

A Water Balance for Municipalities ...

... Made Easy



USAID: RESILIENCE IN THE LIMPOPO BASIN PROGRAM (RESILIM) - OLIFANTS



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Results from the national water losses benchmarking reports have shown that there still remains considerable confusion and opinions on how to deal with certain aspects of the water balance calculation.

To ensure the evaluation of municipalities are equal and just, they need to report on their water balance calculations in the same way.

The Department of Water and Sanitation has subsequently developed **water balance guidelines** to discuss the technicalities and standardise the water balance calculation for the country and provide guidelines which can be used and understood by politicians, officials and the public.

This brochure provides an summary of the guidelines with specific focus on the IWA methodologies adopted, basic information required, audits trails, components of authorised consumption, connections, shortcomings of various key performance indicators, interpretation of results and common errors.

These guidelines provide practical guidance on where to source the information and how to calculate and or estimate figures.

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in conjunction with AWARD

2019



Basic information required

Certain basic information is required to prepare a water balance. Most of the information required should be provided by the engineering and finance departments of the water utility and it is important that these departments work together to develop a single water balance which accurately reflects the volumes of water distributed and not a department specific water balance which gives different answers. Information used in the water balance should be the same as presented in the Integrated Development Plan [IDP], Water Services Development Plan [WSDP], annual report, and other official documents.

The water balance calculation should be based on traceable and credible information which could be verified during an audit. This needs to include information on

- Supply area and schematic
- Population and households served
- Length of mains
- Average system pressure
- Intermittent supply and time pressurised
- Number of connections

Number of connections

A large number of municipalities highlight unauthorised connections as a major problem but continue to supply water to these properties and indicate their consumption as water loss.

To address this problem, a connection is defined as any point of water supply by the utility and can be formal, informal or unauthorised.

A **formal connection** has been installed by the water utility and is controlled with a service level agreement.

An **informal connection** has been installed by the user but is accepted by the water utility.

All users, supplied with potable water by the utility, should therefore be included in the water balance and should either have a metered or unmetered connection. All informal connections that are accepted, and therefore authorised, by the water utility should be considered unmetered connections, unless the utility intends to remove these connections. Connections that are not accepted by the utility should be considered unauthorised [illegal] and removed or formalised, which usually involves a legal process of informing the user, imposing a fine and possible prosecution. Figure 1 provides a connection decision flow chart.

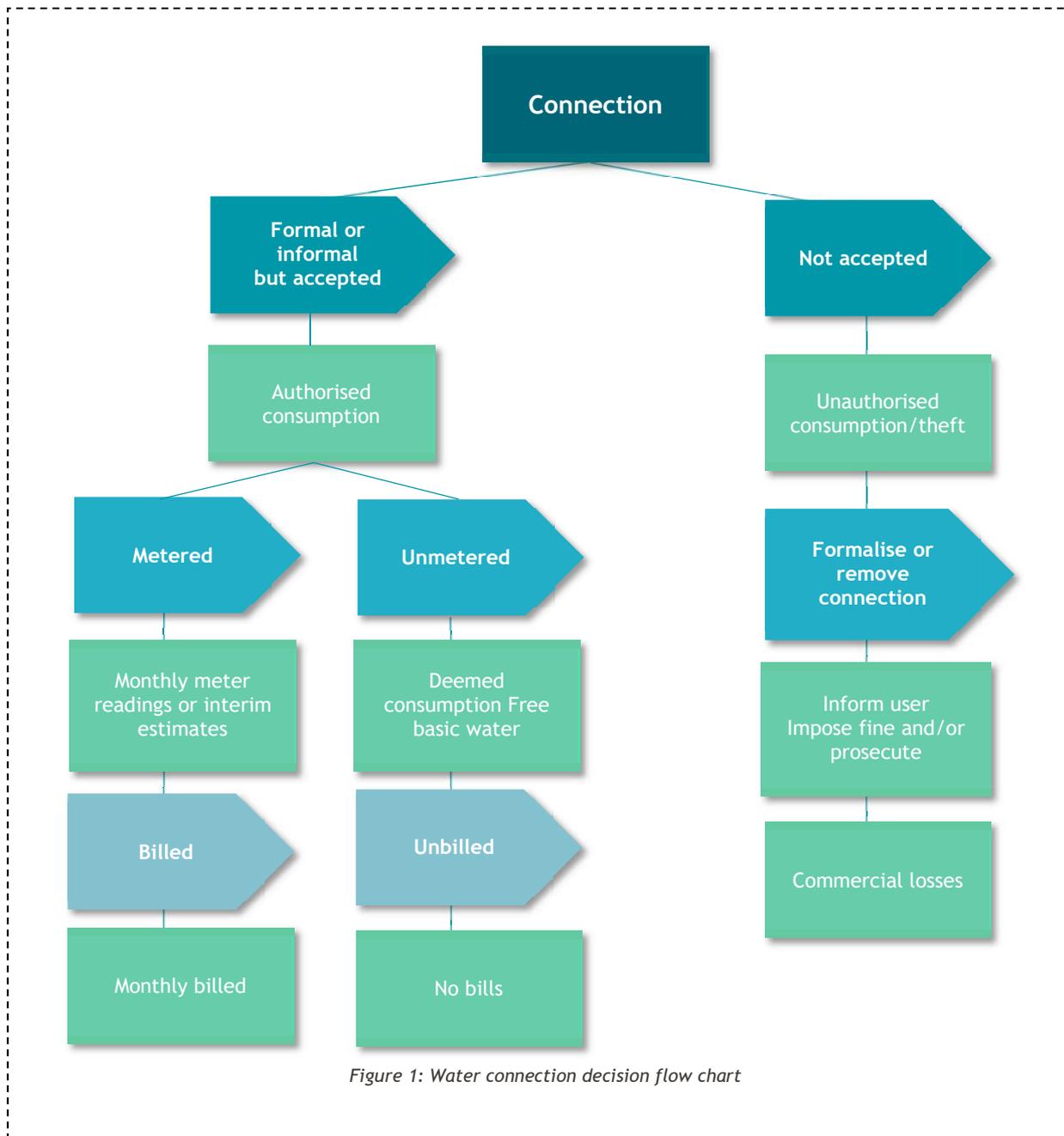


Figure 1: Water connection decision flow chart

The result from this approach means that any water used after the connection can only be authorised consumption [metered or unmetered and billed or unbilled] and any water loss before the connection can only be physical or commercial losses as shown in Figure 2 and Figure 3.

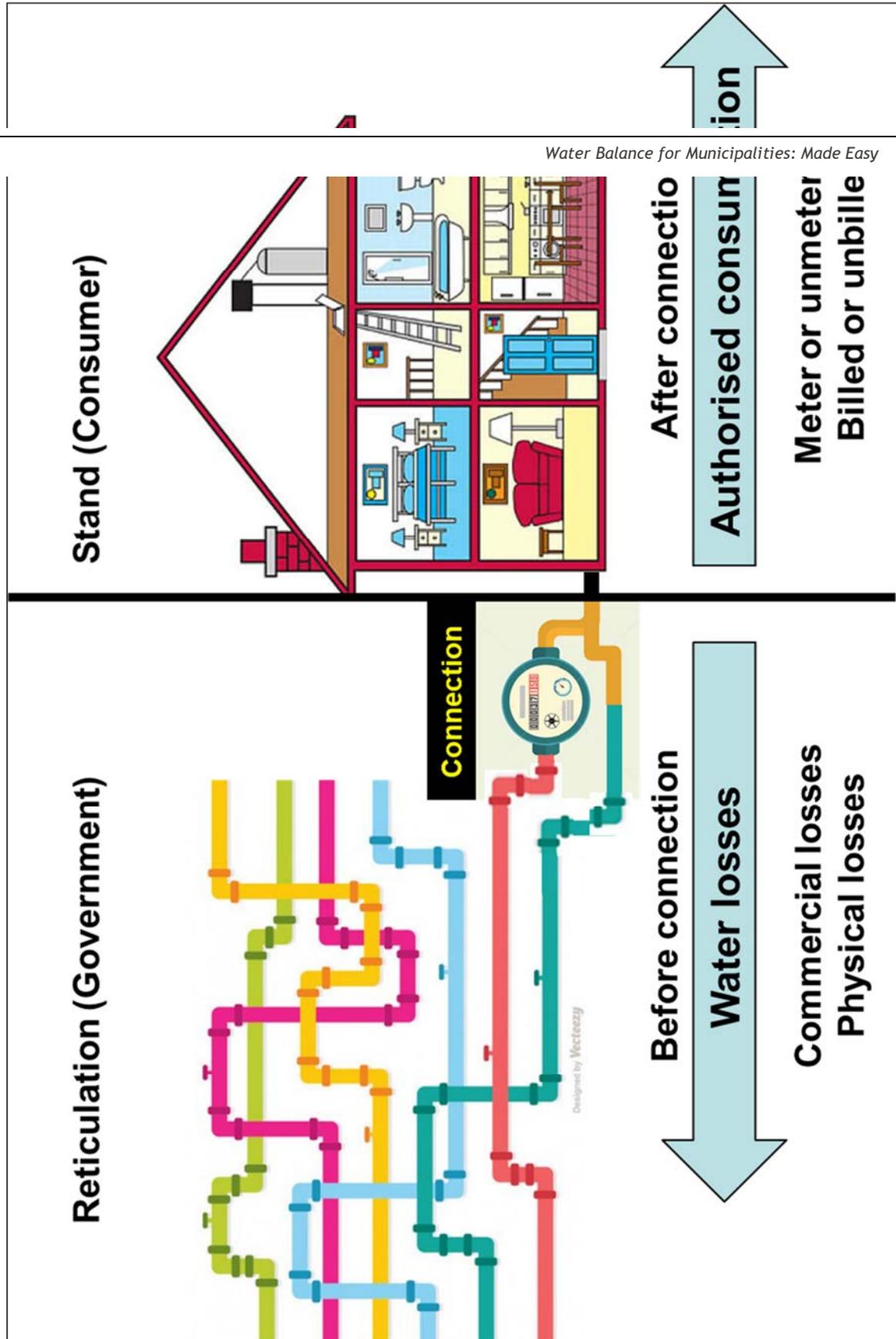


Figure 2: Split between water losses and authorised consumption

System Input Volume	Authorised Consumption	Billed Authorised Consumption	Billed Metered Consumption		Free basic
		Unbilled Authorised Consumption	Billed Unmetered Consumption		Revenue Water
			Unbilled Metered Consumption		Non Revenue Water
		Unbilled Unmetered Consumption			
	Apparent Losses	Unauthorised Consumption			
		Customer Meter Inaccuracies			
	Real Losses	Leakage on Transmission and Distribution Mains			
		Leakage and Overflows at Storage Tanks			
Leakage on Service Connections up to point of Customer Meter					

Figure 3: Authorised consumption versus water losses

Components of the water balance

The IWA developed the standard water balance to benchmark and evaluate the performance of water distribution systems and it is being promoted across the world as best practice. The IWA standard water balance was slightly modified for South Africa to allow for free basic water. The modified IWA water balance is shown in Figure 4.

System input volume (Water security and efficiency)	Authorised Consumption (All water use and wastage after connection on user side)	Billed authorised	Billed metered	Revenue water (Includes free basic water)
		Unbilled authorised	Billed unmetered	
			Commercial / Apparent losses	Unbilled metered
		Unbilled unmetered		
	Water Losses (All losses before the connection on municipal side) (Environmentally and financially unattractive)	Physical / Real losses	Unauthorised consumption	
			Meter inaccuracies	
		Leakage on distribution pipes	Transfer errors	
			Leakage & overflows on storage tanks	
Leakage on connection pipes up to point of connection				

Figure 4: Modified IWA water balance

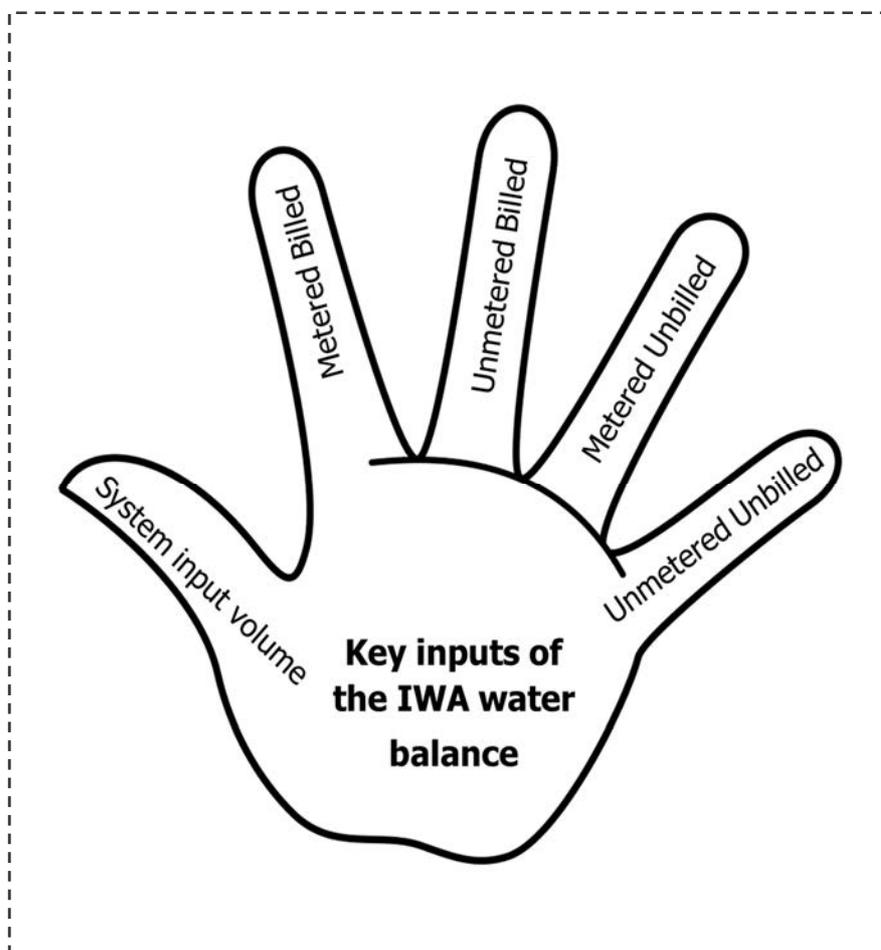
Each component of the water balance is significant as it highlights various important issues. The system input volume provides an indication of the water security, if compared to the licensed abstraction, and the water use efficiency in terms of litres per capita per day. The water losses are financially and environmentally unattractive and cannot be allowed while the NRW provides an indication of the financial sustainability of the WSI. Payment for water services promotes water use efficiency as it has been shown all over the world that people who pay for water tend to use it more sparingly.



Key considerations

The following key issues should be taken into consideration during the water balance calculation:

- The water balance is based on the potable water supplied to the system and does not make allowance for water treatment losses. Water treatment losses are typically between 5 and 10% of system input volume and must not be included in the IWA water balance.
- Free basic water is considered billed metered or unmetered consumption, billed at a zero rate, and forms part of the billed consumption and revenue water. Care must be taken not to duplicate free basic water where it has already been included in the billed consumption.



- Billed consumption is considered the consumption for which an invoice is issued by the utility to the user. Revenue water refers to the volume of water for which revenue should be received, and can be “Billed Metered” as well as “Billed Unmetered” water. The issue of payment of the bill is not addressed under the water balance as this is considered to be a cost recovery [legal] issue and not a technical water balance issue.
- NRW water is becoming the standard term replacing unaccounted-for water [UFW or UAW] in the water balance calculation and is the term recommended by the IWA, in preference to UFW. It is a term that can be clearly defined, unlike the unaccounted-for water term which often represents different components to the various water suppliers.
- Any losses on the reticulation network, before the metered or unmetered connection, should be considered commercial or physical losses, whereas any leakage and water use after the connection should be considered authorised consumption. The objective in this approach is to highlight unbilled or unmetered consumption and should not be confused with commercial or physical losses which occur on the reticulation network.
- The water balance calculation should be based on traceable and credible information which could be verified during an audit.

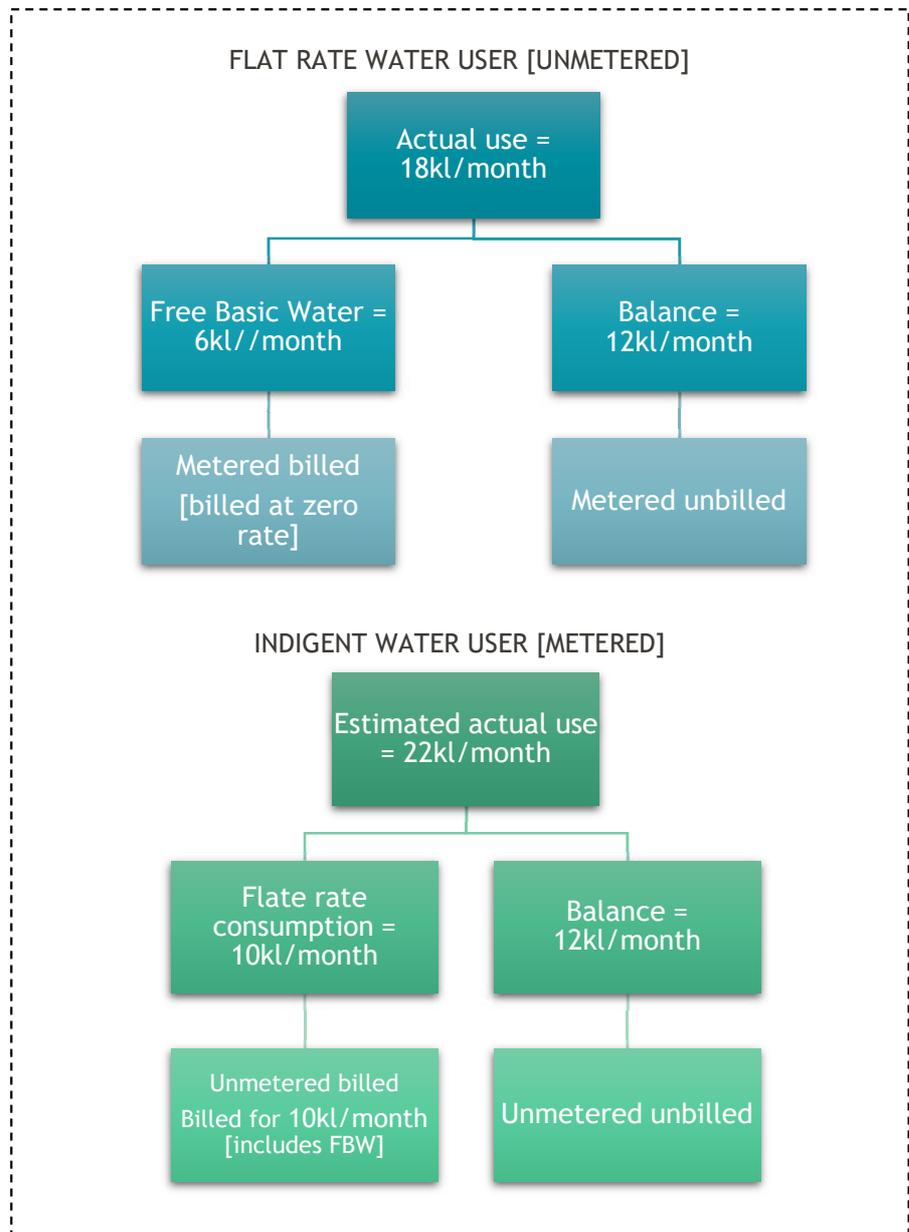
Authorised consumption

Authorised consumption is the volume of metered and unmetered water used by users, the water supplier and others who are implicitly or explicitly authorised to do so by the water services authority, for residential, commercial and industrial purposes. Authorised consumption can only be metered or unmetered and billed or unbilled. All consumption by any user within the municipal system must fall within one of these four categories otherwise, it should be considered unauthorised consumption which forms part of water losses. Any volume of water used by the user in excess of the predetermined deemed or free basic volume of water, should be considered unbilled unmetered consumption. This methodology is explained in the following examples.

For example, a user uses an estimated 22 kℓ/month and is billed based on a deemed consumption of 10 kℓ/month. The 10 kℓ/month is considered billed unmetered consumption while the balance of 12 kℓ/month is considered unbilled unmetered consumption.

Another example is a user receiving 6 kℓ/month free basic water but uses an estimated 18 kℓ/month. The 6 kℓ/month is considered billed [at zero rate] unmetered consumption while the balance of 12 kℓ/month is considered unbilled unmetered consumption.

It is unlikely that the water utility would distribute bills for free basic water at zero rate but the free basic water allocation should be included in the water balance. Ideally, areas billed on deemed consumption should be monitored through zone meters and the estimated actual consumption should be based on the total supply, after allowing for reticulation losses, as opposed to a purely theoretical estimate.





Typical examples

Metered house connection	Authorised connection	Yes	
	Metered	Yes	
	Billed	yes	
	Outcome	Metered billed consumption	
Unmetered house connection	Authorised connection	yes	
	Metered	No	
	Billed	Yes	
	Outcome	Volume \leq deemed or flat rate consumption = unmetered billed Volume $>$ deemed or flat rate consumption = unmetered unbilled	
Metered yard connection	Authorised connection	Yes	
	Metered	Yes	
	Billed	No	
	Outcome	Volume \leq free basic water consumption = metered billed [at zero rate] Volume $>$ free basic water = metered unbilled	
Metered tanker supply	Authorised connection	Yes	
	Metered	Yes	
	Billed	No	
	Outcome	Metered unbilled	
Unmetered livestock watering point	Authorised connection	Yes [The connection is informal but the utility has no intent of removing it]	
	Metered	No	
	Billed	No	
	Outcome	Unmetered unbilled	
Metered public standpipe	Authorised connection	Yes	
	Metered	Yes	
	Billed	No	
	Outcome	Volume \leq free basic water consumption = metered billed [at zero rate] Volume $>$ free basic water = metered unbilled	
Unmetered informal connections	Authorised connection	Yes [The connections are informal but the utility has no intent of removing it]	
	Metered	No	
	Billed	No	
	Outcome	Volume \leq Free basic water consumption = unmetered billed [at zero rate] Volume $>$ Free basic water consumption = unmetered unbilled	

Water balance assessment

ILI [Physical water loss] performance categories

	>8	Extremely high physical water loss
	6-8	Poor performance in physical water loss
	4-6	Average physical water loss performance
	2-4	Good physical water loss performance but some improvement may be possible subject to economic benefit
	<2	Excellent physical water loss management

Apparent / Commercial loss [%] performance categories

	>40%	Extremely high commercial water loss
	30-40%	Poor performance in commercial water loss
	20-30%	Average commercial water loss performance
	10-20%	Good commercial water loss performance but some improvement may be possible subject to economic benefit
	<10%	Excellent commercial water loss management

Non-Revenue Water [%] performance categories

	>40%	Extremely poor non-revenue water management
	30-40%	Poor non-revenue water performance
	20-30%	Average performance with potential for marked improvement
	10-20%	Good performance but some improvement may be possible subject to economic benefit
	<10%	Excellent non-revenue water management

Water Use Efficiency [l/cap/day] performance categories

	>300	Extremely high per capita water use
	250-300	Poor per capita water use
	200-250	Average per capita water use with potential for marked improvement
	150-200	Good per capita water use but some improvement may be possible subject to economic benefit
	<150	Excellent per capita water use management

Key Performance Indicators

Once the IWA water balance has been prepared, the results should be interpreted.

It is recommended that several Key Performance Indicators [KPI] are calculated as no single indicator can be used to assess the performance of the distribution network.

KPIs should also be used to verify and cross check results, for example, a system with a high NRW but low physical leakage might be possible or suggest a calculation or estimation error.

The following KPI are discussed in the guidelines:

- Percentage non-revenue water [NRW]
- Unit consumption or efficiency [litres per capita per day]
- Infrastructure Leakage Index [ILI]
- Real loss indicators
 - Litres/connection/day-metric units where the density of connections is greater than 20 connections per km mains]
 - m³/km mains/day - metric units where the connections drop below 20 per km of mains

Benchmarks

Interpreting the results from the water balance calculation and key performance indicators are critical to assess the performance of the water supply system. The results vary significantly across water utilities and usually depend on the level of service and development. The No Drop performance based regulatory programme has adopted the following KPI performance criteria which are in line with international best practice.

The results for most utilities fall within these performance criteria and should be used to assess the performance of the utility. If the results are not within range, the water balance calculations should be checked or there should be very good reasons for the anomaly.

Common Errors

The following common errors are discussed in the guidelines:

- Unit errors
- Storage volume included in water balance
- Monthly or annual water balance

KPI Limitations

The guidelines do not promote one or two specific KPIs but rather promote the use of multiple KPIs as there is no perfect key performance indicator and KPIs must be used with caution to avoid misleading results.

The limitations of the following KPIs are discussed:

- Litres per capita per day
- Non-revenue water
- Infrastructure leakage index



award

The Association for Water and Rural Development

AWARD is a non-profit organisation specialising in participatory, research-based project implementation. Their work addresses issues of sustainability, inequity and poverty by building natural-resource management competence and supporting sustainable livelihoods. One of their current projects, supported by USAID, focuses on the Olifants River and the way in which people living in South Africa and Mozambique depend on the Olifants and its contributing waterways. It aims to improve water security and resource management in support of the healthy ecosystems to sustain livelihoods and resilient economic development in the catchment.

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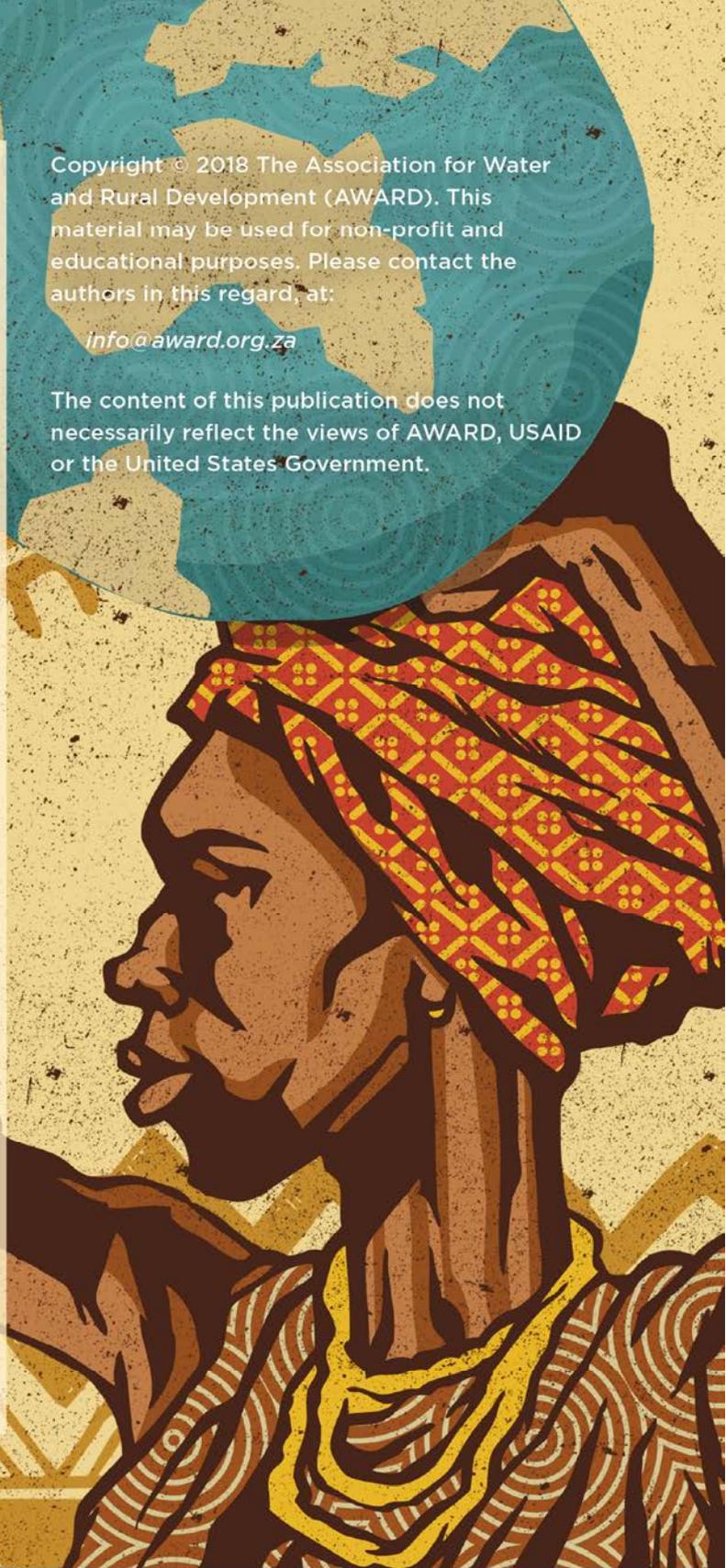
About USAID: RESILIM-O

USAID: RESILIM-O focuses on the Olifants River Basin and the way in which people living in South Africa and Mozambique depend on the Olifants and its contributing waterways. It aims to improve water security and resource management in support of the healthy ecosystems that support livelihoods and resilient economic development in the catchment. The 5-year programme, involving the South African and Mozambican portions of the Olifants catchment, is being implemented by the Association for Water and Rural Development (AWARD) and is funded by USAID Southern Africa.

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The content of this publication does not necessarily reflect the views of AWARD, USAID or the United States Government.



Acknowledgements: Project funding and support

The USAID: RESILIM-O project is funded by the U.S. Agency for International Development under USAID/Southern Africa RESILIENCE IN THE LIMPOPO BASIN PROGRAM (RESILIM). The RESILIM-O project is implemented by the Association for Water and Rural Development (AWARD), in collaboration with partners.
Cooperative Agreement nr AID-674-A-13-00008



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