Counting the lost drops: South Africa’s study into non-revenue water

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Abstract

The Draft Second National Water Resources Strategy of South Africa, which has been published for comment, has identified the implementation of water use efficiency, conservation and water demand management as a core strategy to ensure sufficient water to meet South Africa’s needs going into the future. This, ‘non-negotiable performance area’, it says, must be implemented immediately in all water use sectors, specifically municipalities. ‘In view of water scarcity, it is essential that such water losses must be curtailed, especially in terms of the need to provide for the growing water demands of new socioeconomic development’, the strategy points out.

While South Africa’s non-revenue water levels compare well internationally, as a water scarce country it needs to do all it can to prevent the unnecessary loss of water. This is one of the main recommendations of a recent study into the state of non-revenue water in South Africa commissioned by the Water Research Commission (WRC).

To improve the current situation, the water sector must have a clear indication of the current status of non-revenue water in South African municipalities, more specifically what the actual water losses are and how they are split between physical leakage (real losses) and commercial losses (apparent losses). It is for this reason that the WRC, in collaboration with the Department of Water Affairs, launched the latest investigation into the state of non-revenue water in South Africa, which has now been published.

In the most comprehensive and detailed study of its kind, to date, data were gathered from 132 municipalities throughout South Africa representing over 75% of the total volume of municipal water supply. The study follows on from similar WRC assessments undertaken in 2001, 2005 and 2007. This is the first time the country has a single, representative estimate of non-revenue water as opposed to various estimates in previous years.

The paper shares in more detail findings from this study which have highlighted on average 38% non-revenue water and provide a deeper insight into the problems and challenges faced in tackling water losses in South Africa.

Key words: leakage, non-revenue water, water losses

INTRODUCTION

South Africa is regarded as being in a group of countries in the world which is water stressed. The inequitable distribution of precipitation and evaporation makes the country vulnerable to many effects of extreme climate variability. Over the years the country has responded to these challenges by improving water assurance, availability and security. However, it is moving to a state where the demand is nearly closing the supply gaps. This has prompted Government to introduce strategic measures to respond to this growing challenge. The Draft Second National Water Resources Strategy of South Africa, which has been published for comment, has identified the implementation of water use efficiency, conservation and water demand management as a core strategy to ensure sufficient water to meet South Africa’s needs going into the future. One of the key areas identified is that on non-revenue water or water losses in distribution systems.
Water supply in South Africa is largely a public function and this is achieved through some 297 municipal institutions through a tiered management process, these being urban metros, district municipalities and local municipalities. The metros consist of large water distribution networks serving large urban and peri-urban areas, while local municipalities service small cities and towns and district municipalities servicing a vast number of remote rural settlements. Collectively, these constitute a vast number of water distribution networks. South Africa post democracy inherited huge challenges emanating from the legacy of the apartheid where data, technical information and lack of O&M were prevalent. As early as 1994 the new Government had already identified water use efficiency as part of its strategy and many programmes to stimulate actions have been initiated. The South African Water Research Commission (WRC) had identified this challenge as a key priority as early as the late 1980s. The WRC has been proactively leading and providing support to municipalities throughout South Africa to address leakage and wastage from their potable reticulation systems since the early 1990s. South Africa was one of the first countries outside of the UK to fully recognize the benefits of adopting the Burst and Background Estimate methodology which was initially developed by the UK Water Industry when the major water suppliers in England and Wales were privatized in the early 1990s. The aspect of Non Revenue Water (NRW) measurement and benchmarking has been one of those important interventions which the WRC has been pursuing and developing over the years. Complementing these, the WRC has developed various software models and tools to assist water suppliers in understanding and ultimately reducing their leakage. These included the night-flow analysis model, Sanflow (WRC 1999), the pressure management model, Presmac (WRC 2001), the economics of active leakage control model, Econoleak (WRC 2002a, 2002b), a model to assess the levels of non-revenue water based on the International Water Association (IWA) water balance, aqualite (WRC 2009) and finally a balanced scorecard model to develop a first-order Water Demand Management (WDM) strategy for a municipal water supplier, WDM Scorecard (WRC 2010). All these initiatives has resulted to date in one of the largest and most comprehensive NRW assessments, which provides the state of NRW and benchmarks progress over the past 5 years.

**DEVELOPMENTS OF NRW ASSESSMENTS**

Against this background and challenges, the WRC took a strategic view in driving water loss assessments. To date four assessments have been concluded since 1999. Each assessment has been an incremental process and used the evolving improvements in the Burst and Background losses Estimate (BABE) concepts, as well as the IWA water balance method.

- The initial NRW assessment undertaken in 1999 (WRC 1999) was based on only 20 data sets which were considered to be of an acceptable quality from a potential set of approximately 600 water suppliers. The assessment suggested that the average NRW for the 20 water suppliers was in the order of 25% with an average infrastructure leakage index (ILI) value of 6.0. Most of the acceptable data sets were provided from the larger municipalities which were the only water suppliers at this time who collected the appropriate base data and metre readings. This study also highlighted the huge gaps in information and data, as well as the poor monitoring of water usage at a municipal level.

- The second assessment was commissioned in 2005 (WRC 2005). Information from 60 water suppliers was obtained from which 30 acceptable data sets were identified representing just under 50% of the total municipal water supplied throughout South Africa. In this assessment, the percentage NRW was not calculated in line with the IWA recommendations on avoiding the use of percentages when dealing with NRW. The ILI which provides an indication of the physical leakage was, however, calculated for the 30 municipalities and an average value of 6.3 was derived. The third assessment was undertaken in 2007 (WRC 2007) and involved 100 data sets from which 62 were included in the final assessment representing almost 60% of the total municipal water use in...
South Africa. In this assessment many of the smaller municipalities were included and the NRW was estimated to be 36% with an average ILI of 7.6. The percentage NRW was again included in the assessment despite the fact that it was accepted that percentages can be very misleading. Some of the high level committees and politicians were uncomfortable with the use of the ILI and the various other recommended performance indicators. As a result that they insisted on the use of percentages albeit with a ‘health warning’ to highlight that they can be misleading in certain cases.

- The fourth and latest assessment was concluded in 2012 and is considered to be one of the most comprehensive non-revenue water assessments to date.

THE 2012 NRW ASSESSMENT

Following the success of the 2007 assessment in raising the issue of non-revenue water to a national platform where it was discussed at length by Government, a fourth assessment was undertaken between 2010 and 2012, the results of which were officially released in March 2013 (WRC 2012). This assessment is the most detailed assessment of NRW undertaken in South Africa and involved water balance information from more than 130 municipalities. The project was supported not only by the WRC but also the Department of Water Affairs.

Non-revenue water

The data gathered from 132 of the possible 237 municipalities supplying water to more than 40 million residents throughout South Africa represent over 75% of the total volume of municipal water supply. The results indicate that the current level of non-revenue water estimated for the country as a whole is almost 37% (as shown in Figure 1) with an average ILI of 6.8.

![Figure 1](https://iwaponline.com/wpt/article-pdf/9/4/502/382383/502.pdf)

It should be noted that although the general trend in NRW appears to be increasing as can be seen in Figure 1, the results are influenced by a number of factors which must be carefully considered before reaching such a conclusion. The most important consideration is the size and reliability of the data set used in the analyses. The size and reliability of the data set has been increasing with
each new assessment and it is clear that the additional data sets that are being added annually tend to be the more problematic municipalities that experience much higher levels of leakage than those which have been assessing their NRW levels for the past 10 years or more. With each new assessment, the data sets are being assessed in more detail and various errors and problems with interpretation of the IWA water balance are being corrected. Invariably this tends to push more water into the NRW component which would explain some of the increase shown in Figure 1. As all of the metros and most of the larger cities in South Africa have now been included in the assessment, the database should now be stable and the true trend in NRW will be confirmed over the next few assessments. Establishing the status quo has been a significant challenge for a country with a population of over 50 million and the most recent assessment has created a solid base from which the future assessments and trends can be determined.

Although the NRW figure for South Africa of 37% is high as it suggests that more than one-third of all water supplied to municipalities is not billed to consumers, this figure is broadly in line with the world average of ±36.6% as can be seen in Figure 2.

As can be seen from the figure, the NRW for South Africa appears high if compared to other developed countries but appears low if compared to most developing countries. In this regard South Africa tends to be an anomaly as it has both developed and developing areas which in turn can experience NRW levels as low as some of the best in the world while in nearby developing areas, the NRW levels can be up at ±90%. The figures are further complicated by the fact that there may be dense urban areas adjacent to rural areas with scattered communities and to compare the NRW levels using percentages in such cases is meaningless.

To try and overcome the problems of using percentages in South Africa, the IWA-recommended performance indicator for physical leakage called the ILI is used. South Africa was one of the first countries outside of the UK (where the ILI index was developed) to embrace the use of the ILI as the key leakage indicator. The ILI of 6.8 for the country as a whole is considered to provide a realistic indicator of physical leakage for the South African systems. It is interesting to note that the various estimates of ILI over the past 12 years have all been between 6 and 8. Again, such leakage would
be considered high for most developed countries but low for most developing countries. The ILI highlights the fact that levels of physical leakage are relatively high in South Africa and there is considerable scope for improvement. This is both positive and negative for the country in that the leakage levels are high which has a negative connotation, however, such high leakage represents a ‘resource’ which can be accessed through proper management and better water use practices. This aspect is highlighted in Figure 3 which provides an indication of the per capita consumption in South Africa.

![Figure 3](https://iwaponline.com/wpt/article-pdf/9/4/502/382383/502.pdf)

**Figure 3** | Estimated per capita water consumption in South Africa.

Although the estimates provided in Figure 3 must be considered as relatively course estimates, they highlight that the per capita water consumption in South Africa is significantly higher than the world average despite the fact that South Africa is a water scarce country and should exhibit a per capita consumption below the world average. Once again the figures tend to support the general conclusion that water is being wasted in the country and there is significant scope for improvement. In Australia, for example, during the recent drought, the residents in many water stressed parts of the country reduced their average per capita water use to less than 140 l/day. It can be achieved and the scope for reducing water use in South Africa is significant and provides some level of assurance to support future growth in certain areas where new water resources cannot be developed or are simply unavailable.

**Overall IWA water balance**

The most recent water balance developed for the municipal water use in South Africa is shown in Figure 4 which is based on the standard International Water Association guidelines. It should be noted that in South Africa, every water supplier is categorized according to the size of the population supplied and whether the area is urban or rural. The results from the breakdown into the different categories are provided in Table 1 from the 2012 assessment. Table 2 shows the definitions of the categories in Table 1.

In view of the fact that the 2012 assessment was unable to obtain data from every water supplier in the country, it was still necessary to extrapolate the results in order to derive an estimate of NRW for...
the whole country. Fortunately the available data sets gathered in the 2012 assessment covered ± 37 million of the estimated ± 50 million South Africans and therefore the extrapolation was used to represent the missing ± 13 million. The results from this are shown in the last row of Table 1.

SUMMARY AND CONCLUSIONS

The latest NRW study undertaken by the WRC in partnership with the Department of Water Affairs represents a major advance in the understanding and assessment of water losses from municipal
water supply systems in South Africa. It is the most comprehensive assessment of NRW undertaken to date and provides a solid base on which future assessments can be made and trends established. Despite the many problems experienced with data collection, particularly in the smaller municipalities, it was possible to gather information for more than 75% of the water supplied throughout South Africa. The overall NRW for South Africa is estimated to be 1,580 million m$^3$/annum which is approximately one-third of the total water supplied. Conservatively, this represents a loss of over R7 billion (almost $1 billion) based on an average bulk water tariff of approximately R5/m$^3$ ($0.50).

The average ILI value for all of the South African municipalities was estimated to be 6.8 which again is in line with the world average and would be above average (i.e. bad) when compared to most developed countries and well below average (i.e. good) when compared to most developing countries. Effectively, the ILI value of 6.8 tends to support the perception created from the percentage non-revenue water figures for South Africa (36.8%) where there is clearly a high level of wastage or water losses in the country and considerable scope for improvement.

The above figures are based on the Standard IWA Water Balance in which the ‘revenue water’ figures provided by the Financial Departments are assumed to be correct. In South Africa, however, there can be a significant component of revenue water which is never paid for by the consumers. Preliminary estimates of this component suggest that if it is taken into account, the level of NRW may increase by up to 10%. Investigations are continuing to try and quantify this element with greater reliability so that the next assessment can provide a more complete and accurate water balance.

One of the key positive outcomes from these and especially the 2012 assessment is that Government has introduced an incentive based regulatory system called ‘No Drop’. This programme will now make it a regulatory requirement for all municipalities to undergo annual assessments of the NRW. It is hoped that with its support and investment programmes such as ‘War on Leaks’ and ‘Water Conservation/WDM’, this challenge will be brought under control in a short period of time to the benefit of the country.

**REFERENCES**


