

SUMMARY SHEET FOR LEAKAGE BENCHMARKING IN SOUTH AFRICA

P07017

S1. SYSTEM NAME AND CONTACT DETAILS

Name of Water Undertaking	Swartland Municipality (Malmesbury)	
Name of Water Supply System	Voëlmei Scheme West Coast District Municipality, Paardenberg Dam, Boreholes	
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S2. Performance Indicators of Water Loss

Viewpoint	Level	Parameter	Typical Range			Actual PI	Units
			Excellent	Good	Poor		
Operations management of distribution system at current pressure	Basic	% of year system is pressurised	100	100	<100	100	%
		Current Annual Real Losses (CARL) <small>(when system is pressurised - see note 2)</small>	30 to 100	100 to 200	>200	70	Litres/connection/day
	Detailed	Unavoidable Annual Real Losses (UARL) <small>(see note 3)</small>	n/a	n/a	n/a	49	Litres/connection/day
		Consumption	n/a	n/a	n/a	531	Litres/connection/day
		Infrastructure Leakage Index (ILI) <small>(= CARL/UARL : see note 4)</small>	1	2	>3.0	1.4	non dimensional
Financial management aspects of water losses	Basic	Volume of non-revenue water as a% of system input volume <small>(see note 5)</small>	<10%	20%	30%	15	%
	Detailed	Value of non-revenue water as a % of annual cost of running the system <small>(see note 6)</small>	<5%	10%	15%	9	%

Notes:

- Note 1: taken from data in "AQUA" article, December 1999 or estimated by WRP
- Note 2: takes account of % of time system is pressurised, but not system pressure, density of connections or customer meter location
- Note 3: takes account of density of connections and customer meter location at current pressure
- Note 4: measures overall efficiency of management of distribution system at current operating pressure
- Note 5: strongly influenced by average consumption per service connection
- Note 6: Allows different values of Rand/m3 for different components of non-revenue water

S3. Key Operating Parameters which influence Unavoidable Annual Real Losses (UARL)

Variable	Typical Range			Actual PI	Units
	Low	Medium	High		
Average Operating Pressure	30	45	100	40	Metres
Density of connections	20	45	120	42	per km of mains

4. Key Components of Annual System Input Volume

Component	m3/year	m3/connection/day	% of System Input Volume
Water Exported		not applicable	
Authorised Consumption excluding exports	2173370	0.53	86.2
Apparent Losses	59055	0.01	2.3
Actual Consumption excluding exports	2232424	0.55	88.6
Real Losses	288326	0.07	11.4
System Input Volume	2520750	0.62	100.0

DATA ENTRY SHEET FOR LEAKAGE BENCHMARKING IN SOUTH AFRICA

Note: Note: An example has been included to assist you in completing this data sheet. The example input data can be seen in the pale blue shaded areas. Your input data should appear in the pale yellow shaded areas. The light green shaded areas are protected calculation fields and nothing can be entered in these fields. Use the units as shown. If you have to use other units; you have to change the appropriate cells.

D1. GENERAL

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D2. SYSTEM DATA

Input Description	Variable	Example Data	Actual Data	Units	
Length of Mains (Transmission + Distribution)	Lm	1500	264	km	
Number of Service Connections	Ns	60000	11214	Number	See Notes 1 & 2
Density of Service Connections (per km of mains)	Ns/Lm	40	42	Per km	
Percentage of time system is pressurised during year	T	100	100	%	See Note 3
Average operating pressure when system pressurised	P	45	40	metres	See Note 4
Population served by the supply system	Pop	100000	65835	Number	

Note 1: The number of service connections is not always the same as the number of meters or billed accounts. For South African conditions, however, you can use the total of the number of metered accounts plus the estimated number of unmetered connections

Note 2: In South Africa customer meters are usually located close to the street/stand boundary. If this is not the case for your system, then add a note here.

Average number of consumer units for 2019/2020, as taken from the Financial System = 11214

Note 3: Use T in % eg. If T = 80%, use 80 and not 0.8

Note 4: If you do not have an accurate figure, please make a best estimate and provide brief details of how you derived it.

Water Master Plan

D3. UNAVOIDABLE ANNUAL REAL LOSSES (UARL)

Details	Calculation	Example Result	Actual Data	Units
On mains	$18 \times \text{Lm} \times \text{P} \times 365 \times \text{T}/10^3$	443	70	$10^3 \text{ m}^3/\text{yr}$
On Service Connections	$0.8 \times \text{Ns} \times \text{P} \times 365 \times \text{T}/10^8$	788	131	$10^3 \text{ m}^3/\text{yr}$
Total Volume of UARL		1232	200	$10^3 \text{ m}^3/\text{yr}$
UARL in litres/service conn./day when the system is pressurised	Annual Volume of UARL $\times 10^6 / (\text{Ns} \times 365 \times \text{T}/100)$	56	49	Litres/conn./day

D4. ANNUAL WATER BALANCE DATA

D4a. Data Period

12-MONTH PERIOD FOR WHICH DATA APPLIES	Example Data		Actual Data	
	Start Date	April 1, 1998	July 1, 2019	
	End Date	March 31, 1999	June 30, 2020	

D4b. System Input Volume

Water Supplied	Example Data				Actual Data					
	Metered 10 ³ m ³ /yr	Correction to Source Meter data		Unmetered 10 ³ m ³ /yr	Total 10 ³ m ³ /yr	Metered 10 ³ m ³ /yr	Correction to Source Meter data		Unmetered 10 ³ m ³ /yr	Total 10 ³ m ³ /yr
		+/- %	10 ³ m ³ /yr				+/- %	10 ³ m ³ /yr		
From Own Sources:	36000	2.00%	720		36720	25				25
From Other Suppliers:	1000			280	1280	2496				2496
Total:	37000		720	280	38000	2521				2521

D4c. Components of Authorised Consumption

Components of Authorised Consumption	Example Data					Actual Data				
	Billed Metered 10 ³ m ³ /yr	Billed Unmetered 10 ³ m ³ /yr	Unbilled Metered 10 ³ m ³ /yr	Unbilled Unmetered 10 ³ m ³ /yr	Total 10 ³ m ³ /yr	Billed Metered 10 ³ m ³ /yr	Billed Unmetered 10 ³ m ³ /yr	Unbilled Metered 10 ³ m ³ /yr	Unbilled Unmetered 10 ³ m ³ /yr	Total 10 ³ m ³ /yr
Water Exported:	1500				1500					
Households:	24500	500			25000	1388			27	1415
Non-households:	6900	100			7000	356				356
Standpipes:		500	10		510					
Firefighting:				100	100				2	2
Mains Flushing:				100	100				2	2
Building water:	1040				1040					
Other (specify): Other						285				285
Other (specify): Farms						112				112
TOTALS:	33940	1100	10	200	35250	2141			32	2173

D4d. Components of Water Losses

Details	Example Result	Actual Result	Units
Water Losses = System Input – Authorised Consumption	2750	347	10 ³ m ³ /yr
Percentage of Total Losses estimated to represent the Apparent Losses	20	17	%
Apparent Losses	550	59	10 ³ m ³ /yr
Annual Real Losses (ARL) = Water Losses – Apparent Losses	2200	288	10³ m³/yr

D5. SELECTED OPERATIONAL PERFORMANCE INDICATORS

D5a. Current Annual Real Losses per Connection (CARL) at Current Pressures

Details	Calculation	Example Result	Actual Result	Units
CARL is expressed in Litres/service connection/day, when system is pressurised	$ARL \times 10^6 / (Ns \times T/100 \times 365)$	100	70	Litres /conn./day
Consumption in litres/conn/day		1610	531	Litres /conn./day

D5b. Infrastructure Leakage Index (ILI)

Details	Calculation	Example Result	Actual Result
ILI is the ratio of Current Annual Real Losses (CARL) to Unavoidable Annual Real Losses	$CARL / UARL$	1.79	1.44

D5c. Non-Revenue Water as a % by Volume of System Input

Description of Unbilled Items	Example Result			Actual Result		
	Volume $10^3 \text{ m}^3/\text{yr}$	System Input $10^3 \text{ m}^3/\text{yr}$	% of System Input	Volume $10^3 \text{ m}^3/\text{yr}$	System Input $10^3 \text{ m}^3/\text{yr}$	% of System Input
Unbilled Consumption	210	38000	0.55	32	2521	1.27
Apparent Losses:	550	38000	1.45	59	2521	2.34
Real Losses:	2200	38000	5.79	288	2521	11.44
Total Unbilled:	2960	38000	7.79	379	2521	15.05

D6. SELECTED FINANCIAL PERFORMANCE INDICATORS

D6a. Local Valuation of Real and Apparent Losses

Details	Example Result	Actual Result	Units
Unit Value of Real Losses (eg bulk purchase price)	0.15	6.12	R /m ³
Unit Value of Apparent Losses (eg selling price)	2.70	15.77	R /m ³

D6b. Annual Cost of Running System

Details	Example Cost	Actual Cost	Units
Annual Cost of running system in 1000's of Rand per year	45000	35792	10^3 R/year

D6c. Non-Revenue Water as % by Value of Cost of Running System

Description of Unbilled Items	Example Result				Actual Result			
	Volume $10^3 \text{ m}^3/\text{yr}$	Unit Value R /m ³	Value 10^3 R/year	% of Annual Running Costs Costs	Volume $10^3 \text{ m}^3/\text{yr}$	Unit Value (R /m ³)	Value 10^3 R/year	% of Annual Running Costs Costs
Unbilled Consumption	210	2.70	567	1.26	32	15.77	503	1.41
Apparent Losses:	550	2.70	1485	3.30	59	15.77	931	2.60
Real Losses:	2200	0.15	330	0.73	288	6.12	1765	4.93
Total Unbilled:	2960		2382	5.29	379		3199	8.94

D7. RELATIONSHIP BETWEEN REAL LOSSES EXPRESSED AS % OF SYSTEM INPUT

D7a. Real losses curve definition

Curve Definition					
Consumption litres/serv conn/day	Real losses in litres/service connection/day				
	50	100	200	500	1000
100	33.3	50.0	66.7	83.3	90.9
250	16.7	28.6	44.4	66.7	80.0
500	9.1	16.7	28.6	50.0	66.7
1000	4.8	9.1	16.7	33.3	50.0
2000	2.4	4.8	9.1	20.0	33.3
3000	1.6	3.2	6.3	14.3	25.0
5000	1.0	2.0	3.8	9.1	16.7
10000	0.5	1.0	2.0	4.8	9.1

D7b. Components of water balance in litres/service connection/day (Actual Results)

System Input Volume = 616	Total Consumption = 545	Billed Authorised Consumption = 523	Authorised Consumption = 531	Revenue Water = 523
		Unbilled Authorised Consumption = 8		Non-Revenue Water = 93
		Apparent Losses = 14		
	Real Losses = 70	Total Losses = 85		

D7c. Current Real Losses as % of System Input Volume

Details	Calculation	Actual Result	Units
System Input Volume	from D7b	616	Litres/conn/day
Total Consumption	from D7b	545	Litres/conn/day
Annual Real Losses	from D7b	70	Litres/conn/day
ARL as % of System Input	ARL / System input volume x 100	11	%

D7d. Potential Real Losses as % of System Input Volume

Details	Calculation	Actual Result	Units
Unavoidable Annual Real Losses (UARL)	from D3	49	Litres/conn/day
Target Loss Factor (TLF)	User defined for each system	2	Dimensionless
Target Annual Real Losses (TARL)	TLF x UARL	98	Litres/conn/day
Current Annual Real Losses (CARL)	CARL from D5a	70	Litres/conn/day
Potential savings	CARL - TARL	-28	Litres/conn/day
Potential ARL as % of System Input	TARL / (System input volume - Potential savings) x 100	15	%

D7e. Real Losses as a % of System Input Volume versus Consumption in litres/service connection for different values of Real Losses in litres/service connection/day

