Water Quality Annual Report

2014/15

Falls Creek Alpine Resort Management Board
Water Quality Annual Report

Contents

Legislative Background

Section 26 of the *Safe Drinking Water Act 2003* (SDWA) requires water suppliers and water storage managers to provide to the Secretary of the Department of Health and Human Services (DHHS) an annual report each financial year. Falls Creek Resort Management ('FCRM') is the water supplier for the Falls Creek Alpine Resort. This report is for the 2014-15 reporting period and covers issues relating to the quality of drinking water.

FCRM's obligations under the SDWA include:

- A requirement to prepare and implement plans to manage risks in relation to drinking water;
- A requirement to have the risk management plan audited by approved auditors;
- To ensure that the drinking water meets quality standards specified by the regulations;
- To disclose to the public information concerning the quality of drinking water; and
- To report known or suspected contamination of drinking water to the Secretary of the DHHS.

Some of the information to be included in the annual report is specified by Section 15 of the Safe Drinking Water Regulations 2005 (SDWR) and includes information evidencing compliance or non-compliance (as the case requires) with the regulations; namely:

a) information evidencing compliance or non-compliance (as the case requires) with regulations 10, 11 and Schedule 2;

b) information about actions taken by the water supplier when a drinking water quality standard set out in regulation 10 and Schedule 2 has not been met;

c) information about actions taken by the water supplier in respect of each emergency, incident or event that has arisen that has affected:
   (i) the quality of drinking water supplied generally; and
   (ii) the quality of drinking water supplied where that supply posed a risk to human health;

d) any issues that may have arisen out of the actions referred to in paragraph (c);

e) an analysis of water sample information, data and results relating to the quality of drinking water supplied and a comparison of that information and data, and those results, with water sample information, data and results from the previous 2 financial years;

f) a summary of every:
   (i) variation in aesthetic standards approved under section 19 of the Act in respect of drinking water supplied by the water supplier and any conditions imposed under section 21 of the Act;
   (ii) exemption from a water quality standard approved under section 20 of the Act in respect of drinking water supplied by the water supplier and any conditions imposed under section 21 of the Act; and
   (iii) written undertaking by the water supplier accepted by the Secretary under section 30 of the Act;

g) a summary of complaints received by the water supplier relating to the quality of drinking water supplied, a summary of the responses and any analysis of the issues arising from the complaints;

h) a summary of the process by which the drinking water supplied by the water supplier is disinfected or treated and any other processes applied to the water by the water supplier, and any issues arising out of the application of those processes;

i) a list of all the chemicals and other substances, and any processes, used by the water supplier to disinfect or treat the drinking water supplied by it;

j) a summary of steps taken by the water supplier to manage the aesthetic characteristics of the drinking water supplied by it, including steps taken to manage the taste, odour, clarity and pH of the drinking water supplied;

k) details of any regulated water supplied by the water supplier and the declaration under section 6 of the Act in respect of that regulated water;

l) details of the steps taken in accordance with section 25 of the Act; and

m) a summary of the findings of the most recent risk management plan audit and any issues that the approved auditor raised during the risk management plan audit.

Section 23 of the SDWA requires that FCRM make available for inspection by the public the results of any water quality monitoring program that is conducted on any drinking water supplied by us. Customers and members of the public may access drinking water quality data by contacting FCRM on (03) 5758 1200 during business hours.

1 Introduction and System Overview

FCRM is responsible for the development, promotion and management of the Falls Creek Alpine Resort which is located 120 kilometres south of the Albury/Wodonga area is situated at an altitude of 1210-1830 metres, and is surrounded by the Alpine National Park.

The entire resort area of 1535 hectares is Crown land, which is deemed to be permanently reserved as an alpine resort under the *Crown Land (Reserves) Act 1978*. The Resort area is not part of any municipal district for the purposes of the *Local Government Act 1970* and the Board acts on behalf of the Crown under the direction and guidance of the Minister for Environment and Climate Change ("the Minister").

The Board is established by the *Alpine Resorts (Management) Act 1997* which sets out the objectives for the management of Victoria's alpine resorts.

The resort is set aside for alpine recreation and tourism. The development, promotion, management and use of the resort is to be undertaken in a manner which is compatible with the alpine environment having regard to economic, environmental and cultural considerations. The village area supports administrative, retail and commercial business as well as a large variety of accommodation.

The village population, and consequent demand for water, is highly seasonal. Approximately 140,000 people visited the resort during the 2014 winter season resulting in 356,000 visitor days – a 3% increase on 2013.

FCRM provides a range of services to the community and resort visitors determined by clearly defined functions under the Act. These include the provision of a range of utility services in the nature of:

(i) garbage disposal;
(ii) water supply;
(iii) gas;
(iv) drainage;
(v) sewerage;
(vi) electricity;
(vii) roads;
(viii) fire protection;
(ix) snowmaking; and
(x) transport.

FCRM recognises that it has an obligation to provide quality drinking water services for our customers and has in place a risk management framework that sets out the process and approach for the protection of public health by proactively managing water quality from the source through to the customer points of supply.

This report outlines drinking water quality achieved for the 2014-15 financial year and has been prepared to provide our customers with information relating to the quality of water supplied and to comply with the annual reporting requirements under Section 26 of the SDWA. The report covers issues relating to the quality of drinking water and is structured in accordance with the 2014-15 Annual Report Drinking Water Regulation Guidance Note issued by the DHHS in June 2015.

The report is divided into 10 sections:

1. Introduction and characterisation of the system.
2. Water treatment and water quality management systems.
3. Quality of drinking water for 2014-15.
4. Emergency and incident management.
5. Complaints relating to water quality.
6. Audit outcomes
7. Findings of the most recent risk management audit.
8. Undertakings under section 30 of the Act.
9. Regulated water.
10. Glossary of terms and further information.

For further information, please contact FCRM's Director Infrastructure and Mountain Response, Callum Brown on (03) 5758 1200 during business hours.

1.1 Characterisation of the System

1.1.1 Overview

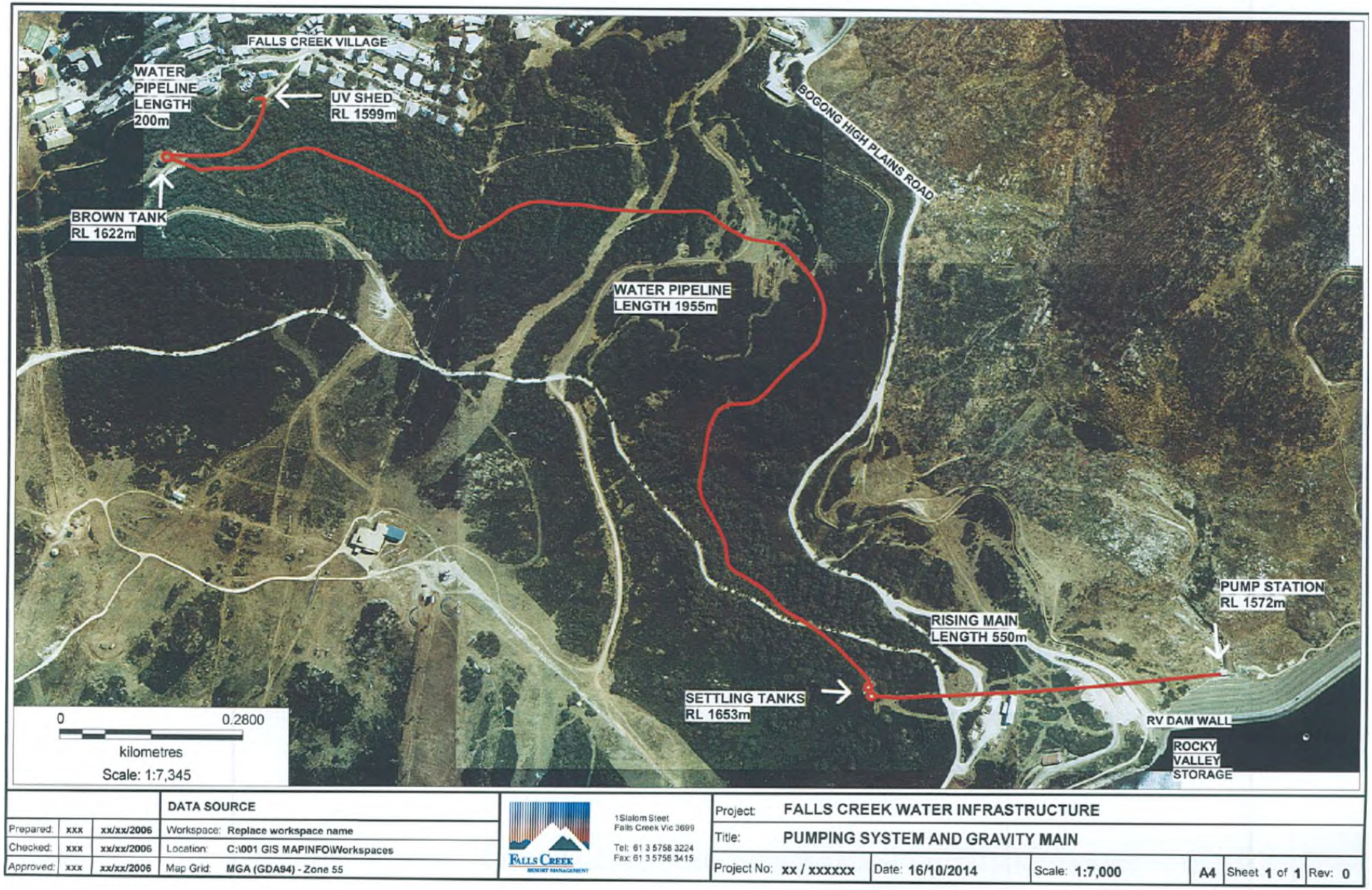
The drinking water for Falls Creek is sourced from Rocky Valley Dam which is located in the Alpine National Park and is operated by AGL Hydro for hydro electricity generation.

The drinking water supply system that services the Falls Creek Alpine Resort is comprised of the following elements:

Table 1: Falls Creek Water Supply System Elements

Element	Description	Location and key information about infrastructure
Catchment	Falls Creek Alpine Resort and Alpine National Park	Catchment is upstream of village area and predominantly within the National Park with no dwellings, farming or industry.
Source Water	Rocky Valley Lake	Operated by AGL Hydro
Headworks	Pump Station and Rising Main	Water is pumped from the dam through duplicate 150mm diameter rising mains to the settling tanks. Pump capacity is 30 L/s.
Distribution System	Settling Tanks, Distribution Main and Brown Tank	Pumped water passes through settling tanks and it is gravity fed by two No. 150mm diameter PVC mains to the service tank (Brown Tank) above the village. From the Brown Tank water is fed by gravity through the UV treatment and into the reticulation system serving the Resort.
Treatment System	UV	Two units installed in parallel: (a) 5 kW medium pressure lamp. (b) 4 kW medium pressure lamp.
Reticulation	Network of pipelines delivering to consumers within the village	Total of almost 4 km reticulation system of predominantly 100mm to 150mm diameter DICL pipe.
Water Sample Locations	Falls Creek	(960A01) Horseshoe Creek Apartments, Falls Creek Road (960A02)Alpha Lodge, Parallel Street (960A03) Administration Building, BHP Road (960A04) Sewerage Treatment Plant (960A05) FCRM Workshop, BHP Road (960A07) Technical Services Building, Snow gum Lane (960A08) Gully Shelter, BHP Road (960A09) Milch, Schuss Street 960A10) Lift Company Building, Village Bowl (960A11) Primary School, Slalom Street
Populations Supplied	120 -1,500 (Summer) to 5,000 (Winter)	
Substances Added	Nil	

Figure 1 – System Diagram



1.1.2 Catchment

The water supply catchment for Falls Creek Alpine Resort is upstream of the Falls Creek village. Runoff in the catchment is from snow melt and rain runoff which is collected in a series of aqueducts and small-mountain streams before flowing into the Rocky Valley Dam which has a full supply capacity of 28,000 megalitres.

Despite the close proximity of the catchment to the town of Falls Creek, there is minimal public access. Only one main road passes through the catchment, which is well vegetated and remains in close to pristine condition. As a result there are no significant point sources of faecal pollution entering the water source – Rocky Valley Dam. There are no intensive livestock operations, dairies, grazing properties, hobby farms, sewage treatment plant discharges, manure spreading applications, aggregations of septic tanks or sewer overflow structures. Recently, access to the catchment to grazing cattle was closed by Parks Victoria, further reducing potential faecal inputs.

The water source is at no immediate risk of gross contamination with faecal-oral pathogens and there is a need to maintain that position through protecting the source. There is recreational access within the catchment with skiing and related activities in winter and hiking and boating activities in summer. Some water reaching the dam flows through the resort area and may pick up material leaching or being spilt within the Resort. Therefore, the source is at some risk from trace levels of contamination from occasional open human defecation, occasional water entry acts by persons, some runoff or exfiltration seepage and some wildlife faecal material. Therefore, like any surface water, there is sufficient risk present to justify disinfecting the source.

The long-term results of raw water monitoring typically show very few detectable *E. coli* in 100 ml samples and what detections there are typically show single digit concentrations per 100 ml. Therefore, the level of risk is adequately mitigated by the current level of disinfection in place involving sedimentation and UV disinfection with the option to draw from one of two quite distinct points in the Rocky Valley Dam source as well as the Frying Pan Spur Aqueduct (discussed in more detail later).

It is possible that the levels of activity in and around the dam may increase in future. Improvements in treatment automation and reliability should help to offset some of the risks of additional contamination that may arise from these increased activities. However, there is a need for FCRM to work with Parks Victoria and AGL Hydro to maintain a good understanding of the level of risk associated with this source. At some point it may be judged necessary to introduce an additional treatment barrier beyond the sedimentation tanks and UV systems currently in place. The logical next step would be to introduce a package membrane filtration system or ozone disinfection system if levels of activity on the lake increase beyond low levels.

1.1.3 Headworks System

Water is drawn from the Rocky Valley Dam which is owned and operated by AGL Hydro and principally used for the commercial generation of electricity.

There is an aerator in the dam itself and a compressor line into the dam. The aerator is important to help reduce stratification of the dam and, in turn, reduce the risk of iron or manganese causing problems with UV disinfection system performance or causing problems with aesthetic water quality.

The Resort supply is pumped from an off-take point on the dam low level outlet and scour pipe to a pair of settling tanks through 550m of duplicate 150mm diameter PVC rising main. There is a level control pressure switch in the settling tanks which is hard wired back to the control panel in the pump station.

There are three (3) pumps in total, two (2) of which operate on a duty/standby arrangement while the third is a stand-alone backup pump. The pumps deliver approximately 30L/s at 70 metres head.

There is no telemetry at the pumping station requiring that the pumps be inspected daily. Access to the pump station in the winter months is usually by oversnow vehicle.

1.1.4 Distribution System - Settling Tanks, Gravity Main and Brown Tank

The settling tanks (0.6ML – constructed in 2004) are located on the hillside above the dam. After a nominal settling period in the tanks, the water flows for just under 2km by gravity through initially 20m of 300mm diameter DI pipe and then two PVC pipes to the header tank ('Brown Tank' – 1.7 ML). The water then flows by gravity for 200m to the UV disinfection plant before entering the reticulation that services the village. The capacity of the Brown Tank is about 15% greater than the current maximum daily demand.

A detailed investigation of the village water reticulation network carried out in 2004/05 highlighted that the twin gravity feed trunk mains which convey water from the high level settling tanks to the 'Brown Tank' above the village needed replacement and plans were made to install a single 300mm main in lieu of the old twin mains. The lower section of 600 metres was replaced in 2005 and it is ultimately planned to complete the remaining 1320 metres to the settling tanks.

Both tanks are inspected regularly (daily in winter) and there is now telemetry and an alarm system for the UV plant operation and the storage tank level.

1.1.5 Reticulation System

The majority of the 3.86km reticulation system is constructed from rubber ring jointed cement lined ductile iron pipe (DICL), 5.5m in length which was installed progressively since 1988. There is a short section of AC pipeline remaining, which is still in use and the remaining uPVC pipes that are still in service are located between the Snow Ski Apartments and the top of Falls Creek Road, and from the Waste Water Treatment Plant to Bogong High Plains Road.

Because of the limited space in many instances most of the utility services have been laid in a common trench.

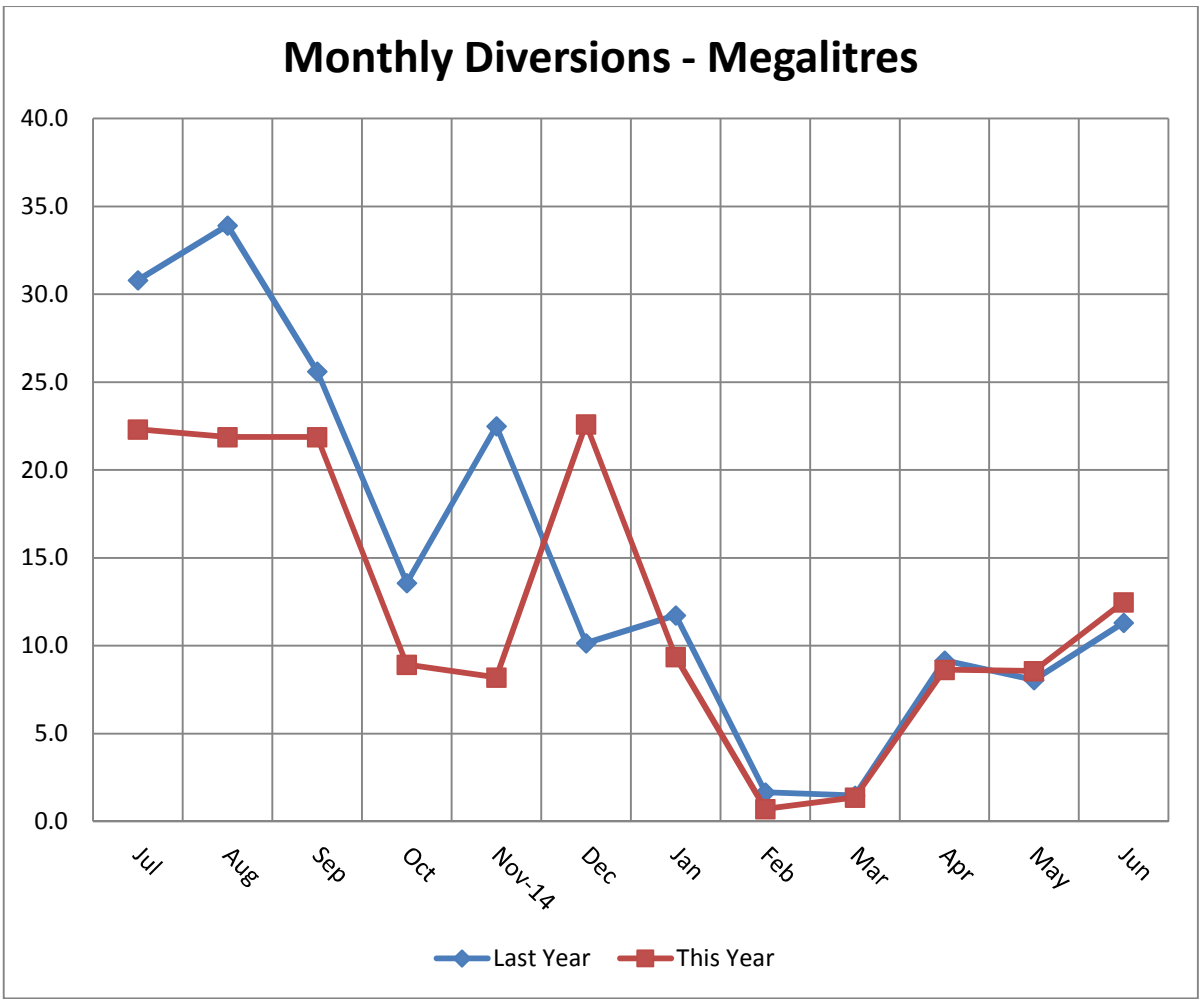
1.2 Demand

System demand varies with seasonal visitation and the average daily flow fluctuates from around 0.25 megalitres per day (ML/d) up to 1.5 ML/d during the peak of winter (population approx. 5000). The total volume pumped from Rocky Valley Dam for the last five years is as per Table 2 below.

Table 2: Consumptive Water Usage

Year	Volume Diverted (ML)
2014-15	147
2013-14	180
2012-13	195
2011-12	171
2010-11	198
2009-10	231

The winter seasonal nature of highest consumptive use is demonstrated in the following graph of monthly diversions.


Monthly Diversions - Megalitres
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Jul
Aug
Sep
Oct
Nov-14
Dec
Jan
Feb
Mar
Apr
May
Jun
Last Year
This Year

2 Water Treatment and Quality Management Systems

2.1 Water Treatment

Water entering the reticulation from the storage tank is disinfected using UV treatment. The UV disinfection plant installed at Falls Creek is adequate to safely disinfect the raw water under normal circumstances and under higher demand than at present.

Disinfection is provided by two UV units in installed in parallel with automatic switching should a failure occur.

One is a 400 kL/h stainless steel UV disinfection system which includes a single standard 5 kW medium pressure lamp. The unit is the 'basic' model with analogue UV intensity sensor and no automated cleaning. Because *E. coli* has a similar sensitivity to protozoan parasites, and because the unit is a medium pressure unit which is much more effective on viruses than low pressure units, the unit is sufficiently effective on all relevant pathogens to treat water from the Rocky Valley Reservoir which is only likely to contain relatively low concentrations of pathogens.

Whilst the manufacturer recommends that lamps are replaced every 6000 hours they are replaced every six months, which is at around 4,380 hours. Lamps may be changed more often than this in practice, e.g. if the lamps appear dirty or if there is any doubt about the lamps.

The second unit has a 4 kW medium pressure lamp with an operating life of 14,000 hours. This unit has been set up as a stand by unit should the main unit fail to operate in accordance with specification.

High turbidity can reduce the amount of UV radiation reaching microorganisms and necessitate higher doses of applied radiation for effective disinfection. Units require regular cleaning and maintenance to remain effective. FCRM has established a Target Level of 3 NTU and a Critical Limit of 5 NTU based on past experience that demonstrates that disinfection of water under such conditions is effective.

Online remote sensing equipment with dial out alarm functionality was installed in 2010-11 which has further enhanced the water treatment system security.

There are no chemicals used for both water treatment and disinfection.

Locality	Source Water	Treatment Process	Added Substances	Comments
Falls Creek	Rocky Valley Lake	UV Disinfection	Nil	Nil

2.2 Quality Management Systems

Prevention is an essential feature of effective drinking water quality management. Preventive measures are those actions, activities and processes used to prevent hazards from occurring or reduce them to acceptable levels. All preventive measures are important and should be given ongoing attention. However, some can significantly prevent or reduce hazards and are amenable to greater operational control than others. From among the preventive measures, critical control points should be identified for those hazards that represent a significant risk and require elimination or reduction to assure supply of safe drinking water.

There are four critical control points associated with the Falls Creek water supply system. These are the lake (source water), the storage tank (Brown Tank), the UV treatment plant and the reticulation system. These are summarised in the following table.

Critical Control Point	Hazard	Controls	Process Monitoring
Raw water source	▪ Lake stratification resulting in stagnant and anoxic conditions at the offtake with consequential increase in dissolved iron and manganese and other detrimental changes in the water supply	▪ Aeration facilities. ▪ Alternative raw water source.	▪ Local 48 hour sampling of iron and temperatures of epilimnion and hypolimnion in mid-summer.

Critical Control Point	Hazard	Controls	Process Monitoring
Storage Tank (Brown Tank)	▪ Loss of supply/pressure	▪ Automatic controls from settling tanks to pump station.	▪ Online monitoring. ▪ Operational responsibility – duty officer response to water level alarm. ▪ Inspection regime in accordance with Risk Management Plan.
Disinfection	▪ Microbial	▪ Operating procedures. ▪ Duplicate UV units. ▪ Back-up power generation.	▪ Online monitoring. ▪ Operational responsibility – 7 days in winter. ▪ Inspection regime in accordance with Risk Management Plan.
Reticulation	▪ Build-up of slimes on walls. ▪ Stagnant areas	▪ Mains flushing	▪ Observational monitoring of physical water quality ▪ Monitoring of plate counts.

Critical Limits and System Targets have been established for each critical control point and detailed operational monitoring and corrective action procedures have been documented.

2.3 Issues

The effectiveness of UV disinfection diminishes with increasing turbidity, colour, iron and organic content in the raw water and at times the source water is outside the accepted desirable values for reliable performance. It is also known that the water in the lake at the off-take becomes stagnant in mid-summer due to thermal stratification. This in turn gives rise to increases in dissolved iron and manganese which affects the aesthetic quality of the water and poses a risk of inadequate disinfection with the UV treatment process.

The measures employed to mitigate the risk are discussed in detail in section 4.3 of this report.

There were no issues arising out of the processes used to disinfect drinking water in 2014-15.

2.4 Mains Cleaning

A mains jet cleaning program was commissioned in March as part of the cyclic maintenance program. All of the reticulation network was cleaned in this manner over a period of about six weeks. This has been effective in eliminating coliform detections in the reticulation samples which had been increasing beforehand.

3 Quality of Drinking Water for 2014-15

The water quality is to be compliant with Regulations 10 and 11 and Schedule 2 of the Regulations. For regulatory compliance, the parameters tested on a weekly basis are *Escherichia coli* and turbidity. Iron at four locations is also tested on a weekly basis and other health and aesthetic characteristics are also tested less frequently throughout the year. *E. coli* and turbidity test results are submitted to the DHHS monthly throughout the year in accordance with Regulation 13. The following table presents the Schedule 2 reporting summary results.

Falls Creek Schedule 2 Summary Details

Water Sampling Locality	Sampling Frequency	Water Quality Standard	Results	Outcome
Escherichia coli	Weekly	At least 98% of all samples of drinking water collected in any 12 months period to contain no *Escherichia coli* per 100mL.	100% of all samples.	Compliant
Turbidity	Weekly	95% upper confidence limit of the mean of drinking water samples collected in the preceding 12 months must be less than or equal to 5.0 NTU	0.8 NTU	Compliant

3.1 E.coli

3.1.1 Test Results

Water Sampling Locality	Sampling Frequency	No. of samples	No. of samples containing *E. coli*	Max Result (orgs/100mL)	% Samples with no *E. coli*	Complying (Yes/No)
Falls Creek	Weekly	104[1]	0	0	100%	Yes

3.1.2 Actions in relation to non-compliance

None required.

3.2 Turbidity

3.2.1 Test Results

Water Sampling Locality	Sampling Frequency	No. of samples	Max NTU	Min NTU	95% UCL of mean	Complying (Yes/No)
Falls Creek	Weekly	52	3.1	0.1	0.8	Yes

3.2.2 Actions undertaken in relation to non-compliance

None required.

3.3 Chlorine based disinfection by-product chemicals

Falls Creek does not use chlorine based disinfection products so this parameter is not monitored.

3.4 Ozone based disinfection by-product chemicals

Falls Creek does not use ozone based disinfection products so this parameter is not monitored.

3.5 Aluminium

Falls Creek does not use aluminium based products in its treatment process so this parameter is not monitored.

[1] Two (2) sampling sites are monitored weekly

3.6 Fluoride

Falls Creek does not add fluoride to its drinking water so this parameter is not monitored.

3.7 Other algae, pathogen, chemical or substance not specified above that may pose a risk to human health

3.7.1 Test Results

Results for the reporting period are as shown below. All tested parameters were within the ADWG guideline values.

2014-15

Parameter	Frequency of Sampling	Number Samples	No of non-complying Results	Maximum test value (mg/L)	ADWG Guideline (mg/L)	Meets Guideline (Yes/No)
Arsenic	6 Monthly	2	0	<0.001	0.01	Yes
Cadmium	6 Monthly	2	0	<0.0002	0.002	Yes
Chromium	6 Monthly	2	0	<0.001	0.05	Yes
Copper	6 Monthly	2	0	0.61	2	Yes
Fluoride	Annually	1	0	<0.05	1.5	Yes
Lead	6 Monthly	2	0	<0.001	0.01	Yes
Manganese	6 Monthly	2	0	0.0	0.5	Yes
Mercury	6 Monthly	2	0	<0.0001	0.001	Yes
Nickel	6 Monthly	2	0	<0.001	0.02	Yes
Selenium	6 Monthly	2	0	<0.001	0.01	Yes
Sulphur	6 Monthly	2	0	<0.5	500	Yes

3.7.2 Actions undertaken in relation to non-compliance

None required.

3.8 Aesthetics

With the exception of iron, all parameters tested were compliant with the aesthetic guideline values for the reporting period.

3.8.1 Test Results

2014-15

Parameter	Frequency of Sampling	Number Samples	Units	Mean Value	Maximum test value	Minimum test value	ADWG Guideline
pH	Quarterly	4	pH units	6.5	6.9	6.1	6.5-8.5
Total Dissolved Solids	4 Monthly	3	EC	13	15	11	1000
Colour	4 Monthly	3	HU	5.3	8	2	15
Total Alkalinity	6 Monthly	2	mg/L	5.5	6.0	5.0	N/A
Calcium	6 Monthly	2	mg/L	1.4	1.4	1.3	N/A
Chloride	6 Monthly	2	mg/L	<1	<1	<1	250
Hardness	6 Monthly	2	mg/L	4.0	4.0	4.0	200
Iron	Weekly	52	mg/L	0.12	0.44	<0.05	0.3
Magnesium	6 Monthly	2	mg/L	0.2	0.2	0.2	N/A
Potassium	6 Monthly	2	mg/L	0.2	0.2	0.2	N/A
Silica	6 Monthly	2	mg/L	2.3	2.8	1.8	N/A
Sodium	6 Monthly	2	mg/L	0.6	0.6	0.6	180
Zinc	6 Monthly	2	mg/L	0.04	0.04	0.03	3

3.8.2 Actions undertaken where aesthetic guideline value is not satisfied.

On 30 October, 2014 a low pH reading of 6.1 was recorded. At this time the supply was being supplemented by a groundwater bore in the vicinity of the Brown tank and the low pH is due to the purity of the groundwater with low buffering capacity dissolving carbon dioxide from the air to form carbonic acid. The bore was disconnected and pH returned to within the guideline values – see also section 5.

On 13 January, 2015 the concentration of dissolved iron in the reticulation sample was 0.44mg/L which is above the guideline value and double that of the preceding week indicating that there has been a rapid onset of stratification of the lake. The supply was immediately switched to the snow making system and iron level fell back to 0.22mg/L within a week. There was another brief spike of 0.42mg/L on the week of 16 March, 2015 which coincided with the switch back to the lake supply due to the residual in the settling tanks. The level quickly receded to 0.18mg/L within a week as this water was flushed through the system.

3.9 Analysis of Results

3.9.1 Overview

The quality of the delivered water is very good. Bacteriological testing results in 2014-15 were fully compliant and the 95% upper confidence limit of the mean for turbidity of 0.8 NTU is comfortably within the required water quality standard of 5.0 NTU. All other health based parameters tested were well within the guideline values.

3.9.2 Discussion and Trends

E. coli

There were no recorded instances of *E. coli* in the reticulation system during the reporting period. Results for the reporting period and the preceding 5 years are shown in the table below.

Year	Sampling Frequency	No. of samples	No. of samples containing *E. coli*	Max Result (orgs/100mL)	% Samples with no *E. coli*	Complying (Yes/No)
2014-15	Weekly	104	0	0	100%	Yes
2013-14	Weekly	104	1	1	99%	Yes
2012-13	Weekly	104	0	0	100%	Yes
2011-12	Weekly	104	0	0	100%	Yes
2010-11	Weekly	104	0	0	100%	Yes
2009-10	Weekly	103	1	1	99%	Yes

Since 1993 there have been 14 recorded instances when the indicator organism *E. coli* had been detected. The maximum recorded was 3 orgs/100mL during the 2003 bushfires. In all other instances the value was 1 org/100mL.

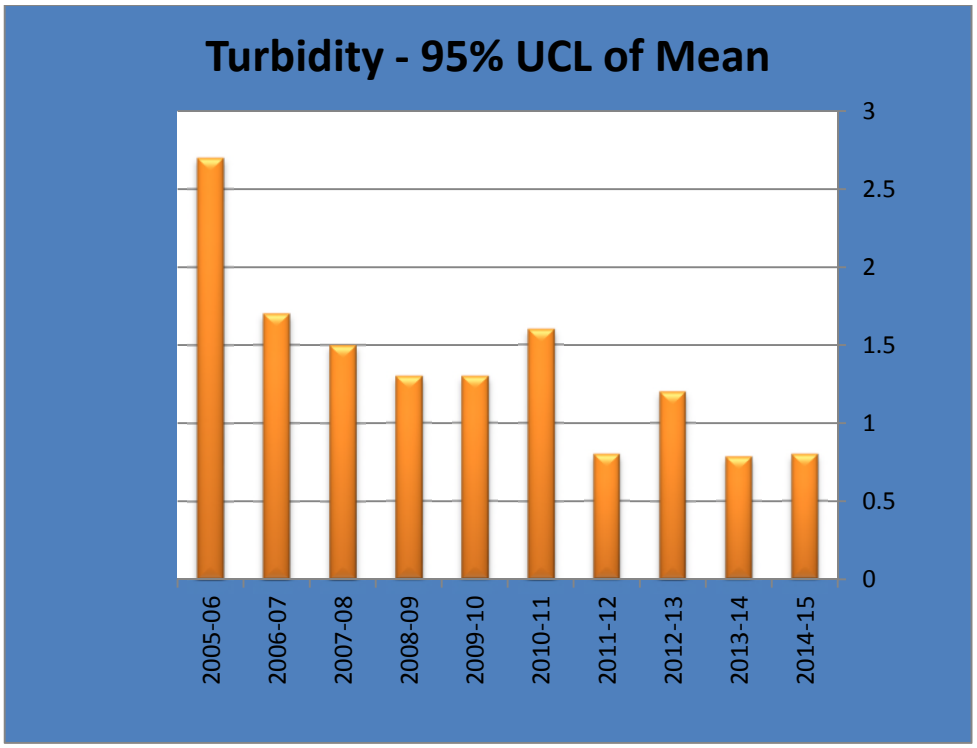
Turbidity

The sedimentation basins are reasonably effective in reducing turbidity levels of the raw water from the dam before UV treatment. During the reporting period the turbidity range was 0.1 to 3.1 NTU and the 95% upper confidence limit of the mean of 0.8 NTU is well within the required water quality standard of 5.0 NTU.

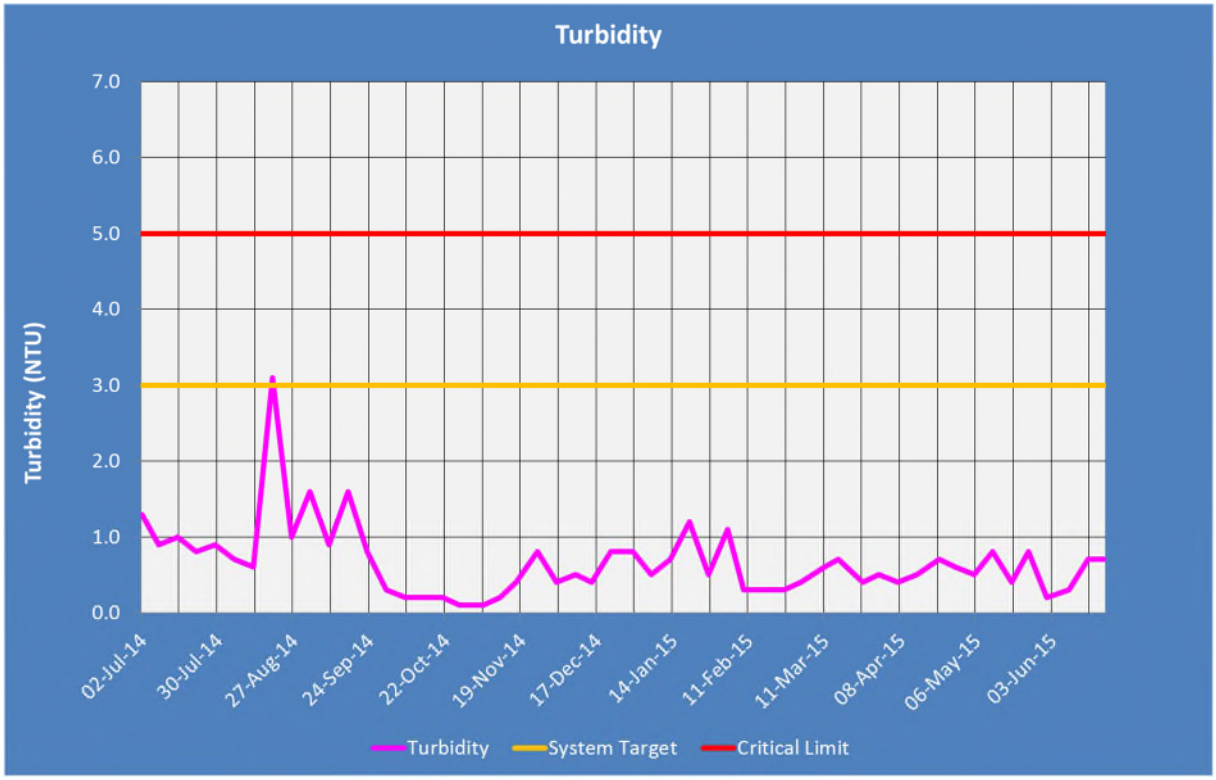
Turbidity sampling results for the reporting period and the preceding 5 years are shown in the following table.

Year	Sampling Frequency	No. of samples	Max NTU	Min NTU	95% UCL of mean	Complying (Yes/No)
2014-15	Weekly	52	3.1	0.1	0.8	Yes
2013-14	Weekly	52	2.3	0.2	0.8	Yes
2012-13	Weekly	52	4.4	0.2	1.3	Yes
2011-12	Weekly	52	0.2	1.6	0.8	Yes
2010-11	Weekly	51	12	0.3	1.6	Yes
2009-10	Weekly	52	3.1	0.3	1.3	Yes

Improved operational procedures in relation to the source water in recent years (refer also to section 4.3) has seen a gradual improvement in the 95% upper confidence limit of the mean as demonstrated in the graph below.



Weekly turbidity readings for the year are show graphically below.

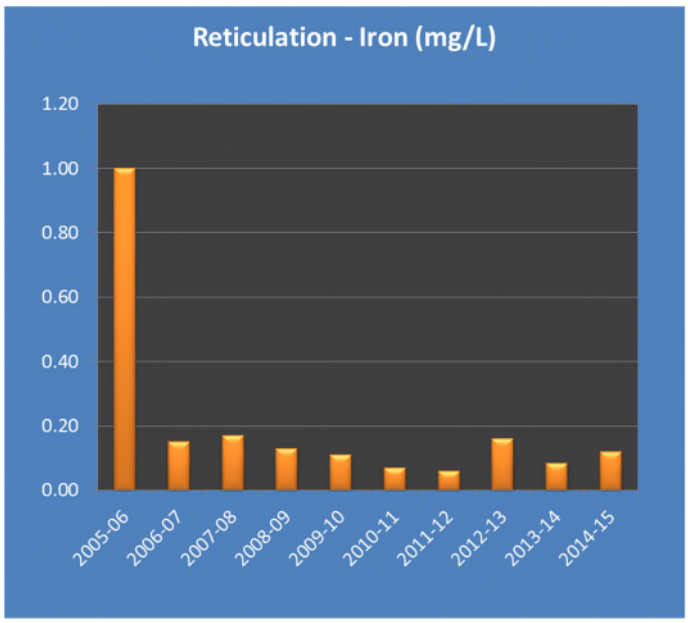


Health Parameters

All health based parameters are well within the guideline values and there is no trend evident with these.

Aesthetics

The water quality testing regime shows that the source water in the dam suffers from dirty water problems in late summer and mid-winter. This is reflected in elevated levels of dissolved iron and manganese which causes a characteristic brown tinge to the water. Improved operational responsiveness to the change in quality of the source water by taking supply from alternative sources (aqueduct or the snow making system) during periods of stagnation in summer started in 2006-07. This has produced a marked improvement in the tested iron levels in the reticulated supply. The trend in dealing with this issue is demonstrated in the graph of annual average levels shown below. For further detail refer also to section 4.3 below.



Summary

In summary, the bacteriological water quality delivered to customers continues to be safe, largely due to the fact that under most circumstances the source water is of high quality and the UV plant has a capacity for significantly higher demand. The long-term results of raw water monitoring typically show very few detectable *E. coli* in 100 ml samples and the current level of risk is adequately mitigated by the treatment processes in place involving sedimentation and UV disinfection. UV treatment has been effective since the new plant was installed in 1997.

The summer stratification of the lake was earlier than normal this year with the source water iron level rising above the aesthetic guideline of 0.3mg/L in the last week of December reaching a peak of 1.4mg/L by 13 January. After switching to the snow making system which draws water from the surface, the iron levels in the reticulation were maintained below 0.3mg/L during the lake stratification period.

4 Emergency/Incident Management

Although preventive strategies are intended to prevent incidents and emergency situations from occurring, some events cannot be anticipated or controlled, or have such a low probability of occurring that providing preventive measures would be too costly. For such incidents, there must be the ability to respond promptly, constructively and efficiently.

There are a number of hazards or events that can lead to emergency situations, including:

- Failing to meet guideline values and other requirements;
- Accidents that increase levels of contaminants (e.g. spills in catchments, incorrect dosing of chemicals);
- Equipment breakdown and mechanical failure;
- Prolonged power outages;
- Extreme weather events (e.g. flash flooding, cyclones);
- Natural disasters (e.g. fire, earthquakes, lightning damage to electrical equipment); and
- Human actions (e.g. serious error, sabotage, strikes).

FCRM has an Emergency Management Plan under the *Emergency Management Act 1986* and this plan is regularly updated and audited. The most recent independent audit of this plan was conducted in June 2011, which found the plan compliant.

4.1 Section 22 Reports

There were no incidents requiring notification under Section 22 of the Act during the reporting period.

4.2 Incidents

Water Leak – August, 2015

On 17 August, 2014 there was a report of a burst water main within the village. Being in the peak of the snow season with an average snow cover in excess of 1.2 metres makes it very difficult to locate the source of a leak. After an extensive search of the system reticulation and many properties within the village the problem was located in a service connection to a property in Slalom Street at 6pm. Some properties were without water for very brief periods while break was being investigated as the process involved isolating small sections of reticulation one at a time between isolating valves until the problem was located. The break was isolated and a temporary connection is was established for the remainder of the snow season until permanent repairs could be carried out.

There was some drawdown of the water level in the Brown tank as a direct result of the water leak which was overcome by connecting to the snow making infrastructure to recharge the tank at a quicker rate and normal levels were restored in the early evening. There was no risk to public health. An email advice to stakeholders explaining what had occurred was sent out at 10pm.

Lightning Damage – June, 2015

As a result of a lightning strike in June, 2015, the uninterrupted power supply unit (UPS) within the UV facility was damaged. The UV plant has two backup power supplies to ensure that any water entering the village is treated and safe to consume. One is the UPS which has enough battery capacity to cover the time it takes for the second backup generator to start up and supply power to the UV lamps.

A brief shut-down while the replacement UPS unit was installed was carried out on 23rd June, 2015 lasting about 40 minutes. The shut-down was planned because of the necessity to isolate the power to the plant during the replacement process. All stakeholders were notified by email on 22nd June and advised to fill kettles and/or water bottles prior to the shutdown and to refrain from other water use during the shut-down. The changeover went smoothly and positive pressure was maintained throughout the system during this time.

4.3 Lake Stratification

Stratification occurs in deep reservoirs and is a common cause of poor water quality, especially where the water supply is taken from the bottom of the reservoir. The source water for the Falls Creek water supply coming from the Rocky Valley Lake is of a poorer quality during two periods of the year which correspond with a stratified condition of the lake. This in turn has the potential to impact on the quality of the drinking water within the village.

There is a marked decrease in dissolved oxygen during the period of stratification. The dissolved oxygen in the hypolimnion (deeper) waters is reduced due to normal biological activity and as this oxygen is not being replenished the water eventually becomes stagnant and anoxic with consequent increase in dissolved iron and manganese and other detrimental changes in the water supply. As the stratification persists obnoxious smelly gases are also generated.

When this water is drawn off and comes in contact with oxygen, the iron dissolved as ferrous carbonate is precipitated as red ferric oxide and the dissolved manganese comes out of solution and causes a build-up of black slime, and there is often a smell of hydrogen sulphide in the water.

The bushfires in December 2006 and January 2003 have exacerbated the effects of lake stratification by increasing chemical levels in the lake. Immediately after the fires, iron and turbidity levels in the lake were extremely high caused by ash being washed into the reservoir.

The two periods in the year when water quality in Rocky Valley falls off are late summer to early autumn and late winter to early spring.

4.3.1 Late-Summer to Early-Autumn

Stratification occurs during the summer from solar heating of the surface water. The depth of this heating depends on the depth to which the wind induced circulating currents penetrate. The warmer, less dense water in the upper waters of the reservoir offer little resistance to the circulating currents and this water is well mixed and aerated. However, where this warmer water meets the colder, lower water, there is a sudden increase in density which forms a physical barrier and prevents further penetration by the wind induced circulating currents. This barrier is known as the thermocline, the warmer, well mixed water above it is the epilimnion and the colder, unmixed water below it is the hypolimnion.

At Rocky Valley the epilimnion temperature starts to rise sharply in summer about mid-January while the hypolimnion temperature stabilises at around 12^{o} C at the bottom of the reservoir. A thermocline is established by late-January to early-February with the epilimnion water being about 5^{o} C higher than the hypolimnion water.

There is a progressive fall off in dissolved oxygen after the circulation of the epilimnion and hypolimnion is cut off. The summer stratification remains quite stable with little or no change in the temperature of the hypolimnion and this persists until the atmospheric temperatures and the influent water temperatures become cooler. The cooler water is mixed throughout the epilimnion and the upper part of the thermocline by convection and wind action. Cooling then continues until the temperature and density of the epilimnion and the thermocline approach those of the hypolimnion. When this is accomplished resistance to mixing diminishes and the autumn "turnover" occurs with the development of a uniform profile.

At Rocky Valley the surface temperature starts to drop about mid-February to early-March and by about mid-March the mixing of the epilimnion and hypolimnion is restored with a total period of stratification of about two (2) months.

4.3.2 2015 Summer Stratification

Stratification of the lake occurred earlier than usual last summer starting in the last week of December and reaching a peak iron level of 1.4mg/L by the second week of January. This caused a minor spike in the reticulation levels as mentioned earlier. The stratified conditions within the lake persisted until mid-March – a period of 12 weeks, or 4 weeks longer than usual.

4.3.3 Late-Winter to Early-Spring

As surface cooling progresses and the water cools to 4°C and below, the colder upper layer becomes less dense. Stratification usually occurs in the winter as soon as ice starts to form. It takes place immediately below the ice layer because water at 0^{o} C is lighter than water at 4^{o} C. However, in winter the colder water is near the surface rather than at the bottom. Occasionally, when there is no or little ice present, strong winds may break up winter stratification for a few days. Little mixing occurs once the layer of ice forms, sealing the lake surface and preserving the stratification until the ice thaws.

In Rocky Valley, winter stratification is less pronounced and is more dependent on the climatic conditions. Usually about early July the water temperature lowers uniformly over the full depth. Ice usually then covers the reservoir about early August. The ice cuts off the mixing effect of the wind and any temperature change, except by conduction through the ice. As a consequence, the water temperature establishes itself such that the temperature immediately below the ice is 0^{o} C and it sharply increases to about 2^{o} C and remains fairly constant until near the bottom where the warmer, denser water remains.

In turn, during August and September there is a progressive fall off in dissolved oxygen towards the bottom as the ice cover persists. However, there is little information available regarding the temperature and dissolved oxygen profile during the late winter period and it is uncertain as to the effect of aeration on the ice cover during this time.

4.3.4 Mitigation Measures

Since the 2006 bushfires the impact of summer stratification on water quality has been more pronounced. Weekly monitoring of iron levels in the lake show that levels of 2.5 mg/L are exceeded during summer stratification, reaching as levels almost twenty times greater than the aesthetic guideline value. Options to relocate the off-take and to provide further treatment of the water are still being explored.

From 2007 a connection to the snowmaking system which draws water from the upper reaches of the lake has been employed to mitigate the stratification effects. While this has been an effective procedure in past years it does not offer a reliable long-term answer to the problem. This was highlighted in 2011 when the snowmaking system was down for maintenance purposes which in turn prompted the need to seek an alternative source.

Good quality water is available from the aqueduct which runs above the village and feeds water into the lake in close proximity to the existing pumping station. The aqueduct runs year round but there is no reliable flow information to determine whether this could be a long-term solution. In 2012-13, however, due to the dry conditions the flow from the aqueduct was well below the demand for potable water and the quality was poorer than normal. Consequently, the practice of taking water from the snow making system is employed as the preferred option to improve the water quality during the period of lake stratification.

5 Complaints

There were three reports of a bluish colour and the presentation of a metallic taste on 29th October, 2014. At this time the supply to the Brown tank was being supplemented from a nearby groundwater bore which, because of the very low post season demand, was the predominant source of supply. The purity of the groundwater supply presents a unique problem in that when exposed to air the water which has low buffering capacity reacts with carbon dioxide to produce carbonic acid. Investigations revealed that the pH in the Brown Tank and through the UV plant were 5.8 and within a number of premises the pH was in the range 6.1 to 6.9.

The supply from groundwater was promptly ceased and the pH returned to within guideline levels within the week. The nature of the complaints was found to be due to the acidic nature of the water which leached copper from piping in some of the buildings, especially where the water has been left in contact for a long period (i.e. the building has not been in use). The problem is more apparent in areas high in the village closest to the UV plant as the water has less time to equilibrate before reaching these lodges.

As supply from groundwater is seen as a potential future source option which would eliminate the issues associated with stratification of the lake, consultants were engaged to assess the cause of the issue and to identify treatments likely to be effective. The suspected copper corrosion related to low pH and alkalinity was confirmed in their findings. The consultants also suggested that certain micro-organisms that form 'bio-films' may also cause corrosion, but further research suggested that this was not a serious issue and was within the normal ranges for potable water.

The addition of a calcium carbonate (calcite) filter was identified as a feasible solution to the low pH and alkalinity of the groundwater source. Further assessment of this option is continuing.

Type of Complaint	No of Complaints	No. of complaints per 100 customers supplied.
Discoloured water	0	0
Taste/Odour	3	3
Blue water	3	3
Air in water	0	0
Suspected illness	0	0
Other	0	0

6 Risk Management Plan Audit

A regulatory audit was not required to be undertaken during this reporting period.

7 Undertakings under Section 30 of the Act

Falls Creek do not have any undertakings with the DHHS.

8 Regulated Water

FCRM does not manage any regulated water supplies.

9 Glossary of Terms and Further Information

Act	See SDWA4
ADWG	Australian Drinking Water Guidelines 2011
AWA	Australian Water Association
Class A water	Recycled water that has been treated to a standard that enables unrestricted public use
CMA	Catchment Management Authority
DHHS	Department of Health and Human Services
DELWP	Department of Environment, Land, Water and Planning
DWQMS	Drinking Water Quality Management System
E. coli	Escherichia coli – organism that indicates faecal contamination. Used as an indicator of safe drinking water
EMP	Emergency Management Plan
EPA	Environment Protection Authority
FCRM	Falls Creek Resort Management
kL	Kilolitre – 1,000 litres
ML	Megalitres – 1,000,000 litres
MOU	Memorandum of Understanding
NTU	Nephelometric Turbidity Units (see Turbidity)
OHS	Occupational Health and Safety
pH	Measure of the acidity or basicity of water e.g.: pH = 7 is neutral; pH < 7 is acidic; pH > 7 is basic
Potable	Drinkable, suitable for human consumption
Regulations	Safe Drinking Water Regulations 2005
SDWA	Safe Drinking Water Act 2003
Turbidity	A measure of the muddiness of water which may be caused by suspended fine clay particles, silts, algae, organic plant and animal debris
UV	Ultra Violet