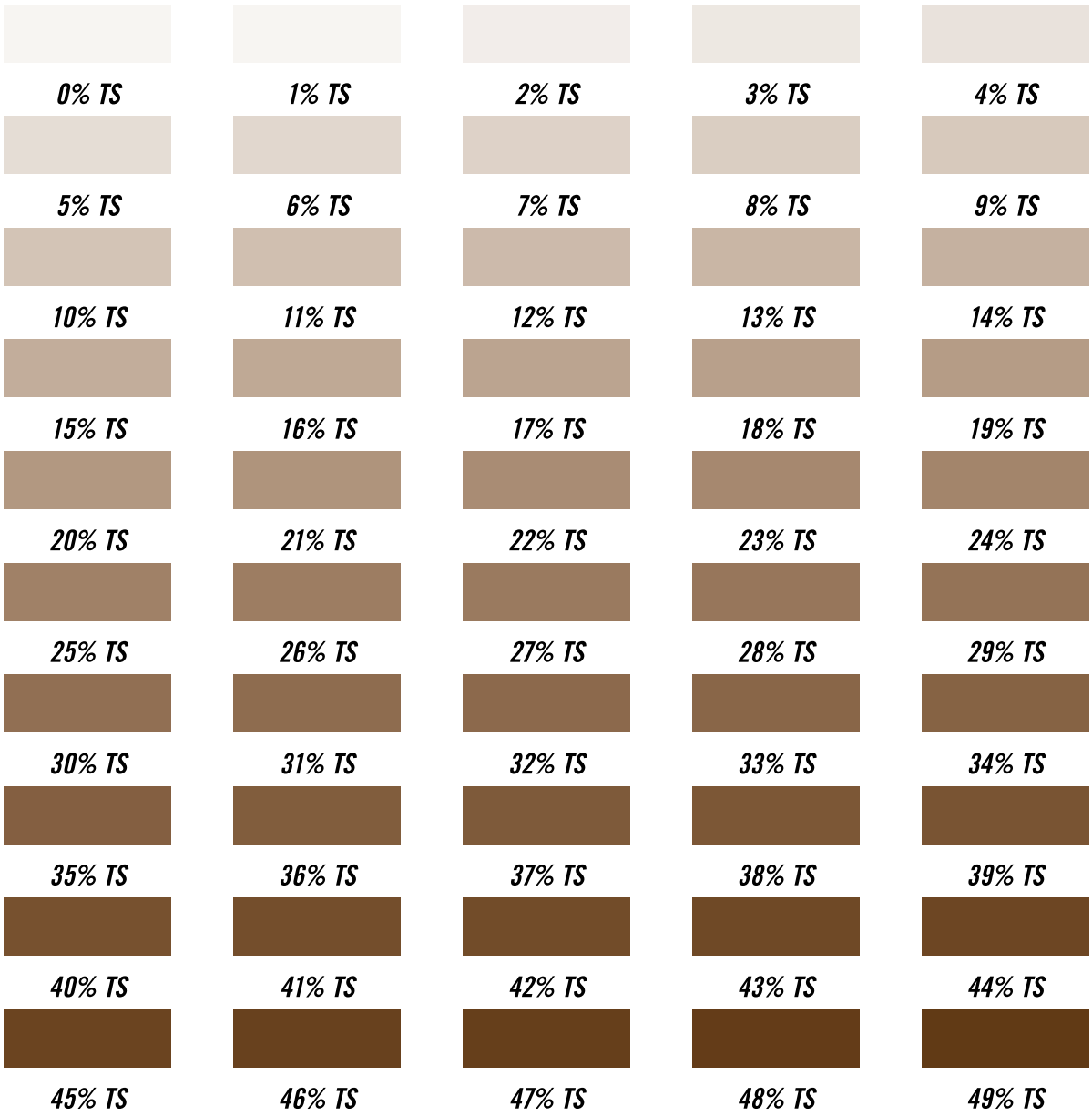
WATER WORKS

TECHNICAL PUBLICATION OF THE WATER INDUSTRY OPERATORS ASSOCIATION OF AUSTRALIA

MAY 2019

Fifty Shades of Sludge

Cerlic
ELETTA GROUP



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WaterWorks
OFFICIAL JOURNAL OF THE WATER INDUSTRY OPERATORS ASSOCIATION OF AUSTRALIA

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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

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WHY DON'T THEY GIVE A FLUSH?

Kristy Elrington

With popular items on the market these days that claim to be flushable, blockages in sewerage systems are creating headaches nationwide. There is a need to educate the community about what is and is not appropriate to dispose of down the toilet. But who should we be targeting and what items are they confused about?

In 2017, I was lucky enough to travel around the USA, as winner of the IWA Victoria Laurie Gleeson Award to discover different ways to educate adults and teenagers about what should and shouldn't be flushed. In Seattle, a study had been completed delving into what the public were flushing and why. It gave them a great insight into the items and people that they should be targeting.

Later that year, we did a similar survey with over 1,200 Goulburn Valley Water customers to get local and current data. The survey was created in SurveyMonkey and emailed out via Campaign Monitor to the customers that we had email addresses for.

Survey Demographic

Of the 7,241 customers that were asked to participate via email, 1,225 completed the survey. The breakdown of the different demographics are as follows:

Gender:

- Female = 766 (62.89%).
- Male = 449 (36.86%).
- Other = 3 (0.25%).
- 7 participants skipped this question.

Living Arrangements:

- Rent = 209 (17.26%).
- Owner occupier = 993 (82.00%).
- Live with family/friends = 9 (0.74%).
- 14 participants skipped this question.

Age Category:

- Under 18 = 2 (0.16%).
- 18-34 years old = 200 (16.39%).
- 35-44 years old = 179 (14.67%).
- 45-54 years old = 214 (17.54%).
- 55-64 years old = 301 (24.67%).
- 65 and over = 324 (26.56%).
- 5 participants skipped this question.

The Survey Results

Participants were initially asked which items they believed were safe to flush down the toilet without causing blockages in toilets, plumbing or sewers (Figure 1).

Figure 1. The percentage of participants who selected each item as safe to flush.

OUR COVER

A new bore being drilled at Eulo in outback Queensland. The bore is being drilled to a depth of approximately 200m to tap water from the Great Artesian Basin.

Figure 2. Cleaning a ragged up pump.

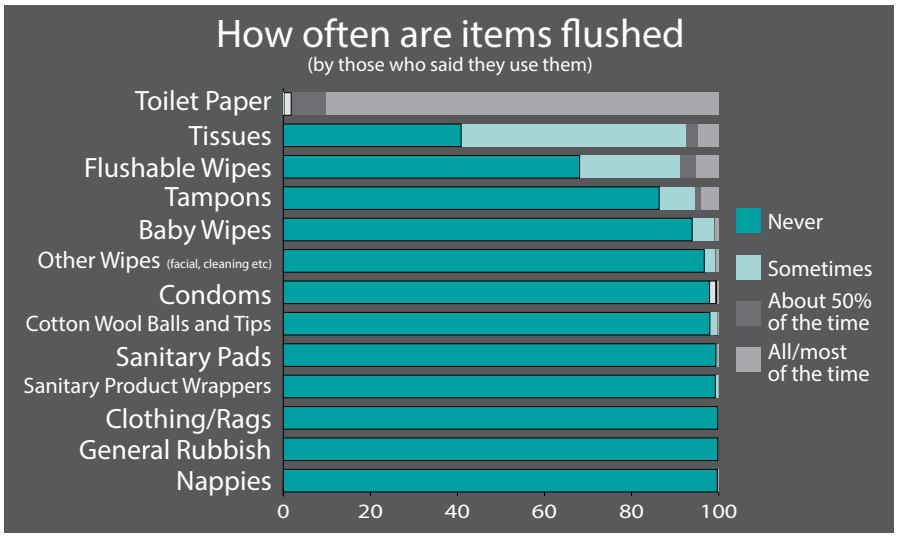

Figure 3. The percentages of frequency at which participants flush the items that they use.

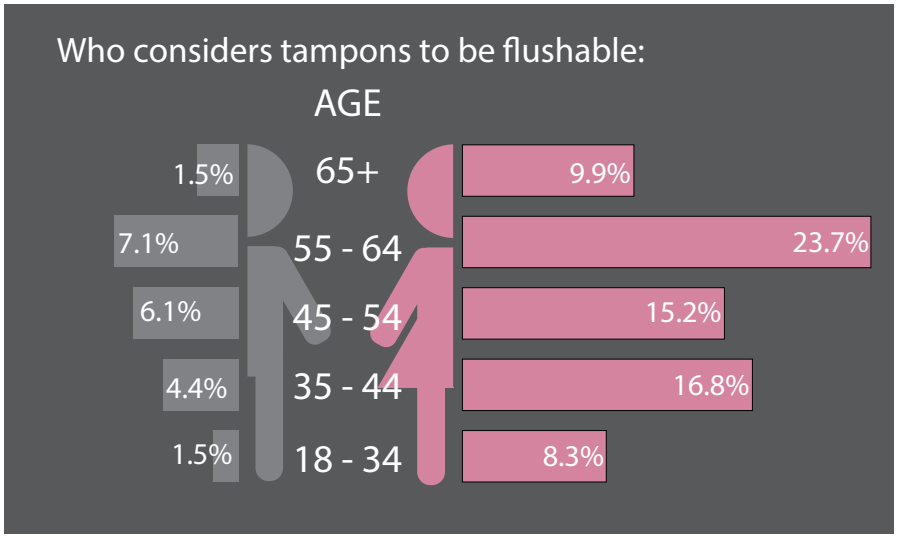

Figure 4. The breakdown of gender and age groups who consider tampons to be flushable.

They were then asked how often they flushed each item (Figure 3), and why.

Flushable wipes and tampons came up as the items of greatest concern, with a significant percentage of people flushing them, and believing that it is safe to do so. Below we look into who are flushing these two items and why.

Tampons

The results for tampons were higher than expected, with 11.25% believing that they are flushable. This result does include males who, although they do not use tampons, had a better knowledge of their flushability, with 4.02% of males indicating that they can be flushed, compared to 15.42% of females. Figure 4 shows the breakdown of gender and age.

There is an obvious misconception about tampons amongst females. The worst performers were 55 to 64 year old females, a generation who may not have received good education in their adolescent years due to private topics not being as commonly spoken about. The age groups to follow were those that could be current mothers of pubescent females.

Of the 460 females who indicated that they use tampons, 17% admitted that they do flush them, whether it be sometimes (10.4%), about 50% of the time (2%), or all/most of the time (4.6%). About half of these people flush tampons for sanitary reasons, almost a third do it for convenience and the rest (17.3%) do it because they believe they can be flushed.

These results show that there is need to educate on correct tampon disposal. This education should not just be targeted at the generations that use them, but also the age groups that might be parents of adolescent females.

To gain an understanding of peoples' knowledge of what items are flushable, they were asked how they decide if an item should be flushed. 70.5% answered that they "have been taught what should and shouldn't be flushed". This reiterates the need to also educate potential parents of adolescent females as they will likely be the ones doing the teaching of this topic.

Flushable Wipes

The results for flushable wipes were high, with almost 35% believing they can safely be flushed. This is expected given that the packet tells you to flush them. The younger

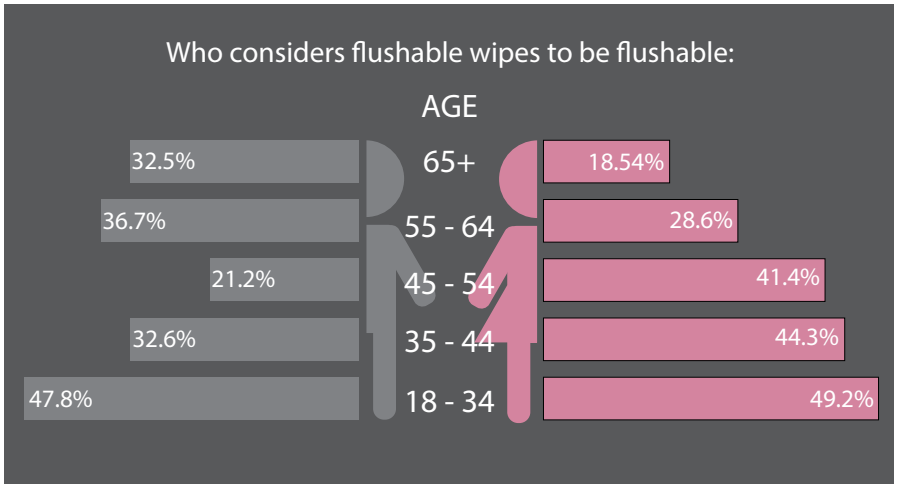

Figure 5. The breakdown of gender and age groups who consider flushable wipes to be flushable.

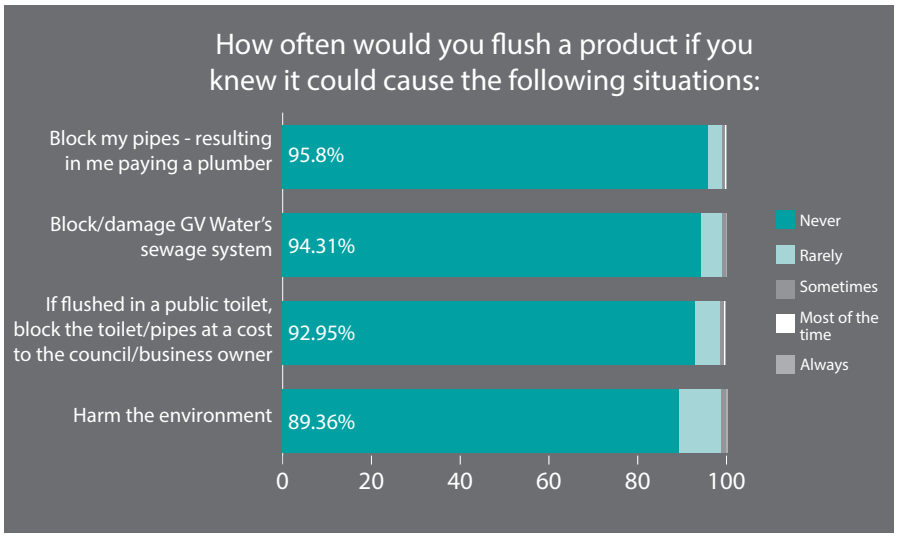

Figure 6. The percentages of the frequency at which participants would flush an item if they knew it could cause the different scenarios.

generation were the highest, with 49% of 18-34 year olds specifying that they are flushable (Figure 5).

Of the 624 people who indicated that they use flushable wipes, almost a third indicated that they do flush them, whether it be sometimes (23%), about 50% of the time (3.7%), or all/most of the time (5.3%). 60% of these people flush wipes because they believe they can be flushed, 22% do it for convenience and 17.8% for sanitary reasons.

Standards Australia gave approval in May last year for the development of a national flushability standard for flushable wipes. The standard will include both the design of the wipe and appropriate package labelling, which will hopefully see a reduced impact from flushable wipes on sewerage systems. Given that these standards are anticipated to take up to two years to develop, there is still an immediate need to be educating the community to help reduce the number of blockages in the meantime.

Consequence of Flushing

The results of the surveys indicate that while there were people who were unaware that certain items should not be flushed, it could also be concluded that there were people that just don't care if they cause a blockage. To get an idea of whether this is the case, participants were asked how often they would flush a product if they knew it would cause one or more of the following scenarios:

- Block my toilet or pipes – resulting in me paying a plumber.
- Block or damage Goulburn Valley Water's sewerage system.
- If flushed in a public toilet, block the toilet or pipes at a cost to the council or business owner.
- Harm the environment.

As shown in Figure 6, the percentage of people selecting the "never" option reduces as the scenario get further from home, with people caring most about the scenario that has the direct cost to themselves. The least care is for the environment.

Interestingly, the care factor for females is less than that of the males with the percentage selecting "never" ranging from 1.1% to 3.4% less for females than males across the four scenarios.

What Next?

The results indicate that education on what is and isn't flushable is required for all people, regardless of age and generation and ethnic background. The public were asked in the survey what methods should be used to educate customers. The popular responses were:

- Information in water bill newsletter.
- School education program.
- Information in public toilets.
- Social media.

At Goulburn Valley Water we implement a popular primary school program called The Big Flush. The near future will involve broadening education to also target teenagers and adults by using the methods above and any other options that are financially feasible.

Sanitary reasons were a popular response for why people flush various items and my understanding of this is that people want to get rid of unhygienic items quickly. In female public toilets it is typical to find a bin beside the toilet. Do people find it sanitary to dispose of an unhygienic product in a bin? Do people have bins in their toilets or bathrooms at home? Conducting further research to get an understanding of what disposal methods people deem as sanitary, along with what proportion of people have a bin within the vicinity of their toilet could provide an insight into this issue.

The Author

Kristy Elrington (KristyE@gvwater.vic.gov.au) is an Education Officer with Goulburn Valley Water in Victoria.

SMART SYSTEMS – YOUR MEASUREMENT EASILY CONNECTED

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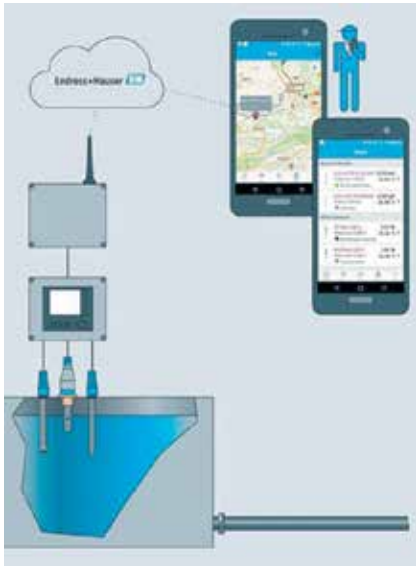
Endress+Hauser's Smart Systems are packages that combine industry-proven measuring instruments with our new Industrial Internet of Things (IIoT) offering. Process values and device diagnostic data are transmitted to a central data hub via edge devices. This provides the user with a wide variety of applications, as well as visualisations, evaluations and functions. Information is transmitted directly to the hub without a control system and is thus accessible to the user from anywhere. The user is therefore always informed about the status, and this means that measures can be initiated right in time or even much earlier!

Two standard sets with instruments for measuring the following parameters are available:

- Surface water monitoring:
  - » pH, dissolved oxygen, conductivity and temperature.
- Aquaculture monitoring:
  - » pH, dissolved oxygen, ammonium nitrate and temperature.

In addition to the instruments, fittings for installation, cables and mounting materials, an edge device is included. This only needs to be connected to the measuring instrument and power supply. The measured values are then automatically transmitted to the user's smartphone via the hub. All transmitted measured values are visualised via the Smart Systems app. The simple visualisation includes geographical overviews, histories and notifications of:



Network topology – from the sensors to the visualisations in the Netilion Smart Systems app

Visualise remotely current/historical process values and get notifications when exceeding predefined limits within a mobile app

- device information with pictures
- visualisation of measured values
- definition of limit values with alarms and notifications
- overview of all accumulated alarms and acknowledgement of messages
- graphical history of measured values
- assignment of the measuring points on a map.

With this package, users can easily access their measuring points from anywhere and at any time. This means that they save manual measurements on site and can react faster in case of deviations.

Package consisting of:

- hardware (one package) containing:
  - » Liquiline CM444
  - » Modbus Edge Device
  - » sensors
  - » armatures, cables and fixation material
  - » documentation.
- IIoT Service:
  - » web application
    - – administration of installation and contracts.
  - » smartphone application
    - – visualisation, alarms and maps.

What can you do with the package?

- one package contains everything needed, from instrumentation to connectivity devices
- mobile access to water quality parameters via smartphone app
- alarms and notifications allowing for quick reactions to limit deviations and changed sensor status.

As the offering contains analytical equipment, which has higher requirements in commissioning and operation, we recommend taking support from Endress+Hauser. The following support is available:

- support services – to have exclusive access to phone, mail and remote support
- commissioning support – to get everything up and running
- maintenance services – to keep everything clean and working
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DNA NGS ANALYSIS FOR WASTEWATER TREATMENT

Biological wastewater treatment is reliant on a microbial community to accelerate the degradation process. The types and abundance of these microbes is directly related to the efficacy of the wastewater treatment process.

Next-generation DNA sequencing (NGS) provides wastewater treatment operators and engineers with the ability to see what is happening inside their process by identifying nearly all of the types of microbes present, and getting an insight into what good or harm they may be causing – all without having to look under a microscope.

Why use LuminUltra's NGS service?

- faster results – two weeks from receipt of sample
- easy-to-follow sample preservation techniques, giving confidence in results
- convenient – no freezers or refrigerated transport required
- reporting includes results and analysis from in-house DNA and application-specific experts.

How do I get my sample tested? The process is simple:

1. collect your sample
2. send it to us hassle free
3. get your report
4. make better decisions based on feedback.

NGS Krona Plot

More data on the microbes in your process means faster, better decision-making for greater operational efficiencies.

Case scenario: identifying the cause of bulking in a bioreactor using NGS

A wastewater treatment plant (WWTP) is having persistent problems with filamentous bulking and sludge carryover in the secondary clarifier. Traditionally, operators used a microscope to try and identify filamentous organisms; however, they switched to NGS to reduce organism misidentification. With NGS, they receive standardised quantitative results that are easy to interpret without additional training or expertise in microbe identification.

NGS also gives the added benefit of identifying all organisms, not just filamentous. This allows the plant to understand other processes, including biological nutrient removal, viscous bulking, foaming and aeration performance. The WWTP identified the significant filamentous bulking organisms leading up to a severe bulking event on 20 August (see table).

Microbe	Relative Abundance		
	23-Jul	06-Aug	20-Aug
Caldilinea *Type 0803* *Cause: Low F:M*	0.23	2.18	13.78
Kouleothrix *Type 1851* *Cause: Low F:M*	0.04	0.96	4.37
Gordonia *Nocardia* *Cause: FOG*	0.45	0.41	0.32

Based on the NGS results, the bulking event was caused by caldilinea and kouleothrix, both of which are associated with low F:M. Gordonia was also found to be present, but its relative abundance did not change during the bulking event. If a microscope was exclusively used for identification, the bulking event may have been misidentified as gordonia-related, which is caused by high fats, oils and grease, not low F:M.

The WWTP corrected the F:M by attributing the microorganism portion to active biomass using LuminUltra's 2nd Generation ATP, as opposed to total or volatile solids. The new F:M corrected the filamentous bulking issue.

A DNA testing program can keep your process running optimally by helping you to:

- understand the cause and effect relationships certain microbes have on your process (positive or negative)
- see trends and understand future triggers for proactive versus reactive decision-making
- apply more targeted treatment.

REMOTE SYSTEM MICROBIOLOGY

Glenda Floriduz

Situated approximately 80 km south of Townsville in North Queensland, the Burdekin Shire covers an area of 5,053 square kilometres and has a population of approximately 17,500 residents. Burdekin Shire Council (BSC) has four water reticulation schemes: Ayr/Brandon, Home Hill and Mount Kelly, supplying drinking water to towns and extensive rural areas. The townships were first provided with drinking water schemes when the Chief Health Officer raised concerns over the many unsealed private shallow bores receiving contamination from leaking septic systems in the 1960s. Sewer schemes were added soon after in the 1970s. For a long time locals have considered their bore water pure and limitless.

Three of the schemes draw from shallow aquifers, with most of the sealed bores drawing from a depth of around 6-30m. Examples of the bores are shown in Figures 1 and 2. The bores are set beside cane fields, on water reserves in sewered urban areas, in an abandoned race course and amongst commercial and recreational areas in town. Iron and manganese levels are the main quality issues in the bore water.

Historic testing for *E. coli* during a wide range of weather and climate conditions have so far not shown any *E. coli* entry into any of the bores. Testing immediately after recent floods produced no change in this.

Recent nitrate, pesticide and PCP testing has shown that small amounts of agricultural run-off are present throughout all aquifers, so they cannot be considered confined. No indication of infiltration of septage or sewage was found. Several bores have had to be abandoned in Ayr due to PFAS contamination in parts of the aquifer. The treatment process in the groundwater schemes operated by BSC is restricted to aeration, for removal of CO_2, followed by chlorination.

Drinking water for Giru is purchased from Townsville City Council. Raw water sourced from the Haughton River undergoes conventional treatment via coagulation, sand filtration and chlorination. Catchment characteristics range from natural bushland to intensive grazing, intensive cultivation and rural low-density housing with

Figure 1. Nelsons Bore. It is one of 6.

Figure 2. Home Hill Bore. It is one of 8.

septic systems. There are therefore varying opportunities for microbial contaminants to enter the source water through the catchment. Leaking septic systems and grazing in areas likely to run straight off into the river or its tributaries pose the greatest risks.

Historically, all samples for microbiological testing had to be transported to a NATA accredited laboratory in Townsville. It was not possible to reliably transport to the Queensland Health laboratories in Brisbane.

Council had no formally trained laboratory personnel; nor did we have a water laboratory at the time. Previous experience with onsite microbial testing systems requiring heat sealing of bubble sheets and colour matching of incubated sheets found the systems to be unreliable, especially in the hands of staff without higher qualifications.

Figure 3. Typical Burdekin micro sample tap site.

The blister-packing of the samples is clumsy and therefore easily open to contamination. Rushing multiplies the risks, as do distractions. Colour-matching is highly subjective and affected by highly coloured samples (with lots of available iron and manganese for example). This is problematic in sewage effluent testing. It could be fatal in drinking water testing. BSC trialled the TECTA system to see if it might offer advantages over this more well-known kit method. If we could gain confidence in a system, BSC would consider doing our own micro testing.

The TECTA system is quite easy to use. Microbiological samples are taken from dedicated sampling taps in our distribution system (Figure 3). The water samples are collected using hygienic sampling methods, placed on ice and returned to our labs.

Each water sample is then transferred to single use TECTA cartridges. Each cartridge has premeasured amounts of growth media specific for the target microorganisms. The firmly sealed cartridges are then placed in the incubator spectrophotometer (Figure 4) and after the required period, the result is available on the touch screen. It's as simple as that! Samples with high levels of contamination return results in as little as 2 hours. Minor contamination results take a little longer.

We simultaneously ran double blind samples with the TECTA system and a Townsville laboratory. A single water sample was collected, then split with one half going to the Townsville lab and the other half used to provide a sample for incubation and testing in the TECTA unit. When we "doctored" some samples (we added varying amounts of bird poo to 4 bottles of distilled water), the TECTA showed early detections a lot sooner than the 24 hour plus turnaround when we send samples to the Townsville laboratory. In fact, in high levels, the alert came in as little as 6 hours. No false positives were encountered on distilled samples either. There was no difference between the TECTA results and the lab results.

We signalled to the Regulator that we would like to update our Drinking Water Quality Management Plan (DWQMP) to include in-house testing of micros. We signalled to the Regulator that we would like to update our Drinking Water Quality Management Plan (DWQMP) to include in-house testing of micros. This included a verification regime where 10% of our tests would be confirmed by double blind samples sent to the Townsville NATA laboratory each year. We also emphasised the advantage to the Regulator that the quick turnaround for results from the TECTA unit, and the fact that the TECTA unit can send an automatic detection notification emailed to the whole team, allows BSC to initiate an incident response swiftly. The TECTA unit also sends all results directly to our enterprise document management system without human interference, thereby maintaining the chain of custody. We have since followed through with the update to our DWQMP, which was accepted and approved by the Regulator.

Figure 4. The TECTA unit in use. Two sample cartridges are shown on the bench and two already in place in the TECTA unit.

Two machines were purchased, one for exclusive use in the Water Treatment lab and one for exclusive use in the Ayr Wastewater Treatment Plant lab to address the obvious cross contamination risks.

Already the TECTA has earned its keep during 2 recent heavy rainfall events, one a moderate flood, when access to the Townsville Laboratory was cut. We were able to continue sampling and testing to ensure we could be confident our drinking water remained safe throughout the events, one of which was 2 weeks long. Although the regularity of testing has meant we have had tests carried out during flood events, we do not do it as a specific practice. Our technical team has discussed the need to sample specifically during flood periods, which present as the main risk to our aquifers being contaminated with microorganisms. This will be included in the next update to the DWQMP.

The Author

Glenda Floriduz (Glenda.floriduz@burdekin.qld.gov.au) is Quality and Compliance Technical Officer with Burdekin Shire Council in North Queensland.

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Project Brief

PROJECT:

South Grafton PS Outfall Pipes, South Grafton.

CLIENT:

Ledonne Constructions Pty Ltd

CARRIER SIZE:

DN375 M-PVC

CASING SIZE:

DN600 Mild Steel casing

SPACER MODEL:

HDX 65

kwik-ZIP HDX 65 casing spacers were used for the South Grafton PS Outfall Pipes project.

The project required two 30 metre lengths of DN375 M-PVC carrier pipe to be installed inside a DN600 mild steel casing. With the two pipe runs not being grouted after installation, the strength and durability of kwik-ZIP HDX spacers are ideal for supporting the combined pipe/water weight once commissioned.

kwik-ZIP model HDX 65 spacers were selected and installed at 1 metre intervals to support the carrier pipe and protect it from abrasion damage during installation for both sections.

kwik-ZIP's spacers have no metal parts and are made from Acetal POM – a high-grade thermoplastic that is flexible, extremely tough and has a low coefficient of friction. The spacer's simple and efficient installation process requires no special tools.

kwik-ZIP HDX spacers are approved by WSAA and meet the requirements of their Product Specification **PS-324 Casing Spacers**.

"kwik-ZIP products are simple and quick to install and ensure the carrier pipe is appropriately protected from abrasion and other damage during installation. Minimal force is required during installation of the carrier pipe due to the products low coefficient of friction."

Michael Allen, Project Engineer, Ledonne Constructions Pty Ltd.

For further information on kwik-ZIP products,
and to discuss your specific project requirements,
please contact us at **sales@kwikzip.com.**

E sales@kwikzip.com **P** +61 8 9725 4678 **W** www.kwikzip.com

USE OF SPOT MARKET ELECTRICITY PRICING AT NORTH EAST WATER

Winner of the Best Paper Overall at the 2018 WIOA Victorian Operations Conference

Michael Chapman

In Australia the production and usage of electricity is undergoing a major transformation, essentially away from fossil fuel to an increasing reliance on renewables. Associated with this is the change in demand for power in the domestic market for heating and cooling in the face of more severe changes in climate.

A comparison of the spot price for electricity in March 2016 against March 2017 after closure of the Hazelwood Power Station in the Latrobe Valley in Victoria (Figure 1), clearly shows how market volatility has greatly increased, and with it electricity costs. The spot pool price for electricity can vary from -$1,000/MWh to +$13,800/MWh. The minus value relates to the fact that when there is a significant surplus of electricity produced, the spot market price drops to a point where consumers are credited for using up this surplus until production once again meets demand.

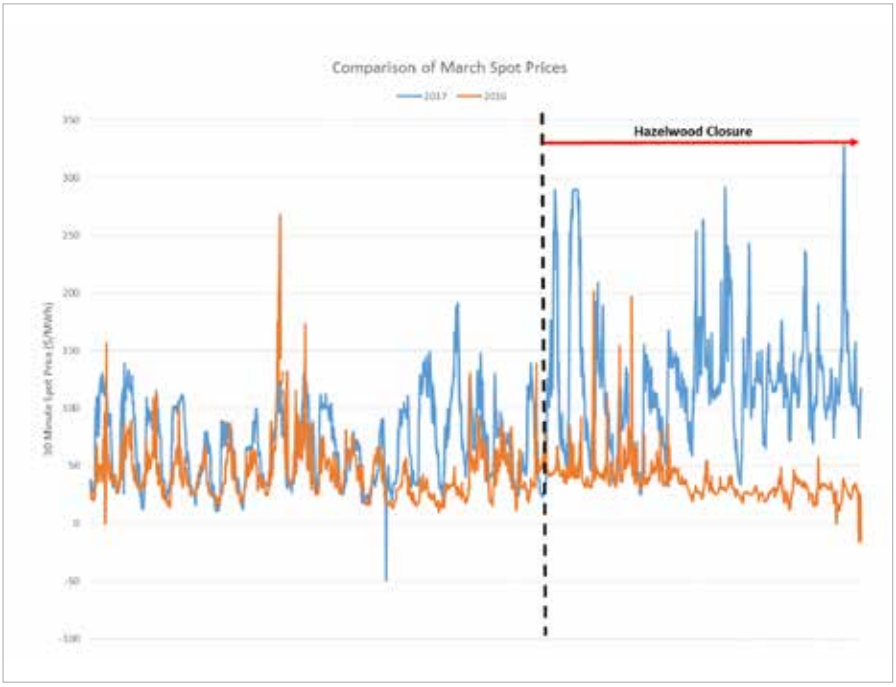

Figure 1. Comparison of March spot prices for 2016 and 2017.

The purchase of electricity can be done in one of three ways:

1. Fixed price contract.
2. Spot market based on 30 minute intervals.
3. Spot market combined with hedging arrangements.

Spot market prices are volatile (Figure 1), however use of hedging can protect against such volatility. Hedging works by paying a set or contract price per MWh (example $100 MWh), but for the power used when the spot price is higher than the contract rate, the spot price *less* the difference between spot and contract rate is paid. Likewise, if power is used when the spot price is lower than the contract rate, then the spot price *plus* the difference between spot and contract rate is paid.

In June 2016, North East Water (NEW) shifted from purchasing electricity on a fixed price contract to purchasing electricity on the spot market with hedge contracts to manage risks. NEW operates 32 large market sites making up 75% of the total electricity spend and 281 small market sites make up the remaining 25%. The largest of these is the West Wodonga WWTP which consumes approximately 6,000 MWh of electricity per annum with an energy spend of over $675,000.

To reduce electricity costs, NEW must firstly have the ability to monitor the market spot price in order to forecast price spikes and using the required electricity as effectively as possible. Secondly, to have the ability to load shed, that is, reducing required electricity by shutting down high electricity consuming plant and equipment during peak demand periods. With load shedding comes the risk to water and wastewater processes. NEW is committed to not compromising safety and product quality in search of energy savings.

Monitoring Spot Prices

NEW currently monitors spot prices through two main sources, an energy broker and the AEMO (Australian Energy Market Operator).

The AEMO operates Australia's National Electricity Market (NEM), the interconnected power system in Australia's eastern and south-eastern seaboard, and the Wholesale Electricity Market (WEM) and power system in Western Australia. They publish a data dashboard (Figure 2) showing the 30 minute spot price $/MWh, demand MW, forecast spot price $/MWh and scheduled demand MW. This allows the operations staff to monitor real time spot prices and begin power shedding at the appropriate time.

Through an energy broker, NEW receives weekly notifications via email

(Figure 3) and text message which detail the upcoming week's market activity forecast including temperatures and risk of high demand periods. This helps the operations staff to plan weekly tasks, maintenance, shutdowns and shedding plans in light of upcoming events.

For example, after reviewing the Market Activity email shown in Figure 3, operations staff noted that Wednesday, Thursday and Friday would be high demand days. So, if appropriate, they can reduce load on the plant, for example by planning shutdown maintenance or running extra machinery earlier in the week to avoid possible higher prices later in the week. They can also arrange staff availability if necessary, to turn the plant off and then back on.

Load Shedding

There are two main forms of load shedding, voluntary and involuntary.

Voluntary load shedding is the ability for the business to reduce the electricity load by turning off energy intensive plant and equipment for short periods of time. The plant and equipment might be simply turned off during the required period, or powered by a secondary source such as a diesel-powered generator/battery backup or the use of storages. For example stored energy in the form of treated water held in a clear water storage or influent held in a storage prior to the wastewater treatment plant. Companies are able to negotiate an agreement with the power provider to voluntarily load shed on a pre-scheduled or on-demand basis.

Involuntary load shedding (Blackouts) occurs when the AEMO directs power companies within Australia to start switching off customers' power supply because the power system is at risk. The system always has to remain in balance between supply and demand. If there is no extra supply available, the authorities have no choice but to reduce demand by shutting customers off. If they don't, the entire system can fail, causing a state-wide blackout as happened in South Australia in September 2016.

Peak Price Event – Usage v Price

In mid-January 2018, NEW experienced a couple of peak price events which resulted in the spot market price

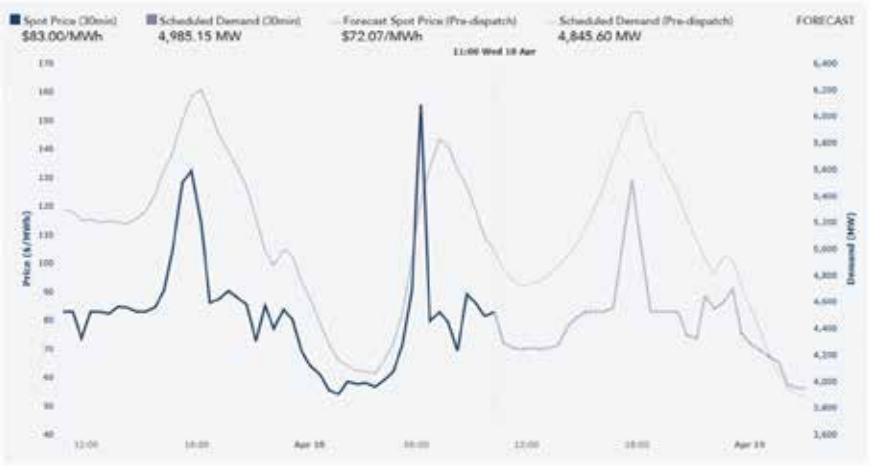

Figure 2. The AEMO Data Dashboard.

Notification Market activity for the week ahead
Friday 10 February 2017

Hi Michael,

Periods of high spot prices can occur at anytime and can occur outside of the higher risk periods shown below. There are many factors that affect spot prices and these cannot always be predicted ahead of time. This information should only be used as guide to assist forward planning of site operations and staffing for sites that are utilizing the pool monitoring system.

TEMPERATURE FORECAST FOR THE WEEK AHEAD

	Sat		Sun		Mon		Tue		Wed		Thu		Fri	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
NSW	24	39	24	28	18	25	19	24	20	27	20	31	23	31
SA	23	36	18	24	18	24	14	28	15	29	17	29	16	28
VIC	19	26	15	19	13	18	14	21	13	29	17	26	15	28
QLD	23	33	24	33	23	32	24	33	24	33	24	32	22	31

VICTORIA

Date	Time				
Saturday 11-2	7am - 10am	10am - 12pm	12pm - 3pm	3pm - 6pm	6pm - 7am
Sunday 12-2	7am - 10am	10am - 12pm	12pm - 3pm	3pm - 6pm	6pm - 7am
Monday 13-2	7am - 10am	10am - 12pm	12pm - 3pm	3pm - 6pm	6pm - 7am
Tuesday 14-2	7am - 10am	10am - 12pm	12pm - 3pm	3pm - 6pm	6pm - 7am
Wednesday 15-2	7am - 10am	10am - 12pm	12pm - 3pm	3pm - 6pm	6pm - 7am
Thursday 16-2	7am - 10am	10am - 12pm	12pm - 3pm	3pm - 6pm	6pm - 7am
Friday 17-2	7am - 10am	10am - 12pm	12pm - 3pm	3pm - 6pm	6pm - 7am

Chart Legend

Low Risk | Medium Risk | High Risk

Figure 3. An example of a Market Activity email.

increasing dramatically. On the 18th of January, the most prominent event occurred which saw the 30 minute spot market price increase from $90/MWh to $12,900/MWh in a very short time. The total event only lasted around one and a half hours but through monitoring the spot market and power shedding energy intensive equipment, NEW was able to reduce electricity demand from over 1,100 kWh to 700 kWh (Figure 4 on page 16). This produced a potential energy saving of $12,000 compared to purchasing straight from the spot market without hedging (Table 1 on page 16). Over this period of time NEW was under a hedging contract so electricity cost reductions were limited. If NEW had purchased straight from the spot market then this would have given the potential of avoiding having to pay an estimated $30,000 in increased electricity prices over the events in mid-January.

Date	Time	Total Demand VIC	$ per MWh	NEW Usage kWh	New $
1/18/2018	12:00	6891.32	94.21		
1/18/2018	12:30	7115.51	100.81		
1/18/2018	13:00	7386.47	93.26		
1/18/2018	13:30	7558.88	105.53		
1/18/2018	14:00	7808.9	107.89		
1/18/2018	14:30	8043.88	136.05		
1/18/2018	15:00	8201.25	1775.2	1,142.63	2,028.39
1/18/2018	15:30	8360.11	86.72	1,124.96	97.56
1/18/2018	16:00	8556.23	1960.54	1,093.70	2,144.24
1/18/2018	16:30	8717.88	5682.01	1,096.74	6,231.70
1/18/2018	17:00	8887.54	12931.04	766.47	9,911.20
1/18/2018	17:30	8899.85	11960.16	713.71	8,536.05
1/18/2018	18:00	8954.82	5078.6	818.45	4,156.59
1/18/2018	18:30	8889.58	238.45		
1/18/2018	19:00	8793.73	178.84		
1/18/2018	19:30	8540.96	230.07		
1/18/2018	20:00	8241.23	124.28		
1/18/2018	20:30	7961	103.98		
1/18/2018	21:00	7566.11	104		

Table 1. Victorian electricity total demand and price vs NEW usage and cost for 18th of January 2018.

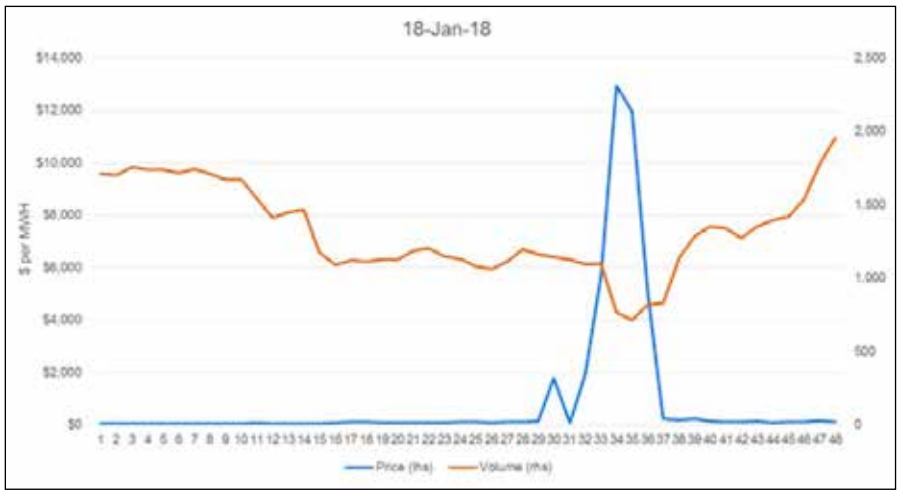

Figure 4. Peak price event in January 2018 vs load shedding. The blue line is the spot market price in $ per MWH and the brown line is NEW power consumption in kWH, both in half hour intervals.

Operations at NEW were alerted of the upcoming events, they started plants early to fill clear water storages at the WTP's, gain capacity for influent storage at the WWTP's and then monitored the market to start the voluntary load shed. At the West Wodonga WWTP, the operations staff switched off the inlet pumping, halted sludge dewatering (centrifuge) and stopped aeration (all 6 blowers turned off) for the peak period. The short outage did not affect effluent quality. With switching off the inlet pumps along with the blowers, the process flow was halted. The aeration was returned before the process flow continued. The plant can handle short aeration outages of up to 4 hours which we have used for planned maintenance. The site has adequate lagoon storage both for influent and effluent in case of such events with emergency inlet storage ponds (2 ML) and an overflow storage (10 ML). With average daily dry weather flows around 10 ML and because this peak was mid-afternoon, minimal flows were entering the plant. As a result, the emergency inlet storage was only partially filled.

Future Plans

The next stage in this energy transformation is to automate the electricity shedding by investing in intelligent controllers which will monitor on-site electricity usage and real time monitoring of market pricing. When a short high priced event is about to occur, the controller will notify the operators and automatically start a sequenced shutdown of pre-selected energy intensive equipment. Once the pricing peak has subsided, the system will return operations to normal.

This will save operations staff having to manually stop and start machinery, especially during out of hour's periods.

Apart from the financial and environmental savings, other bonuses from this transition include the ability to return power to the grid and use alternative energy sources which was not available under a fixed price contract.

The Author

Michael Chapman (MChapman@newater.com.au) is the Wodonga Central Treatment Coordinator, with North East Water in northern Victoria.

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SMART ULTRASONIC RELEASE OF VALVES

TRILITY recently launched SURV, a unique and innovative seized valve technology, in Australia. The service provides ultrasonic seized valve release, valve condition assessment and torque measurement. SURV is a safe and reliable alternative to seized valve replacement, and has already built a successful and proven track record within the Australian water utility sector.

A seized valve can put your business at significant risk, often requiring lengthy emergency operations, or worse – disruption to your customers and loss of supply to thousands. Failure to act quickly will cost you time, money and reputation.

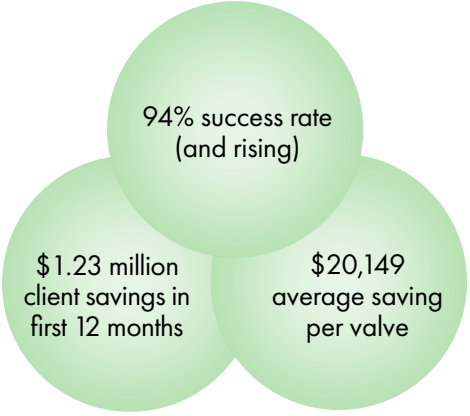

Figure 1. Performance statistics

Through its patented technology, SURV can help you to realise the full asset life; it will restore a valve to its operational state. Without SURV's ultrasonic valve release technology, the same valve would otherwise require replacement.

The technology is operated by experts who are able to monitor and respond to spindle movement in a controlled manner using a multi-action process.

It can further enhance your existing asset management data through its valve diagnostics service. SURV experts liaise with asset operators to develop a program of works to operate valves, through a partial or complete cycle. Through this assessment, the full characteristics of a valve's operational performance will be diagnosed, permitting the valve to be operated more efficiently in the future. This will enhance customer services as it minimises any potential for disruption to the network.

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- pump station valve maintenance
- pipelines operating at high pressure
- pipelines that operate adjacent to, or supply sensitive third parties
- pipelines in poor condition
- pre-assessment for main rehabilitation schemes
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Its ability to deliver the design, procurement, installation, commissioning and training in-house has Simmonds & Bristow well placed in the industry to service clients Australia-wide. The company's focus on whole-of-life costing and reliability-centred maintenance is attractive to both regional and remote water entities, with value for money confirmed by follow-up projects from its loyal customer base. This continued focus on client satisfaction has seen Simmonds & Bristow's client portfolio grow considerably in the last 12 months. Simmonds & Bristow provides maintenance and operation of sites through a fleet of well-equipped, purpose-built service vehicles and personnel, with combined industry experience of over 200 years.

Jason Keane, Operations & Maintenance Manager, Simmonds & Bristow

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BOTULISM IN WILDLIFE AT MT ST JOHN STP

Winner of the Best Operator Paper at the 2018 WIOA Queensland Operations Conference

Glenn Twite

In November 2017, staff at the Mt St John STP in Townsville started noticing the ducks inhabiting the effluent clarifiers becoming ill, losing mobility and in some cases dying. It was common practice for ducks to occupy the clarifiers towards the end of the dry season in search of water. This usually lasted approximately one month prior to the onset of rain, and generally occured in mid-summer when the Town Common wetlands were at their driest.

Treatment plant staff began recording duck deaths in and around the clarifiers, and were disposing of up to 25 carcasses each week. By December, the number of ducks removed increased to 100 each week, as well as up to 100 dead *Tilapia* each day. Historically, *Tilapia* have occupied the clarifiers and the dissolved air flotation lagoon year round. As they are not able to directly access these parts of the plant, it appears likely they have been introduced by birds. Other species of dead birds and eels were also removed (Figure 1).

The number of deaths decreased in January 2018, with none recorded after January.

The last time deceased ducks were found onsite was October 2013, however no deaths occurred in *Tilapia* or any other wildlife at that time.

The cause of death of the ducks is unknown. One theory extends to the drying out of the Town Common due to clearing of para grass from the outfall channel and the birds moving from that site to the plant, in combination with the well-known reports of wetland bird deaths (ducks, geese and ibis) from botulism. This raised concerns among staff about the cause of the deaths. It also raised questions about whether the treatment plant was the cause of the problem, potential environmental harm, and risks to human health.

Wildlife Health Australia Fact Sheet on Botulism in Australian Wild Birds describes the incidents of duck deaths in wetland systems. The fact sheet describes botulism as a paralytic disease that is caused by ingestion of a toxin produced by the bacterium *Clostridium botulinum*. Botulism can occur in any bird species, but is most frequently seen in ducks, geese, swans, ibis, egrets and pelicans. It occurs worldwide and has been reported in wild birds in Australia.

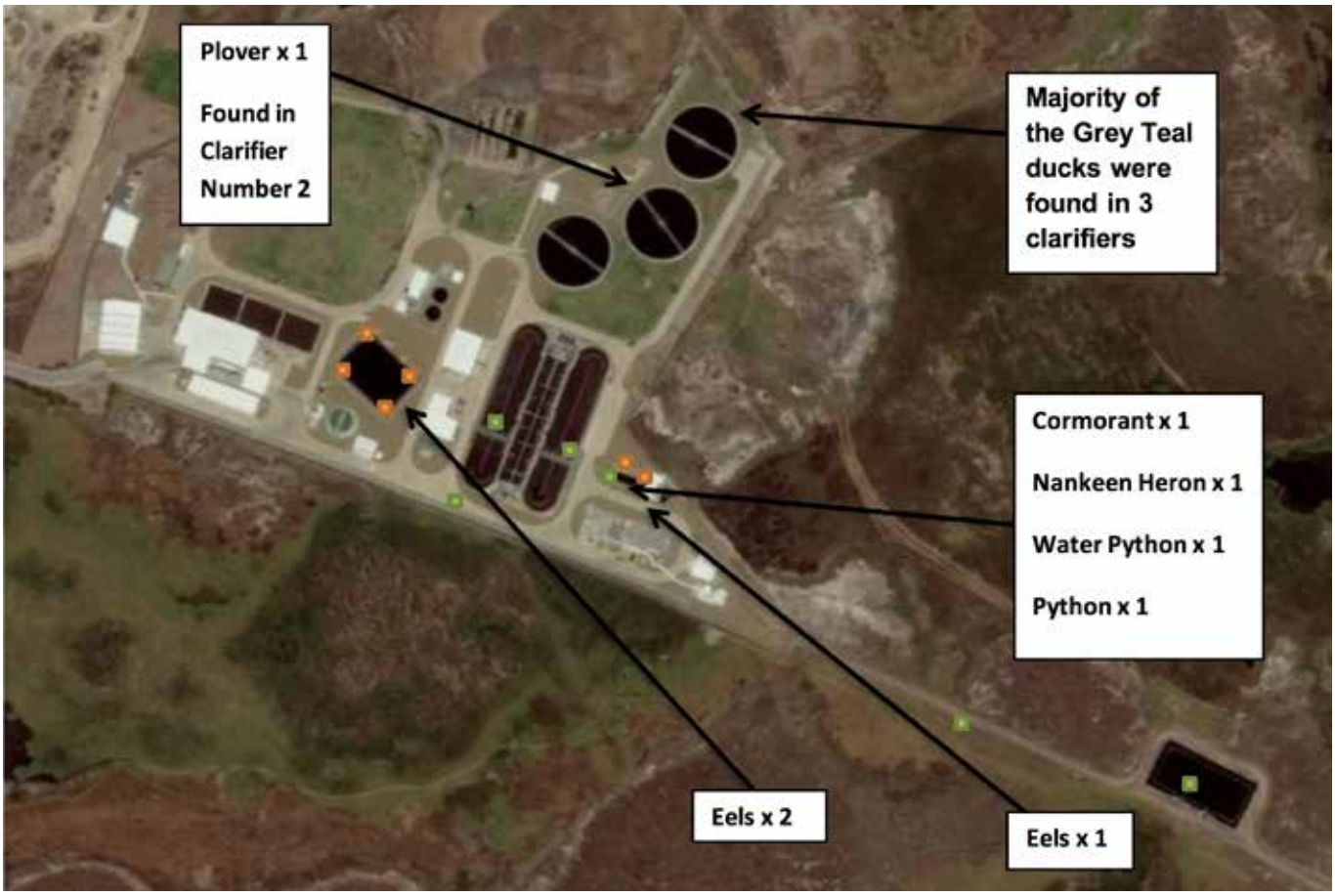

Figure 1. Location of the deceased wildlife. The small green squares are where the ducks were located and the small orange squares are where the *Tilapia* were located.

Figure 2. Ducks inhabiting the outfall channel at the end of January 2018. Para grass is visible in the background.

The majority of birds that develop botulism, if they are not treated, will die. Toxin production by *Clostridium botulinum* can only happen under specific environmental conditions and most outbreaks of botulism occur in the summer and may occur in the same environment repeatedly. The number of birds dying in these outbreaks can be substantial and thus can contribute to local and regional population decline.

During the previous incident in October 2013 when a number of ducks died, Townsville Waste Water commissioned James Cook University's (JCU) Veterinary and Biomedical Science laboratory to autopsy one of the dead ducks. The report concluded that the deaths were possibly caused by a trematode parasite that is typically found in snails which would likely have been consumed within the Town Common wetland. JCU also stated that the likely cause of death was botulism, despite the samples testing negative. The presence of snails has not been reported within the clarifiers and therefore, operation of the plant including the effluent within the structures, were determined not to be the cause of death of the ducks in 2013.

With the larger number of deaths in 2017, Townsville City Council (TCC) began conducting investigations into the wildlife deaths in December 2017. Effluent samples were collected and analysed for blue green algae, and deceased wildlife samples collected and analysed for botulism. Dissolved Oxygen (DO) profiling of the DAF lagoon, clarifier 1 and the reuse pump station was carried out in December 2017. DO profiling examines whether the plant's biomass has been compromised and adequate treatment is occurring. No discrepancies were identified.

Also in December 2017, a Biosecurity Senior Veterinary Officer attended the plant to discuss the duck deaths with staff and suggested the deaths were caused by botulism or blue green algae. Most importantly, Biosecurity Queensland confidently advised staff that the cause of the deaths in no way could be transmitted to humans, but he did remind us to wear the correct PPE and follow guidelines for handling dead animals i.e. gloves and disinfection. Later on, a separate procedure was created for this task.

Figure 3. The "swampy" clearing out the channel.

Clearing of the Outfall

In 2014, TCC were requested by the Department of Environment and Science and National Parks, Sport and Racing (NPSR) to take action to improve the hydraulic flow of the outfall channel. The Mt St John STP discharges effluent to the outfall channel (Figure 2) that is within the Town Common. Over a number of extreme wet seasons, para grass had choked the channel to the point that fresh water was spreading across the Town Common, changing the natural environment and impacting flood drainage.

Following consultation with NPSR and the Department of Agriculture and Water Resources, TCC were granted permission to clear the para grass choking the channel. Throughout August 2017, an amphibious excavator unblocked the 2.5 km of channel (Figure 3) which allowed the Town Common to drain down. The drying out of the Town Common in the summer months of 2017 coincides with the duck death event at Mt St John.

Duck Autopsies

During the November 2017 to January 2018 incident, duck carcasses were taken to JCU for analysis. JCU offered a carcass to Biosecurity Queensland to also conduct analysis. JCU examined the ducks' gross pathology and histopathology. The results were inconclusive but a presumptive diagnosis of botulism was made by JCU based on past history.

Biosecurity Queensland also performed analyses on lead, Botulinum toxin type C-D, Influenza A virus, and Newcastle disease virus. All results came back negative. Again, botulism was suspected as the cause of death but was unable to be confirmed.

Effluent samples were also collected from the clarifier and reuse pump station and taken to Townsville Laboratory Services (TLS) for analysis of blue green algae. The results were negative.

NATA accredited effluent testing undertaken prior to and during the peak of the duck deaths (October-December) remained within licence parameters. Likewise, the receiving environment monitoring program did not return any results of concern. There were no signs of

Figure 4. Electrofishing in progress.

stressed wildlife in the outfall channel and associated water during the monthly sampling events.

Handling the Dead Animals

In addition to the onsite testing, Mt St John STP staff had the task of removing the deceased wildlife from the site. This task was new to the operations team given the higher number of carcasses, and staff changeover since the 2013 event. The operators double bagged all carcasses and placed them in the regulated waste bins onsite. The removal equipment was sterilised and procedures have been updated to include this. A procedure has since been developed, *WPP001 Collecting and Disposing Dead Animals from a Wastewater Treatment Plant*, following this event to assist operators in the safe removal of ducks and other animals should this reoccur next dry season. This procedure outlines the correct PPE to wear. We chose to use chemical gloves, a face shield and a method to disinfect the implements used in handling the carcasses to eliminate any contamination.

Future Considerations

As a result of this latest event, TCC are investigating long term strategies to prevent ducks from settling on the clarifiers in the dry season when the Town Common is dry, and for managing existing fish populations in the clarifiers, DAF lagoon and upstream of the UV. The following options have been considered so far.

Netting is not considered cost effective and cannot be cyclone rated.

Townsville Water is exploring the feasibility of lasers and other bird deterring devices.

Options to remove the existing population of fish from the clarifiers, DAF lagoon and UV structure are being investigated and TCC is in discussions with Tropical River Consulting regarding this. Options include draining of structures and electrofishing (Figure 4).

Despite methods being employed to exclude fish and birds from the STP structures, it is probable that incidents such as these will reoccur given the location of the STP close to the wetland and the large, calm water surfaces of the clarifiers and DAF lagoon. There is no absolute solution to eliminating *Tilapia* at the plant and a population management program may be a more appropriate use of resources.

The Author

Glenn Twite (glenn.twite@townsville.qld.gov.au) is the Team Leader, Mt St John STP in Townsville.

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COMMUNITY BENEFITS FROM TREATED EFFLUENT

Winner of the Best Operator Paper at the 2018 WIOA Victorian Operations Conference

Paul Beard

The Broome North WWTP was built in 2011 to cater for increased flows generated by the growing popularity of Broome as a holiday destination in the dry season (April – September), and a growing core population.

The 3.5 ML/day plant is located 12 kms northeast of town on a 220 ha plot of Water Corporation land. The facility consists of pre-screening, one facultative primary pond, a secondary maturation treatment pond and a treated wastewater storage pond. The distance from traditional recycled water irrigation sites, such as public open space, prompted the Corporation to explore alternative disposal options. Irrigation of Rhodes grass with recycled water was identified as the best disposal option to meet environmental licencing conditions.

The treated wastewater, after chlorine disinfection, is classified as "low risk" according to WA Department of Health Guidelines for the Non-potable Uses of Recycled Water in Western Australia (2011), and is suitable for use on non-edible agricultural crops. The treated effluent is currently applied across a 32 ha plot of Rhodes grass using a centre pivot spray irrigation system (Figure 1). The Rhodes grass crop is harvested every 6–12 weeks, held for a minimum 21-day holding period to limit pathogen risk and processed on site into fodder and sold locally as stockfeed.

In early 2018, the Water Corporation expanded the irrigation scheme by installing a second pivot irrigation system.

Figure 1. Pivot irrigation in Broome.

Community Projects

Kimberley Community Grants

Water Corporation's sustainable supply of Rhodes grass hay has met demands from local markets for fodder and subsequently generated thousands of dollars in revenue. Since March 2016, $111,721 has been made available for grass-roots community projects all from the sale of hay.

The Kimberley Community Grants Scheme is delivered in partnership with the Lions Club of Broome who had prior experience in the administration of community grants. Water Corporation developed the selection criteria and guidelines for grants scheme applicants to ensure that funding would support projects that address a community need. An independent allocations committee consisting of prominent members of the Broome community including representatives from Goolarri Media (an Aboriginal media organisation), WA Netball Association, Department of Water, Shire of Broome and Broome Men's Shed evaluates and awards grants meeting the selection criteria.

Since 2016 the grants scheme has supported 20 community projects. Many of the funded projects directly benefit Aboriginal people of the West Kimberley who make up approximately 47% of the population of the Shire of Derby West Kimberley.

Wunan

In a partnership with Wunan, an Aboriginal organisation based in the East Kimberley, 30 Aboriginal girls from Wyndham, Halls Creek and Kununurra have been provided the opportunity to attend high performing schools across Australia to study principally in the areas of science, technology and maths (Figure 2).

As well as benefitting the students directly, there have been positive flow-on effects for their families and the wider-community. The young women have become positive role models for their siblings and other young people, which helps to promote the value of education and school attendance within their communities.

Figure 2. Wunan girls going to the big smoke.

Native Plant Seed Bank

Mamabulanjin Aboriginal Corporation (MAC) is a not-for-profit organisation based in Broome with demonstrated experience in delivering land care and horticultural projects that create employment and training opportunities for Aboriginal people. MAC was awarded a grant to trial growing native plants with recycled water from the Broome North WWTP.

Some 17.9 ha of land adjacent to the Broome North WWTP was made available for the project. The area has been fenced and cleared of invasive plants and a slow release drip irrigation system installed.

MAC uses a specialised horticultural method whereby seedlings are planted amongst existing vegetation to preserve the

natural environment. The project provides a diverse range of seeds for land care projects in the area, and products for commercial use, such as timber, fruit, cut flowers and oils. A number of rare plant species have been established at the site, so the project also contributes to the protection of threatened native flora (Figure 3).

Depending on rainfall, each plant requires around 4 litres of recycled water per day until established, which can take up to 6 months depending on the species and seasonal conditions. As the plants are native to the area, they require very little irrigation once mature. The drip irrigation system is moved once the plants are established and used to develop further sections of the land.

All plants have responded well to the nutrient-rich recycled water, and further monitoring will continue as the project progresses.

So far, over 90 young people from the area have gained valuable land care experience at the site, with some completing TAFE qualifications in horticulture and land management. Many of the participants are part of the Federal Government Work for the Dole and Green Army programs, and some are minimum security prisoners.

In addition to the employment and professional development opportunities, this project also helps to foster a connection between Aboriginal people and the land. In an area with high levels of socioeconomic disadvantage, the native plant seed bank project has helped to create much-needed social and employment opportunities for Aboriginal people.

Conclusions

The Broome North WWTP is now very much more than a wastewater treatment plant. The treated effluent has been transformed from a waste product requiring disposal, to a valuable commodity for the extended community. The Rhodes grass crop will be expanded in mid-2018, creating more funding for community projects and further learning opportunities for Aboriginal trainees and their families.

The collective success of these projects has created a precedent for similar community-based initiatives and Water Corporation is now exploring options for Aboriginal involvement in the water recycling scheme in the neighbouring East Kimberley and Pilbara region.

Figure 3. The Broome North seedbank.

The Kimberley projects prove that nurturing community relationships and actively seeking to be good corporate citizens, can lead to great outcomes for both community and business.

The Author

Paul Beard (Paul.Beard@watercorporation.com.au) is West Kimberley Operations Manager, with Water Corporation in Western Australia.

Studies have shown that what we do when repairing a water main or more correctly, what we don't do, can have an impact on public health.

People can become sick and some can die.

Where a main can be repaired with the water still flowing under pressure, the risk is low.

The real risk occurs with repairs that require isolation of valves and dewatering of the main.

Why?

Because in the process of repairing a main, disease causing bacteria, viruses or protozoa from bird or mammal faeces can enter the inside of the main and contaminate the water.

Why?

Because in the process of repairing a main, appropriate controls were not maintained to guarantee that contaminated material was kept out of the main.

REMEMBER it is not how long it takes to get the water back on to the customers, but how long it takes to get SAFE drinking water back on to the customers. Safe drinking water will not make anyone who consumes it sick.

The SAFE WATER, Water Mains Repair procedure has been developed based on three guiding principles.

1. Controlling all the possible contamination risks that might arise before, during and after a repair.
2. It is consistent with the Water Research Foundation (WRF) and Drinking Water Inspectorate (DWI) 2014 publication, Effective Microbial Control Strategies for Mains Breaks and Depressurisation.
3. It must be practical and acceptable to field work crews.

Work groups in Goulburn Valley Water and Western Water in Victoria developed the procedure with mentoring guidance from WIOA.

It is now being used by these organisations with complete acceptance from the work teams.

The SAFE WATER, water mains repair video has now been produced as an easy to follow instructional guide which other Utilities can adopt.

The procedure presented in the video works and has been demonstrated that it doesn't add significant costs or time to existing procedures. Importantly it helps protects public health.

IT IS FREE to download from the WIOA website at http://wioa.org.au/resources/#video

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- air scouring of township water mains

- water supply systems management, operations and maintenance
- servicing of mine dewatering pumps
- pump maintenance, overhauls and sales.

Innovation and sustainability are key focuses for Flo-Max moving into the future.

Flo-Max is 100 per cent Australian owned, and the diverse experience of its technical staff, combined with an extensive variety of project work, has led to the development of a powerful network of expertise and resources that Flo-Max can draw upon.

RELOCATABLE EMERGENCY WATER SUPPLY

Bradley Milfull and Steve Young

When a water supply is interrupted unexpectedly (Figures 1 and 2) or the water supply is isolated for a planned water outage, residents and businesses may be inconvenienced for an extended period of time without water supply.

When these situations occur, no matter whether forewarned or not, Council's Customer Service Department and Field Crews would experience a large number of complaints from affected residents and businesses.

This issue is also heightened when kidney dialysis patients become involved, as there are a significant number of people with this condition residing within the Logan water supply network area. They require constant drinking water supply to operate their life sustaining equipment.

Also, with the adoption of Council's newly implemented network water pressure management system, the isolation of the network has become a lot more critical in these types of situations, as a larger portion of the water network could potentially be affected by a water main burst or planned water outage.

Logan Water Operations have faced these issues for many years and have relied on letterbox notification's as well as the patient understanding of the affected residents and business's to allow the field staff reasonable time to effect repairs or perform required works.

With increased public expectations, as well as the need to comply with Council's Customer Service Charter for the supply of water to residents, the residents and business owners are less patient regarding water outages and the amount of time that it now takes field staff to perform required repairs. With other constraints imposed on them, such as fatigue management, WH&S requirements and material shortages, they now make it a much more stressful task to efficiently isolate water supplies and effect repairs.

Taking this into consideration, the challenge was put to the repair crews and the Water Maintenance section of Logan City Council to come up with an alternative solution to this issue. It was decided that a relocatable emergency water supply was needed to fulfil this requirement.

Figure 1. The Stanmore Road water main washed away in a flood event in 2017.

Figure 2. A burst spring top fire hydrant.

Figure 3. A burst trunk main at Daisy Hill in 2017.

The first stage of the development process was what we lovingly call the camel, which is a mobile 1500 litre trailer mounted water tank with a petrol and electrical driven pressure pump which was used to provide critical individual properties with water during interruptions. Unfortunately this equipment was only able to provide a supply for up to 2 properties in close proximity of the tankers location at any one time. It was decided that a system that was capable of supplying a larger area needed to be developed.

After extensive consultation between several sections from the Water Operations branch it was decided that what we now call the T.I.M.S unit would be designed and constructed. The design and construction of the unit has been developed and refined over a number of years by the Logan City Council Water Operations team. The unit consists of a self-contained temporary water supply that can be hooked up to existing isolated infrastructure via a hydrant standpipe, connected to an existing spring top fire hydrant within the isolated water network.

Figure 4. Delivery of the unit to site.

Figure 5. Supply to over 500 properties at Logan Reserve. The red line shows the extent of the community supplied.

Figure 6. Long deployment requires operation at night.

The unit consists of a 13,000 litre poly water tank which is connected to a 2 stage VSD (Variable Speed Drive) pump which is powered by a diesel 9kva electrical generator. The entire unit is currently mounted on a steel cradle with skids and is transported via a tilt tray to the deployment location. This is only limited to the ability of the tilt tray to safely operate in the set down location (Figure 4).

The unit has the ability to have the water storage volume increased by a further 13,000 litres by connecting an additional skid mounted tank.

The emergency supply unit and associated equipment is currently licenced under the Food Act 2006 and also complies with backflow prevention regulations by having a registered backflow prevention device installed on the tank fill point.

This unit has also been setup with telemetry equipment so the operation of the unit can be monitored from a remote location. This allows the system to be operated without operator attendance, except when it requires refuelling or the water tank needs filling.

The unit has recently been used to supply potable water to up to 500 metered properties (Figure 5) during a planned water outage when maintenance work was required on a critical trunk main.

The unit was also utilised when a bridge carrying water infrastructure to supply approximately 15 properties was washed away in the recent floods. This supply was continuously maintained for approximately 130 hours until a temporary water main supply could be constructed and mains supply reinstated.

Since initial deployment in March 2016, the unit has supplied drinking water to over 20,000 metered properties over 1,200 hours of deployment. The longest continuous operation of the unit was 258.9 hours (Figure 6) when the unit was required to supply potable water to ambulance and fire brigade depots along with other business's during a recent water main replacement project.

There is currently a second unit in the design phase which will incorporate additional features;

- The unit will be mounted on a wheeled mobile platform trailer fitted with stabilisers to assist with weight distribution and unit levelling.
- Improved security measures to aid in the prevention of vandalism when the unit is unattended out on site, possibly including video security cameras connected to the telemetry system.
- Improved safe access to the tank inspection hatch for cleaning, maintenance and inspection.
- Improvement of the current skid mounted tank cradle to allow better manoeuvrability when loading and off-loading on site.

The Authors

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SAFE DRINKING WATER IN THE TORRES STRAIT

David Baldwin, Toni Veronese, Brad Milligan and Chris Blake

The Torres Strait Island Regional Council (TSIRC) operates 15 drinking water treatment plants (WTPs) across 14 islands in the Torres Strait, reaching as far north as the border with PNG and south to the tip of Australia (Figures 1 and 2).

The types of WTP vary considerably. Historically, fresh water from springs or from rain water collected on the surface of large covered basins (Figure 3) was filtered through pressure filters (Figure 4), chlorinated and distributed to the communities.

With the increasing demand for water and increasing unreliability of rains, the water supply on most islands has been supplemented with sea water reverse osmosis (SWRO) (Figure 5).

Depending on the turbidity of the sea water source, the membranes may be preceded by conventional coagulation, flocculation and clarification (Figure 6) or media and micron filters.

There are many unique challenges in producing safe drinking water in the region.

- Remoteness.
- Reliance on external funding for both operational and capital expenditure.
- Harsh environment limiting asset life
- Changes in climate and rainfall resulting in annual shortfalls in water supply.
- Logistics and difficulty accessing service providers, in particular laboratory and other service technicians.
- Minimal access in some locations to 3G or any mobile coverage.

Historically, 48 drinking water quality incidents, all involving positive *E. coli* detections, had been reported to the Regulator since 2009 across all 15 island schemes, representing significant potential risk to public health. At one time, 7 of the 15 drinking water schemes (Dauan, Kirriri, Saibai, St Pauls, Erub, Poruma and Mer islands) had ongoing drinking water quality incidents and "Boil Water Alerts" in place.

Some of these continued for many months and even up to a year due to the inability of TSIRC to confirm the water supplies involved were free of *E. coli* and adequate disinfection levels were being reliably maintained.

These concerning trends triggered the Department of Natural Resources, Mines and Energy (DNRME) in conjunction with Queensland Health, Tropical Public Health Services (TPHS Cairns), to conduct a review of the water supplies in 2016.

Figure 1. Torres Strait Island Regional Council locations.

Figure 2a. Water Treatment Plant on Dauan Island.

Figure 2b. Water Treatment Plant on Iama Island.

Figure 3. Part of the large covered storage on Saibai Island used to capture and store rain water.

The review involved an onsite assessment of each drinking water supply scheme conducted by an independent water treatment expert, and representatives from DNRME and TPHS. The onsite assessments identified 434 items requiring attention, however, funding and available capacity limited the ability of TSIRC to rectify those problems.

Following the review, several steps were taken to improve service delivery.

- Review and resubmission of the Drinking Water Quality Management Plans.
- Completion of drinking water risk assessments.
- Transparent reporting of operational data using log sheets and the SWIM Local information management system database.
- Replacement of sampling and testing equipment.
- Improvement in the collection and testing of verification samples.
- Improved access to SCADA for managers and technical officers.
- Continued collaboration with Universities and Government departments.
- Water conservation messaging and water security monitoring.

Two of the largest undertakings however have been the implementation of the 'Safe and Healthy Drinking Water in Indigenous Local Government Areas Project' and successful funding through the Indigenous Community Critical Infrastructure Program (ICCIP).

Following the assessments, two paths could have followed by the Regulators. The traditional issuing of notices and pursuing other enforcement actions, or alternatively, working together collaboratively to build knowledge, skills and capacity of water operators as well as improve the quality of the infrastructure.

TSIRC and TPHS decided to work together to improve key issues (gaps) that were identified during the water systems review in 2016 and in January 2017, the Safe and Healthy Drinking Water in Indigenous Local Government Areas Project' (the Project) was born.

The aim of the Project is to provide a safe, adequate, reliable drinking water supply in each of the selected communities by:

1. Establishing an agreement with TPHS and Council permitting the Project to proceed in their community.

Figure 4. One of the pressure filtration systems on Poruma Island.

Figure 5. A typical Torres Strait RO membrane plant with the membranes in the foreground and a pre membrane pressure media filter and micron filters in the background.

Figure 6. Flocculation tank and upflow clarifier for pre-treatment of turbid sea water.

Figure 7. New duty standby chlorination unit at Poruma Island linked to SCADA.

Figure 8. TPHS and TSIRC staff conducting training.

Figure 9. Operational sample analysis.

2. Enhancing water treatment infrastructure and monitoring technology.
3. Providing user friendly, standard operating procedures and/or instructional films to instil consistency and confidence in operators and boost their capabilities.
4. Increasing understanding and awareness of public health risks that relate to drinking water quality for all WTP operators.
5. Providing remote and onsite mentoring.
6. Delivering periodic Project review reports to allow assessment of the level of achievement of the Project objectives.

The level of success of the Project was to be further assessed by monitoring any reduction in pathogenic bacteria related drinking water incidents.

Some of the key achievements since the start of the Project have included:

- Nine TSIRC communities (Hammond, Warraber, Poruma, Boigu, Saibai, Mabuiag and Iama islands and the Moa island communities of Kubin and St Pauls) are participating in the Project.
- Installation of true duty/standby chlorine dosing pumps with analysers and SCADA capabilities (Figure 7).

Data collected since the start of the project indicated that >90% of daily free chlorine readings taken throughout all participating community drinking water supplies are within acceptable limits (>0.2 mg/L) giving confidence microbial pathogens are being controlled. This is a dramatic improvement to what was happening prior to commencement of the Project.

- 2,135 hours (266 work days) of direct one-on-one, in community engagement with WTP operators.
- 24 WTP operators have received intensive, specialised training in their workplace utilising their equipment (Figure 8).
- 21 support personnel (environmental health workers, sewage treatment operators or other essential services staff) also received training in key areas.
- The commencement of 5 additional Technical Officers to support TSIRC operators.
- 12 tailor-made, pictorial, easy to interpret, site specific SOPs have been developed in close consultation with the water system operators.

- 20 tailor-made training videos, filmed on location, with senior water operator staff, using their equipment in their WTPs have been developed.
- Three tailor-made training packages that are fit for purpose, fit for place and fit for people which address key knowledge gap areas notably:
  1. Drinking water and public health.
  2. Basic water chemistry.
  3. Equipment calibration and use.

Through these training packages, water operators learned about the importance of water treatment principles, the impacts of unsafe water and why verification testing for *E. coli* is conducted. As a result, water operators now take additional care when performing operational tasks (Figure 9) and when sampling water to ensure that no disinfection or sampling failures occur.

Another fundamental success of the Project has been a reduction in the number of microbial drinking water incidents (*E. coli* detection). In 2016 alone, prior to implementation of the Project, 16 *E. coli* drinking water incidents were reported in remote Far North Queensland Indigenous communities. This reduced to 10 incidents after the first year of implementation (2017), to 2 incidents (Mer, Erub) in 2018, the second year of the Project (Figure 10).

The culminating event of this collaborative partnership with TPHS was the first ever Far North Queensland Drinking Water Symposium held on Hammond Island in October 2018. The symposium brought together over 55 Torres Strait and some Cape York Local Council water service providers, government regulatory agencies, university academics and other industry experts (Figure 11).

Importantly, the event enabled Indigenous and non-Indigenous water operators from remote communities an opportunity to network and learn about additional ways to improve and help ensure the provision of safe drinking water to their communities. Symposium sessions included waterborne illnesses, water laboratory requirements and processes, importance of water quality management plans, and water security and public health expectations in managing drinking water supplies.

While the project with TPHS provided extensive training, a large amount of infrastructure in each community remains to be upgraded or replaced to support the operators. A critical infrastructure program has been developed and will result in 77 projects being delivered across TSIRC sites over the next 2 years.

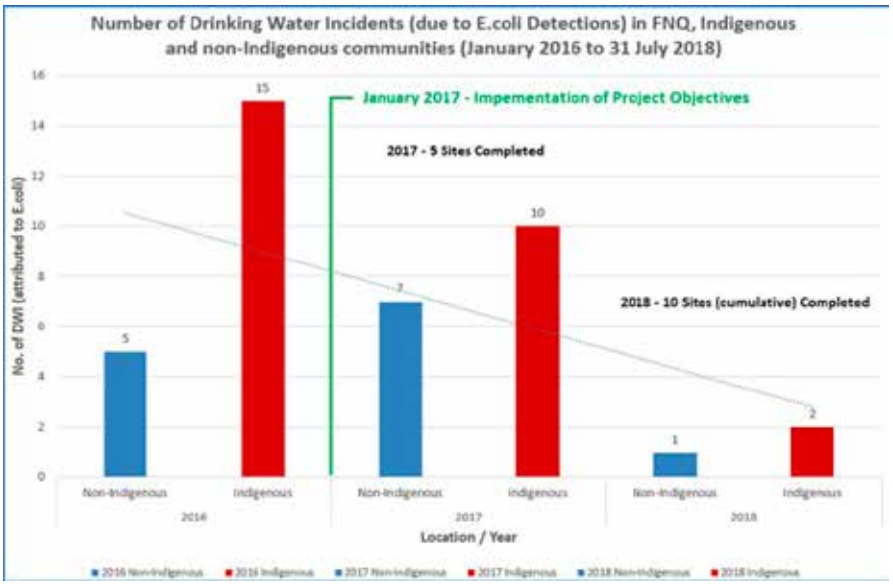

Figure 10. Number of Drinking Water Incidents (due to *E. coli* detections) in FNQ, Indigenous and non-Indigenous Communities (Jan 2016 – July 2018).

Figure 11. Drinking Water Symposium participants on Hammond Island.

The collaboration between Council and the State has demonstrated that such an interactive approach can lead to more than just the improvement of water safety. The program has led to a self-determined, motivated and skilled water team, and this is being passed on to others and into the future.

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WASTEWATER TREATMENT PLANT IN UNITED STATES ADDS GREASE DIGESTER TO SOLVE FOG PROBLEMS

A wastewater treatment plant in central Pennsylvania had a persistent problem in dealing with fats, oils and grease (FOG) products. These FOG products would cause fouling of the primary clarifier and inhibit the settling of solids. It also choked the scum pit and the scum pit transfer line to the pressroom and anaerobic digester.

To solve the problems of handling grease, a very simple grease digester design was selected. Components of the system included:

- a 150,000-litre in-ground tank
- a separate grease receiving area
- a control room
- a pump room and storage area
- a Venturi Aerator to supply the required dissolved oxygen to support the breakdown of the grease
- a tank seeded with live cultured grease-eating bacteria from an incubator.


Venturi Aerator pumping into the digester

A Gorman-Rupp pump pulls from the digester and discharges through a six-inch Venturi Aerator, which pulls in atmospheric air, mixes it with the pumped fluid, and pumps aerated fluid back into the digester.

Since the addition of this grease digester, there have been no plugs or fouling in the plant. The influent biochemical oxygen demand (BOD) loading from the grease is reduced significantly, the clarifier performs better and requires less cleaning from grease fouling, and odours have been reduced in the pressroom.

The Venturi Aerators have been introduced into Australia by Hydro Innovations, who stock and supply both Gorman-Rupp pumps and Venturi Aerators.

SCADA TROUBLESHOOTING

Dave Cameron and Carlie Sargent

Practitioners in the learning and development circles often refer to a 70-20-10 model; that is:

- 70% of knowledge required for a job comes from job-related experiences;
- 20% comes from interaction with others; and
- 10% comes from formal education.

It would be great if after spending a substantial amount of money on training a staff member, an employer could be confident they could pick up the tools and do the job like an expert. Training providers can be criticised for not providing "job ready" skills but it is also important for employers to be able to make sure that learners get access to expertise and mentors throughout the skilling journey.

Every learner is different, and it is difficult for trainers to be able to come up with a magic formula that suits everybody. For operators, the true test of competency comes about when things are out of the ordinary. There are many international case studies of major drinking water or environmental incidents which are attributed to operator error, and they rarely occur when things are running smoothly. Changes in raw water characteristics, plant and equipment failure, or procedural failure can all contribute.

So, how can we train operators to get this operational experience? It's not easy to deliberately fault plant processes and set up scenarios in actual operating treatment plants.

SIM-PLANT, a simulation package for both water and wastewater treatment plants, has been developed in New Zealand and is now available in Australia. The 2019 ***qldwater*** Skills Forum was held in March in Brisbane and brought together over 80 water industry people from around Queensland to hear presentations on a range of issues and to participate in planning for the Water Skills Partnership program.

At the Skills Forum, three teams which included managers, supervisors, operators and trainers all had the opportunity to trial the SIM-PLANT software by participating in a timed competition to complete two separate scenarios.

SIM-PLANT is a fully automated, online SCADA training and competency assessment tool for water and wastewater treatment operators. It features four fully developed treatment plants, 2 water and 2 wastewater, and 80 individual training scenarios. The plants are fully detailed with over 20,000 SCADA tags per plant. In the scenarios, pre-configured SCADA data consisting of full trends and alarm conditions show that something has gone wrong in the plant. Users have to diagnose the issue, identify corrective actions and then put those corrective actions in place to see if they are right or not. To add further to the reality, there is a set time for the operator to make the change. It can be quite "nerve wracking" trying to sort it all out in the 20 minutes available. But that can be what it is like in real life operations!

Failure scenarios have been carefully scripted by operations professionals and consider the cause of the fault, the consequence of the fault, how the fault is shown in the online water quality data and associated alarms, and the corrective action required. This gives the trainees everything they need to be able to learn the discipline of diagnosing faults and solving problems and it gives them simulated experience of what a wide range of faults look like. The failure scenarios cover a full range of issues that can occur in treatment plants. They range from incorrect chemical dose rates, poor control of chemical dosing, incorrect operational settings to equipment issues.

Figure 1. Some of the Skills Forum attendees undertaking the competition.

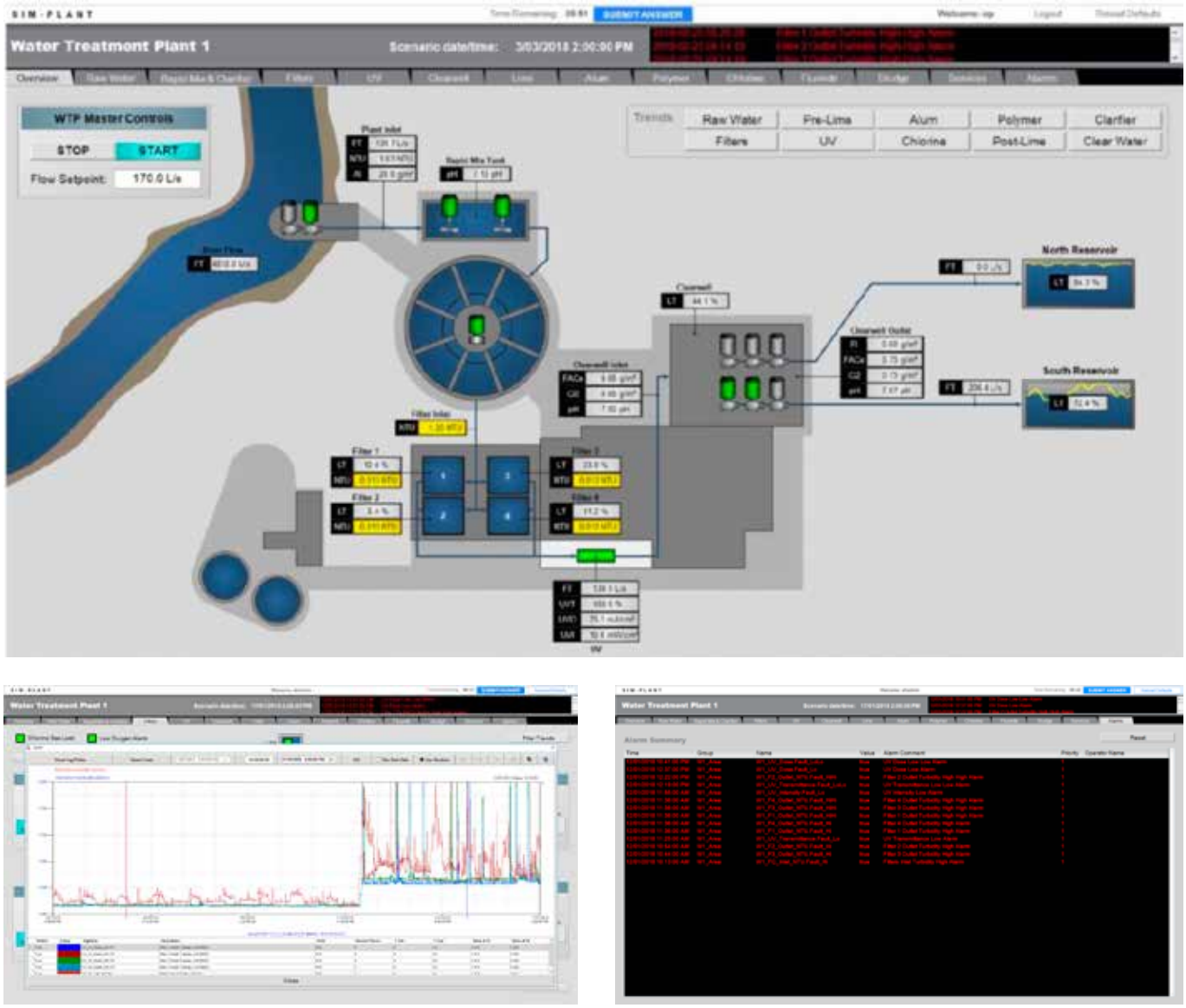


Figure 2. Some of the SCADA pages from one of the WTP scenarios in SIM-PLANT.

There are currently 50 scenarios for water treatment covering coagulation and flocculation, clarification, media filtration, chlorination and UV. There are 30 scenarios for wastewater treatment covering sedimentation, activated sludge and disinfection.

Three separate screen shots for one of the plants in one of the scenarios, namely the relevant SCADA page, trend page and alarm page are shown in Figure 2.

Access to the software scenario training can be gained by individual operators booking time on the system, or by Utilities purchasing an access package with multiple scenarios. The scenarios can be undertaken by groups of operators acting together or individually. The learning potential is maximised if operators work individually. Once purchased, the operator has three attempts at the scenario. If the first response is incorrect, there are two more attempts allowed. If all 3 attempts are incorrect, the scenario will need to be repurchased.

The important thing is that as in normal operations, there are usually a number of things that could be done, but SIM-PLANT requires the one single response that will correct the problem. So for example, a filtered water turbidity alarm might prompt an operator to check the turbidity meter, clean and calibrate it. All reasonable responses, but this will not correct the root cause which may have been a failed backwash.

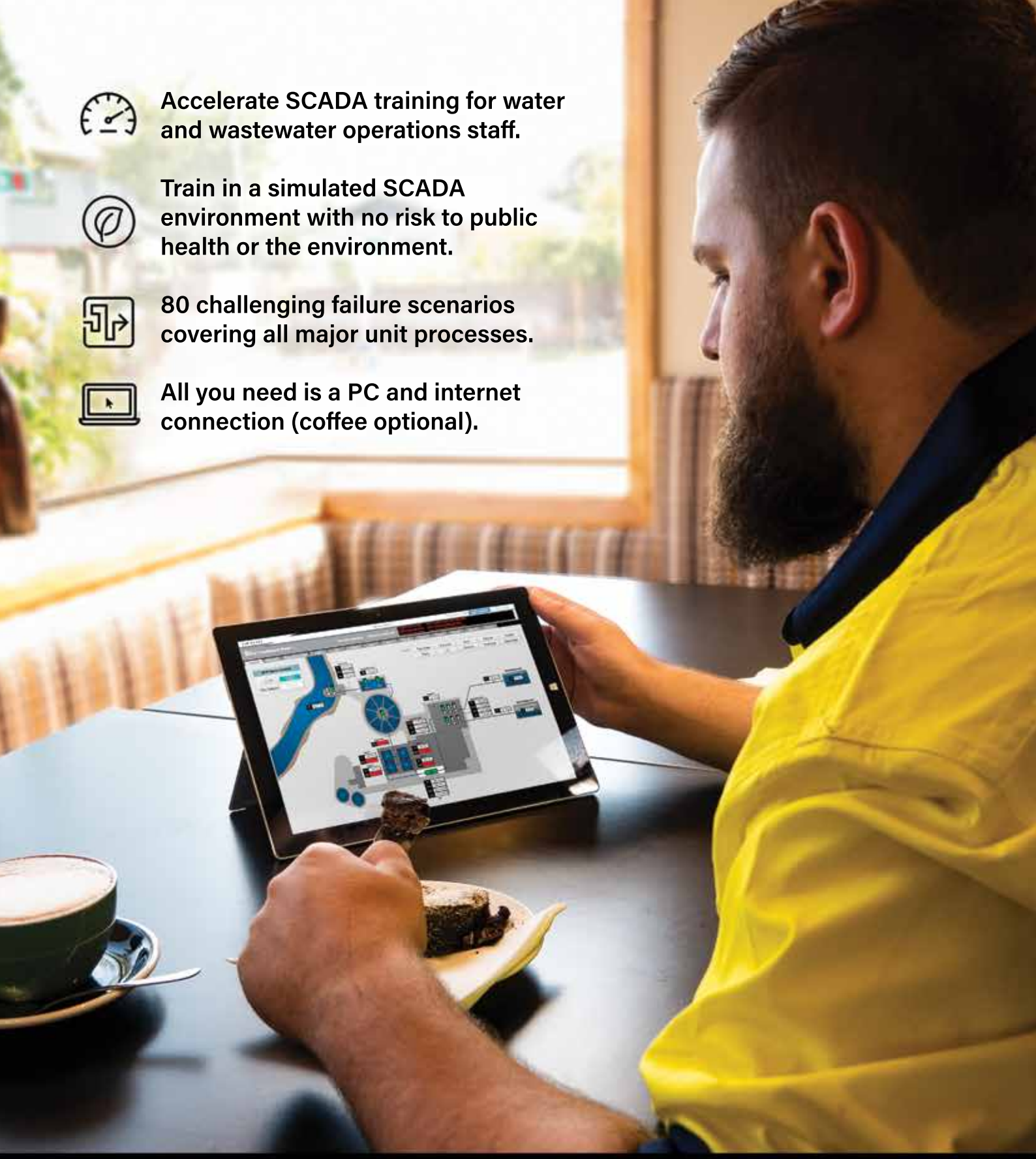
The beauty of a simulated situation is that it provides a safe learning environment without any risk to public health or the environment.

So what was the interest in the competition and the software like? They loved it! Two of the team leaders have since organised to run some facilitated sessions on the software with some of their operators.

There are plenty of other industries which use simulation tools to support learning and we imagine the technical challenges, along with the dispersed nature of our industry have contributed to our being slow on the uptake. From our perspective, we need to embrace these sorts of innovative approaches – it's worth a look.

The Authors

Dave Cameron (dcameron@qldwater.com.au) is the Chief Executive Officer and **Carlie Sargent** (csargent@qldwater.com.au) is the Skills Manager for the Queensland Water Directorate (***qldwater***).



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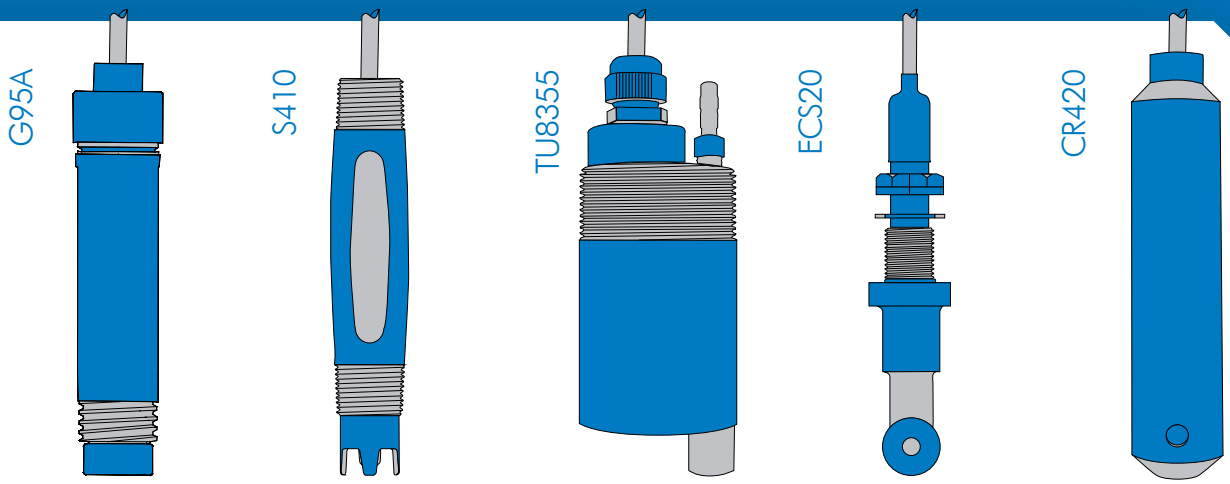

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