MOBILE BORE TESTING CHLORINATION AND BOOSTER PLANT

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ABSTRACT

Toowoomba City Council has recently completed a program to construct up to twenty bores to augment available water supplies. 100 hour bore pumping tests generate significant quantities of pumping test water. Current drought conditions, with Level 5 water restrictions imposed, necessitated measures to prevent pumping test water going to "waste".

An innovative and unique mobile system was developed to overcome this problem, by means of recovering bore pumping test water, chlorinating the recovered water and injecting it into the City's water supply system in accordance with strict HACCP systems. This adaptable, cost effective, yet simple system demonstrates a tangible response to the need for water conservation, particularly in drought conditions.

1.0 INTRODUCTION

In the past Toowoomba City relied exclusively upon groundwater. Since the 1940's with the construction of Cooby Dam, the City has grown to the extent that two more surface storages have been constructed – Perseverance Dam in the 1960's and Cressbrook Dam in the 1980's. The City is continuing to grow, the three surface water storages have reached their safe yield limits and new water sources are required.

Currently, Toowoomba City Council has a licence to extract a total groundwater quantity of 3,800ML/a from the basalt aquifers that underlie Toowoomba for urban water supply purposes. There are 6 irrigation bores and 14 existing water supply bores that provide water to the 9 pressure zones. Two of the pressure zones are supplied exclusively with groundwater. Typically, groundwater is disinfected and in some instances softened before it is pumped into the water supply network.

Current extraction from existing groundwater sources averages 1,800 ML/a. With the potential to extract up to an additional 2,000 ML/a under the current licence; and with a licence application to extract an additional 1,200 ML/a lodged with the Department of Natural Resources, Mines and Water; Council provided funding in its 2005/06 Budget to investigate and construct additional basalt aquifer bores.

2.0 DISCUSSION

2.1 Bore Pumping Tests

The construction and equipping of production bores represents a significant investment of community resources. Proper testing of a bore's capacity to meet the long-term demand placed on it is a cost effective way of ensuring a wise investment of capital funds.
Testing provides information about the quantity and quality of the groundwater, the impact on any other bores in the area, the performance of the aquifer and provides data for the sizing of pump equipment.

There are many types of tests available. The bore pumping test, with the appropriate level of data measurement and analysis, is a practical testing method for town water supply bores. In accordance with established guidelines, a continuous 100 hour pumping cycle is recommended for town water supply bores.

Council adopted the 100 hour bore pumping test for bores to be constructed under the project.

2.2 Bore Pumping Test Water – The Problem

Carrying out a 100 hour bore pumping test generates a significant amount of test water. A pumping test at 5 L/s generates 1,800 kL of water in 100 hours. As the normal pumping test requires the water to be discharged at atmospheric pressure, the pumping test water is normally drained away from the site by channels and/or earth bunds and is "wasted".

Most of the proposed basalt aquifer bores in Toowoomba are located in developed urban areas. Typical options for the management of the bore pumping test water include:

- Broadcasting the water over adjacent land (eg park / sporting field / vacant land);
- Direct or indirect disposal to stormwater systems – creeks, underground stormwater drainage systems;
- Direct or indirect disposal to wastewater systems;
- Making the water available to water carriers; and
- Combinations of the above methods.

Currently large areas of South-East Queensland are in the grip of a prolonged drought. With useable water storage levels in Toowoomba's dams less than 20%, residents of Toowoomba and its customer local governments are under Level 5 water restrictions. No outside watering is allowed under Level 5 water restrictions.

Water restrictions in Toowoomba have generally been well observed. Council is under heavy scrutiny from its residents for Council to conserve water in its own operations. Any "loss" of water, whether real or perceived, quickly receives media and public attention.

Council strives to lead by example and Council officers realised at an early stage that the effective management of the bore pumping test water was of paramount importance. Council recognised the importance and benefits to be gained from proper bore pumping tests and decided that the tests must proceed, and unreservedly endorsed Council officers concerns over the management of bore pumping test water.

2.3 Bore Pumping Test Water – The Solution

The idea of collecting the test water and pumping the collected water into the nearby water supply system was proposed at a Project Control Group (PCG) meeting. Investigations revealed that the idea had not been developed or implemented elsewhere and that Council would need to develop an innovative system to achieve its objectives.

The system developed is essentially a mobile chlorination plant and pumping station to deliver treated water into an adjacent water supply system.

Elements of the system include:

- Holding Tank 1
  Water pumped from the bore by the testing pump is discharged into a ground level 2,000 L polyethylene holding tank (Holding Tank 1).

- Trailer Mounted Pump and Disinfection System Unit
  This unit is the heart of the system developed. The unit comprises:
    - A low head transfer pump unit (flow regulated to match bore output by valve selection);
    - Lowara, Hydrovar frequency converter controlled Duty and Standby multi-stage pressure pumps (with nominal 4-7 L/s against 350-1,180 kPa head depending on location) are utilised to discharge chlorinated water from the mobile plant. The pump sets have Variable Speed Drives to maximise energy savings and maintain constant discharge pressure into the water supply network;
    - Sodium hypochlorite solution in a custom built 36 L container;
    - Sodium hypochlorite dosing pump;
    - Chlorine detention time is achieved by a 28 kL polyethylene tank;
    - Constant in-line water quality is monitored for chlorine residual and pH. This is a fully automated system designed and constructed by a local water treatment company Wendouree Water Treatment Pty Ltd. Any non conformances in water quality will raise an alarm directly to a standby operator by mobile phone who can take necessary action with site personnel to rectify the alarm condition; and
    - A 40 kVA generator mounted in a tandem trailer, supplies the power requirements to run the mobile test plant.

  Water from the Pumping Test Collection Tank 1 is pumped by the centrifugal pump into the bottom of Holding Tank 2. The metering pump doses sodium hypochlorite solution into the delivery line to Holding Tank 2.

  Water overflows from Holding Tank 2 into the top of Holding Tank 3. This overflow pipeline is fitted with water quality monitoring equipment and a sample point. Water from holding tank 3 is pumped from the bottom of the tank by the multi stage pump set into the nearby water supply system.

- Holding Tank 2
  Holding Tank 2 is a 28 kL polyethylene tank that provides 60 minutes chlorine contact detention time at 6 L/s flow rate to ensure effective disinfection.

- Holding Tank 3
  Holding Tank 3 is a 24.5 kL polyethylene tank that provides further chlorine contact detention time and acts as a balance tank for the multi stage booster pumps.

- Power Supply
  An acoustically shielded 40 kVA generator supplies power for the centrifugal pump, the chemical dosing pump and the multi stage pumps. The unit is trailer mounted.

- Delivery Main and Water Supply System Connection
  The multi-stage pumps discharge to a Class 12 polyethylene delivery main (6m lengths with flanged couplings).

Connection to the water supply system is provided at a location that will be used for the permanent connection point of the production bore (if developed).

The locations of the basalt aquifer bores are at strategic locations in the Council's water supply system. Connections are either into existing larger diameter, dedicated delivery mains to reservoirs, or into distribution or reticulation mains that service the area in the immediate vicinity of the bore. Accordingly the pumping system that has been developed necessarily has built in flexibility.

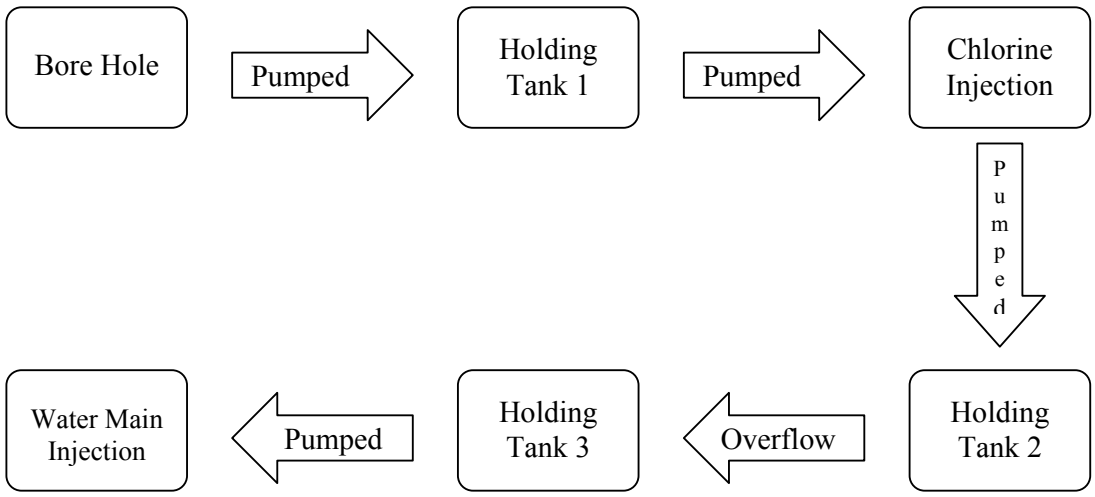

Figure 1: ***Flowchart of the Process***

2.4 System Use and Experience

The system has been used to pump bore pumping test water into the Council's water supply system at 14 bore sites. With the exception of some very minor teething issues, the system has been a complete success.

After using the system at the first site, several modifications were made to the system to further increase its performance. These changes include:

- A second overflow was installed between tanks 2 and 3, assisting with the drainage of water into tank 3.
- The butterfly valves in the pump discharges were replaced with gate valves, allowing greater flow control accuracy.
- A second outlet was cut into tank 1, permitting the first flush of the bore to be discarded without compromising the quality of water in tanks 2 and 3.
- A level indicator was installed on tank 3, so that water level could be determined.

Matters of interest from experience include:

- The pressure at which the test water was injected into the water supply system was set to be slightly above the pressure in the receiving main. This was to reduce the potential for water main breaks due to increased pressures, particularly where injection was into existing aged reticulation mains.

- In some instances where injection was into delivery mains subject to booster pump operation, close monitoring of the mains pressure was required to ensure that while the booster was operational, the mains pressure did not exceed the 350-1,180 kPa capacity of the multi-stage pumps. In one case the mains pressure while the booster pump was operating exceeded 1,250 kPa. This was overcome by ceasing the booster pump operations during the 100 hour pumping test and making up for lost pumping time once the 100 hour test was complete. (Not operating the booster pump during the 100 hour pumping test was achievable due to Level 4 water restrictions and the resultant lower than normal water consumption.)
- Two sets of tanks were purchased and configured to minimise setup time between sites.
- Minor problems with soluble iron in the first hours of bore test pumping at some bores were addressed by the provision of a filling station to allow this water to be tanked away for alternate use (eg construction works, landscape watering, dust suppression).
- As a result of consultation with residents in the vicinity of the bores, and the use of acoustically shielded generators, there have been no adverse complaints or enquiries during bore pumping tests.
- Council's bore drilling and bore pumping test contractor, with over 30 years industry experience, has advised that he has not seen a system similar to that developed for this project. He has advised that, due to the many benefits of the system, he is seriously contemplating further development of the system to provide a single truck mounted unit that incorporates the pumping test equipment, and the pumping water recovery system and power generating equipment.

Table 1: ***Site Results***

	Number	**Flow (ML year @ 16 hrs/d)**
Total Sites	14	2355
Sites Equipped	8	1409

2.5 System Benefits

Many benefits have resulted from the development of the mobile bore pumping test water recovery system and include:

- Up to 2 ML of groundwater is added to the water supply system during each bore pumping test. This currently represents up to 10% of the daily water consumption of the City.
- Groundwater is not "wasted" and potentially lost from the water cycle.
- By not disposing test water to the wastewater system, there are no adverse impacts at the wastewater treatment plant and capacity issues in the wastewater system.
- Positive public relations during water restrictions.

3.0 CONCLUSIONS

The mobile bore pump testing water recovery system was developed out of necessity in a time of strict water restrictions in Toowoomba City. There is no doubt its development will result in the system being a requirement in future bore pumping tests in areas where water supply systems already exist.

100 hour bore pumping tests generate significant quantities of pumping test water which traditionally has gone to "waste". The innovative, unique mobile system to recover and safely inject the pumping test water into a water supply system meets strict quality requirements, including those of Toowoomba City Council's HACCP (Hazard and Critical Control Point) system.

This adaptable, cost effective, yet simple system demonstrates a tangible response to the need for water conservation, particularly in drought conditions.

4.0 ACKNOWLEDGEMENTS

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