WIN-SA
WATER INFORMATION NETWORK
- SOUTH AFRICA -

"Making knowledge work for us"

LESSON SERIES
September 2012

Achieve Green Drop status

Using a Wastewater Risk Abatement Plan (W_2RAP) to Achieve Green Drop Compliance: Lessons from Drakenstein Local Municipality

SALGA
South African Local Government Association

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1 Background

1.1 The WRC and WIN-SA showcase best practice in wastewater treatment

The Water Research Commission (WRC) and Water Information Network of South Africa (WIN-SA) have been actively involved in showcasing municipalities' good practices in wastewater management on the road to Green Drop status. WIN-SA and the WRC identify 'sparks' of excellence in South Africa, write it up and create forums where these good practices can be shared and discussed.

This year, the WIN-SA Lesson Series focuses on the use of a risk abatement plan (also referred to as W_2RAP) to identify and manage risks successfully on the road to Green Drop status.

According to Dr Heidi Snyman, Director, Knowledge Management, of the WRC, "…the W_2RAP is about minimising risk and maximising resources".

Drakenstein LM in the Western Cape was selected on the basis of the following criteria:

- The municipality has a W_2RAP in place and it is being implemented.
- The municipality did not receive any Green Drops in 2011, and achieved an average score of 80.4%*. It is currently using the W_2RAP to work towards Green Drop status in 2012.
- The municipality has a devoted team and a strong champion.
- Various technologies are used, depending on the effluent requirement and the operational cost. Technologies such as pond systems are favoured in rural areas.
- The municipality has the capacity to host a workshop and it has knowledgeable staff who can talk about their subject and transfer knowledge successfully.
- Drakenstein LM plans capital expenses 20 years in advance for all engineering projects.

* *Note: Green Drop Certification is awarded for scores exceeding 90%.*

In addition, Drakenstein LM is closely monitored by the Department of Water Affairs (DWA) as the quality of the Berg River is of strategic importance to South Africa; it is used to irrigate export crops and must therefore meet the quality standards of the European Union.

It is therefore also important for everybody in the water sector to gain an understanding of how the municipality, in close cooperation with all stakeholders, (including SALGA, DWA and the Berg River Irrigation Board), tackled the issue and turned a serious effluent quality problem around.

Word has travelled fast about Drakenstein's successes: Ronald Brown, Drakenstein LM's Engineer Waste Management, is, since June 2012, also an invited member of the Mpumalanga risk-based improvement programme, where he shares Drakenstein LM's approach to risk abatement with municipalities that discharge effluent into the Olifants and Crocodile rivers.

Dr Heidi Snyman, Director, Knowledge Management, of the WRC

The municipality covers an area of 1538 square kilometres. It serves just over 200 000 people. Drakenstein LM has 6 wastewater plants. These facilities treat a total combined average dry weather flow of 34 Megalitres per day and an average peak weather flow in excess of 85 Megalitres per day. The figure below shows the location of these plants in the municipal area.

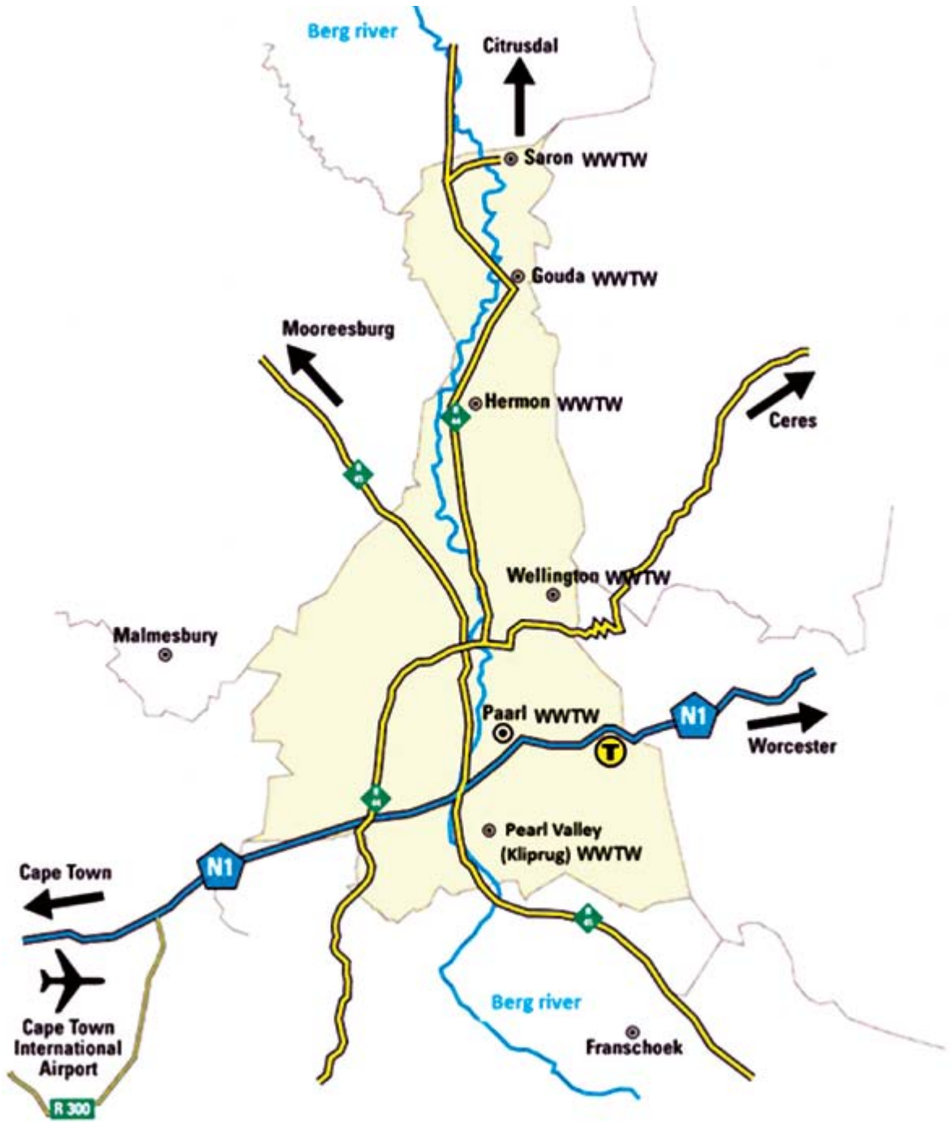

Figure 1: The location of Drakenstein's 6 wastewater treatment plants

1.2 Wastewater management in Drakenstein LM

The capacity and technology used on each plant are summarised in the table below:

Table 1: WWTPs in Drakenstein LM

Name of plant	Capacity in Megalitres per day	Technology
Paarl	25	Biofilters and activated sludge with maturation ponds for tertiary treatment.
Wellington	7	Biofilters and activated sludge with maturation ponds for tertiary treatment.
Kliprug / Pearl Valley / Val de Vie	2	Two activated sludge modules and one maturation pond for tertiary treatment.
Saron	0.83	Open ponds converted to an activated sludge reactor, with an aerobic zone and an anoxic zone.
Gouda	0.38	Oxidation ponds
Hermon	0.92	Oxidation ponds

Drakenstein LM is currently upgrading the Paarl plant to a capacity of 35 Megalitres per day. All the plants, except Gouda and Hermon, discharge effluent into the Berg River.

1.3 The WRC and WIN-SA project

Documenting and sharing good wastewater management practices in Drakenstein entailed:

- A learning visit to Drakenstein LM on 31 January 2012;
- A workshop hosted by Drakenstein LM on 30 March 2012 at the Paarl wastewater treatment plant; and
- Lastly, an information-sharing workshop at the 2012 WISA conference (7-9 May), where the municipality shared its experiences.

The wastewater team of Drakenstein LM impressed the researchers with its people-oriented approach to risk abatement.

The Drakenstein workshop focused on people as risk and resource. 55 people attended the workshop and participants came from as far as Knysna!

2 People: risk and resource

2.1 Introduction

To avoid potential catastrophic failure on the six plants, the wastewater team must continually assess the risks and hazards and manage them appropriately. There is always the risk of a mechanical, structural or process failure within the plant. This is also why the Green Drop process requires an Incident Response Management Protocol, which ensures that risks are dealt with before they are in the red. The extract from Drakenstein LM's W_2RAP below demonstrates such potential risks.

Table 2: Extract from Drakenstein Municipality WWTW's W_2RAP Hazard Assessment

Item no	System	Hazard/ Risk description	Inherent Risk score (before consideration of any controls)		Existing controls	Control effectiveness	Residual Risk Score		Comment	Recommended mitigation/ Improvement plan
		Process failure								
6	Domestic Pumping Station	Influent compliance	20	Medium	Operational monitoring i.e. Laboratory testing	80%	4	Low	Operational monitoring. Determine alert levels and take corrective action according to Incident Response Protocol	Ensure monitoring occurs as scheduled
		Mechanical failure								
14	Industrial Inlet Works	Hand raked screens	15	Medium	Permanent cleaning of the screen throughout the day	70%	4.5	Low	Permanently posted staff clean hand raked screen	Investigate installation of mechanical screens
		Process failure								
15	Industrial Inlet Works	Influent compliance	20	Medium	Operational monitoring i.e. Laboratory testing	80%	4	Low	Operational monitoring is to occur to operational monitoring alert level	Ensure monitoring occurs as scheduled
		Process failure								
21	Flocculator	Operational monitoring	16	Medium	Operational monitoring i.e. Laboratory testing	80%	3.2	Low	Operational monitoring to occur to alert levels with corrective actions as per Alert Level	Ensure monitoring occurs as scheduled and incident management protocol is followed
		Structural failure								
23	Domestic splitter box	Tower	15	Medium	Construction of new tower	0%	15	Medium	Construction of a new tower must be investigated	Investigate structure of tower
		Process failure								
26	Domestic PST's	Operational monitoring	16	Medium	Operational monitoring i.e. Laboratory testing	80%	3.2	Low	Operational monitoring needed with actions as per Alert Level	Follow Alert Level actions
		Structural failure								
29	Biofilters Splitter Tower	Tower	25	High	Tower to be replaced as part of upgrading	100%	0	None	The existing tower will be replaced during upgrading of WWTW	Inspection of new Tower once a year
		Structural failure								
31	Biofilters	Old Biofilter walls	25	High	Structure strapping	25%	18.75	Medium	Currently strapping is used to reinforce broken brickwork outer walls	Refurbish walls as part of future upgrade

The potential is there for mechanical failure, process failure, structural failure, but what about people failures? Typical people failures are illustrated in the diagram below.

Figure 2: Typical people failures

Drakenstein LM recognises that people are their highest risk, but also their most valuable resource. No municipality can manage its wastewater effectively if they don't manage the people relationships involved in the process.

"I think people are our biggest asset. You could have the most expensive equipment, but if you lack the people to run and maintain it, you are in trouble." (Ronald Brown, Engineer, Waste Management, Drakenstein LM).

2.2 A network of many relationships

Each individual wastewater official is part of a network of multiple relationships as the figure below illustrates.

Figure 3: Each wastewater official functions in a network of relationships

The Drakenstein wastewater team manages people successfully, because they are able to manage relationships at different levels successfully – within the team, with Council and senior management, stakeholders in the water sector, consultants, other municipalities and waste dischargers.

Cecil Paulse, the Senior Chemist, has worked at Drakenstein for 30 years.

Frans van Rooyen, the Assistant Superintendent, has worked at Drakenstein for 19 years.

Cedric Morkel, the Senior Superintendent, has worked at Drakenstein for 35 years.

Ronald Brown, Drakenstein Engineer: Waste Management.

2.3 "We are a winning team"

2.3.1 The wastewater team

The Drakenstein wastewater team combines decades of experience at all levels of plant management with dynamic and innovative leadership.

Cecil Paulse, the Senior Chemist, has worked at Drakenstein for 30 years. He manages 6 people in his laboratory, which is also responsible for industrial effluent.

Frans van Rooyen was appointed Assistant Superintendent in August 2011. He started as a painter and over the past 19 years he steadily worked his way up the 'wastewater ladder'.

Cedric Morkel, the Senior Superintendent, is responsible for process performance and maintenance. He has 35 years at Drakenstein under his belt and carries a wealth of institutional memories.

Ronald Brown has been leading the team for the past two years. He previously worked at the Nelson Mandela Metro and George municipalities.

2.3.2 Building a winning team

Becoming a winning team does not happen overnight. It takes careful consideration and planning, building on strengths and supporting weaknesses.

2.3.2.1 Allow people to do what they are passionate about

"My father has taught me to discover excellence in people", Ronald Brown explains. "If you can give a person a task that he is passionate about, he will go that extra mile."

Cedric Morkel ensures that the Drakenstein plants and equipment are maintained with passion. Cedric believes in following a multi-barrier approach to risk management. He knows that one critical failure at the pump station will lead to a failure at the inlet works, which, in turn, will lead to a failure at the settling tanks, and so on. He makes sure that preventative (and reactive) maintenance and repairs are in place to guarantee maximum uptime and to minimise downtime.

"Failing equipment or pumps that do not work, 'steals' the energy and motivation of process controllers", Cedric believes.

Cedric has a daily checklist for pumping stations and generators, and a monthly preventative maintenance plan for service pumps, etc. Generators and motors are serviced each year.

Hints and Tips

DAILY PUMP STATION INSPECTION CHECKLIST: CENTRAFUGAL PUMPS (1, 2, 3, 4)

Checklist	Morning (08:00)	Noon (12:00)	Afternoon (16:00)	Remarks
A. Site (premises and housekeeping)				
1. Security fence and gates				
2. Signage is installed				
3. Building and grounds				
4. Lighting				
5. Ventilation				
6. Stalking and storage (demarcated)				
7. Refuse removal				
8. Ladders, guardrails and stairs				
9. Check lifting gear				
B. Mechanical and electrical				
10. Check operations manual				
11. Check mechanical screens				
12. Check flow meter				
13. Check Amp meter				
14. Check level controls (floats)				
15. Check for switch gear and amps				
16. Check for corrosion				
17. Check for oil levels and leaks				
18. Check for valves and non return valves				
19. Check bearing temperature and noise (pump and motor)				
20. Check for pressure gauges				
21. Check Generator oil, water, diesel, battery and lights				
22. Check motor and cables				
23. Check electric panel (labelling of switches)				
24. Check telemetry system				

DAILY DIESEL GENERATOR INSPECTION CHECKLIST

Hints and Tips

Checklist		
A. Site (premises and housekeeping)		
1. Security fence and gates		
2. Signage is installed		
3. Building and grounds		
4. Lighting		
5. Ventilation		
6. Stalking and storage (demarcated)		
7. Refuse removal		
B. Routine inspection and procedures		
8. Start plant by operating green touch pad on Genset control		
9. Follow to run for about 10-15 minutes		
C. Do the following checks on Genset controller when the plant is running		
10. Generator volts - 525 volts ± 5		
11. Generator frequency – 50.0 Hz ± 0.5		
12. Oil pressure - must be more than 300 kpa		
13. Coolant temperature – must be less than 90 degrees Celsius		
14. Battery volts – must be 27.5 volts ± 0.5		
15. Stop plant by operating red stop touch pad, wait untill engine stopped completely and then select auto mode (auto touch pad)		
16. Ensure that the Genset controller is in auto mode		
17. Ensure that no alarm function is displayed		
18. Ensure that no rags or loose tools are lying about		

PERSONAL PROTECTIVE & ASSOCIATED EQUIPMENT (PPE) CHECKLIST

Hints and Tips

Checklist			
1. Overall		2. Face shields	
3. Pants		4. Dust mask	
5. Top		6. Respirator	
7. Raincoat		8. Ear protection	
9. Apron		10. Safety belt (harness)	
11. Gumboots		12. Gloves	
13. Safety glasses		14. Life buoys	

“Without backup systems, standby teams and pumps and the right spares in stock you cannot do effective incident maintenance”, says Cedric. “We have a spare assembly for each pump. In such an assembly there is typically the impeller, the oil seals and the bearings.”

Fencing and onsite security are a high priority on the plants.

“Cheap parts or materials can turn out to be an expensive mistake”. You have to be aware of incorrect sizing, substandard material and under-specified equipment when you order. I need a bearing that will last for five years; we only buy a specific type of German bearing, which we know will last.” The municipality has also realised the value of standardising equipment.

Electricity interruption is a major risk to compliance. A standby generator is in place to mitigate the risk and it is tested weekly to ensure reliable start-up when required.

“Plants are valuable and costly infrastructure. We give fencing and onsite security high priority. Our Assistant Superintendent and a number of the process controllers stay on the Paarl plant. I rely on them to support security”.

The evidence of these good practices can be seen on the Paarl plant: A 32 year old generator, a boiler that is 40 years old, screw pumps that are now upgraded after 32 years of service and 56 year old pumps, still shining and ready for another couple of years after their motors and Electrical Distribution Boards have recently been replaced.

Sampling, testing and measuring are the final proof of success and it underlies all and any decisions taken.

A mini-lab kit allows staff to do on-site testing for pH, nitrates, ammonia, ortho-phosphate and MLSS.

Fiab Contractors supports Cedric with proactive action and preventative maintenance. Fiab does a monthly inspection of the infrastructure of the plants, based on Drakenstein's preventative maintenance plan.

2.3.2.2 Good people need resources

Without resources, good people, with a passion for what they do, are limited and frustrated. Drakenstein ensures that budget and systems or processes are in place to support tasks.

"We make sure that we put at least 50% of the operating budget aside for maintenance", says Ronald Brown.

"It is also important that you support your people with good IT systems. We use the eWISA Municipal Assistant to extract meaningful information from data, such as trend analysis to track performance. For example, the programme can give you information on the history of a pump and the capital spent on the pump. Eventually you will be able to determine the remaining useful lifespan of the pump and also whether it exceeds its capital value. At the end of the month you can request a status report of all your equipment and submit this as part of the Monthly Operational Report."

Sampling, testing, and measuring are the final proof of success and it underlies all and any decisions taken. "We regard scientific services as a critical support service and regularly invest in upgrading our laboratory and its facilities" says Ronald Brown.

Cecil Paulse agrees: "We understand that everything we do in the laboratory impacts on the image and performance of the municipality."

All plants have been provided with mini-labs to test on-site for pH, nitrates, ammonia, ortho-phosphates and MLSS, at a cost of R12 000 per kit. Settling tests and Dissolved Oxygen tests can also be done at each site. The results show a 2% deviation from lab results, which make them fairly accurate. In this way, Process Controllers have fast access to results and can make process changes accordingly. Lab staff undertake field trips to link what is in the test tubes with with what is in the field.

Hints and Tips

The PF-12 Photometer (minilab kit)

This compact photometer comes in a rugged carrying case and includes:

- A software DVD;
- Manual;
- 4 batteries;
- 4 empty test vials;
- Funnel;
- Beaker;
- Syringe
- USB cable; and
- Certificate.

The PF-12 can be used for more than 100 pre-programmed tests, including pH, Ammonium, COD, Nitrate, Nitrite, Phosphate, Chloride, Chlorine, etc.

Price: ±R11 500

Contact: Shivaan Maharaj, Separations, PO Box 4181, Randburg, Johannesburg, 2125, shivaan@separations.co.za

2.3.2.3 Good people need mentors

"We value and respect the knowledge and experience of our senior staff", says Ronald Brown. The newer and younger team members choose them as their mentors and together they grow in experience. **"The value of an inspired and knowledgeable mentor cannot be measured."**

"When I started working at the George Municipality, Tony Bowers, a past president of WISA and also a Green Drop Lead Assessor, was my mentor. Tony drilled this into me: "You never contemplate low standards. Don't even dream of it."

2.3.2.4 Wastewater is more than just a job; it is a career

Drakenstein puts strong emphasis on skills development and career path planning for all their staff. Ronald Brown and his management team have regular one-on-one talks with staff members to discuss their individual ambitions and their concerns. This gives people the opportunity to build a career in wastewater management, as Frans van Rooyen's story illustrates.

Frans started out as a painter on the Paarl WWTP. He became interested in wastewater processes and the functioning of the plant and progressed to process controller. But that was not enough; he was curious to learn more. He asked questions and in his spare time he read as much as he could on the subject.

Noticing his curiosity and ambition, his superiors gave him the chance to attend courses and to grow his knowledge. Today he is the Assistant Superintendent at the Paarl WWTP and he still continues learning.

Drakenstein LM intends spending 1% of the R78 million that they are currently using to upgrade their infrastructure, that is R780 000, on practical training. From the funding for Phase 3, they hope to fund a staff member to do a B. Tech in wastewater management.

Hints and Tips

Below is a list of the courses that helped Frans to climb the 'wastewater knowledge ladder'.

- Transportation of Dangerous Goods - Sludge, Chlorine, Sewage, etc.
- NQF Level 2 (Water Academy) - Process control
- Safe Handling of Chlorine (Chlorchem) - The disinfection process
- First Aid Course (Medical Events and Training Services) - Occupational Health Safety Act requirement
- 6M Municipal Training (In-house Training) - Municipal Processes
- Free to Grow (In-house Training) - Management Tools, Self-Development, Communication, Handling Conflict Management, Human Relations and Assertiveness
- Process Controllers' Training Day (WISA)
- Health and Safety Representative Training (TechniLaw) - OHS Act Requirement
- Training Course Wastewater Treatment Management (CPUT) - Understanding Processes and reasons for Actions
- Entry Level Adroit Operations Course (SSE) -Telemetry
- NQF Level 3: Water and Wastewater practice
- N3: Water and Wastewater practice
- Computer Training

Ronald Brown with Samantha Lee Daniels, the chemical engineer intern and Harold Hoiting, an exchange student from The Netherlands.

Drakenstein LM is doing pioneering work in creating careers for women in wastewater. The women working on some of Drakenstein's WWTWs are: Daleen Kok, Danusia Williams, Jo-Ann Daniels, Joulene September, Nicolene van der Westhuizen, Zameka Ntsunguzi, and Jolene Geel.

Jo-Ann Daniels, the receptionist on the Paarl WWTW, had the opportunity to participate in an assessment on aspects of wastewater treatment. She surprised everybody with the best mark - 96%.

The Saron plant is in the care of Tanya Simons.

Drakenstein not only look after the career planning of their own staff; they have recently signed a Memorandum of Agreement with Overberg Water to make their facilities available for practical, on-site training.

Job titles are important in the context of making a career of wastewater. At Drakenstein, nobody is just a helper or a worker. You have a proper title, whether it is process controller or laboratory assistant or receptionist.

2.3.2.5 Close gaps in skills and capacity

You need to know your people and their limitations so that you can give them the support they need. Skills development is one way to close these gaps, but this takes time and could put compliance at risk.

Ronald Brown and his management team actively harness external resources to close capacity gaps. And all their staff is encouraged to do the same. For example, when process controllers go out on training, they are requested to come back with a list of at least 10 useful contacts that they could phone or email if and when they are stuck.

A chemical engineer is currently doing her internship in the laboratory. She is excellent with computers, inspections, design and putting quality assurance measures in place. During her internship, Drakenstein makes use of these skills. At the same time, it sets an example for their laboratory assistants.

2.3.2.6 Women in wastewater - exploring new resources

In view of the risk of scarce skilled resources, Drakenstein LM is doing pioneering work in creating careers for women in wastewater.

When the management team gave all the staff on their plants the opportunity to participate in an assessment on aspects of wastewater treatment, Jo-Ann Daniëls, the receptionist on the Paarl WWTW, surprised everybody with the best mark - 96%! An N3 at Overberg Water is her next goal and her aspirations don't end there.

The Saron plant is in the care of Tanya Simons. She was unemployed when she started at Saron. Three years later she has completed her NQF2 and she is currently busy with her NQF3. Tanya sets high standards for herself and the plant and will go out of her way to make sure that the plant's needs are attended to.

The municipality will participate in WISA's groundbreaking workshop, "Women in wastewater", which, which will be held in October 2012 in Ceres as part of the Western Cape Process Controller Open Day.

2.3.2.7 Involve them

It becomes a big risk to wastewater management if people don't understand why they are doing certain tasks. "We encourage our people to ask questions and to give feedback", says Ronald Brown.

The WHYs of wastewater are asked and answered every time when the plant supervisors walk through the plant with their teams.

Hints and Tips

AT THE INLET WORKS		
WHY… ?	**BECAUSE …!**	**IF NOT, THEN...**
Why do I need to remove screenings, grit and sand before the primary and secondary treatment process units?	Inert materials block up mechanical equipment and cause failure. It also accumulates in the treatment units and leads to diminished capacity and anaerobic conditions.	• Smelly ponds. • Expensive to remove solids from treatment structures.
Why do I need to monitor flow to the works?	To measure is to know! Flow measurement is important to ensure that the flow to the plant does not exceed the design specification of the plant.	The flow will exceed the capacity and will not produce good quality effluent.
Why is it important to sample and analyse raw influent to the plant?	The plant is designed to receive a certain organic loading – measuring the actual loading to the plant assists to: • determine its status; • see if undesirable elements like abattoir waste are coming into the plant; and • to see if high water losses come in – by checking if the COD is >300 mg/l.	• Low performance of the plant and poor effluent compliance. • Overflowing at inlet works. • Perceptions that the works are 'overloaded' and need different technologies, plant upgrades are considered – without addressing the root causes first.

The WHYs of wastewater

AT PRIMARY SETTLING TANKS		
WHY… ?	**BECAUSE …!**	**IF NOT, THEN...**
Why must a settling tank be desludged?	The tanks will be operated within its upflow velocity and give good separation between the sludge and liquid phases of the sewage.	Malfunction of the tank and carry-over of sludge to the secondary treatment units
Why must the right volume of sludge be removed – (not over or under desludging)?	Too little sludge: • Overloading of the treatment unit. • Poor affluent quality and poor disinfection. Too much sludge: • Difficulties to dry or digest the watery sludge in the drying beds or the anaerobic digesters. • Poor thickening, dewatering and drying of sludge • Poor anaerobic digestion performance	• Overloading of the treatment unit results in poor effluent quality and poor disinfection. • Drawing off too much sludge results in difficulties to dry or digest the watery sludge in the drying beds or the anaerobic digesters. • Poor thickening, dewatering and drying of sludge • Poor anaerobic digestion performance.

AT BIOFILTERS and ROTATING FILTERS		
WHY… ?	**BECAUSE …!**	**IF NOT, THEN...**
Why must the biofilter arms and centre column be cleaned and repaired?	• These structures are critical to ensure even distribution of the sewage over the biofilter material for optimal treatment. • To allow sufficient oxygen transfer to the filter media to ensure nitrification.	• Sewage will be applied to selected areas of the filter only, resulting in short circuiting, blocking and poor treatment of the sewage. • Poor nitrification results in poor effluent quality.
Why must the rocks or filter media be kept humid and supplied with continuous flow?	The bacteria that grow on the filter media need a constant supply of nutrients to survive and treat wastewater. Oxygen must move freely through the filter bed to ensure optimal removal of nitrogen.	The bacteria will 'starve' and no means of treatment (biological) will be taking place, resulting in poor effluent quality.
Why must recirculation pumps work on high rate biofilters?	High rate biofilters are designed to receive additional nutrients to produce higher quality effluent by recirculating a part of the effluent or sludge to the biofilters.	Decreased biofilter efficiency and poor effluent quality.
Why must the underdrains be kept clean and free of debris and algae?	Algae carry a high COD which, if sampled with the effluent, will result in non-compliant COD and SS values.	Non-compliant effluent quality.

AT HUMUS TANKS		
WHY… ?	**BECAUSE …!**	**IF NOT, THEN...**
Why must the weirs be clean and clear of fungus and solid materials?	To ensure clear effluent overflow of good quality.	Poor effluent quality and high chlorine demand.
Why must grease be absent from scum wells?	To look and smell good and keep flies under control i.e. **Good housekeeping!**	Grease in the final contact chamber does not present well and causes unpleasant odours.
Why must the tanks be desludged regularly?	To prevent sludge belching.	Poor effluent quality, poor compliance and high (costly) chlorine demand.

The weirs of the humus tank must be clean and clear of fungus and solid materials to ensure clean effluent overflow of good quality.

AN ACTIVATED SLUDGE REACTOR		
WHY… ?	**BECAUSE …!**	**IF NOT, THEN...**
Why must all pumps, mixers and aerators or compressors be in working order?	Activated sludge processes are sophisticated and dynamic. They rely therefore entirely on functional, working equipment to control their operational parameters – that is, introducing oxygen and recycling mixed liquor.	Poor efficiency and poor effluent quality, as optimal nitrification, denitrification and phosphate removal cannot take place.
Why must SVI, DO, MLSS and temperature be determined?	Activated sludge contains 'biological agents' that can only function when their conditions are right. These parameters give valuable information pertaining to the bugs' settling potential, density, oxygen levels and temperature.	Process control and process optimisation cannot take place, leading to malfunctioning processes and poor effluent quality.
Why must sludge be 'wasted' from the reactor?	All Activated Sludge processes are designed to operate at a certain sludge age at specific temperatures. Sludge wastage assists to control and manage the age of the sludge.	High sludge age will compromise the equipment and effluent quality, whilst low sludge age will result in white foam and insufficient bugs to perform their treatment duties.
Why is 'foam' on the reactor not good?	• White foam indicates low COD inflow, meaning too little food to the reactor. • Thick brown foam indicates filamentous microorganisms which will compromise sludge settling.	The food: microorganism ratio is disturbed, meaning that the treatment process is compromised. • In the case of 'white foam', stop sludge wastage from reactor until higher MLSS is achieved and/or check if excessive oxygen is introduced (keep <2.0 mg/l). • In the case of thick brown foam, wash the filamentous organisms from the system and avoid recycling this waste sludge back to the reactor. Low dosages of chlorine to the film could also be applied.
Why is a high MLSS better in peak tourism periods or winter (low temperature)?	High loading to the plant or low temperature result in strain on the bugs to perform their duties. Raising the sludge age and mixed liquid will retain additional micro-activity in the basin for additional treatment functionality.	Poor effluent compliance.

AT CLARIFIERS		
WHY… ?	**BECAUSE …!**	**IF NOT, THEN...**
Why must the secondary clarifiers be desludged?	To ensure a distinct separation of the liquid and sludge phases in the mixed liquor.	• Poor disinfection of overflow. • Sludge treatment will be compromised. • Quality of recycled sludge compromised.
Why must the bridge turn (if any) and the weirs and channel beds be cleaned?	The sludge scraper bridge transfers sludge to the middle of the tank for optimal removal. The removal of fungal material in the weirs and channel beds presents the inspector with a clear and aesthetically pleasant impression of the treated effluent.	• Sludge build-up. • All the hard work of nutrient removal during the treatment process will be nullified. • Poor effluent quality and high chlorine demand (costly).

AT OXIDATION AND MATURATION PONDS.		
WHY… ?	**BECAUSE …!**	**IF NOT, THEN...**
Why do I need to remove surface growth algae from the ponds?	Algae is involved in nitrogen conversion and removal in pond systems. Optimal ammonia removal takes place when algae growth is controlled by harvesting. Dense algae growth depletes (natural) oxygen from the pond waters and result in 'anaerobic' conditions which hamper ammonia conversion.	• High ammonia in final effluent. • High phosphate concentrations in final effluent. • 'Septic' smells.
Why do I need to desludge periodically?	Sludge build-up depletes the available capacity of the ponds or dams and compromises effluent (overflow) quality.	Poor effluent quality, anaerobic (septic) conditions in the dams or ponds.
Why do I need to sample ponds and dams?	Trend analysis of nitrogen and phosphate over time are valuable indicators of the status of the ponds or dams.	The ponds' efficiency will be compromised. You cannot make corrections if quality is not measured and trends analysed over time as part of routine monitoring.

AT THE CHLORINATION CHANNEL		
WHY… ?	**BECAUSE …!**	**IF NOT, THEN...**
Why do I need to chlorinate at the final point of delivery	Pathogenic microorganisms reside in the final effluent and need to be eliminated before the effluent enters the water sources.	• Downstream users who drink the water from the stream/ river could become very ill – gastro, etc. • Farmers who use polluted water for crops and animal feed can suffer losses, because of health and disease associated with polluted effluent.
Why is microbiological sample preservation important?	The purpose of sample preservation is to minimise chemical and biological degradation until the sample can be analysed. If a sample is not analysed immediately after collection, it must be properly preserved or the results of that sample will not be accurate.	Inaccurate E coli / Faecal coliform and residual chlorine values will be obtained.
Why is a chlorination (contact) channel important, why should it be kept clean, and why is disinfection not effective in the presence of ammonia and solids?	Chlorine needs a minimal contact time to react with the pathogens for optimal disinfection. If the channels are dirty, i.e. have high solids or high ammonia levels, the available chlorine reacts with the solids and ammonia first, instead of the pathogenic organisms. The organisms thus remain active to cause disease.	• Poor microbiological effluent quality. • Unnecessary high cost of dosing. • Formation of harmful by-products with chlorine.

ON ANAEROBIC DIGESTERS		
WHY… ?	**BECAUSE …!**	**IF NOT, THEN...**
Why must a constant sludge feed be ensured?	Anaerobic digesters are sensitive biological systems. The digesters' performance will decrease if shock loaded.	Unstabilised sludge and loss of bacteria from the digester.
Why must open flames not be used around manholes and anaerobic systems?	Methane is formed during the anaerobic digestion process – it is an explosive gas when mixed with low concentrations of oxygen or when exposed to flame or spark.	Fires and explosions could results in loss of human life and severe infrastructure damages.

ON SLUDGE DRYING BEDS		
WHY… ?	**BECAUSE …!**	**IF NOT, THEN...**
Why must sludge be applied to specific depths to the drying bed?	Sludge drying beds use solar (sun) exposure to dry so that it is easy to remove and transport or bury the dry sludge. Sludge application must take place in accordance with the drying bed design specifications to achieve good sludge character and quick drying times.	Sludge beds will become over-loaded swamps, which will encourage fly breeding and plant invasion.
Why must the underdrains be kept clean and valves / sluices kept in place?	To ensure that any water still remaining in the sludge can be extracted and returned to the plant for final treatment. Valves, pipes and gates are vital equipment to assist with the operational duties.	Poor sludge handling and undesirable sludge quality.

ON THE TERRAIN		
WHY…?	**BECAUSE …!**	**IF NOT, THEN...**
Why must the paving be cleared of plant growth and sand/soil?	Plant growth weakens the civil structures over time and results in early deterioration of the structures. Also, it appears untidy and is evidence of poor housekeeping.	Unsafe walkways and costly replacement of infrastructure before end of planned life duration.
Why must buildings be painted, correctly colour coded and offices kept clean?	The workplace is direct evidence of the person who works there: A sloppy, dirty workplace will indicate sloppy and poor work practices, whilst a clean workplace indicates a disciplined person who takes pride in his work.	Every aspect of the plant is likely to be compromised as the lack in care and work discipline will carry through to all aspects of the plant process, maintenance and operation.
Why must treatment plants be fenced and clearly marked?	Wastewater treatment facilities are not a safe environment for children, animals and people who do not understand the processes. Health and safety regulations require good security and warnings where needed.	• Cattle and children drowning in ponds and tampering or vandalism of plant equipment are well recorded. • Costly repairs and replacement are needed when theft occurs and insurance entities do not insure such replacement as easily anymore.

ON HUMAN CAPITAL – PEOPLE!		
WHY…?	**BECAUSE …!**	**IF NOT, THEN...**
Why must municipal decision makers value, retain and invest in wastewater practitioners?	The expertise of the plant managers, supervisors, process controllers, laboratory technologists and maintenance team is SCARCE. Billions of rands of infrastructure cannot be left to staff who do not have the skills, qualifications and competencies to perform their duties on a plant.	• Plant failure! • Environmental pollution! • Disease outbreak! • Revenue collapse! • Municipality collapse!

Drakenstein's human capital

The mini labs allow the plant process controllers to experience the excitement of compliance and grow their expertise. Cecil has given each process controller a programme of the samples that they must take and the tests that they should do every four hours and they also receive instructions on how they should standardise their equipment. Once a month, Cecil or his assistant or the student goes out to the plant and ask questions, such as: "Show me how you use this buffer to calibrate your pH meter" - just to create confidence.

Staff on all levels participate in decision making: "For example, the Senior Supervisor and the Assistant Superintendent sit in on meetings with consulting engineers when we scope plant upgrade projects. Their contributions in these meetings are unique, as it is practical and very site specific. **Involvement and partaking in the decision-making process breed ownership for life – as they have then been part of the decision".**

2.3.2.8 Nurture ownership

Ownership is a critical ingredient of any winning team. People must take responsibility, not only for their own tasks, but for the Green Drop status of their plant and the wastewater treatment in their municipality in general.

"It is important for us that all our people understand and share the long term vision for wastewater in Drakenstein, which is to be 200% compliant", says Ronald Brown.

To achieve this, every person must understand where he or she fits into the bigger picture. I think we still need to do more to get that awareness", says Cecil Paulse.

Ownership also implies pride in the contribution your work makes to a healthy environment. "We say to our people: 'TALK about your successes and pleasure in work: Talk about your job and its importance outside of the work environment. Start with your own family. **Changing perception is part of elevating the image of wastewater. It is not about 'sewage' – it is about the wonder world of nitrates, pH, bugs and science."**

Changing the face of wastewater is not just talked about, but 'done' at the treatment plants. Initiatives include a state of the art boardroom with library and computer centre, stylish finishing, a bird look out right next to the plant, beautiful gardens and landscaping.

2.3.2.9 Put management processes in place to facilitate good communication

It is no good encouraging staff to speak their mind if there are no opportunities to do so. Every Monday morning, Cedric Morkel meets with the process controllers from all the plants in the new boardroom at the Paarl WWTP. And each week, he visits a different plant to discuss on-site issues.

Regular meetings of the Workers Forum, Safety Forum and Waste Minimisation Forum offer further opportunities for staff to participate in the wastewater business.

Cecil Paulse demonstrates one of the tests that process controllers can do with the minilab kits

Drakenstein staff are very proud of the work they do and the contribution they make to a healthy environment. From left to right are: Willem Williams (Tractor Driver), Ricardo Hendricks (General Worker), Ronald Brown (Engineer: Waste Water), Nicolene v/d Westhuizen (Machine Operator), Kobus West (Assistant Process Controller), Markham Krautz (Painter) and Cedric Morkel (Senior Superintendent).

Ronald Brown and Cedric Morkel discuss on-site issues.

2.3.2.10 Of course there are challenges

Different personalities require skilful differentiating management strategies.

Ronald Brown explains: “Sometimes a manager is too soft-hearted to discipline his staff and then you need to strengthen his hand with external support or by calling on legislative requirements. Or a manager might be over-confident to make decisions, then you have to emphasise that you have to take responsibility for every decision that you have made. “

“When somebody has been in a senior position for many years, they become reluctant to change. You need to manage these sensitivities. Instead of trying to force change, it works better to ask the question: What do you suggest we do?” This approach empowers the person to take the decision to change and, at the same time, you achieve buy in on change.

2.3.2.11 The Green Drop brought a new dimension to motivation

“The Green Drop has put us on a new level of motivation. Our plant managers now all want to be the best and they insist on the support and the resources that they need. Tanya nags Cedric to visit Saron more regularly; Shane at Pearl Valley does the same, because he wants his plant to be the best. Oom Robert never liked paper work, but the Green Drop assessments inspired him to cover his files, add pictures and make sure they are updated… the Green Drop created that kind of excitement.”

“We don’t want to be ready for a Green Drop assessment, because we are expecting the auditors. We want every day to be a Green Drop Day. Green Drop must be a long term implementation of good practice. We want to be at a level where we can compete with the best.”

“With our achievement on the Green Drop score, we want to hold our municipality’s name high, as well as that of our politicians, our senior managers and also our community”, says Ronald Brown.

2.4 Managing the managers - turn reporting into support

The Drakenstein team uses the mandatory requirement for a W_2RAP positively as a management tool to work towards achieving Green Drops for all six plants. Within this framework, **risk abatement becomes a PROCESS to bring focus and priorities to the decision-making table.** Everyone understands the concept of ‘risk’, especially the financial decision-makers.

“As resources are scarce, we always ask two questions before any expenditure: ‘Will this save money for Council?’ and ‘Will this be the best use of public money?’”

The team makes it their mission to understand, embrace and implement the vision and priorities of the Councillor (s) and make him or her look good. This builds relationships, trust and serves the core function of the municipality, which is service delivery.

The Mayor, Councillors and Executive Director are invited to visit the plants and gain first-hand experience. Spot inspections and reporting mechanisms, such as the W_2RAP, Safety Plan, etc. are used to communicate with management and Council and to establish relationships and trust, because they obtain and leverage financial and other support.

“We know that people are competitive by nature, and that they love recognition. Therefore, if your Mayor, Municipal Manager or Executive Director wants to be the best, you make him or her the best.”

2.5 Share your knowledge and learn from your colleagues

Drakenstein LM believes that risk mitigation is a collaborative effort. It is important to complement your own capacity limitations with capacity that can be found elsewhere.

2.5.1 Working with Water Affairs and harnessing the support of SALGA, WISA and other support organisations

The municipality draws strongly on the support and expertise that the Department of Water Affairs (DWA) and SALGA have to offer.

The Western Cape Water Care Forum is an example of a joint initiative of Water Affairs, SALGA and the municipalities in the Western Cape.

“We told each other, we don’t need money, we need each other to network and share knowledge. Every six months, all the water and wastewater managers up to superintendent level meet. Water Affairs draws up the agenda. Part of the agenda is an information session to update us on new legislation,” says Ronald Brown.

The next two-day work session will be in Beaufort West. Drakenstein LM will be presenting their W_2RAP to the group. An expert will take them through the new SANS 241 water quality standard; Leonardo Manus will talk about Regulation 17 and last, but not least, they have the professionalisation of Process Controllers on the agenda.

The long term goal is to form conglomerates of neighbouring municipalities that can report back to the meeting on how they have applied the knowledge. This will help the smaller municipalities.

2.5.2 Relationship with other municipalities

Drakenstein strongly believes in exchanging ideas and solutions with other municipalities.

Ronald Brown explains: “A year ago, we felt that everybody was operating in their own cocoons, although we share a common goal. So we came together and decided that in five years’ time every municipality in the Western Cape must have a Blue Drop and a Green Drop. And how are we going to achieve this? **“We have to work together.”**

Drakenstein and the Western Cape WISA branch then came up with this initiative to hold an Open Day for Process Controllers in partnership with Water Affairs and SALGA. The Directorate: Water Regulation, gave each delegate a certificate, for which their municipality received a bonus point for their Green Drop and Blue Drop assessments. Experts were invited to give practical talks on the Blue Drop and Green Drop criteria and the different aspects of process control, such as pumps and chlorination. The delegates rotated between the different ‘knowledge stations’.

The day was a huge success. 300 process controllers from as far as Namakwaland attended the day.

Last year in November, WISA (Western Cape) organised the second Open Day in Caledon. The theme for the day was ‘Process Controller Open Day for Process Controllers by Process Controllers’. All the presenters were process controllers. This demonstrated that the sector recognises the knowledge, skills and role of each individual and each level of worker.

The Western Cape Water Care Forum is another platform where Municipal Water Care Managers meet every six months (over two days) to discuss with colleagues, DWA and SALGA, how to improve the operations of their respective facilities.

Drakenstein’s support for peer learning extends, however, beyond these initiatives. The wastewater team has regular contact with neighbouring municipalities. “Someone would phone me from Laingsburg to say, Ronald, I have a problem with sludge (build-up) in my oxidation section, what must I do? Or Frans would meet up with someone in Worcester and they would talk and exchange solutions and follow it up with an e-mail. We learned best practice in oxidation pond management from Carnarvon. We visited eThekwini to investigate best practice in managing industrial effluent. In this way, we are working together to achieve Blue and Green Drop status.”

Drakenstein LM held a Process Controllers Open Day to recognise the important work that process controllers do.

2.6 Bring in the experts

Drakenstein LM complements internal capacity with external expertise to achieve their goals.

The wastewater management team regularly uses external consultants and specialists to bridge gaps when they urgently need a solution and lack capacity; they budget for these circumstances and motivate them strongly. However, such support areas are clearly defined, scoped and managed. At the same time, the specialist input is used to build internal capacity.

Examples:

- They use external specialists to conduct an independent Green Drop audit every quarter and to suggest actions to improve compliance. In this way, the validation phase of the W_2RAP is also adhered to.
- External laboratories assist with monitoring effluent quality. They also do the quality assurance of their laboratory and assist with recommended actions.
- A consultant firm was appointed to do a safety audit and an integrated management plan for industrial effluent.
- Prof Lagardien of the Cape Peninsula University of Technology has been approached to perform a Human Capital Development audit, which will inform the municipality on career pathing and training priorities for its staff. This initiative will address risks associated with staff.
- In 2008/9, consulting engineers compiled a storm water management system for Wellington, Gouda, Hermon and Saron to identify all possible areas where surcharges may occur to quantify and prioritise problem points. The project also included a flood-line study for the Berg River, Spruit River and Leeu River in Wellington.
- A consultant was appointed to monitor other effluent discharges into the Berg River between Paarl and Stellenbosch. For example, there are three large correctional institutions in the area: Drakenstein, Allandale and Perdeberg. They treat their own wastewater and discharge into the river.

The Berg River

2.6.1 Keeping the Berg River clean

In 2009, a provincial task team delivered a report on the state of the Berg River. The report stated that the Berg River was in crisis and that it affected fruit and wine exports to European markets. Urgent steps needed to be taken.

The provincial government established the Berg River Task Team to monitor the implementation of an action plan. The Task Team includes the municipalities along the Berg River, relevant provincial and national departments, and agricultural stakeholders.

Drakenstein LM continuously engages with the Deciduous Fruit Trust and the Upper Berg River Irrigation Board on ways to reduce pollution and on water quality matters.

The municipality's agreement with the Irrigation Board is that it will comply with the standards that Water Affairs has set. To date, Drakenstein has spent R300 million on upgrading their treatment plants so that it could meet effluent standards.

It is Ronald Brown's policy that the municipality should cooperate with all stakeholders involved and he has been commended by Water Affairs for his contribution. His approach is: "...do not shy away from angry farmers, embrace the issues, seek solutions and report back regularly".

Workshop particapints active in the labarotory

At some point, different stakeholders were taking samples for analysis independently. When this was discussed at the Irrigation Board, the municipality proposed that the effort be coordinated. Nine points and nine coordinates were identified and Dr Jo Barnes of the University of Stellenbosch was tasked to coordinate the monitoring and to report regularly to the Board. They share the results and collectively discuss actions that need to be taken.

2.6.2 Funding and exchange programme with the Netherlands

It is not only local expertise that is harnessed to improve wastewater management. Drakenstein LM participates in the process controller exchange programme of WISA and the Netherlands Water Partnership (NWP). The municipality has also applied for assistance from the Dutch Ministry of Foreign Affairs. The Facility for Infrastructure Development (ORIO) is a grant for public infrastructure development in developing countries.

2.7 Turning the waste dischargers around to cooperateand self-regulate

Industrial effluent is another important risk factor that the municipality has to manage.

Drakenstein's approach is to focus on the people behind the effluent and to get them to co operate and regulate themselves. It comprises a few basic steps:

- know your customers;
- learn from best practice in other municipalities;
- talk directly to the CEO; and
- seek solutions instead of pointing fingers.

A case study illustrates their approach. "In Wellington, the municipality was experiencing a big problem with a company that produces fruit juices. Their effluent had a very low pH, as low as 1.4, and this was destroying our rising main and putting the Wellington plant under pressure. It was going to cost R2,8 million to replace the pipe."

The team decided to take action: "We talked to the company and put both options on the table: either you help us or you will have to pay as the by-laws determine or we will isolate your effluent and your permit will also be taken away. It was a difficult discussion; their initial attitude was negative, but in the end they agreed to help us. They spent hundreds of thousands of Rands to correct the pH of their effluent, they implemented water balance tests and for the past year we had no further problems with contraventions of the bylaws. We wrote a letter to them, thanking them for their cooperation."

It is very important to know your customers. The municipality is currently undertaking a project to identify the 50 highest water users, the argument being that these will also be the highest industrial effluent producers. When the database is ready, they will visit each of these industries, analyse their effluent, inspect their permits or lack of permits and get them on their system. They will also decide where an impact study will be necessary.

"We are applying the lessons that we learnt at eThekwini. We are developing a formula for waste dischargers that we want to sell to the local business chamber and all role players. In terms of this formula, we want to implement an incentive-based tariff with a window period of a year. We will give a company a year to develop a strategic plan that the Board and the CEO must sign. The plan must be made up of:

a. A detailed description of the quantity and composition of the effluent at each fall out point;
b. A monthly implementation plan with specific targets, for example pH and CODs, that we can monitor. If the plan does not have the desired effect within three months, we will charge penalties.
c. A storm water management plan; and
d. A waste reclaiming plan."

Drakenstein's approach is to focus on the people behind the effluent and to get them to cooperate and regulate themselves.

3 Conclusion: The buck stops with you

Of all the relationships that a wastewater practitioner has, the one with him or herself is probably the most critical.

Fear of failure, fear to dare and failure to take responsibility are critical risks, not only for personal growth and a career, but also for the wastewater systems that the individual is responsible for.

“I have learnt that you have to be brutally honest with yourself, but you must also believe in what you are doing to be successful”, says Ronald Brown.

For Cecil Paulse, the road to personal success can be summarised as follows:

4 The way forward

Drakenstein LM’s wastewater team has many plans and dreams for the future, not only for their individual careers, but for wastewater management and the municipality in general.

Cecil Paulse shared his ACTION list with the researchers:

- A steady increase in Green Drop scores until they achieve 100% compliance.
- Actively improving all the time (and **measuring** improvement).
- Accreditation of Drakenstein’s municipal laboratory. The goal is for the laboratory to become profitable providing a testing service to outside entities.
- Pride in wastewater.

The WIN-SA lesson series aims to capture the innovative work of people tackling real service delivery challenges. It also aims to stimulate learning and sharing around these challenges to support creative solutions. To achieve this, the lessons series is supported by ancillary learning opportunities facilitated by WIN-SA to strengthen people-to-people learning.

To find out more about these and other WIN-SA services go to the WIN-SA portal at www.win-sa.org.za or contact the Network directly.

This document hopes to encourage ongoing discussion, debate and lesson sharing. To comment, make additions or give further input, please visit www.win-sa.org.za or send an email to info@win-sa.org.za.

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Address: 491 18th Avenue, Rietfontein, Pretoria
Postal Address: Private Bag X03, Gezina, 0031
Tel: (012) 330 0340 Fax: (012) 331 2565
E-mail: info@win-sa.org.za
Website: www.win-sa.org.za

DRAKENSTEIN
MUNISIPALITEIT • MUNICIPALITY • U MASIPALA WASE

Bergriver Boulevard
South Africa
Paarl
7622

The Municipal Manager
Tel: 021 807 4500
Fax: 021 872 8054
Email: ceo@drakenstein.gov.za

WATER RESEARCH COMMISSION

Marumati Building
c/o Frederika Street and 18th Avenue,
Rietfontein, Pretoria

Telephone: +27-12-330-0340
Fax: +27-12-331-2565
E-Mail: info@wrc.org.za