

WATER QUALITY - DON'T REST ON YOUR LAURELS



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ABSTRACT

The aim of this paper is to highlight the need for ongoing review of operational procedures and control system programmes.

It will outline the details of two operational events in the Port Macquarie/-Camden Haven water supply scheme that affected water quality and discuss the causes, actions taken to rectify and provide solutions to avoid these issues in the future.

1.0 INTRODUCTION

The Port Macquarie/Camden Haven scheme supplies the majority of residents in the Port Macquarie Hastings Council (PMHC) area (pop 70,000). It is unfiltered with chlorination being the only form of treatment. Water is pumped from the Port Macquarie Off-Creek Storage Dam to five (5) reservoirs that service different supply zones within the Port Macquarie area, from where it is also distributed south to supply the Camden Haven area. Water is initially chlorinated at the Port Dam pump Station. The chlorine residual is topped up at two booster stations along the supply network.

During 2010 a Memorandum of Understanding (MOU) was formulated between North Coast Public Health Unit (NCPHU) and PMHC. Part of this MOU outlines the actions, reporting and investigation procedures in the event of an incident that may affect water quality.

2.0 DISCUSSION

2.1 Investigation into *E.coli* detection In Transit Hill Level storage tanks 23rd May 2011

The Transit Hill High Level Zone is pressurised by a booster pump station. The pump station directly feeds the reticulation system from the main Transit Hill reservoir. The main Transit Hill reservoir is filled with chlorinated water via the Port Macquarie Dam Pump Station. A chlorine residual of 1.5mg/L is normally maintained in the Transit Hill Reservoir.

The booster pump station operates via a variable speed drive to meet the zone demand from 5am to 12am daily. The remaining low flow period demand is met by two High Level Tanks. While the pump station is operating the tanks are filled via a ball float valve and the outlet is isolated from the zone via a non-return valve. In the event of a low pressure event during the low flow period the pump station will be called upon to provide pressure and flow to the zone. The High Level tanks hold a combined total volume of 40kL.

PMHC conducts micro biological testing in line with NSW Department of Health (DOH) requirements. PMHC also conducts additional micro biological sampling to the NSW DOH requirements due to the water supply being unfiltered.

During 2010, a detailed review of the micro biological sampling regime was conducted. The review identified that adjustments were required in some reservoir zones to maintain

compliance. The Transit Hill High Level zone was an area that was not being adequately sampled. The new sampling regime was implemented in March 2011.

2.2 E.coli detected In Transit Hill Level Storage Tanks –

On Wednesday 27th April 2011 - A routine sample was collected on by a junior water treatment operator. Physical tests taken at the time of collection showed no chlorine residual present in the high level tanks. This sample returned a total coliform count of 19 MPN/100mL. No action was taken.

Monday 9th May 2011 - Another sample was collected for testing by a senior water treatment operator. Again no residual chlorine was detected. The water treatment operator added calcium hypo chlorite pills to the tanks to boost the chlorine residual.

Tuesday 10th May 2011 - The follow up sample returned a positive reading for both total coliforms and *E.coli*. *Results* – Total coliform 51MPN/100mL *E.coli* 2MPN/100mL.

Wednesday 11th May 2011 - A 2nd follow up sample was collected. The chlorine residual had increased to 0.8mg/l since the addition of the chlorine pills.

Thursday 12th May 2011 – The 2nd follow up sample detected no *E.coli*.

The main Transit Hill Reservoir and the High Level Zone chlorine residuals were not compromised during this event.

2.3 Mitigation Measures and Actions

On Tuesday 10th May 2011, PMHC's Laboratory Manager activated the response in accordance with the NSW DOH MOU when the *E.coli* had been detected. The following action was taken –

- 1) PMHC Water Supply Manager, Operations Engineer, Water Treatment Technical Officer and NSW DOH all informed of the *E.coli* detection.
- 2) PMHC water services staff were immediately directed to attend and isolate the high level tanks from the reticulation zone.
- 3) Water treatment staff confirmed chlorine residual was being maintained in the system.
- 4) PMHC electrical staff were directed to attend and program the booster pump station to operate on a 24 basis to supply the zone while the tanks were offline.
- 5) NSW DOH informed of High level tank isolation and confirmation of chlorine residual in the supply zone.
- 6) In consultation with DOH, it was decided no boil water alert was required.
- 7) Friday 13th May 2011, Aqualift Potable Water dive team attended to clean and inspect the tanks. Water treatment operators attended and added sodium hypochlorite to each tank to raise the chlorine residual to 5mg/L. High Level Tanks then left to soak over the weekend.
- 8) Monday 16th May 2011, the chlorine residual was checked as 5mg/L. The Tanks were

then topped up to maximum capacity via booster pump station and left over night to dilute.

9) Tuesday 17th May 2011, the tanks were drained and inspected then again refilled.

10) Wednesday 18th May 2011, Chlorine residual and physical water quality tested then a sample was taken and delivered to lab.

11) Friday 20th May 2011, the Laboratory confirmed safe drinking water quality. The High Level Tanks were brought back into service with ongoing monitoring to continue.

2.4 Operational review of Transit Hill High Level Zone

Adding these previously untested tanks to the microbial testing regime clearly identified a problem in our operational system. Upon investigation it was recognised that the high level tanks deliver a minimal amount of water to the reticulation zone during the course of normal operations.

The water quality in the tanks was being compromised by the prolonged retention time. The chlorine residual is being diminished and the water is prone to stagnating.

The report from the Aqualift divers shows that there was significant corrosion in the interconnecting pipe work between the two High Levels tanks.

The chlorination system for the Transit Hill reservoirs is located at the Port Dam pumping station. This system is well maintained and operated. It is adequate for its intended purpose.

The main Transit Hill reservoir is equipped with chlorine, redox and pH online instruments connected to SCADA. The SCADA is monitored and trended daily. Physical chlorine tests are performed on site most days.

2.5 Recommended Follow-Up Actions

Possible automatic cycling of water from the high level tanks back to the Transit Hill reservoir to help maintain chlorine residual and prevent water from stagnating is considered to be the best long term solution. In the short term this will be achieved by taking a tanker load (12kL) out of the tanks on weekly basis and returning it to the Port dam.

A redox probe is to be installed in the high level tank and connected to SCADA to allow monitoring and trending.

The chlorine residual in the high level tank will be tested daily in the short term to determine the chlorine decay rate and weekly in the longer term. This will assist with determining the timing of the proposed the circulation system.

The site has become part of the fortnightly reservoir microbial testing regime and a permanent testing point to be installed on the tank outlet to allow for ease of ongoing monitoring.

A new sample point for the reticulation system will be installed as part of the booster

pump station upgrade planned for 2012. This new site will become the monthly reticulation test site.

Hatch access points need resealing and interconnecting pipework needs to be replaced.

Review the frequency of tank cleaning.

2.6 Conclusion - Transit Hill

The PMHC / DOH MOU was implemented effectively and proved to be a useful tool. Ongoing supervisory staff shortages were highlighted by the fact that in the first instance the junior water treatment operator did not have the expertise or support to report and act upon the original low chlorine residual test.

PMHC staff responded quickly and efficiently to protect the health of the community by isolating the tanks from the supply zone immediately upon the discovery of *E.coli* in the Transit Hill high level tanks.

This incident highlights the need for ongoing operational reviews and improvements to identify problem areas and ensure that public health is protected.

2.7 Lake Rd Booster Pump Station / Mill Hill Reservoir Chlorine Dosing Incident

The Lake Rd Booster Pump Station is designed to transfer potable water from the Widderson St Reservoir to The Mill Hill reservoir in the Port Macquarie area. The pump station is equipped with a sodium hypo chlorite dosing system to boost the chlorine residual in the Mill Hill reservoir. The pump station generally runs for 2 hours every second day.

Approximately 400L of sodium hypochlorite solution was injected into the Lake Road BPS rising main over a 14 hour period following the failure of a flow meter instrument which falsely indicated full flow rate in the rising main. This flow meter instrument failure appeared to have been caused by an electrical surge, during a major storm event which occurred in the local area at 5pm on Thursday 29th September 2011.

Both the hypo dosing pumps operated continuously until this problem was identified on the SCADA system at 5:30am on Friday 30th September 2011. The pumping station water pumps did not operate during this 14 hour period. Therefore the injected hypo solution was confined inside the rising main adjacent to the injection tapping point.

Approximately 20,000L of water was decanted from the hypo injection point on Friday 30th September from 9:30am to 2:30pm, into a road water taker, in an attempt to remove as much of the hypo solution as possible from the rising main. This water had high chlorine content (ie. + 5mg/L) and was disposed into the Port Macquarie Off-Creek Storage Dam.

Water quality monitoring instrumentation at the Mill Hill Reservoir indicated that the chlorine levels in the reservoir remained at 0.25mg/L. At 10pm on Friday 30th September the Lake Road Booster Pumping Station was manually operated to pump water (210 L/s) from the rising main into the Mill Hill reservoir.

The Mill Reservoir has a storage capacity of 12ML and approximately 350,000L was

pumped into the reservoir.

Remote monitoring of Residual Chlorine in Mill Hill Reservoir indicated a peak value of 4.02mg/L at 9:15am on Saturday 1st October 2011.

These results were immediately advised to the North Coast Public Health Unit (NCPHU) and Port Macquarie Base Hospital. Onsite water sampling and testing at the Base Hospital indicated a normal chlorine level of 0.34mg/L.

In consultation with the NCPHU it was agreed that onsite water sampling and testing would be continued three (3) times per day to monitor the situation at the both reservoir and hospital. All results were to be immediately advised to NCPHU and the Port Macquarie Base Hospital.

Onsite water sampling and testing conducted at 7:30am, Sunday 2nd October 2011 at the Hospital and Mill Hill Reservoir indicated 4.14mg/L and 2.44 mg/L respectively.

Subsequent onsite testing at 1pm, Sunday 2nd October 2011 indicated 2.36mg/L at the Hospital and 2.76mg/L at the Reservoir, which suggested the peak value had been reached in the morning and that chlorine levels would now continue to fall to normal levels of approximately 1mg/L.

On Sunday night at 10:05pm the pumping station was again operated manually for a short period of time to slowly move the remaining water in the rising main into the reservoir. During this manual pumping operation the water quality in the reservoir was continuously monitored and chlorine levels decreased from 2.84mg/L (10pm) to 1.96mg/L (12am). This indicated that the water in the rising main was returning to normal chlorine levels.

Subsequent onsite water sampling and testing on Monday, 4th October 2011, confirmed that chlorine levels were continuing to fall in the reservoir and reticulation system.

2.8 Mitigation Measures and Actions

- 1) Shutdown and isolation of booster pumping station and hypo dosing pumps,
- 2) Continuous monitoring of reservoir water quality,
- 3) Decanting of high chlorine content water from hypo injection point,
- 4) Manual operation of booster pumping station to limit transfer of water from rising main to reservoir. This operation was completed late at night (10pm) when reservoir water demands were at a low level to allow maximum time for mixing and dispersion of chlorinated water within the reservoir,
- 5) Regular onsite water sampling and testing of water quality at Base Hospital and reservoir sites, information passed onto NCPHU on each occasion, and
- 6) Regular contact with NCPHU and Base Hospital.

2.9 Recommended Follow-Up Actions

- 1) In the week leading up to this event a new major water main was being connected in the Mill Hill reservoir zone. Preceding this work, a large part of the Mill Hill zone was rezoned to the Widderson St zone. Water treatment staff were not informed of this rezoning. During the course of the week the water treatment operators noticed the diminishing chlorine residual in the Mill Hill Reservoir. On the day of the incident operators adjusted the hypo dosing pumps up to maximum capacity to boost this chlorine residual. Although this lack of communication between work groups did not cause the incident it does highlight an operational oversight.
- 2) It was assumed that multiple permissive signals were programmed into the control system to prevent this type of flow meter failure causing an issue. Therefore an Immediate review and/or rectification of local hypo dosing pump control and interlocks at this site, local control to include one (1) analogue (flow meter) and two (2) digital (pump running and pump MV open) signals to be active before commencing operation of the hypo pumps. A loss of any one of these signal will automatically shut-down hypo dosing pumps and raise an alarm,
- 3) Configure an onsite alarm to be activated if hypo flow is detected and no pumps are running,
- 4) Commence review and /or rectification of local hypo dosing pump control and interlocks at all other water supply facilities, this work to be completed within 1 month.
- 5) Document SOP for dosing pump control configurations at all water supply sites,
- 6) Review and documentation of instrumentation calibration and set points at all hypo dosing plants, including; flow meters and hypo storage tank levels.
- 7) Review and amend SCADA monitoring and alarming for chemical dosing system, all chemical dosing pumps to be configured as “Pump” Plant Type in new SCADA-C system to provide additional derived alarm capability.
- 8) Prepare Standard Operating Procedure for Chlorine/Chemical “Over-Dosing” Incidents in Water Supply System.

2.10 Conclusion – Lake Rd Booster Pump Station

The ongoing review and testing of control system interlocks is required to maintain ensure adequate safety measures are in place to avoid water quality incidents.

Planning and communication between various work groups is required to ensure that good decision are made in relation to systems operations.