COWRA'S WATER TREATMENT PLANT
- A CHANGE IN PROCESS CONTROL PHILOSOPHY

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ABSTRACT

Cowra's Water Treatment Plant (WTP) was originally built in 1939. It has been upgraded in 1959, 1966, 1984 and most recently in 2014. Prior to the most recent upgrade the plant was only capable of manual operation with water quality analysis being done via grab samples. This posed a health risk due to the high reliance on manual operations with water quality challenges due to the intermittent and variable nature of operations for a "run of river" plant.

The upgrade involved replacement of flash mixers and tube settlers, re-building of the filters, automation of plant controls, replacement of plant equipment including chemical dosing systems, installation of online monitors for pH/temperature, turbidity, electrical conductivity, chlorine, aluminium, fluoride and manganese. The SCADA package was also upgraded and with a new found knowledge of our process, operators were able to implement new control philosophies that improved water quality. This paper will present the change in control philosophies brought about by the upgraded infrastructure and feedback from online instrumentation.

1.0 INTRODUCTION

Cowra's water supply comes from the Lachlan River via Wyangala Dam, Central Western NSW. The Central Western region had experienced a long drought before the end of 2010 which resulted in very low dam and river levels. Prior to 2009 Cowra Council had significant discoloured water complaints, approximately 200 to 400 per year. High manganese levels where identified as one of the main causes. In February 2009 the council started a trial potassium permanganate dosing system with improved manganese results. But there were still enough complaints to warrant further investigations.

Around this time there were some personnel changes, which brought a different perspective to the way the WTP was operated.

2.0 DISCUSSION

Traditionally we took one treated and raw water sample at the beginning of the day when we started up the plant after it was shutdown in the afternoon or night before depending on reservoir levels. These samples were tested for the basics, turbidity, free and total chlorine, pH and temperature, as well as fluoride and manganese. The results were recorded on a monthly paper template.

We concluded this form of testing was not giving us the whole picture of our process, only a snapshot. We set about to do as much research, investigation, and development as we were capable of.

2.1 Looking at the Whole Process

By mid-March 2009 we started looking deeper into our process and began by increasing our drop test frequency, regularly checking our pump curves, and jar testing more often.

Raw and treated water sampling was increased to every hour or so and we began testing our settled water at the same times for turbidity and temperature. We had a theory that as our raw water temperature increased, it caused an increase of turbidity (carryover) in our clarifier due to temperature stratification in the sedimentation tank. This theory was quickly proved. This had to be impacting our filters, so we started testing all our running filter outlets for turbidity and started backwashing based on turbidity relative to hours run.

Dose rates were also adjusted depending on the frequency of new found incoming variables and other parameters such as alkalinity, iron, colour, aluminium, TOC's and hardness were added to our testing. All data capture was transferred from paper to electronic spreadsheets.

Figure 1: ***Aerial view of the Cowra WTP***

2.2 The Benefits

By the end of 2010, we had reduced our water complaints to 114 for the year, down from 338 the previous year. We had worked to refine our filter backwash procedure and continued to optimise our process by making our coagulation/flocculation more efficient, saving on coagulant and chlorine through finer adjustments and a reduced chlorine demand. Operator confidence increased with more experience and a better overall understanding of the plant process.

Table 1: ***Cowra Discoloured Water Complaints***

New Calender Year Graph Source Data											
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Jan	131	67	24	86	84	31	19	2	6	1	1
Feb	98	79	12	16	188	14	9	0	3	1	1
Mar	105	36	18	34	39	10	5	3	1	1	2
Apr	45	34	110	39	2	4	1	4	15	1	0
May	22	6	8	55	2	7	3	1	37	2	0
Jun	7	3	1	20	2	8	5	1	35	13	1
Jul	4	2	24	39	2	1	2	0	7	4	0
Aug	5	3	1	33	7	2	1	7	3	33	0
Sep	4	3	10	4	1	16	3	7	20	11	0
Oct	11	2	6	6	1	4	3	3	5	5	0
Nov	16	1	12	11	6	15	15	3	2	4	1
Dec	39	1	5	5	5	2	2	11	0	1	0
Sum=	487	237	231	348	339	114	68	42	134	77	6

2.3 Challenges

December 2010 and March 2012 brought heavy rains, flooding and two significant freshes in the river with raw water turbidity over 2,000 NTU and low alkalinity. Our dedicated monitoring of the plant saw us through these challenges. In late 2011 we installed a variable flow pump in our raw water supply pump station which enabled us to reduce our flow rate from 220L/s down to 70L/s which helped us through the 2012 major fresh. By the end of 2012, despite operational difficulties we had our annual complaints down to 42, nearly an 80% reduction over the five years previous to 2010 average.

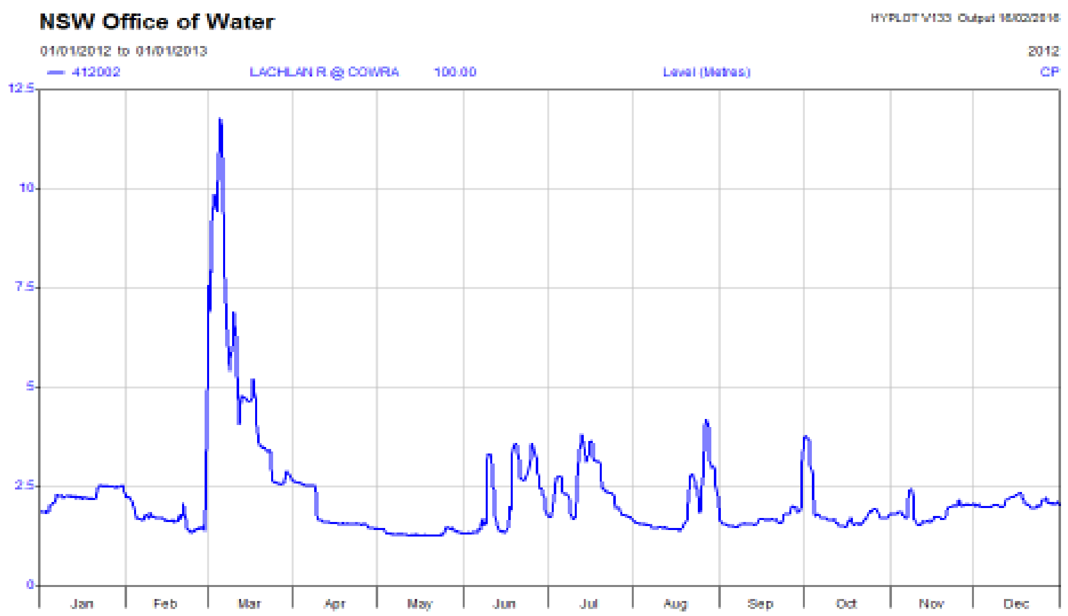

Figure 2: ***Lachlan River 2012 Levels Showing One Major and Several Minor Freshes***

2.4 More Challenges

In 2013 we upgraded our sedimentation tanks and clarifiers with a new sludge removal system and new tube settlers. This meant we had to run the plant at half capacity while each side of the process stream was upgraded.

More operators were brought in to help and a 24/7 rotating operations roster was established. Supplying a quantity of water with the plant at reduced capacity, while maintaining water quality was difficult, as shown by the 2013 results in table 1.

The greatest challenge was the changes brought about in 2014. These included replacement of our flash mixers, re-building of the filters including media and underdrain replacement with variable actuated control valves. There was also new chemical dosing systems with service water, installation of online monitors for pH/temperature, turbidity, electrical conductivity, chlorine, aluminium, fluoride and manganese, upgraded SCADA, automation of plant controls with flow pacing of all chemicals and residual trim on chlorine, pH adjustment and fluoride. This was all done while trying to do the day to day tasks of operating a WTP, participate in the development of a water quality management plan and commissioning a new membrane WTP at one of our remote villages.

2.5 The Major Change of Process Control Philosophy

With the upgrade commissioned by the end of 2014, we were able to take advantage of the real time monitoring of our process through the new filter controls, SCADA system and its process analysis in 2015. We changed from starting and stopping the plant every day when the reservoirs were full, to running the plant flow rate to water consumption and time of day, depending on temperature and settled water turbidity. This reduced the impact of our clarifier carryover due to temperature increases.

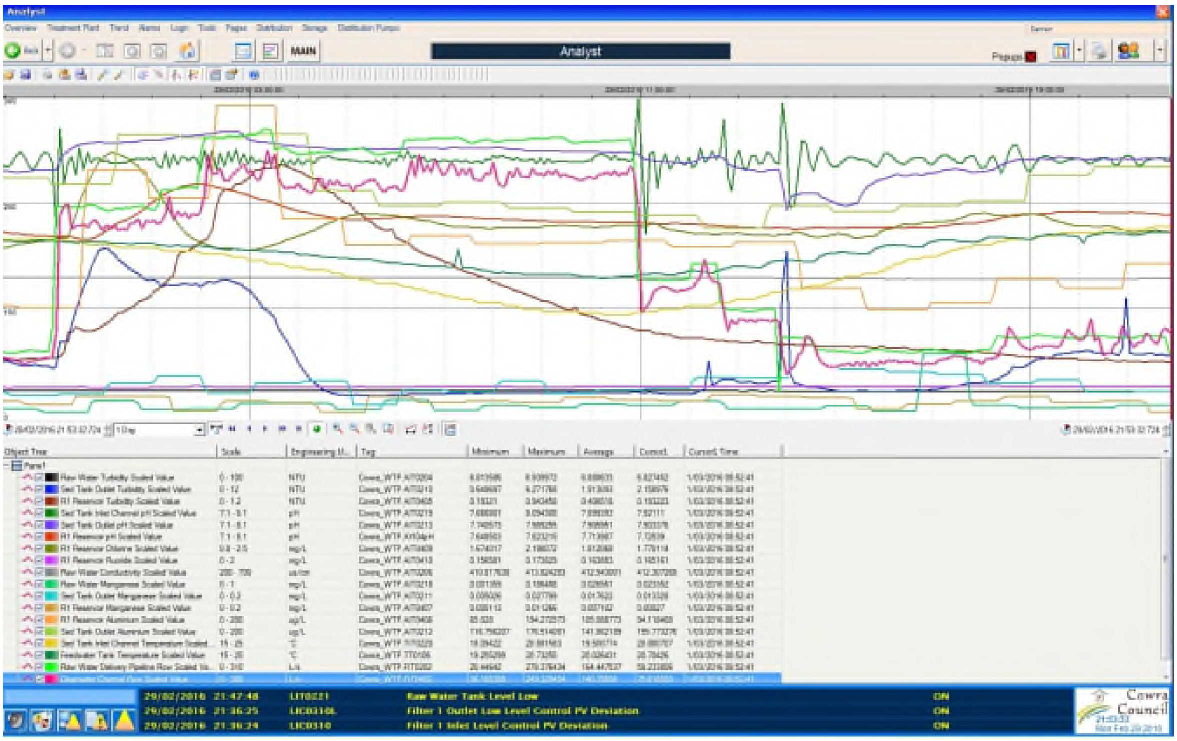

Figure 3: ***SCADA Process Analysis***

Filtration was improved not only by the new media and underdrains, but also by being able to spread our flow over all our eight filters through the new variable control outlet valves. This is instead of the old way of only three to five filters being utilised with the old valves being 100% open. This extended filter hours and improved filter outlet turbidity.

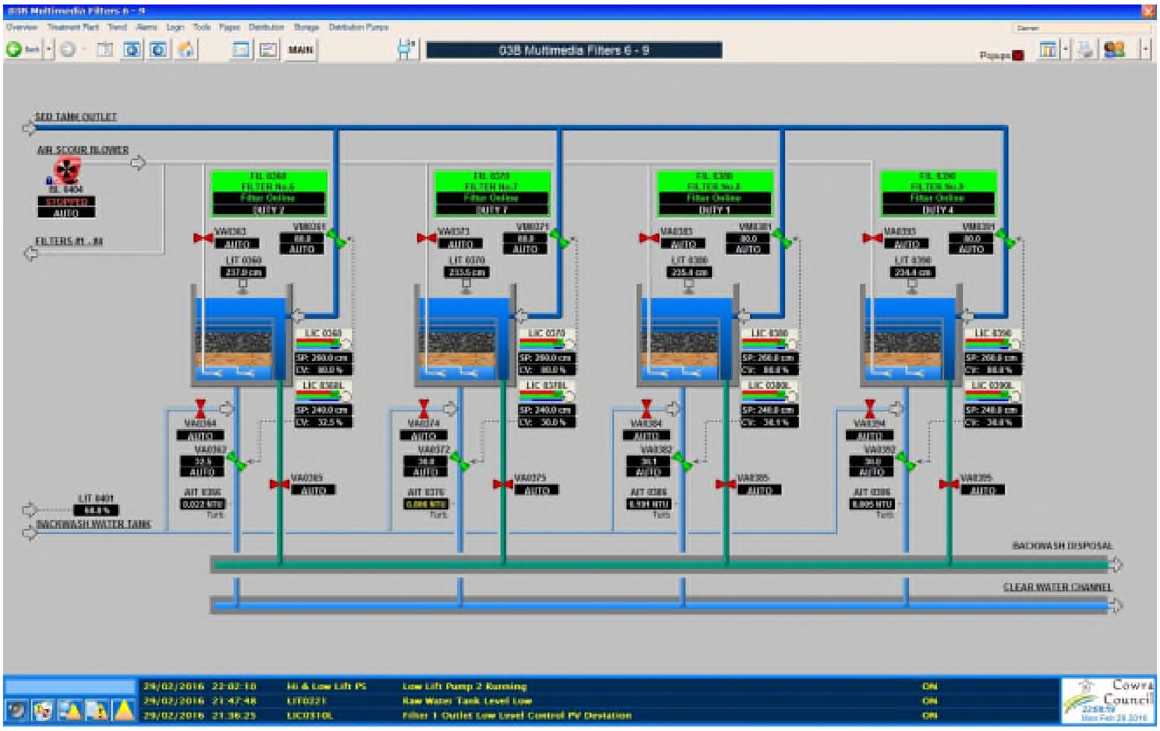

Figure 4: ***SCADA-Filters***

Flow pacing of our primary coagulant with the addition of service water and improved flash mixing forces, definitely made our coagulation more efficient with an approximate 30% saving on chemical usage.

Manganese removal was also improved with the online monitoring of our three sample streams. We were able to reduce our potassium permanganate dosing to a more suitable dose rate based on the raw water manganese average and with an upgrade afterthought, dosed chlorine gas in the settled water to oxidise any remaining manganese.

3.0 CONCLUSION

I am sure we'll have many more challenges ahead of us as any run of river plant does with constantly changing input variables. Having the right tools to do your job helps no end. We may have created a more complex WTP with new technology and instrumentation with a few bugs to iron out yet, but the confidence in our process control, operational savings and reduction in the after-hours burden on the operators is well worth it.

Reducing water complaints to 6 for the year in 2015 shows just how far we've come.

4.0 ACKNOWLEDGEMENTS

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Also NSW DPI Office of Water Inspectors (Paul, Bernie and Chris) and our NSW Dept. of Health Regional Inspector (Marnie), for their support and advice over the years.

5.0 REFERENCES

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