GROUNDWATER – from 'inferior' to 'superior'

Groundwater has long ago shed its historical image as a 'Cinderella' or hidden resource. Following the promulgation of the National Water Act in 1998, in which groundwater finally gained its rightful place in the national water cycle; much work has been done nationally to both gain knowledge of the resource and its interaction with surface water resources, and elevate its status in the water resource planning and development process. Last year the Department of Water Affairs (DWA) completed the National Groundwater Strategy aimed at capturing the understanding, position and value of groundwater so that it can fulfil its role as equal partner in integrated water resource management and use.

Around 2 000 million m^3 of groundwater is currently used every year by South African users, with a further minimum of 3 500 million m^3/year estimated to be in easy reach for future application. In fact, two thirds of the country's population depend on groundwater for their daily domestic needs. Groundwater is also essential to the water supplies of towns such as Beaufort West, Prince Albert, Graaff Reinet, Atlantis, Vryburg and Musina. Even large cities such as Pretoria and Johannesburg are partly dependent on groundwater.

Groundwater provides an invaluable lifeline to millions of South Africans from small, rural areas to large cities yet many still eye it with suspicion, viewing it as an inferior resource. Lani van Vuuren examines the opportunities and hindrances to raising groundwater's profile in the national water supply mix.

David Larsen/Africa Media Online

Despite this important role, groundwater resources have not received the same level of attention, either from managers or users, as surface water. As a result it remains an underutilised resource. According to Fanus Fourie of the DWA Directorate: Water Resource Planning Systems, there is considerable scope to increase and even double the present groundwater volume used in South Africa. "The recent All Town Reconciliation Strategies, in which the present demand and future supply options of more than 1 000 towns were investigated, placed groundwater development high on the list of future water supply options. In almost all instances groundwater was the second water augmentation choice after water conservation and water demand management and, in some areas, it is the only resource development option to meet future demand."

LAST RESORT

Despite this raised profile on paper, experience on the ground indicates that many municipalities only turn to groundwater as a last resort. During recent droughts in the Southern Cape, for example, around 100 boreholes were drilled to relieve critical water shortages in towns such as Plettenberg Bay, George, Mossel Bay, Sedgefield and Knysna. In all instances, the target expected from groundwater projects were met or exceeded. However, only Sedgefield and Plettenberg Bay made use of this water during their greatest time of need (particularly between 2008 and 2009) and as far has been ascertained none of the boreholes have been brought into permanent production. Instead other alternatives schemes have been undertaken, such as desalination plants.

Specialist groundwater consultant Roger Parsons, who undertook drought relief work for Sedgefield, Knysna, George and Mossel Bay, explains some of the hindrances experienced that prevent the increased use of groundwater by South African municipalities. "Generally, engineering responsible for the development and management of water resources in South Africa have no hydrogeological training, and are unfamiliar with the resource. Consequently, they turn to resources with which they are more familiar and understand. Also, groundwater is a logistically more complex resource as boreholes can be distributed over a wide area. In comparison, water from a dam can be supplied by pushing a button or opening a valve."

According to Christine Colvin, Worldwide Fund for Nature Senior Manager: Fresh Water, municipal managers and town engineers are generally uncomfortable dealing directly with science-based information on the availability of groundwater. "They have greater confidence in dealing with engineering-based 'facts' and figures – however, wrong those figures may be, for example, the costs for the Berg River Dam project were initially estimated at R355-million, but concluded at R2,7-billion. In addition, groundwater supply schemes generally prefer a phased approach of exploration drilling and testing with explicit risk and uncertainty of results. Groundwater development is sometimes a slow and steady option, versus quick wins within election time horizons, hence it is ignored by political decision makers."

According to the National Groundwater Strategy, the quantities of water being produced at present by small-scale desalination plants in towns such as Sedgefield are well within what could be provided by even a small groundwater wellfield. Parsons adds that groundwater resources are a much cheaper water resource development option. "The capital cost of developing groundwater resources during the drought in the southern Cape was R700 000/Mℓ. Generally assuming the cost of linking production boreholes to the reticulation infrastructure was double this, then the cost of using groundwater as a source of water during the drought was in the order of R2,1-million/Mℓ.

Guy Stubbs/Africa Media Online

Assuming all desalination plants achieved their target production, the equivalent cost of desalination was in the order of R13,5-million/Mℓ – almost 6,5 times more expensive." Desalination also has serious energy and carbon implications.

Another potential impediment is the fact that the volumes that can be gained from groundwater resources can also be deceiving. "A 2 ℓ/s borehole will be able to yield 173 m^3/day while 8 boreholes with the same yield will yield 0,5 million m^3/year," notes Fourie. This means that an absolute understanding of the resource is required – a challenge since very few municipalities have in-house hydrogeologists.

A particular problem which arose during the emergency drilling of boreholes in the Southern Cape

***Above**: Around two thirds of South Africa's rural population are mainly or solely dependent on groundwater.*

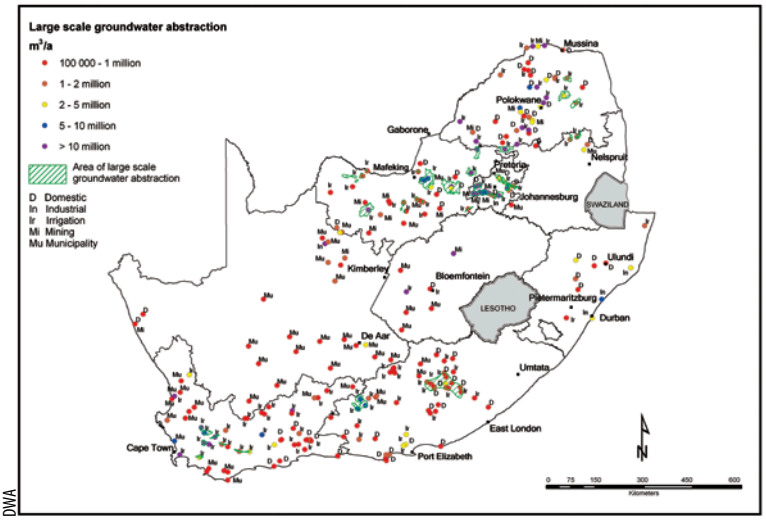
***Below**: Developing one of the emergency boreholes at Sedgefield by air-flushing. This borehole was tested at 8 ℓ/s.*

Roger Parsons

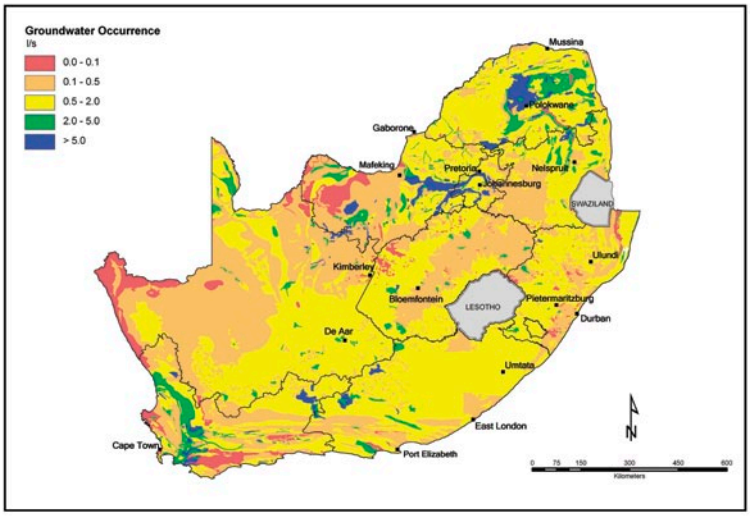
Top right: *Present large-scale groundwater abstraction.*

Middle right: *Groundwater use potential in South Africa.*

Below: *While high yields were obtained from boreholes drilled into the Table Mountain Group in the vicinity of Mossel Bay, surprisingly poor quality limited its immediate use for drought relief purposes.*



DWA



DWA

Roger Parsons

was access to land. "Section 24 of the National Water Act states that a license may be granted to use water found underground on land not owned by the applicant if the owner of the land consents or if there is good reason to do so. Despite the critical situation in the towns gaining access to water on land remained a challenge throughout the drought," notes Parsons. "Most of the drilling targets were outside of the urban area and on property not owned by the municipality. As a result, much time had to be spent with, for example, farmers trying to obtain permission to drill on their farms."

Parsons notes that, groundwater specialists can do much to improve groundwater's image. "The hydrogeological community has still not learnt to speak 'engineering lingo'. If we want our resource to be understood and appreciated, we need to become far better at communicating relevant information pertaining to our resource. For example, we need to give direct and sound answers about how water can be abstracted from boreholes and wellfields so that this information can be taken with confidence by the engineers into the realm of water supply engineering and design."

The groundwater profession also needs to play a leading role in communicating information about the benefits of using groundwater to non-specialists, Parsons notes. "We need to introduce a groundwater component into the education curriculum of engineering and we need to play a bigger role in water resource planning."

LACK OF MONITORING

In addition to being misunderstood, groundwater is viewed by many as being an unreliable resource. Communities often consider it 'backward' – at best an interim solution before a 'proper' surface water supply can be installed. Unfortunately, failure of groundwater schemes is often blamed on the resource when it is almost always

due either to failure of infrastructure (e.g. a blocked borehole screen) or unsuitable pumping regimes (e.g. pumping at very high rates for short periods of times) that are related to a lack of monitoring.

Contrary to belief groundwater supply can be sustainable. "Farmers in the Western Cape, for example, have shown me boreholes that have been handed down with the farm from one generation to another," says Colvin. "One borehole, drilled 80 years ago, is still the prime source of drinking water for the small community resident on the farm. The farm manager has the necessary technical skills to fix a tractor and maintain an irrigation scheme – this means he can maintain a diesel pump or a wind pump. Maintenance is his responsibility and the borehole has never been out of action for longer than four days."

"In almost all instances groundwater was the second water augmentation choice after water conservation and water demand management and, in some areas, it is the only resource development option to meet future demand."

Examples of successful use and protection of open springs also exist in Northern Limpopo where some sources have been fenced off to keep livestock out of the water. "The village elders do not allow anyone to wash in the spring that drinking water is collected from. Cultural beliefs about the protection of the spring by the ancestors also ensure that no-one will break this taboo lightly," notes Colvin.

A vital element of groundwater management is therefore day-to-day operations and maintenance – the mainly routine tasks that should be carried out in the course of operating a groundwater supply scheme. This includes maintaining infrastructure, such as cleaning and de-scaling pipes, replacing worn out components, cleaning of boreholes, checking the operation and switchgear etc. Fourie affirms that in cases where communities have taken responsibility for their boreholes and where operations and maintenance is applied regularly the groundwater supply has proven sustainable.

According to Colvin, local government decision makers must be educated on why groundwater schemes have failed in the past. "They should know that basic, but solid planning for effective maintenance is critical and that groundwater can be relied on in well sited and designed schemes. We should be promoting groundwater as a resource that is buffered from the impacts of climate change. Groundwater-based schemes could provide employment in rural areas and develop low cost, low carbon resources that make best use of our natural capital."

It must be pointed out that, just as it is with all possible sources of water, groundwater is not the silver bullet that is going to solve all the country's water supply problems. "In order for us to make informed decisions we need to assess and evaluable all available options based on environmental, economic, legal and institutional considerations. A combination of schemes is probably the best solution," says Fourie.

At the time of writing the National Groundwater Strategy was being incorporated into the Second Edition of the National Water Resource Strategy (NWRS). Timelines and responsibilities will be established as part of the implementation plan of the NWRS and that will become part of the Business Plan of DWA, which will mean a dedicated budget for groundwater. The department has also progressed with regards to filling its many hydrogeology-related vacancies (at one stage the number of vacant posts in the DWA for hydrogeologists was around 47% and 53% for geotechnicians of existing posts).

"There is great opportunity to increase the present volumes of groundwater used in South Africa," notes Fourie. "At the same time, improved management and protection of present sources of groundwater can play a substantial role as a sustainable, reliable resource for generations to come."

- To access the *DWA Groundwater Strategy 2010* and related documents, Visit: http://www.dwa.gov.za/Groundwater/gs.aspx ❑

CITY OF FOUNTAINS

Few people know that it was the presence of fountains rather than the Apies River, which led to the establishment of Pretoria it its particular location. For the first 50 years of its history, the city was nearly solely dependent on groundwater for its water supply, with its first dam at Rietvlei only being constructed during the Depression years. To this day, a proportion of the water supply to Pretoria is derived from springs and boreholes in the dolomite compartments south of the city, and which includes the now famous Fountains. In total, groundwater supplies about 60 million ℓ/day to the city, mainly to the central business district.

Source: Groundwater Strategy 2010

Windmills are a familiar site on the South African landscape.

Lani van Vuuren