

Benchmarking water use and infrastructure based on water services development plans for nine municipalities in the Western Cape

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With municipalities constantly under pressure due to staff shortages, the need for benchmarks to assist them with the planning process of their water infrastructure becomes an important tool to ensure effective water management. The lack of available and trustworthy data plays an important role. The use of the data provided in the Water Service Development Plan (WSDP), as required by legislation, provides municipalities with a starting point that can be used to measure their performance against other municipalities in similar positions, or against which they can measure their progress towards set goals.

An analysis of the data provided in the WSDPs of nine municipalities, representing 56 communities in the Western Cape, provides the basis for the setting of benchmarks in consumption, non-revenue water, storage capacity, treatment capacity and the re-use of treated effluent.

INTRODUCTION

The Department of Water Affairs and Forestry (DWAFF) is the custodian of water resources in South Africa. One of its main objectives is to plan water resources properly to ensure a sustainable environment for any future developments for all its citizens. Municipalities are responsible for the delivery of water and sanitation services to address the ever-increasing need for economic growth in its area of jurisdiction. While the Constitution makes provision for the division of functions between these two government structures, the cooperation between different organs of state is prescribed in both the National Water Act (NWA) and the Municipal Systems Act.

In striving to meet these challenges within an environment of cooperation, the DWAFF constantly readjusts its strategic plans to provide guidance for future planning. Municipalities, on the other hand, are responsible for planning on an integrated basis and need to do this in accordance with the Integrated Development Plan (IDP), provided through the Municipal Systems Act. These five-year plans focus on municipalities' main function and are the legal contract between themselves and the public.

To create the mutual field of agreement between the municipalities and the DWAFF, Water Services Development Plans (WSDPs) are required by the DWAFF (through the Water Service Act, Act No 108 of 1997, Section 12) from municipalities for

evaluation, as a mechanism to ensure that their strategic plans remain relevant and appropriate. The aim of these plans is to achieve an integrated approach towards the management of all water-related issues and to assist with proper planning and budget procedures in order to provide water and sanitation services in time and at a correct level. It is important to understand that the WSDP is a planning tool provided for in the Act to support municipalities with their own planning exercises.

During 2005 the DWAFF requested an evaluation of the WSDPs (Du Plessis 2005) in two catchment areas, namely the Olifants / Doorn and the Berg River water management areas, both situated in the Western Cape. These catchment areas include 56 different well-defined towns or communities, all falling within nine municipalities, consisting of seven local municipalities (Category B) and two district municipalities (Category C). The local municipalities include Matzikama, Cederberg, Berg River, Saldanha, Swartland, Stellenbosch and Drakenstein municipalities. The two district municipalities were Winelands and West Coast District Municipality. A number of smaller towns, like Calvinia and Nieuwoudtville, which fall within the boundaries of the Hantam Municipality, were also included, but a lack of reliable data, as reported in the available WSDP, excludes these towns from most of the datasets. The locations of these municipi-



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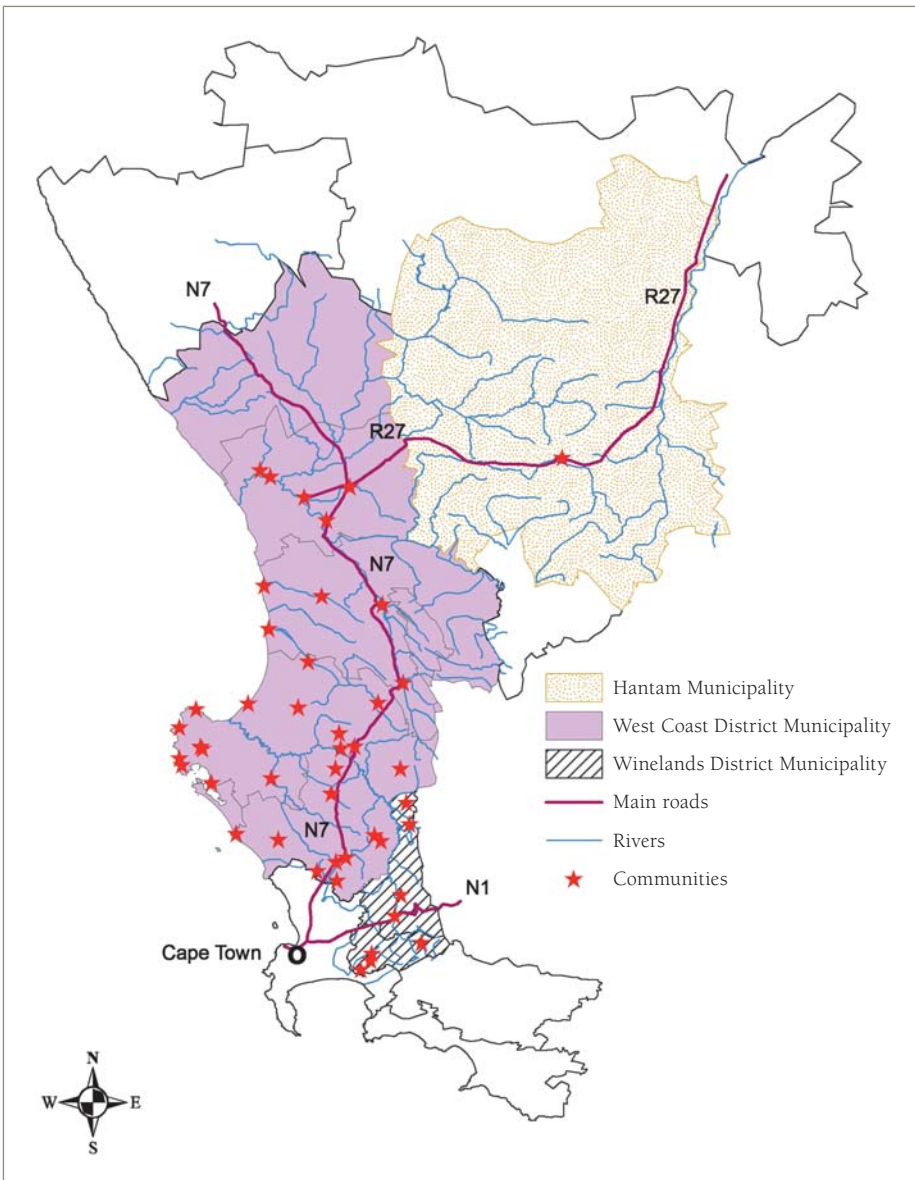


Figure 1 Locality map

palities and communities are shown in figure 1.

Since special arrangements regarding the planning for future water resources are in place between the City of Cape Town, which falls within the Berg River water management area, and the DWAF, it was decided to exclude it from this exercise.

The purpose of the study, which mainly entails the evaluation of all the municipalities' WSDPs for the period 2002/3, was to determine whether municipalities still have access to adequate water resources to provide for their future water demands and to provide a set of comparative values which can be used as benchmark values. This paper will deal with the last objective, that is the benchmark values. The main purpose of the benchmark values is to assist municipalities in their planning process and to serve as a reference value against which progress within the municipality can be measured. These values might also be useful to the DWAF, redirecting their strategic planning objectives and the associated funding support to municipalities.

Benchmark values

Benchmarking can be defined as the process where the effectiveness of achieving a particular goal can be weighed against a standard set by a number of different organisations. The specific goal is referred to as a performance indicator. It is of course not always necessary to measure only against other organisations, but once critical performance indicators have been identified, it is worthwhile and necessary also to measure against previous values achieved within the organisation. This will assist an organisation in evaluating the progress made on a specific issue within that organisation.

Many attempts have been made by different organisations to compile a set of appropriate benchmark values for different performance indicators. In order to calculate an acceptable benchmark value for a specific performance indicator, honest and correct input from a number of role-players is required. These values will reflect on the effectiveness of the management of the specific community and a method needs to be devised to ensure reliable input values.

However, the availability of data which can be used remains a major obstacle in achieving this objective. In this study the values provided in the WSDP were accepted as reliable data and used as a departure point for any comparisons.

Typical benchmark values can differ significantly from community to community, depending on local conditions and a number of technical issues. Within the area of investigation, comparison among municipalities will result in some useful interaction between these municipalities, while in the process of understanding a specific municipality's benchmark value or position on the graphs produced for comparison reasons. It needs to be emphasised that these values will differ from community to community, but it will at least provide the manager of a specific system with an indication of whether, for example, the consumption of a particular community is more or less within general limits, or whether specific actions need to be taken to ensure more efficient water use.

Benchmarking can also be used to measure performance against a specific target set by the municipality itself and, as such, the calculation of the specific value for each municipality is important to monitor general progress for that specific performance indicator.

Projected future demand

The planning of water systems and specifically the future water demand projections are perhaps one of the most critical aspects to be considered at a municipal level. This needs to be done, most of the time, within a framework of very limited available data. In order to deal with these projections, it is necessary to take at least the following factors into consideration:

■ Population growth figures

Many factors can influence the growth of a specific population. Some of the basic aspects to be evaluated are the levels of education, with a typical family unit of about six persons per family on the lower level of education and a typical value of three to four persons on the upper level of education. Illnesses such as HIV do have a substantial influence on the general population growth and can result in specific areas experiencing a negative growth rate.

■ Different user consumption figures

The level of income is another factor that can influence the per capita water consumption figures. While consumption figures as low as 10 l/c/d have been measured, typical figures vary between 100 l/c/d to over 500 l/c/d for upmarket areas. Additional factors such as the willingness to pay and an appropriate billing system can however influence water consumption figures, regardless of the income group.

■ **Tendencies towards urbanisation**

Especially in rural areas, care needs to be taken to include the effect of official policies like 'the right of occupation', which basically ensures permanent residence to people living on private property under certain circumstances. These policies result in large numbers, specifically of farm workers, being evicted from private property to prevent them from obtaining permanent residence. The result is a tendency to move from the farms to the municipal residential areas.

There is always the idea of a better life and work opportunities in city centres and bigger towns, which result in a large number of people moving from the rural areas to these towns.

■ **Political stability**

Quite often ethnic differences result in a sudden move of specific communities to a different area of residence. This however does not take place on a large scale in South Africa, but small municipalities need to be aware of such possible interventions when making decisions regarding future water infrastructure.

■ **Economic climate**

The economic climate of a specific area can have a substantial influence on the growth of the area. Urbanisation is closely linked with the ability of a specific area to supply work to its people. In the rural areas, aspects such as drought can force large numbers of workers to work in towns to sustain their families.

■ **Main focus of community (holiday towns/communities)**

Holiday- or tourism-based communities experience very unique water demand patterns and these need to be incorporated carefully so as not to overcapitalise on infrastructure for only a small portion of the year. It is also to be expected that holiday makers will have a substantially higher per capita consumption given their circumstances.

The main problem is that the data required (as discussed above) to provide a complete picture for future projections is very difficult to obtain. For many municipalities, the tendency quite often is to base future water demands on historical consumption figures only. A basic curve fitting is done on the existing data, and changes for specific industrial or any other specific development are incorporated. This approach is frequently used due to the lack of human resource capacity and reliable, easily accessible data to analyse the factors influencing water demand in more detail. This situation results in a need to base future planning at a municipal level on data which is easily available and which needs limited further

analysis. Once critical areas have been identified, based on such an approach by the municipality, it is recommended and advisable that a more detailed analysis of the data is done before detailed planning is commenced with.

Objectives

The Water Services Act (Act 108 of 1997) (WSA) makes a proper water audit compulsory for all water service providers as part of their WSDP. Since it is anticipated that the WSDPs will play an ever-increasing role in future water planning, these plans were selected to form the basis of research done, as reported in this paper. Data available in these WSDPs will also need to be updated on a regular basis as a requirement from the WSA, ensuring a database which can be used to repeat this exercise regularly in the future.

These WSDPs need to ensure that proper management of existing water resources, including manpower and funding, takes place. Needs are prioritised and aims set by the IDPs of municipalities will ensure that the delivery of water and sanitation services to the end users takes place on a sustainable basis.

Municipalities are however under constant pressure to change and to adapt to present circumstances, leaving the DWAF with some questions about the effective use of these plans by municipalities to ensure integrated planning. This study focused on the evaluation of the existing data for each of the 56 individual communities, as provided in the nine WSDPs of the specific municipalities, with a specific focus on the following basic performance indicators:

- Consumption per capita
- Non-revenue water per capita
- Capacity of existing bulk water infrastructure:
 - Storage
 - Treatment of potable water
 - Treatment works for wastewater
- Re-use of treated water per capita
- Discharge of treated effluent
- Water demand management structures in place to ensure effective water use
- Capacity to address institutional and operational challenges

An important outcome of the study was the availability of comparative data to these participating municipalities so that they can assess themselves against a general set of benchmark values, as experienced by the municipalities within these water management areas. Integrated water resources management involves all stages of water use (catchment management, water treatment, distribution, waste treatment and return flow) and are the main focus of the NWA. In order to be successful with the implementation of integrated water resources management it is, as a starting point, essential to

be able to understand and to set the point of departure. This study therefore aims to provide such a benchmark value platform which can be used by municipalities for planning purposes.

METHODOLOGY

Since all the research questions theoretically could be addressed by the municipalities' management structures with the assistance of their existing WSDPs, the first attempt was to compile a simple questionnaire to be completed by all the municipalities involved in the study. This questionnaire includes basic questions relating to all the research objectives as previously discussed. The perceived assumption was that the municipalities, with very little effort, would be able to answer these questions.

However, the questionnaires used in the first method did not provide the expected end results and the researchers were forced to abstract the data required from the different WSDPs, as provided by the relevant municipalities to the DWAF. Even after this exercise it became clear that not all the WSDPs contained the required information. Data which was still not available after the evaluation of the WSDPs was obtained from separate reports compiled primarily by consultants and eventually through individual interviews with key role players in municipalities. Even after this last attempt, it was not possible to compile a complete list, but the amount of data collected and analysed were considered adequate for the purpose of the main research objectives. The results obtained from this study were based on the data for the 2002/3 period, which was the only officially reported available data at the time of the study in 2005.

The availability of data was a constant problem and no attempts have been made to try to verify the correctness thereof beyond the clarification of the data with the relevant municipality. However, where it was obvious to the researcher, based on his knowledge of the specific area, that specific values are incorrect and no definite explanation could be obtained from alternative sources, these data points were excluded from the comparative study and listed for possible further investigation.

It is important to note that the selected performance indicators were all expressed as a value per capita. It was accepted that all planning exercises regarding water infrastructure can be directly linked to the population growth. This is a simplistic approach, but it is based on the availability of data and data which proved to be fairly easily accessible from the municipality under consideration. Population figures were also easily available from municipalities and all the municipalities did have some indication of the projected future growth.

Table 1 Population figures (2005)

District municipality (Category C)	Municipality (Category B)	Community	Population (2005)	
Winelands District Municipality	Drakenstein	Paarl	124 878	
		Wellington	45 764	
		Hermon	520	
		Gouda	2 630	
		Saron	6 123	
	Stellenbosch	Stellenbosch	60 087	
		Franschhoek	8 139	
		Kylemore	2 706	
		Pniel	2 668	
		Jamestown	2 040	
		Klapmuts	1 704	
		Raithby	579	
		West Coast District Municipality	Saldanha	Saldanha
Vredenburg	50 340			
Langebaan	6 520			
Hopefield	6 421			
Paternoster	2 237			
St Helena Bay	11 186			
Jacobs Bay	650			
Berg River	Aurora			730
	Dwarskersbos		377	
	Eendekuil		1 270	
	Goedverwacht		1 625	
	Piketberg		9 153	
	Porterville		5 815	
	Redelinghuys		658	
	Velddrif		8 400	
	Wittewater		884	
Swartland	Abbotsdale		2 181	
	Chatsworth		1 875	
	Darling		7 078	
	Kalbaskraal		940	
	Koringberg		495	
	Malmesbury		22 998	
	Moorreesburg		10 750	
	Riebeek Kasteel		3 169	
	Riebeek West		3 295	
	Riverland		1 203	
	Yzerfontein		653	
	Cedarberg		Citrusdal	4 521
			Clanwilliam	5 415
Elands Bay			1 371	
Graafwater			1 884	
Lambert's Bay			4 823	
Leipoldtville			299	
Matzikama	Doringbaai		1 516	
	Ebenhaezer		2 232	
	Klawer		5 122	
	Koekenaap		688	
	Lutzville	4 809		
	Vanrhynsdorp	4 703		
	Vredendal	16 720		
	Strandfontein	177		
	DMA	Bitterfontein	826	
Nuwerus		609		
Rietpoort		1 247		
Hantam	Hantam	Calvinia	8 043	
Total			513 925	

These population figures were mostly based on census data, but since the boundaries used for the census do not always correspond to water supply areas in the municipalities, some modifications to the census data are normally necessary. Also, the census data is updated only every five years, with results available at least one year after the census. Most of the municipalities within these water management areas therefore need to update the 'old' census data with specific local trends before it can be used in their IDPs. The correctness of these figures was not tested and some concerns about the figures were expressed during the study. However, it provided a common base of planning for all municipalities and the data was available in the IDPs and WSDPs of the different authorities. It was furthermore recognised that if these values were to be used in the future to assist with an annual internal evaluation by the municipalities, the data needed to be easily available at all stages.

Even though it is agreed that a number of factors can influence these values, it at least provides a starting point for a municipality to position itself in respect of other authorities in the same area.

Values used, specifically population figures, were not always available for the specific timeframe (2002/03) required. The population growth percentage was used to either increase or decrease the population to a common base date from where comparisons could be made.

COMPARISON BETWEEN COMMUNITIES WITHIN THE MUNICIPALITIES

Population figures

Population figures for the different communities within the municipal areas investigated were mainly obtained from the WSDPs provided by the municipalities. It was sometimes necessary to question some of the figures reported in the questionnaires or WSDPs and a final figure was then calculated based on additional information provided by the relevant municipality. These figures, specifically those provided by the municipalities at the request of the researcher, were not always provided for the same base year (2002/03) and it was then necessary to recalculate the population based on the population growth as well as a population figure provided by the relevant municipality. These figures compare well with those reported by Rush *et al* (2000).

Table 1 provides the list of communities involved in the study on population figures, using 2005 as the base year.

Consumption

The water consumption figures were based on the bulk water usage after treatment and population figures during 2002/03, derived from table 1. Consumption was expressed

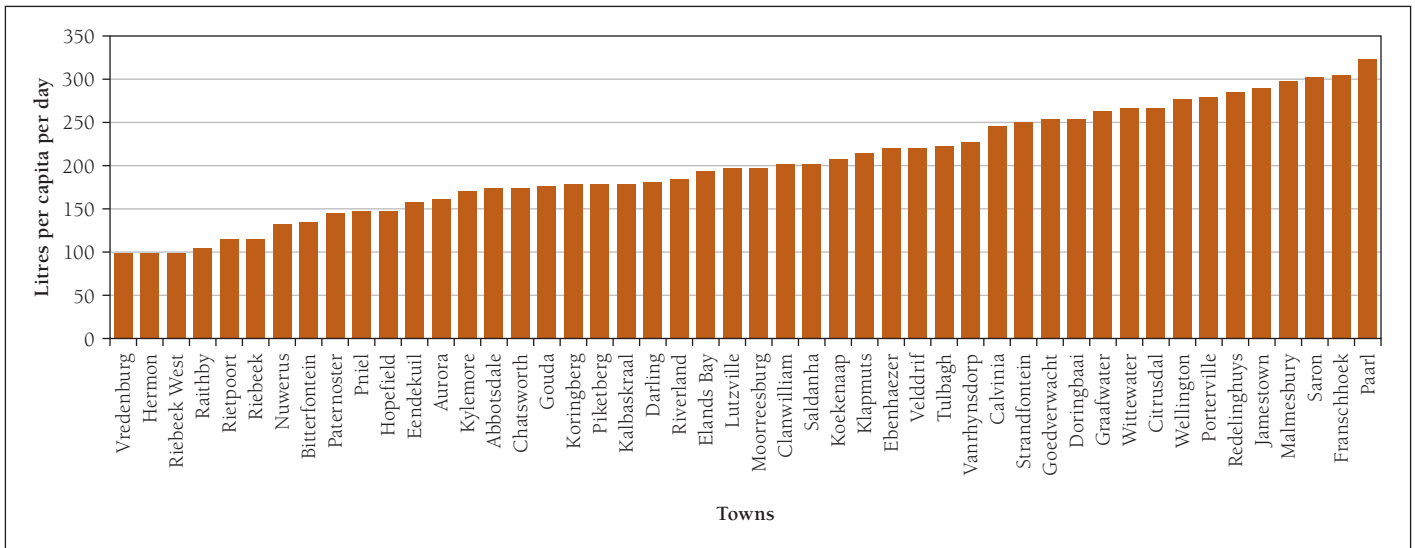


Figure 2 Consumption figures

Table 2 Communities of which the consumption figures were excluded from the analysis

Community	Consumption (ℓ/c/d)
Kliprand	25
Dwarskersbos	404
Klawer	407
Lambert's Bay	409
St Helena Bay	429
Langebaan	442
Stellenbosch	445
Vredendal	497
Yzerfontein	952
Leipoldville	1 479

Table 3 Standard classification of the water in a system

System input volume in m ³ /year	Authorised consumption in m ³ /year	Billed authorised consumption in m ³ /year	Billed metered consumption	Revenue water in m ³ /year
				Billed unmetered consumption
Water losses	Unbilled authorised consumption in m ³ /year		Unbilled metered consumption	Non-revenue water in m ³ /year
			Unbilled unmetered consumption	
	Apparent losses in m ³ /year		Unauthorised consumption	
			Meter inaccuracies	
	Real losses in m ³ /year		Leakage in mains and distribution networks	
			Leakage and overflows at utilities storage tanks	
		Leakage on service connections up to a point of customer metering		

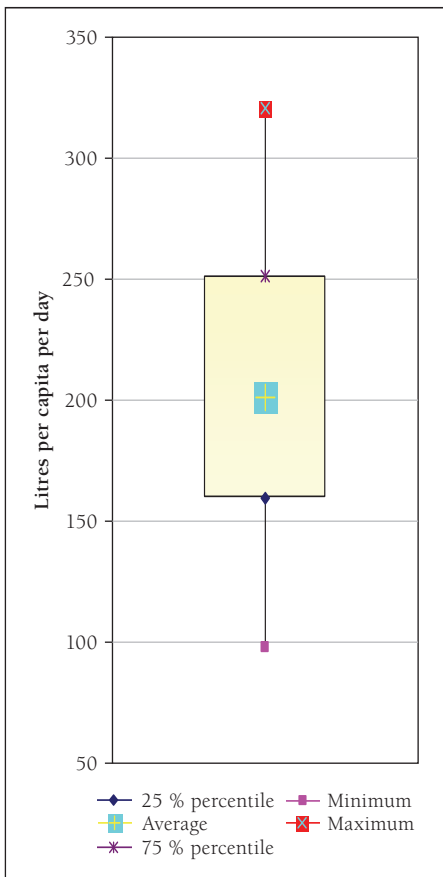


Figure 3 Box plot: consumption

as litre per capita per day (ℓ/c/d) and the bulk usage, including industrial usage, was used.

The average consumption, excluding communities listed in table 2, was 201 ℓ/c/d. The consumption figures for each community are ranked and shown in figure 2.

The box plot in figure 3 provides more detail of the distribution of the different communities' bulk per capita consumption figures. The box plot represents the 25 % (159 ℓ/c/d) and 75 % (251 ℓ/c/d) percentile values, with the average (201 ℓ/c/d) clearly marked.

Special care needs to be taken if industries with an especially high water demand are expected. In specific cases like the Saldanha Bay Municipality, industries like the steel industry use exceptionally large amounts of water. These specific volumes were well recorded separately and were excluded from the consumption figures as defined above.

A number of communities provided data distinctively different from the rest of the dataset. These values are recorded in table 2.

Most of the communities included in table 2 represent coastal communities with a fairly small proportion of permanent residents in comparison to the total population

during holiday periods and weekends. This leads to distorted high values of the per capita consumption based on bulk figures and average population. Although these figures are valid as a measure to evaluate progress within that specific community, it was excluded in the comparison with other municipalities.

The exclusion of Kliprand, a very small rural community on the border with the Northern Cape, which uses very limited borehole water resources as their sole supply of water, was justified as they were already restricted in their consumption due to resource limitations and cannot be used for comparison purposes. Other communities included in table 2 need to be evaluated on an individual basis before a clear assessment of their relatively high per capita consumption can be made.

Non-revenue water

Effective water management is not possible without knowing the losses. Non-revenue water is a very broad term used to express the volume of water entering the water system for which no bill is provided. Originally the term 'unaccounted for water' was used by the International Water Association, but the definition was changed some years ago

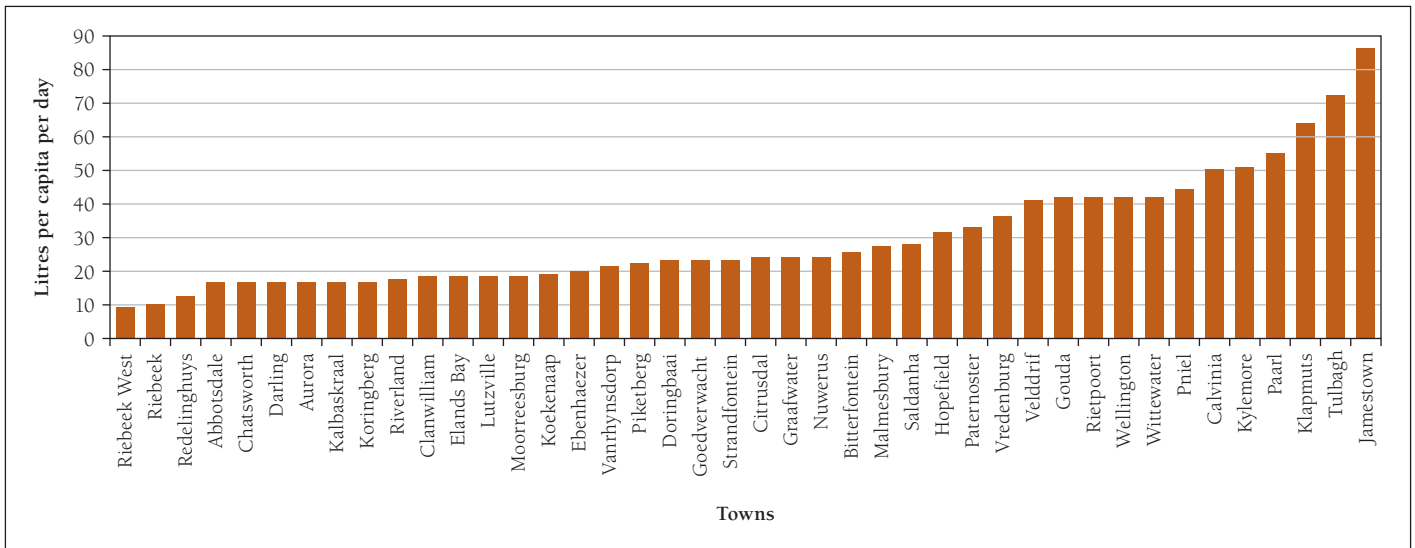


Figure 4 Reported non-revenue water

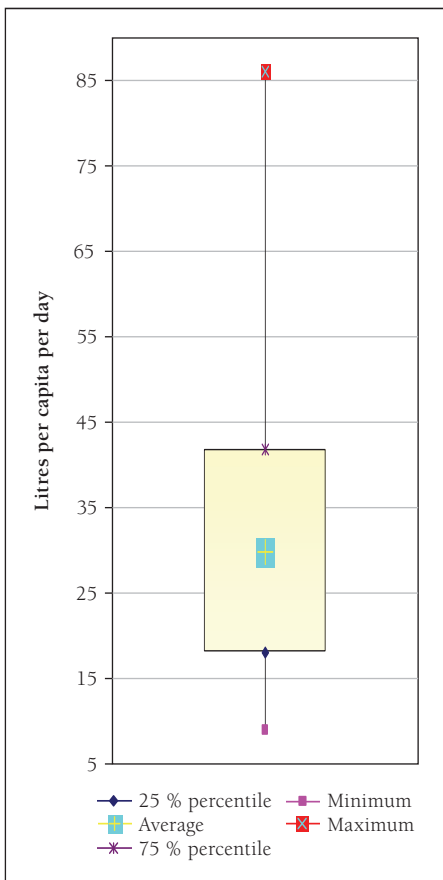


Figure 5 Box plot: non-revenue water

Table 4 Communities of which non-revenue water was excluded

Community	Non-revenue water (ℓ/c/d)
Lambert's Bay	37
Langebaan	51
St Helena Bay	57
Yzerfontein	87
Stellenbosch	135
Klawer	146
Vredendal	147

Table 5 Storage capacity exclusions

Community	Storage (kℓ/c)
Leipoldtville	0,51
Velddrif	0,71
St Helena Bay	0,83
Klawer	0,84
Vredendal	0,84
Stellenbosch	0,89
Lambert's Bay	0,96
Kliprand	1,10
Langebaan	1,15
Dwarskersbos	1,28
Yzerfontein	8,00
Doringbaai	3,47
Strandfontein	28,90

and is presently defined as shown in table 3 (Butler & Memon 2006). This volume does not always reflect a real loss, since it is possible that the water is simply not metered, for example municipal parks or fire fighting usages. Without quantifying this volume it is difficult to manage the water system effectively.

The non-revenue water reported in the WSDPs was expressed in terms of the population and no attempt has been made to classify the nature of the losses during this research project. It was clear from the data provided in the WSDPs that actual measured non-revenue water data was not always available to do a proper assessment, and a typical percentage of 10 % was often used in the WSDPs to reflect these values. These practices will distort the real non-revenue water percentage value when comparing values with other similar communities. Communities excluded from the consumption comparison evaluation were once again

excluded from the non-revenue water analysis for the same reasons as discussed under the consumption section.

It is also important to note that, although the non-revenue water was also expressed in the research as a percentage, it is known that these percentages can only be used if compared with communities with similar consumption figures and patterns. The main application of percentage values is for communities to use these values to monitor their own performance against their own set target values.

The non-revenue water level, expressed as ℓ/c/d, for the communities excluded from the data set are shown in table 4.

The average value for the study area, excluding the communities listed in table 4, was 30 ℓ/c/d, which, if compared to the average consumption of 201 ℓ/c/d, amounts to 15 % non-revenue water for the study area. The non-revenue water figures for each community are ranked and shown in figure 4.

The box plot in figure 5 provides more detail of the distribution of the bulk per capita non-revenue water figures of the different communities. The box plot represents the 25 % (18 ℓ/c/d) and 75 % (42 ℓ/c/d) percentile values, with the average (30 ℓ/c/d) clearly marked.

Storage

Storage is provided to deal with specific peak water demands, among others. During the study it was decided, however, to also express storage as a ratio of kilolitre storage per capita (kℓ storage/c) as an indication of where the possible biggest backlogs in the provision of storage infrastructure might exist. The storage referred to in this study reflects only potable water storage.

The data from the communities with suspect per capita consumption figures once again were not included in the analysis, but are listed in table 5. In addition, the communities of Strandfontein and Doringbaai were

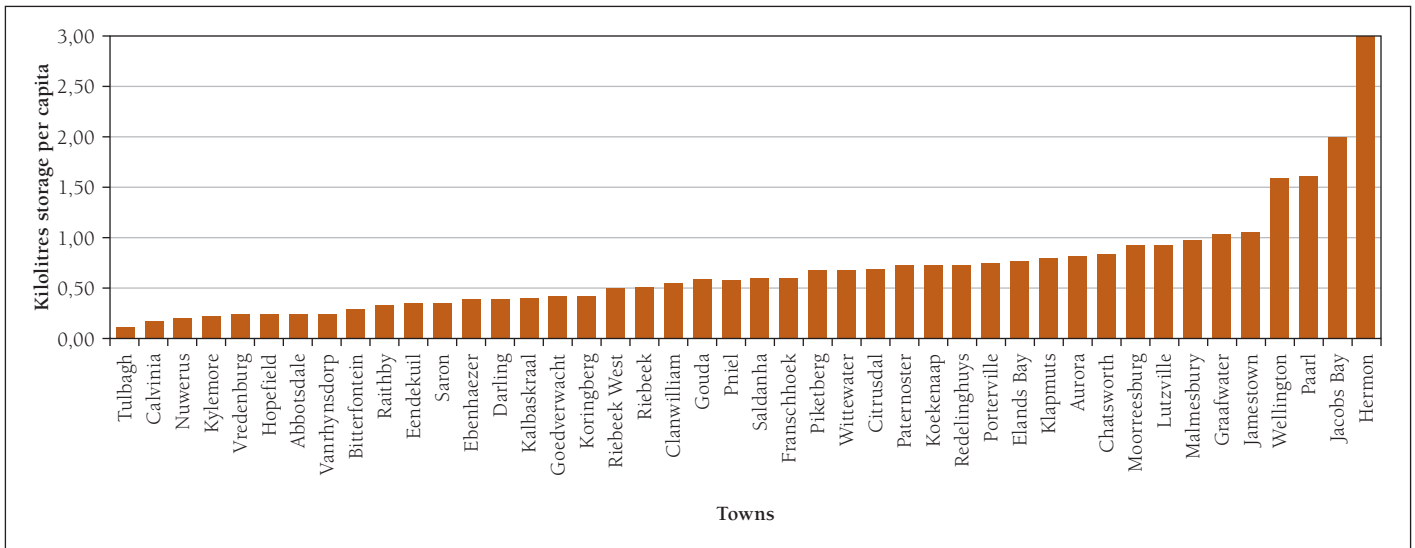


Figure 6 Storage capacity

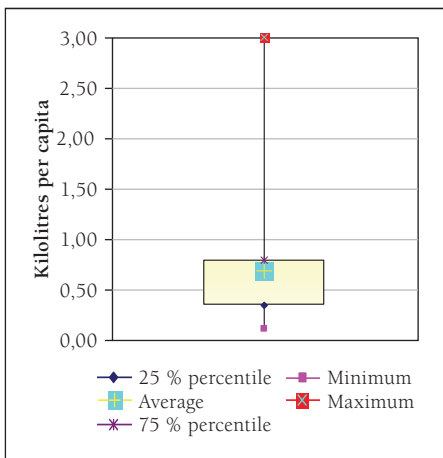


Figure 7 Box plot: storage capacity

excluded, since their storage capacity makes provision for a two-week storage period to meet demand when annual maintenance work on the canal system supplying water to them needs to be done. An additional number of communities were excluded from the analysis because they share the same storage and distribution system, which makes the analysis of the data provided in the WSDP difficult.

The results from this dataset need to be evaluated with extreme caution, since reservoirs are constructed with planning windows of approximately five to ten years in advance and the situation needs to be seen merely as a 'snapshot' of the situation at the time of evaluation.

The average per capita storage capacity provided in the study area amounts to 0,7 kℓ storage/c. The per capita storage figures for each community is ranked and shown in figure 6.

The box plot in figure 7 provides more detail of the distribution of the per capita storage capacity of the different communities. The box plot represents the 25 % (0.3 kℓ storage/c) and 75 % (0,8 kℓ storage/c) percentile values, with the average (0,7 kℓ storage/c) clearly marked. It is notable that the average and the 75 percentile are very

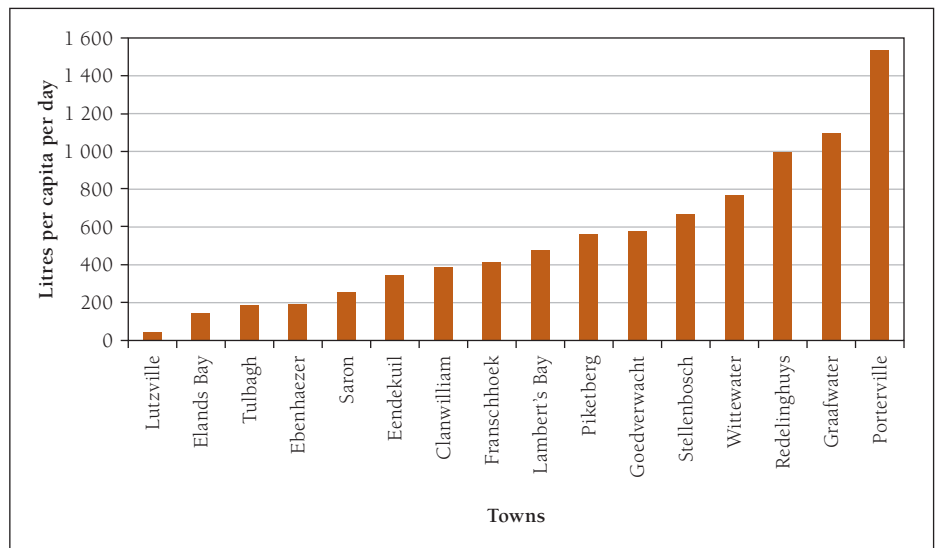


Figure 8 Treatment of potable water

close to each other, indicating that very few municipalities are significantly 'ahead' with the supply of per capita storage capacity.

Treatment capacity (potable water)

The treatment capacity for potable water is expressed in ℓ/c/d. It is very difficult to compare different communities with each other in this regard, since the level of treatment varies from a full water treatment facility to a simple chlorination system and the quality of the raw water also requires a different approach in each situation. The objective of this study however was to provide a set of baseline data which can be used by communities to not only judge their performance in comparison with other communities' ability to provide the required services, but also to evaluate their progress against their existing situation.

Not many municipalities know the capacity of their treatment facilities and a significant number of communities (specifically in the area of the West Coast District Municipality) are supplied from combined treatment facilities, which make individual analysis difficult.

The available data was however all ranked as shown in figure 8. The average treatment capacity for the area of research amounts to 537 ℓ/c/d.

Treatment capacity (wastewater)

Perhaps the most significant finding from the analysis of the capacities of wastewater treatment facilities in the research area is the huge lack in available wastewater data. Only about 50 % of all communities involved in this research were able to provide some figures from which further analysis could be done. Very few communities know the design capacity or the specific quality details, like BOD levels, and as such do not know whether the facilities still operate within their design limits or not.

The per capita wastewater treatment capacities are expressed in ℓ/c/d. The average amounts to 200 ℓ/c/d. This figure seems in general terms just adequate, considering an average consumption figure of 201 ℓ/c/d. Once again the site-specific detail was not evaluated any further, even though it is known that the wastewater treatment facility's capacity needs to be

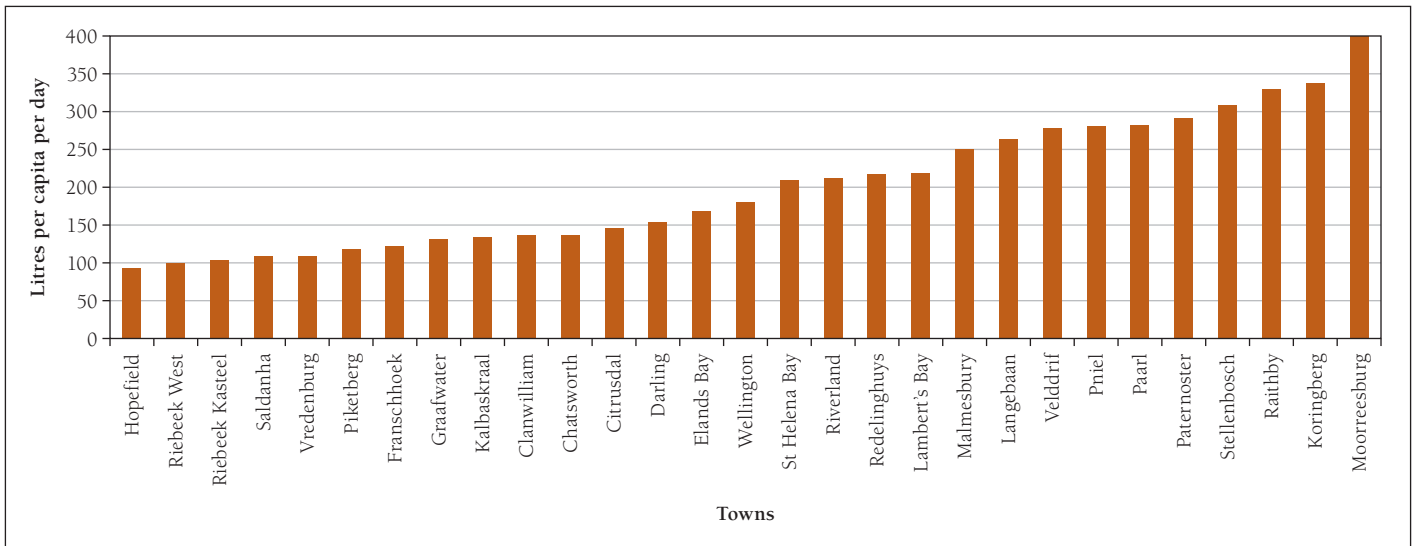


Figure 9 Wastewater treatment capacity

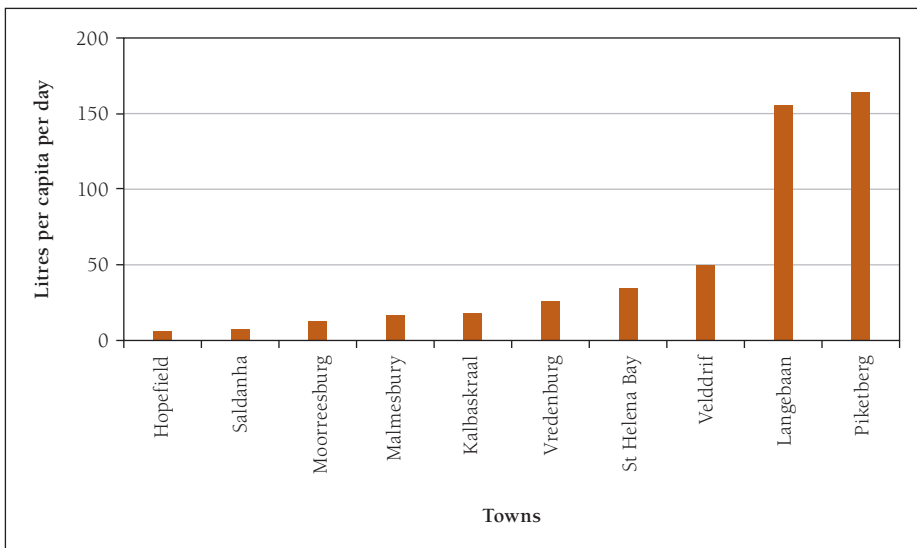


Figure 10 Re-use of effluent

determined based on the quality of the inflow and specific daily peak loads. The available data was however ranked as shown in figure 9.

Re-use

Treated effluent is only used in significant quantities at Langebaan (155 l/c/d) and Piketberg (164 l/c/d) in the study area. The effluent is almost exclusively used for golf course irrigation. Smaller quantities are however reported in some communities, as shown in figure 10.

Capacity to manage

Capacity to manage the municipalities from an engineering point of view seems to be constantly under pressure, with very few qualified engineers and technicians available in these structures. Although a list of technical staff was compiled, most of the positions were reported as vacant or in the process of being filled at the time of this study. As a result, no database was compiled and no further analysis was done. It is however worthwhile to report some of the general comments made by municipalities in

the questionnaires supplied to them. These included:

- A uniform classification system to evaluate and properly place trained operators at the treatment facilities generally is lacking.
- Personnel are trained mainly through programmes previously arranged through the consolidated municipal infrastructure projects, now known as MIG (Municipal Infrastructure Grants) programmes. Very little in-house training, specifically for the engineering staff, is arranged, mainly due to the lack of available programmes and staff shortages.
- More than half the municipalities did indicate that they do not compile their own WSDPs and will not do so in the future.
- Except for a very small number of municipalities, the response to queries was very slow. Answers to basic questions regarding capacity of infrastructure almost always needed to be obtained from work done by consultants.

Water demand management

To understand the level of awareness among municipalities regarding the effective use

of their water resources, some general comments were again retrieved from the completed questionnaires. These comments can be summarised as follows:

- Water demand management is done at a local government level on a rather ad hoc basis, with very little planning regarding the objectives and aims within a limited budget.
- Other than typical good practices, like block tariffs, 24-hour standby personnel, compiling of master plans and the installation of zone meters, very little is generally done to progressively promote water demand management. Most of the municipalities did try to increase public awareness, mostly due to very low dam levels or specific maintenance problems in their own systems.
- Only one municipality, that is Drakenstein Municipality, created a unit within their engineering department to address water demand management specifically.
- Water demand management strategies are still lacking in almost all municipalities and their bylaws still do not include any specific measures to ensure effective water demand management.

DISCUSSION

During the investigation it was clear that WSDPs are not generally used by the municipalities to assist them with proper planning. It is rather seen by most as a legal requirement that needs to be adhered to. Municipalities who did spend some time on the exercise quickly appreciated the value thereof and did make the WSDP part of their day-to-day planning. The values calculated in this study will be influenced by the accuracy of the data supplied in these WSDPs and therefore only serves as a departure point to ensure progress within a specific municipality.

The lack of the ability of municipalities to respond to questions regarding their water infrastructure is of concern. In most cases it

was truly a matter of not having the capacity to sit down and respond to the problem areas. However, if the data was available in the WSDPs, as it was supposed to be, it should not take very long to respond.

Very few municipalities could supply accurate data regarding the capacity of their bulk treatment infrastructure. Wastewater treatment seems to be even further behind, with almost no municipality in a position to supply information regarding sewage production and permit arrangements for the return flow to the river systems.

Good progress seems to be made regarding the measuring of the water that has been sold to the end user. A lot of energy and manpower did go into the smaller communities and most municipalities are addressing the backlog of the supply of services to these communities.

The average per capita consumption of 201 $\ell/c/d$ is generally lower than expected, and 50 % of all communities' recorded consumption is between 159 and 251 $\ell/c/d$. Figures of well above 400 $\ell/c/d$ were recorded in a number of communities, with no obvious reason for such a high consumption. These will have to be investigated further. World (IWA 2006) consumption figures are calculated to be between 120 and 600 $\ell/c/d$. Specific figures have been calculated for Córdoba in Spain (De Miguel *et al* 1999), varying between 142 $\ell/c/d$ and 200 $\ell/c/d$, and Poland, varying between 123 $\ell/c/d$ and 206 $\ell/c/d$ (Kloss-Trębaczkiewicz *et al* 2000), while Schutte *et al* (1997) reported a figure of 276 $\ell/c/d$ for South Africa in 1993. These figures are however household consumption figures which exclude bulk losses and industrial use. It is therefore clear that much has been achieved with water demand management programmes in these areas and that the opportunity to save even more water in the future will become even less as these communities near an effective usage level.

It was clear from the analysis of individual communities' non-revenue water, as reported in their WSDPs, that accurate data is still lacking. Although 50 % of the communities report a non-revenue value varying between 18 and 42 $\ell/c/d$, a number of communities within some specific municipal areas reported exactly the same percentage of non-revenue water, indicating that the figure reported in the WSDP was an estimate rather than an actual measured figure. The average value of 30 $\ell/c/d$ (about 15 % of

the supplied volume) is generally less than expected, with very high figures (above 100 $\ell/c/d$) reported for a number of individual communities. In Spain the loss percentage is approximately 25 % (Chowdhury *et al* 1997).

During the study, potable water storage capacity, potable water and the capacities of wastewater treatment works were all expressed as a value per capita. The use of these values as true benchmark value needs to be considered very carefully due to the design requirements of the specific infrastructure. It only serves as a relative value to evaluate the general level of the specific service. The data highlights possible problem areas in the supply of critical infrastructure in the different communities and the data can be used to further focus investigation and expenditure within the specific catchment or municipal area.

Despite the limited value of the storage benchmark values, it is still surprising to find that the 75 percentile (0,8 $k\ell/c$) and the average (0,7 $k\ell/c$) are so close. The indication is that 75 % of all the communities do have a per capita storage close to the average, and therefore all are approximately at the same level of development in terms of the provision of storage capacity. The communities in the lower 25 % (<0,3 $k\ell/c$) should be attended to as a matter of urgency.

Only about 30 % of all communities investigated could provide values for their potable water treatment facilities and the data were well spread over a wide range varying from 45 $\ell/c/d$ to 1 536 $\ell/c/d$, with the average 537 $\ell/c/d$. Very few conclusions can be derived from this data.

More data was available on the wastewater treatment works than on the potable water treatment works, and only about 50 % of all communities could provide data on the potable water treatment works. These values varied between 94 and 403 $\ell/c/d$, with the average 200 $\ell/c/d$.

Treated effluent is still not generally used as an alternative water source, with only 18 % of all communities investigated making use of this source. No further conclusions can be drawn from the evaluated data.

The study highlights a number of shortfalls in the availability of data through the WSDP, but it also provides an opportunity to municipalities to utilise the available data in the WSDPs to compile valuable benchmark values which can be used to promote more effective planning within municipalities.

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LIST OF ABBREVIATIONS AND ACRONYMS

BOD	biological oxygen demand
DWAF	Department of Water Affairs and Forestry
DMA	District Management Area
EIA	Environmental Impact Assessment
IDP	Integrated Development Plan
MIG	Municipal Infrastructure Grants
NEMA	National Environmental Management Act
NWA	National Water Act
WCDM	West Coast District Municipality
WSA	Water Services Act
WSDP	Water Service Development Plan
$\ell/c/d$	litres per capita per day
$k\ell/c$	kilolitres per capita