SAFE DRINKING WATER AT GRAHAMSTOWN WTP - APRIL 2015 "SUPERSTORM" RESPONSE

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ABSTRACT

Grahamstown Water Treatment Plant (WTP), located 20 km north of Newcastle (NSW), treats water from Grahamstown Dam and supplies safe drinking water to 390,000 people in the lower Hunter region.

On 21st and 22nd April 2015, an East Coast Low (ECL) hit the Hunter region with heavy rainfall and strong winds. This ECL event was termed as a "superstorm" by the local media. In the 48 hours leading to 23 April 2015, 270 mm of rainfall was recorded in Grahamstown Dam catchment resulting in an increase in the Dam level of 1000 mm in two days. Large amounts of stormwater entered the Dam, including runoff from the urban catchment of Medowie via Campvale Canal. As a result, raw water turbidity increased gradually from less than 2 NTU to a peak of 12.6 NTU on 25th April and remained above historical 95th percentile turbidity levels of 4.6 NTU for two more weeks after the ECL storm event.

To respond to this significant challenge posed to raw water quality, Grahamstown WTP was manned 24/7 by Hunter Water's Treatment Operations Contractor, Veolia, providing hourly updates on key operational parameters to Hunter Water's Incident Management Team. Significant changes implemented to treatment processes included enhanced coagulation and wasting of backwash water to minimise the risk of concentrating any pathogens that might be present, increased chlorine dose rates for greater disinfection, a tighter target and critical limit for individual filtered turbidity, and intensive sampling including multiple samples collected on a daily basis for the analysis of protozoa, *E. coli*, enterococci, turbidity and ammonia with a select samples analysed by three NATA accredited laboratories for protozoa.

Monitoring data collected for Grahamstown WTP raw water suggested that raw water received by the WTP was impacted by the ECL storm event as indicated by an increase in turbidity levels. Grahamstown WTP consistently produced safe drinking water in line with performance targets throughout the ECL storm event. This indicated overall low risk to public health in accordance with the Australian Drinking Water Guidelines (ADWG).

1.0 INTRODUCTION

Grahamstown Dam (capacity 182 ML) is an off-river storage with approximately half of the stored water supplied from its own small catchment (area 115 km^2) and the remaining half by pumping from the Williams River. Grahamstown Dam is a major water source for Hunter Water, contributing about 40% of water supplied to its customers overall.

Land use in the dam's direct catchment includes state forest, rural, rural residential and urban. The main land use activities in the Williams River catchment are rural in nature with cattle grazing and dairying predominating. In a trial of the Water Services Association of Australia (WSAA) Health-Based Target methodology for assessing microbial risk to drinking water, the tier one assessment rated the Grahamstown Dam catchment as category 4 – unprotected catchment.

There is an urban development within catchment on the Western side of Medowie, which drains into Campvale Canal and is then pumped into Grahamstown Dam within 2.5 km of the raw water offtake from the dam.

Water from Grahamstown Dam is treated at Grahamstown Water Treatment Plant (WTP) with a maximum capacity of 257 ML/day. Grahamstown WTP is a conventional treatment plant with the following processes:

- Coagulation/flocculation
- Sedimentation
- Filtration
- Disinfection

Treated water from Grahamstown WTP is used to supply water to customers in Stockton, Medowie, Newcastle and Lake Macquarie areas. If required, water from Grahamstown WTP can also be supplied to Beresfield, Maitland, Cessnock and localities within the Dungog Local Government Area as far North as Clarence Town. These areas are usually supplied by water from Chichester Dam and treated at Dungog WTP.

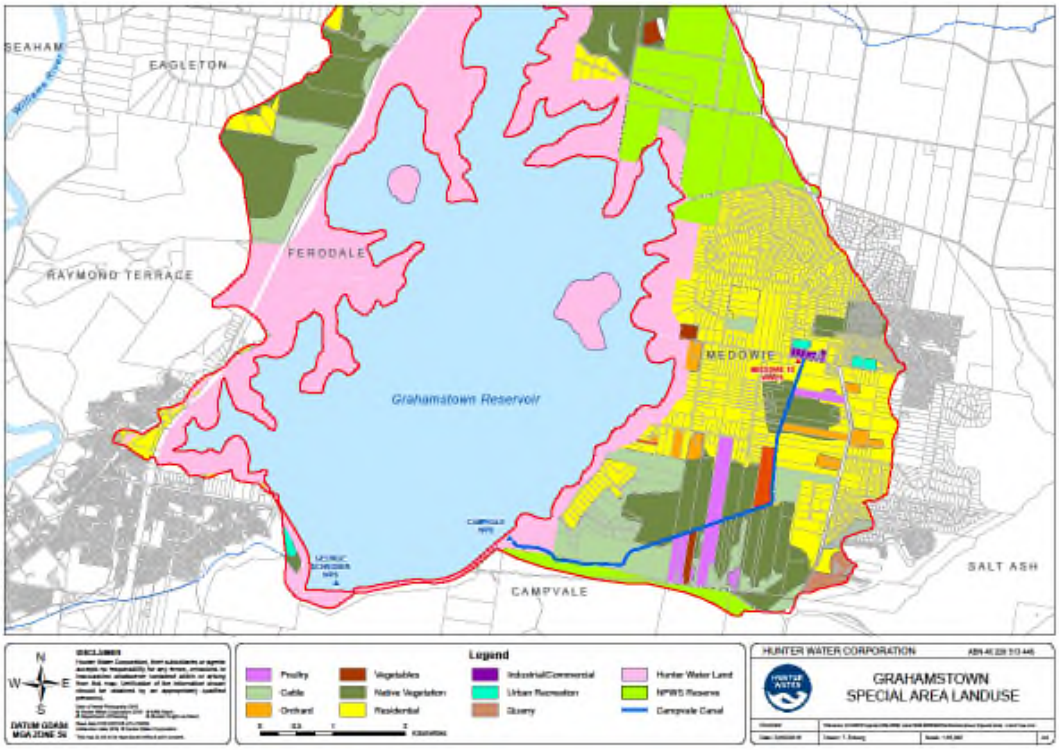

Figure 1: ***Land Uses within the Grahamstown Dam Catchment***

Noting the nature of the catchment, Hunter Water continues to work with stakeholders including NSW Health on a strategy to better understand and manage water quality risk at Grahamstown Dam. This work considers draft health based targets, and includes strategies to manage development impacts, formalising control, monitoring and communication protocols developed through managing this event, treatment process optimisation, and consideration of upgrade works to improve urban source management.

On 21st and 22nd April 2015, an East Coast Low (ECL) hit the Hunter Region with heavy rainfall and strong winds. This ECL event was termed as a "superstorm" by the local media.

In the 48 hours leading to 23 April 2015, 270 mm of rainfall was recorded in Medowie / Williamtown area, resulting in an increase in the Dam level of 1000 mm in two days. This rainfall is representative of a 1-in-20 year storm event. The volume of water (~ 5 GL) entering the dam from Campvale Canal was relatively small compared to the Dam capacity of 182 GL.

The Chichester source was not available due to major damage to trunk mains, and the capacity of the Tomago borefields (another alternative source) was reduced due to damage to power infrastructure during the ECL. With these other major sources unable to meet demand, source substitution was not an option for Hunter Water.

2.0 DISCUSSION

To manage the risk of potential elevated pathogen levels in the Grahamstown source as a result of urban runoff from Campvale Canal during the ECL storm event, Hunter Water in consultation with NSW Health developed a strategy to ensure that continuously safe water was supplied to customers.

The strategy developed and implemented included a range of measures to optimise performance and reliability at Grahamstown WTP. Intensive water quality monitoring was also undertaken during and after this rain event.

2.1 Impacts on Grahamstown Raw Water Quality

Intensive water quality monitoring was undertaken during and after the ECL event. Multiple samples were taken daily during the event and analysed for a range of water quality parameters, including Turbidity, *E coli*, Cryptosporidium and Giardia and ammonia. Select water samples were analysed by three NATA accredited laboratories; ALS Newcastle, ALS Smithfield and Sydney Water.

As a result of elevated rainfall, Grahamstown raw water turbidity increased from less than 2 NTU to a peak of 12.6 NTU on 25th April and remained above historical 95th percentile turbidity levels of 4.6 NTU for two more weeks after the ECL event. Professional advice received from HunterH2O indicated that Grahamstown WTP should be capable of treating raw water turbidity up to 25 NTU. Figure 2 shows historical turbidity levels at Grahamstown raw water tank.

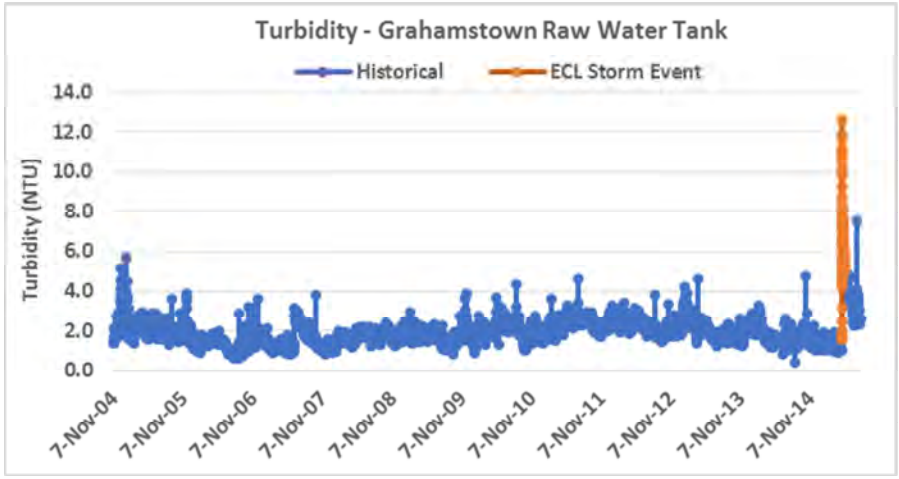

Figure 2: ***Historical Raw Water Turbidity at Grahamstown Raw Water Tank***

Sampling carried out in Grahamstown Dam during and after the storm event indicated that sampling points in the vicinity of the Campvale Water Pump Station discharge point contained the highest turbidity readings amongst dam sampling points. Turbidity levels within the dam on 24th April 2015 are shown in Figure 3.

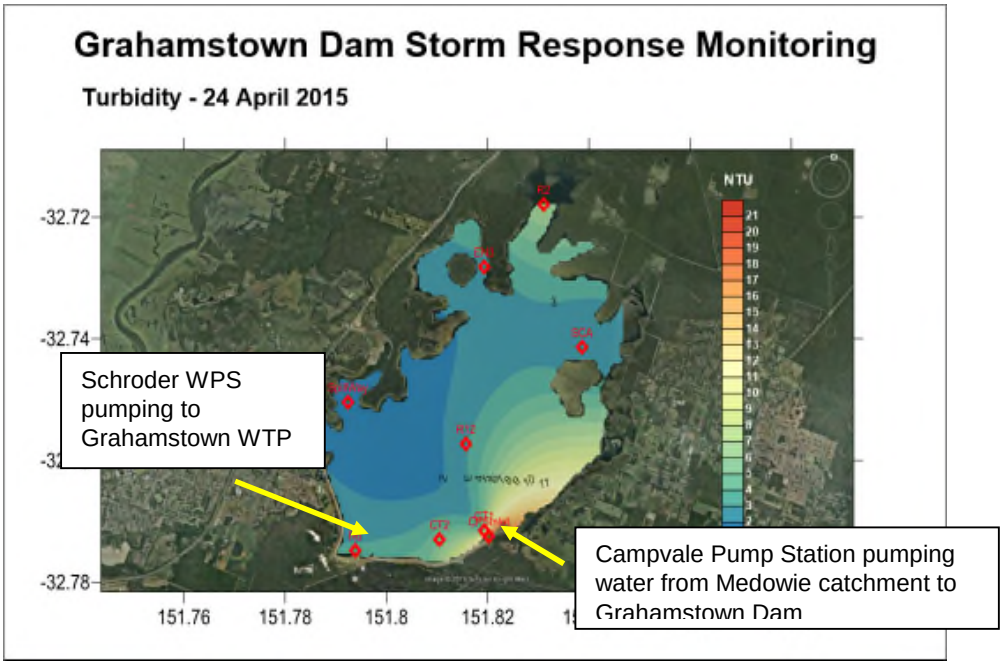

Figure 3: ***Turbidity in Grahamstown Dam on 24 April 2015***

Grahamstown raw water *E. coli* levels during the ECL storm event reached levels higher than typically seen at the WTP as part of routine monitoring. The highest *E. coli* result at Grahamstown WTP raw water tank during the storm event was 29 MPN/100mL. This value lies between the 90th (8 MNP/100mL) and 95th (59 MPN/100mL) percentile values for the raw water tank. Note that many of the historic elevated results for *E. coli* in Grahamstown Raw have been established to have occurred due to environmental bloom strains of *E.coli* which are not indicative of pathogen risk. **Figure 4** shows historical *E. coli* results at Grahamstown Raw Water Tank.

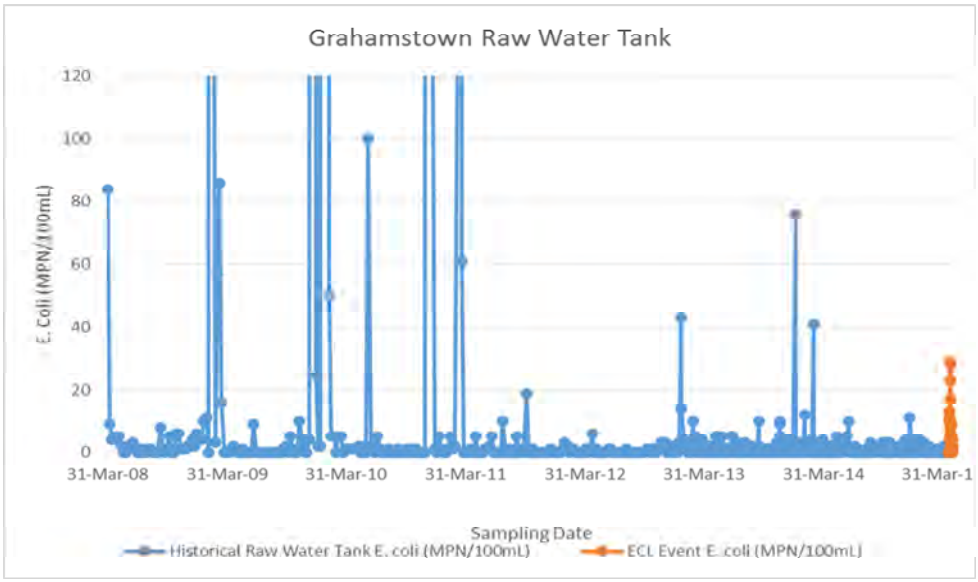

Figure 4: ***Historical E. coli at Grahamstown Raw Water Tank***

A total of about 30 samples were collected at Grahamstown Raw Water Tank for the analysis of cryptosporidium and giardia. There were no detections of cryptosporidium in Grahamstown WTP Raw Water Tank during the event, and 3 detections of Giardia, with a maximum result of 1 cyst/10 L.

Prior to the ECL event, routine fortnightly sampling had been undertaken of Grahamstown Raw Water Tank over a period of 15 years with about 400 samples collected. These samples were analysed by a NATA accredited laboratory for cryptosporidium and giardia. Out of these 400 samples, 5 samples had recorded presumptive detections of giardia (with a maximum result of 4 cysts/10 L) while 4 samples had recorded presumptive detections of cryptosporidium (with a maximum result of 3 oocysts/10 L).

2.2 Response to Ensure Continuous Safe Drinking Water Supply was Maintained

Potential risks to raw water quality were mitigated at Grahamstown WTP through implementation of a range of operational changes.

Grahamstown WTP was staffed 24 hours per day, 7 days per week. Hourly updates on key operational parameters (raw, settled and filtered turbidity and chlorine residual) were provided to Hunter Water's Incident Management Team which included a water quality scientist(s). Hunter Water provided regular updates to NSW Health on the incident situation and Hunter Water's response to the incident.

Process changes were undertaken, including:

- Enhanced coagulation, i.e. higher coagulant dosing to improve filtered water turbidity;
- Filter backwash water was diverted to the sludge lagoon instead of being recycled to the head of the WTP. This minimised the risk of concentrating any pathogens that might be present in the WTP; and
- Chlorine residuals were increased for greater disinfection.

Other operational changes were undertaken, including:

- Reduced maximum flow through the WTP;
- Tightened targets and critical limit for the individual filtered turbidity critical control points. Target and Critical Limits for individual filters were tightened from:
  - Target of < 0.2 NTU for > 95% of the time, and Critical Limit must not exceed 0.5 NTU for > 15 minutes, to
  - Target of < 0.15 NTU for > 95% of the time, and Critical Limit must not exceed 0.3 NTU for > 15 minutes;
- Increased sampling and analysis.

To manage the risk of potential elevated pathogen levels in the Grahamstown source as a result of urban runoff from Campvale Canal during the ECL storm event, Hunter Water in consultation with NSW Health developed a strategy to ensure that continuously safe water was supplied to customers.

Robust and reliable operation of the plant was maintained throughout the event, and compliance with tightened target and critical limits was achieved, which indicated overall low risk to public health in accordance with the Australian Drinking Water Guidelines (ADWG). Hunter Water's management approach to the ECL incident satisfied NSW Health that a boiled water alert was not required.

3.0 CONCLUSION

- Monitoring data collected for Grahamstown WTP raw water during the ECL event suggested that raw water received by the WTP was impacted by the ECL storm event as indicated by an increase in turbidity levels.
- Any potential risks to water quality were mitigated at Grahamstown WTP through implementation of a range of operational changes. Grahamstown WTP consistently produced safe drinking water in line with the performance targets set out throughout the ECL storm event.
- Intensive water quality monitoring data and performance targets set out for Grahamstown WTP during the ECL storm event indicated that there was an overall low risk to public health in accordance with the Australian Drinking Water Quality Guidelines (ADWG).

4.0 ACKNOWLEDGEMENTS

Thanks to the Veolia Water Treatment team at the time for their prompt response and diligent reporting on, and optimisation of performance at Grahamstown WTP – Keith Craig (Manager Technical Services), Dan Slocombe (Manager Water Treatment), Mark Coleman (Team Leader, Water Treatment), David Kingsland (Laboratory Technician), Shanon Davies (Cadet Engineer) and in particular the Water Treatment Plant Operators Shane Rhodes (now Team Leader Water Treatment), James Morrison, Adam Mason, Jason Bakay, Lindsay Boland, Brett Prior, Rebecca Mayo, Scott Scofield and Gerard LeBreton (Water Treatment Plant Operators).

Thanks to ALS staff including Andrea Swan (Manager ALS Water, Mayfield West), Neil Martin, Robin Woodward, all sampling officers and other laboratory staff for their response to greatly increased water quality monitoring and analysis during this ECL event.

5.0 REFERENCES

Water Services Association of Australia *Drinking Water Source Assessment and Treatment Requirements Manual for the Application of Health-Based Treatment Targets* (September 2015).