Urban Water Strategy 2017 Appendices

Version 1.1

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Distribution and Revision History

Table 1: Revision History and Distribution of UWS Appendices

Distribution	Document	Version	Revision Date[1]
Board of Coliban Water	Final	1.0	7 April 2017
Minister for Water	Final	1.0	7 April 2017
DELWP	Final	1.0	7 April 2017
Coliban Water website	Final	1.1	6 July 2017

Note 1: UWS is to be reviewed no later than 2022.

Document Control

Table 2: Document Control

Author (Date)	Controller (Date)
Water Resources Manager (July 2017)	Water Resources Manager (July 2017)

Schedule of Current Revisions & Proposed Amendments

Table 3: Current and Proposed Revisions to UWS Appendices

Section	Sub-Section	Comments
Version 1.1		Minor editorial corrections
		Revised demand estimates

File Number

300/336

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Appendix A - References

AECOM (April 2014), *Loddon Mallee Region Integrated Regional Vulnerability Assessment and Climate Adaptation Plan (Draft),* Developed for City of Greater Bendigo on behalf of the Councils of the Southern Loddon Mallee Region, Identifies climate predictions and risks associated with expected climate change by 2030.

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Appendix B - Glossary

Acute	Occurring over shorter time scales (1-15 years).
Allocation	Water that is actually available to use or trade in any given year, including new allocations and carryover. The water that is actually in the dam in any given year is allocated against water shares. The seasonal allocation is the percentage of water share volume available under current resource conditions, as determined by the resource manager.
Augmentation	Process of making or becoming greater in size or amount.
Aquifer	Underground layer of water-bearing permeable rock, rock fractures or unconsolidated materials from which groundwater can be extracted.
Baseline demand	The baseline demand is the estimated demand for raw water in a year of average rainfall.
Blue-green algae	Algal blooms can cause water to be unsafe for all users of water including agriculture, irrigation and recreation.
Build Own Operate Transfer	Is a public-private partnership project model in which a private organisation conducts a development project under contract to a public-sector partner.
Bulk Entitlement	The right to water held by water corporations and specified entities defined in the *Water Act 1989*. The bulk entitlement defines the amount of water that an authority is entitled to from a river, water storage or aquifer, and may include the rate at which it may be taken and the reliability of the entitlement.
Business as usual	Normal execution of operations within the organisation.
Carryover	Allows entitlement-holders to retain ownership of unused water into the following season.
Chronic	Occurring over long time scales (>50 years).
Climate change	A change in global or regional climate patterns.
Coliban Headwork Storages	Upper Coliban, Lauriston and Malmsbury Reservoirs.
Cool season	Months of April to October.
Demand management	Strategies to increase water supply through water conservation and increased water use efficiency.
Evapotranspiration	Evapo-transpiration is the sum of evaporation and plant transpiration from the Earth's land and ocean surface to the atmosphere.
Greywater	Wastewater generated without faecal contamination.
Groundwater	All subsurface water, generally occupying the pores and crevices of rock and soil.
High Reliability Water Shares Allocations	Water shares are classed by their reliability, which is defined by how often full seasonal allocations are expected to be available. are made to high-reliability water shares before low-reliability shares.

Historical climate	Past climate taken from as far back as records allow.
Inflows	Water flowing into a storage or waterway.
Irrigate	Supply water to help growth.
Irrigation season	Occurs between mid-August and mid-May.
Level of service	Coliban Water has a Level of Service of 95% reliability at no more than Stage 3 Restrictions.
Low Reliability Water Shares	Water shares are classed by their reliability, which is defined by how often full seasonal allocations are expected to be available.
Median	The middle value of a data set.
Meteorological drought	An external restriction on raw water supply beyond CW's control.
Millennium Drought	The drought in Victoria spanning from 1997 to 2009.
Minimum allocation	The lowest receivable allocation.
Nominal capacity	The intended full-load sustained output of a treatment facility.
Non-potable	Water that is not of drinking quality.
Non-revenue water	Water that has been produced and is "lost" before it reaches the customer.
Operational drought	A deliberate decision to restrict the demand on its supply systems.
Passing flow	Flows that a water corporation must allow to pass at a dam or weir before it can take any water for consumptive use.
Peak daily flow	The maximum flow on a daily basis for a treatment facility.
Permanent Water Saving Rules	The Victorian Government's permanent water saving rules are a set of common-sense rules to reduce demand and make sure we use water efficiently. Makes up the new unrestricted demand.
Post 1997	The post Millennium Drought period of 1997 to 2016 ('Step-change').
Potable water	Water of suitable quality for drinking.
Public open space	Space that is owned by a government body.
Raw water	Raw water is natural water found in the environment and has not been treated, nor have any minerals, ions, particles or living organisms removed. Raw water includes rainwater, ground water, water from infiltration wells, and water from bodies like lakes and rivers.
Recycled water	Water derived from sewerage systems or industry processes that is treated to a standard appropriate for its intended use.
Reliability	A measure of how often restrictions may occur over the period to 2065 in keeping with our Level of Service of 95% of no more than Stage 3 restrictions.
Representative Concentration Pathways	Representative Concentration Pathways are four greenhouse gas concentration trajectories adopted by the Intergovernmental Panel on Climate Change.

Rural water	Raw or recycled water for stock and domestic use.
Runoff	The draining away of water from the surface of an area of land, a building or structure, etc.
Severe	Short-term but high impact deficiency that threatens supply.
Shortfall	The maximum amount of water that may be available will not meet the projected PWSR demand.
Source reliability	The source reliability is a high-level indication of how reliable the supply source is without the implementation of any management measures such as storage, system-interconnection and carryover of allocation.
Southern Annular Mode	Describes the north-south movement of the westerly wind belt that circulates Antarctica, dominating the middle to higher latitudes (400 S to 650 S) of the southern hemisphere.
Southern Oscillation Index	Gives an indication of the development and intensity of El Niño or La Niña events in the Pacific Ocean. It's calculated using pressure differences between Tahiti and Darwin.
Spill	Water that is not captured within the storage due to excessive volume.
Stakeholder	A party that has an interest in the company, and can either affect or be affected by the business.
Streamflow	The flow of water in streams, rivers and other channels.
Sub-Tropical Ridge	Is an extensive belt of high pressure that encircles the entire globe at the middle latitudes. The position of the STR varies seasonally, allowing cold fronts to pass over south-eastern Australia in winter but pushing them south in summer.
Supply management	Identifying, acquiring and managing water resources.
Statement of Obligations	Statements made under section 41 of the Water Industry Act 1994 that specify the obligations of Victoria's water corporations in relation to the performance of their functions and the exercise of their powers.
Stock and domestic water	Water that can be used for house, garden and stock purposes.
Stormwater	Water that originates during precipitation events.
System reliability	The system reliability is the indication of how reliable the supply system is to meet the current and future demands under the adopted levels of service when appropriate management measures are in place.
Urban demand	Water demand based on a town or city.
Water corporation	Principal supplier of water, wastewater and drainage services within an area.
Water share	An ongoing entitlement to a share of the water available in a water system.
Water year	July to June. (Fiscal year).

Volumetric trigger	The volumetric trigger applies to the combined storage volume of the Coliban Headworks Storages. It is used to manage the balance of the raw water supply between the northern and southern system based on inflow.
Yield	A measure of how much water can be supplied by a given system with a given set of model assumptions and a given level of reliability.

Abbreviations

ACRONYM	DEFINITION
AOP	Annual Operating Plan
AWAP	Australian Water Availability Project
AWO	Annual Water Outlook
BE	Bulk Entitlement
BoM	Bureau of Meteorology
BOOT	Build Own Operate Transfer
CEWH	Commonwealth Environmental Water Holder
CoGB	City of Greater Bendigo
CW	Coliban Water
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DELWP	Department of Environment, Land, Water and Planning
DEPI	Department of Environment and Primary Industries
DNRE	Department of Natural Resources and Environment
DRMP	Drought Risk Management Plan
DPP	Drought Preparedness Plan; previously the Drought Response Plan (DRP)
ENSO	El Niño Southern Oscillation
EOI	Expression of Interest
EPA	Environmental Protection Authority Victoria
GL	Gigalitre (1,000 megalitres)
GMW	Goulburn Murray Water
GWMWater	Grampians Wimmera Mallee Water

HRWS	High Reliability Water Shares
IOD	Indian Ocean Dipole
IPO	Inter-decadel Pacific Oscillation
IWM	Integrated Water Management
kL	Kilolitre (1 Thousand litres)
km	Kilometre
km^2	Square Kilometre
LRWS	Low Reliability Water Shares
MA	Moving Average
MCA	Multi-Criteria Analysis
ML	Megalitre (1 Million litres)
MSLP	Mean Sea Level Pressure
NCCMA	North Central Catchment Management Authority
POAMA	Predictive Ocean Atmosphere Model for Australia
PWSR	Permanent Water Saving Rules
RCP	Representative Concentration Pathways
RWF	Recycled Water Factory
SAM	Southern Annular Mode
STR	Sub-Tropical Ridge
SOI	Southern Oscillation Index
SoO	Statement of Obligations
SPI	Standardised Precipitation Index
UWS	Urban Water Strategy; previously called the Water Supply Demand Strategy (WSDS)
VEWH	Victorian Environmental Water Holder
VHRWS	Very High Reliability Water Share
VIF	Victoria In The Future
WRC	Water Resources Committee
WSDS	Water Supply Demand Strategy
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

Appendix C – CAMPASPE SYSTEM

Figure 1: Campaspe System showing water sources.

System Description

The Campaspe System supplies the town of Goornong, servicing 141 urban connections (i.e. connection with house) with an estimated customer population of 310 as of July 2016.

Raw water is pumped (rate 0.9 ML/day) from the Campaspe River, and transferred 5 km to the 6 ML service basin at the Goornong Water Treatment Plant (WTP). The water is treated at the WTP and supplied to the town and a 105 KL elevated tank. The WTP provides sand filtration and disinfection.

Water is sourced from Lake Eppalock and the Campaspe River catchment under the Bulk Water Entitlement (Axedale, Goornong & part Rochester) with an annual volume of 349 ML.

- Axedale and Goornong annual volume of 215 ML. From June 2009 Axedale was connected to Bendigo as part of Coliban Northern.
- Rochester annual volume of 134 ML (only during the months of May - September). From July 2005 Rochester has been supplied from the Goulburn Murray Water Goulburn System.

Goulburn-Murray Water is the Storage Manager for the Campaspe System.

Reliability

The Campaspe System has a minimum allocation of 50% (174 ML), which is more than the projected demands for 2040 and 2065.

Based on the DEWLP model for water availability, the source reliability under the high climate change scenario is 84% at 2040 and 73% by 2065. The system reliability is modelled to be 100% for the next 50 years.

System Challenges

Goornong relies on water being available from the Campaspe River with the 6 ML service basin providing a back-up storage.

The Campaspe System's key vulnerability is being reliant on the raw water quality and availability of water from the Campaspe River. In the event an alternative supply is required, potable water can be supplied via road tankers to the treated water storages at Goornong WTP.

Table 1: Vulnerabilities during severe water shortages

Vulnerability	Impact of Water Shortages
Single source of supply	Unable to access alternative sources of raw water.
'Step' change in streamflow	Post-1997 median inflow has declined compared to pre-1997.
Water quality (Acute Impact)	Capacity of WTP to cope with water of varying quality e.g. Lake Eppalock, Campaspe River. Poor quality when river levels are low. Unable to use service basin. Bushfires in the upper catchment could deliver ash and silt.
Evaporation & seepage	Losses from service basin attributable to evaporation and seepage.
Asset condition (Chronic risk)	Any parts of the urban reticulation networks that may be at risk of failure leading to short-term loss of supply. The vulnerability is managed through 'business as usual' operations and maintenance.
Treatment plant efficiency	Water wastage during treatment process.
Reticulation network	Water losses incurred from leakage, pipeline bursts, mains flushing & use of fire hydrants. The vulnerability is managed through 'business as usual' operations and maintenance.
Pump failure	Electricity blackout or brownout, or mechanical failure resulting in no supply to the WTP.

Table 2: Water treatment plant characteristics.

Location	Source of Raw Water	Water Treatment Process	Nominal Capacity (ML/day)[1]	Peak Day Demand 2065 (ML/day)[2]
Goornong	Campaspe River	Sand Filtration, Disinfection	0.43	0.42

Note 1: Based on treatment plant operating 16 hours per day.
Note 2: Estimated Average Day of Peak Month.

Customer Group Characterisation and Growth

The growth in water connections for the Campaspe System is projected to only increase in residential connections. The total amount of new connections is estimated to increase from 175 to 267 by 2065.

Table 3: Projected growth[1] in customer water connections to 2040 and 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	150	7	8	10	175
2040	194	7	8	10	219
2065	242	7	8	10	267

Note 1: *Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system in the 15 years.*

Current and Projected Demand

The current baseline demand for the Campaspe System is 59 ML and with the projected growth in water connections is estimated to increase to 93 ML by 2065. Under a high climate change scenario the impact will increase the 2040 baseline demand by 18% and 25% of the 2065 baseline demand.

Table 4: Projected raw water demands to 2040 and 2065 under a range of climate scenarios.

Analysis	Baseline Demand[1] (ML)	2040 Demand (ML)	2065 Demand (ML)
Current Climate Baseline	59	74	93
Post 1997 Baseline	59	74	93
Climate Change (Low to High)	N/A	84 – 90	113 - 124

Note 1: *The baseline PWSR demand was determined separately for each town and system, based on the actual PWSR demands over the past five years and taking into account actual rainfall.*

Current and Projected Supply

The following supply projections are based on model data provided by DELWP for a range of climate scenarios.

The current climate baseline supply for the Campaspe System is 250 ML and is projected to remain unchanged until 2065. However under a high climate change scenario the available supply will decrease to 230 ML by 2065.

Table 5: Projected raw water supply to 2040 & 2065 under a range of climate scenarios.

Analysis	Baseline Supply (ML)	2040 Supply (ML)	2065 Supply (ML)
Current Climate Baseline	250	250	250
Post 1997 Baseline	230	230	230
Climate Change (Low to High)	N/A	250 - 240	250 - 230

Supply and Demand Balance

All the scenarios depicted in the projections assume 'no intervention' hence they reflect the magnitude of the challenge ahead. The options identified later are intended to address any imbalance between supply and demand.

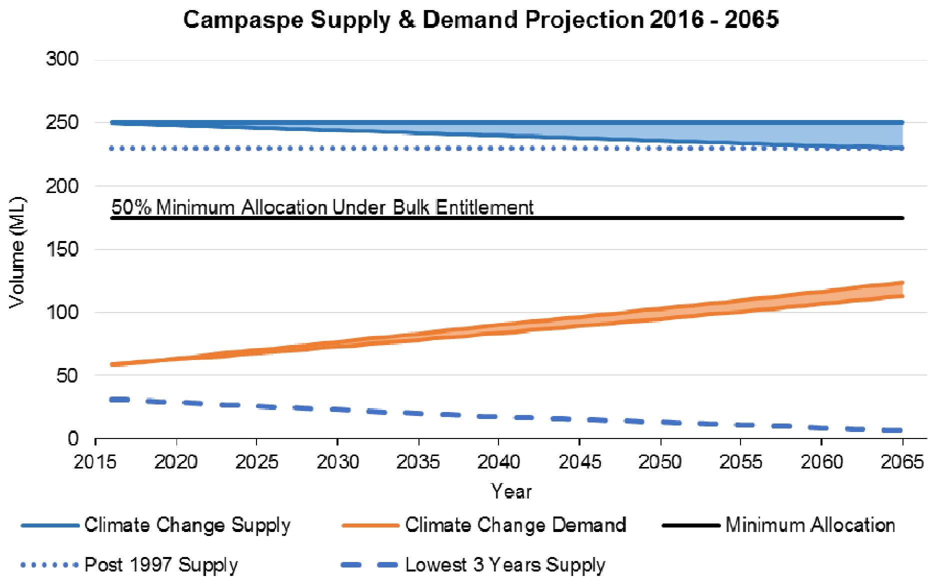

Figure 2: Projected supply and demand to 2065 under a range of climate scenarios.

Supply and Demand Projections (2016 - 2065)

Supply[1]: The component of the graph shows the projected variation in supply under low to high climate change. The projection relies on data supplied by DELWP. Generally there will be a decline in inflows into major storages and or reduced annual allocations from external suppliers of raw water i.e. GMW and GWM Water. The 'post-1997' line reflects the potential supply that may be available if the catchment responds to rainfall in the same manner as during the Millennium Drought.

Lowest 3 Years: This reflects the lowest [modelled] available supply during a consecutive three year period. In general this reflects the potential severity of future droughts that may be similar to the Millennium Drought. Across most systems, the worst three years in recent times were 2007 to 2009.

Demand: The 'supply and demand projection' graph shows the projected variation in growth in raw water demand based on population growth data supplied by DELWP, and the demand based on low to high climate change. Primarily the impact of high climate change is to increase the demand for outdoor water use due to higher temperatures and lower rainfall.

Note 1: The 'supply' is based on the system 'yield' derived from in-house models. The yield indicates the volume of raw water that can be sustainably supplied by the system to meet our minimum Level of Service obligation of no worse than Stage 3 restrictions.

Table 6: Supply and demand water imbalance.

Year	Shortfall in Supply[1] (ML)	Main Strategies
2040	0	No actions proposed.
2065	0	No actions proposed.

Note 1: Shortfall in supply without intervention.

The Campaspe System is not expected to experience any water shortfall for the next 50 years and therefore no action is proposed specifically to improve water security. However there is always opportunity to improve the system performance by initiating measures such as evaporation management and storage capacity improvement. Therefore the capital and BAU measures that are tabled below warrant timely consideration.

Learnings From Recent Experience

Severe water shortages in the Campaspe System resulted in the 50% minimum BE allocation being received for six consecutive years from 2004-05 to 2009-10.

Lake Eppalock received extremely low inflows and held less than 3,000 ML in mid-2007. The severe water shortage also resulted in three years of no irrigation allocation and another three years of irrigation allocations less than 40%.

The decline in inflows and allocations across Victorian left water corporations with few choices to reduce demand without resorting to imposing water restrictions. The Campaspe System was no exception with restrictions imposed for a total of 96 months. Eighty of the 96 months included the period when Axedale was also being supplied from the Campaspe System. Stage 4 restrictions were in place from September 2006 for 38 consecutive months.

Drought Preparedness

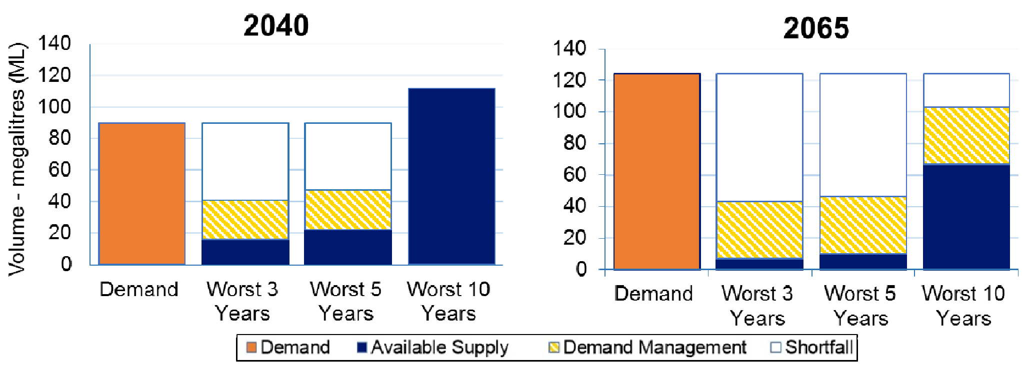

Figure 3: Demand versus projected supply based on lowest consecutive allocations in 2040 and 2065 under a high climate change scenario.

Drought Scenarios

Figure 3 above compares the [modelled] available supply (blue bars), during a future drought e.g. the equivalent of the Millennium Drought. The demand (orange bars) is the same as that depicted in Figure 2 for 2040 and 2065. The graphs represent a 'no intervention' scenario.

Typically the available supply can vary greatly from year to year during a drought hence the use of three different time periods, namely 3, 5 and 10 consecutive years. Coliban Water has chosen not to use the single worst year of drought as the basis for planning as generally existing operational flexibility allows us to cope with up to three dry years without necessarily imposing restrictions.

The 'demand management' measures (yellow hatched bars) reflect the anticipated reduction in demand if Stage 3 restrictions were to be imposed. The blank components reflect the shortfall that would still have to be made up after Stage 3 restrictions were to be imposed.

Table 7: Drought scenario shortfalls.

Year	Time Period (years)	Shortfall (ML)
2040	3	74
	5	68
	10	0
2065	3	117
	5	114
	10	57

Table 8: Estimated reduction in demands when restrictions implemented.

	Stage 1	Stage 2	Stage 3	Stage 4
Water Savings from Restrictions (%)	3%	8%	17%	21%

Water Restriction Calculations

The estimated water savings achieved through water restrictions are based on the actual water savings achieved in the 9-year dry period of water restrictions from 2002 to 2010. The extent of the actual savings achieved during this period of water restrictions was adjusted to take into account the significant water savings achieved over the past five years through the way customers now use water. Stage 4 demands are estimated to be relatively unchanged from previous estimates of 2012 and are based on winter off-season demands.

However, overall PWSR demands have significantly reduced since 2012 due to conservative customer water use behaviour. The extent of system demand between PSWR and Stage 4 is now significantly compressed by as much as 40% whereby there is up to 40% less water that can be further achieved through water restrictions. Accordingly, forecast future water savings from water restrictions were estimated for each water supply system by reducing the actual savings achieved in the most recent restrictions of 2002-2010 by the above calculated level of "compression" for each water supply system.

Next Steps

To ensure the water security of the system by maintaining the balance between supply and demand a list of system specific capital and business as usual initiatives are tabled below. The capital initiatives were subjected to a preliminary analysis using Coliban Water's Multi-Criteria Analysis (MCA) tool.

As part of the future actions, the initiatives will be subjected to further detailed analysis for the following three demand scenarios:

- Baseline demand imbalance
- Dry weather peak month demand, and
- Demand during worst three drought scenarios (worst 3, 5 and 10 years).

Note that the demand and supply considerations are only for high climate change scenarios.

The next steps of the option analysis will include the following:

- Community and stakeholder engagement
- Detail analysis of capital and BAU options (filling the short fall and sequencing), and
- Research projects (such as ground water and evaporation management).

Table 9: Capital projects.

Strategy	Initiative		
Demand Management	**Raw water supply system - reduce evaporation**: Implement evaporation reduction measures for the service basin. This could include mechanical covers on minor basins or evaporation resistant barriers for larger storages. Implementation of this option may require multi-year trials to determine the effectiveness and potential cost. Ideally this includes the parallel use of a Class A evaporation pan to provide baseline data on 'no treatment' and 'with treatment' pans.	MCA Ranking	1
		Estimated cost	$100,000
		Implement time	1 year
		Water gained (ML/Yr.)	3
		$/ML	$1,600
Supply Management	**Additional Storage Capacity**: The Campaspe System is totally reliant on Lake Eppalock for its supply. The system is at risk of severe water restrictions with a return to the dry conditions experienced during the Millennium Drought. Additional storage capacity would reduce the risk of water shortage.	MCA Ranking	2
		Estimated cost	$750,000
		Implement time	2-3 years
		Water gained (ML/Yr.)	-
		$/ML	-
Alternative Water Source	**Groundwater**: Investigate options to access groundwater (Campaspe Deep Lead) for Goornong, or purchase existing groundwater license entitlements. This provides an alternative source of water should the water quality deteriorate in the Campaspe River when at lower levels. Any new source of water may require an upgrade of the water treatment plant to pre-treat the water to a standard suitable for treatment. Any pre-treatment is likely to have a 1 – 2 year lead time to implement. Aquifer Storage and Recovery: The option requires investigation but could provide a mechanism to 'store' water during periods of higher rainfall and streamflow.	MCA Ranking	3
		Estimated cost	$1,000,000
		Implement time	2-3 years
		Water gained (ML/Yr.)	70
		$/ML	$60
Alternative Water Source	**Pipeline connection to Bendigo**: Construction of a pipeline from Goornong to Bendigo would improve the quality risk profile of the water supplied to Goornong. Consideration could be given to transfer the Campaspe Bulk Entitlement of 349 ML to Bendigo.	MCA Ranking	4
		Estimated cost	$4,800,000
		Implement time	3-4 years
		Water gained (ML/Yr.)	70
		$/ML	$1,350

The BAU initiatives listed in Table 10 are in addition to the generic initiatives that are listed Part C.

Table 10: Business as Usual Initiatives.

Strategy	Initiative
Operational Flexibility (Ongoing)	**Service basin level**: The level of the service basin is managed with pumping triggers based on the level in storage. During a 5 hour period in the night, if the basin level is less than 1 m, then pumping will commence from the Campaspe River. Once the level of the service basin reaches 1.4 m pumping will cease. Should the need arise the level could be adjusted to keep the basin full or close to full.

Appendix C – Coliban System Northern

Figure 1: Coliban Northern showing water sources.

System Description

As of July 2016, Coliban System Northern (Coliban Northern) services 43,489 urban connections (i.e. connection with house or business) with an estimated customer population of 108,230 and 658 rural licences with a base entitlement of 5,422.6 ML.

The Coliban Northern comprises two independent potable water supply systems (Bendigo and Heathcote) and a number of rural channel supplies.

- The Sandhurst Reservoir at Bendigo receives raw water from the Coliban Headworks Storages, Lake Eppalock and the Goulburn system. Raw water from the Coliban Headworks Storages is gravity transferred by the 69 km long Coliban Main Channel. Water is pumped from Lake Eppalock via the 27 km Eppalock Pipeline (Eppalock to Sandhurst Reservoir) which is part of the Goldfields Superpipe, and also pumped from the Goulburn System on the Waranga Western Channel at Colbinabbin via the 47 km leg of the Goldfields Superpipe. Water is treated at the Bendigo WTP located at Sandhurst Reservoir and supplied to Bendigo and surrounding townships including Axedale, Strathfieldsaye, Huntly, Maiden Gully, Marong, Raywood and Sebastian.
- The Caledonia Reserve in the Heathcote – Tooborac System receives raw water directly from Lake Eppalock or from the Goldfields Superpipe. The water is treated at the Heathcote WTP and supplied to the townships of Heathcote and Tooborac.

The main rural channels are Cockatoo Hill, Specimen Hill, Emu Valley (supplied off Eppalock Pipeline), Lockwood, Jackass Flat, Ascot, Axe Creek, and directly off the Eppalock Pipeline.

Reliability

Water from Coliban Headwork Storages is released only if the total storage volume is above the volumetric trigger level, which is set based on the storage level at the time of review and short and long term climate forecast.

If the water is not released from Coliban Headworks Storages, Coliban Northern relies entirely on external sources through water entitlement/allocation and water shares from Goulburn Murray Water. Inflow into Lake Eppalock is highly variable and the water quality can be poor when the water level is low. Sourcing water from the Waranga Western Channel is constrained by the fixed capacity of the delivery pipe. The Superpipe is further at risk of not able to pump the full capacity by not having standby pumps at Colbinabbin (intake) and Axe Creek (booster) pump stations.

Based on the DEWLP model, the source reliability is on the decline over the next 50 years from 73% in 2040 to 33% in 2065 under high climate change scenario.

System Challenges

The critical challenges for the Coliban System Northen is the large community size and the dependence on external sources such as GMW's Goulburn and Campase, particularly when Coliban headwork storages are unavailable for Northern systems. Quality of water can also be a concern when the water levels are low in Eppalock.

Table 1: Vulnerabilities during severe water shortages.

Vulnerability	Impact of Water Shortages
Fixed delivery capacity of Goldfields Superpipe	Shared infrastructure between Coliban Water and Central Highlands Water. Only a vulnerability when Operational Mode 2 or Mode 3 is in place.
'Step' change in streamflow	Campaspe River - Pre 1997, post 1997 median inflow into Lake Eppalock.
Large community	Overall the system is too large to fully supply via road or rail tankers. However a partial supply may be feasible to a small community that may urgently need supply.
Rural demand	Rural demand increases during extended periods of dry hot weather hence adequate provision needs to be made for dry conditions.
High demand in dry weather	Additional communities, higher per connection demand, and rural demand from non-Coliban Water customers.
Water quality (Acute Impact)	Capacity of water treatment plant to cope with water of different quality e.g. Lake Eppalock (Campaspe), Waranga Western Channel (WWC) (Goulburn). Poor quality when storage levels are low. Bushfires in the upper catchment could deliver ash and silt.
High evaporation (Chronic Risk)	A system losses are attributable to evaporation from Lake Eppalock and minor storages (Sandhurst, Spring Gully and Caledonia Reservoirs).
Coliban Main Channel (Chronic Risk)	The ~70 km of channel requires annual maintenance to maintain structural integrity and any catastrophic loss of capacity would impact on Bendigo's water supply.
Asset condition (Chronic Risk)	Parts of the urban reticulation networks may be at risk of failure leading to short-term loss of supply. The vulnerability is managed through 'business as usual' operations and maintenance.
Seasonal shutdown of WWC (Applies to Coliban Northern & Goulburn Systems.)	Our Goulburn System and Coliban Northern rely on the delivery of raw water via the GMW Waranga Western Channel. The channel has an annual shutdown from mid-May to mid-August. During drought when allocations are low the channel may operate for a shorter period in order to reduce system losses. When this occurs Coliban Water is unable to draw water from this source.

Table 2: Water treatment plant characteristics.

Location	Source of Raw Water	Water Treatment Process	Nominal Capacity (ML/day)[1]	Peak Day Demand 2065 (ML/day)[2]
Bendigo	Coliban Headwork Storages Lake Eppalock Goldfields Superpipe	Micro Filtration	126.0	101.94
Heathcote	Lake Eppalock Goldfields Superpipe	Clarification, Sand Filtration, Disinfection	2.82	1.74

Note 1: Based on treatment plant operating 16 hours per day.
Note 2: Estimated Average Day of Peak Month.

Customer Group Characterisation and Growth

Bendigo is projected to grow steadily and is expected to double in 50 years. This applies across all the customer groups. Overall the number of connections is expected to increase from 47,325 in 2016 to 109,781 in 2065.

Table 3: Projected growth[1] in customer water connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	43,808	2,822	497	198	47,325
2040	66,129	3,797	685	240	70,850
2065	103,326	5,187	972	296	109,781

Note 1: Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.

Current and Projected Demand

The current climate baseline demand is projected to double in 2065. The baseline demand however is expected increase by 143% in 2065 under high climate change scenario.

Table 4: Projected raw water demands to 2040 & 2065 under a range of climate scenarios.

Analysis	Baseline Demand (ML)	2040 Demand (ML)	2065 Demand (ML)
Current Climate Baseline	14,887	20,461	29,762
Post 1997 Baseline	16,894	22,542	31,968
Climate Change (Low to High)	N/A	22,182 – 24,012	33,184 – 36,129

Note 1: The baseline PWSR demand was determined separately for each town and system based on the actual PWSR demands over the past five years and taking into account actual rainfall.

Current and Projected Supply

The following supply projections are based on model data provided by DELWP for a range of climate scenarios.

The supply is projected to decline for the next 50 years and is expected to reduce to 50% in 2065.

Table 5: Projected raw water supply to 2040 & 2065 under a range of climate scenarios.

Analysis	Baseline Supply (ML)	2040 Supply (ML)	2065 Supply (ML)
Current Climate Baseline	15,482	Not Applicable[1]	Not Applicable[1]
Post 1997 Baseline	15,542	15,103	15,025
Climate Change (Med to High)	N/A	13,069 – 10,085	7,590 – 7,587

Note 1: Current Climate baseline figures are not expected to change over time.

Supply and Demand Balance

All the scenarios depicted in the projections assume 'no intervention' hence they reflect the magnitude of the challenge ahead. The options identified later are intended to address any imbalance between supply and demand.

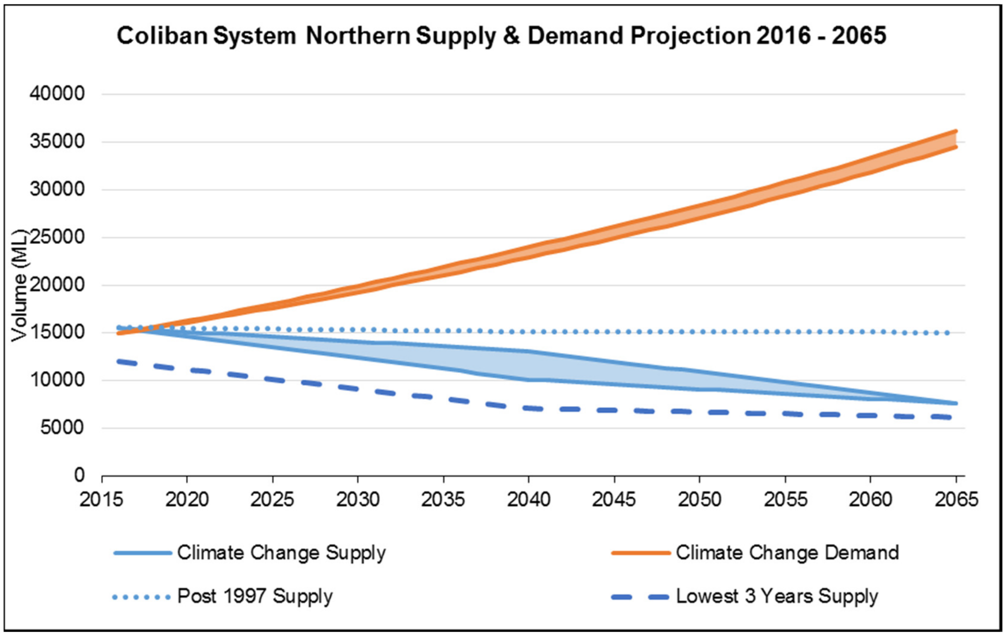

Figure 2: Projected supply and demand to 2065 under a range of climate scenarios.

Supply and Demand Projections (2016 - 2065)

Supply[1]: The component of the graph shows the projected variation in supply under low to high climate change. The projection relies on data supplied by DELWP. Generally there will be a decline in inflows into major storages and/or reduced annual allocations from external suppliers of raw water i.e. GMW and GWMWater. The 'post-1997' line reflects the potential supply that may be available if the catchment responds to rainfall in the same manner as during the Millennium Drought.

Lowest 3 Years: This reflects the lowest [modelled] available supply during a consecutive three year period. In general this reflects the potential severity of future droughts that may be similar to the Millennium Drought. Across most systems, the worst three years in recent times were 2007 to 2009.

Demand: The 'supply and demand projection' graph shows the projected variation in growth in raw water demand based on population growth data supplied by DELWP, and the demand based on low to high climate change. Primarily the impact of high climate change is to increase the demand for outdoor water use due to higher temperatures and lower rainfall.

Note 1: The 'supply' is based on the system 'yield' derived from in-house models. The yield indicates the volume of raw water that can be sustainably supplied by the system to meet our minimum Level of Service obligation of no worse than Stage 3 restrictions.

Table 6: Supply from Coliban storages.

	Baseline (ML)	2040 (ML)	2065 (ML)
Average Supply from Coliban storages	12,945	12,523	4,746

Table 7: Supply and demand water imbalance.

Year	Shortfall in Supply[1] (ML)	Main Strategies
2018	0 – 531	Operational flexibility
2040	9,113 – 13,927	Supply augmentation
2065	26,910 – 28,542	Supply augmentation

Note 1: Shortfall in supply without intervention

The main strategies that are identified in this table will be analysed in detail for possible consideration in the next 5 – 10 years.

Learnings from Recent Experience

The prolonged dry weather that was experienced during the millennium drought had significant impact on the available water resource. During this period the storage levels were critically low (Eppalock was 1% of the capacity in June 2007) and the restrictions level reached to Stage 4 on two occasions (2004-05 and 2007-08). Building the Superpipe in 2007 helped sourcing water from the Goulburn system to ease the pressure, particularly in Bendigo and Heathcote. A large amount of water entitlements and shares were bought during this period.

The heavy rainfalls and very high inflows experienced during 2010-11 filled all the storages. The rainfall and runoff during 2010-11 are the highest on record.

The manganese levels in Lake Eppalock can be high when the water level is low. The Bendigo WTP was recently upgraded to handle increased levels of manganese in the raw water.

Drought Preparedness

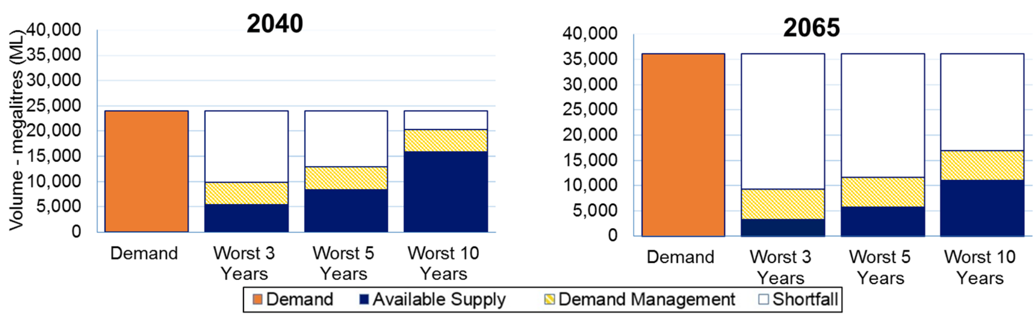

Figure 3: Demand versus projected supply based on lowest consecutive allocations in 2040 and 2065 under a high climate change scenario.

Table 8: Drought scenario shortfalls.

Year	Time Period (Year)	Shortfall (ML)
2040	3	18,635
	5	15,581
	10	8,191
2065	3	32,832
	5	30,425
	10	25,154

Table 9: Estimated reduction in demands when restrictions implemented.

Water Savings from Restrictions (%)	Stage 1	Stage 2	Stage 3	Stage 4
Rural	18%	40%	58%	78%
Urban	2%	9%	12%	15%

Water Restriction Calculations

The estimated water savings achieved through water restrictions are based on the actual water savings achieved in the 9-year dry period of water restrictions from 2002 to 2010. The extent of the actual savings achieved during this period of water restrictions was adjusted to take into account the significant water savings achieved over the past five years through the way customers now use water. Stage 4 demands are estimated to be relatively unchanged from previous estimates of 2012 and are based on winter-off-season demands.

However, overall PWSR demands have significantly reduced since 2012 due to conservative customer water use behaviour. The extent of system demand between PSWR and Stage 4 is now significantly "compressed" by as much as 40% whereby there is up to 40% less water that can be further achieved through water restrictions. Accordingly, forecast future water savings from water restrictions were estimated for each water supply system by reducing the actual savings achieved in the most recent restrictions of 2002-2010 by the above calculated level of "compression" for each water supply system.

Wastewater System Description

The Axedale Water Reclamation plant is located adjacent to the Axedale Golf Course. The sewer system in Axedale was constructed in 2005. It comprises eight kilometres of sewer mains and three pump stations. The plant treats the sewerage to Class B standard using a combination of aeration, clarification and disinfection. Reclaimed water is stored in a plastic-lined lagoon and used to irrigate the golf course. The site operates in accordance with a management plan approved by Environment Protection Authority (EPA) Victoria.

The Bendigo Water Reclamation plant is located in Howard St, Epsom, adjacent to the Bendigo Creek. The majority of sewage in the region is collected in gravity sewers from area including Kangaroo Flat, Golden Square, Spring Hill, Long Gully, Bendigo, Strathdale and White Hills. There are 17 sewer pump stations in the Bendigo System which service areas including Strathfieldsaye, Marong and Eaglehawk. The sewer system also collects wastewater from commercial sites in accordance with trade waste agreements and consents. These businesses range in size from cafes to large industries such as food processors and textile manufacturers. This system is the largest and most complex of our water reclamation plants. It treats wastewater to produce Class A, B and C of recycled water. The site also receives septic tank waste delivered by contractors. The heart of the Epsom water reclamation plant is the biological nutrient removal plant which removes nutrients, carbon and solids to produce Call C reclaimed water. Class C is used as irrigation at the on-sire farm and plantation and supplied to nearby irrigators. The extensive 46 hectare lagoon system is used for treatment and to store excess winter flows. This lagoon system is home to a vast range of birdlife. Class B reclaimed water is produced by further treatment at the tertiary treatment plant using a combination of chemical dosing, filtration and UV disinfection. This water is supplied to the Fosterville Gold Mine and can be discharged to Bendigo Creek in accordance with the EPA Victoria licence. The recycled water factory produces Class A water using a combination of chlorination/UV disinfection and membrane filtration. Class A is the most highly treated and can be used for a wider range of uses. Customers include the City of Greater Bendigo for its sporting facilities, parks and gardens, schools, rural, standpipes, commercial (for dust suppression, carwash and road works) and third-pipe customers in several housing developments. Bio-solids produced at Epsom are treated and then applied to land by farmers to derive the benefit from the associated nutrients. The EPA Victoria licence specifies conditions for the management of emissions from the site including wastewater quality and odour. The beneficial reuse of wastewater and bio-solids is conducted in accordance with the guidelines approved by EPA Victoria, Department of Health and the Victorian Chief Veterinary Officer.

The Heathcote Water Reclamation Plants is three kilometres south west of the township. Wastewater is collected via two pump stations and 20 km of gravity mains and three kilometres of rising mains. Sewage is treated through a two hectare lagoon system and is then kept in a storage lagoon in readiness for irrigation at the Heathcote Golf Course. The treatment lagoons are periodically de-sludged and the bio-solids are beneficially reused for agricultural purposes. The EPA Victoria licence specifies conditions for management of emissions from the site including wastewater quality and odour.

Table 10: Wastewater treatment plant characteristics.

Location	Nominal Capacity[1]	Estimated Augmentation Year[2]	Class of Recycled Water	2015-16 Reuse Volume (ML)	2015-16 Discharge to Waterways (ML)
Axedale	51.0 KL/day	2025	B	14.56	0
Bendigo	23.1 ML/day	2029	A, B & C	1,608.12	3,924.60
Heathcote	425.0 KL/day	2026	C	130.95	0

Note 1: Relates to Peak Daily Flows, not annual plant capacity.
Note 2: Figures taken from regular internal plant review process.

Wastewater Customer Group Characterisation and Growth

The wastewater connections in Bendigo is projected to grow steadily and is expected to more than double in 50 years. This applies across all the customer groups.

Table 11: Projected growth[1] in sewer connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	41,142	2,844	375	71	44,432
2040	62,268	3,835	535	86	66,725
2065	97,522	5,250	786	106	103,663

Note 1: Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.

Next Steps

To ensure the water security of the system by maintaining the balance between supply and demand a list of system specific capital and business as usual initiatives are tabled below. The capital initiatives were subjected to a preliminary analysis using Coliban Water's Multi-Criteria Analysis (MCA) tool.

As part of the future actions, the initiatives will be subjected to further detailed analysis for the following three demand scenarios:

- Baseline demand imbalance
- Dry weather peak month demand
- Demand during worst three drought scenarios (worst 3, 5 and 10 years)

Note that the demand and supply considerations are for high climate change scenarios.

The next steps of the option analysis will include the following:

- Community and stakeholder engagement
- Detail analysis of capital and BAU options (filling the short fall and sequencing)

Table 12: Capital projects.

Strategy	Initiative		
Supply Augmentation	**Upgrade Superpipe:** The Superpipe (Goulburn-Campaspe Link Pipeline) currently has the capacity to transfer 150 ML/day (100 ML for Coliban Water's use and 50 ML for Central Highlands Water's use). This proposal is to upgrade (increase pumping and pipeline capacity) the system to meet the increased demand in the future.	MCA Ranking	1
		Estimated cost	$100 m
		Implement time	3-5 years
		Water gained (ML/Yr.)	29,200
		$/ML	$68

The BAU initiatives listed below are in addition to the generic initiatives that are listed Part C.

Table 13: 'Business as Usual' initiatives.

Strategy	Initiative
Operational Flexibility (Ongoing)	**Develop a pumping trigger to coincide with the volumetric trigger level of Coliban System Southern:** Once the volumetric trigger level is reached for the Coliban Headworks Storages, releases for the Coliban System Northern cease. At this point pumping from external sources would commence to supply Coliban Northern. However pumping can commence ahead of the trigger being reached to preserve reserves for Coliban Southern.

Appendix C – Coliban System Southern

Figure 1: Coliban Southern showing water sources.

System Description

Coliban System Southern (Coliban Southern) services 9,652 urban connections (i.e. connection with house) with an estimated customer population of 23,033, and 716 rural licenses with a base entitlement of 5,177.4 ML, as of July 2016.

Raw water is supplied by our Coliban River catchment storages: Upper Coliban, Lauriston and Malmsbury Reservoirs, located near Kyneton.

The Coliban System Southern comprises two independent potable water supply systems (Castlemaine and Kyneton) and a number of rural channel supplies.

- McCay Reservoir at Castlemaine receives raw water from the Coliban Headworks Storages via the open Coliban Main Channel. The water is treated at the Castlemaine WTP and supplied to Castlemaine, Elphinstone, Taradale, Maldon, Newstead, Harcourt, Guildford and Fryerstown.
- Kyneton WTP; supplies Kyneton, Malmsbury and Tylden. The raw water supply is drawn directly from Lauriston Reservoir (one of three major storages).

The main rural channels are Elphinstone, Harcourt, and Emu Valley. The Harcourt rural network incorporates Barkers Creek Reservoir. The Harcourt rural network has been converted from an open channel to a pressurised pipe system (July 2016).

Reliability

Coliban Southern system relies on rainfall and inflows. Even though, long term source (inflow) reliability estimated at 73% is not promising, the system reliability in 2065 is reasonably high at 95% under high climate change conditions due to management measures such as large storages.

Inability to access alternative source is always a risk, particularly with uncertain long term climate predictions.

System Challenges

Coliban Southern's key vulnerability is its single source of supply linked to a customer demand that is too large to fully service by road or rail tanker should an alternative supply be required.

Table 1: Vulnerabilities during severe water shortages.

Vulnerability	Impact of Water Shortages
Single source of supply	Unable to access alternative sources of raw water.
'Step' change in streamflow	Pre 1996, post 1996 median inflow.
Large community	Overall the system is too large to fully supply via road or rail tankers. However a partial supply may be feasible.
Rural demand	Harcourt region has a high economic dependence on irrigation [raw] water for perennial horticultural plantings.
Poverty Gully Tunnel (Chronic Risk)	Potential collapse in places along its 650 m length would mean raw water could not be delivered to McCay Reservoir. A temporary by-pass would need to be installed, or the tunnel roof secured.
Water quality (Acute Impact)	• Capacity of water treatment plant to cope with water of different quality e.g. Lake Eppalock (Campaspe), Waranga Western Channel (WWC) (Goulburn). • Poor quality when storage levels are low. • Bushfires in the upper catchment could deliver ash and silt.
High evaporation (Chronic Risk)	A high proportion of system losses are attributable to evaporation. Average evaporation is more than double the combined demand for Castlemaine and Kyneton.
Coliban Main Channel (Chronic Risk)	The ~70 km of channel requires annual maintenance to maintain structural integrity and any catastrophic loss of capacity would impact on rural and Castlemaine urban customers until repairs were completed.
Asset condition (Chronic Risk)	Parts of the urban reticulation networks may be at risk of failure leading to short-term loss of supply. The vulnerability is managed through 'business as usual' operations and maintenance.
Seasonal shutdown of WWC (Only applies to Coliban Northern & Goulburn Systems.)	Our Goulburn System and Coliban Northern rely on the delivery of raw water via the GMW Waranga Western Channel. The channel has an annual shutdown from mid-May to mid-August. During drought when allocations are low the channel may operate for a shorter period in order to reduce system losses. When this occurs Coliban Water is unable to draw water from this source. If the Castlemaine Link were in operation it could not be supplied from WWC.

Table 2: Water treatment plant characteristics.

Location	Source of Raw Water	Water Treatment Process	Nominal Capacity (ML/day)[1]	Peak Day Demand 2065 (ML/day)[2]
Castlemaine	Coliban Headwork Storages	Micro Filtration	18.4	17.43
Kyneton	Coliban Headwork Storages	Micro Filtration	7.0	4.79

Note 1: Based on treatment plant operating 16 hours per day.
Note 2: Estimated Average Day of Peak Month.

Customer Group Characterisation and Growth

Customer water connections in the Coliban Southern System are projected to increase from 10,946 to 19,638 by 2065.

Table 3: Projected growth[1] in customer water connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	9,838	772	223	113	10,946
2040	13,947	965	292	113	15,317
2065	17,869	1,260	396	113	19,638

Note 1: Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.

Current and Projected Demand

The current baseline demand for the Coliban Southern System is 6,964 ML and with the projected growth in water connections is estimated to increase to 9,261 ML by 2065. Under a high climate change scenario the impact may increase the 2040 and 2065 baseline demands by 13% and 2%.

Table 4: Projected raw water demands to 2040 & 2065 under a range of climate scenarios.

Climate Scenario	Baseline Demand[1] (ML)	2040 Demand (ML)	2065 Demand (ML)
Current Climate Baseline	6,964	8,127	9,261
Post 1997 Baseline	9,045	8,167	10,375
Climate Change (Med to High)	N/A	8,106 – 9,180	8,300 – 9,478

Note 1: The baseline PWSR demand was determined separately for each town and system, based on the actual PWSR demands over the past five years and taking into account actual rainfall.

Current and Projected Supply

The following supply projections are based on model data provided by DELWP for a range of climate scenarios.

The current climate baseline supply for the Coliban Southern System is 13,162 ML, which is not expected to change over time. However, under a high climate change scenario the available supply could decrease to 7,014 ML by 2065.

Table 5: Projected raw water supply to 2040 & 2065 under a range of climate scenarios.

Analysis	Baseline Supply (ML)	2040 Supply (ML)	2065 Supply (ML)
Climate Change Baseline	13,162	Not Appliable[1]	Not Applicable[1]
Post 1997 Baseline	8,321	8,167	8,093
Climate Change (Med to High)	N/A	11,673 – 9,296	11,016 – 7,014

Note 1: Current Climate baseline figures are not expected to change over time.

Supply and Demand Balance

All the scenarios depicted in the projections assume 'no intervention' hence they reflect the magnitude of the challenge ahead. The options identified later are intended to address any imbalance between supply and demand.

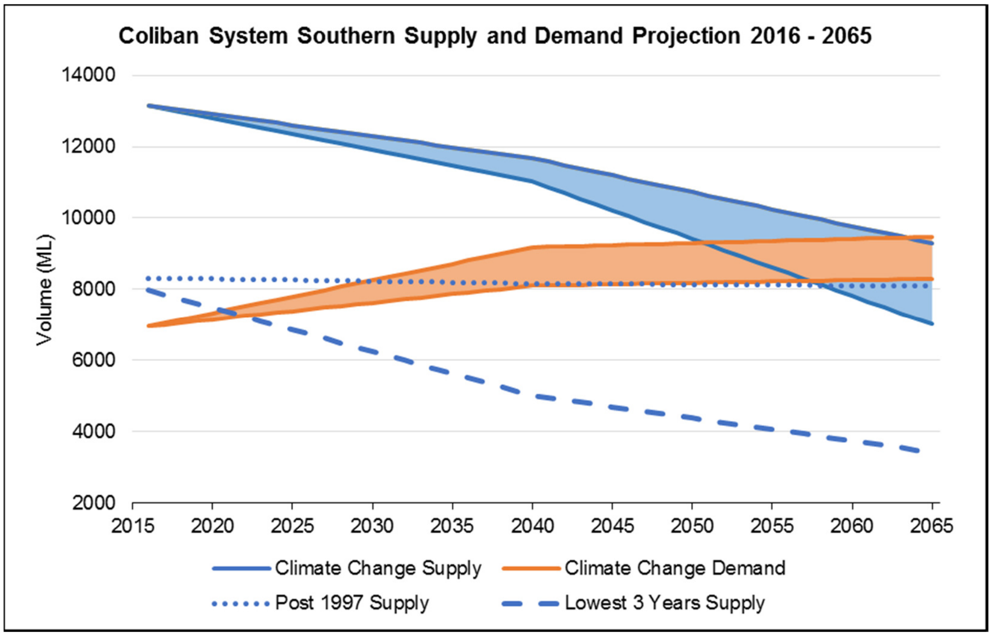

Figure 2: Projected supply and demand to 2065 under a range of climate scenarios.

Supply and Demand Projections (2016 - 2065)

Supply[1]: The component of the graph shows the projected variation in supply under low to high climate change. The projection relies on data supplied by DELWP. Generally there will be a decline in inflows into major storages and/or reduced annual allocations from external suppliers of raw water i.e. GMW and GWMWater. The 'post-1997' line reflects the potential supply that may be available if the catchment responds to rainfall in the same manner as during the Millennium Drought.

Lowest 3 Years: This reflects the lowest [modelled] available supply during a consecutive three year period. In general this reflects the potential severity of future droughts that may be similar to the Millennium Drought. Across most systems, the worst three years in recent times were 2007 to 2009.

Demand: The 'supply and demand projection' graph shows the projected variation in growth in raw water demand based on population growth data supplied by DELWP, and the demand based on low to high climate change. Primarily the impact of high climate change is to increase the demand for outdoor water use due to higher temperatures and lower rainfall.

Note 1: The 'supply' is based on the system 'yield' derived from in-house models. The yield indicates the volume of raw water that can be sustainably supplied by the system to meet our minimum Level of Service obligation of no worse than Stage 3 restrictions.

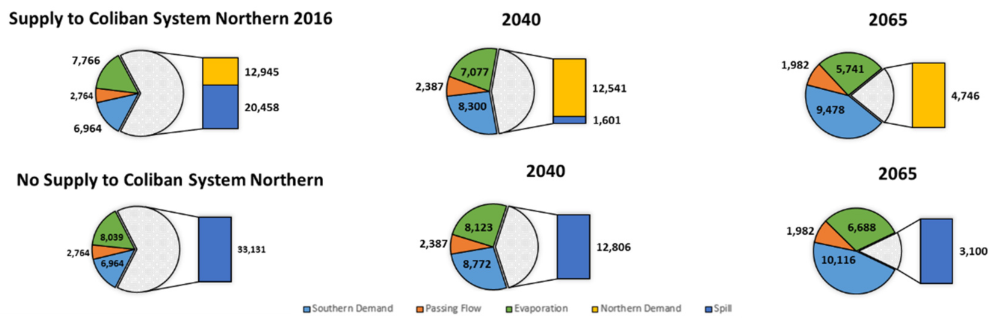

Figure 3: Projected scenarios for Coliban South supplying Coliban North.

Table 6: Supply and demand water imbalance.

Year	Shortfall in Supply[1] (ML)	Main Strategies
2040	0	No actions proposed
2042	0 - 91	No actions proposed
2065	0 – 2,464	Alternative supply

Note 1: Shortfall in supply without intervention.

The Coliban System Southern is not expected to experience water shortfall until after 2042 and therefore no action is proposed specifically to improve water security until 2042. However the traditional water saving measures such as water saving campaigns, customer education and system efficiency improvement programs will be continued to be implemented.

Learnings From Recent Experience

During the Millennium Drought, declines in autumn rainfall were pronounced and the dryness of the catchment leading into the winter months resulted in dramatic reductions in inflow into our storages. Storage levels fell to just 6% of capacity in mid-2007.

At the other extreme, very high inflows were received during 2010-11 with all storages filling by November and major floods occurring downstream of Lake Eppalock in late 2010 and again in early 2011. The rainfall and runoff during 2010-11 are the highest on record.

From a water resource planning perspective the variation in water availability between individual years is partly balanced by the capacity of our storages to smooth out supply. This equally applies to externally managed sources where large storages such as Lake Eildon smooth out supply for the GMW Goulburn System, and Darmouth Dam and Lake Hume smooth out supply along the Murray River.

In addition to annual rainfall and streamflow, Coliban Water also utilises multi-year periods to gauge the risks to overall supply. This equally applies to external sources of supply where annual allocations are announced.

The decline in inflows and allocations across Victorian left water corporations with few choices to reduce demand without resorting to imposing water restrictions. The Coliban Southern system was no exception with restrictions imposed for a total of 104 months. With 13 consecutive months of Stage 4 restrictions.

Drought Preparedness

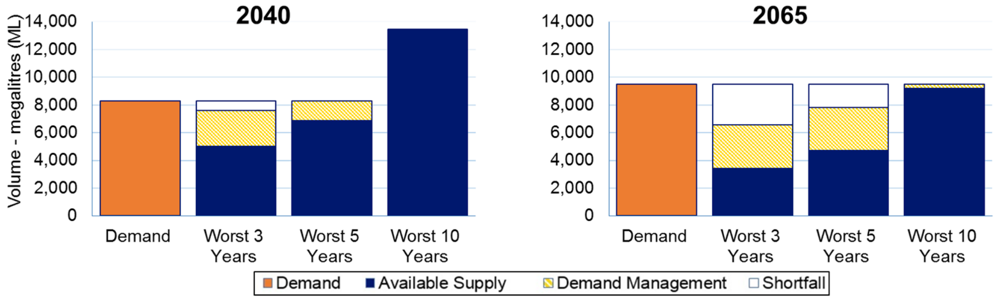

Figure 4: Demand versus projected supply based on lowest consecutive allocations in 2040 and 2065 under a high climate change scenario.

Drought Scenarios

Figure 4 above compares the [modelled] available supply (blue bars), during a future drought e.g. the equivalent of the Millennium Drought. The demand (orange bars) is the same as that depicted in Figure 2 for 2040 and 2065. The graphs represent a 'no intervention' scenario.

Typically the available supply can vary greatly from year to year during a drought hence the use of three different time periods, namely 3, 5 and 10 consecutive years. Coliban Water has chosen not to use the single worst year of drought as the basis for planning as generally existing operational flexibility allows us to cope with up to three dry years without necessarily imposing restrictions.

The 'demand management' measures (yellow hatched bars) reflect the anticipated reduction in demand if Stage 3 restrictions were to be imposed. The blank components reflect the shortfall that would still have to be made up after Stage 3 restrictions were to be imposed.

Table 7: Drought scenario shortfalls.

Year	Time Period (years)	Shortfall (ML)
2040	3	3,284
	5	1,421
	10	0
2065	3	6,049
	5	4,775
	10	274

Table 8: Estimated reduction in demands when restrictions implemented.

Water Savings from Restrictions (%)	Stage 1	Stage 2	Stage 3	Stage 4
Rural	12%	52%	62%	88%
Urban	3%	12%	14%	20%

Water Restriction Calculations

The estimated water savings achieved through water restrictions are based on the actual water savings achieved in the 9-year dry period of water restrictions from 2002 to 2010. The extent of the actual savings achieved during this period of water restrictions was adjusted to take into account the significant water savings achieved over the past five years through the way customers now use water. Stage 4 demands are estimated to be relatively unchanged from previous estimates of 2012 and are based on winter-off-season demands.

However, overall PWSR demands have significantly reduced since 2012 due to conservative customer water use behaviour. The extent of system demand between PSWR and Stage 4 is now significantly “compressed” by as much as 40% whereby there is up to 40% less water that can be further achieved through water restrictions. Accordingly, forecast future water savings from water restrictions were estimated for each water supply system by reducing the actual savings achieved in the most recent restrictions of 2002-2010 by the above calculated level of “compression” for each water supply system.

Wastewater System Description

The Coliban System Southern has two water reclamation plants (Castlemaine and Kyneton).

The Castlemaine Water Reclamation Plant collects wastewater from Castlemaine, Campbells Creek, Chewton, Harcourt, Newstead and Maldon. There are 155 km of gravity mains and 3 km of rising mains in the system. The system also collects wastewater from commercial sites in accordance with the trade waste agreements and consents.

Wastewater is treated through a series of processes including screening, biological nutrient removal, aeration, chemical dosing, clarification and UV disinfection. The EPA Victoria allows discharge of Class B reclaimed water to Campbells Creek. Around 5 – 10% of this water is provided to the Castlemaine Gold Club for irrigation and a smaller quantity is taken from a standpipe by local contractors for dust suppression and construction works.

Biosolids are produced, treated and then applied to land by farmers to derive the benefit from the associated nutrients. The EPA licence specifies conditions for the management of emissions from the site including wastewater quality and odour.

The Kyneton Water Reclamation Plant consists of two systems, domestic wastewater and trade waste.

The domestic wastewater treatment plant treats wastewater from Kyneton, Malmsbury, Trentham and Tylden. The wastewater is collected via 13 pump stations and a sewer network comprising of 80 km of gravity mains and 11 km of rising mains.

The wastewater is treated through a series of processes that includes solids screening, biological nutrient removal, aeration, clarification, micro-screening and UV disinfection. The Class B water produced is used to irrigate the Kyneton racecourse, sports grounds and botanic gardens as well as the extensive irrigation system on the site of the plant. In winter the majority of this water is stored in the on-site lagoons awaiting irrigation over the summer or is discharged to the Campaspe River in accordance with the EPA licence. Sludge is stored in four lagoons.

The trade waste system collects wastewater from the Kyneton industrial estate including the Hardwicks abattoir and the livestock exchange. This together with septic tank waste delivered by local septic contractors is treated in a dedicated aerated lagoon/trickling filter system. Sludge from both treatments plants is periodically removed from the lagoons and the biosolids are beneficially reused for agricultural purposes. The EPA licence specifies condition for the management of emissions from the site including wastewater quality and odour.

Table 9: Wastewater treatment plant characteristics.

Location	Nominal Capacity (ML/day)[1]	Estimated Augmentation Year[2]	Class of Recycled Water	2015-16 Reuse Volume (ML)	2015-16 Discharge to Waterways (ML)
Castlemaine	4.68	After 2043	C	117.10	1,018.85
Kyneton Domestic	2.30	After 2043	B & C	377.25	258.0
Kyneton Trade Waste	2.38	After 2043	N/A	N/A	N/A

Note 1: Relates to Peak Daily Flows, not annual plant capacity.
Note 2: Figures taken from regular internal plant review process.

Wastewater Customer Group Characterisation and Growth

Customer sewer connections in Coliban Southern are projected to increase from 8,986 to 16,186 by 2065.

Table 10: Projected growth[1] in sewer connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	8,070	729	161	26	8,986
2040	11,460	904	209	26	12,599
2065	14,709	1,169	282	26	16,186

Note 1: Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.

Next Steps

To ensure the water security of the system by maintaining the balance between supply and demand a list of system specific capital and business as usual initiatives are tabled below. The capital initiatives were subjected to a preliminary analysis using Coliban Water's Multi-Criteria Analysis (MCA) tool.

As part of the future actions, the initiatives will be subjected to further detailed analysis for the following three demand scenarios:

- Baseline demand imbalance
- Dry weather peak month demand
- Demand during worst three drought scenarios (worst 3, 5 and 10 years)

Note that the demand and supply considerations are for high climate change scenarios.

The next steps of the option analysis will include the following:

- Community and stakeholder engagement
- Detail analysis of capital and BAU options (filling the short fall and sequencing
- Research projects (ground water and evaporation management)

A large amount of water is lost through evaporation from Coliban Headworks Storages. A research project to study possible measures to reduce evaporation is proposed. This could be a collaborative project involving external parties such as universities and private companies. It is also proposed to undertake investigation to access ground water to Kyneton.

Table 11: Capital projects.

Strategy	Initiative		
Demand Management	**Raw Water Supply System - Reduce Evaporation from Storages (Investigation):** Evaporation reduction measures for the Coliban Headworks Storages and minor service basins (McCay and Barkers Creek Reservoirs). This could include mechanical covers on minor basins or evaporation resistant barriers for larger storages.	MCA Ranking	3
		Estimated Cost	$1,000,000
		Implement time	2-3 Years
		Water gained (ML/Yr.)	-
		$/ML	-
Demand Management	**Pipeline connection between Lauriston Reservoir and Coliban Main Channel:** Construct a pipeline from Lauriston Reservoir that allows downstream flows to by-pass Malmsbury Reservoir. This allows Malmsbury Reservoir to be fully drained and improves control of deliveries downstream e.g. to Castlemaine or rural channels.	MCA Ranking	4
		Estimated Cost	$4,300,000
		Implement time	3-4 Years
		Water gained (ML/Yr.)	500
		$/ML	$172
Demand Management	**Selected Rural Channels Connected to External Supply via Pipeline:** Several rural channel systems, which are currently supplied from the Coliban Main Channel, are capable of being connected to external sources e.g. the Lake Eppalock to Sandhurst Pipeline. The channels include; Emu Valley No. 1 (Inc. Abbots) and Emu Valley No. 2, Spring Gully (Inc. Diamond Hill). These channels range in efficiency from 50-70%. The channels could be partially or fully supplied from external sources. If all license holders were fully supplied from the pipeline it would result in demand reduction on the Coliban Headworks Storages of about 1,000-2,000 ML per annum on average. However it may not be feasible to supply all license holders and hence a partial supply would deliver a lower volume of savings depending on the configuration. The net result of this option would be to reduce demand on the Coliban System Southern.	MCA Ranking	2
		Estimated Cost	$3,000,000
		Implement time	3-4 Years
		Water gained (ML/Yr.)	1,000
		$/ML	$60
Alternative Water Sources	**Groundwater:** Investigate options to access groundwater (Central Victorian Mineral Springs, Coliban Zone) for Kyneton, and/or purchase existing groundwater license entitlements. This provides an alternative source of water for Kyneton and would allow the Coliban Headworks Storages to operate at lower levels to supply Castlemaine and connected communities. An alternative source of water will help defer the construction of the 'Castlemaine Link'.	MCA Ranking	5
		Estimated Cost	$4,000,000
		Implement time	5-6 Years
		Water gained (ML/Yr.)	1,000
		$/ML	$1,600

	Any new source of water may require an upgrade of the water treatment plant to pre-treat the water to a standard suitable for treatment. Any pre-treatment is likely to have a 1 – 2 year lead time to implement.		
Alternative Water Sources	**Connect Castlemaine to Bendigo:** This option involves the extension of the Goldfields Superpipe to connect Bendigo to Castlemaine. It would provide greater water security to the Coliban System Southern in times of severe water shortage. However, this option does not provide additional water but rather allows for the distribution of the existing available water to where it is most needed. Planning and construction could take up to 5 years with the necessary upgrades to the Castlemaine WTP taking 2 – 3 years.	MCA Ranking Estimated Cost Implement time Water gained (ML/Yr.) $/ML	7 $27,000,000 4-5 Years 10,000 $54
Supply Augmentation	**Pipeline from Lauriston Reservoir to Kyneton Water Treatment Plant:** Connect the outlet of Lauriston Reservoir via a pipeline directly to the Kyneton Water Treatment Plant. During severe water shortages this allows Lauriston Reservoir to store the bulk of the water within the Coliban Headworks Storages and allows greater access to 'dead' storage' even when the inlet for the Kyneton pumps is no longer able to access raw water. The Kyneton WTP may require upgrading to provide for additional pretreatment (e.g. coagulation and clarification). The upgrade is likely to have at least a two year lead time to implement.	MCA Ranking Estimated Cost Implement time Water gained (ML/Yr.) $/ML	6 $2,200,000 3-4 Years 1,000 $40
Supply Augmentation	**Additional Storage Capacity:** The Coliban Southern system is totally reliant on the Coliban Headworks Storages for its supply. Additional storage capacity would reduce the risk of water shortage. The magnitude of additional capacity would require detailed investigation and is likely to be in the order of 30,000 ML to 40,000 ML. Such an option is not likely to be cost effective.	MCA Ranking Estimated Cost Implement time Water gained (ML/Yr.) $/ML	1 $20,000,000 3-4 Years 30,000 $666

The BAU initiatives listed below are in addition to the generic initiatives that are listed Part C.

Table 12: Business as usual initiatives.

Strategy	Initiative
Operational Flexibility (Ongoing)	**Storage Operating Levels:** The three major storages of Upper Coliban, Lauriston and Malmsbury Reservoirs are operated in conjunction to minimise evaporative losses. The key objective is to maximise storage in Lauriston Reservoir and hence allow Upper Coliban Reservoir to be drawn down during the water year. Lauriston Reservoir is the most efficient of the three storages. Malmsbury Reservoir is usually drawn down to a volume of around 6,000 ML and maintained at this level until sufficient inflows are received to warrant refilling. During a severe or extreme water shortage the reservoir could be drawn down to minimise evaporative losses provided the Coliban Main Channel could continue to be operated.
Operational Flexibility (Ongoing)	**Maintain minimum flows within the Coliban Main Channel:** Coliban Water operates the ~70 km Coliban Main Channel to transfer water from Malmsbury Reservoir to: • Castlemaine (McCay Reservoir) • Harcourt (Barkers Creek Reservoir) • Bendigo (Sandhurst and Spring Gully Reservoirs), and • Rural channels in the Coliban Systems (Northern and Southern). The Coliban Main Channel undergoes routine maintenance each year to ensure the integrity of the channel and reduce seepage. During operations the channel is only operated at or just above the minimum flow necessary to meet demand. In general the lower the flow rate the lower the overall losses. Any raw water not lost in transfer is retained in storage and assists in preserving future supplies.
Operational Flexibility (Ongoing)	**Adjust Demand (linked to Volumetric Trigger):** There are four levels of the Volumetric Trigger. When the trigger level is reached the Coliban Main Channel ceases to supply Bendigo and pumping from external sources becomes the means of supply for the Coliban System Northern. Lowering the flow in the Coliban Main Channel saves water due to the reduction in losses that normally occur from operating the channel. The reset of the volumetric trigger requires little lead time. During years of low water supply or predicted dry years the trigger can be pushed to a higher level which in turn results in the channel operation ceasing at an earlier date and securing more supply for the Coliban System Southern.
Operational Flexibility (Ongoing)	**Volumetric Trigger:** A volumetric trigger applies to the combined storage volume of the Coliban Headworks Storages (CHS). The storages are Upper Coliban, Lauriston and Malmsbury. The storages provide for all of the demands for the Coliban System Southern and any volume above this requirement is allocated to the Coliban System Northern (i.e. Bendigo and connected communities). Since the northern system is able to draw on additional external sources of supply hence there is some flexibility to provide for Bendigo while securing water for Castlemaine, Kyneton and rural customers that can only be supplied from the Coliban Headworks Storages.
Operational Flexibility (Extreme Events)	**Reduce Length of Irrigation Season:** Coliban Water has not adopted this option during previous dry periods. There are precedents from G-MW whereby the length of the irrigation season was reduced in order to minimise system operating losses.

Demand Management (Ongoing)	**Raw Water Supply System - Improve System Efficiencies of Rural Network:** The first stage of the Rural Modernisation project commenced in 2013-14 and involves piping open channels within the Harcourt rural system. Over the next 20 years, the rural modernisation project is estimated to provide water savings of up to 6,000 ML. Some of these water savings may be offset by rural customers utilising more of their water allocations. Should the supply position deteriorate then the rate of modernisation and/or rationalisation of the rural channel system can be accelerated.
Demand Management (Extreme Events)	**Restrict rural supply to priority customers:** The option comes into effect once Stage 4 restrictions are implemented at which point rural customers would receive zero allocation. During the Millennium Drought the rights to water were qualified and 'priority' rural customers received a 30% allocation (Minister for Water, 2009). Coliban Water may consider the implementation of a comparable scheme during severe water shortages. (*This would require the development of a policy position by Coliban Water).*
Demand Management (Extreme Events)	**Close or restrict supply to the least efficient rural channels:** Temporarily close the least efficient, or least efficient sections of the rural channel network. Assumes that Stage 4 restrictions have not been imposed whereby rural allocations would be above zero.

Appendix C – Elmore System

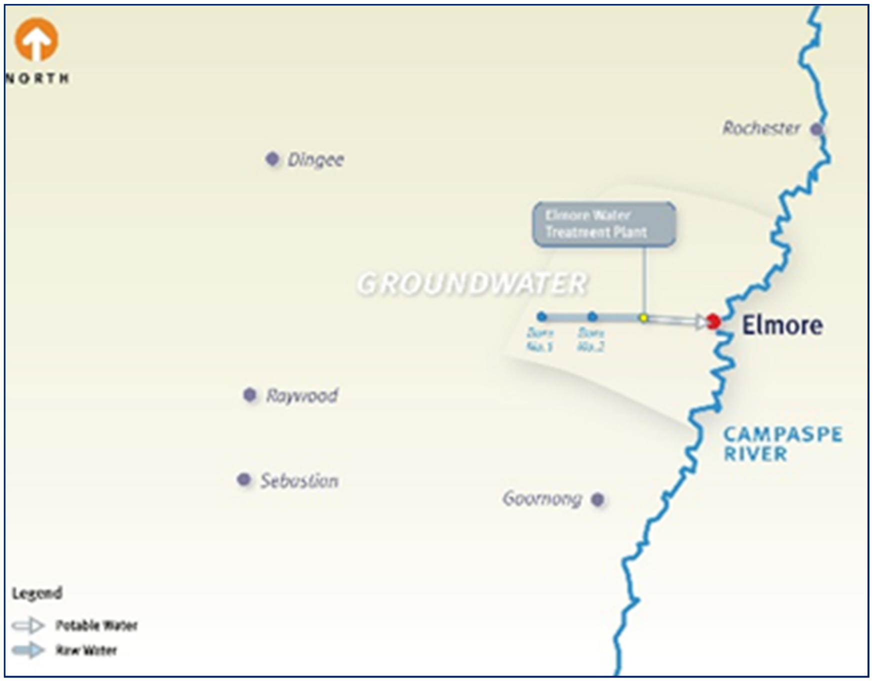

Figure 1: Elmore System showing water sources.

System Description

The Elmore Groundwater System supplies the town of Elmore, servicing 361 urban connections (i.e. connection with house) with an estimated customer population of 632 as of July 2016.

Raw water is pumped (maximum rate of 1.8 ML/day from two groundwater bores (75 m deep) and transferred to the Elmore Water Treatment Plant (WTP). The water is treated and supplied to a 340 KL elevated tank and the township of Elmore. The WTP provides disinfection and ultra violet sterilization.

Groundwater is drawn directly from the Lower Campaspe Valley Water Supply Protection Area (LCV WSPA) under groundwater extraction license with an annual volume of a 284 ML. From November 2012 carryover became available for groundwater licence holders in LCV WSPA. Our licence allows up to 71 ML of unused water to be used in the next year.

The Lower Campaspe WSPA Groundwater Management Plan was endorsed by a consultative committee and approved by the Minister for Water, 17 October 2012. The Plan provides protection for existing users and the environment by supporting a cap on license entitlement; restricting the extraction of groundwater when triggered; and placing limits on the concentration of groundwater pumping. The Plan provides license holders with the opportunity to better manage their entitlements through the introduction of carryover and permanent trade.

Goulburn-Murray Water is the groundwater manager for the LCV WSPA.

Reliability

The Lower Campaspe Valley WSPA is divided into four zones based on recharge characteristics, the aquifers response to pumping and groundwater salinity. The Elmore-Rochester Zone has significant recharge from rainfall and irrigation accessions as well as leakage from the Campaspe River.

In 2012 with the Lower Campaspe WSPA Groundwater Management Plan introduced trigger levels for restriction on allocations to limit groundwater extractions and manage levels. Staged restrictions on the use of licence entitlement apply when the trigger levels are reached.

Allocations are determined by comparing the three year rolling average of the maximum annual groundwater recovery level. The rolling average moderates the seasonal shift in groundwater levels providing users time to adjust to changes in allocations. It can slow the introduction of restrictions in dry years and delay higher allocations in wetter periods when demand is likely to be low.

If the three year average depth below the natural surface remains above 16 m, 100% allocation will be received. Allocations will reduce to 75% (213 ML) once the depth is below 16 m until 19 m, 50% (142 ML) from 19.1 to 22 m and once it reaches below 22 m the allocation will be 40% (113 ML).

Bore number 79324 is the State observation bore used for monitoring and determining seasonal allocations in the Elmore-Rochester Zone.

System Challenges

The worst three year average allocation is 68% (193 ML). This is less than the projected demands from 2052 onwards. In the event an alternative supply is required, potable water can be supplied via road and/or rail tankers from, Bendigo or Rochester.

Table 1: Vulnerabilities during severe water shortages.

Vulnerability	Impact of Water Shortages
Single source of supply	Unable to access alternative sources of raw water.
Water quality (Acute Impact)	Capacity of WTP to cope with water of varying quality e.g. salinity levels. [Regarded as a very low risk with stable water quality.]
Asset condition (Chronic risk)	Any parts of the urban reticulation networks that may be at risk of failure leading to short-term loss of supply. The vulnerability is managed through 'business as usual' operations and maintenance.
Treatment plant efficiency	Water losses during treatment process.
Reticulation network	Water losses incurred from leakage, pipeline bursts, mains flushing and use of fire hydrants.
Pump failure	Electricity blackout or brownout, or mechanical failure resulting in no supply to the WTP.

Table 2: Water treatment plant characteristics.

Location	Source of Raw Water	Water Treatment Process	Nominal Capacity (ML/day)[1]	Peak Day Demand 2065 (ML/day)[2]
Elmore	Groundwater Bore	UV, Caustic Soda	1.64	0.81

Note 1 Based on treatment plant operating 16 hours per day.
Note 2: Estimated Average Day of Peak Month.

Customer Group Characterisation and Growth

The growth in water connections for Elmore is projected to only increase residential connections. The total amount of new connections is estimated to increase from 438 to 591 by 2065.

Table 3: Projected growth[1] in customer water connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	373	28	27	10	438
2040	448	28	27	10	513
2065	526	28	27	10	591

Note 1: *Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.*

Current and Projected Demand

The current baseline demand for Elmore is 125 ML and with the projected growth in water connections is estimated to increase to 176 ML by 2065. Under a high climate change scenario the impact will increase the 2040 baseline demand by 21% and 32% of the 2065 baseline demand.

Table 4: Projected raw water demands to 2040 & 2065 under a range of climate scenarios.

Climate Scenario	Baseline Demand[1] (ML)	2040 Demand (ML)	2065 Demand (ML)
Current Climate Baseline	125	140	156
Post 1997 Baseline	129	145	161
Climate Change (Low to High)	N/A	157 – 172	189 213

Note 1: *The baseline PWSR demand was determined separately for each town and system, based on the actual PWSR demands over the past five years and taking into account actual rainfall.*

Current and Projected Supply

The following supply projections are based on model data provided by DELWP for a range of climate scenarios. The projected water availability of the Elmore groundwater system to 2065 is forecast to remain unchanged.

Table 5: Projected raw water supply to 2040 & 2065 under a range of climate scenarios.

Analysis	Baseline Supply (ML)	2040 Supply (ML)	2065 Supply (ML)
Current Climate Baseline	280	284	284
Post 1997	284	284	284
Climate Change (Low to High)	N/A	284	284

Supply and Demand Balance

All the scenarios depicted in the projections assume 'no intervention' hence they reflect the magnitude of the challenge ahead. The options identified later are intended to address any imbalance between supply and demand.

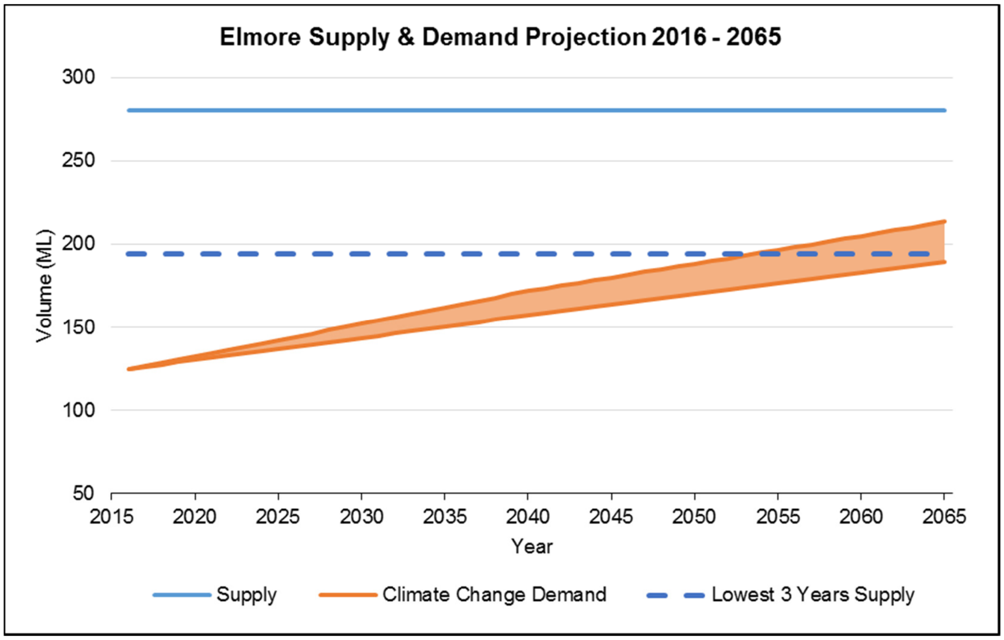

Figure 2: Projected supply and demand to 2065 under a range of climate scenarios.

The Elmore groundwater system is a deep lead aquifer and is not expected to respond to changes in climate over the 50 year timeframe of the UWS, or if it does the change will be gradual allowing adequate time to manage.

Although the lowest available supply during the consecutive three year period 2007 to 2009 was 68%, this was prior to the introduction of trigger levels to impose restrictions on allocations to limit groundwater extractions and manage levels. Based on the depth below the natural surface the allocation received would be 75%.

Supply and Demand Projections (2016 - 2065)

Supply[1]: The component of the graph shows the projected variation in supply under low to high climate change. The projection relies on data supplied by DELWP. Generally there will be a decline in inflows into major storages and/or reduced annual allocations from external suppliers of raw water i.e. GMW and GWM Water. The 'post-1997' line reflects the potential supply that may be available if the catchment responds to rainfall in the same manner as during the Millennium Drought.

Lowest 3 Years: This reflects the lowest [modelled] available supply during a consecutive three year period. In general this reflects the potential severity of future droughts that may be similar to the Millennium Drought. Across most systems, the worst three years in recent times were 2007 to 2009.

Demand: The 'supply and demand projection' graph shows the projected variation in growth in raw water demand based on population growth data supplied by DELWP, and the demand based on low to high climate change. Primarily the impact of high climate change is to increase the demand for outdoor water use due to higher temperatures and lower rainfall.

Note 1: The 'supply' is based on the system 'yield' derived from in-house models. The yield indicates the volume of raw water that can be sustainably supplied by the system to meet our minimum Level of Service obligation of no worse than Stage 3 restrictions.

Table 6: Supply and demand water imbalance.

Year	Shortfall in Supply[1] (ML)	Main Strategies
2040	0	No actions proposed
2065	0	No actions proposed

Note 1: Shortfall in supply without intervention.

The Elmore system is not expected to experience water shortfall for the next 50 years therefore no action is proposed specifically to improve water security. However there is always opportunity to improve the system performance by initiating measures such as storage capacity improvement. The capital and generic BAU measures that are tabled below and in Part C warrant timely consideration.

Learnings From Recent Experience

The Elmore extraction license of 284 ML has historically received 100% allocations. However, for five years from 2006-07 to 2011-12 allocations were less than 100%, with the lowest allocation of 65% received in 2008-09 and 2009-10.

In 2008-09, 50 ML of temporary water was purchased to supplement the allocation and to ensure sufficient supply.

Water restrictions, involving Stage 1 and 2, were in force for more than seven years from November 2002 to July 2006 and from December 2006 to October 2010 when Permanent Water Saving Rules (PWSR) came into place.

Water restrictions had no obvious impact on Elmore's water demand. In 2006-07, at the height of water shortages throughout Central Victoria, there was a significant draw on the Elmore Standpipe by users from outside the Elmore Township utilising water carters.

In 2012 the Lower Campaspe WSPA Groundwater Management Plan introduced carryover and trigger levels to impose restrictions on allocations to limit groundwater extractions and manage levels.

Drought Preparedness

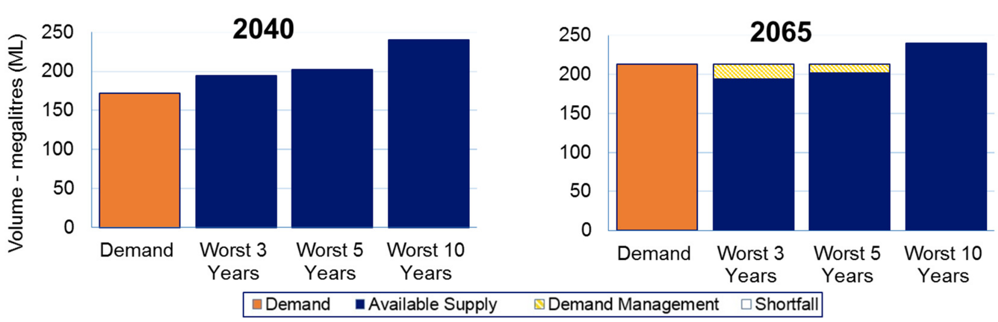

Figure 3: Demand versus projected supply based on lowest consecutive allocations in 2040 and 2065 under a high climate change scenario.

Drought Scenarios

Figure 3 above compares the [modelled] available supply (blue bars), during a future drought e.g. the equivalent of the Millennium Drought. The demand (orange bars) is the same as that depicted in Figure 2 for 2040 and 2065. The graphs represent a 'no intervention' scenario.

Typically the available supply can vary greatly from year to year during a drought hence the use of three different time periods, namely 3, 5 and 10 consecutive years. Coliban Water has chosen not to use the single worst year of drought as the basis for planning as generally existing operational flexibility allows us to cope with up to three dry years without necessarily imposing restrictions.

The 'demand management' measures (yellow hatched bars) reflect the anticipated reduction in demand if Stage 3 restrictions were to be imposed. The blank components reflect the shortfall that would still have to be made up after Stage 3 restrictions were to be imposed.

Table 7: Drought scenario shortfalls.

Year	Time Period (years)	Shortfall (ML)
2040	3	0
	5	0
	10	0
2065	3	19
	5	11
	10	0

Table 8: Estimated reduction in demands when restrictions implemented.

	Stage 1	Stage 2	Stage 3	Stage 4
Water Savings from Restrictions (%)	4%	28%	38%	46%

Water Restriction Calculations

The estimated water savings achieved through water restrictions are based on the actual water savings achieved in the 9-year dry period of water restrictions from 2002 to 2010. The extent of the actual savings achieved during this period of water restrictions was adjusted to take into account the significant water savings achieved over the past five years through the way customers now use water. Stage 4 demands are estimated to be relatively unchanged from previous estimates of 2012 and are based on winter-off-season demands.

However, overall PWSR demands have significantly reduced since 2012 due to conservative customer water use behaviour. The extent of system demand between PSWR and Stage 4 is now significantly compressed by as much as 40% whereby there is up to 40% less water that can be further achieved through water restrictions. Accordingly, forecast future water savings from water restrictions were estimated for each water supply system by reducing the actual savings achieved in the most recent restrictions of 2002-2010 by the above calculated level of "compression" for each water supply system.

Wastewater System Description

Wastewater is collected via five pump stations and approximately 10 km of sewer mains and transferred to the Elmore Water Reclamation Plant located about 4 km east of Elmore. The plant is facultative lagoon system. Treated water is disposed of on-site. Solid wastes are stored at the plant within the lagoon system for periodic disposal to land.

Table 9: Wastewater treatment plant characteristics.

Location	Nominal Capacity KL/day[1]	Estimated Augmentation Year[2]	Class of Recycled Water	2015-16 Reuse Volume (ML)	2015-16 Discharge to Waterways (ML)
Elmore	212.5	After 2040	N/A	N/A	N/A

Note 1: Relates to Peak Daily Flows, not annual plant capacity.
Note 2: Figures taken from regular internal plant review process.

Wastewater Customer Group Characterisation and Growth

The growth in sewer connections for Elmore is projected to only increase residential connections. The total amount of new connections is estimated to increase from 380 to 517 by 2065.

Table 10: Projected growth[1] in sewer connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	335	27	17	1	380
2040	402	27	17	1	447
2065	472	27	17	1	517

Note 1: Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.

Next Steps

To ensure the water security and improve the system performance a system specific capital initiative is tabled below. The capital initiative was subjected to a preliminary analysis using Coliban Water's Multi-Criteria Analysis (MCA) tool.

As part of the future actions, the initiative will be subjected to further detailed analysis for the following three demand scenarios:

- Baseline demand imbalance
- Dry weather peak month demand
- Demand during worst three drought scenarios (worst 3, 5 and 10 years)

Note that the demand and supply considerations are only for high climate change scenarios.

The next steps of the option analysis will include the following:

- Community and stakeholder engagement
- Detail analysis of capital and BAU options (for sequencing)

Table 11: Capital projects.

Strategy	Initiative		
Supply Augmentation	**Additional Storage Capacity:** The Elmore System is totally reliant on groundwater for its supply. Additional storage capacity would reduce the risk of a short-term water shortage due to bore or pump failure.	MCA Ranking	1
		Estimated Cost	$750,000
		Implement time	2-3 Years
		Water gained (ML/Yr.)	-
		$/ML	-

Business as Usual Initiatives

There is no system specific BAU initiative for Elmore. There are generic initiatives that are applicable for all the systems listed in Part C.

Appendix C – Goulburn System

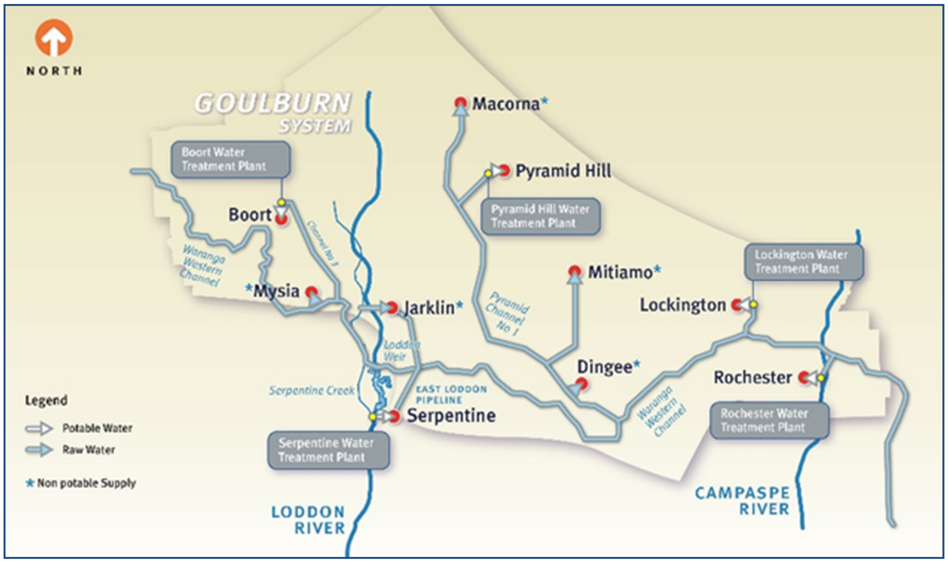

Figure 1: Goulburn System showing water sources.

System Description

The Goulburn System supplies the towns of Rochester, Lockington, Dingee, Pyramid Hill, Boort, Serpentine, Jarklin, Macorna, Mysia and Mitiamo. Water is delivered to the towns' service basins, except for Rochester where these is no service basin.

The primary source of raw water is the Waranga Western Channel (WWC), with the major storage being Lake Eildon. Rochester has the option of drawing water from the Campaspe River, in the event of supply failure or shortage from the WWC. For Serpentine, raw water is pumped via the Goulburn-Murray Water East Loddon (South District) Pipeline.

The Goulburn system has a Bulk Entitlement of 2,420 ML and an additional Water Allowance of 60 ML for Jarklin and Serpentine.

Reliability

Goulburn supply (excluding Serpentine and Jarklin) has a Very High Reliability Water Share (VHRWS) and receives 100% allocation most of the time. The reliability of this supply system is forecasted to be 100% for a foreseeable future. However a single source of supply (except for Rochester) is always a risk. Rochester has the option of sourcing water from the Campaspe system.

Except towns such as Rochester, Boort, Pyramid Hill and Lockington the rest of the Goulburn towns are be able to be serviced by road and/or rail tankers.

The water allowance for Serpentine and Jarklin is equivalent to Goulburn High Reliability Water Share. The projected source reliability for high climate change scenario is low as 64% in 2065. However the system reliability is modeled to be 100% for a foreseeable future.

System Challenges

In addition to being a single source of supply (except Rochester), most of the towns rely on their own storages during seasonal shutdown of the Waranga Western channel. Towns such as Lockington and Pyramid Hill face occasional increased level of turbidity particularly during increased channel flow. Dingee, Mysia and Mitiamo face occasional blue green algal bloom.

Table 1: Vulnerabilities during severe water shortages.

Vulnerability	Impact of Water Shortages
Single source of supply except Rochester	Unable to access alternative sources of raw water.
'Step' change in rainfall	Pre 1996, post 1996 median rainfall.
Restricted supply	Raw water allocations dependent on external provider e.g. GMW. Low allocations, even though Coliban Water is a Very High Reliability Water Share holder.
Medium size community	Towns such as Rochester, Boort, Pyramid Hill and Lockington has an average annual consumption of more than 100ML making these towns too large to supply via road or rail tankers. The Murray Goulburn dairy factory consumes more than 50% of Rochester's total consumption and it will be challenging to maintain supply through alternative means. However a partial supply may be feasible.
Geographical location	Remote location of some of the towns such as Boort, Pyramid Hill, Mysia and Macorna, makes it difficult to maintain supply with alternative means.
Lack of raw water storage for Rochester	If unable to draw water directly from WWC or Campaspe River there is no alternative source such as raw water storage.
Water quality (Acute Impact)	*Boort*: During floods the proportion of water from the Loddon catchment in the raw water is high. This increases the level of salinity (and bromide) in the raw water. *Lockington*: The wind action on the raw water basins increases erosion of the embankment, increasing the turbidity of the raw water. Placing of rock beaching on the embankment would reduce the impact of the wind action. *Dingee*: Experiences occasional blue green algal bloom. *Pyramid Hill*: The narrow channel to the raw water basin gets eroded during high flows and increase the turbidity of the raw water basin. *Mysia*: Experiences very poor water quality in the form of occasional blue green algal bloom and E-coli. *Mitiamo*: Experiences occasional blue green algal bloom. Bushfires in the upper catchment and along the channel system could deliver ash and silt.
Asset condition (Chronic Risk)	Parts of the urban reticulation networks may be at risk of failure leading to short-term loss of supply. The vulnerability is managed through 'business as usual' operations and maintenance.
Evaporation loss	A considerable amount of water is lost through evaporation from the raw water storages (Boort, Lockington and Pyramid Hill).
Seasonal shutdown of WWC	The channel has an annual shutdown from mid-May to mid-August. During drought when allocations are low the channel may operate for a shorter period in order to reduce system losses. When this occurs Coliban Water is unable to draw water from this source without a mid-winter run. Other than Rochester the rest of the system has the storage capacity to store sufficient supply through the shutdown. Rochester is serviced through an arrangement between Coliban

	Water and GMW to maintain a pool of water in the channel during the shutdown. Any operational failure by GMW water could lead to Rochester running out of water as there is no raw water storage and the capacity of the clear water storage is only 30% of the peak day demand.
Power outage	All of the towns on the Goulburn System can be affected by power outage. Rochester has a standby generator to run the WTP during power outage. However the town can still be affected by the inability to pump raw water from WWC in the event of power outage.

Table 2: Water treatment plant characteristics.

Location	Source of Raw Water	Water Treatment Process	Nominal Capacity (ML/day)[1]	Peak Day Demand 2065 (ML/day)[2]
Boort	Waranga Western Channel	Clarification, Sand Filtration, Disinfection	1.47	0.58
Lockington	Waranga Western Channel	Clarification, Sand Filtration, Disinfection	0.41	0.46
Pyramid Hill	Waranga Western Channel	Clarification, Sand Filtration, Disinfection	1.32	0.43
Rochester	Waranga Western Channel	Clarification, Sand Filtration, Disinfection	7.80	4.57
Serpentine	G-MW East Loddon South Pipeline	Clarification, Sand Filtration, Disinfection	0.39	0.13

Note 1: Based on treatment plant operating 16 hours per day.
Note 2: Estimated Average Day of Peak Month.

Customer Group Characterisation and Growth

There is no projected growth across the non-residential customer groups. The projected growth of the residential group is only marginal. The overall growth in connections is projected to be 10% for the next 50 Years.

Table 3: Projected growth[1] in customer water connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	2,332	215	128	49	2,724
2040	2,462	215	128	49	2,854
2065	2,637	215	128	49	3,029

Note 1: Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.

Current and Projected Demand

The current climate baseline demand is projected to increase by 13% for next 50 years. The demand under high climate change scenario however is projected to increase by 51%.

Table 4: Projected raw water demands to 2040 & 2065 under a range of climate scenarios.

Analysis	Baseline Demand (ML)	2040 Demand (ML)	2065 Demand (ML)
Current Climate Baseline	1,656	1,699	1,754
Post 1997 Baseline	1,668	1,711	1,767
Climate Change (Low to High)	N/A	1,862 – 2,049	2,098 – 2,387

Note 1: The baseline PWSR demand was determined separately for each town and system, based on the actual PWSR demands over the past five years and taking into account actual rainfall.

Current and Projected Supply

The following supply projections are based on model data provided by DELWP for a range of climate scenarios.

Given that the Goulburn system has the VHRWS, the supply is not expected to decline for a foreseeable future.

Table 5: Projected raw water supply to 2040 & 2065 under a range of climate scenarios.

Analysis	Baseline Supply (ML)	2040 Supply (ML)	2065 Supply (ML)
Current Climate Baseline	2,420	2,410	2,420
Post 1997	2,240	2,240	2,240
Climate Change (Low to High)	N/A	2,440 - 2,049	2,410 - 2,100

Supply and Demand Balance

All the scenarios depicted in the projections assume 'no intervention' hence they reflect the magnitude of the challenge ahead. The options identified later are intended to address any imbalance between supply and demand.

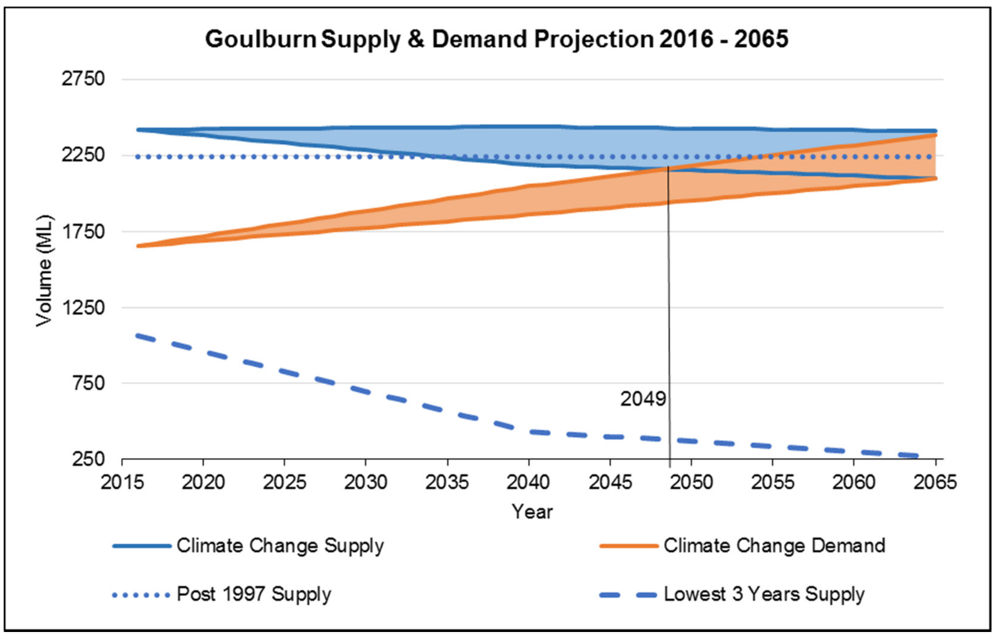

Figure 2: Projected supply and demand to 2065 under a range of climate scenarios.

Lowest 3 years is calculated on the average allocation for the lowest consecutive 3 years on record, 2008 – 2010.

Supply and Demand Projections (2016 - 2065)

Supply[1]: The component of the graph shows the projected variation in supply under low to high climate change. The projection relies on data supplied by DELWP. Generally there will be a decline in inflows into major storages and/or reduced annual allocations from external suppliers of raw water i.e. GMW and GWMWater. The 'post-1997' line reflects the potential supply that may be available if the catchment responds to rainfall in the same manner as during the Millennium Drought.

Lowest 3 Years: This reflects the lowest [modelled] available supply during a consecutive three year period. In general this reflects the potential severity of future droughts that may be similar to the Millennium Drought. Across most systems, the worst three years in recent times were 2007 to 2009.

Demand: The 'supply and demand projection' graph shows the projected variation in growth in raw water demand based on population growth data supplied by DELWP, and the demand based on low to high climate change. Primarily the impact of high climate change is to increase the demand for outdoor water use due to higher temperatures and lower rainfall.

Note 1: The 'supply' is based on the system 'yield' derived from in-house models. The yield indicates the volume of raw water that can be sustainably supplied by the system to meet our minimum Level of Service obligation of no worse than Stage 3 restrictions.

Table 6: Supply and demand water imbalance.

Year	Shortfall in Supply[1] (ML)	Main Strategies
2040	0	No actions proposed
2049	0 - 12	No actions proposed
2065	0 - 287	Supply augmentation

Note 1: Shortfall in supply without intervention.

The Goulburn system is not expected to experience major water shortfall for the next 50 years and therefore no action is proposed specifically to improve water security for next 45 years. However there is always opportunity to improve the system performance by initiating measures such as evaporation management and storage capacity improvement. Therefore the capital and BAU measures that are tabled below and in Part C warrant timely consideration. In Rochester, making the infrastructure to access Campaspe water operational will not only improve the water security of Rochester but also saves available water from the Goulburn system.

Learnings From Recent Experience

Given that the Goulburn system has a VHRWS, the system is reasonably reliable even during dry weather conditions such as the millennium drought. However the lack of raw water storage in Rochester (the biggest town in the Goulburn system) was a concern and Coliban Water was totally relied on the external provider (GMW).

During the 2010-11 flood event when most of the Goulburn towns were flooded, Rochester was badly affected due to heavy flooding (including the WTP) and the WTP's inability to treat extremely poor quality (turbidity and high level of nutrients) water. The town was serviced by bottled water for a considerable period of time. Since then the WTP has been augmented to handle poor quality raw water. The surrounding walls of the WTP has been modified so that the WTP will not be affected during a flood event.

Drought Preparedness

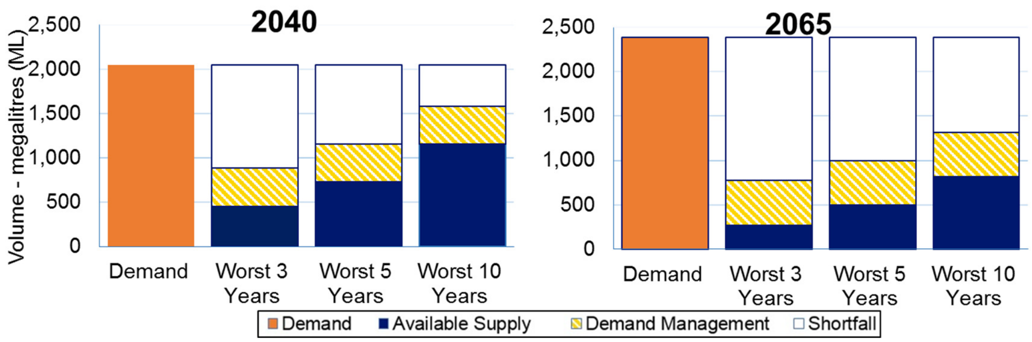

Figure 3: Demand versus projected supply based on lowest consecutive allocations in 2040 and 2065 under a high climate change scenario.

Drought Scenarios

Figure 3 above compares the [modelled] available supply (blue bars), during a future drought e.g. the equivalent of the Millennium Drought. The demand (orange bars) is the same as that depicted in Figure 2 for 2040 and 2065. The graphs represent a 'no intervention' scenario.

Typically the available supply can vary greatly from year to year during a drought hence the use of three different time periods, namely 3, 5 and 10 consecutive years. Coliban Water has chosen not to use the single worst year of drought as the basis for planning as generally existing operational flexibility allows us to cope with up to three dry years without necessarily imposing restrictions.

The 'demand management' measures (yellow hatched bars) reflect the anticipated reduction in demand if Stage 3 restrictions were to be imposed. The blank components reflect the shortfall that would still have to be made up after Stage 3 restrictions were to be imposed.

Table 7: Drought scenario shortfalls.

Year	Time Period (years)	Shortfall (ML)
2040	3	1,594
	5	1,320
	10	896
2065	3	2,114
	5	1,891
	10	1,574

Table 8: Estimated reduction in demands when restrictions implemented.

Water Savings from Restrictions (%)	Stage 1	Stage 2	Stage 3	Stage 4
	5%	11%	21%	25%

Water Restriction Calculations

The estimated water savings achieved through water restrictions are based on the actual water savings achieved in the 9-year dry period of water restrictions from 2002 to 2010. The extent of the actual savings achieved during this period of water restrictions was adjusted to take into account the significant water savings achieved over the past five years through the way customers now use water. Stage 4 demands are estimated to be relatively unchanged from previous estimates of 2012 and are based on winter-off-season demands.

However, overall PWSR demands have significantly reduced since 2012 due to conservative customer water use behaviour. The extent of system demand between PSWR and Stage 4 is now significantly "compressed" by as much as 40% whereby there is up to 40% less water that can be further achieved through water restrictions. Accordingly, forecast future water savings from water restrictions were estimated for each water supply system by reducing the actual savings achieved in the most recent restrictions of 2002-2010 by the above calculated level of "compression" for each water supply system.

Wastewater System Description

The Boort Reclamation Plant is located approximately 2.5 km north of Boort. Wastewater is treated at the plant through a lagoon system to a Class C standard. The system consists of two facultative lagoons, a maturation lagoon and a winter storage lagoon and an irrigation system. The Class C reclaimed water is irrigated to farmland surround the site. The EPA specifies conditions for the management of emissions from the site including wastewater quality and odour.

The Lockington Water Reclamation Plant was constructed in 1927 and wastewater is collected via five pump stations and travels through 10 km of sewer mains. Wastewater is treated at the plant through a 3 hectare lagoon system to a Class C standard. The Class C reclaimed water is evaporated or irrigated to farmland surround the site. The EPA specifies conditions for the management of emissions from the site including wastewater quality and odour.

The Pyramid Hill Reclamation Plant was constructed in 2003 and comprises five pump stations and 8km of sewer network. Wastewater is treated at the plant through a lagoon system to a Class C standard. The system consists of two facultative lagoons, a maturation lagoon, a winter storage lagoon and an irrigation system. The treated water is evaporated or irrigated to an adjacent 8 hectare treated effluent area. The EPA specifies the conditions for the management of emissions from the site including wastewater quality and odour.

The Rochester Water Reclamation plant consists of 14 pump stations and 30 km of sewer mains. The plant was commissioned in 2014 and is operated by an external party on behalf of Coliban Water. Wastewater is treated using a membrane bioreactor process. Wastewater is treated to a Class B standard and piped to storage lagoons and then supplied to local irrigators. The external party holds the EPA license which specifies the conditions for the management of emissions from the site including wastewater quality and odour.

Table 9: Wastewater treatment plant characteristics.

Location	Nominal Capacity (KL/day)[1]	Estimated Augmentation Year[2]	Class of Recycled Water	2015-16 Reuse Volume (ML)	2015-16 Discharge to Waterways (ML)
Boort	137.40	At Capacity	C	19.77	0.00
Lockington	127.50	After 2040	C	0	0
Pyramid Hill	93.5	At Capacity	C	0	0
Rochester[3]	Not assessed	Not assessed	B	0	0

Note 1: Relates to Peak Daily Flows, not annual plant capacity.
Note 2: Figures taken from regular internal plant review process.
Note 3: Rochester is operated under Build Own Operate Transfer arrangement

Wastewater Customer Group Characterisation and Growth

Similar to water connections the wastewater connections are also expected to increase only marginally. The overall increase in connections is 12% for the next 50 years.

Table 10: Projected growth[1] in sewer connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	2,020	187	74	13	2,294
2040	2,138	187	74	13	2,412
2065	2,296	187	74	13	2,570

Note 1: Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.

Next Steps

To ensure the water security of the system by maintaining the balance between supply and demand a list of system specific capital and business as usual initiatives are tabled below. The capital initiatives were subjected to a preliminary analysis using Coliban Water's Multi-Criteria Analysis (MCA) tool.

As part of the future actions, the initiatives will be subjected to further detailed analysis for the following three demand scenarios:

- Baseline demand imbalance
- Dry weather peak month demand
- Demand during worst three drought scenarios (worst 3, 5 and 10 years).

Note that the demand and supply considerations are only for high climate change scenarios.

The next steps of the option analysis will include the following:

- Community and stakeholder engagement
- Detail analysis of capital and BAU options (filling the short fall and sequencing)
- Research projects (ground water and evaporation management).

The evaporation management initiative for the two storage basins in Lockington could be a case study project to analyse the effectiveness of different evaporation control measures. The study on the Campaspe deep lead could provide valuable information to make medium to long decision on accessing ground water for Goornong, Rochester and Lockington.

Table 11: Capital projects.

Strategy	Initiative		
Demand Management	**Raw Water Supply System - Reduce Evaporation from Storage basins:** Implement evaporation reduction measures for the Coliban Water storage basins in Boort, Lockington, Dingee, Pyramid Hill, Macorna, Mysia and Mitiamo. This could include floating covers, Aqua-Cap, Aqua-Armour or Ag-Floats on minor basins and/or evaporation resistant barriers and wind breaks (such as trees) for larger storages.	MCA Ranking	5
		Estimated Cost	$1,600,000
		Implement time	2 Years
		Water gained (ML/Yr.)	94
		$/ML	$830
Alternative Water Sources	**Groundwater – Deep Lead:** The Campaspe Deep Lead which extends from Axedale (near Eppalock) to Echuca (Murray River) is an alternative source to service Rochester and Lockington. The southern part of the Deep Lead (Barnadown Zone) has remained relatively constant despite severe dry conditions (GMW 2012). Even though the Elmore-Rochester Zone felt some impact of the prolonged dry weather, it had the ability to quickly recharge during wet weather and from seepage from the Campaspe River (GMW 2012). A water balance study conducted by GMW suggests that the ground water levels would remain steady under average climate conditions based on recent usage. In general the ground water quality is good. However the northern end of the deep lead experiences increased levels of salinity. The salinity level south of Waranga Western Channel is between 350-1000 mg/L (GMW 2012). A salinity level of less than 600 mg/L is considered to be aesthetically acceptable for potable water. Studies conducted by GMW has indicated that the salinity levels are on the rise (GMW 2012). If this source of water is to be accessed as an alternative for Rochester and Lockington, at some point in time the treatment facilities need to be upgraded to pre-treat the water. Any pre-treatment is likely to have a 1 – 2 year lead time to implement.	MCA Ranking	6
		Estimated Cost	$1,100,000
		Implement time	2 – 3 Years
		Water gained (ML/Yr.)	500
		$/ML	$88
Alternative Water Sources	**Murray River connection to Rochester and Lockington:** Construct a pipeline and pump station (in Echuca) to transfer water from the Murray River	MCA Ranking	9
		Estimated Cost	$18,500,000
		Implement time	3 – 4 Years

	to Rochester and Lockington. If constructed independently, the lengths of the pipelines will be roughly 30 km and 38 km respectively. Alternatively the Lockington branch of the pipeline can be branched-off from the main Rochester pipeline. The Rochester pipeline has the potential for two-way transferring of water either from Murray River to Rochester or from Goulburn or Campaspe Rivers to Echuca. From Rochester the water could be transferred to Echuca by gravity.	Water gained (ML/Yr.)	340
		$/ML	$1,500
Supply Augmentation	**Erosion control measures on the Lockington Basin:** Erosion on the raw water basin embankment at Lockington increases during increased wind action. As a result the turbidity of the raw water increases hence reducing the treatment plant output. Placing rock beaching along the basin embankment will reduce erosion. It is also appropriate to plant trees as wind barriers to slow the wind across the basin.	MCA Ranking	2
		Estimated Cost	$130,000
		Implement time	1 Year
		Water gained (ML/Yr.)	-
		$/ML	-
Supply Augmentation	**Make Campaspe raw water infrastructure operational:** Only about 17% of the Campaspe entitlement was utilised in 2014-15. The existing intake structure need to be improved to conveniently access the water from the Campaspe river near the treatment plant. The salinity level in the river could be a concern. However, during high flow events the salinity level is expected to be low and should be able to be utilised for urban use.	MCA Ranking	3
		Estimated Cost	$200,000
		Implement time	2 Years
		Water gained (ML/Yr.)	134
		$/ML	$100
Supply Augmentation	**Erosion control measures on the Pyramid Hill raw water channel:** Flow through the narrow Coliban Water raw water channel causes erosion and turbidity. The length of the channel is approximately 700 m. Widening and lining of the channel will eliminate erosion and improve the quality of the raw water.	MCA Ranking	4
		Estimated Cost	$200,000
		Implement time	2 Years
		Water gained (ML/Yr.)	-
		$/ML	-
Supply Augmentation	**Backwash water internal reuse:** Roughly 15% of the intake water is lost on treatment processes, in particular on the filter backwash process. If treated adequately the backwash water has the potential to be reused. Treatment plants such as Rochester, Boort, Lockington and Pyramid Hill require upgrade to treat backwash water to a level of reuse.	MCA Ranking	1
		Estimated Cost	$1,100,000
		Implement time	2 Years
		Water gained (ML/Yr.)	200
		$/ML	$360

Supply Augmentation	**Emergency raw water basin for Rochester:** The Waranga Western Channel has an annual shutdown from mid-May to mid-August. During drought when allocations are low the channel may operate for a shorter period in order to reduce system losses. When this occurs Coliban Water is unable to draw water from this source. A new emergency raw water basin is required to improve the water security of Rochester during the winter shutdown. The basin is to store water to be utilised in the event of any operational failure by GMW and to provide Coliban Water an option to fall back on during any such event. The capacity of the storage will depend on the level of security (number of days) Coliban Water requires.	MCA Ranking	7
		Estimated Cost	$1,300,000
		Implement time	2 – 3 Years
		Water gained (ML/Yr.)	-
		$/ML	-
Supply Augmentation	**Desalination for Boort:** Boort has the potential to source water from the Loddon system. However the salinity levels in the Loddon River are generally high and the Boort treatment plant is not designed to remove salt. If the treatment plant is upgraded to remove salt, the Loddon River can be an alternative source for Boort.	MCA Ranking	8
		Estimated Cost	$3,200,000
		Implement time	3 Years
		Water gained (ML/Yr.)	85
		$/ML	$2,500

The BAU initiatives listed below are in addition to the generic initiatives that are listed Part C.

Table 12: Business as usual initiatives.

Strategy	Initiative
Operational Flexibility (Ongoing)	**Operational flexibility between Goulburn and Campaspe – Rochester:** The operator should be able to access water from the Campaspe river when the salinity levels are below a manageable level.
Alternative Water Source	**Backwash water discharge and downstream credit – Rochester:** At Rochester, the treated backwash water has the potential to be discharged into the Campaspe River in order to gain downstream credits. The benefit is estimated to be in the order of 150 ML/year. To achieve the quality required the treatment plant needs to be upgraded. The treated backwash water in Rochester will have the benefits of internal reuse or river discharge for downstream credit depending on the level of treatment.

Appendix C – Loddon System

Figure 1: Loddon System showing water sources.

System Description

The Loddon System services the towns of Bridgewater, Inglewood, Laanecoorie, Tarnagulla, Dunolly and Bealiba.

Bridgewater and Inglewood are serviced by the Bridgewater treatment plant and Laanecoorie, Tarnagulla, Dunolly and Bealiba are serviced by the Laanecoorie treatment plant.

Serpentine and Jarklin which were serviced from the Loddon System are now been serviced from the Goulburn System.

Raw water for Bridgewater is sourced from the Loddon River and stored in two raw water basins (Primary Basin – 4 ML and Secondary Basin – 18 ML). The treated water from the Bridgewater treatment plant is supplied to Bridgewater and Inglewood townships.

Raw water for Laanecoorie is also sourced from the Loddon River. However there is no raw water storage facility in Laanecoorie. The treated water from the Laanecoorie treatment plant is supplied to Laanecoorie, Tarnagulla, Dunolly and Bealiba townships.

Reliability

The Source and System Reliabilities are estimated to be 47% and 85% in 2065 under a high climate change scenario. The Loddon system however, being a single source supply system is prone to suffer during severe drought. In 2008-09 (during Millennium Drought) the allocation was 0%. During a prolonged drought, given that there is no alternative supply, the system is at greater risk.

System Challenges

The Loddon System has a number of vulnerabilities, however the most critical are the single source of supply and salinity in the source water. A critical vulnerability is the difficulty in operating the Loddon River downstream of Cairn Curran Reservoir. GMW need sufficient reserves to allow for system losses. The Loddon River exhibits a wide variation in inflow from year to year.

In addition to water security risks, the Loddon system also suffers from high levels of salinity and constant black water events. During dry weather, the water quality deteriorates and the treatment plants are not designed to treat surge in black water events.

Some of the towns in the system can be serviced by road tanker should an alternative supply be required. However, during a prolonged drought situation, such as the Millennium Drought, the system is at greater risk.

Table 1: Vulnerabilities during severe water shortages.

Vulnerability	Impact of Water Shortages
Single source of supply	Unable to access alternative sources of raw water.
'Step' change in rainfall	Pre 1997, post 1997 median inflow.
Limited inter valley trade (IVT)	Compare to most of the GMW systems the IVT in and out of Loddon system is limited, leading to restricted access to the water market.
Lack of raw water storage for Laanecoorie	The raw water is pumped directly from the Loddon river to the WTP. There is no temporary storage facility/basin to store and draw water when the water level is low in the river or during any other emergency.
Asset condition (Chronic Risk)	Parts of the urban reticulation networks may be at risk of failure leading to short-term loss of supply. The vulnerability is managed through 'business as usual' operations and maintenance.
Network system losses	In 2015-16, 26% and 16% of treated water was lost through leaks in the Laanecoorie and Bridgewater network systems respectively.
Restricted supply	Raw water allocations dependent on external provider e.g. GMW. Allocations can be low during drought, even though Coliban Water has a minimum allocation of 50%.
Water quality (Acute Impact)	Salinity levels in the Loddon system is generally high. During drought, the salinity levels can reach up to 1,730 mg/L and 2019 mg/L in Laanecoorie and Bridgewater respectively. The thirteen year median (2003 – 2016) was 590 mg/L and 647 mg/L respectively. Only Bridgewater has the capacity to remove salt. Bushfires in the upper catchment and along the river system could deliver ash and silt. Black water (dissolved organics and agricultural by-products) has been a constant issue in the Loddon system. The treatment plants are not designed to treat a surge in black water. During dry weather, the water quality deteriorates.
Evaporation losses (Chronic Risk)	A high proportion of GMW system losses are attributable to evaporation.

Power outage	Both Bridgewater and Laanecoorie systems do not have standby generators and are affected by power outages.
Geographical location of Laanecoorie WTP	Even though Coliban Water owns a large area of land, where the WTP is located, densely vegetated surrounding areas makes potential expansion such as building raw basins, difficult.

Table 2: Water treatment plant characteristics.

Location	Source of Raw Water	Water Treatment Process	Nominal Capacity (ML/day)[1]	Peak Day Demand 2065 (ML/day)[2]
Bridgewater	Loddon River	Clarification, Sand Filtration, Disinfection, Reverse Osmosis	2.39	1.17
Laanecoorie	Loddon River	Clarification, Sand Filtration, Disinfection	2.64	0.61

Note 1: *Based on treatment plant operating 16 hours per day.*
Note 2: *Estimated Average Day of Peak Month.*

Customer Group Characterisation and Growth

The growth in water connections for the Loddon System is projected to only increase in residential connections. The total amount of new connections is estimated to increase from 1364 to 1528 by 2065.

Table 3: Projected growth[1] in customer water connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	1,201	84	62	17	1,364
2040	1,277	84	62	17	1,440
2065	1,365	84	62	17	1,528

Note 1: *Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.*

Current and Projected Demand

The current baseline demand for the Loddon System is 375 ML and with the projected growth in water connections is estimated to increase to 391 ML by 2065. Under a high climate change scenario the impact may increase the 2040 and 2065 baseline demands by 14% and 26%.

Table 4: Projected raw water demands to 2040 & 2065 under a range of climate scenarios.

Climate Scenario	Baseline Demand (ML)	2040 Demand (ML)	2065 Demand (ML)
Current Climate Baseline	375	384	391
Post 1997 Baseline	377	386	394
Climate Change (Low to High)	N/A	419 – 440	459 - 495

Note 1: *The baseline PWSR demand was determined separately for each town and system, based on the actual PWSR demands over the past five years and taking into account actual rainfall.*

Current and Projected Supply

The following supply projections are based on model data provided by DELWP for a range of climate scenarios.

The current climate baseline supply for the Loddon System is projected to reduce from 580 ML to 500 ML by 2065. Under a high climate change scenario the 2065 supply could reduce to 470 ML.

Table 5: Projected raw water supply to 2040 & 2065 under a range of climate scenarios.

Analysis	Baseline Supply (ML)	2040 Supply (ML)	2065 Supply (ML)
Current Climate Baseline	580	500	500
Post 1997 Baseline	460	460	460
Climate Change (Low to High)	N/A	520 - 480	520 - 470

System and Demand Balance

All the scenarios depicted in the projections assume 'no intervention' hence they reflect the magnitude of the challenge ahead. The options identified later are intended to address any imbalance between supply and demand.

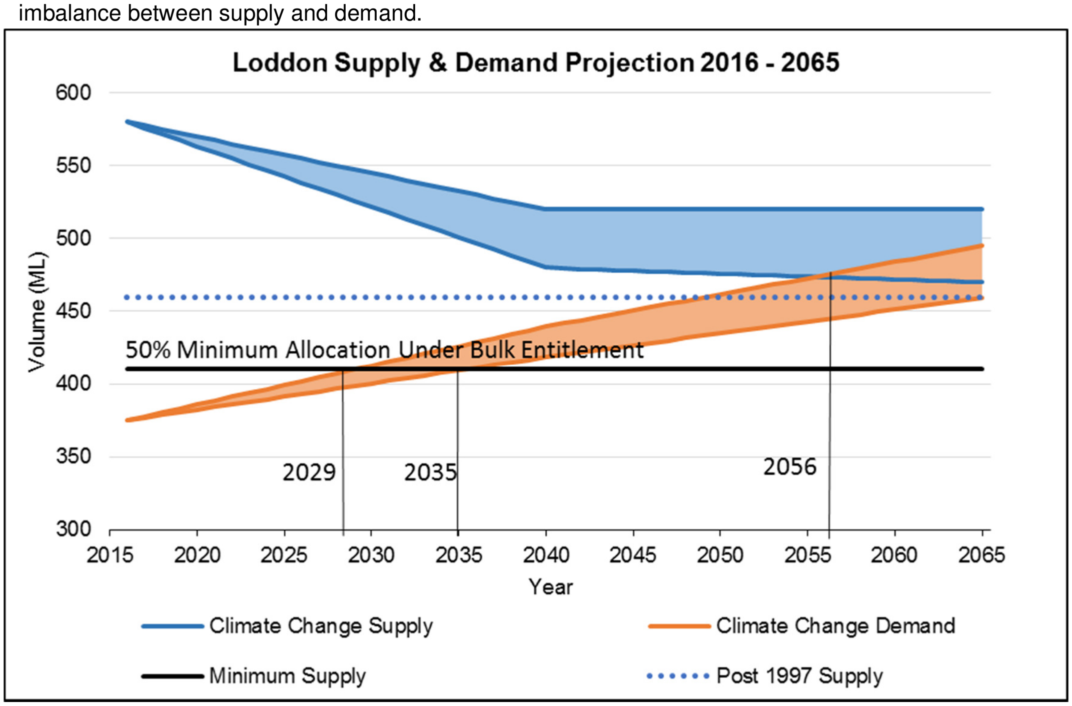

Figure 2: Projected supply and demand to 2065 under a range of climate scenarios.

The Loddon System under high climate change is projected to reach a shortfall between supply and demand by 2056. The 50% minimum allocation rule under the bulk entitlement presents a worst case scenario of augmentation being needed by 2029. In regards to this it should be noted that under a projected post 1997 supply which includes the Millennium Drought, augmentation wouldn't be needed until approximately 2049 in a high climate change demand scenario.

Supply and Demand Projections (2016 - 2065)

Supply[1]: The component of the graph shows the projected variation in supply under low to high climate change. The projection relies on data supplied by DELWP. Generally there will be a decline in inflows into major storages and/or reduced annual allocations from external suppliers of raw water i.e. GMW and GWMWater. The 'post-1997' line reflects the potential supply that may be available if the catchment responds to rainfall in the same manner as during the Millennium Drought.

Lowest 3 Years: This reflects the lowest [modelled] available supply during a consecutive three year period. In general this reflects the potential severity of future droughts that may be similar to the Millennium Drought. Across most systems, the worst three years in recent times were 2007 to 2009.

Demand: The 'supply and demand projection' graph shows the projected variation in growth in raw water demand based on population growth data supplied by DELWP, and the demand based on low to high climate change. Primarily the impact of high climate change is to increase the demand for outdoor water use due to higher temperatures and lower rainfall.

Note 1: The 'supply' is based on the system 'yield' derived from in-house models. The yield indicates the volume of raw water that can be sustainably supplied by the system to meet our minimum Level of Service obligation of no worse than Stage 3 restrictions.

Table 6: Supply and demand water imbalance.

Year	Shortfall in Supply[1] (ML)	Main Strategies
2035	0 – 16	Demand management
2040	0 – 30	Alternative water source
2065	0 – 85	Alternative water source

Note 1: Shortall in supply without intervention.

Even though the system doesn't seem at risk for a foreseeable future, it is extremely vulnerable during dry weather conditions. It is appropriate to start investigating potential alternative sources (such as ground water) at the earliest.

Learnings From Recent Experience

The dry weather conditions that persisted during the Millennium Drought resulted in significant reductions to water allocations from our external bulk supplier Goulburn-Murray Water. The allocation during 2008-09 and 2009-10 was 0% and 3% respectively.

The decline in inflows and allocations across Victoria left water corporations with few choices to reduce demand without resorting to imposing water restrictions. The Loddon System was no exception with restrictions imposed for a total of 96 months since 2002-03, including 46 months on Stage 4 restriction.

Drought Preparedness

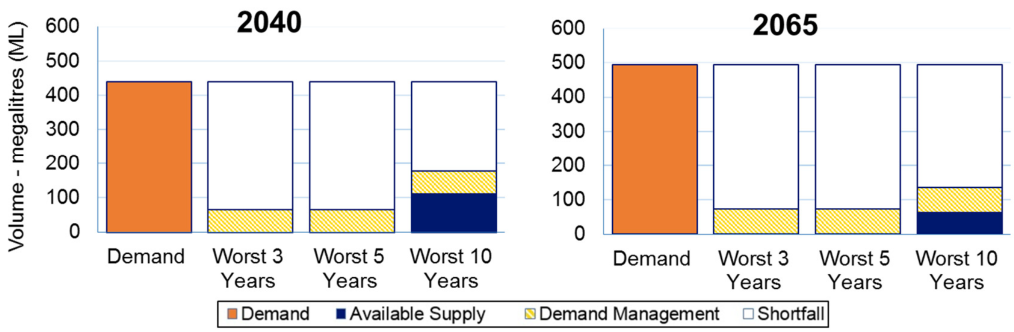

Figure 3: Demand versus projected supply based on lowest consecutive allocations in 2040 and 2065 under a high climate change scenario.

Drought Scenarios

Figure 3 above compares the [modelled] available supply (blue bars), during a future drought e.g. the equivalent of the Millennium Drought. The demand (orange bars) is the same as that depicted in Figure 2 for 2040 and 2065. The graphs represent a 'no intervention' scenario.

Typically the available supply can vary greatly from year to year during a drought hence the use of three different time periods, namely 3, 5 and 10 consecutive years. Coliban Water has chosen not to use the single worst year of drought as the basis for planning as generally existing operational flexibility allows us to cope with up to three dry years without necessarily imposing restrictions.

The 'demand management' measures (yellow hatched bars) reflect the anticipated reduction in demand if Stage 3 restrictions were to be imposed. The blank components reflect the shortfall that would still have to be made up after Stage 3 restrictions were to be imposed.

Table 7: Drought scenario shortfalls.

Year	Time Period (years)	Shortfall (ML)
2040	3	440
	5	440
	10	329
2065	3	495
	5	495
	10	433

Table 8: Estimated reduction in demands when restrictions implemented.

Water Savings from Restrictions (%)	Stage 1	Stage 2	Stage 3	Stage 4
	5%	6%	15%	34%

Water Restriction Calculations

The estimated water savings achieved through water restrictions are based on the actual water savings achieved in the 9-year dry period of water restrictions from 2002 to 2010. The extent of the actual savings achieved during this period of water restrictions was adjusted to take into account the significant water savings achieved over the past five years through the way customers now use water. Stage 4 demands are estimated to be relatively unchanged from previous estimates of 2012 and are based on winter-off-season demands.

However, overall PWSR demands have significantly reduced since 2012 due to conservative customer water use behaviour. The extent of system demand between PSWR and Stage 4 is now significantly "compressed" by as much as 40% whereby there is up to 40% less water that can be further achieved through water restrictions. Accordingly, forecast future water savings from water restrictions were estimated for each water supply system by reducing the actual savings achieved in the most recent restrictions of 2002-2010 by the above calculated level of "compression" for each water supply system.

Wastewater System Description

The Bridgewater-Inglewood Water Reclamation Plant was constructed in 2000 and consists of four pumping stations. It is located on the Calder Highway at Bridgewater. The plant consists of a facultative lagoon and a maturation/winter storage lagoon. The treated water is disposed of through evaporation or discharged on the surrounding on-site farmland.

The Dunolly Water Reclamation Plant was constructed in 2005 and is located 3 km south west of the township. Wastewater is treated at the plant through a three lagoon system to a Class C standard. The system consists of two facultative lagoons, a combine maturation and winter storage lagoon and an irrigation system. The wastewater is used on the land via two woodlots of salt tolerant eucalyptus.

Table 9: Wastewater treatment plant characteristics.

Location	Nominal Capacity (KL/day)[1]	Estimated Augmentation Year[2]	Class of Recycled Water	2015-16 Reuse Volume (ML)	2015-16 Discharge to Waterways (ML)
Bridgewater	170.0	At Capacity	N/A	N/A	N/A
Dunolly	117.3	After 2040	C	0	0

Note 1: Relates to Peak Daily Flows, not annual plant capacity.
Note 2: Figures taken from regular internal plant review process.

Wastewater Customer Group Characterisation and Growth

The growth in sewer connections for the Loddon System is projected to only increase residential connections. The total amount of new connections is estimated to increase from 937 to 1,074 by 2065.

Table 10: Projected growth[1] in sewer connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	824	69	42	2	937
2040	887	69	42	2	1,000
2065	961	69	42	2	1,074

Note 1: Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.

Next Steps

To ensure the water security of the system by maintaining the balance between supply and demand a list of system specific capital and business as usual initiatives are tabled below. The capital initiatives were subjected to a preliminary analysis using Coliban Water's Multi-Criteria Analysis (MCA) tool.

As part of the future actions, the initiatives will be subjected to further detailed analysis for the following three demand scenarios:

- Baseline demand imbalance
- Dry weather peak month demand
- Demand during worst three drought scenarios (worst 3, 5 and 10 years).

Note that the demand and supply considerations are only for high climate change scenarios.

The next steps of the option analysis will include the following:

- Community and stakeholder engagement
- Detail analysis of capital and BAU options (filling the short fall and sequencing)
- Research projects (such as ground water, sewer mining and evaporation management).

Table 11: Capital projects.

Strategy	Initiative		
Demand Management	**Raw Water Supply System - Reduce Evaporation from Storages:** Implement evaporation reduction measures for the Coliban Water storage basins in Bridgewater. This could include floating covers, Aqua-Cap, Aqua-Armour or Ag-Floats on minor basins and/or evaporation resistant barriers and wind breaks (such as trees) for larger storages.	MCA Ranking	1
		Estimated Cost	$315,000
		Implementation time	1 Years
		Water gained (ML/Yr.)	18
		$/ML	$875
Alternative Water Sources	**Groundwater – Deep Lead:** The Loddon Deep Lead which extends from Tullaroop reservoir in the south to Mitiamo in the north is a relatively secure source of water to service Laanecoorie and Bridgewater and their satellite towns. Generally the salinity level of the groundwater in the Loddon deep lead ranges from 1,100 to 1,600 mg/L. The Bridgewater reverse osmosis plant has the capacity to remove TDS concentration of up to 4,000 mg/L. Bridgewater has the potential to use groundwater without upgrades to the treatment facility. However the brine handling system (lagoon) may have to be expanded. Bridgewater already has a groundwater entitlement of 960 ML which is more than the total annual consumption of the Loddon system. The Laanecoorie treatment plant currently does not have the capacity to remove salt. If groundwater is to be considered as an alternative source for Laanecoorie the treatment plant need to be upgraded.	MCA Ranking	2
		Estimated Cost	$7,000,000
		Implementation time	2 – 3 Years
		Water gained (ML/Yr.)	400
		$/ML	$1,600
	Local Sewer Mining: Small scale, community based, local sewer mining schemes can be	MCA Ranking	6
		Estimated Cost	$4,000,000

Alternative Water Sources	considered as an alternative source for public space and potentially for some industrial use. Sewer mining is currently used in parts of Australia including Victoria as an alternative for water supply. Sewer mines also has the benefit of reducing load on the waste water treatment plants. This option requires detailed investigation to assess the suitability for the Loddon system and extensive community consultation.	Implementation time	2 – 3 Years
		Water gained (ML/Yr.)	270
		$/ML	$600
Alternative Water Sources	**Pipeline from Maldon to Laanecoorie:** Extend the Castlemaine to Maldon pipeline to Laanecoorie in order to access treated water from Castlemaine (source water from Coliban Southern storages). The extension work may require pump stations and disinfection booster system.	MCA Ranking	4
		Estimated Cost	$7,500,000
		Implementation time	3 Years
		Water gained (ML/Yr.)	170
		$/ML	$885
Alternative Water Sources	**Treated water pipeline from Bendigo to Laanecoorie and Bridgewater:** This option is to connect Laanecoorie and Bridgewater to Bendigo urban water system. While this option eliminates the need to deal with saline water and to maintain Laanecoorie and Bridgewater WTPs, it adds more demand on the Bendigo system. With the projected increase in demand due to population growth, this option will be the least preferred as increasing demand on Bendigo system could turn out to be a risk on the long run, particularly when the forecast supply is on the decline due to climate change.	MCA Ranking	5
		Estimated Cost	$30,000,000
		Implementation time	3 – 4 Years
		Water gained (ML/Yr.)	400
		$/ML	$3,000
Alternative Water Sources	**Extend East Loddon pipeline (ELPL) to Bridgewater:** The East Loddon pipeline which sources water from Goulburn system (Waranga Western Channel) terminates south of Serpentine. The pipeline is considered to be undersized to be extended to Bridgewater. However, there is a potential to build an intermittent storage tank near Serpentine to collect water during off-peak time and to pump to Bridgewater.	MCA Ranking	7
		Estimated Cost	$8,400,000
		Implementation time	3 – 4 Years
		Water gained (ML/Yr.)	190
		$/ML	$1,800
Supply Augmentation	**New Raw Water Storage – Laanecoorie:** Laanecoorie which sources water from the Loddon River does not have a raw water basin. A new raw water basin is required to improve the water security for Laanecoorie. The capacity of the raw water basins will be about 10 ML for 10 days of supply. The land surrounding the WTP will require clearing of trees in order to construct raw water basins. However there are a number of potential cleared sites in the vicinity that may require acquisition. Alternatively, if geo-bags can be introduced to treat sludge from the WTP, the current sludge lagoons can be converted in to raw water basins.	MCA Ranking	3
		Estimated Cost	$1,100,000
		Implementation time	2 – 3 Years
		Water gained (ML/Yr.)	-
		$/ML	-

Business as Usual Initiatives

There is no system specific BAU initiative for Loddon. There are generic initiatives that are applicable for all the systems listed in Part C.

Appendix C – Murray System

Figure 1: Murray System showing water sources.

System Description

The Murray System supplies the towns of Cohuna, Leitchville, Gunbower and Echuca, servicing 7,345 urban connections (i.e. connection with house) with an estimated customer population of 17,745 as of July 2016.

Each town in the Murray System is supplied with water taken from the Murray River System, treated and then supplied to the townships. Gunbower takes water from Taylors Creek, a tributary of the Murray River. Leitchville takes water from the Cohuna Channel while in winter raw water is pumped from the Gunbower Creek, a tributary of the Murray River. Cohuna takes water from the Gunbower Creek. Echuca takes water directly from the Murray River.

Raw water is drawn directly from the Murray River and channels, refer to Table 1, under a Bulk Entitlement (BE) of 6,285 ML, 54.9 ML of High Reliability Water Shares (HRWS) and 24 ML of Low Reliability Water Shares (LRWS).

The Murray System is part of the southern interconnected Murray Darling Basin which allows additional allocation and/or entitlement to be acquired from the water market of NSW, Victoria and SA. Allocation can also be traded between connected systems. This allows surplus allocation held in other Coliban Water accounts to be transferred into our Murray System.

Reliability

The Murray systems' key vulnerabilities are being a single source of supply and frequent experience of poor raw water quality such as Blue Green Algae. Given that there is no obvious new source of supply, other than the ground water options (the option yet to be explored), the system is under risk of water shortage during prolonged drought.

The projected demand is expected to exceed the current Bulk Entitlement and Water Shares by 2036 under high climate change scenario. If the allocation is less than 100% due to drought, the system could experience shortfall earlier than 2036.

System Challenges

Table 1: Vulnerabilities during severe water shortages.

Vulnerability	Impact of Water Shortages
Restricted Supply	Raw water allocations dependent an external provider e.g. GMW Low allocations.
'Step' change in streamflow	Pre 1997, post 1997 median inflow.
Water quality (Acute Impact)	Poor quality when river levels are low. Blue-green algae (cyanobacteria) is a problem both for Murray River and channels servicing Cohuna, Leitchville and Gunbower. Bushfires along the Murray could deliver ash and silt into the waterway.
Asset condition (Chronic risk)	Any parts of the urban reticulation networks that may be at risk of failure leading to short-term loss of supply. The vulnerability is managed through 'business as usual' operations and maintenance.
Treatment plant efficiency	Water wastage during treatment process.
Reticulation network	Water losses incurred from leakage, pipeline bursts, mains flushing and use of fire hydrants which are managed through 'business as usual' operations and maintenance.
Pump failure	Electricity blackout or brownout, or mechanical failure resulting in no supply to the water treatment plant.

Table 2: Water treatment plant characteristics.

Location	Source of Raw Water	Water Treatment Process	Nominal Capacity (ML/day)[1]	Peak Day Demand 2065 (ML/day)[2]
Gunbower	Taylors Creek	Micro Filtration, Disinfection	0.62	0.31
Cohuna	Gunbower Creek	Clarification, Sand Filtration, Disinfection	5.45	4.68
Leitchville	Cohuna Channel Gunbower Creek	Clarification, Sand Filtration, Disinfection	1.28	0.88
Echuca	Murray River	Clarification, Sand Filtration, Disinfection, Fluoridation	27.10	23.82

Note 1: Based on treatment plant operating 16 hours per day.
Note 2: Estimated Average Day of Peak Month.

Customer Group Characterisation and Growth

Customer water connections in the Murray System are projected to increase from 8,733 to 14,206 by 2065. The highest growth area is residential customers which are 98% of the new water connections.

Table 3: Projected growth[1] in customer water connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	7,412	844	145	372	8,733
2040	9,818	862	145	375	11,200
2065	12,800	881	145	379	14,206

Note 1: *Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.*

Current and Projected Demand

The current baseline demand for the Murray System is 4,263 ML and with the projected growth in water connections is estimated to increase to 6,207 ML by 2065. Under a high climate change scenario the impact will increase the 2040 baseline demand by 17% and 32% of the 2065 baseline demand.

Table 4: Projected raw water demands to 2040 & 2065 under a range of climate scenarios.

Climate Scenario	Baseline Demand[1] (ML)	2040 Demand (ML)	2065 Demand (ML)
Current Climate Baseline	4,263	5,129	6,207
Post 1997 Baseline	4,296	5,168	6,255
Climate Change (Low to High)	N/A	5,941 – 6,791	7,778 – 9,161

Note 1: *The baseline PWSR demand was determined separately for each town and system, based on the actual PWSR demands over the past five years and taking into account actual rainfall.*

Current and Projected Supply

The following supply projections are based on model data provided by DELWP for a range of climate scenarios.

The current climate baseline supply for the Murray System is 5,580 ML which is projected to slightly increase to 5,590 ML by 2065 under a low climate change scenario. However under a high climate change scenario the available supply will decrease to 3,850 ML by 2065.

Table 5: Projected raw water supply to 2040 & 2065 under a range of climate scenarios.

Analysis	Baseline Supply (ML)	2040 Supply (ML)	2065 Supply (ML)
Current Climate Baseline	5,580	5,590	5,590
Post 1997 Baseline	5,280	6,510	5,320
Climate Change (Low to High)	N/A	5,820 – 3,600	5,760 – 3,850

Supply and Demand Balance

All the scenarios depicted in the projections assume 'no intervention' hence they reflect the magnitude of the challenge ahead. The options identified later are intended to address any imbalance between supply and demand.

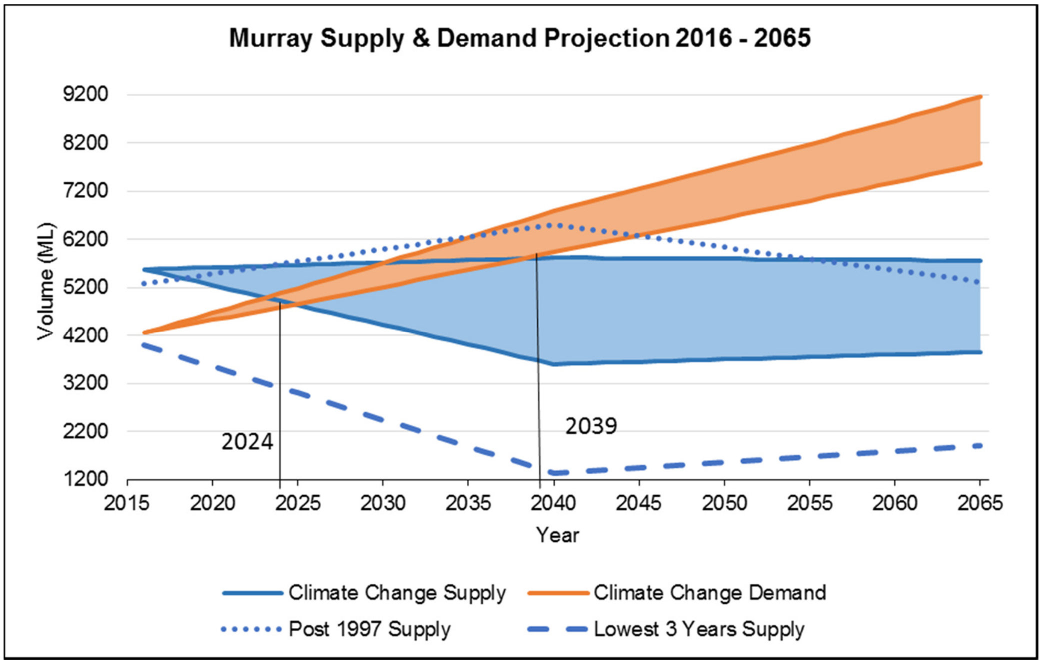

Figure 2: Projected supply and demand to 2065 under a range of climate scenarios.

The lowest 3 years has been calculated on the average allocation for the lowest consecutive 3 years on record, 2008 – 2010.

Supply and Demand Projections (2016 - 2065)

Supply[1]: The component of the graph shows the projected variation in supply under low to high climate change. The projection relies on data supplied by DELWP. Generally there will be a decline in inflows into major storages and/or reduced annual allocations from external suppliers of raw water i.e. GMW and GWM Water. The 'post-1997' line reflects the potential supply that may be available if the catchment responds to rainfall in the same manner as during the Millennium Drought.

Lowest 3 Years: This reflects the lowest [modelled] available supply during a consecutive three year period. In general this reflects the potential severity of future droughts that may be similar to the Millennium Drought. Across most systems, the worst three years in recent times were 2007 to 2009.

Demand: The 'supply and demand projection' graph shows the projected variation in growth in raw water demand based on population growth data supplied by DELWP, and the demand based on low to high climate change. Primarily the impact of high climate change is to increase the demand for outdoor water use due to higher temperatures and lower rainfall.

Note 2: The 'supply' is based on the system 'yield' derived from in-house models. The yield indicates the volume of raw water that can be sustainably supplied by the system to meet our minimum Level of Service obligation of no worse than Stage 3 restrictions.

Table 6: Supply and demand for water imbalance.

Year	Shortfall in Supply[1] ML	Main Strategies
2024	0 - 160	Demand management
2039	56 – 2,998	Supply augmentation
2040	121 – 3,191	Supply augmentation
2065	2,018 – 5,311	Supply augmentation

Note 1: Shortfall in supply without intervention.

While the Supply Augmentation is considered to be the main strategy, it is also appropriate to start investigating on alternative sources in a timely manner.

Learnings From Recent Experience

Low storage levels in the Murray River storages of Dartmouth Dam and Hume Dam between 2006 and 2010 triggered reduced allocations of 95%, 43% and 35% in the years of 2006-07, 2007-08 and 2008-09 respectively. This resulted in temporary allocation purchases in 2008/09 of 1,977ML and another 1,977ML in 2009-10.

The Murray System Bulk Entitlements were amended by Temporary Qualification of Rights in July 2007 and June 2008 due to the low supply availability.

Water restrictions commenced in December 2002 and were in force for most of the next eight years to January 2011. Stage 3 and Stage 4 restrictions were in force for 19 months from July 2007 to December 2008.

Drought Preparedness

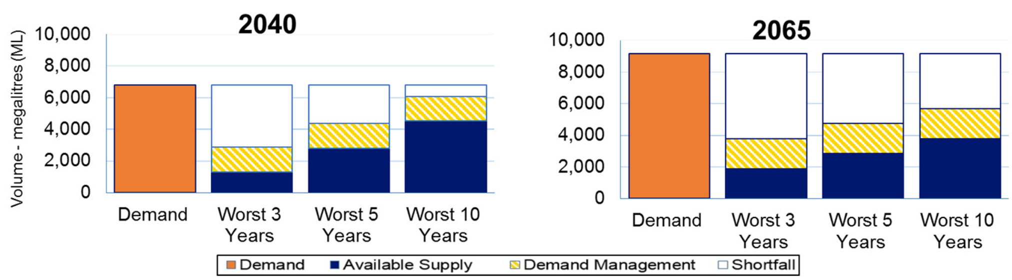

Figure 3: Demand versus projected supply based on lowest consecutive allocations in 2040 and 2065 under a high climate change scenario.

Drought Scenarios

Figure 3 above compares the [modelled] available supply (blue bars), during a future drought e.g. the equivalent of the Millennium Drought. The demand (orange bars) is the same as that depicted in Figure 2 for 2040 and 2065. The graphs represent a ‘no intervention’ scenario.

Typically the available supply can vary greatly from year to year during a drought hence the use of three different time periods, namely 3, 5 and 10 consecutive years. Coliban Water has chosen not to use the single worst year of drought as the basis for planning as generally existing operational flexibility allows us to cope with up to three dry years without necessarily imposing restrictions.

The ‘demand management’ measures (yellow hatched bars) reflect the anticipated reduction in demand if Stage 3 restrictions were to be imposed. The blank components reflect the shortfall that would still have to be made up after Stage 3 restrictions were to be imposed.

Table 7: Drought scenario shortfalls.

Year	Time Period (years)	Shortfall (ML)
2040	3	5,481
	5	4,001
	10	2,277
2065	3	7,280
	5	6,295
	10	5,376

Table 8: Estimated reduction in demands when restrictions implemented.

Water Savings from Restrictions (%)	Stage 1	Stage 2	Stage 3	Stage 4
	2%	23%	31%	36%

Water Restriction Calculations

The estimated water savings achieved through water restrictions are based on the actual water savings achieved in the 9-year dry period of water restrictions from 2002 to 2010. The extent of the actual savings achieved during this period of water restrictions was adjusted to take into account the significant water savings achieved over the past five years through the way customers now use water. Stage 4 demands are estimated to be relatively unchanged from previous estimates of 2012 and are based on winter-off-season demands.

However, overall PWSR demands have significantly reduced since 2012 due to conservative customer water use behaviour. The extent of system demand between PSWR and Stage 4 is now significantly “compressed” by as much as 40% whereby there is up to 40% less water that can be further achieved through water restrictions. Accordingly, forecast future water savings from water restrictions were estimated for each water supply system by reducing the actual savings achieved in the most recent restrictions of 2002-2010 by the above calculated level of “compression” for each water supply system.

Wastewater System Description

The Gunbower Water Reclamation Plant is located 4km south of Gunbower and also collects wastewater from Leitchville. Wastewater is treated at the plant through a lagoon system to a Class C standard. The Class C reclaimed water is evaporated or irrigated to farmland surrounding the site. The EPA Victoria licence specifies conditions for the management of emissions from the site including wastewater quality and odour.

The Cohuna Water Reclamation Plant is located 2km south of the township. The system comprises a network of gravity collection systems connected to neighbouring pumping stations. Effluent is treated at the plant by a series of treatment lagoons that provide secondary treatment of wastewater. Treated effluent or reclaimed water can be stored in two lagoons and allowed to evaporate. There is no reclaimed water reuse at this site due the high evaporation rates in the area.

The Echuca Water Reclamation Plant was built and managed by a third party operator on behalf of Coliban Water. The plant is located 4 km west of Echuca and sewage from the township is collected in an extensive system of gravity sewers and sewage pump stations.

The sewer system also collects wastewater from commercial sites in accordance with trade waste agreements and consents. These businesses range in size from cafes to large industries such as food processors like Fonterra, Riverside Meats, Kagome, Simplot and Heinz.

Wastewater is treated to a Class B standard and piped to storage lagoons 10 km south of the plant and is then supplied to local irrigators. The plant operator hold the EPA licence which specifies conditions for the management of emissions from the site including wastewater quality and odour.

Table 9: Wastewater treatment plant characteristics.

Location	Nominal Capacity[1]	Estimated Augmentation Year[2]	Class of Recycled Water	2015-16 Reuse Volume (ML)	2015-16 Discharge to Waterways (ML)
Gunbower	102.12 KL/day	At Capacity	C	0	0
Cohuna	425.0 KL/day	At Capacity	N/A	N/A	N/A
Echuca	5.09 ML/day	2027	B	1,147.75	0.0

Note 1: Relates to Peak Daily Flows, not annual plant capacity.
Note 2: Figures taken from regular internal plant review process.

Wastewater Customer Group Characterisation and Growth

Customer sewer connections in the Murray System are projected to increase from 8,064 to 13,267 by 2065. The highest growth area is residential customers which are 99% of the new sewer connections.

Table 10: Projected growth[1] in sewer connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	7,083	830	110	41	8,064
2040	9,391	846	110	41	10,388
2065	12,252	863	110	42	13,267

Note 1: Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.

Next Steps

To ensure the water security of the system by maintaining the balance between supply and demand a list of system specific capital and business as usual initiatives are tabled below. The capital initiatives were subjected to a preliminary analysis using Coliban Water's Multi-Criteria Analysis (MCA) tool.

As part of the future actions, the initiatives will be subjected to further detailed analysis for the following three demand scenarios:

- Baseline demand imbalance
- Dry weather peak month demand
- Demand during worst three drought scenarios (worst 3, 5 and 10 years).

Note that the demand and supply considerations are only for high climate change scenarios.

The next steps of the option analysis will include the following:

- Community and stakeholder engagement
- Detail analysis of capital and BAU options (filling the short fall and sequencing)
- Research projects (such as ground water).

Table 11: Capital projects.

Strategy	Initiative		
Alternative Water Source	**Groundwater:** There may be scope to find aquifers which fit the requirements for drawing groundwater. However problems may exist with the interconnectivity between aquifers and the Murray River, and the salinity of groundwater. There may also be insufficient storage and recovery rates for groundwater to be an efficient long term option for this region.	MCA Ranking	1
		Estimated Cost	$2,000,000
		Implement time	2 – 3 Years
		Water gained (ML/Yr.)	1,250
		$/ML	$64

Business as Usual Initiatives

There is no system specific BAU initiative for Murray. There are generic initiatives that are applicable for all the systems listed in Part C.

Appendix C – Trentham System

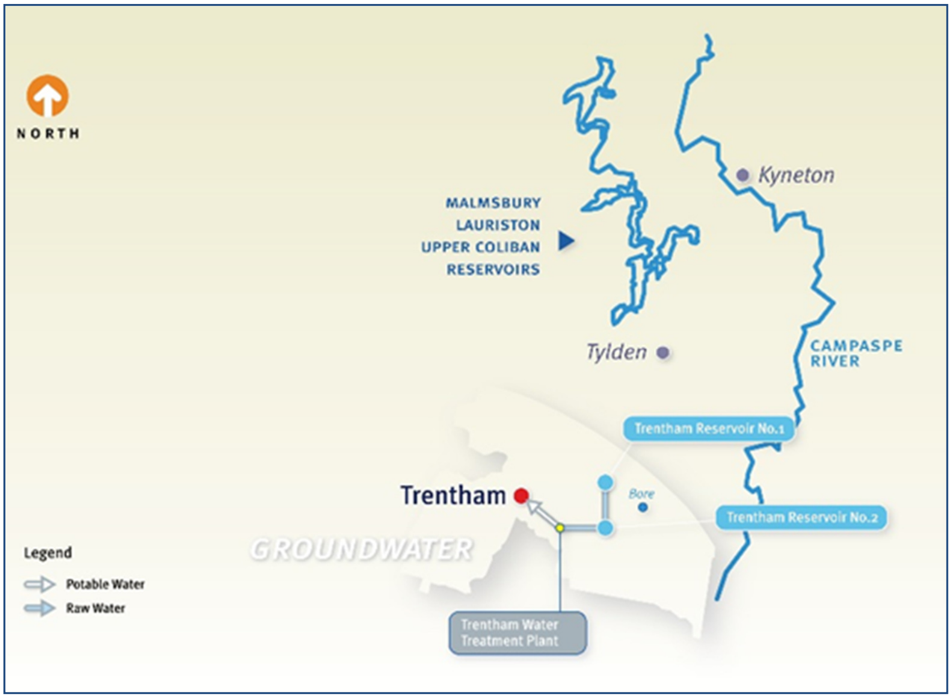

Figure 1: Trentham System showing water sources.

System Description

The system is located in the upper (unregulated) reaches of the Coliban River System in the Campaspe Basin. Natural spring water flows into the Trentham Reservoir No 1 and from there into Reservoir No 2. The spring has provided the majority of water supply for Trentham and has been supplemented with bore supply in the summer months or during drought.

Reliability

The ground water system is not under stress and the allocations have been 100%, even during the Millennium Drought. However the spring water source is highly responsive to climate conditions.

While the current sources of supply are fairly reliable, the available water will soon become inadequate when the projected demand exceed supply by early as 2018. Currently with only one bore operational, the maximum amount of water drawn from the system is 32 ML. This makes the system more vulnerable.

System Challenges

The biggest challenge for Trentham is the single source of supply (bores and springs access groundwater). Trentham also faces occasional blue green algal bloom in the storages basins.

Table 1: Vulnerabilities during severe water shortages.

Vulnerability	Impact of Water Shortages
Single source of supply	Unable to access alternative sources of raw water. Both sources are derived from groundwater.
'Step' change in rainfall	Pre 1997, post 1997 median rainfall
Water quality	Potentially poor quality in storage level.

Table 2: Water treatment plant characteristics.

Location	Source of Raw Water	Water Treatment Process	Nominal Capacity (ML/day)[1]	Peak Day Demand 2065 (ML/day)[2]
Trentham	Natural Spring Water Bore Water	Micro Filtration, Ozone Disinfection	0..85	1.30

Note 1: Based on treatment plant operating 16 hours per day.
Note 2: Estimated Average Day of Peak Month.

Customer Group Characterisation and Growth

Trentham is one of the fastest growing system. Even though no non-residential growth is projected the residential growth is projected to grow by 138% in 2065.

Table 3: Projected growth[1] in customer water connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	529	41	19	6	595
2040	888	41	19	6	954
2065	1,261	41	19	6	1,327

Note 1: Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.

Current and Projected Demand

The current climate baseline demand is projected to almost double by 2065, however under a high climate change scenario, it is expected to increase by 127%.

Table 4: Projected raw water demands to 2040 & 2065 under a range of climate scenarios.

Climate Scenario	Baseline Demand (ML)	2040 Demand (ML)	2065 Demand (ML)
Current Climate Baseline	157	213	271
Post 1997 Baseline	162	221	282
Climate Change (Low to High)	N/A	231 – 262	308 - 357

Note 1: The baseline PWSR demand was determined separately for each town and system, based on the actual PWSR demands over the past five years and taking into account actual rainfall.

Current and Projected Supply

The following supply projections are based on model data provided by DELWP for a range of climate scenarios.

There is no change to the supply is projected for the Trentham system.

Table 5: Projected raw water supply to 2040 & 2065 under a range of climate scenarios.

Analysis	Baseline Supply (ML)	2040 Supply (ML)	2065 Supply (ML)
Current Climate Baseline	160	160	160
Post 1997 Baseline	140	140	140
Climate Change (Low to High)	N/A	160 – 140	160 - 140

Supply and Demand Balance

All the scenarios depicted in the projections assume 'no intervention' hence they reflect the magnitude of the challenge ahead. The options identified later are intended to address any imbalance between supply and demand.

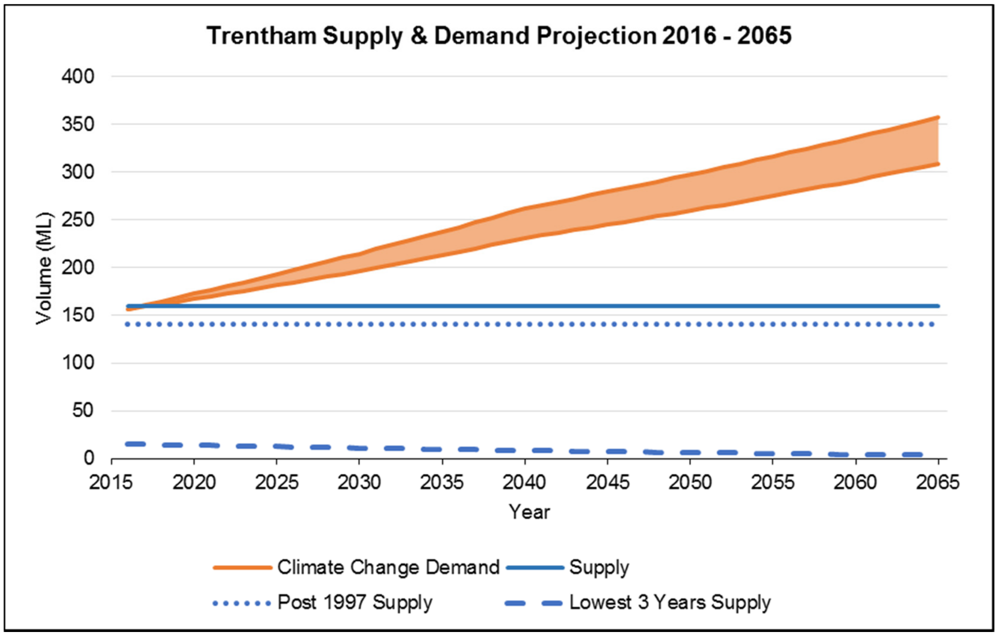

Figure 2: Projected supply and demand to 2065 under a range of climate scenarios.

Supply and Demand Projections (2016 - 2065)

Supply[1]: The component of the graph shows the projected variation in supply under low to high climate change. The projection relies on data supplied by DELWP. Generally there will be a decline in inflows into major storages and/or reduced annual allocations from external suppliers of raw water i.e. GMW and GWMWater. The 'post-1997' line reflects the potential supply that may be available if the catchment responds to rainfall in the same manner as during the Millennium Drought.

Lowest 3 Years: This reflects the lowest [modelled] available supply during a consecutive three year period. In general this reflects the potential severity of future droughts that may be similar to the Millennium Drought. Across most systems, the worst three years in recent times were 2007 to 2009.

Demand: The 'supply and demand projection' graph shows the projected variation in growth in raw water demand based on population growth data supplied by DELWP, and the demand based on low to high climate change. Primarily the impact of high climate change is to increase the demand for outdoor water use due to higher temperatures and lower rainfall.

Note 1: The 'supply' is based on the system 'yield' derived from in-house models. The yield indicates the volume of raw water that can be sustainably supplied by the system to meet our minimum Level of Service obligation of no worse than Stage 3 restrictions.

Table 6: Supply and demand water imbalance.

Year	Shortfall in Supply[1] (ML)	Main Strategies
2016	0 -3	Demand management
2040	53 - 122	Supply augmentation
2065	111 - 217	Supply augmentation

Note 1: Shortall in supply without intervention.

While the Supply Augmentation is considered to be the main strategy, it is also appropriate to start investigating on Alternative Sources such as connecting to the Kyneton (Coliban head works) system.

Learnings From Recent Experience

The Trentham raw water sources (ground water and natural springs) are fairly reliable. The restriction levels during the millennium drought was not as severe as in other parts of Coliban region. However, Trentham has the highest population growth rate in the region and with a limited amount of water available from the current sources, it could faces water shortage soon. Looking for alternative sources of water, including augmenting the second bore which is currently not is use, will be an important task in the short term.

Drought Preparedness

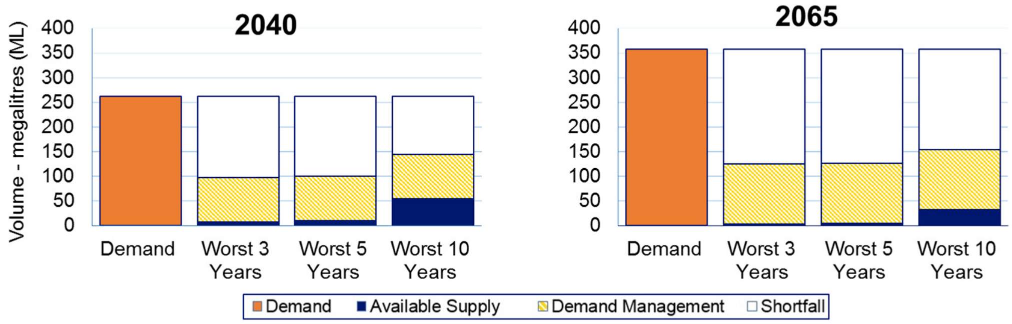

Figure 3: Demand versus projected supply based on lowest consecutive allocations in 2040 and 2065 under a high climate change scenario.

Drought Scenarios

Figure 3 above compares the [modelled] available supply (blue bars), during a future drought e.g. the equivalent of the Millennium Drought. The demand (orange bars) is the same as that depicted in Figure 2 for 2040 and 2065. The graphs represent a 'no intervention' scenario.

Typically the available supply can vary greatly from year to year during a drought hence the use of three different time periods, namely 3, 5 and 10 consecutive years. Coliban Water has chosen not to use the single worst year of drought as the basis for planning as generally existing operational flexibility allows us to cope with up to three dry years without necessarily imposing restrictions.

The 'demand management' measures (yellow hatched bars) reflect the anticipated reduction in demand if Stage 3 restrictions were to be imposed. The blank components reflect the shortfall that would still have to be made up after Stage 3 restrictions were to be imposed.

Table 7: Drought scenario shortfalls.

Year	Time Period (years)	Shortfall (ML)
2040	3	254
	5	252
	10	208
2065	3	354
	5	352
	10	325

Table 8: Estimated reduction in demands when restrictions implemented.

Water Savings from Restrictions (%)	Stage 1	Stage 2	Stage 3	Stage 4
	2%	31%	34%	44%

Water Restriction Calculations

The estimated water savings achieved through water restrictions are based on the actual water savings achieved in the 9-year dry period of water restrictions from 2002 to 2010. The extent of the actual savings achieved during this period of water restrictions was adjusted to take into account the significant water savings achieved over the past five years through the way customers now use water. Stage 4 demands are estimated to be relatively unchanged from previous estimates of 2012 and are based on winter-off-season demands.

However, overall PWSR demands have significantly reduced since 2012 due to conservative customer water use behaviour. The extent of system demand between PSWR and Stage 4 is now significantly "compressed" by as much as 40% whereby there is up to 40% less water that can be further achieved through water restrictions. Accordingly, forecast future water savings from water restrictions were estimated for each water supply system by reducing the actual savings achieved in the most recent restrictions of 2002-2010 by the above calculated level of "compression" for each water supply system.

Wastewater System Description

Wastewater from Trentham is treated at the Kyneton Water Reclamation Plant.

Wastewater Customer Group Characterisation and Growth

Even though there is no growth projected with non-residential connections, the residential connections is projected to be grow by 144% for the next 50 years.

Table 9: Projected growth[1] in sewer connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	488	42	18	2	550
2040	819	42	18	2	881
2065	1,163	42	18	2	1,225

Note 1: Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.

Next Steps

To ensure the water security of the system by maintaining the balance between supply and demand a list of system specific capital and business as usual initiatives are tabled below. The capital initiatives were subjected to a preliminary analysis using Coliban Water's Multi-Criteria Analysis (MCA) tool.

As part of the future actions, the initiatives will be subjected to further detailed analysis for the following three demand scenarios:

- Baseline demand imbalance
- Dry weather peak month demand
- Demand during worst three drought scenarios (worst 3, 5 and 10 years).

Note that the demand and supply considerations are only for high climate change scenarios.

The next steps of the option analysis will include the following:

- Community and stakeholder engagement
- Detail analysis of capital and BAU options (filling the short fall and sequencing)
- Research projects (such as capping of springs).

Table 10: Capital projects.

Strategy	Initiative		
Alternative Water Supply	**Connect to Tylden:** This option would involve the connection of Trentham to Tylden by an approximate 16 kilometre long pipeline. This option would improve the reliability of supply to Trentham as it would be connected to a much bigger system. Infrastructure augmentations may also be required between Kyneton and Tylden.	MCA Ranking	3
		Estimated Cost	$4,800,000
		Implement time	3 – 4 Years
		Water gained (ML/Yr.)	60
		$/ML	$3,200
Supply Augmentation	**Capping of springs:** In addition to ground water, Trentham sources water from a natural spring system. The spring system is not controlled and a large amount of water is wasted/lost. Capping the spring system would enable to control and manage the flow and minimise contamination.	MCA Ranking	2
		Estimated Cost	$100.000
		Implement time	2 Years
		Water gained (ML/Yr.)	-
		$/ML	-
Supply Augmentation	**Groundwater – Operation of second bore:** Coliban Water has two existing groundwater bore licences. At present only one bore is operational and we are unable to access our full entitlement of 48 ML/year. In order to be able to extract the full entitlement of 48 ML, the second groundwater bore needs to be brought into operation. This would also provide operational redundancy and is currently under development.	MCA Ranking	1
		Estimated Cost	$1,000,000
		Implement time	2 – 3 Years
		Water gained (ML/Yr.)	200
		$/ML	$200

Business as Usual Initiatives

There is no system specific BAU initiative for Trentham. There are generic initiatives that are applicable for all the systems listed in Part C.

Appendix C – Wimmera System

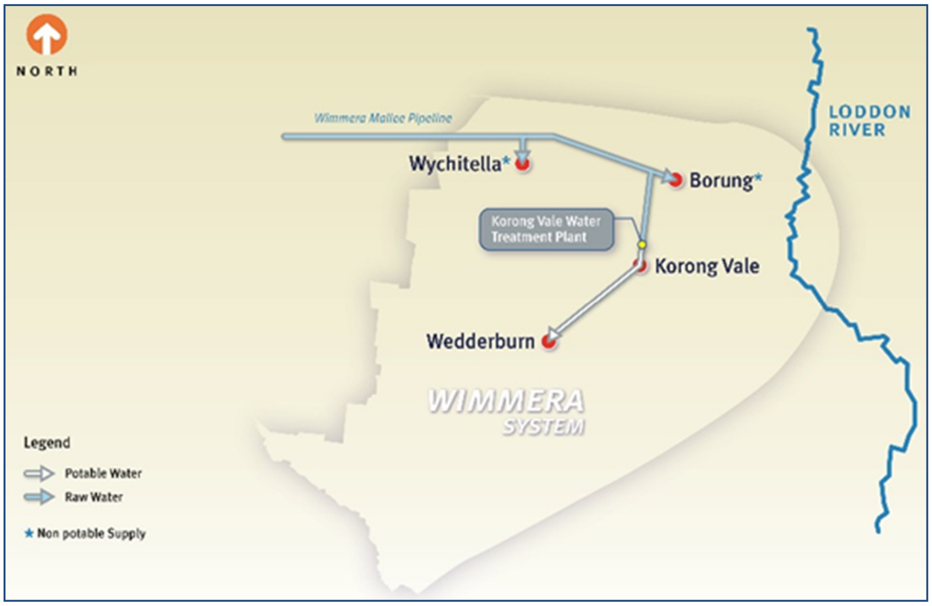

Figure 1: Wimmera System showing water sources.

System Description

The Wimmera System compromises one potable water supply system which includes Korong Vale and Wedderburn, and two non-potable towns: Wychitella and Borung. Raw water is delivered via the Wimmera-Mallee Pipeline system under a 300 ML Bulk Water Entitlement (BE). The BE accounts for approximately 0.3% of the water entitlements and water shares supplied from the Grampians Wimmera-Mallee System.

For Korong Vale and Wedderburn, raw water is delivered to the lined and covered storages at Korong Vale and treated there. The Korong Vale Water Treatment Plant has a capacity of 3.6 ML/day. For Borung and Wychitella, the raw water is delivered to the 100 KL tanks. The water is not treated and this system is not a drinking water supply.

Reliability

Wimmera being a single source supply system and totally dependent on the allocation set by a third party (GMW), is one of the least reliable systems.

The Source and System Reliabilities are estimated to be 59% and 72% in 2040 under high climate change scenario. Further, the projected baseline demand is expected to exceed the current entitlement by 2054 under high climate change scenario.

System Challenges

The Wimmera System's key vulnerability is its reliance on a single source of supply. Water security is also very dependent on allocations which are set by GWM Water and have low reliability in times of severe drought.

Table 1: Vulnerabilities during severe water shortages.

Vulnerability	Impact of Water Shortages
Single source of supply	Unable to access alternative sources of raw water.
Allocation Dependent	Water security risk is very dependent on allocations which are set by GWM Water. Low reliability in times of severe drought.

'Step' change in rainfall	Pre 1997, post 1997 median rainfall, refer to Table 3 and Figure 3. There was a significant decline in rainfall and subsequently allocation to entitlement holders.
Low inflows	Low allocation, refer to Table 4.
High evaporation	(Chronic risk.) A high proportion of system losses are attributable to evaporation.
Water quality	Potentially poor quality when storage levels are low (historically, GWM Water has not experienced any major deterioration of water quality).
Ageing infrastructure	Failure of the infrastructures, beaching the supply security.
Reactive soil	Potential for the soil to shrink and swell under extreme dry and wet periods respectively. The deformation can lead to infrastructure failure e.g. cracks in ageing pipework and channels.

Table 2: Water treatment plant characteristics.

Location	Source of Raw Water	Water Treatment Process	Nominal Capacity (ML/day)[1]	Peak Day Demand 2065 (ML/day)[2]
Korong Vale	Wimmera-Mallee pipeline system	Clarification, Sand Filtration, Disinfection	1.36	0.93

Note 1: Based on treatment plant operating 16 hours per day.
Note 2: Estimated Average Day of Peak Month.

Customer Group Characterisation and Growth

The growth in water connections for the Wimmera System is projected to only increase in residential connections. The total amount of new connections is estimated to increase from 659 to 779 by 2065.

Table 3: Projected growth[1] in customer water connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	584	35	29	11	659
2040	625	35	29	11	700
2065	704	35	29	11	779

Note 1: Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.

Current and Projected Demand

The current baseline demand for the Wimmera System is 172 ML and with the projected growth in water connections is estimated to increase to 197 ML by 2065. Under a high climate change scenario the impact may increase the 2040 and 2065 baseline demands by 39% and 66%.

Table 4: Projected raw water demands to 2040 & 2065 under a range of climate scenarios.

Analysis	Baseline Demand (ML)	2040 Demand (ML)	2065 Demand (ML)
Current Climate Baseline	172	180	197
Post 1997 Baseline	177	186	202
Climate Change (Low to High)	N/A	213 – 251	260 - 327

Note 1: The baseline PWSR demand was determined separately for each town and system, based on the actual PWSR demands over the past five years and taking into account actual rainfall.

Current and Projected Supply

The following supply projections are based on model data provided by DELWP for a range of climate scenarios.

The projected water availability of the Wimmera System under the current climate baseline is 180 ML and is forecast to remain unchanged to 2065. However, under a high climate change scenario it is projected to reduce to 60 ML by 2065.

Table 5: Projected raw water supply to 2040 & 2065 under a range of climate scenarios.

Analysis	Baseline Supply (ML)	2040 Supply (ML)	2065 Supply (ML)
Current Climate Baseline	180	180	180
Post 1997 Baseline	150	150	150
Climate Change (Low to High)	N/A	150 - 100	140 - 70

Supply and Demand Balance

All the scenarios depicted in the projections assume 'no intervention' hence they reflect the magnitude of the challenge ahead. The options identified later are intended to address any imbalance between supply and demand.

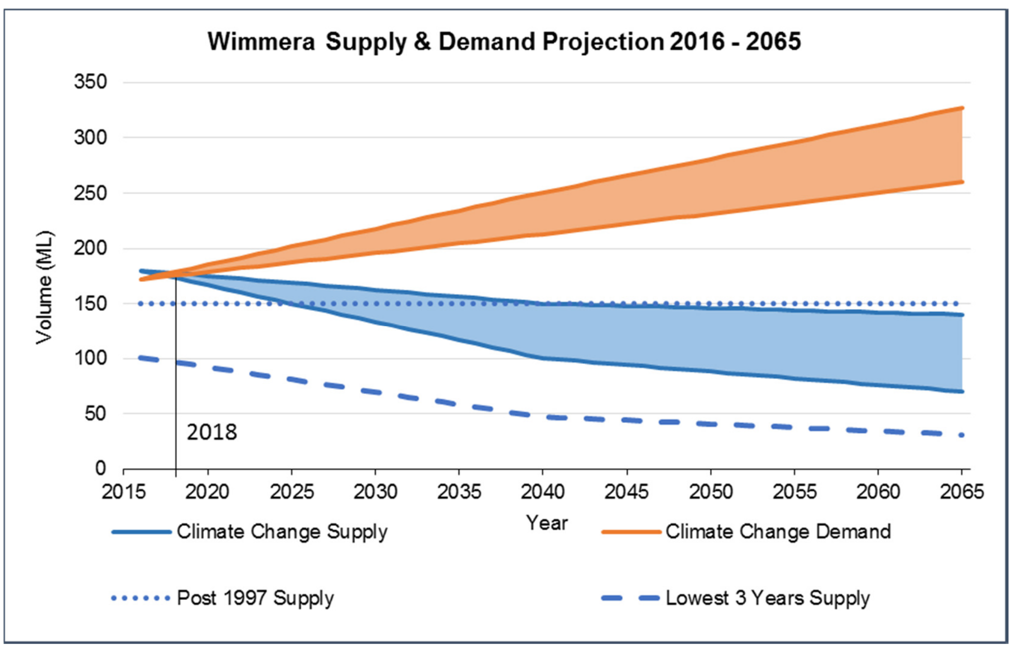

Figure 2: Projected supply and demand to 2065 under a range of climate scenarios.

The Wimmera System under a high climate change scenario is projected to reach a shortfall between supply and demand by 2018.

Supply and Demand Projections (2016 - 2065)

Supply[1]: The component of the graph shows the projected variation in supply under low to high climate change. The projection relies on data supplied by DELWP. Generally there will be a decline in inflows into major storages and/or reduced annual allocations from external suppliers of raw water i.e. GMW and GWMWater. The 'post-1997' line reflects the potential supply that may be available if the catchment responds to rainfall in the same manner as during the Millennium Drought.

Lowest 3 Years: This reflects the lowest [modelled] available supply during a consecutive three year period. In general this reflects the potential severity of future droughts that may be similar to the Millennium Drought. Across most systems, the worst three years in recent times were 2007 to 2009.

Demand: The 'supply and demand projection' graph shows the projected variation in growth in raw water demand based on population growth data supplied by DELWP, and the demand based on low to high climate change. Primarily the impact of high climate change is to increase the demand for outdoor water use due to higher temperatures and lower rainfall.

Note 1: The 'supply' is based on the system 'yield' derived from in-house models. The yield indicates the volume of raw water that can be sustainably supplied by the system to meet our minimum Level of Service obligation of no worse than Stage 3 restrictions.

Table 6: Supply and demand water imbalance.

Year	Shortfall in Supply[1] (ML)	Main Strategies
2018	0 - 6	Demand management
2040	63 - 151	Supply augmentation
2065	120 - 257	Supply augmentation

Note 1: Shortfall in supply without intervention.

The work connecting Korong Vale and Wedderburn to Waranga Western Channel is already underway. Once completed it is expected to provide additional water to these two towns.

Learnings From Recent Experience

The decline in rainfall, and consequential decline in inflows and allocations across Victoria left water corporations with few choices to reduce demand without resorting to imposing water restrictions. The Wimmera System was no exception, with restrictions imposed for a total of 138 months. Stage 4 restrictions were in place from October 2006 for 47 consecutive months.

Another consequence of the rainfall decline and variation was reduced allocations. This resulted in a low of 63% in 2006-07. It should also be noted that as recently as 2015-16 allocations were 16%.

Drought Preparedness

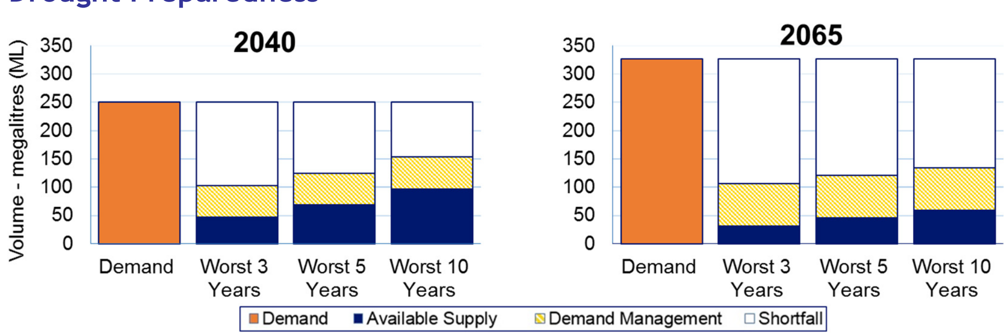

Figure 3: Demand versus projected supply based on lowest consecutive allocations in 2040 and 2065 under a high climate change scenario.

Drought Scenarios

Figure 3 above compares the [modelled] available supply (blue bars), during a future drought e.g. the equivalent of the Millennium Drought. The demand (orange bars) is the same as that depicted in Figure 2 for 2040 and 2065. The graphs represent a 'no intervention' scenario.

Typically the available supply can vary greatly from year to year during a drought hence the use of three different time periods, namely 3, 5 and 10 consecutive years. Coliban Water has chosen not to use the single worst year of drought as the basis for planning as generally existing operational flexibility allows us to cope with up to three dry years without necessarily imposing restrictions.

The 'demand management' measures (yellow hatched bars) reflect the anticipated reduction in demand if Stage 3 restrictions were to be imposed. The blank components reflect the shortfall that would still have to be made up after Stage 3 restrictions were to be imposed.

Table 7: Drought scenario shortfalls.

Year	Time Period (years)	Shortfall (ML)
2040	3	204
	5	182
	10	154
2065	3	296
	5	281
	10	268

Table 8: Estimated reduction in demands when restrictions implemented.

	Stage 1	Stage 2	Stage 3	Stage 4
Water Savings from Restrictions (%)	13%	21%	22%	32%

Water Restriction Calculations

The estimated water savings achieved through water restrictions are based on the actual water savings achieved in the 9-year dry period of water restrictions from 2002 to 2010. The extent of the actual savings achieved during this period of water restrictions was adjusted to take into account the significant water savings achieved over the past five years through the way customers now use water. Stage 4 demands are estimated to be relatively unchanged from previous estimates of 2012 and are based on winter-off-season demands.

However, overall PWSR demands have significantly reduced since 2012 due to conservative customer water use behaviour. The extent of system demand between PSWR and Stage 4 is now significantly "compressed" by as much as 40% whereby there is up to 40% less water that can be further achieved through water restrictions. Accordingly, forecast future water savings from water restrictions were estimated for each water supply system by reducing the actual savings achieved in the most recent restrictions of 2002-2010 by the above calculated level of "compression" for each water supply system.

Wastewater System Description

The Wedderburn Water Reclamation plant was constructed in 2005. Wastewater is collected via a pump station and a 20 km sewer network. This is a mechanical treatment plant with treats wastewater to a Class C standard. The treatment plant is intended to produce irrigation water to enable it to be re-used in a sustainable manner. It is currently used on-site by our lease farmer.

Table 9: Wastewater treatment plant characteristics.

Location	Nominal Capacity (KL/day)[1]	Estimated Augmentation Year[2]	Class of Recycled Water	2015-16 Reuse Volume (ML)	2015-16 Discharge to Waterways (ML)
Wedderburn	160.0	After 2045	C	28.20	0.0

Note 1: Relates to Peak Daily Flows, not annual plant capacity.
Note 2: Figures taken from regular internal plant review process.

Wastewater Customer Group Characterisation and Growth

The growth in sewer connections for the Loddon System is projected to only increase residential connections. The total amount of new connections is estimated to increase from 446 to 552 by 2065.

Table 10: Projected growth[1] in sewer connections to 2040 & 2065.

Year	Residential	Commercial & Industrial	Community Infrastructure & Public Open Space	Other Non-Residential	Total
2016	391	35	20	0	446
2040	427	35	20	0	482
2065	497	35	20	0	552

Note 1: Figures derived from 'forecast.id' or 'Victoria in Future' values where appropriate and available. Otherwise a projection has been made based upon new connections for the system over the last 15 years.

Next Steps

To ensure the water security of the system by maintaining the balance between supply and demand a list of system specific capital and business as usual initiatives are tabled below. The capital initiatives were subjected to a preliminary analysis using Coliban Water's Multi-Criteria Analysis (MCA) tool.

As part of the future actions, the initiatives will be subjected to further detailed analysis for the following three demand scenarios:

- Baseline demand imbalance
- Dry weather peak month demand
- Demand during worst three drought scenarios (worst 3, 5 and 10 years).

Note that the demand and supply considerations are only for high climate change scenarios.

The next steps of the option analysis will include the following:

- Community and stakeholder engagement
- Detail analysis of capital and BAU options (filling the short fall and sequencing).

Table 11: Capital projects.

Strategy	Initiative		
Supply Augmentation	**Connect Korong Vale – Wedderburn to Waranga Western Channel:** For Wimmera System, the connection of Korong Vale – Wedderburn to Waranga Western Chanel is being under construction as part of a broader water security project in the south of Loddon Shire. Since this option provides access to the additional water resource, it brings greater water security to the Korong Vale System in times of severe water shortage. Coliban Water's only capital expenditure is to upgrade the WTP to treat a different water quality from the Waranga Western Channel.	MCA Ranking	
		Estimated Cost	$500,000
		Implement time	2-3 Years
		Water gained (ML/Yr.)	-
		$/ML	-

Business as Usual Initiatives

There is no system specific BAU initiative for Wimmera. There are generic initiatives that are applicable for all the systems listed in Part C.

Appendix D - Gap Analysis

Table 1 outlines the degree of alignment between the requirements within the DELWP guidelines and the content of the Coliban Water 'Urban Water Strategy' (UWS). Additional actions are proposed in relation to the UWS after it has been submitted to DELWP. The future actions focus on customer and stakeholder engagement and further analysis of the proposed options.

Table 1: Comparison of DELWP Guidelines and Coliban Water's UWS.

Section	DELWP UWS Guidelines Requirements Coliban Water's Current and Proposed Actions
1.4	Principles to apply in developing an Urban Water Strategy
	Status: Significantly Complete to Complete Actions to Date: Web based survey of customers undertaken; climate scenarios used in planning; integrated water management plans underway on four communities; option assessment includes social, economic, environmental and technical assessment; Coliban Water is already active in the water market; one of the key strategies recognises the need to be flexible. Proposed Actions: Engagement plan to be implemented; participation in regional integrated water forums.
3.2	Provide key system characteristics
	Status: Complete Actions to Date: Information provided in Appendix C. Proposed Actions: Nil.
3.3	Include maps showing regional context and water atlas
	Status: Partially Complete to Complete Actions to Date: Regional maps included in the UWS. Proposed Actions: Water atlas to be included in a later version of the UWS.
3.4	Include summary of water supply system and catchment characteristics
	Status: Partially Complete Actions to Date: Limited information provided on the upper Coliban River catchment. Other supply catchments and groundwater are managed by other corporations. Proposed Actions: Nil.
3.6	UWS to be based on recent learnings
	Status: Partially Complete Actions to Date: Lessons from the Millennium Drought are incorporated into UWS. Service levels for urban and rural customers are set out in the UWS. Proposed Actions: Engagement with customers in the lead up to the pricing submission to the ESC. Identification of high value community open space assets.
4.2	Outline approach adopted in demand forecasts
	Status: Complete Actions to Date: Approach outlined in UWS includes the correlation between demand, rainfall, temperature and growth projections. Proposed Actions: Nil.
4.3	Provide detailed projects of urban water demand and high-level projections on wastewater discharge
	Status: Significantly Complete. Actions to Date: Urban demand projections provided by customer sector including rural customers. Wastewater discharges are estimates only and only for selected systems. Proposed Actions: Nil.
4.4	Include baseline demand from a 'business as usual' perspective
	Status: Complete Actions to Date: Baseline demand identified for all nine systems.

	Proposed Actions: Nil.
4.5	Document cost and impact of water restrictions and how incorporated
	Status: Significantly Complete Actions to Date: Impact on demand has been incorporated into drought scenario planning. Proposed Actions: Cost of restrictions to be based on DELWP research project once available.
6.2.1	Estimate system yield and the earliest year that augmentation is required
	Status: Complete Actions to Date: All nine supply systems have yield estimates for 2040 and 2065, and show the year that augmentation may be required. Proposed Actions: Nil.
6.2.2	Assess community sentiment in relation to options that can keep supply in balance with demand
	Status: Not Complete. Actions to Date: Limited customer engagement to date via web based survey. Proposed Actions: Engagement in the lead up to the pricing submission to the ESC.
7.2.1	Planning for climate change and climate variability
	Status: Complete Actions to Date: Range of climate scenarios considered in the UWS. Proposed Actions: Nil.
7.2.2	Qualitative assessment of extreme events when supply is unavailable
	Status: Significantly Complete Actions to Date: Part of the drought preparedness includes assessment of severe drought. Proposed Actions: Nil.
7.2.3	Groundwater investigations where there is uncertainty on quality or quantity
	Status: Complete Actions to Date: Recommendations are made for selected systems. Proposed Actions: Nil.
7.2.4	Consider a reduction in catchment yield
	Status: Complete Actions to Date: Assessment has only been made for the Upper Coliban River Proposed Actions: Nil.
7.2.5	Include, where appropriate, an assessment of the risks to water availability from planned and unplanned shutdowns of assets
	Status: Not Complete Actions to Date: Contingency plans are under development. Proposed Actions: Nil as the contingency planning will form part of Coliban Water's overall risk management framework.
7.2.6	Assessment of risks associated with poor raw water quality events
	Status: Significantly Complete Actions to Date: Many of our water treatment plants have previously been upgraded due the frequent poor raw water quality events e.g. Murray River, Lake Eppalock. Proposed Actions: Assessment of potential risks to water treatment plant capacity to be undertaken.
7.2.7	Risk associated with limitations in water transfer capacity
	Status: Complete Actions to Date: Goldfields Superpipe assessed. Supply augmentation plans undertaken on a regular basis for each system. Proposed Actions: Nil.

7.3.1	UWS to take into account growth projections from 'Victoria in Future 2016'
	Status: Complete. Actions to Date: Growth projections provided by DELWP out to 2065 have been used to estimate growth in customer connections. Proposed Actions: Nil.
7.3.3	Environmental flow requirements
	Status: Complete. Actions to Date: Passing flow requirements under our Bulk Entitlements has been included as a 'demand'. Proposed Actions: Nil.
7.4	Decision making approach should be adaptive
	Status: Significantly Complete. Actions to Date: The need to be adaptive is acknowledged in one of the key strategies i.e. the need to maximise operational flexibility. Proposed Actions: Systems with multiple options will have a more detailed assessment of the interaction between options.
8.1.2	Identify initiatives to decrease demand inc. water efficiency
	Status: Significantly Complete to Complete Actions to Date: Demand management is one of the key strategies. Initial option assessment undertaken. Proposed Actions: Options will be refined further in a future draft of the UWS.
8.1.3	Identify supply initiatives
	Status: Significantly Complete Actions to Date: Initial option assessment has been undertaken. Proposed Actions: Options will be refined further in a future draft of the UWS.
8.1.4	Identify wastewater management options to address any capacity constraint
	Status: Partially Complete Actions to Date: Existing master plans for the wastewater treatment plants have been reviewed and potential upgrade requirements identified. Proposed Actions: Further refinement of upgrade requirements may be considered.
8.2.1	Undertake detailed options assessment after community consultation
	Status: Partially Complete Actions to Date: Only initial option assessment completed. Proposed Actions: Engagement with the community will be conducted in the lead up to the pricing submission to the ESC.
8.2.2	Document approach for evaluating options
	Status: Significantly Complete Actions to Date: Initial option assessment completed. Proposed Actions: Engagement with the community will be conducted in the lead up to the pricing submission to the ESC.
8.2.3	Use best judgement for detailed option assessment
	Status: Significantly Complete Actions to Date: Multi-criteria analysis used for initial assessment. Proposed Actions: Further assessment will consider interactions between options.
8.2.5	List of priority actions over next 5 and 50 years
	Status: Significantly Complete Actions to Date: Options listed by proposed delivery sequence. Proposed Actions: Develop internal methodology to assess water efficiency savings.
9.1.1	Involve customers and key stakeholders in decision making
	Status: Partially Complete

	Actions to Date: Web-based customer survey, on-going visits to towns providing an opportunity for the community to ask questions and receive feedback. Initial engagement with Dja Dja Wurrung Clans Aboriginal Corporation commenced. Discussions with Central Highlands Water and GWM Water regarding 'shared infrastructure'. Proposed Actions: Engage with the community in the lead up to the pricing submission to the ESC.
9.1.2	Develop an Engagement Plan
	Status: Complete Actions to Date: Engagement plan outlined in Part E. Proposed Actions: Engage with the community in the lead up to the pricing submission to the ESC.
10.1.1	Priority actions to be included in the pricing submission and corporate plan
	Status: Not Complete Actions to Date: Pricing submission is not finalised and endorsed by the Board of Coliban Water. Proposed Actions: Continued internal engagement in the lead up to the pricing submission to the ESC.
11	Drought Preparedness Plans to be prepared in conjunction with the UWS
	Status: Complete Actions to Date: Savings from water restrictions revised along with future drought scenarios. Key elements of the drought plans included as part of the UWS. Proposed Actions: All nine Drought Preparedness Plans will be reviewed to ensure consistency with the UWS.
12 & 12.2	Make available an Annual Water Outlook by 1 December and assess short-term performance and the need for action
	Status: Complete Actions to Date: Annual Water Outlook submitted to DELWP in late November 2016. Proposed Actions: Submission of 2017 Annual Water Outlook by December 2017.

Appendix E – Engagement Plan

Introduction

About This Plan

All that Coliban Water does to communicate and engage with stakeholders should aim to directly support our purpose to 'deliver water services for community needs now and into the future'.

This Engagement Plan has been included in our Urban Water Strategy to help ensure that how and when we implement the strategy is informed by stakeholder values and achieves the right outcomes for the community. It includes

- Our engagement goal
- Our objectives and how we will measure success
- Our strategic approach
- Key messages
- Communication and engagement tools
- Stakeholder groups
- Risks and mitigation strategies
- An implementation plan

Definition of a Stakeholder

A stakeholder is defined as anyone who has an interest in Coliban Water's Urban Water Strategy (UWS), can influence or have an impact on the success of the Strategy, or who will be affected by the Strategy in some way (either real or perceived impact).

Coliban Water will actively identify and engage with stakeholders to:

- Gain their participation in helping to inform how and when the Strategy will be implemented.
- Build their support and commitment to steer the Strategy towards achievable and mutually beneficial outcomes.

Privacy and Confidentiality

All Coliban Water staff delegated a role in this Engagement Plan contribute to ensuring stakeholders' privacy and confidentiality is respected before, during and after engagement has taken place.

All information collected by Coliban Water will be securely collected and stored in line with its Privacy Policy outlined here www.coliban.com.au/site/root/privacy and in compliance with the Information Privacy Principles (IPPs) outlined in the *Victorian Information Privacy Act 2000*.

Context for Engagement

Why We Are Engaging

Coliban Water's Urban Water Strategy identifies the best mix of measures to provide water services in our towns and cities for the next 50 years.

Bringing the Strategy to life requires us to make a number of value judgements and decisions about how and when Coliban Water will implement the options recommended in the Strategy. Many of these options will have varying levels of impact on our stakeholders.

Coliban Water recognises that inviting stakeholders to participate in this decision-making process will help to translate the Strategy into activities and projects that positively contribute to achieving the right outcomes, at the right time, for the communities we serve and in which we operate.

How We Will Engage

Coliban Water is committed to engaging with our stakeholders in transparent, clear, respectful and constructive ways. We also recognise that our stakeholders are not all the same and that when, in what way, and how much they want to participate in decision-making will vary.

The following three principles will drive how we engage with stakeholders.

- We are prepared.
  We clearly define our role and the roles of our team members, plan the processes and tools we will use and the resources we will need.
- We understand who our stakeholders are.
  We identify which stakeholders are most likely to be affected by, or interested in, the Urban Water Strategy and how we can best involve them in decision-making. We also offer a range of ways for stakeholders to choose to participate.
- We communicate clearly and directly.
  We provide stakeholders with timely, accurate and relevant information. We make it clear which decisions stakeholders can help make, how they can participate, and how their input will be used.

This plan is informed by the guidelines for consulting with stakeholders outlined in the Victorian Department of Environment Land, Water and Planning (DELWP) *Guidelines for the Development of Urban Water Strategies and the Melbourne Water System Strategy (2016)*, the Victorian Auditor-General's Office *Public Participation in Government Decision-making Better Practice Guide (2015)*, and the International Association for Public Participation's Public Participation Spectrum.

Other Engagement That Informs This Plan

Coliban Water is committed to ongoing engagement with our communities and stakeholders to help improve living standards, inform, educate and support. We seek regular feedback in relation to our services, operations and projects. Some of our regular engagement activities include:

- Establishing and working with customer committees, reference and advisory groups to help us ensure our community is engaged in future-planning and decision-making.
- Coordinating 'Your Town Visits' to provide customers with an opportunity to meet with staff face to face in the communities where we provide services.
- Holding annual public meetings open to all customers and community groups to outline our focus for the coming year and provide context to the last 12 months.
- Undertaking customer and stakeholder research to evaluate and benchmark our performance and understand the opinions and perceptions of our customers. We carry out customer-wide research, as well as targeted research for specific customer groups such as Rural, Commercial and Trade Waste.
- Delivering education and water savings programs for local schools and communities.
- Engaging regularly with key stakeholders including Councils, neighbouring water authorities, and Government departments and agencies.

We also undertake significant engagement programs for major projects and strategic planning. Some recent projects that have involved significant engagment programs include:

- Developing our Water Plan 2013-2018. This involved mailing the draft plan to all our customers and surveying our residential and most of our non-residential customers. We held 19 information sessions and received more than 1300 feedback forms, phone calls, emails and letters.

- Developing our Integrated Water Strategy involved engagement with our service providers and local government.
- Developing our Pricing Submission 2018. This work is still underway and includes online surveys, community information sessions and 'pop up' events, face-to-face interviews with major trade waste customers, a community forum, a stakeholder workshop, and pricing focused 'Your Town' visits.

These engagement activities have allowed us to gain a strong understanding of who our stakeholders are and what matters to them.

This Urban Water Strategy Engagement Plan has been developed to:

- Tap into and build on Coliban Water's existing postitive and productive relationships with key stakeholders.
- Share and confirm what we have already heard from stakeholders about their water values, concerns and issues through previous engagement.
- Wherever possible integrate with other engagement activities planned for the next 12 months such as our Annual Public Meetings and Your Town visits. This will help make sure our stakeholders find it as straightforward as possible to participate.
- Seek specific, and highly targeted feedback to help us implement the Urban Water Strategy.

Engagement Plan

Our Goal

Our goal captures why we are engaging and what we want to achieve. Our engagement goal is:

- To build confidence in and acceptance of Coliban Water's Urban Water Strategy while enabling communities and key stakeholders to make informed and ongoing contributions towards its implementation.

Coliban Water's Urban Water Strategy includes four core strategies and a long list of options to implement each strategy. Stakeholders will participate in helping Coliban Water to prioritise which options we implement and in what order.

To ensure that we can clearly define the decisions required, and the scope of public participation, Coliban Water will first develop a short list of options using a Multi-Criteria Assessment approach.

Refining the list of options into a short list will allow us to:

- Seek stakeholder feedback that is directly relevant to the specific decisions required.
- Seek stakeholder feedback that is appropriate and readily actionable.
- Engage in a purposeful and meaningful way.

While a key element of our engagement plan is to encourage stakeholders to help us prioritise the options on the short list, we also recognise that it is important for stakeholders to have confidence that the process to develop the Urban Water Strategy and refine the short list has been robust, thorough and fair. This is included in our goal and incorporated into our plan.

Ongoing engagement has been included to ensure that stakeholders have an opportunity to understand how their feedback has contributed to the Strategy both in the immediate and over the long term, and to encourage them to participate further if appropriate, particularly around delivery of key projects.

Our Objectives

Our objectives tell us what we need to do to achieve our engagement goal and measure our success.

- Objective 1: Hear from a broad and balanced range of interests, concerns and voices.
- To make sure the options we prioritise offer solutions to managing water supply that balance financial, environmental, social and technical aspects it is important we hear from a balanced cross-section of our stakeholder community.

  How we will measure success: By setting benchmarks for participation based on demographic and customer data.
- Objective 2: Communicate – firstly the context and purpose of the Urban Water Strategy, secondly what the medium and long term risks to water security are (including climate change), and thirdly how Coliban Water plans to manage future risks and maintain liveability.

  To enable stakeholders to participate effectively it is essential that they are well informed. This includes clearly understanding the purpose and context of the Strategy (including risks to water supply) and the solutions (options) that Coliban Water is proposing.

  How we will measure success: By measuring how many stakeholders read or hear the information we share. This will include the number of visits to the project webpage, social media metrics, distribution of printed communication pieces and media coverage. Because it is difficult to ascertain the degree of information retained or understood using these measures alone, they will be assessed together with the participation measures listed in Objective 3.
- Objective 3: Gain participation from key stakeholders and communities.

  Active participation from stakeholders is essential to the success of this plan.

  How we will measure success: Participation will be measured by action. We will measure participation based on attendance at workshops, community information sessions and information booths, survey responses, engagement via a purpose-built online platform, and the number of formal submissions received.
- Objective 4: Develop an Urban Water Strategy informed by Indigenous water values.

  Coliban Water is committed to involving Aboriginal representation in water planning, and better recognising Aboriginal values and building capacity to increase Aboriginal participation in water resource management.

  How we will measure success: Success will be measured by participation by the Dja Dja Wurrung, Taungurong and Yorta Yorta in engagement activities and tangible outcomes such as a Water Values statement or a MOU, and a demonstrated application of Indigenous water values in how our strategy is implemented.

  The timing of engagement with Indigenous stakeholders will also be a measure of our success. DELWP's Guidelines for the Development of Urban Water Strategies and the Melbourne Water System Strategy recommends that "approaches to Traditional Owner groups should occur during the preliminary stages of planning and prior to any stakeholder consultations so as to honour their status as partners in natural resource management matters and meet our statutory obligations ..."

  Engagement with Traditional Owners has already commenced.

Note: The section above details what we will measure to define success. The exact measures (i.e. percentages and numbers) will be set during Stage 1 of the implementation plan when we are able to evaluate the decision required, the stakeholders likely to be most affected, and the most suitable engagement approach.

Our Strategic Approach

Our strategic approach explains how we will achieve our objectives.

- Strategy 1: Clear and compelling communication

We will communicate to:

- Build knowledge and understanding of why Coliban Water has developed the Urban Water Strategy.
- Build confidence in the four core strategies within the Urban Water Strategy and the options short listed by explaining the approach used to develop them.
- Excite and inspire participation by personalising and localising the Urban Water Strategy.

- Strategy 2: Strong relationships

  We will:

  - Maintain and enhance relationships with established stakeholders through targeted engagement activities.
  - Identify and build relationships with new stakeholders, including those who can help communicate the 'Urban Water Strategy story' through traditional media content (i.e. newspaper articles).

- Strategy 3: Meaningful engagement

  We will:

  - Create genuine and purposeful opportunities for communities and stakeholders to participate in helping Coliban Water to prioritise the short list of options.
  - Be honest and transparent about which elements are non-negotiable and which elements are negotiable, and how stakeholder input will be used to implement the Strategy.
  - Close the loop. Share with stakeholders how their feedback has contributed to how the Strategy will be implemented.

- Strategy 4: Best for purpose, relevant engagement

  We will:

  - Get the best outcome by using suitable engagement approaches at the right time – inform, consult, involve, collaborate or empower.
  - Segment stakeholders to ask relevant questions. Stakeholders will be segmented by level of interest and impact, location and water use.

Key Messages

The following key messages have been developed to:

1. Ensure that information about the Strategy is communicated clearly and consistently.
2. Promote and encourage participation.

Key message 1: Risks and Challenges

<u>Purpose</u>
To inspire and motivate participation while informing stakeholders about the medium to long-term risks to water security (including climate change).

<u>Message</u>
Victoria is becoming hotter and drier and our population is growing. We face significant challenges in meeting future demands for water and maintaining liveability.

<u>Supporting facts</u>

- Our population is projected to more than double in the next 50 years.
- Climate modelling predicts hotter, drier weather. This means our water supply will reduce and our demand for water will increase.
- Some of the water resources supplying our urban and rural communities are near or already at their sustainable limits.

Key message 2: Future planning

<u>Purpose</u>
To explain the purpose and context of the Urban Water Strategy.

Message
The purpose of the Urban Water Strategy is to identify the best mix of measures to provide water services now and into the future.

Supporting facts

- The Urban Water Strategy is our plan to manage water supply for the next 50 years.
- The Urban Water Strategy has been developed to help to support growing, resilient, prosperous and liveable communities.
- The Urban Water Strategy balances social, environmental and economic risks, costs and benefits.

Key message 3: Strategic approach

Purpose
To build confidence in the approach used to develop the Urban Water Strategy.

Message
We are committed to exploring options that are sustainable and cost effective but also support what is needed for the region in the long term.

Supporting facts

- The Urban Water Strategy is informed by comprehensive water, population and climate change modelling as well as Government guidelines, frameworks and legislation.
- The Urban Water Strategy includes four key strategies to ensure safe, secure, reliable and affordable water services:
    - Operational flexibility: Use what we already have to achieve the best outcomes for communities, our economy and environment.
    - Manage demand: Reduce demand for water by making our systems more efficient through upgrades and encouraging changes to user behaviour.
    - Use alternative water sources: Optimise the use of alternative water sources on a best-for-purpose basis. Options include recycling water and extracting groundwater.
    - Supply upgrades: Improve system capacity through upgrades and pipeline connections and use of the water market.

Key message 4: Decision-making

Purpose
To communicate the role of stakeholders in the decision-making process, the scope of consultation, and when and how they can participate.

Message
We are seeking community input to help prioritise which elements of the plan we deliver and when.

Supporting facts

- The information on our webpage and in our summary plan will help you learn more about our Strategy, consider the options to bring it to life, and understand how they will affect you.
- We want to hear what matters to you. You can get involved by completing a survey, joining our online conversation, attending a community information session, or by making a formal submission.

- Your input will help to shape how we manage water for the next 50 years. We will share what we have heard you say and how we will use your feedback.

Communication and Engagement Tools

We will use communication and engagement tools that:

- Ensure stakeholders are aware of the opportunity to participate and have a choice as to how they participate.
- Allow stakeholders to access information they need to make informed contributions in a format they prefer (i.e. in print, online or in person).
- Encourage and respond to feedback. This will help stakeholders to understand that we have heard, understood, and will consider their concerns and aspirations. This two-way process promotes inclusiveness and transparency.

Our stakeholders are not all the same. When, in what way, and how much they want to participate in decision-making will vary. This will affect the type and level of engagement that will best suit their needs.

Stakeholders will also require different information and opportunities to participate at different times during the engagement process.

Table 1: Anticipated levels of public participation.

Participation Level	Objective	Commitment
Inform	To provide balanced and objective information to support understanding by the public.	To keep the public informed.
Consult	To obtain public feedback on analysis, alternatives and or decisions.	To listen to and acknowledge the public's concerns.
Involve	To work with the public to ensure concerns and aspirations are understood and considered.	To work with the public to exchange information, ideas and concerns.
Collaborate	To engage with the public on each aspect of the decision, including the development of alternatives and a preferred solution.	To seek advice and innovations from and amongst various public parties.

Source: Adapted from the International Association for Public Participation's Public Participation Spectrum.

Table 2: Communication and engagement tools.

Tool	Description/Purpose	Participation level
Summary Urban Water Strategy	To capture and share • The Urban Water Strategy 'story' for each supply system • Existing stakeholder water values, interests and concerns The document will be available for download online. It will also be available in hard copy at face-to-face events, the Coliban Water office, and on request.	Inform
Bill insert (call to action)	To share • Basic 'who, what, when, why, how' information about the Urban Water Strategy • Simple information about how stakeholders can participate.	Inform
Bill insert (progress update or consultation close out)	To share information about what feedback has been received, and how Coliban Water will use or is using it to shape how the Urban Water Strategy will be implemented.	Inform

Fact sheet	To share detailed information about the Urban Water Strategy and existing stakeholder water values, interests and concerns. The document will be available for download online. It will also be available in hard copy at selected outlets (i.e. public libraries and Council service centre's, Coliban Water office), at information and other relevant events and on request.	Inform
Posters	To share specific detail about particular components of the Urban Water Strategy. Posters will be used at information sessions and other relevant events.	Inform
Direct mail letter to key stakeholders	To invite relevant stakeholders to participate in specific and targeted engagement opportunities (i.e. workshops).	Inform
Urban Water Strategy webpage	To share with all stakeholders • Detailed 'who, what, when, why, how' information about the Urban Water Strategy including specific detail about relevant components including the four core strategies and implementation options. • Existing stakeholder water values, interests and concerns. • Information about ways they can participate in the decision-making process. • Updates on the engagement process (such as sample feedback received or total responses received).	Inform
Traditional media (media releases and editorial content)	To share information about the Urban Water Strategy in a way that is local, personal and encourages participation (i.e. stories about locals, how they use water, what matters to them, what they think about the Urban Water Strategy and how they are participating). Potential story ideas include: • A school participating in the Victorian Government's Schools Water Efficiency Program with support from Coliban Water. • An urban customer with high or very low water use levels. • A major trade waste customer who is also a major regional employer. • A sports team who relies on a public green space. • A rural customer running a water reliant business.	Inform
Social media (content and posting schedule using Coliban Water's existing Facebook and Twitter channels)	To share with all stakeholders in a timely and engaging way: • Detailed 'who, what, when, why, how' information about the Urban Water Strategy in a format appropriate for social media (i.e. a series of 'fast fact' infographics) • Existing stakeholder water values, interests and concerns to seek confirmation and inspire participation. • Information about ways they can participate, and provide encouragement to get involved (i.e. reminders to	Inform

	participate in the survey, information session notifications). • Updates on the engagement process (such as sample feedback received, total responses received and how the feedback is being used).	
	To invite and respond to comments and feedback on the Urban Water Strategy.	Consult
Face-to-face workshops	To share with relevant stakeholders detailed information about the Urban Water Strategy and existing stakeholder water values, receive feedback, exchange information, ideas concerns and seek advice.	Collaborate
Survey (online)	To receive feedback in response to specific questions including confirmation of existing stakeholder water values, issues and concerns.	Consult
Online engagement platform (Your Say)	To receive feedback in response to specific questions including confirmation of existing stakeholder water values, issues and concerns.	Consult
	To ask open-ended questions, and facilitate interaction, discussion and ideas sharing between stakeholders.	Involve
Community information sessions	To receive feedback in response to specific questions including confirmation of existing stakeholder water values, issues and concerns.	Consult
	To ask open-ended questions, and facilitate interaction, discussion and ideas sharing between stakeholders.	Involve
Formal submissions (post or email)	To provide a channel for stakeholders to provide feedback in a structure and format of their choosing. Coliban Water will acknowledge receipt of all formal submissions received in writing.	Consult
Your Town Visits	Your Town visits form part of Coliban Water's regular annual engagement program. The Your Town visits program provides customers with an opportunity to meet with staff face-to-face, ask questions and receive information on projects in the area, billing and service, and tips on saving water. Depending on timing, the Your Town visits program will be used to facilitate participating in the Urban Water Strategy or to share information about what feedback has been received and how it will be used to shape how and when the Strategy will be implemented.	Inform or Consult subject to timing.
Annual Public Meetings	Coliban Water holds a public meeting around April each year. Meetings are open to all customers and communities. The 2018 annual meeting will be used to share information about what feedback has been received on the Urban Water Strategy and how it will be or is being used to shape how and when the Strategy will be implemented.	Inform

Our Stakeholders

To help us tailor engagement and encourage participation by asking relevant questions and using the right tools at the right time, stakeholders have been segmented based on their anticipated level of interest in participation, location and water use.

Table 3: Stakeholders.

Group	Details	Participation Level
Coliban Water staff and Board	• Growth planning and DWWMP (Domestic Waste Water Management Policy) • Water Services Sector Group • Coliban Water Board	Collaborate
Coliban Water customer committees	• Harcourt Water Services Committee • Rural Customer Advisory Group	Collaborate
Government departments and authorities	• Department of Environment, Land, Water and Planning (DELWP) • Department of Economic Development, Jobs, Transport and Resources (DEDJTR) • Environment Protection Authority (EPA) • CERT Australia • VicTrack • VicRoads • Heritage Victoria	Collaborate
Emergency services	• Emergency Management Victoria • Forrest Fire Management Victoria (Vic Gov) • Country Fire Authority (CFA)	Collaborate
Traditional Owners	• Dja Dja Wurrung • Taungurong • Yorta Yorta • Loddon Mallee Local Aboriginal Network (Aboriginal Victoria)	Collaborate
Councils	• Campaspe Shire Council • Central Goldfields Shire Council • City of Greater Bendigo • Gannawarra Shire Council • Hepburn Shire Council • Loddon Shire Council • Macedon Ranges Shire Council • Mitchell Shire Council • Mt Alexander Shire Council	Collaborate
Water authorities	• Central Highlands Water • Goulburn-Murray Water • Goulburn Valley Water • GWM Water • North Central Catchment Management Authority	Collaborate
Industry	• Builders and developers (i.e. Lend Lease and Veolia) • Master Plumbers Association • Plumbers • Tree maintenance contractors • Fencing contractors • Weed spraying contractors • Conveyancers and Solicitors • Bendigo mine	Collaborate
Institutes and NGOs	• La Trobe University • Plumbing Industry Climate Action Centre • Water Services Association of Australia (WSAA)	Collaborate

	• Institute of Water Administration (IWA) Technical Services Special Interest Group • Victorian Farmers Federation • AUSVEG VIC • Growers associations and cooperatives	
Major customers	• Hazeldene's Chicken Farm Pty Ltd • Kagome Foods Australia Pty Ltd • Murray Goulburn Co-operative Co Ltd • N&C Enterprises Pty Ltd • Parmalat Australia Pty Ltd • Hardwick's Meat Works Pty Ltd	Collaborate
Customers	• Recycled water customers • Urban customers • Rural customers • Minor trade waste customers	Involve
Community groups and associations	• Conservation groups • 'Friends of' groups • Landcare groups	Involve
Other interested parties	• Landowners of adjoining lots	Consult
Media	• Bendigo Advertiser • Bendigo Weekly • ABC Regional radio	Inform

Risks and Risk Mitigation

Table 4 provides an overview of issues and risks to engaging, and our approach to mitigating these risks.

Table 4: Risks and risk mitigation.

Risk	Mitigation/Response
Heightened public concern about future water supply.	Communicate risks to future water supply (such as climate change and population growth) in a balanced way. Clearly explain to stakeholders how the Urban Water Strategy plans and accounts for these risks.
Confusion among stakeholders resulting from poor integration and conflicts between communication and engagement activities related to the Urban Water Strategy, other Coliban Water projects, and 'business as usual' activities.	Coliban Water's in-house team will develop, deliver and manage communication and engagement activities for the Urban Water Strategy. This will ensure that Coliban Water can successfully coordinate and streamline all concurrent communication and engagement activities and avoid conflicts. It will also allow Coliban Water to identify opportunities to optimise 'business as usual activities' to support Urban Water Strategy engagement and avoid duplication (i.e. potential duplication between Your Town visits and Urban Water Strategy community information sessions).
That the appetite for participation in workshops and information sessions exceeds the resources and therefore the deadlines of the project.	We will seek to ensure that the timelines for engagement are embedded into all formal and informal project communication and offer a range of scalable ways for stakeholders to participate, particularly online.
Lack of interest in participating.	We will actively identify, review and update performance and timeframes against the plan schedule to identify lack of interest early and respond proactively.

Outcomes not aligned with community expectations.	Our engagement plan is designed to ensure that the goal and scope of the engagement is clearly defined and communicated clearly and frequently.

Reporting and Evaluation

Coliban Water collates data from our customer contact center in relation to the nature of the enquiry. We also collate data from 'Your Town' visits and any survey that may be undertaken. Many of the surveys are conducted on-line and collating the information is straightforward.

Implementation Plan

Stage 1 – Engage with Traditional Owners

Timeframe: Already commenced	
No	**Task**
1	Commence engagement with Traditional Owners

Stage 2 – Prepare for Participation

Timeframe: April 2017	
No	**Task**
1	Define role and scope of participation based on final short list of options and decisions required.
2	Define specific success measures (i.e. participation percentages or number values).
3	Review engagement work already completed for other projects and extract relevant findings (particularly those related to stakeholder and community water values) to include in Urban Water Strategy communication and engagement materials.
4	Develop engagement tools • Online engagement platform (YourSay) • Online survey • Select appropriate stakeholders for participation in workshops, develop appropriate format and schedule. Suitable stakeholders to participate in workshops are likely to include: o Coliban Water staff o Coliban Water customer committees o Councils o Government departments and authorities o Emergency Services o Water authorities o Industry o Institutes and NGOs o Major customers o Community groups and associations • Select appropriate locations and dates for community information sessions.
5	Develop communication tools • Summary Urban Water Strategy • Website • Bill insert, fact sheets and posters • Social media content schedule
6	Identity stories suitable to pitch to local media and develop media releases. Brief local media contacts in advance.
7	Establish systems and processes to capture feedback received during participation.

Stage 3 – Participation

Timeframe: May – July 2017	
No	**Task**
1	Digital materials • Launch webpage (including Summary Urban Water Strategy) • Start social media content schedule • Open online engagement platform • Open online survey (YourSay)
2	Print materials • Send bill insert • Distribute fact sheet • Make Summary Urban Water Strategy available
3	Traditional media • Distribute media releases * Stories will be shared regularly with the media during Stage 2.
4	Send invitations and host workshops for appropriate stakeholders.
5	Host community information sessions using supporting material • Summary Urban Water Strategy • Fact sheet(s) • Posters
6	Provide regular updates via digital channels (website, social media, and online engagement platform) to acknowledge feedback received and invite and encourage further participation.

Stage 4 – Evaluation, Analysis and Reporting

Timeframe: August-September 2017	
No	**Task**
1	Collate and analyse feedback and use it to help prioritise the short list of options.
2	Share results with stakeholders • On the webpage (including Summary Urban Water Strategy) • On the online engagement platform (YourSay) • On social media • Through traditional media

Stage 5 – Ongoing Participation

Timeframe: October 2017 onwards	
No	**Task**
1	Re-share relevant results and tangible outcomes with stakeholders (i.e. implementation of individual projects/activities) using 'Business as usual' channels • Website • Social media • Your Town visits • Annual Public Meetings
2	Identify and act on further opportunities for public participation around project delivery stages.