WATER WORKS

TECHNICAL PUBLICATION OF THE WATER INDUSTRY OPERATORS ASSOCIATION OF AUSTRALIA

NOVEMBER 2022

WATERWORKS

Editorial Committee

Peter Mosse, Editor
peter.mosse@gmail.com

George Wall
george@wioa.org.au

Direct mail to
WaterWorks Editor
WIOA, 24 New Dookie Road
Shepparton, Victoria 3630

WaterWorks is the technical publication of the Water Industry Operators Association of Australia (WIOA). It is published twice yearly. WIOA does not assume responsibility for opinions or statements of facts expressed by contributors or advertisers.

Advertising & Production

WIOA
24 New Dookie Road
Shepparton, Victoria 3630
Phone: (03) 5821 6744
Email: info@wioa.org.au
Web: www.wioa.org.au

Contributions Wanted

WaterWorks welcomes the submission of articles relating to any operations area associated with the water industry. Articles can include brief accounts of one-off experiences or longer articles describing detailed studies or events. Submissions may be emailed to: peter.mosse@gmail.com or info@wioa.org.au

CONTENTS

WHO WILL TRAIN OUR OPERATORS

Peter Mosse and Stephen Wilson

Water industry operator training in Australia is in crisis.

The training sector is fragmented. Well respected Registered Training Organisation's (RTOs) have closed. Trainers have left the industry or retired. Many of our current trainers have more than a few grey hairs.

In this environment, why would anyone choose to become a trainer with limited career prospects and possible lack of respect.

New providers enter and leave the training industry including TAFEs, water industry contracting companies and Water Utilities. Many only offer a limited selection of the necessary units.

We need to make it attractive for dedicated water industry Registered Training Organisations to have a future. It is difficult for existing training organisations who are mostly too small to have a proper succession plan.

Trainers are required to demonstrate competence and current industry skills in units they deliver, but the depth of knowledge and experience required to engage with the learners needs time to develop. Some will learn on the job with good mentors and targeted professional development, others run the risk of losing the respect of learners along the way. Inexperienced trainers may also spoon feed the correct answers to learners and compromise the whole training experience.

Operators are frustrated at the quality of training they are receiving and the attempt by some providers to offer online training during the pandemic has done more damage than good.

Is the RTO system failing our industry?

We have a National Water Training Package which forms the basis of training however the content of the training needs clearer definitions.

The content and quality of training is highly variable in part because the unit content can be broad and open to interpretation. The wording of the competency-based assessment requirements by their nature are often too general, although some implementation advice can be found in the Training Package Companion Volume.

OUR COVER

Westernport Water operator Tony Ferres, checking the solar panels at the King Road Wastewater Treatment Plant.

An old-style curriculum supported by a national set of industry validated assessment tools (tests) required to be used by all training providers would be supported by many Water Utilities and RTO's. Every operator would be required to pass the same knowledge questions and complete the same skills assessments and importantly be completely independent of the trainer or training organisation.

We need to value add to the vocational training RTO system. We need a centralised Australian Water Industry Training Body that reinforces standards and supports our training organisations with clearly defined assessment resources and compliance services.

Any new structure would need to retain national recognition with Australian Skills Quality Authority (ASQA) registration so that training qualifications would be legally recognised for compliance by Water Utilities, but it could provide industry endorsement of RTO's and better-defined training content.

The Water Training Package is very broad in terms of the occupational outcomes it assesses and RTO's find it difficult to provide all the units with experienced trainers and quality training materials covered by their scope of registration.

Where will the trainers come from?

One source as is the case now might be retiring operators with many years of experience, but that is not a long term solution. We need to encourage young operators who have a gift and an interest in training and offer them a career path in the same way school leavers or recent graduates might hear a calling for mainstream teaching.

We need to identify existing operators and graduates with experience who also have an interest in training their fellow operators and who, with adequate training and assistance, could become Water Industry Operator Trainers. These operators should be encouraged to undertake a TAE 40116 Certificate IV in Training and Assessment even while they are still engaged in their operational employment within their Utility. An industry train-the-trainer program delivered by experienced trainers could be established to complement the TAE 40116 qualification.

When do we need this?

NOW.

Too many meetings, too much discussion over too many years has left us in this untenable position.

We need a strong leader to take the reins and guide us sympathetically out of this mess and develop a sustainable National Water Industry training system and an associated career path for new trainers.

SAFE DRINKING WATER IN TASMANIA

Stephen Westgate and Matthew Robertson

Historically, the supply of drinking water in Tasmania was managed by a large number of small separate Councils. During this time there were many supplies with water quality problems ranging from elevated lead levels to permanent Boil Water Alerts.

In 2009, three Regional Corporations were formed, Cradle Mountain Water, Southern Water and Ben Lomond Water. The Corporations were owned by local government councils within their respective regions.

TasWater was formed in 2013 as the sole water and sewage utility, and currently operates 61 drinking water systems state-wide. These systems varied considerably in complexity, and had an inconsistent application of water quality targets and management practices.

A large number of these systems were considered high risk regarding their ability to consistently deliver safe drinking water and therefore required significant improvement. Due to cost and prioritisation, all the necessary improvements could not all be delivered at the one time.

The two principal factors driving an elevated risk profile were:

- An insufficient level of treatment barriers to manage the catchment microbial risk.
- Poor operational performance of the existing treatment processes.

Understanding and quantifying these risks was critical to effective prioritisation. TasWater developed a visual approach to assessing its water quality risk profile, which was achieved through an amalgamation of two pieces of industry recognised methodology.

1. The "Manual for the Application of Health-Based Treatment Targets" (HBT), Water Services Association of Australia, (2015)
2. The "Good Practice Guide to the Operation of Drinking Water Supply Systems for the Management of Microbial Risk" (GPG), Water Research Australia, (Mosse & Murray, 2015)

The objective for TasWater was to develop a method capable of comparing and prioritising water quality risk across all drinking water systems regardless of catchment, process complexity or size. In addition, it was designed to allow the organisation to track improvement and thus demonstrate value for money.

The project involved comprehensive system assessments against the requirements of the HBT manual and the operational objectives outlined in the GPG. This provided an overall view of water quality risk, highlighting deficiencies in both operational practices as well as the adequacy of existing treatment barriers.

In order to collect the necessary data set, an assessment was conducted of all treatment plants across the state from February 2017 to June 2017.

Health Based Targets Assessment – Treatment Adequacy

The HBT manual outlines the treatment and performance requirements necessary to reduce the pathogen risk identified in the catchment.

As a prerequisite, the HBT manual requires that a catchment assessment and risk classification be conducted for every system. TasWater had already completed this step and this informed the basis of the assessment process. As anticipated for surface water supplies, the majority of TasWater's systems fell within the HBT Type 3 or 4 classification, thus requiring significant, multi barrier treatment to fully reduce the pathogen risk to acceptable levels.

By comparing the catchment classifications and assessment findings, the pathogen log removal (LRV) surplus or deficit of a system could be determined.

An example is provided in Table 1. The most unfavourable LRV balance (Protozoa -0.5 in the example) then forms the x-axis value of the Galaxy chart (Figure 1).

The Good Practice Guide Assessment – Operational Practices

The GPG provides an accepted benchmark for good practice operation of a water supply system. The requirements outlined in the guide were adapted into a simple pass/fail questionnaire, with score weighting attributed to the identified criticality. The applied weightings are outlined in Table 2. The benefit of adopting this methodology is that factors critical to ensuring water quality are given more impact and improvements focussing on these will have a larger impact on the operation and risk of the system.

Table 1. Example LRV assessment.

Item	Detail				LRV Balance	Comments
Water Quality Objectives (LRV reduction Required)	Bacteria = 5; Protozoa = 3.5; Virus = 4					Type 3 catchment classification
Theoretical maximum LRV credits from current plant barriers		Conventional	Cl	Total		Total LRV achievable assuming optimum plant operations and compliance with HBT manual.
	Bacteria	2	4	6	1	
	Protozoa	3	0	3	- 0.5	
	Virus	2	4	6	2	

The assessment questionnaire consisted of 146 questions divided across 13 aspects of treatment. These categories, including the weighted criticality and maximum possible score, are given in Table 3.

Table 2. Weighting attributed to table entries in the GPG.

Criticality	Weighting
Required - (red)	5
Supporting - (amber)	3
Desirable - (green)	1

Only the categories applicable to the individual system were assessed and thus a final score against the maximum available score was established and used to give a percent compliance. This then provides the value on the y axis of the Galaxy chart (Figure 1). It represents the ability of the system to manage the microbial risks within the catchment.

The size of each point indicates the size of population served by each WTP. The scale is logarithmic so larger systems do not obscure the majority of the plot.

The Galaxy Chart is simply a scatter plot. The y-axis represents the percentage score from the GPG assessment and the x-axis the worst case LRV balance. This methodology therefore positions all Tasmanian water supply systems on a single graph and shows relative risk as

Table 3. GPG questionnaire categories and total possible score.

Category	No. of Required	No. of Supporting	No. of Desirable	Total Possible Score
Raw water extraction and storage	1	4	1	18
Supernatant return	2	2	0	16
Coagulation	5	6	1	44
Flocculation	0	5	1	16
Clarification/DAF	2	5	0	25
Media filtration	15	8	1	100
UV disinfection	4	0	0	20
Membrane filtration	10	3	2	61
Chlorine-based primary disinfection	3	3	0	24
Distribution system	7	4	4	51
Water quality information management	7	2	0	41
General water treatment plant operations	4	13	5	64
Equipment and instrumentation	11	4	1	68

So for example the value of 18 for Raw Water Extraction and Storage is derived as follows: (1x5) + (4x3) + (1x1) =18.

systems move from bottom left (highest risk) to top right (lowest risk).

The coloured boundaries along the x-axis were adopted from the Water Safety Continuum risk regions as outlined in the HBT manual, and the y-axis defined from internal benchmarking using the GPG scores.

The Galaxy Chart has been widely adopted by the business and is now beginning to help inform the strategic direction of TasWater's long-term capital (CAPEX) and operational (OPEX) plan.

OPEX vs CAPEX - Project Planning

In general, to improve the GPG score, some OPEX and minor CAPEX is required.

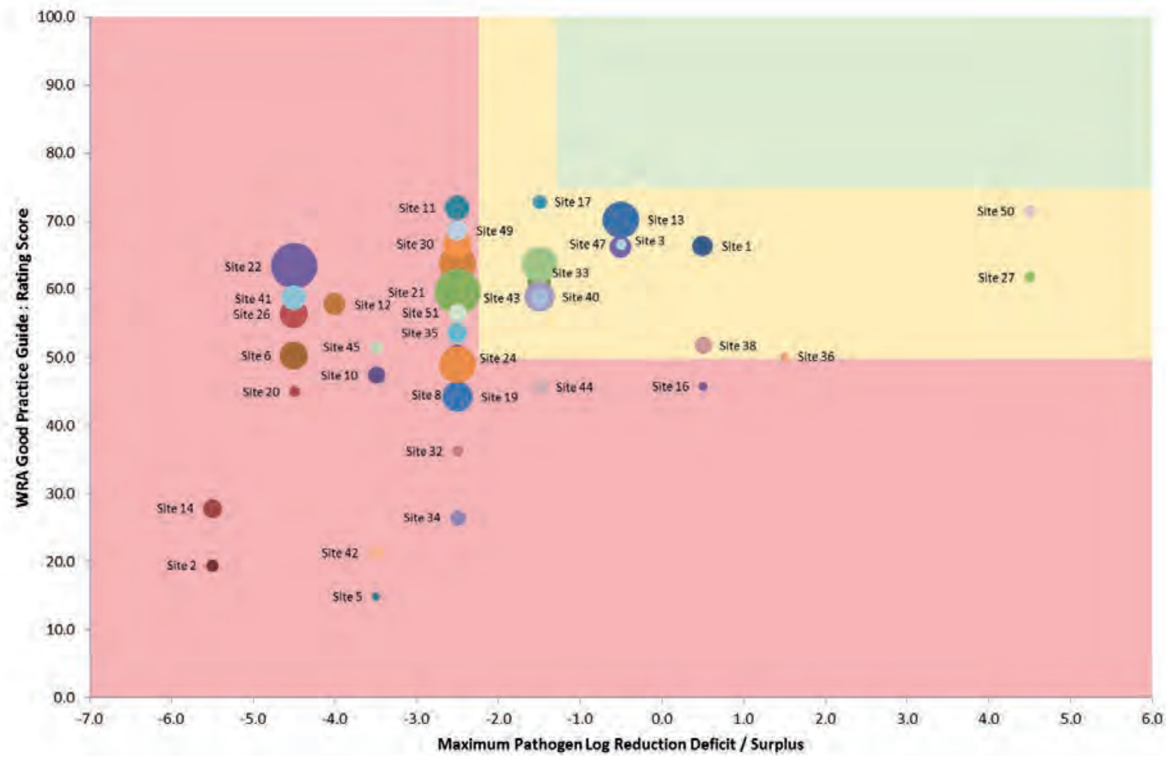


Figure 1. The Galaxy Chart summarising the risk status of each Tasmanian water supply system.

Improving or implementing operational procedures such as daily monitoring and trending, online monitoring, alarming and procedures (e.g. jar testing) will add more passes to the GPG assessment, thereby increasing compliance and shifting the percentage up.

Major CAPEX investments, such as major process upgrades or additional process units will typically shift the points to the right as additional LRV credits are gained. It is however also possible to achieve minor improvements on this axis via optimisation OPEX by optimising existing treatment processes (for example refurbishing a filter with new media).

A combination of both will move the points closer to the top right (lowest risk) region of the graph.

With a strong understanding of the CAPEX and OPEX requirements of each system, it was then possible to group systems according to common strategies or work plans to reduce risk. The groupings that emerged are described below and illustrated in Figure 2.

- **Type 1** systems are characterised as not requiring any immediate work. They currently reside in the tolerable risk region.
- **Type 2** systems are characterised as systems with barriers not currently meeting acceptable standards (HBT manual). Therefore they only received partial or no LRV credits. These systems typically require process optimisation and minor operational improvement in regard to the GPG.
- **Type 3** systems are characterised as having insufficient barriers in place or those requiring only minor GPG improvement. The barriers installed at these plants are operating as required. A program of UV installation has been prioritised for some systems in this classification.
- **Type 4** systems are TasWater's most at risk plants. The risk profile of these systems cannot be adequately reduced without both significant operational intervention and major CAPEX upgrades.

System Improvement Pathways

Due to the fact that the GPG assessment is conveniently divided into individual treatment process steps, it is possible to determine and even model the improvement outcomes (y-axis) from implementing different strategies. This was achieved by simply reviewing the current GPG pass/fail score of a system and implementing a new theoretical score, based on the successful completion of a proposed project.

This process also applies to improvement projects targeting LRV improvements (x-axis) by simply reassessing the theoretical LRV score post project completion.

Through an understanding of the improvement needs of individual systems, and armed with a model to predict the improvement outcomes, it was therefore possible to plot a CAPEX and OPEX pathway to sufficiently manage the microbial risk posed by the catchment. And, by rearranging the order of improvements, the chart can functionally show the best value for dollar improvements (i.e some improvements will have a much larger impact than others but may, in comparison, be relatively cheap and could therefore be given a higher priority).

The plot also provided TasWater a valuable visual training tool for TasWater staff and assisted in the understanding of HBT performance targets.

The Authors

Stephen Westgate (Stephen.Westgate@taswater.com.au) is Leader Water Systems Performance and **Matthew Robertson** is a Water Process Engineer, both with TasWater in Tasmania.

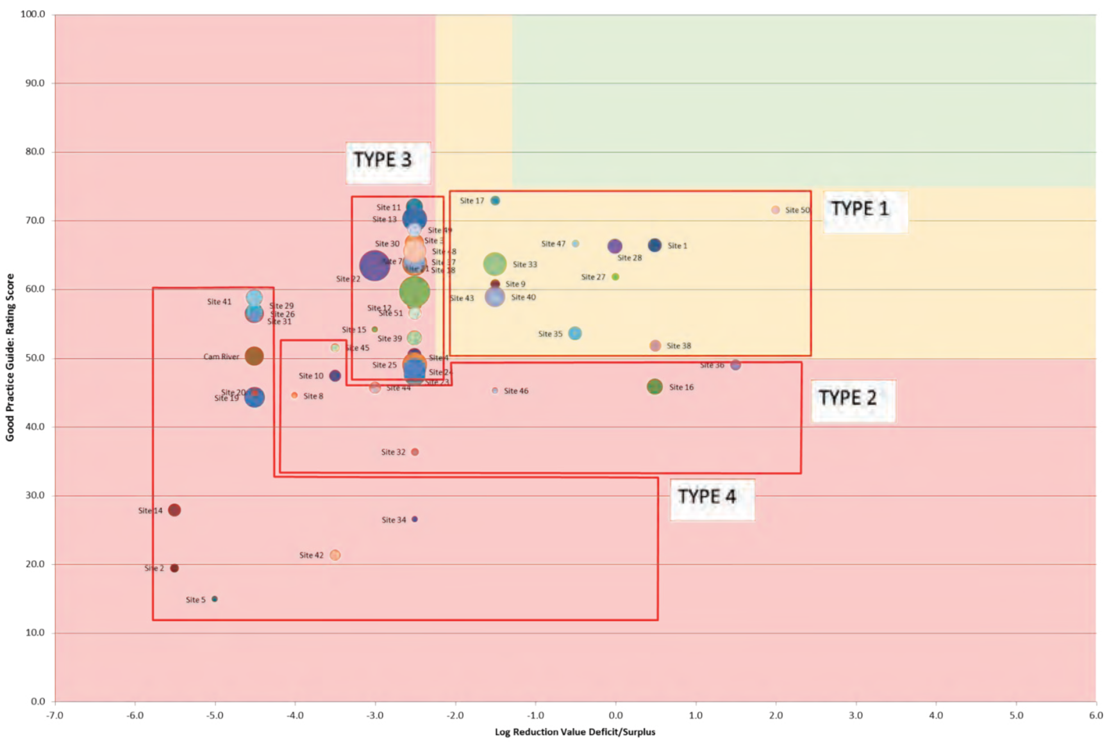


Figure 2. System improvement groupings.

CARBON NANOTUBES IMPROVE CONCRETE

Winner of the Best Paper Overall at the 2022 WIOA Victorian Operations Conference

Tasha Eagle and Robert Cavaliero

Our industry continues to strive for increased durability of concrete and concrete structures, to extend the life of our valuable assets.

Enhanced Carbon Nanotubes (CNTs) have been used for years in electronics, human medicine, and the automotive and aeronautics industries. In recent years, CNT-enriched liquid additives have been developed which improve compressive and split-tensile strength, resistance to abrasion and cracking in concrete, mortar, and shotcrete. Nanoparticles serve as nucleation sites during cement hydration to help create a denser cement paste composition.

A carbon nanotube is a sheet of graphene having a thickness equal to one atom, rolled up into the shape of a tube (Figure 1). The chemical bonds between the hexagonal-shaped lattice structure are very strong, providing extreme tensile capacity and a unique set of benefits to concrete.

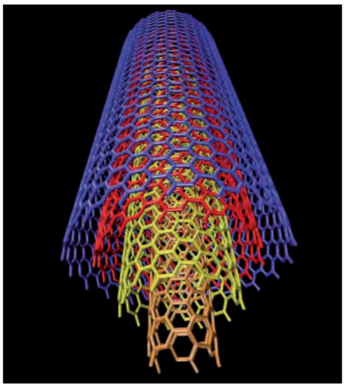


Figure 1. CAD drawing of a multi walled carbon nanotube.

When effectively dispersed in concrete, CNT's function as nano-sized pieces of carbon reinforcement. The hydration of cement onto the CNTs provides increased strength to the hardened cement paste matrix. Carbon nanotubes are only 17% the weight of steel, more than 100 - 300 times stronger in tensile capacity than steel, and do not corrode. Like macro fibres, the shape of CNTs help them improve the mechanical performance of concrete, including shrinkage and resistance to crack propagation. Unlike macro fibres however, CNTs improve the strength and abrasion resistance of concrete. In many cases, the improved strength provided by CNT additives may allow for a reduction in total cementitious content per m^3 to i.e. reduced General Purpose Cement (GP) use, to achieve the same design strength from the concrete mix. Additionally, CNT additives have been shown to improve concrete durability by reducing permeability, which is important in combating freeze/thaw and reducing scaling from de-icer chemicals that may be used in winter conditions.

Results of two Australian trials, and one American trial are described below.

Trial 1 Precast Concrete Elements

A trial was conducted in 2019 using CNT additives to assess their impact on the overall durability, abrasion resistance and permeability of precast concrete. A local ready-mix supplier agreed to take part in the trial, dosing the CNT additive at the concrete plant, prior to supplying the concrete to the precast yard.

Important attributes of concrete for precast placement applications are flowability and workability. During the trial, the plastic concrete properties were closely monitored to ensure the addition of the CNT additive maintained the same flowability and workability, when compared to the reference mix.

During placement of the treated cement, observations were made as to the characteristics of the cement. The comments included:

- "plastic properties are a thicker concrete that remains spreadable (Figure 2)
- "has an increased workability".
- "Looks really good, it's better than the normal stuff".
- "It's visually and physically thicker and not sticky"

Testing was contracted by a 3rd party approved laboratory, to verify compressive strength and chloride ion diffusion.

Concrete dosed with the CNT additive yielded increases between 10mpa – 20mpa, equalling ~10% - 30% improvements in compressive strength as tested to AS1012.9 2014. The CNT dispersed additive also significantly reduced permeability to chloride ingress by 37% per Method NT Build 443 1995-II.

Whilst the high early strength (HES) was slightly lower at days 1 and 3 with use of the CNT additive, the compressive strength at 28 days was increased and continued to increase to 56 days (Table 1).

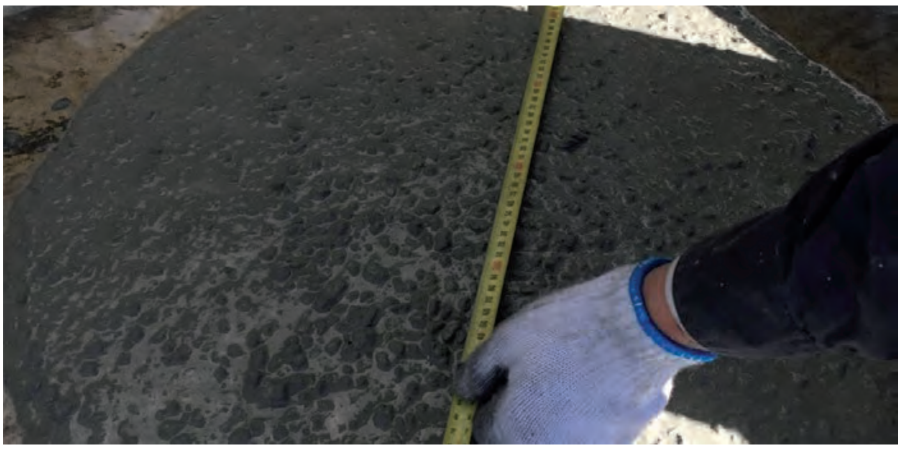


Figure 2. Measuring spread during the slump flow test.

Trial 2 Extended Design Life

In May 2020, a laboratory trial was conducted in Brisbane, to determine performance results prior to a field trial. The mix was a ternary blended mix with a total cementitious of 526 kg/m³, at a ratio of 55% GP, 25% flyash and 20% slag, and a water cement ratio (w/c) of 0.37. Compressive strength of the CNT additive dosed concrete mix at 5 L/m³, achieved a 10% increase when compared to the reference mix. The testing program included determination of the Chloride Ion Diffusion Coefficient. The results for both the reference mix and the CNT additive dosed mix, were entered into the LIFE-365 service life prediction model. This program enables various environmental conditions to be chosen, as part of the service life prediction.

Table 2 gives the results for a 'Parking Garage' environment. The results suggest an increase of predicted total service life of ~19 years for the CNT additive dosed concrete when compared to the reference mix. In addition, the reduction in repair cost prediction over a Table 3 provides similar results for a 'Marine Spray Zone' environment which is considered a highly corrosive environment. The results indicate an increase of predicted total service life of greater than 20 years for the CNT additive dosed concrete when compared to the reference mix. In addition, the reduction in repair cost prediction over a 100 year period is 41%.

Trial 3. Trafficable Concrete Drainage Project (USA).

In May 2015, a Denver contractor evaluated the CNT additive in the expansion of a residential town. Concrete drain sections, with and without CNT additive in the concrete, were placed in a new concrete system for directional flow of stormwater runoff within the asphalt parking and common use areas of the housing subdivision (Figure 3).

These areas are exposed to abrasive conditions from surface water flow, passenger vehicles, and commercial vehicles such as snow ploughs and garbage trucks. Exposure to de-icer chemicals and waste in refuse areas was also a challenge. Within the same community, the concrete for the existing town homes had developed severe pitting from de-icer chemicals, abrasion from vehicles, and cracking in many places due to heavy loads. The evaluation involved a five-yard load of concrete containing the CNT additive at a dosage equal to 8.3 L/m³ of concrete, compared to a five-yard load of concrete not containing the additive, referred to as the reference.

The reference and the sections containing the CNT additive were placed end to end in the new section of the facility, to provide identical in-service conditions during the evaluation. The goal was not to improve strength, rather it was to improve the in-service performance of the concrete after exposure to stormwater runoff and de-icer chemicals, combined with abrasion from concentrated vehicle traffic.

Results from laboratory testing confirmed the CNT additive's ability to improve the split-tensile strength and resistance to abrasion by approximately 22% and 40%, respectively. In fact, after 20 minutes of the abrasion resistance test, the CNT treated concrete was only abraded to a depth equal to the abraded depth measured for reference samples after only the first 3 minutes of the test. Adding the CNT additive significantly improved the concrete's resistance to abrasive wear.

Results from the field tell a familiar story. The sections containing the CNT additive performed significantly better than the reference from the abrasive wear created by water flow and passenger/commercial service vehicles. Figure 4 shows a comparison of the two sections after 31 months in service.

Table 1. Compressive strength tests (AS 1012.9:2014 (2.1)) of concrete with CNT added at 2.5 L/m³ and 5 L/m³ compared to a reference mix without CNT.

Hardened Properties	Day	Reference	2.5L/m³	5L/m³
MPa	1	20	19.5	17
MPa	3	41.5	38	38
MPa	11	57	60	59
MPa	28	67	74.5	74.5
MPa	56	73.5	83.25	81.25

Table 2. Reference mix vs. concrete with CNT additive. Chloride Ion Diffusion Coefficient results and total service life prediction in a 'Parking Garage' environment.

Diffusion Properties and Service Lives

Alt name	D28	m	Ct	Init.	Prop.	Service life
Control	-> 1.12E-12 m*m/sec	-> 0.2	-> 0.08 % wt. conc.	65.2 yrs	-> 6 yrs	71.2 yrs
EX HC @ 5L	-> 7.70E-13 m*m/sec	-> 0.2	-> 0.08 % wt. conc.	84.4 yrs	-> 6 yrs	90.4 yrs

Table 3. Reference mix vs. concrete with CNT additive. Chloride Ion Diffusion Coefficient results and total service life prediction in a 'Marine Spray Zone' environment.

Diffusion Properties and Service Lives

Alt name	D28	m	Ct	Init.	Prop.	Service life
Control	-> 1.12E-12 m*m/sec	-> 0.2	-> 0.08 % wt. conc.	47.3 yrs	-> 6 yrs	53.3 yrs
EX HC @ 5L	-> 7.70E-13 m*m/sec	-> 0.2	-> 0.08 % wt. conc.	68 yrs	-> 6 yrs	74 yrs

Figure 3. The town drainage system in May 2015 (left), and December 2017 (right).

The reference concrete section is stained and pitted from de-icer chemicals, and also shows signs of deterioration from snow ploughs and traffic. The sections containing the CNT additive were uncracked, less abraded, and in significantly better shape.

The additive has helped the concrete to maintain a brighter albedo and minimise staining or pitting from chemicals. The texture from the broom finish has diminished on the reference but is still intact on the test sections. It is anticipated that the use of the CNT additive in applications exposed to these conditions will extend the service life and reduce the maintenance schedule, ultimately increasing the customer's return on investment and minimising disturbances to residents for repair work.

Figure 4. The town drainage concrete areas in December 2017 after 31-months of use. Reference cement (left) and CNT additive cement (right).

Conclusion

The results of the trials presented above have confirmed the ability of CNT additives to improve the durability and service life of concrete. From roadway applications and hardstand areas subjected to extreme impact, point, and rolling loads, to residential driveways and light – heavy commercial slab construction, a growing number of applications support the conclusion that using this CNT additive enhances concrete performance compared to traditional concrete.

To improve the durability and service life of the concrete, will come with an up-front added cost at the construction stage, however the use of CNT in these case studies remains an economic value, extending the life of the asset, when compared to ongoing maintenance costs of use of the reference mix. The cost for durable concrete and the economic value, will vary for each different concrete mix that is designed, project by project.

While the concrete placements using CNT additives are young, the benefits shown to date are extremely impressive and support their continued use and evaluation to fully understand the extent to which they improve concrete.

The Authors

Tasha Eagle (tasha.eagle@fosroc.com.au) is Product Segment Specialist & Business Development Manager with Parchem Construction Suppliers Pty Ltd and **Robert W Cavaliero** is Vice President of Edencrete Admixtures with Eden Innovations LLC

HORIZONTAL DRUM SCREENING OF WASTEWATER

Mike Bambridge

Efficient and easily maintained screening is the first and very critical stage in municipal and industrial wastewater treatment.

Wastewater Treatment Plant (WWTP) operators are the people who have to ensure that screens and compactors capture solids that would otherwise flow through a WWTP, potentially causing equipment damage and blockages downstream of the screens.

Headworks are the first line of defence to help prevent issues with downstream processing. It is true that pumps and dewatering systems are engineered to handle some solids and load variations, but, beyond a certain level, debris can lead to equipment failures and faster component wear.

Unless solids are efficiently separated out from wastewater at the start of the treatment process, you are inviting trouble into the system. This can cost dearly in terms of downtime, environmental risk, clean-up costs and WH&S hazards for the operators.

This means ease of maintenance of headworks is a key consideration in preventing trouble, especially for municipalities and industrial companies operating on tight budgets. These organisations do not always have the financial resources or large engineering teams to implement complex technologies for wastewater treatment.

The engineering approach presented here is not one-size-fits-all, because one size (or type) does not. Horizontal in-channel rotary drum screening technology (Figures 1 and 2) is built from the outset to be both robust and adaptable.

Compared with typical traditional screening at WWTPs, the in channel technology has lower fluid head loss at peak flows to increase solids removal efficiency.

When dealing with fine screening of larger flows, this technology has the advantage of mechanical simplicity, self-cleaning and high efficiency screening. This results in reduced maintenance and cheaper whole-of-life costs compared with other types of screens, such as band and inclined drum screen designs.

Key to delivering this functionality is the configuration, in which the screening drum is installed horizontally, semi-submerged in line with the incoming wastewater. The plate at the back of the drum re-directs flow radially through the mesh to optimise solids separation and minimise blinding.

The rotary drum is manufactured from either self-cleaning wedge wire for primary screening, or perforated plate for fine pre-membrane bioreactor (pre-MBR) screening. There are two external spray bars that flush screenings into the collection hopper and wash the screen at a moderate pressure.

The screening technology provides for optimal adjustment of screen gap widths and hole diameters for the most appropriate screening result when matched to individual installations' characteristics, such as the application flow and local site conditions.

An internal hopper collects the screenings, which are flumed out to the integral lifting and dewatering screw (Firgure 3), to efficiently dewater and reduce screenings volume.

The lifting screw is shaftless to avoid any blockages, even in the presence of fibrous products, and includes screen and screenings washing. Figure 1 shows the integral or in-channel lifting and dewatering of screenings, but being a separate process, screenings can be flumed outside the channel, which increases options for additional washing and dewatering, according to individual applications.

The horizontal drum design has more screening lower down. This lowers operating depth, head, over a wider range of flows to reduce average screen velocities for higher removal efficiencies and easier cleaning than most alternative screens.

The robust design of this equipment means that apart from regular housekeeping and maintenance, replacement and servicing is only required only every four to six years.

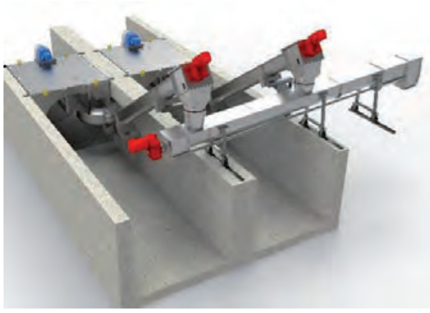


Figure 1. Functional layout of the "In-Channel" Rotary Drum.

Figure 2. Internal view of the stainless steel wastewater screen drum.

Figure 3. Solids being lifted by the screw to a waste bin.

Local manufacture of the screen places the customer next to the source of supply for spare parts, future extensions and retrofits to boost performance long-term.

The Author

Mike Bambridge (info@cstwastewater.com) is Managing Director of CST Wastewater Solutions based in Sydney.

DOES YOUR DISTRIBUTION NETWORK OPERATE AS WELL AS YOU THINK?

Carmel Cumming and David Sheehan

What do you know about your water distribution network? Where is it performing well, and where is it not? Is your disinfection residual consistent? What do your staff and operators understand about its performance? Coliban Water took a step towards trying to answer these questions by undertaking a systematic, whole-of-business distribution network optimisation review of one of its systems, through joining up to a US-based optimisation program.

In 2017, Coliban Water began participating in a Distribution System Optimisation Program (the Program). The Program is managed by the American Water Works Association (AWWA), as part of its Partnership for Safe Water.

The Partnership's mission is to improve the quality of drinking water delivered to customers by offering optimisation programs to improve performance. This improvement is achieved by focusing on system operations, rather than relying solely on capital improvements, and the Program encourages water corporations to voluntarily improve performance beyond current regulatory requirements.

The Program was of interest to Coliban Water due to the Program's unique framework to assess and optimise performance in the water distribution network. Such a framework has not been used outside North America before, and there are currently no similar programs available in Australia. The Program uses a holistic approach, including consideration of network operations, management practices, business finances, and staffing numbers. Coliban Water was the Program's first participant outside North America.

There are four distinct phases of the Program:

1. Commitment to the Program.
2. Baseline data reporting, followed by annual data reporting.
3. Self-assessment of the network operation.
4. Achievement of optimised performance.

While only a few systems are expected to achieve optimised performance, progress towards optimised system operation will result in high quality safe drinking water being delivered to customers and improved system reliability.

The objective of Coliban Water's participation was to have a documented and structured process through which we could undertake a thorough assessment of our water supply system performance, identify gaps for optimising the water distribution network and, upon completion, have a tangible improvement plan.

Phase I Commitment

Phase I of the Program is basically just signing up to the Program and committing to implementing the Program in your business. For a water corporation the size of Coliban Water, the annual participation fee is about $US1000.

Phase II Baseline Data Reporting

There are three system integrity indictors, Water Quality (maintaining disinfectant residual), Hydraulic (maintaining positive pressure) and Physical (main break frequency). The Program has developed three databases with inbuilt software to enable data to be produced for analysing the systems performance. The initial input and outcomes form the baseline data and are sent to The Partnership for review.

This data is used to construct national trends and for benchmarking. The Partnership has set a target of 0.20 mg/L free chlorine (in a free chlorinated system) throughout the network as the daily minimum residual for a utility to attain.

Phase III Self-assessment

Phase III is the main element of the Program. The self-assessment examines the operation of the distribution network, spanning from when the water exits the water treatment plant to its delivery at the customer tap.

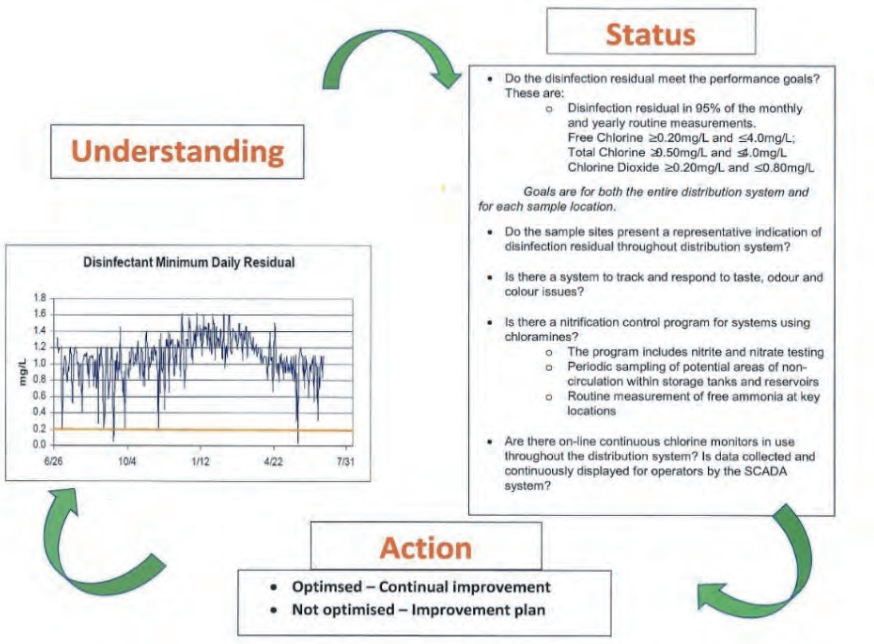


Figure 1. Understanding/status/action example.

Underpinning the assessment of each component of the network is an "understanding, status and action" approach to ensure the utility understands what they are reviewing, the current status of the component, and what actions need to be undertaken for improvement to be achieved (Figure 1.). Participants score the status of each network component as either Optimised and Documented, Partially Optimised or Not Optimised.

The self-assessment is best considered as five areas.

- Performance Assessment: Compares results against Program-set targets (disinfection residual, mains breaks & pressure management).
- Operational Variables: Reviews individual operational tasks such as flushing or valve exercising.
- System Design Evaluation: Assesses design-related factors such as pipework and network storage.
- Application of Operational Concepts: Discusses operational management and communication.
- Administration: Considers staffing, budgets and policy implications.

The first step in the self-assessment process is the assessment of operational performance. This assessment uses three measures of system integrity (Table 1):

- Water quality (measured by network disinfectant residual data).
- Hydraulic reliability (pressure data).
- Physical integrity (mains breaks data), which are assessed against Program or utility goals (whichever is appropriate).

The Partnership sets goals, but each utility can modify these. Analysis and scoring are undertaken using utility generated data, and by answering a series of questions.

The questions were designed to engage staff from all areas of the utility and encourage in-depth discussion and consideration of the current operations, any intricacies specific to the system being assessed, and the presence of contingencies, including managing staff leave.

Example questions are listed below:

System sampling:

- Does the utility have a system sampling map?

Table 1. System integrity targets.

System Integrity Targets	
Component	**Target**
Residual free chlorine	>0.2mg/L & <4.0 mg/L [total chlorine >0.5mg/L & <4.0 mg/L]
Pressure	Minimum pressure 20 psi for 99.5% of the minimum daily reading, 35 psi mininimum monthly average.
Mains breaks	Annual maximum 15 breaks for each 100 miles of distribution pipes

- Are sample collection sites representative of the overall distribution system?
- Are there on-line continuous chlorine monitors in use throughout the distribution system?

Pressure monitoring:

- Are pressure monitoring instruments routinely calibrated?
- Are maximum system pressures established and supported with documentation?
- Are pressure fluctuations monitored, investigated, and procedures used to reduce variations?
- Are main breaks correlated to variations in pressure?

The second step (operational variables) involves reviewing multiple operational tasks, such as flushing programs and corrosion control, by answering a series of questions for each aspect. In the following step, factors that influence these, such as system design evaluation, the application of operational concepts, and administrative support, were also assessed.

The assessment was undertaken through workshops involving the relevant staff for each of the topics. Each workshop consisted of discussions around current processes, answering a series of questions and agreeing on the status as either, Optimised and Documented, Partially Optimised or Not Optimised.

Once scoring is complete, any component found as partially optimised or not optimised is identified as a Performance-Limiting Factor. These are ranked in terms of priority through a discussion with relevant staff members utilising the Program's Prioritisation Ranking Scales (Table 2). The team identified actions to improve these factors, and developed an in-depth improvement plan.

As part of the Distribution System Optimisation Program, a Phase III Distribution System Self-Assessment Report is completed. This report answers all questions and shows the outcome of Optimised and Documented, Partially Optimised or Not Optimised. This document, together with other supporting documentation (as outlined in the Program), were forwarded to Partnership for Safe Water for a peer review.

Table 2. Prioritisation ranking scales.

1. Impact Rating Classifications

Rating	Classification
5	Major impact on long-term optimisation goals
4	Major impact on short-term optimisation goals
3	Important impact on optimisation
2	Minor impact but sustainable
1	Minor short-term impact

2. Urgency Rank Descriptions

Point value	Description
5	High, very important to accomplish this improvement within 12 months
3	Medium, important to complete this improvement but may take 1-3 years
1	Low, although important may wait more than 3 years

Assessment of the Echuca Distribution Network

In order to assess the merits of the Program, and to keep the initial commitment to a manageable size, Coliban Water trialled the Program on the Echuca distribution network.

Echuca is located in Northern Victoria, with a population of approximately 15,000, serviced by 7,200 connections. This network is one of Coliban Water's larger systems and operates on a free chlorine residual. This town provided a network of manageable size that was not too complex, but would have enough system components to provide a robust assessment process.

Baseline Data

Baseline data reporting for the years 2017–2019 showed the Echuca distribution network met the specified residual goals (0.2–4.0 mg/L) at all times. It should be noted that Coliban Water uses a maximum residual of 2.5 mg/L as part of its commitment to improving the taste of drinking water. The Program does not take the aesthetic qualities of drinking water into account. Figure 2 visualises an extract of the 2018 data. The database input is average daily residual at the entry point, together with weekly customer tap, and network tank data. To enable the graph to be readable, the supplied database produces the graph that is shown, which displays one data point per week

Self-assessment Outcomes

Figure 3 summarises the self-assessment outcomes for system components within each area. The diagram summarises the overall health of the system, and helps to identify the areas where the business is meeting targets, and areas of potential improvement.

Table 3 shows a snapshot of the components of the Echuca system that were scored as Optimised and Documented, Partially Optimised or Not Optimised. Note that this table is not an exhaustive list of all components.

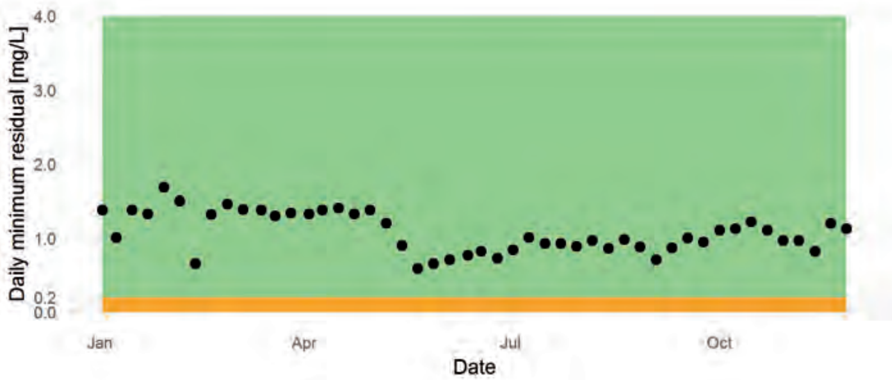


Figure 2. Minimum daily free chlorine residual for 2018 submitted as part of Phase II baseline reporting for Echuca.

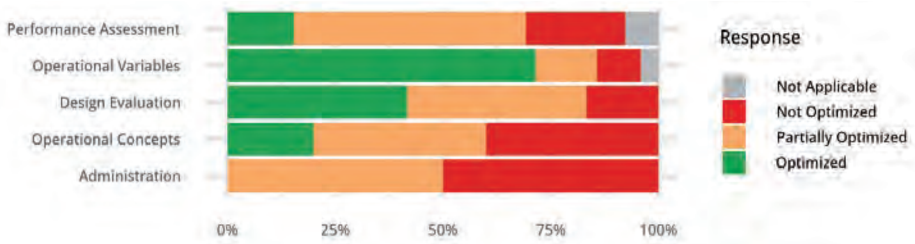


Figure 3. Summary of system components.

Table 3. Self-assessment outcomes.

Rating	Topic
Optimised and Documented	Maintenance of disinfection residual
	Backflow prevention
	Mains renewals and pipe inspections
	Asset inventory
	Customer complaint management
Partially Optimised	Individual site testing
	Storage tank condition assessments
	Flushing program
	Pressure monitoring
	Water age tracking
Not Optimised	Mains breaks
	Pressure management
	Pump operation and efficiency
	Demand management
	Hydraulic modelling

Improvement plan

After the Performance Limiting Factors were prioritised, some were included in the improvement plan for the Echuca distribution network. Not all were included, however, the high priority and the 'low hanging fruit' were included. Table 4 summarises items included in the improvement plan.

Lessons Learned

The pilot of the Program was a lengthy process that took over two years to complete. During this time the team identified a number of strengths and challenges, and opportunities for improvement, within the pilot of the Program. Key take homes from the pilot are detailed in Table 5.

The challenge of implementing the improvement plan has highlighted the importance of achieving buy-in from upper management for the Program.

Relevant areas of the business must also engage, both with respect to the time commitment to attend workshops, but also the commitment associated with delivering the improvement plan.

Data gathered across the business identified inconsistencies in data interpretation and usage by different departments. The pilot highlighted the need for an automated and reproducible report for the routine acquisition of data.

Several staff changes throughout the life of the pilot meant that team members had to learn about the Program quickly, but then they often moved on after a short period to other parts of the business. This highlighted the importance of team member selection and consistent staffing.

The self-assessment process was very involved and time-intensive, which highlighted the importance of a clear path to follow, and the importance of streamlining the process, such as automating data collection and analysis where possible.

Lastly, at Coliban Water we believe the Program's methodology can be improved by adding a greater focus on customer-centricity in assessing network performance. Counting complaints is not an effective proxy for how customers view the performance of the system. Allowing a chlorine residual of up to 4 mg/L will undoubtedly not be appreciated by consumers who drink the water. Only a small percentage of customers who have a negative experience will lodge a complaint. Water quality managers need to also understand the expectations of customers and manage their water quality parameters accordingly.

The overall outcome of the pilot was that Coliban Water successfully completed Phase III of the Program for the Echuca distribution network, which is formally recognised by the Partnership.

Next Steps

The next steps will involve implementation of the improvement plan for the Echuca network, including discussing responsibilities and delivery timeframes with different departments, and developing a robust system for monitoring progress and ongoing review for continuous improvement. The next question facing Coliban Water is whether to roll the Program out to other water supply systems. As discussed above, the time taken for the self-assessment process was identified as a challenge of the Program, as it was highly labour intensive, and data acquisition was a large part of this. However, theoretically, a number of systems can undergo the self-assessment simultaneously. Many of the assessed areas are utility-wide, so do not need to be revisited in much detail. Some components are system specific, such as data that makes up the system integrity measures. As Coliban Water has 19 water treatment plants with related discrete supply systems, undertaking the self-assessment on each system would be quite a time consuming and in-depth exercise. We hope to apply a more effective and efficient process when using the Program in future to assess other Coliban Water distribution networks. We would recommend this program to any water utility looking for a robust framework to assist in distribution network optimisation.

Table 4. Improvement plan items.

Issue	Action
No online continuous chlorine monitors in network.	Investigation into possibility of online chlorine analysers within the network.
Sample collection sites not representative of overall distribution system.	Review of sample sites and implementation of recommendations.
No ongoing maintenance or calibration of Pressure Monitoring Stations (PMS) and PMS not configured to alarm.	Adding calibration of PMS to the annual works plan and alarming PMS.
Critical items identified in storage tank condition assessments not notified to relevant personnel for actions.	Amending the storage tank condition assessment so that relevant staff were notified when critical items were identified.
No formal procedure for communication of water quality test results to networks teams and subsequent adjustments to operation.	Standard Operating Procedure for water quality results driving operational changes.
Asset management program not yet comprehensive.	Implement asset management improvement plan.

Table 5. Strengths, Weaknesses, Opportunities, Threats identified during the pilot.

Strengths noted during the pilot	Weaknesses noted during the pilot
• Knowledge of what areas we do well in and what areas need improvement. • Development of an improvement plan with input from relevant staff. • Opportunities for in-depth discussion. Ensuring staff understand the focus on continual improvement, not on why the component may have scored less than optimised, to ensure open and honest discussion was an important part of this.	• Extent of Improvement Plan. • Project team structure. • Workflow of self-assessment is resource-intensive.
Opportunities to achieve objectives	**Threats to achieving objectives**
• Automation of aspects of the distribution network.	• Buy-in from upper management. • Data acquisition. • Potential resistance to delivering assigned actions.

Authors

Carmel Cumming (Carmel.Cumming@coliban.com.au) is the Water Quality Risk Coordinator and **David Sheehan** is Manager Water Regulations, both with Coliban Water in central Victoria.

BETTER BACKWASHES AT WINNEKE

Winner of the Best Paper by an Operator at the 2022 WIOA Victorian Operations Conference

John deBoer

The Winneke Treatment Plant (Figure 1) is situated in Victoria and provides up to 30% of Melbourne's drinking water. The plant was constructed in 1980 with a current design capacity of 560 ML/d. Coagulation and filtration are the two main mechanisms for removal of protozoa, bacteria and viruses followed by post chlorination for inactivation of viruses and bacteria.

The Winneke filters are a mono-media design with three grades of support gravels and 1 metre depth of filter sand (Table 1). They are a closed plenum arrangement with a central launder and media beds on either side of the launder, each containing 2200 filter nozzles which protrude into 100 mm diameter lateral pipes. The nozzle slots are 3 mm.

Raw water for the plant comes from Sugarloaf Reservoir which is a blend of Yarra River and Maroondah Reservoir water. The river is unprotected and runs through rural areas including vineyards and cattle farms and has a number of STP's upstream which are operated by another Victorian Utility. Discharge events require Melbourne Water to cease harvesting into Sugarloaf via the Yering gorge pump station. The second source is from the Maroondah aqueduct which supplies water from the Maroondah Reservoir in Healesville which has a protected catchment. There is also the potential to receive water from the Goulburn River via the Sugarloaf pipeline but this has not been in service for over 10 years.

Sugarloaf Reservoir can suffer from high manganese levels requiring periodic aeration but is typically low in turbidity and colour.

The backwash sequence consists of three minutes of air scour followed by six minutes of washwater.

In 2009/10, a project commenced to replace the original filter media in filters 1-12 noting that filters 13-16 had only been in service since 2008. The project involved replacement of all filter nozzles, support gravels and sand media as well as raising the height of the backwash launders.

This paper addresses some of the impacts faced when undertaking such a project without first conducting a robust review of the existing backwash regime.

During a filter inspection program in 2015, operators identified a number of significant deficiencies relating to media appearance and backwashing.

- Boiling and displacement of the filter media due to trapped air in the plenum space after the air scour (Figure 2).
- Media loss into the plenum chamber, backwash launders and washwater recovery tank (Figure 3)

Figure 1. Aerial view of the Winneke Treatment Plant showing the four square clarifiers and rectangular filters in the background.

Table 1. Winneke filter backwash process and media specifications.

Media Type	Effective size	Uniformity coefficient	Support Gravels
Silica based sand @ 1000 mm depth	0.62 mm	< 1.3	3 layers of Quartz pebbles: 75 mm of 1.5-3.0 mm 75 mm of 3.0-6.0 mm 100 mm of 6.0-12 mm

Figure 2. Boiling occurring due to rapid onset of the washwater pumps after the air scour.

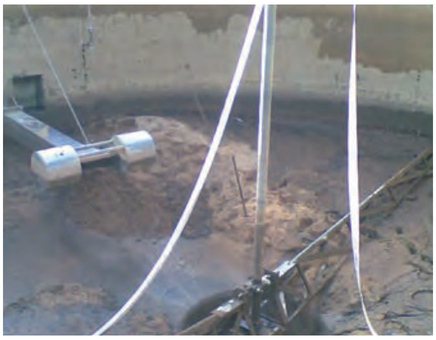


Figure 3. Sand build up in the washwater recovery tank.

- Media blocking lateral pipework and nozzles leading to high solids retention and media cracking (Figures 4, 5, 6 and 7). The deep cracks in the filter media increased the risk of short-circuiting and potential reduction in pathogen log removal.

Figure 4. Sand build up in one of the laterals. The nozzle stems are visible in the background.

Figure 5. A nozzle blocked with sand.

Figure 6. High solids retention in the media as shown in this media shake test.

Figure 7. A substantial crack in the media in one of the filters at Winneke Treatment Plant.

- Mud balls and mud below the filter surface were observed indicating that the filters were not cleaning effectively.
- Supporting gravel was also found near the surface in some parts of the filter indicating significant disruption to the layering of the support media.
- Inadequate washwater flow rates for media fluidisation and expansion.
- Ineffective washwater draw across the filter resulting in poor turbidity profiles and extended backwash times.

The significant deficiencies identified, if not adequately addressed, could have substantial impacts on filtration efficiency resulting in increased risk of pathogen breakthrough. The Winneke Operations Team were presented with the immediate challenge to improve the efficiency of the backwashing in order to minimise gravel disruption, improve washing of the media and achieve effective fluidisation and expansion during the backwash.

The main question they faced was what could be done in a short period of time using the existing plant infrastructure to prevent further degradation of the recently replaced filter media. Several projects were identified in an effort to control and reverse these failings.

1. Introduction of an air scour 'Pause Timer' to allow much of the residual air in the plenum space to vent to atmosphere prior to introduction of the washwater.
2. Use of Variable Speed Drives (VSDs) to control ramping of the backwash pumps and reduce the volume of air being forced through the filter media.
3. Increasing the backwash rate by changing the operation of the existing pumps to improve media fluidisation and expansion.
4. Changes to the backwash penstock opening sequence resulting in improved solids removal and reduced washwater volumes.

The impact of these issues and the solutions implemented are described below.

Boiling and Displacement of the Filter Media due to Trapped Air in the Plenum Space.

At the completion of the air scour, a significant volume of air remained trapped within the filter plenum space. Originally, washwater was introduced by two backwash pumps, starting up within 20 seconds of each other, reaching a combined flow rate of 900 L/s in less than one minute.

This resulted in the volume of trapped air being forced through the filter media at a rate much higher than that normally delivered during a typical air scour. The high volume air flow resulted in the disruption of supporting gravels and excessive localised boiling leading to media carryover into the backwash launder throughout the washwater cycle.

The excessive boiling and disruption of supporting gravels had two major impacts.

1. Sand media carried over into the backwash launder was deposited in downstream systems such as the washwater recovery tanks, sludge thickeners and centrifuge feed systems. This led to blockages in the desludge pipework and accelerated wear on the sludge thickener and centrifuge feed pumps.
2. The disruption of the supporting gravels also resulted in sand media washing through, blocking filter nozzles and depositing media in the filter laterals and plenum space. This further exacerbated the ineffectiveness of the backwash cycle leading to localised areas of extreme mud deposits throughout the depth of the media. Subsequent filter inspections revealed that the solids retained within these areas after a backwash were often in the range of 30-50% (Figure 6) which is far in excess of the recommended value of 5-10% solids retention. This level of mud layering throughout the depth of the media also resulted in significant surface cracking (Figure 7) increasing the risk of short circuiting and the potential for pathogen breakthrough.

In order to reduce the impact of excess air being forced through the media, two fundamental changes were made to the programmable logic controller (PLC).

Previously, air relief valves relieved excess pressure in the air manifold whilst the filter air inlet valves remained shut. The PLC program was modified to hold the air inlet valves open during the air relief process allowing the trapped air within the filters to equilibrate to atmospheric pressure before washwater is introduced. This then reduced the amount of pressurised air being pushed through the filter during the washwater process, therefore reducing disturbance of the media and subsequent media loss. This change alone has resulted in a significant reduction in sand carryover and its impact on downstream recovery systems.

The second PLC change involved optimisation of the existing backwash pump VSDs to progressively ramp up the introduction of washwater, thus slowly squeezing the trapped air out through the filter nozzles without over pressurising it. This simple change significantly reduced the boiling effect and subsequent disruption of the support gravels and media loss.

Inadequate Washwater Flow Rates for Media Fluidisation and Expansion

The original washwater phase of the backwash cycle consisted of three backwash pumps operating in a Duty/Assist/Standby mode, providing 900 L/s of washwater flow. This equates to a backwash rate of around 22 $m^3/m^2/hr$ which is far lower than the minimum of 37 $m^3/m^2/h$ recommended by consultants to Melbourne Water in the past. Whilst bed fluidisation in excess of 90% was being achieved, bed expansion was typically around 7-9% which is much lower than the 10-15% expansion required for effective removal of suspended particles.

At Winneke, there is limited access to the filters with no walkways provided around the filters. Access is only possible at the far end of the filter from the concrete pavement surrounding the filters. Thus fluidisation and expansion tests could only be conducted at one location at the settled water inlet end of the filter. Where tests could be conducted at the filtered water outlet end, the results showed poor fluidisation at around 50% and expansion typically below 5% .

This demonstrated that fluidisation and expansion values were highly variable from one end of the filter to the other indicating zones of compromised media, particularly at the filtered water outlet end of the filter where the backwash water is introduced.

This situation was marginally improved by modifying the backwash program to operate all three pumps in a Duty/Duty/Assist configuration. The result of this was an increase in washwater flows from 900 L/s to 1200 L/s increasing the backwash rate from 22 $m^3/m^2/hr$ to up to 30 $m^3/m^2/hr$ (Figure 8).

Whilst this still falls short of the desired 37 $m^3/m^2/hr$, this was the maximum flow achievable given the hydraulic constraints of the existing backwash pumps, concrete ducts and associated valves and pipework.

Ineffective Washwater Draw Across the Filter

During the previous filter backwash program, the opening of the backwash outlet penstock was delayed to allow the incoming washwater to fill the filter to approximately 300 mm above the backwash launder before the penstock began to open. This practice was thought to have been introduced in an attempt to prevent filter media from washing over the launder. The actual effect of this deferred opening delays the wash over of turbid backwash water into the launder and allows suspended solids to settle back onto the media surface resulting in poor turbidity profiles and extended backwash times. It is much more efficient to allow the washwater to enter an empty launder as soon as it is introduced to the filter.

In order to rectify this issue, the backwash PLC program was amended to ensure the backwash outlet penstock opened immediately upon start-up of the backwash pumps. This resulted in a significant reduction in the washwater time required to reach a nominal 10 NTU, of up to two minutes (Figure 9). An opportunity was therefore presented to reduce the washwater phase from six minutes down to four minutes equating to a potential reduction in washwater volumes of up to 30%.

The changes described above have considerably improved the effectiveness of the backwash cycle by reducing the disruption of the filter support layers and volumes of lost media. Unfortunately, they have not been completely successful in halting the localised degradation of the filter media, particularly at the outlet end of the filters. This is thought to be largely due to the inability of the current backwash pumps and pipework to provide the required rise rates to ensure sufficient fluidisation and expansion of the current sand media throughout the entire filter. This results in poor backwash performance and inability to remove embedded mud layers from some parts of the filter media.

The other contributing factor is the deficiencies in the original civil design of the filters which results in a localised low pressure zone within the plenum space as the washwater enters the plenum. This low pressure zone together with the insufficient washwater flows results in poor washing of the filter media at the immediate end of the filter where the washwater is introduced.

Melbourne Water has recently embarked on a new project to refurbish the Winneke filters. This project will seek to address a number of key issues including:

- Pilot trials of alternative media combinations to maximise filter run times and ensure effective backwashing within the current limitations of the existing equipment.

- Computational Fluid Dynamics, (CFD) modelling of backwash flows within the filter plenum and lateral pipework to further understand the hydraulic limitations within the filter plenum space.
- Installation of baffles within the filter plenum to improve flow distribution and address localised low pressure zones identified by CFD modelling.

Partial replacement of the filter media where the first 2-4 meters of media in the filters will be replaced with sand media of the same specification in order to remove the localised zone of degraded media most impacted by the backwash limitations previously described.

The intent of these works is to further improve the back wash efficiency and to help nurse the media through until a wholesale replacement project can be implemented in the future.

The Author

John deBoer (john.deboer@melbournewater.com.au) is an Operations Specialist, Water Supply with Melbourne Water in Victoria.

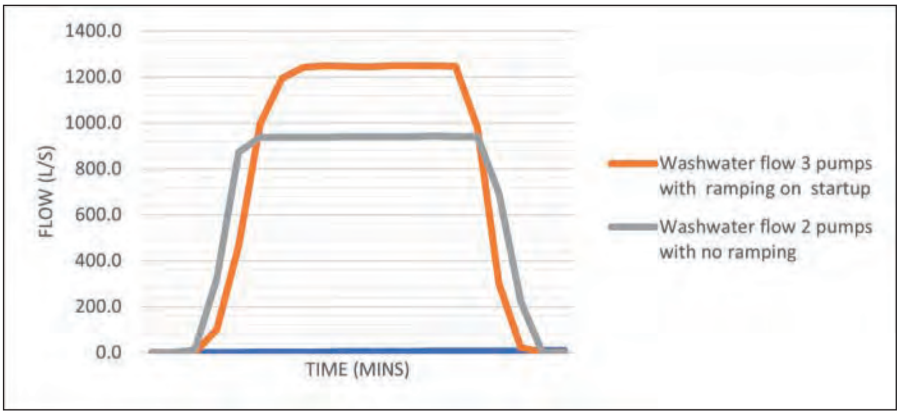


Figure 8. Backwash flow data comparing 2 pumps at 900 L/s with 3 pumps at 1200 L/s

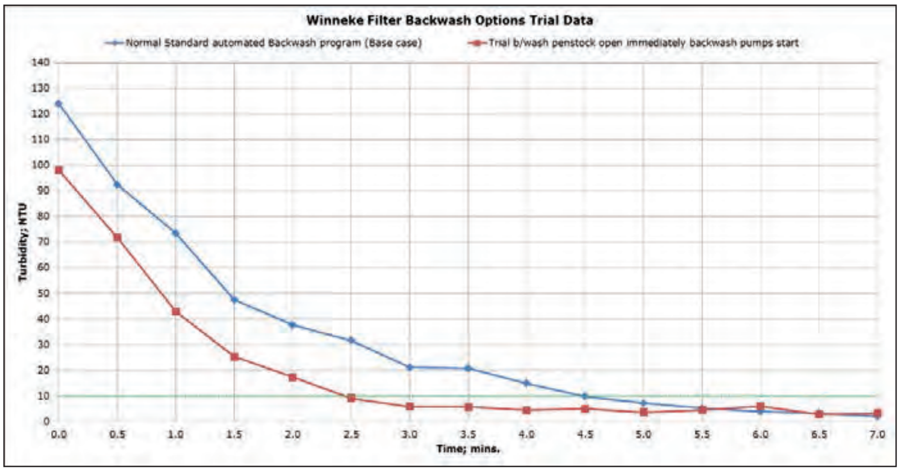


Figure 9. Turbidity profiles comparing delayed opening of the backwash penstock (blue line) with immediate opening on start-up of the washwater phase (red line).

Superior solution for Trouble-free operation for All wastewater applications

INSTALLATION OPTION

SE pumps can be dry installed either vertically or horizontally, offering versatility for your project.

GRUNDFOS SE/SL WASTEWATER PUMPS WITH OPEN S-TUBE® IMPELLER

Grundfos updated range of SE/SL wastewater pumps are available in multiple versions from 1 to 30 kW and with a range of hydraulic designs, including the new Open S-tube® impeller that can be trimmed to meet a specific duty point. Built with a robust design, the SE/SL pumps with Open S-tube® impeller are the ideal solution for light to extremely contaminated wastewater, and ensures:

- A reliable operation with optimised flow and blockage prevention
- A wide range of applications
- Many customisation possibilities for an extended suitability
- Extensive range of accessories reducing operation and maintenance cost

For more information or to find your nearest Authorised Grundfos Dealer, visit **grundfos.com/au/campaign/professional-wastewater-solutions**

GRUNDFOS

Possibility in every drop

AUSTRALIAN OPERATOR EXCHANGE PROGRAM

Peter Mosse

Certificate level training is an essential part of the development of a water industry operator. However, once trained, the opportunities for operator development and increased skills and knowledge acquisition can be limited. Development within one Utility, only exposes operators to that Utility's operating philosophy, and mentoring within a Utility can be limited.

WIOA and WSAA are developing a nationwide, Water Industry Operator Exchange Program. The aim is to provide selected operators with an opportunity for development outside their direct employer, by spending time with another Utility, working with other operators and at a different plant.

How Would the Exchange Work

The exchange is not a reciprocal exchange but rather, an operator from one Utility will visit and be hosted by another Utility.

In the first instance, each participating Utility will need to nominate one or two WTP's and one or two WWTP's they feel they would like to make available, or that they think may be of interest to operators from another Utility. There is no need to offer both WTPs and WWTPs or two plants, just those that the participating Utility would like to invite other operators to visit.

Participating Utilities would then provide a brief paragraph for each nominated plant describing the features of the plant and its operation, and the process steps inherent in the plant(s). Other relevant and interesting information would also be provided such as challenges of treating a difficult raw water, blue green algae, manganese, high organics, very variable raw water, UV disinfection, membranes, large variations in demand. For wastewater plants, unusual treatment processes, difficult industrial waste, variable loads and any other relevant information.

There would also be the opportunity for Utilities to list any exclusions for visiting a particular plant. For example

- Summer period from December 20th (before Christmas) until the end of the school holidays.
- Maximum number of visits per plant.
- Any other exclusions.

Contact details (email and phone number) would be provided for the nominated contact person for each plant. This would normally be a senior operator.

Once the information is received, a listing of all the participating Utilities and the plants that they plan to offer along with the summaries of the plant and the contact person and details will be made available. A booking system will also be developed.

The Exchange Process

Once all the plant details have been received, and the booking system has been established and tested, participating Utilities will be invited to start the exchange process which should occur in the following way.

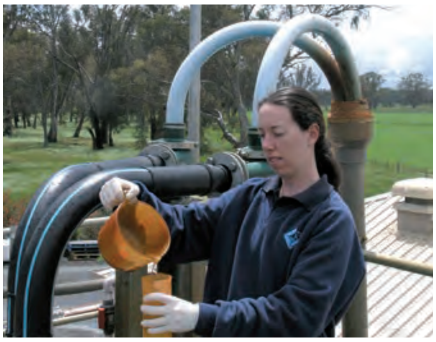
The selected operator checks the plant availability and selects a plant they would like to attend.

- The selected operator makes contact with the nominated plant contact person.
- The operators agree on a week for the visit.
- The selected operator selects the plant on the system and enters the exchange dates. That plant will become unavailable as soon as this occurs.
- The selected operator approaches their HR department and arranges travel and accommodation details for the nominated week.
- The visiting operator will complete all necessary online inductions prior to attending site.
- The site visit takes place.

During the Exchange

The aim of the exchange is not just a site visit. The intention is for the exchange operator to undertake as many of the normal operational tasks as possible under the guidance of the host plant operator who naturally will maintain responsibility for the site. The aim is for the exchange operator to participate as fully as possible in the operations of the host plant.

During the exchange week, there may also be the possibility for the exchange operator to experience many other aspects



of the host Utilities operations. These could include:

- Meeting and discussions with the host General Manager of Operations.
- Visits to any other sites that are the normal requirement for the host operator.
- Meeting with Quality or Environmental Team members and understanding the host Utility's water and wastewater monitoring and data handling and reporting.

The aim is for the exchange operator to be exposed to as much as possible of the host operators normal (and emergency, as for example in call outs) duties and to return to their Utility with a deep understanding of the operation of the host treatment plant and the operational requirements and philosophy of the host Utility.

After The Exchange

At the conclusion of the exchange, the visiting operator is required to prepare a report to be delivered to his or her fellow operators, supervisors and managers on their experiences and any ideas they would like to introduce into their own plants, or suggest to their Utility for improved operations.

A written report would also need to be submitted to WIOA and WSAA potentially for publication in WaterWords or Water Works, or it could be delivered at a WIOA conference as a poster or a platform paper.

What Happens Now

Stay tuned. We aim to start exchanges in the first quarter of 2023 and we will be seeking to get commitment from your Utility later this year. So why not talk to your Manager now and register your interest to participate.

PIPE DESCALING IN MUNDUBBERA

Winner of the Best Paper by an Operator at the 2022 WIOA Qld Operations Conference

Tim Merrett

The township of Mundubbera is located approximately 200 km west of Hervey Bay and is part of the North Burnett Regional Council. The water supply scheme serves a population of 1261 persons through 573 connections. Water is sourced from the Burnett River with several water quality issues including hardness, iron, and manganese. The treatment process includes clarification, filtration and pH adjustment. Disinfection is achieved through liquid chlorine injection.

In September 2021, Council received a call from the Mundubbera hospital advising that they had no water pressure, and that this had been an ongoing problem for several months. When the water crew arrived to investigate, the pressure had returned to normal.

The issue was discussed in the office and it was identified that other properties in the vicinity of the elevated reservoir were also experiencing low water pressure during periods of high demand. A check of SCADA indicated that the elevated reservoir had not run out of water when the pressure issues were occurring.

The elevated reservoir was constructed in 1967. The vertical 150 mm diameter CICL (cast iron concrete lined) inlet/outlet main and a short horizontal section through the base of the structure are original pipework. The reticulation network up to the base of the elevated storage has been previously upgraded. The network issues suggested a restriction in this pipework. An elbow was removed at the base of the elevated storage and significant iron and manganese scaling was found internally (Figure 1).

Figure 1. Significant scaling had reduced the effective diameter of the old pipe.

Options to improve the pressure and flow out of the reservoir included replacing the pipe, constructing a new outlet line, or trying to descale the existing pipe.

To identify descaling options, a Google search was undertaken. A YouTube video showing pipes being descaled using descaling chains looked promising. The company was contacted and they provided the name of a plumber in Bundaberg who had recently purchased the equipment (Figure 2). Contact was made with the plumber who made the trip to Mundubbera to inspect the job.

Figure 2. The chain descaling unit.

A day was set in December 2021 to undertake the job. The plumber, a vac truck, and a 30 tonne crane were engaged. Under clear skies, the reservoir was isolated from the network and drained. The horizontal section of pipe was the first to be descaled. The vac truck was used to collect the material removed from the pipe lining.

The vertical section of pipework was next to be descaled. The descaling tool needed to be launched from inside the elevated reservoir. This required crews, equipment and vacuum hoses to be craned the 30 m vertical distance to undertake the work (Figure 3). Safety issues that needed to be considered included working at heights, confined space entry and working in the vicinity of telecommunications equipment.

Figure 3. Descaling the vertical inlet/outlet pipe.

Weather was another safety issue. An approaching thunderstorm cut short the vertical descaling after only two passes were completed. Another one or two passes were planned with a final pass with a polishing head.

The reservoir was partially filled and flushed before being returned to service. Figure 4 shows a SCADA plot of the storage levels before and after the descaling with the inflow and outflow rates also shown.

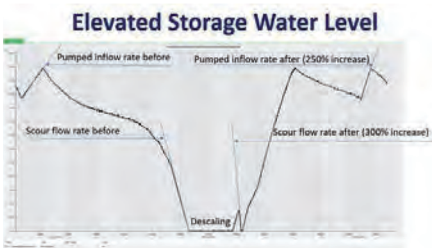


Figure 4. Flow rates into and out of the reservoir

The pumped inflow rate showed a 250% improvement, while the gravity outflow rate improved by 300%.

The descaling project cost $12,000. This was about 1/10th of the estimated cost of replacing the pipework.

No pressure or supply issues have been reported since the work was undertaken.

The Author

Tim Merrett (tim.merrett@northburnett.qld.gov.au) is Water and Wastewater Treatment Operator with North Burnett Regional Council in central Queensland.

fluidion
Water Intelligence

Your fully-automated in situ microbiology Lab

Continuous, real time measurement of E. coli, total & faecal coliforms

ALERT SYSTEM V2

- Autonomous, remotely-controllable analyser for quantifying E. coli, total and faecal coliforms.
- Suitable for environmental and water treatment process monitoring.
- Uses innovative disposable cartridge concept to provide unprecedented accuracy and repeatability, while greatly simplifying maintenance procedures.
- Installed in situ, the ALERT SYSTEM V2 measures E. coli and faecal coliform concentration and provides automatic alerts in real time.

Portable E. coli Analyser

ALERT LAB

- Fully portable, autonomous and remotely-controllable analyser for the measurement of E. coli and other bacteria.
- Suitable for source water and environmental monitoring at a field location, in a moving vehicle, or in a lab.
- Performs six measurements using a 12V power source or battery.
- The ALERT LAB enables rapid bacterial enumeration immediately following water sampling by field personnel.

GET IN CONTACT TODAY

WEBSITE
www.roycewater.com.au / contact@roycewater.com.au

QLD / NT	NZ	NSW / ACT	TAS	WA	VIC / SA
PHONE	PHONE	PHONE	PHONE	PHONE	PHONE
0437 742 859	**+64 3928 8765**	**0429 623 308**	**0407 342 113**	**08 9455 6777**	**0439 337 247**

ROYCE WATER TECHNOLOGIES PTY LTD ABN 21 110 057 399

Royce RWT Water Technologies