Affordable fixes to SA's poor water infra

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The site of the Polihali Dam in Lesotho.

By Eamonn Ryan

The best way for other areas of South Africa to avoid the harsh measures being implemented in the Western Cape, is to start using water more consciously through innovation.

South Africa's latest SAICE infrastructure scorecard paints a dismal picture as far as water infrastructure is concerned: D+ for bulk water resources; C+ for water supply in major urban areas; D- for water supply in all other areas; C- for sanitation and wastewater in major urban areas; and E for all other areas. By comparison, national roads rate B and airports a creditable B+.

Grade E, by the way, stands for 'unfit for purpose' — infrastructure that has failed; D is infrastructure 'not coping with demand'; and C is 'satisfactory for now'. The knee-jerk reaction is that hundreds of billions of rand need to be spent to get infrastructure to standard — well, we all know we don't have that. In fact, lack of capital was what got us into this latrine pit in the first place. It is trite to simply quote the amount of money that has to be spent — surely there must be cheaper ways of addressing the problem?

Fully 40% of South Africa's water is either lost to the system or not paid for, while another third of accounted-for water is lost in the agricultural process. In "Israeli water desalination insights" on page 28 in this issue, the Israeli Water Authority's head of reclaimed water, Danny Greenwald, explains that water efficiency is core to Israel's self-sufficiency, and the first step to efficiency was achieved by Israel ensuring water use is "both measured and paid for" — two policy areas South Africa is particularly weak at.

Population growth, irrigation development, and other economic activity mean that South Africa has long since passed the stage where the requirement for water can be met from natural availability. The solutions Israel designed to address these issues are: an emphasis on the decrease in the overall water

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usage; use of cleansed wastewater in agriculture; and the implementation of new methods such as the desalination of seawater, which now provides almost unlimited water resources.

Willie de Jager, MD of Corestruc, a company which manufactures and installs concrete precast structures including water reservoirs, outlines the water needs at municipal level as contained in the government's Draft Water Strategy:

- 89% of households have access to operational services but reliability is only at 63%.
- Current access to sanitation services is 80% on average (50% in some local municipalities).
- It is reported that 56% of the approximately 1 150 wastewater treatment works are in poor or critical state, and need to be rehabilitated urgently and properly maintained afterwards.
- 44% of 962 domestic water treatment works are in a poor condition and need urgent rehabilitation. This excludes private works and industrial treatment.

He notes that water, sanitation, and health infrastructure is a global challenge, and the majority of the world's communities that lack improved sanitation facilities or a reliable supply of potable water reside in rural areas of Africa. "Corestruc sees huge potential for its complete reservoir construction projects in other countries, such as Zimbabwe, Mozambique, and Namibia, and we have been liaising with client bodies and professional teams in these countries," says De Jager. Its primary market is South Africa.

'Wat 'er the alternatives?'

According to an Institute for Security Studies report, *A Delicate Balance: Water Scarcity in South Africa*, "At a national level, this research has pointed to broad areas that the South African government can focus on: increasing the amount of wastewater that is treated and reused, minimising non-revenue water or otherwise increasing efficiency in the municipal sector, increasing the intensity of groundwater use in areas where it is sustainable, and increasing the share of renewable sources in the national energy mix."

Consequently, there are several ways of improving water supply, not all of which require massive expenditure:

- New dams and reservoirs
- Wastewater treatment
- Conservation
- Desalination
- Public-private partnerships (PPPs)
- Getting people to pay (and so reducing non-revenue water).

New dams and reservoirs: Due to high variability in river flow, both within a year and between years, storage needs to be provided to cater for low-flow periods, through dams and reservoirs. Some rivers experience three to six times their average flows in wet years, water that runs into the ocean unless dammed. According to a report by Sancold, the Vaal's flow in some years is only 10% of its potential, but with the Vaal and Grootdraai dams, this has become controlled at 50% as the long-term average flow.

Wastewater treatment: According to the latest Aquastat data (from 2009), South Africa only treats about 54% of its municipal wastewater. This compares to almost 90% in Israel. Furthermore, South Africa's existing wastewater treatment infrastructure requires substantial investment. The *2014 Green Drop Report* concluded that nearly a quarter of South Africa's wastewater treatment facilities are in a 'critical state', defined as needing urgent intervention, while roughly another quarter are defined as 'high risk'.

Conservation: Water conservation and efficient usage of it are the cheapest, most available sources of water. The Israeli Water Authority explains that "Savings campaigns carried out in the past have shown, without doubt, that 10–20% of [the] total consumed in the municipal sector may be saved, while making sure not to affect the consumer's welfare." This last part is perhaps the most important. It is possible to decrease water consumption on a large scale, without significant sacrifices in the day-to-day lives of South Africans. The previously announced War on Leaks campaign by the Department of Water and Sanitation (DWS), which was not fully implemented, could have resulted in 15 000 plumbers having been trained to address the multiple water management problems.

A Delicate Balance: Water Scarcity in South Africa states: "There is a misconception that water restrictions are draconian measures reserved for near-emergency situations such as those in the Western Cape or in California in 2014/15. However, examples from other communities demonstrate that conservation need not compromise quality of life. Tucson, Arizona, is a city with a population of about 500 000 that receives about 30cm of rainfall a year. The municipality began to run out of groundwater in the 1970s

Damming the Vaal River has resulted in average river flows of 50%, when it could on occasion have fallen to 10% in a year.

and adopted a multifaceted policy response that has enabled the city to reduce per capita consumption by roughly one-third (from just over 700ℓ/day in 1989 to less than 500ℓ/day in 2015). This multipronged approach involved instituting tiered water pricing (higher rates for larger consumers), implementing new building codes (reducing irrigation for landscaping and mandating efficient utilities in commercial spaces), encouraging the collection of rainwater, and offering a slew of incentives for private individuals to invest in water-efficient appliances. The result is that total consumption in the city is roughly the same as it was in the late 1980s, despite its population growing by about 25% over the same time period."

Desalination: These plants are expensive, and the one existing plant we have in Mossel Bay is apparently not in use, as it is highly energy demanding. There are believed to be 10 small (community-based) plants dotted along the coast. However, the advantage of this strategy is that with more and more desalinated water in circulation, there will also be more wastewater to reclaim. Greenwald says that what has fundamentally changed in Israel is its sources of water: 15 years ago, 77% of its water supply was from natural sources and today, that per cent of natural potable water has fallen to 35%.

PPPs: Speaking at a seminar on water, MDA Consulting senior associate Natalie Reyneke says that in an environment of a DWS without budget for water infrastructure such as desalination plants, such projects would have to be bottom-up driven — "the private sector must create them and fund them". At present, there are about 30 PPPs in South Africa, but none for a desalination plant and only one for waste treatment plant in the implementation phase, which is a waste treatment plant in eThekwini. There is also alternative waste treatment methodology in Johannesburg in its feasibility stage.

Given the high cost of energy associated with desalination plants, Reyneke described the plant design as one of the biggest project risks (alongside the need for land expropriation and environmental risks), requiring acceptable technology and revenue streams that make it profitable. "The project would be predicated on a certain revenue stream, and the financiers would want to secure that revenue stream. This tends to raise the risk profile, as any construction delays may result in further funding being required, and with this comes the potential for high delay penalties," says Reyneke. It is these factors, she says, which make municipalities question the PPP model versus doing the project themselves. It is municipalities that would typically be the procuring agency for PPPs as a solicited offer. There is also scope for non-solicited offers from contractors.

Municipal capacity: Elsewhere in this issue, Chris Campbell, CEO of CESA, says business and the financial sector are currently looking at "how might they make sensible investments to improve capacity at municipal level". (Read more on page 38.)

Reducing non-revenue water: *A Delicate Balance: Water Scarcity in South Africa* states: "Although the level of non-revenue water in South Africa is on par with the global average, it is significantly higher than in other water-stressed countries. For example, Australia has limited its non-revenue water to roughly 10%. If South Africa were to accomplish a similar feat, it could reduce total withdrawals in the country by 1.1km^3 — or approximately 75% of total estimated industrial withdrawals in 2017."

Quick wins

Washington-based Zachary Donnenfeld, a senior researcher at the Institute for Security Studies' African Futures & Innovation, outlines some quick wins that could be obtained in resolving South Africa's water infrastructure crisis: "The first priority, in my view, should be to reduce consumption. There's a lot of dispute over the actual figure, but little debate that per capita water consumption in South Africa is above the global average. This is in a country where nearly three million people don't have access to piped water and at least 10 million people live in extreme poverty, with who knows how many more living in transitory poverty. This means that 'luxury' consumption is extremely high. I think it's imperative to have water be very expensive for those that can afford it, and very cheap for those that can't. This will help raise revenue, but more importantly, encourage a culture of conservation around water use, which I think is sorely lacking in South Africa at the moment.

"The second quick win is to repair wastewater treatment infrastructure. This is also beneficial because it helps restore water quality, which appears to be deteriorating in parts of the country," says Donnenfeld. "I think reducing non-revenue water is a good idea, but it's definitely only part of the puzzle.

"My view is that the War on Leaks is a classic example of a good idea that was poorly implemented. If 37% of municipal water is lost before it reaches the consumer and three-quarters of that is from poor infrastructure, then fixing leaky pipes can get that figure down to a very respectable number — in terms of international comparisons.

It would also create jobs, which are sorely needed.

"As far as I can tell, the government has not followed through on the timely delivery of stipends for enrolees, nor provided adequate access to apprenticeships or job opportunities, among other issues. If it were done properly, it is hard for me to think of a better way to spend taxpayer money than by training 15 000 plumbers to go to work repairing the nation's infrastructure and endowing them with a lifelong skill in the process, one that is not going to be easily replaced by automation.

"I think it is more useful to think of the War on Leaks as a supply enhancement measure, since you are effectively returning that lost water to the system. I think reducing consumption is extremely important. There is a real dearth of information about water in South Africa. The government stopped publishing the *Green Drop* and *Blue Drop* reports in 2015, and no one (as far as I am aware) has a reliable estimate of how much groundwater is potentially exploitable, which could be another important piece of the puzzle in terms of restoring stability," says Donnenfeld.

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MDA Consulting senior associate, Natalie Reyneke.

Corestruc

Willie de Jager, MD of Corestruc.

Given South Africa's debt situation and the uncertainty of the rand, Donnenfeld says he does not see a way to improve the country's water infrastructure without some degree of PPPs. "I don't think they're necessarily a bad thing, but I do think that South Africa can negotiate them better. In terms of infrastructure investment, I think the ripest areas are wastewater treatment and fixing leaky pipes. They are inexpensive and will deliver immediate benefits. Desalination may have a place eventually, but compared to the other options, it is still very, very expensive and I don't think it makes sense. I think of desal[ination] the way I think of the nuclear deal — yes it solves the problem, but it probably creates more in the long run.

"It may be possible to restore stability without PPPs, but I think that would involve tough political sacrifices that I'm not sure the government is prepared for. For example, I think the DWS has somewhat revived the War on Leaks, but I do not think there are any appropriations for it in the new budget, which doesn't make me terribly optimistic that this is an actual priority," says Donnenfeld.

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Innovations assist municipalities

De Jager says: "We are encouraged by President Ramaphosa's focus on alternative building technologies. He made reference to this earlier this year when highlighting concerns around basic services in poor areas of the country.

"The key challenge is to move from the current 65% availability of water to 90% reliability by 2019. This implies a 13% improvement a year at a national scale, and 27% for the 27 priority district municipalities. For the worst water supply authorities, an improvement of 40% per annum is required. It has been described as a ticking bomb by the authorities, and the complexity of the situation is compounded by an array of factors. This includes the state of the economy. There is currently as much as a 40% shortfall in the financing that is required for operation and maintenance of the infrastructure. It also seems that much of the focus has been on attending to the demands of increasing urbanisation, considering that government spending on infrastructure has also not kept pace with the investment demands of population growth in the major cities.

"We have been extensively involved in various water-augmentation projects. Reservoirs remain our main focus. We have built more than 50 reservoir roofs of various sizes since our inception in 2010. The largest of these are the roof structures we have built for 50Mℓ reservoirs as part of professional teams appointed by municipalities. The demand for our precast-concrete roof system remains high, considering the role that it is able to play in significantly fast-tracking this critical infrastructure. On these projects, we are appointed as a specialist subcontractor to the main contractor. The main contractor builds the walls of the structure and associated infrastructure while we construct the roof. This does away with the need to erect and install tons of scaffolding and formwork. Higher degrees of accuracy are also achieved by manufacturing the concrete elements in a controlled setting. Another advantage of building the roof in this manner is that it contributes towards a more robust final structure, considering that all of the pre-stressed elements exceed 50MPa," says De Jager.

Corestruc

Corestruc has built more than 50 reservoir roofs of various sizes since its inception in 2010.

"More recently," adds De Jager, "we launched a reservoir wall system to complement this technology. It is already being used by a municipality to build two 10Mℓ reservoirs. By constructing the walls and roof of the structure in this manner, the critical path of the programme runs through the earthworks and foundations. The construction of the floor overlaps the installation of the walls and roof on the works programme. We are able to construct the walls and roof in three months on site. Meanwhile, the manufacture of the structure takes place at our factory during the earthworks and construction of the foundations.

"This will be a major focus for us moving forward, considering the interest that both consulting engineers and client bodies have shown in our offering thus far. In terms of other water-related infrastructure, we are appointed to design, manufacture, and build sections of the infrastructure to help reduce construction times. This is just one of the known merits of precast concrete technologies and hybrid concrete construction, which are starting to gain momentum in the country."

De Jager continues to say that the design of the infrastructure can be standardised to better incorporate precast-concrete technologies. Corestruc has been talking to various public sector client bodies to develop such a modular system. They anticipate being ready to launch this technology within two to three years. It will also provide a more cost-effective solution to conventional construction methods.

"For larger plants of up to 600Mℓ, we have designed a precast-concrete roof and wall system to accelerate construction and provide a more cost-effective alternative to in situ techniques. However, there is still a lot of scope to construct other sections of the infrastructure with precast-concrete technologies," says De Jager. ■■