TAKING ON A NEW WATER SUPPLY CATCHMENT IN THE ACT AND ITS IMPACT ON WATER TREATMENT PROCESSES

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ABSTRACT

Investigation of future water supply sources for the ACT identified the need to pump water from the Murrumbidgee River and in May 2007 ActewAGL commenced the abstraction of raw water from the Murrumbidgee River for the first time.

The water quality of the new catchment had a major impact on the water treatment processes and operations at Mt Stromlo Water Treatment Plant. Plant performance assessment was based on the US EPA LT2ESWTR system and to date the plant has met all turbidity targets, producing safe drinking water.

KEY WORDS

Murrumbidgee, LT2ESWTR, Turbidity, Dissolved Air Flotation, Streaming Current Detector

1.0 INTRODUCTION

Historically Canberra's primary water supply has been obtained from good quality sources in the Cotter catchments, namely from Corin, Bendora and Cotter Dams.

Investigation of future water supply sources identified the need to pump water from the Murrumbidgee River to avoid new dam construction before ~2023. Drought modelling indicated that the new water source was needed immediately.

In May 2007 ActewAGL commenced the abstraction of raw water from the Murrumbidgee River for the first time, with the new catchment water quality having a major impact on the water treatment processes and operations at Stromlo Water Treatment Plant.

2.0 DISCUSSION

2.1 New Stromlo Water Treatment Plant

The Mt Stromlo WTP is designed to treat 250 ML/day at 25ºC. The plant is manned 24 hours per day on a single operator 12 hour shift rotation. HACCP Certification for the water supply system was achieved in 2006.

Normally water is sourced by gravity via pipeline from Bendora Dam, or pumped from Cotter Dam. Source water is generally good quality with low turbidity (1-2 NTU), low DOC (<2 mg/L) and colour (5-10 PtCo), but low alkalinity (10-20 mg/L). Raw water temperatures vary seasonally from 7ºC to 25ºC.

The filtration plant consists of 10 multimedia filters with anthracite, sand and gravel media. Normal operation is direct filtration mode, however dissolved air flotation and filtration (DAF) is also available.

Pre-treatment chemical dosing includes pre-lime for alkalinity, carbon dioxide for pH control, aluminium sulphate and poly-aluminium chloride for coagulation, and polymer as filter aid. Potassium permanganate can also be dosed for dissolved manganese removal. Post-treatment chemical dosing includes chlorine gas disinfection, fluoride dosing and post-lime for final pH control.

2.2 Murrumbidgee River Catchment Risk Assessment

Prior to abstraction from the Murrumbidgee River a detailed risk assessment of the new catchment was undertaken. A set of risk-based "pumping rules" were developed to ensure that water harvested from the river was of good enough quality that it could provide a safe source for drinking water once treated. Stakeholders in the decision making process included ACTEW Corporation, ActewAGL, ACT Health, and Environment ACT.

Pathogens presented the most significant risk to drinking water quality, followed by turbidity. Other issues of lower risk were colour, iron, manganese and cyanobacteria. Toxic metals and organics were deemed not significant.

Monitoring between July 2005 and February 2007, during a period of low river flow, detected cryptosporidium oocysts by microscopy in the range 0.075 to 1/L. Therefore the concentration was at the lower end of the US EPA LT2ESWTR 'Bin 2' category, attracting a 4-$\log_{10}$ reduction requirement. The following table outlines the Log reduction credits for the existing Stromlo WTP under the LT2ESWTR system.

Table 1: ***Log reduction credits for the existing Mt Stromlo WTP***

Process step	**Log credit**	**Summary of requirements**
Direct filtration	2.5 $\log_{10}$	Combined filter effluent ≥ 95% of measurements ≤ 0.3 NTU in each month; Sampling rate at least 4-hourly Monitor individual filter effluent online and report every 15 mins and follow up exceedances > 0.5 NTU
Dissolved Air Flotation (DAF)	0.5 $\log_{10}$	Continual operation of the DAF system is required
Combined filter performance credit	0.5 $\log_{10}$	≥ 95% of measurements ≤ 0.15 NTU in each month Sampling rate at least 4-hourly
Individual filter performance credit	0.5 $\log_{10}$	≥ 95% of measurements ≤ 0.15 NTU in each month and no two sequential samples > 0.3 NTU Sampling rate at least every 15 min
Total process	**4.0 $\log_{10}$**	**In DAFF mode with both filter performance credits**

Therefore, it was considered acceptable to treat water from the Murrumbidgee using the existing Mt Stromlo WTP process during base-flow conditions, as an interim measure. An additional UV disinfection barrier was recommended in the future to comply with multiple barrier requirements and to provide protection during high and event flow periods.

The principle of the Interim Pumping Rules was to provide guidance to the operator by setting critical limits for the control point which is selective abstraction. The rules provide guidance

in avoiding periods during which fresh runoff may contaminate the raw water, such as following storm events, or following spill events contaminating the raw water and periods of treatment plant failure.

The main pumping guidance rules are currently:

- Cease pumping if river flow rate downstream is greater than 1500 ML/day for more than 30 minutes
- Cease if raw water turbidity is greater than 40 NTU for more than 30 minutes
- Cease if raw water E coli detected greater than 500 organisms/100 mL

There are a number of other rules based on water quality changes which are designed to warn of changing river conditions and to prompt a review of the source water quality risks.

2.3 Operational Preparation

Each of the two Murrumbidgee pumps has a flow capacity of 20 ML/day in the existing arrangement. The pumps can be remotely controlled and there is online water quality monitoring available via the SCADA system.

Filter assessments were undertaken during the winter of 2006 to confirm filter performance. This included backwash fluidisation and expansion testing, washwater turbidity profiling, media sampling and mapping. The outcomes of the assessments were: improved seasonal backwashing settings, modifications to control sequences and implementation of a routine filter assessment and cleaning regime. To ensure that the filters met the LT2ESWTR targets, alarm setpoints were established such that individual filters queue for backwash at 0.15 NTU and are taken automatically offline at 0.25 NTU.

A Water Treatment Alliance Filter Assessment Course was run at Mt Stromlo WTP to provide WTP operators with increased knowledge about their plant and practical skills for optimising the filters.

The DAF system, which had not been run for a significant time since last operation, was trialled for a period in January 2007 to ensure that all equipment was operating satisfactorily.

Preliminary jar testing was undertaken to determine the expected starting point for coagulant dosing. These tests were conducted on individual Bendora, Cotter, and Murrumbidgee samples as well as blends matching the expected abstraction ratios.

Employee awareness and training is regarded as critical in safely handling the risks involved with the new water source. Training sessions for operations, maintenance and technical staff were undertaken to ensure that everyone clearly understood the pumping rules.

2.4 Operations response to treating Murrumbidgee River water

When approval for abstraction was given the plant was started using water from Bendora (usual source) to ripen filters and establish DAF operation. Plant flow settings were initially reduced so that maximum filter loading rates were decreased from the design of 25 ML/day per filter (12.5 m/hr) to 15 ML/day per filter (7.5 m/hr).

The expected alum dose from jar testing of 20 to 25mg/L was well above the normal dose of 10 to 13mg/L. Preparations were made for arrival of the blend approximately 4 hours after

starting the pump. There was a slight increase in raw water turbidity prior to actual arrival of Murrumbidgee due to scouring of main.

Changes from the typical levels observed on the online Streaming Current Detector (SCD) and Plant Inlet pH meter provided an indication of the arrival of Murrumbidgee water. Rapid changes in carbon dioxide dosing were initially required to keep pH in the ideal range for coagulation. Due to a substantial increase in raw water alkalinity (around 50 mg/L as $CaCO_3$), pre-lime dosing was switched off which helped stabilise inlet pH and also assisted in meeting final water pH targets.

Ideally the SCD should be re-zeroed when optimum dosing conditions are reached for the water source used. Due to expected continuous changes in raw water blend, instead, we used the detector as a guide but noted the rate of change. With Bendora water the ideal reading was around 4.5%. With the blended water the ideal reading was around 7.5%. When a change was noticed in the streaming current, alum dose was adjusted in increments and increased to 24mg/L over a period of 4 hours.

The SCD allowed "pre-emptive" dosing adjustments without waiting for significant changes in filter turbidities. The main point here is that without SCD there is a significant time delay and volume of water treated due to the slower reaction time of the pH analyser.

2.5 Operational Issues with treating Murrumbidgee Water

During the period of pumping operation thus far there have been two significant storm events that tested the Pumping Rules. The first event was a major storm which resulted in elevated faecal coliform results (>1000 cfu/100 mL), caused by upstream stormwater overflows. The pumps were shut down based a rapid change in turbidity and they remained offline for five days until three consecutive days of E. coli readings <500 cfu/100 mL were measured. The second event was less severe, and although still resulted in stormwater overflow, the proportion of flow in the river made up of stormwater was much less and it was considered to be acceptable for treatment.

With a subsequent increase in the proportion of Murrumbidgee water to over 50% of inflow, coagulant doses increased up to 33 mg/L of alum. At this time coagulant aid dosing was started with an initial dose of 5 mg/L of PACl, which halved the alum dose and reduced the volume of sludge production. Coagulant doses will be continually reviewed and optimised as water temperatures continue to decrease over the coming months.

There has been a substantial increase in sludge production per volume of water treated. In addition, the return of centrate from the sludge thickening process to the washwater system compounded the effect of high total manganese levels in the raw water (up to 0.07 mg/L). The insoluble manganese removed by the filters became solubilised in the washwater handling system and was returned to the head of the plant in supernatant return. This resulted in elevated final manganese concentrations (up to 0.04 mg/L, target <0.02 mg/L). The solution to this issue was temporary diversion of centrate to reclaim basins for disposal. Potassium permanganate dosing was considered, however was expected to add to the problem by increasing the overall inventory of total manganese in the washwater system.

Filter duty rotation and media ripening has proved very important to minimise the risk of turbidity breakthrough, which can be a health risk. Backwash effectiveness is monitored to

ensure that targets for final washwater turbidity of around 15 NTU are achieved without over-washing the filters.

2.6 Plant Performance

To end May 2007 the total volume of water abstracted from the Murrumbidgee River and treated at Mt Stromlo WTP was 569 ML, equal to 23% of the total 2465 ML treated during this period. The proportion of Murrumbidgee water has been up to 67% of the total water sourced.

The following table shows the plant performance to date in meeting the LT2ESWTR targets. The results show that the plant has met all turbidity requirements. There was however a brief period when the DAF system shutdown unexpectedly, however filter turbidities were unaffected during this event and alarms and interlocks were modified to prevent this from reoccurring.

Table 2: ***LT2ESWTR Plant performance to 31 May 2007***

Requirement	**Compliance**
Combined filter effluent ≥ 95% of measurements ≤ 0.3 NTU	100% Compliant
Continual operation of DAF	Non-Compliant
Combined filter effluent ≥ 95% of measurements ≤ 0.15 NTU in each month	100% Compliant
Individual filter effluent ≥ 95% of measurements ≤ 0.15 NTU in each month	All 10 Filters Compliant: Max 100%, Min 98.5%
Individual filter effluent, no two sequential samples > 0.3 NTU	All 10 Filters 100% Compliant

During the period of Murrumbidgee abstraction there has been no significant change in final water quality parameters compared with performance when using better quality water sources. The effect of higher raw water alkalinity was that treated pH was more difficult to control which caused two slightly higher daily average treated water turbidities due to operation of the post lime dosing system.

2.7 Capital Works Improvements

A number of projects are underway to improve the management of the Murrumbidgee raw water source. The catchment risk assessment indicated the need for an additional disinfection barrier to reduce the potential risk posed by cryptosporidium. Installation of UV disinfection was identified as the most cost effective option. The UV system under construction at Mt Stromlo will be the largest in Australia.

The Mt Stromlo WTP washwater and sludge handling system is being duplicated to manage the larger quantities of sludge produced when treating Murrumbidgee water. Works are also underway to increase the capacity of the Murrumbidgee pump station to increase the volume which can be abstracted.

3.0 CONCLUSIONS

As with most areas across Australia that have been affected by drought, ActewAGL are currently facing many different issues which have added to the effects of the 2003 bushfires.

Predictions of the impact on Canberra's water supply have proved to be very true, and the importance and value of pre-planning for these types of events is clear for any water utility.

Though we curse the drought and its effects, we are all learning some valuable lessons on how to cope, many "outside the square" solutions to water harvesting have been conceived and implemented in a very short period of time. These solutions have created many new operational challenges and opportunities.

Taking on the new catchment of the Murrumbidgee has thus far proved a valuable source of water to supplement the ACT water supply. To date Mt Stromlo WTP performance has met all turbidity targets under the LT2ESWTR system, producing safe drinking water.

We are not out of the woods yet, we all look forward to being able to say "Back in the drought of the early century, we had to do so and so".

4.0 ACKNOWLEDGEMENTS:

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