GOOGONG WATER TREATMENT PLANT DRYING BED IMPROVEMENTS

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8th Annual WIOA
NSW Water Industry Operations Conference and Exhibition
PCYC in Orange,
1 to 3 April, 2014

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ABSTRACT

Googong Water Treatment Plant (GWTP) was commissioned in 1979 with a capacity of 180ML/d; in 2004 the capacity was increased to 270ML/d with the construction of a parallel Dissolved Air Floatation in Filter (DAFF) plant. In this time however the profile of the dam has changed and the plant now has to cope with water that is outside of the design specifications of the plant. Algal blooms, high colour and higher metals have appeared in the source water. The combination of raw water quality, an increase in coagulant and the introduction of powdered activated carbon and pre-treatment lime have resulted in a large increase in the volume of sludge produced at the plant. The capacity of the plant's sludge lagoons and drying beds became a limiting factor in how long the plant could operate continuously.

Over the years there have been improvements made to the sludge handling systems; however the drying beds and lagoons still impede the plant's production capacity. This paper details the most recent changes to the drying beds that have vastly improved the way GWTP can handle sludge. The drying beds were redesigned with new inlets and outlets, some beds were joined, pipe work was changed, polishing beds were introduced and storm water was redirected.

This has allowed ACTEW Water to greatly increase the efficiency of each and every bed as well as making the drying beds safer and easier to operate.

1.0 INTRODUCTION

Googong Water Treatment Plant has struggled to treat the volume of sludge produced in the treatment process in recent years. Drying beds and lagoons were filling close to capacity, which was impacting the maximum run time and production total during the plant's seasonal operation. This has been a consequence of a number of contributing factors.

GWTP operation is intermittent: the plant typically runs for 4 to 5 weeks in late Winter or early Spring while ACTEW Water's other treatment plant, Stromlo Water Treatment Plant (SWTP), is shut down for maintenance. GWTP also operates during high consumption periods in summer as required to supplement SWTP in supplying Canberra's drinking water needs.

The original plant, with production capacity of 180ML/d, included a design in 1979 for 17 large drying beds to dewater sludge from an average flow of 86ML/d. The design sludge production was 9.5 kg solids per ML of treated water. A sludge solids concentration of 30% was expected to be treated by the drying beds. Out of the 17 large beds in the design, only 8 were built: 4 in 1979 and 4 in 1980. In 1980, all beds were split in two, making 16 smaller beds in total.

In 2004, plant augmentation occurred with a parallel DAFF plant being built, increasing production capacity to 270ML/d. At the same time, a sludge thickener was built to thicken sludge from the DAFF system. Thickened sludge was then pumped to two lagoons that had been constructed in 2002, and supernatant from the lagoons was pumped to the drying beds.

Also in 2004, a Powdered Activated Carbon (PAC) system was constructed to treat taste and odour from algae. PAC was introduced at approximately 5-10mg/L, producing a large amount of additional sludge.

The algae in Googong Dam also caused taste and odour concerns, so the sludge Management Plan was changed. Concerns were raised about ageing algae in the reclaimed wash water sludge, so wash water reclamation basins are now changed over and cleaned fortnightly instead of monthly. During cleaning, sludge is hosed and pumped straight to the drying beds at approximately 0.5% solids, putting a high load on the beds. In addition, the taste and odour concerns means the plant is operated with a minimal sludge inventory in the thickener and, at high risk times, the clarifiers. However, operating with the lower inventory, the sludge blankets aren't formed as well and the resulting sludge goes to the lagoons/beds with low solids content. The solids content now going to the beds is only 0.5-3.0% and the sludge production is three times the design specification at approximately 28kg/ML of treated water.

The year 2010 brought the biggest challenge to the already overloaded sludge system, when the plant's source water dam filled from drought level to overflowing. The rapid fill of the dam brought an increase in algae, colour, metals (manganese & iron) and turbidity. GWTP had to treat water that was well out of design specification. The Alum dose was almost tripled from 30mg/L to 88mg/L, causing another large increase in sludge production, which increased to approximately 70kg/ML (8 times design).

Another issue to note over recent years is the time of year that the plant operates. Operating in late Winter/early Spring, GWTP operates in the wettest/coolest months in Canberra's year. These weather conditions reduce the effectiveness of the drying beds due to low evaporation rates.

Figure 1: ***GWTP drying beds North 4 (foreground) and South 4 full of PAC sludge.***

2.0 DISCUSSION

Identified issues with sludge management were addressed by multiple changes between 2008 and 2010 to improve the way sludge is dewatered. These changes included redirecting clarified sludge to the wash water reclamation basins sludge sump for thickening, constructing overflow weirs in the lagoons and modifications to the drying bed inlet and outlets.

In addition to this, some drying beds were repurposed as polishing drying beds, roads and guttering were constructed for the redirection of storm water, a storm water outflow V-notch was added and drying bed weir boxes were upgraded.

2.1 Clarified Sludge Redirection

Clarified Sludge was previously considered thick enough to send straight to the drying beds/lagoons. After the decision to run with less sludge in the clarifiers, the sludge produced had a lower solids content. One considered option was to dump straight into the reclamation basin inlet. This option was rejected because it would have upset settling and the recycle of clean supernatant to the head of the plant. It was decided to redirect this sludge directly to the reclaimed sludge sump. This sump is pumped to the thickener before being pumped to the drying beds. This meant that clarified sludge is thickened before being pumped to the beds, reducing the load on the beds.

2.2 Lagoon Improvements

The lagoons had proven to be a risk due to the lack of controlled overflow. New overflow weirs constructed in the Lagoons removed the possibility of an environmental breach caused by a lagoon overflowing uncontrolled. Lagoon A now overflows to Lagoon B. Lagoon B overflows through new pipe work to the inlet of the polishing beds. The weirs also changed the way the lagoons are operated. Allowing the lagoons to fill to the new overflow level causing clean supernatant to free flow out of the lagoon, decanting the lagoons more quickly than when supernatant was only pumped.

2.3 Drying Bed Valve Changes

Drying bed inlet valves were an assortment of different gate valves requiring a variety of valve keys. They were slow to open; they leaked and it was a time consuming process to check which drying bed was online or offline as there was no valve position indication. A hazard relating to the old sunken inlet valves was the presence of snakes in the valve pits. With the improvements, all valves were swapped with ¼ turn butterfly valves with permanent valve keys attached. Now the valves are quicker and easier to operate and a quick glance along the beds reveals the position of the valves. The valves are on the surface with a clear area around them, reducing the snake risk. The new valves don't leak, and they are now clearly marked with open/closed and bed number, which has eliminated confusion for Operators.

<u>**Figure 2:**</u> ***New Drying Bed Inlet Valves. Left showing the new valves with labels the right showing a row of closed inlet valves.***

2.4 Introduction of Polishing Beds

The lower 4 drying beds were changed into polishing beds. New inlet pipe work was constructed from the Lagoon B overflow and from the other 12 drying bed weirs. The polishing beds provide two benefits. The main benefit is polishing of the supernatant from the other 12 beds prior to discharge. The second benefit is to provide a controlled overflow for lagoon B if sludge is to overflow for any reason. This means we produce a better quality product going offsite. All drying beds under floor drains still flow directly to outflow.

2.5 Separation of Storm Water

Previously, storm water was able to run uncontrolled into the drying beds from the poorly constructed roads surrounding them. Every time it rained, sludge filled beds would have to be settled, decanted and dried again. This process took weeks and was dependent upon the right weather, reducing the dewatering capacity of the beds. The rain water would flow straight through the empty beds, scouring the outflow pipe work and polluting the outflow with high turbidity. This problem was resolved by installing guttering and an improved road system, as well plumbing new storm water drains into the storm water pond. Now the beds stay relatively dry and empty in wet weather conditions, which has alleviated the stress rain would put on the system. The new road systems also improved both vehicle and pedestrian access to the drying beds and eliminated the trip hazards of poorly constructed roads.

2.6 Storm Water Outflow Weir

Along with the installation of the roads, guttering and drains, the storm water retaining pond was upgraded. New inlet and outlet pipe work was constructed, along with a V notch installed in the outflow. These changes allowed Operations to decant storm water as required instead of it just free flowing out of the pond. Now when it is released, Operations are able to measure what percentage of the drying bed outflow is storm water.

2.7 Drying Bed Overflow Weir Upgrades

The biggest operating improvement to the drying beds was the introduction of single piece decanting weir boards that were not only inexpensive and easy to install but also very efficient.

Previously, the weirs were made up of multiple boards that were removed individually to allow different heights of decanting. The old boards used to leak, allowing unsettled supernatant to the outflow. They were difficult to remove and often came out in pairs or threes. This meant that too much water was released too fast, causing settled sludge to be sucked up and over the weir. Operators used to have to lie down right over the water to pull the boards out. This was an unsafe practice. A further hazard was that some of the older board were constructed from Asbestos. Due to the difficulty and unpredictability of removal, Operations would only decant when absolutely necessary. The decanting process was unreliable and threatened the outflow licence.

Figure 3: ***Old Drying Bed Decanting Weir Boards***

The 'keep-it-simple' principle was applied to the design of the new outflow weir boards. Single piece boards were installed with 2 inch ball valves at differing levels for decanting. The new boards are installed with seals and they don't leak. The new valves allow water to be decanted slowly, so no sludge gets sucked out. Every weir has its own long valve handle that makes it safe, simple and quick for operating the decanting weirs.

Figure 4: ***The new Drying Bed Decanting Weir Boards showing the 4 valves at differing levels.***

2.8 Future Operations

To meet operational expectations of predicted higher flows and longer run times, other options are being considered to further improve the sludge dewatering capacity of the plant. The addition of mechanical dewatering, installation of geotubes and the addition of another thickener are all being investigated for the future.

3.0 CONCLUSION

Each of these modifications to the sludge handling systems has improved the sludge dewatering capacity of the plant and reduced the possibility of breaches to the environmental licence. The quality of the offsite discharge has been improved and the changes have also improved safety for operations staff, as well allowing staff to run the plant more efficiently.

These small investments have improved the efficiency of the drying beds and will complement mechanical dewatering, when installed. The current improved systems work well for very short production runs on the seasonal stop start plant. Mechanical dewatering remains necessary for extended periods of operation in the future. However, owing to the above improvements in sludge handling, the required capacity of the proposed mechanical dewatering project has been reduced.

4.0 ACKNOWLEDGEMENTS

Kimberly Lippmeier, Cameron Patrick and Wesley Trotter for their valuable inputs.

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