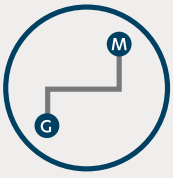
Geelong's annual water demand of **31,070 ML** is comprised of residential and non-residential (commercial and industrial) use. The region includes a number of large users, such as refineries, research institutes, metal processors, malting houses, wood processors and breweries. Demand is projected to potentially double over the planning horizon.

Although more recently diversified to include other sources, Geelong traditionally relied upon the three major surface water catchments of the Barwon, East Moorabool and West Moorabool Rivers. Barwon Water is entitled to take up to **130,400 ML over three years** in the Barwon system, **23,800 ML over three years** from the West Moorabool and **9,000 ML/year** from the East Moorabool system. Importantly, these volumes are subject to streamflows into the reservoirs.

Storage in the Geelong system totals **96,000 ML**, which is about three years' supply. Major reservoirs include the **West Barwon (21,500 ML)** and **Wurdee Boluc (38,000 ML)** in the Barwon system; **Lal Lal (16,800 ML share)** in the West Moorabool system; **Korweingboora (2,300 ML)** and **Bostock (7,500 ML)** in the East Moorabool system; and the **Stony Creek** reservoirs **(9,500 ML)**.

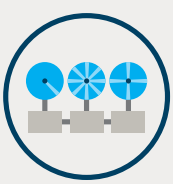
Geelong's water supply includes a licence to extract groundwater sourced from the **Barwon Downs Borefield** within the Gerangamete Groundwater Management Area and a bulk entitlement for the **Anglesea Borefield** within the Jan Juc Groundwater Management Area.

Periodic operation of the borefields is based on system attributes and requirements, and in accordance with the licence and entitlement conditions. The licence to operate Barwon Downs is due for renewal in 2019.



Completion of the Melbourne to Geelong Pipeline in 2012 connects Geelong to the resources of the Melbourne system. Barwon Water holds an entitlement to **16,000 ML/year** in the Greater Yarra System – Thomson River Pool and access to storage in the Melbourne system.

Recent connections have expanded the Geelong system along the Surf Coast and will incorporate Colac via a new pipeline in 2017.



The Greater Geelong region has a complex supply system due to its diverse water sources and geographical expanse.

Water sourced from the Barwon system is treated at the **Wurdee Boluc Water Treatment Plant** and distributed to the main Geelong network. Forrest and Birregurra have independent treatment plants.

The **Moorabool Water Treatment Plant** at She Oaks treats water from the Moorabool system, prior to distribution through the Geelong network as well as to several smaller townships in the vicinity.

The Melbourne to Geelong pipeline (MGP) delivers water from the **Melbourne Bulk Transfer System** to the Lovely Banks storage basins before distribution to the Geelong supply network.

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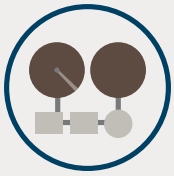
Wastewater Management in Geelong



Eight water reclamation plants treat wastewater across the Greater Geelong region. The **Black Rock** and **Northern Water Reclamation Plants** are the largest and treat sewage from much of Geelong and the Bellarine Peninsula.

The **Northern Water Plant** provides up to 2,000 ML/year of Class A recycled water to the Viva refinery in Corio. The Black Rock water reclamation plant provides recycled water for agricultural and residential customers, with the excess discharged to Bass Strait under an EPA discharge licence.

All treated water from **Bannockburn**, **Winchelsea** and **Portarlington** water reclamation plants is reused either onsite or for irrigation of nearby golf courses, recreation reserves or farmland. A portion of treated wastewater from **Anglesea Water Reclamation Plant** is used for irrigation of the local golf course and recreation reserve, with the remainder discharged to Bass Strait under an EPA discharge licence.

Outlook for Geelong

Water supply system outlook	Secure

Recent investments have ensured that water supply to the Greater Geelong region is secure. Population growth and the impacts of climate change will mean that further supply augmentations are required in the future, though this is not anticipated until 2035 at the earliest.

Water security vulnerability assessment	Low

A diverse portfolio of secure water resources provides resilient and flexible supply.

Forecast water supply upgrade requirements (all figures in ML/year)			
Climate change and population growth scenario	**Median**	**High**	**Step-change**
Current demand:	31,070	31,070	31,070
Current yield:	53,480	53,480	40,570
Demand at 2065:	53,850	61,270	61,270
Yield at 2065:	51,640	46,110	40,570
Year demand equates to yield:	2061	2047	2035
Extra yield required to meet demand in 2065:	2,210	15,160	20,700

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Options for investigation		Indicative volume (ML/year)
Optimising existing assets and resources where efficient	Use a portion of the peak winter flow from Gellibrand River via a tunnel or pipeline to West Barwon Reservoir	1,800
	Use a portion of the peak winter flow from Gellibrand River by backflow through new Colac pipeline to aquifer storage and recovery (ASR) at Barwon Downs, or to the Wurdee Boluc Inlet Channel (WBIC)	540
	Optimise operation of available water sources in the Geelong system	TBC
New or expanded water sources and connecting to the Victorian water grid	Use recycled water for agriculture, industry and to support the environment and recreation, and investigate the potential for indirect potable reuse	Up to 15,000 ^*
	Increase the capacity of the MGP and purchase additional entitlements from the Melbourne system	8,000 ^
	Local desalination plant	5,000 ^
	Access groundwater held by Alcoa Anglesea	2,000
	Use alternative water to irrigate public open space	TBC
	New suburb dual pipes	750
	Rainwater tanks for fit-for-purpose use in new developments	650
	Retrofit rainwater tanks for fit-for-purpose use in some existing houses	TBC

^ Can be designed to meet a wide range of volumes
* Would require regulatory approval

Wastewater system outlook	Some upgrades planned
In the Geelong region, upgrades are planned at the Black Rock, Winchelsea, Portarlington, Bannockburn and Birregurra water reclamation plants in accordance with the regional wastewater strategy.	

Geelong system actions	
G1	We will investigate further optimising the way we use available water sources in the Geelong water supply system by developing a decision-making framework to guide operation
G2	We will work with the community, government and other stakeholders to renew our Barwon Downs groundwater licence by 2019, developed in consideration of an improved understanding of the environmental and social impacts of the borefield operation
G3	We will further investigate the options available to contribute to water supply security for the Greater Geelong region in the longer term
G4	We will implement progressive upgrades to the Black Rock Water Reclamation Plant to cater for growth beyond 2050
G5	We will investigate options to use recycled water from the Birregurra and Winchelsea Water Reclamation Plants for environmental flows in the Barwon River

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Water supply in Colac

The Colac area has a population of approximately 14,000, which is projected to increase to around 20,000 by 2065 under a high growth scenario.

Current demand is approximately **3,250 ML/year**, comprising residential, industrial and agricultural use.

Major non-residential use include local industries such as timber processing, abattoirs and dairy processing. Changes in land use and local industry are expected to have a more profound impact on demand over time than residential population growth.

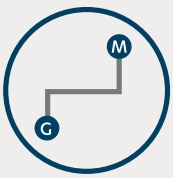
Water supply to Colac is sourced from the protected catchments of the **Gellibrand River** and **Olangolah Creek** in accordance with a bulk entitlement for up to **5,400 ML/year**.

The catchments are noted for their high environmental value as part of the Otways Ranges.

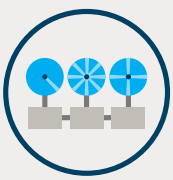
The **West Gellibrand Reservoir**, located on the Gellibrand River, has a storage capacity of **1,850 ML**. The **Olangolah Reservoir**, on the Olangolah Creek, has a storage capacity of **150 ML**. These reservoirs generally spill over the course of each winter and spring.

A main supply pipeline transfers water approximately 25km from the reservoirs to two basins on the outskirts of Colac with total storage capacity of 640 ML.

Colac will be connected to the Geelong system in 2017, providing the ability to deliver water to Colac from the Barwon system. The new pipeline improves the resilience of the Colac supply, which otherwise relies on a single source.



Through the connection to the Geelong system, Colac will be able to take water from the Barwon Downs borefield.

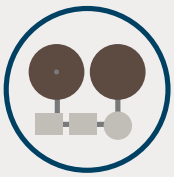


Water is treated at the Colac Water Treatment Plant prior to distribution. The Colac urban area, which comprises approximately 50-60 per cent of the system's usage, is supplied via a 4.5 ML covered storage at Elliminyt.

The surrounding townships of Alvie, Beeac, Corrorooke and Cressy are supplied directly from the Clear Water Storage Tank at the Water Treatment Plant. A 50 ML balancing storage at Alvie and elevated water tower at Cressy manage periods of high demand.

Urban Water Strategies are updated every five years in response to constant changes in the supply and demand balance. For example, Barwon Water is not currently able to access water from the Barwon Downs borefield to supply Geelong and Colac. An updated Urban Water Strategy is being prepared as part of Barwon Water's Water for our Future program – refer **www.barwonwater.vic.gov.au/future** for more information.

Wastewater Management in Colac



The Colac Water Reclamation Plant is located on the north eastern edge of the town and treats approximately **1,450 ML/year**.

The plant treats wastewater from residential, commercial and industrial customers in the area to produce Class-C recycled water. A small proportion of recycled water is reused onsite, with the remainder being discharged to Lake Colac.

Lake Colac largely dried out during the Millennium Drought and as recently as summer 2015/16. Discharges from the Colac WRP are important as one of the major sources of water for the lake during dry periods.

Recycling of treated wastewater is limited to less than 5 per cent of total annual flows, indicating an available resource of more than 1,300 ML/year.

A biological treatment process is utilised to produce effluent to a quality suitable for discharge to Lake Colac in accordance with Barwon Water's EPA licence. This process is beneficial for the lake as an additional source of inflow throughout the year.

Wurdee Boluc Reservoir

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Outlook for Colac

Water supply system outlook	Secure

A pipeline connecting Colac to the Geelong system will be completed in 2017. The connection provides Colac with backup supply during periods of drought, ensuring more secure and resilient supply to the town.

Water security vulnerability assessment	Low

With provision of a second source, the existing vulnerability of the Colac water supply system to risks such as bushfire and landslip, as well as reliance on seasonal filling conditions, is substantially mitigated.

Forecast water supply upgrade requirements (all figures in ML/year)

Climate change and population growth scenario	Median	High	Step-change
Current demand:	3,248	3,248	3,248
Current yield:	5,200	5,200	5,200
Demand at 2065:	4,136	4,679	4,679
Yield at 2065:	5,200	5,200	5,200
Year demand equates to yield:	Beyond 2065		
Extra yield required to meet demand in 2065:	None		

Options for investigation

No options are explored given that there is no need for additional yield to be delivered over the planning horizon.

Wastewater system outlook	Some upgrades planned

Additional infrastructure was commissioned at the Colac water reclamation plant in 2016 to address a significant increase in flows and loads from new industry. Further works are proposed to progressively increase the capacity of the plant to manage the changes and further growth in local industry.

Colac system actions

C1 We will continue to deliver the Colac Demand Management Strategy and commission the new pipeline connecting Colac to the Geelong system

C2 We will implement progressive upgrades to the Colac Water Reclamation Plant to cater for growth in loads for industry and manufacturing

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Water supply in Apollo Bay and Skenes Creek

The existing permanent population of Apollo Bay and surrounds is approximately 2,000. This is projected to grow towards 3,000 by 2065 under a high growth scenario.

However, visitors to the coastal destination temporarily increase the population to around 20,000 each summer.

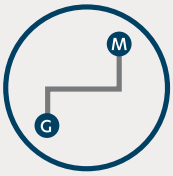
Apollo Bay's annual water demand of 375 ML is predominantly for residential use. Daily demand is substantially higher over the summer months with the influx of visitors. This period also coincides with higher water use to maintain gardens, public open space and other irrigated areas such as the golf course.

Water supply for the towns of Apollo Bay, Skenes Creek and Marengo is sourced from the Barham River in accordance with a bulk entitlement for up to 800 ML/year. In practice, the volume of water harvested by Barwon Water is limited by seasonal water availability, storage capacity and passing flow conditions that prioritise water for the environment. The Barham River originates in the Otways Ranges, which typically experience high, reliable rainfall.

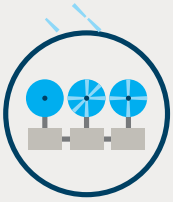
The Apollo Bay system relies on 'run-of-the-river' harvesting, which means that water is taken directly from the Barham River rather than being held back in a reservoir or dam. Water is extracted from the river when flows permit and stored in two off-stream storages with total capacity of 375 ML.

These characteristics reflect the seasonal nature of the Apollo Bay system, which relies on storage that can be drawn upon to meet peak summer demand, then reliably filled by harvesting at other times.

Apollo Bay does not rely on any additional supply from groundwater. The limited groundwater resources in the area are often brackish.



Apollo Bay's water supply is not connected to the wider water grid. The location and surrounding geography of Apollo Bay mean that a connection to the broader Victorian grid, although feasible, would be a substantial investment.



The Apollo Bay WTP is adjacent to the Marengo Basin. Water passing through the microfiltration plant is pumped to a high level balancing tank, from which it gravitates to Apollo Bay through two main pipelines. A small balancing tank and pump station at the northern end of the system transfers water to a high level tank at Skenes Creek. Additional booster pumps and another high level tank at Skenes Creek service the more elevated parts of the system.

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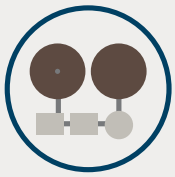
Wastewater Management in Apollo Bay and Skenes Creek



Wastewater is delivered to the Apollo Bay Water Reclamation Plant, located within agricultural surrounds outside the town. Constructed in 1997, the plant is designed to cater for the fluctuation in flows at different times of the year. It treats an average of approximately 375 ML/year, with capacity for double this volume.

No augmentations to the wastewater system are planned in the short term, however upgrade of the hydraulic capacity between the WRP and the ocean is likely to be required within the 50 year planning horizon.

Reclaimed water is discharged via a submerged ocean outfall pipeline under an EPA discharge licence. Less than 5 per cent of the volume of wastewater treated each year is reused on-site at the WRP. While opportunities to increase recycled water use will continue to be explored, the cost of additional treatment, storage and distribution may present a barrier.

Outlook for Apollo Bay and Skenes Creek

Water supply system outlook	Action required
Since the 2012 Water Supply Demand Strategy, revisions to projected climate change impacts, along with the experience of unprecedented conditions in the summer of 2015/16, have reduced the forecast water supply security for Apollo Bay and Skenes Creek. An upgrade to the system may be required as soon as 2024 under worst-case conditions, though this could be deferred until 2032 under median climate change and population growth. A number of options to maintain secure water supply have been identified. To ensure we are ready to act, we will explore these options with the community and progress planning works so that we are prepared to respond with the preferred approach when it is required.	

Water security vulnerability assessment	Medium
The seasonal nature of the system means there is some vulnerability to severe, short-term climate conditions.	

Forecast water supply upgrade requirements (all figures in ML/year)			
Climate change and population growth scenario	**Median**	**High**	**Step-change**
Current demand:	371	371	(High scenario reflects worse case for inflows)
Current yield:	408	408	
Demand at 2065:	470	539	
Yield at 2065:	397	342	
Year demand equates to yield:	2032	2024	
Extra yield required to meet demand in 2065:	73	197	

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Options for investigation		Indicative volume (ML/year)
Optimising existing assets and resources where efficient	Increase efficiency of water treatment	18
	Renegotiate bulk entitlement conditions	90
	Use alternative water for irrigation of open spaces	12
	Rainwater tanks for fit-for-purpose use in new homes	9
	Retrofit rainwater tanks for fit-for-purpose use in some existing houses	TBC
	Recycled water to offset environmental flows	90
New or expanded water sources and connecting to the Victorian water grid	Additional off-stream storage	197*
	Local desalination plant	197*
	Connection to Geelong system from West Barwon Reservoir	197*
	Connection to Geelong system from West Gellibrand Reservoir	197*

*Can be designed to meet a wide range volumes

Wastewater system outlook	No upgrade required
The Apollo Bay Water Reclamation Plant is currently operating at approximately half its design capacity. However, there is a hydraulic constraint between the WRP and the ocean that will need to be addressed during the 50 year planning horizon. There is no imminent need for major works to improve sewerage infrastructure in Apollo Bay and Skenes Creek.	

Apollo Bay and Skenes Creek system actions
AB1 We will complete a review of the environmental flow recommendations for the Barham River in 2017, to inform a review of Bulk Entitlement rules
AB2 We will commence engagement with the community and Traditional Owners in 2018 to review options and identify a preferred approach to ensure water supply security for the long term
AB3 We will commence early planning works in 2019 for the preferred approach to maintain water security in the long term

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Water supply in Lorne

Lorne has a permanent residential population of approximately 2,000 people, which increases up to 20,000 over the summer holiday period.

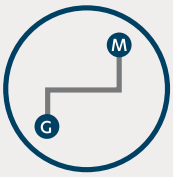
Lorne's annual demand of **375 ML** is comprised predominantly of residential use. Daily demands are significantly higher during summer, when the population swells substantially.

Lorne's water is sourced from the protected catchment of the **St George River** in accordance with a bulk entitlement for up to **510 ML/year**.

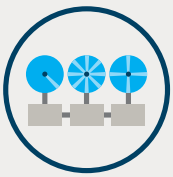
The catchment is noted for its high environmental value as part of the Otways Ranges.

The **Allen Reservoir** is located on the St George River, west of Lorne. Although the reservoir capacity of **196 ML** is significantly less than annual demand, the steep, forested catchment means that runoff during rain events is high and the storage can fill rapidly.

Lorne does not rely on any additional supply from groundwater.



Lorne's water supply is not connected to the wider water grid. Hemmed in between the sea and the steep terrain of the Otway Ranges, Lorne's location and geography would make construction of a pipeline to connect to the neighbouring Geelong system – either at Aireys Inlet or West Barwon Reservoir – challenging.



Lorne has a complex supply system due to its hilly terrain. The system includes a Water Treatment Plant (WTP), three water basins and five water storage tanks, including at the WTP and Teddy's Lookout.

Opposite: Apollo Bay Basin

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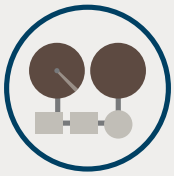
Wastewater Management in Lorne



Wastewater from the town is delivered to the Lorne Water Reclamation Plant. The plant treats approximately 284 ML/year but is designed to cater for the large fluctuations in flows that result from the increase in population over summer. Inflows for much of the year average around 0.6 ML/day, increasing up to 3.5 ML/day over the peak season.

A small proportion of the Class C recycled water produced each year is reused onsite. The remainder is discharged via an ocean outfall in accordance with an EPA Licence.

Outlook for Lorne

Water supply system outlook	Plan and prepare

Lorne's water supply may require an upgrade as soon as 2032, although median climate change and population growth would defer this need beyond 2050. The wide range in the timing reflects the responsiveness of the Lorne system to climate conditions impacting streamflows in the St George River, as well as uncertainty about population growth.

We have identified a range of options to respond to this uncertainty and deliver additional supply security whenever required. We will engage with the community to explore and develop these options to ensure a readiness to act in response to conditions as they evolve.

Water security vulnerability assessment	Medium

Lorne relies on a single source of supply and seasonal filling conditions to meet peak demand over summer months.

Forecast water supply upgrade requirements (all figures in ML/year)			
Climate change and population growth scenario	**Median**	**High**	**Step-change**
Current demand:	375	375	(High scenario reflects worse case for inflows)
Current yield:	443	443	
Demand at 2065:	436	499	
Yield at 2065:	378	300	
Year demand equates to yield:	2050	2032	
Extra yield required to meet demand in 2065:	41	139	

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Options for investigation		Indicative volume (ML/year)
Optimising existing assets and resources where efficient	Increase efficiency of water treatment	16
	Use alternative water to irrigate public open space	3
	Rainwater tank for fit-for-purpose use in new homes	9
	Retrofit rainwater tanks for fit-for-purpose use in some homes	TBC
New or expanded water sources and connecting to the Victorian water grid	Raise height of Allen Dam	63
	Local desalination	139*
	Connection to the Geelong system at Aireys Inlet	139*

*Can be designed to meet a wide range volumes

Wastewater system outlook	No upgrade planned
In the Geelong region, upgrades are planned at the Black Rock, Winchelsea, Portarlington, Bannockburn and Birregurra water reclamation plants in accordance with the regional wastewater strategy.	

Lorne system actions	
L1	We will engage with the community and Traditional Owners to review options and identify a preferred approach by 2022 to ensure water supply security for the long term
L2	We will commence early planning works for the preferred approach to maintain water security in the long term

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Water supply in Gellibrand

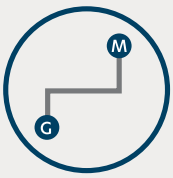
Gellibrand has a permanent residential population of around 72. Regional growth projections have limited applicability for a town such as Gellibrand, but water supply infrastructure is adequate to cater for a substantial proportional increase in population should it eventuate.

Gellibrand's annual demand of **18 ML** is comprised predominantly of residential use.

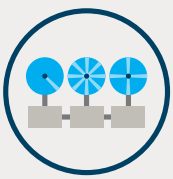
Gellibrand's water is sourced from Lardner Creek in accordance with the conditions of our bulk entitlement for up to **60 ML/year**.

The reliability of flows in Lardner Creek and the small volume of demand means that there is no need to store water in Gellibrand. There is limited storage at the Water Treatment Plant to balance peak demands.

Gellibrand does not rely on groundwater.



Gellibrand's water supply is not connected to the wider water grid. The town's location, very limited demand and the reliability of the Lardner Creek mean that a connection to neighbouring supply systems is not required.



Water from Lardner Creek is treated at the Gellibrand Water Treatment Plant prior to distribution.

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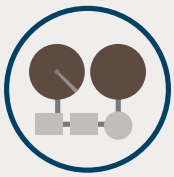
Gellibrand Water Treatment Plant

Wastewater Management in Gellibrand



Gellibrand is not currently serviced by reticulated sewage collection and treatment. Each property is responsible for managing its own wastewater in on-site septic or treatment systems.

There is no recycled water production or use in Gellibrand.

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Outlook for Gellibrand

Water supply system outlook	Secure
The volume of water supplied to the Gellibrand township is a small proportion of streamflows in the Gellibrand River. Even under the worst conditions on record and the most severe climate change projections, available water far exceeds demand. No actions are required to maintain service levels in Gellibrand over the planning horizon.	

Water security vulnerability assessment	Medium
The main risk to water supply in Gellibrand is associated with impacts to water quality from bushfire or prolonged dry periods. However, given the small size of the system, short-term impacts can be readily managed by carting water from the Colac system or the Barwon system.	

Forecast water supply upgrade requirements		
Current demand:		18 ML
Current yield:		60 ML
Climate change and population growth scenario	**Median**	**High**
Demand equates to yield at:		Beyond 2065
Extra yield required to meet demand in 2065:		Not required

Options for investigation
There is no need for augmentations to the Gellibrand system over the planning horizon. Barwon Water will monitor any risks to supply through the preparation of the *Annual Water Outlook*.

Wastewater system outlook	Not applicable
The isolated township of Gellibrand is not currently serviced by sewerage infrastructure. Properties are responsible for managing their own wastewater in on-site septic systems. There are no plans to construct a wastewater collection and treatment system in Gellibrand.	

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1. Introduction

Water is central to our existence. Beyond its essential role in sustaining human life, water supports healthy environments and is fundamental to the productivity of the economy and wellbeing of communities. At the same time, challenges such as climate change – including an increasingly variable climate – and a growing population mean that sustainable management of our water resources is more critical than ever.

Barwon Water works with its customers and stakeholders to deliver water cycle services that support a wide range of social, economic and environmental outcomes. Providing secure water supplies in an uncertain future is central to achieving those outcomes.

Barwon Water's 2012 *Water Supply Demand Strategy* identified a number of actions that have helped improve the security of water supply across Barwon Water's service area. These actions build on a strong legacy of investment in critical water infrastructure. In more recent times this has been driven by the challenges of severe drought. Our extensive network of dams, treatment plants, pipes and other assets, which now service more than 300,000 customers, date back as far as 1873 when water was first reticulated to Geelong from Stony Creek Reservoir.

Reflecting on the past provides an important basis for planning for the future. We expect the impacts of climate change to reduce the reliability of traditional surface water catchments, and while drought will inevitably return, we are better informed and prepared to manage the impacts. We understand that, during these times, it is critical to maintain the parks, gardens and sports fields that communities value so highly. Similarly, in sharing stewardship of our waterways and catchments, we understand that there are recreational, Aboriginal and waterway health values that must also be protected.

A greater awareness of the diverse values of water requires management approaches to evolve accordingly. To achieve the breadth of outcomes expected of water cycle services, more holistic and integrated planning is essential. While focused on securing water supplies for the future, this Urban Water Strategy includes principals and actions that will ensure Barwon Water continues to invest towards the outcomes expected by our customers and the region's communities.

1.1 Achievements since the 2012 *Water Supply Demand Strategy*

The 2012 *Water Supply Demand Strategy* (WSDS) continued a period of major investment to improve water supply security across Barwon Water's service area. Actions identified in the 2012 WSDS responded to the conditions characterising our region at the time, including emerging from one of the worst droughts in recorded history (now referred to as the Millennium Drought). Barwon Water made a number of significant investments to ensure that service levels continue to be maintained in the face of such challenges in the future.

The early part of this century has seen Barwon Water embark on the most ambitious period of capital works in its history. The delivery of a number of major projects, commencing with the Anglesea Borefield in 2009, has been the most substantial period of investment in water resources for Barwon Water since the early 1980s.

A selection of the key projects that have been successfully delivered or progressed since 2012 is included in the tables below.

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Table 1: Achievements since 2012 – water supply

System	Achievement
Apollo Bay and Skenes Creek	A new 250 ML storage increases the volume that can be harvested from the Barham River when flows are more plentiful over the winter period. The new asset triples the volume of storage available, providing a greater reserve to draw on over the busy summer months and removing the need for restrictions every summer under normal conditions.
	Completed: 2014 **Investment: $23 million**
Colac	Reliance on seasonal catchment inflows, limited storage capacity and risks from bushfire and landslip indicated the need for an upgrade to the Colac system. Since 2012, extensive planning and community engagement has been undertaken to identify the preferred solution for a connecting pipeline to the Geelong system. The pipeline is scheduled for completion in 2017 and will provide greater water supply security, resilience and flexibility for Colac. Additional water security is an important factor in supporting the growth of local industry and the economy in the area.
	Completed: Scheduled 2017 **Investment: $19 million**
Colac	The Colac Demand Management Program (2013 – 2018) was developed as part of the strategic response to securing water supply for Colac. The program consists of a targeted suite of demand management activities for key customer segments in the Colac district. It is estimated that approximately 370ML of drinking water will be saved annually in the Colac water supply district when all projects are fully operational. This represents over 10 per cent of the annual consumption in the system. The program includes an innovative On-Farm Leak Detection Program using Taggle Technology and a residential leak detection trial using the same technology.
	Completed: Scheduled 2018 **Investment: $0.5 million**
Aireys Inlet and Fairhaven	An 11km pipeline from Anglesea connecting Aireys Inlet to the Geelong system was completed in 2016. The need for an improvement to the Aireys Inlet system was identified in 2013, as the existing infrastructure treating water sourced from Painkalac Reservoir approached the end of its life. Community engagement and consideration of a broad range of factors identified the new pipeline as the optimal solution. It provides greater security and flexibility by connecting to the substantial and diverse water sources of the Geelong system. Barwon Water has established a community group to consider future public uses of Painkalac Reservoir, which will continue to be maintained to provide environmental flows in Painkalac Creek and be available as a future long-term water supply if required.
	Completed: 2016 **Investment: $6.5 million**
Geelong	Water supply to Geelong was boosted by the completion of the Melbourne to Geelong pipeline, further diversifying existing sources. The pipeline and corresponding bulk entitlement allows Barwon Water to take up to 16,000ML/year allocated from the Greater Yarra System - Thomson River Pool.
	Completed: 2012 **Investment: $76 million**
Geelong	The reinstatement of the Dewing Creek diversion was identified as an action in the 2006 *Central Region Sustainable Water Strategy*. Reinstatement of the diversion allows water to be harvested from Dewing Creek and delivered into the Wurdee Boluc Inlet Channel. The diversion increases the yield of the Geelong supply system by an average of 700ML/year.
	Completed: 2013 **Investment: $1.8 million**

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Table 1: Achievements since 2012 – water supply (continued)

System	Achievement
Geelong	The Moorabool Water Treatment Plant (WTP) filters were upgraded to incorporate granular activated carbon (GAC). The upgrade improves the aesthetics of the water produced by ensuring greater removal of organics and taste and odour compounds in the source water. The upgrade enables the WTP to be operated for more of the year, including during low flow periods in the Moorabool River when the water quality deteriorates.
	Completed: 2016 **Investment: $0.3 million**
Geelong	The implementation of pressure management areas (PMAs) across parts of Geelong have reduced excess water pressure in water mains, contributing to significant reductions in the amount of water lost through leakage and burst mains.
	Completed: Ongoing **Investment: $7.1 million**
All	Over the last five years, Barwon Water has carried out an aquifer storage and recovery (ASR) research program. The program involved reviewing aquifer potential across the region for storage of drinking water, recycled water or stormwater.
All	In response to the need for greater integration across water agencies, Barwon Water led the establishment of the Barwon Region Integrated Water Cycle Management (IWCM) Network in 2012. The Network continues to identify opportunities for the use of alternative water sources and supports IWCM.

Construction of the Colac pipeline

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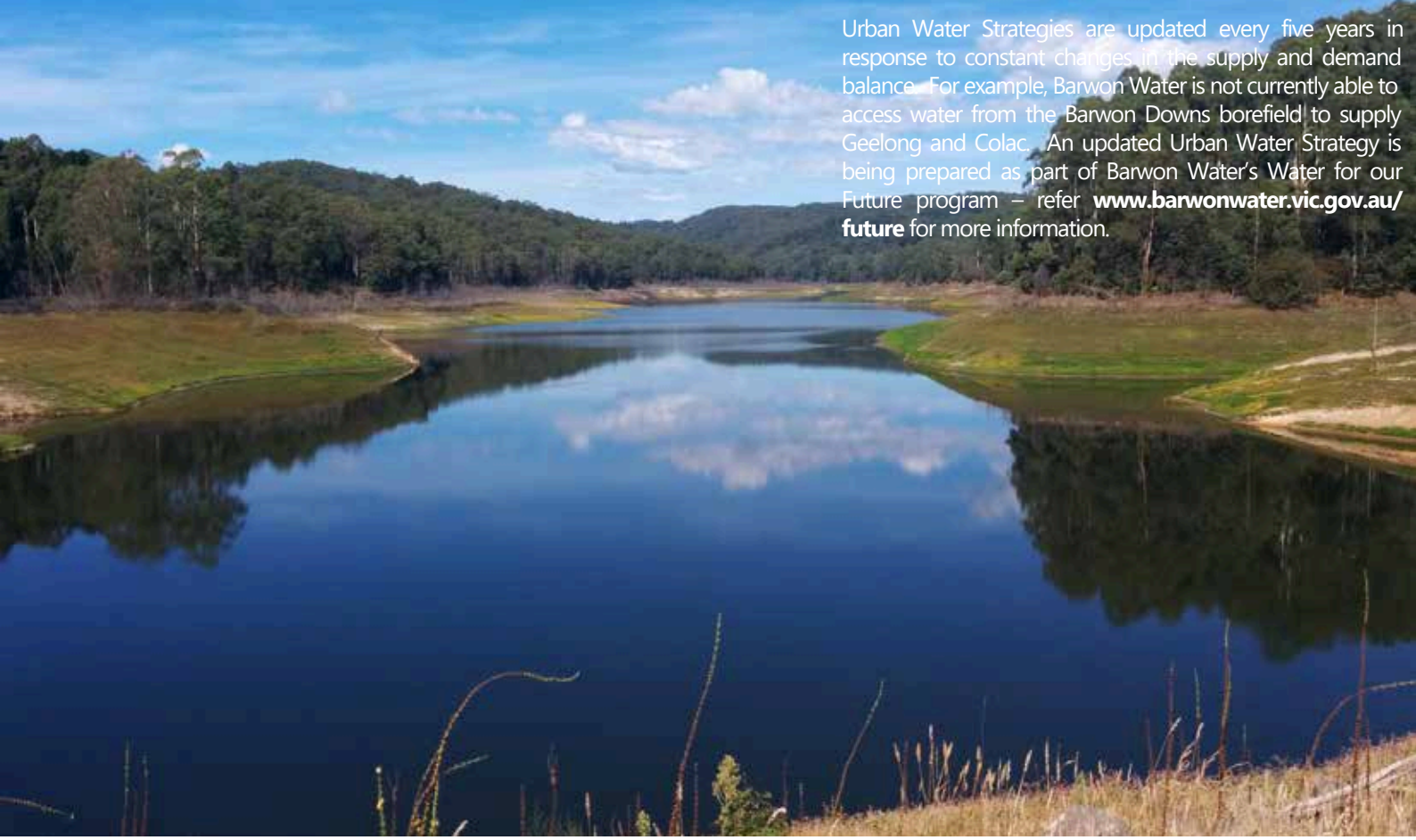
Table 2: Achievements since 2012 – wastewater management and recycled water

System	Achievement	
Geelong	The Northern Water Plant was officially opened in April, 2013. The plant supplies an average of 1,700ML of Class A recycled water each year in place of the drinking water previously used by the Shell refinery (subsequently acquired by Viva Energy) in Corio. The plant represents a successful partnership between government and the private sector, with Shell, the Australian Government, Barwon Water and the Victorian Government all committing funds.	
	Completed: 2013	**Investment: $93 million**
Geelong	The completion of the Black Rock Recycled Water Plant enables Barwon Water to provide Class A recycled water to surrounding businesses and the residential growth areas of Armstrong Creek and Torquay North, servicing 25,000 lots at full development. Class A recycled water is suitable for toilet flushing, garden watering, car washing and irrigation of public open space such as sports fields.	
	Completed: 2013	**Investment: $42 million**
Geelong	Extensive infrastructure, including recycled water pump stations, storage tanks, transfer and distribution mains, has been constructed to supply the residential growth areas in Armstrong Creek and Torquay North. The scheme was commissioned in 2014 and continues to expand with development.	
	Completed: 2013	**Investment: $65 million**
Geelong	To cater for future residential and industrial growth in Geelong, the Bellarine Peninsula and the Surf Coast, the water reclamation plant at Black Rock is currently being upgraded to increase the plant's hydraulic capacity.	
	Completed: 2017	**Investment: $15 million**
Colac	To cater for residential and manufacturing growth, the Colac Water Reclamation Plant (WRP) is being progressively upgraded. The first stage involved the construction of two high rate anaerobic lagoons.	
	Completed: 2016	**Investment: $10 million**
Birregurra	The Birregurra township was connected to a reticulated sewerage scheme. The scheme comprises a gravity sewer network, maturation lagoons and storage lagoon.	
	Completed: 2011	**Investment: $15 million**
Bannockburn	The Bannockburn Water Reclamation Plant was upgraded to cater for growth in the Bannockburn township and involved an additional 16ML maturation lagoon, 85ML winter storage and associated transfer pump station.	
	Completed: 2012	**Investment: $5.2 million**



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West Barwon Reservoir

1.2 Roadmap to this document

The *Urban Water Strategy* is a detailed response to many of the challenges we face in fulfilling our obligations and supporting the communities, environment and economy of our region. To help navigate the document, the approach to articulating our strategy is set out below.

1.	**Introduction**	Describes the role of the Urban Water Strategy and the strategic context for its development
2.	**What is the Urban Water Strategy?**	
3.	**Strategic context**	
4.	**Future challenges**	Observations since the last strategy, key challenges we face and the vision and goal we aspire to in meeting those challenges
5.	**Future direction**	
6.	**Delivering our services in an uncertain future**	
7.	**Engaging with our customers and the community**	Delivering service levels and supporting community and Aboriginal values through informed, engaged planning
8.	**Delivering water efficiency and alternative water sources**	How we work collaboratively to support resilient and liveable towns and cities
9.	**Supporting a healthy environment**	How we contribute to catchment and waterway health
10.	**Using the Victorian water grid and water markets**	Making the most of the opportunities from Victoria's evolving water infrastructure and management
11.	**Adaptive planning**	How we ensure that we make the right decisions at the right time
12.	**Service area strategies**	The status, outlook and response required across each of our systems: Greater Geelong; Colac; Apollo Bay and Skenes Creek; Lorne; and Gellibrand

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2. What is the *Urban Water Strategy*?

2.1 Purpose

The *Urban Water Strategy* details how, in an uncertain future, Barwon Water will continue to provide secure water supplies that meet customer service expectations. It updates and replaces Barwon Water's 2012 *Water Supply Demand Strategy* (WSDS).

While primarily focused on water supply security, the strategy also has a role in supporting a broader range of outcomes that we now recognise as intrinsically linked as part of the urban water cycle. Barwon Water works with various stakeholders to ensure the services we provide contribute to the Victorian Government's aspiration for resilient and liveable communities.

This strategy addresses Barwon Water's key accountabilities to provide safe, secure water supply and collect and treat wastewater. In delivering these services, we work collaboratively with other urban water managers (see Figure 1) to ensure that integrated solutions can be provided.

Although it is revised every five years, the *Urban Water Strategy* has a long-term outlook of 50 years. This ensures that longer term challenges, such as population growth and changes to our climate, are thoroughly considered when planning future actions.

Evolving conditions will require the implementation of new measures to maintain secure water supplies and manage wastewater into the future. The strategy describes the options available and the resulting actions identified for the next five years and beyond. Any investment that is proposed within the five-year life of the strategy is also incorporated into the parallel development of Barwon Water's 2017 Pricing Submission. This submission to Victoria's economic regulator, the Essential Services Commission, is the first step in the process that sets customer prices over a five-year period, based on the investments we need to make to deliver our services. A key part of this process, and the strategy implementation, is ongoing customer engagement.

Figure 1: Accountabilities of key stakeholders in the urban water cycle

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2.2 How the strategy was developed

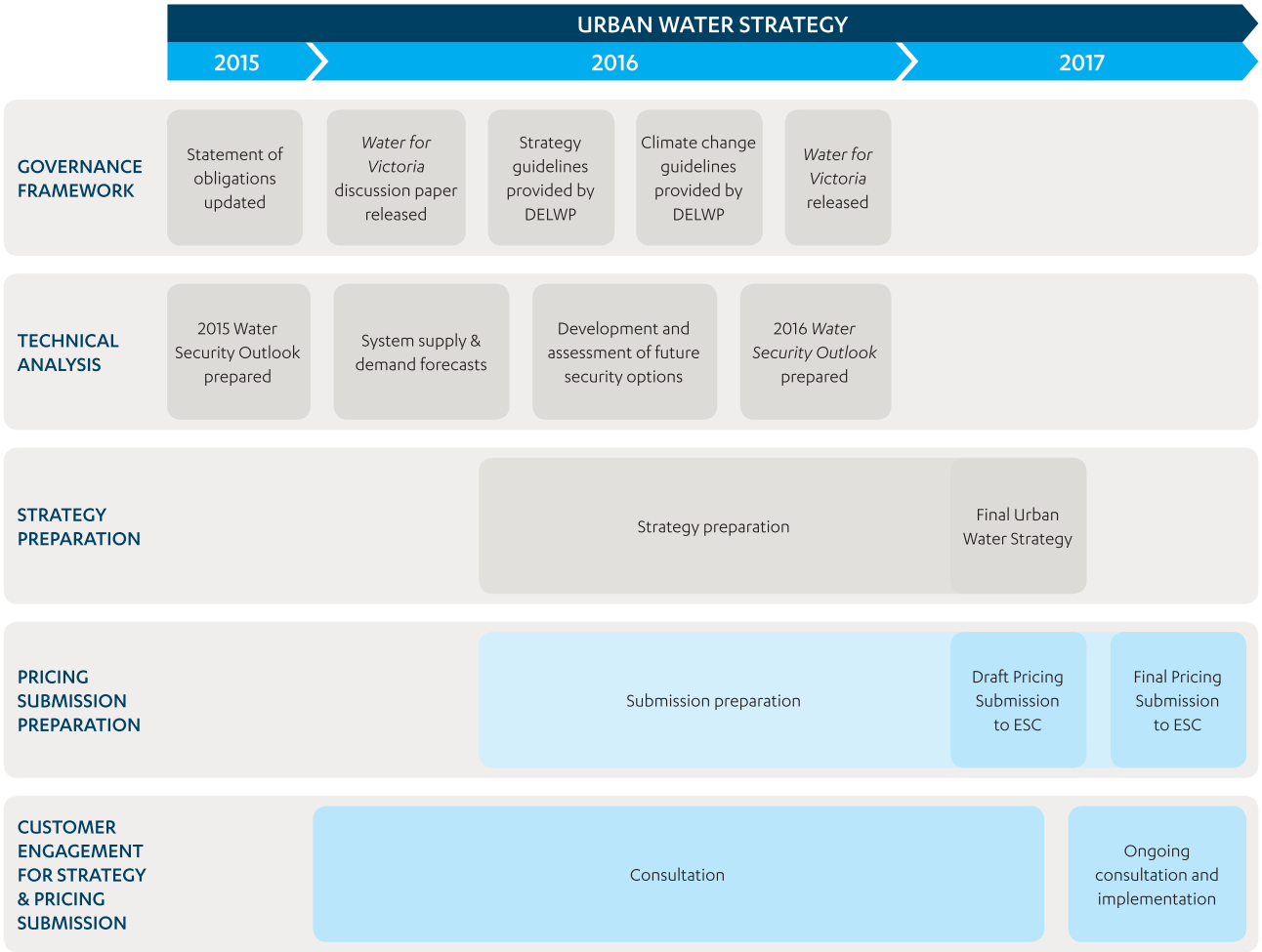
Each Victorian water corporation is required to develop an *Urban Water Strategy* in accordance with its Statement of Obligations and guidelines subsequently provided by the Department of Environment, Land, Water and Planning (DELWP) on behalf of the Minister for Water.

The development of the *Urban Water Strategy* has built on the work of preceding Water Supply Demand Strategies, as well as other relevant plans, strategies and the broader context of the Victorian Government's new Water Plan, *Water for Victoria*.

It has also benefitted from stakeholder and customer feedback, particularly ongoing consultation undertaken as part of the development of the 2018 Pricing Submission. Continued customer engagement will be a key feature of the strategy implementation.

Figure 2 summarises the key phases and parallel activities undertaken in the preparation of the *Urban Water Strategy*.

Figure 2: Overview of the approach to developing the Urban Water Strategy



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3. Strategic context

3.1 How we work with other stakeholders

Barwon Water delivers water, recycled water and wastewater services in accordance with its responsibilities under the *Water Act 1989* and other relevant legislation. As an essential service provider and regulated business, we have important relationships with a diverse and wide range of stakeholders. The most important and central of these relationships is our commitment to working with the customers and the communities we service.

The range of stakeholders we work with is illustrated in Figure 3 below.

Overarching policy direction is provided by the Victorian Government, which has recently delivered a new water plan, *Water for Victoria*, to guide the management of water resources to support a healthy environment, prosperous economy and thriving communities. *Water for Victoria* describes the characteristics of liveable and resilient cities and towns, with which Barwon Water's role and responsibilities closely align. Figure 4 illustrates the obligations we have in working with other stakeholders to contribute to those characteristics.

Figure 3: The range of key stakeholders we work with

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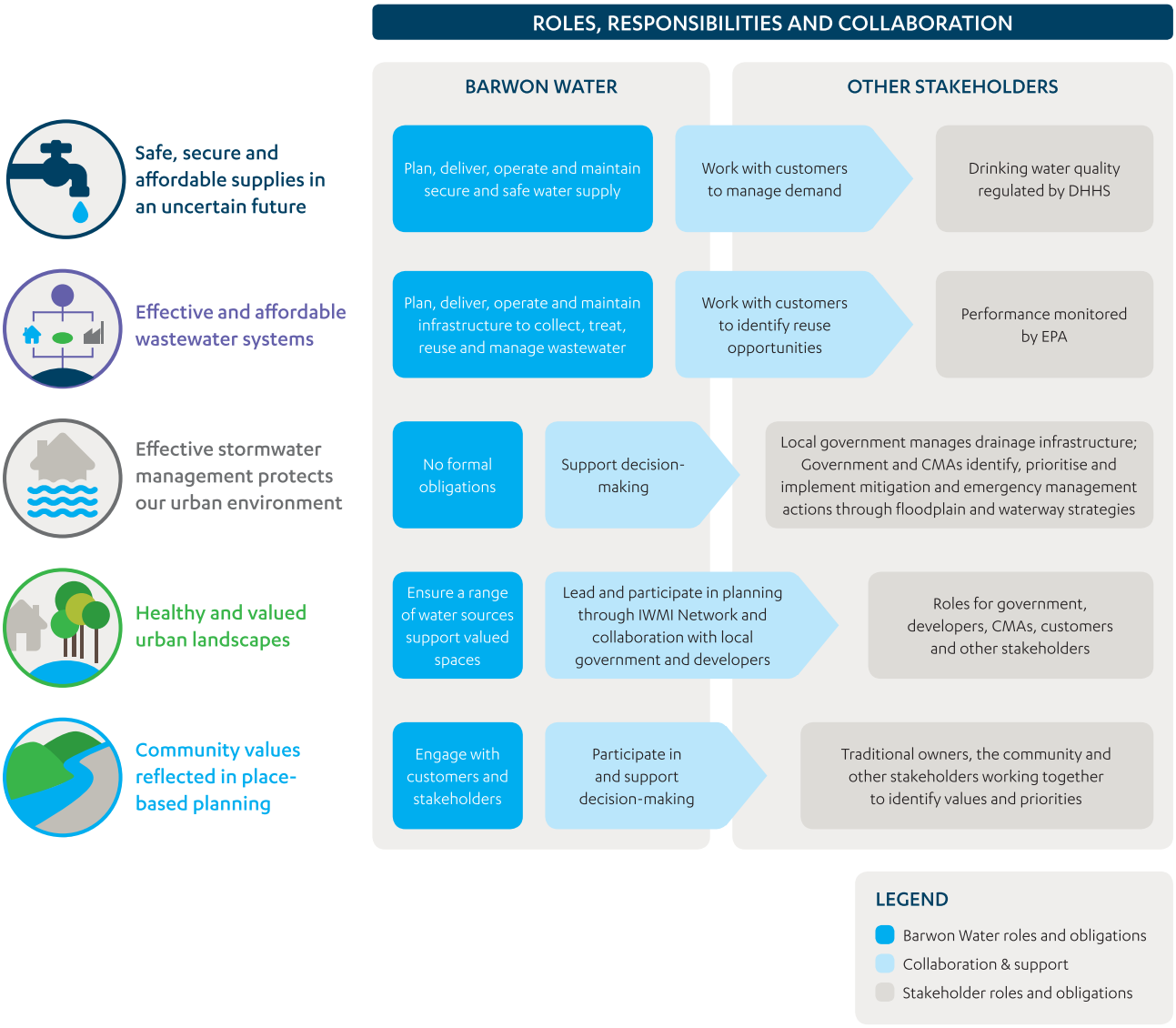
Figure 4: Roles and responsibilities in contributing to resilient and liveable towns and cities



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3.2 Barwon Water's Strategic Intent

The way we operate is guided by our Strategic Intent, shown in Figure 5. This has been developed to reflect the direction provided by *Water for Victoria* and Barwon Water's Board, as well as our obligations as an efficient and effective service provider.

3.2.1 *Water for Victoria*

The policy direction for water resource management in Victoria is provided by the state's new water plan, *Water for Victoria*. Launched in October, 2016, following 18 months of community engagement, *Water for Victoria* is the platform for future management of the state's water resources to support a healthy environment, thriving economy and vibrant community.

In setting the direction for water management in Victoria, *Water for Victoria* includes themes and actions with varying implications for key stakeholders in the sector. Barwon Water will work collaboratively with all stakeholders, including DELWP, local government, the Corangamite CMA, local Aboriginal groups and the community, to help achieve the goal of a modern and efficient, innovative, future-focused and affordable water system.

Barwon Water's Strategic Intent and *Water for Victoria* provide important direction in shaping the way we meet the challenges of the future. Some of the key challenges faced are introduced in Chapter 4.

Figure 5: Barwon Water's Strategic Intent

Opposite: An aerial view of West Barwon Reservoir

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4. Future challenges

We must address a number of significant challenges to continue to deliver safe, reliable, sustainable and affordable services. As well as a broader scan of the conditions shaping our future, these challenges are informed in part by our recent experience.

4.1 Insights from the past five years

While the period since the 2012 WSDS has not been characterised by extended drought, variability and extremes in our climate remain prominent. Higher temperatures and significant heatwaves have been a recurrent feature, with average annual or seasonal temperatures the warmest on record in Victoria on several occasions between 2012 and 2016.

Australia's climate is projected to become warmer and drier in the future, but greater fluctuations in seasonal conditions also pose real challenges for managing water supply security. This was demonstrated in the summer and autumn of 2015/16, when an unprecedented dry period dramatically reduced streamflows in the rivers that supply Lorne and Apollo Bay (see Box 1).

Historical climate conditions, as well as the projected impacts of climate change, are a critical input to water resource planning. Insights from localised events and conditions that have occurred since the last WSDS have helped shape the way we plan for the future.

Box 1: What we learnt over summer 2015/16

When Barwon Water prepared the annual *Water Security Outlook* in December, 2015, water storage levels in Apollo Bay were close to 80 per cent full and the Allen Reservoir in Lorne was at 95 per cent of capacity. There was no expectation that drought response measures would be required over the subsequent 12 months based on storage levels and the short-term climate outlook.

However, by May 1, 2016, Barwon Water had initiated Stage 3 water restrictions across a number of systems, including Apollo Bay and Lorne, following unprecedented dry conditions during spring and summer. The period of low rainfall resulted in conditions worse than anything experienced during the Millennium Drought. In Lorne, by late April we progressed to carting water into the town's water storage as an additional precaution to supplement supplies.

Some of the rainfall and streamflow statistics from the period reveal how this was beyond anything we had experienced before:

- rainfall between October, 2015, and March, 2016, was approximately half the average and lower than anything previously recorded for the period
- streamflows in the Barham River during this time were 80 per cent below average, and 14 per cent lower than the worst conditions on record
- summer streamflows in the St George River were 90 per cent lower than average, and more than 30 per cent lower than the driest conditions on record between October and March.

Nonetheless, by early June the restrictions were lifted, with storages boosted by rainfall in May that was double the monthly average.

Such events highlight the natural variability of our climate and the resulting challenge for forecasting water supply. We rely on the historical climate and streamflow record to inform robust statistical analysis, including consideration of 'worst case' scenarios. However, the period of October, 2015, to March, 2016, was so much drier than anything on record that storage levels declined even more sharply from those forecast under dry conditions.

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Figure 6 compares actual storage levels at Apollo Bay between September, 2015, and July, 2016, with those forecast based on historical climate conditions. The sharp decline in storage levels was more severe than behaviour predicted in 'dry' conditions (represented by the 5th percentile, or the driest 5 per cent of conditions experienced based on historical observations).

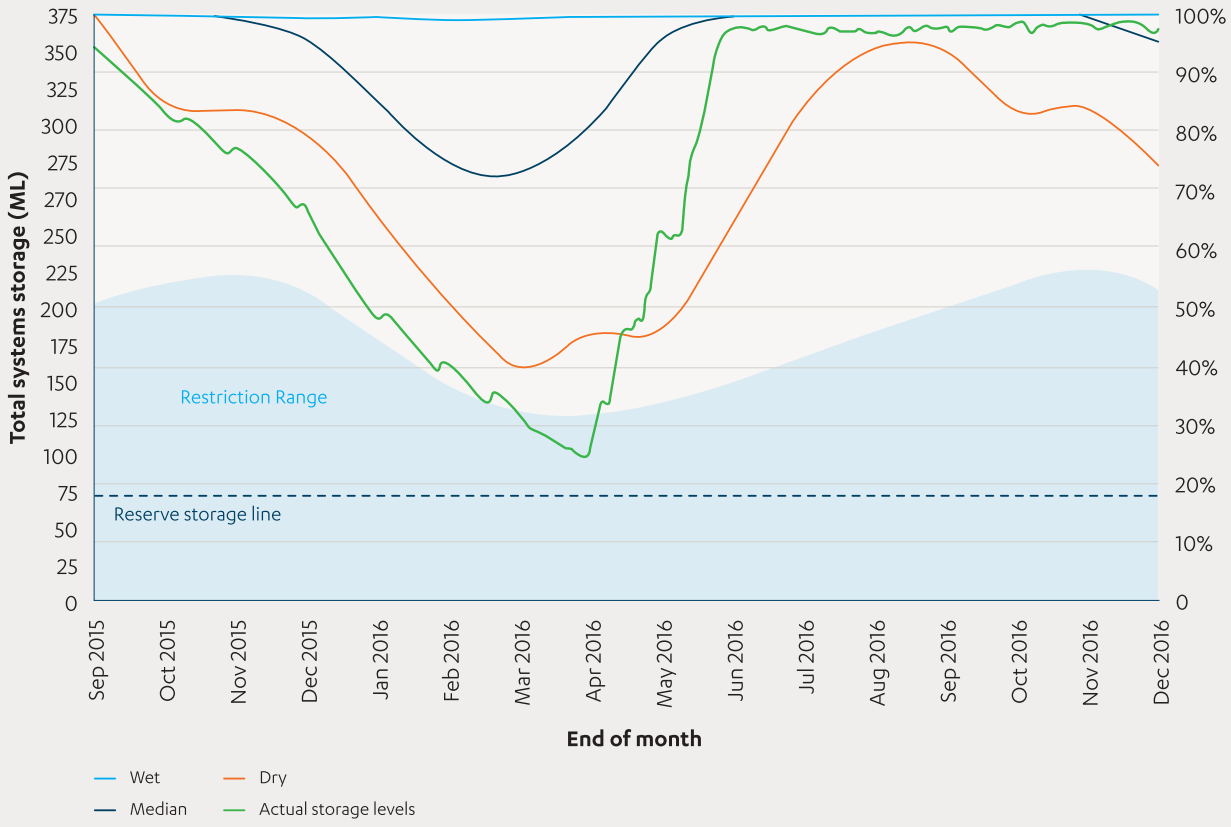
As well as showing the extent to which storages declined well below forecast levels, the chart also illustrates the rapid recovery once rainfall returned. This emphasises the influence of seasonal patterns on the Apollo Bay system, which are similarly reflected at Lorne.

This period also highlighted the important role of drought response measures as part of an adaptive management framework to maintain secure water supplies. Once introduced, water restrictions helped to reduce demand so that further decline in storages was limited, until reversed by the return of wetter conditions. Had dry conditions persisted even further, Barwon Water would have been able to implement other measures to ensure that water supply to Apollo Bay and Lorne was maintained.

Despite the brief duration of restrictions during this climate event, we understand the concern the community may have experienced with their rapid onset and limited warning. We have learnt that short-term conditions can be more extreme than any experienced in the past, and it is prudent for long-term planning to be based on a range of scenarios (consistent with best-practice guidelines).

The implications of a variable climate are particularly acute for supply systems that do not have extensive storage, since there is greater reliance on inflows throughout the year. Although we know that those streamflows will be available in the majority of years, when they do not eventuate the amount of water in storage can only meet unrestricted demand for a period of months. This means there is limited time to implement new infrastructure solutions, but temporary responses such as water restrictions can be effectively and rapidly employed to help balance the system until seasonal rainfall returns.

Figure 6: Water storage levels in Apollo Bay over summer and autumn 2015/16



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4.2 Future challenges

Planning for the future must consider the range of issues that may impact on the services Barwon Water provides. Some of the most prominent challenges that we face are described in Table 3 below. The approach to addressing these challenges starts with ensuring that planning for future outcomes considers a wide range of possible scenarios.

Table 3: Key challenges

Challenge	Implications
Climate variability and change	Australia's climate naturally exhibits a high degree of variability. Forecasting water supply must account for a wide range of possible outcomes, of which the historical record provides only some indication. This variability is expected to be further exacerbated by the impacts of climate change, which will result in more extreme events and drier conditions that will reduce catchment yields. Climate change is also expected to increase the risk of extreme events, such as bushfires and floods.
Servicing growth	Sustained rates of high population growth will increase water demand, impacting the balance with the supply capacity of each system. The timing of future measures to maintain this balance must avoid investing in substantial infrastructure earlier than required, but ensure that secure supply is maintained at all times. The way in which new growth occurs, particularly increased urbanisation, also has implications for the way services are provided to support liveable and sustainable communities.
Predicting water use	Forecasting future demand is also complicated by trends in water consumption. Per capita consumption has declined markedly in recent decades with greater awareness, but various factors can contribute to changes in water demand. Understanding and being prepared for these changes requires a range of possible demand trends to be considered. Maintaining a focus on driving more efficient use of water is a key part of understanding future demand.
Resource scarcity	The collective pressures of population growth and climate change reflect an increasing strain on limited water resources. Traditional water supplies that have sustained us to date cannot meet future needs inexorably. Other resources, such as desalinated water, recycled water and stormwater will become an increasingly important part of the supply portfolio. However, they may come at a higher cost in some instances, emphasising the need to both value our existing water resources, and invest prudently in future infrastructure. We must recognise the value of alternative water sources as part of the resource pool and seek to make best use of what is available.
Extreme events	While the forested water supply catchments of the Otway Ranges provide pristine drinking water, bushfires could have a significant impact on both water quality and yield. Runoff after a bushfire event is laden with ash, nutrients and other organic content that can cause a drop in water quality. If this impact is too great for existing water treatment infrastructure to cope with, additional treatment may be required or the impacted source may be unusable until quality recovers. This reduces the diversity of supply and places greater reliance on other resources. Regrowth in a fire-affected catchment consumes more water than mature trees, which can reduce catchment yields for many decades. Floods, too, can impact water quality by transporting high sediment loads.

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Challenge	Implications
Waterway and catchment health	Many waterways are recognised as stressed and in need of additional flows. In the future, these flows may need to be met by making more water available from catchments and storages, potentially in ways that differ from current system operation. Any new environmental demands will likely need to be offset with additional sources. Changing land use, increased human activity and development also has implications for the quality and quantity of flows in waterways. Poorer water quality not only has environmental impacts, but potentially also reduces reliability and availability of streamflows for water supply. Natural events, such as blue green algae and stratification, can also temporarily eliminate supply from a water source. Conditions that lead to these types of events are expected to be more common with climate change.
Changing needs in a drying climate	Agriculture is a significant part of our region's economy and character. A drier climate will have implications for agriculture that could lead to a shift in current land use and practices, as well as the way available water resources support agriculture and associated industries. We need to be aware of how demand for water is changing over time and ensure that we are prepared to support the industries that are critical to our region.
Changing customer expectations	Customers currently have limited choice about the level of service they receive, which is the same across each of Barwon Water's service areas. Greater understanding and awareness about the role of water services in supporting sustainable and liveable communities is driving diverse expectations. In the future, water corporations may need to be able to offer different levels of service to different customers depending on their preferences and willingness to pay for particular outcomes.
Cost of living	Prevailing economic conditions are placing increasing pressure on household incomes and the affordability of essential services. While ensuring that customer expectations are met and reliable water services maintained, Barwon Water will need to ensure that it demonstrates efficiency and increasing value for money to customers.
Grid	Victoria's water supply network is increasingly inter-connected. The water grid connects Barwon Water to Melbourne, as well as to Ballarat. Trade and transfer of water via water markets and the grid introduces a huge opportunity to optimise the way resources are used – but there is inherent complexity and governance challenges that must be understood and overcome.
Changes in technology and thinking	To meet the evolving challenges of the future we must also be prepared to adapt and change. The continuing advance of technology will facilitate a wide range of new opportunities, supporting smarter ways to deliver better services. We must be open to new ideas and actively encourage a culture of innovation to ensure that difficult challenges are met with creative thinking.

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5. Future direction

Our response to the challenges of the future starts with our vision and mission, and the goals that we want to achieve. A fifty-year outlook also affords the opportunity to articulate our longer-term aspirations.

Vision

Community-minded, performance-driven, future-focused

The vision in Barwon Water's Strategic Intent reflects our aspiration to support the region's communities with efficient, high-performance service that meets their needs now and in the future.

Mission

Deliver quality and affordable water and sewerage services that strengthen the economy, promote liveability and protect the environment

Our mission recognises the critical role played by Barwon Water in supporting a strong economy and liveable, sustainable communities.

Goal of the *Urban Water Strategy*

To deliver secure water supplies, supporting resilient and liveable communities under a range of climate futures

The goal of the *Urban Water Strategy* is primarily to ensure the security of water supply across each of Barwon Water's systems, particularly in a future characterised by the uncertainty of population growth and climate change.

Water is fundamental to the economy, the environment and to the way we live.

Beyond an essential role sustaining human life, secure water supplies also support a broader range of outcomes, from underpinning industry productivity to sustaining green open spaces that communities value so highly.

The goal of the *Urban Water Strategy* sits alongside Barwon Water's mission at the core of the business' Strategic Intent.

Long-term aspirations

The fifty-year planning horizon for the Urban Water Strategy means we have both an opportunity and an obligation to be future-focused, thinking beyond the short-term to envision what may be possible over the next half a century. While many of the challenges are clear, the way in which we respond to support a prosperous and liveable region will necessarily evolve. In particular, continual advances in technology and thinking will provide new solutions and opportunities, including many we can't yet imagine.

Engaged and empowered customers will continue to be central to the direction we take. As our services evolve, we must ensure that they do so to meet the needs and preferences of communities, customers and Traditional Owners across the region. Recognising and supporting Aboriginal values will help underpin sustainable stewardship of our land and water. A commitment to better reflecting Aboriginal values and knowledge in our planning will support a healthy environment, provide economic opportunities for Aboriginal groups and enhance our region for future generations.

We understand that there are sustainable limits on the use of natural resources such as water. Optimising the value from existing infrastructure and available resources is therefore essential to provide the foundation for a strong economy, healthy environment, liveable towns and cities and a prosperous region in the decades to come. Innovation, technology and a willingness to embrace new ideas will be pivotal in helping make the most of what we have.

Our long-term ambition is to achieve optimal use of our resources to the full extent possible – to manage our water and wastewater systems with zero waste, seeking to recover and reuse not only water but other resources, such as energy and nutrients, embodied within waste streams. Beyond reflecting our desire to protect the environment that sustains us, this will underpin a resilience that supports regional growth and prosperity in the face of change.

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Solar panels

Making the most productive use of available resources means:

- **reducing** water consumption through efficiency and conservation
- **replacing** drinking water use with alternative sources where they are fit-for-purpose
- **recycling** the water discharged from our water reclamation plants
- **recovering** other resources, such as energy and nutrients, that are embedded in waste streams.

We already do all of these things to some extent, and we understand that a long-term goal of fully recovering or recycling all resources is ambitious. Alongside our strategic objectives for climate change mitigation and adaptation, it will also require us to think carefully about our energy needs.

There is strong a connection between energy and water. The water sector is a major consumer of energy, which is generally required whenever water and wastewater are treated or pumped. However, there is also considerable potential for water businesses to generate energy – for example, as part of wastewater management processes. Aligning our water and energy needs is a prime example of the opportunity to further improve the way we think about and manage resources. Beyond simply being efficient, we must ensure that resource use is optimised to drive regional prosperity.

Delivering our long-term aspirations will, in many cases, require a step-change in the way we operate. This will only be achieved through a commitment to innovation and a willingness to embrace new ideas. We are optimistic about the role that innovation and advances in knowledge and technology can play in changing the way we do business, and we will drive and embed a supportive culture to explore the opportunities that evolve.

We have deliberately set our long-term aspirations high. While they are undoubtedly challenging, we believe the first step in achieving such substantial change is articulating the desire to make it happen. This ambition will guide our focus and direction, with the actions in this strategy setting us on a clear path for the next five years.

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6. Delivering our services in an uncertain future

Planning secure water supplies into the future must balance demand for water with available resources. Both the demand and supply sides of this equation are influenced by various factors. Our planning must address the resulting uncertainty by considering a range of scenarios.

6.1 Managing our water resources under a range of climate futures

A changing climate poses perhaps the most substantial risk to secure water supply in the future, particularly given the traditional reliance on surface water resources that tend to be very climate dependent. The impacts of climate change also pose major challenges for our business more broadly, including to the integrity and functionality of our extensive network of assets.

This challenge is acknowledged within our Strategic Intent, which includes a commitment to *'deliver climate change action by ensuring through adaptation and mitigation that the business is climate change resilient for the future'.*

We have developed both a *Climate Change Mitigation Plan* and a *Climate Change Adaptation Plan* as strategic responses to this challenge, with the following focus:

- **Mitigation** covers those measures the business will take to reduce its own contribution to greenhouse gas emissions, to help reduce the likelihood and severity of future climate change impacts.
- **Adaptation** is the way the business will operate and respond to specific threats posed by a changing climate that may occur despite mitigation efforts.

We have made the significant commitment in our *Climate Change Mitigation Plan* to:

- transition to 100 per cent renewable energy use by 2025
- achieve net zero greenhouse gas emissions by 2030.

Meeting these important targets will be achieved by making informed choices about how we source energy, increasing efficiency, and mitigating further growth in emissions through clever asset design and operation.

Adaptation begins with an understanding of how conditions may change regardless of our mitigation efforts. A snapshot of the changing conditions expected in our region as a result of climate change is provided in Table 4.

Table 4: Climate change predictions for the Corangamite region of south west Victoria (source: CSIRO)

Prediction	Level of confidence
Less rainfall in winter and spring	High
Average temperatures continue to increase in all seasons	Very high
Sea levels continue to increase	Very high
More hot days and warm spells	Very high
Fewer frost days	High
Increased intensity of extreme rainfall events	High
Increase in time spent in drought	Medium
Harsher fire weather	High
Increase in evapotranspiration	High
Increase in solar radiation and decrease in relative humidity	High
Natural climate variability will either enhance or mark long-term trends from year to year	High

Planning to meet the challenge of an uncertain future climate is a critical part of this *Urban Water Strategy*. Box 2 provides further detail about the approach, consistent with our climate change adaptation and mitigation strategies, that we have adopted to address this challenge.

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Box 2: How we have considered climate change in this strategy

Adapting to the impacts of climate change

Almost all of our water sources are climate dependent. They rely on rainfall, but are also influenced by conditions such as temperature and evaporation. These factors also influence the amount of water our customers use. For example, consumption increases during hotter, drier periods which is typically when water availability is at a minimum, with more frequent and intensive use for activities like garden watering and appliances such as air conditioners.

Although scientific knowledge about climate change is continually evolving, there is inherent uncertainty about both natural climate variability and the future impacts of climate change. Given the effect of climate on both water demand and supply, it is essential that long-term water resource planning considers a wide range of future climate outcomes.

To ensure a consistent and robust approach to modelling different climate futures, the Victorian Government provides guidelines to water corporations for assessing the impact of future climate projections on water resources. This guidance is based on the latest climate research from institutions such as the CSIRO, Bureau of Meteorology and the findings of the Intergovernmental Panel on Climate Change. It is underpinned by the sophisticated outputs of 42 global climate models (GCMs) and hydrological modelling.

Four plausible future climate scenarios are identified by the guidelines for specific consideration, noting that there is no 'most likely' scenario. Barwon Water has assessed its supply systems against each of these scenarios, which include low, medium and high climate change, as well as a post-1997 step-change in the climate that reflects a continuation of recent trends more severe than the GCM models suggest in the short term. This scenario is important, as it captures many of the seasonal changes in rainfall that have occurred over recent years that are not fully reflected in the global climate models. In our region, the post-1997 step-change scenario has the greatest impact on the Greater Geelong supply system.

Together, these climate scenarios effectively describe a range of possible outcomes for our water supplies, which are typically expected to decline to some extent in a hotter, drier future impacted by climate change.

We also consider the possibility of a range of demand scenarios in the future. While this is principally influenced by projections of population growth, our modelling also accounts for the impact of climate conditions on levels of water consumption.

The combination of demand and supply scenarios is used to inform the possible timing of action that may be required to maintain service levels in the future. This is described by the intersection of the various supply and demand projections, as illustrated in the example of Figure 7 below. A chart of this nature is provided for each supply system.

Climate change projections approximate impacts as linear over time, but in practice they may eventuate sooner or later than anticipated. This means that we must be prepared to adapt to whatever conditions eventuate. Robust scenario planning, combined with an adaptive management framework (described in Chapter 11), ensures that we are aware of the range of potential conditions in the future, and prepared to respond accordingly.

It is also important that we consider the individual characteristics of each supply system. While climate change projections describe expected impacts over time, there are also impacts within a given year that have implications for systems that are more reliant on seasonal climate patterns.

We have applied the best available science in accordance with industry guidance to ensure that we are prepared and able to adapt to a changing climate.

Box 2 continued overleaf

1. Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria, 2016, DELWP

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Box 2: How we have considered climate change in this strategy

Continued from page 45

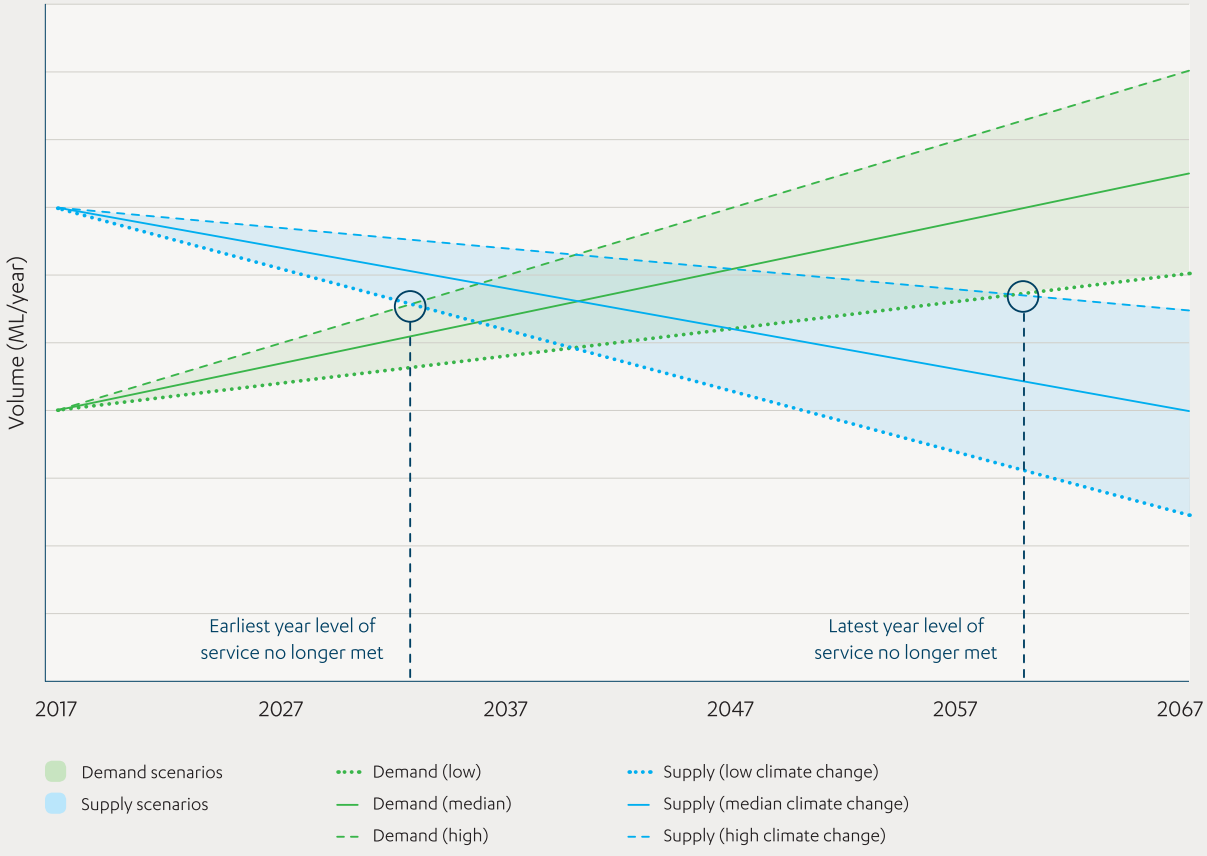
Mitigating the impacts of climate change

Consistent with the objectives of *Water for Victoria*, Barwon Water is committed to a long-term goal of achieving zero net greenhouse gas emissions. Meeting this target not only means addressing the emissions from current operations, but considering the potential contribution from any new infrastructure required in the future.

As part of this strategy, many options to maintain water supply security in each system have been identified and assessed. The relative extent of greenhouse gas emissions for each option was one criteria considered in the assessment process.

As options are developed and investigated further, the implications for Barwon Water's goal for carbon neutrality will need to be explicitly included in any analysis. This does not necessarily mean automatically excluding options that generate more emissions than others, but it will require the implications of offsetting those emissions to be included in the evaluation process.

Figure 7: Example of supply demand balance under a range of climate scenarios



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Importantly, the forecasting used to inform this strategy assumes that current bulk entitlements and licences are unchanged over the next 50 years. If they alter as a consequence of any mechanism, including the review of the *Central Region Sustainable Water Strategy* or the Barwon Downs borefield licence renewal due in 2019, the forecasts will also need to be reviewed.

Actions	
6.1	We will continue to use the latest climate science and scenario analysis in water resource modelling
6.2	We will collaborate on further research into the impact of bushfires on yield from the Barwon, Moorabool and Gellibrand catchments
6.3	We will deliver on our *Climate Change Mitigation Plan* targets: achieving 100 per cent renewable energy use by 2025 and zero net greenhouse gas emissions by 2030

6.2 Forecasting changing demand

Our region is constantly changing. A growing population will generate new urban development as well as shifts in land use, industry composition and demographics. The way we use water is also evolving, with new properties tending to have more water efficient appliances and smaller gardens, while customer awareness about the value of water continues to improve. Factors like these influence the level of demand for water across the cities and towns in our region.

The variability of these factors makes forecasting demand a complex task. We incorporate best-practice methods, in accordance with guidelines from the Victorian Government, into a computer-based model to produce an estimate of future demand (Box 3).

In order to better understand how changes in technology and customer behaviour will impact water use we, along with several other water organisations, have worked with The Institute for Sustainable Futures on a research project that aims to investigate and quantify these influences. The results of this research has clarified our expectations about the future of water use and helped to refine our forecasts.

One of the most important factors influencing demand forecasts is the projected rate of population growth. *Victoria in Future 2015*, the official state government projection of population and households, is the basis for this information and has been adapted for use across different parts of our region.

Given the significance of demand forecasts in planning future investments, we should continue to investigate opportunities to further increase the sophistication of our approach. Accurately forecasting demand is particularly relevant in smaller systems, where minor changes may have proportionally greater implications.

The increasing demand for water, driven by a growing population, also emphasises the importance of making the most of the resources that are available. Delivering water efficiency improvements and better use of alternative water sources are key areas of focus (see Chapter 8). We need to ensure that this is embedded in planning for new urban development in particular, as part of an integrated water management approach.

Actions	
6.4	We will participate in industry research and apply emerging approaches to improve the accuracy of demand forecasts

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Box 3: How we forecast demand

Estimating demand across our service area requires an understanding of the characteristics contributing to water use. In the first instance, demand is considered in terms of residential and non-residential users.

Residential use

A wide range of inter-connected factors influence residential water demand, as illustrated in Figure 8. To cater for this complexity, we disaggregate the various customer uses for water – such as showering, toilet-flushing or washing dishes – so that different assumptions can be made at the most detailed level. Once aggregated again, this end-use model provides a projection of total demand across the system.

Some of the more influential factors are discussed further below:

Climate: Conditions over summer, in particular, have a large impact on demand trends. A hot, dry summer typically means increased consumption for uses such as garden watering, swimming pools and air conditioners. Understanding the implications of this is especially important in smaller systems, such as Lorne and Apollo Bay, which are more responsive to seasonal conditions. Our modelling accounts for natural climate variability, as well as the projected impacts of climate change that may increase demand under drier, warmer conditions.

Population and demographics: Growth in population is the most significant factor influencing projected demand. However, population alone is not sufficient to describe the way water is used. We use information from the Australian Bureau of Statistics (ABS) to identify property types, accounting for the different consumption profiles of larger homes and apartments. *Victoria in Future* projections are also complemented by ABS census data to inform scenarios of low and high population growth.

Customer behaviour and appliance stock: Changes in technology, water efficiency programs and customer awareness are all examples of factors that influence levels of water use in households and businesses. As technology changes, the turnover of older appliances and fittings with more efficient stock contributes to lower per-capita consumption over time. This is accompanied by changes in behaviour, such as more efficient garden watering practices. The level of adoption of alternative sources, such as rainwater tanks, also contributes to reducing demand for drinking water. Relevant assumptions adopted in the end-use modelling are supported by applied research and calibration against historical usage.

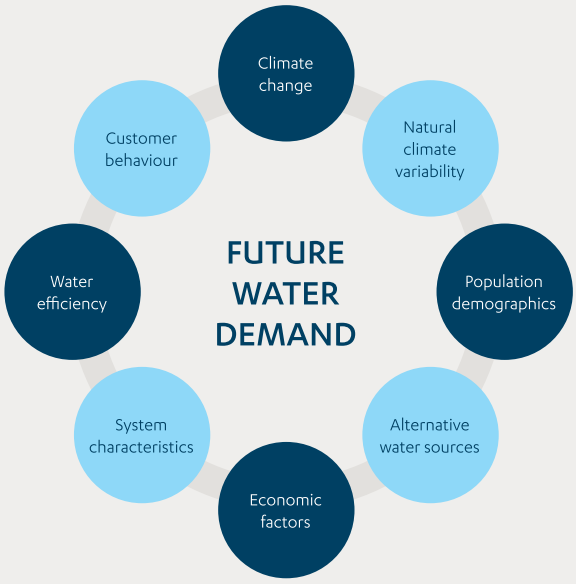
Non-residential use

The diversity of water use by industrial, commercial and agriculture customers that comprise non-residential demand means that consumption cannot be readily analysed in terms of common end uses. Instead, we analyse historical trends in water use by these customer-types and apply a growth factor aligned with population growth. This assumes that growth in residential population is accompanied by growth in local employment and business.

Scenario planning

To allow for the uncertainty in population growth projections and other factors, our demand forecasting incorporates a number of scenarios. We also undertake sensitivity analysis to understand the relative impact on the forecasts of different variables. The scenarios describe forecast demand under low, median and high rates of projected population growth.

Figure 8: Typical factors influencing residential urban water demand (source: DSE, 2011)



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Barwon Water's 2018 Pricing Submission Community Panel

7. Engaging with our customers and the community

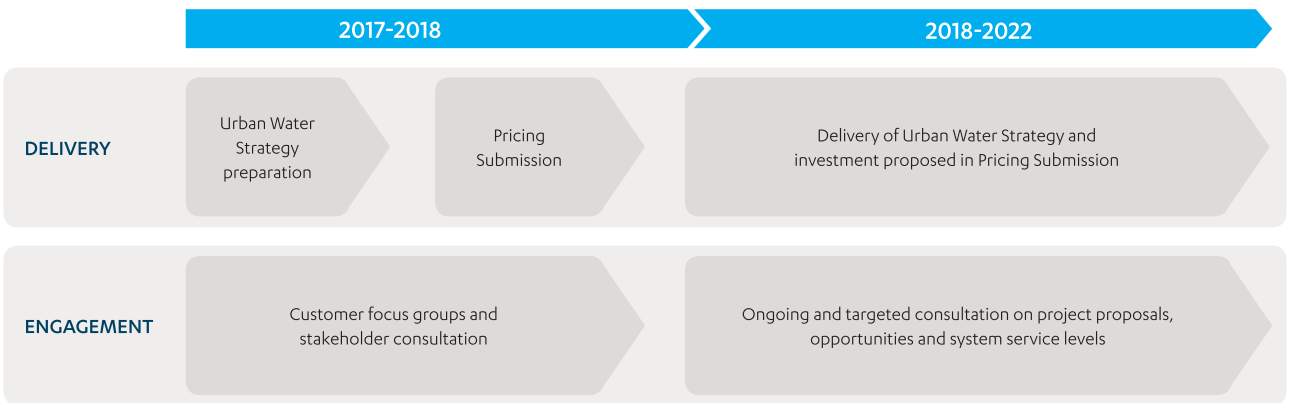
Barwon Water strives to be recognised as customer-focused and community-minded. By engaging with customers and stakeholders we aim to deliver services that meet expectations and contribute to broader environmental, social and economic outcomes.

7.1 Customer engagement

A commitment to ongoing engagement with our customers and the community is a key feature of this strategy, detailed further in Box 4. Although the nature of this consultation will evolve over time, the broad approach adopted is illustrated in Figure 8.

The feedback we have received in the course of the strategy preparation has helped inform both the Urban Water Strategy and Pricing Submission. Delivering the actions proposed will be underpinned by a strong focus on continued engagement.

Figure 8. Broad approach to customer engagement



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Box 4: Barwon Water's approach to customer engagement

Consistent with Barwon Water's commitment to open and transparent consultation with our customers and community, a Communication and Engagement Plan has been developed for the *Urban Water Strategy* and to align with the Pricing Submission process. The Plan complements the role of the existing Customer Consultative Committee (CCC) and Environmental Consultative Committee (ECC) that continue to guide our response to customer needs and expectations.

The objectives of the Communication and Engagement Plan are to:

1. inform Barwon Water employees, customers and key stakeholders about the development of the *Urban Water Strategy*
2. understand customer and key stakeholder views on water security matters, including levels of service and alternative water sources, to inform the development of future actions
3. emphasise our commitment to continued engagement throughout the 5 years of the strategy.

Our approach to consultation is based on maintaining the engagement that has helped inform the strategy throughout its implementation. A summary of some of the specific engagement objectives during both the development and implementation of the strategy are summarised below.

	Engagement objectives	Participants and action
Strategy development	Understand customer expectations about: – water security – existing Levels of Service, and whether there is a desire for change as part of the next strategy – suitability of the different level of water restrictions – possible future drinking water sources including surface water, groundwater, desalinated water, water from Melbourne and recycled water – support for water efficiency – alternative water and its role in improving urban liveability	Customer forums and surveys as part of the Pricing Submission process Presentations to the Environmental Consultative Committee (ECC) and Customer Consultative Committee (CCC)
	Understand stakeholder views about the need to ensure that priority public open spaces and sports ground always have access to water, even during drought	Meetings with local government
	Understand how Traditional Owners would like to be engaged to ensure that future water resource planning and the delivery of the Urban Water Strategy considers Aboriginal values	Meetings with local Aboriginal Groups and Registered Aboriginal Parties (RAP)
	Understand stakeholder views on the opportunities for alternative water use	Continued engagement with Barwon Region IWCM Network
	Update other agencies on the direction of the Urban Water Strategy	Meetings with DELWP, Southern Rural Water and Corangamite CMA
	Raise awareness of: – Barwon Water's long term planning framework for water security – supply system characteristics and levels of security – the role of water in contributing to liveable and resilient cities and towns.	Ongoing community and customer engagement via our website, social media and other forums

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Box 4: Barwon Water's approach to customer engagement

Continued

	Engagement objectives	Participants and action
Strategy delivery	Continuing to inform and update the community on Barwon Water's water security status and forecast, including the *Annual Water Outlook* Ongoing engagement with customers and stakeholders in response to the issues raised during the strategy development Focused engagement on key issues and actions identified as part of the strategy, such as: – exploring options for different levels of service and water restrictions – consulting with the Apollo Bay and Lorne communities to identify preferred initiatives from a short-list of options to secure future water supply – updating the Geelong and Colac communities on the anticipated timing of future actions – future water sources including the possible use of recycled water Ongoing engagement with all stakeholders to identify and pursue opportunities for integrated water management Ongoing engagement with Traditional Owners on water resource planning	Engagement activities to be developed

Actions	
7.1	We will continue to engage with our customers, the community and other stakeholders on issues identified in the Urban Water Strategy
7.2	We will update the community on Barwon Water's water security status and forecast each year by publishing the Annual Water Outlook

7.2 Customer feedback

Our customers have provided a range of insights that provide us with an understanding of the important issues that we need to continue to address. These insights have emerged from the consultation process that has been delivered to help inform our 2018 Pricing Submission to the Essential Services Commission.

Our customer engagement process has included:

- **The 'Your Say at Barwon Water' online engagement platform:** this project page accessible through our website received more than 700 visits
- **Community pop-up kiosks:** Barwon Water hosted nine community information kiosks and spoke to almost 600 people from late October to mid-December 2016, raising awareness for the Urban Water Strategy and Pricing Submission.
- **Qualitative and quantitative research:** this extensive phase of research covered:
  - six residential focus groups across the service region
  - just over 1,100 telephone and online surveys
  - five interviews with major customers
  - three interviews with customer support organisations
- **Community panel:** formed to delve further into our qualitative and quantitative community feedback, the panel was randomly selected from a pool of 10,000 residential and non-residential customers. From this pool 221 people registered to be involved and from these registrations our panel comprised 23 residential and 7 non-residential customers from across our service region. The panel met over four days in three separate workshops.

A snapshot of the some of the key research findings is captured in Table 5.

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Table 5. Snapshot of key findings from qualitative and quantitative research

Topic	Customer feedback
Levels of service	There is a high degree of acceptance for current water supply levels of service (water restrictions no more than five percent of the time).
Water restrictions	More than 60 per cent of respondents feel restrictions are appropriate when 'storage levels are low', while one-quarter believe they should be implemented every summer. However, only 25 per cent support the most severe (Stage 4) restrictions, when no outdoor water use is permitted.
Water sources	Approximately half of respondents support greater use of surface water resources in the future. There is support for use of alternative water sources such as recycled water, but mixed views on whether this is appropriate for potable use (with the right systems in place to protect public health) in the long term. There is relatively less support for desalination, sourcing water from Melbourne, and use of groundwater.
Community assets	Strong support was expressed for a range of community outcomes, including: the possibility of a community fund to support the use of alternative water sources to irrigate public spaces; community-led water projects; and improving access and facilities at sites with recreational value, such as reservoirs.
Water efficiency and recycled water	There is strong support for water efficiency, with 60 per cent of respondents indicating a willingness to pay for more investment in water efficiency programs. By contrast, 60 per cent of those surveyed felt that current levels of support for recycled water use are sufficient.

The Community Panel workshops were framed by asking participants: *what do you value most about your water and sewerage services and what do you expect in the future?*

The Panel was an opportunity for a representative group of customers from across our region to come together to: understand what others had already said about Barwon Water's services and prices; appreciate accompanying data; share ideas; discuss future possibilities; and form a collective view on what Barwon Water's water and sewerage services should look like, now and into the future.

The Community Panel's recommendations, which it presented to the Board of Barwon Water, have helped shape the Urban Water Strategy and will influence Barwon Water's 2018 Pricing Submission.

The major outcomes of the Community Panel's report for the Urban Water Strategy are summarised in Table 6.

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Table 6. Summary of Community Panel recommendations for outcomes relevant to Urban Water Strategy

Topic	Community Panel recommendations
1. Use of innovation and technology	Working in partnership with customers, Barwon Water should embrace innovation and stay at the forefront of technological advances to encourage greater water efficiency. This is driven by an expectation of sustainability and a need to adapt to the uncertainty of climate change impacts over time.
2. Environmentally sustainable services	Support for Barwon Water's commitment to making the most of available resources – such as energy recovery and water recycling – to deliver services in an environmentally and financially sustainable manner.
3. Community resources, knowledge and education	To ensure that use of water as a valuable and finite resource is sustainable in the long term, whilst ensuring services remain affordable for future generations, Barwon Water should better inform and educate the community on: – the complexities of harvesting and supplying water – different ways to save water and use it efficiently and effectively – new water-related products and solutions that are available.
4. Reliable supply of water for the future	Continue to plan and invest in infrastructure that will ensure secure and safe water supply to a growing and increasingly urban population
5. Supporting the community	Increase community education for water saving measures, which will contribute to reduced costs for customers
6. Creating liveable communities	A liveable community is "a community that irrigates recreational spaces with recycled water, uses stormwater, and creates community projects to improve public spaces, thus creating a desirable place to live." Through strengthened relationships with existing stakeholders, Barwon Water should help deliver healthy urban landscapes and places, effective wastewater management and healthy and valued waterways.
7. Action on climate change	Support for the Board's goal for 100 per cent renewable energy by 2025.
8. Water efficiency	Barwon Water should consider more stringent permanent water restrictions coupled with greater economic incentives for efficient water use. For example, encouraging the use of water saving and harvesting devices such as rainwater tanks, timers and instant water heating.
9. Class A recycled water	Recognising the role that recycled water plays in reducing demand for potable supplies, Barwon Water should invest in education to shift community perceptions about the use of recycled water for various purposes, including for indirect potable use.

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7.3 Customer service levels

We have a range of customer service obligations. In addition to the service standards and conditions that are enshrined in our Customer Charter, the service levels below describe the reliability of water supply that we commit to providing.

AGREED SERVICE LEVEL
during normal operation

Barwon Water will supply water to meet unrestricted demand at least 95 per cent of the time. Water restrictions will be required no more than 5 per cent of the time.

What does this mean in practice?

The reliability of traditional water supply systems will always be influenced by climatic conditions. A system that meets unrestricted demand 100 percent of the time would mean investing substantially to provide enough water under any circumstances, however infrequent, unlikely or severe they may be. By contrast, maintaining adequate supply for the majority of years, complemented by other measures (such as water restrictions) to ensure that there is sufficient water supply to meet essential needs in all years, means that investment in infrastructure can be reduced. Achieving a balance between the likelihood of water restrictions and investment in supply is necessary to keep customer bills affordable.

The likelihood, duration and severity of restrictions depends not only on the climate, but also on the individual characteristics of each supply system. For example, restrictions are unlikely to be required in Geelong in the near term as a result of recent investments to boost supply.

The prospect of water restrictions as a measure to balance supply and demand may be more real for smaller, independent systems, where seasonal conditions have a more pronounced influence.

However, based on detailed modelling, restrictions in any system are expected no more than 5% of the time over the long term.

In the most severe droughts, or during other emergencies that lead to water shortages, Barwon Water plans to always maintain adequate water supply for essential human needs.

MINIMUM SERVICE LEVEL
During drought and emergency

At all times, even during droughts and emergencies, Barwon Water will continue to supply drinking water to meet essential human needs.

What does this mean in practice?

The staged implementation of water restrictions tends to be the first response to balance supply and demand through dry conditions. However, in extreme conditions and once the most severe water restrictions are in place, it may also be necessary to draw on alternative water sources. Since these sources are only intended to provide temporary, back-up supply, it is necessary to restrict consumption so that sufficient water can be provided to meet the basic needs of all customers.

These measures are only required in the most extreme or emergency conditions. Every water supply system is different, which is why water restrictions may be required in one area but not another at the same time.

No change is proposed to the service levels that were agreed in the previous three strategies (from 2003 onwards). These service levels are longstanding and were again endorsed in the community consultation undertaken in the course of developing this strategy. This suggests there is a good level of understanding and acceptance of these standards at present, with limited evidence that they need to change.

However, as part of an evolving regulatory and strategic framework for the industry, we will be engaging with customers across each system to further test preferences about future service levels. The results of this engagement will inform any changes in the next iteration of the Urban Water Strategy.

Actions

7.3 We will engage with customers to establish whether existing service levels and stages and severity of restrictions are understood and align with customer preferences, or should be revisited as part of the next Urban Water Strategy

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7.4 Recognising Aboriginal values

We acknowledge Aboriginal people as the Traditional Owners and custodians of the land and water on which we rely. Traditional Owners have a strong connection to water as a vital part of their life and culture.

Traditional Owners are represented by five Aboriginal groups across our service area: the Wadawurrung, Kuu Yang Maar, Eastern Marr, Guli-Gad, and Wathaurong Aboriginal Co-operative.

We have engaged with each of these groups in the course of preparing this *Urban Water Strategy* and the Pricing Submission. This consultation represents just the first stage in improving our understanding of Aboriginal values and better incorporating them in our water resource planning.

The waterways of our region have great significance for Traditional Owners. Understanding and documenting their stories will be an important first step to recognising this cultural value and ensuring it is considered in future water resource planning. The close association of Traditional Owners to water and land also provides economic opportunities for Aboriginal groups. These could arise through related ventures, such as eco-tourism along waterways, or extend to access to water for Aboriginal groups to use in a way that contributes to economic development. We will explore these opportunities as part of the review of the *Central Regional Sustainable Water Strategy* and in consultation with local Aboriginal groups.

Our commitment to recognising, including and supporting Aboriginal values is detailed in Box 5 below. Ongoing engagement with Aboriginal groups in our region is a key feature of our Communication and Engagement Plan.

Box 5: Commitment to recognising, including and supporting Aboriginal values

We will recognise Aboriginal values for water and incorporate Aboriginal values and expertise into water management

We will build capacity in Barwon Water to facilitate increased Aboriginal participation in water resource management

- We will actively support employees to engage and build partnerships.
- We will spend the time, resources and effort necessary to facilitate participation.

We will build relationships with Traditional Owners

- We will value the importance of building relationships with Traditional Owners and the value of leveraging from existing relationships (for example, those established by the Corangamite Catchment Management Authority) as a way to develop our own.
- We will build on the engagement commenced during the development of the Urban Water Strategy and we are committed to keeping these conversations going over the next 5 years and into the future.

We will enable effective Aboriginal participation in water resource planning and management to protect Aboriginal values and improve the sustainable management of our water resources

- We will coordinate with other agencies including DELWP, the Victorian Environmental Water Holder (VEWH) and the Corangamite CMA to integrate our activities and reduce administrative burdens
- We will integrate Aboriginal engagement and participation in the planning, governance, implementation and review of our programs and projects
- We will work transparently and respectfully and establish clear roles and expectations
- We will engage with the Aboriginal community to seek their input when we are updating or developing new strategies and plans, such as the Urban Water Strategy and the Pricing Submission
- The appropriate people will be engaged at the correct time during the process
- We will meaningfully engage with Aboriginal Groups early in the planning phase for water resource projects to ensure they are aligned with Aboriginal values and to achieve shared benefits

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Actions	
7.4	We will engage with Traditional Owner groups to recognise, include and support inclusion of Aboriginal values in water resource management
7.5	We will explore opportunities as part of the review of the Central Region Sustainable Water Strategy to provide access to water to Aboriginal groups for economic development
7.6	We will work with the Corangamite CMA and Traditional Owners to document the cultural values in the Barwon, Moorabool and Otway Coast river systems to increase understanding of Aboriginal values that can be supported with environmental water

7.5 Planning and emergency response framework

This *Urban Water Strategy* is part of a planning framework that is in place to ensure that customer service levels are maintained and can be met in even the most challenging circumstances. The role of each element of this framework, illustrated in Figure 9, is described in Table 7 below.

Table 7: Summary of elements of planning and emergency response framework

Adaptive Management Framework	Uncertainty about future conditions requires an adaptive planning approach that secures water supplies, but avoids investing too much or too soon in new measures. This approach is detailed in Chapter 11.
Drought Preparedness Plan	In the event of severe or prolonged dry conditions, Barwon Water may implement some or all of the actions that are identified in the Drought Preparedness Plan for each system. Drought response measures and the decision-making principles that guide their implementation are described in Appendix A. These are supported by more detailed operational plans.
Emergency Management Plan	The Emergency Management Plan guides Barwon Water's actions if activated under the most extreme and rare circumstances. This includes, for example: – Natural disasters – An event that impacts water quality – An extreme water shortage (without historical precedent and beyond circumstances addressed by the Drought Response Plan)
Water Quality Management System	Barwon Water must meet the strict requirements of the *Safe Drinking Water Act 2003* and the *Safe Drinking Water Regulations 2005*. Adopting the *Australian Drinking Water Guidelines 2004* as a benchmark, Barwon Water maintains a comprehensive, risk-based management system of its water supplies, from catchment to tap. This includes performance reporting to the public in the *Annual Drinking Water Quality Report* available on our website.

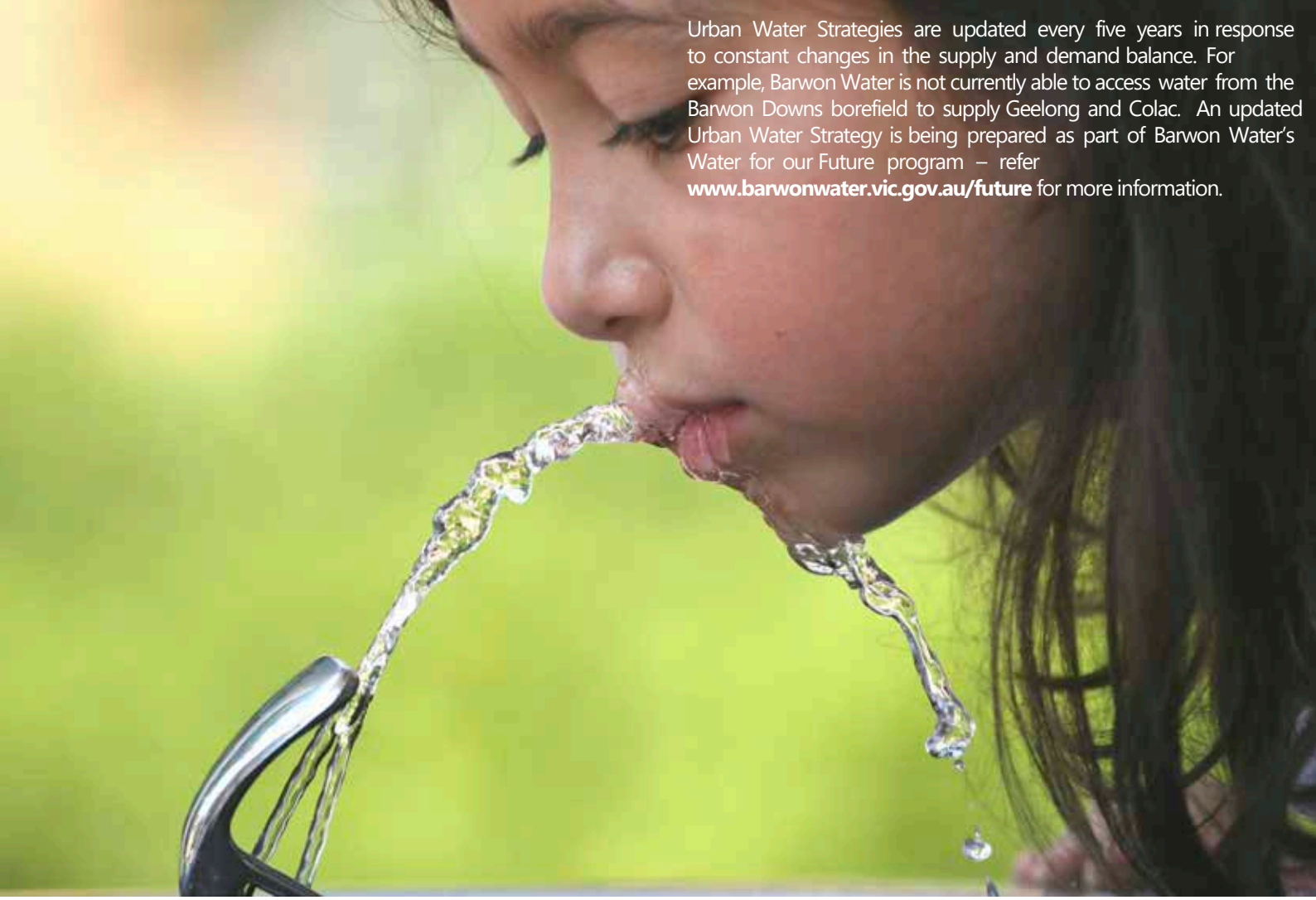

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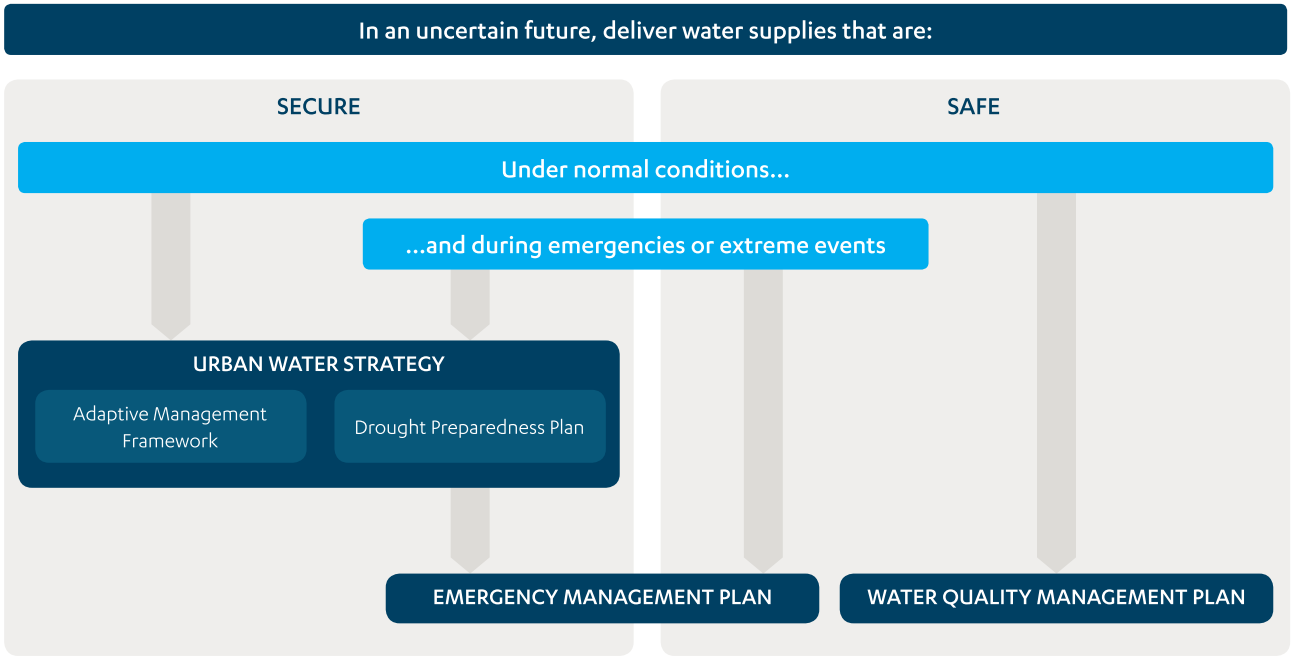
Figure 9: Framework for ensuring delivery of safe and secure water supplies



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8. Delivering water efficiency and alternative water sources

In Victoria, a wide range of organisations contribute to managing the urban water cycle. Barwon Water recognises the benefits that are realised by working collaboratively with others to achieve greater synergy across planning and delivery of water cycle services.

As our towns and cities grow and evolve, the integration of land and water planning – including consideration of drinking water, wastewater, recycled water, rainwater and stormwater – is also critical to ensure we foster places that are sustainable, liveable and prosperous.

This reflects our aspiration to make the most of all available water resources, while contributing to desirable places to live and the region's economic prosperity. Realising our long-term aspiration for zero waste and complete resource recovery could minimise the need for ocean outfalls, instead diverting valuable recycled water to drive regional productivity. Progressing towards this goal involves:

- leadership, engagement and collaboration through integrated water management (IWM) planning
- exploring and encouraging use of alternative water sources, including rainwater, stormwater and recycled water
- supporting the efficient use of water
- a commitment to innovation.

8.1 Supporting resilient and liveable cities and towns

Water for Victoria articulates the role that water plays in contributing to resilient and liveable cities and towns.

The delivery of the *Urban Water Strategy* coincides with the Victorian Government's plans to establish Integrated Water Management (IWM) Forums to guide more collaborative management of the urban water cycle. The IWM Forums will play a role in reviewing and identifying opportunities through IWM Plans for integrated servicing solutions that deliver multiple benefits for the community and environment.

This approach is already embedded in our region, led by the establishment of the Barwon Region Integrated Water Cycle Management (IWCM) Network in 2012 to formalise and strengthen the productive working relationship between the region's five councils, Corangamite Catchment Management Authority, Southern Rural Water and Barwon Water (see Box 6). The Barwon Region IWCM Network is a primary example of the IWM Forums proposed by Water for Victoria to identify, investigate and advance opportunities for more integrated management of urban land and water planning.

The integration of water and land planning requires local, place-based planning that recognises the particular characteristics, challenges and opportunities that are present in different areas. An IWM Plan prepared for the growth area of Spring Creek, in Torquay, is an example of how the identification of alternative water cycle servicing strategies can help inform the Precinct Structure Plan (PSP), which becomes the blueprint for the area's development. Aligning community expectations, environmental outcomes and water cycle services in this process ensures that growth areas are established as desirable places to live.

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Box 6: The Barwon Region IWCM Network – Integrated Water Management in practice

The Geelong region includes some of the fastest growing areas in Australia, which must be supported in the context of other major challenges such as climate change. Successfully facilitating this growth needs to recognise the community's desire to reside in urban landscapes that are liveable, sustainable and resilient. Many factors influence and contribute to the liveability of new and existing urban landscapes. The urban water cycle is one of these factors.

The urban water cycle comprises a number of different but interconnected elements that span both the natural and built environment, and include critical services such as provision of water and wastewater management. Early consideration of these elements in a more integrated manner in planning and design can help deliver more liveable urban landscapes.

However, an integrated approach is often challenged by complexity arising from the number of agencies with responsibilities across urban water cycle management in Victoria. This can result in lost opportunities for more liveable urban landscapes and occasionally even lead to conflict and confusion. The critical need is for all these agencies to work more collaboratively in an integrated water cycle management approach.

In response to this challenge, all the key agencies across the G21 region involved in water management established the Barwon Region IWCM Network in 2012. The foundation agencies include:

- City Of Greater Geelong
- Borough of Queenscliffe
- Colac Otway Shire
- Surf Coast Shire
- Golden Plains Shire
- Barwon Water
- Southern Rural Water
- Corangamite Catchment Management Authority.

Through Memorandum of Understanding (MOU), these agencies committed to the shared vision that better integration on issues of urban water cycle management would lead to improved outcomes for the community. The Network comprises urban and water planners, engineers and operational staff who all play some active role in water cycle management. The Network's first task was to identify key challenges and opportunities and develop an action plan to achieve the goals outlined in the MOU.

The Network identified five focus areas:

- establishing the Network governance, support and administration
- raising awareness of IWCM amongst the agency staff
- building knowledge to help staff apply IWCM in practice
- building confidence in methods and processes for integration
- developing tools and support.

Actions have typically been implemented collectively by the network, with key organisations taking lead responsibility as required. In the brief period since its inception the Network has made a number of significant achievements, including:

- developing a shared understanding of the scope of IWCM
- developing an agreed method for applying IWCM thinking early in the concept stages of new urban development
- an IWCM Plan for Colac, the first of its type in Victoria
- the Urban Water Planning Guide (see http://www.urbanwaterplanner.com.au/)
- IWCM Plans for Fyansford and Springs Creek.

2. Integrated Water Management Framework for Victoria. Working Draft for Consultation. DELWP, November 2016

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Local IWM Plans will be appropriate in a range of circumstances, not just in areas experiencing growth or development. The primary role of IWM Forums in the future will be to identify and prioritise opportunities where a local IWM Plan could address existing challenges and opportunities, such as:

- An identified need for new infrastructure (for example, water supply augmentation, sewer duplication or drainage renewals)
- Catchment improvements (for example, addressing localised urban flooding, streetscape renewals or waterway revegetation)
- Land use planning (for example, growth area, redevelopment, public open space or urban renewal master planning).

The responsibility for preparing local IWM Plans will be shared between collaborating organisations. Barwon Water expects to play a key role in leading these plans where appropriate.

We see a particular opportunity for local IWM Plans to add value to planning in our smaller systems of Lorne and Apollo Bay, where community values will shape the way we meet future challenges. The characteristics of these systems also mean that even small volumes of alternative water, provided at the right time, could have a material impact on future upgrade requirements. Within the governance framework of the proposed IWM Forum in our region, we will propose these towns be considered as key opportunities for place-based IWM plans.

Geelong's major growth areas, which will accommodate more than 30,000 new properties in the future, also provide a prime opportunity for integrated water management to contribute to liveable and resilient communities. We will propose IWM Plans be delivered for the northern and western growth areas to ensure that we support the prosperous and sustainable development of the region's major centre.

Actions	
8.1	We will continue to lead investigation of integrated water management and alternative water opportunities through the Barwon Region IWCM Network and IWM Forums
8.2	We will lead the development and implementation of local IWM Plans for Lorne and Apollo Bay
8.3	We will lead the development and implementation of IWM Plans for Geelong's future northern and western growth areas in collaboration with the City of Greater Geelong and other stakeholders
8.4	We will continue to work with local government to ensure that planning for new land development contributes to liveable and resilient communities

8.2 Supporting the use of alternative water sources

Diversifying water sources for fit-for-purpose use has contributed to reducing demand for drinking water. Rainwater, stormwater and recycled water can all form an important part of a 'portfolio' of resources, particularly in areas of new urban development.

We operate the Black Rock Water Reclamation Plant to provide recycled water to a growing number of customers in Armstrong Creek and Torquay North. Recycled water delivered to the Viva Energy refinery in Corio from the Northern Water Plant provides the ability to save more than 5 per cent of Geelong's current water demand. We also provide fit-for-purpose recycled water from our water reclamation plants for the irrigation of golf courses, tree plantations and horticultural and agricultural crops. These existing assets are examples of the role that alternative water sources can play in contributing to secure water supplies.

We recognise the value of the recycled water that we produce and will continue to explore opportunities for its use for agriculture, industry and other applications – including investigating the potential for indirect potable reuse to fully utilise this resource in the longer term (see further discussion of 'future options for investigation' for the greater Geelong system). Making best productive use of this resource will contribute to supporting regional prosperity into the future.

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A prominent opportunity for the use of alternative water sources is for irrigation, particularly of high value open space such as parks, street trees, gardens, sports fields and golf courses. These community assets tend to be the first to be impacted during drought, sometimes to the point where their use is limited or their value undermined.

To ensure that green spaces are always maintained to support active living and wellbeing, we will work with local councils to ensure that reliable water supply for priority assets is maintained, even during drought or water restrictions.

Ongoing engagement with the local councils in our region has already identified priority open spaces that the community values highly, including the Colac Botanic Gardens and Eastern Beach and Johnstone Park in Geelong. From here, we will:

- confirm the water demand for priority spaces and undertake modelling to understand the implications of exempting these locations from water restrictions
- investigate alternative water supplies
- undertake an economic evaluation that compares the costs borne by the community due to the diminished quality of priority open spaces during water restrictions, with the costs of ensuring secure water supply
- confirm the approach to managing priority green spaces during drought.

Actions	
8.5	We will determine arrangements for the protection of priority open spaces during drought in consultation with local government and the community

8.3 Supporting the efficient use of water

Our customers have played a critical role in helping to make the best use of available water resources. Water consumption in Geelong in the early 1980s was greater than it is today, despite the city's population doubling since that time. Efforts in water conservation and efficiency have reduced average household consumption by about 40 per cent over recent decades.

The significance of this achievement should not be underestimated. More efficient water use not only contributed to ensuring supplies were maintained through the worst drought in recent history, but meant that investment in new infrastructure was deferred until much later than otherwise would have been the case. The sequence of major water resource projects that have recently been delivered would have been required many years ago had efforts not been made to reduce water consumption. Deferring the construction of this infrastructure has ultimately meant that customer bills have been more affordable for longer.

Whilst we have continued to improve water supply security by making substantial investments in essential infrastructure, it is critical that, as a community, we do not neglect the importance of water efficiency as part of sustainable water management. Improving water efficiency provides insurance against short term changes in demand driven by seasonal variability, as well as future uncertainty driven by population growth and climate change. The Permanent Water Saving Plan (PWSPs), a set of simple common-sense everyday rules, have now been in place for several years to ensure that responsible water use remains common practice.

The demonstrated benefits of greater water efficiency mean we should also aspire to go further. While it becomes more difficult to make continued efficiency gains over time, innovation and changes in technology can make it possible. As a period of rapid population growth and urban development continues, there is a particular opportunity to ensure that this occurs in a way that minimises the impact on limited drinking water resources. This includes both water efficiency measures and the use of alternative water sources such as rainwater, recycled water and stormwater.

Efforts in research and development have delivered substantial advances in the way we think about and deliver water cycle services. At a time of rapid population growth and uncertain future climate, the need for ongoing innovation, research and development remains compelling.

Although community awareness about water conservation remains strong, there is a risk of complacency, particularly outside drought periods. A 'Target Your Water Use' program identified in Water for Victoria places renewed emphasis on water efficiency, recognising the critical role that an informed community will play in making the most of existing water supplies. Barwon Water will implement this program (see Box 7) and continue to provide information to our customers to increase understanding of the water cycle and the challenges we face.

Actions	
8.6	We will undertake research and development that contributes to ongoing innovation in water efficiency measures
8.7	We will develop, implement and monitor water efficiency programs such as the 'Target Your Water Use' program

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8.4 Supporting innovation and new technology

A commitment to innovation underpins the way we operate more broadly, but is perhaps best exemplified in the opportunities presented by more integrated and efficient use of our water resources. The increasing use of recycled water is an example of the way in which our approaches can change, with evolving technology and thinking shifting the perception of recycled water as a waste product to recognition of its value as a water resource.

Historically, water cycle services were delivered as part of a 'once-through' system, with water harvested from catchments to be used once, then treated as wastewater and discharged to the environment. Similarly, drainage systems were designed to convey stormwater away from people and property as rapidly as possible, transferring the impact of large quantities of poor quality stormwater to receiving waterways.

There are opportunities to address the deficiencies of this traditional approach at many scales, including at an individual property, within a precinct, or across the centralised infrastructure system.

Table 8 introduces just a few examples of the types of opportunities we might explore – or support our customers to implement – over time and across these various scales.

The opportunities for innovation are endless and will only be constrained by our willingness to explore and test new ideas. We are committed to embracing innovation as a key part of our business.

Actions

8.8 We will facilitate and partner in research and development that contributes to ongoing innovation in the water sector

Table 8. Selected examples of opportunities for innovation

Property Scale	– Better use of real-time information (for example, through smart meters and mobile device apps) to enable customers to make decisions about how and when they use water – Rainwater tanks and other on-site measures, such as raingardens, to help manage stormwater and mitigate flood risk – More efficient fixtures and fittings – Smarter wastewater systems that, through the use of telemetry, reduce peak flows so that downstream infrastructure needs are reduced
Precinct Scale	– Localised treatment solutions (for stormwater and recycled water) to provide a fit-for-purpose water resource that supplements existing supplies and provides opportunities for economic growth – Better integration of water planning to support the liveability of communities with 'green' infrastructure and adequate water resources to protect green space
Central Systems	– Large-scale water recycling to take advantage of the significant resource available, particularly from Black Rock Water Reclamation Plant. Continually evolving treatment technologies and precedents around the world mean that any potential use may be feasible in the long term, including potentially incorporating recycled water as part of the drinking water system – Resource recovery from wastewater treatment by-products, particularly biosolids (we will maintain our current practice of achieving 100 per cent reuse of the biosolids from Black Rock as a soil conditioning product). – Incorporating energy generation within our systems, whether directly (for example, through the use of biogas in wastewater management or hydroelectricity at our water storages) or by incorporating renewable energy production on the land and property we manage – Integrating management of organic waste from external sources (such as food waste) with wastewater and biosolids management to contribute to energy recovery

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Box 7: Barwon Water's *Target Your Water Use* program

Target Your Water Use (TYWU) is the regional approach to water efficiency across Victoria. The program is designed to provide useful information to regional Victorians on how to be more water efficient within their homes and how to use water more wisely.

Our TYWU program:

- sets out how Barwon Water will continue to support sustainable water use by customers
- focuses on 'behind-the-meter' water efficiency activities designed to support customers' sustainable use of water
- is part of a holistic approach to regional water security, reflected in this *Urban Water Strategy*.

The program excludes other areas we focus on independently, such as system efficiencies (for example, leakage reduction) and other 'before-the-meter' activities to save water. Nor does it include non-voluntary programs such as water restrictions.

The TYWU Program will comprise a combination of existing water efficiency programs alongside new or enhanced initiatives, as illustrated in Figure 10.

Existing water efficiency initiatives include: advertising and promotion of the permanent water saving rules, legacy showerhead exchange and rebate programs, the *Water: Learn It. Live It.* Program and *Schools Water Efficiency Program* (SWEP), limited advice through key account managers and monitoring programs for some key customers.

A number of new or enhanced programs are also proposed:

Community Water Literacy Program: A broad regional water literacy program, including a Summer Water Literacy program targeted at peak coastal summer holiday water users.

Schools Water Efficiency Program: In line with the commitment in Water Victoria, a campaign to increase the level of participation in the Schools Water Efficiency Program (SWEP), as well as investigating expanding the program into other areas, such as government buildings. This could also include increasing the water efficiency focus of the existing schools *Water: Learn It. Live It. Program*.

Business Water Efficiency Support Program: Provide support in the form of water efficiency consulting services (such as water use and process audits, advisory services, rebates and potential grant assistance) to eligible businesses. Direct grants may be available to agreed projects that achieve ongoing reductions in drinking water use.

Community Water Efficiency Support Program: Provide support in the form of water efficiency consulting services to eligible community, school and not-for-profit groups and schools. Direct grants may be available to agreed projects which achieve ongoing reductions in drinking water use and/or promote community water literacy in meaningful ways.

Community Rebates (Hardship) Program: This program is proposed to be re-established. This would provide rebates to eligible hardship-affected customers for water use audits by licensed plumbers, plus replacement at the time of audit of leaking or faulty fixtures and/or appliances up to a nominal value per customer.

TARGET YOUR WATER USE

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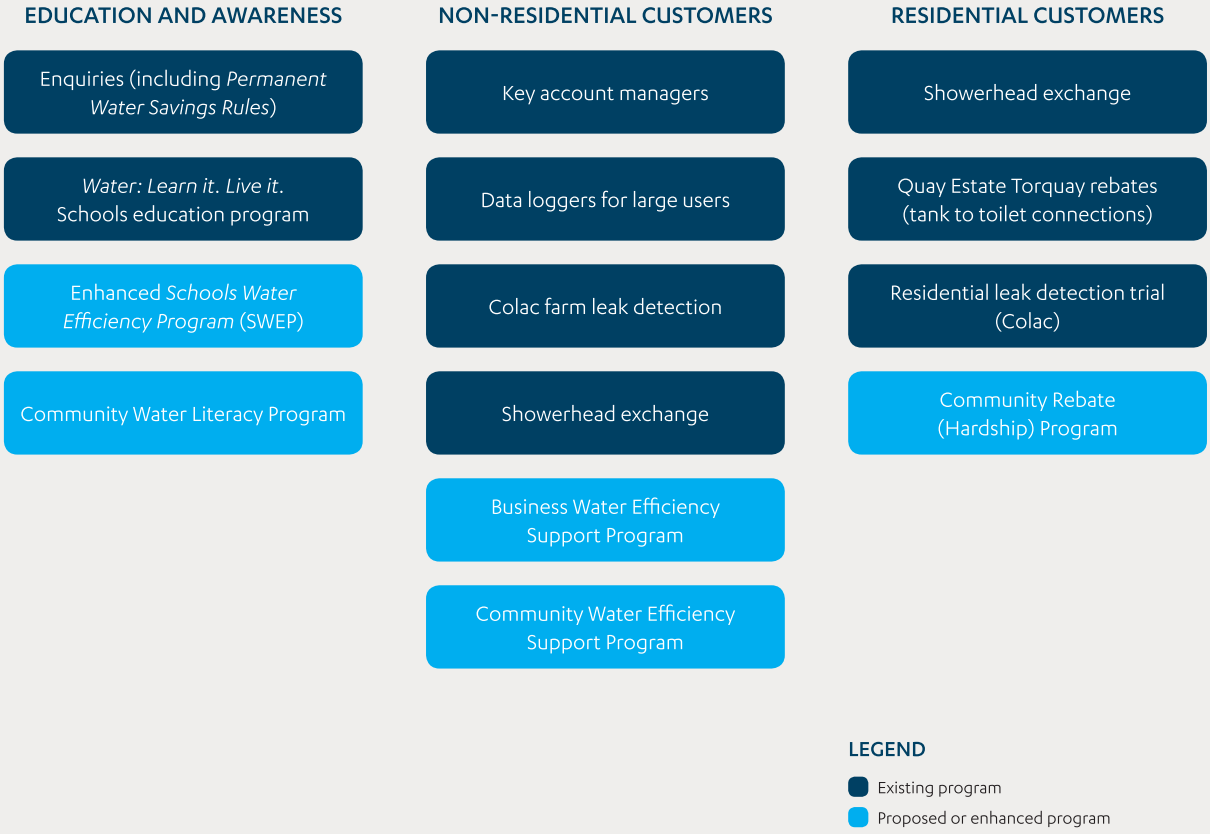
Box 7: Barwon Water's *Target Your Water Use* program

Continued

Figure 10: New, enhanced and existing water efficiency programs



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9. Supporting a healthy environment

Water resource management must balance the needs of competing uses. The water available in our region to support agriculture and sustain our cities and towns must be shared equitably, while ensuring that enough remains and is managed to support environmental, Aboriginal and recreational values.

The water we take from waterways and aquifers is harvested in accordance with the conditions of bulk entitlements and licences, issued to us by the Minister for Water, as part of Victoria's water planning and entitlement framework. This is a secure right to water that enables us to plan with certainty and flexibility.

Every bulk entitlement includes conditions that protect the needs of the environment, ensuring sufficient passing flows at a point in time and sustainable use of the resource over the longer term. The environment also has entitlements of its own, managed by the Victorian Environmental Water Holder (VEWH).

Where appropriate, we work with VEWH to co-ordinate releases from our storages to provide the greatest benefit to the environment with the resources available. We recognise that, in the future, there will also be opportunities to ensure that the way we manage water resources, storages and releases is better aligned with Aboriginal and recreational values.

Many of our storages also spill on a regular basis. These high flow events provide an important contribution to the natural ecology and environmental health of the downstream waterways. Bulk entitlement conditions are deliberately structured so that these events can occur.

9.1 Future water resource planning

Consistent with the state's framework for water resource planning, the Victorian Government will undertake a comprehensive review of resources across our region coinciding with the period of this Urban Water Strategy. The key elements of the framework include:

- **long-term water resource assessments**, which identify whether broad-scale resource availability has changed, and if so, the severity of the impact on consumptive and environmental use
- regionally focused **sustainable water strategies**, which identify and manage threats to the supply and quality of water resources, ensure entitlement holders have the tools to manage their own risks, and identify the potential to improve waterway health.

Barwon Water's own planning, including the preparation of this *Urban Water Strategy*, will make an important contribution to the long-term and regional resource reviews. We will actively participate in the regional planning to occur in coming years (see Figure 11), including focused engagement with our customers, the community and Traditional Owners.

Considering the needs of the environment will be an important part of the long-term water resource assessment. In our region, the Moorabool River in particular would benefit from increased flows, with targets for additional environmental water identified in past Sustainable Water Strategies and reiterated in Water for Victoria.

Our engagement with representatives of the Wadawurrung Aboriginal Group has also helped us understand the significance of the Moorabool River for local Aboriginal people (Box 8). The importance of the Moorabool to Traditional Owners emphasises the need to include Aboriginal values as part of future goals for the river, as well as the opportunity to align these with environmental outcomes.

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Box 8: The story of the wedge tailed eagle and the Moorabool River – a story from Uncle Bryon Powell, Wadawarrung Elder

As I follow the river from Ballarat to Geelong, I see the Wedge Tailed Eagle flying over the river. The Wedge Tailed Eagle is the earthly form that our creator Bunjil takes. When we see the Wedge Tailed Eagle we feel comfortable and connected to the land as we know he is looking after us. If the flows aren't maintained and the river becomes sick, Bunjil will leave. This will break our spiritual connection to the land and is a sign that we are no longer caring for our country and that we need to heal country.

We worked with the Victorian Government to achieve the environmental water targets identified in the 2006 *Central Region Sustainable Water Strategy*. As part of the strategy, Barwon Water and Central Highlands Water worked together to return 2,500 ML/year to the Moorabool River. Barwon Water is also currently working with Corangamite CMA and VEWH to return 1,000 ML/year to the Upper Barwon River by the end of 2017. As part of the review of the *Central Region Sustainable Water Strategy*, we will continue to work with the Government and stakeholders to explore options to continue to improve the health of both rivers.

Actions	
9.1	We will work with VEWH and Aboriginal groups to explore further opportunities to operate our headworks systems so that environmental and Aboriginal values are supported
9.2	We will contribute to the review of the Central and Western Region Sustainable Water Strategies and regional long-term water resource assessment
9.3	We will work with stakeholders to explore options to achieve goals for environmental flows in the Barwon and Moorabool Rivers, while continuing to ensure secure and affordable water supply in the Geelong system

9.2 Supporting wastewater management needs in small towns

Many small towns within our region – and across Victoria – are not serviced by reticulated sewer networks and centralised wastewater treatment (sewerage systems).

In the absence of sewerage infrastructure, individual properties adopt the long-standing practice of relying on a domestic wastewater management system (such as a septic tank). For the most part, this is an efficient and effective solution that continues to serve many towns and properties well.

In some instances, though, it can lead to localised risks to public health and amenity where wastewater management is inadequate. This can arise, for example, where the condition of ageing infrastructure has deteriorated, or is no longer suitable for a growing household or business.

Wherever these risks are evident, stakeholders work to identify an appropriate solution that protects public health, the environment and liveability, while supporting future growth.

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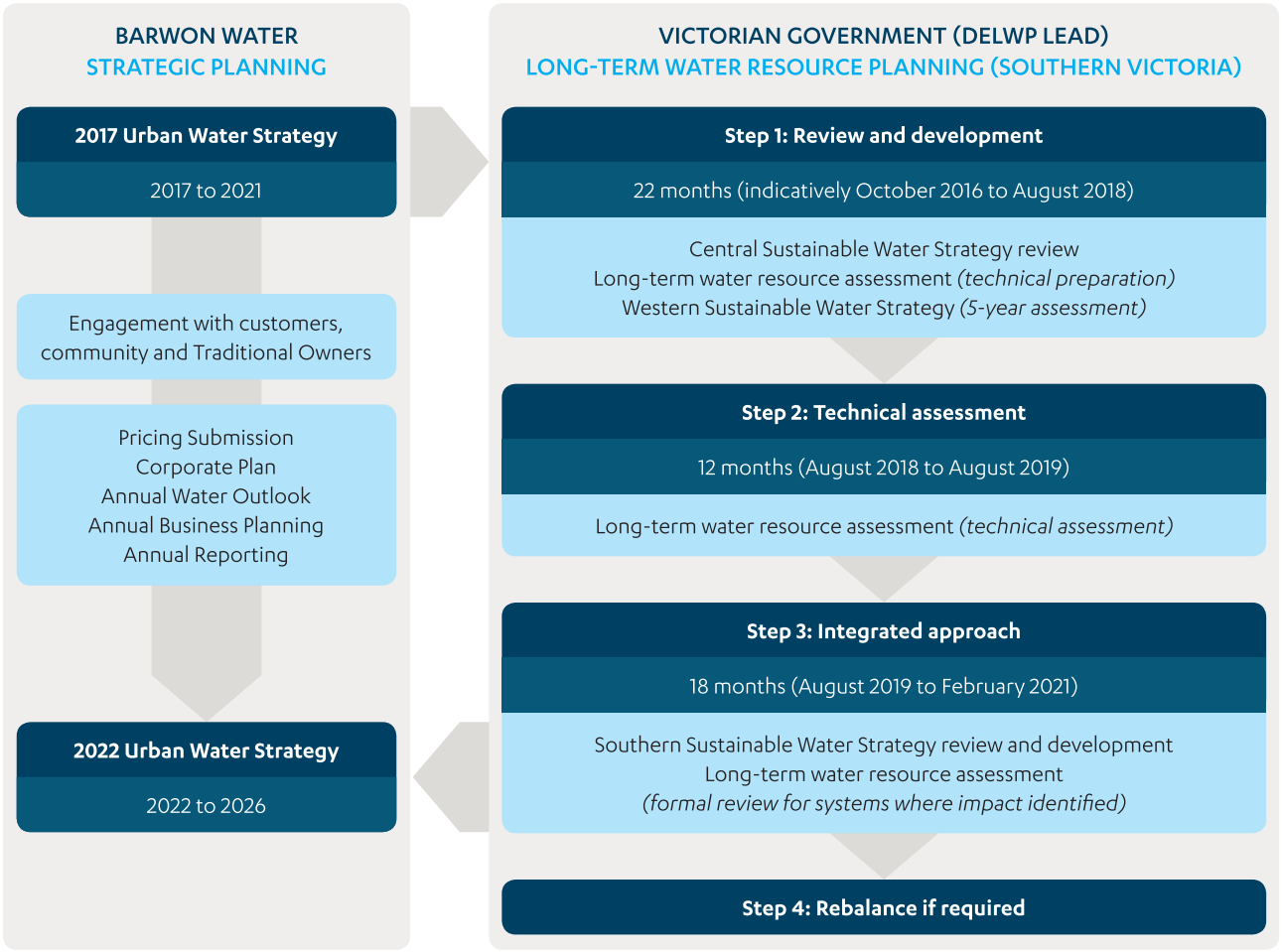
Figure 11: Alignment between Barwon Water's planning and state-wide water resource planning during the implementation of this Urban Water Strategy (source: Water for Victoria)



This does not mean we will progressively construct sewerage systems in every town. In many cases this would be inefficient, simply incurring an unnecessary cost to be recovered from customers, which would impact affordability. Instead, we identify and prioritise action on an outcomes basis, working to address each location-specific issue so that health, amenity, environmental and economic outcomes are delivered at least cost.

There are a number of towns in our region that do not presently have a sewerage system. In some instances, it may never be necessary to provide this infrastructure, particularly where the risk to public health and the environment from domestic wastewater management is low. In other cases, new sewerage infrastructure may be the best way to support the growth and prosperity of a small town and ensure that public health and the environment are protected.

We will work with local government across our region to identify and prioritise those towns where domestic wastewater management is an issue and assist in the development of appropriate solutions.

Actions	
9.4	We will collaborate with local government and stakeholders to ensure appropriate domestic wastewater management that supports growth and protects public health, the environment and liveability

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10. Using the Victorian water grid and markets

The Melbourne-Geelong pipeline is one of the key investments that has been made in recent years to expand Victoria's water grid. The pipeline has played a key role in providing water security for Geelong by connecting it to the substantial resources of the Melbourne system.

The Lal Lal reservoir, which we share with Central Highlands Water, also provides a connection with Ballarat to the north.

The water grid creates the opportunity to participate in the trade of those connected resources within an evolving water market. The ability to buy and sell rights to water, either temporarily or permanently, means that water can be provided where it is valued most highly. This enables market participants to independently manage the balance between supply security, risk and financial outcomes.

10.1 The expanding water grid

In 2017, Colac will be connected to the Geelong system, improving water security for Colac and providing greater resilience and operational flexibility. In recent years the Geelong system has also been expanded to include Aireys Inlet and Fairhaven, as well as the connection to Melbourne.

Across our service area, only the comparatively isolated townships of Lorne, Apollo Bay and Gellibrand remain independent from the Geelong supply system. Each has its own source, while distance and geography means that the costs of connecting to the grid would presently outweigh the benefits. Connection to the Geelong system remains a potential option for these towns in the future, if competitive with other available measures to maintain levels of service.

Our connections within the Victorian water grid link water resources as diverse as the Victorian Desalination Plant, groundwater and traditional surface water catchments. Each of these sources has different attributes, including the way they respond under different climate conditions.

The grid provides greater flexibility to choose between different water sources at different times, as well as improving resilience by linking multiple supplies that can be drawn upon if a particular source is constrained.

One of the key short-term opportunities presented by the expanding water grid is to better understand the operational possibilities for our growing and increasingly interconnected Geelong water supply system. Investigating this and developing a decision-making framework to help optimise the system's operation is one of the actions identified in the Geelong system strategy (Chapter 13).

10.2 The evolving water market

Water markets are well established in northern Victoria, where there is a significant volume of trading activity that includes interstate transactions within the Murray-Darling Basin. While markets also function well in other parts of Victoria, including the west of the state and irrigation districts such as Werribee and Macalister in the south, arrangements are currently limited in the south central part of Victoria that includes Barwon Water's service area.

To promote the development of a water market in south central Victoria, the Victorian Government is initiating a trial in 2017. Barwon Water will actively participate in the trial, which will initially be focused on information collection and an understanding of market implications and foundations. The characteristics of the south central market (which predominantly comprises urban water corporations responsible for providing secure water supplies to a substantial proportion of the state's population) mean that a considered approach will be required to ensure that benefits can be realised without compromising supply security.

Urban Water Strategies are updated every five years in response to constant changes in the supply and demand balance. For example, Barwon Water is not currently able to access water from the Barwon Downs borefield to supply Geelong and Colac. An updated Urban Water Strategy is being prepared as part of Barwon Water's Water for our Future program – refer **www.barwonwater.vic.gov.au/future** for more information.

Barwon Water holds a bulk entitlement to 16,000 ML/year in the Greater Yarra System–Thomson River Pool as one of the water resources available to supply the Geelong system. During periods when those collective resources exceed demand, we could sell some of the surplus to other entitlement holders within the connected system. Similarly, purchasing entitlements from others (whether permanently or temporarily) is one means of Barwon Water adding to its resources to enhance supply security in the future.

We have already taken a lead in exploring these opportunities. In 2016, recognising that we were in a position to sell some water without impacting supply security, the Board approved pursuit of trade of a portion of the water allocated to our bulk entitlement in the Greater Yarra System. We initiated and successfully facilitated the sale of 5,000 ML to another water corporation.

Importantly, this was a 'temporary' trade of some of the water allocated annually to our permanent entitlement. We still retain the right to the water allocated to that entitlement in the future, so there was no longer term impact on our water resource portfolio or supply security.

This transparent and competitive process was mutually beneficial for both Barwon Water and the trading partner, which was able to increase its own water security in response to the particular variability in water availability at that time across southern Victoria. We were pleased to demonstrate leadership in promoting and advancing the Victorian government's policy to catalyse development of a water market in south central Victoria. The learnings from the process will help inform the development of our own decision-making framework for water trading.

The changing value of water entitlements over time will also provide signals to water corporations about the need to generate additional sources of supply, and whether investment in new sources (such as desalination or alternative water supplies) is prudent.

Water markets and the water grid provide the opportunity to ensure water security is provided efficiently, supporting identification of lowest-cost options to maintain service levels and helping to minimise price impacts on customers. However, as the south central market evolves, there will be a need to ensure that appropriate principles and policies are in place to balance risk and benefits. For example, selling surplus water at a point in time provides an opportunity for a financial return and helps to maintain affordable water prices, but we need to make sure that this never compromises customers' water security.

The water grid and markets may also play a role in helping to rebalance resources between consumptive and environmental uses (see Box 9).

Barwon Water will actively participate in the south central Victoria market trial and continue to explore the opportunities that the water grid and markets can provide. This includes carefully considering the particular implications for Barwon Water and developing our own strategy and policies to make the most of this opportunity.

Actions	
10.1	We will actively participate in the south central market trial being initiated by the Victorian Government in 2017
10.2	We will, in parallel with the south central market trial, investigate the opportunities and risks specific to Barwon Water and develop a decision-making framework for water trading
10.3	We will explore opportunities for the evolving water grid and markets to help contribute to meeting environmental water recovery targets in the Barwon and Moorabool Rivers

Urban Water Strategies are updated every five years in response to constant changes in the supply and demand balance. For example, Barwon Water is not currently able to access water from the Barwon Downs borefield to supply Geelong and Colac. An updated Urban Water Strategy is being prepared as part of Barwon Water's Water for our Future program – refer **www.barwonwater.vic.gov.au/future** for more information.

Box 9: Water markets and environmental water

Although many targets for environmental water recovery identified in the 2006 *Central Region Sustainable Water Strategy* have been achieved, the strategy also acknowledges that more is required in the longer term, especially in the Moorabool River. Further water recovery options will need to be explored and implemented if the full extent of scientific environmental flow recommendations are to be met in the future. *Water for Victoria*, identifies that this is likely to be a key focus of the forthcoming review of the *Central Region Sustainable Water Strategy*, taking into account the findings of long-term water resource assessments. Sustainable water strategies will rely on evidence-based principles, priorities and community input.

The increasing ability to share a diverse range of water sources through the Victorian water grid may assist in identifying more options for environmental water recovery. Additional water needed by the environment could come from other entitlement holders, where the volume returned to the environment can be pragmatically replaced by other sources via the grid.

We will continue to work with stakeholders to explore opportunities to return water to the environment if required, especially for the Barwon and Moorabool Rivers, recognising our primary responsibility to manage our bulk entitlements to ensure water security for our customers.

Our entitlements to water are an essential right that underpin our ability to plan and operate with certainty. Water markets play a role in quantifying the value of this right, enabling parties to transparently trade in entitlements so that resources are distributed where they are valued most highly.

Should the trade of our entitlements prove an efficient means of returning water to the environment, the value of those entitlements will provide the means to balance the volume given up with new entitlements from an alternative source. This will ensure that we can maintain water supply security without additional cost to our customers.

We will continue to work with the Victorian Government and other key stakeholders, such as the Victorian Environmental Water Holder, to explore opportunities for the water grid and markets to play a role in environmental water recovery.

Urban Water Strategies are updated every five years in response to constant changes in the supply and demand balance. For example, Barwon Water is not currently able to access water from the Barwon Downs borefield to supply Geelong and Colac. An updated Urban Water Strategy is being prepared as part of Barwon Water's Water for our Future program – refer **www.barwonwater.vic.gov.au/future** for more information.

11. An adaptive planning and investment approach

In an uncertain future, one of the key challenges we face is ensuring we make the right decisions at the right time. It is critical that we invest wisely to ensure that levels of service for our customers continue to be met. However, investing too much or too soon would mean higher prices.

11.1 Adaptive planning framework

An adaptive planning framework helps to manage uncertainty by responding to prevailing conditions in a considered and informed manner. This is achieved by undertaking thorough scenario planning, supported with a simple and well-understood framework for decision-making.

The context for Barwon Water's adaptive planning framework is illustrated in Figure 12. In combination with our broader strategic, corporate and capital expenditure planning (including the pricing submission), the Urban Water Strategy plays a key role in identifying the actions required to ensure service levels are maintained. The timing, prioritisation and implementation of some actions may then depend on actual circumstances, reviewed on an ongoing basis and reflected in annual operating plans.

The key elements of the adaptive management framework are illustrated in Figure 13 and explained further below.

The role of the *Urban Water Strategy*

This *Urban Water Strategy* identifies the options available and necessary next steps to ensure immediate and long-term water security in each of Barwon Water's supply systems.

To do this, it incorporates:

- Detailed **scenario planning**, based on the best available information about changes in our climate and population, to understand the range of possible future outcomes for water demand and supply. An awareness of potential future scenarios ensures we can prepare to respond appropriately as conditions evolve, including a readiness for a worst-case scenario if it eventuates. This is particularly important because of the long lead time that is often required to implement new infrastructure. The process of planning, investigation, options evaluation, design and construction (informed by community engagement throughout) can take many years for major investments. Progressing planning and engagement in advance is critical to ensure that solutions can be implemented when required.
- An **Action Plan** summarising the actions identified and their indicative timing. This includes actions specific to each system, as well as those applicable more broadly. Where actions relate to further investigation and implementation of water supply infrastructure, the timing is often dependent on the system outlook and the conditions forecast under different scenarios of climate change and population growth.
- A **Drought Preparedness Plan** that identifies the approach to managing periods of water shortage. This includes the hierarchy of actions available and the principles and rationale for their implementation.

In combination, the Action Plan and Drought Preparedness Plan provide clear actions that will be taken to secure water supply in the longer term, as well as those to be implemented in the event of the temporary impact of drought.

Urban Water Strategies are updated every five years in response to constant changes in the supply and demand balance. For example, Barwon Water is not currently able to access water from the Barwon Downs borefield to supply Geelong and Colac. An updated Urban Water Strategy is being prepared as part of Barwon Water's Water for our Future program – refer **www.barwonwater.vic.gov.au/future** for more information.

Figure 12: Context for planning and operational decision-making

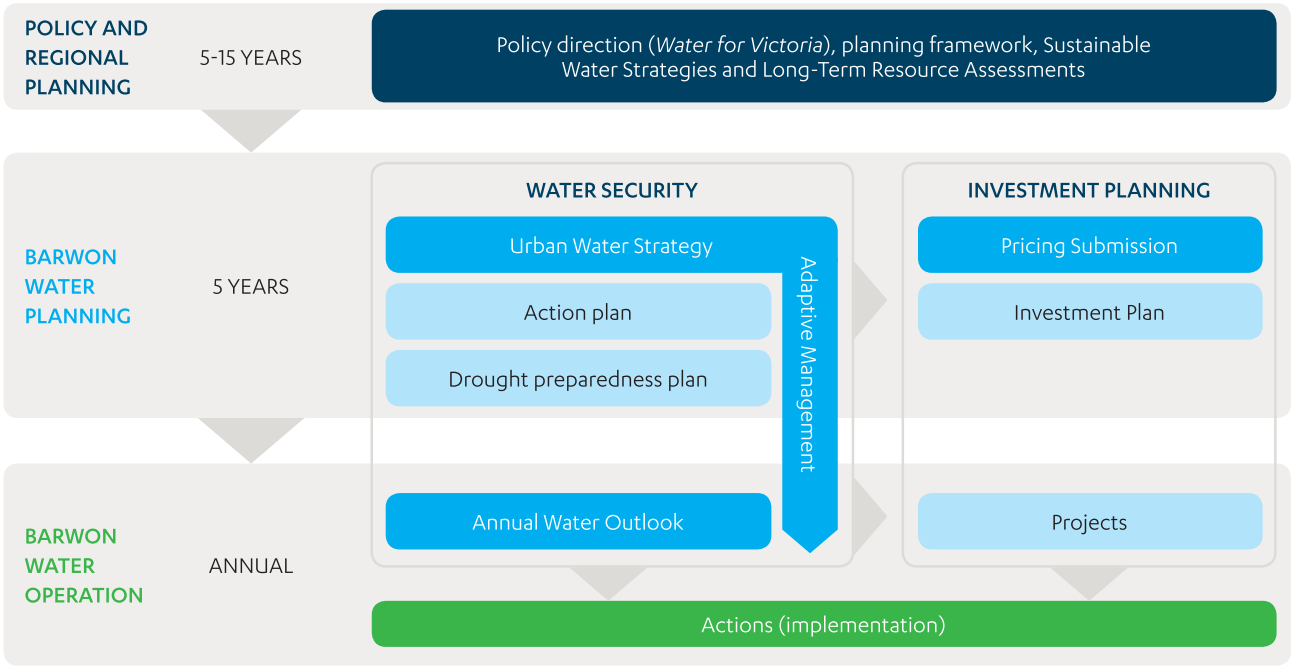
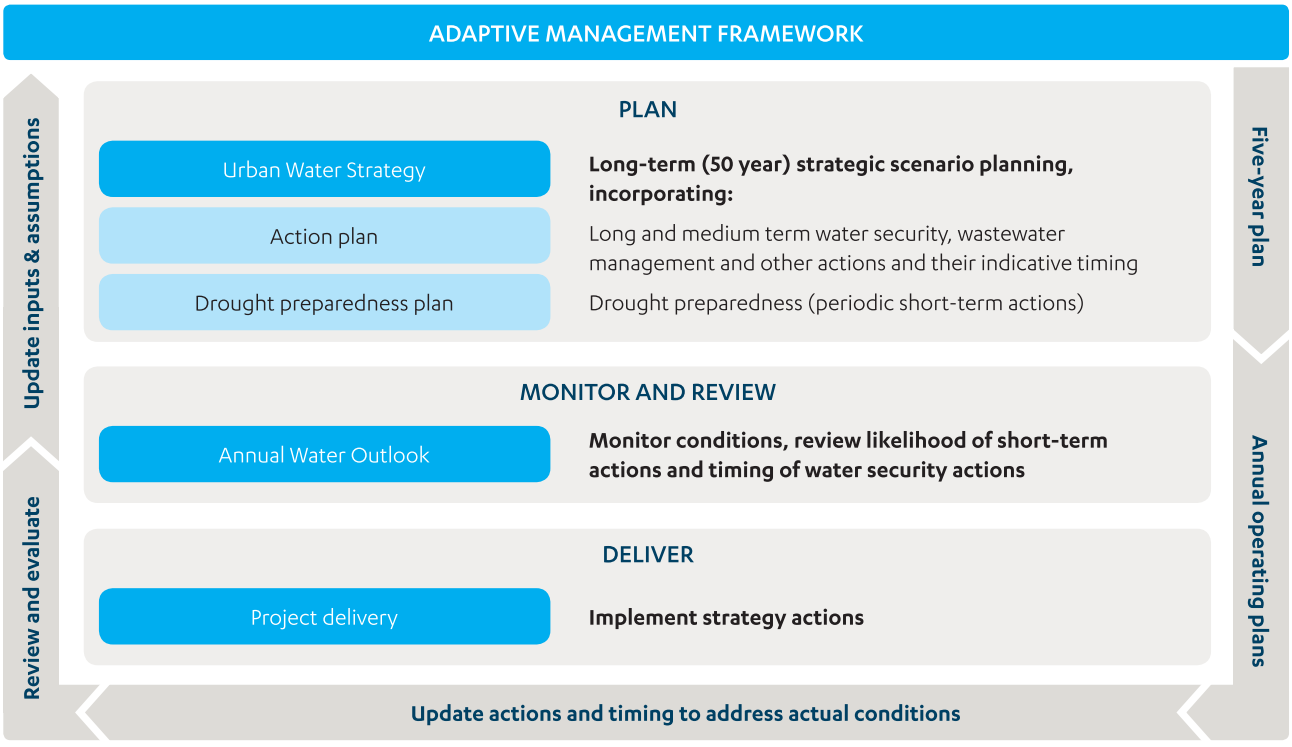


Figure 13: Adaptive management framework



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Annual Water Outlook

Published on December 1 each year, the *Annual Water Outlook* demonstrates how Barwon Water's supply systems will provide sufficient water security in the short-term and whether any action needs to be taken to ensure this. The short-term outlook considers:

- current storage volumes
- historical inflows under a range of climate scenarios
- any changes to historical demand patterns
- the latest climate outlook from the Bureau of Meteorology.

The *Annual Water Outlook* is an opportunity, ahead of each summer, to periodically review the status of each system in the context of existing and forecast conditions. It enables us to communicate the likelihood of any actions – such as the potential need for water restrictions – so that our customers are informed. It therefore helps to guide the need for the short-term actions that are set out in the Drought Preparedness Plan.

The *Annual Water Outlook* is an annual update of the constant monitoring that we undertake to continually review supply security. In some instances this monitoring will influence the timing and prioritisation of projects that we have identified. For example, if conditions have been wetter than average, the imminent need for a supply upgrade might be deferred. Conversely, if conditions are tracking along a 'worst case' scenario, it may trigger action sooner than planned under median conditions.

Project delivery

Our strategic planning informs a large and ongoing program of capital investment, including projects to meet the needs of future growth, renew ageing infrastructure, or address changing compliance requirements. Depending on the scale and complexity of each project, there is typically a substantial lead time to allow for the community engagement, planning, design and approvals that precede construction.

While it is critical that we allow sufficient time for these activities prior to the project's eventual need, they are also an opportunity to ensure a preparedness to act when required. Having the necessary planning and design completed well in advance of the project need means that it can be brought forward if conditions dictate, but equally that the investment in construction can be delayed if prudent.

A recent example of this process is the investment made to secure Colac's water supply. The need for this infrastructure was identified in the 2012 WSDS, although the precise time at which it would be required was uncertain.

We proceeded to undertake all necessary options investigations, technical analysis, planning, design and community consultation well in advance of the eventual need for the investment. This meant that, when conditions dictated it be implemented sooner rather than later, we were then ready to progress immediately to construction.

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12. System strategies

Water supply and wastewater management across our service area is provided within several largely independent systems: Geelong, Colac, Lorne, Apollo Bay and Gellibrand. The Urban Water Strategy describes the characteristics of each system, the water security outlook and any resulting actions identified to ensure service levels are maintained into the future.

12.1 Approach to system investigation

The approach adopted to investigate each system as part of this strategy is summarised in Figure 14. The analysis has been undertaken in accordance with the guidance provided by the Victorian Government.

One of the key outputs of this process is the system outlook, which is a forecast balance between supply and demand over the planning horizon. The chart produced for each system reflects the period over which action, if any, is expected to be required.

12.1.1 Forecasting demand and supply

As described in Chapter 5, water supply and demand is influenced by a wide range of factors, including climate change. When determining the available water supply, modelling is used to simulate conditions and operational rules within each system in order to forecast the system yield, which is the average annual demand that can be supplied such that agreed levels of service are met. Based on current levels of service, this means that restrictions do not occur more than 5 per cent of the time and storage levels never become critically low.

From a historical climate baseline, we also model several climate scenarios that represent the potential future impacts of climate change (see Box 2). Importantly, there is no 'most likely' scenario and so the resulting system yields therefore describe possible outcomes under a range of plausible climate futures.

12.1.2 Water supply outlook

Together, forecasts of system demand and supply describe the ability of a system to continue to meet agreed levels of service over time. This is illustrated in the long-term forecast charts that are provided for each system in the subsequent service area strategies.

As long as system yield is greater than demand, service levels will be met. This does not mean that restrictions will not be implemented at all, but that, on average, they will not be required any more than 5 per cent of the time.

Over time, this level of service typically becomes more difficult to maintain as demand begins to match yield, and once there is a deficit in yield (demand is greater), the level of service is no longer expected to be achieved (Figure 15). The intersection of system demand and yield is therefore typically used to describe the point at which an upgrade should be implemented to ensure that service levels can continue to be delivered.

The balance between system demand and supply is further complicated by uncertainty and the range of potential scenarios that are identified. These scenarios ultimately describe the different points in time at which levels of service may no longer be achieved if particular climate change and population growth conditions eventuate.

Since there is no 'most likely' scenario, and there is similar uncertainty about future population growth, the scenarios modelled are described according to their relative impact, as follows:

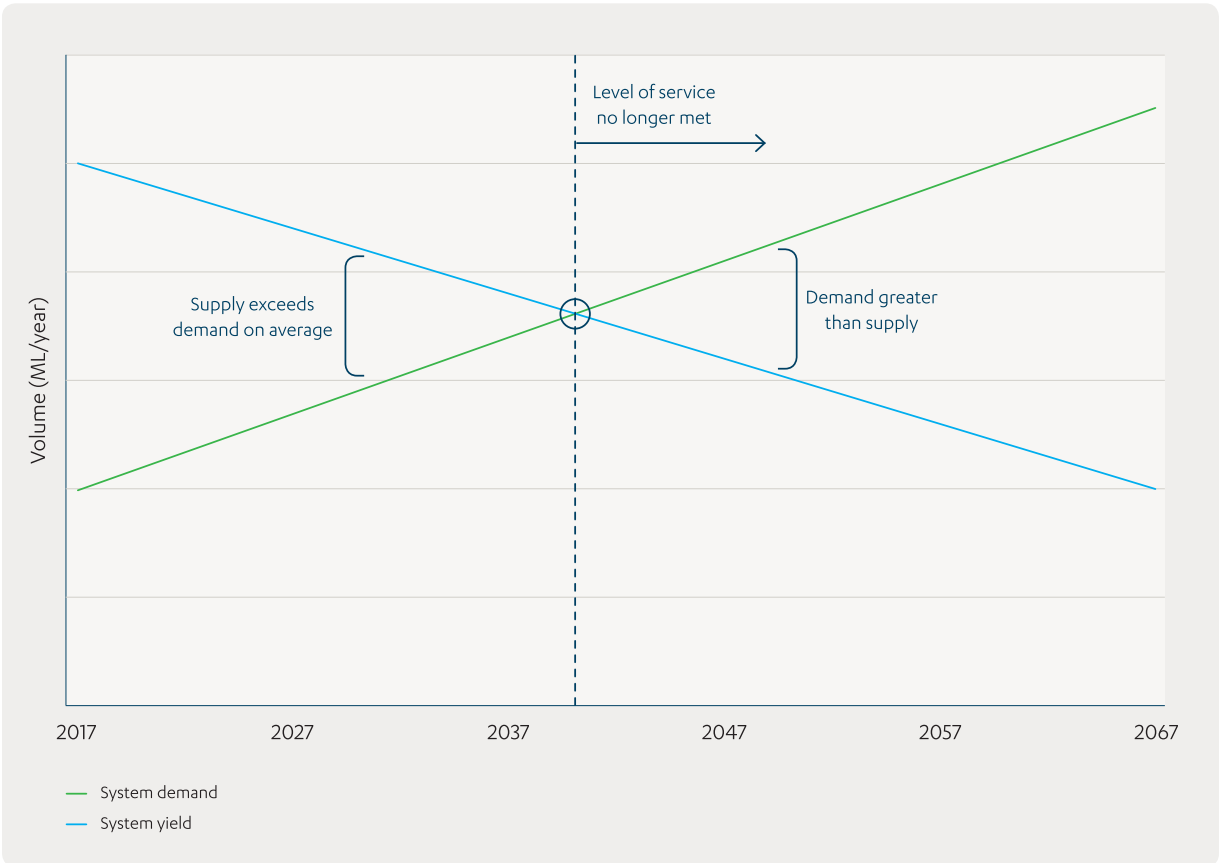
- **Low:** 'best-case' scenario where growth in population (and therefore demand) is low, impacts from climate change on yield are low, and any need for an upgrade is deferred further into the future
- **Median:** describes the outcome under median population growth and median climate change impacts
- **High:** describes both high population growth and high impacts from climate change, with any resulting need for an upgrade earlier than in low or median scenarios
- **Step-Change:** describes a step-change in climate as well as high population growth, with any resulting need for an upgrade earlier than in low or median scenarios (depending on the response of the individual system to climate change projections, either the high or step-change scenarios may be the 'worst case').

Urban Water Strategies are updated every five years in response to constant changes in the supply and demand balance. For example, Barwon Water is not currently able to access water from the Barwon Downs borefield to supply Geelong and Colac. An updated Urban Water Strategy is being prepared as part of Barwon Water's Water for our Future program – refer **www.barwonwater.vic.gov.au/future** for more information.

Figure 14: Approach to investigating and identifying actions for water supply systems

SYSTEM ANALYSIS	– Customer engagement to understand key issues – Demand forecasting – Water resource modelling, including climate change scenarios – Identify future challenges and constraints (including wastewater) – Vulnerability assessment
SYSTEM OUTLOOK	– Describe status of water supply security, including timing and extent of any future deficit – Publish 2016 Annual Water Outlook to communicate short-term forecast and actions
OPTION IDENTIFICATION AND ASSESSMENT	– Understand integrated water management, supply augmentation and demand reduction opportunities – Identify options available to ensure levels of service are maintained over planning horizon – Characterise and assess options to identify priorities for further investigation
SYSTEM STRATEGY AND ACTIONS	– Confirm the availability of options to maintain service levels over the planning horizon – Articulate action plan to progress investigation and implementation within an Adaptive Management Framework – Update Drought Preparedness Plan

Figure 15: Interpreting long-term forecast charts



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While we need to be vigilant in monitoring conditions as they evolve, some systems are better placed to cope with imminent change than others. To assist in interpreting the outcomes of our scenario modelling, we characterise the water supply outlook for each of our systems according to the descriptions in Table 9.

Table 9: Water supply outlook categories

Category	Description
SECURE	Levels of service can be maintained to 2035 under worst-case conditions
PLAN AND PREPARE	There is the possibility that action may be required within the next 15 years to 2032 or soon after, reflecting the need to commence engagement and preparation now
ACTION REQUIRED	Action may be required within the next 10 years to 2027, reflecting the need to commence planning, design and approvals so that implementation can proceed when required

12.1.3 Vulnerability assessment

The system analysis also incorporates a vulnerability assessment, which considers a range of attributes (beyond the findings of detailed modelling) that also contribute to the resilience of each system under different circumstances. Illustrated in Figure 16, the vulnerability assessment recognises the implications of the specific characteristics of each system, such as:

- dependence on seasonal conditions
- availability of multiple or backup resources
- the implications of natural disasters and other emergencies
- the effectiveness of drought preparedness and emergency response measures.

The vulnerability assessment is a measure of the ability of each system to cope with short-term shocks, such as extreme climate events or natural disaster. It is not a reflection of ongoing water security, which is assessed in the system outlook.

In rare instances, if vulnerability were assessed as 'high' it would identify the need for immediate action to improve water security. In general, though, the vulnerability assessment helps to guide the approach to managing the attributes of individual systems, including ensuring that Drought Preparedness Plans and Emergency Management Plans are up to date and effective.

12.1.4 Approach to options identification and assessment

A key part of this strategy is identifying the steps that will be taken to ensure ongoing provision of safe and secure water supplies into the future. The approach adopted to achieve this is summarised in Figure 17.

The options identified through this process underpin many of the actions identified for each system.

12.2 Structure of individual service area strategies

The service area strategies that follow are described according to the structure set out in Table 10.

Table 10: Approach to describing status, outlook and actions for each service area

Section	Description
About the system	Describes the water supply and wastewater system, including key infrastructure and operating characteristics.
Bulk entitlements	Identifies the relevant bulk entitlements Barwon Water holds.
System performance	Assessment of the performance of both water supply and wastewater systems. Analysis of water supply includes insights since the 2012 WSDS, vulnerability assessment and long-term forecast.
Future options	The options available to ensure that levels of service are maintained into the future.
Action plan	The actions that Barwon Water will deliver as part of the implementation of the Urban Water Strategy.

In each case, the service area strategies are supported by more detailed information in Appendix B: Water security option long and short lists.

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The township of Apollo Bay

Figure 16: Vulnerability assessment

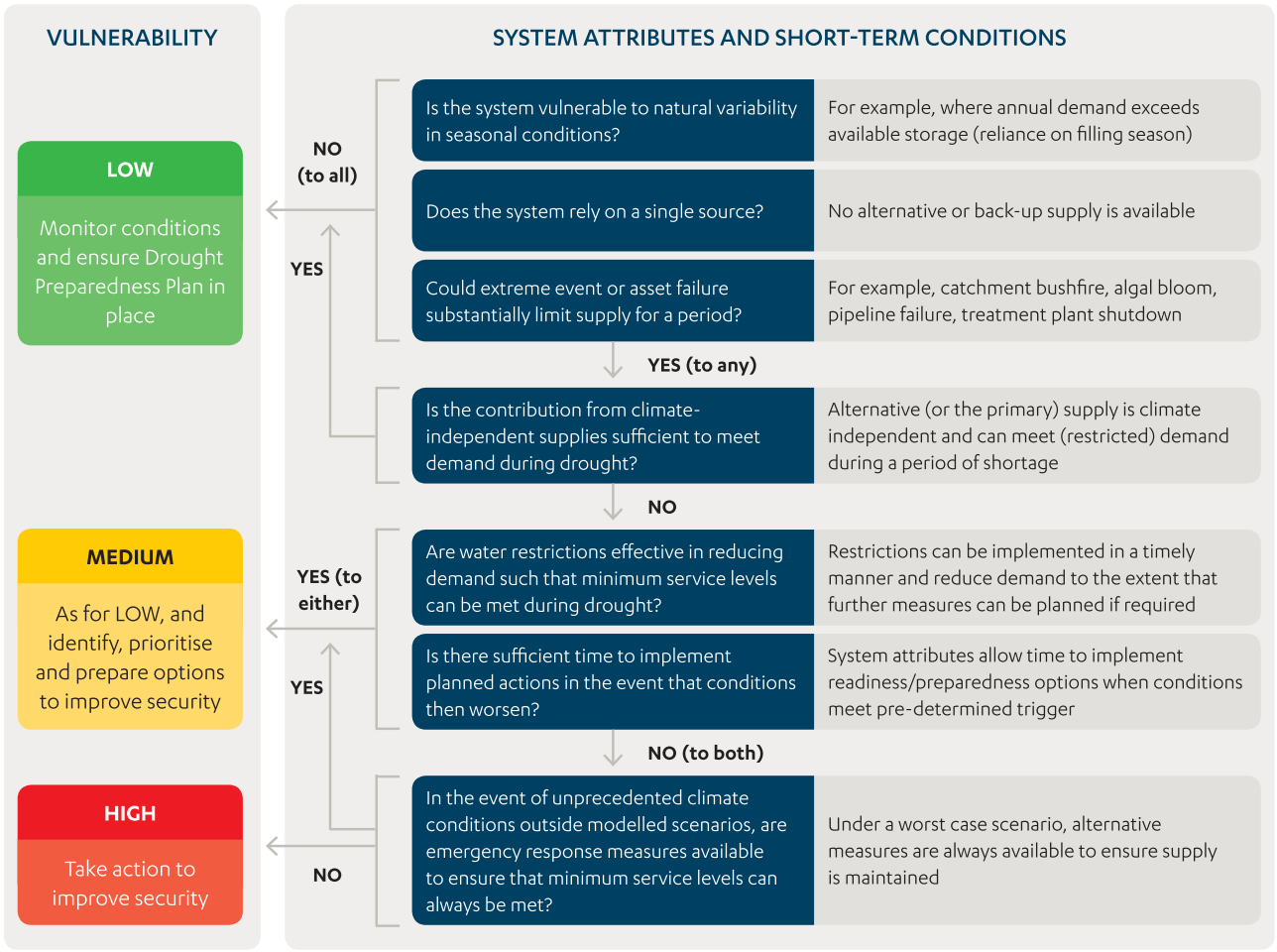

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Figure 17: Approach adopted to identifying and assessing water security options

OPTIONS IDENTIFICATION AND ASSESSMENT PROCESS	
DEVELOP RAPID ASSESSMENT FRAMEWORK	Develop, refine and agree a framework for assessing options, based on a staged approach
IDENTIFY COARSE FILTER CRITERIA	Establish initial criteria that must be met for an option to be short-listed for further consideration
IDENTIFY OPTIONS LONG- LIST	Broad scan and consultation to identify all possible options
APPLY COARSE FILTER	Review all options against initial criteria, eliminating those that are considered infeasible with the remainder short-listed for further consideration
DEVELOP SHORT-LISTED OPTIONS	Further develop the concept for each short-listed option, including expected yield, cost estimates and other characteristics
OPTIONS ANALYSIS	Consider the characteristics of each option and identify those that should be prioritised for further investigation

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Greater Geelong

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13. Greater Geelong

13.1 About the Greater Geelong system

13.1.1 Water supply

The Geelong system covers much of Barwon Water's service area. It extends from Little River in the east to Birregurra and Forrest in the west, as far along the Surf Coast as Fairhaven and to Meredith in the north. It services the Geelong city area, Bellarine Peninsula, Golden Plains and Surf Coast.

Historically, Geelong's water supply was provided by the three major surface water catchments of the Barwon, East Moorabool and West Moorabool Rivers. In recent times this has been diversified to include groundwater resources at Anglesea and Barwon Downs, as well as a connection to Melbourne's water supply system. Provision of recycled water also plays a role in reducing demand for potable supplies.

Water harvested from on-stream storages, diversions or borefields is treated to drinking water standard and transferred to covered urban storage basins for distribution.

Water from the Barwon system (including Barwon Downs and Anglesea borefields) is treated at the Wurdee Boluc Water Treatment Plant. Some water from Wurdee Boluc is stored at Pettavel Basin prior to distribution to coastal towns and the Bellarine Peninsula, while the remainder is sent to basins at Highton, Montpellier and Lovely Banks for distribution to the Geelong area (encompassing Lara and Little River). The basins at Lovely Banks also receive water from the Melbourne-Geelong pipeline.

Water from the Moorabool system is treated at the Moorabool Water Treatment Plant based at She Oaks. This supplies the communities of Lethbridge, Meredith, Inverleigh, Shelford, Gheringhap, Teesdale and Bannockburn in the Golden Plains Shire. It is also blended with the Barwon system at the Montpellier Basin.

13.1.2 Wastewater management

There are eight water reclamation plants in the Greater Geelong region, as illustrated in Figure 18. Six plants service independent networks across smaller townships, while the major Geelong network is serviced by the Black Rock and Northern WRPs.

The volume of recycled water produced, particularly at the Black Rock WRP, represents a substantial resource. Continuing to explore opportunities to make better use of available recycled water will be a key focus in the future. Recycled water discharged to Bass Strait from Black Rock is currently a Class C quality effluent.

We already achieve 100 per cent re-use of the biosolids produced at Black Rock. We are committed to maintaining this into the future.

13.2 Bulk entitlements

Access to water resources in the Greater Geelong system is enshrined in the bulk entitlements and licence summarised in Table 11. The actual volume that may be available in a given year is limited by annual water availability, passing flow conditions, environmental entitlements and other conditions (such as long-term caps) that may apply.

Table 11: Barwon Water's bulk entitlements in the Greater Geelong system

Bulk entitlement	Volume
Barwon	130,400 ML over 3 years
West Moorabool	6,000 ML over 3 years at She Oaks 17,775 ML over 3 years at Lal Lal
East Moorabool	9,000 ML/year
Barwon Downs borefield	Up to 20,000 ML/year
Anglesea borefield	7,000 ML/year
Greater Yarra System – Thomson River Pool	16,000 ML/year
Average annual total	**Up to 103,392 ML/year**

Although Geelong's water supply has been boosted by additional sources in recent years, each entitlement and licence makes a material contribution to the total pool available. The diversity and extent of water resources not only provides capacity to cater for population growth, but also increases the resilience and flexibility of the system to cope with unplanned events, such as bushfire.

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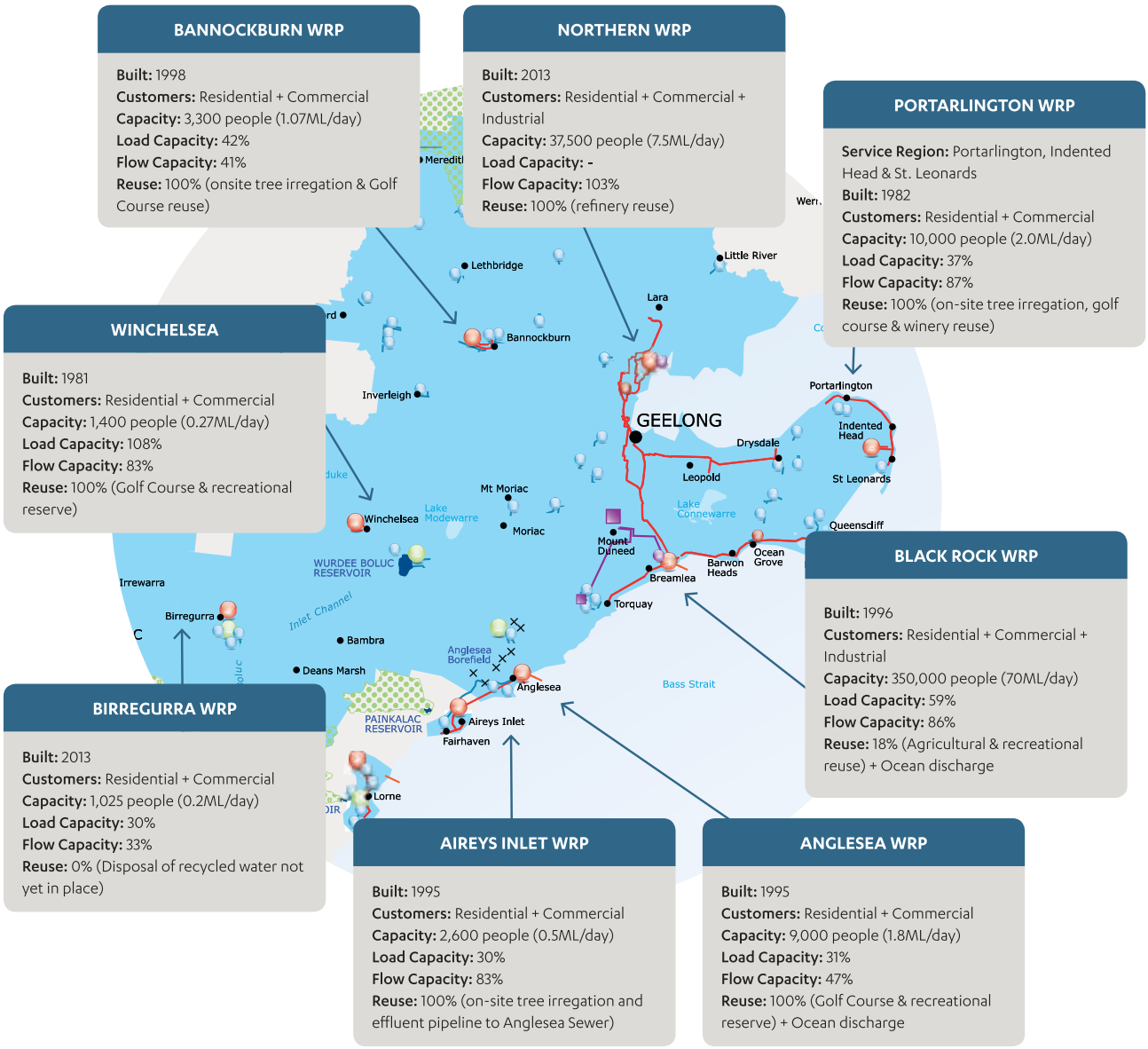
Figure 18: Water reclamation plants in the Greater Geelong region



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Each bulk entitlement and licence includes detailed conditions that are designed to protect environmental values. These conditions may reduce or prevent extraction during periods of low flow, or place longer term caps to ensure sustainable use over time.

While we are entitled to harvest water within these constraints, in some instances longer term resource assessments acknowledge a need to increase the amount of water available for the environment in the future.

We work with stakeholders such as the Victorian Environmental Water Holder to ensure that we operate our system to minimise the impact on the environment. As long as our available resources exceed demand, there is greater flexibility to achieve this. However, as demand grows, there will be increasing pressure to balance the consumptive use of a growing population with the needs of the environment.

We are committed to collaboratively exploring opportunities with key stakeholders to meet targets for additional environmental flows in the Moorabool River. This needs to be pragmatically balanced with our primary obligation to deliver secure water supplies.

Our analysis emphasises the importance of each of our entitlements to Geelong's long-term water security. Understanding the significance of these resources is a strong basis for identifying possible options to offset or reduce their use in the future. Box 10 details the importance of our Barwon Down licence, where there may be a particular focus on the possibility of restoring some water to the environment.

Our groundwater extraction licence for the Barwon Downs borefield, issued by Southern Rural Water, is due for renewal in 2019. Supported by an extensive program of groundwater monitoring and community engagement, we are confident we can demonstrate that this resource – critical for Geelong's water supply security – can continue to be used sustainably.

Our approach to the licence renewal is being developed by improving the understanding of the environmental and social impacts of the borefield operation. To prepare an application for the licence renewal we will:

1. Understand the issues of most interest and/or concern to the community and stakeholders about current borefield operation;
2. Enhance the scientific understanding in key areas of interest and concern;
3. Submit a licence renewal application that includes modified operating conditions that recognise the improved scientific understanding of the impacts of borefield operation.

13.3 System performance

13.3.1 What we've learnt since the 2012 WSDS

For the Geelong system, the period leading to the 2012 WSDS was characterised by substantial investment to secure water supply, as the region emerged from the impacts of the Millennium Drought and an extended period of water restrictions. New water source projects diversified and supplemented Geelong's supply, with the focus shifting to optimising operation to provide greatest benefit to customers.

The merits of investing in Geelong's water supply were profoundly demonstrated in 2015/16, when severe drought conditions returned. Storages dropped to levels not experienced since the Millennium Drought, triggering the use of the Melbourne – Geelong Pipeline for the first time. The Barwon Downs borefield also resumed operation for the first time since 2012. However, unlike operation during the Millennium Drought, when Barwon Downs provided up to 70 per cent of Geelong's drinking water, just three of six bores were required to supplement the water provided from our new Melbourne entitlement.

These sources provided a steady supply that arrested any further drop in storage levels and proved their worth as secure sources that flow regardless of rainfall.

As part of a diverse portfolio of resources, Barwon Downs and the Melbourne – Geelong pipeline are primarily intended to be called upon during drought conditions when supplies drop from our traditional surface water catchments.

13.3.2 Assessment of vulnerability to short-term shocks

Vulnerability assessment	Description
Low	Multiple sources provide resilience and sufficient capacity to manage short-term shocks and plan and implement a timely response

The key characteristics of the Geelong system contributing to this assessment include the following:

- the availability of multiple, diverse water sources
- responsiveness to longer-term climate trends rather than seasonal conditions
- access to resources in the greater Melbourne system
- the ability to implement restrictions and respond to water shortages with planned actions in a timely manner.

Urban Water Strategies are updated every five years in response to constant changes in the supply and demand balance. For example, Barwon Water is not currently able to access water from the Barwon Downs borefield to supply Geelong and Colac. An updated Urban Water Strategy is being prepared as part of Barwon Water's Water for our Future program – refer **www.barwonwater.vic.gov.au/future** for more information.

Box 10: The importance of our Barwon Downs groundwater licence to long-term water security in the greater Geelong system

The Barwon Downs borefield is a critical resource for the greater Geelong system, including Colac. The borefield is primarily intended to be called upon during drought conditions when supplies from our traditional surface water catchments decline.

The Barwon Downs extraction licence, issued by Southern Rural Water, is due for renewal in 2019. To better understand the importance of the borefield, we have determined the yield of the system without the borefield under current climate and demand, and again in 2065 under conditions of high climate change and population growth. This demonstrates the impact on system yield if the groundwater source was no longer available.

Without access to the Barwon Downs borefield, the yield of the greater Geelong and Colac system would be reduced by 11,000 ML/year, equivalent to 20 per cent of the current yield. By 2065, under a high climate change and high population growth scenario – when runoff is forecast to be almost 50 per cent lower than that under the current climate1 – the impact of not having the groundwater resource at Barwon Downs becomes even more significant, with a reduction in yield of more than 14,000 ML/year, or more than 30 per cent.

It is important to realise that these numbers do not reflect the volume Barwon Water expects to take each year from the Barwon Downs borefield. However, they do indicate the potential impact on water security without this important part of the system.

1. Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria, 2016, DELWP

Scenario	Current yield (ML/year)	Yield without Barwon Downs (ML/year)	Reduction in yield (ML/year)
Historical climate	54,219	43,200	11,019
High climate change @ 2065	46,105	31,700	14,405

13.3.3 Long-term forecast

Although Geelong benefits from a diverse range of water sources, the majority of supply is still dependent on climate conditions. The potential yield from these resources varies widely under the range of scenarios projected in a future impacted by climate change. To a lesser extent, there is also uncertainty about the future rate of population growth and its impact on demand.

Under worst-case conditions (where long-term climate conditions are consistent with the step-change experienced during the Millennium Drought), an upgrade to Geelong's water supply system may be required as early as 2035. However, this could be deferred until around 2061 under median climate and growth projections.

The analysis confirms the value of each water resource for Geelong's water supply, emphasising the need to maintain a diverse portfolio of entitlements. It also reiterates the critical role that the Barwon Downs borefield plays in delivering water security for the region.

Figure 19 illustrates the forecast range of water consumption and system yield over time resulting from the scenarios modelled. The future uncertainty emphasises the need for an adaptive planning approach, but also indicates the security of the Geelong water supply system in the immediate term. This provides a reliable basis from which to monitor conditions and begin to plan and prepare for future upgrades.

The long-term outlook for Geelong demonstrates the possibility that, under worst-case conditions of high climate change and population growth, a substantial augmentation to the city's supply may be required within the next two decades. This scenario is important in the context of planning and preparing for an augmentation of the scale that would be required.

As much as this emphasises the need for adaptive planning, it also illustrates the substantial benefits of making the most of the resources that are currently available. More efficient use of water, along with greater use of the significant volumes of recycled water and other alternative resources that are available, will contribute to deferring large and expensive augmentations in the future.

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13.3.4 Wastewater management

The water reclamation plants in the Greater Geelong operate within their design capacity. However, analysis indicates that the water reclamation plants at Black Rock, Winchelsea, Portarlington, Bannockburn and Birregurra will require upgrades within this planning period.

As the largest of Barwon Water's water reclamation plants, Black Rock, which services Geelong, Torquay and the Bellarine Peninsula, has been the focus of more detailed investigation and the completion of a study to develop a long-term upgrade strategy for the plant to 2050. The purpose of the strategy is to:

- guide long-term planning for site utilisation
- inform long-term capital works investment planning
- enable consideration of the impact of alternative servicing solutions for future growth areas (which may impact loads and timing of future upgrades).

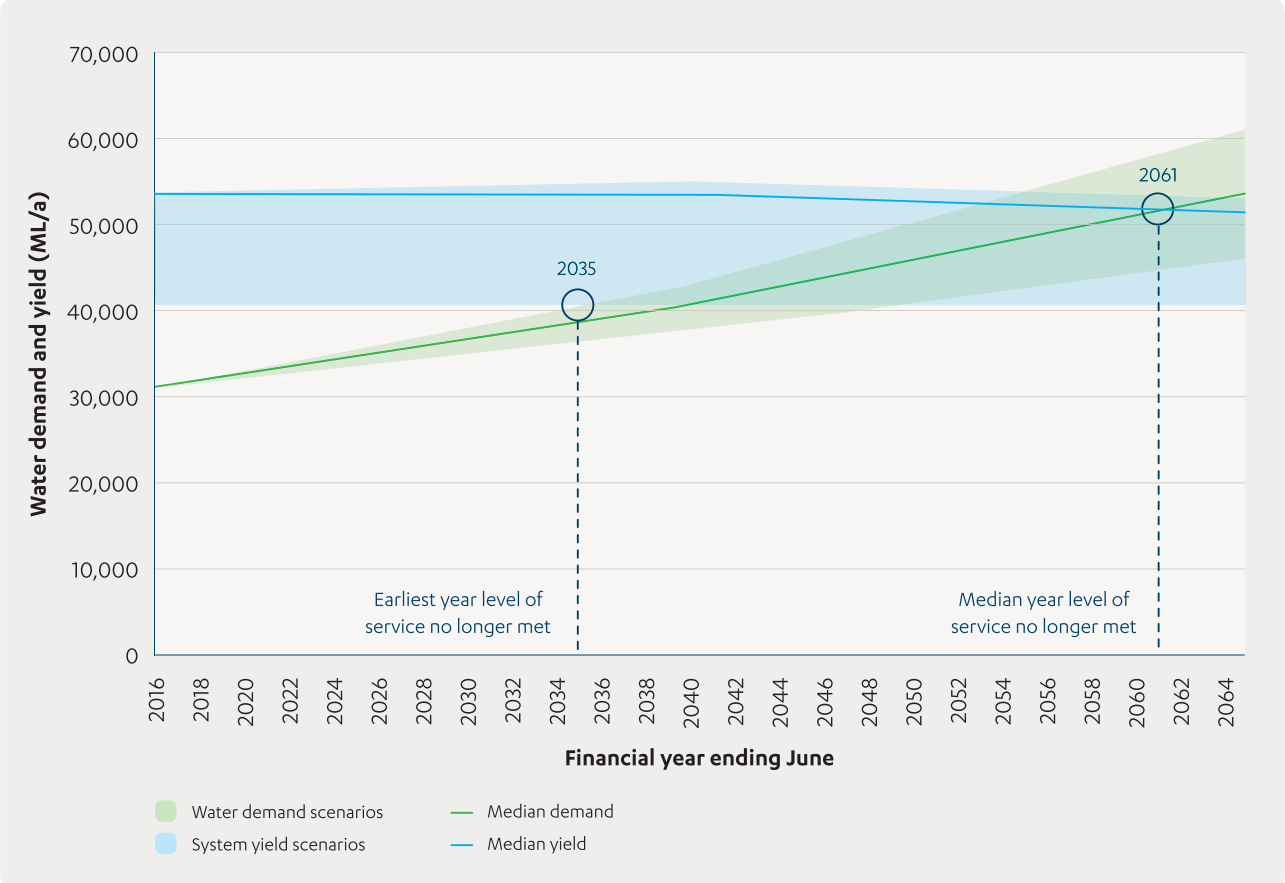
The study recommended four major stages to upgrade the plant to cater for growth beyond 2050:

Year	Works	Capital cost ($M)
2018	Sludge dewatering upgrade	5.1
2020	Recommission 4th biological treatment tank	1.9
2034	Increase capacity of biological treatment	114
2038	Increase hydraulic capacity of ocean outfall	15

As a major source of recycled water, assessment of the timing and nature of future upgrades at Black Rock will be integrated with consideration of recycled water opportunities as part of Geelong's water supply.

The Winchelsea, Portarlington, Bannockburn and Birregurra plants also require upgrades to facilitate greater reuse of recycled water. At Winchelsea and Birregurra, we will investigate options to use recycled water for environmental flows in the Barwon River.

Figure 19: Forecast balance between water supply and demand for the Greater Geelong system



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13.4 Future options

As our supply system and connections to the wider grid expand, so too does its potential complexity. Following a period of investment in Geelong's water supply, there is an opportunity to consider the way we operate the system and investigate whether this can be improved even further. Building on our existing understanding, we will undertake additional investigation to further optimise the way we operate the system and use available resources (see Box 11).

The extensive infrastructure and diverse water resources of the Geelong water supply system provide opportunities to build on existing arrangements to access additional yield in the future. Beyond this, there are also options to generate or access new sources of water.

The scale of the Geelong system means that options for additional resources tend to be substantial and accordingly represent large investments. For now, Geelong's water supply has been secured by the major projects that Barwon Water has recently delivered, providing time to further develop and carefully evaluate the options identified.

Box 11: The opportunity to optimise use of a diverse portfolio of water resources

Barwon Water has invested significantly in recent times to expand and diversify the portfolio of water sources contributing to Geelong's water supply system. Each source has different characteristics, including:

- performance (yield) under varying climate conditions
- implications for supply security over time
- water quality, greenhouse gas emissions and other operational considerations
- operating costs
- environmental and social considerations, including customer preferences.

Traditionally, we have broadly operated the system based on a hierarchy of supply that prioritises lowest-cost options. Water supply to Geelong is delivered effectively and efficiently to minimise costs to our customers. However, there may be other factors that we could consider when deciding how best to use the resources available to us.

The different profile of each source provides an opportunity to balance their collective use, so that customer needs are met, risks are managed, and environmental and social goals are achieved. This balance requires trade-offs to be made, indicating the need for a decision-making framework to help guide system operation.

Many of the arrangements we need to consider are complex. As just one example, we are permitted to 'carryover' our share in the Greater Yarra System–Thomson River Pool each year, providing the ability to control how much water we retain in storage over time. However, there is a risk of losing this water in the event that the storage spills. There is also the potential to balance the need for this water with financial outcomes by trading allocations. This points to the need for risk management to be an important consideration, so that short-term financial outcomes are not realised at the expense of longer term water security.

We need to develop a framework for operating the Geelong water supply system in a way that maximises the benefit to our customers and supports the preferences of the broader community. This starts with a need to understand the nature of the various objectives that are important.

Optimising the way we operate the Geelong water supply system is about refining processes that currently function well, so that we can make the most of the resilient and flexible arrangements we have established.

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Optimising existing assets and resources where efficient

One feature of our systems that source water from the Otway Ranges is that there is frequently more water available during some periods of the year than we can store. Typically our reservoirs spill during winter and spring, when demand is lowest and rainfall and streamflows tend to be highest. While capturing more of this water would increase the yield of our systems, the spill from a reservoir is part of the environmental water reserve in the same way as any passing flow required from a dam or any separate environmental entitlement. This water reserve, including the intermittent high and flooding flows, are part of the flow regime required to maintain downstream ecological values.

We would only be able to capture more of this water if minimum environmental water requirements are able to be met. It would also require changes to physical constraints such as reservoir or channel/transfer capacity and would likely require the Bulk Entitlement to be amended.

In the case of the Barwon River, the last Central Region Sustainable Water Strategy indicated a need for more water to maintain minimum environmental requirements. It is therefore considered unlikely that amendments to our Bulk Entitlement to increase yield would be permitted.

In the case of the Gellibrand River, which spills every winter and spring, additional water harvesting during these periods may be possible, subject to further investigation. In particular, harvesting additional water and transferring it to the Barwon system could be achieved by:

- utilising existing infrastructure, including delivering water back through the new Geelong-Colac pipeline to the Wurdee Boluc Inlet Channel (and reservoir), possibly enhanced with additional storage through aquifer storage and recovery (ASR)
- constructing a new tunnel to transfer flows from the Gellibrand catchment to the West Barwon Reservoir.

The latter option, while it could potentially deliver a greater yield, would require more substantial infrastructure.

New or expanded water sources and making use of the victorian water grid

Groundwater

While surface water resources are well utilised across our region, there are some groundwater resources that are either unallocated or unused at present.

Alcoa has long held an entitlement to groundwater in the Upper Eastern View Formation at Anglesea, which it no longer requires now that its operations have ceased. Purchase of this entitlement would represent a new resource for Barwon Water, further diversifying existing sources and aligning with our current infrastructure in the area.

This option represents the transfer from one party to another of a share in the allocated resources within the groundwater management area. It does not mean taking more water from the aquifer than has occurred previously and is allocated within sustainable limits.

However, some new, currently unallocated groundwater resources may also be available in our region. We have previously investigated groundwater in the Gellibrand and Newlingrook groundwater management areas, providing valuable insights into the resource.

In late 2016, Southern Rural Water released the Otway Lower Aquifers Local Management Plan. The plan includes a 'partitioned volume' of 5,000 ML for Newlingrook GMA, which is water that may be allocated for use, but only where the applicant can demonstrate through appropriate hydrogeological assessment that the volume applied for can be extracted with low risk to the environment, existing users and other aquifers. Our previous investigations identified that further research would be required to properly evaluate the risks and benefits of accessing the Newlingrook aquifer.

Making further use of the Victorian water grid

The Melbourne-Geelong pipeline, along with our entitlement and access to storage in the Melbourne system, has made a significant contribution to diversifying and enhancing Geelong's water supplies. Leveraging from this connection may be an efficient means of increasing supply in the future.

As both Melbourne and Geelong continue to grow, increasing demand will mean making the most of existing resources, as well as considering new sources in the longer term. The connection between the cities means that decisions about some of these future investments are more interrelated than in the past.

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The water grid enables water resources to be transferred where needed and valued most highly, so there is an opportunity for Barwon Water to increase its resources in the Melbourne system through further entitlements. This may mean purchasing a volume of existing entitlement from a willing seller, or potentially taking a share of any new sources in the future (such as an augmentation of the Victorian Desalination Plant).

Where the volume is significant enough, the capacity of the Melbourne-Geelong pipeline may itself become a constraint on the amount of water that can be physically transferred from the Melbourne system, regardless of our entitlements. Duplicating the pipeline to increase this capacity will remain an option in the long term.

Alternative water resources

Making the most of existing water resources extends beyond conservation and efficiency. Using alternative resources, particularly recycled water, stormwater and rainwater, for fit-for-purpose uses is an important means of reducing the consumption of limited drinking water supplies. Realising the full potential of these sources will underpin regional prosperity in the future by contributing to the security, resilience and sustainability of water supplies.

We have made substantial progress in increasing the use of alternative water resources. Nonetheless, large volumes of recycled water and stormwater are still generated each year that remain unused. There are often a number of challenges to making greater use of these resources, and it will not be practical or efficient in every instance.

However, there are a number of opportunities that may warrant investigation and comparison, including:

- using alternative water to irrigate public open space such as parks, gardens and sports fields, contributing to green spaces that enhance liveability for local communities
- facilitating alternative water use in new suburbs through dual pipe infrastructure, such as that incorporated in new development in Armstrong Creek near Torquay
- the role of rainwater tanks to provide water for fit-for-purpose use in both new development and potentially retrofitted in some existing houses.

These options represent comparatively decentralised and localised opportunities, which will likely only go some way to using the full extent of alternative water resources available. We will continue to explore opportunities for recycled water to be used on a much larger scale for agriculture, industry, the environment and to irrigate recreational assets. We also propose to investigate the potential opportunity for indirect potable reuse in the longer term.

Indirect potable reuse involves the practice of introducing highly purified recycled water into the drinking water system, with one or more intermediate steps as additional barriers between wastewater treatment and water treatment (for example, via a waterway or aquifer). Indirect potable reuse is not an uncommon practice around the world, whether in a planned or incidental manner, although is not yet widely endorsed in Australia.

Importantly, this is only a long term option that would require considered consultation with our customers and community, in combination with the right level of technical investigation to guarantee that Victoria's stringent drinking water guidelines continue to be met.

Indirect potable reuse would represent an effective means of taking advantage of the significant and consistent volumes of recycled water that are available each year from the Black Rock Water Reclamation Plant. Conceptually, it would involve delivering recycled water back into the Wurdee Boluc Reservoir, where it would mix with existing raw water from the Barwon catchment, prior to treatment at the Wurdee Boluc water treatment plant.

There are examples of planned indirect potable reuse schemes around the world. More common, though, is the frequent practice of towns and cities taking their raw water from waterways that incorporate flows from the treated wastewater discharge of upstream urban centres. Such unplanned potable reuse has always been commonplace and is exemplified locally in town water supplies drawn from the Yarra, Murray and Hawkesbury Rivers.

While it is being used successfully in some places, perceptions around indirect potable reuse have proven challenging to overcome in promoting it as part of water supply systems – particularly where other resources are available – even though continued improvements in technology mean we can produce safe, high quality treated water more efficiently, and at lower cost, than ever before.

Indirect potable reuse could contribute substantially to making best use of the region's water resources in the future. As existing resources become more constrained, a failure to achieve large-scale use of a readily available, high reliability source in recycled water will become less acceptable. Our long-term aspiration is to ensure we can recycle all resources to sustainably provide the inputs required for regional prosperity.

We recognise that there are some major hurdles to overcome if indirect potable reuse is to be accepted and implemented. Given the substantial lead time that is required to address these hurdles through community consultation and technical investigation, we believe that this option needs to be part of the conversation now.

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Desalination

Geelong's location on the coast lends itself to consideration of seawater desalination as a feasible long term option.

While the costs and environmental impacts of desalination would need careful consideration, it does provide a secure, climate-independent supply that displaces further pressure on traditional sources increasingly impacted by climate change. The rapid advance of technology also means that the attributes of options such as desalination may change significantly in the future.

A summary of the options identified to maintain secure water supply for the Geelong system into the future is summarised in Table 12. The volumes attributed to these options are indicative and in many instances could be varied depending on requirements.

The options identified have been short-listed from a substantive list of possibilities, all of which are listed in Appendix B. While those described are the priority for further investigation, others may be revisited in the future as circumstances change. Many options have been identified and considered at different times as Geelong's needs have evolved. One example of this is the potential for a new dam on Dewing Creek. Posed at various times, this option warranted some additional investigation before we determined again that it does not qualify for further detailed consideration (see Box 12).

Table 12: Summary of water supply security options identified for the Geelong system

Options for investigation	Indicative volume (ML/year)
Optimising existing assets and resources where efficient	
Use a portion of the peak winter flow from Gellibrand River via a tunnel or pipeline to West Barwon Reservoir	1,800
Use a portion of the peak winter flow from Gellibrand River by backflow through new Colac pipeline to ASR at Barwon Downs, or to WBIC	540
Optimise operation of available water sources in the Geelong system	TBC
New or expanded water sources and connecting to the Victorian water grid system	
Use recycled water for agriculture, industry and to support the environment and recreation, and investigate the potential for indirect potable reuse	Up to 15,000 ^*
Increase the capacity of the MGP and purchase additional entitlements from the Melbourne system	8,000 ^
Local desalination plant	5,000 ^
Access groundwater held by Alcoa Anglesea	2,000
Use alternative water to irrigate public open space	TBC
New suburb dual pipes	750
Rainwater tanks for fit-for-purpose use in new developments	650
Retrofit rainwater tanks for fit-for-purpose use in some existing houses	TBC

^ can be designed to meet a wide range volumes
* would require regulatory approval

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Box 12: considering a new dam on Dewing Creek

Dewing Creek is part of the Barwon River basin and one of a number of catchments to the north of the West Barwon reservoir in the Otway Ranges. The Wurdee Boluc Inlet Channel intersects several small waterways, including Dewing Creek, along its course between the West Barwon and Wurdee Boluc Reservoirs.

As part of steps to secure Geelong's water supply, the 2006 *Central Region Sustainable Water Strategy* included an action to reinstate a diversion from Dewing Creek into the Wurdee Boluc Inlet Channel. The diversion was commissioned in 2013 and is designed to provide an additional 700 ML/year.

Barwon Water purchased farm land alongside Dewing Creek in the 1990s as a potential site for a future dam. Development of the dam has subsequently been considered at a conceptual level (including as part of the 2012 Water Supply Demand Strategy) but found to: be technically challenging; have likely impacts on the Barwon River system; and provide limited yield at a high cost.

All water supply options identified previously were revisited as part of this Urban Water Strategy, including the potential for a new dam at Dewing Creek. Water resource modelling of the dam yield was updated to reflect the latest climate baseline and projections of climate change impacts.

The analysis demonstrates:

- limited additional yield in the order of 2,000 to 2,500 ML/year depending on the dam capacity, based on historical climate conditions
- a significant reduction in this yield by 2065 under projected climate change scenarios to between 700 and 1,100 ML/year depending on the dam capacity
- reductions in downstream flows in Dewing Creek
- indicative construction costs between approximately $60 million and $100 million, depending on the dam capacity.

Assessment of the option reiterated the conclusion of the 2012 WSDS that a Dewing Creek dam is not favourable, on the basis that:

- it would deliver relatively limited yield at a high cost
- there is considerable uncertainty about future performance under a changing climate
- it is considered unlikely, given efforts to identify additional environmental water in the Barwon River, that a new bulk entitlement would be granted in the catchment.

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13.5 Action plan

The Geelong system is now characterised by the diverse and extensive range of resources that contribute to the current resilience and security of water supply. By considering the different attributes of each supply source, we may identify different ways in which they can be operated to provide the greatest benefit to our customers and the environment. This process will be undertaken in the context of our Strategic Intent and Water for Victoria, which inform relevant objectives and new approaches.

Our analysis confirms the value of each water resource to Geelong's water supply. It emphasises the important role that the Barwon Downs borefield has played and will fulfil in the future. We will work with stakeholders to ensure that our Barwon Downs extraction licence is successfully renewed in 2019 with the new licence amended, if necessary, based on an improved scientific understanding of the aquifer.

Even under conditions of high population growth and impact from climate change, we can continue to meet levels of service in Geelong until at least 2035. However, given the potential scale of any future upgrades to maintain service in the longer term, it is necessary to plan now for the steps we will take to maintain this status. Major augmentations will take many years to plan, evaluate and prepare in consultation with the community. Readiness to act in a timely and informed manner is a critical means of managing the uncertainty of the future.

Actions	
G1	We will investigate the opportunity to further optimise the way we use available water sources in the Geelong water supply system by developing a decision-making framework to guide operation
G2	We will work with the community, government and other stakeholders to renew our Barwon Downs groundwater licence by 2019 developed in consideration of an improved understanding of the environmental and social impacts of the borefield operation
G3	We will further investigate the options available to contribute to water supply security for the Greater Geelong region in the longer term
G4	We will implement progressive upgrades to the Black Rock Water Reclamation Plant to cater for growth beyond 2050
G5	We will investigate options to use recycled water from the Birregurra and Winchelsea Water Reclamation Plants for environmental flows in the Barwon River

Opposite: Wurdee Boluc Water Treatment Plant

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Colac

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14. Colac

14.1 About the Colac system

14.1.1 Water supply

Colac's water supply is sourced from the West Gellibrand and Olangolah Reservoirs in the Otway Ranges. Water is transferred 25km through a main supply pipeline to two basins on the outskirts of Colac, prior to treatment and distribution.

The 2012 WSDS identified the need for an upgrade to the Colac water supply system in the near term. While it has historically performed well under normal climate conditions, the particular characteristics of the system mean that a variable and changing climate present a real risk to service levels in the future.

Barwon Water subsequently progressed the identification and development of a solution in consultation with the local community. At the same time, careful monitoring of conditions informed a decision about the appropriate timing for the upgrade. The planning, monitoring and early engagement with the community enabled us to proceed to implementation as soon as the decision was made to do so in 2016.

The need for the project is reflected in three key drivers:

- **Balancing supply and demand in the long term:** the 2012 WSDS identified that a system augmentation was required to securely meet demand and support regional growth and development into the future.
- **Securing supply in a variable climate:** the characteristics of the existing Colac system place emphasis on the importance of seasonal inflows to ensure that storage levels recover each year following summer. This is increasingly uncertain in a future impacted by climate change.
- **Improving resilience and supply security:** there are currently limited controls at Barwon Water's disposal to manage periods of low or disrupted supply. As a single source system, the Colac water supply has no alternative backup supply available in the event of emergencies such as catchment bushfires or major pipeline failure.

The new pipeline connecting Colac to the Geelong system in 2017 will address each of these drivers and ensure the security and resilience of Colac's water supply.

14.1.2 Wastewater management

The Colac Water Reclamation Plant is located to the north east of the town alongside Lake Colac. The plant's design capacity of 5.7 ML/day is equivalent to flows from a population of 28,500. However, a significant proportion of sewage flows to the Colac Water Reclamation Plant originate from non-residential customers, including local abattoir and dairy businesses.

The first stage of work to increase the capacity of the plant was completed in 2016. Further work is planned to progressively ensure adequate capacity for growth within the biological treatment process.

Class C recycled water produced by the plant that is not reused on site is discharged to Lake Colac.

14.2 Bulk entitlements

Barwon Water holds a bulk entitlement for 5,400 ML/year from the West Gellibrand and Olangolah Reservoirs in the Otway Coast Basin. Conditions in the entitlement prioritise the protection of environmental flows in the waterways. Water harvested from the catchment is limited by seasonal availability and conditions.

14.3 System performance

14.3.1 What we've learnt since the 2012 WSDS

The 2012 WSDS indicated the expectation that Colac's water supply would need to be upgraded at some stage between 2017 and 2019. While the need for the upgrade was clear, the imprecise timing demonstrates the inherent uncertainty in predicting future conditions.

This uncertainty is addressed by planning for a number of scenarios. Monitoring conditions against these scenarios then helps to inform when action should be taken.

The large proportion of non-residential demand in the Colac system is a particular source of uncertainty when projecting future demand. Unlike the system's residential demand, which tends to be comparatively uniform and predictable over time, patterns and peaks in non-residential demand (including industry and agricultural use) are less consistent. Given the high proportion of non-residential demand, a sudden increase (for example, associated with a large new business) could have a material impact on system performance.

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The Otway Ranges catchments are very responsive to rainfall, which means that there is also considerable uncertainty about future supply in a changing climate. The small volume of available storage relative to annual demand means that the system relies on seasonal rainfall to fill the storages each year. A dry summer and autumn period can place the system under stress, which was exemplified in 2013 when restrictions were required in such conditions despite being preceded by a wet winter and spring.

Monitoring these conditions over time began to inform the likelihood that an upgrade would be required sooner rather than later. By 2016, we made the decision to proceed with the planned augmentation.

This decision was also facilitated by the extensive work that had been done since the 2012 WSDS to develop a preferred solution. A Colac Community Reference Group (CCRG) was established at an early stage and engaged throughout an options identification and assessment process. Independent assessment of six strategic options by both the CCRG and Barwon Water identified a common preferred option in 2013. This option is the basis for the pipeline connection to the Barwon system that will be completed in 2017.

The implementation of an upgrade to Colac's water supply is a prime example of adaptive planning, ensuring a well-informed and timely response to an identified need.

14.3.2 Assessment of vulnerability to short-term shocks

	Vulnerability assessment	Description
Pre-upgrade	High	Colac's water supply system relied upon seasonal rainfall to fill storages and depended on the integrity of a single source. No back-up supplies were available in the event of an emergency.
Post-upgrade	Low	Connection to the Geelong system provides an additional water source that delivers backup supply, operational flexibility and resilience.

Although Colac's water supply system has been historically reliable, it has relied upon a single source and seasonal rainfall. The main supply pipeline from the Gellibrand catchment traverses diverse terrain, including occasionally steep and heavily vegetated land that is prone to landslips in places. The catchment is also subject to the risk of bushfire that is a feature of Victoria's climate and geography. During such an emergency the system has very limited storage to maintain supply during any disruption.

The pipeline connection to the Geelong system provides alternative supply from the Barwon system, including both the West Barwon Reservoir and the Barwon Downs borefield. This provides access to additional resources to secure Colac's water supply in the longer term, but also ensures a back-up supply from diverse sources during drought or an emergency. The upgrade will substantially mitigate the key risks the system currently faces.

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14.3.3 Long-term forecast

With the connection of Colac to the Geelong system, the assessment of long-term water security for Colac becomes aligned with that for the Greater Geelong region. The connection consolidates to some extent the resources available in each system, within the physical limitations of the network infrastructure.

The connection does not imply a substantial change in the way we will operate Colac's water supply system. In the shorter term, it is expected to provide a boost to supply during drought conditions or backup in the event of an emergency. However, it does provide operational flexibility that we will seek to optimise as conditions change across the Geelong and Colac region over time.

The pipeline connection is presently designed to transfer water in one direction only, to provide a reliable backup supply to Colac. In the longer term, the connection potentially also facilitates moving water from the Gellibrand catchment to the Barwon system. This example of the expansion of the Victorian water grid within our service area creates a number of opportunities to share resources efficiently and sustainably in the future.

The upgrade to Colac's water supply means that there is no resource constraint over the planning horizon. The system yield is sufficient to maintain levels of service for even the highest forecast growth in demand, as shown in Figure 20. With access to the water resources of both the Gellibrand and Barwon systems, the primary constraint becomes infrastructure limitations – that is, the capacity of the main supply pipelines to transfer flows to the town. Easing these limitations would provide an even greater yield that will be able to support growth in Colac well into the future.

14.3.4 Wastewater management

Colac's Water Reclamation Plant is being upgraded to support future growth in local industry. A program of upgrade works has commenced following a substantial step-change increase in inflows associated with new and growing industry in the area. The progressive upgrades will ensure sufficient capacity to handle projected increases in flows and loads over time.

14.4 Future options

Given the ability to maintain service levels over the planning horizon under any scenario of growth in population and demand, there has been no need to prioritise options to generate additional yield for the Colac water supply system for this Urban Water Strategy.

Options identified in the course of developing the strategy are identified in the long-list included in Appendix B. The interconnection between the Colac and Geelong system means that many options are common across each.

We will continue to implement the Colac Demand Management Strategy (due to be completed in 2018) and, where prudent and efficient, investigate integrated water management opportunities. Efforts to reduce demand, including offsetting the use of drinking water with alternative resources such as recycled water, can still make sense where they reduce operating costs or deliver other liveability benefits.

14.5 Action plan

Beyond continuing to deliver our current key projects in Colac – a Demand Management Strategy and the new pipeline connecting to the Geelong system – the immediate focus in Colac turns to ensuring sufficient capacity in Colac's Water Reclamation Plant.

Actions	
C1	We will continue to deliver the Colac Demand Management Strategy and commission the new pipeline connecting Colac to the Geelong system
C2	We will implement progressive upgrades to the Colac Water Reclamation Plant to cater for growth in loads for industry and manufacturing

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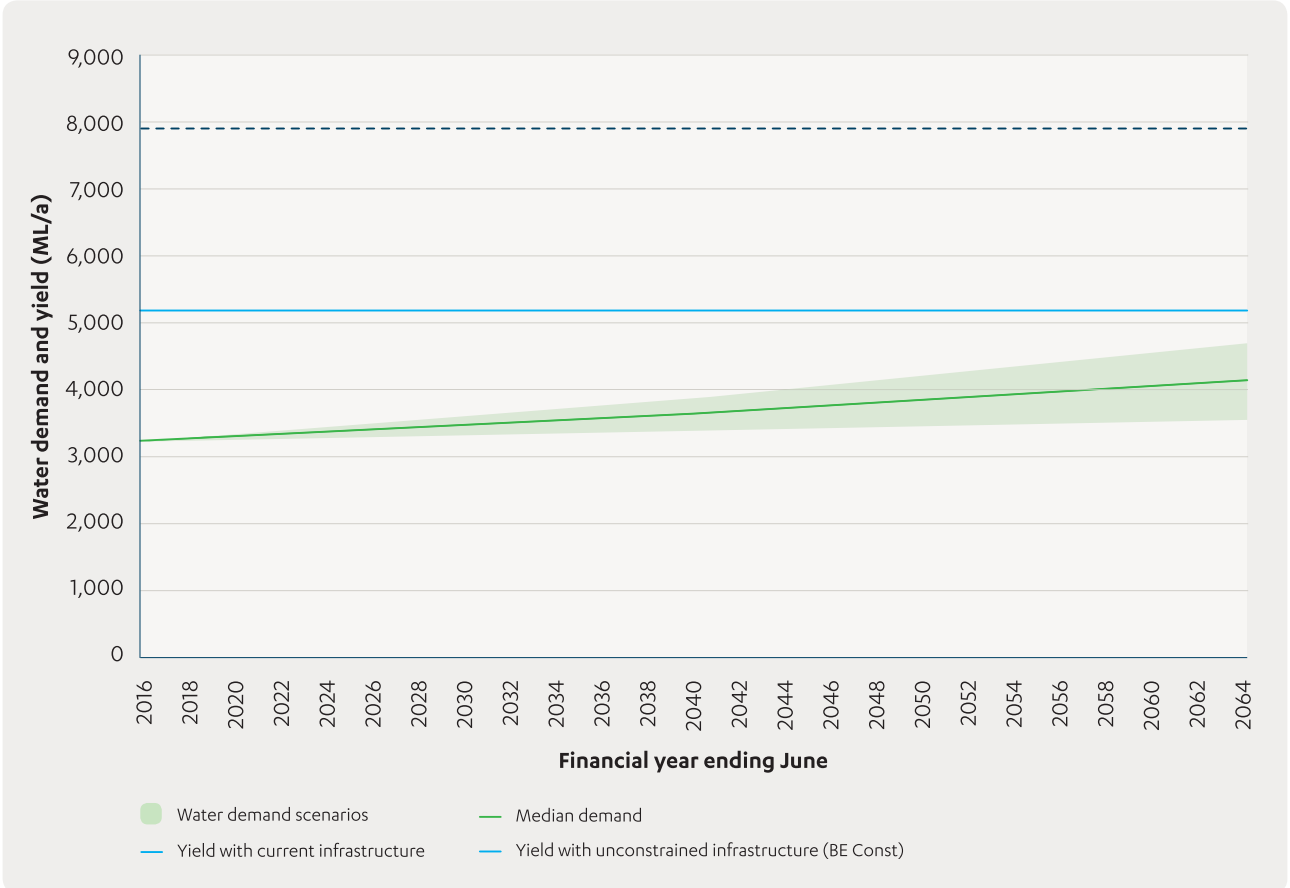
West Gellibrand Reservoir

Figure 20: Forecast balance between water supply and demand for the Colac system



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Apollo Bay and Skenes Creek

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15. Apollo Bay and Skenes Creek

15.1 About the Apollo Bay system

15.1.1 Water supply

The Apollo Bay system services the towns of Apollo Bay, Skenes Creek and Marengo. Water supply is sourced from the Barham River, which rises in the Otway Ranges where high, reliable rainfall ranges between 800mm and 1,200mm in most parts. However, rainfall is seasonally variable and drier periods do occur.

Streamflows tend to be lowest over the summer, when demand for water is at its highest. In coastal towns such as Apollo Bay, this peak period of demand is further increased by the influx of a large tourist population. To help balance supply and demand through the year, the system incorporates off-stream storage that enables water to be extracted from the Barham River when flows are higher (particularly over winter), to be drawn upon over the peak summer months.

A pipeline delivers water from a weir on the east branch of the river to the 125 ML Marengo Basin, located adjacent to the Apollo Bay Water Treatment Plant. An additional 250 ML off-stream storage was constructed in 2014 to take advantage of flows available through winter, which are extracted via a pump station on the west branch of the river. Water is transferred from this storage to the Marengo Basin when required.

Construction of the additional storage in 2014 was the culmination of planning that commenced in 2001, when it was recognised that growing demand over summer was driving the need for augmentation to ensure future demands could be met. A range of options was considered, but investigations proved challenging and time consuming as a result of the unfavourable ground conditions that constrain major storage construction in the area.

While the additional storage has substantially improved the security of water supply for Apollo Bay and Skenes Creek, conditions continue to change. In particular, revised guidance from CSIRO and the Bureau of Meteorology about the severity of future climate change impacts, as well as recent experience of conditions drier than anything on record, reflect the need to continually revise expectations about – and planning for – the future.

15.1.2 Wastewater management

The Apollo Bay Water Reclamation Plant (WRP) treats wastewater from residential and commercial customers in Apollo Bay, Marengo and Skenes Creek to produce Class-C recycled water. A small proportion of this recycled water is used in an on-site nursery, with the remainder being discharged via an ocean outfall in accordance with an EPA licence.

The main challenge for wastewater management in Apollo Bay is the seasonal fluctuation in flows, which increase substantially over summer. The plant design is modular to cater for the seasonal variation in flows and loads.

15.2 Bulk entitlements

Barwon Water holds a bulk entitlement that permits extraction of up to 800 ML/year from the Barham River. Conditions attached to the entitlement are provided to ensure that priority is always given to maintaining adequate environmental flows. In practice, this means that the actual volume of water that may be extracted by Barwon Water is limited by seasonal water availability and storage capacity.

Optimising storage volume and pumping regimes is an important part of managing water security in the Apollo Bay system. The storages are often full during wetter months when flows in the Barham River are higher, while during summer flows are more likely to be prioritised for the environment and therefore unavailable for water supply.

A number of options have been identified that may contribute to making better use of Barwon Water's annual entitlement.

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15.3 System performance

15.3.1 What we've learnt since the 2012 WSDS

There were relatively few actions identified for the Apollo Bay system in the 2012 WSDS, with the focus on completing the construction of additional storage anticipated to secure supply over the planning horizon. The timely delivery of this upgrade meant an end to the precautionary implementation of water restrictions between November and April every year.

However, Apollo Bay experienced water restrictions again in early 2016, which were the result of climate conditions never before encountered over the historical record. Implementation of drought preparedness measures ensured that water supply was always secure, but this unprecedented climate event provided some valuable learnings for Barwon Water, including:

- the effectiveness of restrictions in slowing a decline in storage levels
- an understanding of the impact of restrictions on priority open spaces that provide significant value to the community
- an understanding of other indicators that can contribute to better informing the water security outlook.

In accordance with our obligations after restrictions are imposed, we have undertaken a review of the circumstances and identified some actions to improve our response to similar events in the future.

15.3.2 Assessment of vulnerability to short-term shocks

Vulnerability assessment	Description
Medium	Despite some vulnerability to short-term events outside the historical climate record, the system continues to meet agreed levels of service. However, these extreme, short-term events can impact water supply and require Barwon Water to initiate a response in accordance with the system Drought Preparedness Plan. Strategy actions should identify, prioritise and prepare options required in the future to continue to meet service levels.

The vulnerability assessment of the water supply system for Apollo Bay and Skenes Creek is influenced by the specific system characteristics, particularly:

- reliance on seasonal conditions (adequate flows in the Barham River to ensure storages are filled ahead of summer demand)
- reliance on the Barham River as a single major source of water
- a limited period over which water restrictions can be implemented effectively each year
- a limited timeframe over which to respond in the event of an unprecedented and prolonged period of extreme water shortage.

The Drought Preparedness Plan for the system summarises the process and actions Barwon Water employs to ensure that water supply is always maintained, even in the unlikely event of extreme and short-term impacts to the towns' water resources.

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15.3.3 Long-term forecast

The long-term forecast for Apollo Bay and Skenes Creek has changed substantially from the 2012 WSDS, which forecast that supply to the towns was secure beyond 2050. Updates to climate change projections, as well as the unprecedented conditions experienced in the early part of 2016, have had a material impact on the future outcomes forecast for the system. Modelling indicates that, under a scenario of high climate change and high population growth, an upgrade to the Apollo Bay and Skenes Creek water supply system may be required as soon as 2024. Under median conditions, this would be deferred to around 2032.

Figure 21 illustrates the range of outcomes from the scenarios investigated. It emphasises how the uncertainty associated with both the impacts of climate change and population growth compounds over time, particularly over the latter part of the planning horizon.

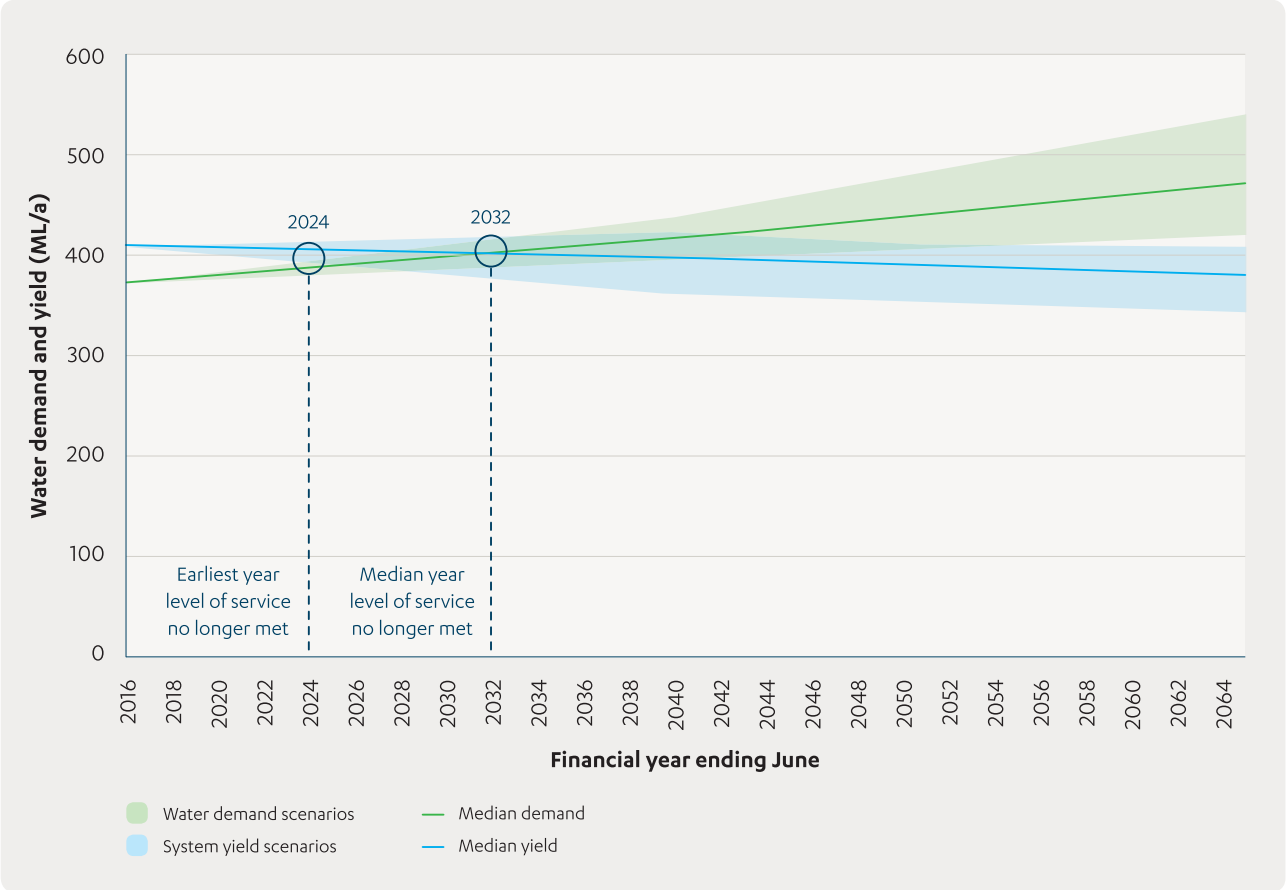
Modelling the impacts of climate change is based on the best available scientific information, which will continue to evolve as we monitor conditions and update our analysis.

However, it is also challenging to predict the way small towns such as Apollo Bay and Lorne will grow and change in the future. The official estimates of Victoria in Future 2015 can often only provide regional trends that may not be the best reflection of what is occurring in individual townships or areas. We need to identify and use available resources to better project the change in population (and therefore water demand) over time.

This analysis demonstrates the need to begin to prepare future measures to maintain supply security now. Although intervention is not anticipated until at least 2024 and may be deferred beyond this, planning must progress well in advance to ensure we are ready to progress to implementation when required.

This means we will actively advance the identification, development and planning of future options to maintain secure water supply during the five years to 2022. In combination with ongoing monitoring and an adaptive management framework, this will ensure that Barwon Water is prepared to take action when conditions require.

Figure 21. Forecast balance between water supply and demand for the Apollo Bay system



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15.3.4 Wastewater management

The Apollo Bay Water Reclamation Plant is currently operating at approximately half its design capacity. However, there is a hydraulic constraint between the WRP and the ocean that will need to be addressed during the 50 year planning horizon. There is no imminent need for major works to improve sewerage infrastructure in Apollo Bay and Skenes Creek.

15.4 Future options

The options available to maintain secure water supply in the Apollo Bay into the future range from improvements to the way we currently operate, through to substantial investment in major new infrastructure. Identifying these options is important as part of an adaptive planning approach, which is necessary to respond to conditions in a timely and measured manner.

It is also important that the options we pursue are prudent, provide flexibility and do not impose a higher cost on customers than is necessary. This typically means that priority will be given to exploring options that (individually or together) can be implemented in a staged, measured way with the least impact and cost.

Optimising existing assets and resources where efficient

Opportunities to enhance the efficiency of current arrangements include improving operation of the Water Treatment Plant, as well as continuing to optimise the way we harvest water from the Barham River. Given that the system relies on off-stream storages, making the most of our entitlement means extracting water whenever it is both available and required. Operationally, this means pumping arrangements must be able to balance a range of factors at any point in time, including storage levels, streamflow and bulk entitlement conditions. Improving the way we currently manage these arrangements may yield additional supply within our existing bulk entitlement.

We will also explore whether the bulk entitlement conditions themselves can be renegotiated to enable us to access a greater proportion of our annual entitlement. A change in passing flow limits could increase the volume that we are able to extract from the Barham River, without impacting materially on the local environment.

Any change to the rules specified in the bulk entitlement must have an appropriate scientific basis, which is generally founded on an environmental flow study. The scientific community's understanding of the ecology and conditions of the Barham River and estuary has evolved since the last environmental flow study in 2003. We will take the opportunity to review the recommendations and basis of the environmental flow study to determine whether the bulk entitlement rules should be revisited.

Beyond the Barham River, the most proximate water resources that may be available to enhance supply are alternative source such as recycled water, stormwater and rainwater. Utilising these resources can be constrained by a number of factors, particularly where demand for fit-for-purpose use is either limited or dispersed. However, we will explore whether there is an opportunity to take greater advantage of the large volume of recycled water available, particularly for irrigation of open spaces.

Residential rainwater tanks also have the potential to save a volume of potable water each year. However, the cost of retrofitting tanks can be high, while their contribution to improving supply at critical times of water shortage would need to be assessed.

It could also be feasible to introduce recycled water to the Barham River as environmental flows at certain times (downstream of our offtakes), as an offset that would then enable increased harvesting. This option would require careful exploration with the EPA and other stakeholders to ensure that the arrangement represents a net benefit to the environment.

New or expanded water sources and connecting to the Victorian water grid

The other means of making the most of our available bulk entitlement is to further increase available storage, in order to harvest more water when it is available in wetter months. A number of options were identified as part of the investigations that preceded construction of a new storage in 2014. While ground conditions in the area are challenging, this work provides a basis for revisiting other favourable options for implementation of further storage.

Other than alternative water sources, the other new water resources that may feasibly augment supply in Apollo Bay in the longer term include local desalination, or a connection to the Geelong system. These options represent major investments with substantial infrastructure and associated impacts that would need careful management. While technically feasible, we expect they will remain lower priority, long-term options that could be investigated in more detail when conditions dictate.

A summary of the options identified to maintain secure water supply for the Apollo Bay system into the future is summarised in Table 13.

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Table 13: Summary of water supply security options identified for the Apollo Bay system

Options	Indicative volume (ML/year)
Optimising existing assets and resources where efficient	
Increase efficiency of water treatment	18
Renegotiate bulk entitlement conditions	90
Alternative water for irrigation of open spaces	12
Rainwater tanks for fit-for-purpose use in new homes	9
Retrofit rainwater tanks for fit-for-purpose use in some existing houses	TBC
Recycled water to offset environmental flows	90
New or expanded water sources and connecting to the Victorian water grid	
Additional off-stream storage	197*
Local desalination plant	197*
Connection to Geelong system from West Barwon Reservoir	197*
Connection to Geelong system from West Gellibrand Reservoir	197*

*Can be designed to meet a wide range of volumes

15.5 Action plan

Analysis indicates that augmentation to supply may be required by 2024 under worst-case conditions. Although potentially sooner than previously anticipated, this still allows time to plan and prepare so that we can take action in response to the conditions that emerge.

Given the time required to identify, plan and design solutions ahead of their implementation, it is prudent that we commence that process now. In addition to optimising current arrangements, the focus of our actions for the period of this strategy is therefore to further investigate the more substantial investments that may be required in the future. A key element of this approach is engaging with the Apollo Bay community to understand their preferences.

Actions	
AB1	We will complete a review of the environmental flow recommendations for the Barham River in 2017, to inform a review of the Bulk Entitlement rules
AB2	We will commence engagement with the community and Traditional Owners in 2018 to review options and identify a preferred approach to ensure water supply security for the long term
AB3	We will commence early planning works in 2019 for the preferred approach to maintain water security in the long term

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Lorne

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16. Lorne

16.1 About the Lorne system

16.1.1 Water supply

Water is supplied to Lorne from the Allen Reservoir, which is located on the St George River in the Otway Ranges. Water is piped approximately 2.5km to the Lorne Water Treatment Plant, where it is treated to drinking water quality prior to distribution via the supply system.

The Lorne water supply system is best characterised as 'seasonal', with storage levels drawn down over the peak summer months then recovering during winter and spring. Although annual water demand in Lorne exceeds the capacity of the Allen Reservoir, the high, reliable rainfall and steep catchment generally means that the system responds well to rainfall and the reservoir fills rapidly during wetter periods.

16.1.2 Wastewater management

Sewage is delivered to the Lorne Water Reclamation Plant, located approximately 1km inland from the township. The plant treats wastewater from residential and commercial customers in the area to produce Class C recycled water. A small proportion of this is used on-site, with the remainder being discharged to the ocean.

The plant is designed to cater for the substantial variation in inflows that results from the increase in population over the summer months. Flows into the plant are typically 0.6 ML/d during the year and up to 3.5 ML/d over summer.

Wastewater is treated via an Intermittently Decanted Extended Aeration (IDEA) process, which can operate using one or two aeration and selector tanks to cater for the seasonal variation in flows and loads.

16.2 Bulk entitlements

Barwon Water holds a bulk entitlement that permits extraction of up to 510 ML/year from the St George River. Conditions attached to the entitlement are provided to ensure that priority is always given to ensuring adequate environmental flows. In practice, this means that the actual volume of water that may be extracted by Barwon Water is limited by seasonal water availability, environmental passing flow requirements and storage capacity.

16.3 System performance

16.3.1 What we've learnt since the 2012 WSDS

While the system has traditionally performed well under historical climate conditions, the seasonal reliance on rainfall and streamflows does present some risk, particularly in a variable and changing climate. This was demonstrated in the summer of 2015/16, when prolonged and unprecedented dry conditions through summer and autumn resulted in the Allen Reservoir falling to just 33 per cent of capacity.

No other system illustrated the severity of the dry conditions at this time more than Lorne. Even during the Millennium Drought the town received sufficient rainfall to maintain unrestricted supply. But in early 2016, the Allen Reservoir had dropped to its lowest level on record as a result of conditions that were beyond anything Barwon Water had previously experienced. Rainfall between October, 2015, and March, 2016, was less than half the long-term average, but the prolonged dry conditions in the catchment reduced summer streamflows in the St George River by 90 per cent below average, and over 30 per cent lower than the driest conditions on record between October and March.

Storage levels were also impacted by water carting to provide drinking water to the bushfire-affected towns of Wye River and Separation Creek.

Barwon Water enacted Lorne's Drought Response Plan, implementing Stage 2 restrictions in late March that were increased to Stage 3 on May 1. In a first, water was carted from the Geelong system as an additional precaution to shore up supplies. These measures were sufficient to maintain supply until rainfall returned and rapidly restored water levels in Allen Reservoir.

While this event was unprecedented in nature and the system recovered rapidly, it highlights the need to be prepared for conditions outside the historical record.

The characteristics of the Lorne system indicate a need to carefully monitor conditions over time. The long-term forecast discussed below is based on scenarios reflecting the best available information about possible climate change impacts over time. However, the system's reliance on seasonal conditions means we must be equally vigilant for changes in annual rainfall patterns.

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16.3.2 Assessment of vulnerability to short-term shocks

Vulnerability assessment	Description
Medium	An extreme, short-term event can impact water supply and require Barwon Water to initiate a response in accordance with the system Drought Preparedness Plan. Strategy actions should identify, prioritise and prepare options required in the future to continue to meet service levels.

The vulnerability assessment of the water supply system for Lorne is influenced by the specific system characteristics, particularly:

- reliance on seasonal conditions (adequate flows in the St George River to ensure the Allen Reservoir fills ahead of summer demand)
- reliance on a single source of water
- a limited period over which water restrictions can be implemented effectively each year
- a limited timeframe over which to respond in the event of an unprecedented and prolonged period of extreme water shortage.

The Drought Preparedness Plan for the system summarises the process and actions Barwon Water employs to ensure that water supply is always maintained, even in the unlikely event of extreme and short-term impacts to the towns' water resources.

16.3.3 Long-term forecast

The long-term forecast for Lorne emphasises the need to be prepared for a wide range of potential future outcomes. Modelling of different water consumption and system yield scenarios indicates that an upgrade may be required by 2032 under conditions of high population growth and climate change impacts, but this need could be deferred beyond 2050 under median projections.

Figure 22 illustrates the range of outcomes from the scenarios investigated. Echoing the analysis for Apollo Bay, it emphasises the impact of increasing uncertainty over time, particularly over the latter part of the planning horizon. Again, we will seek to identify and use available resources that enable us to better project changes in population (and therefore water demand) to help reduce some of this uncertainty.

Despite the experience of 2015/16, Lorne's water supply has historically demonstrated a high degree of reliability. In the immediate term, modelling suggests the yield from the St George River will continue to maintain levels of service. Beyond the next five to ten years, projections based on the best available information begin to diverge and become increasingly uncertain over time.

Perhaps more than other systems, Lorne illustrates the need for an adaptive planning approach to manage this uncertainty. While it is possible that a major upgrade could be required at some point in the future, it is also plausible that any upgrade, if required at all, need only be small.

In this situation, a decision to invest in a substantial augmentation – while it may secure supply for the long term – could burden customers with the cost of infrastructure that is ultimately not required. A more prudent approach is to investigate the opportunity for smaller, incremental investments that effectively provide more time to monitor and respond to the system's needs. In the meantime, we can also begin to undertake the early planning and preparation for a more substantial infrastructure solution, which often takes many years, in the event that this is required.

16.3.4 Wastewater management

Lorne's Water Reclamation Plant is currently operating well within its design capacity and there are no planned upgrades over the strategy period.

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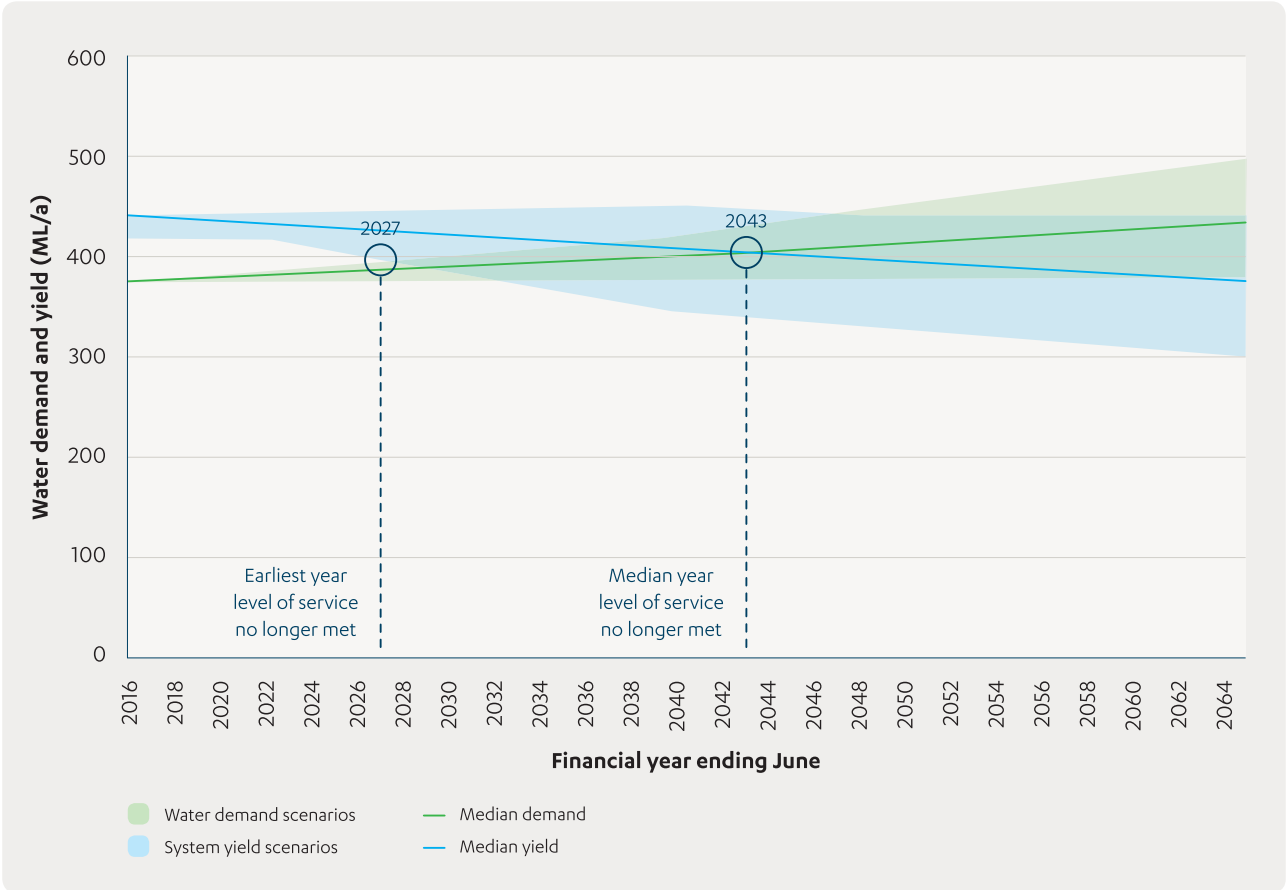
Table 14: Summary of water supply security options identified for the Lorne system

Options	Indicative volume (ML/year)
Optimising existing assets and resources where efficient	
Increase efficiency of water treatment	16
Use alternative water to irrigate public open space	3
Rainwater tank for fit-for-purpose use in new homes	9
Retrofit rainwater tanks for fit-for-purpose use in some existing houses	TBC
New or expanded water sources and connecting to the Victorian water grid	
Raise height of Allen Dam	63
Local desalination plant	139*
Connection to Geelong system at Aireys Inlet	139*

*Can be designed to meet a wide range volumes

Figure 22: Forecast balance between water supply and demand for the Lorne system



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Allen Reservoir

16.4 Future options

Future options to secure water supply in Lorne range from measures to provide incremental increases in yield, to major augmentations that would address the long-term deficit in supply that could eventuate in a scenario of high population growth and climate change impacts.

Optimising existing assets and resources where efficient

Current operational arrangements generally maximise the volume of water it is possible for us to harvest under the conditions of our bulk entitlement. The main constraint to increasing this volume is the storage capacity of the Allen Dam.

The primary opportunity for any operational improvements to yield additional supply is the potential for more efficient operation of the Lorne Water Treatment Plant, which will be investigated further.

There is limited use of alternative water resources at present, implying an opportunity to explore the potential for recycled water, stormwater and rainwater to contribute to supply. Provision of recycled water to irrigate green spaces could offset some existing potable demand. This does not represent a substantial volume in Lorne, but it may be particularly beneficial if it helps to reduce demand during those drier periods when drinking water resources are under more pressure.

Rainwater tanks could play a role in reducing residential demand, although costs of installation and effectiveness during drier periods would require further investigation.

New or expanded water sources and connecting to the Victorian water grid

Increasing the capacity of Allen Dam would enable a greater volume of water to be harvested in accordance with the conditions of our bulk entitlement. This could be achieved by increasing the height of the dam.

There are limited other surface water or groundwater resources in the area, with the surrounding terrain a challenge to accessing resources further afield. In the event that longer term conditions require a more substantive upgrade, options such as desalination or a connection to the Geelong system, which are technically feasible but have more considerable costs and impacts, would be investigated.

16.5 Action plan

Actions for Lorne are focused on ensuring an informed and measured approach to addressing the town's water supply needs over time.

Actions	
L1	We will engage with the community and Traditional Owners to review options and identify a preferred approach by 2022 to ensure water supply security for the long term
L2	We will commence early planning works for the preferred approach to maintain water security in the long term

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Gellibrand

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17. Gellibrand

17.1 About the Gellibrand system

17.1.1 Water supply

Located approximately 25km south of Colac in the Otway Ranges, the Gellibrand water supply system is Barwon Water's smallest independent system. Water supply for the town is sourced from Lardner Creek. A riverside pump station delivers water to the water treatment plant, from where it is gravity fed to the distribution network.

The year-round reliability of flows in Lardner Creek means that there is no need for substantial system storage. This means that the primary risk for the system is the impact of events such as bushfire or prolonged dry conditions that cause a deterioration in water quality.

The very small scale of the system means that short-term impacts or changes in conditions can be easily managed. If supply is threatened through bushfire or drought, the town can be readily supplied by water tanker from Colac or the Barwon River.

17.1.2 Wastewater management

Gellibrand is not currently serviced by reticulated sewage collection and treatment. Each property is responsible for managing its own wastewater in on-site septic or treatment systems.

The small size of the township means that environmental impacts from wastewater can be sustainably managed in a decentralised manner. This is more efficient than constructing a sewer network and wastewater treatment infrastructure for such a small population.

17.2 Bulk entitlements

Barwon Water holds a bulk entitlement for 60 ML/year from Gellibrand's supply catchment. The entitlement includes passing flow conditions that give priority to the environment. The actual volume harvested is dependent on seasonal water availability.

17.3 System performance

17.3.1 Assessment of vulnerability to short-term shocks

Vulnerability assessment	Description
Medium	Gellibrand relies upon a single source, which is at potential risk of water quality impacts during an event such as bushfire or prolonged drought.

Gellibrand's vulnerability assessment reflects the reliance of the town on a single source, albeit one that demonstrates reliability in even the worst climate conditions. The main risk to supply is associated with the impacts from an emergency event, such as bushfire, or prolonged drought impacting water quality.

The vulnerability assessment framework helps to identify the potential risks to Barwon Water's water supply systems in order to inform our Drought Preparedness Plans and Emergency Management Plan. In practice, the risks to Gellibrand's system can be readily managed by carting water from neighbouring systems.

17.3.2 Long-term forecast

Year-round flows in the Lardner Creek are so much higher than levels of consumption that even the impacts of a drier climate do not impact the system's reliability.

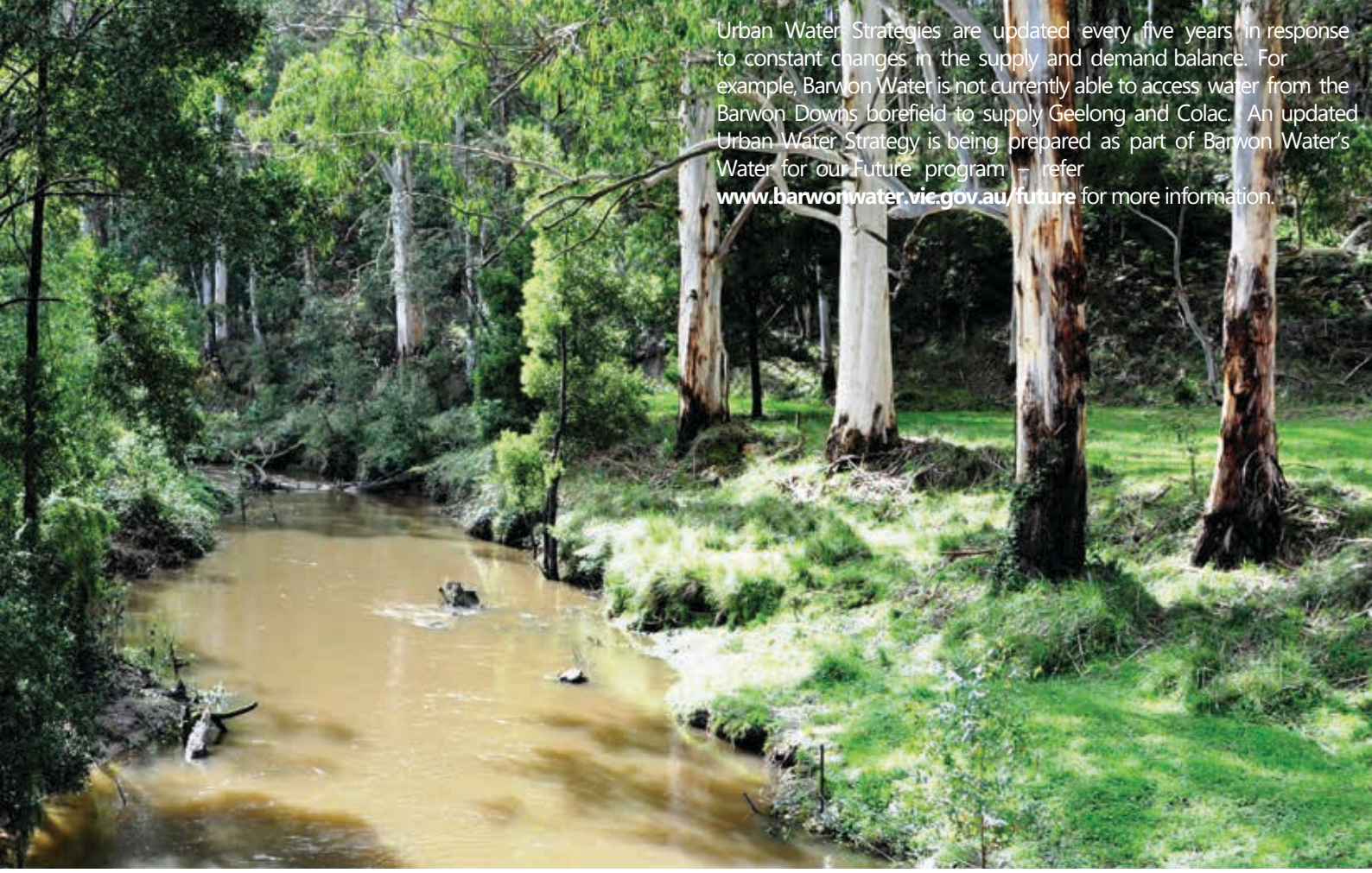
17.4 Future options

There is no need for augmentations to the Gellibrand system over the planning horizon. Barwon Water will monitor any risks to supply through the preparation of the Annual Water Outlook.

Any short-term impacts to supply can be readily managed by carting water from Colac or the Barwon River.

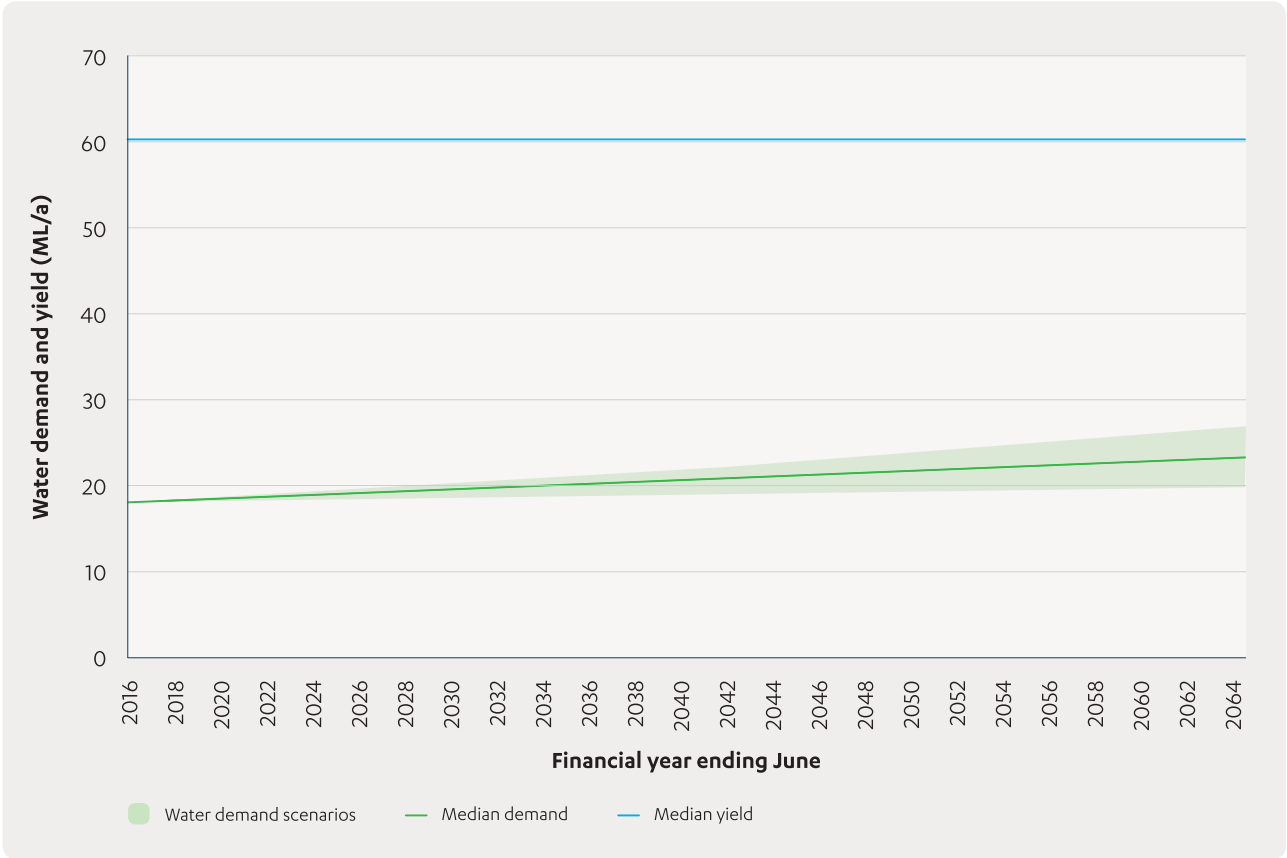
17.5 Action plan

Beyond Barwon Water's ongoing operational processes to monitor conditions and maintain supplies, there are no specific actions for the Gellibrand water supply system.



Urban Water Strategies are updated every five years in response to constant changes in the supply and demand balance. For example, Barwon Water is not currently able to access water from the Barwon Downs borefield to supply Geelong and Colac. An updated Urban Water Strategy is being prepared as part of Barwon Water's Water for our Future program – refer **www.barwonwater.vic.gov.au/future** for more information.

Figure 23: Forecast balance between water supply and demand for the Gellibrand system



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Appendices

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Appendix A – Drought preparedness plan

The Drought Preparedness Plan has been developed to ensure that Barwon Water will always be able to meet critical human needs for water, even during extreme events that lead to water shortages.

It outlines actions that are undertaken to ensure that communities are prepared for the eventuality of drought. The Drought Preparedness Plan describes our level of service commitment, the basis for water restrictions and water restriction By-Laws. It also includes a Drought Response Plan, which details the specific steps we will take when a response to dry conditions is required.

Level of Service

Barwon Water has an agreed level of service for the reliability of our water supply. It is our commitment to our customers and has two parts.

1. At all times, even during droughts and emergencies that lead to water shortages, Barwon Water will continue to supply an adequate supply of drinking water to meet essential human needs.
2. During extreme dry periods we may need to implement water restrictions. However, we plan for restrictions to be required no more than 5 per cent of the time.

Updating our Levels of Service

Barwon Water is committed to engaging with our customers and the community. Over the next five years, we plan to discuss levels of service with our customers to investigate whether there is any desire for these to change. A key part of this is understanding preferences about the frequency and severity of water restrictions.

If we change our levels of service, it may have an impact on what we need to do to manage each of our water supply systems. For example, if customers are prepared for the likelihood and frequency of restrictions to increase, this would reduce or defer the need for us to invest in increasing supplies. Alternatively, if customers expressed a desire to never experience water restrictions again, we would need to act immediately to substantially invest in each of our water supply systems to cater for the most extreme conditions. This type of investment would have flow-on impacts for the bills customers pay.

Water Restriction By-Law

The Water Restriction By-Law No. 190 was approved in 2012 by the Minister for Water, as the Minster administering the Water Act 1989. The By-Law is based on a model by-law which has been adopted by all Victorian water corporations. It describes the conditions under each stage of water restrictions, sets out how we can impose and lift restrictions, as well as indicating when and how we can choose not to impose or lift water restrictions.

For example, we may choose not to implement water restrictions when a drop in storage levels below the restriction rule curve appears likely to be temporary and brief, as the inconvenience they cause may outweigh any benefit. Barwon Water also has the authority under the by-law to continue water restrictions, where we think ongoing water savings are necessary to maintain secure supply.

The by-law also allows Barwon Water to issue infringement notices for breaches of water restriction conditions, as well as grant exemptions for certain activities upon review of customer exemption applications. Some examples may include watering of new turf, or irrigation of public open spaces.

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Consideration of exemptions

Barwon Water recognises that the health of key public assets – such as sports fields and public open space – is often critical to the health, wellbeing and liveability of communities during drought periods. We are working with local government to identify priority open space assets for which we will seek to ensure adequate water supply under any conditions. This may be through exemptions to water restrictions (with an appropriate Water Use Plan), or provision of an alternative water source such as recycled water or stormwater.

Through ongoing engagement with the local councils in our region we have been identifying priority open spaces that the community values highly. From here, by July, 2018, we will:

- confirm the water demand for priority spaces and undertake modelling to understand the implications of exempting these locations from water restrictions
- investigate alternative water supplies
- undertake an economic evaluation that compares the costs borne by the community due to the diminished quality of priority open spaces during water restrictions, with the costs of ensuring secure water supply
- confirm the approach to managing priority green spaces during drought.

Permanent Water Saving Plan

The Permanent Water Saving Plan (PWSP) contains a set of rules which are applied every day, regardless of rainfall, weather and water storage volumes. The permanent water saving rules do not restrict water use but do encourage the efficient use of water. They are simple, common-sense measures that ensure that we are continually conserving water now and into the future. PWSP measures include four key rules:

- Hand-held hoses must be fitted with trigger nozzles and be free of leaks.
- Gardens and lawns may be watered with a hand-held hose or watering can anytime and sprinklers and watering systems may be used after 6pm and before 10am.
- Fountains and water features can be used provided they recirculate water.
- Paved areas and hard surfaces should only be washed if required after an accident, for safety reasons, to remove stains yearly or during building work.

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Stages of water restrictions

There are four stages of water restrictions under the by-law, which build on the rules set out in the Permanent Water Saving Plan. The stages increase in severity and are designed to be implemented as drought climate conditions continue and water storage levels decline. The implementation of restriction levels is triggered by using restriction rule curves (explained further below).

Water restrictions do not restrict the use of water for indoor purposes such as drinking, washing, cleaning or sanitation. The four stages of water restrictions are summarised below. The full list of restrictions is contained in Barwon Water's Water Restriction By-Law No. 190.

Stage 1 water restriction rules

The first stage of water restrictions is implemented when water storage levels fall below the relevant restriction curve and the outlook is for ongoing dry conditions. Beyond the PWSP rules, some of the main Stage 1 water restriction rules include:

- Gardens and lawns may be watered with a hand-held hose or watering can at any time and sprinklers and watering systems may be used between 6pm and 10pm and between 6am and 10 am and on alternate days
- Public gardens or lawns can be watered where an approved Water Use Plan is in place.

Stage 2 water restriction rules

The second stage of water restrictions is implemented when dry conditions persist and water storages continue to decline. Stage 2 water restrictions rules include, but are not limited to the following:

- Lawns cannot be watered at any time
- Gardens can be watered with a hand-held hose or watering can at any time; watering systems may be used between 6pm and 8pm and between 6am and 8am and on alternate days
- Public gardens or lawns can be watered where an approved Water Use Plan is in place.

Stage 3 water restriction rules

A continued decline in storage levels and persistent drought may trigger the third stage of restrictions. A summary of the key rules under this category include:

- Lawns cannot be watered at any time
- Gardens can only be watered with a hand held hose or watering can between 6am and 8am on alternate days (watering systems are not permitted)
- Public gardens or lawns can be watered where an approved Water Use Plan is in place.

Stage 4 water restriction rules

As the most severe level of restrictions, Stage 4 is implemented in the driest drought conditions when water storages are approaching critical levels. Under Stage 4 water restrictions lawns and gardens cannot be watered at any time.

Water restriction rule curves

To ensure we can maintain water supply during a drought or emergency, we follow restriction rule curves to avoid our water storages falling below 'contingency storage' levels. The contingency storage is the volume of water that we aim to always maintain in reserve and plan never to need. This water is an additional safeguard in the event of unprecedented climate conditions or major emergencies.

Each of our water supply systems has a different contingency storage. For Lorne and Apollo Bay, at any point in time, the volume is equivalent to the next 60 days of demand. We also assume that river flows during this period are the lowest that have been experienced before. For the Geelong system, we aim to have the equivalent of two years of water demand in storage, again assuming that inflows during this period are the lowest that have been experienced. The smaller water supply systems require smaller contingency volumes as they can be more easily supplemented with water carting or other responses. The Geelong system however, requires two years contingency storage because sourcing additional water for such a large population requires a longer period of time to address the complexity of providing the large volume of water required.

Based on our knowledge of annual patterns in demand and supply, the restriction rule curves describe the minimum storage level we would prefer at any point through the year in order to avoid levels potentially dropping into the contingency storage. The restriction curves factor in a reduction in demand due to each stage of water restrictions.

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There is a curve for each stage of water restrictions, which describes the storage level below which restrictions should be triggered. We use the curves as a guide and apply some discretion based on prevailing conditions and the short-term climate outlook.

The restriction rule curves are determined to ensure that we continue to meet service levels over time. This is done by assessing how much water will be needed to ensure that water levels do not drop into the contingency storage section of the reservoir if only minimum water inflows occur. When water inflows are higher in winter and demand is lower, the storage level trigger for restrictions is lower. In summer, higher demand and lower water inflows mean that restrictions should be triggered with more water in reserve. It is this seasonal pattern that describes the 'curve' in the restriction rule curves. The restriction rule curves across our systems are illustrated in the Drought Response Plan that follows.

Drought Response Plan

A Drought Response Plan has been developed by Barwon Water to describe the actions we will take in response to drought or any other water shortage. This plan meets the requirements of, and should be read in conjunction with, Barwon Water's Statement of Obligations and the Water Restriction By-Law No. 190.

Restriction Rule Curve Zones

Water restrictions are implemented by considering water restriction rule curves for each system. The system storage volume is split into three main zones: normal operating zone; water restriction zone; and contingency storage zone. The descriptions and actions for each zone are shown in Table 15.

The volume of water in each storage is published on the Barwon Water website on a daily basis. Water restrictions may be triggered when the storage volume in a given system declines and crosses into Zone 2 – Water Restriction Zone. Barwon Water will inform customers when the water storages are approaching the water restriction zone and contingency storage zone.

Table 15: Water restriction curve zone descriptions

Zone	Description	Actions
Zone 1 – Normal operating zone	Storage levels are at a healthy level.	– Continue PWSP – Monitor water storage levels
Zone 2 – Water restriction zone	Water storage levels at a level where demand reduction measures are required to stop levels dropping into the contingency storage	– Implement water restrictions stages – Implement system specific drought response measures – Monitor water storage levels closely
Zone 3 – Contingency storage zone	Water held in reserve for emergencies. Planning is based on avoiding water storages ever declining below this level	– Implement system specific drought response measures – Monitor water storage levels closely

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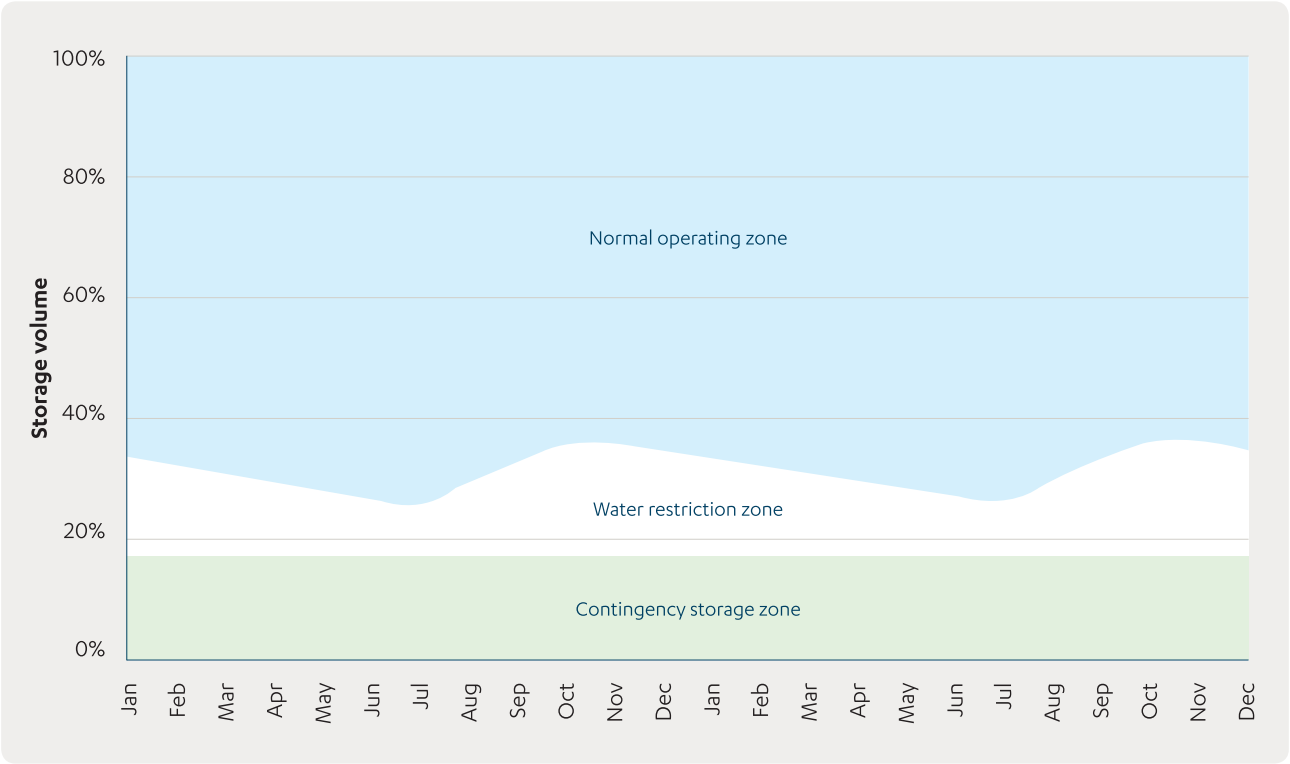
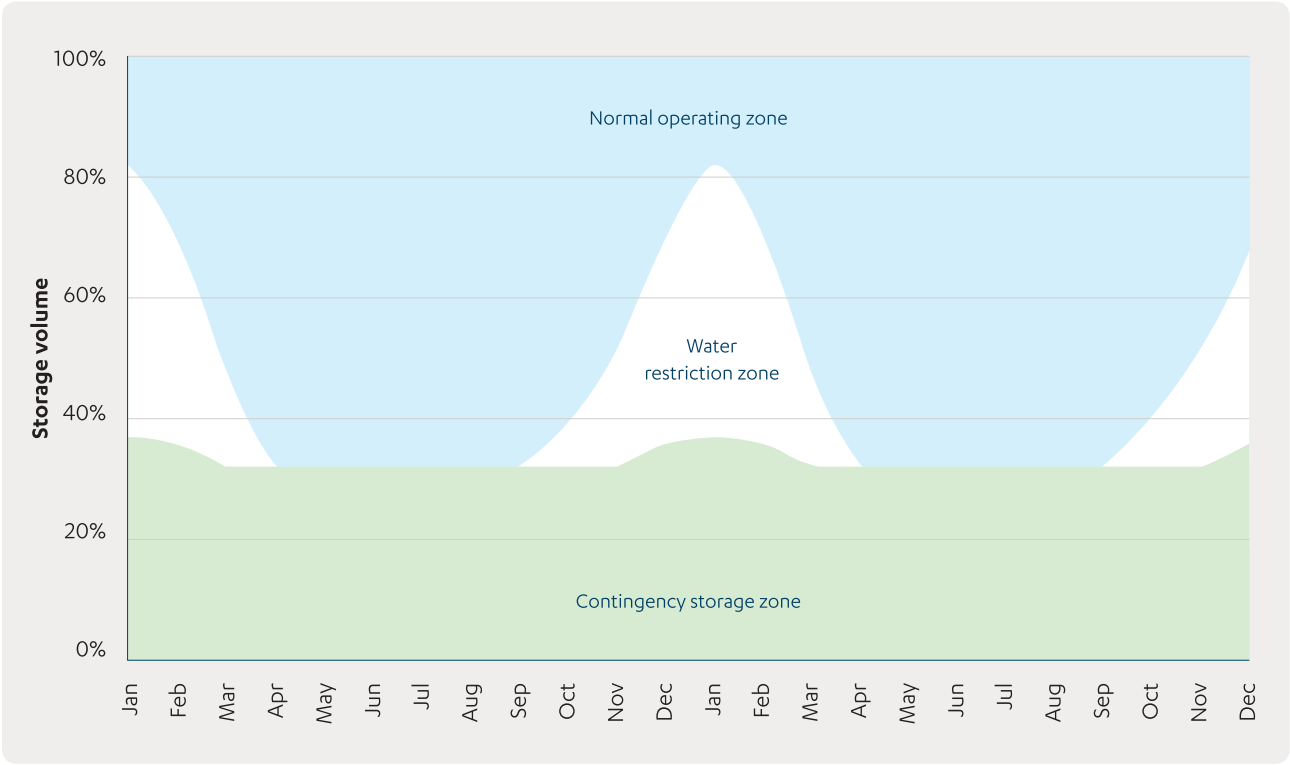
Geelong and Colac Restriction Rule Curves

Figure 24: Water Restriction curve zones for the Geelong and Colac system



Lorne Restriction Rule Curves

Figure 25: Water Restriction curve zones for the Lorne system



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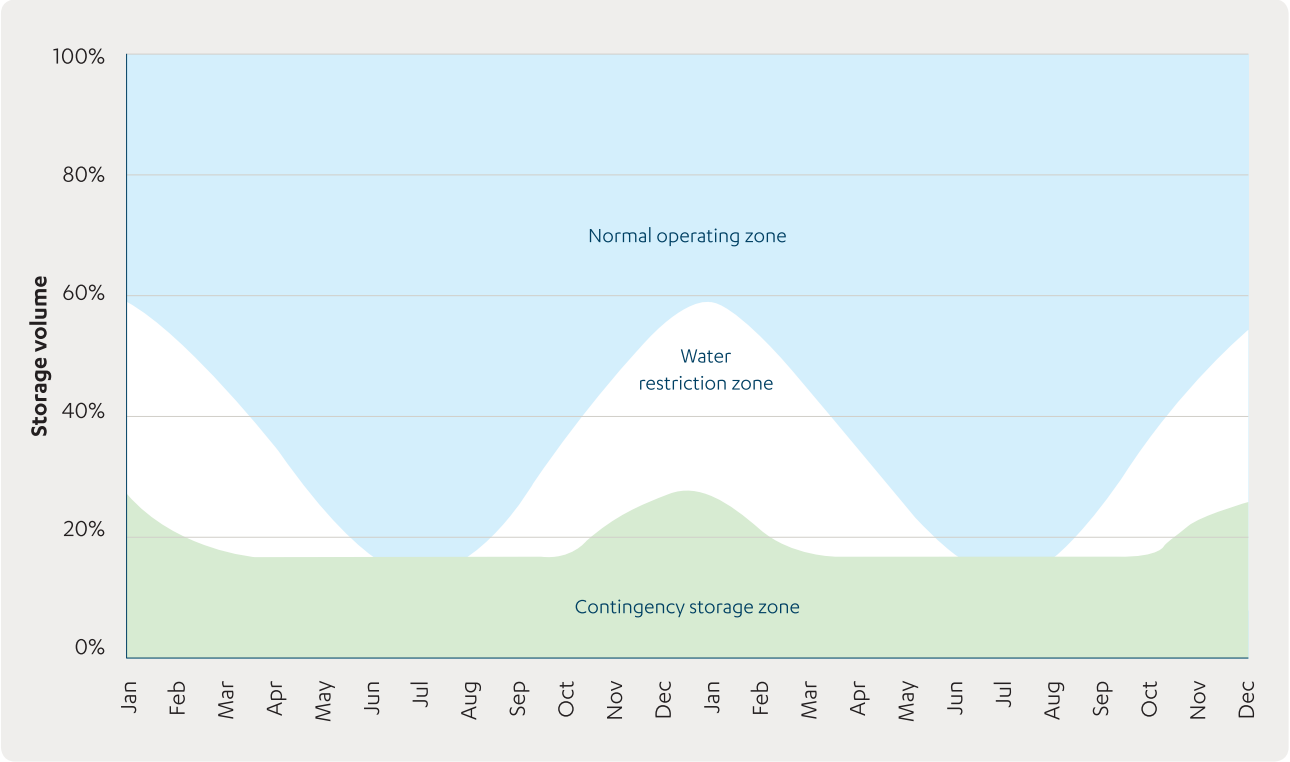
Apollo Bay Restriction Rule Curves

Figure 26: Water Restriction curve zones for the Apollo Bay system



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System-specific drought response measures

Drought response measures may include water restrictions, specific awareness campaigns, trucking of water to smaller water systems, and the use of additional water sources such as groundwater and the Melbourne to Geelong pipeline. For each water supply system, there is a specific contingency plan tailored to suit the different system size and characteristics.

Geelong

A number of actions have been reserved for implementation as a short-term response to drought. These items are usually reserved for ongoing dry conditions, however, they could also be used in response to other water shortages in the future.

The following drought response measures are reserved for Geelong and can be activated when required:

- Implement water restrictions in accordance with restriction rule curves to reduce water demand
- Increased water efficiency awareness campaigns
- Source additional water from the standby water sources (Melbourne to Geelong pipeline, Anglesea groundwater field and Barwon Downs groundwater field)
- Optimise water treatment plant operation
- Engage with large water users regarding water conservation measures
- Consider the need to bring forward actions from the Urban Water Strategy if drought conditions persist.

Colac

Drought response measures for Colac can be activated when required, and have been summarised below:

- Source additional water from the pipeline linking Geelong to Colac
- Water restrictions to reduce water demand
- Optimise water treatment plant operation
- Engage with large water users regarding water conservation measures
- Increased water efficiency awareness campaigns
- Limit water carting from the Colac water supply system.

Lorne

Due to the smaller system size of Lorne, drought response measures can be activated quickly. The reserved responses are summarised below:

- Implement water restrictions to reduce water demand
- Increased water efficiency awareness campaigns
- Engage with large water users regarding water conservation measures
- Optimise water treatment plant operation
- Limit water carting from the Lorne water supply system
- Implement water carting to supply additional water to the Lorne water supply system
- Consider the need to bring forward actions from the Urban Water Strategy if drought conditions persist

Apollo Bay

Similar to the Lorne system, drought response measures can be activated quickly in Apollo Bay. The actions used for drought in Apollo Bay consist of:

- Implement water restrictions to reduce water demand
- Optimise water treatment plant operation
- Engage with large water users regarding water conservation measures
- Limit water carting from Apollo Bay water supply system
- Implement water carting to Apollo Bay to supply additional water
- Increased water efficiency awareness campaigns
- Consider the need to bring forward actions from the Urban Water Strategy if drought conditions persist

Gellibrand

Barwon Water's smallest water supply system, Gellibrand, has high water security. In the event of drought, or when water supply is an issue, the following measures may be implemented:

- Implement water restrictions to reduce water demand
- Optimise water treatment plant operation
- Increased water efficiency awareness campaigns
- Engage with largest water users regarding water conservation measures
- Limit water carting from the Gellibrand water supply system
- Implement water carting to Gellibrand to supply additional water.

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Appendix B – Water security option long and short lists

Lorne long list

Category	Option Description	Consider Further?	Reason
Indirect Potable Reuse	Indirect Potable Reuse from Water Reclamation Plant to Allen Reservoir	No	Significant community and stakeholder consultation required. Environmentally sensitive pipe route.
Water Diversion	Recommission Rough & Tumble system from Erskine River system	No	To be most effective, this option would need to include an on-stream or off-stream storage, assumed to be Allen Reservoir. Implies low system resilience, as option depends on stream flow and is likely to have the highest yields when Allen Reservoir is also high yielding. Heritage listed.
	Harvest from Cumberland River	No	To be most effective, this option would need to include an on-stream or off-stream storage, assumed to be Allen Reservoir. Implies low system resilience, as option also depends on stream flow and is likely to have the highest yields when Allen Reservoir is also high yielding.
	Harvest directly from Erskine River	No	To be most effective, this option would need to include an on-stream or off-stream storage, assumed to be Allen Reservoir. Implies low system resilience, as option also depends on stream flow and is likely to have the highest yields when Allen Reservoir is also high yielding.
	Water carting	No	Water carting during late summer and autumn. This is not a long term solution, however it is an effective drought response measure.
Groundwater	Potable groundwater investigation	No	Investigation required on yield, water quality and environmental impact.
Connect to Grid	New pipeline from West Barwon to Lorne	No	Very large cost for pipeline or tunnel options.
	New pipeline from Aireys Inlet to Lorne	**Yes**	Technically challenging but cheaper than West Barwon option. Connection to grid increases system resilience.
Increase Storage	Raise Allen Dam	**Yes**	Initial investigation has been undertaken. Large winter flows.
	Allen Dam covering	No	High cost & technical difficulty. Low yield increase
	Off-stream storage in Lorne	No	Hard to find a suitable location to have an extra storage

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Lorne long list (continued)

Category	Option Description	Consider Further?	Reason
Desalination	Local desalination plant	**Yes**	Increases system resilience, increasingly common and affordable technology.
Water Treatment Plant Efficiency	Water Treatment Plant efficiency improvements	**Yes**	Continue work to increase efficiency at WTP.
Alternative Water	Supply stormwater to irrigate public open space	**Yes**	Difficult to capture and store general run-off. An estimated irrigation demand for Lorne Oval is 3 ML/year during summer months and more than 5ML was used in summer 15/16 in Lorne. Consider along with recycled water when considering alternative water options.
	Supply stormwater to the industrial estate	No	Very low demand. Total industrial demand <0.1 ML/year in Lorne.
	Roof-top harvest and green roofs	No	Minimal yield and high cost. Difficult to implement.
	Recycled water to irrigate public open space	**Yes**	Possibility for sewer mining or pipeline from the WRP. An estimated irrigation demand for Lorne Oval is 3 ML/year during summer months – more than 5ML was used in summer 15/16 in Lorne. Consider along with stormwater when considering alternative water options.
	Recycled water for the caravan park	No	The total caravan park usage is only 0.25 ML/year.
	Recycled water for the Lorne Golf Course	No	The total potable water usage is only 0.5 ML/year.
	Recycled water for agriculture, industry and recreation	No	Very little demand for agriculture or industry. This option would be mainly for recreational supply which is already covered by options for caravan park, golf course and Lorne oval.
	Rainwater tank for toilet and outdoor use for new homes	**Yes**	Assume rainwater tanks for 200 lots.
	Retrofit rainwater tanks for toilet and outdoor use for some existing houses	**Yes**	For investigation. The number of properties TBC.

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Lorne short list

Category	Option For Further Investigation	Average Annual Yield, ML	Total Capital Cost, $M	Annual Opex, $M per year	Levelised cost ($/ML)
Connect to Grid	New pipeline from Aireys Inlet to Lorne	139	47.0	0.789	25,300
Increase Storage	Raise Allen Dam	63	9.0	0.135	10,100
Desalination	Localised desalination plant	139	20.0	0.494	11,500
Water Treatment Plant Efficiency	Water Treatment Plant efficiency improvements	16	1.3	0.033	6,600
Alternative Water	Use alternative water to irrigate public open space	3	1.2	0.020	28,500
	Rainwater tank for fit-for-purpose use for new homes	9	0.8	0.014	6,600
	Retrofit rainwater tanks for fit-for-purpose use for some existing houses	Site Specific			

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Apollo Bay long list

Category	Option Description	Consider Further?	Reason
Potable Reuse	Indirect Potable Reuse from Water Reclamation Plant to Marengo Basin or 250ML Apollo Bay storage	No	Significant community and stakeholder consultation required.
Water Diversion	Renegotiate Apollo Bay Bulk Entitlement	Yes	To allow for greater flows to be taken at some times. Potential environmental impact would need to be assessed.
	Water carting to Apollo Bay	No	Water carting during late summer and autumn. This is not a long term solution, however can be part of the drought response measures.
	Supply from West Barwon	Yes	Large volumes available for Apollo Bay. Increases system reliability and diversity.
	Supply from West Gellibrand	Yes	Large volumes available for Apollo Bay. Increases system reliability and diversity.
	Recommission the old harvesting system	No	New bulk entitlement in place and reverting back to old entitlement is unlikely.
	Recommission Skenes Creek weir	No	Minimal yield when required in drier months.
Storage	Off-stream storage	Yes	Existing concepts developed and large volumes of winter flows available for harvesting.
	On-stream storage	No	Significant environmental issues likely.
	Cover water storages to prevent evaporation	No	Large cost for small yield.
	Extend Marengo Basin	No	Technical and construction issues on constrained site.
Groundwater	Local borefield	No	Low yield per bore, requiring numerous bores to be installed. Brackish water requiring desalination.
Desalination	Local desalination plant	Yes	Increases system resilience, increasingly common and affordable technology.
Water Treatment Plant Efficiency	Increase efficiency of WTP	Yes	Continue work to increase efficiency at WTP.

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Category	Option Description	Consider Further?	Reason
Alternative Water	Supply stormwater to irrigate public open space	Yes	An estimated irrigation demand of 3ML/year during summer months for the golf course, and annual demand >10ML/year at the caravan parks
	Supply industry estate with stormwater	No	Very small demand.
	Roof-top harvest and green roofs	No	Minimal yield and high cost. Difficult to implement.
	New development dual pipes	No	Minimal new suburb developments and typically low water usage on new smaller lots.
	Recycled water to irrigate public open space	Yes	Possibility for sewer mining or pipeline from the WRP. An estimated irrigation demand of 3ML/year during summer months for the golf course, and annual demand >10ML/year at the caravan parks
	Discharge Class A recycled water to Barham River to allow increased potable water extractions	Yes	Substitute extracted river flows with recycled water at same point. Significant yield possible.
	Rainwater tanks for toilet and outdoor use for new homes	Yes	Assume rainwater tanks for 200 lots.
	Retrofit rainwater tanks for toilet and outdoor use for some existing houses	Yes	For investigation. The number of properties TBC.

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Apollo Bay short list

Category	Option For Further Investigation	Average Annual Yield, ML	Total Capital Cost, $M	Annual Opex, $M per year	Levelised cost ($/ML)	Comments
Water Diversion	Renegotiate Apollo Bay Bulk Entitlement	90	-		-	New BE. Use of existing PS, storage and transfer infrastructure.
Connect to Grid	Supply from West Barwon	200	54.1	0.843	19,100	
	Supply from West Gellibrand	200	65.7	1.003	23,100	
Increase Storage	Off-stream storage	200	19.3	0.298	6,800	
Desalination	Local desalination plant	200	19.0	0.473	7,600	
Water Treatment Plant Efficiency	Increase efficiency of WTP	18	1.3	0.034	5,900	
Alternative Water	Use alternative water to irrigate public open space	12	2.6	0.048	16,100	Volume TBC but more than 10ML used on open spaces in 15/16. Costs uncertain due to number of sites and site complexities.
	Discharge Class A recycled water to Barham River to offset increased potable water extractions	90	3.9	0.117	3,700	
	Rainwater tanks for toilet and outdoor use for new homes	9	0.8	0.014	6,600	Rainwater tanks for 200 lots.
	Retrofit rainwater tanks for toilet and outdoor use for some existing houses	Site Specific	For investigation. The number of properties TBC.			

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Geelong long list

Category	Option Description	Consider Further?	Reason
Potable Re-use	Direct potable reuse from Black Rock Water Reclamation Plant to potable water storages or basins	No	Significant community opposition likely.
	Stormwater potable reuse	No	Likely low yield impact and challenging to capture, store and treat. Monitor new research. Opportunity to gauge views of public.
Water Diversion or Trade	Increase the capacity of the MGP and purchase additional entitlements from the Melbourne system	Yes	High yield and high reliability water. High cost. Costs include augmentation of PS and transfer pipeline to Lovely Banks. Annual costs TBC but to include Melbourne Water's operating and financing costs of BW share of additional 50GL at Victorian Desalination Plant.
	Use excess winter flow from Gellibrand River via a tunnel or pipeline to West Barwon Reservoir	Yes	Large cost but likely to be significant yield available accessing excess winter flows.
	Gellibrand River diversion to Roadknight Creek dam to WBIC	No	Large dam, high cost and likely to be environmental issues.
	Gellibrand River diversion to Lardner, Charley or Carlisle Creek/River Dams to WBIC	No	Large dam, high cost and likely to be environmental issues.
	Divert from Allen or Painkalac Reservoir to ASR or directly to transfer pipeline at Anglesea borefield	No	Painkalac yield is around 270ML, which is relatively small to supply Geelong. Painkalac now also used for recreational purposes.
	Build new pipeline from Lal Lal Reservoir to Moorabool WTP with pipeline replacing river as transfer method	No	Community concern regarding reduced opportunity for environmental benefit if no piggybacking of environmental flows on Barwon Water releases. Significant waterway nominated in Water for Victoria as a "priority waterway for long term investment". Very minor impact to current yield.
	Purchase additional entitlements from Barwon or Moorabool River	No	Barwon and Moorabool are fully or over allocated and so additional entitlements not likely to be available.
	Weir on lower Barwon River and direct water to Fyansford Quarry for storage	No	Technically difficult, likely to be high cost as require new WTP. Barwon is also fully allocated and so additional entitlements not likely to be available.
	Pipeline from Pykes Creek to Ballan Channel	No	Low yield during dry periods.
	Barwon River @ Conns Lane for diversion to WBIC @10 ML/day	No	Barwon is fully allocated and no additional entitlement is likely to be available. Likely to have minimal impact on yield.
	Increase WBIC capacity to 240ML/day	No	Small yield increase of <400 ML/year for large cost.

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Geelong long list (continued)

Category	Option Description	Consider Further?	Reason
Water Diversion or Trade (continued)	Use excess winter flow from Gellibrand River by backflow through new Colac pipeline to ASR at Barwon Downs	Yes	Large excess winter flows likely to be available. Existing Colac MPL asset available for transfer to Barwon Downs but limits yield. Storage in aquifer. ASR costs TBC.
	Use excess winter flow from Gellibrand River by backflow through new Colac pipeline to WBIC	Yes	Large excess winter flows likely to be available. Existing Colac MPL asset available for transfer to WBIC but limits yield.
Storage	Dam on Stony Creek	No	Moorabool is fully or over allocated and so additional entitlements not likely to be available.
	New Gellibrand Dam 30,000ML	No	High yield but likely community concern and environmental impact.
	Dewing Creek Dam 5,000ML	No	Low yield as <2,000 ML/year under historical climate change and < 800 ML/year in 2065 under high growth high climate change scenario. High cost as the latest cost estimate is $62M and so the levelised cost $ per ML is also high. The granting of an additional BE in the Upper Barwon system to allow Barwon Water to increase storage in the system is also unlikely as the Barwon system is fully allocated. Significant impact on flows downstream of any dam and in the Barwon River.
	Dewing Creek Dam 20,000ML	No	Low yield as <2,600 ML/year under historical climate change and < 1,200 ML/year in 2065 under high growth high climate change scenario. High cost as the latest cost estimate is $102M and so the levelised cost $ per ML is also high. The granting of an additional BE in the Upper Barwon system to allow Barwon Water to increase storage in the system is also unlikely as the Barwon system is fully allocated. Significant impact on flows downstream of any dam and in the Barwon River.
	Deepen Wurdee Boluc Reservoir	No	Significant cost. Potential acid sulphate soil disturbance and potential issues with spoil disposal.
	West Barwon enlargement	No	Significant yield possible but high cost and likely impact on Barwon flows. Barwon is fully allocated and no additional entitlement is likely to be available.
	Small dam <2,000 ML behind existing weirs on Barwon River tributaries	No	Barwon is fully allocated and no additional entitlement is likely to be available. Likely to have minimal impact on yield.
	Callahans Creek Dam 8,000ML with additional pumping from WBIC	No	Barwon is fully allocated and no additional entitlement is likely to be available. Likely to have minimal impact on yield. Large cost, Less community support for large dams.

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Category	Option Description	Consider Further?	Reason
Storage (continued)	Wormbete Creek Dam 22,000ML with additional pumping from WBIC	No	Barwon is fully allocated and no additional entitlement is likely to be available. Likely to have minimal impact on yield. Large cost, Less community support for large dams.
	Increase storage capacity of Korweinguboora Reservoir	No	Low yield expected during dry years and unlikely to get additional entitlement in Moorabool.
	East Moorabool River Dam 10,000ML at Pine Grove. Pump station and pipeline to Ballan Channel	No	Low yield expected during dry years and unlikely to get additional entitlement in Moorabool. Less community support for large dams.
	Roadknight Creek Dam 10,000ML with pipeline to WBIC	No	Impacts on environmental flows. Basin is fully allocated and no additional entitlement is likely to be available. Large costs. Low community support for large dams.
	Lardner Creek Dam 22,000ML with pipeline to WBIC	No	Impacts on environmental flows. Large costs. Low community support for large dams and pipeline technically difficult due to terrain.
	Charley Creek Dam 70,000ML with pipeline to WBIC	No	Impacts on environmental flows. Large costs. Low community support for large dams and pipeline technically difficult due to terrain.
	Carlisle River Dam 70,000ML with pipeline to WBIC	No	Impacts on environmental flows. Large costs. Low community support for large dams and pipeline technically difficult due to terrain.
	West Gellibrand Reservoir enlargement and diversion	No	Limited Colac pipeline capacity would impact yield. Potential geotechnical issues. Impact on environmental flows.
Groundwater / ASR	Access groundwater entitlement from Newlingrook	No	SRW released Otways Lower Aquifers LMP in late 2016. The plan is to the finalised by the middle of the year. It includes a 'partitioned volume' of 5GL for Newlingrook GMA which is water that may be allocated but only where it can be shown that there is no impact on other aquifers and the environment. The current Permissible Consumptive Volume is zero. We have assumed only 2GL per year can be extracted. High costs likely.
	Access groundwater from Dilwyn Aquifer closer to coast	No	Entitlement may be available but high costs. Long distance from nearest asset.
	Access groundwater held by Alcoa Anglesea in the Upper Eastern View Formation	Yes	Assumed 2GL of Alcoa's 4GL may be available depending on EIA. Close to existing infrastructure.
	Fyansford Quarry Precinct: recycled water and urban stormwater to ASR and treat via localised RO Plant @ 10-30 ML/day	No	Large storage available in aquifer and quarry close to Geelong. Combine surface water, groundwater, stormwater and recycled water to have resilient system. RO water treatment plant required. Very large costs.

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Geelong long list (continued)

Category	Option Description	Consider Further?	Reason
Groundwater / ASR (continued)	Fyansford Quarry Storage: store the existing groundwater ~2000 ML/ year and treat via localised RO Plant @ 10-30 ML/day	No	Barwon and Moorabool are fully or over allocated and so additional entitlements not likely to be available.
	Fyansford Quarry Precinct Storage: store excess Moorabool and Barwon River flows and treat via localised RO Plant @ 10-30 ML/day	No	Impact to river flows. Entitlement to surface water unlikely.
	Use excess winter flow from West Barwon Reservoir to ASR at Barwon Downs	No	Barwon system is fully or over allocated and so additional entitlements not likely to be available. Existing infrastructure, provides additional storage, improve BD aquifer recovery, good yield at moderate cost.
	Anglesea ASR using excess water from Wurdee Boluc Reservoir	No	Limited excess water available at Wurdee Boluc
	Torquay Groundwater Bores @ 8 ML/day	No	Possible water quality issues and low yield
	Bambra Groundwater Bores @ 7.5 ML/day	No	Same water resource as Barwon Downs borefield.
	Kawarren Groundwater Bores @ 6 ML/day	No	Possible Gellibrand River impact and community concern
	Carlisle groundwater Bores @ 32 ML/day	No	Same as Newlingrook option as in Newlingrook GMA.
Desalination	Local Desalination Plant	Yes	High reliability and large yield independent of climate. High cost and high GHG.
	New Bulk Entitlement in 50GL Victoria Desalination Project	No	This is considered above in option to purchase additional Melbourne entitlement and increase capacity of MGP.
Water Treatment and Process Efficiency	WTP efficiency improvements to reduce losses	No	Minimal benefit to yield so not an option for long term resource but makes the most of existing resources.
	WTP sludge dewatering @ WBWTP and MWTP	No	Minimal benefit to yield.
	Batesford quarry brackish water treatment plant	No	Water quality issues would require large capital expenditure
Alternative Water	Additional recycled water customers for NWP	No	Only low yield < 100 ML/year before having to upgrade NWP capacity. If so, high cost.
	Use recycled water for agriculture, industry and to support the environment and recreation, and investigate the potential for indirect potable reuse	Yes	Significant recycled water volumes available at Black Rock at a high reliability. Costs and yield uncertain as wide range of options available. Advancements in technology are likely leading to more efficient and lower cost treatment processes. Significant community and stakeholder consultation required.

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Category	Option Description	Consider Further?	Reason
Alternative Water (continued)	Recycled water to irrigate public open space	Yes	To be further investigated. Use of recycled water or stormwater. In year 151/6 more than 1GL was used at more than 170 sites including golf courses, caravan parks, reserves, bowling clubs, and parks. Costs and yield uncertain due to number of sites and site complexities.
	New suburb dual pipes	Yes	For investigation. High cost as Black Rock fully utilised for Armstrong's Creek and Torquay North so new Class A plant to supply new 14,000 lot residential growth area including open spaces.
	Stormwater in suburbs for non-potable uses	No	High costs and difficulty to retrofit pipe network and build storages in existing suburbs. Variable yield.
	Supply stormwater to irrigate public open space	Yes	To be further investigated. Use of recycled water or stormwater. In year 15/16 more than 1GL was used at more than 170 sites including golf courses, caravan parks, reserves, bowling clubs, and parks. Costs and yield uncertain due to number of sites and site complexities.
	Recover stormwater for Industry estate stormwater and process waste	No	Likely to be low yield.
	Roof-top rainwater / stormwater harvest & green roofs	No	Minimal yield and high cost. Difficult to implement in existing areas. Good for liveability.
	Rainwater tanks for toilet and outdoor use for new developments	Yes	Rainwater tanks for new 14,000 lot residential growth area.
	Retrofit rainwater tanks for toilet and outdoor use for some existing houses	Yes	For investigation. The number of properties TBC.
	Mandate tank to hot water system for new developments	No	For investigation. New technology being introduced in Melbourne trial. Monitor developments and opportunity to be involved in any research. Assumed 500 homes.
Other	Reduce Wurdee Reservoir evaporation by covering	No	Technically difficult to cover large area. High cost. New technology.
	Line or replace WBIC with pipe	No	High cost for low yield.
	Optimisation of harvesting the tributaries through upgrade of harvesting equipment to achieve 'smarter' harvesting and improved pump efficiencies	No	Modelling of yield already assumes full optimisation of harvesting.
	Optimise operation of available water sources in the Geelong system	Yes	Optimise operation of diverse sources for Geelong to maximise yield and cost effectiveness. Project identified in strategy to quantify benefits and costs.

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Geelong short list

Category	Option For Further Investigation	Average Annual Yield, ML	Total Capital Cost, $M	Annual Opex, $M per year	Levelised cost ($/ML)	Comments
Water Diversion or Trade	Increase the capacity of the MGP and purchase additional entitlements from the Melbourne system	8000 ^	213.4	16.450	3,524	Capital costs include augmentation of PS, transfer pipeline to Lovely Banks and share of cost to construct additional 50GL at Victorian Desalination Plant. Annual costs include Melbourne Water's operating and financing costs of BW share of additional 50GL at VDP plus MW and BW transfer costs.
	Use excess winter flow from Gellibrand River via a tunnel or pipeline to West Barwon Reservoir	1,800	53.8	0.807	2,100	
	Use excess winter flow from Gellibrand River by backflow through new Colac pipeline to ASR at Barwon Downs	540	6.9	0.453	1,500	Yield limited by spare capacity in Colac MPL. ASR costs TBC.
	Use excess winter flow from Gellibrand River by backflow through new Colac pipeline to WBIC	540	0.7	0.043	200	Yield limited by spare capacity in Colac MPL.
	Optimise operation of available water sources in the Geelong system	Site Specific				Optimise operation of diverse sources for Geelong to maximise yield and cost effectiveness. Project identified in strategy to quantify benefits and costs.
Groundwater	Access groundwater held by Alcoa Anglesea in the Upper Eastern View Formation	2,000	3.4	0.128	200	Assumed 2GL of Alcoa's 4GL may be available depending on environmental impact assessment.
Desalination	Localised desalination plant	5000 ^	123.0	7.135	2,800	

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Category	Option For Further Investigation	Average Annual Yield, ML	Total Capital Cost, $M	Annual Opex, $M per year	Levelised cost ($/ML)	Comments
Alternative Water	Use recycled water for agriculture, industry and to support the environment and recreation, and investigate the potential for indirect potable reuse	15000 ^*	Site Specific			To be further investigated. Costs and yield uncertain as wide range of options available.
	Use alternative water to irrigate public open space	Site Specific				To be further investigated. Use of recycled water or stormwater. In year 15/16 more than 1GL was used at more than 170 sites including golf courses, caravan parks, reserves, bowling clubs, and parks. Costs and yield uncertain due to number of sites and site complexities.
	New suburb dual pipes	750	105.0	0.780	8,700	To supply Class A recycled water to new 14,000 lot residential growth area including open spaces. New Class A plant required.
	Rainwater tanks for fit-for-purpose use for new developments	650	57.4	0.031	4,900	Rainwater tanks for new 14,000 lot residential growth area.
	Retrofit rainwater tanks for fit-for-purpose use for some existing houses	Site Specific				For investigation. The number of properties TBC.

^ can be designed to meet a wide range of volumes
* would require regulatory approval

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Barwon Water

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