Bloomsbury Bore: Remote supply challenges, one bore with Iron & Manganese

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ABSTRACT

Figure 1: Bloomsbury WTP Location

The Bloomsbury Water Treatment Plant is a remotely operated site almost 90 km North of Mackay. The scheme supplies water to the community of Bloomsbury which has around 350 people in as well as a busy service station popular with passing travellers. The annual water demand is approximately 22 ML.

1.0 THE PROCESS

Figure 2: Bloomsbury WTP

Bloomsbury sources its raw water from a single bore associated with O'Connell River. The raw water is pumped from the bore at the riverbed and into a raw water dosing tank before being dosed with Sodium Hypochlorite to a level above 1.4ppm. This level is monitored by a dedicated chlorine analyser for the polishing process stage. The bore water after being chlorinated will now oxidise the iron and manganese whilst also creating a chlorine residual high enough to maintain disinfection after treatment.

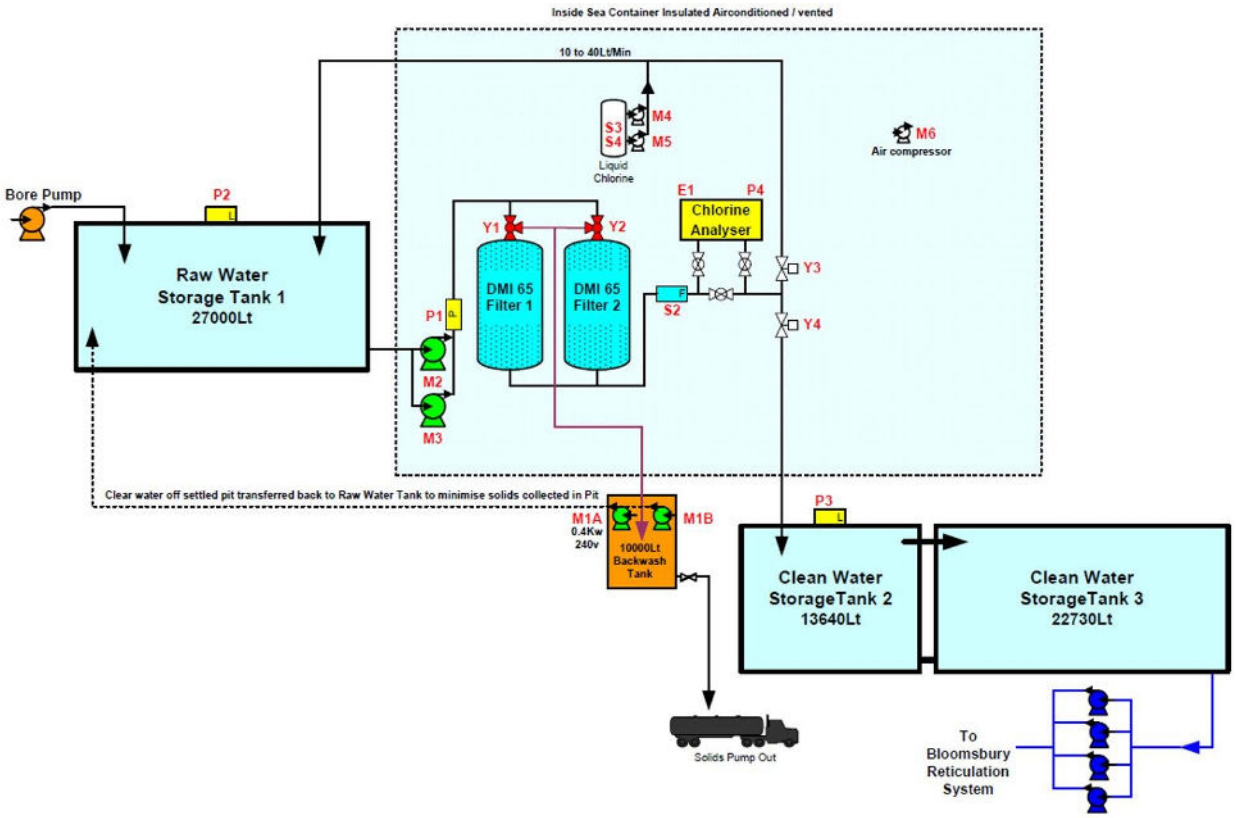


Figure 3: Bloomsbury WTP Process

This water is circulated in closed loop using polishing pumps to circulate the water from the raw water tank, through DMI filters designed to remove the heavy metals by absorption as well as filtering out any particulate. These captured metals and particulate will then be backwashed into a backwash tank for settling after every 70 KL that passes through the DMI filters and eventually pumped from the backwash tank and transported off site whilst a portion of the supernatant will be drawn off the top level of the raw tank to allow room for further backwashes after set time to allow settling of heavy metals and particulate.

The polishing water will continue to recirculate from the raw water tank through the DMI filters until a stable chlorine residual of above 1.4ppm is maintained for a set time and with treated water having dropped to a triggered fill level setpoint in the two treated water storage tanks a transfer pneumatic valve will open, and the polishing pneumatic valve will close allowing the polishing pumps to stop polishing in a closed loop and transfer the treated water over to the treated water tanks for storage and ready for distribution.

This process is level controlled in the treated water tanks and the WTP starts up on demand. Treated water is pumped into the network at a set pressure of 500kpa via 4 booster pumps which will come online to maintain this, and the distributed water is monitored by a 2nd chlorine analyser monitoring the outgoing chlorine residual 24/7 alerting our on-call operator and shutting down the booster pumps should this reading be outside our operational setpoints.

The operators also have remote access to the control system for the site through SCADA and periodically visit to undertake onsite operational checks and maintenance.

Unfortunately, Bloomsbury only has a single bore and in the recent times the raw water quality has changed significantly from years of dry conditions with iron and manganese at levels that the WTP cannot always effectively treat resulting in significant costs and challenges. We now are

having to cart water from over an hour away just to meet drinking water quality requirements.

Our operational team have developed a strategy to maintain the supply to Bloomsbury residents whilst we investigate alternative options and solutions.

2.0 INTRODUCTION

Figure 4: Flushed bore water

Twelve months ago, coincidentally the morning we were travelling back from the WIOA QLD 2021 conference in Toowoomba, some 1000kms away, one of those dreaded phone calls was received from our treatment team. The call you do not want to hear when you are nursing the morning hangover before your flight home. Bloomsbury WTP was unable to treat the raw water.

With recent years of dry conditions demonstrated by data collected over may years of routine testing, the levels of iron and manganese in ground water had elevated along with reduced recharge of the water table from the years of drier than average years.

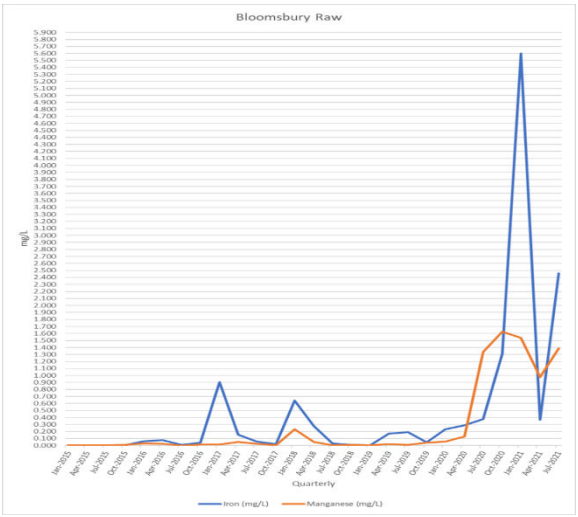


Figure 5: Data indicating rising levels of Iron and Manganese

With our operational team reporting surging in the bore flow either due to a reduced recharge or a collapsed bore as well as having limited success in flushing /backwashing filters and treating the water to a suitable standard to supply our customers of Bloomsbury, we had to resort to securing

a water truck loaded with one product we all take for granted, good quality potable drinking water.

Providing a good quality product is something our team and Mackay Regional Council have always taken pride in winning several awards in previous year as well as making the stage on a global front running in 2nd at the world water best tasting drinking water competition.

3.0 DISCUSSION

Figure 6: Compromised water quality

With the towns bore water supply being compromised the plan was to continue to cart water from the township of Marian, almost an hour away although with road works in place at times this could be an hour and a half at times.
Although this decision was costly to the budget, it was essential and would ensure a supply of safe drinking water to the community of Bloomsbury which was our priority until other options could be investigated.

This solution however presented several opportunities and challenges….

3.1 Storage Capacity

The site had two concrete tanks onsite, that gave us 40kL of storage space with 30 % of this figure being unavailable to utilise having to maintain a level in the tanks for the booster pumps not running dry. With limited contractors available in Mackay to cart water, we were only able to engage a company that had two trucks with storage capacities of either 26kL or 32kL each load.

We initially tried setting up rendezvous meets in Bloomsbury, attempting to synchronise our availability, the driver's availability, and the town's demand, and to compete against Bruce Highway roadworks…. This was a very frustrating juggling act and not efficient, operators and drivers were waiting onsite at times for the other due to traffic or other jobs, or simply the stars did not align, and the town would need less water than what was carted, or we could not cart it fast enough. We even had to resort to driving around to please ask residents to stop their sprinklers!

Simple solution to this would be more storage! Also, a little bit costly, but luckily, we had some suitable poly tanks that had just been used as temporary storage for a reservoir repair job, so with the assistance of our maintenance team we redeployed two additional 20 kL black poly tanks which would now give us a total of 80kL storage and 56kL of usable storage.

Figure 7: temporary tank connections

After some plumbing and valving to balance these tanks, we were then better able to schedule and coordinate routine site deliveries to maintain the water supply.

3.2 Chlorine dosing and chlorine decay

Carting chlorinated water and storing it in reservoirs ready for distribution and consumption sounds like a straightforward process. In theory yes but leading into the warmer months here in tropical Queensland chlorine decay is a big problem.

With chlorine decay, lower chlorine residuals impact disinfection which in turn impact the risk of being able to provide safe drinking water. It also results in the production of chlorates as by product of using Sodium Hypochlorite for disinfection and amplified when increased decay occurs.

Chlorine decay is an issue we had to resolve with Bloomsbury now having to store greater volumes of potable water whist dealing with high temperatures amplified by the colour of our new 'black' tanks and the colour not being ideal which contributes to this existing chlorine decay issue. The team began manual dosing also known as bucket chemistry….

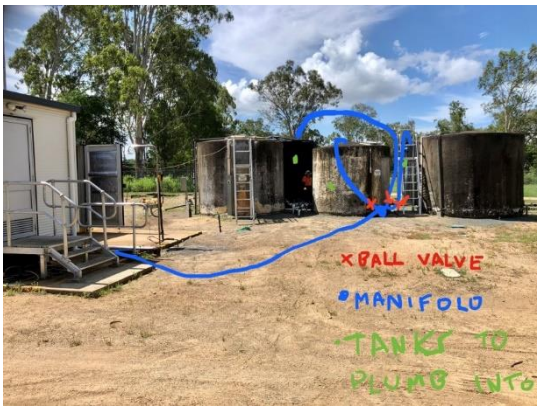


Figure 8: Modified recirculation system

We added a recirculation system using the existing booster pumps and needing nothing more than

some extra piping and valves. Tapping into the outlet side of the booster pumps and utilising a small percentage of the pressurized water heading to town diverting and splitting it between the tanks to create a constant water flow loop. This loop helped create an even distribution of chlorine levels by this added mixing. With a simple ball valve installed we were able increase or decrease the total amount of mixing required as well as valves on a common manifold giving operators further control over the process by adjusting individual flows to each tank depending on the requirement for increased or decreased mixing.

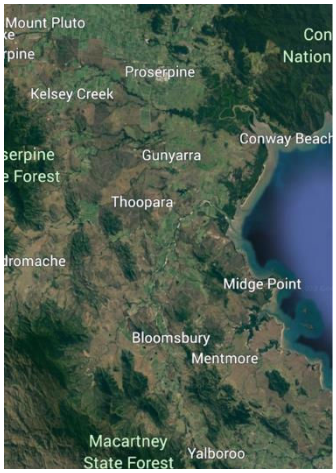
Furthermore, we also created a table as a guide utilising data we captured during the initial manual dosing trials testing chlorine residuals of each of the 4 four reservoir tanks prior to adding water from the delivery water tanker / chlorine residual of the tanker water itself / Volume of chlorine added and final residuals in each tank 30mins after manual dosing and mixing using the modified mixing system using the booster pumps.
Other factors we had to use when determining the amount of sodium hypochlorite manually dosed would be the forecast temperatures, expected consumption and the age of the chemical.

The chlorates issues we have had in recent times has also driven an upgrade not only at Bloomsbury WTP but also across many of our other remote sites, switching from Sodium Hypochlorite over the Chlorine gas. Chlorine gas does not have the same by products such as chlorates compared to its liquid cousin chlorine gas and in general also addresses many other issues we have had.

3.3 Alternative supply

Figure 9: Alternative Bore Drilling

We have also been looking at how to eliminate the raw water quality issues.
We looked if we could drill a second bore onsite at the WTP itself. After having to drill down quite some distance, testing was carried out and unfortunately, we discovered the water quality in this bore tested unsuitable with existing elevated levels of chloride.
We then decided to drill a 2nd bore near to the original bore on a 45-degree angle beneath the riverbed. This drill did not come without challenges hitting bedrock during the job but was completed and now we are awaiting test results. The thinking is that drilling closer to the surface water that being a shallower bore then the supply should have picked up less minerals. We are still pursuing this, unfortunately due to issues with the contractor, there are no records from the company of the drilling logs, so they are coming back to redrill down by the riverbed.



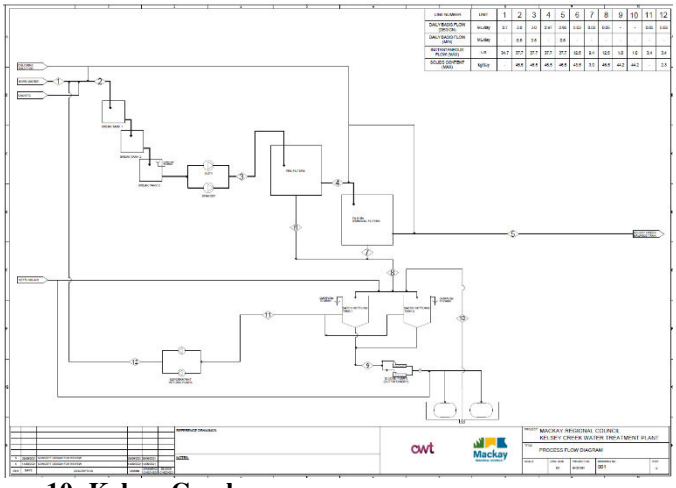


Figure 10: Kelsey Creek

Also, we are working with our planning and capital team on a long-term solution. There is an upgrade due to commence on a nearby scheme at the township Kelsy Creek and commissioned by the end of the calendar year. This upgrade is to also resolve iron and manganese issues by implementing a water treatment plant solution that includes dedicated dosing, filtration, and a residual handling. The scheme delivers water via a pipeline which includes supply to the residents of Midge point. Council is developing a design to extend this pipeline 12 km away to the Bloomsbury scheme which would then potentially see Bloomsbury as a storage and chlorination booster site.

4.0 CONCLUSION

Although historically the Bloomsbury bore water supply has served the community well in the past, changing water quality has driven the need to alterations to existing processes and development of new ones along with utilising other resources. Hopefully in the future with these and further developments to our treatment systems will have a more robust system that will withstand the impact of risks arising to our water supplies even in remote communities such as Bloomsbury… Our water treatment team have worked well together and put in a lot of long hours on this to continue to deliver potable water to our customers in the community.

5.0 ACKNOWLEDGEMENTS

This work has been challenging to our team and credit goes to not only our team of operators working together being Steve Crispin, Brad Richards, Ben Falconer, Ian Frey, Murray Nel but also many hours of behind the scenes work also from Brian Woods, Leon Atta, Stephen Nutt, Stuart Boyd along with all the contractors involved. A special mention to Emma Schmitz who has not only helped in this paper but been a major driver in supporting the team throughout this time.