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Sitting on the Horns of a Dilemma: Water as a Strategic Resource in South Africa

South Africa is a water-constrained country with a vital need to conserve, manage, and expand its limited water resources as efficiently as possible. Since 1994, however, strategic planning has deteriorated, along with operational efficiency. Under the supposed imperatives of 'transformation', skilled engineering and other professional staff have been driven out of water boards (responsible for bulk water supply) and municipalities (charged with local reticulation and often also with waste management). Municipalities are now discharging around 4 billion litres of untreated or partially treated sewage into the country's rivers and dams every day. The Government refuses to admit the extent to which water quality has deteriorated, and a public health crisis now looms. Various reforms are feasible, but the ruling party shows little willingness to allow practical reality to prevail over its transformation ideology.

The water constraint

South Africa's rainfall is half the global average, making it a water-scarce country. The first proposal for the construction of large dams was made in the 1870s. In 1886 Thomas Bain, a civil engineer in the public roads department in the Cape, followed up with a book on 'water finding' and 'dam-making', which urged state intervention in the construction of hydraulic (water-driven) infrastructure as an essential foundation for economic growth and social cohesion.

When South Africa became a republic in 1961, one of the State's first major projects was the creation of a scheme to transfer water from one river basin to another. This was achieved via the Orange-Fish-Sundays scheme,

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After 1970, South Africa became a global leader in the management of water.

which transfers water from the Gariep Dam in the Free State to arid areas in the Eastern Cape. This initiative was specifically designed not only to address the water challenge in parts of the Karoo but also to restore investor confidence after the Sharpeville shootings in 1960.

In 1970 came the report of the *Commission of Enquiry into Water Matters*. This report warned that South Africa's economic development would always be water-constrained unless a coherent plan was implemented by the State to overcome this obstacle. In response, the Government imposed a tax on the bulk sale of water (the first of its kind in the world) to fund a new body called the Water Research Commission. This commission was given the task, in partnership with the Council for Scientific and Industrial Research (CSIR), of developing the science and engineering technology needed to address the country's endemic water scarcity and so promote economic growth and prosperity.

Working from this foundation, South Africa became a global leader in the management of water. This allowed the country to develop the most diversified economy in the world compared with other nations with similar climatic regimes. One of its great achievements in the 1970s was the CSIR's development of the first sewage recycling technology. This cutting-edge innovation was put into operation in Windhoek (in what was then South West Africa and is now Namibia) in response to the absolute water scarcity in the city. This development was also part of a wider strategic initiative to harness water from a multiplicity of sources. South Africa thus became globally recognised for its ability to achieve economic growth and development despite its fundamental water constraint, which was largely overcome through high levels of technical ingenuity.

The National Water Act of 1998

The National Water Act of 1998 ended private water rights and made the State the public trustee of all water resources.

After the transition to democracy in 1994, the new Government adopted the National Water Act of 1998 as one of its first 'transformation' interventions. This removed riparian and other common-law rights to water and made the State the public trustee of the nation's water resources. It also gives the State the power to decide on 'the equitable allocation of water in the public interest', in order to address past racial and gender discrimination. Though compensation for the loss of existing water rights is payable, the statute limits the amount which can be claimed. A key underlying purpose of the Act is to help the State redistribute farm land through its control over the water that gives the land much of its commercial value.

The new water use licences are very different from the riparian rights they replace, for they may not last more than 40 years and are in any event subject to review at five-yearly intervals. The licensing system is also complicated, and has virtually ground to a halt at various times under the burden of the thousands of water users needing to obtain the new authorisations.

Some of the many problems in the process were highlighted in August 2011, when Acting Judge James Goodey in the North Gauteng High Court in Pretoria criticised the way in which departmental officials and a new Water Tribunal – which had been established under the 1998 statute to decide disputes over the grant or refusal of the new licences – were handling their responsibilities.

Unlawfully, the Water Tribunal has made race the key consideration in deciding on water use licences.

Section 27(1) of the National Water Act lists 11 factors relevant to the granting or refusal of water use licences. These range from the need to promote the efficient and beneficial use of water to the extent of the investments that applicants have previously made in irrigation dams and pumps. Also on the list is the need to re-allocate water to overcome past racial and gender inequality. Regional officials are supposed to weigh all these factors in making recommendations to the national official responsible for granting or refusing applications. This official's decisions are subject to review by the Water Tribunal, which is appointed by the minister of water and sanitation on the recommendation of the Judicial Service Commission.

The relevant case was brought by Goede Wellington Boerdery (Goede Wellington), a farm on the banks of the Berg River in the Western Cape. The suit was launched after the national director had declined Goede Wellington's application for the transfer of water-use rights, citing Section 27(1) and the need to redress past racial inequality. The Water Tribunal upheld this decision, prompting Goede Wellington to bring the matter before the Pretoria High Court.

Handing down his ruling, Judge Goodey said the tribunal had failed to apply its mind to the facts of the case. Instead, it had effectively cut and pasted one of its earlier rulings in making its decision. The court also criticised the department's application of Section 27, which made it clear that all 11 factors had to be taken into account – and that a farmer's race or gender could not be the sole consideration in deciding on a water use licence. The judge added that the tribunal's decisions displayed 'an alarming degree of ineptitude...and a lack of...rationality and common sense'. The department lodged an appeal against this ruling, but it was upheld by the Supreme Court of Appeal in 2012.

The Goede Wellington ruling became an obstacle to the racial engineering underlying the National Water Act as it provided an important basis for challenging the refusal of water use licences to commercial farmers. It also put the tribunal under pressure, while the then minister of water and environmental affairs, Edna Molewa, began calling for amendments to the National Water Act that would allow her to appoint the tribunal's members without reference to the Judicial Service Commission. She also said that she wanted the terms of all tribunal members to come to an end, so that she could appoint a new tribunal under the amended law. The chairman of the tribunal resigned in November 2011 (soon after the Pretoria court's judgment had been handed down) and was not replaced, which meant the tribunal could not be properly constituted or issue any binding ruling. The tribunal thus ceased to function the following year. But in 2014 the Durban High Court (in the case of *Kwazulu Bulk Logistics (CC) and others v Minister of Water and Sanitation*) effectively demanded that it be re-established. The travails of the tribunal are symptomatic of a broader problem of weak capacity in water management.

Ineptitude in administering the water use licence system has cost South Africa at least one major foreign investment.

Ineptitude in administering the water use licence system has cost South Africa at least one major proposed foreign investment. In the 'honeymoon' period following the country's transition to democracy, South Africa became the darling of the world. A large multinational corporation, with a head office in London, wanted to make what would have been the largest foreign direct investment in the country at the time. However, the corporation then slammed into a bureaucratic cul-de-sac.

Its proposed investment in a major processing plant needed an 'integrated water use licence' (IWUL), but this licence could not be granted because the relevant 'comprehensive reserve determination' had not yet been made. (This determination is needed under the National Water Act to identify the volume of water in a given river system that is required to meet basic human needs and preserve the functional integrity of the aquatic ecosystem.) Moreover, only a handful of trained professionals in the country had the capacity to make this reserve determination, while the proposed plant was located on a river that had not been prioritised. Hence, the necessary determination would be made only a decade into the future.

No newspaper reported the company's decision not to invest and it become a non-event.

During the complex negotiations that followed, a technical team led by the CSIR was appointed to determine the reserve and the IWUL was eventually issued. By then, however, the corporation's board of directors had become so spooked by the uncertainty inherent in the process that it declined to authorise the investment. What would have been the largest single foreign direct investment into a young democracy simply never happened. No newspaper reported it and it became a non-event. However, to the informed few, this was the first red flag indicating that the water constraint on South Africa's economy might not derive solely from the volume of water available. Equally significant were the institutional deficiencies and financial risks stemming from the National Water Act and its insistence on water use licences which the State could not rationally or efficiently provide.

Since those early days, the uncertainty associated with water use licences has increasingly been identified as a key commercial risk constraining the investment decisions of the private sector. In addition, little significant progress has yet been made in making the necessary reserve determinations. This has been done within a few catchment areas, but most of these assessments are still at 'the desktop level', which means no accurate on-site measurements have been made. This is a key obstacle to the granting of water use licences. It also means that the lack of technical capacity within the State is hampering informed decision-making on these licences and preventing it from properly implementing the National Water Act. This has further negative ramifications in other spheres as well, for the Department of Water and Sanitation (the department) is now having to deal, for example, with the current drought in KwaZulu-Natal without the richness of the data that would normally be included in a comprehensive reserve determination.

Long delays in the granting of water use licences also have a major impact on the country's mines, which are prohibited from starting up mining operations without a water use licence. But mining companies also stand to lose their mining rights if they do not begin mining within 12 months of these rights being granted. If the necessary water use licence is not granted in this 12-month period, a mining company then faces the unpalatable choice of either losing its mining right – and so jeopardising its investment – or starting up mining operations without the necessary water use licence.

Long delays in granting of the necessary water use licences also inhibit mining investment.

Many mining companies have chosen the latter course, which largely explains why 53 mines were operating without water use licences in March 2012 (down from 69 in June 2011). In answer to a parliamentary question on the issue, Ms Molewa said the department had 'embarked on a special initiative, the Letsema Project, to expedite the process of issuing water use licences,

Municipalities often fail to comply with water use licences, which the national department seems unable to prevent.

especially to mines that were operating without them'. The Letsema project had already processed 3 250 applications, she went on, leaving only some 520 still to be finalised. This backlog has since been further reduced, but many of the water use licences granted seem to have been issued on a 'cut-and-paste' basis. They thus often include conditions that might be suitable in one context but are inappropriate in another. (Officials in the water department have acknowledged this problem, but seem unable to fix it.)

At the same time, the difficulty in securing water use licences remains a significant barrier to investment, particularly in the mining sector. Public companies can lose their stock exchange listings for failure to comply with their legal obligations, so any instance of non-compliance is a very serious matter for them. Many potential investors are simply unwilling to take this risk.

Municipalities also need water use licences, which often extend beyond the reticulation of waste and potable water to the provision of bulk water and the running of wastewater treatment works. Often, however, they seem unable to comply with the conditions of their water use licences, while the national water department seems equally unable to stop these contraventions. This is graphically illustrated by the example of the Rooiwal waste treatment plant in the Pretoria area (see box on page 27).

The Rooiwal story goes back to 2001, when it became clear that the Tshwane Metropolitan Municipality (Tshwane), one of the largest and best resourced local authorities in the country, was failing to manage the Rooiwal wastewater treatment plant in accordance with the specifications set out in its water use licence. The national department's response was to excuse it from having to do so via an 'exemption notice' which relaxed these specifications. But Tshwane still failed to comply with even these diminished responsibilities, so the national department declared a 'state of emergency' in October 2011, ten years after the problem had first arisen. Tshwane then tried to take remedial action, but ran into procurement difficulties and never managed to bring the plant into compliance. In 2013, with full knowledge of the situation, the national department nevertheless issued it with a new waste management licence.

Tshwane remains non-compliant to this day, while the national department has failed to intervene. Instead, the minister has reportedly issued an internal instruction to all departmental enforcement officials not to prosecute any municipality in the build-up to the 2016 municipal elections. The minister claims that enforcement by the national department against a municipality would be in breach of the constitutional requirement for 'co-operative governance' and the avoidance of legal proceedings as between the national, provincial, and local tiers of government. But this view ignores other important 'co-operative governance' provisions, which require all organs of state to 'provide effective....government' and to 'secure the well-being' of the population. Instead, the national department's apparent indifference to municipal water treatment failures is a major factor in the huge volume of untreated (or partially treated) sewage effluent that is being returned to rivers and dams in Pretoria and elsewhere (see *The extent of eutrophication,* below).

The Rooiwal plant near Pretoria has remained non-compliant for almost 15 years.

A 1970 report on water warned of 'serious shortages...somewhere before the close of the century' without remedial action.

Projecting future water needs

After 1994 the new Government made a critical decision with far-reaching consequences. As earlier noted, the 1970 report of the *Commission of Enquiry into Water Matters* created a highly successful strategic framework for the management of South Africa's limited water resources. This in turn paved the way for consistent economic growth, despite apartheid's economic distortions and the financial sanctions implemented in the 1980s. However, the commission's report also warned of 'serious shortages...somewhere before the close of the century' unless 'essential steps were taken to plan the exploitation and augmentation of our water resources, to conserve and re-use our available supplies, and to manage and control our resources in the most efficient manner'.

Instead of heeding this important message, the ruling African National Congress (ANC) seemed to regard the commission's report – with all its hard-earned factual wisdom – as an apartheid instrument which should simply be jettisoned. The unintended consequence is that all the institutionalised knowledge and learning accumulated over three decades (from 1961 to 1994) have been lost. Worse still, the 1970 report has not been replaced by a viable alternative strategy – and this despite the requirement in the National Water Act for fresh strategic plans to be drawn up every five years.

The National Water Act calls for a 'national water resource strategy' to be adopted every five years. The objective of this strategy is to provide a comprehensive inventory of total national water resources and compare these with localised demand in the various Water Management Areas established under the statute. The national strategy is thus supposed to provide an overall blueprint for the management of water across the country. It is also supposed to provide the factual data against which the Government's aspirations for faster economic development can be set against the harsh reality of South Africa's water constraints.

Only two national strategy documents have been completed since the National Water Act was adopted in 1998. The first, drawn up in 2004, is very much a technical document. The second, drawn up in 2012, is a predominantly political document with a strong ideological dimension. It thus contrasts, for example, 'the false sense of water security within the privileged sectors of South African society' with the 'high levels of water insecurity the poor and marginalised...have always experienced'. This politicises water resource management, while overlooking the relevant biophysical facts and the difficulties in ensuring adequate water supply in a water-stressed country.

The ANC jettisoned the 1970 report – with all its hard-earned factual wisdom – as an apartheid instrument.

The second document was controversial from the start, because the consultants hired to do the work allegedly absconded with the cash and failed to deliver the final product. This led to a hasty internal cover-up by a handful of technically competent employees of the then Department of Water Affairs, in which the data from the first (2004) document was rehashed but not fundamentally reworked. The 2012 document is often also inconsistent and seems more aspirational than practical. For example, it seeks a greater emphasis on 'equity' and wants water to be 'placed at the centre of integrated development planning', but it overlooks the shortage of water of an acceptable quality. It wants more South Africans to have an increased water supply,

The most important national strategy document was drawn up in 2004.

but it also emphasises the need for 'water conservation' and 'demand management'. It speaks of developing alternative water sources via recycling, desalination, and ground water use (technologies that are consistent with global best practice), but it ignores the deteriorating quality of the water currently stored in the country's dams. It calls for increased protection for aquatic ecosystems, but overlooks increasing contamination from failing wastewater treatment plants, such as the Rooiwal one in Tshwane.

The most important national strategy document remains the 2004 one, which is based on data collected in 1998. This document examines the likely balance between water demand and available supply over a 20-year period (from 2005 to 2025), in each of the 19 Water Management Areas established under the National Water Act. It also uses two scenarios: a *base scenario*, in which both population growth and economic growth are limited; and a *high scenario* in which population growth remains constrained but the economic growth rate is significantly higher.

Central to both scenarios is an assumption that population growth will be moderate, given the impact of HIV/AIDS (then difficult to assess) and projected urbanisation rates. The base scenario projects a total population of 50 million by 2025, of which 32 million will be urbanised. The high scenario projects a total population of some 55 million by 2025, with 35 million people then living in urban areas.

As regards economic growth, the base scenario projects a real average annual growth rate of 1.5% of gross domestic product (GDP) over the 20-year period. As a rule of thumb, a 1.5% increase in GDP is seen as resulting in a 2% deficit in water allocation. The high scenario is based on real annual average growth of 4% of GDP from 2005 until 2025.

Both scenarios assume that 'return flows' from urban areas will play an important part in meeting water needs. 'Return flows' refer to water that has been used in agriculture, industry or domestic settings and is now contaminated in some way, but which becomes available as a water resource once again after being discharged as treated effluent (or after seeping back into rivers from farm land, for example). The strategy document takes it for granted that these flows will be of a useable quality – an expectation which assumes that wastewater treatment plants will remain functional and that treatment standards will be rigidly enforced.

The document uses two scenarios to project water demand and supply to 2025.

Based on data gathered in 1998, both scenarios identify the water 'potentially available' for development as some 5 410 million cubic metres in the year 2025. This term refers to water that is currently under-utilised but could be developed if needed. Under the base scenario, projected water demand is more limited and so the expected national shortfall or water deficit in that year is relatively small at 234 million cubic metres. However, under the high scenario, projected water demand is significantly greater, putting the expected national water deficit in 2025 at 2 044 million cubic metres. In both scenarios, the water potentially available for development remains at 5 410 million cubic metres, which is more than enough to meet these projected shortages.

The datasets for both scenarios are shown as *Tables 1* and *2*. *Table 1* shows the base scenario and *Table 2* the high scenario. The data in these tables does not cross-compute, because each column is a summary of a complex set of calculations. All volumes are given in millions of cubic metres per year ($10^6 m^3 yr^1$).

Table 1
Reconciliation of the Requirements for, and Availability of, Water for the Year 2025 in terms of the Base Scenario (economic growth at 1.5% of GDP). All volumes given in millions of cubic metres per year ($10^6 m^3 yr^1$), while WMA means Water Management Area. (Source: Adapted from the National Water Resource Strategy, 2004:41).

WMA	Reliable Yield	Transfers In	Local Req'ts	Transfers Out	(Shortfall) Surplus (+)	Potential for Dev't
Limpopo	281	18	347	0	(48)	8
Levuvhu/ Letaba	404	0	349	13	42	102
Crocodile West & Marico	846	727	1,438	10	125	0
Olifants	630	210	1,075	7	(242)	239
Incomati	1,028	0	914	311	(197)	104
Usutu to Mhlatuze	1,113	40	728	114	311	110
Thukela	742	0	347	506	(111)	598
Upper Vaal	1,229	1,630	1,269	1,632	(42)	50
Middle Vaal	55	838	381	503	9	0
Lower Vaal	127	571	641	0	57	0
Mvoti to Umzimkulu	555	34	1,012	0	(423)	1,018
Mzimvubu to Keiskamma	872	0	413	0	459	1,500
Upper Orange	4,734	2	1,059	3,589	88	900
Lower Orange	(956)	2,082	1,079	54	(7)	150
Fish to Tsitsikamma	456	603	988	0	71	85
Gouritz	278	0	353	1	(76)	110
Olifants / Doring	335	3	370	0	(32)	185
Breede	869	1	638	196	36	124
Berg	568	194	829	0	(67)	127
Total for Country	**14,166**	**0**	**14,230**	**170**	**(234)**	**5,410**

Table 2 shows the high scenario, which is the worst case projected by the 2004 document in terms of water availability.

Table 2
Reconciliation of the Requirements for, and Availability of, Water for the Year 2025 in terms of the High Scenario (economic growth at 4%). All volumes given in millions of cubic metres per year ($10^6 m^3 yr^1$). WMA means Water Management Area.
(Source: Adapted from the National Water Resource Strategy, 2004:42).

WMA	Reliable Yield	Transfers In	Local Req'ts	Transfers Out	(Shortfall) Surplus (+)	Potential for Dev't
Limpopo	295	23	379	0	(61)	8
Levuvhu/ Letaba	405	0	351	13	41	102
Crocodile West & Marico	1,084	1,159	1,898	10	335	0
Olifants	665	210	1,143	13	(281)	239
Incomati	1,036	0	957	311	(232)	104
Usutu to Mhlatuze	1,124	40	812	114	238	110
Thukela	776	0	420	506	(150)	598
Upper Vaal	1,486	1,630	1,742	2,138	(764)	50
Middle Vaal	67	911	415	557	6	0
Lower Vaal	127	646	703	0	70	0
Mvoti to Umzimkulu	614	34	1,436	0	(788)	1,018
Mzimvubu to Keiskamma	886	0	449	0	437	1,500
Upper Orange	4,755	2	1,122	3,678	(43)	900
Lower Orange	(956)	2,100	1,102	54	(12)	150
Fish to Tsitsikamma	452	653	1,053	0	52	85
Gouritz	288	0	444	1	(157)	110
Olifants / Doring	337	3	380	0	(40)	185
Breede	897	1	704	196	(2)	124
Berg	602	194	1,304	0	(508)	127
Total for Country	**14,940**	**0**	**16,814**	**170**	**(2,044)**	**5,410**

Both scenarios understate water demand, as the population has already grown to 55 million.

One of the problems with both scenarios is that water demand is already higher than either envisages. This is partly because the population has already grown to 55 million, the figure the high scenario sees as being reached in 2025. In addition, the department has done more than was anticipated in rolling out piped water. The number of households with access to piped water has thus gone up from some 9 300 in 2005 to more than 13 200 now, an increase of 42%. This has helped improve the living conditions of millions of South Africans, but has also put severe pressure on limited water resources. Another weakness is that strict standards for waste water treatment have not in fact been upheld, as both scenarios assumed would be the case. Instead, the quality of return flows has sharply deteriorated, so limiting the quantity of suitable water available.

Also relevant is the fact that some Water Management Areas have higher water needs than others, mainly as a result of greater population pressures and more concentrated economic activity. Taking population and economic factors into account, four Water Management Areas stand out. These are:

- the Crocodile West & Marico area, centred on the Hartebeestpoort Dam north of Pretoria, which relies significantly on the return flow of treated sewage from Johannesburg and Pretoria;
- the Upper Vaal area, which contains the industrial heartland of the country;
- the eastern coastal area, which extends from northern KwaZulu-Natal down to the Eastern Cape; and
- the Berg River area that sustains Cape Town and Stellenbosch.

Key data from these four Water Management Areas is contained in *Table 3*. This information shows the trophic status, or the biological productive capacity, of the water in each area. This trophic status depends on the presence in the water of nutrients such as phosphates and nitrates, which come from untreated (or partially treated) sewage, as well as agricultural return flows from major irrigation areas. Water with an enriched biological productive capacity is said to be eutrophic, while highly enriched systems are classified as hypertrophic. Eutrophic water is unsafe for various reasons (as further explained below), while hypertrophic water is even more so.

Table 3 also shows the projected water balance in these four key areas, using the high scenario set out in *Table 2*, which is the more realistic one. It further includes brief comments on the major water challenges each area faces and the extent to which desalination or the use of 'grey' water could help to boost its water supply.

Desalination has become a viable option since the successful commissioning of the Trekkopje Desalination Plant in Namibia in April 2010. A number of additional desalination plants are now being planned in Durban, Cape Town, Port Elizabeth, and elsewhere. The main constraints on this technology are the long-term disposal of highly concentrated brine and the need for sufficient electricity, which means that Eskom's uncertain capacity has to be factored in as well.

Both scenarios also assumed that strict standards for waste water treatment would be upheld.

Grey water can be recovered from sewage plants, but only if these are upgraded and then properly operated. All the country's sewage plants together could yield around 5 billion

litres of safe water per day if the systems were functioning as designed. This water could even be treated to potable standards if next-generation technology were to be installed. The first essential step is thus to manage them properly, in keeping with their current technical capacity, and they will return 5 billion litres per day of safe water back into rivers. The second is to upgrade them with new technology, and they will then generate 5 billion litres a day of drinking-quality water.

Two of these key areas – the Upper Vaal and Crocodile West & Marico – are inland areas, where desalination is not readily available because of the brine disposal constraints. However, these areas are highly suited for grey water recovery options, particularly the Crocodile system, which already survives on sewage return flows out of Gauteng. The other two – Mvoti to Umzimkulu and the Berg area – are coastal, which makes them ideally suited for both desalination and grey water recovery operations.

Table 3
Summary of the four most critical Water Management Areas (WMAs)

WMA	Trophic Status	Water Balance 2025 (Table 2)	Comments
Upper Vaal	High	(764)	Highly stressed, with coal mining as a key issue and grey water recovery as an option
Mvoti to Umzimkulu	High	(788)	Worst drought in 33 years, with desalination and grey water recovery as options
Crocodile West & Marico	High	+ 355	Mostly sewage return flows from Gauteng, with grey water recovery options
Berg	High	(508)	Highly stressed, with desalination and grey water recovery as options

The extent of eutrophication

A recent survey by AfriForum, using data obtained under the Promotion of Access to Information Act (PAIA) of 2000, reveals a startling set of facts. Wastewater service delivery is provided by 152 Water Service Authorities via an infrastructure network comprising 824 collector and treatment systems. Collectively, according to the *Green Drop* reports compiled by the department to monitor the effectiveness of wastewater treatment, these 824 plants receive 4 901 million litres per day (Ml/d) of sewage flows. What AfriForum's analysis now shows is that, of this total daily flow, only 1 259 Ml/d (26%) is treated to satisfactory standards before being discharged back into rivers. The remainder – a staggering 3 642 Ml/d – is returned to the country's rivers as partially treated or untreated sewage. This makes the State the single largest polluter of water in the country.

Close on 4 billion litres a day are returned to rivers as partially treated or untreated sewage.

The department denies this, claiming that its 2013 *Green Drop* report on the quality of wastewater management in the country shows significant improvement. In particular, it says, whereas the national score for managing waste water was 71% in 2011, this has risen to 74% in 2013. Comments AfriForum: 'This sounds very impressive until a note is read that the National *Green Drop* score applies weight per system, which means that a massive works like the Johannesburg Northern Works, with a capacity of 450 Ml/day and performing very well, can "pull up" many smaller works with capacities of 5 to 10 Ml/day.' In addition, by the department's own admission, 248 wastewater systems received scores of below 30%, thereby marking them as 'systems in crisis'.

Poor waste water treatment is driving the eutrophication of all major dams.

Poor waste water treatment is now driving the eutrophication of all major dams. As earlier noted, eutrophic water is characterised by the presence of high levels of nutrients, including phosphates and nitrates. These are likely, among other things, to promote the growth of a dangerous form of blue-green algae (see below). Eutrophication is thus a serious problem, while the Government seems to be under-reporting its extent. Official reports on eutrophication indicate that only 5% of the national water resource is at risk, but this severely understates the magnitude of the phenomenon. This could be the result of flawed methods of measuring phosphate levels, in particular. However, the level and consistency of the under-reporting suggests a deliberate attempt to mislead the public and shield the Government from political embarrassment.

A recent study by Rand Water (the water board responsible for bulk water supply in Gauteng and elsewhere), also fudges the issue of eutrophication. It nevertheless highlights a number of factors pointing towards this problem in the Vaal Dam, one of South Africa's most important water sources. This study collected data from 22 monitoring points in the Vaal Dam system in the period from July 2014 to June 2015. Of these 22 monitoring points:

- seven show high levels of ammonia, a complex form of nitrogen and hydrogen which is a by-product of decay and a key element in eutrophication. Ammonia is toxic to most aquatic life forms and can create major fish kills;
- more than 20 show high levels of nitrate, which is produced by nitrifying bacteria and return flows of agricultural fertiliser. It is the ratio of nitrate to phosphate that triggers vast blooms of toxic blue-green algae;
- seven show elevated levels of phosphate, but this number would probably be higher if phosphate was more accurately monitored and measured;
- at least 13 show unacceptable levels of chemical oxygen demand, which is indicative of inadequately treated sewage return flows and the presence of other decaying organic matter;
- around 7 show elevated levels of conductivity (the capacity of an electrical charge to pass through water), which points to a high concentration of dissolved salts and ions; and
- 12 show the presence of the bacterium *Escherichia coli* or *e-Coli*. This bacterium is found

in the gut of warm-blooded mammals (including humans), and its presence is a direct pointer to contamination by sewage return flows.

Eutrophication means the water potentially available for development does not in fact exist.

According to a recent study by the CSIR, about two thirds of the country's 50 largest dams are now eutrophic. Other studies put the percentage even higher, at more than three quarters. At the same time, neither the department, nor many of the other state entities responsible for water provision, have the capacity to manage the problems arising from eutrophication.

Wrote respected limnologist William R Harding in March 2015 in *Transactions of the Royal Society of South Africa* (a recognised scientific journal used by the aquatic sciences community): 'With as much as 76% of the impounded water affected by eutrophication, [South Africa] is ill-equipped to understand and manage the burgeoning crisis. There is a near-total lack of the structures, skills, and planning needed to address the water quality issues that will, in effect, reduce the availability of those water resources stored in reservoir lakes.' (Dr Harding has effectively been silenced by the State because his work on eutrophication was considered too damaging. This was after his peer-reviewed analysis showed that the millions of rands being spent on the supposed 'rehabilitation' of the Hartbeespoort Dam have no scientific merit and amount to an Nkandla-scale misappropriation of state resources.)

Eutrophication is one of the core challenges the country now faces, for it means that the water potentially available for development (on both the base and high scenarios earlier described) does not in fact exist. It is impossible to calculate exactly how much of the water thought to be available for development has been lost through the presence of untreated (or partially treated) sewage. However, just as a small volume of oil destroys the quality of a large volume of water, so a small source of persistent sewage has essentially the same effect. In the current situation in South Africa, the roughly 4 billion litres of sewage being discharged every day are destroying a far greater volume of potentially useable water. It is impossible to say precisely how great the damage is, as the exact ratio of unit of sewage to unit of water destroyed has never been authoritatively calculated.

Relevant too is the fact that the discharge of inadequately treated sewage effluent from even a single wastewater treatment plant overloads the bulk water treatment plant which is supposed to produce potable water for immediate downstream users. This is a problem particularly affecting the Olifants River in Mpumalanga, in its passage from eMalahleni (Witbank) to the Kruger National Park. There are six water supply loops in the area, all of which source drinking water from a river that is heavily contaminated by sewage. Effectively, this means that the water flowing in the Olifants River passes through at least six people (or six sets of alimentary canals and kidneys) before it reaches Mozambique. Much the same can be said of all the major river basins in South Africa. In addition, there are very few potable water treatment works in the country which are able to source their bulk water from rivers uncontaminated by sewage.

Almost all potable water in South Africa is sourced downstream of dysfunctional sewage plants.

The general public remains largely ignorant of the fact that almost all potable water in South Africa is sourced downstream of dysfunctional sewage plants and is treated by a bulk water plant that is not designed for this purpose. Simply stated, South Africa has polluted its

national water resource to such an extent that it now faces a crisis of *induced* scarcity, which could have been avoided.

Microcystin levels in South Africa far exceed those in other countries.

The microcystin danger

One of the dangers in eutrophication is that it promotes the growth of a family of primitive organisms that are commonly described as 'blue-green algae' but technically are known as cyanobacteria. These primordial life forms are neither plant nor animal, but display some of the characteristics of both. As plants, they photosynthesise and are thus reliant on the sun. As animals, they are capable of seemingly intelligent movement. This means that they congregate in vast numbers where conditions are ideal.

One of the most common species of cyanobacteria is *Microcystis aeruginosa*. This species of cyanobacteria produces a potent toxin known as microcystin. This has hepatoxic (liver-damaging) properties, along with carcinogenic (cancer-producing) ones and neutrotoxic ones (which impair the central nervous system). While it is unclear what benefits the *Microcystis* organism derives from this toxin, it is known to be chemically similar to cobra venom.

This analysis of the microcystin toxin is one of the findings that emerged in 2005 from a major study of the Hartbeespoort Dam near Pretoria. This study also measured the microcystin toxin levels in the water for the period from August 2003 to May 2004. It revealed microcystin levels at a median concentration of 580 micrograms per litre (µg/l) within the dam. The highest concentration found was 14 400 µg/l, while minimum concentrations persistently exceeded 10 µg/l.

Another study found microcystin levels in South Africa that ranged from 10 000 µg/l at the lowest to a spike of 18 000 µg/l in some areas. This study canvassed a representative sample of the most eutrophic dams in the country, including but not limited to the Hartbeespoort Dam, the Midmar and Hazelmere Dams in KwaZulu-Natal, and the Vaal Dam. These microcystin levels are amongst the highest ever measured in the world. Microcystin toxin levels become a concern in developed countries at three orders of magnitude below the levels commonly found in South Africa.

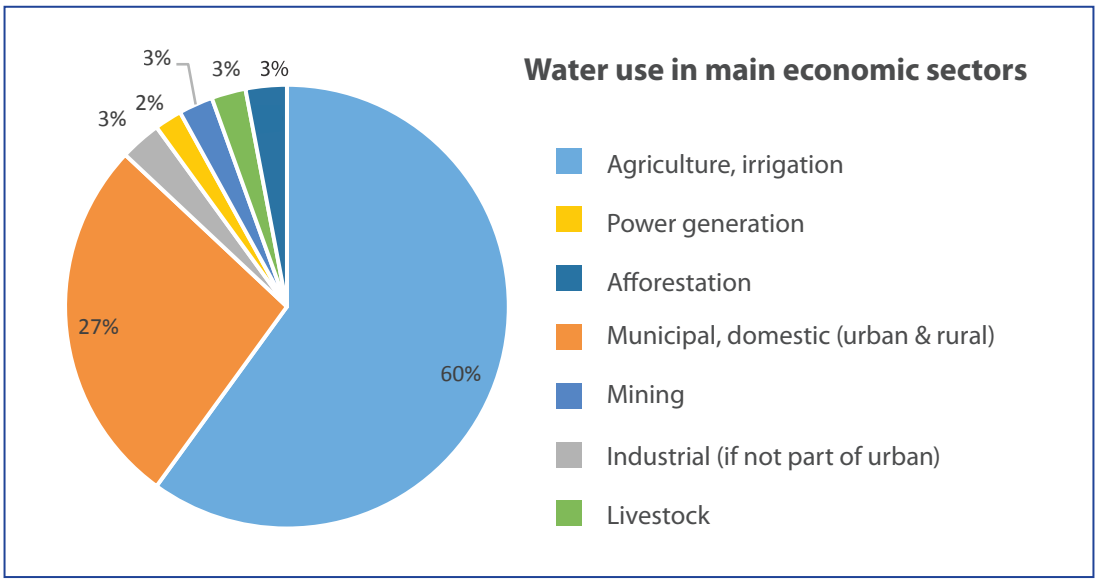
Still more worrying is the fact that none of South Africa's 1 085 water supply systems have the capacity to remove microcystin. There are only two known technologies capable of neutralising microcystin (advanced oxidisation processes and activated carbon), but these are not in mainstream use in any of the bulk potable water treatment plants in the country. In addition, no one knows whether these technologies are in fact capable of neutralising microcystin at the concentrations found in South Africa. In this regard, we are truly flying blind. This may also be encouraging the Government to deny the full extent of the problem, rather than developing a rigorous monitoring program that would unveil it.

We do not apply the only two known methods to neutralise microcystin, which may also be ineffective at our high levels.

Other unacknowledged problems

The agricultural sector, the single largest water user, uses some 60% of South Africa's water, mainly for irrigation (see *Figure 4*). The Department of Agriculture, Forestry, and Fisheries wants to increase the quantity of irrigated land by more than 50%, but assumes that this can be achieved without increasing the amount of water allocated to farming. The increase in

Figure 4.
Sectoral water use in terms of the national water resource strategy drawn up in 2012.



irrigated land is supposed to be achieved through greater efficiencies in water use (through an increased use of drip irrigation, for instance), coupled with some additional water supply developments, including the new Umzimvubu Dam being planned for the Eastern Cape. However, construction of this dam has not yet begun and it is unlikely to be completed by 2018, as currently scheduled.

The idea that the quantity of irrigated land can be doubled without increasing the water made available for agriculture is supremely ambitious. It is also not grounded in any empirical reality, especially as efficiencies are diminishing rather than increasing. This has been the case since 1994 and is largely the result of infrastructural and institutional failings. In addition, irrigation systems are typically old and often in a state of disrepair, which means they generally lose water long before it even reaches farms. Many irrigation farmers are also effectively barred from carrying out their own improvements because their land is under claim and cannot easily be used as collateral for bank loans. The capacity of all government entities has also been undermined by transformation, so the Government's determination to accelerate this process is likely to make things worse rather than better.

Average water consumption is 235 litres per person per day, 26% higher than the global average of 173l/p/d.

As Figure 4 also shows, municipalities are the second largest water users, using 27% of the national water resource. Here, many more inefficiencies are evident, for average water consumption in South Africa is 235 litres per person per day (l/p/d), which is a staggering 26% higher than the global average of 173 l/p/d. A key part of the problem is that 37% of the water supplied by municipalities is 'non-revenue' water, which is either lost to leakages or is never billed or paid for. In some of the worse performing municipalities, distribution losses are estimated to be close on 50%. These losses cost municipalities around R11bn a year, but cannot easily be overcome with existing state capacity.

Despite some glimmers of hope, municipal water reticulation is generally deteriorating.

What this also means is that the usual benefits of urbanisation in water management – benefits stemming from the greater density of consumers in cities – are being lost through increasing inefficiency in the reticulation system. Some glimmers of hope can be found in municipalities such as Drakenstein (near Paarl in the Western Cape), which has succeeded in reducing non-revenue water from 33% in 1999 to 12% in July 2013, while also limiting both water consumption and waste. However, these are patchy results, with the general trend being towards a deterioration in municipal reticulation.

Institutional capacity is a fundamental constraint at all levels of the water management system. For example, while the 2004 national strategy document identifies 19 Water Management Areas (WMAs), each of which is supposed to have its own 'catchment management agency' (CMA), only two of these CMAs have been brought into operation. (These are the Inkomati CMA in Mpumalanga and the Breede-Overberg CMA in the Western Cape.) The 2012 national strategy document is more realistic in proposing that the 19 WMAs be consolidated into nine new structures, which is a step in the right direction. However, it remains unclear how this will improve the management of water when the fundamental need to gather accurate and regular hydrological and other biophysical data remains subordinated to the political imperatives of transformation.

The WMAs also require sophisticated data on which to base their planning and operational decision-making. Since 2004, however, little water planning information has been gathered. In addition, no updated water account – a record of water use, allocation, and supply at a specified moment in time (similar to a financial balance sheet) – has been made available since 2000. There has also been a dramatic decline in the generation of useful hydrological data, so much so that current hydrological monitoring is at the same level as the country had achieved in the 1950s.

The transformation imperative has pushed competent professionals out of water institutions.

Hydrometric (rainfall) monitoring by the South African Weather Service is also much diminished. Only two out of 13 monitoring stations in the Mvoti River basin in KwaZulu-Natal have been yielding regular data, which helps explain why the current major drought in the province remained invisible to decision-makers until the Mvoti Water Treatment Plant suddenly ran out of water. This triggered a panicked response by managers at the plant, who then tried to shift the blame to other factors rather than admit to the current deficiencies in data capture and processing.

Reasons for the deterioration in data management are many and varied. One is the transformation imperative, which has helped to push experienced professionals out of government departments and into commercial consulting firms. These individuals have been replaced by people with fewer skills and less experience, so creating a vacuum in professional expertise. This has also rendered state agencies heavily dependent on consultants for the delivery of critical services, including data collection and analysis. Commercial consultants quickly learned that data equates to money, and began recycling much of the same data every time a new consulting report needed to be produced. This has resulted in multiple billings for the same data, but has had to be accepted as a necessary evil as the State's own capacity has declined. This reduced ability to manage data is also unlikely to be reversed, despite some recent positive developments. (These include the creation of the Gauteng City Regional Observatory, which is intended to become a central depository for all spatial data on Gauteng and Johannesburg.)

Particularly worrying is the persistence of poor wastewater management, most notably at municipal and provincial levels. The reasons for this are complex. However, despite 20 years of governing and many promises of reform, the ruling ANC is still battling to improve the competence of its deployed cadres. Ironically, there also seems to be an inverse relationship between the functionality of state entities and their proximity to the individual. Municipalities are responsible for delivering the water, electricity, and other services that have the most immediate impact on the daily lives of individuals. But it is precisely at this local level that state capacity is most limited.

The shortage of engineers at local level is an 'induced' deficit directly related to the ANC's insistence on racial targets.

Decision-makers within the ruling party are acutely aware of this problem, as is the national Government. In addition, a comprehensive survey by the South African Institute of Civil Engineers (SAICE) in 2008 highlighted a shortage of engineering skills at local level which has yet to be overcome (and will surely not be solved by the recent appointment of 35 Cuban engineers to municipalities around the country). The shortage of engineering skills at third-tier level is also an 'induced' deficit directly related to the ANC's insistence on racial transformation. Were it not for this factor, the engineering skills available would suffice to meet present needs. Hence, if the Government were willing to deracialise the appointment of technical skills, the current shortage would be overcome. It is an induced shortage, much like the induced scarcity arising from sewage work dysfunction.

However, for as long as current transformation policies persist, municipalities will battle to fulfil their responsibilities to treat wastewater properly. A key pointer to this malaise is the ongoing inability of the Tshwane Metropolitan Municipality to overcome the 'state of emergency' at the Rooiwal wastewater plant. That this crisis situation has persisted since 2011 – for close on 15 years – points to systemic failures so deep-rooted they cannot easily be resolved. This particular example should be closely monitored as it could be the equivalent of the 'canary in the coal mine'. If the situation at Rooiwal worsens, this could thus provide empirical evidence of wider impending institutional collapse. Conversely, if the deficiencies at the plant can be overcome, this could be an equally significant pointer in the opposite direction.

In the interim, transformation policies are now also having major impact on the water boards which obtain bulk water from dams, pass it through potable water treatment plants, and then supply it to municipalities for onward distribution to end-users. Engineers sitting on the boards of directors of these vital organisations are now also being replaced by the ANC's deployed cadres. The result is that Rand Water, one of the largest water boards in the world, currently has a board of directors on which no single professional engineer serves. The ruling party's emphasis on transformation has affected staff as well and has resulted in highly qualified specialists (ranging from engineers to microbiologists and ecologists) being placed under great pressure to leave, long before they reach retirement age. Many have succumbed to the pressure and resigned, while their replacements have rarely had the same qualifications and experience.

Engineers on water boards, which supply bulk potable water to municipalities, are being replaced by deployed cadres.

Solutions to the growing water crisis

The first essential requirement is a new and technically robust national strategic plan for managing, conserving, and augmenting the country's limited water supplies. This strategic plan needs to draw on all the information and insights contained in the 1970 report of the *Commission of Enquiry into Water Matters*. The new plan must put its emphasis on improving water quality, enhancing professional and technical skills, developing innovative water recovery technologies, overcoming the problem of non-revenue water, and laying out a suitable framework for public-private partnerships in water provision.

The first imperative is a technically robust national strategic plan for managing and augmenting water supplies.

Implementation of the strategic plan should be driven by the Presidency, and must have clear goals for the efficient recycling of water. Our national water resource, as collected in dams, currently stands at some 38 billion cubic metres, provided that this water is not lost to eutrophication. The country's projected demand in 2030 is some 60 billion cubic metres. If we could use our existing 38 billion cubic metres roughly 1.6 times over, this would generate the 60 billion cubic metres required (38 x 1.6 = 60.8). If every water authority were to achieve this goal over the next 15 years, the cumulative impact would be a national recycling strategy that would meet the overall need and provide an essential foundation for increased growth and employment.

However, if this overarching goal is to be attained, the next urgent need is to reinvigorate all the institutions involved in water management and supply. These extend from the national department itself, with its overall responsibility for water policy and its implementation, through the water boards responsible for bulk water provision, to the municipalities responsible for the reticulation of potable and waste water and often also for the management of wastewater treatment plants. Also relevant here are the various institutions established under the National Water Act, which include the Water Tribunal responsible for deciding on applications for water use licences and the CMAs responsible for managing the various WMAs.

Appointments and promotions to all engineering, technical, and managerial posts within these institutions must in future be based primarily on professional knowledge and experience. Current targets for employment equity in such positions should also be revised down because they overlook the age and skills profile of the black African population. Though black Africans make up 75% of the economically active population, this group includes all those people between the ages of 15 and 64 who either work or wish to do so. The black African population is also a particularly youthful one: so much so that more than 52% of black Africans are currently under the age of 25. In addition, many management and professional posts require either a relevant degree or at least some form of tertiary training, whereas only some 5% of black Africans currently have any post-Grade 12 education. Among professional engineers, moreover, only 1 500 are black Africans, while roughly 1 000 are Indian, 160 are 'coloured', and 13 800 are white.

The economically active population thus includes many black Africans who are too young, unskilled, and inexperienced to be eligible for managerial, engineering, and professional posts. Targets for black African representation at these positions should therefore be reduced to realistic levels which take these factors into account. At the same time, the quality

Among professional engineers, only 1 500 are black Africans while 13 800 are white.

We must urgently fix the wastewater treatment plants that spill so much untreated sewage into our rivers every day.

of schooling needs urgently to be improved, while every effort should be made to attract black African graduates with suitable qualifications into water institutions. Here, these individuals should be trained, mentored, and helped to rise as rapidly as possible into more senior posts. White African professionals should be recognised for what they are – citizens who wish to contribute to South Africa's success and have the core technical skills required.

With more realistic employment equity targets in place, it should be easier to retain the skills, experience, and institutional memory still to be found in water institutions. This nucleus of skills should be used to build up additional professional and managerial capacity over time. The country must shift away from cadre deployment and an emphasis on unrealistic racial targets to the development of a cohort of experienced professionals who are rigorously measured on their performance and can be fired if they fail to deliver to the required standard.

A key task for these revitalised institutions will be to reinvigorate the country's hydrometric (rainfall) and hydrological (streamflow) data stations, most of which are in a serious state of disrepair. Comprehensive and accurate data must again be assembled, so as to provide early warning of drought, for example, and ensure that eutrophication levels are properly monitored, analysed, and mitigated. Current inadequate measurements of phosphate levels, for example – which seem to be allowing the Government to under-state the eutrophication problem by a factor of some 90% – must urgently be resolved.

The most vital challenge of all is to find a speedy way to fix the poorly managed wastewater treatment plants which presently spew some 3 642 Ml/d of untreated or partially treated sewage into the country's rivers and dams every day. This requires, in the first instance, that people with the requisite skills and experience be appointed to run these plants. However, procurement difficulties also play a part in their current poor performance, as the Rooiwal plant in the Tshwane area shows. There, attempts by the plant's managers to end the state of emergency declared by the national department were stymied, in part at least, by procurement problems (see box on page 27). Bad financial management also often undermines procurement, as budgeted revenue is frequently frittered away in unauthorised, irregular, and wasteful expenditure. Procurement is further complicated by black economic empowerment (BEE) requirements, which generally add to tender costs, overlook the shortage of black-empowered firms with the necessary capacities, and can give impetus to corruption.

Transformation must no longer trump the imperative to safeguard public health.

Overall, the supposed needs of 'transformation' must no longer be allowed to trump the imperative to safeguard public health. The relatively small elite which benefits from current employment equity and BEE policies is likely to object vociferously, but their narrow self-interest cannot continue to be put before the needs of the country as a whole. If current transformation policies continue to take precedence, we can anticipate a further deterioration in the operation of wastewater treatment plants. This in turn is likely to generate a growing burden of disease, especially in poor communities, and an escalating cost for the treatment of potable water from sources contaminated by sewage flows.

The possibility of major public health crises in the short to medium term is growing and can no longer be discounted. We could soon see a major bloom of toxic cyanobacteria, especially in the light of the increased water temperatures likely to result from the El Nino Southern Oscillation now evident in southern Africa. The growing risk to both companies and individuals needs to be anticipated and understood, so that remedial action can be taken as quickly and effectively as possible.

All bulk potable water treatment plants must apply the only known methods of neutralising microcystin.

We must also embark on a broad awareness campaign to inform the public about the extent of eutrophication and the problem of microcystin toxicity. The public needs to be aware of the risks, while policy reforms need to be accelerated through informed debate. The initial emphasis will have to be on ensuring that adequate 'end-of-pipe' solutions are found and implemented as quickly as possible. We must also ensure that all bulk potable water treatment plants start applying the only two known technologies capable of neutralising mycrocystin. These are the only responses likely to be viable in the short-term. We must further urgently re-invest in the elimination of eutrophication, but this will yield positive results only in the long term.

South Africa also needs to find realistic ways of increasing its water supply. The Lesotho Highlands Water Project is often touted as an important way of doing so, but cannot in fact achieve this as all water from Lesotho flows into South Africa already. What the project does is to divert the flow and retain it in high mountains where deep storage is possible and evaporation losses are lower. At the same time, however, the yield from the project is increasingly being 'stolen' by farmers long before any water reaches the Vaal Dam. This is a perverse consequence of the department's water use licensing system, which is reducing the water available to commercial farmers (without yielding compensatory benefits to emergent farmers, who generally lack the skills, experience, infrastructure, and capital to succeed in their small farming ventures). Many commercial farmers have responded to this situation by simply abstracting the water that they need. The department is now using satellite data to verify these abstractions and prosecutions are said to be imminent. However, even if current unauthorised abstractions can be stopped, the deeper problem of providing an adequate water supply to the commercial farming sector – which is vital to the country's food security – will not easily be resolved.

The department speaks of building bigger dams to capture more water, but this is not a viable option.

The department speaks also of building bigger dams to capture more of the water in the Vaal, Gariep, and other major rivers. However, this is not a viable option. The Gariep River, for one, already has a total dam storage capacity amounting to 271% of the available stream flow. In other words, if the annual average flow of water in the river is assumed to equal 100%, then its total dam storage capacity already stands at 271% – or almost three times the water available. Hence, there is little point in building new dams on this river, or on many others. In addition, even if new dams could be built, rising temperatures could increase losses to evaporation, heighten salinity levels, and accelerate the rate of eutrophication, especially if current nutrient loads persist.

An alternative method of storing water is thus urgently required. Here, the best option could be new methods of aquifer storage and recovery – also known as managed aquifer recharge

The best way to store water may now be in aquifers, but we need to research this more.

– that are currently being developed in countries such as Australia, the United States, and Namibia. This technology has important potential, but various constraints on its use – including the importance of appropriate geological conditions – still need to be better understood.

Financial issues also need to be resolved. The tax revenues allocated to water management need to be increased, and must also be much more efficiently used. Official estimates by the department indicate that more than R800bn – or R80bn a year – is needed over the next decade simply to overcome the maintenance backlog in water infrastructure. But annual budgetary allocations are generally below this sum, while many municipalities and other state entities either under-spend their budgets or fritter much of the money away. The State also loses an estimated R30bn to corruption each year, which must affect the water sector too. Overall, the country is not spending enough – or getting enough 'bang for its buck' – even on essential maintenance, let alone the new technologies needed to manage microcystin, develop aquifer storage and recovery, or remove the endocrine disrupting chemicals (oestrogen, for one) that current sewage treatment methods cannot counter.

The problem of 'non-revenue' water must also be overcome if South Africa is to reduce its massive water wastage. Significant quantities of water are lost through leaking pipes and other infrastructure, which poorly skilled municipalities generally lack the capacity to address. But much of the water supplied is not metered at all, while end-users often also fail to pay the water charges levied by local authorities. Reasons for non-payment include the 'rent boycott' (a refusal to pay electricity and water charges as a political protest against apartheid), which was encouraged by the ANC in the 'struggle' years and which persists to this day. Also relevant here are the inaccuracies in billing systems in many municipalities, an ideological belief that access to water is a basic human right for which poor people should not have to pay, and a deepening crisis of unemployment which has significantly eroded household incomes.

Raising water tariffs is sometimes seen as a way of encouraging more prudent water use. However, global experience shows that this is unlikely to make much difference, as usage generally goes up again after the short-term shock of a tariff increase has been felt. In addition, higher water tariffs would not address the key financial challenges confronting South Africa's water sector. These problems cannot be resolved without better financial and technical skills, less corruption and wasteful spending, and a shift away from preferential procurement under BEE rules to transparent and competitive tender processes. The high percentage of 'non-revenue' water must also be reduced.

All the solutions outlined here are premised on state institutions becoming very much more efficient at water management. However, this will be difficult to achieve in the short term at least. South Africa thus needs to learn from the experience of other African countries and start introducing public-private partnerships (PPPs) that would immediately draw private-sector efficiencies into the mix.

The problem of non-revenue water must be overcome to reduce our massive water wastage.

Public-private partnerships in water management

Public-private partnerships (PPPs) in the water sector in Africa date back to 1959, when Cote d'Ivoire successfully embarked on an urban water 'affermage' or lease agreement. Under this agreement, the government retained ownership of water infrastructure but responsibility for

day-to-day operations was transferred to the private sector. This PPP remains in operation and continues to provide water to more than 7 million people to this day.

South Africa needs water PPPs to improve efficiency and increase water supply.

Many of the water PPPs in Africa have been implemented with the help of the International Finance Corporation (IFC) forming part of the World Bank. Some of these African PPPs have failed, but the great majority, as the IFC records, have succeeded in 'improving operational efficiency, reducing non-revenue water, and enhancing labour productivity'. Some have also mobilised new sources of capital, and involved significant innovation and technology transfers. Overall, the 50 or so PPPs implemented in the water sector in Africa during the past 20 years have generally succeeded in enhancing water management, increasing access to water, and maintaining affordability through increased efficiency and economies of scale.

PPPs can take different forms. Under the Build-Operate-Transfer (BOT) model, the private sector takes on the task of building and delivering new infrastructure (such as a wastewater treatment plant) and must do so on time and on budget. As the IFC writes, this model 'encourages the private company to build a high quality asset up front to minimise the maintenance later'. The private sector must also mobilise the capital needed for construction and cannot easily change the contract price if input costs rise. This gives the private partner an important incentive to prevent construction delays and cost overruns, whereas government-managed construction contracts commonly run over budget while falling way behind schedule.

Examples of BOT agreements include a contract for a wastewater treatment plant that was concluded in 2009 in New Cairo City (Egypt), a satellite town of greater Cairo. The New Cairo plant mobilised some $200m in private investment and the new plant was completed in 2012. The BOT model has also been used for a number of potable water treatment plants, including desalination plants. Most of these contracts have been concluded in North African countries, where total investments of this kind have risen to more than $3bn.

A successful BOT has also been implemented in South Africa already. In 1999, soon after the adoption of the National Water Act, the Government showed an interest in supporting flagship projects that would demonstrate how differently things could be done. There was also a significant water problem in Durban, where a wastewater treatment plant south of the city was discharging partially treated sewage effluent into the ocean via a lengthy undersea pipeline. At the same time, two major bulk users of water – a paper-and-pulp plant and an oil-processing company, both located close to this plant – required a constant stream of industrial grade processed water that need not be of potable standard.

Two problems could thus be solved via a single intervention. In 1999 a contract was awarded to Durban Recycling (Pty) Ltd, under which the discharging of sewage effluent into the ocean was ended while the company undertook the bulk supply of industrial grade processed water at a cost below that of potable water. The major technical participant was Vivendi Water, which included various other entities (among them Umgeni Water, Khulani Holdings, Ketachem, and Marubeni Europe). Veolia, a major water services company based in France but with a global footprint, provided some of the technology, including advanced oxidisation of the

More than 50 water PPPs have been implemented elsewhere in Africa over the past 20 years.

A successful PPP in Durban saves potable water by providing industrial grade water to two plants.

final effluent stream to destroy all residual pathogens. The plant was opened in 2001 by Ronnie Kasrils, then minister of water affairs and forestry, who praised the project and publicly affirmed his confidence in it by drinking a glass of treated effluent in the presence of industry leaders and the media. This successful BOT has never received the recognition it deserves. It did, however, become a blueprint for South Africa's subsequent 'dual-stream' reticulation model, in which water of different value and quality is provided to different users, with a preference for recycled grey water.

A second PPP model is the 'affermage' or lease agreement, in which the public sector retains ownership of water infrastructure but the responsibility for day-to-day operations is transferred to the private sector. A third model, generally applied in small towns and rural areas, involves the conclusion of a management contract which (as the IFC describes it) 'allocates the risk of operations, revenue, and collection to private companies, while keeping the costs of service affordable through public funding for capital development'. Adds the IFC:

> Some studies of PPPs in urban water utilities have found significant efficiency gains achieved through the involvement of the private party, including reduced water losses, increased staff efficiency, coverage, and daily hours of service. Service delivery by government is often poor because [of] limited capacity and [a] lack of management incentives, [which also] increases its cost... In small towns and villages with few customers, poor populations, and distribution systems ranging from a few hundred to several thousand connections, small local private providers are successfully meeting people's basic water needs... In small piped systems, there is a strong correlation between PPPs and increases in connections and collections, [which] in turn enhance accountability... A recent review of Uganda's ten-year experience in small town water PPPs finds that connections have almost tripled since the introduction of PPPs in 2002. Over 1.5 million people are now served through PPPs in small towns, and tariffs have risen by less than inflation.

Experience in Uganda also shows how quickly efficiency gains can be realised through effective PPPs. While the World Bank financed the development of small town water infrastructure, the Ugandan government began introducing one-year annual performance contracts (APCs) that tied the remuneration of local managers (via bonuses and penalties of up to 25% of basic salary) to their attainment of specified targets. Notes the IFC:

> Under the APCs, the operational performance of the largest utility [operative in] secondary towns improved strongly: non-revenue water decreased from 32% to 22% in fewer than three years, and bill collection improved dramatically. The introduction of APCs in small towns attracted private sector operators in the management of water supply, improved service quality and raised customer satisfaction levels.... As of 2010, 18 private operations were running 95 water systems in small towns. The number of towns being serviced increased from 15 in 2001/2 to over 90 in 2010/11. After the launch of private sector participation reform, private operators in small towns improved tariff collection and achieved almost universal metering, while maintaining affordable tariffs.

In Uganda, PPPs have brought water to 1.5 million people in small towns and kept tariff increases down.

The benefits of the affermage model are also illustrated by recent experience in Niger, which decided in 1999 to use this form of PPP to overcome the poor performance of the water sector. A new state-owned company (Société de Patrimoine des Eaux du Niger or SPEN) was established to take over the ownership of water assets and infrastructure development, as well as to oversee the servicing of debt and the monitoring of service quality. The Government retained responsibility for policy, tariff setting, and the overall management of the country's water resources.

A PPP in Niger has injected new capital, while increasing reliability and affordability.

SPEN then entered into a ten-year affermage with a professional operator, the Société d'Exploitation des Eaux du Niger (SEEN), which was accorded an exclusive right to provide water services in SPEN's area of jurisdiction. A ten-year performance contract specified SEEN's technical and commercial performance obligations, laid down financial incentives and penalties, and spelt out the operator's responsibilities for the rehabilitation of water systems. A special multi-sector regulatory agency was created to oversee the contract.

SEEN was incorporated in 2001 with initial capital equivalent to some $2m. International water operator Veolia Water acquired 52% of SEEN, while 34% was owned by private investors, 9% by SEEN's staff, and 5% by the Niger government. The reform programme and establishment of SEEN attracted a positive response from external financiers, including the World Bank, the African Development Bank, and Chinese investors, who agreed to contribute 85% of the $103m cost of the initial investment programme. Writes the IFC:

> Between 2001 and 2013, the performance of the system in SEEN's service areas improved significantly in terms of access to piped water, reliability of the service, non-revenue water, bill collection ratio, operational efficiency, financial viability, labour productivity, and affordability. For example, the proportion of people with direct access to a residential connection increased from 31 percent to 59 percent, and the number of residential connections increased threefold (from 56 300 to 171 750 units). Since 2006, water has been available on a continuous basis in most urban centres and areas of Niamey. Ninety-eight percent of water samples now comply with bacteriological standards. Non revenue water has declined from 22 percent to about 17 percent. The bill collection ratio of private consumers has increased by six percentage points, from 91 percent to 97 percent. Staff productivity has improved from 8.6 employees to 3.6 employees per 1 000 connections, without any layoff programme, and a 20 percent increase in salary has been instituted. Only five years after the beginning of the reform, the sector was able to recover its operating and maintenance costs, service its debt, and contribute to its capital expenditure from user charges. Since then it has become financially autonomous, and no longer relies on government subsidies.

Under this PPP, 98% of water samples now comply with bacteriological standards.

IFC experience with PPPs in the water sector in Africa shows how much can be gained from partnerships of this kind. It also stresses that success depends on strong political support and a long-term commitment from both partners. Adds the IFC: 'For developing countries, dependable funding from the public partner is key to promoting the expansion of access. Maintaining an affordable tariff and keeping overall risk levels acceptable for the private sector are equally necessary. Tellingly, successful water PPPs are usually designed around a mix of funding sources. Therefore, the focus should be

on building a partnership that layers a degree of public sector financing on top of private sector skills and expertise. This can improve the sustainability of systems, strengthen financial viability, and boost quality of service.'

In India, prime minister Narenda Modi plans water PPPs in more than 600 cities.

Many other countries have also embraced the PPP option to improve the quality of water management. In India, for example, the reform-minded government of Narendra Modi is developing various PPP models for water management in more than 600 cities. At present, almost all Indian water utilities are publicly owned and controlled, but operational efficiency is often limited while only some 20% of water connections are metered. In future, PPPs will be used in many cities to put private players in charge of operations in return for fixed fees. Some PPP agreements may also give private firms responsibility for refurbishing and expanding water infrastructure. State governments and urban municipalities will be expected to contribute to operating costs, but the bulk of funding will be garnered from the private sector.

The lessons for South Africa from the success of PPPs elsewhere in Africa, in particular, are clear and compelling. The country is also fortunate in having a relatively strong tax base, along with significant water infrastructure, important professional skills, and a still vibrant private sector on which to draw. However, various proposed PPP initiatives (including those earlier envisaged for the Indian cities of Delhi and Mumbai) have been defeated by protests sparked by left-leaning civil society organisations seemingly so opposed to the 'commodification' of water that they would prefer to see poor people remain without access to clean water rather than allow private firms to supply this for a reasonable fee. The South African Government at times also displays an ideological hostility to the private sector which could undermine the success of water PPPs, despite the urgent need for them.

Conclusion

All available data suggests there is little in South Africa's water sector to be optimistic about. The level of politicisation has become so high that decision-making is no longer rooted in hydrological realities. Ideology is regarded as paramount, while reality counts only as a secondary factor. The ideological filters in place make it very difficult to carry out any serious technical assessment of water quality or management. In addition, no serious attempt is currently in place to embark on evidence-based policy reforms.

Ideology is regarded as paramount, while reality counts only as a secondary factor.

Political aspirations are now also being frustrated by the persistent under-performance of the national economy, which is beginning to translate into major job losses in mining and elsewhere. The Government frequently blames poor economic growth on insufficient transformation – for which it sees the remedy as accelerated and deeper transformation. Nowhere is there a serious effort to ask whether the institutional constraints arising from accelerated transformation might in fact be largely responsible for the dismal performance of the economy.

Until the country reaches a level of political maturity at which such questions can be seriously considered, we are unlikely to resolve either the challenge of low growth or the looming dangers from poor water management. But the public backlash from appalling sewage management could begin to challenge the wisdom of the cadre deployment policy, while the forthcoming municipal elections could provide the setting for a necessary debate around this issue.

Perhaps the greatest failure since 1994 has been deteriorating water quality – a looming disaster which could have been avoided.

Perhaps the greatest failure of the new order since 1994 has been deteriorating water quality. This has been caused primarily by massive failures in the management of municipal wastewater treatment plants, which have made the State the biggest polluter of water in the country. This looming disaster could have been avoided by more rational and less ideologically-driven policy choices. We need to challenge this approach if we are to re-invigorate our democracy and extricate ourselves from the horns of the dilemma arising from the politicisation of water in a highly water-constrained national economy.

- by Anthony Turton

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No Effective Remedial Action at Rooiwal for Fourteen Years

The Rooiwal Wastewater Management Plant (Rooiwal) is a large sewage processing plant north of Pretoria. Initially constructed to provide cooling water for an Eskom power station that has since been mothballed, this plant now discharges 150 million litres per day of effluent into the Apies River. Since this is the maximum capacity of the plant, it has lost its ability to manage the natural peaks that happen daily and the surges that occur after heavy rain, when illegal stormwater pours into the system in vast quantities.

The entry of stormwater stems from inadequate maintenance as well as the illegal connection of gutters to sewers. The Rooiwal plant is now hydraulically overloaded, which means the biological processes needed to digest the sewage into effluent safe enough for discharge have been overwhelmed. Instead, partially treated effluent is regularly discharged into the river.

Rooiwal has thus long been failing to comply with the terms of the water use licence issued to it under the National Water Act of 1998. Its significant discharges of sludge on to farmland that in turn drains into a large wetland are also in breach of this licence.

In 2001, in response to Rooiwal's persistent failures, the then Department of Water and Environmental Affairs (the department) issued it with an 'exception' notice, which relaxed the conditions of the water use licence and allowed the plant to exceed normal safety specifications. At the same time, the Tshwane Metropolitan Municipality (Tshwane) was expected to carry out necessary repairs.

Tshwane responded by drafting an official 'plan of action' – but this was done only *ten years* later, in September 2011. A month thereafter, in October 2011, the department issued a directive for remedial action. It also declared 'a state of emergency' at Rooiwal because its persistent compliance failures had damaging (even potentially lethal) consequences.

Still no improvements were made. In 2013, with full knowledge of the situation, the department nevertheless issued the plant with a new waste management licence. This licence did, however, lay down a number of additional reporting requirements, which have at least generated a rich paper trail of forensic evidence (including the names of the officials appointed to deal with specific issues).

Included in this paper trail is a document requesting permission to deviate from official procurement processes so as to carry out the emergency repairs the department had demanded back in 2011. A tender was thereafter issued to a professional company to do the remedial work, but this was cancelled when it was discovered that 'fronting' (the exaggeration of black economic empowerment status) had occurred. A second firm of consulting engineers was then appointed, but by then the relevant tendering period had lapsed, which meant this contract could not proceed. This created an internal crisis within the metropolitan authority, which the department tried in various ways to address.

Despite the efforts made, the problem has yet to be rectified. On the contrary, the factors that prompted the declaration of a state of emergency four years ago still remain unchanged. In the interim, a number of the officials tasked with resolving the crisis have either been suspended or re-deployed elsewhere.

Rooiwal presents a classic example of systemic failure, for it lacks both the engineering and the institutional capacity to self-correct. External intervention is thus needed if a major health crisis is to be averted.

That health crisis could be triggered by a severe drought, as this would reduce the natural flow of the Apies River and diminish its normal dilution effect. Sewage flows would remain much the same, of course, which means the ratio of sewage effluent to the volume of the receiving water body would increase. This could lead to an epidemic of pathogenic disease.

The Apies River has become little more than an open sewer. However, communities downstream continue to source their drinking water from the river. So too do irrigation farmers whose livelihoods depend on the delivery of food crops to consumers who in turn rely on them to maintain appropriate safety standards.

The department's interventions, though ineffective overall, have at least generated an important information trail as to who was supposed to do what and when. This could result in the conviction of various officials on several criminal charges. In practice, however, these officials are more likely to be shielded from punishment by a perverse reliance on a 'co-operative government' clause in the Constitution, which says that government entities should 'avoid legal proceedings against each other'.

This clause should, of course, be read in conjunction with other relevant provisions, which stress the need for all state entities to 'secure the well-being of the people of South Africa' and to provide them with 'effective' and 'accountable' government. However, it is the clause supposedly barring court action that is likely to be given precedence – even as Rooiwal's dismal performance continues unchecked.

- by Anthony Turton