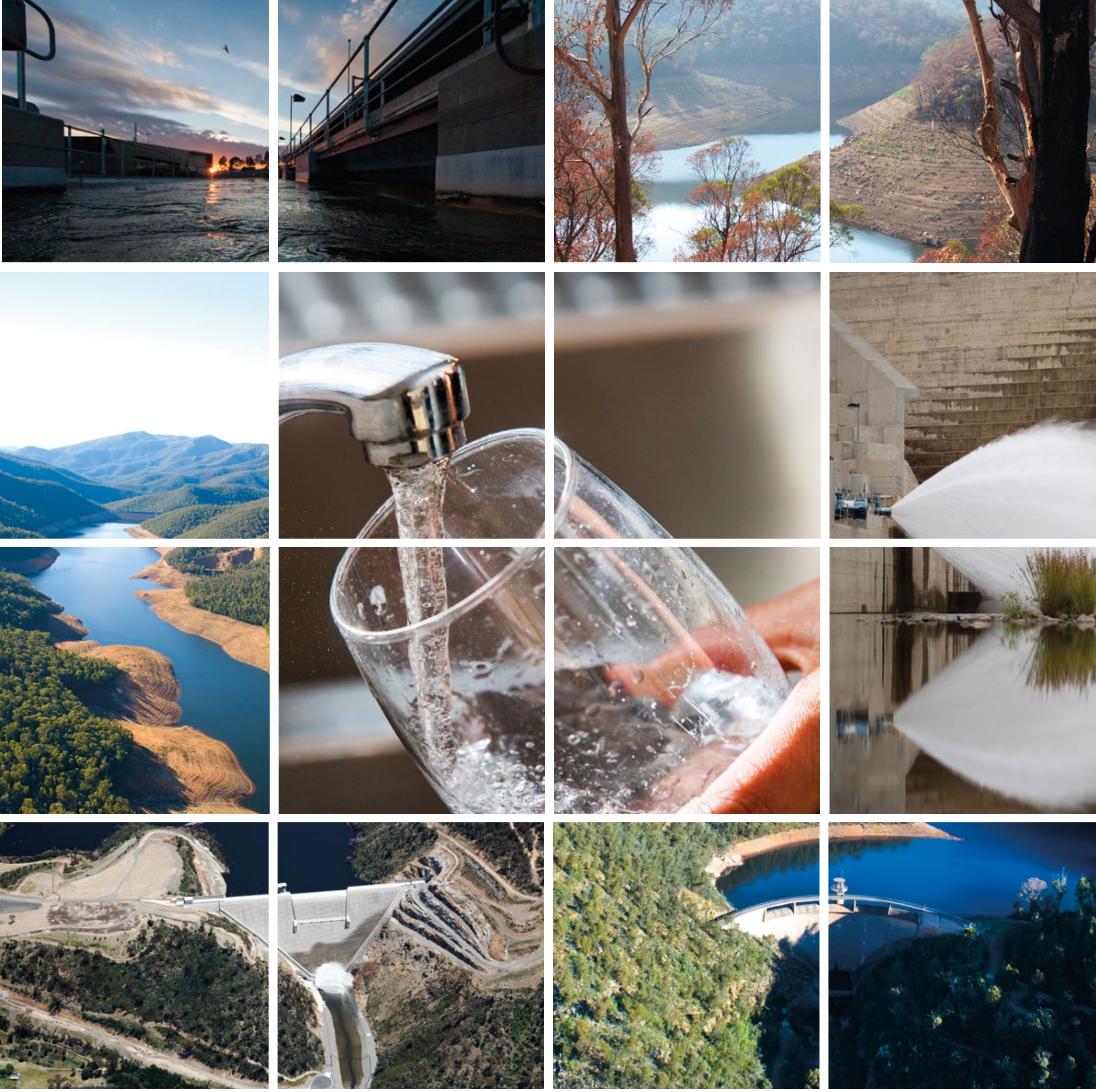

Annual Drinking Water Quality Report 2015–16

talktous@iconwater.com.au | (02) 6248 3111 | @iconwater | **iconwater.com.au**

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Information about Icon Water and an electronic version of this report can be found on the Icon Water website iconwater.com.au.

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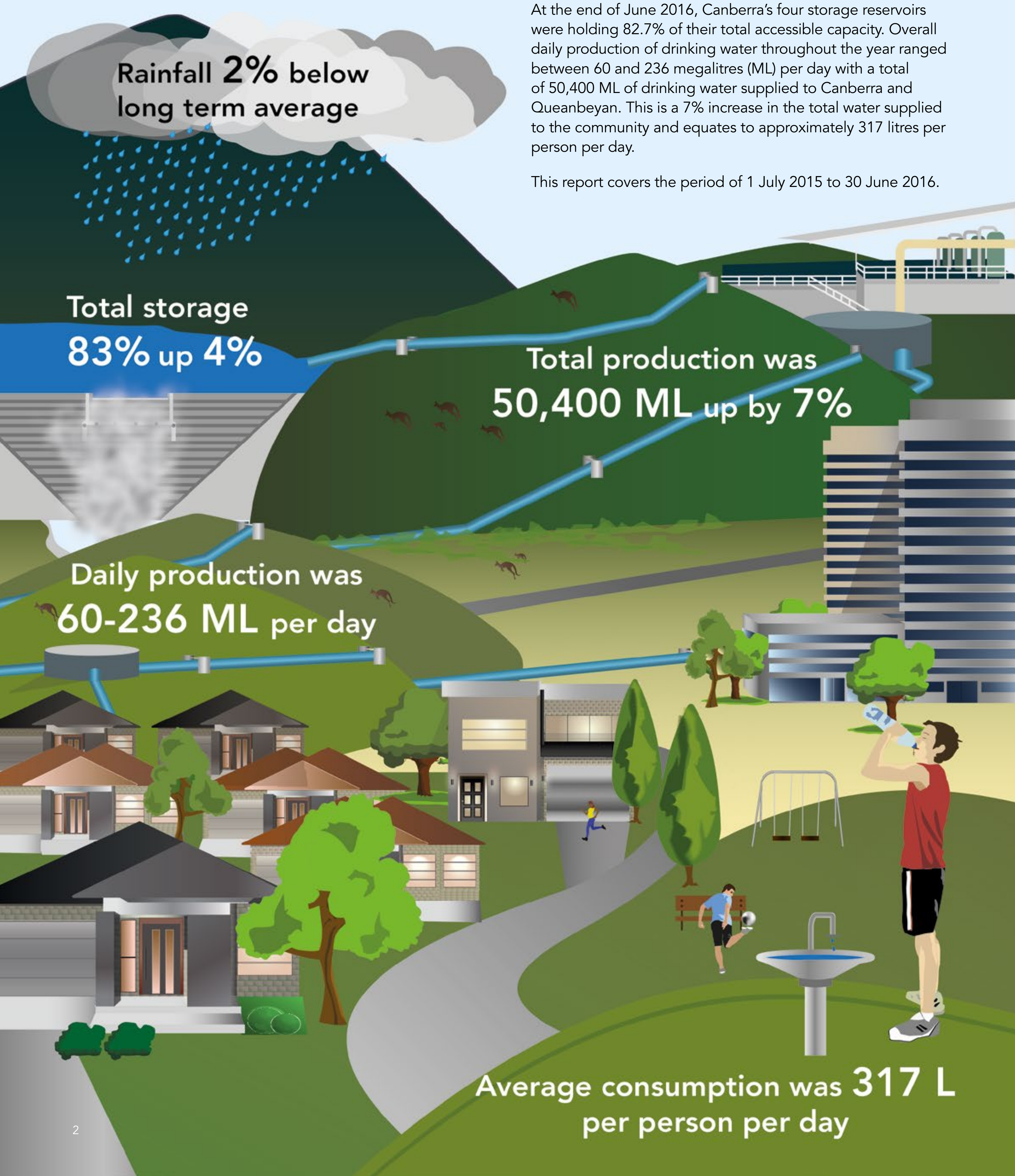
Summary

Icon Water supports and protects the community and the environment by providing safe, clean drinking water. Icon Water carries out an extensive drinking water quality monitoring program that includes the catchments and storage reservoirs, water treatment plants, service reservoirs and customers' taps. The information generated within this monitoring program assists Icon Water in its operations and ensures that high quality water is delivered to Canberra and Queanbeyan.

At the end of June 2016, Canberra's four storage reservoirs were holding 82.7% of their total accessible capacity. Overall daily production of drinking water throughout the year ranged between 60 and 236 megalitres (ML) per day with a total of 50,400 ML of drinking water supplied to Canberra and Queanbeyan. This is a 7% increase in the total water supplied to the community and equates to approximately 317 litres per person per day.

This report covers the period of 1 July 2015 to 30 June 2016.



1 Canberra's drinking water supply system

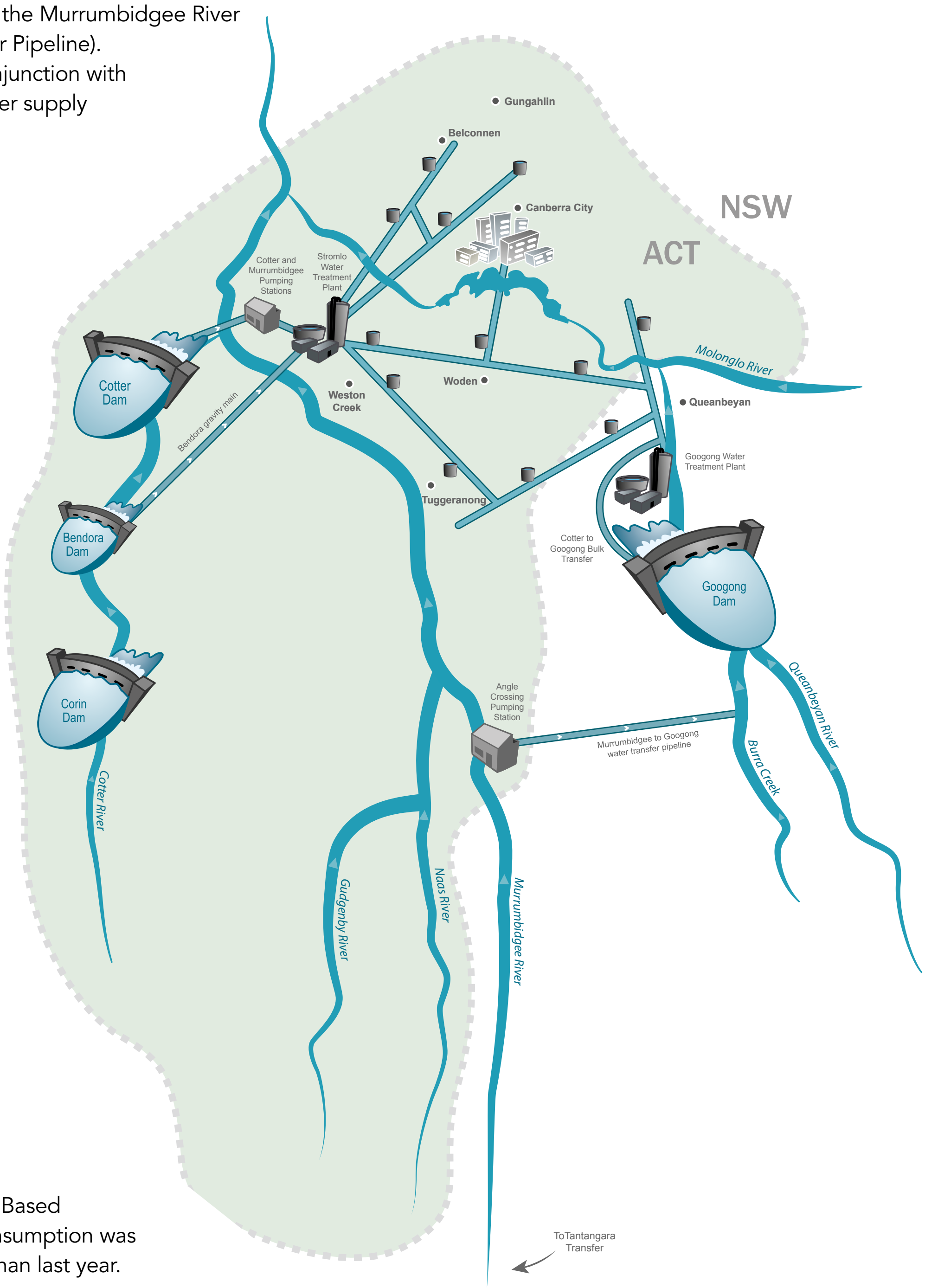
Canberra's drinking water is primarily sourced from the Cotter River and Queanbeyan River and may be sourced from the Murrumbidgee River. It is stored in four storage reservoirs across the Cotter River catchment and Queanbeyan River catchment. The Cotter River catchment is predominantly within the ACT and includes three storage reservoirs—Corin, Bendora and Cotter. The Queanbeyan River catchment lies within NSW and has one reservoir—Googong. Together with the ACT/NSW Governments and the community, Icon Water protects and manages these catchments to ensure Canberra's drinking water supply remains amongst the best in the country.

Prior to distribution to the community, the water abstracted from the storage reservoirs is treated at water treatment plants operated by Icon Water. The Mount Stromlo Water Treatment Plant (WTP) has operated since 1967 and can treat water from the Cotter catchment and the Murrumbidgee River, whilst the Googong WTP has operated since 1979 and can treat water from the Queanbeyan catchment and indirectly from the Murrumbidgee River (via the Murrumbidgee to Googong Transfer Pipeline). The Googong WTP may be operated in conjunction with the Mount Stromlo WTP to supplement water supply during summer peak demands and allow essential maintenance to occur at the Mount Stromlo WTP. Both WTPs are continously being upgraded and maintained to ensure they can meet their performance objectives.

Once treated, Icon Water distributes the water throughout Canberra utilising a complex network of pipelines and service reservoirs. Icon Water also supplies bulk water to Queanbeyan-Palerang Regional Council (QPRC), who distributes the water to Queanbeyan and Googong Township. Icon Water operates and maintains 47 service reservoirs, 25 pump stations and over 3,300 km of water pipelines. This infrastructure is maintained and closely monitored to ensure the Canberra community receives good quality drinking water direct to their tap.

During 2015–16 Icon Water supplied 50,400 ML of drinking water to Canberra and Queanbeyan. The average daily production ranged from 60 ML to 236 ML. Overall the total volume of water supplied represents an increase of 7% from the previous year.

Canberra and Queanbeyan's urban development is continuing to evolve and grow. The most recent estimates put Canberra's population at 393,000 and Queanbeyan at 41,000, representing an average annual population growth of 1.3%. Based on these figures, the average per capita consumption was 317 L/person/day, which is slightly greater than last year.



[1] Australian Bureau of Statistics, 3101.0 – Australian Demographic Statistics, Dec 2015 (released 23/06/2016) and 3218.0 – Regional Population Growth, Australia, 2014-15 (released 30/03/2016)

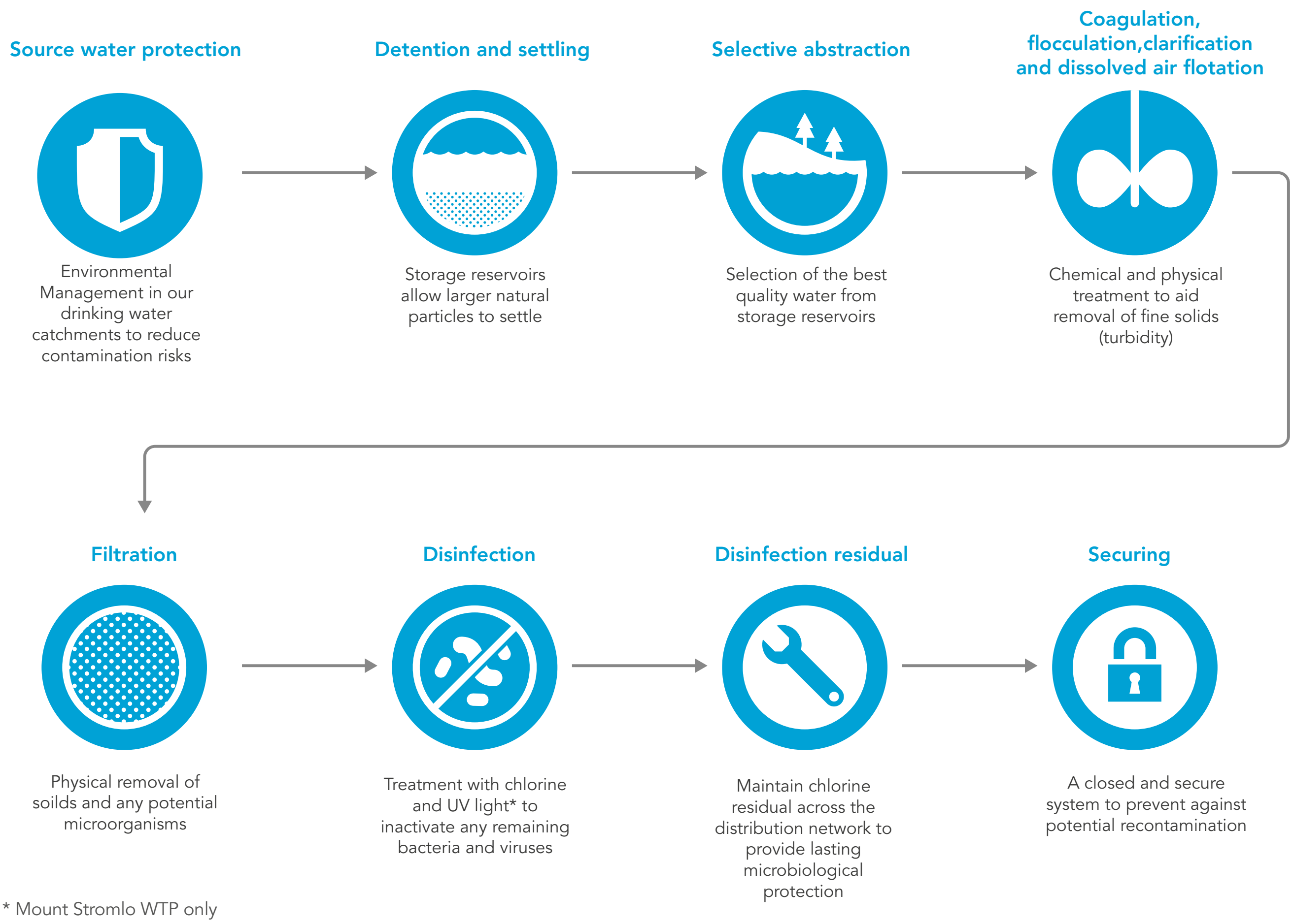
2 Managing Canberra's drinking water supply

Multiple-barrier approach

Icon Water supports and protects the community and the environment by providing safe, clean drinking water.

A preventative risk management approach is utilised to ensure the risks to water quality are minimised and controlled. Throughout its operations Icon Water applies multiple-barriers to protect the water supply from contaminants, including pathogenic microorganisms. This approach is consistent with the internationally recognised Hazard Analysis and Critical Control Point (HACCP) principles.

Figure 2-1 Drinking water supply barriers



* Mount Stromlo WTP only

The performance of these barriers is managed and monitored utilising a range of different measures. This includes a source water protection program, real-time online analysers, internal laboratory testing and a routine verification sampling program conducted by an accredited independent laboratory. These measures enable Icon Water to protect Canberra's water supply against potential risks to public health.

The drinking water quality monitoring program measures physical, chemical and microbiological parameters of the water supplied to customers. The water quality testing results are verified for compliance with the Australian Drinking Water Guidelines (2011) (ADWG). The ADWG includes two types of criteria that Icon Water use to manage the performance of the water supply system.

These criteria are:

- A health guideline value; which is the concentration or measure of a water quality characteristic that does not result in any significant risk to the consumer and is generally based on a lifetime of consumption; and
- An aesthetic value; which is the concentration or measure of a water quality characteristic that is associated with acceptability of water to the consumer; for example appearance, taste and odour.

Management framework

Icon Water holds the following licences for the operation of a drinking water distribution and supply service:

- Drinking Water Utility Licence, issued by the ACT Health Directorate under the Public Health Act 1997
- Utilities Service Licence, issued by the Independent Competition and Regulatory Commission (ICRC) under the Utilities Act 2000.

Icon Water also complies with the Public Health (Drinking Water) Code of Practice (2007) (the Code) which is issued by ACT Health.

Icon Water operates the water supply system under an Integrated Management System (IMS) to meet quality, environmental, regulatory and workplace health and safety requirements. The IMS is certified and complies with the following Australian and international standards:

- AS/NZS ISO 9001:2008. Quality management systems
- AS/NZS 4801:2001. Occupational health and safety management systems
- AS/NSZ ISO 14001:2004. Environmental management systems
- CAC/RCP 1 – 1969, REV.4 – 2003. General principles of food hygiene and guidelines for the application of the HACCP system

Drinking water quality management is based on the ADWG Framework and the HACCP system. Both systems cover water production from the source water catchment to the customer's tap. The externally certified HACCP system has been adapted to suit the water supply process. It enhances the organisations ability to manage drinking water quality and ensures continuous evaluation and improvement. Icon Water continues to retain external accreditation for the HACCP system implemented for the water supply system.

Bendora Dam cone valve, 2015

Cotter Dam, 2015

3 Canberra's source water catchments

Source water supply

Canberra's source water catchments consist of Corin (70.9 GL), Bendora (11.5 GL) and Cotter (79.4 GL) storage reservoirs on the Cotter River; the Googong (121.1 GL) storage reservoir on the Queanbeyan River; and the Murrumbidgee River.

The majority of the Cotter River catchment is within the Namadgi National Park and is largely protected from pollutants (e.g. faecal, pesticides etc.) that can be associated with more intensive land uses and activities such as agriculture, residential and recreation. The Cotter River reservoirs have an accessible combined full capacity of 158.4 GL and were on average 69.7% full at the end of June 2016. During 2015–16 the Cotter River storage reservoirs provided 80.4% of the water supplied to Canberra and Queanbeyan (Figure 3-1), of which Bendora reservoir contributed 79.8% and the Cotter reservoir supplied 0.6%.

The Queanbeyan River catchment, located to the south-east of Canberra, contains both developed and impacted land, which includes forestry reserves, rural pasture and rural residential properties. NSW state agencies and local government councils regulate land planning and manage activities in this catchment. Parks and Conservation Services (PCS) manage the immediate area around the Googong reservoir and recreational access to the water body and foreshore. The Googong reservoir on the Queanbeyan River is the largest of the four water supply reservoirs and represents 43.0% of Canberra's storage capacity. At the end of June 2016 Googong reservoir was at 100% capacity. The Googong reservoir provided 19.6% of the water supplied to Canberra and Queanbeyan during 2015–16 (Figure 3-1).

Finally, the Murrumbidgee catchment contains a wide variety of agricultural land uses, as well as the towns of Cooma, Numeralla, Bredbo and the suburbs of Tuggeranong. During 2015–16 water was abstracted from the Murrumbidgee River for environmental flows and to exercise equipment for maintenance purposes only. No water was abstracted for drinking water purposes.

The climate and storage reservoir capacity

Weather patterns were variable during 2015–16, with the wettest June ever recorded at Canberra Airport. Despite this, the rainfall at Canberra Airport was 2% below the long term average and total evaporation was 8% above the long term average. The total inflows to the four storage reservoirs totalled 174 GL, which is 22% above the average of the last 15 years. As a result, Icon Water's storage reservoirs finished the year at a healthy 83%, a small increase on the 79% storage recorded at the end of 2014–15.

Table 3-1 Rainfall, evaporation and reservoir capacity 2015–16

Total rainfall (mm)	Long term average rainfall (mm)	Evaporation (mm)	Total reservoir volume (end 2016)
604	617	1847	83%

Figure 3-1 Reservoir storage levels and drinking water production for 2015–16

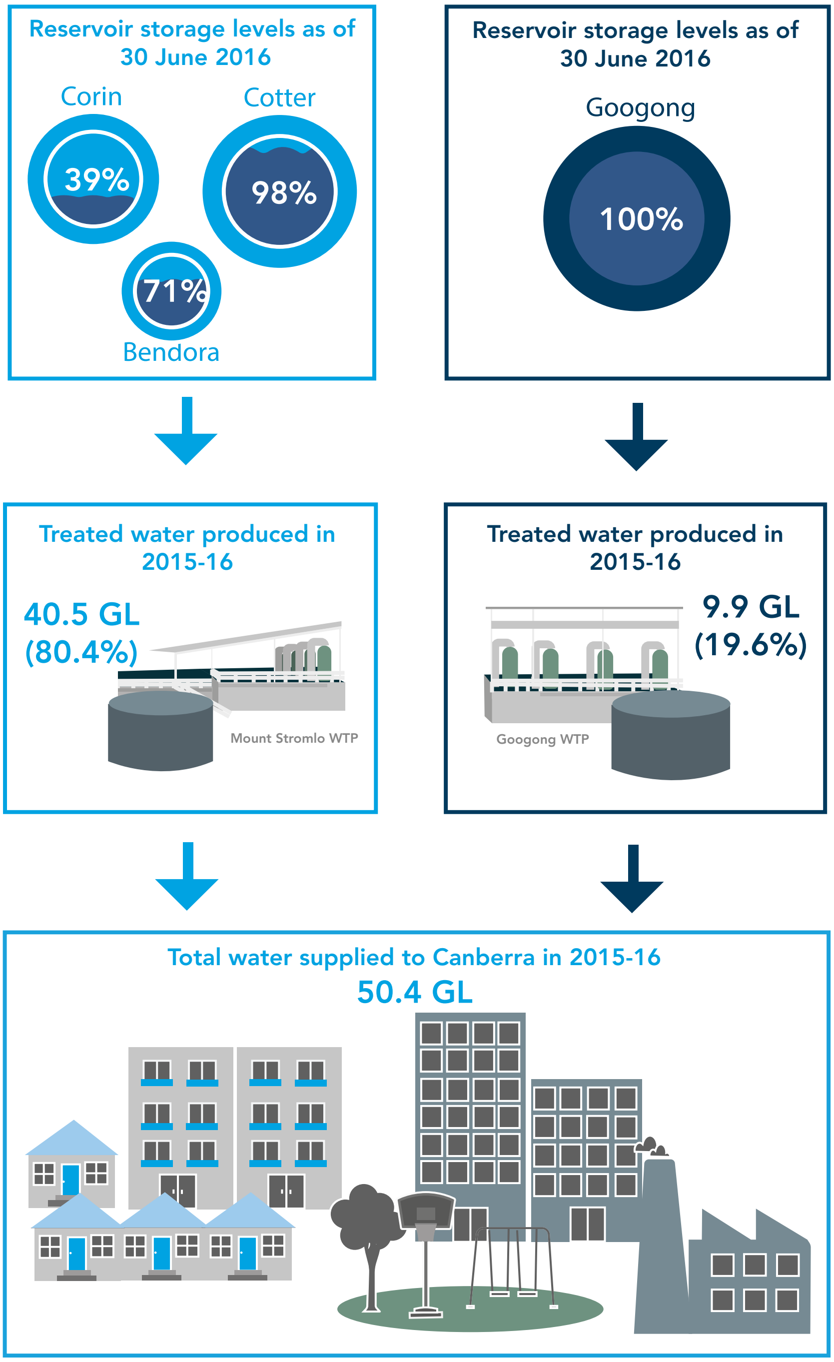
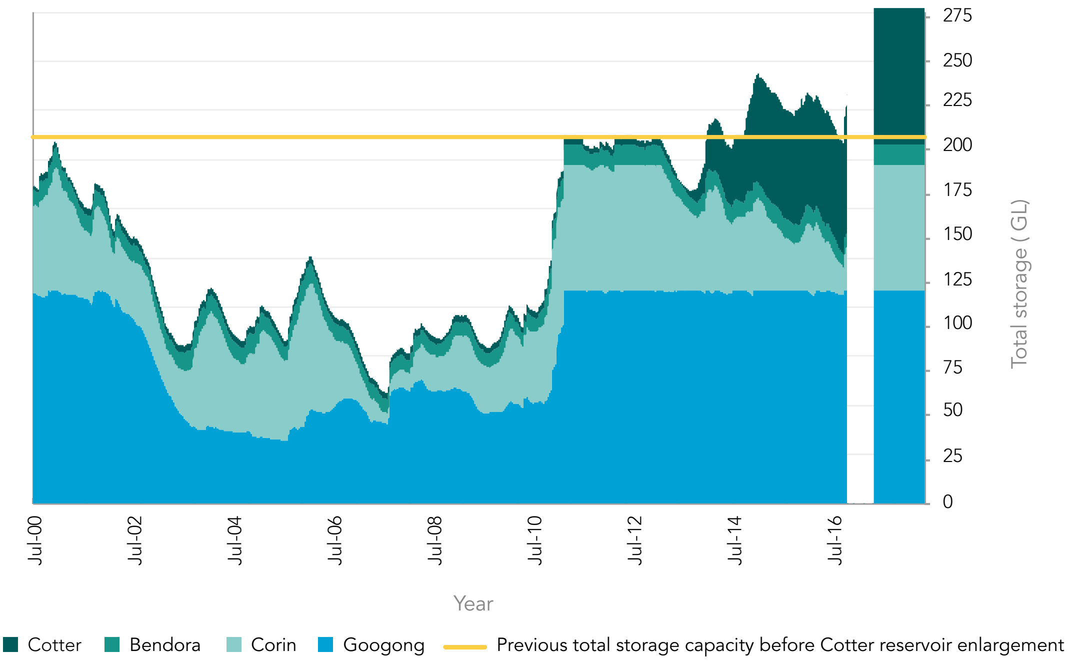


Figure 3-2

Combined storage levels of Corin, Bendora, Cotter and Googong reservoirs from 2000–16



Source water protection

In 2015–16, Icon Water continued to identify and mitigate potential contamination hazards within the catchments, the first barrier to protect the quality of water sources for potable water supply as defined in the Code and the ADWG.

Key activities undertaken by Icon Water for protection of source water in the 2015–16 year included:

- Policy and legal protections and enhancements.
- Community engagement and education activities and campaigns.
- On-ground works and monitoring of water quality and ecological condition.

In January 2016, Icon Water finalised and submitted the 2012–15 Sanitary Survey to ACT Health, which is conducted for all of the ACT's drinking water catchments every three years to determine the nature and extent of likely contaminants entering the catchments. Water quality results for the catchments were generally consistent with the previous survey period and within the raw water supply specification for successful processing at the water treatment plants.

Policy and legal protections

Icon Water has limited direct legislative power in the land management of the ACT and region's water supply catchments. Land management in the Cotter is the responsibility of the ACT Government; while the Queanbeyan and Murrumbidgee catchments are a mix of Government and private land management. As a result, one of Icon Water's key source water protection objectives is to influence the NSW and ACT regulatory frameworks which govern the water supply catchments.

Key interactions undertaken by Icon Water in 2015–16 included representation on the ACT Government Interim Catchment Management Group (and associated Working Group) and review of proposed developments in the catchment.

Community engagement and education

Much of the ACT and region's water supply catchment areas in Queanbeyan and Murrumbidgee are privately owned. Additionally, the community has a high level of interaction with the water quality in the catchments through recreational activities.

Icon Water undertook a range of land manager engagement and community education activities throughout 2015–16 to influence land use and recreation, which included:

- The ongoing provision of financial support together with the ACT Government to allow for WaterWatch positions to be continued in the Cooma-Monaro and Southern ACT regions. These positions coordinated the collection of water quality data across the respective regions and engaged with landholders and the community to understand the linkages between land management and water quality protection.
- The implementation of the Googong Dam Education and Engagement Strategy providing water quality protection messages to the Googong Township community through cooperative delivery with the developers, school and the ACT Parks and Conservation Service.

On-ground works and monitoring

In the ACT and region's water supply catchments, opportunities can arise where the delivery of on-ground works can be an effective mechanism at controlling localised source water quality impacts. Such opportunities typically include partnerships with other projects or organisations. The monitoring of water quality in the water supply catchments is critical in understanding the changing risks to source water throughout the catchment; which in turn informs on-ground works, policy interactions and community engagement programs.

Key on-ground works and water monitoring programs implemented by Icon Water in 2015–16 included the provision of funding to the Molonglo Catchment Group for delivery of the Burra Erosion Control Project over a two-year period and delivery of a suite of ecological monitoring programs in all catchments.

Icon Water has also provided modelling and advice to the ACT Government to inform monitoring of trial pine forest removal techniques for the purpose of minimising soil movement and protecting the water quality of Condor Creek and the Cotter reservoir from turbidity generated from forestry activities.

Water quality in the raw water sources

Icon Water storage reservoirs are a fundamental part of the drinking water supply system. They allow water to be stored during low rainfall periods and assist to stabilise water quality through detention and settling of contaminants. This is particularly important after large rain events when inflows can transport large amounts of sediments and organics into the reservoir or when currents mix the reservoirs.

Icon Water undertakes an extensive sampling and analysis program to monitor water quality in its storage reservoirs and the Murrumbidgee River. The program, which is developed in consultation with ACT Health, is adaptively managed to ensure it continues to adequately assess the quality of source waters and identify emerging issues that could affect the drinking water supply. The parameters routinely monitored within the raw water sources are detailed in Table 3-2. In addition, the raw water sources also have continuous online monitoring for select parameters. This enables Icon Water to react rapidly to changes in the raw water quality and ensure only the best quality water is abstracted for treatment at the WTPs.

Table 3-2 Parameters routinely monitored in raw water sources

Microbiological	Physical	Chemical
Cryptosporidium and *Giardia*	Colour	Alkalinity
Escherichia coli (E. coli)	Conductivity	Chlorophyll-a
Heterotrophic bacteria	Dissolved oxygen	Nutrients (e.g. nitrogen and phosphorous)
Phytoplankton incl. blue-green algae	pH	Organic compounds (including herbicides and pesticides)
Total coliforms	Temperature	Radionuclides
	Turbidity	Total and dissolved metals
	UV absorbance	Total and dissolved organic carbon

Googong Dam, 2002

Cyanobacteria (blue-green algae)

Cyanobacteria occurs naturally in water bodies; however, when the water is warm, calm and nutrient rich the conditions are most favourable and they can grow into excessive numbers termed blooms. Our storage reservoirs, predominantly the Googong reservoir, occasionally experience blue-green algae blooms, typically of *Anabaena circinalis* and *Microcystis aeruginosa* which can produce taste and odour compounds and toxins that can be harmful to humans and animals.

Icon Water carries out regular monitoring of blue-green algae in all its raw water sources. The extent and frequency of monitoring varies with season, but is generally at its most frequent in the warmer months when algal blooms are more likely. Agriculture and other development in the Queanbeyan and Murrumbidgee catchments increase the nutrient levels in the waterways making these raw water sources more susceptible to algal blooms.

Concentrations of blue-green algae (*Anabaena circinalis*) in the Googong reservoir were lower in 2015–16 compared to 2014–15 with only one short-lived bloom detected during March 2016. No water was required to be abstracted from Googong reservoir during this time.

Anabaena circinalis and *Microcystis aeruginosa* were detected in the Cotter reservoir for the first time in 2013 and *Anabaena circinalis* was subsequently detected in lower numbers in 2014–15. The appearance of blue-green algae was likely caused by increased nutrient content in the water associated with the enlarged reservoir filling for the first time and inundating vegetation. The reservoir water level remained stable at approximately 80% full for most of 2015–16 during which time the reservoirs water quality continued to improve. This has resulted in no *Anabaena circinalis* or *Microcystis aeruginosa* being detected in Cotter reservoir during 2015-16. With the continued active management of this reservoir it is expected that blue-green algae numbers will remain low within the Cotter reservoir in future years.

In response to an elevated detection of blue-green algae Icon Water's blue-green algae response plan is activated and increased monitoring conducted within the reservoir and at the associated WTP. Under the Code, ACT Health is consulted if elevated levels of blue-green algae are detected. Details of the notifications provided to ACT Health, including blue-green algae are provided in Section 7 of this report.

Cryptosporidium and *Giardia*

Cryptosporidium and *Giardia* are microorganisms that can cause gastroenteritis. Infected people show either no symptoms or can suffer diarrhoea, vomiting and fever, and healthy people usually recover fully. These naturally occurring organisms are usually spread through contact with pets, farm animals or people who are already infected. There is a background level of infection by *Cryptosporidium* and *Giardia* in the community.

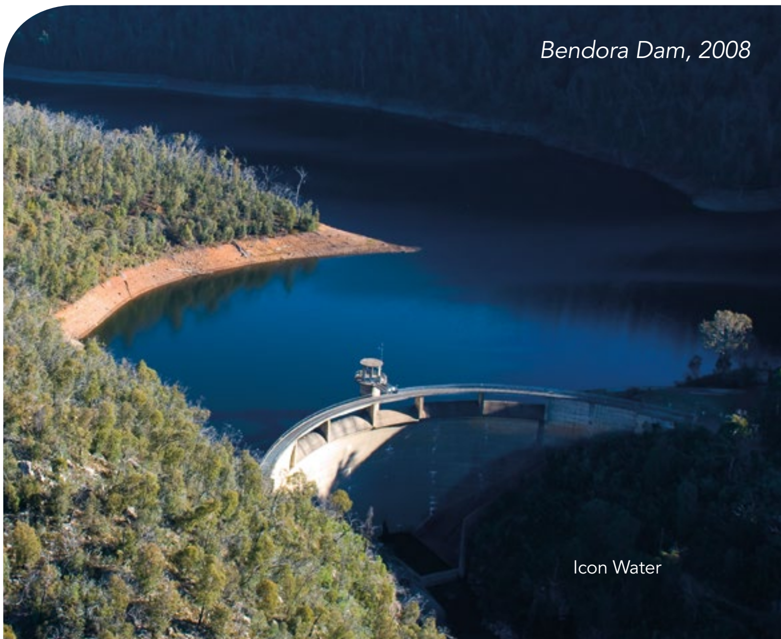
Testing methods for *Cryptosporidium* and *Giardia* are complex and if detected, it is difficult to confirm whether they are infectious to humans. Icon Water undertakes a routine monitoring program for *Cryptosporidium* and *Giardia* in the storage reservoirs and the Murrumbidgee River.

Cryptosporidium and *Giardia* are generally not detected in the Cotter catchment storage reservoirs or the Googong reservoir. Again during 2015–16 they were not detected in the routine monitoring program samples collected.

Due to the lower levels of catchment protection and little detention time the Murrumbidgee River is more likely to contain *Cryptosporidium* and *Giardia*. The risk increases further during rainfall events with increased runoff and; therefore, in addition to routine testing, extra monitoring may be conducted during these times. There were two positive detections of *Giardia* and one positive detection of *Cryptosporidium* within the Murrumbidgee River during 2015–16. During 2015–16, no water was abstracted from the Murrumbidgee River for drinking water use.

Pesticide and herbicide monitoring in drinking water supplies

Specific monitoring for selected pesticides and herbicides is undertaken in all drinking water sources using a risk-based approach. During 2015–16 there were no pesticide detections above ADWG health values in any of the four storage reservoirs or the Murrumbidgee River.


Bendora Dam, 2008

Mount Stromlo WTP filter inlet channel, 2015

4 Water treatment operations

Water treatment

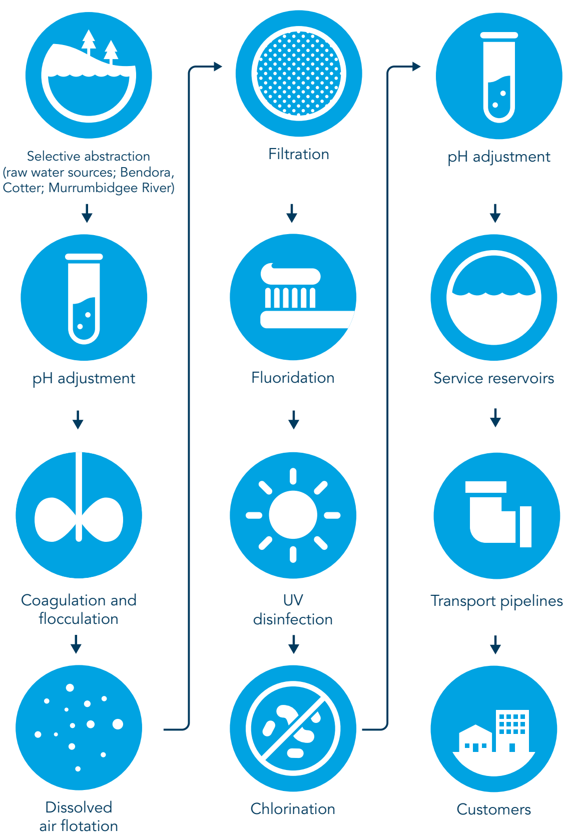
Icon Water operates two water treatment plants (WTPs), the Mount Stromlo WTP, which treats water from the Cotter catchment reservoirs and the Murrumbidgee River; and the Googong WTP, which treats water from Googong reservoir.

Mount Stromlo Water Treatment Plant

Mount Stromlo WTP has a treatment capacity of 250 ML of water per day. Treatment processes are designed to remove contaminants from drinking water. The WTP can operate in two treatment process modes; direct filtration or dissolved air flotation and filtration (DAFF). The dissolved air flotation step is an optional treatment step which enhances treatment capabilities to address periods when poorer raw water quality may need to be treated. The treatment process is shown in Figure 4-1 and it involves:

- pre-treatment for pH adjustment and stabilisation with lime and carbon dioxide;
- coagulation by polyaluminium chloride and/or aluminium sulphate;
- flocculation aided by polyelectrolyte;
- optional dissolved air flotation;
- filtration;
- fluoridation by sodium fluorosilicate;
- disinfection by ultraviolet (UV) light;
- disinfection by chlorination;
- pH adjustment and stabilisation with lime.

Figure 4-1 Water supply from catchment to Mount Stromlo WTP to customers' taps



Googong WTP clarifier, 2016

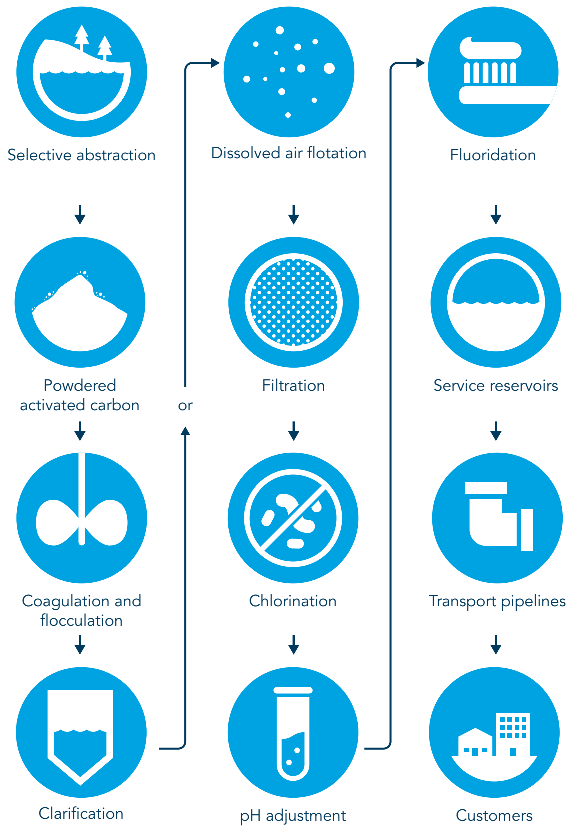
Googong Water Treatment Plant

Googong WTP has a treatment capacity of 270 ML of water per day. Googong WTP continues to be used in conjunction with Mount Stromlo WTP to meet summer peak demand and enable maintenance tasks to be carried out at Mount Stromlo WTP.

The water treatment process used at Googong WTP is as follows:

- powdered-activated carbon (PAC) for taste and odour compound removal (if required);
- coagulation by aluminium sulphate;
- flocculation aided by polyelectrolyte;
- dissolved air flotation and filtration (augmented plant) or clarification and filtration (original plant), depending on operational mode;
- disinfection by chlorination;
- pH adjustment and stabilisation with lime; and
- fluoridation by sodium fluorosilicate.

Figure 4-2 Water supply process from catchment to Googong WTP to customers' taps



Water treatment plant performance

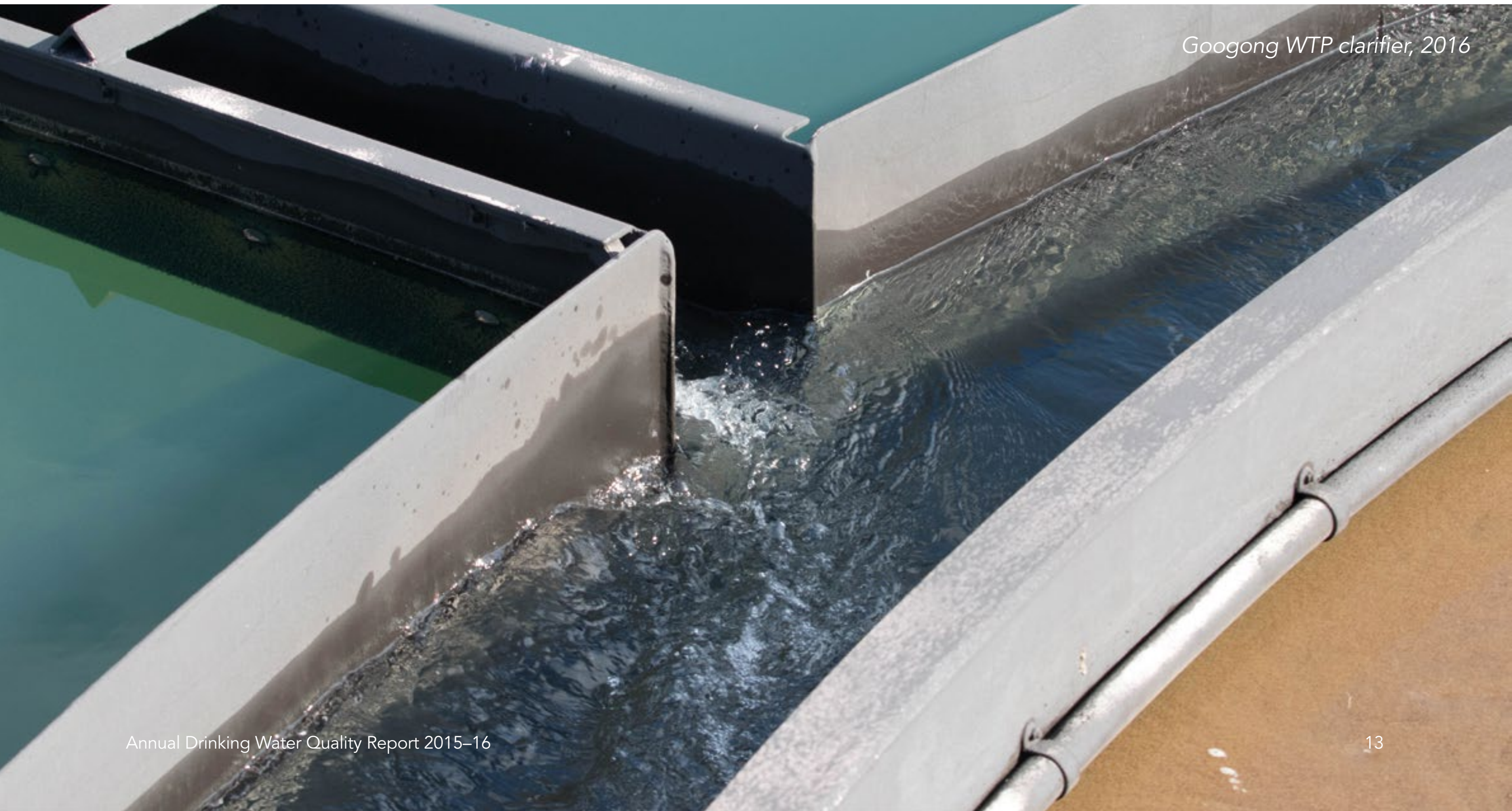
Extensive monitoring of process operations are required to ensure optimum performance of treatment barriers. Under Icon Water's HACCP-based water quality management system five critical control points are applied in the supply system to ensure Canberra and Queanbeyan receive high quality water. Four of these critical control points exist within the WTPs, highlighting the importance of the water treatment operations to the delivery of safe drinking water.

Online analysers enable continual monitoring of key water quality parameters, which means that changes in the raw or process water quality are quickly identified and addressed. Turbidity, chlorine, pH, fluoride and UV dose (at Mount Stromlo WTP) are all monitored continuously to ensure the treatment processes are operating correctly. Regular laboratory monitoring involves analysing for a range of parameters including, but not limited to, colour, turbidity, chlorine, *Escherichia coli (E. coli)*, *Cryptosporidium* and *Giardia*. Table 4-1 shows average treated water quality values for key parameters at both WTPs. The ADWG health guideline is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer and is generally based on a lifetime of consumption.

Table 4-1 Final treated water quality at WTPs

Parameter		Units	ADWG	Mount Stromlo WTP	Googong WTP	ADWG compliance
			Health value	Mean result	Mean result	Health value
Chlorine	Free	mg/L	-	1.36	1.83	-
	Total	mg/L	0.6* & 5	1.40	1.98	✓
Colour	True	Pt.Co	15*	0.83	2.50	-
Cryptosporidium		cells/L	-†	<0.006	<0.004	-
E. coli		MPN/100 mL	<1	<1	<1	✓
Fluoride		mg/L	1.5	0.82	0.74	✓
Giardia		cells/L	-†	<0.006	<0.004	-
pH		pH units	6.5–8.5*	7.58	7.49	-

*aesthetic value only; - no current ADWG health value; †no heath value has been set due to the lack of a routine method to identify human infectious strains in drinking water.



Googong WTP clarifier, 2016

Turbidity

Turbidity is a measurement of the suspended and dissolved particulates in water. These include suspended colloidal particles, clay and silt. Water with a high level of turbidity often has a muddy or milky appearance. Continuous monitoring of turbidity at the WTPs is undertaken and is used as a key indicator of filter performance. The ADWG states "Where filtration alone is used as the water treatment process to address identified risks from *Cryptosporidium* and *Giardia*, it is essential that filtration is optimised and consequently the target for the turbidity leaving the individual filter should be less than 0.2 NTU, and should not exceed 0.5 NTU at any time". Icon Water utilise this guidance and optimise operations to meet these targets at the WTPs. During 2015–16 the turbidity of the water produced by the filters at Mount Stromlo and Googong WTPs were below 0.2 NTU 99% and 98% of the time, respectively. Individual direct filter turbidity performance for Mount Stromlo WTP for 2015–16 is shown in Figure 4-3, whilst the direct filter and dissolved air flotation filter (DAFF) performance at Googong WTP is displayed in Figure 4-4a and Figure 4-4b, respectively.

Figure 4-3 Mount Stromlo WTP direct filter performance

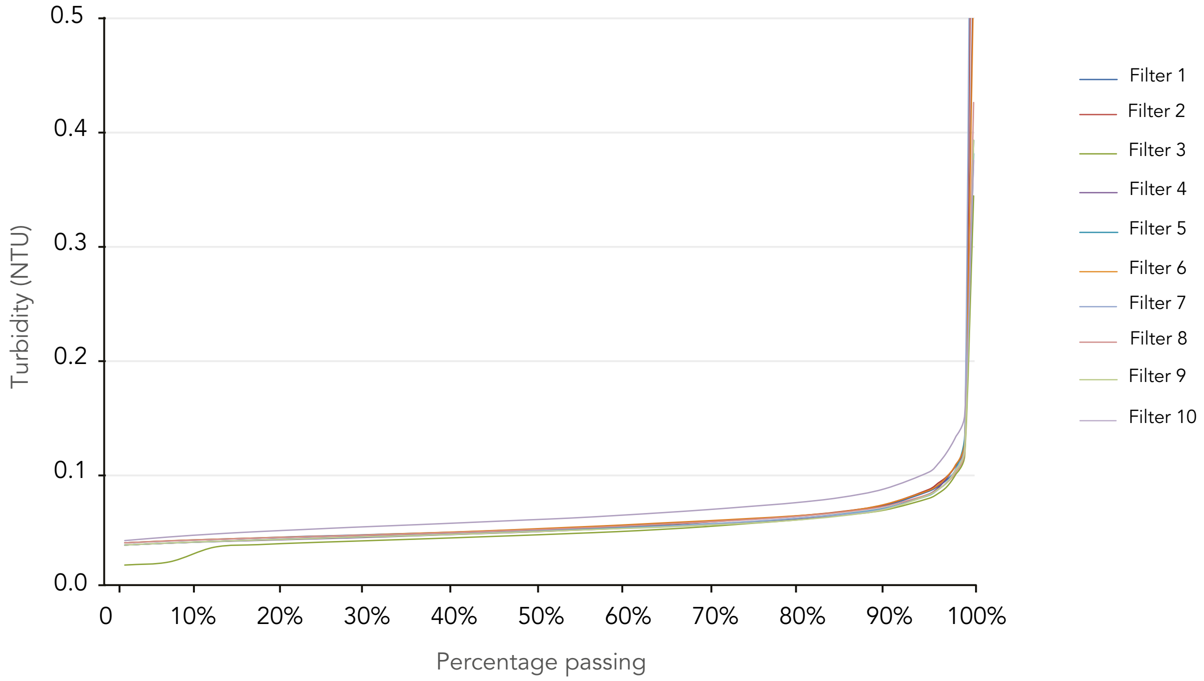


Figure 4-4a Googong WTP direct filter performance

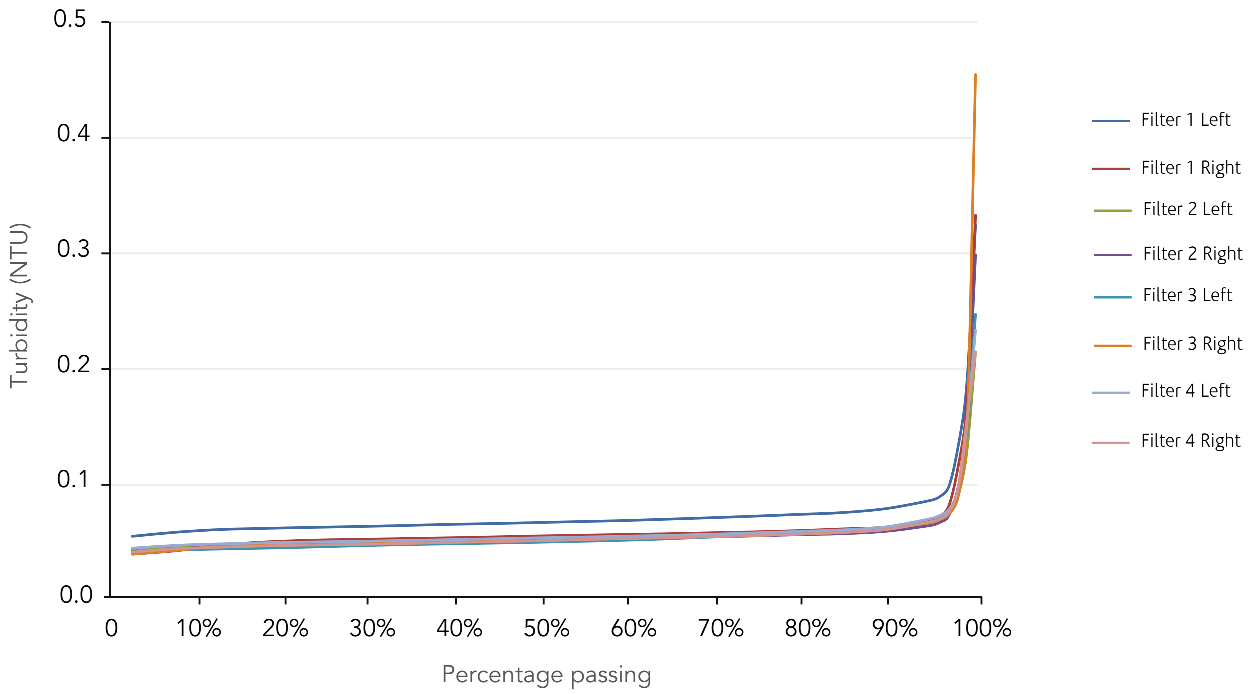
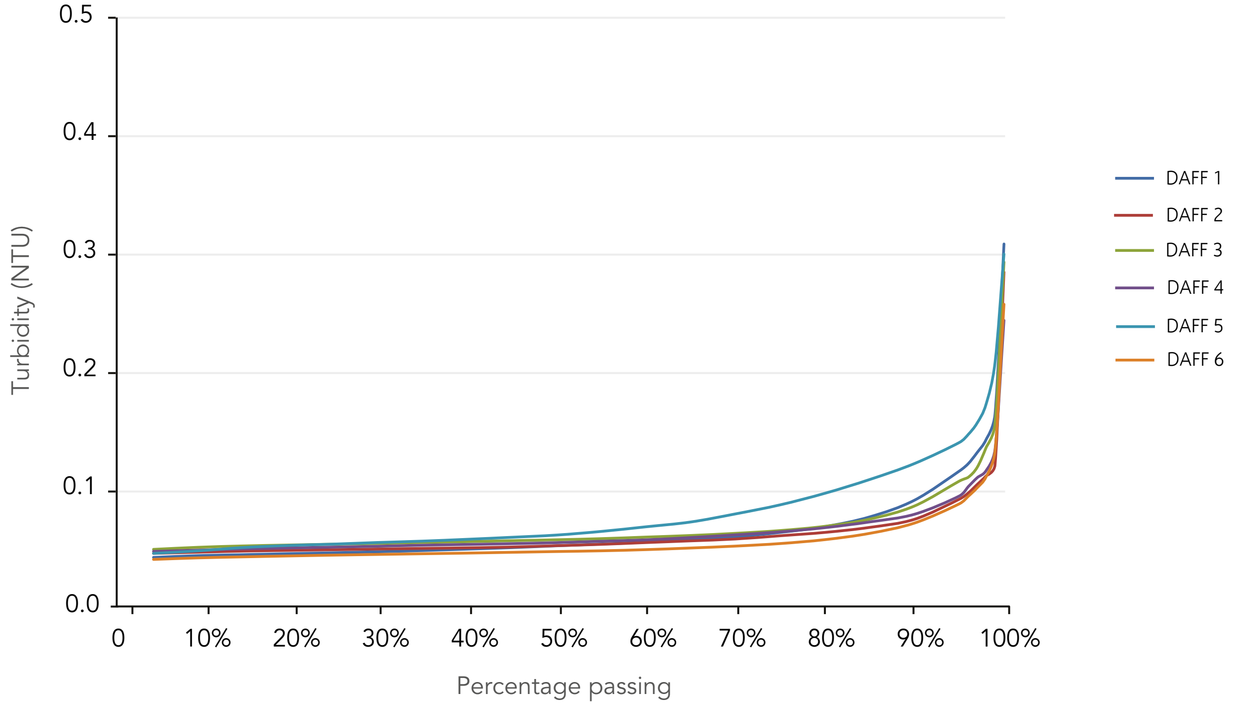


Figure 4-4b Googong WTP DAFF performance



Microbiological

The greatest risk to drinking water is microbiological contaminants. Microbiological contaminants have the potential to multiply quickly and cause widespread illness. The treatment process is designed to remove the microbiological contaminants that may be present in raw water sources.

E. coli

The faecal indicator bacteria *E. coli* is used to determine whether potential faecal contamination has occurred. If *E. coli* is present in drinking water, it may suggest that enteric pathogenic microorganisms are present. The ADWG suggest that *E. coli* should not be detected in a minimum 100 mL sample of drinking water.

During 2015–16 there were no *E. coli* detected in the treated water leaving the WTPs.

Cryptosporidium and *Giardia*

Icon Water undertakes a routine monitoring program for *Cryptosporidium* and *Giardia* in the raw water sources, in the raw water received at the WTPs and the final treated water. Any positive detection from the raw or treated water at the WTPs is reported to ACT Health.

UV disinfection is used at the Mount Stromlo WTP to further reduce the risk of pathogens entering the drinking water supply. The UV system contains three parallel treatment trains, each of which have three banks of high-intensity, medium-pressure ultraviolet lamps.

The quality of filtered water passing through the units is monitored online and each UV reactor includes sensors to continuously measure the UV irradiance in the water to ensure that an adequate UV dose is achieved. The power of each lamp is automatically regulated to ensure the required dose is maintained based on flow rate.

The UV system should provide a dose of greater than 30 mJ/cm^2 for at least 95% of the treated water. The system continued to exceed this performance objective and in 2015–16 the total proportion of water that received a dose greater than 30 mJ/cm^2 was more than 99.5%.

In 2015–16 Icon Water achieved 100% compliance with UV disinfection

100% compliant

Cryptosporidium and *Giardia* were not detected in any raw or final water being treated at both the Mount Stromlo and Googong WTPs during 2015–16.

Chlorine

All drinking water processed by the WTPs is disinfected using chlorine. Chlorine is widely used in treatment plants throughout the world to control microbiological contaminants, such as bacteria and viruses. Chlorine gas is added to Canberra's water at a concentration sufficient enough to disinfect the water leaving the WTPs and to provide a free chlorine residual that will continue to protect against contamination in the distribution network. The ADWG health guideline for chlorine is 5 mg/L and the aesthetic value is 0.6 mg/L, which is based on an odour threshold. Some customers are sensitive to the taste or smell of chlorine and Icon Water endeavours to manage chlorination to optimise the concentrations at the customers' tap. During 2015–16 free chlorine concentration in the treated water leaving Mount Stromlo WTP was maintained at an average of 1.36 mg/L. Due to its different raw water characteristics and geographical location, resulting in potential extended detention times within the distribution network, Googong WTP generally produces final treated water with a higher free chlorine concentration (average of 1.83 mg/L in 2015–16). Chloramine is not used within Canberra's water network.

Fluoride

The Drinking Water Utility Licence, issued by ACT Health, requires fluoride to be added to the ACT's drinking water network at a concentration between 0.6 and 1.1 mg/L. "The aim of water fluoridation is the adjustment of the natural fluoride concentration in fluoride deficient water to that recommended for optimal dental health" (NHMRC, 2007).

In order to achieve compliance with the Licence, Icon Water adds sodium fluorosilicate into the drinking water at the WTPs. In 2015–16 fluoride concentrations were maintained in the final treated water at Mount Stromlo WTP at an average of 0.82 mg/L and Googong WTP at an average of 0.74 mg/L.

pH

The pH of the drinking water is adjusted at the beginning of the treatment process and again prior to leaving the WTP. The pH of the water prior to coagulation and flocculation is decreased to between 6.0 and 6.2 to ensure it is within the effective range of the coagulant utilised.

The ADWG advises that "chlorine disinfection efficiency is impaired above pH 8.0…whilst below 6.5 may be corrosive". As such the pH of the treated water is subsequently increased prior to distribution so that it is within the optimal range to ensure effective disinfection potential whilst also preventing corrosion of the distribution pipelines. The optimal pH range targeted by Icon Water is 6.5–8.5. The average pH of final treated water at both WTPs was between 7.5 and 7.6 during 2015–16.

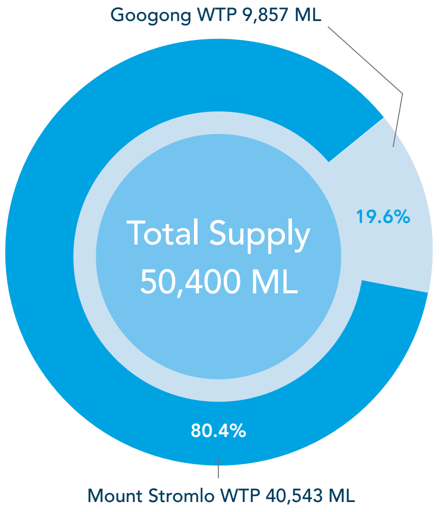
Icon Water

Water production

50,400 ML of water was produced during 2015–16 between the two WTPs, for distribution to the Canberra and Queanbeyan communities. The majority (80.4%) of the water produced was treated by the Mount Stromlo WTP.

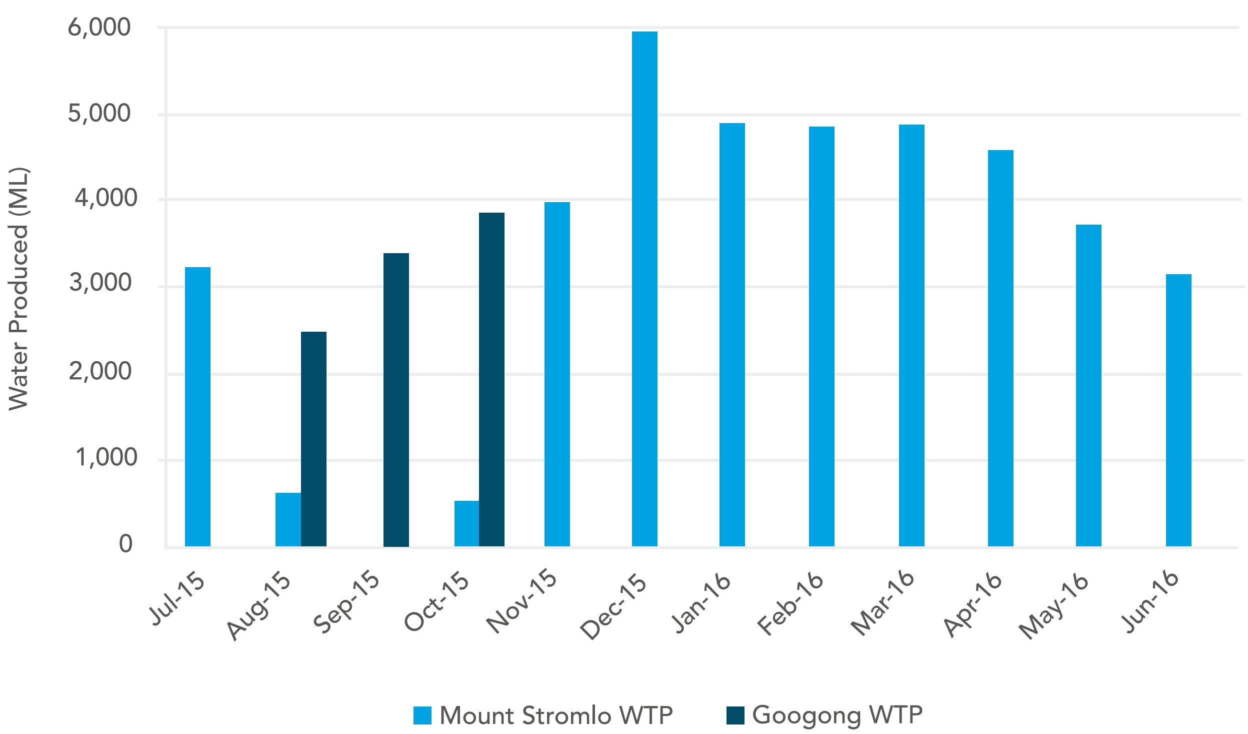
A summary of WTP operations over the 2015–16 year is provided in the figures below.

Figure 4-6 Total water produced by treatment plant during 2015–16



Mount Stromlo WTP filter inlet channel, 2015

Figure 4-7 Monthly treated water production by WTP




Mount Stromlo WTP Balancing Reservoir, 2016

5 The distribution system

Icon Water distributes water throughout Canberra utilising a complex network of pipelines and service reservoirs. Icon Water also supplies bulk water to Queanbeyan-Palerang Regional Council (QPRC), who distributes the water to Queanbeyan and the Googong Township.

Icon Water operates and maintains 47 service reservoirs, 25 pump stations and over 3,300 km of water pipelines. This infrastructure is maintained and closely monitored to ensure the Canberra community receives good quality drinking water direct to their tap.

The drinking water distribution system is operated with a number of physical and chemical disinfection barriers in place to minimise the potential for contamination of the water.

Some of the physical barriers include:

- Sewerage mains are generally located deeper than the water network, minimising the risk of contamination through groundwater.
- The water distribution system is a closed network from the WTPs to customer's taps, preventing potential external contamination.
- The water mains are operated under positive pressure to prevent contaminants entering the network.
- Backflow prevention devices are installed at customer supply points to protect against contaminants entering the network.

In addition to the physical barriers, a free chlorine concentration in the water distribution network is maintained to protect against microbiological contamination of the water between the WTP and the customer's tap.

The Canberra distribution system is divided into four water quality supply zones based on population, hydraulic characteristics and geography. These zones are used in Icon Water operations to assess the quality of drinking water supplied to the customer's tap.

- Water quality zone 1 – North Canberra and Gungahlin
- Water quality zone 2 – Belconnen
- Water quality zone 3 – South Canberra, Woden and Weston Creek
- Water quality zone 4 – Tuggeranong

Figure 5-1 Water quality monitoring zone map

Distribution service reservoirs

In 2015–16 Icon Water operated 47 service reservoirs and three tanks located throughout Canberra. These reservoirs receive water from the WTPs via bulk supply and trunk mains and provide storage for between 450 ML and 680 ML of water depending on demand. All Canberra service reservoirs are secure structures to ensure the integrity of the supply system is maintained and to prevent contamination from birds and animals. Regular inspections are carried out to assess their external condition and the security of the site. Reservoir cleaning is also routinely undertaken with each reservoir being cleaned, on average once every five years. During the cleaning, the reservoir is emptied, cleaned, inspected internally and maintenance performed as required.

Frequent water quality monitoring occurs at each reservoir which includes analysis for a range of parameters to verify that the water quality complies with the ADWG and to optimise system operations. A summary of water quality analysis undertaken at the service reservoirs across all four water quality supply zones is presented in the Table 5-1.

Table 5-1 Water quality at service reservoirs

Parameter		Units	ADWG health value	Service reservoirs mean concentration	ADWG compliance health value
Escherichia coli (E. coli)		MPN/100 mL	<1	<1	✓
Total coliforms		MPN/100 mL	-	<1	-
Heterotrophic plate counts		CFU/1 mL	-	2	-
Chlorine	Free	mg/L	-	0.71	-
	Total	mg/L	0.6* & 5	0.81	✓
pH		pH units	6.5-8.5*	8.00	-

*aesthetic value only; - no current ADWG health value

Supply to customers' taps

Ensuring that high quality water is delivered to customers is a priority to Icon Water. A comprehensive routine drinking water quality monitoring program based on the ADWG verifies the water quality throughout the distribution system. During 2015–16, a minimum of 84 random customer garden taps were monitored on a monthly basis from a pool in excess of 400 sites throughout Canberra suburbs. As of March 2016 the minimum number of taps sampled each month was increased to 100 to address growth of the Canberra community. Garden taps are used as they are easily accessible, provide static sample points in the distribution system, allowing historical data acquisition, and they enable verification of the actual water received by customers. The parameters that are routinely tested are summarised in Table 5-2.

Table 5-2 Parameters monitored at customers' taps

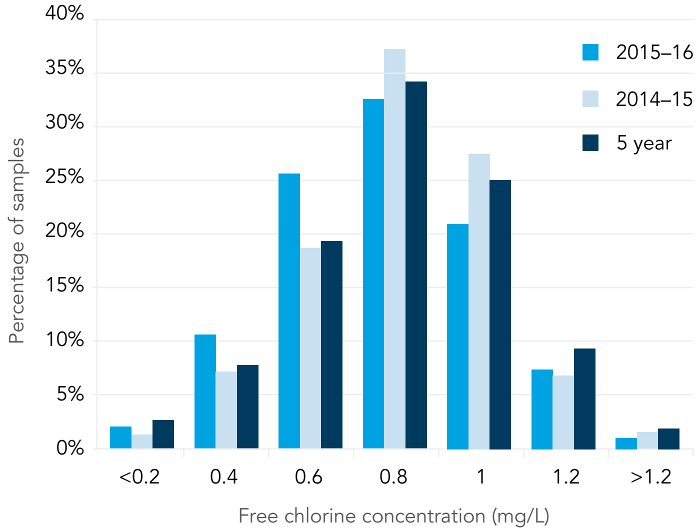
Microbiological	Physical	Chemical
Escherichia coli (E. coli)	Conductivity	Alkalinity
Heterotrophic bacteria	pH	Anions
Total coliforms	Temperature	Asbestos
	Total dissolved solids	Chlorine
	True Colour	Fluoride
	Turbidity	Haloacetic acids
		Hardness
		Metals
		Trihalomethanes (THM)
		Semi-volatile organic compounds (SVOC)

Disinfection in the distribution system

Chlorine is added to water in the final stages of treatment at Mount Stromlo and Googong WTPs. Water entering the distribution system needs to contain an appropriate free chlorine concentration, termed disinfection residual, when delivered to customers' taps. This ensures that chlorine continues to provide protection against microbiological contamination in the distribution network. Chlorine and bacterial levels are frequently monitored in the distribution system.

In 2015–16 the concentrations of free chlorine at customers' taps across all four water quality supply zones were below the ADWG health guideline level (5 mg/L). The concentrations ranged from <0.03 mg/L to 1.43 mg/L. The distribution of chlorine results for customer taps across all four water supply zones is shown in Figure 5-2.

Figure 5-2 Free chlorine concentration at customers' taps



Microbiological monitoring

The WTPs are designed to remove any potential microbiological contaminants prior to distribution to customers, however as the water moves through the water distribution network there remains a small potential for re-contamination. To help prevent this, adequate free chlorine residual for continual disinfection is maintained.

Icon Water conducts verification monitoring of *E. coli* (faecal indicator) at customers' taps to ensure the water supplied is free from microbiological contamination.

The ADWG suggests that *E. coli* should not be detected in a minimum 100 mL sample of drinking water. During 2015–16, 100% of samples returned no detections of *E. coli* across all four water quality supply zones.

Service reservoir sample point, 2016

Physical and chemical monitoring

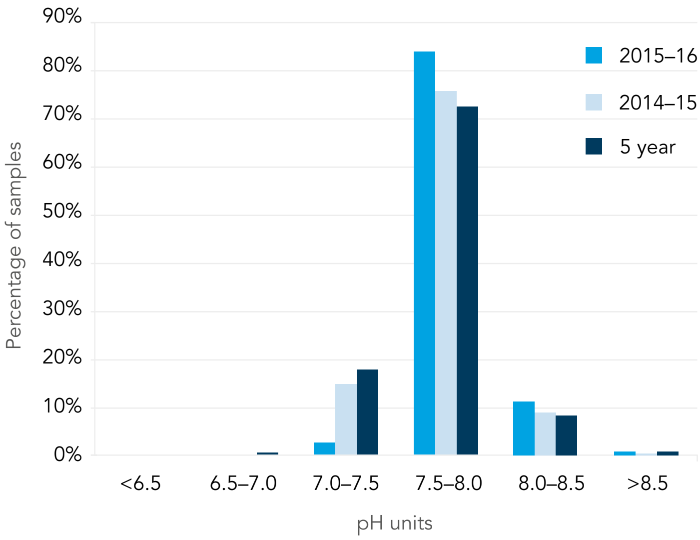
Icon Water monitors a wide range of both physical and chemical parameters as part of the customer tap water quality monitoring program. Detailed information for a selection of these parameters is provided below. Results for all parameters monitored are displayed in Section 9.

pH

pH of drinking water generally increases as it travels through the distribution system due to leaching of lime from cement lined pipes and concrete service reservoirs. This increase is generally proportional to the detention time of the water within the distribution network.

The buffering capacity of water at the WTPs has continued to provide a positive impact on management of pH within the distribution system. A pH value in the range of 6.5 to 8.5 is optimal for water supply systems. The upper limit of 8.5 is set to minimise the potential for taste problems or scaling of water pipelines, however this is not of particular concern in Canberra due to the low mineral content of the drinking water.

Figure 5-3 pH at customers' taps



Chlorine disinfection is also affected by pH such that as pH increases the disinfection potential of chlorine decreases. However, as pH decreases the corrosion potential of the water increases, which may lead to increased levels of contaminants, for example heavy metals, in the water and cause damage to assets. It is therefore necessary to balance pH in the network to minimise corrosion while ensuring effective disinfection is maintained.

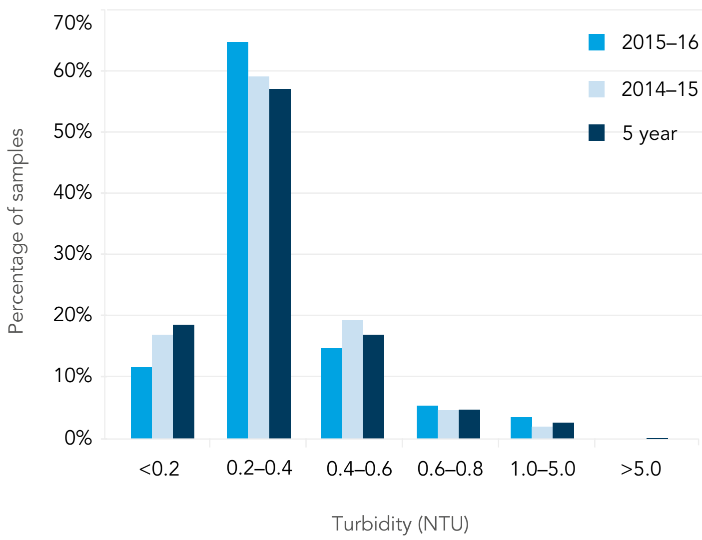
The distribution of pH results for customer taps across all four water supply zones is shown in Figure 5-3 and a summary of the results is listed in Table 5-3.

Turbidity

Turbidity is a measurement of the suspended and dissolved particulates in water. The ADWG does not outline a health value; however the aesthetic value is 5 nephelometric turbidity units (NTU)—a level of turbidity that is just noticeable in a glass.

The distribution of turbidity results for customer taps across all four water supply zones is shown in Figure 5-4 and a summary of the results are in Table 5-3.

Figure 5-4 Turbidity at customers' taps



Colour

Colour is mainly present in the raw water because of a range of natural organic compounds—from small hydrophilic acids, proteins and amino acids to larger humic and fulvic acids. These substances originate from organic matter through, or over which, the water has passed in the catchment. The majority of natural organic matter is removed by coagulation in the water treatment process. The ADWG does not outline a health value, however the aesthetic guideline for apparent colour is based on what is just noticeable in a glass of water. Results are reported in platinum-cobalt units (Pt-Co), and the aesthetic guideline is 15 Pt-Co. A summary of the results are in Table 5-3.

Metals

Iron

The ADWG aesthetic guideline value for iron is 0.3 mg/L, which is based on the taste threshold in water. The ADWG states that "insufficient data are available to determine a health-based guideline value for iron in drinking water". Iron is typically present in the water supply from the corrosion of iron or steel pipes or other components of the plumbing system. A summary of the results are in Table 5-3.

Manganese

Water percolating through soil and rocks can dissolve minerals that contain manganese. The ADWG health guideline value for manganese is 0.5 mg/L. Levels above the ADWG aesthetic guideline level of 0.1 mg/L can cause an undesirable taste and stain clothes during washing. At concentrations above 0.1 mg/L manganese can also contribute to the formation of biofilms on the insides of pipes, which may detach during high flows and appear as black particles. A summary of the results are in Table 5-3.

Copper

Copper is found naturally in raw water, generally in low concentrations. Drinking water from customers' taps may contain higher levels of copper if the water has been in contact with copper plumbing and fixtures. Sometimes copper levels may increase if water remains stagnant in the plumbing system for long periods, for example, during holidays when residents may be away from home for an extended time. Water which contains a high level of copper often has a blue/green appearance.

The ADWG sets an aesthetic limit of 1 mg/L for copper based on the potential for staining. Copper should not exceed 2 mg/L for health considerations. The guidelines state that "water that has been in stagnant contact (six hours or more) with copper pipes and fittings should not be used in the preparation of food and drink". A summary of the results are in Table 5-3.

Fluoride

Fluoride is added to Canberra's drinking water supply at the WTPs, prior to distribution to our customers. Icon Water adds fluoride to the Canberra drinking water as directed by ACT Health under the Drinking Water Utility Licence at concentrations between 0.6 mg/L and 1.1 mg/L. During 2015–16 the average fluoride concentration in the drinking water at customers' taps in Canberra was 0.8 mg/L. A summary of the results is presented in Table 5-3.

Other compounds

Other substances that Icon Water monitors in the distribution network include a range of semi volatile organic compounds (SVOC). SVOCs include chemicals such as plasticisers and hydrocarbons. Plasticisers are used in a broad range of products including food packaging, whilst hydrocarbons are utilised in an array of industrial applications. Icon Water monitor for these compounds within the distribution network in line with the ADWG. All routine monitoring results for these compounds were below the limit of reporting (i.e. not detected) during 2015–16. Full results are presented in Section 9.

Table 5-3 Summary of key physical and chemical parameters at customers' taps

Parameter	Units	ADWG health criteria	ADWG aesthetic criteria	Minimum concentration	Maximum concentration	Mean concentration	ADWG compliance health value
pH	pH units	-	6.5 - 8.5	7.32	8.89	7.83	-
Colour	Pt-Co	-	15	<1	5	1	-
Turbidity	NTU	-	5	<0.1	4.8	0.4	-
Iron	mg/L	-	0.3	<0.01	0.59	<0.01	-
Manganese	mg/L	0.5	0.1	<0.0005	0.281	0.006	✓
Copper	mg/L	2	1	<0.001	0.277	0.017	✓
Fluoride	mg/L	1.5	-	0.5	1.0	0.8	✓


Burst water main, 2015

6 Common water quality problems

Icon Water manages approximately 169,000 connections to the water network in the ACT. Occasionally customers experience problems with the quality of their water supply and contact Icon Water for advice. Any concern expressed by the community is investigated to determine the likely cause and, if required, corrective actions are taken. Enquiries and complaints are recorded along with the actions taken to rectify any problem.

Often issues related to water quality are short-term and may be associated with water main bursts, maintenance work or a change in usage patterns within the water supply network. Valve operations required for maintenance work may reverse the direction of flow of water, causing shearing of pipe surfaces, which may result in discoloured water. Where customers are likely to be affected by maintenance activities, Icon Water endeavours to notify customers in advance.

Customers are urged to contact Icon Water if they have any questions relating to water quality. During 2015–16 a total of 230 water quality complaints were received. Of the 230 complaints 51% of the cases were related to discoloured water. A summary of the types of complaints received is detailed in Table 6-1.

Icon Water utilises feedback from the community relating to water quality and network reviews following discoloured water events to better understand the network, and the impact that our operations have on network performance. All complaints are taken seriously and we value feedback about our product.

Table 6-1 Summary of water quality issues

Complaint	Frequency	Comments
Discoloured	117	Discoloured water is most often associated with maintenance work or a change in usage patterns but may also be associated with internal plumbing. Discoloured water resulting from maintenance work generally clears within a short period; however, if a customer continues to experience problems Icon Water may flush the mains to minimise further inconvenience.
White/cloudy	7	This usually presents as cloudy water resulting from air bubbles generated by flushing of the mains, hot water units or aerators on taps.
Blue/green	2	Blue or green water can be associated with the corrosion of copper pipes.
Staining	7	Deposits dislodged from domestic plumbing or from the water main can cause staining of washing.
Black particles	6	Black particles may originate from degrading internal plumbing fittings such as flexible rubber hoses, flick-mixers, rubber washers and internal hot water system components.
Chlorine odour	16	Chlorination is necessary for the disinfection of the water supply. Usually these enquiries relate to a change (increase or decrease) in the level of chlorine that a customer is receiving. These problems are usually aesthetic and short-term.
Odour (other)	17	Miscellaneous smell enquires are investigated individually. These problems are usually short-term.
Taste	16	Miscellaneous taste enquiries are investigated individually. This also includes bitter and metallic tastes experienced by customers. These problems are usually short-term.
Customer believed water to be unsafe	26	Customers may raise concern that the water is unsafe to drink. In most cases water is tested by an independent laboratory to ensure compliance with the Australian Drinking Water Guidelines.
Other	16	Issues not otherwise categorised.
TOTAL	**230**	

7 Icon Water and ACT Health

Icon Water complies with the Public Health (Drinking Water) Code of Practice (2007) (the Code) which was issued by ACT Health. Copies of the Code are available from the ACT Health website at www.health.act.gov.au.

The Code sets out operational, communication, reporting and response requirements for both Icon Water and ACT Health to ensure the supply of safe drinking water. The Code also sets out specific water quality events or incidents that Icon Water must notify to ACT Health.

During the 2015–16 year, a number of notifications to ACT Health were issued. These notifiable incidents are captured in Table 7-1.

Table 7-1 Summary of notifications and action taken by Icon Water

Source	Date	Criteria	Incident and action taken
Water within the distribution system at customer tap	20/08/15	Metals	Lead was detected above the ADWG health value in a front garden tap sample and in a hydrant sample in response to a customer complaint who observed black debris in their water. Samples were collected using a "first flush" method in an attempt to collect debris that the customer had previously observed. No debris was observed during sampling. Icon Water immediately arranged for the site to be re-sampled using standard sampling methods. All samples returned results below ADWG health values.
Water within the distribution system at customer tap	28/10/15	Metals	Lead was detected above the ADWG health value at a customer tap during the routine drinking water quality monitoring program. Other parameters including colour, turbidity, total iron, total manganese and copper were elevated but not above ADWG health and aesthetic values. Icon Water arranged for ALS to re-sample the site, the water main and service reservoir supplying the zone. All results were below the ADWG health values.

Source	Date	Criteria	Incident and action taken
Water within the distribution system at customer tap	3/11/15	Hydrocarbon	In response to a customer complaint of their water having an odour similar to petrol Icon Water conducted an investigation. Concentrations of hydrocarbons above ADWG health values were identified from the internal plumbing of the property. No detections of hydrocarbons were found within the street water main confirming this issue was isolated to one property. Given that all evidence suggested this to be an internal plumbing issue and not a broader network issue, the matter was referred to ACT Health for further investigation.
Water within the distribution system at customer tap	7/12/15	Hydrocarbon	A customer complaint relating to an unusual odour was received by Icon Water via ACT Health. ACT Health advised that they had investigated and found concentrations of hydrocarbons above ADWG health values within the internal plumbing of the property. Icon Water attended the property and collected samples for analysis from the street water main and the service meter. Results from the street water main did not detect any hydrocarbons and no odour was present, confirming this issue was isolated to one property. Sample results from the service meter of the property returned hydrocarbon results above ADWG health value. Icon Water replaced the service line to the property as it was likely that hydrocarbons may have permeated the polyethylene line via the soil. The internal plumbing of the property was flushed to remove residual contamination. Additional water samples from the property were collected and confirmed hydrocarbon concentrations were below ADWG health values.
Raw water in a storage reservoir	11/04/16	Cyanobacteria	High risk cyanobacteria, *Anabaena*, was detected at a concentration of 3,081 cells/mL in a surface water sample within the Googong storage reservoir, approximately 2.5 km upstream from the off take tower. Googong Water Treatment Plant was offline at the time of sampling. Water quality monitoring continued at the storage reservoir as per the routine monitoring program. No further action was required.
Water within the distribution system at customer tap	13/05/16	Plasticiser and Metals	Plasticisers, antimony and lead were detected above ADWG health values in a sample submitted by a customer in response to white debris found in their water at their property. Icon Water does not typically analyse samples submitted by customers as they have not been collected using NATA approved methods. Icon Water arranged for ALS to attend site and collect samples from the customer's kitchen and front garden tap as well as a sample from the water main supplying the property. All samples collected by ALS returned results below ADWG health values. This issue was isolated to one property. Icon Water is conducting an investigation into the white particulate matter.

Cotter Dam spillway, 2016

8 Managing Canberra's water quality into the future

Icon Water is committed to the continuous improvement of water quality management practices. The Strategic Water Quality Improvement Plan summarises the drinking water quality improvement activities, which are proposed or underway throughout the ACT water supply network, that address identified strategic risks associated with drinking water supply. There are no systemic issues that result in poor quality treated water within Icon Water's supply network and as such the majority of the current and proposed water quality improvement projects relate to maintenance, risk management, or continual improvement. Many of these are longer term projects and updates on the status of these projects along with any new projects are outlined in this plan. A selection of projects from 2015–16 and those underway in 2016–17 are detailed below.

Future water quality issues

There are a number of policies, plans and projects (proposed or underway) by third parties within our catchments that could impact on water quality. Icon Water maintains an active interest in these developments to ensure we can continue to adequately protect our water quality into the future. These include but are not limited to; implementation of the Water Resource Plan, the proposed Cotter Hub development, further subdivision and development of the Burra area and responding to the Government's energy and climate change policies.

Source water protection program

Catchment risk assessment and prioritisation

Icon Water is currently revising the Source Water Protection Strategy. The updated strategy will inform, influence and drive participation in risk-based management of the ACT region's drinking water supply catchments located within Commonwealth, ACT and NSW jurisdictions. The core elements of the strategy include; Catchment Surveillance Plans, Catchment Risk Assessments and Catchment Asset Management Plans. Icon Water has also been working on refining the catchment risk prioritisation tool; Source Water Assessment Monitoring Prioritisation (SWAMP). This tool will help Icon Water to identify high risk areas and key threatening processes and engage with landholders and managers to identify opportunities to assist in the delivery of targeted on-ground remedial works.

Enlarged Cotter Dam Biodiversity Offsets Implementation Program (ECD BOIP)

As part of the ACT Environmental Impact Statement (EIS) for the Enlarged Cotter Dam (ECD), Icon Water was required to provide a compensatory biodiversity offset area within the Lower Cotter Catchment (LCC) and implement a program of works as outlined in the ECD Biodiversity Offsets Implementation Plan (2009). Icon Water has successfully implemented an offset for the ECD project which is in accordance with the objectives and principles specified in the EIS for the project. The offset delivery has been complementary with the objectives of land management within the broader landscape and has achieved a positive benefit at the ecosystem process and landscape level through increased cover of native species, reduced cover of dominant exotic species and re-establishment of a more natural vegetation structure across the offset area. The program has been completed and the offset area has been handed over to PCS to manage into the future.

Additionally, a Memorandum of Understanding (MoU) was developed between ACT Parks and Conservation Service (PCS) and Icon Water to provide funding for maintenance of roads and erosion control structures across the LCC.

Applied research and development projects related to water quality assessment or improvement

Water quality impacts of extreme weather events

To facilitate planning and improve the management of water quality impacts of extreme weather events, two extreme weather events (a heavy rainfall event and a bushfire) were run as hypothetical event simulations. A diverse range of personnel from water utilities and other relevant agencies attended, forming a hypothetical water utility faced with managing water quality during an extreme weather event.

At the conclusion of each simulation a discussion was facilitated to identify new insights, key learnings, vulnerabilities and areas for improvement. A case study paper and a report have been written to document this valuable and informative exercise.

Diagnosing river health using invertebrate traits and DNA barcodes

Icon Water devotes substantial resources to monitoring the ecological condition of waterways. With such expenditure, appropriate bio-assessment methods are important to ensure the causes of ecological impairment are identified and targeted. The incorporation of successful diagnostic indices as tools for use within the AUSRIVAS software will enable Icon Water to better interpret biological monitoring data. This in turn enables greater understanding of the potential for water quality hazards and impacts in our water storages. The project aims to combine genetic barcoding with cost-effective molecular identification methods to provide significant and innovative benefits to routine monitoring of freshwater ecosystems.

Enlarged Cotter Dam Biodivesity Offset site, 2015

Water treatment plants

Chlorine dosing system upgrades

Chlorine dosing is recognised as a Critical Control Point (CCP) in Icon Water's HACCP-based drinking water quality risk management system. The chlorine system is critical to the operation of the WTPs and ensures disinfection is continued into the reticulation network. This project will provide renewal of aged assets and upgrade to the existing systems at both the Mount Stromlo and Googong WTPs to ensure their ongoing serviceability and reliability. This project is currently undergoing a detailed design and remains on schedule to be completed during 2017–18.

Googong WTP powdered activated carbon and inlet channel mixing

The powdered activated carbon (PAC) system enables taste and odour compounds, algal toxins and other organic compounds to be removed from the raw water at the plant. The original system was installed in 2004 at a time where the need for PAC dosing was identified but operation was expected to be intermittent. In recent years the reliance on the PAC dosing system at Googong WTP has increased. The PAC dosing system was successfully upgraded during 2015–16 to improve safety and reliability of operation.

Googong WTP fluoride system upgrade

The Googong WTPs fluoride dosing system capabilities and vulnerabilities were reviewed and assessed against the NSW Code of Practice for the Fluoridation of Public Water Supplies (2011), as a best practice benchmark. The upgrades have brought the fluoride system into line with the standards recommended in the NSW code and improved its safety and reliability. The project has also established a system which meets current work safety standards, in particular, manual handling and dust control.

Googong WTP Dissolved Air Flotation Filtration (DAFF) process upgrades

Two treatment stages exist at Googong WTP that can be operated independently or simultaneously. Stage 1 is the original plant, which uses clarification and direct filtration, whilst Stage 2 uses dissolved air flotation filtration (DAFF), to achieve sediment and pathogen removal. The DAFF plant has the ability to produce water more quickly and with more flexibility than the Stage 1 plant. The project involves the renewal of associated equipment (i.e. valves, level controls etc.) to improve and optimise the plants performance to realise its full potential.

Distribution system

Mains replacement project

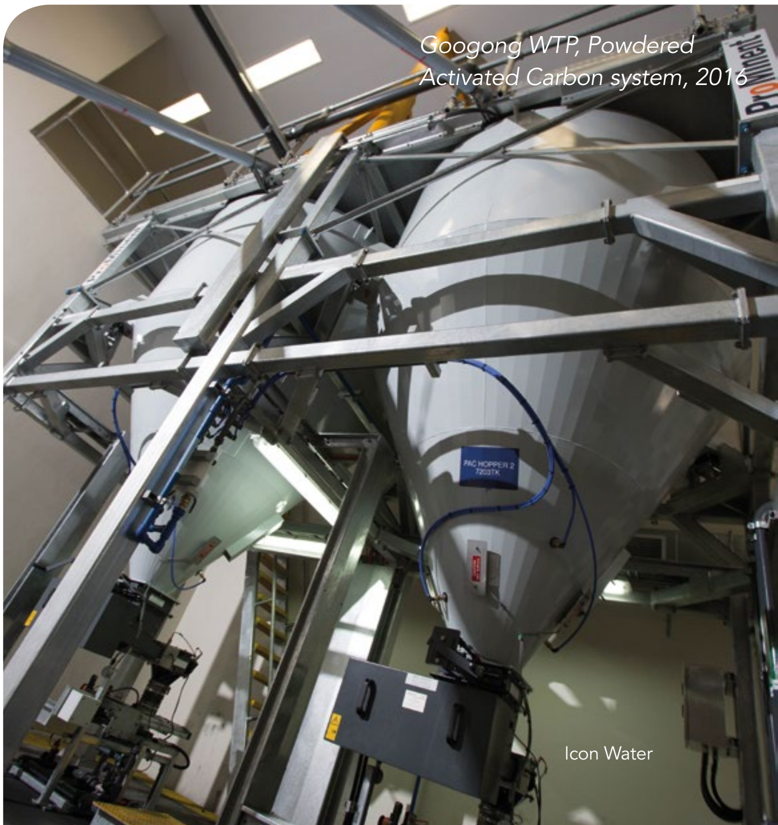
Icon Water has identified several sections of ageing mains within the reticulation network that experience reoccurring bursts. These mains are typically old unlined cast iron mains that have a significant build-up of tuberculation or rust nodes inside the pipes. The build-up has been identified as the cause of reduced hydraulic capacity resulting in these mains failing to meet Icon Water's flow rate standards. These mains have also been identified as causing discoloured water, predominantly due to iron and manganese deposits, taste and odour issues, higher turbidity and lower chlorine residuals.

There are several methods available for removing the build-up; however, most removal methods can worsen water quality and increase customer complaints. The preferred method for remediation involves replacing the mains. During 2015–16, approximately 10km of affected main were replaced.

Reticulation sampling point review and implementation

Between 2014 and 2016 Icon Water reviewed its drinking water quality monitoring program to ensure the number and distribution of sampling points adequately reflected the distribution of Canberra's population. The program is designed to provide a representative assessment of the water quality being supplied to its customers and to meet legislative requirements.

Numerous new participating properties were added to the program to fill spatial gaps and address increases in population. The sampling pool is now in excess of 400 sampling points. The review has improved the spatial distribution of sample points and included the implementation of a formal process to manage participants and routinely review the programs currency.



Googong WTP, Powdered Activated Carbon system, 2016

9 Laboratory analysis

Icon Water contracts ALS Global to collect and analyse drinking water samples. The monitoring program is defined by a Service Level Agreement, which is revised annually to reflect Icon Water's changing needs and priorities.

ALS Global operates a NATA-registered laboratory. NATA provides specific technical evaluation combined with international recognition by its overseas counterparts, enabling laboratories accredited by NATA to be recognised worldwide.

As part of its NATA registration, ALS Global participates in regular audits and proficiency testing whereby results for identical samples are compared with other NATA-registered laboratories. The most recent NATA audits were carried out in the chemistry area in September 2015 and in the biological area in January 2015. The facility was found to comply with the criteria of NATA Policy Circular 1 – Corporate Accreditation.

A summary of the laboratory analysis completed for the customer tap water quality monitoring program is presented in the following tables;

- Table 9-1 Summary data for all water quality zones
- Table 9-2 Summary data for water quality zone 1: North Canberra and Gungahlin
- Table 9-3 Summary data for water quality zone 2: Belconnen
- Table 9-4 Summary data for water quality zone 3: South Canberra, Woden and Weston Creek
- Table 9-5 Summary data for water quality zone 4: Tuggeranong

Table 9-1 Summary data for all water quality zones

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
Microbiological									
E. coli	APHA 9223 B	MPN/100mL	<1	<1	1082	<1	<1	<1	<1
Total Coliforms	APHA 9223 B	MPN/100mL	-	<1	1082	<1	>2400	3	<1
Heterotrophic Plate Count	APHA 9215 B	CFU/mL	-	<1	1082	<1	4220	9	10
Physical									
Conductivity	APHA 2510 B	µS/cm	-	<2	122	76	170	101	160
pH	APHA 4500-H B	pH units	-	<0.01	1081	7.32	8.89	7.83	8.16
Temperature	APHA 4500-H B	deg.C	-	<0.1	402	7.0	25.9	16.8	23.9
Total Dissolved Salts	APHA 2540 C	mg/L	-	<20	122	24	120	64	100
True colour	Lachat QuikChem Method, Colour in Waters 10-308-00-1-A	Pt-Co	-	<1	402	<1	5	1	2
Turbidity	APHA 2130 B	NTU	-	<0.1	402	<0.1	4.8	0.4	0.7
Inorganic									
Alkalinity bicarb	APHA 2320 A/B	mg/L	-	<0.1	203	29.4	46.8	37.3	40.9
Alkalinity carb	APHA 2320 A/B	mg/L	-	<0.1	203	<0.1	1.2	<0.1	<0.1
Alkalinity hydrox	APHA 2320 A/B	mg/L	-	<0.1	203	<0.1	<0.1	<0.1	<0.1
Alkalinity total	APHA 2320 A/B	mg/L	-	<1	203	29	47	37	41
Aluminium Acid Soluble	USEPA 200.8	µg/L	-	<5	122	7	56	29	43
Asbestos	AS4964-2000	Present/ Absent	-	Absent	95	Absent	Present	Absent	Absent
Calcium Dissolved	USEPA 200.7	mg/L	-	<0.05	122	10.30	18.00	12.90	16.40
Chloride	APHA 21st Ed. 2005, Part 4110 B	mg/L	-	<0.1	48	2.8	9.2	4.3	7.7
Chlorine Combined	APHA 4500 -CL G	mg/L	-	<0.03	1082	<0.03	0.83	0.10	0.23
Chlorine Free	APHA 4500 -CL G	mg/L	-	<0.03	1082	<0.03	1.43	0.68	1.07
Chlorine Total	APHA 4500 -CL G	mg/L	5	<0.03	1082	0.03	1.97	0.78	1.17
Cyanide	APHA 4500_CN	mg/L	0.08	<0.004	48	<0.004	0.010	<0.004	<0.004
Fluoride	APHA 4500-FC	mg/L	1.5	<0.1	122	0.5	1.0	0.8	0.9
Hardness Total	APHA 2340 B	mg/L	-	<0.1	119	29.0	57.0	37.8	55.1
Iodide	VIC-CM078	mg/L	0.5	<0.01	48	<0.01	0.02	0.01	0.01
Magnesium Dissolved	USEPA 200.7	mg/L	-	<0.05	122	0.68	3.93	1.34	3.60
Nitrate	APHA 21st Ed. 2005, Part 4110 B	mg/L	50	<0.1	48	<0.1	<0.1	<0.1	<0.1
Potassium Dissolved	USEPA 200.7	mg/L	-	<0.1	48	0.4	1.7	0.7	1.6
Sodium Dissolved	USEPA 200.7	mg/L	-	<0.1	48	2.6	8.4	3.7	7.4
Sulphate	APHA 21st Ed. 2005, Part 4110 B	mg/L	500	<0.4	48	0.6	28.0	5.1	25.0
Total Metals									
Aluminium Total	USEPA 200.8	µg/L	-	<9	122	<9	74	34	50
Antimony Total	USEPA 200.8	µg/L	3	<3	122	<3	<3	<3	<3
Arsenic Total	USEPA 200.8	µg/L	10	<1	122	<1	1	<1	<1
Barium Total	USEPA 200.8	µg/L	2000	<2	122	<2	10	4	6
Beryllium Total	USEPA 200.8	µg/L	60	<0.1	122	<0.1	0.2	<0.1	<0.1
Boron Total	USEPA 200.7	mg/L	4	<0.01	48	<0.01	0.02	<0.01	<0.01
Cadmium Total	USEPA 200.8	µg/L	2	<0.05	122	<0.05	0.06	<0.05	<0.05
Chromium Total	USEPA 200.8	µg/L	-	<2	121	<2	5	<2	<2
Cobalt Total	USEPA 200.8	µg/L	-	<0.2	122	<0.2	<0.2	<0.2	<0.2

Table 9-1 Summary data for all water quality zones (cont.)

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
Copper Total	USEPA 200.8	µg/L	2000	<1	400	<1	277	17	56
Iron Total	USEPA 200.7	mg/L	-	<0.01	244	<0.01	0.59	<0.01	<0.01
Lead Total	USEPA 200.8	µg/L	10	<0.2	244	<0.2	12.0	0.4	0.9
Manganese Total	USEPA 200.7	mg/L	0.5	<0.001	392	<0.001	0.281	0.007	0.016
Manganese Total	USEPA 200.8	µg/L	500	<0.5	89	<0.5	23.4	3.1	8.7
Mercury Total	USEPA 200.8	µg/L	1	<0.1	48	<0.1	<0.1	<0.1	<0.1
Molybdenum Total	USEPA 200.8	µg/L	50	<1	122	<1	2	<1	<1
Nickel Total	USEPA 200.8	µg/L	20	<1	122	<1	1	<1	<1
Selenium Total	USEPA 200.8	µg/L	10	<1	122	<1	<2	<1	<1
Silver Total	USEPA 200.8	µg/L	100	<1	122	<1	<1	<1	<1
Zinc Total	USEPA 200.8	µg/L	-	<5	122	<5	36	<5	7
Haloacetic Acids									
Bromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<5	202	<5	<5	<5	<5
Bromochloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	202	<1	13	2	4
Bromodichloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	202	<1	8	2	5
Dibromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	202	<1	4	<1	<1
Dibromochloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<10	202	<10	24	<10	<10
Dichloroacetic Acid	ALS: HS/GC/FID	µg/L	100	<1	202	4	45	17	35
Monochloroacetic Acid	ALS: HS/GC/FID	µg/L	150	<1	202	<1	4	<1	2
Tribromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<10	202	<10	<10	<10	<10
Trichloroacetic Acid	ALS: HS/GC/FID	µg/L	100	<1	202	8	55	26	48
Sum of Haloacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	68	21	108	38	51
Trihalomethanes									
Bromoform	VIC-CM047	mg/L	-	<0.001	202	<0.001	<0.001	<0.001	<0.001
Chloroform	VIC-CM047	mg/L	-	<0.001	202	0.009	0.089	0.035	0.064
Dibromochloromethane	VIC-CM047	mg/L	-	<0.001	202	<0.001	<0.001	<0.001	<0.001
Dichlorobromomethane	VIC-CM047	mg/L	-	<0.001	202	0.001	0.011	0.004	0.009
Trihalomethanes Total	VIC-CM047	mg/L	0.25	<0.001	202	0.010	0.100	0.039	0.073
Semi Voltaile Organic Compounds (SVOC)									
Anilines and Benzidines									
2 Nitroaniline	US EPA 3510/8270	µg/L	-	<4	122	<4	<4	<4	<4
3 Nitroaniline	US EPA 3510/8270	µg/L	-	<4	122	<4	<4	<4	<4
3,3 Dichlorobenzidine	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
4 Chloroaniline	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
4 Nitroaniline	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Aniline	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Carbazole	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Dibenzofuran	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Chlorinated Hydrocarbons									
1,2 Dichlorobenzene	US EPA 3510/8270	µg/L	1500	<2	122	<2	<2	<2	<2
1,2,4 Trichlorobenzene	US EPA 3510/8270	µg/L	30	<2	122	<2	<2	<2	<2
1,3 Dichlorobenzene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
1,4 Dichlorobenzene	US EPA 3510/8270	µg/L	40	<2	122	<2	<2	<2	<2
Hexachlorobenzene	US EPA 3510/8270	µg/L	-	<4	122	<4	<4	<4	<4
Hexachlorobutadiene	US EPA 3510/8270	µg/L	0.7	<2	122	<2	<2	<2	<2
Hexachlorocyclopentadiene	US EPA 3510/8270	µg/L	-	<10	122	<10	<10	<10	<10

Table 9-1 Summary data for all water quality zones (cont.)

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
Hexachloroethane	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Hexachloropropylene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Pentachlorobenzene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Haloethers									
4 Bromophenyl phenyl ether	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
4 Chlorophenyl phenyl ether	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Bis(2-chloroethoxy) methane	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Bis(2-chloroethyl) ether	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Nitroaromatics and Ketones									
1 Naphthylamine	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
1,3,5 Trinitrobenzene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
2 Picoline	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
2,4 Dinitrotoluene	US EPA 3510/8270	µg/L	-	<4	122	<4	<4	<4	<4
2,6 Dinitrotoluene	US EPA 3510/8270	µg/L	-	<4	122	<4	<4	<4	<4
4-Aminobiphenyl	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
4-Nitroquinoline-N-oxide	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
5 Nitro-o-toluidine	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Acetophenone	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Azobenzene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Chlorobenzilate	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Dimethylaminoazobenzene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Isophorone	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Nitrobenzene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Pentachloronitrobenzene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Phenacetin	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Pronamide	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Nitrosamines									
Methapyrilene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
N-Nitrosodibutylamine	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
N-Nitrosodiethylamine	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
N-Nitrosodi-n-propylamine	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
N-Nitrosodiphenyl & Diphenylamine	US EPA 3510/8270	µg/L	-	<4	122	<4	<4	<4	<4
N-Nitrosomethylethylamine	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
N-Nitrosomorpholine	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
N-Nitrosopiperidine	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
N-Nitrosopyrrolidine	US EPA 3510/8270	µg/L	-	<4	122	<4	<4	<4	<4
Organochlorine Pesticides									
4,4 DDD	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
4,4 DDE	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
4,4 DDT	US EPA 3510/8270	µg/L	9	<4	122	<4	<4	<4	<4
Aldrin	US EPA 3510/8270	µg/L	0.3	<2	122	<2	<2	<2	<2
alpha BHC	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
alpha Endosulfan	US EPA 3510/8270	µg/L	20	<2	122	<2	<2	<2	<2
beta BHC	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
beta Endosulfan	US EPA 3510/8270	µg/L	20	<2	122	<2	<2	<2	<2

Table 9-1 Summary data for all water quality zones (cont.)

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
delta BHC	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Dieldrin	US EPA 3510/8270	µg/L	0.3	<2	122	<2	<2	<2	<2
Endrin	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Endosulfan sulfate	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
gamma BHC	US EPA 3510/8270	µg/L	10	<2	122	<2	<2	<2	<2
Heptachlor	US EPA 3510/8270	µg/L	0.3	<2	122	<2	<2	<2	<2
Heptachlor epoxide	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Organophosphorous Pesticides									
Chlorfenvinphos	US EPA 3510/8270	µg/L	2	<2	122	<2	<2	<2	<2
Chlorpyrifos	US EPA 3510/8270	µg/L	10	<2	122	<2	<2	<2	<2
Chlorpyrifos-methyl	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Diazinon	US EPA 3510/8270	µg/L	4	<2	122	<2	<2	<2	<2
Dichlorvos	US EPA 3510/8270	µg/L	5	<2	122	<2	<2	<2	<2
Dimethoate	US EPA 3510/8270	µg/L	7	<2	122	<2	<2	<2	<2
Ethion	US EPA 3510/8270	µg/L	4	<2	122	<2	<2	<2	<2
Fenthion	US EPA 3510/8270	µg/L	7	<2	122	<2	<2	<2	<2
Malathion	US EPA 3510/8270	µg/L	70	<2	122	<2	<2	<2	<2
Pirimiphos-ethyl	US EPA 3510/8270	µg/L	0.5	<2	122	<2	<2	<2	<2
Prothiofos	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Phenolic Compounds									
2,3,4,6 Tetrachlorophenol	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
2,4 Dichlorophenol	US EPA 3510/8270	µg/L	200	<2	122	<2	<2	<2	<2
2,4 Dimethylphenol	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
2,4,5 Trichlorophenol	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
2,4,6 Trichlorophenol	US EPA 3510/8270	µg/L	20	<2	122	<2	<2	<2	<2
2,6 Dichlorophenol	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
2 Chlorophenol	US EPA 3510/8270	µg/L	300	<2	122	<2	<2	<2	<2
2 Methylphenol	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
2 Nitrophenol	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
3- & 4-Methylphenol	US EPA 3510/8270	µg/L	-	<4	122	<4	<4	<4	<4
4-Chloro-3-Methylphenol	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Pentachlorophenol	US EPA 3510/8270	µg/L	10	<4	122	<4	<4	<4	<4
Phenol	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Phthalates									
Bis(2-ethylhexyl) phthalate	US EPA 3510/8270	µg/L	10	<10	164	<10	<10	<10	<10
Butyl benzyl phthalate	US EPA 3510/8270	µg/L	-	<2	164	<2	<2	<2	<2
Diethyl phthalate	US EPA 3510/8270	µg/L	-	<2	164	<2	<2	<2	<2
Dimethyl phthalate	US EPA 3510/8270	µg/L	-	<2	164	<2	<2	<2	<2
Di-n-butyl phthalate	US EPA 3510/8270	µg/L	-	<2	164	<2	<2	<2	<2
Di-n-octyl phthalate	US EPA 3510/8270	µg/L	-	<2	164	<2	<2	<2	<2
Polycyclic Aromatic Hydrocarbons									
2-Chloronaphthalene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
2-Methylnaphthalene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
3-Methylcholanthrene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
12-Dimethylbenz(a)anthracene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Acenaphthene	US EPA 3510/8270	µg/L	-	<1	121	<1	<1	<1	<1

Table 9-1 Summary data for all water quality zones (cont.)

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
Acenaphthene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Acenaphthylene	US EPA 3510/8270	µg/L	-	<1	121	<1	<1	<1	<1
Acenaphthylene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Anthracene	US EPA 3510/8270	µg/L	-	<1	121	<1	<1	<1	<1
Anthracene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Benz(a)anthracene	US EPA 3510/8270	µg/L	-	<1	121	<1	<1	<1	<1
Benz(a)anthracene	US EPA 3510/8270	µg/L	-	<1	122	<2	<2	<2	<2
Benzo(a)pyrene	US EPA 3510/8270	µg/L	0.01	<0.5	121	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	US EPA 3510/8270	µg/L	0.01	<2	122	<2	<2	<2	<2
Benzo(b) fluoranthene	US EPA 3510/8270	µg/L	-	<1	111	<1	<1	<1	<1
Benzo(k) fluoranthene	US EPA 3510/8270	µg/L	-	<1	121	<1	<1	<1	<1
Benzo(b) & Benzo(k)fluoranthene	US EPA 3510/8270	µg/L	-	<4	122	<4	<4	<4	<4
Benzo(g.h.i)perylene	US EPA 3510/8270	µg/L	-	<1	121	<1	<1	<1	<1
Benzo(g.h.i)perylene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Chrysene	US EPA 3510/8270	µg/L	-	<1	121	<1	<1	<1	<1
Chrysene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Dibenz(a.h)anthracene	US EPA 3510/8270	µg/L	-	<1	121	<1	<1	<1	<1
Dibenz(a.h)anthracene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Fluoranthene	US EPA 3510/8270	µg/L	-	<1	121	<1	<1	<1	<1
Fluoranthene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Fluorene	US EPA 3510/8270	µg/L	-	<1	121	<1	<1	<1	<1
Fluorene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Indeno(1.2.3.cd)pyrene	US EPA 3510/8270	µg/L	-	<1	121	<1	<1	<1	<1
Indeno(1.2.3-cd)pyrene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
2-Fluorenyl Acetamide	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Naphthalene	US EPA 3510/8270	µg/L	-	<1	121	<1	<1	<1	<1
Naphthalene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Phenanthrene	US EPA 3510/8270	µg/L	-	<1	121	<1	<1	<1	<1
Phenanthrene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
Pyrene	US EPA 3510/8270	µg/L	-	<1	121	<1	<1	<1	<1
Pyrene	US EPA 3510/8270	µg/L	-	<2	122	<2	<2	<2	<2
PAH (total)	US EPA 3510/8270	µg/L	-	<0.5	121	<0.5	<0.5	<0.5	<0.5

ADWG Australian Drinking Water Guidelines – Health Guideline Value
CFU/mL colony forming units per millilitre
Deg C degrees Celsius
µg/L micrograms per litre
mg/L milligrams per litre
µS/cm micro siemens per centimetre
MPN most probable number
NTU nephelometric units
Pt-Co platinum-cobalt units

The 95th percentile is a statistical calculation based on 'normal' distribution. In the context of this report, it estimates the value for which 95% of all the water that passes through the distribution system in this 12 month period falls below.

Table 9-2 Summary data for water quality zone 1: North Canberra and Gungahlin

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
Microbiological									
E. coli	APHA 9223 B	MPN/100mL	<1	<1	283	<1	<1	<1	<1
Total Coliforms	APHA 9223 B	MPN/100mL	-	<1	283	<1	1	<1	<1
Heterotrophic Plate Count	APHA 9215 B	CFU/mL	-	<1	283	<1	321	4	10
Physical									
Conductivity	APHA 2510 B	µS/cm	-	<2	29	78	160	96	160
pH	APHA 4500-H B	pH units	-	<0.01	283	7.40	8.45	7.77	8.05
Temperature	APHA 4500-H B	deg.C	-	<0.1	104	7.0	25.9	16.8	23.8
Total Dissolved Salts	APHA 2540 C	mg/L	-	<20	29	24	100	61	90
True colour	Lachat QuikChem Method, Colour in Waters 10-308-00-1-A	Pt-Co	-	<1	104	<1	5	1	2
Turbidity	APHA 2130 B	NTU	-	<0.1	104	0.1	4.8	0.4	0.9
Inorganic									
Alkalinity bicarb	APHA 2320 A/B	mg/L	-	<0.1	53	32.5	44.4	37.6	40.7
Alkalinity carb	APHA 2320 A/B	mg/L	-	<0.1	53	<0.1	<0.1	<0.1	<0.1
Alkalinity hydrox	APHA 2320 A/B	mg/L	-	<0.1	53	<0.1	<0.1	<0.1	<0.1
Alkalinity total	APHA 2320 A/B	mg/L	-	<1	53	32	44	38	41
Aluminium Acid Soluble	USEPA 200.8	µg/L	-	<5	29	19	56	31	44
Asbestos	AS4964-2000	Present/ Absent	-	Absent	20	Absent	Absent	Absent	Absent
Calcium Dissolved	USEPA 200.7	mg/L	-	<0.05	29	10.70	16.00	12.72	16.00
Chloride	APHA 21st Ed. 2005, Part 4110 B	mg/L	-	<0.1	12	3.1	8.3	4.4	7.6
Chlorine Combined	APHA 4500 -CL G	mg/L	-	<0.03	283	<0.03	0.83	0.11	0.25
Chlorine Free	APHA 4500 -CL G	mg/L	-	<0.03	283	<0.03	1.26	0.76	1.12
Chlorine Total	APHA 4500 -CL G	mg/L	5	<0.03	283	0.21	1.97	0.86	1.24
Cyanide	APHA 4500_CN	mg/L	0.08	<0.004	12	0.002	0.010	0.003	0.006
Fluoride	APHA 4500-FC	mg/L	1.5	<0.1	29	0.5	1.0	0.8	0.9
Hardness Total	APHA 2340 B	mg/L	-	<0.1	28	30	54	37	54
Iodide	VIC-CM078	mg/L	0.5	<0.01	12	<0.01	<0.01	0.01	0.01
Magnesium Dissolved	USEPA 200.7	mg/L	-	<0.05	29	0.70	3.80	1.17	3.46
Nitrate	APHA 21st Ed. 2005, Part 4110 B	mg/L	50	<0.1	12	<0.1	<0.1	<0.1	<0.1
Potassium Dissolved	USEPA 200.7	mg/L	-	<0.1	12	0.4	1.7	0.7	1.6
Sodium Dissolved	USEPA 200.7	mg/L	-	<0.1	12	2.8	7.4	3.6	6.6
Sulphate	APHA 21st Ed. 2005, Part 4110 B	mg/L	500	<0.4	12	0.7	28.0	4.9	25.3

Table 9-2 Summary data for water quality zone 1: North Canberra and Gungahlin (cont.)

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
Total Metals									
Aluminium Total	USEPA 200.8	µg/L	-	<9	29	22	74	36	56
Antimony Total	USEPA 200.8	µg/L	3	<3	29	<3	<3	<3	<3
Arsenic Total	USEPA 200.8	µg/L	10	<1	29	<1	1	<1	<1
Barium Total	USEPA 200.8	µg/L	2000	<2	29	<2	10	4	7
Beryllium Total	USEPA 200.8	µg/L	60	<0.1	29	<0.1	0.2	<0.1	<0.1
Boron Total	USEPA 200.7	mg/L	4	<0.01	12	<0.01	0.02	<0.01	0.02
Cadmium Total	USEPA 200.8	µg/L	2	<0.05	29	<0.05	<0.05	<0.05	<0.05
Chromium Total	USEPA 200.8	µg/L	-	<2	28	<2	2	<2	<2
Cobalt Total	USEPA 200.8	µg/L	-	<0.2	29	<0.2	<0.2	<0.2	<0.2
Copper Total	USEPA 200.8	µg/L	2000	<1	104	<1	240	19	70
Iron Total	USEPA 200.7	mg/L	-	<0.01	65	<0.01	0.59	0.02	0.03
Lead Total	USEPA 200.8	µg/L	10	<0.2	65	<0.2	12.0	0.6	2.1
Manganese Total	USEPA 200.7	mg/L	0.5	<0.001	101	<0.001	0.281	0.011	0.023
Manganese Total	USEPA 200.8	µg/L	500	<0.5	19	<0.5	17.0	4.8	14.6
Mercury Total	USEPA 200.8	µg/L	1	<0.1	12	<0.1	<0.1	<0.1	<0.1
Molybdenum Total	USEPA 200.8	µg/L	50	<1	29	<1	2	<1	<1
Nickel Total	USEPA 200.8	µg/L	20	<1	29	<1	1	<1	1
Selenium Total	USEPA 200.8	µg/L	10	<1	29	<1	1	<1	1
Silver Total	USEPA 200.8	µg/L	100	<1	29	<1	<1	<1	<1
Zinc Total	USEPA 200.8	µg/L	-	<5	29	<5	17	<5	14
Haloacetic Acids									
Bromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<5	53	<5	<5	<5	<5
Bromochloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	53	<1	6	1	4
Bromodichloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	53	<1	6	2	5
Dibromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	53	<1	<1	<1	<1
Dibromochloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<10	53	<10	24	<10	<10
Dichloroacetic Acid	ALS: HS/GC/FID	µg/L	100	<1	53	5	45	17	35
Monochloroacetic Acid	ALS: HS/GC/FID	µg/L	150	<1	53	<1	4	<1	2
Tribromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<10	53	<10	<10	<10	<10
Trichloroacetic Acid	ALS: HS/GC/FID	µg/L	100	<1	53	11	49	24	48
Sum of Haloacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	21	24	108	40	59
Trihalomethanes									
Bromoform	VIC-CM047	mg/L	-	<0.001	53	<0.001	<0.001	0.001	0.001
Chloroform	VIC-CM047	mg/L	-	<0.001	53	0.013	0.089	0.035	0.067
Dibromochloromethane	VIC-CM047	mg/L	-	<0.001	53	<0.001	<0.001	0.001	0.001
Dichlorobromomethane	VIC-CM047	mg/L	-	<0.001	53	0.001	0.011	0.004	0.010
Trihalomethanes Total	VIC-CM047	mg/L	0.25	<0.001	53	0.014	0.100	0.039	0.077

Table 9-2 Summary data for water quality zone 1: North Canberra and Gungahlin (cont.)

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
Semi Voltaile Organic Compounds (SVOC)									
Anilines and Benzidines	US EPA 3510/8270	µg/L	All results < LOR						
Chlorinated Hydrocarbons	US EPA 3510/8270	µg/L							
Haloethers	US EPA 3510/8270	µg/L							
Nitroaromatics and Ketones	US EPA 3510/8270	µg/L							
Nitrosamines	US EPA 3510/8270	µg/L							
Organochlorine Pesticides	US EPA 3510/8270	µg/L							
Organophosphorous Pesticides	US EPA 3510/8270	µg/L							
Phenolic Compounds	US EPA 3510/8270	µg/L							
Phthalates	US EPA 3510/8270	µg/L							
Polycyclic Aromatic Hydrocarbons	US EPA 3510/8270	µg/L							

ADWG	Australian Drinking Water Guidelines – Health Guideline Value
CFU/mL	colony forming units per millilitre
Deg C	degrees Celsius
LOR	limit of reporting
µg/L	micrograms per litre
mg/L	milligrams per litre
µS/cm	micro siemens per centimetre
MPN	most probable number
NTU	nephelometric units
Pt-Co	platinum-cobalt units

The 95th percentile is a statistical calculation based on 'normal' distribution. In the context of this report, it estimates the value for which 95% of all the water that passes through the distribution system in this 12 month period falls below.

Table 9-3 Summary data for water quality zone 2: Belconnen

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
Microbiological									
E. coli	APHA 9223 B	MPN/100mL	<1	<1	282	<1	<1	<1	<1
Total Coliforms	APHA 9223 B	MPN/100mL	-	<1	282	<1	<1	<1	<1
Heterotrophic Plate Count	APHA 9215 B	CFU/mL	-	<1	282	<1	59	2	6
Physical									
Conductivity	APHA 2510 B	µS/cm	-	<2	36	76	170	101	163
pH	APHA 4500-H B	pH units	-	<0.01	282	7.40	8.80	7.86	8.12
Temperature	APHA 4500-H B	deg.C	-	<0.1	105	8.0	25.3	16.7	23.9
Total Dissolved Salts	APHA 2540 C	mg/L	-	<20	36	27	120	63	100
True colour	Lachat QuikChem Method, Colour in Waters 10-308-00-1-A	Pt-Co	-	<1	105	<1	2	1	2
Turbidity	APHA 2130 B	NTU	-	<0.1	105	<0.1	2.7	0.4	0.7
Inorganic									
Alkalinity bicarb	APHA 2320 A/B	mg/L	-	<0.1	57	31.6	46.8	37.2	40.8
Alkalinity carb	APHA 2320 A/B	mg/L	-	<0.1	57	<0.1	<0.1	<0.1	<0.1
Alkalinity hydrox	APHA 2320 A/B	mg/L	-	<0.1	57	<0.1	<0.1	<0.1	<0.1
Alkalinity total	APHA 2320 A/B	mg/L	-	<1	57	32	47	37	41
Aluminium Acid Soluble	USEPA 200.8	µg/L	-	<5	36	8	47	29	41
Asbestos	AS4964-2000	Present/ Absent	-	Absent	28	Absent	Present	Absent	Absent
Calcium Dissolved	USEPA 200.7	mg/L	-	<0.05	36	10.60	18.00	13.01	17.25
Chloride	APHA 21st Ed. 2005, Part 4110 B	mg/L	-	<0.1	12	2.8	7.8	4.2	7.6
Chlorine Combined	APHA 4500 -CL G	mg/L	-	<0.03	282	<0.03	0.48	0.10	0.24
Chlorine Free	APHA 4500 -CL G	mg/L	-	<0.03	282	0.08	1.13	0.62	0.95
Chlorine Total	APHA 4500 -CL G	mg/L	5	<0.03	282	0.25	1.24	0.72	1.01
Cyanide	APHA 4500_CN	mg/L	0.08	<0.004	12	<0.004	<0.004	<0.004	<0.004
Fluoride	APHA 4500-FC	mg/L	1.5	<0.1	36	0.6	1.0	0.8	0.9
Hardness Total	APHA 2340 B	mg/L	-	<0.1	36	30.0	56.0	37.9	55.3
Iodide	VIC-CM078	mg/L	0.5	<0.01	12	<0.01	0.02	0.01	0.01
Magnesium Dissolved	USEPA 200.7	mg/L	-	<0.05	36	0.68	3.50	1.31	3.40
Nitrate	APHA 21st Ed. 2005, Part 4110 B	mg/L	50	<0.1	12	<0.1	<0.1	<0.1	<0.1
Potassium Dissolved	USEPA 200.7	mg/L	-	<0.1	12	0.4	1.6	0.7	1.5
Sodium Dissolved	USEPA 200.7	mg/L	-	<0.1	12	2.6	7.4	3.7	7.3
Sulphate	APHA 21st Ed. 2005, Part 4110 B	mg/L	500	<0.4	12	0.6	25.0	4.9	25.0

Table 9-3 Summary data for water quality zone 2: Belconnen (cont.)

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
Total Metals									
Aluminium Total	USEPA 200.8	µg/L	-	<9	36	<9	59	34	50
Antimony Total	USEPA 200.8	µg/L	3	<3	36	<3	<3	<3	<3
Arsenic Total	USEPA 200.8	µg/L	10	<1	36	<1	<1	<1	<1
Barium Total	USEPA 200.8	µg/L	2000	<2	36	2.7	6.1	4	6
Beryllium Total	USEPA 200.8	µg/L	60	<0.1	36	<0.1	<0.1	<0.1	<0.1
Boron Total	USEPA 200.7	mg/L	4	<0.01	12	<0.01	0.01	<0.01	0.01
Cadmium Total	USEPA 200.8	µg/L	2	<0.05	36	<0.05	<0.05	<0.05	<0.05
Chromium Total	USEPA 200.8	µg/L	-	<2	36	<2	5	<2	<2
Cobalt Total	USEPA 200.8	µg/L	-	<0.2	36	<0.2	<0.2	<0.2	<0.2
Copper Total	USEPA 200.8	µg/L	2000	<1	105	1	120	13	33
Iron Total	USEPA 200.7	mg/L	-	<0.01	65	<0.01	0.03	<0.01	0.01
Lead Total	USEPA 200.8	µg/L	10	<0.2	65	<0.2	1.2	0.2	0.5
Manganese Total	USEPA 200.7	mg/L	0.5	<0.001	102	<0.001	0.110	0.006	0.017
Manganese Total	USEPA 200.8	µg/L	500	<0.5	27	<0.5	5.8	1.9	4.6
Mercury Total	USEPA 200.8	µg/L	1	<0.1	12	<0.1	<0.1	<0.1	<0.1
Molybdenum Total	USEPA 200.8	µg/L	50	<1	36	<1	<1	<1	<1
Nickel Total	USEPA 200.8	µg/L	20	<1	36	<1	1	<1	1
Selenium Total	USEPA 200.8	µg/L	10	<1	36	<1	1	<1	1
Silver Total	USEPA 200.8	µg/L	100	<1	36	<1	<1	<1	<1
Zinc Total	USEPA 200.8	µg/L	-	<5	36	<5	7	<5	<5
Haloacetic Acid									
Bromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<5	52	<5	<5	<5	<5
Bromochloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	52	<1	5	1	4
Bromodichloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	52	<1	6	2	5
Dibromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	52	<1	1	<1	<1
Dibromochloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<10	52	<10	<10	<10	<10
Dichloroacetic Acid	ALS: HS/GC/FID	µg/L	100	<1	52	6	35	16	34
Monochloroacetic Acid	ALS: HS/GC/FID	µg/L	150	<1	52	<1	4	<1	2
Tribromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<10	52	<10	<10	<10	<10
Trichloroacetic Acid	ALS: HS/GC/FID	µg/L	100	<1	52	8	48	26	45
Sum of Haloacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	18	28	59	39	47
Trihalomethanes									
Bromoform	VIC-CM047	mg/L	-	<0.001	52	<0.001	<0.001	0.001	0.001
Chloroform	VIC-CM047	mg/L	-	<0.001	52	0.009	0.063	0.034	0.059
Dibromochloromethane	VIC-CM047	mg/L	-	<0.001	52	<0.001	<0.001	0.001	0.001
Dichlorobromomethane	VIC-CM047	mg/L	-	<0.001	52	0.001	0.009	0.004	0.008
Trihalomethanes Total	VIC-CM047	mg/L	0.25	<0.001	52	0.010	0.072	0.038	0.067

Table 9-3 Summary data for water quality zone 2: Belconnen (cont.)

<table>
<tr><th>Analyte</th><th>Method ID</th><th>Units</th><th>ADWG (Health)</th><th>Limit of Reporting</th><th>Number of Samples</th><th>Minimum</th><th>Maximum</th><th>Mean</th><th>95th Percentile</th></tr>
<tr><td colspan="10">Semi Voltaile Organic Compounds (SVOC)</td></tr>
<tr><td>Anilines and Benzidines</td><td>US EPA 3510/8270</td><td>µg/L</td><td colspan="7" rowspan="10">All results < LOR</td></tr>
<tr><td>Chlorinated Hydrocarbons</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Haloethers</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Nitroaromatics and Ketones</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Nitrosamines</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Organochlorine Pesticides</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Organophosphorous Pesticides</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Phenolic Compounds</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Phthalates</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Polycyclic Aromatic Hydrocarbons</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
</table>

ADWG	Australian Drinking Water Guidelines – Health Guideline Value
CFU/mL	colony forming units per millilitre
Deg C	degrees Celsius
LOR	limit of reporting
µg/L	micrograms per litre
mg/L	milligrams per litre
µS/cm	micro siemens per centimetre
MPN	most probable number
NTU	nephelometric units
Pt-Co	platinum-cobalt units

The 95th percentile is a statistical calculation based on 'normal' distribution. In the context of this report, it estimates the value for which 95% of all the water that passes through the distribution system in this 12 month period falls below.

Table 9-4 Summary data for water quality zone 3: South Canberra, Woden and Weston Creek

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
Mircrobiological									
E. coli	APHA 9223 B	MPN/100mL	<1	<1	256	<1	<1	<1	<1
Total Coliforms	APHA 9223 B	MPN/100mL	-	<1	256	<1	<1	<1	<1
Heterotrophic Plate Count	APHA 9215 B	CFU/mL	-	<1	256	<1	87	3	13
Physical									
Conductivity	APHA 2510 B	µS/cm	-	<2	32	78	168	103	160
pH	APHA 4500-H B	pH units	-	<0.01	256	7.40	8.16	7.78	7.97
Temperature	APHA 4500-H B	deg.C	-	<0.1	95	8.8	25.8	16.7	24.3
Total Dissolved Salts	APHA 2540 C	mg/L	-	<20	32	26	110	65	110
True colour	Lachat QuikChem Method, Colour in Waters 10-308-00-1-A	Pt-Co	-	<1	95	<1	5	1	2
Turbidity	APHA 2130 B	NTU	-	<0.1	95	<0.1	1.1	0.3	0.6
Inorganic									
Alkalinity bicarb	APHA 2320 A/B	mg/L	-	<0.1	47	31.8	43.8	36.7	40.7
Alkalinity carb	APHA 2320 A/B	mg/L	-	<0.1	47	<0.1	<0.1	<0.1	<0.1
Alkalinity hydrox	APHA 2320 A/B	mg/L	-	<0.1	47	<0.1	<0.1	<0.1	<0.1
Alkalinity total	APHA 2320 A/B	mg/L	-	<1	47	32	44	37	41
Aluminium Acid Soluble	USEPA 200.8	µg/L	-	<5	32	7	50	28	41
Asbestos	AS4964-2000	Present/ Absent	-	Absent	27	Absent	Absent	Absent	Absent
Calcium Dissolved	USEPA 200.7	mg/L	-	<0.05	32	10.40	16.40	12.61	16.00
Chloride	APHA 21st Ed. 2005, Part 4110 B	mg/L	-	<0.1	12	3.0	7.6	4.3	7.4
Chlorine Combined	APHA 4500 -CL G	mg/L	-	<0.03	256	<0.03	0.38	0.10	0.22
Chlorine Free	APHA 4500 -CL G	mg/L	-	<0.03	256	<0.03	1.43	0.69	1.05
Chlorine Total	APHA 4500 -CL G	mg/L	5	<0.03	256	0.03	1.49	0.79	1.17
Cyanide	APHA 4500_CN	mg/L	0.08	<0.004	12	<0.004	0.006	<0.004	<0.004
Fluoride	APHA 4500-FC	mg/L	1.5	<0.1	32	0.5	1.0	0.8	0.9
Hardness Total	APHA 2340 B	mg/L	-	<0.1	31	29.0	56.0	38.0	54.5
Iodide	VIC-CM078	mg/L	0.5	<0.01	12	<0.01	<0.01	0.01	0.01
Magnesium Dissolved	USEPA 200.7	mg/L	-	<0.05	32	0.75	3.90	1.50	3.70
Nitrate	APHA 21st Ed. 2005, Part 4110 B	mg/L	50	<0.1	12	<0.1	<0.1	<0.1	<0.1
Potassium Dissolved	USEPA 200.7	mg/L	-	<0.1	12	0.4	1.6	0.7	1.5
Sodium Dissolved	USEPA 200.7	mg/L	-	<0.1	12	2.6	7.5	3.8	7.3
Sulphate	APHA 21st Ed. 2005, Part 4110 B	mg/L	500	<0.4	12	0.6	25.0	5.5	24.5

Table 9-4 Summary data for water quality zone 3: South Canberra, Woden and Weston Creek (cont)

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
Total Metals									
Aluminium Total	USEPA 200.8	µg/L	-	<9	32	<9	50	33	43
Antimony Total	USEPA 200.8	µg/L	3	<3	32	<3	<3	<3	<3
Arsenic Total	USEPA 200.8	µg/L	10	<1	32	<1	<1	<1	<1
Barium Total	USEPA 200.8	µg/L	2000	<2	32	3	6	4	6
Beryllium Total	USEPA 200.8	µg/L	60	<0.1	32	<0.1	<0.1	<0.1	<0.1
Boron Total	USEPA 200.7	mg/L	4	<0.01	12	<0.01	<0.01	0.01	0.01
Cadmium Total	USEPA 200.8	µg/L	2	<0.05	32	<0.05	0.06	<0.05	<0.05
Chromium Total	USEPA 200.8	µg/L	-	<2	32	<2	<2	<2	<2
Cobalt Total	USEPA 200.8	µg/L	-	<0.2	32	<0.2	<0.2	<0.2	<0.2
Copper Total	USEPA 200.8	µg/L	2000	<1	95	<1	277	21	61
Iron Total	USEPA 200.7	mg/L	-	<0.01	56	<0.01	0.07	<0.01	0.02
Lead Total	USEPA 200.8	µg/L	10	<0.2	56	<0.2	6.9	0.5	1.1
Manganese Total	USEPA 200.7	mg/L	0.5	<0.001	93	<0.001	0.024	0.005	0.013
Manganese Total	USEPA 200.8	µg/L	500	<0.5	25	<0.5	23.4	3.4	9.7
Mercury Total	USEPA 200.8	µg/L	1	<0.1	12	<0.1	<0.1	<0.1	<0.1
Molybdenum Total	USEPA 200.8	µg/L	50	<1	32	<1	<1	<1	<1
Nickel Total	USEPA 200.8	µg/L	20	<1	32	<1	1	<1	<1
Selenium Total	USEPA 200.8	µg/L	10	<1	32	<1	1	<1	1
Silver Total	USEPA 200.8	µg/L	100	<1	32	<1	<1	<1	<1
Zinc Total	USEPA 200.8	µg/L	-	<5	32	<5	22	<5	10
Haloacetic Acid									
Bromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<5	48	<5	<5	<5	<5
Bromochloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	48	<1	13	2	5
Bromodichloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	48	<1	8	2	6
Dibromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	48	<1	4	<1	<1
Dibromochloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<10	48	<10	<10	<10	<10
Dichloroacetic Acid	ALS: HS/GC/FID	µg/L	100	<1	48	5	40	17	36
Monochloroacetic Acid	ALS: HS/GC/FID	µg/L	150	<1	48	<1	3	<1	2
Tribromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<10	48	<10	<10	<10	<10
Trichloroacetic Acid	ALS: HS/GC/FID	µg/L	100	<1	48	12	55	26	49
Sum of Haloacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	15	21	44	36	43
Trihalomethanes									
Bromoform	VIC–CM047	mg/L	–	<0.001	48	<0.001	<0.001	0.001	0.001
Chloroform	VIC–CM047	mg/L	–	<0.001	48	0.015	0.073	0.035	0.067
Dibromochloromethane	VIC–CM047	mg/L	–	<0.001	48	<0.001	<0.001	0.001	0.001
Dichlorobromomethane	VIC–CM047	mg/L	–	<0.001	48	0.001	0.011	0.004	0.009
Trihalomethanes Total	VIC–CM047	mg/L	0.25	<0.001	48	0.016	0.084	0.039	0.076

Table 9-4 Summary data for water quality zone 3: South Canberra, Woden and Weston Creek (cont)

<table>
<tr><th>Analyte</th><th>Method ID</th><th>Units</th><th>ADWG (Health)</th><th>Limit of Reporting</th><th>Number of Samples</th><th>Minimum</th><th>Maximum</th><th>Mean</th><th>95th Percentile</th></tr>
<tr><td colspan="10">Semi Voltaile Organic Compounds (SVOC)</td></tr>
<tr><td>Anilines and Benzidines</td><td>US EPA 3510/8270</td><td>µg/L</td><td colspan="7" rowspan="10">All results < LOR</td></tr>
<tr><td>Chlorinated Hydrocarbons</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Haloethers</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Nitroaromatics and Ketones</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Nitrosamines</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Organochlorine Pesticides</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Organophosphorous Pesticides</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Phenolic Compounds</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Phthalates</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
<tr><td>Polycyclic Aromatic Hydrocarbons</td><td>US EPA 3510/8270</td><td>µg/L</td></tr>
</table>

ADWG	Australian Drinking Water Guidelines – Health Guideline Value
CFU/mL	colony forming units per millilitre
Deg C	degrees Celsius
LOR	limit of reporting
µg/L	micrograms per litre
mg/L	milligrams per litre
µS/cm	micro siemens per centimetre
MPN	most probable number
NTU	nephelometric units
Pt-Co	platinum-cobalt units

The 95th percentile is a statistical calculation based on 'normal' distribution. In the context of this report, it estimates the value for which 95% of all the water that passes through the distribution system in this 12 month period falls below.

Table 9-5 Summary data for water quality zone 4: Tuggeranong

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
Microbiological									
E. coli	APHA 9223 B	MPN/100mL	<1	<1	261	<1	<1	<1	<1
Total Coliforms	APHA 9223 B	MPN/100mL	-	<1	261	<1	2400	10	<1
Heterotrophic Plate Count	APHA 9215 B	CFU/mL	-	<1	261	<1	4220	29	10
Physical									
Conductivity	APHA 2510 B	µS/cm	-	<2	25	80	170	104	169
pH	APHA 4500-H B	pH units	-	<0.01	260	7.32	8.89	7.92	8.40
Temperature	APHA 4500-H B	deg.C	-	<0.1	98	7.5	25.4	16.8	23.8
Total Dissolved Salts	APHA 2540 C	mg/L	-	<20	25	45	100	70	100
True colour	Lachat QuikChem Method, Colour in Waters 10-308-00-1-A	Pt-Co	-	<1	98	<1	2	1	2
Turbidity	APHA 2130 B	NTU	-	<0.1	98	<0.1	2.0	0.4	0.7
Inorganic									
Alkalinity bicarb	APHA 2320 A/B	mg/L	-	<0.1	46	29.4	46.1	37.7	42.1
Alkalinity carb	APHA 2320 A/B	mg/L	-	<0.1	46	<0.1	1.2	0.1	0.1
Alkalinity hydrox	APHA 2320 A/B	mg/L	-	<0.1	46	<0.1	<0.1	<0.1	<0.1
Alkalinity total	APHA 2320 A/B	mg/L	-	<1	46	29	46	38	42
Aluminium Acid Soluble	USEPA 200.8	µg/L	-	<5	25	7	47	30	42
Asbestos	AS4964-2000	Present/ Absent	-	Absent	20	Absent	Absent	Absent	Absent
Calcium Dissolved	USEPA 200.7	mg/L	-	<0.05	25	10.30	17.00	13.29	16.88
Chloride	APHA 21st Ed. 2005, Part 4110 B	mg/L	-	<0.1	12	2.9	9.2	4.4	8.3
Chlorine Combined	APHA 4500 -CL G	mg/L	-	<0.03	261	<0.03	0.55	0.10	0.23
Chlorine Free	APHA 4500 -CL G	mg/L	-	<0.03	261	0.06	1.36	0.64	1.08
Chlorine Total	APHA 4500 -CL G	mg/L	5	<0.03	261	0.11	1.58	0.74	1.18
Cyanide	APHA 4500_CN	mg/L	0.08	<0.004	12	<0.004	<0.004	<0.004	<0.004
Fluoride	APHA 4500-FC	mg/L	1.5	<0.1	25	0.6	1.0	0.8	0.9
Hardness Total	APHA 2340 B	mg/L	-	<0.1	24	29.0	57.0	39.0	56.9
Iodide	VIC-CM078	mg/L	0.5	<0.01	12	<0.01	<0.01	0.01	0.01
Magnesium Dissolved	USEPA 200.7	mg/L	-	<0.05	25	0.68	3.93	1.36	3.28
Nitrate	APHA 21st Ed. 2005, Part 4110 B	mg/L	50	<0.1	12	<0.1	<0.1	<0.1	<0.1
Potassium Dissolved	USEPA 200.7	mg/L	-	<0.1	12	0.4	1.6	0.6	1.6
Sodium Dissolved	USEPA 200.7	mg/L	-	<0.1	12	2.7	8.4	3.8	7.7
Sulphate	APHA 21st Ed. 2005, Part 4110 B	mg/L	500	<0.4	12	0.7	25.0	5.1	25.0

Table 9-5 Summary data for water quality zone 4: Tuggeranong (cont.)

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
Total Metals									
Aluminium Total	USEPA 200.8	µg/L	-	<9	25	<9	50	34	48
Antimony Total	USEPA 200.8	µg/L	3	<3	25	<3	<3	<3	<3
Arsenic Total	USEPA 200.8	µg/L	10	<1	25	<1	<1	<1	<1
Barium Total	USEPA 200.8	µg/L	2000	<2	25	2.6	7	4	6
Beryllium Total	USEPA 200.8	µg/L	60	<0.1	25	<0.1	0.2	<0.1	0.1
Boron Total	USEPA 200.7	mg/L	4	<0.01	12	<0.01	<0.01	<0.01	<0.01
Cadmium Total	USEPA 200.8	µg/L	2	<0.05	25	<0.05	<0.05	<0.05	<0.05
Chromium Total	USEPA 200.8	µg/L	-	<2	25	<2	3	<2	<2
Cobalt Total	USEPA 200.8	µg/L	-	<0.2	25	<0.2	<0.2	<0.2	<0.2
Copper Total	USEPA 200.8	µg/L	2000	<1	97	<1	113	17	57
Iron Total	USEPA 200.7	mg/L	-	<0.01	58	<0.01	0.01	<0.01	0.01
Lead Total	USEPA 200.8	µg/L	10	<0.2	58	<0.2	2.7	0.2	0.3
Manganese Total	USEPA 200.7	mg/L	0.5	<0.001	96	<0.001	0.024	<0.001	0.015
Manganese Total	USEPA 200.8	µg/L	500	<0.5	18	<0.5	7.2	2.6	6.4
Mercury Total	USEPA 200.8	µg/L	1	<0.1	12	<0.1	<0.1	<0.1	<0.1
Molybdenum Total	USEPA 200.8	µg/L	50	<1	25	<1	<1	<1	<1
Nickel Total	USEPA 200.8	µg/L	20	<1	25	<1	1	<1	1
Selenium Total	USEPA 200.8	µg/L	10	<1	25	<1	1	<1	1
Silver Total	USEPA 200.8	µg/L	100	<1	25	<1	<1	<1	<1
Zinc Total	USEPA 200.8	µg/L	-	<5	25	<5	36	<5	5
Haloacetic Acids									
Bromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<5	49	<5	<5	<5	<5
Bromochloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	49	<1	5	1	4
Bromodichloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	49	<1	6	2	5
Dibromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	49	<1	2	<1	<1
Dibromochloroacetic Acid	ALS: HS/GC/FID	µg/L	-	<10	49	<10	<10	<10	<10
Dichloroacetic Acid	ALS: HS/GC/FID	µg/L	100	<1	49	4	45	16	34
Monochloroacetic Acid	ALS: HS/GC/FID	µg/L	150	<1	49	<1	4	<1	2
Tribromoacetic Acid	ALS: HS/GC/FID	µg/L	-	<10	49	<10	<10	<10	<10
Trichloroacetic Acid	ALS: HS/GC/FID	µg/L	100	<1	49	10	54	26	45
Sum of Haloacetic Acid	ALS: HS/GC/FID	µg/L	-	<1	14	27	50	37	45
Trihalomethanes									
Bromoform	VIC-CM047	mg/L	-	<0.001	49	<0.001	<0.001	0.001	0.001
Chloroform	VIC-CM047	mg/L	-	<0.001	49	0.012	0.071	0.037	0.064
Dibromochloromethane	VIC-CM047	mg/L	-	<0.001	49	<0.001	<0.001	0.001	0.001
Dichlorobromomethane	VIC-CM047	mg/L	-	<0.001	49	0.002	0.010	0.004	0.009
Trihalomethanes Total	VIC-CM047	mg/L	0.25	<0.001	49	0.014	0.078	0.041	0.073

Table 9-5 Summary data for water quality zone 4: Tuggeranong (cont.)

Analyte	Method ID	Units	ADWG (Health)	Limit of Reporting	Number of Samples	Minimum	Maximum	Mean	95th Percentile
Semi Voltaile Organic Compounds (SVOC)									
Anilines and Benzidines	US EPA 3510/8270	µg/L	All results < LOR						
Chlorinated Hydrocarbons	US EPA 3510/8270	µg/L							
Haloethers	US EPA 3510/8270	µg/L							
Nitroaromatics and Ketones	US EPA 3510/8270	µg/L							
Nitrosamines	US EPA 3510/8270	µg/L							
Organochlorine Pesticides	US EPA 3510/8270	µg/L							
Organophosphorous Pesticides	US EPA 3510/8270	µg/L							
Phenolic Compounds	US EPA 3510/8270	µg/L							
Phthalates	US EPA 3510/8270	µg/L							
Polycyclic Aromatic Hydrocarbons	US EPA 3510/8270	µg/L							

ADWG	Australian Drinking Water Guidelines – Health Guideline Value
CFU/mL	colony forming units per millilitre
Deg C	degrees Celsius
LOR	limit of reporting
µg/L	micrograms per litre
mg/L	milligrams per litre
µS/cm	micro siemens per centimetre
MPN	most probable number
NTU	nephelometric units
Pt-Co	platinum-cobalt units

The 95th percentile is a statistical calculation based on 'normal' distribution. In the context of this report, it estimates the value for which 95% of all the water that passes through the distribution system in this 12 month period falls below.

10 References

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Corin Dam, 2016

11 Abbreviations

ACT	Australian Capital Territory
ACT Health	Health Directorate
ADWG	Australian Drinking Water Guidelines (2011)
ALS	ALS Global
AS/NZS	Australian Standards/New Zealand Standards
BOIP	biodiversity offsets implementation program
CCP	critical control point
CFU	colony forming units
cm^2	centimeters squared
DAFF	dissolved air flotation and filtration
DALY	disability-adjusted life year
ECD	Enlarged Cotter Dam
EIS	Environmental Impact Statement
GL	gigalitre
HACCP	Hazard Analysis and Critical Control Point
ICRC	Independent Competition and Regulatory Commission
IMS	Integrated Management System
ISO	International Standards Organisation
km	kilometre
L	litre
LCC	Lower Cotter Catchment
LOR	limit of reporting
mg	milligram
mJ	megajoule
ML	megalitre
mL	millilitre
mm	millimetre
mm^3	millimetres cubed

MoU	menorandum of understanding
MPN	most probable number
µg	micrograms
µS	micro Siemens
NATA	National Association of Testing Authorities
ND	not detected
NHMRC/NRMMC	National Health and Medical Research Council/ Natural Resource Management Ministerial Council
NSW	New South Wales
NTU	nephelometric turbidity units
PAC	powdered activated carbon
PCS	Parks and Conservation Services
Pt-Co	platinum-cobalt units
%	percent
QPRC	Queanbeyan - Palerang Regional Council
SVOC	semi volatile organic compound
SWAMP	Source Water Assessment Monitoring Prioritisation
The Code	Public Health (Drinking Water) Code of Practice (2007)
THM	trihalomethanes
UV	ultraviolet light
WSAA	Water Services Association of Australia
WTP	Water Treatment Plant

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