THE FUTURE IS CLEAR – IMPROVED DATA COLLECTION FOR ROBUST FILTERED WATER TURBIDITY MONITORING

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ABSTRACT

The Australian Drinking Water Guidelines (2011) state that, "where filtration alone is used to manage risks identified from *Cryptosporidium* and/or *Giardia*, the filtered water turbidity target should be ≤ 0.2 NTU, and should not exceed 0.5 NTU". This has prompted East Gippsland Water to further develop continuous water treatment plant filter performance monitoring, to facilitate accurate monthly and annual in-house reporting. The Victorian Department of Health are currently reviewing the Safe Drinking Water Regulations (2005) and have flagged that operational reporting requirements may be introduced in the 2015 version. It is possible that the new regulations closely follow the current Australian Drinking Water Guidelines for filtered water turbidity, with a 0.2 NTU limit 95% of the time and a 0.5 NTU limit 100% of the time.

An initial review of East Gippsland Water's filter performance during 2011, against these targets, uncovered many challenges regarding the collection and analysis of data. Several upgrades were made as a result of this initial investigation to allow simple but effective data collection and analysis. The main upgrade to the data collection process was the introduction of a one minute polling interval to SCADA Historian for both the raw water flow and the filtered water turbidity. This allowed a simple determination of whether or not the plant is in operation and therefore the relevance of the corresponding turbidity values. This was a simple and cost effective project that has allowed accurate analysis of filter performance.

1.0 INTRODUCTION

The Australian Drinking Water Guidelines (2011) state that, 'where filtration alone is used to manage risks identified from chlorine resistant pathogens (e.g. *Cryptosporidium* and/or *Giardia*), the filtered water turbidity target should be ≤ 0.2 NTU, and should not exceed 0.5 NTU'. Due to the relatively pristine catchment condition in East Gippsland Water's declared water supply catchments (typically >80% of catchments are ranked in good to excellent condition [EGCMA, 2006]), water quality risk assessments have identified that the overall level of risk from chlorine resistant pathogens is low. However, to pre-empt potential future tightening of best practice guidelines, this prompted an investigation into East Gippsland Water's (EGW) water treatment plant (WTP) filter performance on both a monthly and an annual basis.

This investigation had several key questions that we set out to answer, including:

- Can we achieve filtered water turbidity less than 0.2 NTU 95% of the time and a 0.5 NTU limit 100% of the time?
- If not, can we upgrade/optimise our plants cost effectively to achieve the targets?

It was found that our onsite displays and trending showed that we were largely meeting these targets. However, this data was limited by the systems in place for longer term trending, namely SCADA and SCADA Historian. We found that there needed to be several modest upgrades to our SCADA and SCADA Historian reporting systems to enable accurate reporting of our filtered water turbidity trends on a monthly basis. After upgrading our reporting systems, it can be seen that it is possible to achieve these limits through a combination of plant optimisation, careful monitoring and effective communication.

2.0 DISCUSSION

2.1 The Sites

Below is a summary of the eight water treatment plants operated by EGW (Table 1).

Table 1: ***Summary of East Gippsland Water's Water Treatment Plants***

Treatment Plant	Water Treatment Process	Added Chemicals
Woodglen Flow = 125 - 255L/sec	Coagulation, flocculation Dissolved air flotation Filtration (granular media) Disinfection Fluoridation **NOTE: 2 Cells = 2 filters (monitored individually)**	Caustic soda Poly aluminium chlorohydrate (PAC 23) Chlorine gas Fluoride (FSA)
Buchan Flow = 6L/sec	Coagulation, flocculation Dissolved air flotation Filtration (granular media) Disinfection	Caustic soda Poly aluminium chlorohydrate (PAC 23) Sodium Hypochlorite
Cann River Flow = 7.5L/sec		
Swifts Creek Flow = 4L/sec		
Bemm River Flow = 4L/sec		
Orbost Flow = 30 - 35L/sec	Coagulation Flocculation Pulsed blanket clarification Filtration (granular media) Disinfection	Soda Ash Poly aluminium chlorohydrate (PAC 23) Sodium Hypochlorite Polyelectrolyte LT 20
Omeo Flow = 3 - 4L/sec	Coagulation Flocculation Upflow clarification Filtration (granular media) Disinfection	
Mallacoota Flow = 7.5 - 14L/sec		Caustic Soda Poly aluminium chlorohydrate (PAC 23) Sodium Hypochlorite Polyelectrolyte LT 20

2.2 The Approach and the Issues

The approach for this review was shaped significantly by the issues that were found during the initial study on filter performance.

The issues we found with our first attempt are:

- *Turbidity Trends:* We found that although plants would consistently produce high quality water, certain events needed to be controlled. The cleaning of turbidity units was something that has previously been a routine task but the effect on the trends was never considered. The ability to place the units in 'hold' mode has now been incorporated into the standard procedure for any maintenance on the meters.

- *Reporting intervals:* There were two main issues with the reporting intervals, namely frequency and alignment. The frequency was previously a one hour report from SCADA to SCADA Historian. The main issue was that the data for flow and turbidity were not always recorded together, because if the value of the parameter changed outside a predetermined band, an entry would be made. See tables below for examples of the previous data that was reported (Table 2) and how we now report data under the improved system (Table 3).

Comparing Tables 2 and 3, the upgrades have allowed an easier system that requires much less data manipulation and is therefore more accurate.

Table 2: ***Example of data generated prior to upgrades. Note the inconsistent frequency and the lack of aligned data***

Turbidity Data		Flow Data	
Date Time	**Turbidity (NTU)**	**Date Time**	**Flow (L/sec)**
4/03/2012 8:00	0.032	**4/03/2012 8:00**	185.6
4/03/2012 7:48	0.034	**4/03/2012 7:17**	172.4
4/03/2012 7:40	0.038	**4/03/2012 7:16**	128.0
4/03/2012 7:30	0.043	**4/03/2012 7:15**	94.7

Table 3: ***Example of data generated after completion of upgrades. Note the alignment of the turbidity and the flow data***

Turbidity Data		Flow Data	
Date Time	**Turbidity (NTU)**	**Date Time**	**Flow (L/sec)**
1/03/2013 9:37	0.068	**1/03/2013 9:37**	7.1
1/03/2013 9:38	0.062	**1/03/2013 9:38**	7.0
1/03/2013 9:39	0.059	**1/03/2013 9:39**	7.1
1/03/2013 9:40	0.059	**1/03/2013 9:40**	7.1

To summarise, these improvements have facilitated:

- Robust data collation via one minute interval data for both turbidity and raw water flow
- Accurate data that indicates if the filter was in operation (raw water flow)
- Improved procedures that allow accurate data to be reported efficiently.

2.3 The Analysis

A summary of the method used for analysing the data is presented in the following six step process:

1. Gather data and align the flow and turbidity values
2. Sort the flows and remove all turbidity results from when filter is not in operation
3. Determine total number of readings = X

4. Sort the turbidity values and count results that are above turbidity values (min. 0.5 and 0.2 NTU) = Y
5. Calculate percentage of values below the same turbidity values = (X – Y)/ X * 100
6. Summarise similar to Table 4 (see below).

2.4 The Results

The results achieved from EGW's filters is not the primary focus of this paper but it is important to show examples of the results we have achieved compared to the 0.2 NTU target 95% of the time and a 0.5 NTU limit 100% of the time.

Table 4: ***Example of results from effective reporting system (April 2013)***

	Percentage of plant flow where turbidity is:					
Site	**<0.1 NTU**	**<0.15 NTU**	**<0.2 NTU**	**<0.3 NTU**	**<0.4 NTU**	**<0.5 NTU**
Bemm River	99.6	100	100	100	100	100
Buchan	95.9	98	98.2	98.9	99.3	99.7
Cann River	99.3	100	100	100	100	100
Mallacoota	97.6	98.3	98.8	99.5	99.8	99.9
Omeo	97.9	98.7	99.0	99.5	99.9	99.9
Orbost	95.3	97.9	99.4	99.8	100	100
Swifts Creek	98.9	99.6	99.9	100	100	100
Woodglen 1	100	100	100	100	100	100
Woodglen 2	100	100	100	100	100	100

It can be seen from Table 4 that all of EGW's plants achieved the target of 0.2 NTU target 95% of the time for this month.

On the other hand, to successfully produce filtered water that is less than 0.5 NTU 100% of the time is significantly more difficult. It can be seen above that depending on the rounding of values, all sites were either extremely close or managed to stay below this limit. Most of these sites are deemed to be low risk from chlorine resistant pathogens due to having (i) pristine catchments with very little land cleared for agriculture, (ii) selective harvesting with raw water storages, (iii) clarified (pre-filtered) water that is lower than this 0.5 NTU and (iv) filtered water to waste capacity. This may not be the case for other organisations and it is recommended that a study similar to this be undertaken to determine areas for improvement in both the reporting systems and also the WTP performance.

Figure 1: ***High quality clarified water can reduce the risk of poor filter performance***

3.0 CONCLUSION

The initial process of attempting the annual filter review in 2011 outlined significant areas for improvement in both our reporting and communication between sites and staff. Significant improvements were made in this regard late in 2012. As mentioned earlier in this report, recent improvement to the frequency of polling should result in improved confidence and accuracy of reporting in 2013. This has already been observed in the first few months of 2013.

All of EGW's plants achieved the <0.2 NTU 95% of the time operational target. Due to filter ripening and spikes during start-up, the adopted guideline target of <0.5 NTU 100% of the time was more difficult to achieve. However, all but three plants achieved this relatively strict benchmark. A key factor that needs to be considered is the removal of any filtered water results that are sent to waste following a backwash or other event. This additional reporting improvement step is to be implemented in the near future, and will only further improve the accuracy of the data and ease of reporting.

Monthly monitoring allows any changes in long-term filter performance to be identified and remedied before any major issues occur. Despite fluctuations in filter performance as a result of changes in raw water quality, severe weather events and occasional operational issues, no deterioration in filter performance has been observed over the 12-month study period.

This study will provide important information for implementation into system specific water quality risk management plans. A risk assessment on the catchment should also be considered alongside the monitoring of filtered water turbidity. This is supported by the ADWG (2011) with the statement, 'Targets for filtered water turbidity should be based on the pathogen risks in the raw water; for example, surface run-off from a catchment with significant sewage inputs or dairy farms would have tighter turbidity targets than a catchment without such impacts'. At this stage, these targets and limits are at the organisation's discretion, but it is likely that water quality regulations are only going to push for cleaner water and tighter regulations in the future.

4.0 ACKNOWLEDGEMENTS

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5.0 REFERENCES

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