WATERWORKS

OFFICIAL JOURNAL OF THE WATER INDUSTRY OPERATORS ASSOCIATION

DECEMBER 2003

GUIDELINES and ACTS: Get Involved

The Australian Drinking Water Guidelines (ADWG) provide a framework for the management of drinking water quality. The framework is based on 12 elements that guide water suppliers in the implementation of a water quality management program.

In Victoria, the new *Safe Drinking Water Act 2003* requires water suppliers to prepare and implement risk management plans. The risk management plans referred to in the Act contain many of the same elements presented in the ADWG.

How many operators have a copy of the draft 2002 ADWG?

How many operators have read the section in the guidelines entitled *"Framework for the management of drinking water quality"*?

How many Victorian operators have read the *Safe Drinking Water Act 2003?*

How many operators really know and understand how these management plans are being produced within their Authorities?

The provision of safe drinking water is not a "head office" thing. It is the operators who, day to day, and at night when things go wrong, actually manage the hazards and reduce the risk to the consumer. As such you need to get involved with process from its beginnings.

Actively seek participation in the formulation of the management plans, in particular the system hazard assessments and the production of procedures. Ask questions. Find out who is responsible for the development of the plans. Ask to be involved.

Look at your plants and distribution systems with a new set of eyes. Eyes that are guided by an understanding of your system based on the identification of hazards and an assessment of the risks they pose. Although it is easy to say that there is no money available or that management has ignored suggestions for years, that is the easy way out. Yes indeed, often it would be appropriate to spend money but equally often it is not readily available. Operators over the years have provided ingenious solutions to problems at low cost. Look at what you have and what can be done at each of the critical steps. Make the changes and document what has been done and why.

Many quality systems fail to achieve their potential to bring about improvement because they become top heavy, and focused on procedures and meeting audit requirements, rather than effecting change in the actual areas where improvement will come from. Often, procedures and plans are written to meet the needs of audit but fail dismally because operational staff cannot access them easily, cannot understand them and have a system of their own. Lets try to make the procedures easily understood, accessible and useable.

Both the ADWG and *Safe Drinking Water Act* require audits of the water quality management system. In one way or another, operators will become involved in the audit process. Audits are carried out in different ways. Many focus on the machinery of the system rather than the outcomes of the system. If the paperwork and documentation is in place, the audit outcome is generally satisfactory. It can only be hoped that the audit of the drinking water systems will focus on the implementation of quality management steps in the field. This means at your raw water storages, plants and distribution systems.

Get on board early, get involved in the formulation of the plans, be prepared for audits of your sites and most importantly be part of the solution.

Peter Mosse
December 2003

Our Cover: Operator Garry Parsons operating a hydrant during air scouring. Air scouring is used to clean the inside of the pipes to help maintain the quality of water as it passes through the distribution system.

WATERWORKS

Editorial Committee

Peter Mosse, Editor
mossep@gippswater.com.au

Russell Mack
mackr@gippswater.com.au

George Wall
GeorgeW@gvwater.vic.gov.au

Direct mail to:
WaterWorks Editor
c/-Peter Mosse, Gippsland Water
PO Box 348, Traralgon, Vic 3844

Advertising & Production
Hallmark Editions
PO Box 84, Hampton, Vic 3188
Level 1, 99 Bay Street, Brighton, Vic 3186
Tel (03) 9530 8900 Fax (03) 9530 8911
Email: hallmark@halledit.com.au

WaterWorks is the publication of the Water Industry Operators Association (WIOA). It is published twice yearly and distributed with *Water Journal*.

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. These can be e mailed to a member of the editorial committee or mailed to the above address in handwritten, typed or printed form. Longer articles may need to be copied to CD and mailed also.

CONTENTS

President's Prattle

I don't know whether it's a function of age, or how busy things are in the water industry, but its now nearly Christmas and it seems like only yesterday that the fat fella in the red suit shouting "ho ho ho" was last here. Much as we'd like to sometimes, we can't stop the clock.

Over this year, the opportunity for operators to get together and learn from one another has been enhanced by the successful staging of conferences in three states – Queensland, Victoria and New South Wales. Reports are that these events are gaining the support of the wider industry and trade companies, and are getting bigger and better each year. We offer our congratulations to the organising committees in each State for doing such a fine job.

Many major challenges were faced and successfully overcome by operators in 2003 including bushfires, floods and drought. Dealing with problems such as these puts enormous pressure onto water companies and their staff, so to all those people who contributed in some way to maintaining or restoring services to their community, I say well done.

We know that operators can be ingenious people when difficult situations put them to the test. I send out a challenge to all operators to share their experiences, whether via the operator newsletters or through a technical or poster paper at one of the conferences next year. The best way to learn is to draw on and be prepared to share each others experiences.

A major review of the National Water Industry Training Package was undertaken through the course of 2003 with many operators and interested water industry people involved in this process. As Chair of the Steering Committee for this project, I can report that ANTA was very pleased with the work done by all concerned. We expect to be informed on the outcomes from the project in the New Year.

Finally, for those that use this time of year for annual leave, enjoy the break and keep safe. To all operators, including WIOA members and their families, have a very Merry Christmas and a Happy New Year.

Look forward to catching up with you all in the New Year.

"Happy Operating"

John Harris, WIOA President
December 2003

Leon Henry: Leadership and Training in Australia's Water Industry

Don Mackay

Many of our readers have completed courses in water and wastewater operations but few would have given a second thought to how these courses came about. I had cause to reflect on this following the recent passing of one of the industry's leaders, Leon Henry AM.

Leon was himself a scholar of note, who earned an Open Scholarship to the University of Queensland in 1935 (in those days only twenty were given out per annum). Due to family difficulties faced during the depression, he was unable to take up this scholarship. He eventually gained his engineering qualifications as a cadet with the Queensland Main Roads Commission. His considerable abilities were soon recognised and he eventually rose to the position of Director of Water Quality within Queensland's Department of Local Government.

Leon is widely recognised as the driving force behind the first attempt to address environmental water quality in Queensland through our first *Clean Waters Act in 1971.* Even at that time he recognised the importance of training for operational staff and included a provision in the Act requiring Licencees to "train their staff".

Before 1971 Leon participated in the development of Queensland's first "Operations Courses". The course was first offered statewide in 1966 through the then Technical Correspondence School in Brisbane. This first course of twelve correspondence lectures included water, wastewater and swimming pool treatment all in the same course.

Following the successful introduction of the *Clean Waters Act* in 1971, it was recognised that separate Water, Wastewater and Swimming Pool Courses were required. Once again Leon Henry initiated these developments. A team led by Norm Whyte from Local Government Technical Services prepared a successful course in Sewage and Wastewater Treatment Plant Operations. The course included a Water Quality Practical and was first offered in 1978. Although costly to support, this initiative was embraced by an industry in need of training to meet the new environmental standards in Queensland.

Over the next few years this group, led by Leon, worked to ensure that the emerging issues of new technologies and environmental standards were adequately addressed through the provision of regular, statewide, high-quality accredited courses. These needs eventually led to the incorporation of the Water Industry Training Association of Queensland, (WITA) with Leon Henry as the first and only President.

By 1990 "formal" training was emerging as a national issue, and after vigorous representations by the Queensland group a national body was organised to make representations to the Federal Department of Education, Employment and Training. This led to the formation of the Water Industry Education and Training Association of Australia (WIETAA) with one Leon Henry as the inaugural Vice President.

Leon would be the first to admit that because of competing agendas the issues and outcomes that WIETAA was set up to address have not been as successful as he would have hoped. However, it is critically important that the water industry be represented on this most political of all stages, the education industry (and he was a very good political operator).

Leon remained active in his representations for legislation in Queensland to require the formal "Licensing" of operational staff. Leon died within a week of being re-elected to "his" position of President of WITA(Qld).

Leon's wise counsel and remarkable energy for water industry education and training will be sadly missed by those who worked with him throughout his retirement "career". He leaves behind a considerable legacy that we would be wise to build upon.

The Author

Don Mackay (Donald.Mackay@det.qld.gov.au) is Principal Teacher in Water and Wastewater Treatment at the Open Learning Institute in Brisbane.

OMEGA CHEMICALS

"THE ALUM PEOPLE"

NEW PRODUCTS COMING SOON . . .

Omega Chemicals is proud to announce the construction of a new Chlor-Alkali plant in Melbourne, due for completion in 2004.

The 100% Australian owned company will be producing:

- **Sodium Hypochlorite Solution**
- **Sodium Hydroxide Solution and**
- **Hydrochloric Acid Solution.**

Omega Chemical's new plant will utilize the most up-to-date and internationally proven technologies in manufacturing the above products.

The new product range will be made available at various technical grades as required by individual customers.

For more information please call our head office and speak to either Michael Fried or Roz De Bortoli on (03) 9572 0078.

Omega Chemicals have over 30 years experience in manufacture and supply of potable water, sewage and waste water treatment chemicals.

Own and operate the largest capacity Liquid Alum and Aluminum Chlorohydrate plants in Australia.

Manufacturers of:

- Liquid Alum TIF
- Liquid Alum – Bauxitic Grade
- Granular Alum
- Liquid Ferric Sulphate – **"Megaclear 12"**
- Polyaluminium Chloride – **"Megapac 10"**
- Aluminium Chlorohydrate – **"Megapac 23"**

Suppliers and Blenders

Omega Chemicals can provide its customers with a large range of water and waste water treatment chemicals.

Full technical support is available through Omega Chemicals and its association with some of Australia's leading water treatment companies.

Manufacture and Supply

Omega Chemicals have four strategically located plants located in:

- Melbourne
- Newcastle
- Gold Coast
- Brisbane

100% Australian owned

Once known only as "The Alum People", now delivering a whole lot more.

Omega Chemicals • Melbourne Head Office • ph: (03) 9572 0078 • Fax: (03) 9572 0084 • E-mail: info@omegachem.com.au
Web: www.omegachem.com.au

DETECTING ODOUR POTENTIAL AT AN INDUSTRIAL TREATMENT PLANT

John Day

Judged Best Paper at the Annual Victorian Water Industry Engineers and Operators Conference 2003

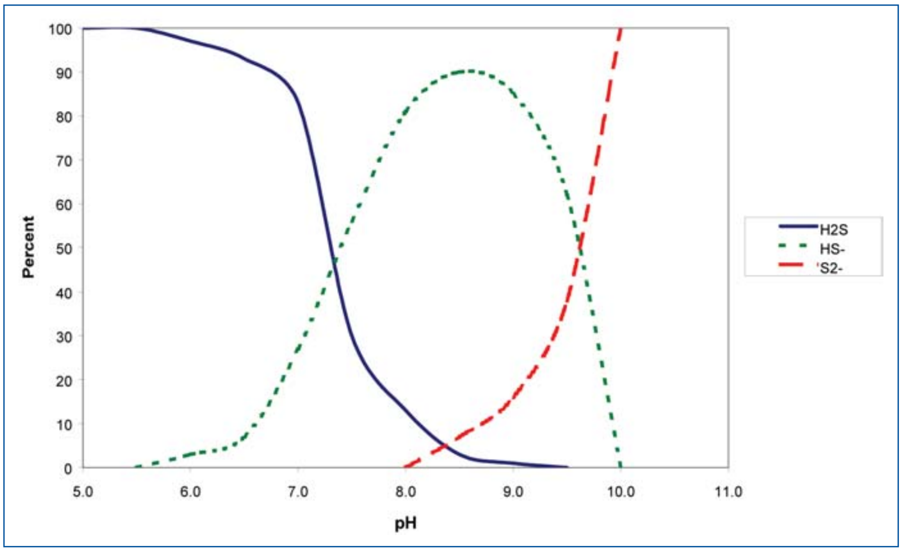


Figure 1. pH Effects on Percentages of Gas Production

Norske-Skog (previously Australian Newsprint Mills) has been operating since 1981. Situated on the Hume Highway 13 km north of Albury, the mill produces newsprint through a mix of wood fibre from *Pinus Radiata*, and recycled fibre from newspaper and magazines. The treatment plant processes on average 8 ML/d of effluent. Treating pulp and paper effluent can be broken into three components – settle, cool and treat. The traditional way to treat this type of effluent is to store it as long as is needed to lower the solids and temperature then either use an anaerobic treatment process (ie larger ponds), or as in our case an aerated biological process. Both of these can lead to one thing – **strong odour**.

In 1998 Norske Skog started an extensive program to reduce odour generated from its effluent treatment plant. The Pollution Reduction Program issued on June 15th 1998 required the company to:

> "Prepare and submit a report to the EPA on preferred options for introduction of in-line continuous monitoring that identify the onset of conditions for anaerobic decay within individual plant units. The report must identify operational contingency plans when the onset of conditions for anaerobic decay are detected by the monitors."

The purpose of this report is to summarise the work done to fulfil the EPA requirement to reduce the odours so that they could no longer be detected by neighbouring houses, and if detected the actions to be undertaken to reduce the odours. After putting into place major changes to the treatment plant, the challenge was to find a reliable early detection program. Odour could then be dealt with before it became detectable by the neighbours.

Plant Changes

The main changes made to remove odour being generated were to reduce the retention time within the plant, to raise the pH and to change operational controls.

Retention Time

Retention time reduction was carried out in two parts of the plant, the Primary Clarifier and the Equalisation Storage, or Cooling Ponds. To reduce the retention time in the Primary Clarifier, flows were diverted to one Clarifier, instead of splitting all flow to two clarifiers. This reduced the average retention time from 25 hrs to 14 hours.

The capacity of the underflow pumps was increased so the thickened underflow could be removed at a larger volume to the presses. This reduced the chance for sulphur producing bacteria to populate in any anaerobic pockets.

To reduce the retention time in the buffer storage section of the plant, an unused aeration tank was converted to an Aeration Feed Tank (AFT). Large earthen cooling ponds with a retention time of around 50 hours had previously been in place. After converting to the AFT, the average retention time of 24 hours was achieved.

The purpose of the AFT, as an equalisation basin, is to:

- Cool the effluent to less than 40°C to ensure efficient biological treatment.
- Buffer flow surges through the plant to protect the biological process.
- Buffer spike loads of toxic or high organic material to protect the biological process.

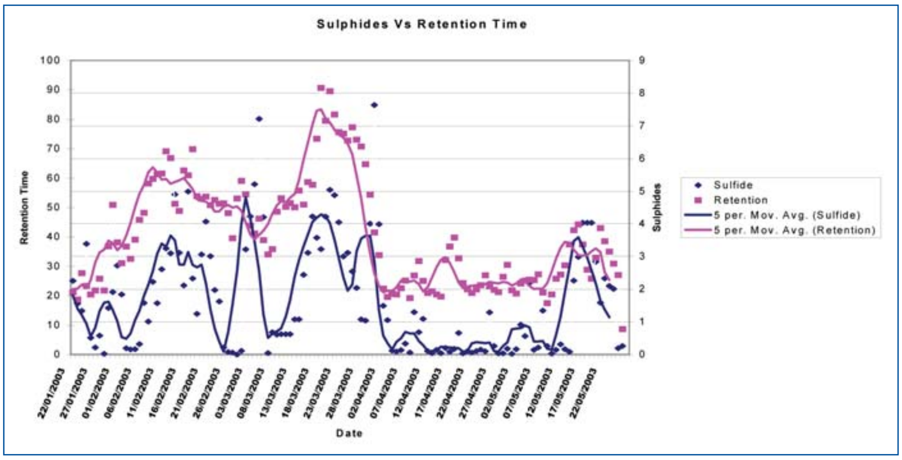


Figure 2. Effects of Retention Time on Percentages of Gas Production.

Environmental Technologies
division of BIOLAB

Introducing...

The New Industry Standard For Field-Portable Instrumentation

HACH
Be Right™

Rugged Waterproof Backlit

- Fully Waterproof IP67 Rating
- Complete Ready-to-Use Kits
- New Expanded Measuring Ranges
- Over 35 Individual Test Parameters
- Backlit Display
- Simple-to-Use Intuitive Procedures

HACH
POCKET COLORIMETER™ II

For more information please contact
Environmental Technologies
division of Biolab

Australia phone 1300 735 295 or email environmental@aus.biolabgroup.com
New Zealand phone 0800 422 469 or email environmentaltech@nzl.biolabgroup.com

• Ensure adequate mixing to prevent deposition of solids and assist with pH control.

To ensure adequate mixing in the AFT 10 aspirators were located in position to circulate the flow.

pH Control

The next change was to maintain the pH in the AFT between 7.5 and 8.2 by the addition of lime. As shown in Fig 1, when raising the pH above 7.5, the chances of H_2S being produced are reduced by transforming the H_2S into HS^- and S^{2-}. These are both aqueous species and do not smell, whereas when H_2S is formed as a gas, it has a very offensive characteristic odour (rotten egg gas). This forms the basis for the focus on pH control in controlling odour, as maintaining a pH above 7.5 significantly reduces the proportion of the sulfide that can exist as H_2S. There is approximately eight times as much odour (H_2S) generated at pH 7.0 compared to pH 8.0 for a given dissolved sulfide level.

Control Measures

A study carried out in 1999 identified areas that could be more closely monitored to control odour. These included:

• **Failure of the floating aspirators in the AFT**. The sulfide level in the AFT significantly increases if the aspirators are off for any extended period of time (>4 hours). Should this occur, the pH of the effluent is monitored closely to ensure it is within the appropriate range (7.7 to 8.2) to minimise the generation of H_2S.

• **A drop in AFT pH below 7.5**. The majority of the days when odour was "noticeable" on site occurred when the pH in the AFT was lower than 7.5. It is important to note, however, that the lower the sulfide concentration, the less important pH becomes in controlling odour generation.

• **A rise in the AFT operating level above 1.5 metres**. The AFT operating level or retention has an effect on the dissolved sulfide concentration. There may be occasions when it is necessary to raise the AFT operating level higher than 1.5 metres, such as during major maintenance periods within the process plants. During these occasions, odour will be managed by close control of the pH in the AFT. Note that the normal operating level of the AFT will vary between 0.9 and 1.3 metres in order to buffer any large flow surges from the process. This can be seen clearly in Figure 2. When AFT retention rose, so to did the sulphide test results.

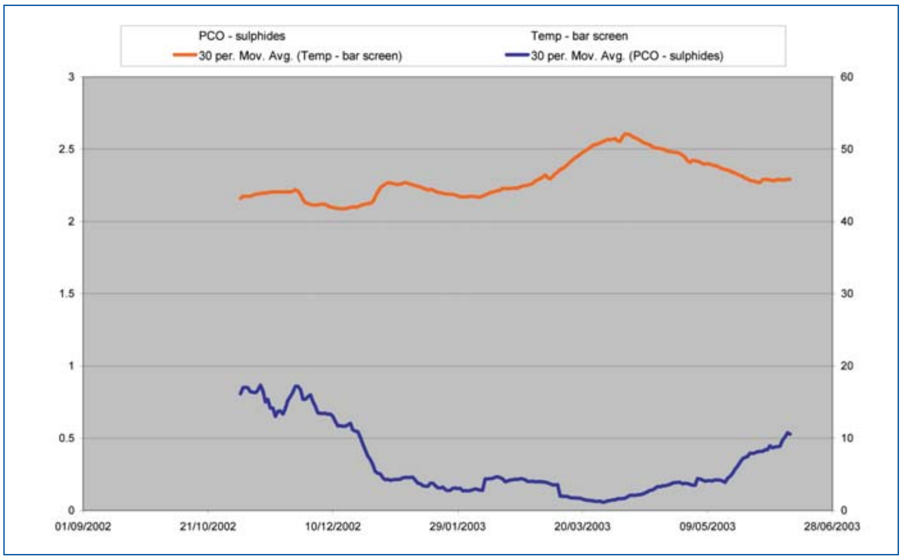


Figure 3. Effects of Temperature on Sulfide Production.

• **Sludge build-up in the Primary Clarifier**. A thick primary clarifier underflow increases the sludge residence time and the chance of sulfide generation. Note that although the primary clarifier is not a significant odour source, this situation requires monitoring to prevent extremely high sulfide levels being carried on to the AFT.

After successfully running under these operational parameters for two years, we experienced one major problem of high temperature due to the reduced retention time of the Primary clarifier and the AFT.

This problem increased when pulp production required a rise in the operating temperature to reduce pitch deposits caused in the paper making process. Influent temperatures were to be raised from 50°C to an average 75°C. This gave us only two choices – either increase retention time and use chemical addition to reduce odour, or, stick to our odour management plan and install cooling towers prior to the aeration tanks. The cooling towers were an obvious and logical choice. This also then gave us the opportunity of using temperature to control odour by using the higher temperatures to kill, or slow down any odour producing bacteria. This has worked extremely well in the primary clarifier in reducing sulfides, as indicated in Figure 3.

Odour Potential

During the process of identifying the odour producing sections of the plant several test methods were used to measure odour. These included:

• Dissolved Sulfide testing using the HACH method #8131;

• Redox Potential using an inline probe;

• Subjective odour surveys using mill staff and community members;

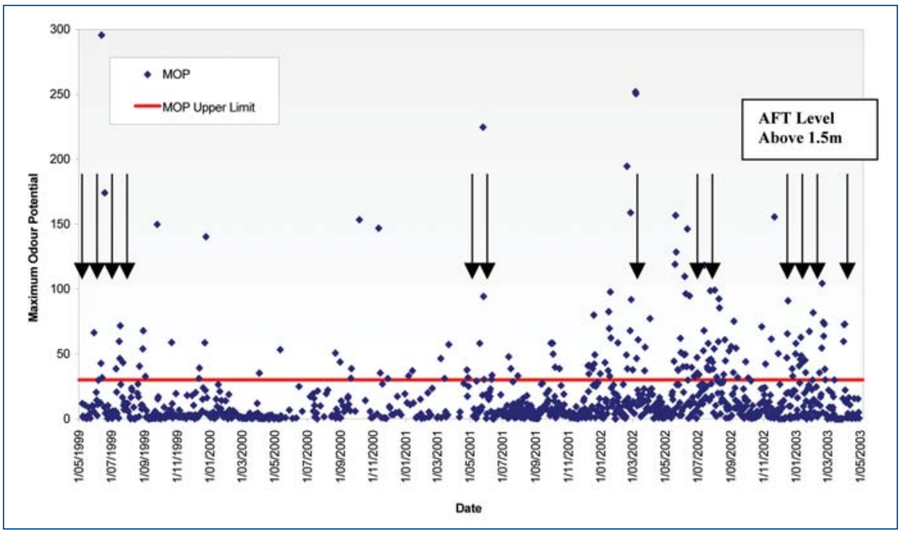


Figure 4. Aeration Feed Tank Maximum Odour Potential.

- Volatile Fatty Acids;
- Dissolved Sulfates.

From trials on these methods it was agreed by all parties that measurement of dissolved sulfides was a reliable test that could be carried out by operators on a daily basis. The test points identified to give us early indication were the primary clarifier overflow; the primary clarifier underflow and the outlet of the AFT.

Thistlethwayte (1972), has developed an empirical correlation that predicts the equilibrium gas concentration of H_2S above a liquid of a given sulfide concentration, pH and temperature.

This calculation works well giving an early indication of potential for odours detectable by neighbours (Figure 4). In general, when the odour potential rises above 30, odour complaints are received from neighbours. This is indicated by the arrows in Figure 4.

Application of Thistlewayte's equation was too cumbersome, so a much simpler method was developed. The new calculation takes into account retention time and is (Retention Time x Temp x Sulphide)/pH. The theory is that increasing retention time, temperature and sulphide can cause detectable odour, whereas a higher pH will reduce the risk. Once a calculation was formulated and operators were confident it was "useable", it was checked against the Thistlewayte's calculation to make sure it was not drifting to far away from the previous work.

The next step was to produce a trouble shooting guide to be used when the odour potential result reached 200. The following is the standard trouble shooting checklist that is followed when a high result or odour is detected by either external or internal complaints.(Table 1).

The next step was to make this odour trouble shooting checklist a live document that was accessible online at all times, instead of just when problems arose. By using the mill's online statistical data recording system known as MOPs, an operational sheet that collected all the parameters that we had previously identified was designed and put online. When any result is out of its preset limit, it will alarm in red. This alerts the operator to possible odour problems that need attention. It also has the odour potential figure with an alarm limit. This way the operator can check the alarm against the odour figure to see if action is needed urgently or monitoring will need to be followed closely until the alarm is disabled.

Table 1. Troubleshooting Guide for the WWTP.

CHECK POINT STEPS	PROBLEM INDICATOR	ACTION
Notification of internal or external odour generation	Either	Contact the shift coordinator, environmental personnel and/or production on-call
Plant Parameters:-		
• Bar screen chemical dosing system	System not working correctly	Remedy or contact maintenance if required
• Primary clarifier underflow concentration	U/F concentration >1.5%	Increase primary clarifier underflow pump rate if possible
• AFT pH	Outside range 7.7 to 8.2	Adjust rotary valve timer on lime system as per procedure
• AFT operating level	Level:- a) > 1.3m or, b) < 0.8 m	a) Increase flow rate to the aeration tanks if possible b) Decrease flow to the aeration tanks if possible
• AFT aspirator operation	Any not working	Remedy or contact maintenance (log work order)
• Tertiary clarifier underflow NFR	T/C Underflow NFR >1000 mg/L	Ensure desludging is operational
Complete odour monitoring sheet		Environmental personnel or production on-call to complete *Odour Monitoring Sheet* in conjunction with WWTP operators

Has it Worked?

The mill has enjoyed several years without a complaint from its neighbours and we thought that could well be attributed to the success of the odour potential figure. This was eventually tested when, starting in February, the mill made process changes that caused the influent flows to the plant to increase. The WWTP process suffered considerably causing the through-put to be reduced. This then resulted in the AFT level rising above its normal operating limits with the retention time going from 24 to 30 hrs to over 80 hours. This led to an increase in the odour potential figure which was now well above 500, 300 units higher than the alarm limit. As you can see in Figure 4, within two weeks of this plant condition we started to receive odour complaints from our neighbours.

After getting the plant on track and reducing the influent flows the odour potential figure dropped below 200 and immediately complaints ceased. This gave an excellent indication that the online checklist was a very useful tool. This helps us now be able to predict when odour will become a problem for our neighbours and let us correct the action before it becomes an odour complaint.

So, as always with a water treatment plant, one problem solved only gives us time to solve the next issue.

References

Thistlethwayte, D.K.B. (1972). *The Control of Sulfide in Sewerage Systems,* Butterworths, Sydney.

The Author

John Day (John.Day@norske-skog.com.au) is a Wastewater Treatment Operator, at the Norske-Skog Newsprint Mill in Albury, Victoria.

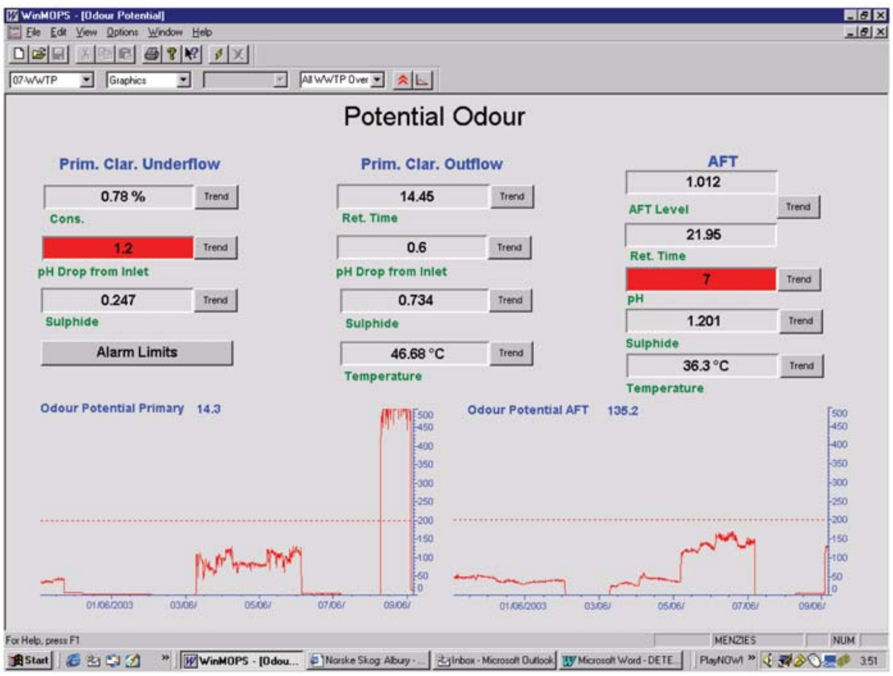


Figure 5. Depiction of MOP's Alarm Screen.

< GOLF DAY

WIOA Water Industry Charity Golf Day

50 Keen Golfers attended this years charity golf day at the Trafalgar (VIC) Golf Course to help raise over $2000 for Charity. The day was a huge success .

WIOA EVENTS

< PRESENTATION

Presentation of Certificates in Water Industry Operations at the recent WIOA Engineers and Operators Conference in Shepparton, Victoria.

< CONFERENCE

Victorian Engineers & Operators Conference Held in Shepparton. It turned out to be another highly successful Conference

pH BUFFERING IN THE GREAVES CREEK WATER SUPPLY SYSTEM

Carolyn Haupt & John van der Meulen

Judged Best Paper at the NSW Operators Conference, 2003

Maintaining the pH in the delivery system within the Australian Drinking Water Guidelines (ADWG) (1996) has been one of the greatest challenges facing the operators of Greaves Creek Water Filtration Plant (WFP). The Greaves Creek WFP supplies water to the Upper Blue Mountains townships of Blackheath, Mount Victoria and Medlow Bath in NSW.

Raw water for the WFP is sourced from two dams located upstream of the plant, Lake Medlow and Lake Greaves. The raw water is typically characterised by relatively high colour (10-20 TCU at 400nm wavelength), low turbidity (1.0-3.0 NTU) and extremely low alkalinity (1.5-4.0 mg/L).

Following commissioning of the plant in 1991 and the commencement of water quality testing in the distribution system, the lack of pH buffering in the raw water source became a significant issue. The original lime dosing system at the plant was designed for pH control with little regard to alkalinity (buffering capacity). As a result, whilst the plant met process guidelines for pH (7.0-8.0), the low buffering capacity meant there was a significant increase in pH at the extremities of the distribution system. Overall, 79.3% of samples complied with the ADWG pH range of 6.5- 8.5. The system did achieve 100% compliance for the pH range of 6.5-9.2.

The Greaves Creek supply system consists of a network of cement lined steel mains. Leaching of the cement lining occurs as the water ages in the pipelines, resulting in an increase in pH as the water moves further from the filtration plant. As a consequence, the sample sites at the extremities of the system, particularly those in the Mt Victoria Reservoir zone, were identified as the source of most pH failures (see Figure 1 prior to 1999).

A series of process changes and optimisation projects were initiated to improve the consistency of pH control and the pH buffering of the final water.

The general treatment process at Greaves Creek WFP is direct filtration. Prior to the changes described in this report the water was treated using

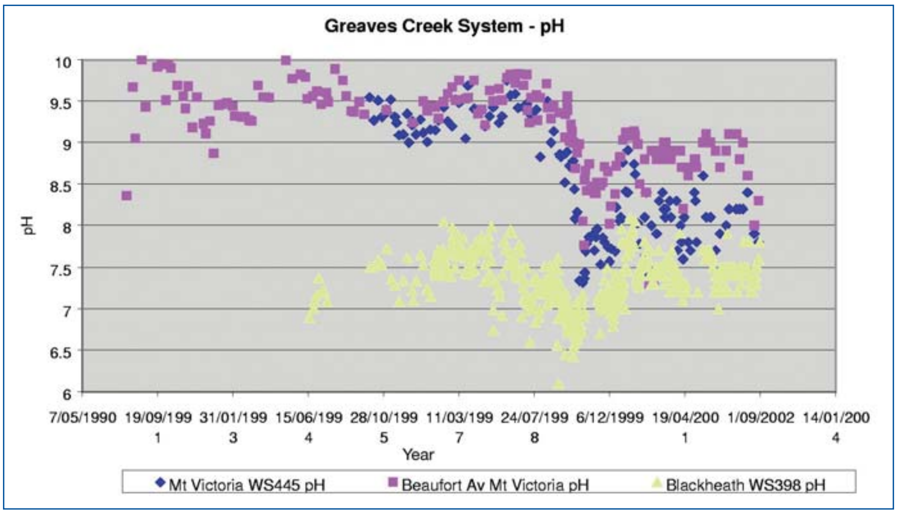


Figure 1. Blackheath Reservoir, Mount Victoria Reservoir & Beaufort Avenue pH trends.

Polymerised Ferric Sulphate (PFS) and cationic polymer (LT410) as coagulants, an acrylamide polymer (LT20) as a flocculant aid, and lime to control the coagulation pH. Chlorine and fluoride were also added.

Several changes have been made to improve the pH in the Greaves Creek Supply System, including the addition of carbon dioxide dosing (post filtration) into the final water and the installation of a new lime dosing system in 1999.

Figure 2. Lime system suction tube prior to modifications. Hole diameter = 3mm.

Figure 1 shows a clear improvement in 1999, when the carbon dioxide dosing was introduced. As a result of the CO2 dosing and commissioning of a new lime plant, the final water alkalinity was increased from an average of 6 mg/L to 20 mg/L. Before this change, all samples at Beaufort Avenue (and other sites in the outer reticulation system) exceeded the upper ADWG pH guideline of 8.5.

In June 2002, several major modifications were made to the lime dosing plant at Greaves Creek WFP.

The suction tubes of the venturi system were changed from the original design (Figure 2). The production officers at the plant had noted a strong correlation between lime blockages in the suction tubes and the lime dose rate. At a final water alkalinity of less than 20mg/L there were few problems with lime blockages in the suction tubes.

The suction tubes were re-designed to draw lime through the bottom of the tube (diameter 20 mm), and the tube length was shortened to prevent sludge from the bottom of the tank being dosed. The plant team also introduced regular flushing of the sludge from the base of the tank, and made some minor modifications to the mixers to prevent sludge build up.

Production officers at the plant also identified many concerns about the safety of personnel operating and cleaning the lime system as it was designed and installed in 1999/2000.

The Blue Mountains Team conducted a risk assessment of the lime system in December 2001. The outcome of the assessment was a risk matrix assigning a level of risk (1-6) to each hazard associated with the lime plant. From the risk matrix, a risk control plan was developed and implemented over the period from January 2002-June 2002.

The following major modifications were made to the lime system at Greaves Creek:

1. Access to the lime tanks moved away from the feeders and pumps.
2. Eductor suction tubes were re-designed so they are removable for cleaning purposes.
3. Removal of the base of the eductor tubes, so lime flow is now through a 2cm diameter tube instead of 16 (2mm diameter holes.
4. Raising of air lines.
5. Installation of new ball valves to improve drainage from the tanks.
6. PVC drainage pipework replaced by flexible hoses, enabling cleaning.
7. Recessing of drainage pipework into the floor of the lime room to remove trip hazards.
8. Replacement of lime sump grate to improve access and cleaning of the lime sump.
9. Installation of safety padding on building and equipment struts.
10. Installation of eye-wash and safety shower in the lime plant.
11. Installation of flood-lighting for night time access to the plant.
12. Installation and fit out of a PPE storage box outside the lime plant.

These modifications have either eliminated or reduced most of the hazards associated with routine operation of the lime system. The use of personal protective equipment (PPE) will further reduce the remaining safety risk associated with the system.

Improving Water Quality In The Supply System

Following the modifications to the lime plant, a trial was commenced to assess the impact of increasing final water alkalinity at Greaves Creek WFP on the pH in the supply system. In order to effectively monitor the change, production officers at Greaves Creek WFP firstly examined the pipe layout of the system to improve their understanding of the dynamics of water movement within the system. Key points were identified for monitoring to give a good picture of the relationship between pH and water age in the supply system.

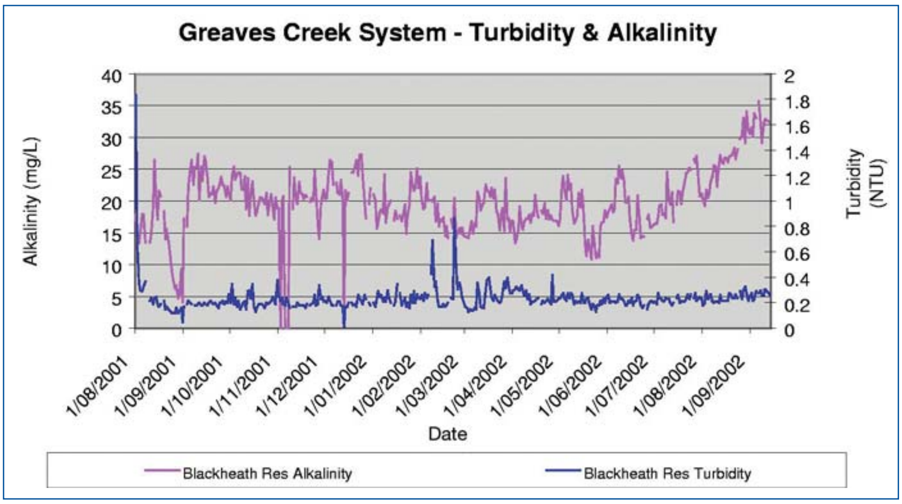


Figure 3. Alkalinity & turbidity at Blackheath Reservoir.

The post lime dose was gradually increased to improve the alkalinity of the water in the system. At an alkalinity of 30mg/L, the change in pH of the water through the supply system was reduced sufficiently to achieve a pH of between 8.2 and 8.3 at the outlying sites.

The plant could reliably achieve this level of final water alkalinity (30mg/L), without compromising other water quality parameters such as turbidity (Figure 3).

The variation in pH between all of the sample sites within the system has been reduced, which has resulted in a system which is more pH stable

Since the changes in June 2002, the performance of the Greaves Creek Distribution system to the ADWG pH guidelines improved significantly (Figure 4). For eight of the 12 months after the dosing changes were implemented, there was 100% compliance to the pH guidelines. This was the first time that monthly pH samples had achieved 100% compliance to the ADWG (1996) Guidelines.

The reduction in compliance in October 2002 was directly related to a problem at the plant where the carbon dioxide dosing system was off-line and the alkalinity of the final water was around 8mg/L.

The pH failures in January and February 2003 can also be attributed to low alkalinity water being generated by the WFP, as the old lime dosing system was run due to problems with the new dosing system.

The two pH failures in March 2003 were at Harley Avenue, Mount Victoria. This site is located at the end of the main. The Mount Victoria Bush Fire Brigade draws water from the sample site. Low alkalinity water had been fed into the distribution system during January/February, and significant rainfall

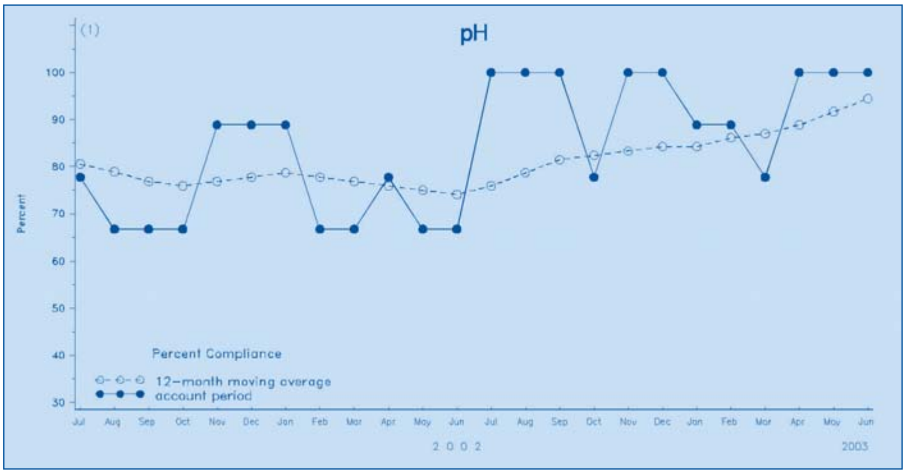


Figure 4. Greaves Creek Delivery System Compliance to ADWG pH Guidelines.

during March may have reduced demand from the Fire Station, resulting in increased retention time in the main.

Lime system callouts

Prior to the modifications to the lime system, the production team noted a correlation between the post lime dose and the frequency of lime blockages at Greaves Creek WFP. When the post lime dose was increased to improve the final water alkalinity the likelihood of lime blockages also increased. The lime dosing system could not consistently maintain the dose rate required to achieve a final water alkalinity above 20mg/L. Even at these dose rates, there was an average of 3 callouts (overtime events) per month related to the lime system (Figure 5).

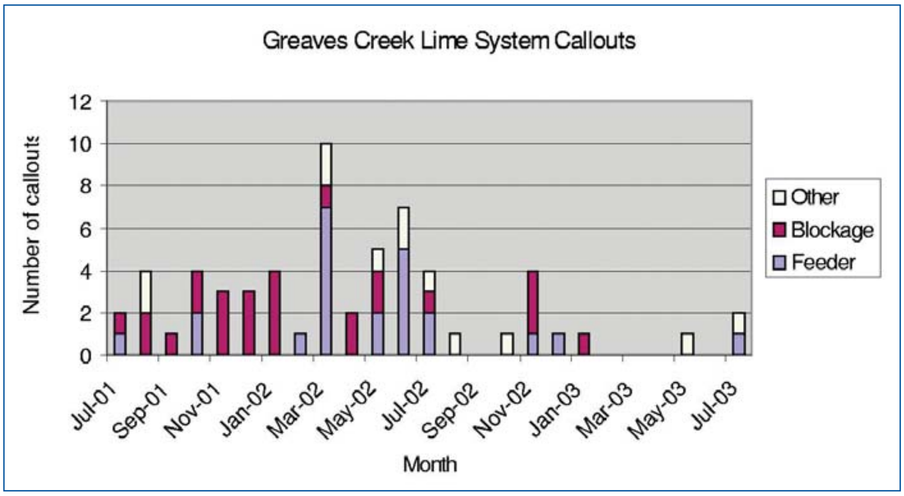


Figure 5. Lime system callouts (overtime events) at Greaves Creek. Callouts classified 'other' relate to faults with the air compressor, pumps & slurry tank level.

Whilst the lime dose rate has been increased to achieve an average final water alkalinity of 30mg/L since June 2002, there has been a significant reduction in the number of callouts caused by the lime plant. This can be attributed in part to the modifications made to the lime plant, and in part to the improved preventative maintenance program implemented for the lime dosing system.

Customer Complaints - Greaves Creek Water Supply System

Past experience in Sydney Water has shown that there is a limit to the amount of buffering (alkalinities around 45–50mg/L) which can be provided before other problems become significant. In particular, the precipitation of calcium salts can occur when the water is boiled. There has been no detrimental impact on the customers created by increasing the alkalinity of water within the Greaves Creek Supply System. In fact there has been a reduction in customer complaints since the alkalinity was increased at Greaves Creek WFP.

Conclusion

The improved buffering capacity of the water has resulted in the Greaves Creek Water Supply System achieving significantly improved compliance with the ADWG (1996) pH guidelines of 6.5 –8.5. Alkalinity in the final water now averages 30 – 35mg/L compared to around 6mg/L when the plant was commissioned in 1991.

The operational safety of the lime system has been improved and at the same time, an economic saving has been achieved through a reduction in call outs.

Acknowledgements

The authors wish to thank Lachlan Joyner, Phil Duker and Percy Ridley for their help and support with the project.

The Authors

Carolyn Haupt (carolyn.haupt@sydneywater.com.au) and **John van der Meulen** (john.van.der.meulen@sydneywater.com.au) are Production Officers with Sydney Water.

VETIVER GRASS WETLANDS TO TREAT SEWAGE IN ESK SHIRE

John Granzien and Lloyd King
Judged Best Paper at the Queensland Operators Conference, 2003

Esk Shire is situated on the north western edge of Brisbane and covers an area of 3,946 square kilometres. The population of 14,800 people in the shire are widely scattered over most of the area. The shire is 125 kilometres long (running north/south) and 70 kilometres wide.

The town of Toogoolawah is situated right in the centre of the shire and adjacent to the Brisbane River. The town has a population of approximately 1,000 persons and provides the local people with a quiet rural lifestyle about an hour and a half drive from Brisbane.

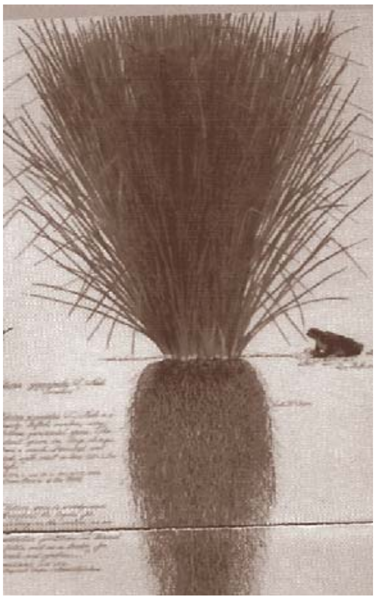
The sewerage scheme for Toogoolawah was built in 1970 and consists of a primary sedimentation (Imhoff) tank followed by three sewerage ponds. The effluent from the ponds was designed to flow into a swamp area before it entered into the local creek. The plant construction was based on a very simple design but is effective. The biggest problem with the quality of the effluent is its high nutrient loading. The high nutrient load in the three ponds also provides an environment for the production of high concentrations of algae thus leading to high pH levels.

With recent changes to license conditions imposed by the EPA, the existing treatment plant no longer complies with the license and an upgrade of the plant was required.

Various options were considered such as a nutrient removal plant, a sand filter or a rock filter. These are expensive options and would require considerable ongoing operational costs. Utilities Engineer Mr. Ralph Ash consulted Mr. Paul Truong from Veticon Consulting and it was decided to introduce a wetland system. A Vetiver Grass wetlands system was considered since it would take up most of the water, as well as remove nutrients and heavy metals from the effluent.

The Vetiver System

The Vetiver System is an innovative nutrient removal technology recently developed in Queensland by the Department of Natural Resources and Mines, DNR, (Truong and Hart, 2001). It is a green and environmentally friendly treatment technology as well as a natural recycling method. Its end-products include animal fodder, mulch, compost and even perfume.



Vetiver Grass *(Vetiveria zizanioides* L.)

The system is based on the use of Vetiver grass *(Vetiveria zizanioides* L.), which was recognised early in the 1990s as having "super absorbent" characteristics suitable for the treatment of wastewater and leachate generated from landfill (Truong and Stone, 1996). Research conducted by the DNR showed that Vetiver grass has a fast and very high capacity for absorbing nutrients, particularly nitrogen and phosphorus in wastewater. In addition it has a very high water use rate and is tolerant to elevated levels of herbicides, pesticides and heavy metals in effluent. As a result the Vetiver System has been used successfully for these purposes in Australia, China, Thailand, Vietnam and Senegal (Truong and Hart, 2001; Truong, 2000). The system has been also been used or trialled across Australia for effluent, leachate and soil erosion treatment, with great success.

Before any work commenced on the installation of the Vetiver System, the effluent discharged from the Toogoolawah STP had the following characteristics:

Daily output	250 kL
Nitrogen concentration	21mg/L
Phosphorus concentration	9 mg/L

A model simulation predicted that less than 3ha of land was needed to treat the entire effluent output to comply with EPA licensing conditions. However if the effluent were pre-treated in the ponds to reduce N and P concentrations by approximately 10% before releasing into the Vetiver plots, the area needed would be less than 1.5ha.

A three-phase treatment program was adopted:

Phase 1. Backwash waste water and sludge from two clarifiers at the Water Treatment Plant was directed to the sewerage reticulation system. This method has been trialled elsewhere with success. The alum reduces the amount of phosphates in the waste water.

Phase 2. The effluent in the three ponds was first treated hydroponically by the installation of Vetiver pontoons, to reduce N and particularly P in the effluent before releasing it to the wetlands.

Floating pontoon design: The 21 floating pontoons were designed so the roots of the Vetiver plants were suspended in the effluent. The size of each pontoon is 2.4m x 2.4m with about 300 individual plants placed on each pontoon. The number of pontoons required depends on the level of nutrients.

In addition, around 6000 Vetiver plants were planted at the high water level around the ponds to further reduce the nutrient loading and also to stabilise the pond banks.

Phase 3: After being treated hydroponically in the 3-pond system, effluent is released to the main Vetiver grass wetlands area.

The Vetiver Wetlands

Vetiver grass was planted in rows on approximate contour lines to spread the effluent, trapping sediment and slow down flow velocity during storms. The interval between rows is at about 12 metres. Temporary earth mounds were placed behind these rows to enable the effluent to be held back so that all the young plants receive water. Following full establishment, when the gaps between plants are closed the rows will take over the work of the mounds, so that the earth mounds can be removed.

Two separate areas have been planted and each area is fed by its own pipeline from the treatment ponds. This means that both areas can be operated at the same time, or one of them can be taken off line and dried out so that maintenance work can be undertaken on the grass in that area. In between the main rows of Vetiver grass, extra rows were planted to increase the amount of grass in the area.

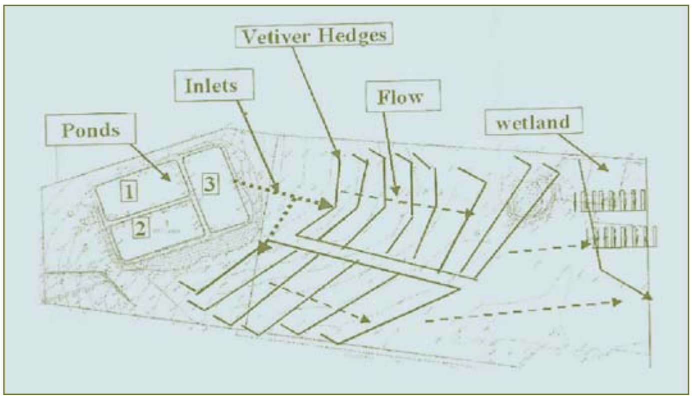


Figure 1. A general outline of the treatment area.

The rows have been designed to ensure all effluent will remain in the wetlands area during normal sunny days and during high rainfall period all excess flow is directed toward the natural swamp at the lower end of the treatment area.

A maintenance program will include replacement of dead plants, regular harvest to encourage new growth.

Monitoring of both surface and sub-surface flows are also being carried out to ensure adequate treatment and to provide data for management of the site. Groundwater monitoring wells are being installed at strategic points and will be sampled on regular basis. Service water monitoring is undertaken at the inlet to the plant, at the outlet of the Imhoff tank and lagoons, at the natural wetlands below the Vetiver Grass wetlands and finally at the discharge into the local creek.

The wetlands were constructed over a six month period. They are situated on a 8 ha block of land to the east of the Toogoolawah STP. The site was firstly cleared of all trees and bushes. Care was taken to remove all large root systems. The site was broken up into two areas with a road down the middle. About 60% of the areas to be planted were prepared. Firstly the ground was sprayed with herbicide to kill the grass. The ground was then ripped using a dozer, then a rotary hoe was used to level the area off. The area was then sprayed again using Roundup.

Using a laser level, contour rows were pegged out across the slope for each area. These rows were about 12 metres apart with a fall of 200 mm between each row. Trenches were then dug along each row with the spoil used to form a mound on the down hill side of the trench. The area is fed by a 150 mm diameter PVC pipeline from the lagoon outflow.

Fertiliser was applied to each row at a rate of 600 mg per hectare. The grass was delivered in clumps with about fifty plants in each clump. The grass was planted along the rows at 100 mm intervals. Watering of the plants started immediately after each day of planting.

Once the main rows were planted then further rows about 3 metres apart were also planted. The main problem with watering was not to flood the plants for too long. The best results were obtained when the grass was given a good watering and then was given time to dry out. Planting started in early February and was completed by the end of March. In total about 25,000 Vetiver Grass plants have been placed in the wetlands so far.

The 21 floating pontoons have been placed on the treatment lagoons. Vigorous growth has been seen in the Vetiver Grass plants that were placed onto the pontoons. The plants were first placed in pots and then allowed to start to grow before they are placed onto the pontoons. These plants remove nutrients from the lagoons and so will improve water quality. About 6,000 plants have been used in the pontoons.

During the planting stage, effluent was flooded onto the wetlands to enable the grass to grow. In most of the areas the growth was good although nothing like the growth of the grass on the floating pontoons. However when the grass was flooded for too long a period, say for more than two days, then the grass didn't grow or growth was reduced. The grass needed time in the early stages to dry out. The normal operation of the wetlands did not commence until early May and so the real growth cannot be expected until the next Spring.

Because there was not enough staff to undertake the planting quickly a small shaded nursery was constructed on site to keep the plants alive during planting and to produce potted plants for the floating pontoons. Whenever the operator of the STP turns on the pump to break up floating scum in the Imhoff tank the plants in the nursery are watered automatically. This nursery has proven to be very worthwhile and has been a great help in enabling the project to succeed.

Results So Far

Results of a preliminary trial conducted on site with the first 3 pontoons, show that Vetiver established and flourished (up to 1.5m in 3 months) under hydroponic conditions in all three ponds. These pontoons have been removed and the grass harvested to produce about 5 new stems of grass from each original plant placed on the pontoons. The pontoons have now become the source of Vetiver grass for the project.

The growth of the Vetiver grass has been varied for the first three months. Where the grass was able to dry out between watering, the growth was good. In places where the water lay around the grass the growth was poor. Some of the grass was planted late and so growth is not expected until spring. The grass is also

Table 1

		AMMONIA	TOTAL N	TOTAL P
15-10-2002	PREVIOUS EFFLUENT	9.1	20	6.3
8-4-2003	LAGOON INFLUENT	49	58	6.6
	LAGOON EFFLUENT	0.65	15	3.3
	WETLAND EFFLUENT	0.57	6.7	1.2
20-5-2003	LAGOON INFLUENT	34	41	9.2
	LAGOON EFFLUENT	2.9	14	4.4
	WETLAND EFFLUENT	0.072	7.3	2.1

highly tolerant to frost so therefore it will survive our cold winter months.

There is already some evidence that the water quality is improving in respect to nutrient load. Overall an 88 per cent reduction in the nitrogen level, an 81 per cent reduction in the phosphate level and approx 78 per cent reduction in faecal coliforms cfu/100ml have been achieved so far. The results are shown in the Table 1.

Conclusion

The information above and the results achieved so far indicate that the Vetiver Wetland System is treating the effluent to a better standard. Also the system is very easy to implement and is a very low cost method for treating effluent and leachate in both domestic and industrial situations. At the time of this paper the grass was not fully functional and results in time should show its true success.

Acknowledgements

The authors wish to thank Paul Truong (Veticon Consulting) and Ralph Ash (Esk Shire).

The Authors

John Granzien is Leading Hand Water and Sewage Operator/Plumber and **Lloyd King** is Water and Sewage Operator, for the Council of the Shire of Esk.

Water Industry Training Package Review: Progress Report

As advised in the June 2002 edition of WaterWorks, the Water Industry Training Package is under review as part of a two phase project being coordinated by Australian Local Government Training (ALGT), the organisation responsible for the maintenance of the Package.

A series of national consultation workshops were completed to identify if, where, and how the existing Water Industry Training Package could be enhanced. This review exercise has resulted in a number of key recommendations for enhancement of the existing Training Package being put forward to the Australian National Training Authority (recommendations can be viewed at www.algt.com.au). The next and important stage of this review process is expected to commence early next year. ALGT will once again be calling on the expertise and involvement of all Water Industry personnel. Input will be sought from the Operator through to the CEO to ensure that we end up with a national Training Package that truly reflects the diverse skill needs of the Water Industry.

Although the current Training Package, endorsed in October 2001, requires updating in certain areas, it still provides for specialist training that can lead to the awarding of nationally recognised qualifications. Qualifications range from a Certificate I to a Diploma in Water Industry Operations.

For more information on how you or your organisation can utilise the Water Industry Training Package contact Joan Whelan at National Training Advisory on (03) 9349 3911 or joan@algt.com.au

HACCP AT MOLENDINAR WTP

John Jacobs and Craig Bolin

Hazard Analysis Critical Control Point (HACCP) originated in America during 1960's as a system of controlling quality in the processing of food. In 1998 Gold Coast Water decided that in order to minimise risks to water quality and safety, a formally structured risk management and quality assurance system would be developed and implemented. Gold Coast Water decided HACCP was best suited for this task.

HACCP has a simple but elegant structure that is easy to develop, communicate and maintain. It uses 7 principles.

1. Identify the hazard in your system.
2. Determine Critical Control Points.
3. Determine Critical Performance Limits.
4. Establish a monitoring system.
5. Design corrective action procedures.
6. Have a formal system of organising records and procedures.
7. Be able to verify that the system is working.

Molendinar Water Purification Plant (WPP) is a conventional treatment plant capable of treating 180 ML/Day. Raw water is drawn from the Hinze dam which is located approximately 15km west of the City and has a capacity of 162,500 Megalitres.

Critical control points were identified and critical limits set for the Molendinar WPP (Table 1). The critical limits set were only marginally poorer than optimal and considerably better than required by guidelines. Plant knowledge enabled critical monitoring to be identified and specific corrective action to be indicated. The internal reporting system combined with on line monitoring made it almost impossible for poor performance to survive unnoticed.

Procedures were created to support the critical control points and critical limits developed. The procedures were developed with the help of Operation staff at the plant. These are listed briefly below.

Table 1. Molendinar Water Purification Plant. HACCP Critical Control Points and Reporting Limits.

Critical Control Point	Critical Control Limit	Excursion / Reporting Limits	Action
CARBON DOSING	Event determined	Detection of taste and odour by panel members or public	Alter dosing regime
RECYCLED WATER	Blue Green Count <50,000 cells per mL	> 50,000	Discharge to sewer
	Faecal coliforms < 100 c.f.u./mL	>100	Inspect wash water recovery system as per procedure.
DOSED WATER PH (USING ALUM)	6.5 - 7.0	5.7 - 6.4 for 4-8 hours	Report
		5.7 - 6.4 for > 8 hours	SHUTDOWN and report
		7.0 - 7.5 for 4-8 hours	Report
		7.0 - 7.5 for >8 hours	Report
		< 5.7 for 2 hours	SHUTDOWN and report
		> 7.5 for 2 hours	SHUTDOWN and report
Dosed Water pH with $KMnO_4$	7.0 - 7.3	< 6.9 for 4-8 hours	Report
		< 6.9 for > 8 hours	SHUTDOWN and report
FILTRATION	Filtered Water Turbidity < 0.2 N.T.U	Average of all filters	
		> 0.2 for 2 hours	Report
		> 0.2 for 5 hours	SHUTDOWN and report
		> 0.3 for 2 hours	SHUTDOWN and report
		>0.3 (any single filter) for 2 hours	
ACID SOLUBLE ALUMINIUM	< 0.15 mg/L	> 0.15 mg/L	Report
TRUE COLOUR	< 5 c.p.u	> 5 c.p.u for > 24 hours	Report
		> 10 c.p.u for > 4 hours	SHUTDOWN and report
ALKALINITY		<35 or >50 mg/L for >48 hours	Report
FILTERED WATER			
• Chlorine Residual	1.0 to 1.5 mg/L	1.5 - 2.0 or 0.5 - 1.0 for > 8 hours	Report
		> 2.0 or < 0.5 for 2 hours	Report
		> 3.0 or < 0.2 for 1 hour	Report and contact Manager Operations & Maintenance
• PH	6.9 to 7.5	> 7.5 or < 6.9 for 5 hours	Report
		> 8.5 or < 6.0 for 5 hours	SHUTDOWN and report

• **Optimising Raw Water Quality.** Operators are required to check water quality at the different draw-off levels from the Hinze Dam and select the one that will provide the best quality water. The Operators are also responsible to insure that when the turbidity of the raw water has a significant increase from heavy rain, land slippage, algal blooms or other unexplained events, the operator shall contact GCW Scientific Services to sample for Cryptosporidium & Giardia.

• **Hinze Dam Carbon Dosing.** This procedure provides instructions for the commencement, operation, and the halting of carbon at the Hinze Dam carbon dosing site. Commencement of carbon dosing is done by algal alert levels or by the number of taste and odour complaints. Dose rates would be closely monitored by the number of taste and odour complaints. Ongoing carbon dosing is based on daily algal counts.

The procedure also provides safety requirements and ensuring correct carbon dosing concentrations are met.

• **Pre Lime Dosing.** Pre lime dosing is a CCP because this controls pH that is important with our $KMnO_4$ dosing. This requires a pH between 7.1 -7.3 and an alkalinity of 35-50 mg/L.

• **CO_2 Dosing.** To resist rising pH caused by long detention times in concrete mains it is important to have an alkalinity between 35 -50 mg/L. This procedure provides instructions on the management of the carbon dioxide dosing facility. Treated water alkalinity is tested twice daily.

• **Alum Dosing**. The Critical Control Limit for true colour is < 5 PtCo and turbidity < 0.2 NTU. This procedure describes how jar testing and monitoring raw water colour are used to identify the correct dose setting for alum.

• **Coagulant Aid Dosing**. The aim is to describe the usage of coagulant aid. The plant usually operates with a combination of alum and coagulant aid. A series of jar tests would be performed by the operators to select the right dose to minimise turbidity.

• **Permanganate Dosing**. GCW seeks to produce treated water with a soluble manganese content of < 0.02 mg/L. Dosing of Potassium Permanganate can be commenced at any time when soluble manganese in the raw water rises above 0.05 mg/L. A graph is attached to the procedure for operators to work out pump stroke settings for soluble raw water Mn.

• **Recycled Water Control**. Recycled water constitutes from 4-5 % of the daily flow into the plant. Daily samples are taken from the recycled water and the Mn and Al aluminium levels measured. Turbidity and pH are continuously monitored. Weekly samples are taken for for faecal coliforms and algal identification and enumeration. The procedure describes the action to be taken if any of these measurements exceed the critical limits.

Figure 1. Critical Control Point excursion notification form.

SPECIFICATION EXCURSION ADVICE OM-1101

Site:	Please email form to either:
Reported By:	Operations & Maintenance or Service Delivery
Telephone No.:	
Date of Excursion:	
Time Excursion Commenced:	
*Duration of Excursion:	
Suspected Cause:	
Actions taken:	
**Impact on Plant Output	

Parameter/s Affected: Eg. pH, turbidity	Level of Specification Affected:	***Excursion Value:	Specification Value/s:
	....		
	....		

• **Dosed Water pH**. At the treatment plant CO_2 controls the dosed water pH. Critical limits for dosed water in normal condition are 6.5 to 7.0 while during permanganate dosing the pH limits are 7.0 to 7.3. The procedure also covers corrective action. Prolonged failure of dosed water pH will lead to reporting to the manager. The plant may be shutdown until the pH problem has been rectified.

• **Pre Chlorination**. Pre chlorination is used to assist in manganese removal with the addition of permanganate dosing. The pre chlorination has also shown lower turbidity in filtered water. Dose rates between 0.4 and 0.6 mg/L are required during a manganese event.

• **Filtration and Turbidity Control**. Filtration is monitored by online turbidity meters, head loss and unit filter run volumes via the SCADA. The turbidity has a 0.20 N.T.U critical control limit for the combined filtered water. If this is exceeded for more than 2 hours a report of non-conforming water quality is sent to senior staff. If it exceeds for more than 5 hours with the managers decision the plant will be shut down until the problem has been rectified.

• **Disinfection Control**. There are two online analysers at the treatment plant with alarm settings. The critical limits leaving the clear water tank are 1.0 to 1.5 mg/L between pH value of 6.9 and 7.5. A non-conformance report is required if these are not met.

An example of a critical control point excursion notification is provided in Figure 1.

HACCP is also used in the management of the Catchment, the Reticulation and at the Customers Tap.

For the catchment, baseline information is being collected at strategically located sites in order that Critical Limits may be derived for selected water quality parameters.

In the reticulation system, there are several thousand kilometres of water mains with 74 storage tanks and 2 rechlorination facilities. Knowledge of this system was acquired with the help of operations staff. A monitoring system was developed for each storage. Important testing parameters were chosen and Critical Limits, only marginally inferior to water treatment plant performance limits, were established (Table 2).

All of the limits in Table 2 appear in procedures which outline the theory behind them and what specific things to do to investigate and correct problems.

Supporting these critical limits are a number of requirements and procedures.

• Reservoir sanitary and condition inspections must be carried out quarterly and a written report prepared.

• Each reservoir zone must have an unambiguous sample site.

• New mains must have a "bacto" and pressure certificate before charging.

• Repair work has a requirement to "flush hydrant till clear" instruction

• Any more than 6 dirty water calls in 24 hours must be investigated and reported.

• Any more than 6 Taste and Odour calls in 24 hours must be investigated and reported.

• Any more than 3 illness related calls in 24 hours must be referred to the Coordinator for investigation

There are 3 rechlorination facilities within the reticulation system all with on line chlorine analysers. Two also have pH and turbidity analysers. There are limits for these as well as corrective action procedures.

Investigative, communication and corrective action procedures exist for failures against any of these.

Backing the whole thing up is the excursion reporting system and the internal audit system.

At the customers' tap Gold Coast Water saw an opportunity to improve its system performance by making use of the customer driven information. Procedures for investigating taste, odour, corrosion, illness and dirty water complaints were devised that enabled staff to provide better advice and options to the consumer. Critical Limits for those events were then applied, breaching these limits improved better performance throughout various departments of GCW.

To support the implementation of HACCP at the plant a number of service level agreements have been set up. These are formal agreements between various branches within Gold Coast Water wherein, one party to the agreement specifies services required and one party agrees to provide the specified services. For example, the Service Delivery branch will specify that Operations & Maintenance calibrate and maintain all measuring equipment.

Process audits are also carried out to determine the efficiency of current processes and the condition and suitability of existing equipment. The reviews cover process and component issues such as equipment aging, suitability for future demands, breakdown frequency, safety, efficiency, staff knowledge and awareness. The reports from these audits provide a series of recommendations to the Manager of Service Delivery that prove useful in avoiding problems that would be difficult to deal with on a reactive basis.

Table 2. Critical limits for parameters in the Reticulation system.

Parameter	Critical Limits
Faecal coliforms	0 cfu
Total coliforms	0 cfu
Total plate count	<100 cfu
Turbidity	< 1 NTU
Colour	<5 PtCo
pH	7-8

Staff training is an important part of the HACCP program. Gold Coast Water has implemented a Total Training Plan. The plan covers the identification of training needs, the assessment of the staff competence and the formulation of a training programme to reduce any gaps between required training and actual training levels. Again the reporting of HACCP failures provides input into training requirements.

The program offers a number of benefits to operators. These include:

- Clear water quality specification
- Written instruction on achieving specification
- A reporting system for specification failure
- Processes ownership and incentive
- Reduces conflicts
- Shift in responsibility

Benefits to GCW management include:

- Increased awareness of how well plants are actually performing
- Increased awareness of where weaknesses exists
- More effective prioritising of financial resources
- Improved relations with plant staff

The Authors

John Jacobs (jjacobs@goldcoast.qld.gov.au) is the Senior Operator at the Molendinar WTP and **Craig Bolin** (cbolin@goldcoast.qld.gov.au) is a Water Treatment Plant Operator at the Molendinar and Mudgeeraba WTP's. Both plants are operated by Gold Coast Water.

Thames Water

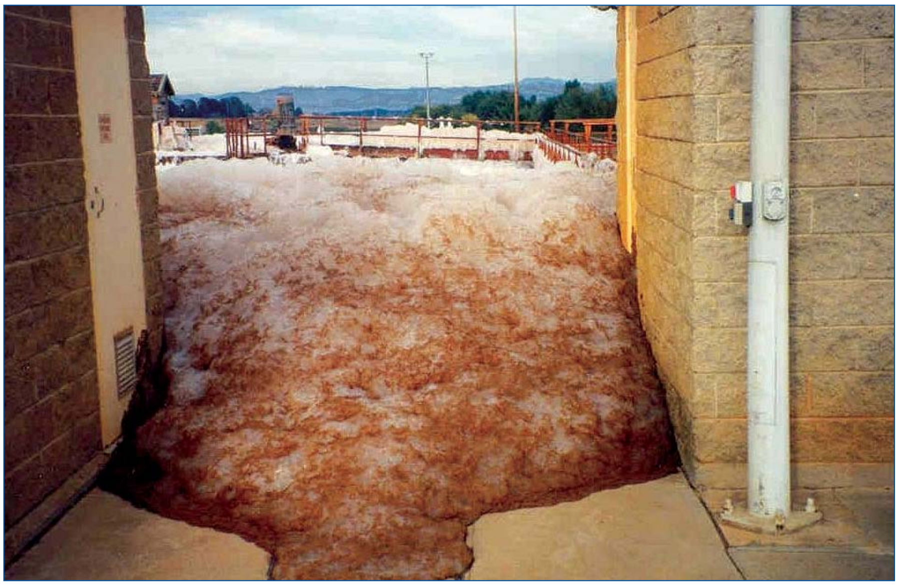
Thames Water Projects (Australia)
www.thameswaterprojects.com
thameswater@thameswater.com.au
Tel: (03) 9239 4100
Fax: (03) 9239 4200

RWE GROUP

FOAMING STP AT QUEANBEYAN

Greg Fogarty

What do you do when you arrive at work and your sewage treatment plant resembles an Alfred Hitchcock horror movie? This was the scene confronted by operators of the Queanbeyan Sewage Treatment Plant, who immediately rang for help as they faced a huge problem with foam.



Queanbeyan Sewage Treatment Plant was designed to process all sewage from the City of Queanbeyan (situated on the NSW, ACT border). The water discharged from the treatment works flows directly into the Molonglo River which feeds into Canberra's Lake Burley Griffin. Therefore, producing an effluent of particularly high quality free from pollutants and nutrients is imperative. To achieve these standards, the tertiary treatment plant consists of an activated sludge system, maturation ponds and chemical dosing for phosphorus removal.

All stages of the plant are tested by highly trained analytical chemists at the onsite laboratory. On a daily and weekly basis the plant's chemists study nutrient and pollution levels as well as determine the microbiological make up of activated sludge. Activated sludge is a complex ecosystem constituted of mainly bacteria and protozoa. A good balance between the different species is necessary for efficient pollution removal, good settleability of the sludge in the final clarifier and a low level of suspended solids in the effluent. Understanding the microbial community in the sludge assists in performance monitoring of the plant as micro-organisms are responsive to changes in their environment.

The microfauna and filaments numbers determined under the chemists' studies are used in calculating weekly Sludge Biotic Index (SBI) and Filament Biotic Index (FBI). SBI monitoring is used to evaluate the depuration in activated sludge systems and consequently the performance of the plant by monitoring the dynamic colonisation of the dominant protozoa groups and their respective quantity. Being strict anaerobes, protozoa prove to be excellent indicators of an aerobic environment. Evidence of toxicity is made obvious in the absence of or lack of mobility of these micro organisms in activated sludge as they exhibit a greater sensitivity to toxicity than bacteria. Excessive growth of filamentous bacteria causes bulking and scum formation which leads to a deterioration of effluent quality and to severe operational problems. The extent of filament colonisation is assessed through the FBI.

SBI and FBI evaluations the day prior to the foam incident revealed a well colonised and stable sludge with excellent biological activity. The microfauna were found to be a mix of *Litonotus fasciola, Trachelophyllum pusillum, Parameciam* spp., *Aspidisca* spp., *Vorticella convallaria, Vorticella* spp., *Vaginicola crystallina, Poderiodendron*. The primary filament was type 0041/0675 with negligible levels of *Nocardia* spp. The quick actions of the plant's operators led to the discovery that the sludge composition had not changed greatly overnight. With this valuable information, the operators eliminated the possibility that the foaming problem was due to excessive growths in aerobic filaments such as *Nocardia* spp. which are known to be responsible for the most common and severe foaming problems. It was shortly ascertained that the cause of the foam problem was from large quantities of dumped surfactants.

Once operators concluded that the foam problem was caused by dumped surfactants, a massive clean up operation began. The overflows from tanks were hosed down and the surfactant residuals inside the tanks gradually disappeared. Normal operations resumed the next day. The lesson to be learnt from Queanbeyan's experience is that valuable scientific data is worth more than assumptions.

The Author

Greg Fogarty (greg.fogarty@qcc.nsw.gov.au) is engineering manager with Queanbeyan City Council.

GERARD BARRY - VICTORIAN OPERATOR OF THE YEAR 2003

John Park, AWA (Vic) Committee Member

Western Water Team Leader, Gerard Barry, was awarded the Wal Whiteside Victorian Operator of the Year Award at the recent Annual Victorian Water Industry Engineers and Operators Conference in Shepparton.

At a special morning tea function held at Western Water's Gisborne office on 30th September, members of Western Water Board, staff and Gerard's fellow team members gathered to congratulate Gerard on his achievement. The Award was presented to Gerard by AWA representative, John Park, who together with Western Water Chairman, Terry Larkins and CEO, John Wilkinson outlined some of Gerard's many attributes and achievements. WIOA President, John Harris also attended to personally congratulate Gerard on his achievement.

Gerard Barry receives his award. Pictured are (L to R): John Wilkinson, CEO, Western Water; John Harris, WIOA President; John Park, AWA; Gerard Barry; and Terry Larkins, Chairman, Western Water.

This award has been presented to Victorian water industry operators' since1980. The list of recipients includes many of the industry's most capable treatment plant operators. It commemorates Wal Whiteside who, as Chairman of the Geelong and District Water Board, was a great supporter of Operators and their participation in the Engineers and Operators conference.

Gerard was nominated by Western Water along with 5 other Victorian operators. So good were the credentials of some of the nominees, the judges had a difficult task in reaching a decision.

Gerard is Team Leader of the Sunbury Purification Team which has responsibilities for the operation of 5 wastewater treatment plants. He has 14 years of experience with Western Water and has an ability to communicate through all levels of the organisation.

One of the compelling reasons for Gerard receiving the award was the 100% EPA compliance achieved in the 5 treatment plants for the first time in 2001/02. This is testament to the diligence and routine initiative shown by Gerard and his team at all times. Some of his initiatives include power savings through the installation and optimisation of power monitoring equipment and the development of a sustainable biosolids management program at the Sunbury purification plant. Gerard's activities have a dedicated environmental focus which extends beyond his workplace and includes a partnering relationship with the Deep Creek Landcare Group.

His dedication and commitment to his work is recognised by all at Western Water and he is certainly a very worthy recipient of this prestigious award.

Biosolids Field Day

A field day on biosolids management was held at the University of Melbourne's Dookie Campus in September 2003. This day was attended by over 100 interested participants who heard presentations from researchers, University lecturers, reuse practitioners, EPA and food industry people. The participants ranged from farmers interested in using the end product to consultants and staff from Water Authorities and other government departments.

Apart from the technical presentations, a field tour to look over the National Biosolids Research Program trial site at Dookie was incorporated into the day. A visit to the Dookie dairy was also arranged to look at some practical uses for dairy shed effluents and other manures as well as the equipment used to apply these products.

One of the outcomes of the field day was a commitment to develop a model EIP for the use of the water industry, based on the soon to be released EPA Victorian Biosolids Use Guidelines. Work on the development of this EIP is underway at present. Additional field days are planned for the future so keep your eye out for future flyers.

Pictured is Michael Fried, General Manager of Omega Chemicals at the company's display booth in Shepparton at the Annual Operators' Challenge. Omega Chemicals sponsored the first prize at the event.

SPIRAC ST Screen

For removal of solids from effluent streams

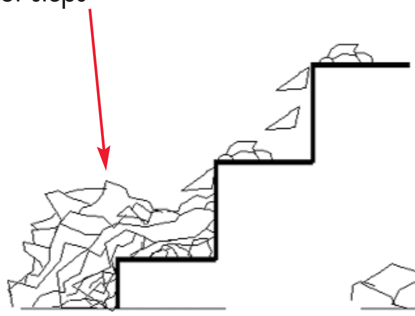
NEW

SPIRAC Conveying Technology

SPIRAC ST Screen

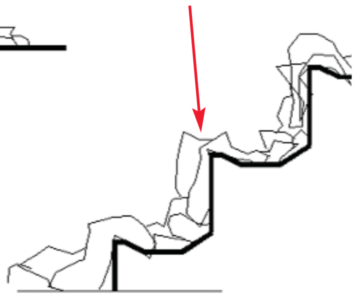
- No chains, therefore no chain wheels in water
- 5mm heavy duty frame
- Long life bearings with automatic greasing
- Low speed operation
- Virtually maintenance free

Stringy, slippery or rubbery solids agglomerate at bottom of steps



Traditional step screen

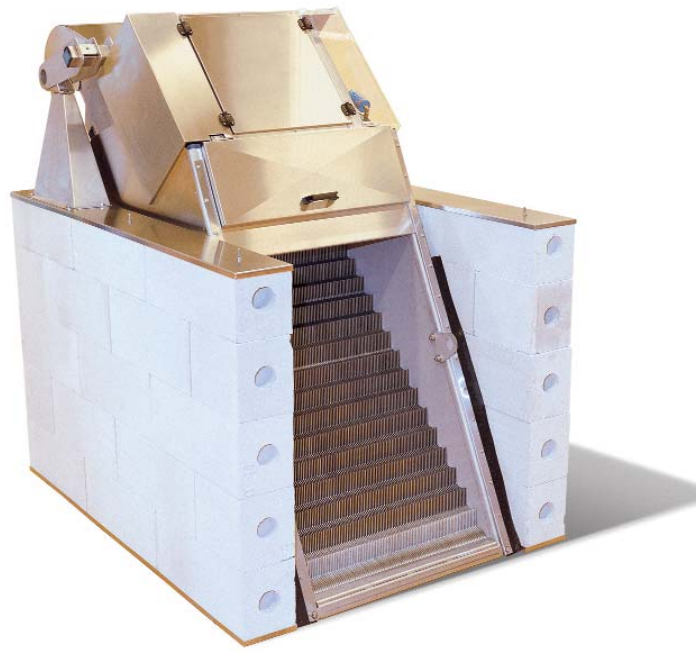
"Hooked" profile hooks difficult solids to create uniform step distribution



SPIRAC ST screen

To ensure optimum performance of your screenings system, combine with these proven SPIRAC products:

- Screenings washers, compactors, dewaterers
- Grit classifiers and washers
- SPIRAC shaftless conveyors
- SPIROTAINERS – containers and silo systems



Five reasons to specify the SPIRAC ST Screen

- Optimised step profile for better capture of screenings
- "Stop in home position" brake eliminates roll back
- Strongest screen on the market
- Shorter beach area minimises screenings hangup
- Lower maintenance costs than competitors' screens

Head Office
2 Kalmia Road, Bibra Lake WA 6153
Tel (08) 9434 2127 Fax (08) 9434 2128
Email info@spirac.com.au Website www.spirac.com.au

NSW
Tel (02) 9680 9381 Fax (02) 9680 9382
VIC
Tel (03) 9408 3373 Fax (03) 9408 3384