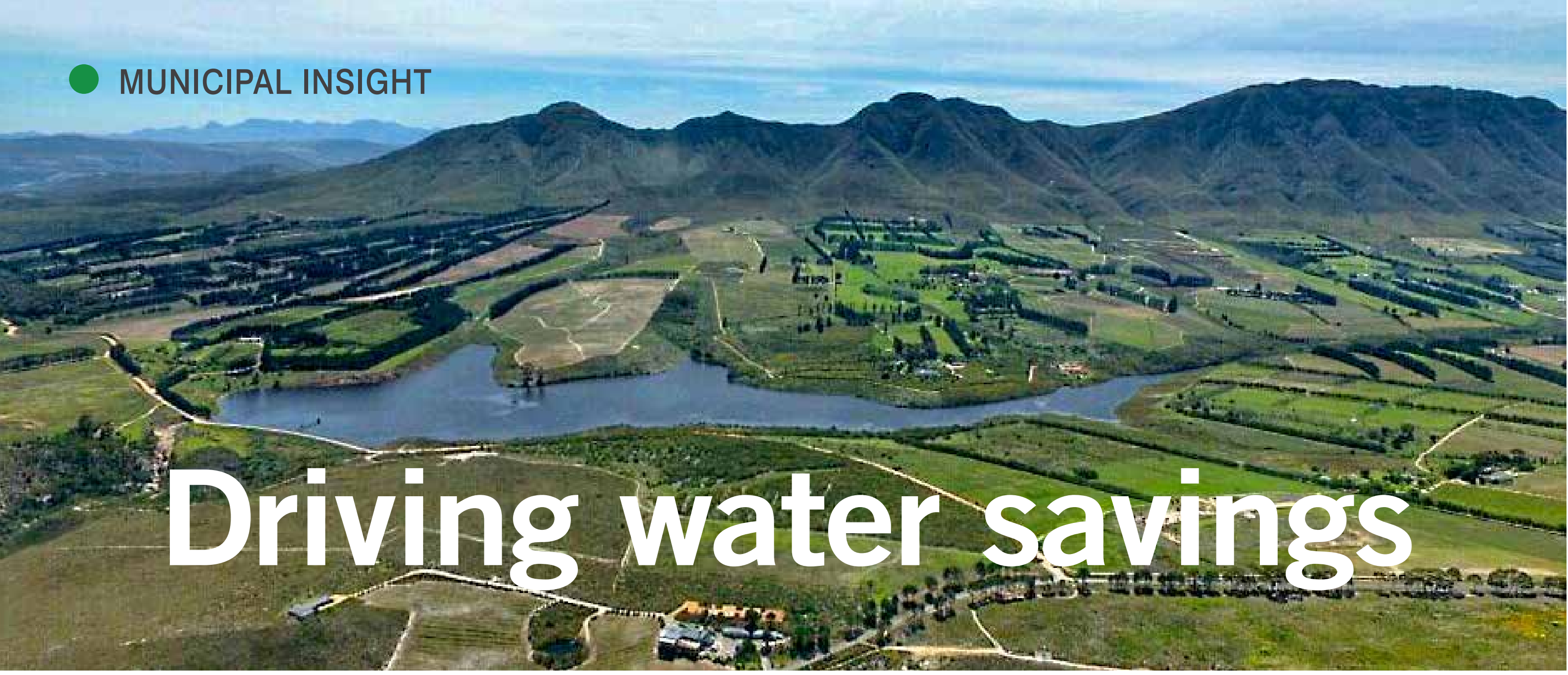


Driving water savings

In 2008, water losses in the Western Cape's Overstrand municipal area stood at almost 30%, and were on the rise. In an effort to remedy the situation, the council adopted a turnaround strategy, with the aim to reduce water losses to 17% by 2017. **BY DANIELLE PETTERSON**

OVERSTRAND'S EXTENSIVE turnaround strategy, part of the Integrated Development Plan, included its aggressive replacement of ageing pipes, installation of intelligent pressure management systems and the phased replacement of ageing water meters. A focus was placed on leak detection and repairs, particularly repairing household leaks at indigent households, and improving telemetry systems for the monitoring of minimum night flows.

Managing water balances in smaller distribution zones, and maximising the use of treated effluent for irrigation, also became a priority under the strategy and the municipality began to proactively source external funds for water demand management projects.

Public awareness on water issues was seen as another way to increase water savings; water tariffs were structured to discourage excessive use of water, accompanied by volumetric sewerage tariffs based on water consumption.

The result is a 21.1% reduction in water demand, despite a rapidly growing population, Hanré Blignaut, deputy director: Engineering and Planning, Overstrand Municipality, tells **IMIESA**.

Developing a water and sewer master plan

GLS Consulting performed the first master planning of the water and sewer networks in Overstrand in 2006 and has since been involved in a number of updates of these master plans. As consultant, GLS has played a major role in initiating some of the municipality's major water loss reduction projects.

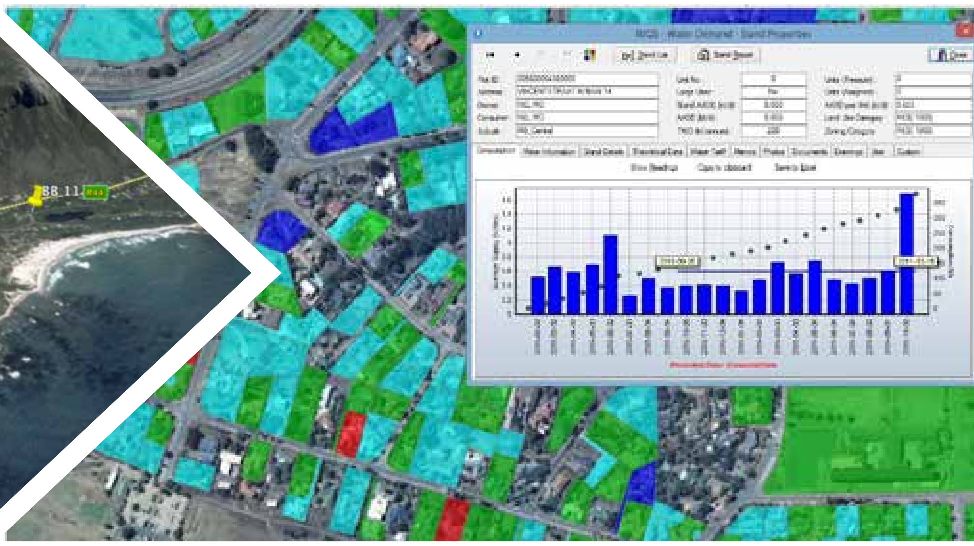
"GLS has contributed significantly to the successes achieved with water demand management in the Overstrand Municipality through the company's highly professional services rendered over the years," says Blignaut.

According to him, continuous accurate flow data is one of the biggest challenges in terms of water loss management. Hanré Streicher, director, GLS Consulting, adds that the integrity of the data is an important issue to keep in mind when evaluating the results from a master plan. In the process of compiling a hydraulic model to represent the existing distribution network, it is important to gather the best available data and get it verified by field personnel, he explains. To further improve the confidence level of the hydraulic models, a degree of calibration is needed. In the case of water, the hydraulic models are calibrated using bulk water measurements, pressure loggings and flow loggings in the various distribution zones. There is always scope for improving data integrity, but funding constraints normally limit the efforts in this regard. In the case of Overstrand Municipality, each update was also an opportunity to resolve queries and gather outstanding network components, thereby improving the data.

(Left to right) Goosen le Roux, manager: Bulk Water & Sanitation; Patrick Robinson, manager: Water Infrastructure & Quality; Mike Bartman, deputy director: Operational Services; and Hanré Blignaut, deputy director: Engineering and Planning

Managing pressure is managing loss

During the modelling and master planning of the water distribution networks, the



ABOVE LEFT Logger locations in Betty's Bay

ABOVE RIGHT Integration of water pipe and billing into one system in the master plan

potential for pressure management was also assessed. The areas with the biggest potential for pressure management were identified as Kleinmond, Stanford, and Betty's Bay. GLS was able to conceptualise specific pressure management projects for budgeting and planning purposes, to be implemented by the municipality.

"Pressure management has arguably been proved to be the most effective water demand management measure implemented at local municipalities," says Streicher. "Changing the network characteristics by creating smaller district management areas and reducing pressures should simply not be done without, first, taking into account the degree of network conveyance that is forfeited and, second, determining the critical point – the point where minimum pressure during peak demand conditions is experienced. These investigations are best performed by using sophisticated hydraulic modelling software," he adds.

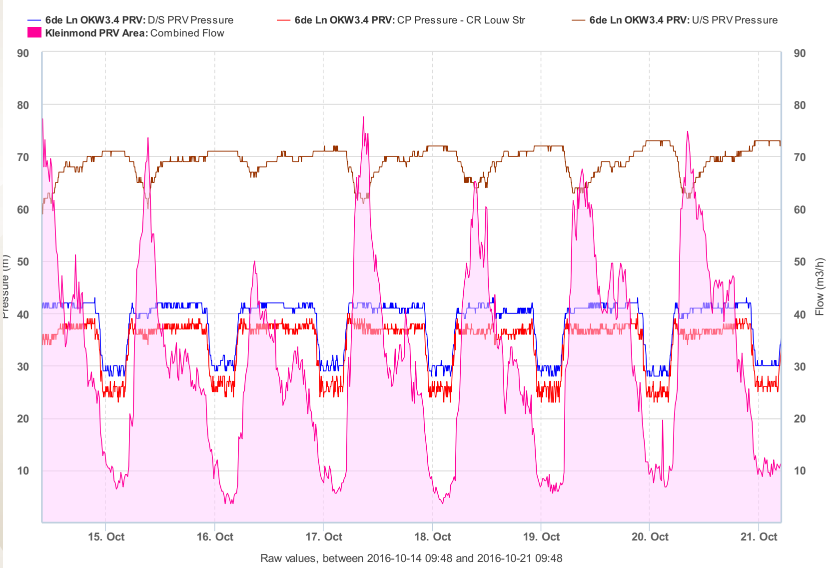
WRP acted as the specialist subconsultant in the implementation of the Kleinmond, Stanford and Betty's Bay pressure management initiatives. WRP was responsible for the pressure management feasibility assessments, logging and analysis of flows and pressures, input with the design process, and the final commissioning of the pressure reducing valves (PRVs) and smart pressure controllers. The company also supplied the Zednet data logging and evaluation software which was used to monitor the actual flows and pressures on a "live" cloud-based system.

PRVs and flow controllers were installed in phases in these areas to reduce the pressures of typically up to 7 bar to 3.5 bar during the day, and 2.5 bar at night at the critical points (the highest elevated points of consumption in the various zones). The average daily flows and minimum night flows reduced substantially in these areas along with pipe bursts.

In Kleinmond, water savings from pressure management amounted to 100 000 m^3 or R900 000 per annum, and pipe bursts were reduced from 107 to 62 per year – at a cost R3 500 per pipe burst – adding up to R160 000 a year, says Neil Meyer, manager and technical specialist, WRP. In Stanford, water savings from pressure management amounted to 49 000 m^3 or R420 000 a year, and pipe bursts were reduced from 19 to 9 per year, amounting to an annual saving of R35 000.

"There is always a fine balance between sophistication and appropriate technology, and this is a challenge that water managers must address," says Meyer. When using smart controllers in a water distribution system, you are effectively adding functionality to a standard PRV through the use of either an electronic or hydraulic controlling device.

According to Meyer, there is no single solution that will address every problem and, while there are some very sophisticated forms of pressure control currently available, in most cases, the most basic time control or slightly more sophisticated flow control will provide a reliable and sustainable solution. Effectively, these forms of pressure control will reduce excess system pressures during off-peak periods, thereby reducing losses through



Kleinmond's PRV zone pressure and flow logging results recorded by Zednet

existing leaks and reducing the occurrence of new leaks.

According to Blignaut, the locally developed Zednet real-time, internet-based monitoring and logging system was instrumental to the success of the projects.

WRP installed Technolog GSM loggers to monitor flows and pressures in the PRV zones, with live data from these loggers relayed to Zednet. Zednet allows the user to view, manage and export the pressure and flow data from any computer, tablet or smartphone and it provides functionality to set up alarms, automatic reports and invoices. Using a "live" logging system of this nature helps water reticulation managers to pick up leaks and other operational problems as soon as they occur; by taking immediate action, they can reduce the volume of water lost through a new leak or prevent a small operational problem from becoming a serious one.

Aggressive pipe replacement approach

In order to drive the replacement of ageing pipes under the turnaround strategy, GLS Consulting developed a water pipe replacement model for Overstrand Municipality in 2009. This model, which has subsequently been updated and refined, assists the municipality in prioritising which pipes are to be replaced within the available annual budget.

The pipe replacement potential (PRP) for any pipe in the water distribution network is assessed by combining two critical indices: the likelihood of failure (LF) and the consequence of failure (CF). Each index comprises factors that are individually scored and then summated using weights. The factors for LF are typically the material, age, diameter, condition, pressures and historic failure rate of each pipe, while the factors for CF are typically potential repair cost, potential damage, strategic location, and lack of redundancy, explains Streicher.

Workshops were held with Overstrand to determine the factors and their respective weights. The two indices are multiplied to obtain a risk-based PRP per pipe, which is then ranked from highest to lowest. The highest-priority pipelines can then be identified per area and replacement can then be planned and budgeted for.

The pipe replacement work consists largely of the replacement of old asbestos pipes with new HDPE pipes, using trenchless methods. By installing continuously butt-welded HDPE pipes through the application of trenchless technology, pipe joints are minimised, and the potential for leaks and pipe failures is reduced significantly, explains Blignaut. Open trenching during construction is reduced, resulting in fewer disruptions to residents, and minimal reinstatement of infrastructure such as roads, sidewalks, gardens and vehicle entrances is required.

By selecting the correct class of HDPE pipeline for a specific application, a long lifespan of the pipeline can be expected under normal operating conditions. "We try to maximise the lifespan of infrastructure by using durable material, such as the use of butt-welded HDPE pipes with HDPE fittings, where possible," explains Blignaut. Where trenchless construction methods are not practical or feasible, or under specific site conditions, the long-term feasibility of other pipe material options, such as uPVC, PVC-O and ductile iron, is considered.

Neil Lyners & Associates (Lyners) has been involved with the Overstrand water pipe replacement programme for the past six years, acting as consulting engineer. During this time, more than 76 km of new pipes have been installed by replacing existing pipes and extending and reinforcing the networks. The networks replaced by new pipes ranged in diameter between ø110 mm and ø250 mm. Sections of bulk pipelines were replaced with ø400 mm pipes and the bulk supply to Kleinmond was upsized by means of trenchless methods, from ø200 mm pipe to ø355 mm pipe. According to Blignaut, Lyners' excellent engineering skills, practical insights and integrity ensured the successful completion of these projects for the benefit of the Overstrand community at large.

The pipe replacement projects included the replacement of sections of the water reticulation system in the towns of Rooi Els, Betty's Bay, Kleinmond, Onrus, Hermanus, Stanford and Gansbaai, all situated in the Overstrand municipal area and predominantly holiday destinations. In certain towns, the projects also included the extension of the reticulation system and the upgrade of the bulk supply pipelines.

The reticulation systems of these town function differently to those of most towns because they are subjected to high water demands during holiday periods and then underutilised for long periods, when many of the homes are unoccupied. The reticulation systems often experienced water pipe failures and high percentages of unaccounted-for water were measured, explains Mario Filippi, director, Lyners.

Lyners reviewed the water master plan compiled by GLS Consulting, evaluated the pipe breakages information recorded over a period of three years, scrutinised existing reticulation drawings, conducted site visits and inspections, and held meetings with local area managers and plumbers to establish the high-priority pipelines to be replaced for each town within the Overstrand area.

A limited conditional assessment of the water network was undertaken by Lyners. Pipe sections of the existing reticulation were removed and tested to determine the inherent strength of the pipelines, to evaluate the corroded pipe sections and to measure reduced pipe diameters due to various deposits and encrustation and corrosion in the pipelines. The limited budget allocated to the replacement of pipes and upgrading of the network required careful consideration of the priority list.

The age of the pipes, pipe material, type of couplings and fittings, historical breakages on a specific pipeline, geotechnical conditions, geographical location and strategic importance of the pipeline, and the potential negative impact should the pipe burst were some of the considerations used for determining the priority list. Lyners held additional workshops with operational staff of the municipality to obtain further information on problematic portions of the network, which included unacceptable water quality due to deposits in old pipes, which contained manganese and iron.

The upgrade of the network included the installation of new pipes, valves, fire hydrants and additional air valves to ensure sufficient air is released from the reticulation system, especially during periods of low consumption. The projects included conventional open excavation construction methods, steel pipes fixed to bridges and plinths for certain stream crossings, but mostly included trenchless methods for the upsizing and replacement of pipes.

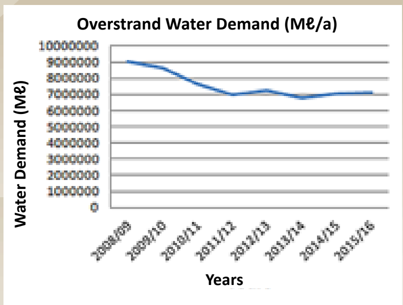
It was largely reticulation pipelines that were replaced, but certain bulk pipelines from reservoirs to the towns had to be upgraded or upsized. Even in these instances, trenchless methods were the preferred method, as these pipelines were located in environmentally sensitive areas and the trenchless construction methods reduced the impact on the environment.

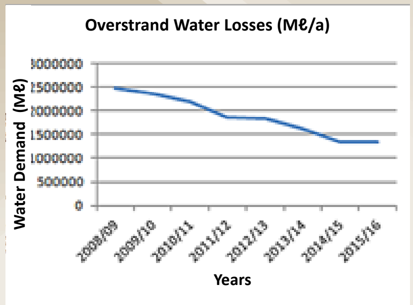
In 2014, the Overstrand municipal project received an award for excellence from the South African Society for Trenchless Technology (SASTT) – the first time the award was bestowed on a municipality outside of a metropole. "The replacement of water mains in Overstrand was a success due to a coordinated team approach and the implementation of trenchless technology. The pipelines were constructed within the contracted amount and time frames, with minimal social impact and disturbance to important, environmentally sensitive areas," Filippi added.

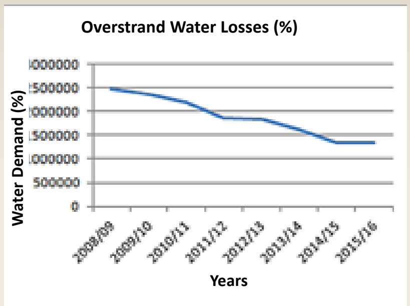
Typical pressure reducing valve installation in Overstrand

Meter replacement

There are more than 34 800 consumer water meters in the Overstrand area. As in all municipalities, mechanical water meters are used to







measure water consumption at individual residential properties. However, accuracy tends to decline with age, resulting in an increase in the water loss percentage, as well as an increasing loss of revenue for the municipality.

To address this, Overstrand Municipality and iX Engineers performed a comprehensive audit of all the consumer water meters in the area during 2011. The audit included determining the age of all the water meters by verifying their serial numbers. It was established that almost 5 000 meters were older than 20 years, and more than 18 000 were older than eight years. The phased replacement of the oldest meters started in 2012 and, to date, 8 839 domestic water meters have been replaced. For all new and replacement installations, plastic water meters are being used, because of the prevalence of the theft of copper and brass fittings and equipment.

Before and after meter installation by iX Engineers

Leak repairs at indigent households

iX Engineers has a long-standing professional relationship with Overstrand Municipality, and headed up the leak repairs at indigent households. To date, three methods have been applied in the different areas of the municipality: physical inspection, listening sticks and correlation. Most of the leaks found were on house connections, with no major mains leaks. The repair of domestic plumbing leaks was done at indigent households over a period of two years, amounting to 1 587 leak repairs.

Reducing consumption

In an attempt to reduce excessive water consumption, Overstrand Municipality has been using a rising block tariff. There are six steps in the rising block tariff structure, with the highest being R47.64/kℓ for consumption above 60 kℓ per month. Provision has been made for drought situations, with Level 1 to Level 3 restriction tariffs also approved by council as part of the tariff structure, ready for implementation during periods of water scarcity at various levels of severity.

In parallel with this, the municipality's sewerage tariff is charged per kilolitre, based on 70% of the water consumption at a property, to a maximum of 50 kℓ of water consumed per month. This allows for irrigation consumption, which is not returned to the sewerage system.

Every property owner receives a graph illustrating their last 24 months' water consumption trend on their monthly municipal bill, allowing them to identify abnormal consumption.

Success water savings

Through the turnaround strategy, water loss decreased from a high of 28.5% in 2009/10 to a significantly lower 18.8% in 2015/16. The total volume of water losses in Overstrand decreased from 2 467 Mℓ in 2008/09 to 1 342 Mℓ in 2015/16 – a decrease of 45.6%. In addition, the total water demand for the Overstrand area decreased from 9 054 Mℓ in 2008/09 to 7 148 Mℓ in 2015/16 – a decrease of 21.1% – despite a rapidly growing population.

While securing a continuous stream of funding for the maintenance and replacement of infrastructure and equipment remains a constant challenge, Overstrand Municipality has made significant progress in meeting its target to reduce water losses to 17% by 2017. 3S