

# Modern system keeping Hermanus' wells flowing



Sue Matthews



***A state-of-the-art groundwater monitoring system in Hermanus, on the Cape South Coast, is ensuring that municipal abstraction is efficient and sustainable, while also providing valuable insight into aquifer structure and functioning. Article by Sue Matthews.***

Cape Town-based earth sciences consultancy Umvoto Africa was contracted by Overstrand Municipality from 2002 when it became clear that surface water resources would no longer meet the needs of the rapidly developing coastal town. Since then, three wellfields have been developed, with the potential of supplementing the annual municipal allocation of 2.8 million m<sup>3</sup> of water from the De Bos Dam by a maximum of 3.2 million m<sup>3</sup> of groundwater per year.

Currently, only the Gateway Wellfield – named after a nearby shopping centre – is in production, the licence having been issued in June 2011. The Camphill and

Volmoed Wellfields in the Hemel en Aarde Valley are still in testing phase under a draft licence, but are expected to become operational this summer. In all cases the production boreholes target the fractured-rock aquifer of the Peninsula Formation – a quartzitic sandstone component of the Table Mountain Group – but the three wellfields occur in separate hydrogeological zones.

The Gateway Wellfield consists of four boreholes, three of which are production boreholes and the remaining one used for monitoring purposes only. The Camphill and Volmoed Wellfields have 11 boreholes in total, with four of these being dedicated to monitoring. In all boreholes, monitoring begun prior to abstraction to establish baseline information and increase understanding about the connectivity between surface waters and the underground primary and fractured-rock aquifers. It also helped inform the development of a hydrogeological model, which will be periodically updated and refined with the knowledge gained from ongoing data collection. The

model will, in turn, be used in an adaptive management approach, in which operational procedures are adjusted on the basis of improved understanding.

Most of the borehole monitoring instrumentation is linked to a telemetry system, with data transmitted at either 30-minute or 12-hour intervals, although manual download on a quarterly basis is required at some of the far-field monitoring boreholes. The near real-time availability of data allows for close surveillance of the wellfields' operation by both Umvoto Africa and the local municipal staff.

Production boreholes are equipped with flow meters that automatically record the pumped flow rate at 30-minute intervals, and there is also a flow meter on the groundwater inlet pipe at the Preekstoel water treatment works to measure the total flow from the boreholes. Sensors in both production and monitoring boreholes record water level on either a half-hourly or hourly basis; the few monitoring boreholes that do not have water level sensors are manually monitored every three months.



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**Left:** Karen Burgers of Umvoto Africa lowers a logger into a borehole during a field trip arranged for the Hemel en Aarde groundwater monitoring committee.

**Right:** A production borehole in the Volmoed Wellfield overlooks the lower Hemel en Aarde Valley.

The three Hermanus wellfields and associated monitoring sites. The red block represents the Gateway wellfield, the green Campbell and the yellow Volmoed wellfield.



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Since the Gateway Wellfield is down on the coastal plain and only 2 km from the sea, saline intrusion with over-abstraction was identified as a potential concern. A minimum water level in the boreholes of 5 m above mean sea level has therefore been set, and pump rates automatically decrease if this is reached to allow water levels to recover. In addition, electrical conductivity meters in the Gateway production boreholes record EC every half-hour during pumping, and pumps will stop automatically if EC rises to 150 mS/m. Reaching either of these limits sets off an alarm on the telemetry panel at the water treatment plant and sends out an SMS alert.

“The SMS alerts come through to us and to municipal staff, who can respond quickly if something happens,” explains Karen Burgers, Umvoto Africa’s geoscientist

responsible for management of the wellfields. “Also if there are any infrastructural problems – something stops working, or there’s a power failure – they can see on the telemetry system where the problem is, and can go and investigate if necessary. We’ve trained them so that they know what to look out for, and they only contact us if there’s something out of the norm that they can’t explain.”

“Our role is to look after the monitoring network and keep an eye on the wellfield. Apart from checking the data frequently for any red flags and analysing it for monthly reports, it’s a constant maintenance job – for example, checking battery voltages in the telemetry system, servicing loggers and cleaning contacts – whatever needs to be done to ensure a smooth running operation.”

Umvoto staff also carry out comprehensive water quality monitoring

on a quarterly basis. Every three months EC, pH and temperature are manually measured in all boreholes using handheld probes. At the same time, samples are taken for bacteriological monitoring and for laboratory analysis of EC, pH and the concentrations of chloride, calcium, sodium, sulphate, nitrate, ammonium, magnesium, aluminium, iron and manganese. Occasional elevated levels of some of these chemicals have been attributed to contamination by agricultural fertilizers or farming activity in the vicinity of the boreholes, while iron and manganese concentrations are naturally high, in common with most groundwater sourced from TMG aquifers. Periodically, water samples from the boreholes are analysed for oxygen and hydrogen isotopic signatures, which provide clues to the mechanism of recharge.

An ecological monitoring programme is also conducted with the



aim of detecting any impacts of groundwater abstraction on vegetation, wetlands and other special habitats. Aerial photos taken twice per year since 2008 and remote-sensing data from MODIS (Moderate Resolution Imaging Spectroradiometer) are analysed for any changes in vegetation cover at selected sites, and confirmed through botanical fieldwork. To date, only normal seasonal variation is evident.

Piezometers, which measure water pressure as a substitute for depth, have been installed in a few wetlands and streams to provide a continuous record of water level. Stream flow and water level are also measured manually every three months, using a bucket and stopwatch, so that the relationship between them can be established. The aim is to use this relationship to translate the piezometer water level readings into continuous flow data.

In addition, water samples are collected at the stream sites during the quarterly field monitoring for analysis of silica and dissolved organic carbon concentration (DOC). The silica concentration is naturally higher in groundwater than in streams, given the slow process of dissolution of quartzite and the short residence times of water in streams, while the reverse is true for DOC, since streams have more leaf litter and other organic matter. Their levels are therefore indicative of the relative contribution of groundwater to surface water, which can be expected to vary on a seasonal basis with rainfall runoff.

Rainfall data is sourced from a number of private weather stations in the area, as well as the former Hermanus Magnetic Observatory, now part of the South African National Space Agency. Umvoto have also encouraged local landowners to install monitoring equipment at their own boreholes, which target the shallow alluvium or primary aquifer sands. However, there is no evidence of any link between these

and the deeper Peninsula Formation aquifer, supported by the lack of any response to pumping at Gateway. There is likewise no detectable response in the wellfield's monitoring boreholes in the upper aquifers, nor in the recharge zone in Fernkloof Nature Reserve or the Camphill and Volmoed Wellfields in the Hemel en Aarde Valley. Radiocarbon analysis of water samples from the Gateway production boreholes suggest it is stored water approximately 10 000 years old that is being abstracted.

All the data collected in the monitoring programmes are used by Umvoto to compile a comprehensive annual report, as well as an interim report in mid-year. These are presented to monitoring committees made up of representatives from the Overstrand Municipality, Department of Water Affairs, Breede-Overberg Catchment Management Agency, conservation agencies and NGOs, ratepayers associations, local landowners and other interested parties.

The thorough and transparent approach followed has paid dividends in terms of allaying fears amongst Hermanus residents that the 'hidden treasure' of groundwater will be plundered. It will no doubt also help increase confidence in other municipalities that aquifers can provide a viable and cost-effective alternative to surface water supplies.

"Groundwater has had a reputation in a lot of municipalities of being unreliable, because equipment breaks down or the boreholes get clogged. We know we have iron and manganese problems, and borehole cleaning every few years just has to be built into the budget," says Burgers.

An oxidation process causes iron and manganese dissolved in groundwater to precipitate out on contact with air, resulting in reddish brown or black residues that foul boreholes and associated infrastructure over time.

"The biggest problem I think is that groundwater practitioners are



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generally hired to drill a hole, then hand it over and walk away. Umvoto has turned that on its head, in that we drill the holes, make recommendations, and get involved in the infrastructure and running of the wellfield afterwards. I hope more hydrogeologists go that way. By staying involved in the management of the wellfield we can ensure that its properly operated, and that our recommendations for sustainable pumping are followed." □

**Above:** Paul Lee of Umvoto Africa at the control panel of one of the boreholes as he explains the telemetry system.

**Below:** A transect is marked out for a botanical survey as part of the ecological monitoring programme.



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