

# SUMMARY SHEET FOR LEAKAGE BENCHMARKING IN SOUTH AFRICA

C00700/A0003

## S1. SYSTEM NAME AND CONTACT DETAILS

|                             |   |                  |  |
|-----------------------------|---|------------------|--|
| Name of Water Undertaking   | Swartland Municipality (Riebeeck Kasteel)         |                  |  |
| Name of Water Supply System | Voëlvllei Scheme West Coast District Municipality |                  |  |
| Contact Details:            | Name  | Mr L Zikman      |  |
|                             | Address   | Private Bag X52  |  |
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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)<br>(when system is pressurised - see note 2)      | 30 to 100     | 100 to 200 | >200 | 84        | Litres/connection/day |
|  | Detailed | Unavoidable Annual Real Losses (UARL)<br>(see note 3)                               | n/a           | n/a        | n/a  | 58        | Litres/connection/day |
|  |          | Consumption   | n/a           | n/a        | n/a  | 494       | Litres/connection/day |
|  |          | Infrastructure Leakage Index (ILI)<br>(= CARL/UARL : see note 4)                    | 1             | 2          | >3.0 | 1.5       | non dimensional       |
| Financial management aspects of water losses                     | Basic    | Volume of non-revenue water as a% of system input volume (see note 5)               | <10%          | 20%        | 30%  | 17        | %                     |
|  | Detailed | Value of non-revenue water as a % of annual cost of running the system (see note 6) | <5%           | 10%        | 15%  | 10        | %                     |

### 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  | 50        | Metres          |
| Density of connections     | 20            | 45     | 120  | 51        | 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 | 207983  | 0.49              | 83.0                     |
| Apparent Losses                          | 7251    | 0.02              | 2.9                      |
| Actual Consumption excluding exports     | 215234  | 0.51              | 85.9                     |
| Real Losses                              | 35402   | 0.08              | 14.1                     |
| System Input Volume                      | 250636  | 0.60              | 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

|                                    |   |                  |
|------------------------------------|---|------------------|
| <b>Name of Water Undertaking</b>   | Swartland Municipality (Riebeeck Kasteel)         |                  |
| <b>Name of Water Supply System</b> | Voëlvrlei Scheme West Coast District Municipality |                  |
| <b>Contact Details:</b>            | <b>Name</b>                                       | Mr L Zikman      |
|                                    | <b>Address</b>                                    | Private Bag X52  |
|                                    |   | Malmesbury       |
|                                    |   | 7299             |
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### D2. SYSTEM DATA

| Input Description                                    | Variable | Example Data | Actual Data | Units  |                 |
|--|----------|--------------|-------------|--------|-----------------|
| Length of Mains (Transmission + Distribution)        | Lm       | 1500         | 22          | km     |                 |
| Number of Service Connections                        | Ns       | 60000        | 1153        | Number | See Notes 1 & 2 |
| Density of Service Connections (per km of mains)     | Ns/Lm    | 40           | 51          | Per km |                 |
| Percentage of time system is pressurised during year | T        | 100          | 100         | %      | See Note 3      |
| Average operating pressure when system pressurised   | P        | 45           | 50          | metres | See Note 4      |
| Population served by the supply system               | Pop      | 100000       | 6678        | 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 2016/2017, as taken from the Financial System = 1153

**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  | $18 \times \text{Lm} \times \text{P} \times 365 \times \text{T}/10^8$            | 443            | 7           | $10^3 \text{ m}^3/\text{yr}$ |
| On Service Connections  | $0.8 \times \text{Ns} \times \text{P} \times 365 \times \text{T}/10^8$           | 788            | 17          | $10^3 \text{ m}^3/\text{yr}$ |
| Total Volume of UARL  |  | 1232           | 24          | $10^3 \text{ m}^3/\text{yr}$ |
| 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             | 58          | 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, 2016  |  |
|  | End Date     | March 31, 1999 | June 30, 2017 |  |

### D4b. System Input Volume

| Water Supplied        | Example Data                               |                                 |                                    |  | Actual Data                              |  |                                 |                                    |  |  |
|-----------------------|--|---------------------------------|------------------------------------|--|--|--|---------------------------------|------------------------------------|--|--|
|                       | Metered 10 <sup>3</sup> m <sup>3</sup> /yr | Correction to Source Meter data |                                    | Unmetered 10 <sup>3</sup> m <sup>3</sup> /yr | Total 10 <sup>3</sup> m <sup>3</sup> /yr | Metered 10 <sup>3</sup> m <sup>3</sup> /yr | Correction to Source Meter data |                                    | Unmetered 10 <sup>3</sup> m <sup>3</sup> /yr | Total 10 <sup>3</sup> m <sup>3</sup> /yr |
|                       |  | +/- %                           | 10 <sup>3</sup> m <sup>3</sup> /yr |  |  |  | +/- %                           | 10 <sup>3</sup> m <sup>3</sup> /yr |  |  |
| From Own Sources:     | 36000                                      | 2.00%                           | 720                                |  | 36720                                    |  |                                 |                                    |  |  |
| From Other Suppliers: | 1000                                       |                                 |                                    | 280  | 1280                                     | 251  |                                 |                                    |  | 251                                      |
| <b>Total:</b>         | <b>37000</b>                               |                                 | <b>720</b>                         | <b>280</b>                                   | <b>38000</b>                             | <b>251</b>                                 |                                 |                                    |  | <b>251</b>                               |

### D4c. Components of Authorised Consumption

| Components of Authorised Consumption | Example Data                                      |   |   |   |  | Actual Data                                       |   |   |   |  |
|--------------------------------------|---|---|---|---|--|---|---|---|---|--|
|                                      | Billed Metered 10 <sup>3</sup> m <sup>3</sup> /yr | Billed Unmetered 10 <sup>3</sup> m <sup>3</sup> /yr | Unbilled Metered 10 <sup>3</sup> m <sup>3</sup> /yr | Unbilled Unmetered 10 <sup>3</sup> m <sup>3</sup> /yr | Total 10 <sup>3</sup> m <sup>3</sup> /yr | Billed Metered 10 <sup>3</sup> m <sup>3</sup> /yr | Billed Unmetered 10 <sup>3</sup> m <sup>3</sup> /yr | Unbilled Metered 10 <sup>3</sup> m <sup>3</sup> /yr | Unbilled Unmetered 10 <sup>3</sup> m <sup>3</sup> /yr | Total 10 <sup>3</sup> m <sup>3</sup> /yr |
| Water Exported:                      | 1500  |   |   |   | 1500                                     |   |   |   |   |  |
| Households:                          | 24500   | 500   |   |   | 25000                                    | 166   |   |   |   | 166                                      |
| Non-households:                      | 6900  | 100   |   |   | 7000                                     | 22  |   |   |   | 22                                       |
| Standpipes:                          |   | 500   | 10  |   | 510                                      |   |   |   | 0   | 0  |
| Firefighting:                        |   |   |   | 100   | 100                                      |   |   |   | 0   | 0  |
| Mains Flushing:                      |   |   |   | 100   | 100                                      |   |   |   |   |  |
| Building water:                      | 1040  |   |   |   | 1040                                     |   |   |   |   |  |
| Other (specify):<br>Other            |   |   |   |   |  | 8   |   |   |   | 8  |
| Other (specify):<br>Farms            |   |   |   |   |  | 11  |   |   |   | 11                                       |
| <b>TOTALS:</b>                       | <b>33940</b>                                      | <b>1100</b>   | <b>10</b>   | <b>200</b>  | <b>35250</b>                             | <b>207</b>  |   |   | <b>1</b>  | <b>208</b>                               |

### D4d. Components of Water Losses

| Details   | Example Result | Actual Result | Units                                  |
|---|----------------|---------------|--|
| Water Losses = System Input – Authorised Consumption                  | 2750           | 43            | 10 <sup>3</sup> m <sup>3</sup> /yr     |
| Percentage of Total Losses estimated to represent the Apparent Losses | 20             | 17            | %                                      |
| Apparent Losses   | 550            | 7             | 10 <sup>3</sup> m <sup>3</sup> /yr     |
| <b>Annual Real Losses (ARL) = Water Losses – Apparent Losses</b>      | <b>2200</b>    | <b>35</b>     | <b>10<sup>3</sup> m<sup>3</sup>/yr</b> |

## 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            | 84            | Litres /conn./day |
| Consumption in litres/conn./day  |  | 1610           | 494           | 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           | 1.46          |

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

| Description of Unbilled Items | Example Result                         |  |                   | Actual Result                          |  |                   |
|-------------------------------|--|--|-------------------|--|--|-------------------|
|                               | Volume<br>$10^3 \text{ m}^3/\text{yr}$ | System Input<br>$10^3 \text{ m}^3/\text{yr}$ | % of System Input | Volume<br>$10^3 \text{ m}^3/\text{yr}$ | System Input<br>$10^3 \text{ m}^3/\text{yr}$ | % of System Input |
| Unbilled Consumption          | 210                                    | 38000  | 0.55              | 1                                      | 251  | 0.20              |
| Apparent Losses:              | 550                                    | 38000  | 1.45              | 7                                      | 251  | 2.89              |
| Real Losses:                  | 2200                                   | 38000  | 5.79              | 35                                     | 251  | 14.12             |
| <b>Total Unbilled:</b>        | <b>2960</b>                            | <b>38000</b>                                 | <b>7.79</b>       | <b>43</b>                              | <b>251</b>                                   | <b>17.22</b>      |

## 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           | 3.80          | R /m <sup>3</sup> |
| Unit Value of Apparent Losses (eg selling price)   | 2.70           | 11.23         | R /m <sup>3</sup> |

### 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        | 2298        | $10^3 \text{ R/year}$ |

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

| Description of Unbilled Items | Example Result                         |                                 |                                |                                    | Actual Result                          |                                     |                                |                                    |
|-------------------------------|--|---------------------------------|--------------------------------|------------------------------------|--|-------------------------------------|--------------------------------|------------------------------------|
|                               | Volume<br>$10^3 \text{ m}^3/\text{yr}$ | Unit Value<br>R /m <sup>3</sup> | Value<br>$10^3 \text{ R/year}$ | % of Annual Running Costs<br>Costs | Volume<br>$10^3 \text{ m}^3/\text{yr}$ | Unit Value<br>( R /m <sup>3</sup> ) | Value<br>$10^3 \text{ R/year}$ | % of Annual Running Costs<br>Costs |
| Unbilled Consumption          | 210                                    | 2.70                            | 567                            | 1.26                               | 1                                      | 11.23                               | 6                              | 0.24                               |
| Apparent Losses:              | 550                                    | 2.70                            | 1485                           | 3.30                               | 7                                      | 11.23                               | 81                             | 3.54                               |
| Real Losses:                  | 2200                                   | 0.15                            | 330                            | 0.73                               | 35                                     | 3.80                                | 135                            | 5.85                               |
| <b>Total Unbilled:</b>        | <b>2960</b>                            |                                 | <b>2382</b>                    | <b>5.29</b>                        | <b>43</b>                              |                                     | <b>222</b>                     | <b>9.64</b>                        |

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

### D7a. Real losses curve definition

| Curve Definition                    |  |      |      |      |      |
|-------------------------------------|--|------|------|------|------|
| Consumption<br>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<br>= 596 | Total Consumption<br>= 511 | Billed Authorised Consumption<br>= 493 | Authorised Consumption<br>= 494 | Revenue Water<br>493       |
|                              |                            | Unbilled Authorised Consumption<br>= 1 |                                 | Non-Revenue Water<br>= 103 |
|                              | Apparent Losses<br>= 17    | Total Losses<br>= 101                  |                                 |                            |
|                              | Real Losses<br>= 84        |  |                                 |                            |

### D7c. Current Real Losses as % of System Input Volume

| Details                  | Calculation                     | Actual Result | Units           |
|--------------------------|---------------------------------|---------------|-----------------|
| System Input Volume      | from D7b                        | 596           | Litres/conn/day |
| Total Consumption        | from D7b                        | 511           | Litres/conn/day |
| Annual Real Losses       | from D7b                        | 84            | Litres/conn/day |
| ARL as % of System Input | ARL / System input volume x 100 | 14            | %               |

### D7d. Potential Real Losses as % of System Input Volume

| Details                               | Calculation  | Actual Result | Units           |
|---------------------------------------|--|---------------|-----------------|
| Unavoidable Annual Real Losses (UARL) | from D3  | 58            | Litres/conn/day |
| Target Loss Factor (TLF)              | User defined for each system                           | 2             | Dimensionless   |
| Target Annual Real Losses (TARL)      | TLF x UARL   | 115           | Litres/conn/day |
| Current Annual Real Losses (CARL)     | CARL from D5a  | 84            | Litres/conn/day |
| Potential savings                     | CARL - TARL  | -31           | Litres/conn/day |
| Potential ARL as % of System Input    | TARL / (System input volume - Potential savings) x 100 | 18            | %               |

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

