Des Midgley Memorial Lecture

The Water Crisis in South Africa

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ABSTRACT

South Africa is currently facing a number of inter-related water crises, any one of which is a potential show stopper, but all of which can be managed. These include:

- Mismatch between water supply and water demand
- Failure to achieve demand management targets
- Theft of water resources
- Demand management failure
- Decaying infrastructure
- Deteriorating water quality
- Loss of essential skills
- Strangling of educational pipeline.

It has been publicly stated that by 2013 the water demand in the Vaal River system will outstrip the available yield. What is not commonly known is that this is based on achieving a 15% saving in water demand. To date no noticeable saving has been realised. Against this the next raw water augmentation will not come on stream in less than 10 years. Moreover, the theft of expensive imported water by farmers in the Upper Vaal catchment has effectively reduced the system yield by 175 MCM p.a., plunging us immediately into a supply deficit in the region supporting half of the GNP of the country. Water supply mismatches are also evident in other parts of the country, notably the strategic Umgeni system, which has been in deficit for over a decade.

These are not so much planning problems, as failure to achieve the demand savings on which the plans were based. Huge amounts of water are lost through decaying distribution systems, with further leakage in consumer systems. At the same time widespread sanitation failure is threatening the well being of users and the environment.

Underlying all of these crises is the widening loss of essential skills. Over the last decade and a half the municipal sector has lost six-sevenths of its engineers and technicians, rendering most outlying municipalities impotent to deliver even the most rudimentary services. The loss of skills is also creating a widening middle management gap that is starting to unravel the bigger institutions. The erosion of maths and science education in secondary schools is also throttling the professional education pipeline, threatening even bigger future crises.

Despite being of huge proportion, all of these problems can and must be solved. There is great urgency to address the immediate big problems. There is an equally urgent need to deal with the longer term, but potentially much more devastating educational issues.

BACKGROUND

A secure and safe water supply and protection of essential water resources is the backbone of any economy. These requirements are amplified in a largely semi-arid country with a burgeoning economy that is also the economic hub of Africa. South Africa is fast approaching water scarcity, but dares not slacken the pace of economic development when there are still so many in desperate need of economic emancipation. Increasing water scarcity creates enormous challenges in equitably allocating this precious resource to competing sectors. Provision has to be made to sustain essential economic growth both for present and future generations, while at the same time securing basic human needs, meeting international obligations and protecting the resource and the fragile environment that it supports.

However, at this critical juncture in our history, a number of strategically important concerns have arisen regarding the continued successful management of our water resources.

At the April 2008 South African Institution of Civil Engineering (SAICE) council meeting the question was raised, “Are we facing a water crisis similar to the energy crisis?” The Water Division took up the challenge of addressing this question. Several discussions with key role players confirmed that there are indeed a number of challenges that can be described no other way than as crises that need to be met with great urgency.

The following key concerns are dealt with in this paper, along with some of the actions required to address them:

- Mismatch between water supply and water demand
- Theft of water resources
- Failure to achieve demand management targets
- Decaying infrastructure
- Deteriorating water quality
- Loss of essential skills
- Strangling of educational pipeline.

A crisis committee of top experts was identified and convened, that includes, amongst others, two past presidents of SAICE, the then sitting and two previous presidents of WISA, a former Director General of the DWA and a representative of the DBSA. Expertise was drawn from the top echelons of management, water resources, water quality, municipal services, research, economics capacity building and academic fields. It is noteworthy that without exception every one of the carefully identified and extremely busy individuals recognised the need and joined the group without hesitation, and all continue to provide enthusiastic support. The first product of this group was a submission to the Portfolio Committee of Water Affairs and Forestry on 22 October 2008. In recognition of the crucial strategic importance of water in our land and the wish to lend weight to the grave concerns regarding what many responsible practitioners from diverse quarters can only describe as a national crisis of the first rank, the unprecedented step was taken of making a joint SAICE / WISA submission to represent most of the professional water engineers and water scientists in South Africa. This led to many opportunities for constructive engagement with the media and all levels of Government.

WATER SUPPLY AND DEMAND MISMATCH

Local Authorities (LAs), through their Water Services Development Plans (WSDPs), are tasked with providing Water Service Providers and ultimately DWA, with water demand projections and indicating how they are to be met. DWA is responsible for developing the

resource to meet these demands. In the face of increasing water scarcity, the unquestioned matching of escalating demands could become unsustainable, or at least very expensive to achieve when increasingly distant resources have to be tapped. Under such circumstances the DWA needs to point out the economic and practical implications and may suggest the need for Water Conservation (WC) and Water Demand Management (WDC) measures. A healthy feedback between the DWA and LAs should ensue, leading to the adoption of a viable and efficient plan.

The glue that holds these functions together is the National Water Resources Strategy (NWRS). This should address the availability of the resource and the steps to be taken to meet demands – or indicate where they cannot be met. The NWRS should be informed by the WSDPs provided by the LAs. But can we be sure that the LAs and Water Boards plan and communicate their needs? Where WSDPs are being prepared, are they based on reality? Are they responding to calls for WC and WDM? And are they addressing the critical issues?

The long awaited draft of the 2010 NWRS, which is due out every 5 years, is also running late and in danger of becoming a rear view mirror, rather than a forward looking strategy against which to benchmark progress.

It is apparent that inconsistencies and implementation failures have led to extremely serious problems.

The Vaal River system

The water supply to half of the GNP of South Africa is supported by the Vaal River catchment. The economic and strategic importance of this complex water supply system cannot be over-emphasised. Failure of this crucial water supply will directly demolish the hopes for poverty alleviation for millions in this region, deprive the fiscus of the economic resources required for this throughout South Africa and hold repercussions for the prosperity and prestige of the entire SADC region.

Against this background, the statement by DWA's Director General regarding supply to Gauteng, which of necessity applies equally to the entire Vaal River and Crocodile West system, was cause for deep concern: *"Unless we do something about the current growth trends and needs, we are going to have a water shortage by 2013 … But even with the fastest implementation, these [projects] will only be ready by 2019". (Engineering* News, 26 September 2008). This alone portends a national crisis of the first order.

However, this is to understate the problem. Although seldom stated, overtaking of the system yield by 2013, with no reasonable hope of increasing the resource supply within the next decade, relies on the attainment of a very substantial 15% reduction in demand. To date there is no evidence of any such reduction and year by year the water demands are climbing inexorably along the high demand curve. Put bluntly, this implies that right now we are already living with a 2% supply deficit in the Vaal system. By 2013 we will face a 6% supply deficit, which would rise continually until 2019 when it would reach a staggering 11%. By the time Polihatse Dam (Phase 2 of the Lesotho Highlands Water Project) has warmed up, 86% of its yield would already have been committed, and Mielietuin Dam in the Tugela River catchment would have to be commissioned 3 years later. If we are to go this route then we would have to start on the Tugela project a year after next year's World Cup, while we are still in the early stages of the Polihatse Dam project. After that there remains only Jana Dam on the Tugela.

Figure 1 shows the consequences of not achieving the targeted demand reduction, which is the current status quo.

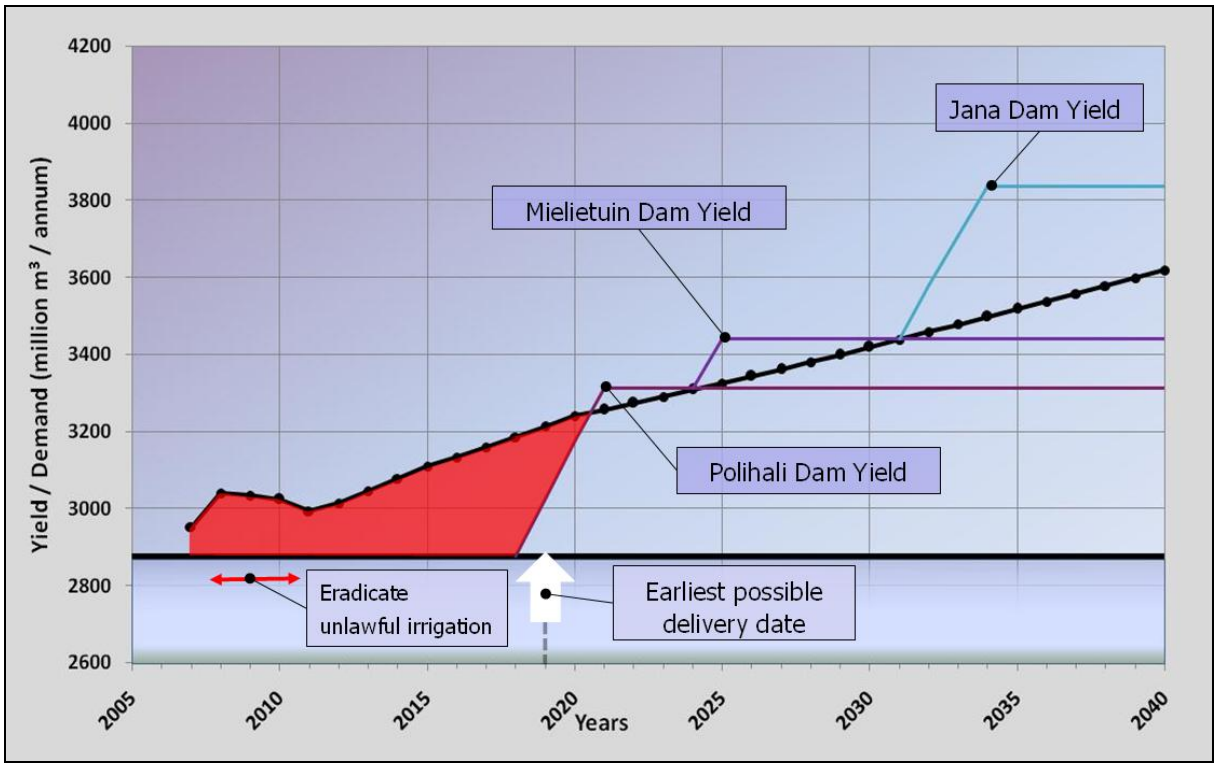

Figure 1: Consequences of not achieving demand reduction in the Vaal River system (information provided by DWA, January 2009)

Having said that, it needs to be recognised that a water crisis in a complex inter-dependent system is not a binary on/off switch like an energy blackout. It is much slower in developing, like a motor accident viewed in slow motion, or a large ship bearing down on an iceberg, with lots of time to contemplate the approaching collision. Taking account of both the in-stream and off-channel pumped storage and interconnections with distant donor catchments, a critical drought sequence in the Vaal system can take up to 8½ years to reach its end, with progressively more severe water restrictions coming into force as the declining system storage increases the risk of supply failure. This is advantageous since some precious time can be bought to implement emergency measures (such as WDM and WC). However, it also holds inherent risks since decision makers can easily be lured into a false sense of security and leave it too late to react.

It is a consummate waste of time to panic once we are already in the grips of a severe drought. Rather, we need to recognise the crisis now and act expeditiously while there is still time. Effective management requires decision makers to plan and invest decades in advance, since any new bulk infrastructure requires lead times that stretch longer than the critical drought sequence itself. Hence, even now we are 10 years too late to implement a purely supply side solution. Even if a new dam were to be commissioned during the drought, it would be of little use since dams do not fill during critical droughts. The uncertainties of whether or not we will actually face a severe drought while we remain exposed during the next 10 years can also lure managers into taking unacceptable risks in the hope that they will not occur. This would amount to reckless gambling with the vital interests of the 10 million inhabitants of Gauteng and the many others dependent on the Vaal River system and the prosperity of the nation.

Like it or not, we have already entered this unnerving marathon race, 10 years behind our competitor. The question is, do we plod along uphill being dragged down by an ever increasing deficit and attendant risk of supply shortfall until 2019, or do we find a better way? Clearly up to now the LAs have failed miserably in delivering on the WDM and WC targets. It could also be argued that these targets should have been set while there was still time to implement stop-gap supply side solutions (i.e. implement the next raw water resources scheme) and that the actual delivery should have been closely monitored and any deviation responded to before the cut off date was reached. Here there may be a parallel with the energy crisis. While some of these essential actions may have been called for, they were kept behind closed doors until we were already in deficit.

The better way is to close the yawning gap between the supply strategy and the water demand growth by vigorously implementing the targeted WDM and WC measures. There is no other means left open to escape from further imperilling the water supply to this critically important system.

Indeed, most of the crises that we now face had their origins in poor management decisions taken over the last decade or two.

The Mgeni River system

The Mgeni River system supplies water to the third largest economic region in South Africa. Two-thirds of the GNP of South Africa is accounted for by the Vaal and Mgeni River systems combined. Yet it has come to our attention that this region now only has a 92% assuredness of supply with about a 1 in 13 year risk of facing severe water restrictions.

Figure 2 shows that the users of this system have been in a precarious deficit situation for the last 4 years (more like 15 years, if it is considered that the raising of Midmar Dam, scheme MMTS-1, brought only fleeting relief). Spring Grove Dam (Scheme MMTS-2) was due to have commenced storing water by the end of 2006. However, by late 2008 design work on the dam had not yet commenced and the expected date of commissioning was 2012 at the earliest.

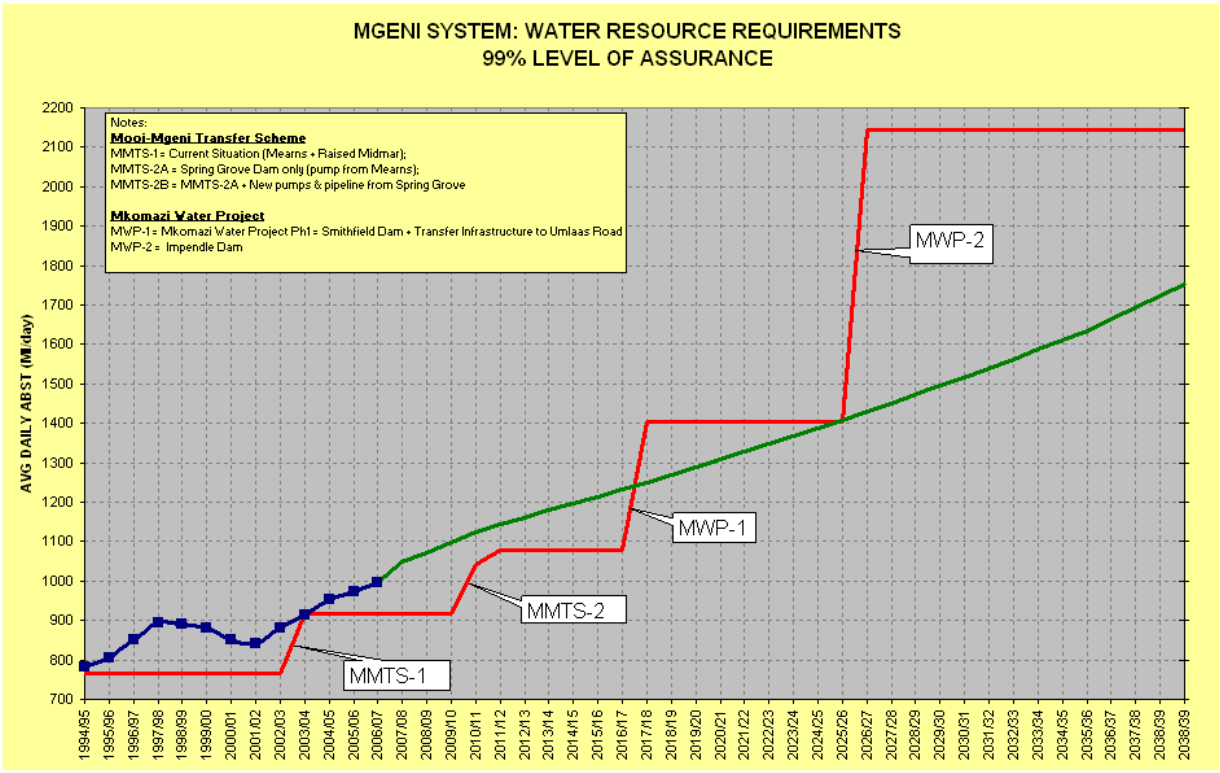

Figure 2: Demand - supply curves for Mgeni River (diagram provided by Ethekwini, October 2009)

It must be stressed that even if commissioned in 2012, the proposed dam could play little part in a major drought until it has "warmed up" by substantially filling. Hence a period of severe risk of restrictions even deeper than shown in Figure 2 could extend well beyond 2012. After commissioning of Spring Grove Dam the system would in any event remain in deficit for a further 4 years until the end of 2017.

The question must also be addressed as why the 6-year delay in the commissioning of Spring Grove Dam has been allowed to happen?

All of this points to a national crisis unfolding before our eyes, with severe disjoint between the planning by DWA, the LAs and the actual implementation.

National Water Resource Strategy

It is a legal requirement for the Minister to produce a National Water Resources Strategy (NWRS) every 5 years. The serious failures enumerated above clearly demonstrate that this is not merely an administrative chore. It is essential to the well being of our country.

The NWRS must set out the key water challenges and proposed responses. The NWRS (2009/2014) is due out next year. There must be wide consultation before this is finalised. Where is it?

WATER THEFT

Unfortunately the beleaguered Vaal River system is subject to further depredation. A recent article on the Vaal River system, based on the findings of recent studies revealed: *"irrigation water use in the Vaal River System has increased by more than 100% between 1998 and 2005 for the area upstream of Vaal Dam alone. … Up to 240 million m^3/a of irrigation water use in the Upper Vaal WMA is estimated to be unlawful. ... This has been a shocking discovery, and probably the main reason why the Vaal River System is currently in deficit."* (The Water Wheel May/June 2008). Comparisons have been drawn between the water theft and the yield of Mohali Dam, Phase 1b of the Lesotho Highlands Water Project (LHWP).

The estimated water theft has since been revised to 175 million m^3/a, which remains a very substantial reduction in yield.

As pointed out earlier, the Vaal River system is already in deficit by about 2%. The water theft quadruples this to a very significant 8%. There is thus no doubt whatsoever that the system is currently in deficit.

It might have been expected that the water theft could have been remedied soon after being unearthed, simply by bringing the offenders to book. However, it turns out that the legal, administrative and all important abstraction monitoring mechanisms are not yet in place, 11 years after the promulgation of the 1998 National Water Act. Hence, for fear of losing a case and the risk of setting an unfavourable legal precedent, it has been estimated that curbing the water theft could take up to 4 years. This is analogous to reporting a robbery in progress and being told to hang on because the police will take four years to arrive. In the meantime 175 million m^3 of expensive imported water that urban consumers are paying dearly for is being stolen in full view of the entire nation. It is ironical that if water restrictions are implemented, the first to be affected will be the farmers themselves, including innocent

parties located throughout the Vaal River system. Perhaps peer pressure could play a role in curbing the theft?

Aside from criminal prosecution, perhaps we should consider simply billing the perpetrators for the full incremental cost of the water that is being stolen? This would probably amount to around R2 million per 50 ha centre pivot.

It might be argued that the problem will not influence us if it takes 4 years to stop the theft, seeing as during the 2008/9 season the major dams of the Vaal system filled. The state of the dams certainly does diminish the risk of short-term failure. However, we are in it for the long haul. A critical drought sequence always starts with the dams full, with no further system spillage until the drought is finally broken. Moreover, the onset of such a drought is never known in advance. Even a few years into the drought, it is always possible that good rains could curtail the magnitude of the drought by filling and thereby re-setting the system. However, if the 2008/9 season was the start of a 1:50 or worse drought sequence, then we would be entering it short of about 73 million m^3/a stored in our dams (assuming that the last filling occurred towards the end of the last season). This figure would increase by 1 million m^3 every second day. Assuming that 1 of the 4 years has already elapsed, we could be down by 598 million m^3, or 21% of the current annual demand, by the time the theft is halted. These figures are only illustrative, since the loss would be modified somewhat by evaporation, but they serve to illustrate the crisis that the water theft is plunging our water security into and how seriously we should be taking it.

It defies the imagination how the theft of 175 million m^3/a could have gone undetected for so long. The same Water Wheel article states that the Polihali Dam scheme, (which will take at least another decade to develop) will deliver a further 15 m^3/s (i.e. 473 million m^3/a). This means that the current water theft in the Upper Vaal WMA alone is a whopping 37% of the entire delivery of the next major water augmentation scheme. How could operators and managers have missed such a large reduction (5.5 m^3/s of base flow) in the amount of water reaching Vaal Dam? This is inconceivable seeing as a new Crump weir was constructed on the lower Liebenbergsvlei River at Frederiksdal in 1985 (12 years before the first phase of the LHWP was commissioned) with the express purpose of measuring water losses of the LHWP? The hydrological records were available for the Ash River outfall, for this weir, Saulspoort Dam, two other intermediate points on the Liebenbergsvlei River and further downstream at Frankfort below the Wilge River confluence. The unwarranted proliferation of irrigation activity would also have shown clearly in satellite imagery, to which DWA has full access. In this regard there was already evidence of farmers purchasing new centre pivot irrigation systems in anticipation of the LHWP. Finally, regular ground inspections of the river should have revealed the multiplication of pumps.

Unlike the preceding crises in which LAs played a significant role, this one arises purely from failure to define water rights, enforce monitoring, interpret readily available information that is collected at great cost and enforce compliance. Clearly it speaks of crumbling capacity within DWA. This is evidence of another national crisis of immense proportions that is quietly unfolding and is discussed later in this article.

DEMAND MANAGEMENT FAILURE

Local Authorities

The greater part of the mismatch between water supply and water demand is attributable to the failure of LAs to deliver on WDM and WC targets.

Municipal water infrastructure, and especially buried pipe work has a reasonable service life of 50 years. This means that 2% of the capital works need to be replaced every year. As these works near the end of their service lives water leaks become more and more frequent and maintenance becomes more onerous. In addition, it is essential to continuously carry out maintenance to deal with ongoing leaks and other repairs. This is required to curtail water losses and ensure that the intended service lives are attained.

Earlier DWA estimates indicated that R600 million per year was needed between 2004/5 and 2009/10 in Gauteng to redress the capital replacement backlog and to carry out regular maintenance. Against this, the 2008 WDM expenditure in Gauteng was only between R50 and R100 million, which is only sufficient to cover 20% to 40% of the annual maintenance requirement, without even touching the backlog. Moreover, during this period the capital replacement backlog would have grown by 2% of the existing infrastructure per year, accruing to a massive additional 10% of existing infrastructure. It is small wonder that the infrastructure leakage has reached crisis proportions and that municipalities are consistently failing to meet WDM targets.

Figure 3 reveals a long history of the credibility gap between the planned and actually achieved demand reductions in the Umgeni River catchment. Comparison of the 2006 demand projections made between 2000 and 2005 displays an almost exponentially diminishing expectation of meaningful demand reductions being achieved, until the 2007 projection (based on Figure 2) appears to reflect giving up of hope and acceptance of the status quo, presumably since the demands have grown steadily since 2001 with no apparent sign of abating.

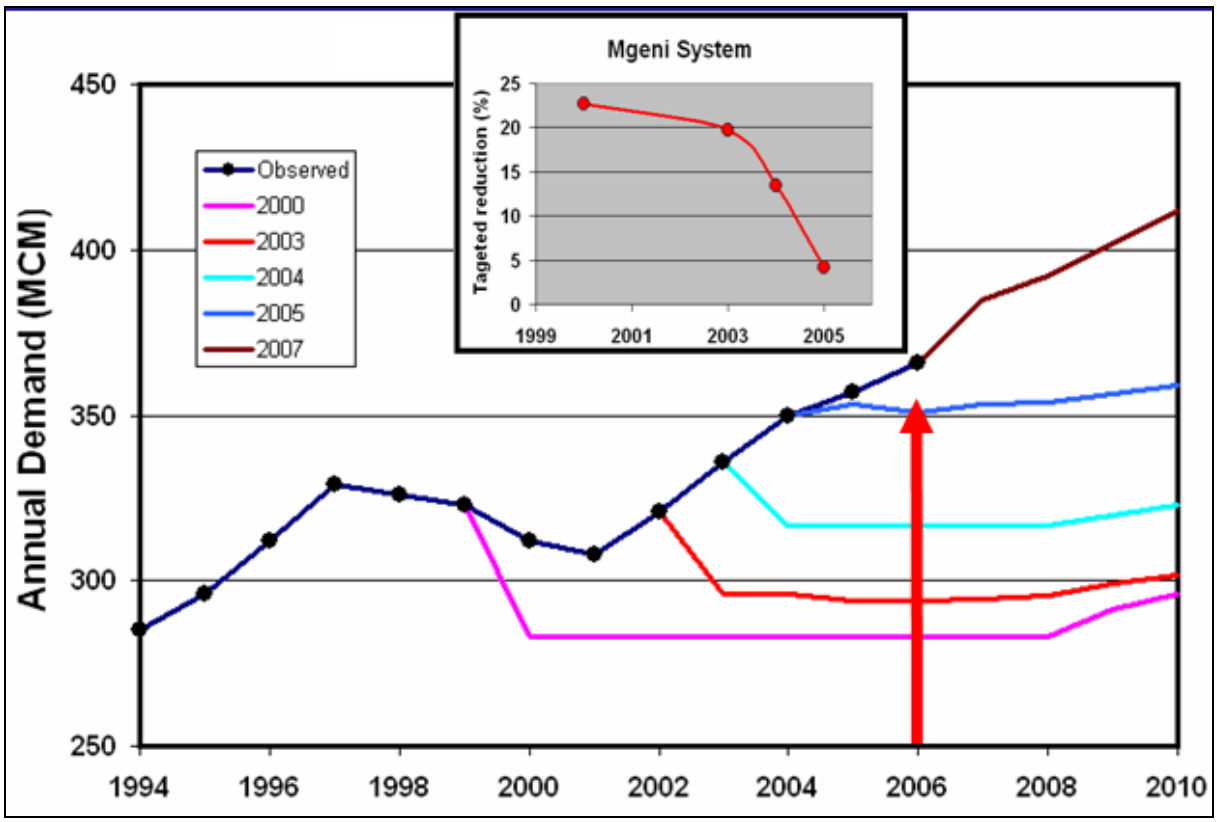

Figure 3: History of targeted and achieved Mgeni system demand reductions

Undue vacillation on the part of municipal decision makers appears to have played a major role in the failure to achieve WDM. Not only has this placed national water supply systems at

risk for years, it is also extremely short sighted given the large economic advantage to be gained from curtailing the water losses.

The DWA has called for the implementation of laudable measures to reduce the Umgeni Demand by 16% through curbing water theft (8%) and replacing broken asbestos cement pipes (8%). Thankfully some of these initiatives are at last moving ahead. Further savings should accrue from the recycling of effluent that at present is running to waste at sea. While these initiatives are costly and time consuming (for example, R850 million over 3 years to replace the old asbestos-cement pipes), they hold tremendous economic advantage since the reduced water losses result in a short payback period. Since the dams are currently near full, the time frame of these actions may be short enough to significantly reduce, or even eliminate the exposure to unacceptable risk. But the curbing of water theft and wasteful practices and ongoing essential maintenance and refurbishment will require enduring political will and the ongoing employment of sufficient resources.

Consumers

It is important not to overlook the fact that much, perhaps up to half, of the water losses occur in the properties of consumers, whose pipe work and plumbing fixtures are also subject to decay and the need for maintenance and replacement. This is particularly apparent in areas where residents do not pay for their water and therefore treat it as a free good and have no incentive to repair leaks. The indigent might also lack the means to affect the necessary repairs.

There is thus an urgent need to educate users on the need to curtail leaks and to institute and sustain adequately funded programs to render plumbing services in poorer areas.

DECAYING INFRASTRUCTURE

Ageing infrastructure affects both LAs and the DWA. These are discussed below.

Local Authorities

In addition to the lack of achievement of WDM and maintenance targets by LAs, the collapse of water supply and sanitation infrastructure is well into crisis mode in many, if not most, rural areas.

Bulk infrastructure

The DWA's Strategic Framework on Water for Sustainable Growth and Development discussion document (April 2008) cites numerous cases where major water resources infrastructure is in serious need of maintenance and refurbishment. This includes *"160 out of 294 dams owned and operated by the department (54%) require maintenance to meet current safety standards"* and 17 canal schemes that require major rehabilitation work.

Some of the pumps driving links of the water transfer schemes to strategic industries have also failed.

In March it came to light that the outlet canal from Grootdraai Dam, which feeds water to the highly strategic Sasol / Secunda complex and to some Eskom power stations is in a dangerous state and urgently in need of refurbishment. The work has been held up by delays in the appointment of Professional Service Providers.

Some of the feeder canals to the foot of the Tugela-Vaal water transfer scheme are also in a state if disrepair, reportedly with trees growing through them, and have apparently been

partially abandoned. While this may be feasible during wet conditions when other parts of the system can supply sufficient water, will this infrastructure be operative when we really need it during times of drought?

Midgley once described the Rhenosterspruit valley as South Africa's largest single block of irrigable soil, which could not be irrigated due to a shortage of water. While it is a relatively small scheme, reports have been received that the Koppies Dam outlet canal is now inoperative.

Information systems

To measure is to know. However, growing gaps are evident in both flow and water quality monitoring networks. The capacity to run associated information systems is also declining, with the result that threatening trends are not being identified, leading to inevitable consequences such as the undetected theft of water from the Liebenbergsvlei and other rivers in the Upper Vaal catchment. It is likely that there are other incipient or even long-standing problems that are as yet undetected due to inadequate monitoring and lack of the resources and capacity to interpret the information and take appropriate remedial action.

Funding deficit

The Strategic Framework on Water for Sustainable Growth and Development discussion document indicates a gross under provision of expenditure for the maintenance of water services assets.

National Water Resources Infrastructure Agency (NWRIA)

The new NWRIA (yet to be operational) is envisaged to handle the financing, construction and management of major water resource works. Its establishment will see a phased integration of DWA's National Water Resources Infrastructure (NWRI) branch and the Trans-Caledon Tunnel Authority (TCTA). The NWRIA will raise investment funds on the capital market, supplemented by the DWA budget where extra costs are envisaged for 'social' requirements. The NWRIA was initially planned to be operational last year (2008) but it is nowhere near. Where is it?

WATER QUALITY

The challenge is not just quantity. Water that is too polluted to use is as serious as no water at all. This is beginning to happen in some areas, to name but a few:

Pollution problems inhibiting water use

<u>Vaal River Catchment</u>

- Coal and gold mining and industrial pollution impairs water quality in the Waterval River.
- Large pollution sources in the small but highly developed Barrage catchment cause severe salinity, eutrophication and biological pollution, which in turn lead to huge economic loss, necessitating blending and dilution operating rules that entail the discharge of additional water from Vaal Dam.
- NW Province and Welkom / Virginia gold mining decant (acid mine drainage) and sewage effluent in the Middle Vaal WMA create similar problems.
- Salts are further concentrated in the Vaalharts irrigation scheme.

- Intensive irrigation in the Modder-Riet catchment reduces the large quantity of fresh water imported from the Orange River to a trickle of highly saline water entering Douglas Weir.

- Polluted water spilling from Douglas Weir contributes to the salinity of the downstream Orange River.

Crocodile West

- Much of the water resource of the upper Crocodile River catchment is derived from saline and nutrient enriched sewage effluent. This leads to salinity problems throughout the downstream river system and severe eutrophication of the major impoundments. Severe eutrophication in Hartbeespoort Dam has persisted for decades, so much so that as early as the 1980s it was rejected as a source of raw water for Rustenburg in favour of a new pipeline all the way from Rand Water.

- This could also affect water supply to the old and planned new power stations in the Waterberg area.

- Severe eutrophication led to the cancellation of an international event at Roodeplaat Dam.

Mpumalanga

- Intensive coal mining in the upper Olifants River catchment has resulted in severe sulphate and salinity problems.

- Salinity levels in the remainder of the catchment are impaired by irrigation and mining in the Phalaborwa area.

- Pollution has also been cited as a possible cause of crocodile kills in Loskop Dam and in the Kruger National Park.

Mgeni and Durban beaches

- Biological pollution is a serious health threat in the Mgeni catchment and at various beaches.

Atmospheric deposition

- The deposition of sulphate salts arising from emissions from power stations, Sasol and other industries has been recognised as a major long-term threat to the salinity and possibly the acidity of the water resources of the Upper Vaal catchment. The potential for these problems is viewed in so serious a light that it has become a consideration in the siting of future major power stations and consequently Eskom and Sasol are undertaking a major study of these impacts.

Biological health threat

The preceding pollution problems are serious enough to constitute crises in their own rights. However, the health threat posed by biological pollution is such an affront to the poor and indigent, who comprise so large a proportion of our population, that it warrants consideration on its own.

Hardly any portion of the country (except the least populated areas) is immune to health threats arising from biological contamination of essential water resources. The poorest communities are the most compromised. These communities also contain disproportionately high proportions of citizens whose health is compromised by HIV and Aids. Infants and children are highly vulnerable to water borne disease, as witnessed by recent alarming press and TV reports. Outbreaks of cholera are also a serious threat.

Much of this problem is the direct result of the collapse of existing sanitation systems and difficulties encountered in the siting of informal settlements and the provision and maintenance of essential services. This is already a major crisis in rural communities. In some areas short sighted planning has resulted in new bucket eradication schemes actually causing a sharp deterioration in service provision. For example, in some Freestate settlements replacement of bucket sanitation systems with ambitious sophisticated flush sewer systems has left residents with no sanitation at all since the water supply is insufficient to flush their toilets. In other instances the large increases in sewage inflow volume has led to the overloading of inadequate sewage works and dangerous pollution of downstream river systems.

Larger metros are also showing strain, the main saving grace being the fact that these areas are largely provided with good potable water supplies and hence the poor generally do not need to drink the polluted river water.

The gravity of the human dilemma is best illustrated by the following e-mail:

"I was at the Howick WWTW "outfall" into the Mngeni River today – looked like the effluent in an anaerobic digester – dark brown, thick and smelly. It flows through an informal settlement, which is about two paces away from the houses on either side of the torrent, which then disappears over the Krantz to meet the river after the scenic Howick Falls. I saw a child take a container and rinse it out in the "water". Absolutely horrific!"

Judy Bell, Environmental Consultant, 13 October 2008

The reality is that LAs in rural areas clearly lack the capacity to deal with these problems.

This is a national crisis.

Capacity constraints

The few professional personnel in directorates and sub-directorates in the DWA head office and in the regions are trying valiantly to deal with these multiple crises. However, many of the staff under them lack the necessary experience and are often too mobile to acquire the necessary skills. Moreover, the experienced personnel are stretched to the point of near ineffectiveness and cannot find the time to train staff. Many of the water quality managers are so much in demand that appointments to see them have to be made one or even 1½ months in advance, and often these are broken or cut short to deal with urgent matters, such as answering urgent parliamentary questions.

Clearly these departments are critically under-resourced.

This is a national crisis that is no doubt significantly contributing to the preceding crises.

Waste Water Charges

The Waste Discharge Charge System (WDCS) is viewed as an important vehicle for alleviating some of the pollution problems and ensuring that polluters are not allowed to

continue externalising the costs of their production to the detriment of downstream users and the environment.

Why has the WDCS not yet been implemented?

CAPACITY AND SKILLS

The loss of capacity and skills is one of the main reasons why the National Water Act (NWA) is not being implemented successfully.

Local Authorities

Over the last 15 years LAs have experienced a 7-fold loss of engineers and technologists. This has inevitably resulted in:

- The collapse of infrastructure and maintenance programmes
- Widespread demand management failures
- Water treatment failure.

This is a major national crisis that threatens the life-blood of the country.

Middle management gap

DWA has an essentially technical function, which has need of 250 engineering posts. Of these only 39% were filled last year.

Over a number of years a gap has been opening in the middle management ranks of the DWA. This widening has accelerated and now extends into metros and Water Boards. These organisations have a core of experienced senior managers who are barely coping.

The gravity of the situation is illustrated by the fact that last year DWA grades 8 and 9, which should be entered by graduate engineers who have completed their professional training, had only 6 out of 45 posts filled. On the other side of the middle management chasm, 47% of the skilled staff will retire within 10 years, representing a catastrophic haemorrhaging of institutional memory.

The problem originates from the inability to retain new staff inducted into the organisations. Recruitment of young professionals comes mainly from bursary students who leave the organisation soon after working off their bursary obligations, by which time they have barely begun to be effective even in the lower levels of the organisation. Few stay long enough to gain meaningful experience and advance through the organisation. This opens up a widening middle management gap that starves the organisation of skilled manpower. This has a negative feedback, since the few experienced managers who are left have less time to give the necessary training to their protégés. Most of these leave anyway, since the professional salary scales at the lower end of the organisation are hopelessly inadequate compared with what can be earned in the consulting and contracting fields, both of which are actively recruiting.

It is expected that many of the experienced senior managers would tend to stay with the Department longer than the junior recruits since they have better salaries, hold responsible positions, derive a high level of job satisfaction, are dedicated to their work and tend to hold out for their retirement benefits. However, they are becoming increasingly stressed as the magnitude of the problems facing them magnify while at the same time their numbers diminish due to retirement and resignation. Pressure of work is also making them increasingly inaccessible, which carries inherent dangers.

It is a matter of deep concern that on aggregate the relevant experience level in the DWA is declining.

Attempts to fill the management gap by rapidly advancing junior professionals meets with limited success since such leapfrogging deprives these individuals of essential experience, leaving them insecure and unable to function effectively. Even less successful are attempts to fill senior positions with inappropriately experienced importees from outside the organisation. Often the new appointees serve only to dilute the management structure, inhibit effective vertical communication and increase the burden on experienced managers who then have to attempt the near impossible task of training their new inexperienced colleagues and bosses. The appointment of inexperienced and often inappropriately qualified personnel over their heads and the blocking of advancement paths also increases frustration levels and has a demoralising effect. The better new managers recognise their limitations and lean heavily on their subordinates for advice and might eventually gain a measure of competence. However, gaps in their experience can remain dormant and might only come to the fore when important decisions have to be made or when critical problems go unnoticed by default. The most dangerous problems arise when the new managers actually delude themselves into thinking that they know what is going on (an unfortunate trait of the young who get promoted too rapidly). Such managers can cause untold damage.

Unfortunately these attempts at filling management positions with inexperienced personnel do little to alleviate the middle management gap.

The growing middle management gap is responsible for precipitating many of the crises discussed in the preceding sections. This is a national crisis of the highest order that threatens to destroy the very fabric of fine organisations such as DWA, Water Boards and major metros.

EDUCATION

The recruitment and education of engineers and water scientists has become a critical bottleneck that will seriously affect the DWA, LAs and Water Boards for many years to come. Figure 4 illustrates the pipeline leading to the development of competent, but still relatively inexperienced engineers or water scientists.

All children are recruited into the education system. During the following 12 years these move though primary and secondary school education, the majority of whom leave to enter non-professional careers. Typically the upper 5% have the necessary intellectual skills to gain university entrance and master the complex mathematical and scientific competencies required to successfully enter an engineering or scientific career.

However, on gaining a university entrance certificate some 19 out of 20 matriculants find that they cannot enter an engineering or scientific career for the simple reason that they do not have sufficient competency in mathematics. The blockage occurs more than three years earlier when grade 9 learners are compelled to make their subject choices for the last three years of secondary school. More often than not they are badly advised to take maths literacy since it is much easier than core maths and they should therefore be able to get better matriculation grades. It is only three years later that they find numerous profession career paths closed to them, including engineering, science, medicine, accounting, and economics, etc. Ironically one of the few university faculties that will accept their inadequate maths literacy qualification is that of education.

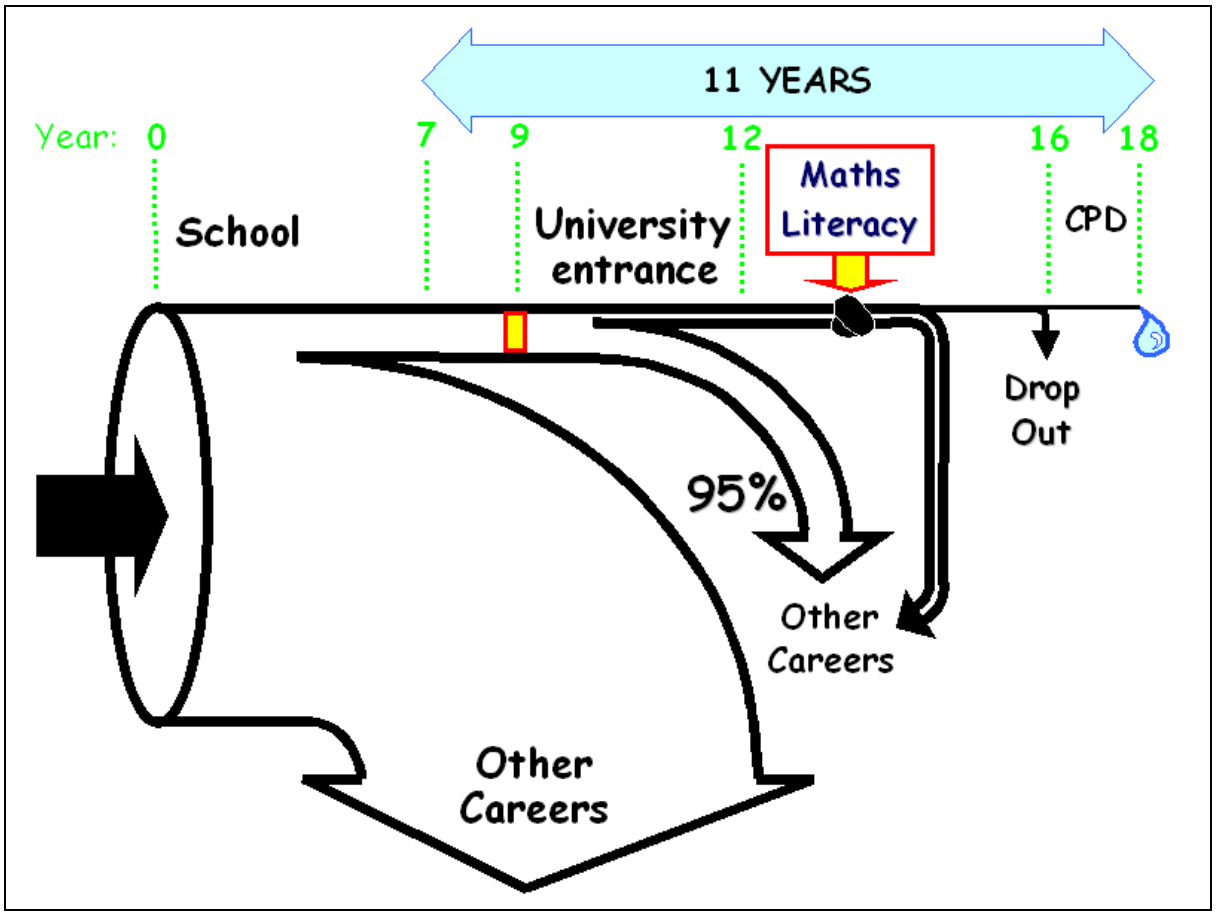

Figure 4: Water professional training pipeline

Aside from the allure of easy access to higher symbols, maths literacy is often promoted because of a lack of competent core maths teachers.

As implemented, the advent of core maths as a replacement for higher grade maths is a further setback. This is because geometry has been excised from the mainstream and has become an optional third maths paper, for which the students gain no additional recognition. A further disincentive is that this additional paper has been rendered more difficult by adding most of the contents of applied maths, which used to be a separate fully accredited subject. Dropping geometry appears to be little more than a thinly disguised cover for the lack of adequately trained maths teachers. Moreover, most schools do not even offer tuition for the 3rd maths paper. Three dimensional perception and geometry are essential features of engineering. Their exclusion is perhaps akin to submitting to surgery by a doctor who lacks depth perception.

To make matters worse, the first crop of new matriculants passing through the new education system at the end of 2008 displayed a huge increase in maths grades, which was totally unsupported by a similar rise in science competence, the two of which have been closely linked in the past. It has been suggested by competent analysts that the grades may have been artificially inflated by up to 25%. This means that a student who in the past would have received 35% would now fulfil the minimum 60% requirement for admission to the engineering faculties of many universities. Without exception, universities were surprised by the phenomenal upsurge in the number of applicants who fulfilled the matriculation requirements for entry into engineering faculties. For example, grade creep forced the Civil Engineering faculty of Wits University to accept 270 first year students, when they were

expecting only 100. There was always the remote possibility that the upsurge might be symptomatic of a greater proportion of the available pool of students choosing engineering because of the publicity surrounding the construction of new stadiums and the Gautrain. Alas this was not to be, and the first semester results showed very high first year failure rates, confirming the worst fears regarding grade creep.

The previous government attempted to get the top 5% of the professionals out of only 10% of the population, which was a genetic impossibility. As a result of this deliberate policy there were enough professionals to extend adequate services to only a small portion of the population. By now we should have been in a position to draw on a much larger pool of professionals approaching 10 times the previous size. However, the situation has now arisen where all of our share of engineering and scientific professionals have to be drawn from only 5% of 5% of the population, which is only half of what we had before. This has not been done intentionally for political gain. But the results are devastating.

One of the consequences of the failure of the education system has been to set back the attainment of HDI goals among engineering and science professions by decades. The school system is starving universities of HDIs with the required skills to enter engineering, scientific and other technically demanding faculties, and successfully complete their degrees. It is not for want of ability. 95% of the talent is simply being lost to engineering and sciences – victims of inadequate maths and science training.

Far from fixing the problem, the front page headline of last week's Sunday Times read: *"Plan to dumb down matric"* with the sub heading: *"Department proposes that requirement for distinction be lowered from 80% to 70%" (Sunday Times, 13 September 2009).* Hopefully this is a throw back to the previous regime and this proposal will be rejected.

Education is a national disaster of monumental proportions.

Obviously not all of the few university recruits with the necessary skills will choose engineering and science career paths, and fewer still will lean towards the water field. Some will drop out of university, leaving only a trickle entering the water field.

Even if it takes only two years to revamp the maths education in our secondary schools (which is unlikely to suffice, since the essential feedstock of good maths teachers has to be built up), it would still take 12 years before an appreciable effect is felt at the end of the professional pipeline. (Five years in secondary school, four years at university and another three years of on the job professional training.) And even then they would still have a long way to go in gaining sufficient experience.

CLIMATE CHANGE

Compared with the man-made crises that we are facing, climate change is still a much less imminent threat. However, it has been suggested that the impact of global warming would be amplified in the water environment with greater variability reflected in bigger and more frequent floods and longer droughts. To date there has been no evidence of this in our local hydrological records, but if it should occur it would increase the challenge of managing our precious water resources. The much bigger man-made threats that have been pointed out in the preceding sections will simply be overlaid with a higher risk of system failure and the need to plan that much more effectively.

Therefore, if we are concerned about managing the impacts of climate change and adapting to them, it is vitally important that we should strengthen, not weaken, our capacity to manage our water resources.

CONCLUSION

It is clear that on a number of fronts the water sector is already facing crises of national importance. If left unattended they will have catastrophic consequences. However, even at this stage all of them can and must be managed. Government is well aware of the problems and is taking steps to rectify them, especially the crises within Local Government. We must help them to succeed.

REMEDIATION

The following issues have to be addressed as matters of great national urgency:

Supply side provision

It is essential to ensure that phase 2 of the LHWP proceeds on schedule and that Spring Grove Dam is expedited.

Eradication of water theft

No effort should be spared in speeding up the eradication of the water theft in the Upper Vaal River catchment. Use of the media should not be discounted, plus enlisting the opinion of other framers who would be adversely affected by water restrictions. Consideration should also be given to making civil cases against recalcitrant farmers to sue for damages to recover the full cost of the water theft.

Accelerate WDM / WC initiatives

The great urgency to get demand management initiatives operational cannot be over stated. It is understood that large sums of money have been allocated for this purpose. This is necessary to deal with the maintenance and refurbishment backlogs. This needs to be allocated wisely at the local level and translated into rapid delivery. This will require full cooperation from decision makers in the LAs. Moreover water revenues need to be strictly ring-fenced to ensure that in the future sufficient allocation is made to fund the all important routine maintenance and refurbishment programmes.

Build capacity in Local Authorities

There is an urgent need to build capacity at every level in local authorities and ensure that the WDSPs are produced in time, the water supply infrastructure is maintained and refurbished and that household water leakage and water theft is curbed. This will require active recruiting and substantial improvement in service conditions, including attractive salaries and sufficient status to affect the decision making process.

Build capacity in DWA

There is an urgent need to improve service conditions for professional engineers and scientists in DWA to save the organisation from crippling loss of essential middle and top management skills. It is essential to make salary scales and service conditions attractive at every level, especially at the entry level. A doubling of salaries at the entry level might be appropriate. Clear growth paths need to be established for all competent personnel.

Refurbish and maintain aging bulk water infrastructure

Programmes for the systematic maintenance of bulk water infrastructure should be established and the necessary funding secured.

Strengthen link between water resource and water demand management

Foster effective linkage between the WDSPs and the NWRS to ensure the development of coordinated plans and effective implementation.

Flow monitoring and feedback

Rebuild the capacity to run and interpret flow monitoring systems to ensure that future theft of the resource is identified and dealt with timeously.

Establish Waste Discharge Charge System

The Waste Discharge Charge System should be established as soon as possible, but be kept simple to implement and manage.

Implement effective sanitation

Every effort should be made to establish effective sanitation systems in all LAs and to empower proper management. This requires the complete buy-in of local politicians, strict control of funding and transparent accountability and may require the removal of ineffective or corrupt managers. Central monitoring and public feedback, such as the blue drop and green drop accreditation are valuable moves in this regard.

Revamp maths and science education

Every effort should be made to impress on the Department of Education the damage that they are inflicting on the economy and the urgent need to overhaul maths education in secondary schools with a view to utilising the full potential of learners.

Short-sighted policies that promote “grade creep” and engender glaring gaps in the incomplete preparation of university candidates are a major disservice to the students themselves and to the community that they aspire to help.

It is essential to raise the bar for teachers to ensure the necessary improvement in education standards. The remuneration of good maths and science teachers should be radically increased. However, to be fully effective this should be accompanied by the disciplining and even dismissal of lazy and incompetent teachers.

Good quality career guidance should be provided, at least from grade 9, to ensure that scholars can make properly informed choices of matric subjects.

Open up and collaborate

In view of the fact that capacity is currently in a critical condition and the length of time required to rebuild it, it is essential to use the human resources at our disposal to their fullest potential.

The imperative for transparency in DWA cannot be over stated. The public has the right to know about the decisions that affect their and their children’s future.

The private sector has a large reservoir of desperately needed professional expertise and technical skills that can and must be tapped to their full potential. In this regard SAICE and WISA have taken several initiatives to assist and their members are ready to do much more. Initiatives already underway include:

- SAICE set up a Section 21 company devoted to addressing skills shortages, particularly in Local Authorities.

- The spirit of cooperation is evidenced by the fact that DWA was a co-funder of the ENERGYS programme and they are currently funding several capacity building programmes through WISA and SAICE.

- SAICE pioneered a meeting of Tertiary Institutions to discuss bottlenecks and made representations to the Department of Education. The SAICE Section 21 Company was subsequently appointed by JPSA to submit a report and make recommendations on how to deal with this issue.

Prioritise

Given the capacity constraints, DWA should focus on the priorities, not on “nice to haves”.

Programme

The NWA does not require everything to be done at once.

Simplify

Some parts of the NWA, and particularly the ensuing regulations, are too complex and need to be simplified to be feasible and to avoid diverting scarce resources.

Partner

South Africa still has many highly regarded skills in the water sector. They must be harnessed and fully used.

FINAL REMARKS

Finally, we would all do well to heed the following words of wisdom:

“The prudent see danger and take refuge, but the simple keep on going and suffer for it.”
Proverbs 27:12