RESERVOIR MIXING – WHAT'S REALLY GOING ON INSIDE YOUR WATER SUPPLY RESERVOIR?

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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

The Hastings District Water Supply Augmentation Scheme has been developed to cater for future urban population growth over the next 30 years within the Port Macquarie-Hastings local government area.

The associated water supply infrastructure works have included several large trunk mains and reservoirs. The need to size this infrastructure to cater for future water demands has resulted in some of these reservoirs having long detention times due to the current low water demands.

The New Bonny Hills Reservoir has a capacity of 13ML and will ultimately operate as both a balance tank on a major trunk main network and also as a local supply reservoir to service the daily water supply needs in the Lake Cathie and Bonny Hills urban areas.

Currently this reservoir is only supplying a quarter of its ultimate water supply demand zone and this situation is adversely impacting upon the quality of drinking water supplied to consumers.

Port Macquarie-Hastings Council (PMHC) in conjunction with Aqualift has recently implemented a reservoir dosing and mixing system to improve the quality of water stored within the reservoir and to provide a dosing injection point for the addition of chlorine and carbon dioxide gas.

This pumped dosing and mixing system has improved the quality of water stored in the reservoir and ensured that adequate residual chlorine levels are maintained at all times within the downstream distribution network.

KEY WORDS

Reservoir dosing and mixing, water quality and maintaining residual chlorine.

1.0 INTRODUCTION

The Hastings District Water Supply Augmentation Scheme has been developed and is being progressively implemented to cater for additional urban population growth within the PMHC LGA over the next 30 years and to ensure the protection of minimum environment flows in the Hastings River, which is main source of the drinking water.

Stage 1 (complete)

Reservoirs	Bonny Hills Laurieton Lakewood Village
Pumping Station	North Haven Booster
Pipelines	Rosewood Road to King Creek West Haven to Lakewood

Stage 2

New Dam	Cowarra State Forest
Reservoirs	Dam site Rosewood Road
Pumping Stations	Dam site Koree Island
Pipelines	Connection to new dam site Southern Arm Link to Bonny Hills
Water Treatment	Rosewood Water Conditioning Plant Wauchope Treatment Plant

Stage 3

Pipelines	Bonny Hills to Laurieton
Pumping Stations (Upgrading)	Dam site Koree Island North Haven Booster

Stage 4

Pipeline	Rosewood to Dam
Pumping Stations	Koree Upgrade Lakewood Booster

Facts File

	PROJECTED TIMETABLE	PIPELINES	RESERVOIRS	PUMPING STATION ACTIVITY
STAGE 1	1996	17.34 km	21.5 ML	15.0 ML/day
STAGE 2	2001	18.7 km	18.0 ML	57.6 ML/day
STAGE 3	2006	10.36 km		72.6 ML/day
STAGE 4	2011	10.0 km		35.8 ML/day
TOTALS	15 years	56.4km	39.5ML	

HASTINGS

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2.0 DISCUSSION

2.1 Background

The New Bonny Hills is a concrete reservoir with a height of 10.2 metres, diameter of 40 metres and a capacity of 13ML, with extended detention times in the order of several days, due to limited customer water demands.

Chlorine residual levels are difficult to maintain both within the reservoir and in the downstream distribution network. In an attempt to overcome these low chlorine residual levels it has been necessary to regularly undertake manual chlorine dosing of the reservoir.

PMHC had also installed a directional inlet flow nozzle inside the reservoir in an attempt to introduce mixing energy and improve the distribution of the manual chlorine dosing. However due to the low water demands this reservoir would often only fill every second day, so the mixing energy was not being continuously applied inside the reservoir.

In order to complete the manual chlorine dosing of the reservoir PMHC's water operators needed to attend the site 2 to 3 times per week. This work would include climbing the reservoir ladder to dose chlorine into the entry hatch of the reservoir.

This high frequency of manual dosing was required due to a number of reasons including; the long detention times, location of the entry hatch close to common reservoir inlet/outlet pipework and short circuiting of the reservoir via this common inlet/outlet pipework.

This manual chlorine dosing procedure had several disadvantages and risk management issues including; high labour, plant and chemical cost, WH&S issues associated with climbing reservoirs and manual handling of the chemical dosing, localised corrosion damage to the internal reservoir ladder, hatch and structure from chemical attack and water quality concerns, due to inadequate mixing.

A number of options were considered to improve the quality of the water stored within the reservoir, particularly as the low water demands will remain a reality at this location for the next 10 to 15 years. In the interim changing reservoir filling operating levels and the installation of the directional inlet zone, together with manual chlorine dosing were trialled in a number of configurations. However, none of these configurations could provide a reliable and suitable risk profile procedure to improve the quality of water stored in the reservoir.

As part of the testing and monitoring of these configurations a system of water sample monitoring points, using 50mm HDPE pipe, were installed within the reservoir to allow water samples to be easily collected from different locations and depths within the reservoir.

This monitoring quickly confirmed and demonstrated that that the long detention times and limited internal mixing time within the reservoir resulted in low chlorine residual levels. It also confirmed that the manual chlorine dosing was having limited impact and that short-circuiting was occurring at the inlet/outlet pipework.

PMHC then considered a number of options to improve mixing within the reservoir including; a variety of commercially available ‘in tank’ mixers, but they all appeared to be relatively expensive to purchase, install and maintain. An externally mounted pump was then decided upon to provide a source of mixing energy and a suitable chlorine injection point.

2.2 External Mixing Pump & Chlorine Injection System

An externally mounted mixing pump was installed at the base of the reservoir and draws water from a 50mm HDPE suction pipe and foot valve mounted inside the reservoir and discharges water through a 50mm PN 16 HDPE pipe and jet nozzle located inside the reservoir. Both the suction and discharge pipelines are fixed to the internal and external walls of the reservoir.

PMHC’s workshop manufactured a swivel mounted fixture to mount the internal jet nozzle on the wall inside the reservoir and to also allow it to be adjusted for angle and direction once it was in operation. The jet nozzle is currently set to operate in the same direction as the larger nozzle unit fitted to the inlet pipework.

The Aqualift Diving team were able to install the internal 50mm HDPE pipework while the reservoir remained in service. This underwater work involved fixing two separate 50mm HDPE pipes into the tank, running them over the top of the reservoir wall and back down to the ground level.

The mixing pump is able to draw water from the foot valve located inside the reservoir and recirculates it through the jet nozzle back inside the reservoir. It is also possible to dose chlorine into this mixing pipework downstream of the mixing pump.

Figure 1: ***Suction & Discharge 50mm HDPE pipework mounted on outside of reservoir wall***

The internal jet nozzle can be exchanged to trial different water quantities and pressures once in operation and following the establishment of a stable chlorine residual regime within the reservoir.

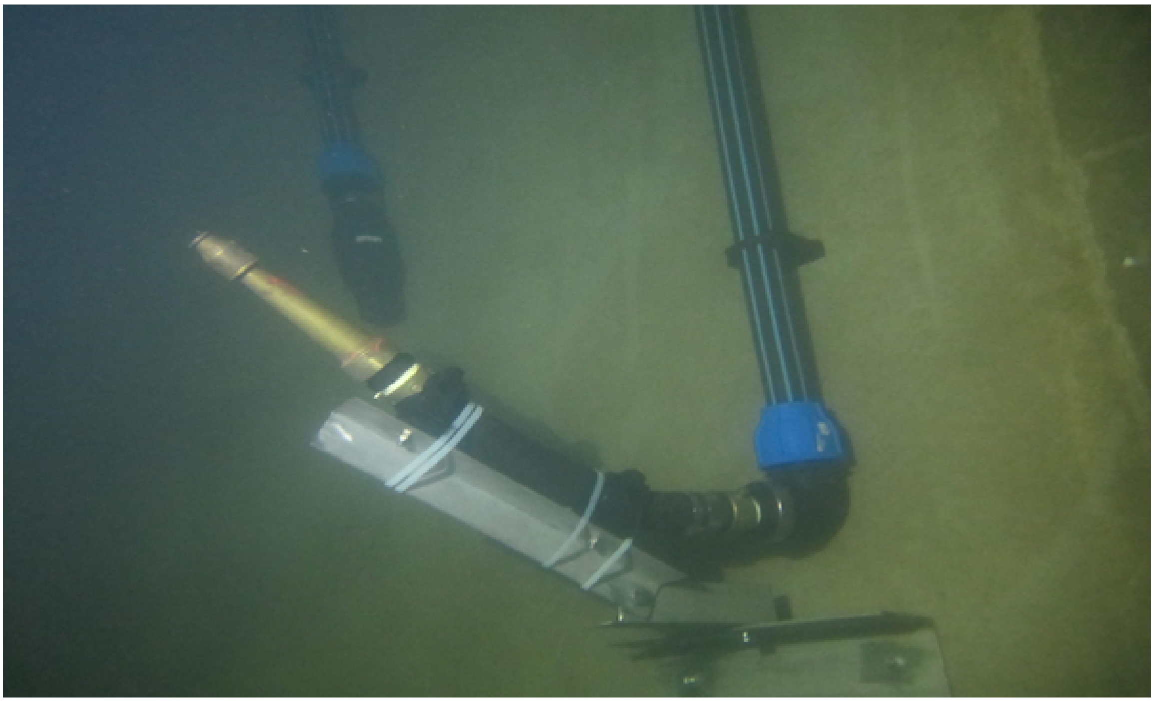

Figure 2: ***Directional jet nozzle attached to the mixing pump discharge pipeline, located on the wall inside reservoir***

3.0 CONCLUSION

This simple reservoir mixing system has multiple benefits including;

1. Ability to circulate water flow within the reservoir to maintain water quality across the entire volume of stored water (ie. no more dead spots),
2. An effective and controlled chlorine dosing system,
3. Elimination of chlorine “short circuiting” and problems related to slug dosing of chlorine,
4. Elimination of a working at height risk involving manual chemical handling and transfer,
5. Elimination of corrosion issues related to slug chlorine dosing of reservoir,
6. Reduced chemical cost achieved by effective chlorine dosing,
7. Reduced labour cost as water operators can complete testing and chlorination adjustments quickly (no longer required to climb ladder), and
8. Accurate sampling regime to ensure water quality across the entire reservoir.

4.0 ACKNOWLEDGEMENTS

The assistance provided by the following individuals and organisations is gratefully acknowledged; Terry Randall and Bevan Hudson from PMHC, Aqualift Diving Services and PMHC water supply & laboratory staff in the design, construction, installation and water quality monitoring activities associated with this project.