2021/2022
annual report

water quality

GWMWater

2021/2022 Annual Report for Water Quality

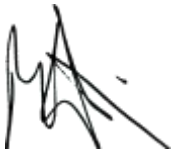
To provide safe, high quality drinking water to customers GWMWater has developed a water quality management system that follows the principles in the Australian Drinking Water Guidelines. This involves management of water quality by understanding, controlling and preventing of risks from catchment to customer tap; proactive maintenance programs; operation and process control managed by appropriately trained staff; verification of water quality by a sampling and testing; and water quality improvement programs.

GWMWater's aims to support the community to thrive through water quality improvement capital works programs throughout the region.

A pilot 'clean water' project for the Wemen pump station supplied area will involve a Dissolved Air Flotation Plant to deliver water to rural customers. In doing so it will improve the operational performance of the Ouyen treatment and Underbool Water Treatment Plants. This will provide a marked improvement in the consistency of water quality delivered to rural customers. This project also aims to lessen the risk climate change poses to the water quality received by GWMWater customers. As a consequence of climate change it is anticipated there will be an increase in the duration and frequency of blue green algae blooms and floods that can give rise to black water events.

Four towns currently receiving a regulated water supply will be upgraded to drinking water from commitments made in the 2018-2023 Water Price Submission are at various stages of delivery and will be completed over the next two years: Elmhurst (end of 2023), Kaniva (in 2024), Moyston (in 2024) and Ultima (beginning of 2023). Conversion of Ultima from Swan Hill drinking water supply is ostensibly complete and will be converted in the first half of the 2023 calendar year. Elmhurst will have a new treatment plant built with construction presently underway. Kaniva will be supplied from an upgraded Dimboola treatment plant via an extension of the pipeline that supplies Nhill. Moyston will be supplied from Ararat via a pipeline to be constructed to Moyston. Commitments have also been made to upgrade the water supply of Berriwillock and Culgoa to drinking water by extending the drinking water pipeline network and this will be delivered early in the 2023-2028 regulatory period.

GWMWater endeavours to continue to improve water security and water quality throughout the region in the upcoming year to promote the productivity and liveability of the communities we serve.



Mark Williams
Managing Director

Section 23 of the Safe Drinking Water Act 2003 requires Grampians Wimmera Mallee Water Corporation (GWMWater) to make available for inspection by the public the results of any water quality monitoring program conducted on any drinking water supplied by GWMWater. Customers and members of the public may access drinking water quality data by contacting GWMWater either by telephone on 1300 659 961 or by the internet at www.gwmwater.org.au.

Revision	Revision Date	Details	Authorised
1	08/08/2022	Draft for internal review	Matthew Kube
2	03/10/2022	Water Regulation review	Mark Ferguson
3	06/10/2022	Executive Manager Infrastructure review	Nalaka Vitharana
4	10/10/2022	Department of Health review	Kamal Khatri
5	20/10/2022	Review by Senior Leadership Team	Senior Leadership Team
6	24/10/2022	Managing Director review and sign off	Mark Williams
7		Final copy to Department of Health	

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1 Introduction

Grampians Wimmera Mallee Water Corporation (trading as GWMWater) is a government-owned corporation, created by an order of the Victorian Government under the *Water Act 1989*. On 1 July 2004, GWMWater assumed the responsibilities of the predecessor organisations Grampians Water and Wimmera Mallee Water. The vision and mission of GWMWater are:

Vision
'Healthy environment, thriving community.'

Mission
'Through partnerships with our stakeholders, we will provide affordable services using our precious resources to ensure a productive and liveable region.'

GWMWater provides water services to a population of around 72,000 customers in a region covers an area of 62,000 km^2, with a population density of only a little over one person/km^2. This includes people living in 71 urban areas throughout the region and domestic and stock water supplies to rural customers.

1.1 Safe Drinking Water Act 2003

1.1.1 Background

The *Safe Drinking Water Act 2003* (the Act) and the Safe Drinking Water Regulations 2015 (the Regulations) is the legislative framework for assuring drinking water quality in Victoria.

The Act is based on:
a) Adoption of 'catchment-to-tap' risk management obligations.
b) Standards are applicable to all drinking water samples for key water quality criteria.
c) Information disclosure obligations for water suppliers.
d) Adoption of systemic community consultation processes.

This approach is consistent with regulatory best practice for the management of complex and inter-dependent risks.

1.1.2 Purpose and Outline

The Act:
a) Requires water suppliers and water storage managers to prepare and implement Risk Management Plans (RMP) to manage risk in relation to drinking water and some types of non-potable water.
b) Provides for the auditing of those plans by approved auditors.
c) Requires water suppliers to ensure that the drinking water they supply meets quality standards specified by the regulations.
d) Requires water suppliers to disclose to the public information concerning the quality of drinking water.

e) Provides for the variation, after community consultation, of water quality standards that relate only to aesthetic factors.
f) Requires the reporting of known or suspected contamination of drinking water to the Department of Health (DH).

1.1.3 Definitions

The Act provides the following definitions for water quality classification:

Drinking Water
Water that is intended for human consumption or for purposes connected with human consumption, such as the preparation of food or the making of ice for consumption or for the preservation of unpackaged food, whether or not the water is used for other purposes.

Regulated Water
Regulated water is defined as water that is not drinking water but may in circumstances be mistaken as being drinking water according to Section 6 (2) in the Act.

1.1.4 Safe Drinking Water Regulations 2015

This annual report includes the specific requirements from the Regulations.

The objective of the Regulations is to give effect to key aspects of the Act. In particular, the Regulations:
a) Specifies the major elements to be incorporated in risk management plans.
b) Specifies the standards relating to the quality of drinking water supplied to customers by water suppliers.
c) Specifies criteria for approval of auditors.
d) Specifies details to be included in annual reports.

1.1.5 *Health Fluoridation Act 1973*

The *Health Fluoridation Act 1973* governs the addition of fluoride to drinking water. Fluoridation of drinking water supplies requires a preventive risk management approach. For this purpose, the Code of practice for fluoridation of drinking water supplies, second edition (2018) supports utilities in the adoption and safe operation of fluoride addition to drinking water supplies.

1.2 Australian Drinking Water Guidelines 2011

The Australian Drinking Water Guidelines 2011 (ADWG) provide a framework for the management of drinking water supplies and is designed to assure safety at point of use. The ADWG has been developed after consideration of the best available scientific evidence.

The ADWG provides an authoritative reference of what comprises safe, good quality water, how it can be achieved and how it can be assured. The ADWG is concerned with both health and aesthetic quality.

The ADWG is the authoritative reference of what constitutes safe, good quality water, and aligns with the Victorian's Safe Drinking Water Regulatory Framework. The ADWG and Safe Drinking Water Regulations are consistent with the Act, and provide a basis for determining the quality of water to be supplied to consumers in all parts of Australia. These need to consider the diverse array of regional or local factors, and consider economic, political and cultural issues, including customer expectations and willingness and the ability to pay.

The ADWG are intended for use by the Australian community and all agencies with responsibilities associated with the supply of drinking water, including catchment and water resource managers, drinking water suppliers, water regulators and health authorities.

1.3 GWMWater Drinking Water Quality Policy

GWMWater is committed to managing its water supply to provide safe drinking water that meets the ADWG, other regulatory and consumer expectations. For this purpose, GWMWater has a drinking water quality policy (Figure 1-1) that provides the framework for managing the risks involved in harvesting, treating and distributing drinking water.

drinking water quality policy

GWMWater

GWMWater is committed to managing its water supply effectively to provide a safe high quality drinking water that consistently meets the Australian Drinking Water Guidelines and consumer and other regulatory requirements.

To achieve this, in partnership with stakeholders and relevant agencies, GWMWater will:

- **Manage water quality** at all points along the delivery chain from catchment to the customers' tap.
- Use a **risk based approach** in which potential threats to water quality are identified and balanced.
- Integrate the **needs and expectations** of our customers, stakeholders, regulators and employees into our planning.
- Establish **regular monitoring** of the quality of drinking water and effective reporting mechanisms to provide relevant and timely information and promote confidence in the water supply and its management.
- Develop appropriate **contingency planning** and incident response capability.
- Participate in appropriate **research and development** activities to ensure continued understanding of drinking water quality issues and performance.
- Contribute to the debate on setting industry **regulations and guidelines**, and other standards relevant to public health and the water cycle.
- **Continually improve** our performance against corporate commitments and stakeholder expectations.

The organisation will implement and maintain a water quality management system consistent with the Australian Drinking Water Guidelines to effectively manage the risks to drinking water quality.

All GWMWater employees involved in the supply of drinking water are responsible for understanding, maintaining and continuously improving the water quality management system.

Mark Williams
Managing Director

Peter Vogel
Chairman

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Figure 1-1 - Statement for GWMWater's Drinking Water Quality Policy.

1.4 Characterisation of the System

GWMWater's operational area is shown in Figure 1-2. Key components of the water supply system include:

1. Headworks system, comprising the area in and around the Grampians Ranges and the Wimmera River. The main storages are Lake Bellfield, Taylors Lake, Lake Wartook and Rocklands Reservoir. The total catchment area is 400,000 hectares with a maximum reservoir operating capacity of 522,000 megalitres.
2. GWMWater provides water to the majority of towns through two extensive pipeline systems.
    a. The Wimmera Mallee Pipeline (WMP) system, as follows:
        i. Supply Systems 1,2,3,4,6 and the South West Loddon Pipeline, all originate from the Grampians headworks and consist of 9,270 kilometres of pipeline; and
        ii. Supply System 5, draws water from the Murray River and consists of approximately 860 kilometres of pipeline.
    b. The Northern Mallee Pipeline (NMP) system consisting of 3,390 kilometres of pipeline which draws water from the Murray River.
3. A total of 1,620 kilometres of pipeline classified as urban, servicing the 71 urban water supplies.
4. Thirty-two towns receive water that is classified as drinking water (Table 1-1).
5. The fully treated water is supplied by 15 water treatment plants owned and operated by GWMWater, and a further 4 water treatment plants operated under a Build, Own, Operate and Transfer (BOOT) agreement. These BOOT plants are located at Halls Gap, Ararat, Great Western and Stawell, and as of 23 June 2014 have been operated by Trility, an independent private sector owner and operator.
6. GWMWater also supplies regulated water to 39 towns (Table 1-2).
   These supplies are harvested from a range of sources, including surface water and groundwater. Regulated supplies have low-level or no treatment, and is not intended for human consumption, drinking or food preparation.

1.5 Source of Water

GWMWater sources water from a range of surface water catchments, rivers and groundwater aquifers across the region. The catchments located within National Parks and State Forest are co-managed with Parks Victoria and the Department of Environment, Land, Water and Planning (DELWP). GWMWater also works in partnership with Catchment Management Authorities, Local Government, Goulburn Murray Water, Coliban Water, and Wannon Water to address issues affecting water quality in the catchments from where water is sourced.

The Safe Drinking Water Regulations 2015 require water suppliers to detail the methodology used to quantify microbial hazards in source waters. GWMWater conducted

sanitary surveys and vulnerability assessments of raw water source based on the drinking water source assessment and treatment requirements: manual for the application of Health-Based Treatment Targets, developed by Water Services Association of Australia (WSAA). The last major review for the Sanitary Survey was conducted in 2019, with minor amendments when new information becomes available or changes occur made since then. GWMWater has a Hazard Analysis and Critical Control Points (HACCP) Plan for operation of the water treatment plants and supply system it operates to ensure the delivery of safe drinking water. Sanitary surveys, vulnerability assessment and HACCP are continuously reviewed, audited and improved.

Table 1-1 and Table 1-2 provide a summary of the source waters by water supply for both drinking water and regulated water.

Figure 1-2 - GWMWater's Operational Area.

Table 1-1 - Water Source for Drinking Water Supplies (32 Localities).

Locality	Source Water	Water Storages	Treatment Plant	Population
Ararat	Surface water (Lake Fyans, Mt Cole & Langi Ghiran Reservoirs)	Copes Hill and Olivers Gully earthen storages (raw) 1 x lined steel tank (treated) 1 x concrete elevated tank (treated)	Ararat WTP	8500
Beulah	Grampians Headworks (WMP)	2 x lined steel tanks (treated)	Warracknabeal WTP	310
Birchip	Grampians Headworks (WMP)	1 x lined earthen storages (raw) 2 x lined steel tanks (treated)	Birchip WTP	690
Brim	Grampians Headworks (WMP)	2 x lined steel tanks (treated) 1 x fibreglass elevated tank (treated)	Warracknabeal WTP	180
Charlton	Grampians Headworks (WMP)	1 x lined earthen storages (raw) 2 x lined steel tanks (treated) 1 x lined steel elevated tank (treated)	Charlton WTP	1100
Dimboola	Grampians Headworks (WMP)	2 x lined earthen storages (raw) 2 x lined steel tanks (treated)	Dimboola WTP	1640
Donald	Grampians Headworks (WMP)	2 x lined steel tanks (treated) 1 x lined steel elevated tank (treated)	St Arnaud WTP	1470
Edenhope	Groundwater (bores)	Fed directly from bores (raw) 1 x concrete tank (treated) 1 x elevated tank (treated)	Edenhope WTP	940
Great Western	Surface water (Lake Fyans)	1 x earthen storage (raw) 1 x lined steel tanks (treated)	Great Western WTP	430
Halls Gap	Surface water (Lake Bellfield, Dairy Creek)	Lake Bellfield and Dairy Creek earthen storages (raw) 1 x concrete tank (treated)	Halls Gap WTP	500
Hopetoun	Grampians Headworks (WMP)	1 x lined earthen storages (raw) 1 x lined steel tank (treated)	Hopetoun WTP	690
Horsham	Surface (Lake Wartook) and back up bore water and (Laharum bores)	1 x earthen storage (raw) 1 x concrete tank (treated) 1 x concrete storage (treated) 1 x concrete elevated tank (treated)	Mt Zero WTP	15130
Jeparit	Grampians Headworks (WMP)	2 x lined steel tanks (treated)	Rainbow WTP	480
Lake Bolac	Surface water (Mt William Creek, Stony Creek, Masons Creek) & Groundwater (bores)	1 x lined steel tank (raw) 1 x lined steel tanks (treated) 2 x lined steel tanks (treated)	Willaura WTP	370
Manangatang	Surface water (Murray River via NMP)	1 x lined steel tank (raw) 1 x lined steel tank (treated) 1 x lined steel elevated tank (treated)	Manangatang WTP	270
Minyip	Grampians Headworks (WMP)	2 x lined steel tanks (treated)	Murtoa WTP	530
Murtoa	Grampians Headworks (WMP)	2 x lined earthen storages (raw) 1 x lined steel tank (treated) 1 x lined steel elevated tank (treated)	Murtoa WTP	900
Natimuk	Surface (Lake Wartook) and back up bore water and (Laharum bores)	1 x lined steel tank (treated)	Mt Zero WTP	550
Nhill	Grampians Headworks (WMP)	3 x lined steel tanks (treated) 1x elevated tank (treated)	Dimboola WTP	2400

Locality	Source Water	Water Storages	Treatment Plant	Population
Ouyen	Surface water (Murray River via NMP)	2 x earthen storages (raw) 1 x lined steel tank (treated) 2 x lined steel elevated tank (treated)	Ouyen WTP	1170
Pomonal	Surface water (Lake Bellfield)	1 x concrete tank (treated)	Halls Gap WTP	360
Quambatook	Surface water (Goulburn & Loddon Rivers) via Normanville Pipeline	1 x earthen storage (raw) 1 x steel elevated tank (treated)	Quambatook WTP	230
Rainbow	Grampians Headworks (WMP)	2 x lined earthen storages (raw) 1 x lined steel tank (treated)	Rainbow WTP	670
Rupanyup	Grampians Headworks (WMP)	2 x lined steel tanks (treated)	Murtoa WTP	550
Sea Lake	Grampians Headworks (WMP)	2 x lined steel tanks (treated)	Warracknabeal WTP	620
St Arnaud	Grampians Headworks (WMP)	Volcano lined & St Arnaud earthen storage (raw) 3 x concrete tanks (treated)	St. Arnaud WTP	2320
Stawell	Surface water (Lake Fyans, Lake Bellfield, Fyans Creek)	3 x earthen storages (raw) 1 x lined steel tank (treated) 2 x elevated tanks (treated)	Stawell WTP	6220
Underbool	Surface water (Murray River via NMP)	2 x earthen storages (raw) 1 x lined steel tank (treated) 1 x elevated tank (treated)	Underbool WTP	220
Warracknabeal	Grampians Headworks (WMP)	2 x lined earthen storages (raw) 2 x lined steel tank (treated) 1 x steel elevated tank (treated)	Warracknabeal WTP	2360
Willaura	Surface water (Mt William Creek, Stony Creek, Masons Creek) and Groundwater (bores)	2 x earthen storages at Willaura and Mt Pleasant (raw) 1 x lined steel tank (treated) 1 x lined steel tank (treated)	Willaura WTP	440
Woomelang	Grampians Headworks (WMP)	2 x lined steel tanks (treated) 1 x steel elevated tank (treated)	Warracknabeal WTP	190
Wycheproof	Grampians Headworks (WMP)	2 x lined steel tanks (treated) 1 x concrete elevated tank (treated)	Charlton WTP	610

WMP – Wimmera Mallee Pipeline **NMP – Northern Mallee Pipeline**

Table 1-2 - Water Source for Regulated Water Supplies (39 Localities).

Water Supply	Source Water	Water Storages	Population
Antwerp	Grampians Headworks (WMP)	2 x poly lined steel tanks	50
Apsley	Groundwater (bores)	1 x elevated steel tank	330
Berriwillock	Surface water (Murray River via NMP)	2 x earthen storages	180
Buangor	Surface water (McLeods Creek)	1 x earthen storage	110
Chillingollah	Surface water (Murray River via NMP)	1 x concrete tank	<10
Chinkapook	Surface water (Murray River via NMP)	1 x concrete tank	20
Cowangie	Groundwater (bores)	1 x elevated tank	30
Culgoa	Surface water (Murray River via NMP)	1 x earthen storage	90
Dooen	Grampians Headworks (WMP)	2 x poly tanks	250
Elmhurst	Surface water (Hickmans Creek)	1 x earthen storage	190
Glenorchy	Grampians Headworks (WMP)	1 x steel tank 1 x elevated steel tanks	130
Goroke	Groundwater (bores)	1 x elevated steel tanks	300
Harrow	Groundwater (bores) & surface water (Glenelg River)	2 x poly lined steel tanks	180
Jung	Grampians Headworks (WMP)	2 x poly lined steel tanks 1 x elevated steel tank	280
Kaniva	Groundwater (bores)	1x elevated concrete tank	890
Kiata	Groundwater (bores)	2 x poly tanks 1 x elevated steel tank	60
Lalbert	Surface water (Murray River via NMP)	2 x poly lined steel tanks 1 x elevated steel tank	140
Lascelles	Grampians Headworks (WMP)	2 x lined steel tanks	80
Lillimur	Groundwater (bores)	1x elevated steel tank	110
Marnoo	Grampians Headworks (WMP)	1 x steel tank	100
Miram	Groundwater (bores)	1 x elevated steel tank	40
Moyston	Surface water (Mt William, Stony and Masons Creeks) and Groundwater (bores)	1 x earthen storage	400
Murrayville	Groundwater (bores)	1 x elevated tank	280
Nandaly	Surface water (Murray River via NMP)	1 x concrete tank	30
Nullawil	Surface water (Murray River via NMP)	2 x lined steel tanks	90
Patchewollock	Surface water (Murray River via NMP)	1 x concrete elevated tank	150
Pimpinio	Grampians Headworks (WMP)	2 x lined earthen storages 1 x elevated tank storage	190
Serviceton	Groundwater (bores)	1 x elevated steel tank	130
Speed	Surface water (Murray River via NMP)	1 x concrete tank	50
Streatham	Groundwater (bores)	1 x earthen storage	160
Tarranyurk	Grampians Headworks (WMP)	2 x lined steel tanks	40
Tempy	Surface water (Murray River via NMP)	1 x steel tank 1 x concrete tank	60
Ultima	Surface water (Murray River via NMP)	2 x poly lined steel tanks	170
Waitchie	Surface water (Murray River via NMP)	1 x concrete tank	40
Walpeup	Surface water (Murray River via NMP)	2 x earthen storages	170
Watchem	Grampians Headworks (WMP)	2 x poly lined steel tanks	120
Westmere	Groundwater (bores)	1 x earthen storage	60
Wickliffe	Surface water (Mt William, Stony and Masons Creeks) and Groundwater (bores)	1 x earthen storage	120
Yaapeet	Grampians Headworks (WMP)	2 x poly lined steel tanks	80

WMP – Wimmera Mallee Pipeline **NMP – Northern Mallee Pipeline**

2 Quality Management System

2.1 Water Treatment

The water treatment processes utilised at the drinking water treatment plants are shown in Table 2-1.

Table 2-1 - Water Treatment Processes and Chemicals in Drinking Water Towns (32 Localities).

Water Sampling Localities	Treatment Processes	Chemicals that can be added
Ararat*^	Coagulation, flocculation, dissolved air flotation, filtration, disinfection, pH correction, fluoridation	Lime, potassium permanganate, powder activated carbon, aluminium sulphate (alum), polymer, chlorine, hydrofluorosilicic acid
Beulah	Receives water from Warracknabeal WTP, booster disinfection	Chlorine
Birchip*	Coagulation, flocculation, dissolved air flotation, filtration, disinfection, pH correction	Aluminium chlorohydrate (Megapac 23), sodium hydroxide, chlorine
Brim	Receives water from Warracknabeal WTP, booster disinfection	Chlorine
Charlton*	Coagulation, flocculation, dissolved air flotation, filtration, disinfection, pH correction	Aluminium chlorohydrate (Megapac 23), chlorine
Dimboola*	Coagulation, flocculation, dissolved air flotation, filtration disinfection, pH correction	Sodium hydroxide, aluminium chlorohydrate (Megapac 23), chlorine
Donald	Receives water from St Arnaud WTP, booster disinfection	Chlorine
Edenhope*	Coagulation, flocculation, dissolved air flotation, filtration, desalination, disinfection	Aluminium chlorohydrate (Megapac 23), chlorine
Great Western*^	Microfiltration, disinfection, pH correction	Sulphuric acid, polyaluminium chloride (PACl), sodium hydroxide, chlorine
Halls Gap*^	Coagulation, flocculation, dissolved air flotation, filtration, disinfection, pH correction	Lime, aluminium sulphate (alum), polymer, chlorine
Hopetoun*	Coagulation, flocculation, dissolved air flotation, filtration, disinfection, pH correction	Aluminium chlorohydrate (Megapac 23), chlorine
Horsham*	Powdered activated carbon dosing, coagulation, flocculation, dissolved air flotation, filtration, disinfection, pH correction, fluoridation	Lime, aluminium chlorohydrate (Megapac 23), chlorine, carbon dioxide, hydrofluorosilicic acid
Jeparit	Receives water from Rainbow WTP, booster disinfection	Chlorine
Lake Bolac	Receives water from Willaura WTP	None additional
Manangatang*	Coagulation, flocculation, multimedia filtration, microfiber filtration (2 µm), disinfection	Ultrion 44560 coagulant, chlorine

Water Sampling Localities	Treatment Processes	Chemicals that can be added
Minyip	Receives water from Murtoa WTP, booster disinfection	Chlorine
Murtoa*	Coagulation, flocculation, dissolved air flotation, filtration, pH correction, disinfection	Sodium hydroxide, Aluminium chlorohydrate (Megapac 23), chlorine
Natimuk	Receives water from Horsham WTP, booster disinfection	Chlorine
Nhill	Receives water from Dimboola WTP, booster disinfection	Chlorine
Ouyen*	Microfiltration, disinfection	Aluminium chlorohydrate (Megapac 23), chlorine
Pomonal	Receives water from Halls Gap WTP, booster disinfection	Chlorine
Quambatook*	Coagulation, flocculation, dissolved air flotation, filtration, granular activated carbon filtration, pH correction, disinfection	Aluminium chlorohydrate (Megapac 23), hydrochloric acid, chlorine
Rainbow*	Coagulation, flocculation, dissolved air flotation, filtration, disinfection	Aluminium chlorohydrate (Megapac 23), chlorine
Rupanyup	Receives water from Murtoa WTP, booster disinfection	Chlorine
Sea Lake	Receives water from Warracknabeal WTP, booster disinfection	Chlorine
St Arnaud*	Coagulation, flocculation, dissolved air flotation, filtration, pH correction, disinfection	Aluminium chlorohydrate (Megapac 23), sodium hydroxide, chlorine
Stawell*^	Coagulation, flocculation, dissolved air flotation, filtration, disinfection, pH correction	Lime, aluminium sulphate (alum), polymer, chlorine
Underbool*	Coagulation, flocculation, sand filters, pH correction	Ultrion 44560 coagulant, chlorine
Warracknabeal*	Coagulation, flocculation, dissolved air flotation, filtration, pH correction, disinfection	Lime, aluminium chlorohydrate (Megapac 23), chlorine
Willaura*	Coagulation, flocculation, dissolved air flotation, microfiltration, pH correction, disinfection	Soda ash, calcite, aluminium chlorohydrate (Megapac 23), sodium hypochlorite, carbon dioxide, ammonia
Woomelang	Receives water from Warracknabeal WTP, booster disinfection	Chlorine
Wycheproof	Receives water from Charlton WTP, booster disinfection	Chlorine

^ Operated by Trility under a BOOT Contract
** Localities with a Water Treatment Plant*

Table 2-2 - Water Treatment Processes and Chemicals in Regulated Towns.

Water Supply	Treatment Processes	Chemicals used in Treatment
Berriwillock	Coagulation	PolyDADMAC
Culgoa	Coagulation	PolyDADMAC
Glenorchy	Coagulation	PolyDADMAC
Jung	Coagulation, disinfection	PolyDADMAC, chlorine
Lalbert	Coagulation, disinfection	PolyDADMAC, chlorine
Marnoo	Coagulation	PolyDADMAC
Murrayville	Disinfection	Chlorine
Nullawil	Coagulation	PolyDADMAC
Ultima	Coagulation	PolyDADMAC
Walpeup	Disinfection	Chlorine
Watchem	Coagulation, disinfection	PolyDADMAC, sodium hypochlorite, hydrochloric acid

2.2 Water Treatment Changes

There have been no major changes to water treatment systems.

2.3 Water Treatment Issues

Issues related to water quality that occurred in 2021/2022 include:

- *E. coli* detected in Donald in January 2022.
- Blue-green algae in the Murray River and receiving water storages in February 2022.

These issues are discussed further in the section Emergency, Incident and Event Management.

3 Drinking Water Quality Results

For the 2021/2022 year, the sampling frequency and drinking water quality standards for *Escherichia coli*¸ trihalomethanes and turbidity were as specified in Schedule 2 under the Regulations (Table 3-2). The water quality standards are discussed below.

The water sampling program is based on ADWG recommendations, specific risks, historical data and operational changes, from catchment to tap. The water sampling points are located within a water sampling locality and are designed to ensure that the samples collected are representative of the supply system. Samples are sent to a National Association of Testing Authorities (NATA) accredited laboratory for analysis.

The sampling program is reviewed periodically and as risk changes to align with changes in the risk profile of each locality. The review of the sampling program involves risk assessing each parameter based on the frequency that it is expected to exceed limits at that location and the consequence of the parameter exceeding that limit. This is conducted over all regulated and drinking water systems from catchment to tap, and a conclusion made on the frequency of sampling required to appropriately manage identified risks. The current sampling program was implemented in July 2021.

Regulation 6 of the Regulations states that a water sampling locality is:

- An area supplied with drinking water.
- A discrete area of similar water quality – generally water entering the area is supplied from a common source.
- Inclusive of all consumers supplied with drinking water of similar water quality.
- Able to be described by its boundaries.

Table 3-1 – Changes in water quality sampling frequency (2020/2021 compared with 2021/2022).

Parameter(s)	Town(s)	Change	Reason
Electrical Conductivity	All towns	From Weekly to Monthly	Aesthetic implications only, electrical conductivity water quality well understood in all localities.
Chloroacetic Acids	Manangatang, Quambatook	From Monthly to None	Historic trends indicated risk of exceedance has reduced.
	Ouyen	From Monthly to Quarterly	Historic trends indicated risk of exceedance had reduced.
Metal Suite	Stawell	From selected metals (arsenic, copper, zinc) to annual full metals suite (See Table 3-17)	A low risk from local mine.
Arsenic	Murtoa, Nhill	From Biannual to Quarterly	Historic metals deposits in reticulation before upgraded to drinking water.
	Edenhope	From Biannual to Monthly	Bore raw water supply.
	All other towns	From Biannual to None	Historic trends and risk profile indicated negligible risk of exceedance.

Parameter(s)	Town(s)	Change	Reason
Iron	Murtoa, Nhill	From None to Quarterly	Historic metals deposits in reticulation before upgraded to drinking water.
	Quambatook	From Monthly to None	Historic trends and risk profile indicated negligible risk of exceedance.
Lead	All towns	From Biannual to Quarterly	Health implications and low risk from leaching from fittings
Hardness and Alkalinity	All towns	Variable frequencies to all towns aligned to be Annual	Low risk parameter, stable in all localities.
True Colour	Lake Bolac, Quambatook, Willaura	From Monthly to None	Installation of DAF at Willaura (which supplies Lake Bolac) and historic trends at Quambatook show negligible risk of exceeding ADWG limits.
Nitrate, Nitrite	Lake Bolac	From Weekly to Monthly	Historic trends showed risk of nitrification in Lake Bolac had reduced.
Ammonia	Lake Bolac, Willaura	From None to Monthly	Align with best practise monitoring for minimising nitrification risk of chloramination systems.

Table 3-2 – Summary of sampling and 2021/2022 results to meet Schedule 2 under the Regulations.

Parameter	Sampling frequency	Benchmark compliance standard	All Standards met	Comments
Escherichia coli (*E. coli*)	Weekly	No *Escherichia coli* per 100 mL of drinking water, with the exception of any false positive samples.	No	The locality of Donald was not compliant with a section 18s notification made for *E. coli* detection. Refer to Section 3.1 for details.
Trihalomethanes (THM)	Monthly	Must not exceed 0.25 mg/L.	Yes	All localities were compliant for the period. Refer to Section 3.2 for details.
Turbidity	Weekly	95th percentile of results for samples in any 12 months must be ≤ 5.0 NTU.	Yes	All localities were compliant for the period. Refer to Section 3.3 for details.

3.1 Escherichia coli (*E. coli*)

The health impacts and epidemiology of thermotolerant coliforms, and specifically *E. coli*, are described in detail in the ADWG fact sheet.

E. coli is used as a specific indicator of faecal contamination and hence is a measure used to determine the drinking water safety. *E. coli* should not be detected in a sample of drinking water. If detected, immediate action is taken.

As required by the Regulations, one sample of drinking water is collected each week per water sampling locality and two samples per week are collected for towns greater than 5000 people. All samples of drinking water collected in any 12 months period must contain no *E.*

coli per 100 mL, with the exception of any false positive sample. In the case that *E. coli* is detected, an investigation is conducted in accordance with regulation 14 to determine whether the result was representative of the drinking water in the relevant locality. A false positive is considered to have occurred where the water supplier can demonstrate treatment and control systems were in place and the detection is more likely be from an external factor such as laboratory or sampling error.

3.1.1 Results

E. coli sampling and analysis was undertaken at two sites weekly for the larger towns and weekly for all the smaller potable towns. There were no missed samples for *E. coli* in this reporting period.

A sample from Donald recorded 490 *E. coli*/100 mL on the 27 January 2022. The Department of Health (DH) was provided with a Section 22 report immediately and following investigation, based on (c)(i)(ii)(iii) or (iv) in Schedule 2 of the Regulations no conclusive evidence of an error or a real cause for the *E. coli* result was found, as such the *E. coli* reading was assumed to be real and a Section 18 notification was provided to DH. Please refer to the Emergency, Incident and Event Management section for further information.

All other samples met the standard for the reporting period of 2021/2022 (Table 3-3).

Table 3-3 – Results for Escherichia coli in Drinking Water: 1 July 2021 – 30 June 2022. All samples of drinking water collected in any 12 months period must contain no E. coli/100 mL, with the exception of any false positive samples.

Sampling Locality	Sampling Frequency	No. of Samples	(*Escherichia coli*/100 mL)	No. of samples where standard was not met (S 18)
Ararat*	Weekly (2)	104	0	0
Beulah	Weekly	52	0	0
Birchip	Weekly	52	0	0
Brim	Weekly	52	0	0
Charlton	Weekly	52	0	0
Dimboola	Weekly	52	0	0
Donald	Weekly	52	490	1
Edenhope	Weekly	52	0	0
Great Western	Weekly	52	0	0
Halls Gap	Weekly	52	0	0
Hopetoun	Weekly	52	0	0
Horsham*	Weekly (2)	104	0	0
Jeparit	Weekly	52	0	0
Lake Bolac	Weekly	52	0	0
Manangatang	Weekly	52	0	0
Minyip	Weekly	52	0	0
Murtoa	Weekly	52	0	0
Natimuk	Weekly	52	0	0

Sampling Locality	Sampling Frequency	No. of Samples	(*Escherichia coli*/100 mL)	No. of samples where standard was not met (S 18)
Nhill	Weekly	52	0	0
Ouyen	Weekly	52	0	0
Pomonal	Weekly	52	0	0
Quambatook	Weekly	52	0	0
Rainbow	Weekly	52	0	0
Rupanyup	Weekly	52	0	0
Sea Lake	Weekly	52	0	0
St. Arnaud	Weekly	52	0	0
Stawell*	Weekly (2)	104	0	0
Underbool	Weekly	52	0	0
Warracknabeal	Weekly	52	0	0
Willaura	Weekly	52	0	0
Woomelang	Weekly	52	0	0
Wycheproof	Weekly	52	0	0

** Due to the population size of these towns two samples are taken.*

3.2 Trihalomethanes (THMs)

Trihalomethanes (THMs) are present in drinking water, principally as the result of a reaction between organic and inorganic material in the water with chlorine, and to a lesser extent chloramine.

Based on health considerations, the concentration of THMs, either individually or in total, in drinking water should not exceed 0.25 mg/L.

3.2.1 Results

THM sampling and analysis was undertaken on a minimum monthly basis for all drinking water supplies. There were no missed samples for THMs and all sites met the standard for this reporting period (Table 3-4).

Table 3-4 – Results for Trihalomethanes in Drinking Water: 1 July 2021 – 30 June 2022. The concentration of THMs must not exceed 0.25 mg/L.

Sampling Locality	Sampling Frequency	No. of Samples	Max (mg/L)	Average (mg/L)	No. of samples where standard was not met (S 18)
Ararat*	Monthly (2)	24	0.084	0.058	0
Beulah	Monthly	12	0.068	0.054	0
Birchip	Monthly	12	0.062	0.040	0
Brim	Monthly	12	0.130	0.069	0
Charlton	Monthly	12	0.081	0.065	0
Dimboola	Monthly	12	0.090	0.051	0
Donald	Monthly	12	0.095	0.076	0

Sampling Locality	Sampling Frequency	No. of Samples	Max (mg/L)	Average (mg/L)	No. of samples where standard was not met (S 18)
Edenhope	Monthly	12	0.140	0.095	0
Great Western	Monthly	12	0.130	0.115	0
Halls Gap	Monthly	12	0.067	0.050	0
Hopetoun	Monthly	12	0.067	0.035	0
Horsham*	Monthly (2)	24	0.140	0.091	0
Jeparit	Monthly	12	0.072	0.052	0
Lake Bolac	Monthly	12	0.014	0.008	0
Manangatang	Monthly	12	0.130	0.060	0
Minyip	Monthly	12	0.100	0.064	0
Murtoa	Monthly	12	0.081	0.060	0
Natimuk	Monthly	12	0.160	0.127	0
Nhill	Monthly	12	0.086	0.061	0
Ouyen	Monthly	12	0.220	0.142	0
Pomonal	Monthly	12	0.074	0.061	0
Quambatook	Monthly	12	0.210	0.140	0
Rainbow	Monthly	12	0.086	0.036	0
Rupanyup	Monthly	12	0.110	0.067	0
Sea Lake	Monthly	12	0.090	0.073	0
St. Arnaud	Monthly	12	0.110	0.061	0
Stawell*	Monthly (2)	24	0.081	0.057	0
Underbool	Monthly	12	0.120	0.079	0
Warracknabeal	Monthly	12	0.088	0.065	0
Willaura	Monthly	12	0.019	0.008	0
Woomelang	Monthly	12	0.084	0.067	0
Wycheproof	Monthly	12	0.083	0.063	0

** Due to the population size of these towns two samples are taken every month.*

3.3 Turbidity

Turbidity is caused by the presence of very fine suspended matter, such as clay, silt, colloidal particles, plankton and other microscopic organisms in water. High turbidity can result in a water sample having a 'muddy' or 'milky' appearance.

Turbidity is a measurement of the light scattering property of water, and the degree of scattering is dependent on the amount, size and composition of the suspended matter.

The ADWG fact sheet contains a detailed account of turbidity and its implications for water supply. The Regulations require that the 95th percentile of results for samples in any 12-month period must not exceed five Nephelometric Turbidity Units (NTU).

3.3.1 Results

Turbidity sampling and analysis is undertaken as a minimum, on a weekly basis for all drinking water supplies. There were no missed samples for turbidity for the reporting period of 2021/2022 and all sites met the standard Schedule 2 of the Regulations (Table 3-5).

The ADWG recommends turbidity should not exceed 5 NTU for aesthetic purposes. One sample from Brim on 8 February 2022 had a turbidity of 24 NTU and one sample from Woomelang on 16 February 2022 had a turbidity of 7.1 NTU. The high turbidity at Woomelang was a one-off sampling outlier with all other results for the town below 0.7 NTU. The high turbidity at Brim was due to the sample being taken on the same day that sections of the town were being shut down for installation of a new water main, which would have stirred up sediment in the reticulation. Flushing until the turbidity was less than 3 NTU was undertaken after the works, and follow up sampling confirmed turbidity had returned to below the ADWG guideline value. No customer complaints occurred as a result of the high turbidity.

Table 3-5 – Results for turbidity in Drinking Water: 1 July 2021 – 30 June 2022. The 95th percentile of results for samples in any 12 month period must be less than or equal to 5.0 NTU.

Sampling Locality	Sampling Frequency	No. of Samples	Max (NTU)	Max 95th percentile in any 12 months (NTU)	No. of 95th percentile of results in any 12 months above standard (S 18)
Ararat*	Weekly (2)	104	0.5	0.3	0
Beulah	Weekly	52	0.2	0.2	0
Birchip	Weekly	52	0.5	0.2	0
Brim	Weekly	52	24	0.5	0
Charlton	Weekly	52	0.9	0.3	0
Dimboola	Weekly	52	0.5	0.2	0
Donald	Weekly	52	0.3	0.2	0
Edenhope	Weekly	52	0.4	0.2	0
Great Western	Weekly	52	0.4	0.2	0
Halls Gap	Weekly	52	0.3	0.5	0
Hopetoun	Weekly	52	0.5	0.4	0
Horsham*	Weekly (2)	104	3.3	0.3	0
Jeparit	Weekly	52	0.4	0.2	0
Lake Bolac	Weekly	52	0.2	0.1	0
Manangatang	Weekly	52	0.9	0.5	0
Minyip	Weekly	52	0.8	0.4	0
Murtoa	Weekly	52	2.1	0.7	0
Natimuk	Weekly	52	1.4	0.7	0
Nhill	Weekly	52	0.6	0.2	0
Ouyen	Weekly	52	0.4	0.1	0
Pomonal	Weekly	52	4.8	0.3	0
Quambatook	Weekly	52	0.3	0.2	0
Rainbow	Weekly	52	0.5	0.2	0

Sampling Locality	Sampling Frequency	No. of Samples	Max (NTU)	Max 95th percentile in any 12 months (NTU)	No. of 95th percentile of results in any 12 months above standard (S 18)
Rupanyup	Weekly	52	0.5	0.3	0
Sea Lake	Weekly	52	0.4	0.1	0
St. Arnaud	Weekly	52	1.1	0.4	0
Stawell*	Weekly (2)	104	2.1	0.2	0
Underbool	Weekly	52	0.3	0.3	0
Warracknabeal	Weekly	52	0.4	0.1	0
Willaura	Weekly	52	0.7	0.3	0
Woomelang	Weekly	52	7.1	0.8	0
Wycheproof	Weekly	52	0.9	0.3	0

** Due to the population size of these towns two samples are taken every week.*

3.4 Other chemicals, pathogens, algal toxins or substance that may pose a risk to human health

Regulation 12(b) requires the water supplier to ensure that the drinking water supplied to customers does not contain any chemical, toxin, pathogen or other substance at the levels that may pose a risk to human health. The ADWG fact sheets contain a detailed account of other water quality standards and their implications for water supply.

3.4.1 Algal toxins, pesticides and radiological parameters

The sampling of Algal toxins, pesticides and radiological parameters is risk-based. All tests of pesticides, algal toxins or radiological parameters in raw water storages and reservoirs for drinking water supplies were well within ADWG values.

3.4.2 Chlorine

Chlorine is used extensively as a disinfectant for drinking water supplies. Based on health considerations, the guideline value for total chlorine in drinking water is 5 mg/L. The fact sheets in ADWG provide a detailed account of the health impacts and other considerations relating to chlorine.

3.4.2.1 Results

In addition to chlorine sampling in the reticulation, chlorine contact times are calculated for each drinking water town to ensure the water delivered to customers has sufficient disinfection. Critical alarms are adjusted at the WTP to meet this chlorine contact time and customer aesthetic expectations. Free chlorine was measured in localities treated by chlorination, and total chlorine was measured in localities treated by chloramination systems. The ADWG gives general guidance that chlorine should be at least 0.2 mg/L at the end of the reticulation system and a maximum of 5.0 mg/L at any point. GWMWater aims to meet this guidance by providing adequate chlorine dose at the WTP and flushing when required.

Table 3-6 - Concentrations of chlorine in Drinking Water for 1 July 2021 – 30 June 2022.

Sampling Locality	Sampling Frequency	No. of Samples	Max (mg/L)	Average (mg/L)	No. of samples where standard was not met (S 18)
Ararat*	Weekly (2)	104	1.00	0.56	0
Beulah	Weekly	52	1.54	1.16	0
Birchip	Weekly	52	1.57	0.93	0
Brim	Weekly	52	1.31	0.75	0
Charlton	Weekly	52	1.65	0.57	0
Dimboola	Weekly	52	1.56	1.04	0
Donald	Weekly	52	1.18	0.72	0
Edenhope	Weekly	52	1.40	0.80	0
Great Western	Weekly	52	1.31	0.61	0
Halls Gap	Weekly	52	1.26	0.96	0
Hopetoun	Weekly	52	1.58	1.03	0
Horsham*	Weekly (2)	104	1.70	0.91	0
Jeparit	Weekly	52	1.55	0.75	0
Lake Bolac (Total Chlorine)	Weekly	52	2.20	1.76	0
Manangatang	Weekly	52	1.89	0.99	0
Minyip	Weekly	52	1.20	0.86	0
Murtoa	Weekly	52	1.16	0.70	0
Natimuk	Weekly	52	1.56	0.89	0
Nhill	Weekly	52	1.40	0.80	0
Ouyen	Weekly	52	1.48	0.74	0
Pomonal	Weekly	52	1.00	0.62	0
Quambatook	Weekly	52	1.51	0.80	0
Rainbow	Weekly	52	1.49	1.15	0
Rupanyup	Weekly	52	1.49	0.87	0
Sea Lake	Weekly	52	1.38	0.86	0
St. Arnaud	Weekly	52	1.97	1.19	0
Stawell*	Weekly (2)	104	1.09	0.53	0
Underbool	Weekly	52	1.52	1.01	0
Warracknabeal	Weekly	52	1.17	0.68	0
Willaura (Total Chlorine)	Weekly	52	2.20	1.82	0
Woomelang	Weekly	52	1.35	0.71	0
Wycheproof	Weekly	52	1.49	0.95	0

** Due to the population size of these towns two samples are taken every sampling visit.*

3.4.3 Fluoride

Fluoride is added to some water supplies to help protect teeth against dental decay. Based on health considerations, the concentration of fluoride in fluoridated drinking water supplies should not exceed 1.5 mg/L and Under s. 5 (3) of the *Health (Fluoridation) Act 1973*,

fluoride added to drinking water must not result in an average optimum concentration of 1 mg/L. A detailed description of fluoride and its implications in a water supply can also be found by reference to the ADWG.

GWMWater has three fluoridated water supplies, including Ararat, Horsham and Natimuk. Fluoridation was installed at the Horsham WTP in November 2006 and Ararat WTP in August 2016. Natimuk receives treated water from Horsham.

3.4.3.1 Results

The sampling of fluoride is based on ADWG recommendations, the Code of practice for fluoridation of drinking water supplies, risks, historical data and any operational changes.

No water supplies exceeded the ADWG health-based guideline value for fluoride, and the average fluoride concentration delivered did not exceed the 1 mg/L (0.1 mg/L over the optimum target of 0.9 mg/L) designated by the *Health (Fluoridation) Act 1973* (Table 3-7).

With the first stage of upgrades to the Horsham WTP fluoride plant PLC and dosing panel causing the fluoride dosing to be offline from 1 June to 15 July 2021, a site-specific test and recommissioning plan was put in place for the re-instatement of fluoride dosing. This involved fluoride dosing being gradually increased to guideline levels over several months, leading to the average fluoride detected in the Horsham and Natimuk reticulations being less than the optimum target of 0.9 mg/L for the 2021/2022 reporting period. The average fluoride in the Horsham and Natimuk is expected to be closer to the target optimal concentration in the upcoming year.

Table 3-7 - Fluoride Results in Drinking Water for 1 July 2021 – 30 June 2022. The total concentration of fluoride should not exceed 1.5 mg/L.

Sampling Locality	Sampling Frequency	No. of Samples	Max (mg/L)	Average (mg/L)	Target optimum concentration (mg/L)	No. of samples where standard was not met (S 18)
Ararat*	Weekly (2)	104	0.98	0.92	0.9	0
Horsham*	Weekly (2)	104	0.90	0.61	0.9	0
Natimuk	Weekly	52	0.79	0.58	0.9	0

** Due to the population size of these towns two samples are taken every sampling visit.*

3.4.4 Chloroacetic acids

Chloroacetic acids (monochloroacetic acid, dichloroacetic acid and trichloroacetic acid) are produced in drinking water as disinfection by-products (DBPs) of the reaction between chlorine and naturally occurring humic and fulvic acids. The fact sheets in ADWG provide a detailed account of the health impacts and other considerations relating to chloroacetic acids.

3.4.4.1 Results

The sampling of these parameters is based on ADWG recommendations, risks, historical data and any operational changes. There were no missed samples for chloroacetic acids during this reporting period and all samples met the standard.

Table 3-8 - Concentrations of Monochloroacetic Acid in Drinking Water for 1 July 2021 – 30 June 2022. The concentration of monochloroacetic acid should not exceed 0.15 mg/L.

Sampling Locality	Sampling Frequency	No. of Samples	Results (mg/L)		No. of samples where standard was not met (S 18)
			Max	Average	
Great Western	Monthly	12	0.006	0.005	0
Ouyen	Quarterly	4	0.005	0.005	0

Table 3-9 - Concentrations of Dichloroacetic Acids in Drinking Water of 1 July 2021 – 30 June 2022. The concentration of dichloroacetic acid should not exceed 0.1 mg/L.

Sampling Locality	Sampling Frequency	No. of Samples	Results (mg/L)		No. of samples where standard was not met (S 18)
			Max	Average	
Great Western	Monthly	12	0.068	0.045	0
Ouyen	Quarterly	4	0.050	0.034	0

Table 3-10 - Concentrations of Trichloroacetic Acids in Drinking Water for 1 July 2021 – 30 June 2022. The concentration of trichloroacetic acid should not exceed 0.1 mg/L.

Sampling Locality	Sampling Frequency	No. of Samples	Results (mg/L)		No. of samples where standard was not met (S 18)
			Max	Average	
Great Western	Monthly	12	0.075	0.051	0
Ouyen	Quarterly	4	0.10	0.069	0

3.4.5 Ammonia, Nitrite, Nitrate and NDMA

Ammonia: Based on aesthetic considerations, ammonia in drinking water should not exceed 0.5 mg-NH_3/L. Presence of ammonia can increase nitrification (nitrite and nitrate formation).

Nitrite: Based on health considerations, the concentration of nitrite in drinking water should not exceed 3 mg-NO_2/L, equivalent to 0.913 mg N/L. Nitrite can be formed by nitrifying bacteria in reticulations of chloramination systems.

Nitrate: Based on health considerations, the concentration of nitrate in drinking water should not exceed 50 mg-NO_3/L, equivalent to 11.3 mg/L.

NDMA: Based on health considerations NDMA in drinking water should not exceed 0.0001 mg/L. NDMA forms when nitrates and nitrites are present and cross react with amines and can be a by-product of chloramination.

A detailed description of ammonia, nitrite, nitrate and NDMA and its implications in a water supply can be found by reference to the ADWG.

3.4.5.1 Results

Ammonia, Nitrite, Nitrate and NDMA were measured in the chloramination system of Willaura and Lake Bolac. The concentration of ammonia in both Willaura and Lake Bolac (Table 3-11) was above the ADWG aesthetic guideline value of 0.5 mg/L which is based on minimising corrosion in copper pipes and fittings. However, all results in these localities were below the ADWG stated odour threshold for ammonia in water of 1.5 mg/L, and there were no aesthetic water quality customer complaints for either Willaura and Lake

Bolac. All the results for nitrite (Table 3-12), nitrate (Table 3-13) and NDMA (Table 3-14) met the standard for this reporting period.

Table 3-11 - Concentrations of Ammonia in Drinking Water for 1 July 2021 – 30 June 2022. The concentration of Nitrite should not exceed 0.5 mg-NH_3/L (0.41 mg N/L).

Sampling Locality	Sampling Frequency	No. of Samples	Max (mg N/L)	Average (mg N/L)	No of samples where standard was not met
Lake Bolac	Monthly	12	0.79	0.58	12
Willaura	Monthly	12	0.75	0.56	12

Table 3-12 - Concentrations of Nitrite in Drinking Water for 1 July 2021 – 30 June 2022. The concentration of Nitrite should not exceed 3 mg-NO_2/L (0.913 mg N/L).

Sampling Locality	Sampling Frequency	No. of Samples	Max (mg N/L)	Average (mg N/L)	No of samples where standard was not met (S 18)
Lake Bolac	Monthly	12	0.026	0.013	0
Willaura	Monthly	12	0.002	0.002	0

Table 3-13 - Concentrations of Nitrate in Drinking Water for 1 July 2021 – 30 June 2022. The concentration of Nitrate should not exceed 50 mg-NO_3/L (11.3 mg N/L).

Sampling Locality	Sampling Frequency	No. of Samples	Max (mg N/L)	Average (mg N/L)	No of samples where standard was not met (S 18)
Lake Bolac	Monthly	12	0.059	0.046	0
Willaura	Monthly	12	0.040	0.034	0

Table 3-14 - Concentrations of NDMA in Drinking Water for 1 July 2021 – 30 June 2022. The concentration of NDMA should not exceed 0.0001 mg/L.

Sampling Locality	Sampling Frequency	No. of Samples	Max (mg/L)	Average (mg/L)	No of samples where standard was not met (S 18)
Lake Bolac	Quarterly	4	0.000008	0.000005	0
Willaura	Quarterly	4	0.000007	0.000005	0

3.4.6 Arsenic

The concentration of arsenic should not exceed 0.01 mg/L in drinking water based on health consideration. Arsenic is naturally occurring element, which can be introduced into water through dissolution of minerals and ore from industrial effluent and atmospheric deposition.

A detailed description of arsenic and its implications in a water supply can be found by reference to the ADWG.

3.4.6.1 Results

The sampling of arsenic is based on ADWG recommendations, risks, historical data and any operational changes. All samples for arsenic met the standard for the reporting period (Table 3-15).

Table 3-15 - Concentrations of Arsenic in Drinking Water for 1 July 2021 – 30 June 2022. The concentration of Arsenic should not exceed 0.1 mg/L.

Sampling Locality	Sampling Frequency	No. of Samples	Max (mg/L)	Average (mg/L)	No. of samples where standard was not met (S 18)
Edenhope	Monthly	12	0.003	0.003	0
Murtoa	Quarterly	4	0.001	0.001	0
Nhill	Quarterly	4	0.001	0.001	0

3.4.7 Lead

Lead can be present in drinking water as a result of dissolution from natural sources, or from household plumbing systems containing lead. Lead concentrations in drinking water can be reduced by conventional methods of water treatment using coagulants or lime softening.

Based on health considerations, the guideline value of lead in drinking water should not exceed 0.01 mg/L. The fact sheets in the ADWG provide a detailed account of the health impacts and other considerations relating to lead.

3.4.7.1 Results

The sampling of lead is based on ADWG recommendations, risks and historical data. All samples for lead met the standard for the 2021/2022 reporting period (Table 3-16).

Table 3-16 - Concentrations of Lead in Drinking Water for 1 July 2021 – 30 June 2022. The concentration of lead should not exceed 0.01 mg/L.

Sampling Locality	Sampling Frequency	No. of Samples	Max (mg/L)	Average (mg/L)	No. of samples where standard was not met (S 18)
Ararat*	Quarterly (2)	8	0.001	0.001	0
Beulah	Quarterly	4	0.002	0.001	0
Birchip	Quarterly	4	0.001	0.001	0
Brim	Quarterly	4	0.001	0.001	0
Charlton	Quarterly	4	0.001	0.001	0
Dimboola	Quarterly	4	0.001	0.001	0
Donald	Quarterly	4	0.001	0.001	0
Edenhope	Quarterly	4	0.002	0.001	0
Great Western	Quarterly	4	0.001	0.001	0
Halls Gap	Quarterly	4	0.001	0.001	0
Hopetoun	Quarterly	4	0.001	0.001	0
Horsham*	Quarterly (2)	8	0.001	0.001	0
Jeparit	Quarterly	4	0.003	0.002	0
Lake Bolac	Quarterly	4	0.001	0.001	0
Manangatang	Quarterly	4	0.003	0.002	0
Minyip	Quarterly	4	0.001	0.001	0
Murtoa	Quarterly	4	0.001	0.001	0

Sampling Locality	Sampling Frequency	No. of Samples	Max (mg/L)	Average (mg/L)	No. of samples where standard was not met (S 18)
Natimuk	Quarterly	4	0.001	0.001	0
Nhill	Quarterly	4	0.001	0.001	0
Ouyen	Quarterly	4	0.001	0.001	0
Pomonal	Quarterly	4	0.001	0.001	0
Quambatook	Quarterly	4	0.001	0.001	0
Rainbow	Quarterly	4	0.005	0.002	0
Rupanyup	Quarterly	4	0.001	0.001	0
Sea Lake	Quarterly	4	0.001	0.001	0
St. Arnaud	Quarterly	4	0.001	0.001	0
Stawell*	Quarterly (2)	8	0.001	0.001	0
Underbool	Quarterly	4	0.001	0.001	0
Warracknabeal	Quarterly	4	0.001	0.001	0
Willaura	Quarterly	4	0.001	0.001	0
Woomelang	Quarterly	4	0.001	0.001	0
Wycheproof	Quarterly	4	0.001	0.001	0

** Due to the population size of these towns two samples are taken every sampling visit.*

3.4.8 Other metals

A suite of metals, scheduled on an annual basis, is sampled in the Stawell reticulation due to the presence of mining at the town. The standards recommended by the ADWG for these metals are listed in Table 3-17. Whether the ADWG standard is based on Health considerations or Aesthetic factors is also included. Each of these metals has a fact sheet in the ADWG that can be referred to for detailed information and their relevance in drinking water systems.

3.4.8.1 Results

All metals sampled in the annual metals suite at Stawell met the standard for the reporting period (Table 3-17).

Table 3-17 - Concentrations of Metals in Stawell in Drinking Water for 1 July 2021 – 30 June 2022.

Sampling Locality	Sampling Frequency	No. of Samples	Max Result (mg/L)	Standard type	Standard (mg/L)	No. of samples where standard was not met (S 18)
Aluminium	Annual	2	0.03	Aesthetic	0.2	0
Antimony	Annual	2	0.001	Health	0.003	0
Arsenic	Annual	2	0.001	Health	0.01	0
Barium	Annual	2	0.017	Health	2	0
Beryllium	Annual	2	0.001	Health	0.06	0
Boron	Annual	2	0.02	Health	4	0
Cadmium	Annual	2	0.0002	Health	0.002	0

Sampling Locality	Sampling Frequency	No. of Samples	Max Result (mg/L)	Standard type	Standard (mg/L)	No. of samples where standard was not met (S 18)
Chromium	Annual	2	0.001	Health	0.05	0
Cobalt	Annual	2	0.001	N/A	N/A	0
Copper	Annual	2	0.009	Aesthetic Health	1 2	0
Iron	Annual	2	0.03	Aesthetic	0.3	0
Lead	Annual	2	0.001	Health	0.01	0
Manganese	Annual	2	0.001	Aesthetic Health	0.1 0.5	0
Mercury	Annual	2	0.0001	Health	0.001	0
Molybdenum	Annual	2	0.001	Health	0.05	0
Nickel	Annual	2	0.001	Health	0.02	0
Selenium	Annual	2	0.001	Health	0.01	0
Silver	Annual	2	0.001	Health	0.1	0
Strontium	Annual	2	0.03	N/A	N/A	0
Thallium	Annual	2	0.001	N/A	N/A	0
Tin	Annual	2	0.001	None	None	0
Titanium	Annual	2	0.001	N/A	N/A	0
Vanadium	Annual	2	0.001	N/A	N/A	0
Zinc	Annual	2	0.012	Aesthetic	3	0

** Due to the population size of Stawell two samples are taken every sampling visit.*

4 Aesthetic Parameters

Individual monitoring results for 2021/2022 that exceed the aesthetic guideline value set out in ADWG are highlighted in the tables in this section.

4.1 pH

The aesthetic parameter, pH is a measure of the hydrogen ion concentration of water. It is measured on a logarithmic scale from 0 to 14. A pH of seven is neutral, while a pH greater than seven is alkaline, and a pH less than seven is acidic.

The ADWG suggests that, based on the need to reduce corrosion and encrustation in pipework, drinking water should have a pH value between pH 6.5 and pH 8.5.

4.1.1 Results

Sampling and laboratory analysis for pH during the reporting period was undertaken on a weekly basis for all drinking water towns (Table 4-1).

There was one missed parameter analysis for pH on 8 November 2022 in Ouyen, relevant to regulation 14(2). The sampler filling in for the regular sampler did not have a pH meter available to measure pH in the field as per GWMWater's usual process. The sampler communicated to the laboratory on the chain of custody for the pH to be measured when the laboratory received the sample, however this was communication was missed. All other parameters for that sample were recorded. Risk investigation found that the continuously monitored pH at the Ouyen WTP was within range, all WTP processes were operating well, there were no major changes in the network and historic pH trends in reticulation were acceptable. With pH considered an aesthetic parameter in the ADWG this missed sample was deemed to be low risk. All other scheduled pH sampling was conducted.

There were 5.1% of results across all samples that did not satisfy the aesthetic guideline values set out in the ADWG. The pH varies in the reticulation due to reaction with the pipeline, particularly when water usage is low leading to greater water age. Flushing is undertaken if the pH variation persists. The average pH for each town was within the expected ADWG range, and continuous monitoring at the WTPs showed no deviations in critical control limits of pH.

Table 4-1 - pH of Drinking Water for 1 July 2021 – 30 June 2022. pH value should be between pH 6.5 and pH 8.5.

Sampling Locality	Sampling Frequency	No. of Samples	Max pH	Min pH	Average pH
Ararat*	Weekly	104	8.02	6.78	7.17
Beulah	Weekly	52	8.89	6.64	7.58
Birchip	Weekly	52	8.55	6.40	7.28
Brim	Weekly	52	8.60	6.20	7.25
Charlton	Weekly	52	10.23	6.46	7.40
Dimboola	Weekly	52	7.74	6.50	7.07

Sampling Locality	Sampling Frequency	No. of Samples	Max pH	Min pH	Average pH
Donald	Weekly	52	9.60	6.73	7.59
Edenhope	Weekly	52	8.06	6.70	7.30
Great Western	Weekly	52	8.30	7.00	7.33
Halls Gap	Weekly	52	8.26	6.60	7.18
Hopetoun	Weekly	52	8.84	6.76	7.55
Horsham*	Weekly	104	7.94	6.30	7.10
Jeparit	Weekly	52	9.72	6.65	7.69
Lake Bolac	Weekly	52	9.25	7.20	7.98
Manangatang	Weekly	52	8.57	6.78	7.40
Minyip	Weekly	52	9.43	6.30	7.24
Murtoa	Weekly	52	7.76	6.60	7.13
Natimuk	Weekly	52	8.51	6.40	7.16
Nhill	Weekly	52	8.06	6.40	7.09
Ouyen	Weekly	51	8.90	7.00	7.80
Pomonal	Weekly	52	7.60	6.60	7.07
Quambatook	Weekly	52	8.77	6.84	7.61
Rainbow	Weekly	52	9.98	6.77	7.50
Rupanyup	Weekly	52	7.90	6.30	6.94
Sea Lake	Weekly	52	8.64	6.84	7.56
St Arnaud	Weekly	52	9.49	6.40	7.34
Stawell*	Weekly	104	8.13	6.70	7.16
Underbool	Weekly	52	9.07	7.30	7.92
Warracknabeal	Weekly	52	8.97	6.40	7.23
Willaura	Weekly	52	8.19	6.70	7.26
Woomelang	Weekly	52	9.18	7.04	7.81
Wycheproof	Weekly	52	8.59	6.30	7.44

** Due to the population size of these towns two samples are taken every sampling visit.*

4.2 Aluminium

Aluminium chlorohydrate (Megapac 23) is a coagulant used in water treatment to remove turbidity, natural organic matter (including colour), microorganisms and many inorganic chemicals. The coagulant is aluminium based, however, under normal operation, no aluminium is contained in the final drinking water.

As stated in the ADWG, based on aesthetic problems caused by post-flocculation, the concentration of acid-soluble aluminium in drinking water should not exceed 0.2 mg/L. Water agencies are strongly encouraged to keep acid-soluble aluminium concentrations as low as possible, preferably below 0.1 mg/L. There are no health-based guideline values set for aluminium at this time.

4.2.1 Results

The sampling of acid-soluble aluminium is based on ADWG recommendations, risks and historical data. All samples for acid-soluble aluminium met the standard for the reporting period (Table 4-2).

The ADWG recommends aluminium acid-soluble should not exceed 0.2 mg/L for aesthetic purposes. A sample in Brim on 8 February 2022 exceeded the guideline with 0.47 mg/L of acid-soluble aluminium. This sample was taken on the same day that sections of the town were being shut down for installation of a new water main, which would have stirred up sediment in the reticulation. Once the works were completed significant flushing was undertaken to bring down the turbidity and all other acid-soluble aluminium results for the locality for the year were below 0.02 mg/L, significantly less than the ADWG aesthetic guideline. No customer complaints occurred as a result of the high aluminium acid-soluble.

Table 4-2 – Aluminium acid-soluble in Drinking Water for 1 July 2021 – 30 June 2022. The concentration of Aluminium acid-soluble should not exceed 0.2 mg/L.

Sampling Locality	Sampling Frequency	No. of Samples	Max (mg/L)	Average (mg/L)	No. of samples where standard was not met
Ararat*	Monthly (2)	24	0.07	0.04	0
Beulah	Monthly	12	0.02	0.01	0
Birchip	Monthly	12	0.04	0.01	0
Brim	Monthly	12	0.47	0.05	1
Charlton	Monthly	12	0.02	0.01	0
Dimboola	Monthly	12	0.02	0.01	0
Donald	Monthly	12	0.03	0.02	0
Edenhope	Monthly	12	0.01	0.01	0
Great Western	Monthly	12	0.04	0.03	0
Halls Gap	Monthly	12	0.02	0.01	0
Hopetoun	Monthly	12	0.03	0.02	0
Horsham*	Monthly (2)	24	0.05	0.03	0
Jeparit	Monthly	12	0.02	0.01	0
Lake Bolac	Monthly	12	0.04	0.02	0
Manangatang	Monthly	12	0.01	0.01	0
Minyip	Monthly	12	0.02	0.01	0
Murtoa	Monthly	12	0.03	0.01	0
Natimuk	Monthly	12	0.04	0.03	0
Nhill	Monthly	12	0.01	0.01	0
Ouyen	Monthly	12	0.02	0.01	0
Pomonal	Monthly	12	0.03	0.01	0
Quambatook	Monthly	12	0.03	0.01	0
Rainbow	Monthly	12	0.04	0.01	0
Rupanyup	Monthly	12	0.03	0.01	0
Sea Lake	Monthly	12	0.01	0.01	0

Sampling Locality	Sampling Frequency	No. of Samples	Max (mg/L)	Average (mg/L)	No. of samples where standard was not met
St. Arnaud	Monthly	12	0.04	0.02	0
Stawell*	Monthly (2)	24	0.07	0.03	0
Underbool	Monthly	12	0.03	0.02	0
Warracknabeal	Monthly	12	0.04	0.02	0
Willaura	Monthly	12	0.02	0.01	0
Woomelang	Monthly	12	0.03	0.01	0
Wycheproof	Monthly	12	0.02	0.01	0

** Due to the population size of these towns two samples are taken every sampling visit.*

4.3 Hardness

Hardness is the sum of calcium and magnesium ions. Alkalinity is the sum of carbonate, bicarbonate and hydroxide content. High total hardness may be a problem for supplies reliant on groundwater. Surface waters can generally be expected to have acceptable values.

ADWG suggest that to minimise build-up of scale in hot water systems total hardness in drinking water should not exceed 200 mg $CaCO_3$/L. The ADWG discusses ramifications of hardness and what constitutes hard and soft water. Alkalinity has no independent ADWG guideline value.

4.3.1 Results

Hardness and alkalinity sampling and analysis was conducted annually for all drinking water towns. The Hardness result in Edenhope sampled on 8 July 2021 was above the 200 mg/L benchmark set for aesthetic purposes. Edenhope is supplied from groundwater bores, which commonly have higher hardness than surface waters. While this has no health implications, this can increase the level of scale and deposit build-up in customer's systems, and can also increase the amount of soap and detergent required for cleaning. All other samples for hardness met the standard for the reporting period (Table 4-3).

Table 4-3 – Average hardness and alkalinity of Drinking Water for 1 July 2021 – 30 June 2022. GWMWater internal performance benchmark that the average hardness should be less than 200 mg/L.

Sampling Locality	Sampling Frequency	No. of Samples	Hardness (mg $CaCO_3$/L)	Alkalinity (mg $CaCO_3$/L)
Ararat*	Annually (2)	2	53	23
Beulah	Annually	1	23	12
Birchip	Annually	1	14	9
Brim	Annually	1	23	13
Charlton	Annually	1	24	15
Dimboola	Annually	1	17	14
Donald	Annually	1	23	17
Edenhope	Annually	1	210	150
Great Western	Annually	1	41	27

Sampling Locality	Sampling Frequency	No. of Samples	Hardness (mg $CaCO_3$/L)	Alkalinity (mg $CaCO_3$/L)
Halls Gap	Annually	1	35	10
Hopetoun	Annually	1	19	11
Horsham*	Annually (2)	2	34	14
Jeparit	Annually	1	19	10
Lake Bolac	Annually	1	25	26
Manangatang	Annually	1	21	19
Minyip	Annually	1	19	12
Murtoa	Annually	1	16	13
Natimuk	Annually	1	35	13
Nhill	Annually	1	16	14
Ouyen	Annually	1	50	42
Pomonal	Annually	1	33	10
Quambatook	Annually	1	130	100
Rainbow	Annually	1	19	10
Rupanyup	Annually	1	19	13
Sea Lake	Annually	1	20	12
St Arnaud	Annually	1	20	14
Stawell*	Annually (2)	2	37	19
Underbool	Annually	1	97	79
Warracknabeal	Annually	1	23	18
Willaura	Annually	1	17	20
Woomelang	Annually	1	22	11
Wycheproof	Annually	1	17	10

** Due to the population size of these towns two samples are taken every sampling visit. The average result is given for these towns.*

4.4 Electrical Conductivity

Electrical Conductivity (EC) is caused by inorganic salts and small amounts of organic matter that are dissolved in water. Electrical conductivity mostly comprises sodium, potassium, calcium, magnesium, chloride, sulphate, bicarbonate, carbonate, silica, organic matter, fluoride, iron, manganese, nitrate (and nitrite) and phosphate.

High EC values may be associated with excessive scaling in pipes, fittings and household appliances.

The ADWG sets a guideline values for Total Dissolved Solids (TDS) of 600 mg/L and approximates that the TDS is 0.64 times the electrical conductivity value. As it is more cost effective to monitor electrical conductivity than total dissolved solids, the analysis for compliance is based on electrical conductivity. The ADWG value for TDS is equivalent to an electrical conductivity of 1000 µS/cm.

4.4.1 Results

Sampling and field analysis for electrical conductivity was undertaken on a monthly basis. All samples for electrical conductivity met the standard for the reporting period (Table 4-4).

Table 4-4 - Electrical Conductivity (EC) of Drinking Water for 1 July 2021 – 30 June 2022. EC in drinking water should be less than 1000 µS/cm.

Sampling Locality	Sampling Frequency	No. of Samples	Max (µS/cm)	Average (µS/cm)
Ararat*	Monthly (2)	24	230	184
Beulah	Monthly	12	137	106
Birchip	Monthly	12	137	104
Brim	Monthly	12	105	94
Charlton	Monthly	12	176	106
Dimboola	Monthly	12	100	91
Donald	Monthly	12	188	109
Edenhope	Monthly	12	885	741
Great Western	Monthly	12	205	185
Halls Gap	Monthly	12	125	117
Hopetoun	Monthly	12	118	106
Horsham*	Monthly (2)	24	154	131
Jeparit	Monthly	12	126	110
Lake Bolac	Monthly	12	135	118
Manangatang	Monthly	12	138	101
Minyip	Monthly	12	137	99
Murtoa	Monthly	12	100	92
Natimuk	Monthly	12	150	129
Nhill	Monthly	12	105	94
Ouyen	Monthly	12	263	175
Pomonal	Monthly	12	130	117
Quambatook	Monthly	12	670	621
Rainbow	Monthly	12	132	111
Rupanyup	Monthly	12	189	101
Sea Lake	Monthly	12	145	110
St Arnaud	Monthly	12	186	111
Stawell*	Monthly (2)	24	195	169
Underbool	Monthly	12	262	240
Warracknabeal	Monthly	12	110	94
Willaura	Monthly	12	125	112
Woomelang	Monthly	12	120	109
Wycheproof	Monthly	12	124	110

** Due to the population size of these towns two samples are taken every sampling visit.*

4.5 Iron

At concentrations exceeding 0.3 mg/L, iron imparts an undesirable taste to water and stains plumbing fixtures and laundry. Some micro-organisms can concentrate iron and give rise to taste, odour and turbidity problems in distribution systems.

Based on aesthetic considerations the ADWG suggests that the concentration of iron in drinking water should not exceed 0.3 mg/L. A detailed description of iron and its implications in a water supply can be found by reference to the ADWG.

4.5.1 Results

The sampling of iron is based on ADWG recommendations, risks, and historical data. There were no exceedances of iron this reporting period (Table 4-5).

Table 4-5 - Iron in Drinking Water for 1 July 2021 – 30 June 2022. The concentration of iron in drinking water should not exceed 0.3 mg/L.

Sampling Locality	Sampling Frequency	No. of Samples	Max (mg/L)	Average (mg/L)
Murtoa	Quarterly	4	0.060	0.035
Nhill	Quarterly	4	0.030	0.015

5 Analysis of Results

5.1 Sampling Requirements

For 2021/2022 there were no missed samples according to regulation 13, and one parameter was not analysed according to regulation 14(2), of the Safe Water Drinking Regulations 2015.

There was one missed parameter analysis for pH on 8 November 2022 in Ouyen. The field sampler could not measure pH and communicated to the laboratory on the chain of custody to measure pH however this was missed. All other parameters for that sample were recorded. Risk investigation found that pH is continuously monitored and was within range at the Ouyen WTP, all WTP processes were operating well, there were no major changes in the network and historic pH trends in reticulation were acceptable. With pH considered an aesthetic parameter only in ADWG this missed sample was deemed to be low risk. All other scheduled pH sampling was conducted.

5.2 Water Quality

Analysis of all water quality sample information, data and results of drinking water supplied for this reporting period (2021/2022) with the last two reporting periods, 2020/2021 and 2019/2020 is summarised in Table 5-1.

The only health-based exceedance this year was a sample from Donald recorded 490 *E. coli*/100 mL on 27 January 2022. No conclusive evidence for an error or a real cause for the *E. coli* result was found, as such the *E. coli* reading was assumed to be real and a Section 18 notification was provided to DH. Please refer to the Emergency, Incident and Event Management section for further information. No other parameters for Donald were found to be out of specification for the year.

This financial year and in the last three years there have been no other exceedances of the ADWG limits for health-based parameters in any drinking water town.

In 2021/2022 5.1% of all pH samples exceeded the 6.5-8.5 range recommended in the ADWG. This was comparable to the previous year of 5.3% of samples that exceeded the recommended aesthetic range. The average pH in the reticulation of all localities met the ADWG and WTPs were producing water within ADWG. Factors contributing to the number of pH exceedances were field instrument error and reaction with the reticulation pipes leading to variation in pH. There were no customer complaints that could be linked to pH at any locality.

There was one exceedance of acid-soluble aluminium from a sample in Brim on 8 February 2022. This sample was taken during major works at the town that would have stirred up sediment in the reticulation. Once the works were completed significant flushing was undertaken to bring down the turbidity and all other acid-soluble aluminium results for the year at Brim were below 0.02 mg/L, significantly less than the ADWG aesthetic guideline.

The concentration of ammonia in both Willaura and Lake Bolac was above the ADWG aesthetic guideline value of 0.5 mg-NH_3/L for all monthly samples taken for the year. This ADWG value is based on minimising corrosion in copper pipes and fittings. All results in these localities were below the ADWG stated odour threshold for ammonia in water of 1.5 mg-NH_3/L, and there were no customer complaints due to the aesthetic of the water at either Willaura or Lake Bolac.

There was one result above the aesthetic guideline for hardness of 200 mg/L at Edenhope, sampled on 8 July 2021. Edenhope is supplied from groundwater bores, which commonly have higher hardness than surface waters. While this has no health implications, it can increase the level of scale and deposit build-up in customer's systems, and increase the amount of soap and detergent required for cleaning. All other samples for hardness met the standard for the reporting period.

Table 5-1 - Comparison of analysis of water quality results of drinking water supplied from 2019/2020 to 2021/2022.

Parameters	2019/2020		2020/2021		2021/2022	
	Localities supplied drinking water that met standard (%)	Customers supplied drinking water that met standard (%)	Localities supplied drinking water that met standard (%)	Customers supplied drinking water that met standard (%)	Localities supplied drinking water that met standard (%)	Customers supplied drinking water that met standard (%)
Escherichia coli	100	100	100	100	96.9	97.2
Trihalomethanes	100	100	100	100	100	100
Turbidity	100	100	100	100	100	100
Chlorine	100	100	100	100	100	100
Fluoride	100	100	100	100	100	100
Monochloroacetic acid	100	100	100	100	100	100
Dichloroacetic acid	100	100	100	100	100	100
Trichloroacetic acid	100	100	100	100	100	100
Ammonia	N/A	N/A	N/A	N/A	93.8	98.5
Nitrite	100	100	100	100	100	100
Nitrate	100	100	100	100	100	100
NDMA	100	100	100	100	100	100
Copper	100	100	100	100	100	100
Arsenic	100	100	100	100	100	100
Lead	100	100	100	100	100	100
Other metals	N/A	N/A	N/A	N/A	100	100
pH*	37.5	41.4	53.1	79.8	34.4	42.6
Aluminium acid-soluble	100	100	96.9	98.6	96.9	99.7
Hardness	100	100	100	100	96.9	98.2
Electrical conductivity	100	100	100	100	100	100

Iron	100	100	100	100	100	100

* pH counted as not meeting targeted standard for the locality if multiple (≥2) exceedances occurred.
N/A: If not analysed that year

6 Complaints

6.1 Complaints and Responses

GWMWater's Customer Complaints and Disputes Policy recognises the customer's rights, including the right to complain. GWMWater systematically records all complaints in a register and investigates them to determine the cause and significance. Complaints response vary depending on the nature of the complaint but can include further customer consultation and corrective actions such flushing. Operational changes or capital improvements which optimise treated water quality may be implemented in response to customer complaints.

Table 6-1 and Table 6-2 summarises the complaints received during the reporting period for both drinking water and regulated water supplies, respectively.

Table 6-3 and Table 6-4 provide a detailed breakdown of the total number of complaints received from customers supplied with drinking and regulated water, respectively.

Table 6-1 – Drinking Water Quality Complaints comparison between 2019/2020 to 2021/2022.

Type of Complaint	Number of complaints			Comparison with previous reporting periods
	2019/2020	2020/2021	2021/2022	
Discoloured	74	59	35	Reduction in complaints. Ararat had 14 less complaints compared with previous year.
Taste/Odour	6	27	10	Back to normal number of complaints after 2020/2021 Horsham Taste and Odour Incident.
Other	7	2	6	Typically there are only scattered complaints categorised as other.
Total	89	88	51	42% decrease. No major aesthetic water quality incidents occurred in the year.

Table 6-2 – Regulated Water* Quality Complaints comparison between 2019/2020 to 2021/2022.

Type of Complaint	Number of complaints			Comparison with previous reporting periods
	2019/2020	2020/2021	2021/2022	
Discoloured	35	30	51	Higher from Elmhurst incident.
Odour	7	19	23	Higher from Elmhurst incident.
Other	3	5	2	Typically there are only scattered complaints categorised as other.
Total	45	54	76	41% Increase. Higher from Elmhurst incident (30 complaints), Elmhurst is to be upgraded to drinking water.

** Regulated water is water that is not intended for drinking.*

6.2 Analysis of Issues

Over the 2021/2022 year the total number of customer complaints for drinking water was lower than the previous reporting periods.

Ararat received 5 dirty water complaints this year, a significant reduction on the 19 dirty water complaints received last year. These complaints have been mostly due to air in water after works on mains. Fewer major breaks and better flushing practise may have led to less complaints of this nature this year. Horsham had 3 taste and odour complaints this year, a significant reduction on the 13 taste and odour complaints received last year. This is due to proactive operation of Powder Activated Carbon (PAC) at the Mt Zero WTP, which can remove the non-hazardous compound geosmin that was the cause for these complaints last year. The 3 taste and odour complaints that occurred in Horsham were all in July 2021, likely as a residual consequence of February 2021 taste and odour incident. Otherwise there were no noticeable changes or widespread cause of complaints for any drinking water towns. Horsham (6 dirty water complaints) and Stawell (5 dirty water complaints) have no major issues however there are several dead ends in the reticulations that can accumulate sediments, for which proactive flushing is undertaken.

Over the 2021/2022 year the total number of customer complaints for regulated water supply increased significantly compared with the previous reporting periods. This was due to an aesthetic water quality incident in Elmhurst that resulted in 28 dirty water and odour complaints, with the first complaint occurring 4 January 2022 and the last complaint on 7 February 2022. There was algal growth in the open storage that supplies Elmhurst, resulting in clogging of customer meters. The algae in the storage were treated and subsequent algal die off resulted in additional odour complaints. The storage was aerated and the condition of the reticulation monitored until quality returned to normal.

Complaints in Berriwillock reduced from 13 in total last year to 2 this year due to upgrades of Berriwillock pumps that has reduced the times lower quality Murray River water is supplied to the town instead of Lake Bellfield water. Culgoa is however still supplied with Murray River water and had 8 water quality complaints which were due to the Murray River having periods of dirty water impacting the quality of water supplied to customers. Coagulant dosing is applied prior to storages at Culgoa to improve water quality.

The greatest number of complaints amongst other regulated towns were Ultima (7 complaints), Kaniva (6 complaints), and Moyston (3 complaints). Drinking water is to be provided to these towns as part of the current water plan. Wickliffe (4 complaints), Streatham (3 complaints) and Westmere (5 complaints) will also be supplied better quality water through the East Grampians Pipeline. In addition to these towns, networks in Buangor (3 complaints), Glenorchy and Marnoo will be air scoured to clean up their reticulation systems.

In general, GWMWater improves the water quality of regulated towns by swabbing and flushing of the Mallee pipelines, flushing of water reticulations, a raw water storage cleaning program, and coagulant dosing. GWMWater is also preparing plans for additional regulated towns to be upgraded to drinking water in the 2023-2028 pricing period. The decision of which towns to upgrade considers multiple factors, with improvement to quality and safety the main drivers for upgrades.

Table 6-3 - Water Quality Complaints for Drinking Water Towns for 2021/2022.

Locality	Population	Number of Complaints			
		Colour	T&O^	Other	Total
Ararat	8500	5	2		7
Beulah	310				
Birchip	690	2	1	1	4
Brim	180				
Charlton	1100	1		1	2
Dimboola	1640	1			1
Donald	1470	1			1
Edenhope	940				
Great Western	430				
Halls Gap	500	1			1
Hopetoun	690				
Horsham	15130	6	3	2	11
Jeparit	480	1			1
Lake Bolac	370			1	1
Manangatang	270	1			1
Minyip	530				
Murtoa	900		1		1
Natimuk	550				
Nhill	2400	2	1		3
Ouyen	1170	1			1
Pomonal	360				
Quambatook	230		1		1
Rainbow	670				
Rupanyup	550				
Sea Lake	620	3			3
St Arnaud	2320	1		1	2
Stawell	6220	5	1		6
Underbool	220				
Warracknabeal	2360	3			3
Willaura	440				
Woomelang	190	1			1
Wycheproof	610				
Total	53010	**35**	**10**	**6**	**51**

^ *Taste and Odour (T & O).*

Table 6-4 - Water Quality Complaints for Regulated Supplies for 2021/2022.

Locality	Population	Number of Complaints			
		Colour	Odour	Other	Total
Antwerp	50				
Apsley	330				
Berriwillock	180	2			2
Buangor	110	3			3
Chillingollah	<10				
Chinkapook	20				
Cowangie	30				
Culgoa	90	4	4		8
Dooen	250				
Elmhurst	190	17	12	1	30
Glenorchy	130				
Goroke	300				
Harrow	180				
Jung	280				
Kaniva	890	4	1	1	6
Kiata	60				
Lalbert	140		1		1
Lascelles	80				
Lillimur	110				
Marnoo	100				
Miram	40				
Moyston	400	3			3
Murrayville	280				
Nandaly	30				
Nullawil	90				
Patchewollock	150	1	2		3
Pimpinio	190				
Serviceton	130				
Speed	50				
Streatham	160	2	1		3
Tarranyurk	40				
Tempy	60				
Ultima	170	6	1		7
Waitchie	40				
Walpeup	170				
Watchem	120				
Westmere	60	4	1		5
Wickliffe	120	4			4
Yaapeet	80	1			1
Total	5910	**51**	**23**	**2**	76

7 Risk Management Plan Audit

A risk management plan audit was conducted by Viridis Consultants Pty Ltd in July 2020 in accordance with s. 11 of the *Safe Drinking Water Act 2003*. The period audited was from 28 March 2018 to 26 August 2020. Under s. 9 of the Act, the auditor determined that GWMWater:

- complied with the obligations imposed by section 7 (1) of the *Safe Drinking Water Act 2003*, and
- complied with the obligations imposed by section 8 (1) of the *Safe Drinking Water Act 2003*.

Opportunities for improvements identified in the audit are summarised in Table 7-1, with an update on their status provided. Nine of these ten identified OFIs have been completed.

Table 7-1 - Summary of audit actions and status.

OFI	**ACTIONS**	**STATUS**
Track all risk reduction measures through, from identification to completion, including status and date required for actions.	A tracking process is being implemented through TechnologyOne to track risk reduction measures.	A full module for managing risk in TechnologyOne is currently being commissioned.
Revise the risk management plan to document the need for a review of the risk assessment following an incident.	The GWMWater operational response procedure now includes a section to review the relevant water quality risks following an incident.	Complete
Consider increasing the review frequency in the document management system for drinking water risk management plans.	GWMWater has changed the water quality document review process to be completed every 2 years.	Complete
Make minor corrections to schematics in the risk management plans for Brim and Jung.	GWMWater has completed the nominated Audit Action to update the Brim and Jung Schematics. We have undertaken to update all schematics across all systems.	Completed.
Develop a stakeholder management plan for business as usual.	A stakeholder management plan is being developed in consultation with other water agencies.	Complete
Include details for events (e.g. black water) and response to these in the monitoring program.	This information has been updated in water quality management plans.	Complete

OFI	ACTIONS	STATUS
Review treatment processes against the WaterRA publication 'Good Practice Guide to the Operation of Drinking Water Supply systems for Management of Microbial Risk'.	GWMWater has reviewed the WaterRA Health based targets against our current treatment processes.	Complete
Simplify the risk management plan documentation and risk register for easier maintenance and to improve ease of conveying information.	A summary chart was developed with digital links to assist in navigating the system.	Complete
Review the Catchment to Tap Risk Assessment and consider the risks posed by cybersecurity at tanker fill points and workforce management.	Risks of cybersecurity, tanker fill points and workforce management have been added to the catchment to tap risk assessment.	Complete
Finalise the procedure for mains repairs and installation.	The procedure is complete and has been presented to operational staff. Field training has been conducted.	Complete

8 Undertakings under Section 30 of the Act

There were no undertakings during the reporting period.

9 Regulated Water

Regulated water is water that is not intended for drinking, but which could reasonably be mistaken as drinking water. This could be the case when such water is, for example, delivered to households through a piped reticulation system.

Section 6 of the *Safe Drinking Water Act 2003* allows the Minister for Health to declare certain water as regulated. The Minister for Health declared all rural water pipelines, other than the WMP, as regulated supplies in the Victorian Government Gazette No. S 36 on Monday 23 February 2009.

GWMWater must manage risks in relation to water that is not intended for drinking, as part of its normal business practices. GWMWater is required to:

- Prepare a Risk Management Plan for the regulated water.
- Ensure the Risk Management Plan contains the matters specified in Regulation 8 of the Safe Drinking Water Regulations.
- Have the Plan audited by an approved auditor.
- Take all reasonable steps to minimise the likelihood of the water being mistaken as drinking water.
- Include a summary of the management activities for regulated water supply in the Annual Report.

GWMWater had a total of 39 towns supplied with water classified as 'regulated water' under Section 6 of the Act during the reporting period. The regulated water supplies are listed in Table 1-2.

Under Section 25 of the *Safe Drinking Water Act 2003*, water suppliers are required to report on the steps taken to make the public aware of regulated water (non-drinking water). GWMWater informs their customers in towns with a regulated water supply are advised of the water quality through:

a) 'Do not drink the water' symbol notices on their water bills, - four bills per annum.
b) Issue 'Untreated Water Supply' newsletters annually.
c) Provide 'Do not drink the water' signage/stickers to Local Government to place on publicly accessible taps in each town.
d) Provide information on GWMWater's website.

10 Emergency, Incident and Event Management

GWMWater has developed an Emergency Management Plan, and specific procedures for the management of water quality incidents.

Water quality incidents are notifiable to DH under Section 18s and 22s of the *Safe Drinking Water Act 2003*. Section 22s reports give DH an early warning notification of any known or suspected problem, whereas section 18s notifications are given when the water quality standard has not been met. For the 2021/2022 year, GWMWater:

- provided DH with one notification for section 18 of the *Safe Drinking Water Act 2003*, and
- provided DH with one report for section 22 of the *Safe Drinking Water Act 2003*.

10.1 Detection of E*scherichia. coli* – section 18 notification and section 22 report

A reading of 490 *E. coli*/100 mL was recorded in Donald locality on the 27 January 2022. In response, the Department of Health (DH) was immediately provided with a Section 22 report, corrective actions taken of a comprehensive sampling and flushing program, and an investigation carried out to determine risk to public health.

In accordance with regulation 14 of the Safe Drinking Water Regulations 2015, to evaluate the risk to consumers the investigation was conducted to determine if:

- any other factors that would indicate the presence of *E. coli* were present in the water
- the drinking water treatment processes applied were expected to have eliminated the presence of *E. coli* in the water
- all plant and infrastructure associated with the water treatment process were operating to specification
- there were any issues arising from degradation of the plant or infrastructure that could reasonably be suspected to have contributed to the presence of *E. coli*.

The key findings from the incident response were:

- There were no issues at the treatment plant, and no tanks or no potential points of contamination were found in the system.
- There was chlorine residual found in all samples and the water age at the incident sample point was found to be acceptable, with potential stagnant water at a dead end further downstream from the sample point.
- A break had occurred on the adjacent street in the reticulation system 14 January 2022, however this was repaired under positive pressure. A nearby asbestos socket was also replaced.
- The re-sample of the incident sample tap prior to flushing also contained 7 *E. coli*/100 mL.

- All other samples taken in response to the *E. coli* detection had good chlorine residual and had no microorganisms detected.

With no conclusive evidence for the source of the *E. coli*, and with the detection of *E. coli* in the re-sample at the incident sample tap, a Section 18 notification was provided to DH indicating that the drinking water is not likely to have complied with the water quality standards.

10.2 Blue-Green Algae (BGA)

BGA in the Murray River was at levels that indicated increased vigilance and monitoring between January 2022 and April 2022.

The Wemen pump station supplies water from the Murray River to two open raw water storages at Ouyen for the Ouyen WTP, Underbool WTP and rural customers. BGA concentrations approached trigger levels in one of the storages on 21 February 2022. As a precaution supply was switched to the storage with the least BGA, and the BGA levels were monitored with no further action required. To help manage future BGA blooms GWMWater will be installing Dissolved Air Flotation by December 2022 to pre-treat the water from the Ouyen storages.

The Nyah pump station supplies water from the Murray River to open raw water storages at Eureka which are used only for rural supply. An algal bloom reached red alert levels on 17 February 2022 leading to a BGA warning notice to not use the water being provided to the rural customers in the supply system. Coagulant dosing was applied to the storage and effectively removed the BGA, meaning the warning could be closed on 3 March 2022.

11 Water Storage Manager

In addition to being a water supplier for the purposes of the *Safe Drinking Water Regulations*, GWMWater is also a water storage manager. This arises when a water corporation owns reservoirs or major headworks assets that supply water to multiple users, including other water corporations. Other water corporations may in turn use the water to supply drinking water to various localities.

GWMWater is a Water Storage Manager for some of the water used by Wannon Water and Coliban Water. To address GWMWater's obligations as a water storage manager a Memorandum of Understanding (MoU) between GWMWater and both these corporations is in place.

GWMWater has developed a risk management framework for the headworks storages under its control and meet with Coliban Water and Wannon Water on an annual basis. The management role includes water quality monitoring for a suite of predetermined parameters with all analysis being conducted by a NATA accredited laboratory. These results are made available to the other water corporations as needed, who have access to monitoring data conducted by GWMWater in its role of water storage manager.

In management of reservoirs in the Wimmera catchment, GWMWater liaise with the Wimmera CMA, and liaise with the Glenelg Hopkins CMA for management of Rocklands and Moora Moora Reservoirs.

Table 11-1 – Summary of water supply systems and relevant GWMWater infrastructure.

Catchments	Source Water	Raw water storage area	Treatment*	Treatment Plant	Water Receivers
Lake Bellfield	Supply System 4, Wimmera Mallee Pipeline	N/A	N/A	N/A	Coliban Water
Waranga Western Channel	Waranga Basin	N/A	N/A	N/A	Coliban Water
Willaura Headwork (Mt William and Stoney Creek or bore field)	Glenthompson Pipeline	N/A	N/A	N/A	Wannon Water
Rocklands Reservoir	Pipeline	N/A	N/A	N/A	Wannon Water

* The water storage manager does not apply any drinking water treatment processes before supplying its water.

11.1 Coliban Water

GWMWater provides raw water to Coliban Water, which subsequently treats the water and supplies it to the localities of Wedderburn, Bridgewater, Inglewood, Borung, Korong Vale and Wychitella (Figure 11-1). In winter this water is sourced predominately from Supply System 4 of the WMP, which is fed from the Grampians Headworks, primarily Lake Bellfield. Between November and April the raw water supply to Coliban Water can be switched to the Waranga Basin via the Waranga Western Channel. The supply was from the

Grampians Headworks at all times during the 2021/2022 period as there was sufficient capacity from Lake Bellfield and better water quality.

The catchment of Lake Bellfield is in the Grampians National Park, and is a moderately protected surface water (category 3). Taylors Lake provides an emergency back-up source of supply to the WMP if Lake Bellfield water is unsuitable. The catchment of Taylors Lake includes inflow from the Grampians National Park and land utilised for farming. Taylors Lake can also receive water transfers from other reservoirs within the Grampians Headworks. Taylors Lake and the Waranga Basin are considered to be a poorly protected catchment (category 4).

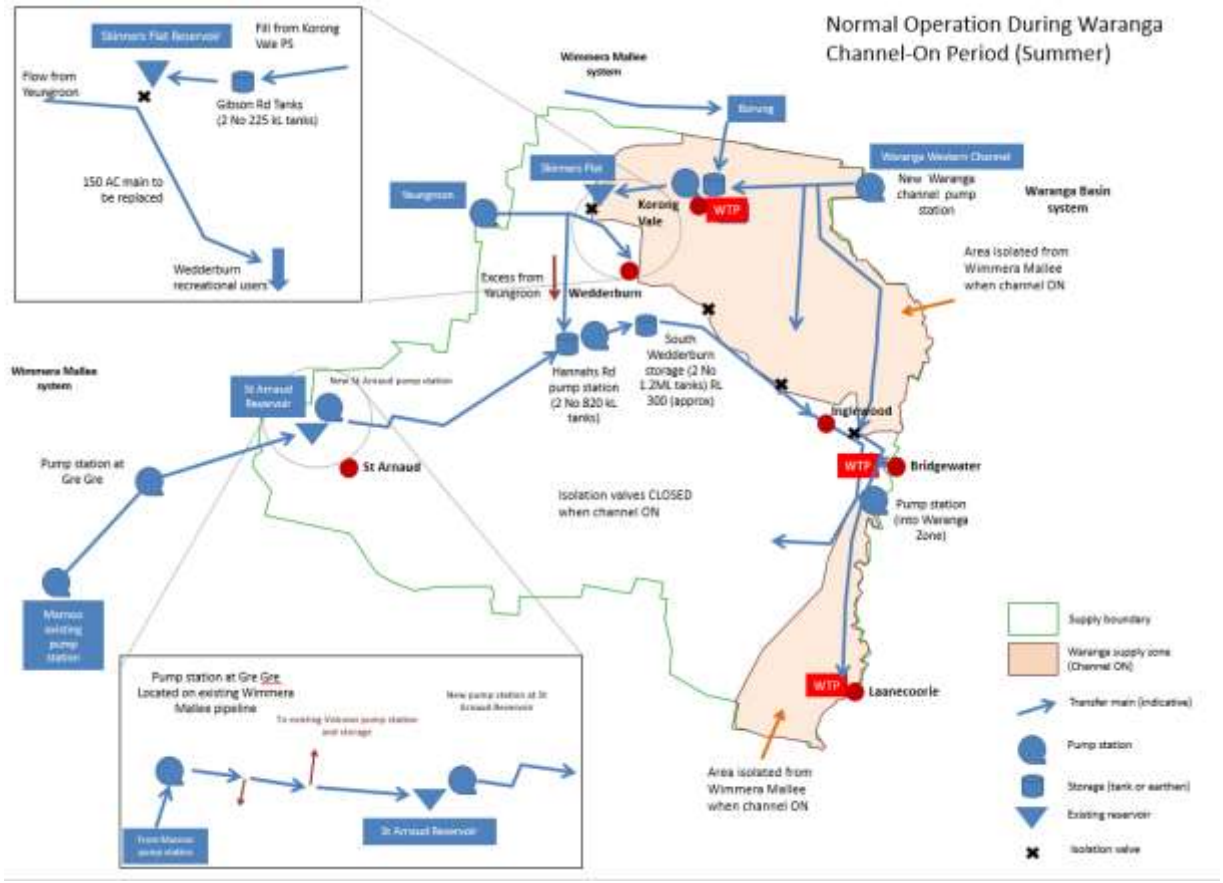

Figure 11-1 - Schematic showing supplies to Coliban Water from Bellfield and Waranga Western Channel (during summer).

11.2 Wannon Water

GWMWater delivers untreated water from the Willaura Headworks (Mt William and Stoney Creek) to Wannon Water through the Glenthompson Pipeline (Figure 11-2). Between the months of June and December, water supplied to Glenthompson is primarily from surface water diversion from unregulated waterways in the Grampians National Park. Groundwater bores supply water between January to May.

The bore water is considered a protected catchment (category 1), while the creeks deliver water from a moderately protected catchment (category 2). The overall catchment classification is category 2.

The water for Hamilton and Balmoral is taken directly from Rocklands Reservoir. Rocklands Reservoir is located between the Grampians National Park and Black Range State Park. The majority of the catchment is native forest; however, the storage is poorly protected (category 4).

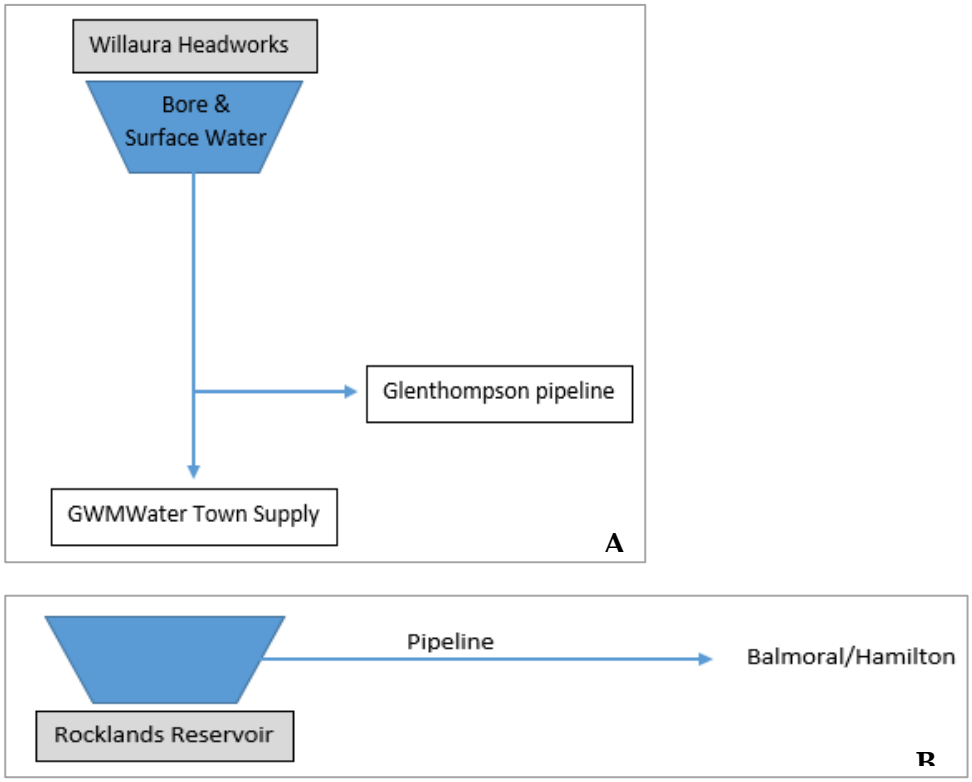

Figure 11-2 - Simplified schematic diagram showing supplies to Wannon Water from Willaura Headworks (A), and Rocklands Reservoir (B).

11.3 Water Storage Manager: Emergency, Incident and Event Management

The supply to Coliban Water was supplied through the Wimmera Mallee Pipeline from Lake Bellfield and not taken from the West Waranga Channel at any point for the year.

No incidents occurred for the Lake Bellfield supplied water.

No incidents occurred for the Rocklands Reservoir supplied water.

12 Glossary of Terms

Terms and abbreviations used in this report have been collated into a Glossary to provide clarity.

Term/Abbreviation	Description
ADWG, 2011:	The Australian Drinking Water Guidelines provide a framework for the management of drinking water supplies designed to ensure safety at the point of use.
Alum:	Aluminium sulphate as used as a coagulant in the water treatment process.
BGA:	Blue Green Algae.
BOOT:	Build, Own, Operate and Transfer. A form of commercial contract associated with the provision of treated water at privately-owned water treatment plants.
Bore:	Conduit for extracting groundwater from an aquifer to the surface for use in a town water supply.
CCP:	Critical Control Point in the Risk Management Plan.
Chlorination:	Process of adding chlorine to water as a disinfectant.
Coagulation:	The clumping together of solids so they can more easily be settled out or filtered out of water. A chemical called aluminium sulphate (alum) or aluminium chlorohydrate (Megapac 23) is generally used to aid coagulation in water treatment.
Concentration:	A measure of how much of a given substance there is mixed with another substance (in this case water), usually expressed as a weight to volume, e.g. milligrams per litre (mg/L).
CWS:	Clear Water Storage.
DELWP:	Department of Environment, Land, Water and Planning
DH:	Department of Health.
DBP:	Disinfection by-product – a reaction of natural organic material with the disinfectant medium producing by-products via reaction.
Disinfection-only	Water supplies that have disinfection as their only form of treatment.
Dissolution:	A form of chemical weathering in which water molecules, sometimes in combination with acid or another compound in the environment, attract and remove oppositely charged ions or ion groups from a mineral or rock.
Distribution system:	The system of pipes delivering water from the water treatment plant to the reticulation system.
Drinking water:	Legislatively defined as water intended for human consumption or associated with purposes for human consumption. Also known as a potable supply.
EC:	Electrical conductivity as measured in micro Siemens per centimetre (µS/cm).
Flocculation:	The water treatment process after coagulation that uses gentle stirring to cause suspended particles to form larger, aggregated masses (floc). The aggregates are removed from the water by a separation process (e.g. sedimentation, flotation, or filtration).
Fluoridation:	The act of adding fluoride to a water supply in accordance with the *Health (Fluoridation) Act 1973*.
Fully-treated water Supplies:	Water supplies that have coagulation and filtration processes in addition to disinfection.

GWMWater:	Grampians Wimmera Mallee Water Corporation (trading as GWMWater).
Hardness:	Caused by the presence of calcium and magnesium ions in water and can contribute to scale build up in pipes and appliances.
HU:	Scientific units for true colour measurements – Hazen Units.
kL:	Kilolitre (1,000 L).
L:	Litre
Megapac 23:	Aluminium chlorohydrate as used as a coagulant in the water treatment process.
mg/L:	Scientific units for the concentration of a parameter given as milligrams per litre. Also known as parts per million (ppm).
ML:	Megalitre (1,000,000 L).
NATA:	National Association of Testing Authorities, Australia. National Accredited Testing Authority.
NMP:	Northern Mallee Pipeline drawing its water from the Murray River.
Notifications:	Pursuant to Sections 18 and 22 of the *Safe Drinking Water Act,* 2003.
NTU:	Scientific units for turbidity measurements – Nephelometric Turbidity Units.
Orgs/100 mL:	Organisms per 100 mL. A measure of the number of *E. coli*.
pH:	The measure of the concentration of hydrogen ions in a sample related to a logarithmic scale between 1 (acidic) and 14 (basic).
Regulated water:	Water not intended for human consumption, but that could easily be mistaken as such. Also known as non-potable supply. This term is defined in the *Safe Drinking Water Act,* 2003.
Reticulation system:	The system of pipes delivering water to the customers tap from the entry point of the system.
RMP:	Risk Management Plan pursuant to the *Safe Drinking Water Act 2003*.
Safe Drinking Water Act, 2003:	Legislative framework for assuring drinking water quality in Victoria.
Safe Drinking Water Regulations, 2015:	Regulations made subsequent to the *Safe Drinking Water Act 2003* that give effect to key aspects of the Act.
Sampling:	The process of collecting a representative amount of water from a reticulation system to analyse and compare against the ADWG Standards and subsequently report to DH.
T&O:	Taste and odour.
THMs:	Trihalomethanes – disinfection by-products formed when using chlorine as a disinfectant. Take the form of trichloromethane, bromodichloromethane, dibromochloromethane and tribromomethane.
Undertakings:	Legally binding commitment made pursuant to Section 30 of the *Safe Drinking Water Act,* 2003.
WMP:	Wimmera Mallee Pipeline.
WPS:	Water pump station.
WTP:	Water treatment plant.
95th Percentile:	The value for which 95 percent of the time the data is below.

13 References

a) **Australian Drinking Water Guidelines 2011**, National Health and Medical Research Council, Canberra, 2011

b) ***Safe Drinking Water Act 2003*** (Act No. 46/2003), 11 June 2003, Parliament of Victoria.

c) **Safe Drinking Water Regulations 2015** (S/R No. 88/2015), 18 July 2015, Parliament of Victoria.

d) ***Health (Fluoridation) Act 1973***, (Act No. 8506/1973), 1 July 1973, Parliament of Victoria.

e) **Code of Practice for fluoridation of drinking water supplies**, Second edition, Department of Health and Human Services, Victoria, 2018.

f) **Victoria Government Gazette No. S 344,** 30 August 2019, Victorian Government.