



Project Shows WHAT A LOT WE GOT — But Cautions Care On How We Use It

South Africa is closer than ever in quantifying its groundwater resources thanks to a project led by the Department of Water Affairs & Forestry (DWAF). Results are showing a resource with significant potential, but not all of it can be abstracted sustainably.

Lani Holtzhausen reports.

It has been called the country's 'hidden treasure' and 'liquid gold', but to date the question of exactly how much water South Africa has stored underground has remained largely unanswered, much to the frustration of engineers and planners, even hydrogeologists themselves.

Groundwater abstraction is far from new practice. Many of South Africa's indigenous communities survived mostly on groundwater, while the names of many modern-day towns reflect the dependence of early settlers on underground water and its importance in the establishment and spread of settlements (just think of

place names such as De Aar and Springs). Even Johannesburg owes its early survival to the availability of borehole water. Yet the first attempt at a synoptic and visual representation of the country's groundwater resources was made only ten years ago. However, these attempts at measuring exactly how much water is stored underground were largely educated guesses rather than being based on algorithms.

MEASURING THE INVISIBLE

In late 2003, DWAF initiated the Groundwater Resource Assessment

Phase 2 (GRA2) project, aimed at quantifying the groundwater resources of South Africa on a national scale. The project, which was concluded earlier this year, was carried out by a consortium of consultants comprising SRK Consulting, GEOSS, Water Systems Management and CSIR. It followed on Phase 1, which produced a set of 21 hydrogeological maps covering the country at a scale of 1:500 000, with accompanying explanatory booklets.

GRA2 had five main tasks, namely quantification (of aquifer storage), producing a groundwater planning potential map, calculating ground-

water recharge and groundwater/surface interaction; and the classification of aquifers and water use. It is considered the most detailed, comprehensive, and integrated study of this nature ever undertaken in South Africa. "It was a daunting but rewarding task undertaken by a team which included many of the leading hydrogeologists and other scientists in the country, both on the consultant's and the client's side", Peter Rosewarne of SRK Consulting tells *the Water Wheel*.

A CRUCIAL RESOURCE

Why quantify the country's groundwater resources at all? "Since it is found virtually everywhere in South Africa in varying amounts, groundwater can serve as a strategic resource to rural and urban communities," explains Rosewarne. "It can be used as a renewable resource and is slower to be affected by droughts, whereas, if it does not rain, dams will start to 'dry up' almost immediately. For example, two years of drought in the Western Cape led to dam levels serving Cape Town to drop to 28% of full supply capacity, whereas local aquifers still had relatively high water levels."

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However, the conjunctive use of ground and surface water resources is usually the most efficient method of utilisation of catchment water resources. Indeed, the National Water Act of 1996 makes no distinction between these different but inter-related phases of the hydrological cycle.

In addition, groundwater can often be developed close to the proposed

How much groundwater do we have?	
Total volume of groundwater	235,5 billion m ³
Groundwater resource potential	49 billion m ³ /a
Average groundwater exploitation potential	19 billion m ³ /a
Potable groundwater exploitation potential	14,8 billion m ³ /a
Utilisable Groundwater Exploitation Potential	10,3 billion m ³ /a

Source: GRA2

end-user, and can be relatively cheap to develop. As the approximately 300 towns and smaller settlements which are already dependent on groundwater for their main water supply can testify, groundwater is naturally filtered by the rocks and materials through which it flows.

Some of the most favourable areas or aquifers regarding groundwater availability include the dolomites of the West Rand and Far West Rand. It is said that here deep leaching gives rise to some of the highest yielding boreholes in the country (up to 100 l/s). Then there is the Table Mountain Group Aquifers of the Western and Eastern Cape. Here, sustainable borehole yields of more than 10 l/s are common. Other major sources of groundwater are the coastal sand aquifers in the Western

and Eastern Cape and northern KwaZulu-Natal.

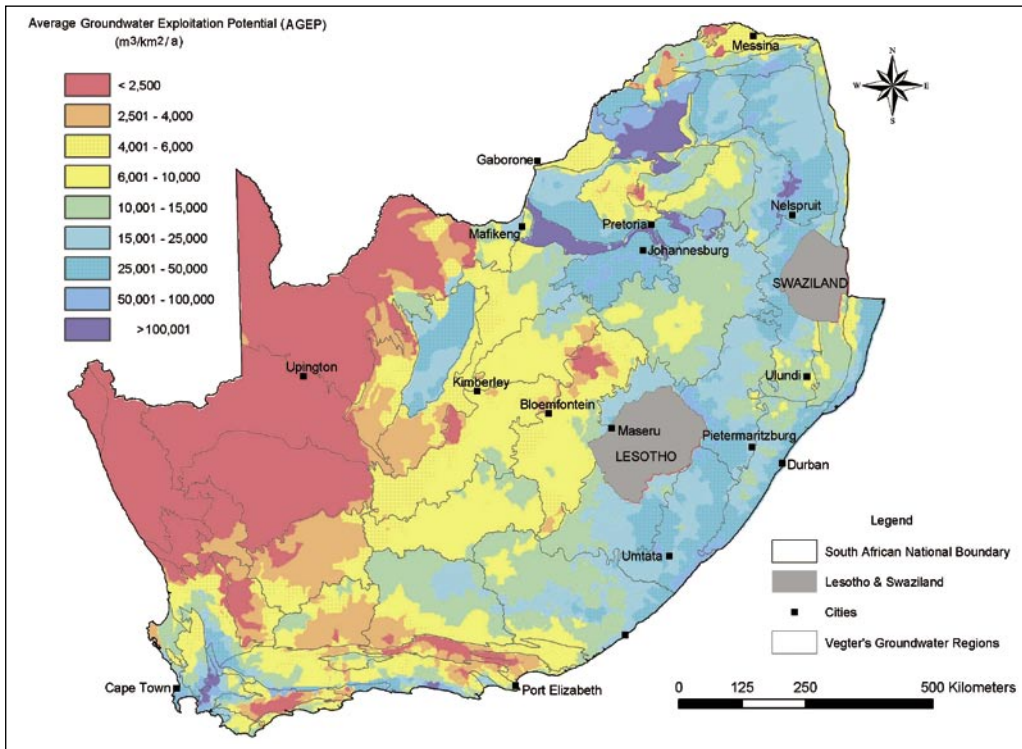
High-yielding aquifers can also be found in the basement granites in the Pietersburg-Dendron-Coetzerdam area, alluvial deposits along sections of major rivers such as the Limpopo and parts of the Karoo Sequence associated with dolerite dykes and ring structures.

Why has it traditionally been so difficult to quantify the country's groundwater resources? "The most obvious reason is because groundwater is hidden from sight and cannot be measured or quantified by direct methods as with surface water," says Dr Jan Girman of DWAF. "It is also largely (about 90%) contained within fractured rocks. The geometry of these openings is hard to define

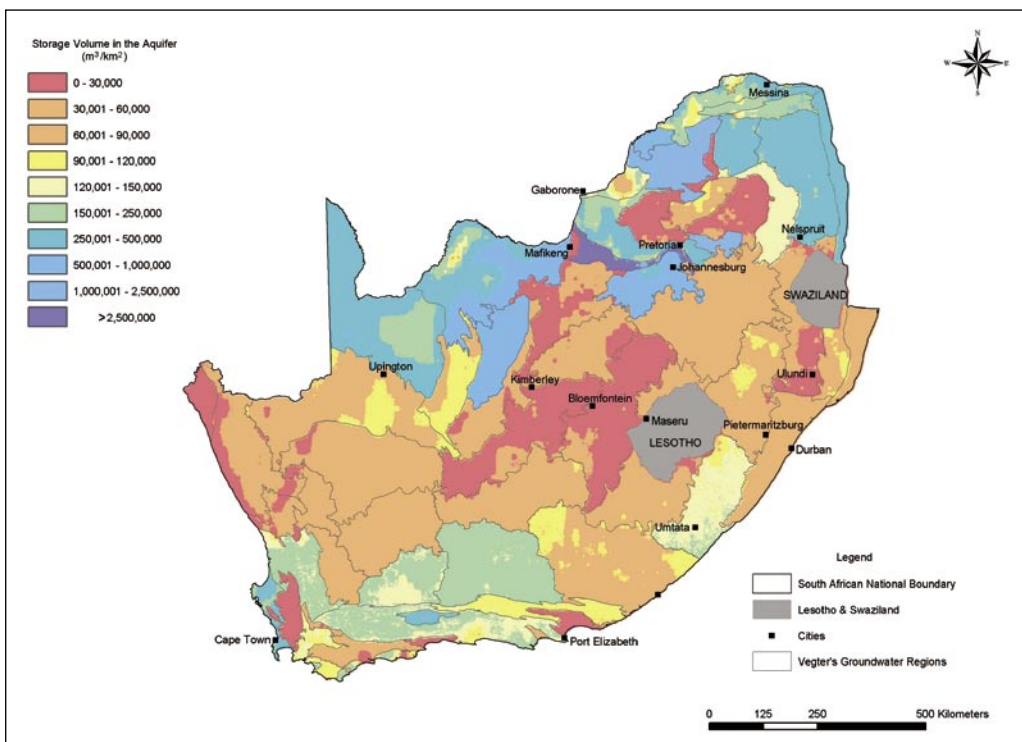


Groundwater is set to play an increasingly strategic role in serving rural areas.

16 GROUNDWATER ASSESSMENT



Average groundwater exploitation potential for South Africa.



The estimated total volume (m³/km³) of groundwater stored in South African aquifers.

accurately. Monitoring records are relatively short and often sparse and widely spread."

The methodologies developed for most of GRA2's tasks were new and

improved on previous methods, although they incorporated and built on earlier methodologies, for example, planning potential maps. Developing national level algorithms to provide an accurate yet robust and simple

methodology within a geographical information system (GIS) environment was particularly demanding. Another challenge was obtaining acceptable cross-balancing of catchment water budgets between the sub-projects.

SO HOW MUCH GROUNDWATER DO WE HAVE?

In total, some 235,5 billion cubic metres of groundwater may be stored in aquifers in South Africa. Of course, not all of it is usable and can be abstracted. There are many limitations to the possible abstraction of groundwater for use, for example, restrictions to ensure enough water for the environment (the Ecological Reserve), and restrictions on the maximum level drawdown in dolomitic aquifers due to the hazard of sinkhole formation or avoiding intrusion of saline water.

“In total, some 235,5 billion cubic metres of groundwater may be stored in aquifers in South Africa.”

The groundwater resource potential is the maximum volume (m^3) of groundwater that can be abstracted per unit area per annum without causing any long-term ‘mining’ of the aquifer system (i.e. without continued long-term declining water levels). It is not equivalent to the sustainable or optimal yield of the system, which normally takes into account issues such as intrusion of poor quality water, practical and cost issues relating to extracting the water and so forth. The average groundwater resource potential of aquifers in South Africa is estimated under normal rainfall conditions at 49 billion m^3/a , which decreases to 42 billion m^3/a during a drought.

Groundwater quality is one of the main factors restricting the development of available groundwater resources. Quality problems include high concentrations of total dissolved solids, nitrates and fluoride, which can be difficult and expensive to remedy.



Not all of South Africa's groundwater can be abstracted sustainably.

When taking into account limitations such as groundwater quality, the potable groundwater exploitation of aquifers in South Africa is estimated at 14,8 billion m^3/a , which declines to 12,6 billion m^3/a during a drought. Nationally this represents almost a 30% reduction in the annual volumes of available groundwater for domestic supply due to water quality constraints, Rosewarne points out.

Finally, the volume of water that may be abstracted from a groundwater resource may be limited by anthropogenic, ecological and/or legislative considerations, which is ultimately a management decision that will reduce the total volume of groundwater available for development – referred to as the utilisable groundwater exploitation potential. Under normal rainfall conditions this volume is 10,4 billion m^3 and 7,5 billion m^3 under drought conditions.

For general planning purposes, it is recommended that the average utilisable groundwater exploitation potential volume be adopted. It is interesting to note that only about 20% of this volume is currently being abstracted on an annual basis.

THE WAY FORWARD

The results of the GRA2 study have been incorporated into the Water Resources 2005 (WR2005) study, a three-year assessment of South Africa's water resources. Funded by the Water Research Commission, this project will be completed by 2007. This will seek to provide, for the first time, an integrated assessment of the surface and groundwater resources of the country.

The process of groundwater resource assessment is set to continue in the near future, paying attention to the issues of monitoring and protection of groundwater resources, as well as to information products in support of decision makers and general public.

Rosewarne concludes: “There is no doubt that groundwater will play an increasingly strategic role in serving rural areas either as a stand-alone source, in conjunctive use schemes with surface water and as a bridging supply, particularly to assist in drought management and possibly in terms of reducing the effects of climate change.” 