water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

SALGA
Inspiring service delivery

Japan International Cooperation Agency
JICA

STRATEGY AND IMPLEMENTATION PLANS ON NRW MANAGMENT

The National
Non-Revenue Water (NRW) Training
for Municipalities by Municipalities
in South Africa

A 09 - 174

1. How to make a strategy

The 8 steps for problem solving

- Start from the Purpose
- See what's actually happening
- Understand the root cause (=problem)
- Confirm which tools or resources you have
- Select the way to solve the problem (to improve 80%)
- Just do it
- Asses the output
- Start for the next try

The 8 steps for problem solving

EX-1:Your family case

- Start from the Purpose — **Family trip to CT! (Need R2400 !!)**
- See what's actually happening — Crucial! **Check Pocket** / **Check bank account** / **Check bills not yet paid** / **Check shopping list**
- Understand the root cause (=problem)
- Confirm which tools or resources you have — **Just the monthly salary...**
- Select the way to solve the problem (to improve 80%) — **Make a decision:**
- J...
- A... — **The output: "How much money saved?"**
- S...

The 8 steps for problem solving

EX-1:Your family case

1. Start from the Purpose
2. See **what's actually happening**
3. Understand the **root cause** (=problem)

Main expenditure:

School Textbook	Book store
My Beer	Heineken

The 8 steps for problem solving

EX-1:Your family case

1. Start from the Purpose
2. See **what's actually happening**
3. Understand the **root cause** (=problem)

Option:

School Textbook	Book store →	Library	Save 400R/Month
My Beer	Heineken →	Hansa	Save 400R/Month

The 8 steps for problem solving

EX-1:Your family case

1. Start from the Purpose
2. See **what's actually happening**
3. Understand the **root cause** (=problem)

Option:

School Textbook	Book store →	Library	Save 400R/Month
My Beer	Heineken →	Hansa	Save 400R/Month

Select intervention! = "Strategy"

What is "Strategy" ?

- "Roughly 80% of the effects come from 20% of the causes"

  --- **Pareto principle** (also known as the **80/20 rule)**

To Find and fix 20% of a easy part

--- which causes 80% of your NRW

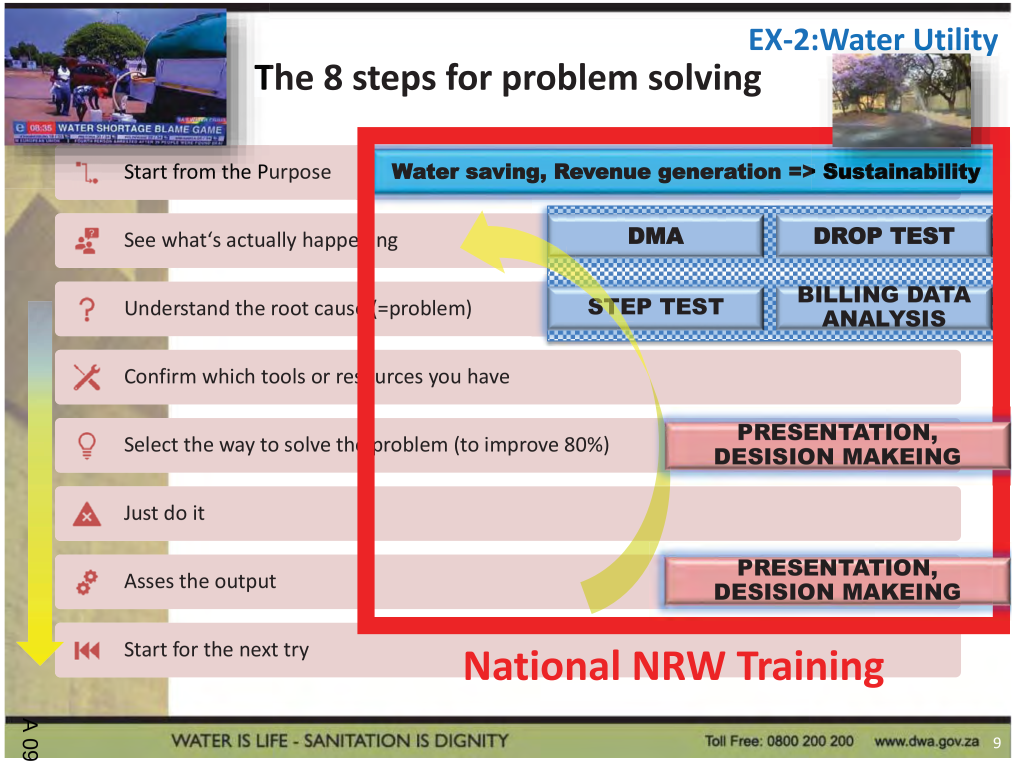
(that is a one of the "root cause")

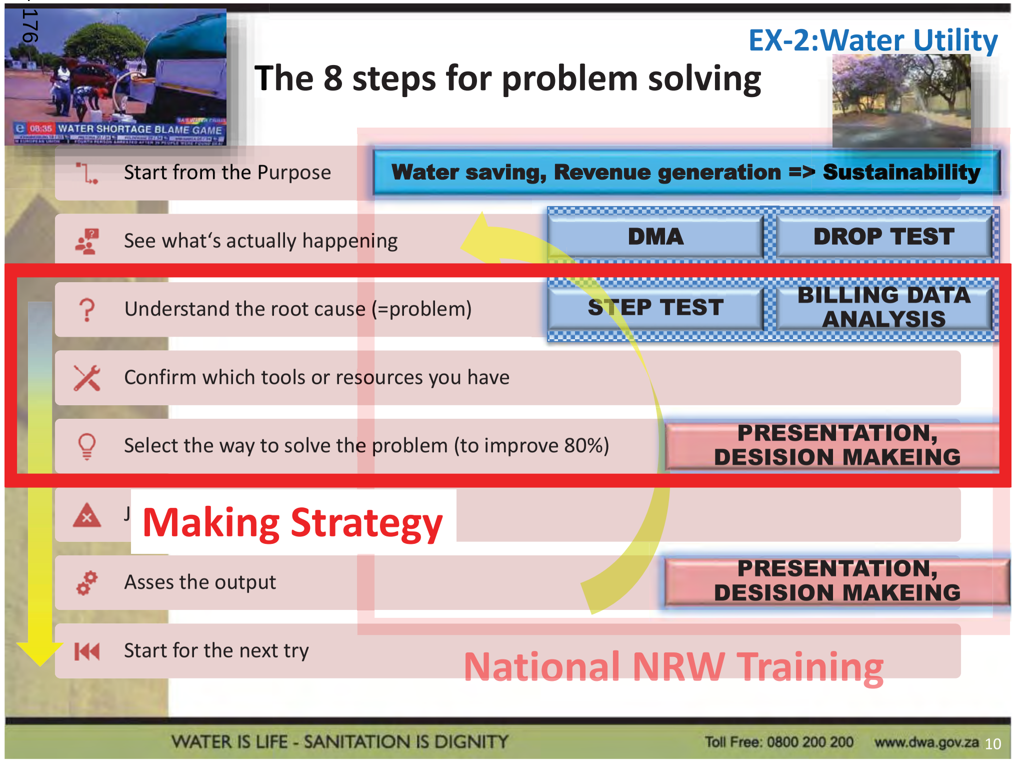
Do not determine to fix 100% ---Don't touch all of the intervention at the same time.

To Select the most effective one or two intervention

is the key to quick win

... This is the mean of "Strategy"


EX-2:Water Utility
The 8 steps for problem solving
Start from the Purpose
See what's actually happening
Understand the root cause (=problem)
Confirm which tools or resources you have
Select the way to solve the problem (to improve 80%)
Just do it
Asses the output
Start for the next try
Water saving, Revenue generation => Sustainability
DMA
DROP TEST
STEP TEST
BILLING DATA ANALYSIS
PRESENTATION, DESISION MAKEING
PRESENTATION, DESISION MAKEING
National NRW Training
WATER IS LIFE - SANITATION IS DIGNITY
Toll Free: 0800 200 200 www.dwa.gov.za 9


EX-2:Water Utility
The 8 steps for problem solving
Start from the Purpose
See what's actually happening
Understand the root cause (=problem)
Confirm which tools or resources you have
Select the way to solve the problem (to improve 80%)
Making Strategy
Asses the output
Start for the next try
Water saving, Revenue generation => Sustainability
DMA
DROP TEST
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BILLING DATA ANALYSIS
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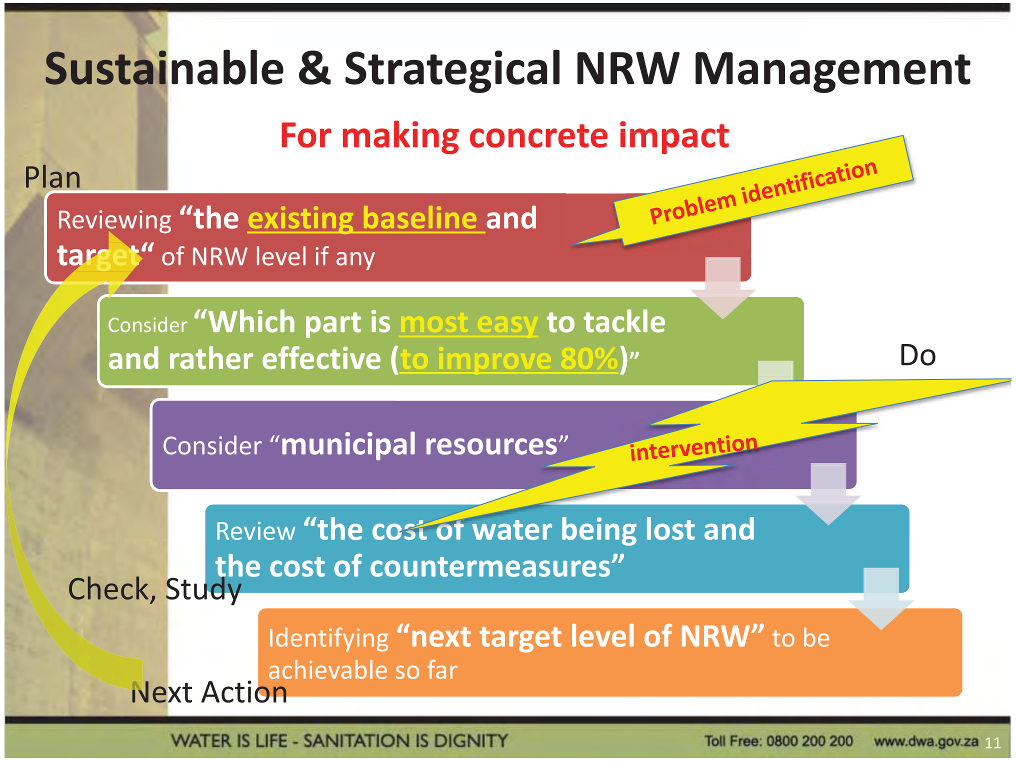
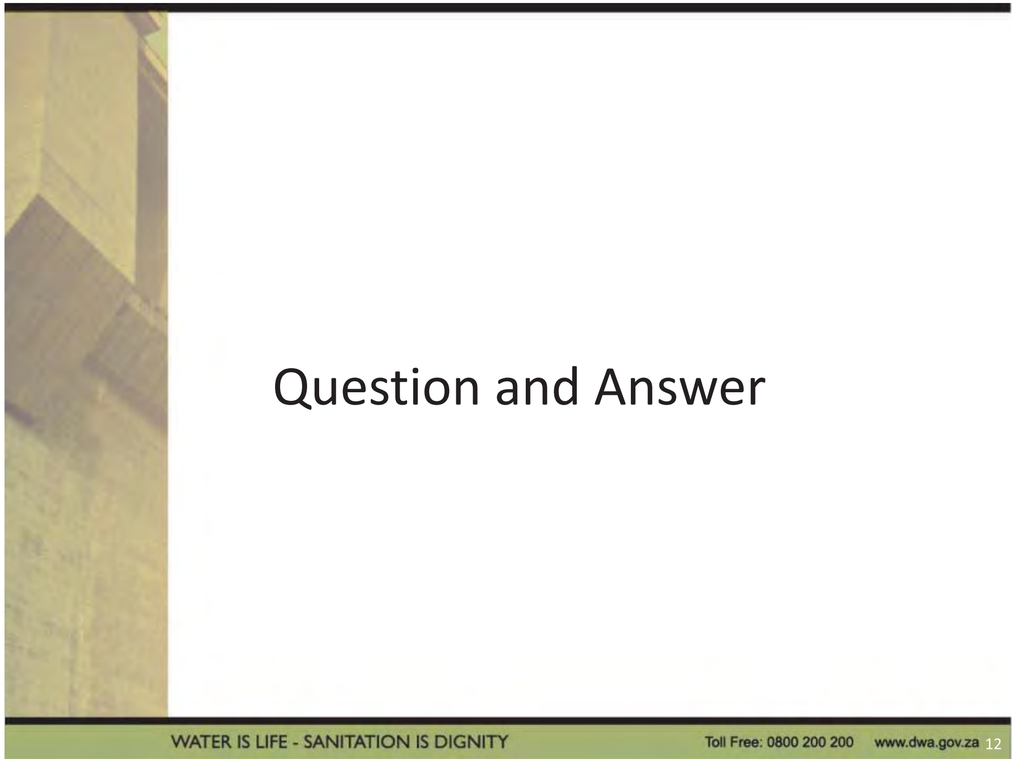

Sustainable & Strategical NRW Management
For making concrete impact
Plan
Reviewing "the existing baseline and target" of NRW level if any
Problem identification
Consider "Which part is most easy to tackle and rather effective (to improve 80%)"
Do
Consider "municipal resources"
intervention
Review "the cost of water being lost and the cost of countermeasures"
Check, Study
Identifying "next target level of NRW" to be achievable so far
Next Action
WATER IS LIFE - SANITATION IS DIGNITY
Toll Free: 0800 200 200 www.dwa.gov.za 11


Question and Answer
WATER IS LIFE - SANITATION IS DIGNITY
Toll Free: 0800 200 200 www.dwa.gov.za 12

Example-1

DMA tells us the solution.

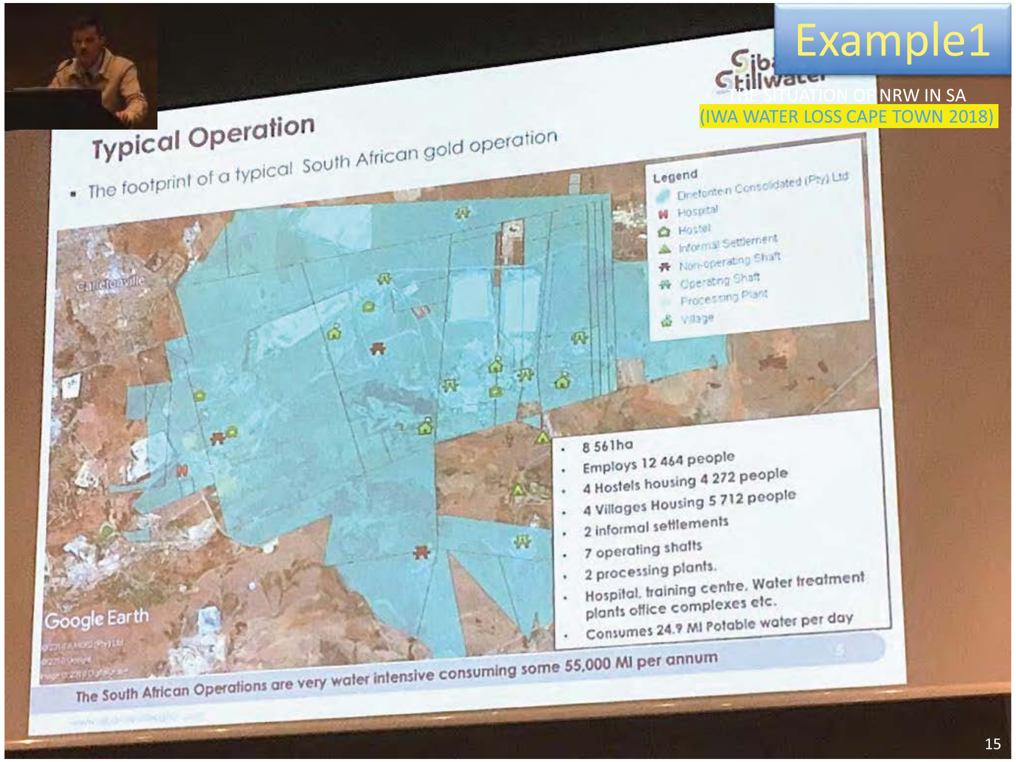
MINING INDUSTRY:
SIBANYE STILL WATER

Example1

THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)

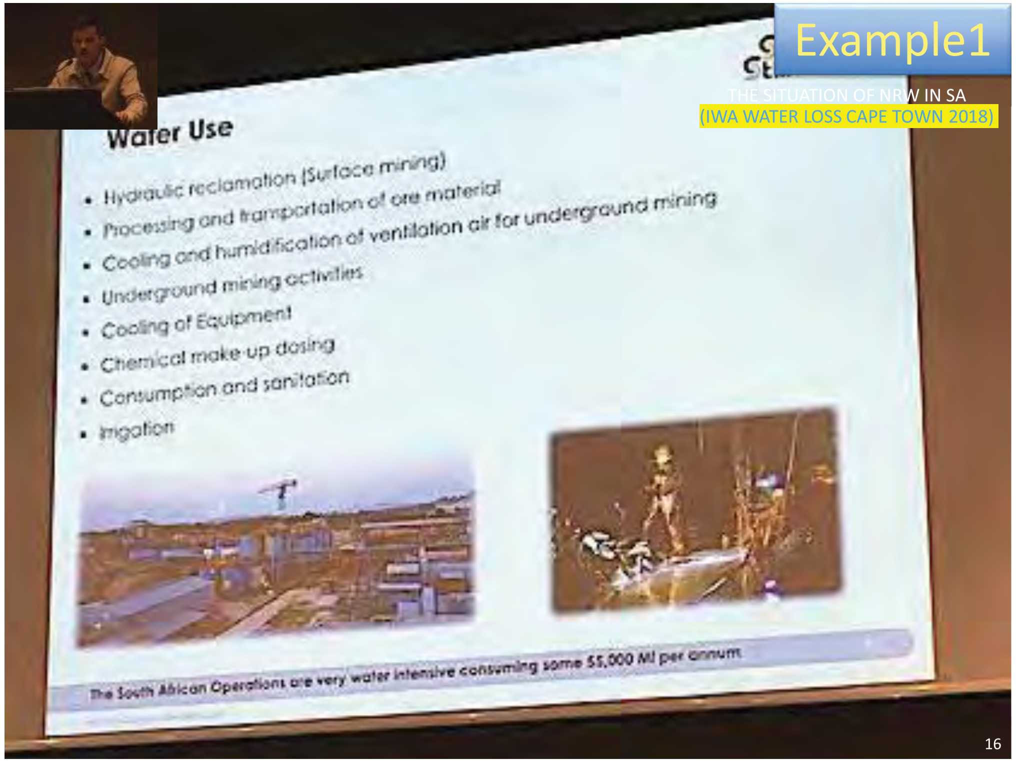
Example1

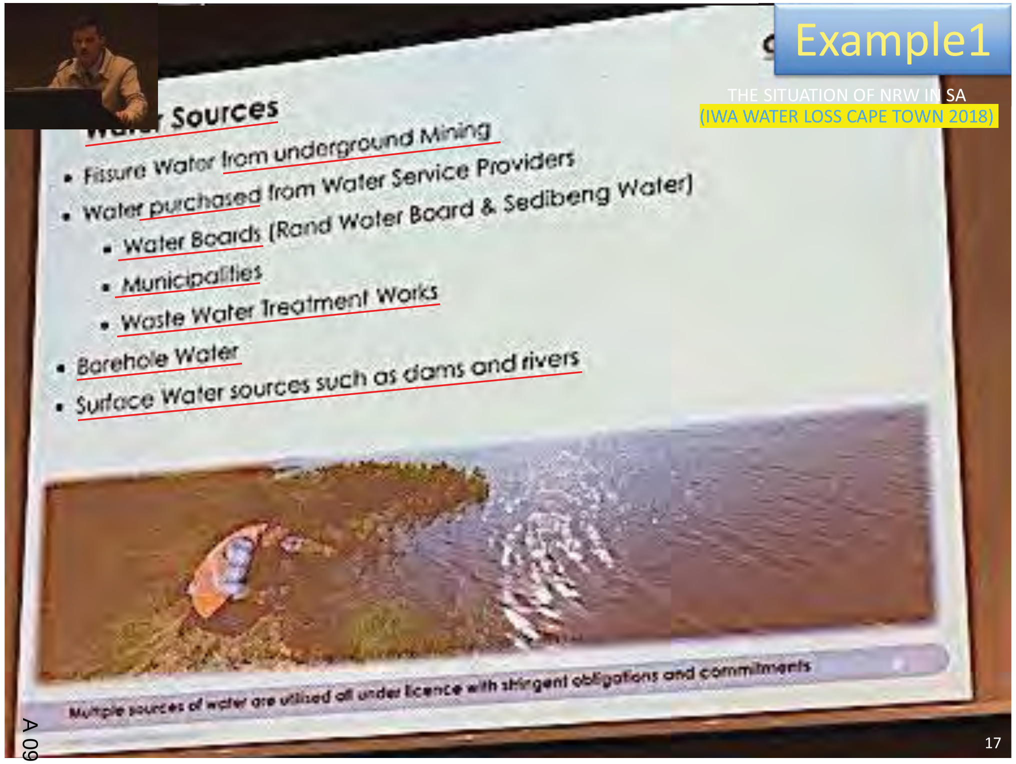
THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)

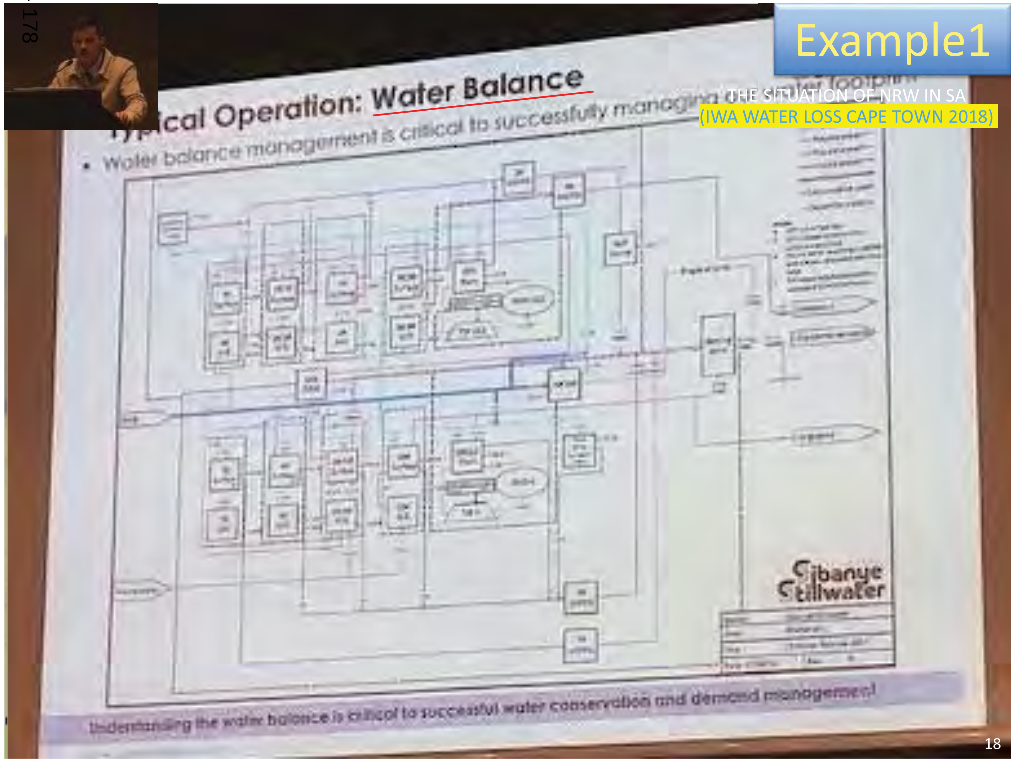


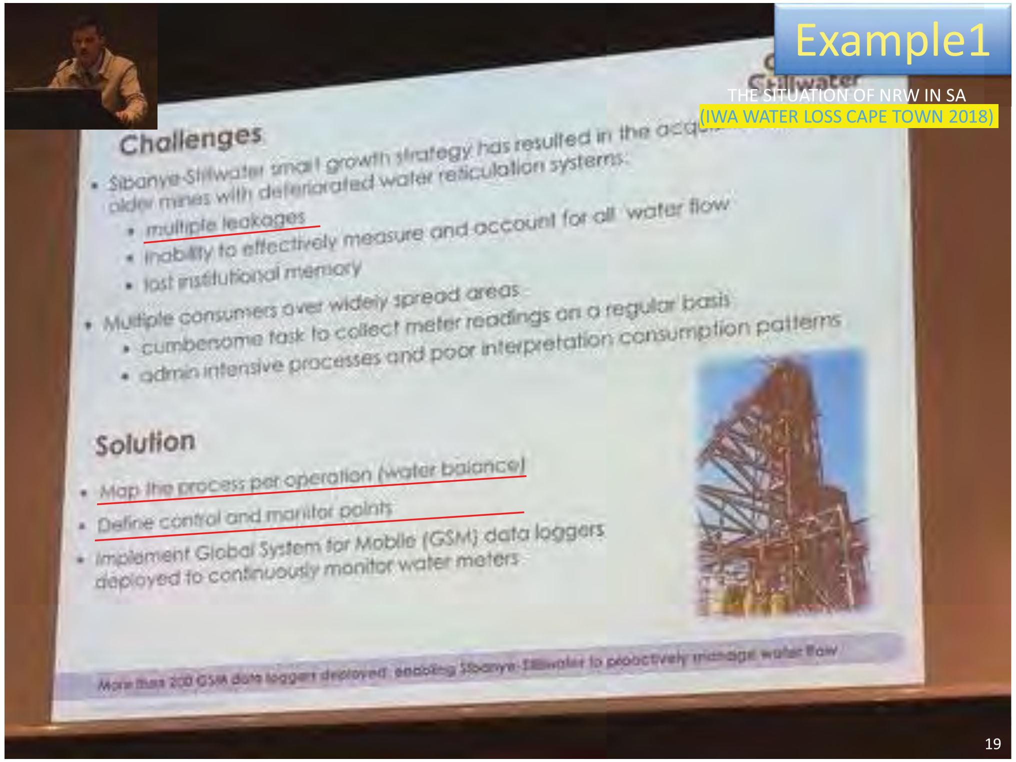
Example1

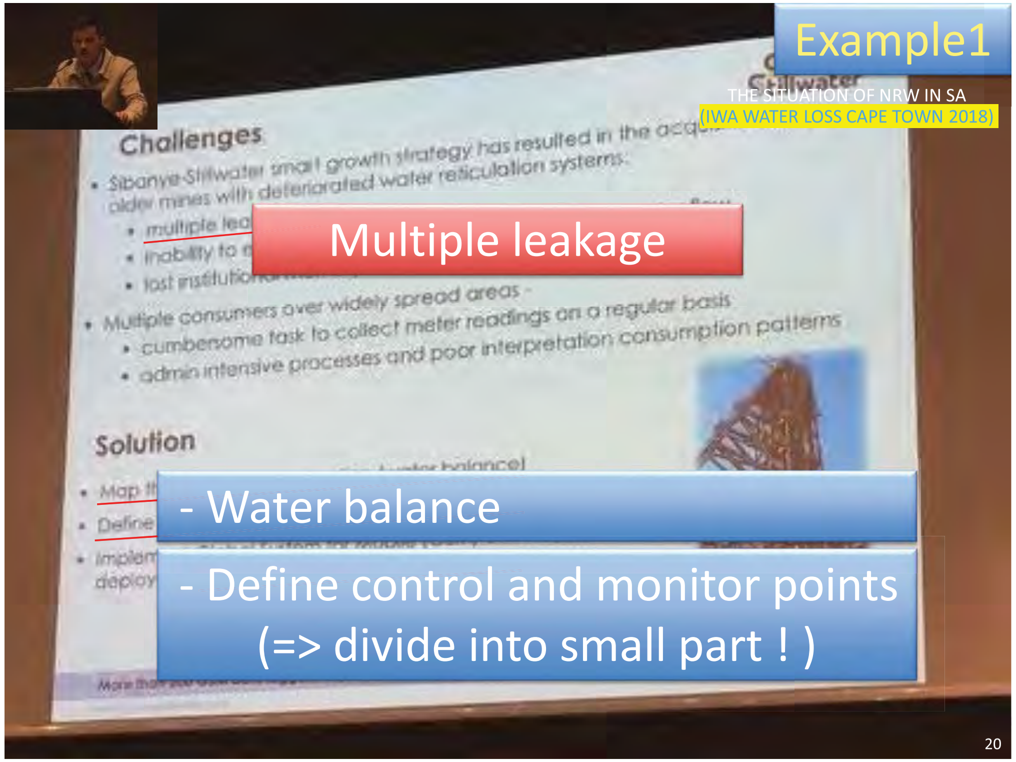
THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)

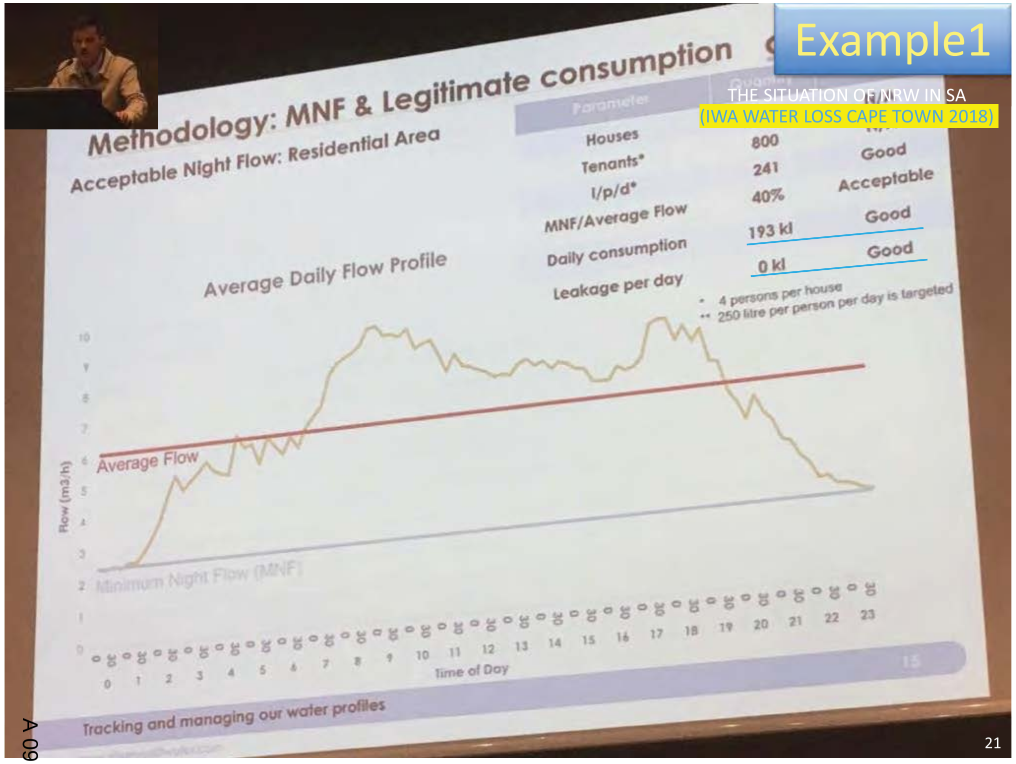


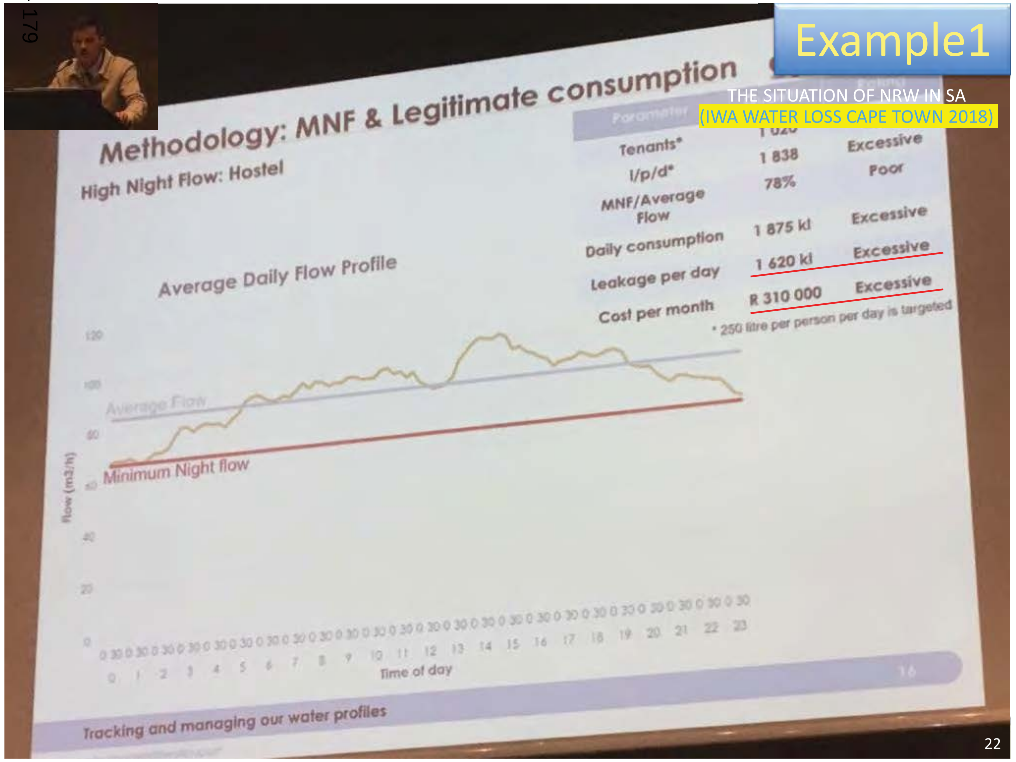

Example1
THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)
Sources
Fissure Water from underground Mining
Water purchased from Water Service Providers
Water Boards (Rand Water Board & Sedibeng Water)
Municipalities
Waste Water Treatment Works
Borehole Water
Surface Water sources such as dams and rivers
Multiple sources of water are utilised all under licence with stringent obligations and commitments
17

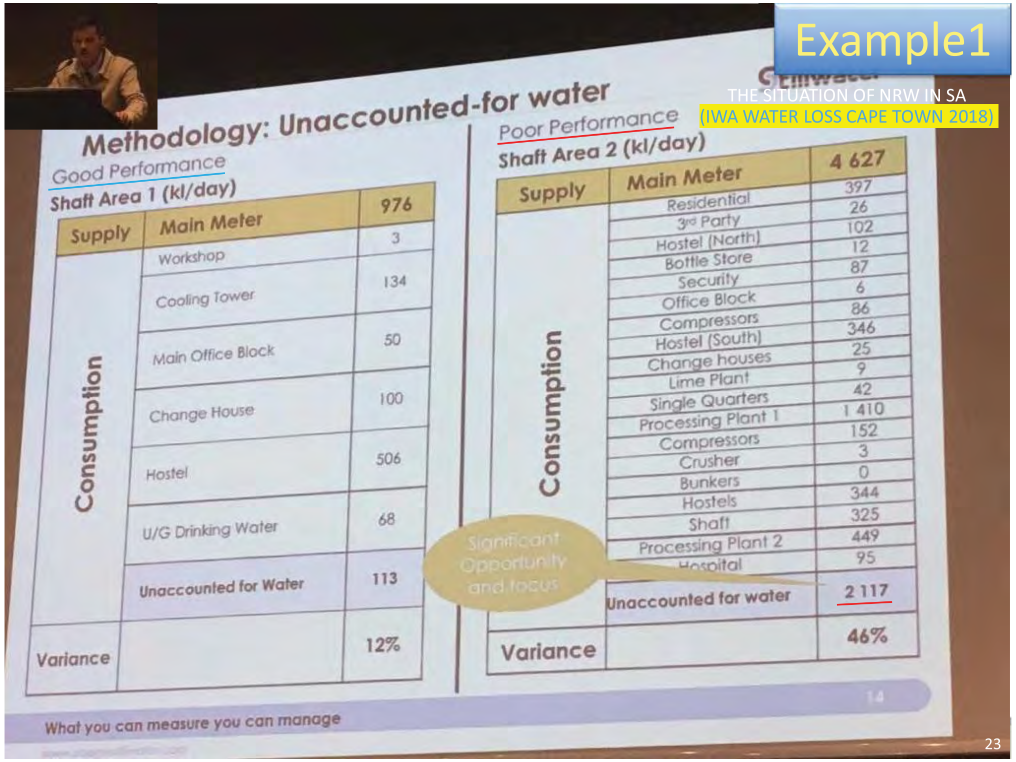

Example1
THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)
Typical Operation: Water Balance
Water balance management is critical to successfully managing
Sibanye Stillwater
Understanding the water balance is critical to successful water conservation and demand management
18

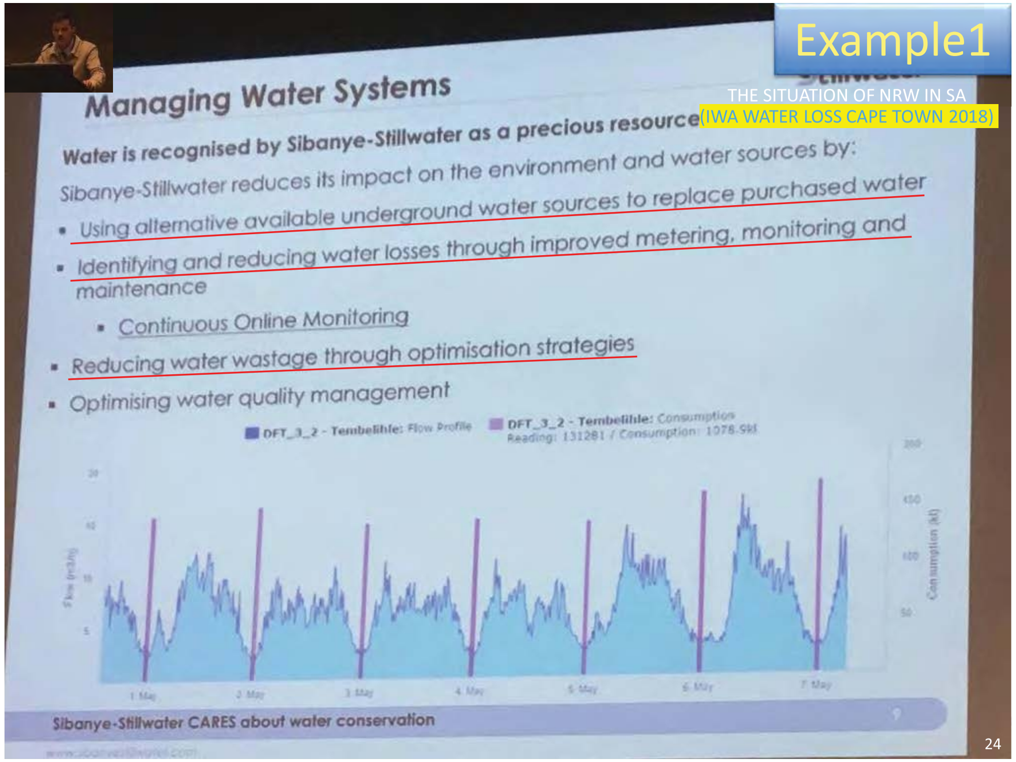

Example1
THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)
Challenges
Sibanye-Stillwater small growth strategy has resulted in the acq
older mines with deteriorated water reticulation systems:
multiple leakages
inability to effectively measure and account for all water flow
lost institutional memory
Multiple consumers over widely spread areas
cumbersome task to collect meter readings on a regular basis
admin intensive processes and poor interpretation consumption patterns
Solution
Map the process per operation (water balance)
Define control and monitor points
Implement Global System for Mobile (GSM) data loggers deployed to continuously monitor water meters
19


Example1
THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)
Challenges
Multiple leakage
Multiple consumers over widely spread areas
cumbersome task to collect meter readings on a regular basis
admin intensive processes and poor interpretation consumption patterns
Solution
- Water balance
- Define control and monitor points
(=> divide into small part !)
20

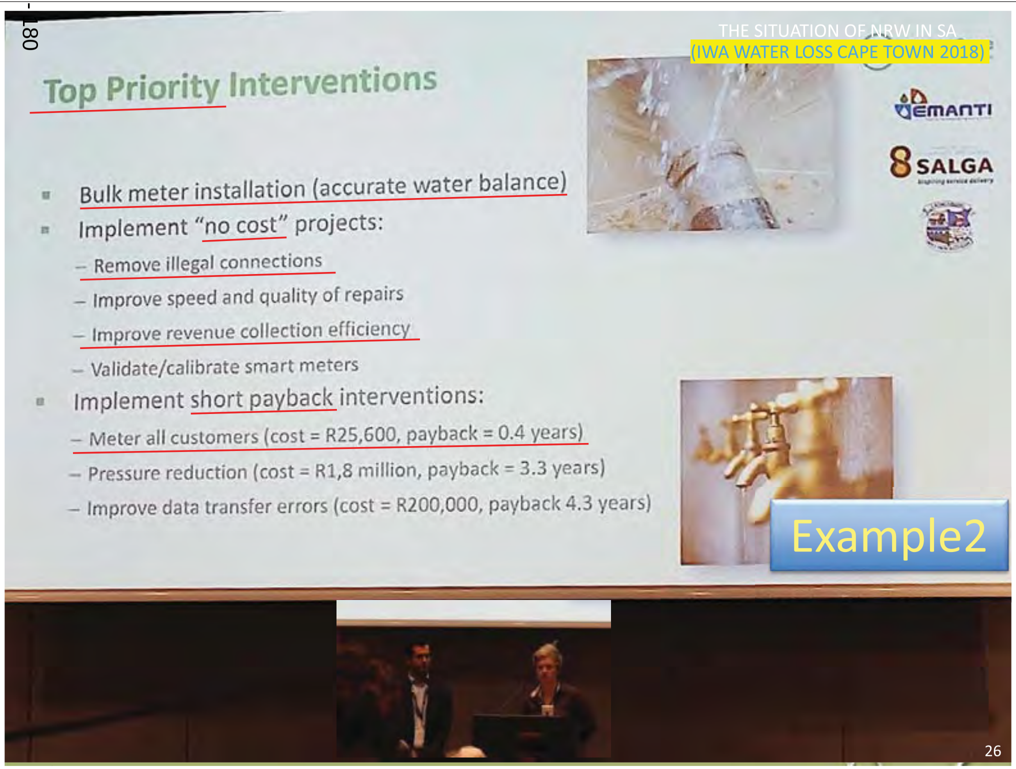

Example1
THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)
Methodology: MNF & Legitimate consumption
Acceptable Night Flow: Residential Area
Average Daily Flow Profile
Parameter
Houses 800
Tenants* 241 Good
l/p/d* 40% Acceptable
MNF/Average Flow
Daily consumption 193 kl Good
Leakage per day 0 kl Good
* 4 persons per house
** 250 litre per person per day is targeted
Average Flow
Minimum Night Flow (MNF)
Flow (m3/h)
Time of Day
Tracking and managing our water profiles
21

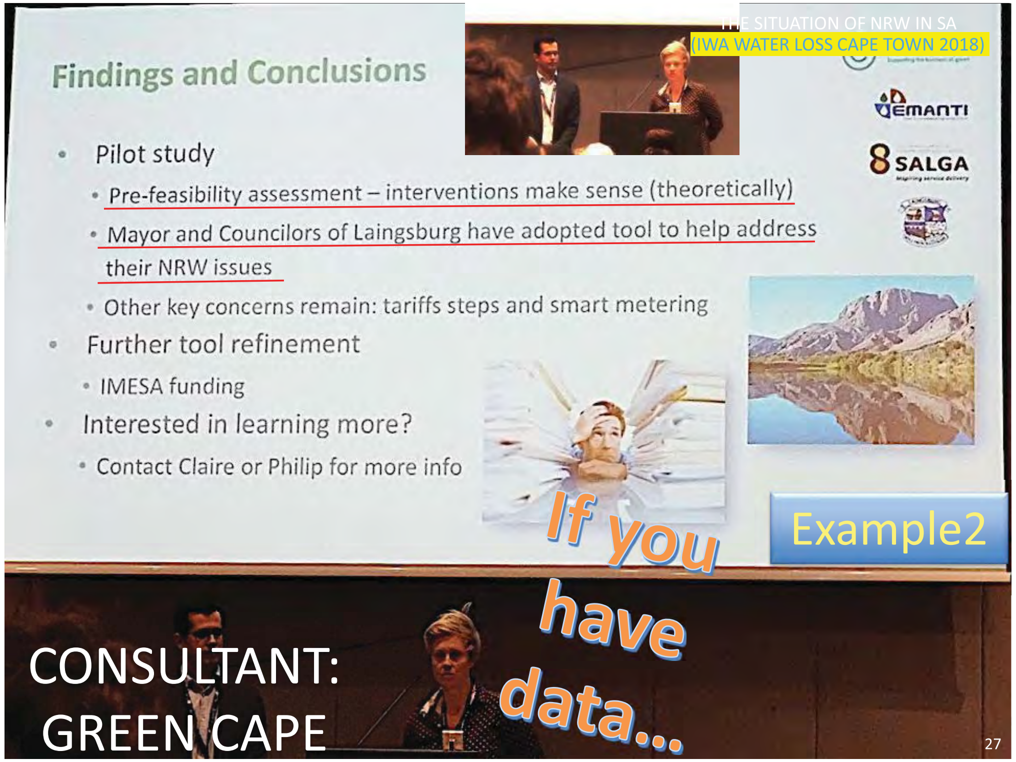

Example1
THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)
Methodology: MNF & Legitimate consumption
High Night Flow: Hostel
Average Daily Flow Profile
Parameter
Tenants* 1 838 Excessive
l/p/d* 78% Poor
MNF/Average Flow
Daily consumption 1 875 kl Excessive
Leakage per day 1 620 kl Excessive
Cost per month R 310 000 Excessive
* 250 litre per person per day is targeted
Average Flow
Minimum Night flow
Flow (m3/h)
Time of day
Tracking and managing our water profiles
22


Example1
THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)
Methodology: Unaccounted-for water
Good Performance
Shaft Area 1 (kl/day)
Supply
Main Meter 976
Consumption
Workshop 3
Cooling Tower 134
Main Office Block 50
Change House 100
Hostel 506
U/G Drinking Water 68
Unaccounted for Water 113
Variance 12%
Poor Performance
Shaft Area 2 (kl/day)
Supply
Main Meter 4 627
Consumption
Residential 397
3rd Party 26
Hostel (North) 102
Bottle Store 12
Security 87
Office Block 6
Compressors 86
Hostel (South) 346
Change houses 25
Lime Plant 9
Single Quarters 42
Processing Plant 1 1 410
Compressors 152
Crusher 3
Bunkers 0
Hostels 344
Shaft 325
Processing Plant 2 449
Hospital 95
Unaccounted for water 2 117
Variance 46%
Significant Opportunity and focus
What you can measure you can manage
23


Example1
THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)
Managing Water Systems
Water is recognised by Sibanye-Stillwater as a precious resource
Sibanye-Stillwater reduces its impact on the environment and water sources by:
Using alternative available underground water sources to replace purchased water
Identifying and reducing water losses through improved metering, monitoring and maintenance
Continuous Online Monitoring
Reducing water wastage through optimisation strategies
Optimising water quality management
DFT_3_2 - Tembelihle: Flow Profile
DFT_3_2 - Tembelihle: Consumption
Sibanye-Stillwater CARES about water conservation
24

Example-2





Example-3

Example3

BL survey: Mbombela LM

- NRW ratio: from 44.3%(2014) → 24%(2017)
- Change water meter
- Change Tarif structure (flat rate → pay-as-you-use system)

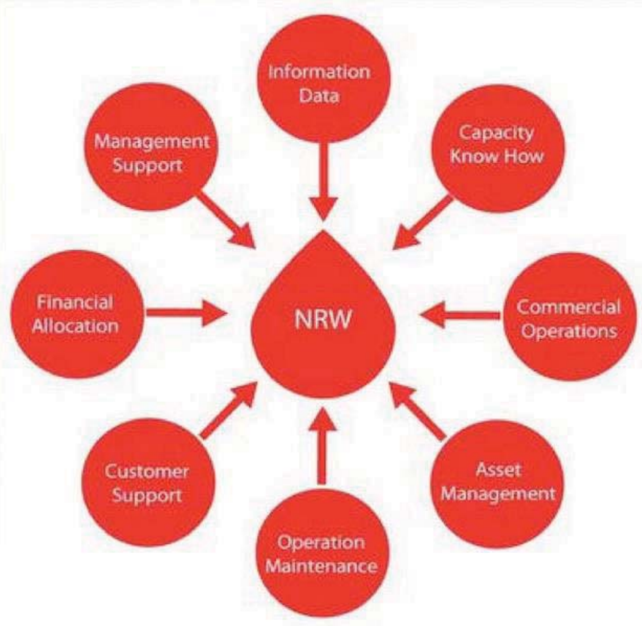
Then ...

Let's look back

2. What is NRW?

Once again

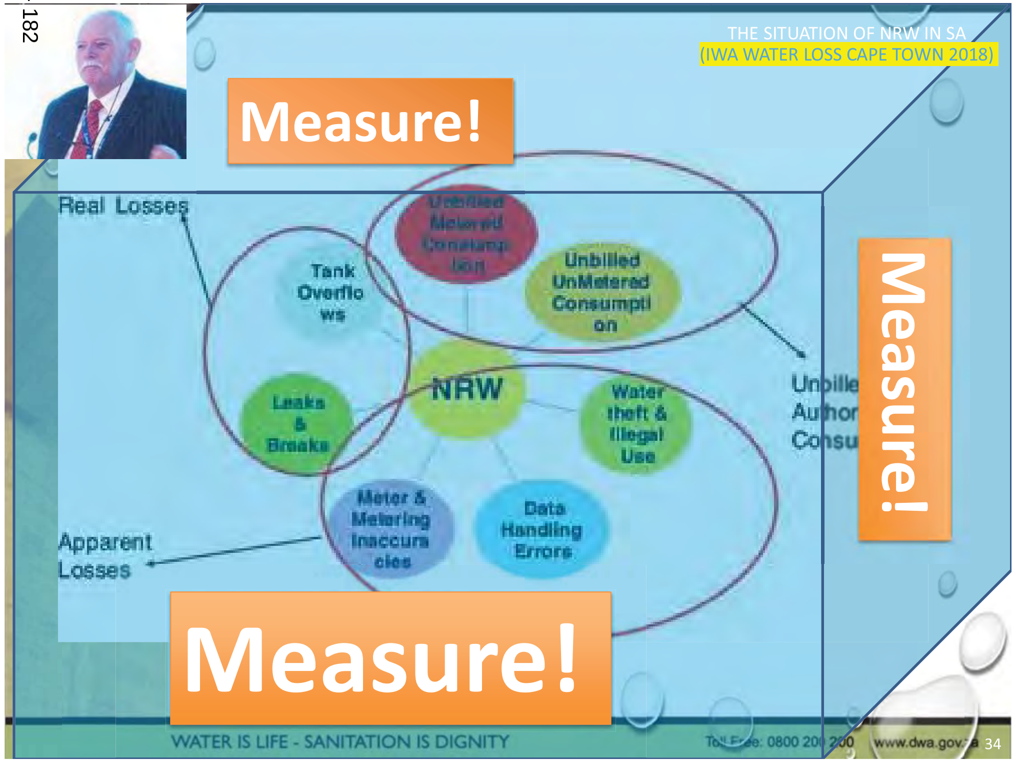
2. WHAT IS NRW?

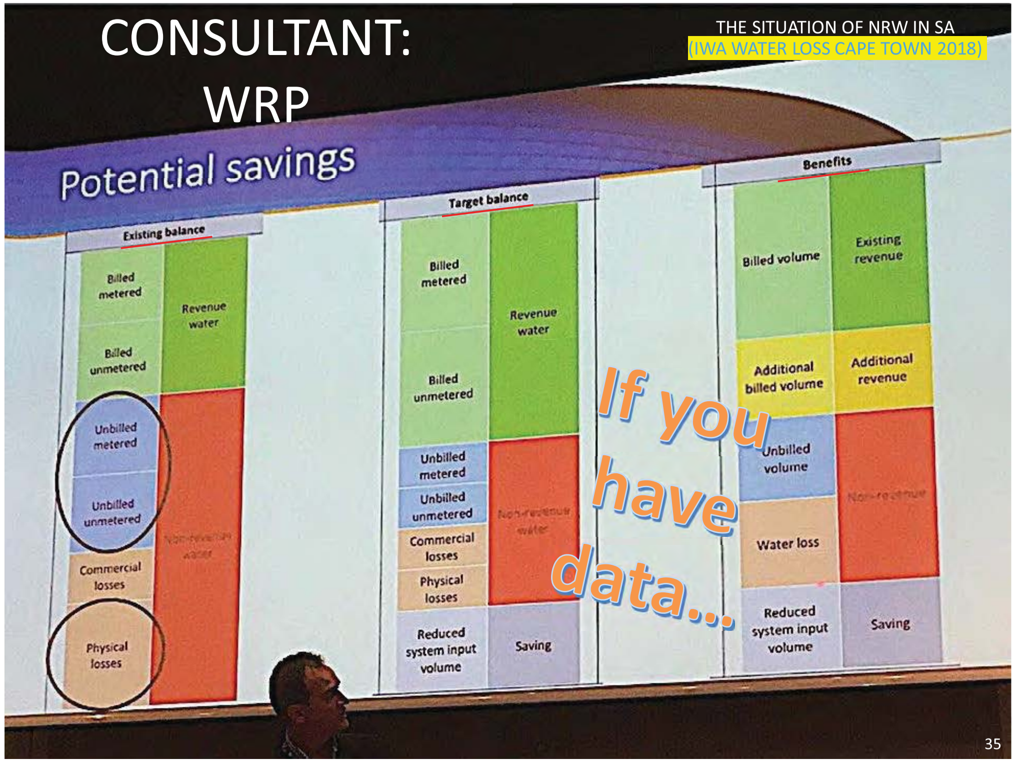


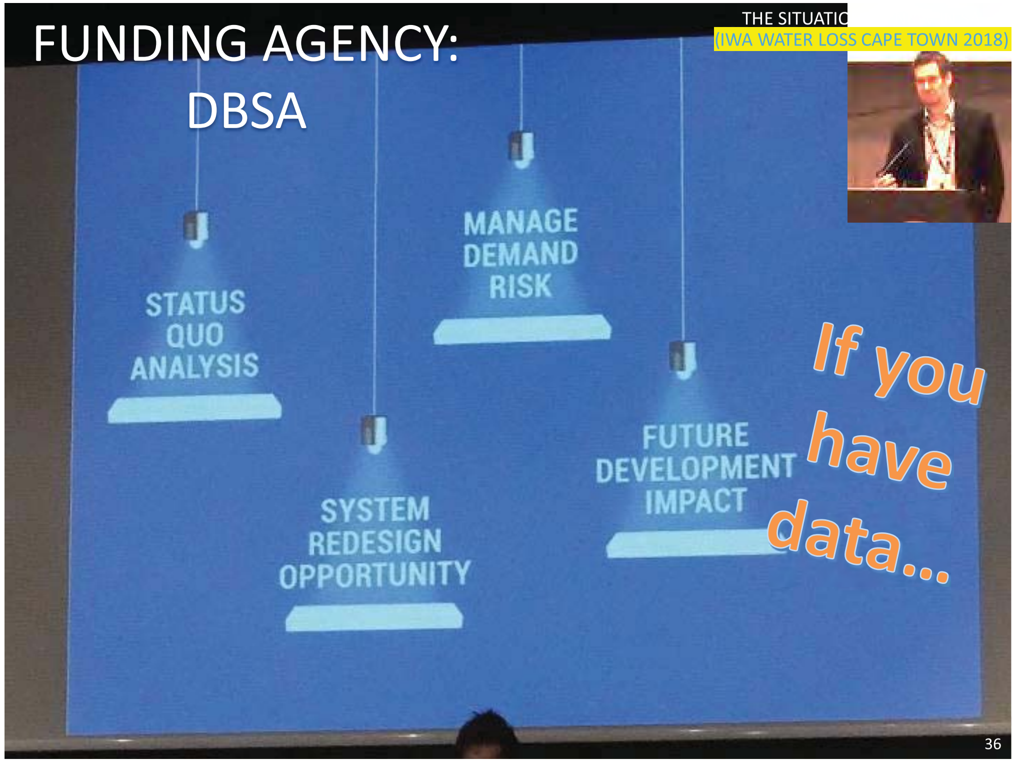
Sustainable NRW Management

VARIOUS COUNTERMEASURES IN NRW MANAGEMENT

Bulk (system input) metering and accuracy	Zonal metering and accuracy (including installation/refurbishment)	Customer metering and accuracy (including installation/re-installation)	Reservoir overflow control and monitoring
DMA establishment	Surface leakage locating and repair	Underground leakage detection and repair	Pressure management
Meter installation	System maintenance improvement	Network drawing quality improvement	GIS and hydraulic modelling improvement
Meter reading and billing system improvement	Treating "Free Basic Water"	Record keeping improvement	Pipe replacement (asset management)
Reorganization (staffing)	Awareness programme	Customer awareness	Monitoring & Evaluation

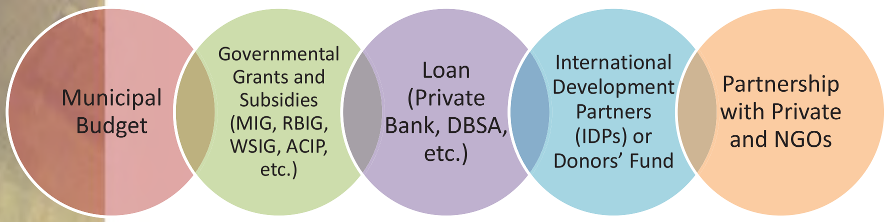






Sustainable NRW Management

FUNDING SOURCES



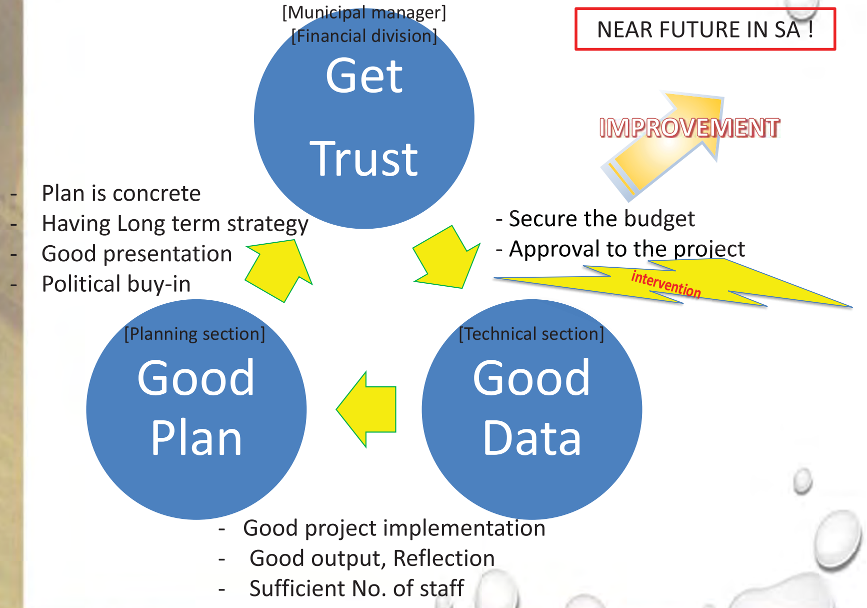
The stakeholders should proactively provide information, guide/support municipalities for application and optimize the use of the advantage of scale because it is hard for the small- and medium-size municipalities to access funding sources by single municipality.

Vicious cycle to Virtuous cycle

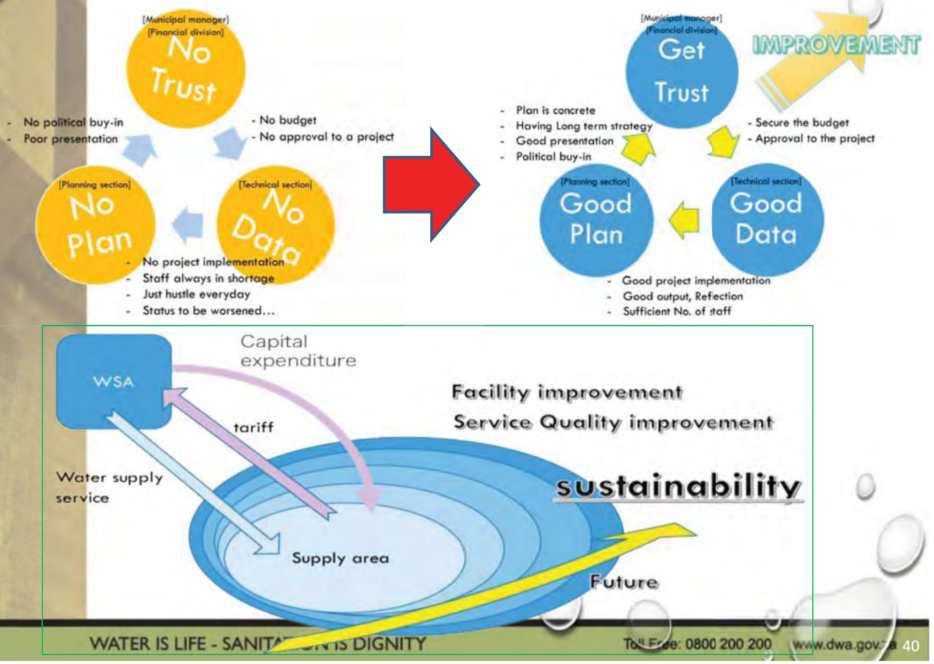
NOW IN SA

Vicious cycle to Virtuous cycle

NEAR FUTURE IN SA !



Vicious cycle to Virtuous cycle



Question and Answer

Tips for Presentation

- Full-Coverage Information
- Reconfiguration according to Audience
- If audiences are decision makers, Simple Facts and Recommendation in their languages
- If audiences are colleagues in the practical level, Details in Procedures and Setting
- If audiences are nontechnical, interpretation to their languages
- Highlighting by coloring, bold and inducing audiences' interests and questions
- Slide numbering, Recording, Photos, Graphic (Visualization)
- List of Team members and Contacts

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WORKPLACE TRAINING PREPARATION

The National
Non-Revenue Water (NRW) Training
for Municipalities by Municipalities
in South Africa

Programme Conceptual Flow

1st IBTC	NRW and Reticulation System Basics
1st WP	Problem Identification / Obtaining the Baseline / Workplace **Zone/area Configuration, Flow Measurement, Billing Data Analysis**
	A weak point of municipalities Most crucial part of this programme
2nd WP	Effective Countermeasures / Workplace
2nd IBTC	Outcome, Findings and Actions to be taken
	Way forward

Schedule

Day	Time	Contents	Remarks
2nd week (Preparatory)			
Day 6 -10	-	- Preparation by learners in workplaces (DWS Coordinators support learners if necessary) - Confirmation of pilot DMA at the site - Starting data logging - Collect billing data in the DMA by learners	-
3rd week (Workplace)			
Day 11 (Mon)	am	* Travelling (DWS Coordinators and Facilitators)	-
	pm	Participant assembly, meeting about training plan and courtesy call	Office
Day 12 (Tue)	am	DMA configuration	Site
	pm	DMA configuration	Site
Day 13 (Wed)	am	DMA configuration	Site
	pm	DMA configuration, MNF (by step measurement) at night	Site
Day 14 (Thu)	am	Data retrieval and Data analysis	Site and office
	pm	Reporting (Baseline & problem identification)	Office
Day 15 (Fri)	am	Presentation to managers of each Municipality Wrap up workplace training results	Office
	pm	* Travelling (DWS Coordinators and Facilitators)	-
4th week (Buffer)			
Day 16 - 20	-	(DWS Coordinators support learners if necessary) (MNF and SIV measurement if necessary)	-
5th week (Workplace)			
Day 21 (Mon)	am	Travelling (DWS Coordinators and Facilitators)	-
	pm	Participant assembly and meeting about training plan	Office
Day 22 (Tue)	am	NRW Countermeasures	Site
	pm	NRW Countermeasures	Site
Day 23 (Wed)	am	NRW Countermeasures	Site
	pm	NRW Countermeasures, MNF (by step measurement) at night	Site
Day 24 (Thu)	am	Data retrieval/analysis	Office
	pm	Preparation for presentation (Findings, results, remaining issues, strategic implementation planning with considering funding application)	Office
Day 25 (Fri)	am	Presentation to relevant managers Wrap up workplace training results	Office
	pm	* Travelling (DWS Coordinators and Facilitators)	-

6th week (IBTC)			
Day 26 (Mon)	-	-	-
Day 27 (Tue)	-	-	-
Day 28 (Wed)	-	* Traveling (facilitators and learners)	-
Day 29 (Thu)	8:30-10:00	Workplace training results, findings and actions to be taken, Q&A [Presentation]	Room
	10:15-11:50	Workplace training results, findings and actions to be taken, Q&A [Presentation]	Room
		Lunch	
	13:00-14:00	Modification of presentations	Room
	14:15-16:00	Follow-up lectures [Theory & Practices]	Room / Yard
Day 30 (Fri)	8:30-9:00	Output Sharing Seminar * Invite various stakeholders Introduction of participants [Orientation]	Room
	9:00-11:00	Workplace training results, findings and actions to be taken, Q&A [Presentation]	Room
	11:00-11:50	Overall evaluation and assessment	Room
		Lunch	
	pm	* Travelling (facilitators and learners)	-

Day 6-10: Preparation by municipalities as well as DWS(WUE&IBTC) & JICA Team for their trip

Workplace Daily Activity: 9h00 to 16h00 (standard)

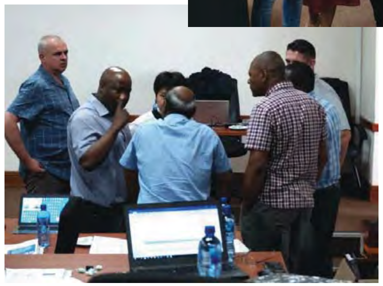
Members of Workplace Training

+ Learners	-----	3-5 persons
+ Facilitators (Municipalities)	-----	2 persons
+ Coordinator (DWS)	-----	1 person
+ Technical support (JICA)	-----	1 person

Learners:
- Municipal water services officials (3-5 officials as a team consisting WCWDM, O&M, Billing, etc)

Facilitators:
- Skilled and experienced municipal water services officials
- DWS officials

Coordinator:
- DWS officials



1st Half Workplace Training (Baseline)

1) Isolation confirmation in DMA & Sub-Zones and Findings on Pipelines and Drawings

2) Identification of problematic sub-zone(s) by flow logging data

3) Analysis of Billing data and calculate NRW from Current SIV

4) Findings in O&M and Billing

IWA Water Balance Process (in SA)

A. Determine System Input Volume (SIV)
(Reading data of purchase water, outflows from WTWs, boreholes, etc.)

B. Determine/Estimate Billed Authorized Consumption: Revenue Water
(Metered / Unmetered)

A (SIV) - B (Revenue Water) = NRW

C. Determine/Estimate Unbilled Authorized Consumption
(Metered / Unmetered)

D. Estimate Commercial Loss
(Unauthorized consumption, Customer meter inaccuracy)

E. Estimate Physical Losses
Physical Losses (Leakages) = NRW - C - D

Water Balance in our DMAs to reflect Reality

A. Determine System Input Volume (SIV)
(Bulk flow measurement)

B. Determine/Accurately-Estimate Billed Authorized Consumption: Revenue Water
(Metered / Unmetered)

A (SIV) - B (Revenue Water) = NRW

Physical Loss

D. Determine Physical Loss ⇦ *Easiest to measure*
Minimum Night Flow = Leakage *There is possibility of inclusive of small consumption and domestic leaks.

Apparent Loss

C. Determine/Accurately-Estimate Unbilled Authorized Consumption
(Metered / Unmetered)

E. Accurately-Estimate Commercial Loss
Commercial Loss (Unauthorized consumption, Customer meter inaccuracy) = NRW - D -C

Preparation Items from 3rd to 7th February

General (important)

- To inform/remind your Managers and colleagues of workplace training from 10th to 17th February and their understanding/cooperation.
- Appointment of courtesy call on them in the afternoon of 10th February.
- Explanation/request to your colleagues (site teams) for cooperation/ participation in workplace training.
- Engagement of community leaders, traditional leaders and ward councilors for workplace training if necessary (notice, explanation, security, etc.). *Should we meet them when we start at site?
- Desk-work or meeting space in municipality office and workplace or near during workplace
- Confirmation of security for the team in pilot DMA. *Should we inform SAPS or others? Do we need police escort particularly in night time?

Technical information

- Pipeline drawing(s) of the pilot DMA, and its pipeline information (bulk meter(s), pipe materials, diameter, valves, air valves, hydrants, PRV, washout/scour valves, etc.)
- Conditions/function of bulk meter(s) to measure SIV to the pilot DMA
- Diameter, manufacturer and model of bulk meter(s) *Important for data logging setting
- List and billing data (monthly data for last 12 months) of customers including major consumers and prepaid customers in the pilot DMA

And if possible,

- Any available equipment/device with specification for workplace training which exist in your municipality if any (e.c. data logger)
- Any available data from IMQS or equivalent (water flow volume, flow direction, velocity, maximum/minimum pressure, etc.)
- Confirmation of location of boundary and isolation valves at sites, and also their function if possible
- Confirmation of location of the hydrant and PRV at the highest point in the pilot DMA, and also their function if possible (to be used for isolation check)
- Confirmation of location of major consumers and their customer meters.
- Confirmation of location of high buildings and water storage tanks if any

Presentation for Workplace Training

- **Details of the pilot DMA: pipeline information, existing flow meters (in/out flow), valves, air valves, hydrants, topographic conditions, customers and etc.**
- **Measurement plan: things to be confirmed/clarified, workflow, measurement procedures, possible risks, challenges and etc.**
- **Safety/security considerations**
- **Necessary preparation before Workplace**

Tips for Presentation

Full-Coverage Information
↓
Reconfiguration according to Audience
↓
If audiences are decision makers, Simple Facts and Recommendation in their languages
↓
If audiences are colleagues in the practical level, Details in Procedures and Setting
↓
If audiences are nontechnical, interpretation to their languages
↓
Highlighting by coloring, bold and inducing audiences' interests and questions
↓
Slide numbering, Recording, Photos, Graphic (Visualization)
↓
List of Team members and Contacts

Equipment for the Workplace Training

Munics must have:

- Gas/O_2 Checker
- Ventilation fan

Better to have:

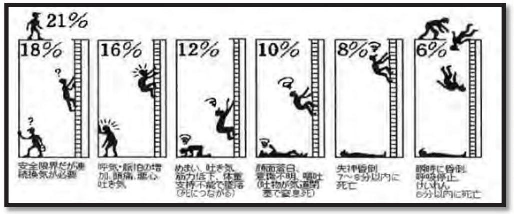
Logger & Pulsar
listening stick
Transceiver
Flashlight
Chalk
Digital camera
Tablet (iPad)

☑:Rental from IBTC during Workplace Training

Equipment for Safety

Munics must have:

- Gas/O_2 Checker
- Ventilation fan



* In chamber work, we need to avoid our colleagues to lose their lives. (Air that has no O_2 causes <u>sudden death</u>. And that is invisible) **If you haven't confirmed O_2 level, never go into the chamber**

Emails and Contact Details of the Team

DWS (HO, WUE)

Mr Hadebe Xolani
Mr Michael Singh *KZN only
Mr Thabo MASIKE
Mr Andries Padi
Mr Tapiwanashe Musara
Mr Michael Maluleke *KZN only

DWS (IBTC)

Ms Rosa M. Rahube *Centre Manager
Ms Kgoputso Sekgoilane *Logistics
Ms Verusha Govemder
Mr Armand Basson
Mr Riaan Stassen

Facilitators from Municipalities

TBC

JICA Team

Mr Akinori Miyoshi
Mr Nobutaka Maruyama
Mr Hiroyuki Morita
Mr Hiroki Niimura

If any challenges in preparation and Workplace Training, please let us know promptly.

water & sanitation
Department: Water and Sanitation
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The Project for Strengthening the Training Capacity of IBTC on NRW

Supplemental Notes

The National
Non-Revenue Water (NRW) Training
for Municipalities by Municipalities
in South Africa

Contents

1. Meter Size Selection

2. Steps for finding a service pipe leak (around a meter)

3. Improvement of Drawing/GIS/IMQS Data

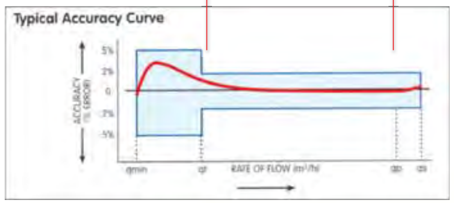
4. Any other items

1. Meter Size Selection

Water Meter Selection for MNF measurement

- **Qmax**: Maximum flow rate
- **Qp**: Permanent flow rate
- **Qt**: Transitional flow rate
- **Qmin**: Minimum flow rate
- **Starting flow rate**

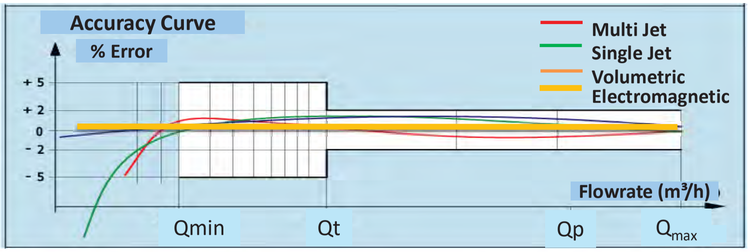
Basically,
We use within here!



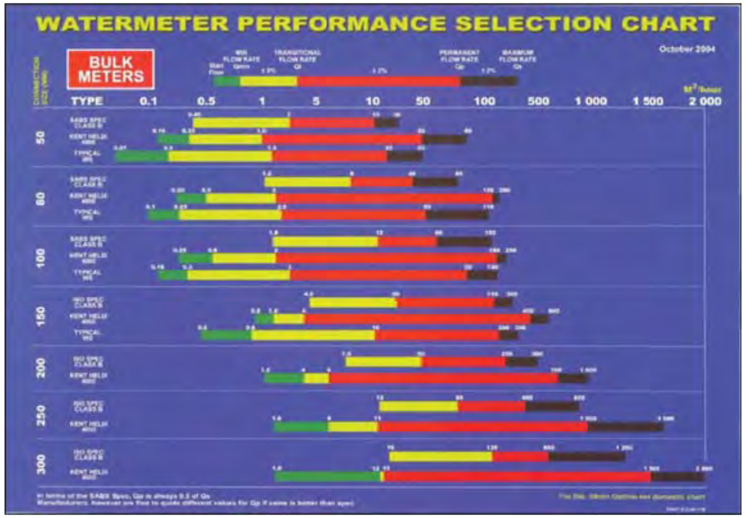
*Confirm SABS (South African Bureau of Standards) approval

Definitions

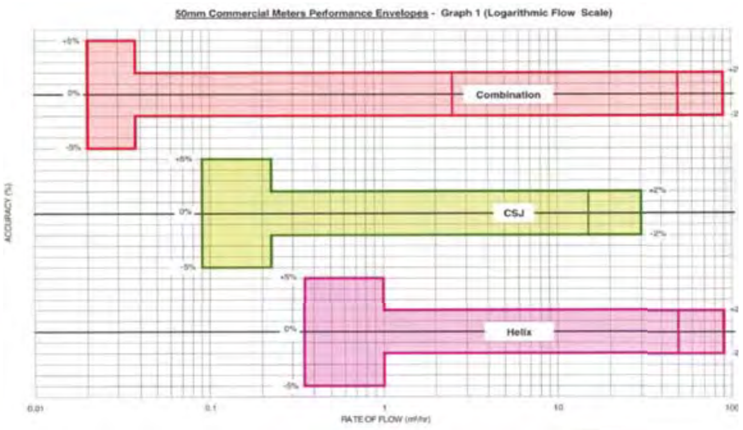
- **Qmax - Maximum flow rate :** The highest flow rate where meter can operate for a short period without permanent damage to its accuracy.
- **Qp - Permanent flow rate:** Flow rate where meter is designed to operate
- **Qt -Transitional flow rate:** The flow rate at which the maximum permissible error changes in value from +- 5% to +- 2%.
- **Qmin - Minimum flow rate:** The lowest flow rate where meter can operate within the maximum permissible error tolerance.
- **Starting flow rate:** The flow rate at which the meter starts to measure without any known accuracy.



Performance Chart



Meter Performance Sheet (3 Types, 50DN)



Required Volume for Qt (2%), Class-B

Meistream (Sensus)

Qt = 1.8m^3/h, for 100mm (DN) — More accurate for small flow

Qt = 4.0m^3/h, for 150mm (DN)

Elster H4000 (Kent)

Qt = 2.0m^3/h, for 100mm(DN) — More accurate for small flow

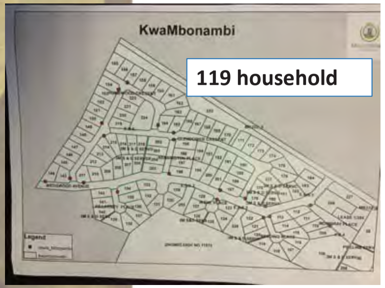
Qt = 4.0m^3/h, for 150mm (DN)

Bulk LXLC (Precision Meters)

Ot = 12.0m^3/h, for 100mm(DN) — More accurate for small flow

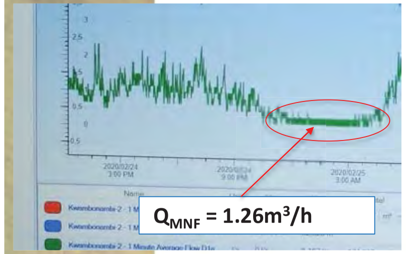
Qt = 30.0m^3/h, for 150mm(DN)

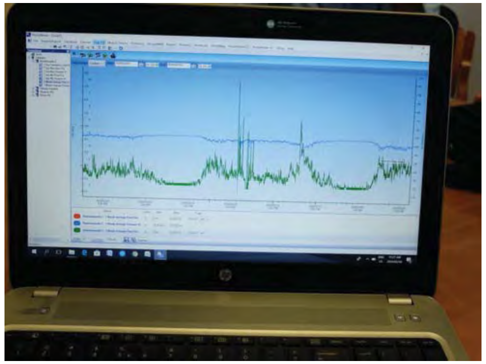
EX. King Cetshwayo DM



Meistream (Sensus)
Qt = 1.80m³/h, for 100mm (DN)

Q_{MNF} = 1.26m³/h **<** Qt = 1.80m³/h
(Cannot measure properly !!)





Pulse Output for MNF Step Test (precise logging)

- Pulse output:
  0.01m³/pulse (one pulse for 10L) For MNF Step Test
- DMA size:
  Around 100 to 150 houses

c.f.

Meistream (Sensus)
Less than 150DN can output 0.01m³/pulse
Elster (Kent)
Less than 150DN can output 0.01m³/pulse

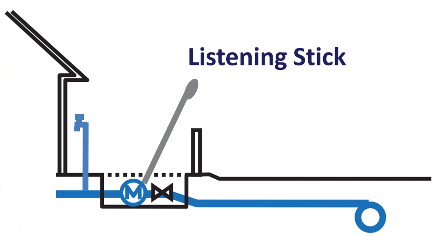
*You need to order when you purchase the meter.

2. Steps for finding a service pipe leak (around a meter)

Leak Detection (Listening Stick)

Leak Detection around a Water Meter

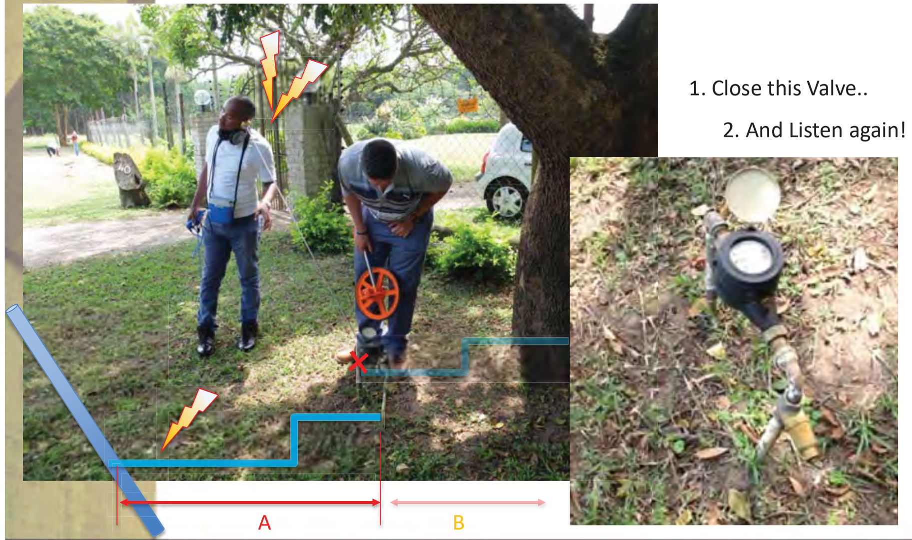
Listening stick detects the sound of leak



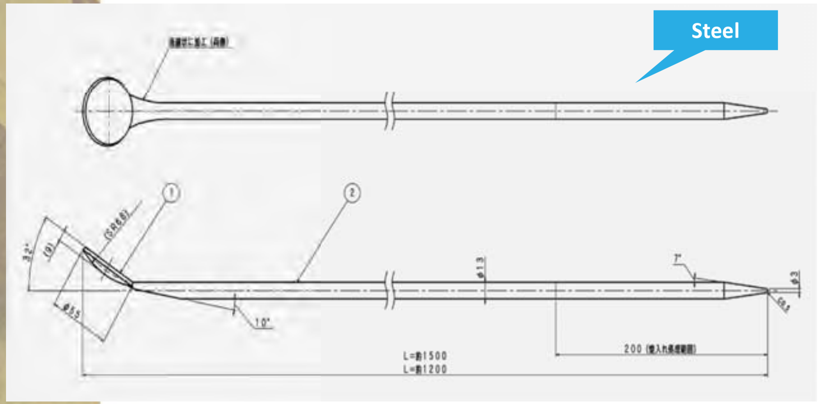
Is that Internal or External Leakage?

1. Detect noise
2. Close a stop valve (cock)
   Case-1: Noise continues -> External Leak (Municipal reticulation) = NRW
   Case-2: No noise -> Internal Leak (Customer) = RW

EX. King Cetshwayo DM

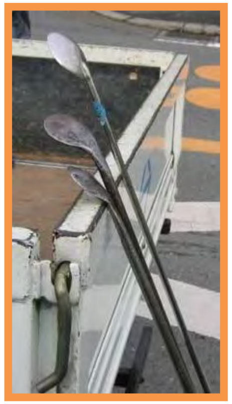


You can make Listening Stick



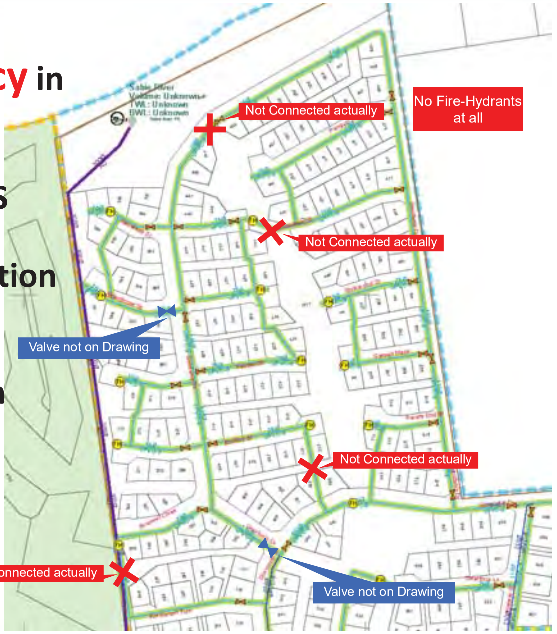
Painting is required to avoid rusting

How to use self-made Listening Stick

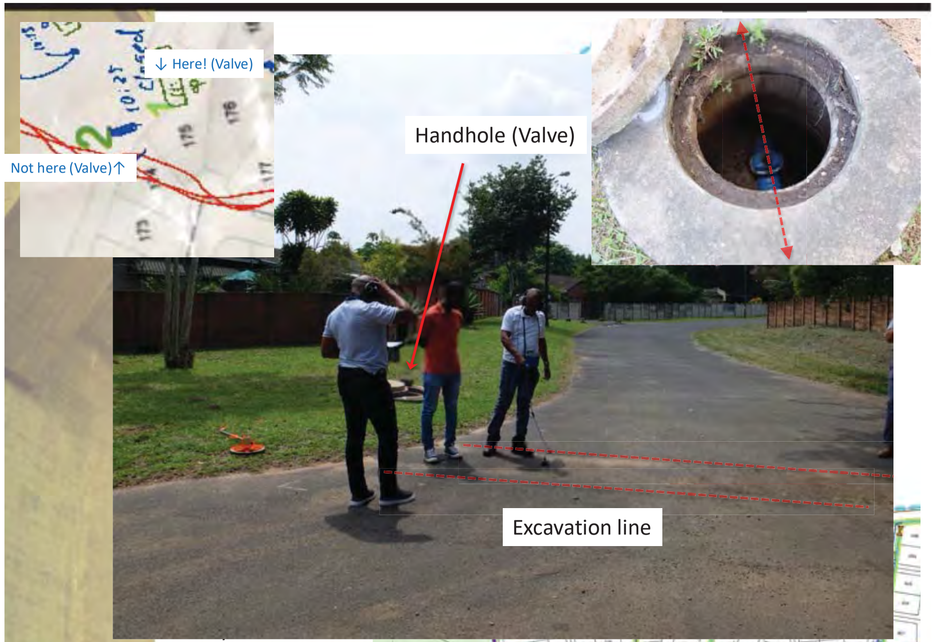


3. Improvement of Drawing/GIS/IMQS Data

Discrepancy in information between "Drawing/GIS /IMQS" and "Actual Situation in the field" in Zone Configuration



Hazyview Case



Key Attributes

1. Pipe Location
2. Valve position
3. Fire-hydrant position
4. Connectivity
5. Diameter
6. Material
7. Depth
8. Integrity

What should we do for this kind of discrepancy?

- **Record & report to update the drawing (Paper/GIS/IMQS)**
- **Share the updated data regularly to officials (GIS section)**
- **You must check the revised drawing!**

=> Through the Zone Configuration activity

4. Any other items

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Technical Review and Recapping

The National
Non-Revenue Water (NRW) Training
for Municipalities by Municipalities
in South Africa

WATER IS LIFE, SANITATION IS DIGNITY

Programme Conceptual Flow

1st IBTC	NRW and Reticulation System Basics
1st WP	Problem Identification / Obtaining the Baseline / Workplace **Zone/area Configuration, Flow Measurement, Billing Data Analysis** A weak point of municipalities Most crucial part of this programme
2nd WP	Effective Countermeasures / Workplace
2nd IBTC	Outcome, Findings and Actions to be taken Way forward

Schedule

Day	Time	Contents	Remarks
2nd week (Preparatory)			
Day 6 - 10	-	- Preparation by learners in workplaces (DWS Coordinators support learners if necessary) - Confirmation of pilot DMA at the site - Starting data logging - Collect billing data in the DMA by learners	-
3rd week (Workplace)			
Day 11 (Mon)	am	* Travelling (DWS Coordinators and Facilitators)	-
	pm	Participant assembly, meeting about training plan and courtesy call	Office
Day 12 (Tue)	am	DMA configuration	Site
	pm	DMA configuration	Site
Day 13 (Wed)	am	DMA configuration	Site
	pm	DMA configuration, MNF (by step measurement) at night	Site
Day 14 (Thu)	am	Data retrieval and Data analysis	Site and office
	pm	Reporting (Baseline & problem identification)	Office
Day 15 (Fri)	am	Presentation to managers of each Municipality Wrap up workplace training results	Office
	pm	* Travelling (DWS Coordinators and Facilitators)	-
4th week (Buffer)			
Day 16 - 20	-	(DWS Coordinators support learners if necessary) (MNF and SIV measurement if necessary)	-
5th week (Workplace)			
Day 21 (Mon)	am	Travelling (DWS Coordinators and Facilitators)	-
	pm	Participant assembly and meeting about training plan	Office
Day 22 (Tue)	am	NRW Countermeasures	Site
	pm	NRW Countermeasures	Site
Day 23 (Wed)	am	NRW Countermeasures	Site
	pm	NRW Countermeasures, MNF (by step measurement) at night	Site
Day 24 (Thu)	am	Data retrieval/analysis	Office
	pm	Preparation for presentation (Findings, results, remaining issues, strategic implementation planning with considering funding application)	Office
Day 25 (Fri)	am	Presentation to relevant managers Wrap up workplace training results	Office
	pm	* Travelling (DWS Coordinators and Facilitators)	-

6th week (IBTC)			
Day 26 (Mon)	-	-	-
Day 27 (Tue)	-	-	-
Day 28 (Wed)	-	* Traveling (facilitators and learners)	-
Day 29 (Thu)	8:30-10:00	Workplace training results, findings and actions to be taken, Q&A [Presentation]	Room
	10:15-11:50	Workplace training results, findings and actions to be taken, Q&A [Presentation]	Room
	Lunch		
	13:00-14:00	Modification of presentations	Room
	14:15-16:00	Follow-up lectures [Theory & Practices]	Room / Yard
Day 30 (Fri)	8:30-9:00	Output Sharing Seminar * Invite various stakeholders Introduction of participants [Orientation]	Room
	9:00-11:00	Workplace training results, findings and actions to be taken, Q&A [Presentation]	Room
	11:00-11:50	Overall evaluation and assessment	Room
	Lunch		
	pm	* Travelling (facilitators and learners)	-

Day 6-10: Preparation by municipalities as well as DWS(WUE&IBTC) & JICA Team for their trip

Workplace Daily Activity: 9h00 to 16h00 (standard)

Members of Workplace Training

- + **Learners** ----- 3-5 persons
- + **Facilitators (Municipalities)** ----- 2 persons
- + **Coordinator (DWS)** ----- 1 person
- + **Technical support (JICA)** ----- 1 person

Learners:
- Municipal water services officials (3-5 officials as a team consisting WCWDM, O&M, Billing, etc)

Facilitators:
- Skilled and experienced municipal water services officials
- DWS officials

Coordinator:
- DWS officials

Workplace Training (Baseline)

1) Isolation confirmation in DMA & Sub-Zones and Findings on Pipelines and Drawings
↓
2) Identification of problematic sub-zone(s) by flow logging data
↓
3) Analysis of Billing data and calculate NRW from Current SIV
↓
4) Findings in O&M and Billing

IWA Water Balance Process (in SA)

A. Determine System Input Volume (SIV)
(Reading data of purchase water, outflows from WTWs, boreholes, etc.)
↓
B. Determine/Estimate Billed Authorized Consumption: Revenue Water
(Metered / Unmetered)
↓ **A (SIV) - B (Revenue Water) = NRW**
C. Determine/Estimate Unbilled Authorized Consumption
(Metered / Unmetered)
↓
D. Estimate Commercial Loss
(Unauthorized consumption, Customer meter inaccuracy)
↓
E. Estimate Physical Losses
Physical Losses (Leakages) = NRW - C - D

Water Balance in our DMAs to reflect Reality

A. Determine System Input Volume (SIV)
(Bulk flow measurement)
↓
B. Determine/Accurately-Estimate Billed Authorized Consumption: Revenue Water
(Metered / Unmetered)
↓ **A (SIV) - B (Revenue Water) = NRW**

Physical Loss
D. Determine Physical Loss ⇦ ***Easiest to measure***
Minimum Night Flow = Leakage *There is possibility of inclusive of small consumption and domestic leaks.
↓
Apparent Loss
C. Determine/Accurately-Estimate Unbilled Authorized Consumption
(Metered / Unmetered)
E. Accurately-Estimate Commercial Loss
Commercial Loss (Unauthorized consumption, Customer meter inaccuracy) = NRW - D -C

Tips for Presentation

Full-Coverage Information
↓
Reconfiguration according to Audience
↓
If audiences are decision makers, Simple Facts and Recommendation in their languages
↓
If audiences are colleagues in the practical level, Details in Procedures and Setting
↓
If audiences are nontechnical, interpretation to their languages
↓
Highlighting by coloring, bold and inducing audiences' interests and questions
↓
Slide numbering, Recording, Photos, Graphic (Visualization)
↓
List of Team members and Contacts

Equipment for the Workplace Training

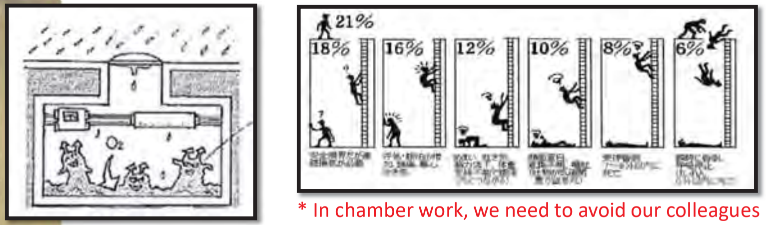
Munics must have:
- Gas/O_2 Checker
- Ventilation fan

Better to have:
- ☐ Logger & Pulsar
- ☐ listening stick
- ☐ Transceiver
- ☐ Flashlight
- ☐ Chalk
- ☐ Digital camera
- ☐ Tablet (iPad)

☑:Rental from IBTC during Workplace Training

Equipment for Safety

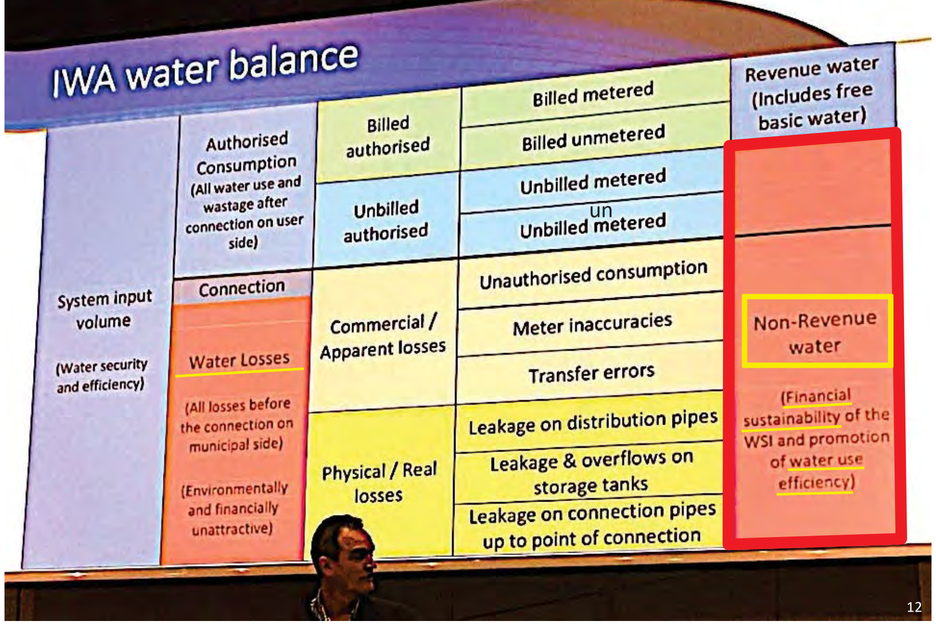
Munics must have:
- Gas/O_2 Checker
- Ventilation fan



* In chamber work, we need to avoid our colleagues to lose their lives. (Air that has no O_2 causes sudden death. And that is invisible) **If you haven't confirmed O_2 level, never go into the chamber**

Again, What is NRW?

What is NRW?



What is NRW?

NRW is a KPI, INCLUDES;

- Physical Losses → *Technical aspect*
- Commercial Losses, billing → *Institutional aspect*

it represents:

“EFFICIENCY OF WATERWORKS AS A BUSINESS” of each municipality

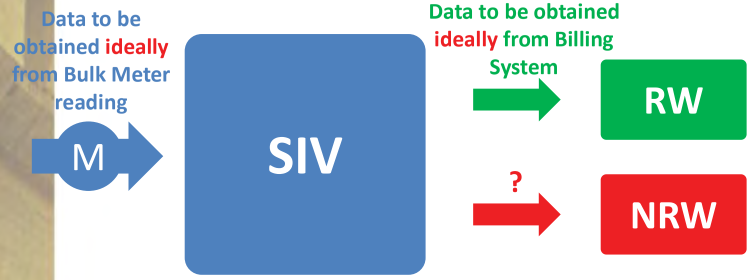
Why business? :

Sustainability is vital !

(including financial aspect)

Non-Revenue Water Basics

Simple way to identify municipal NRW



$SIV\ (m^3) = RW\ (m^3) + NRW\ (m^3)$

i.e. $NRW = SIV - RW$

Volumes to be in the same period!

NRW Ratio (%) = (SIV-RW)/SIV x 100%

The situation of NRW in SA

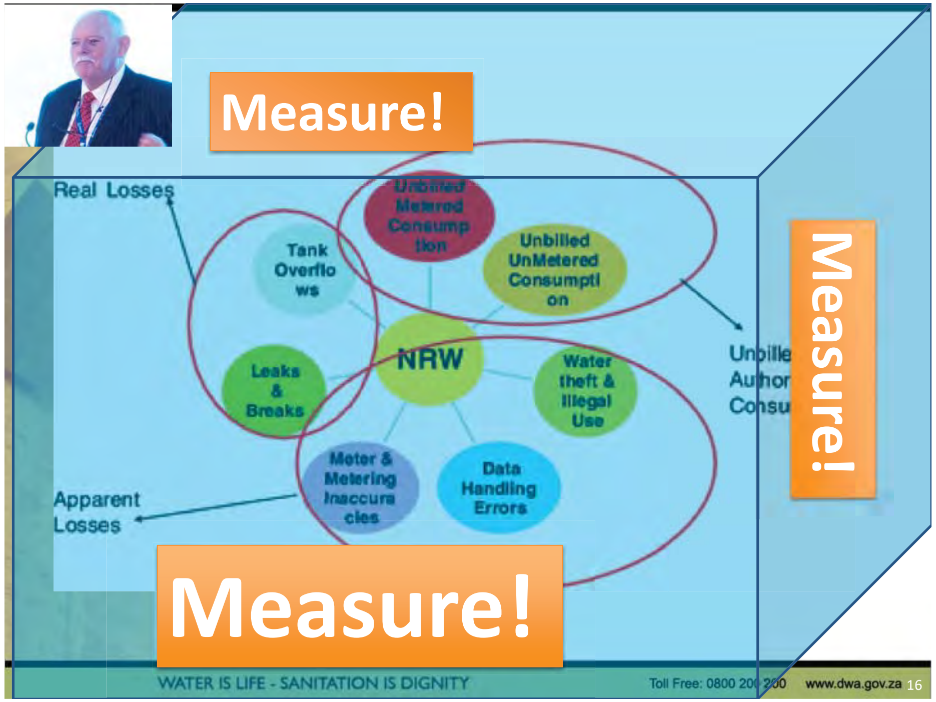
In general, We don’t know Actual situation of NRW.

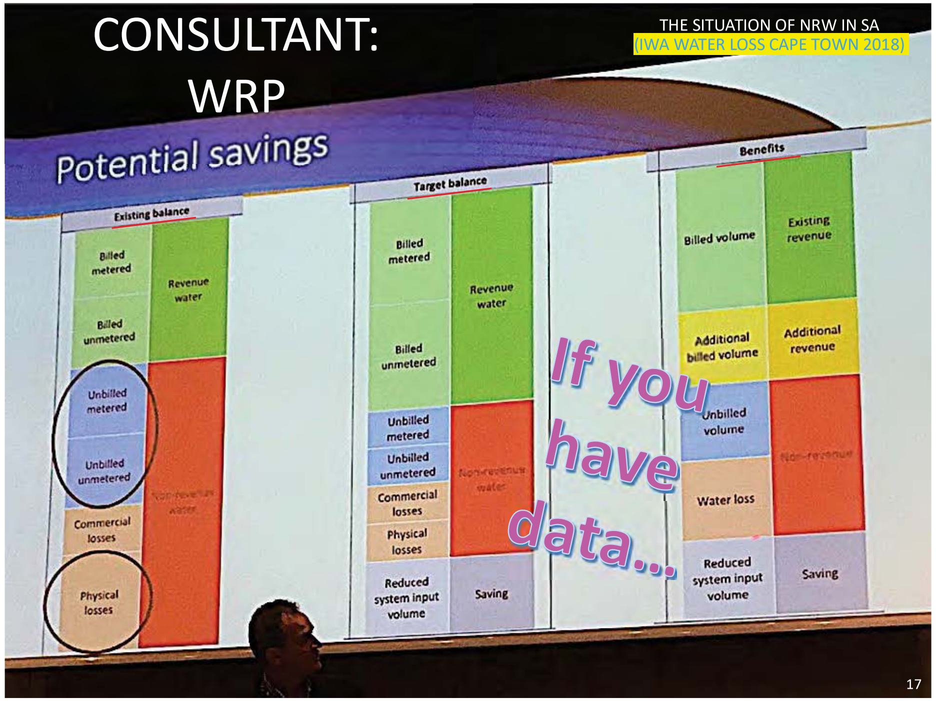
Because of lacking of the data (Water balance)

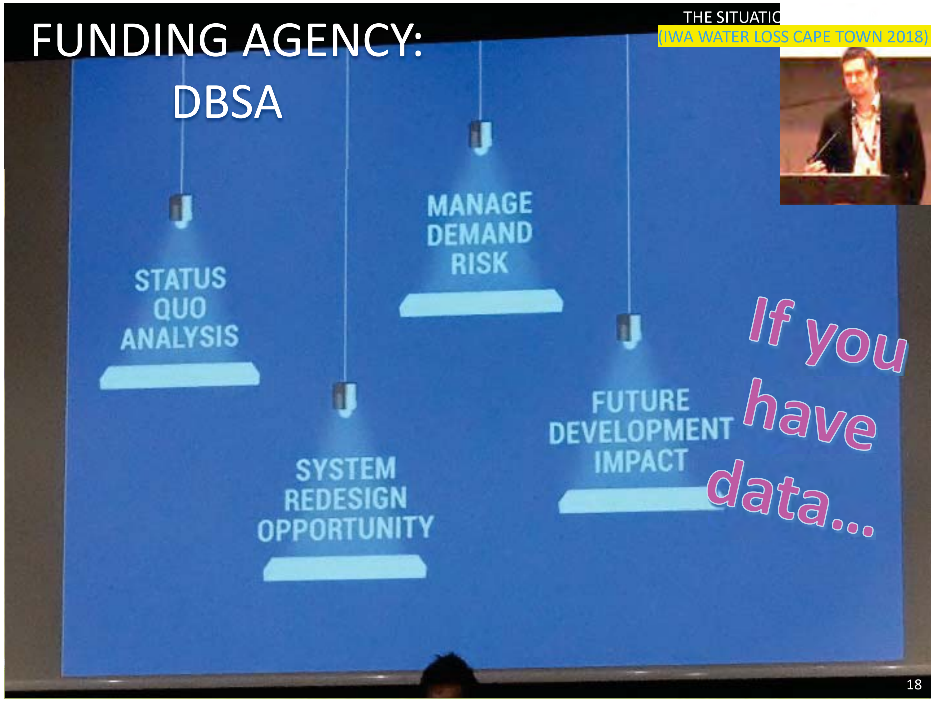
No drop submission and valid data set is only half!

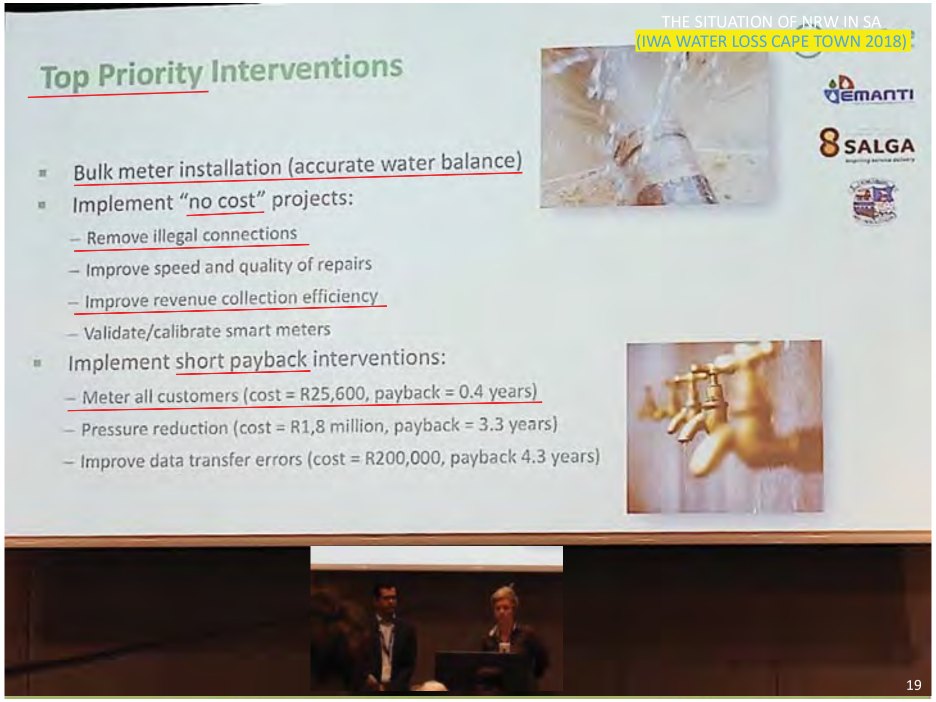
The situation is that we don’t know the status quo of NRW!

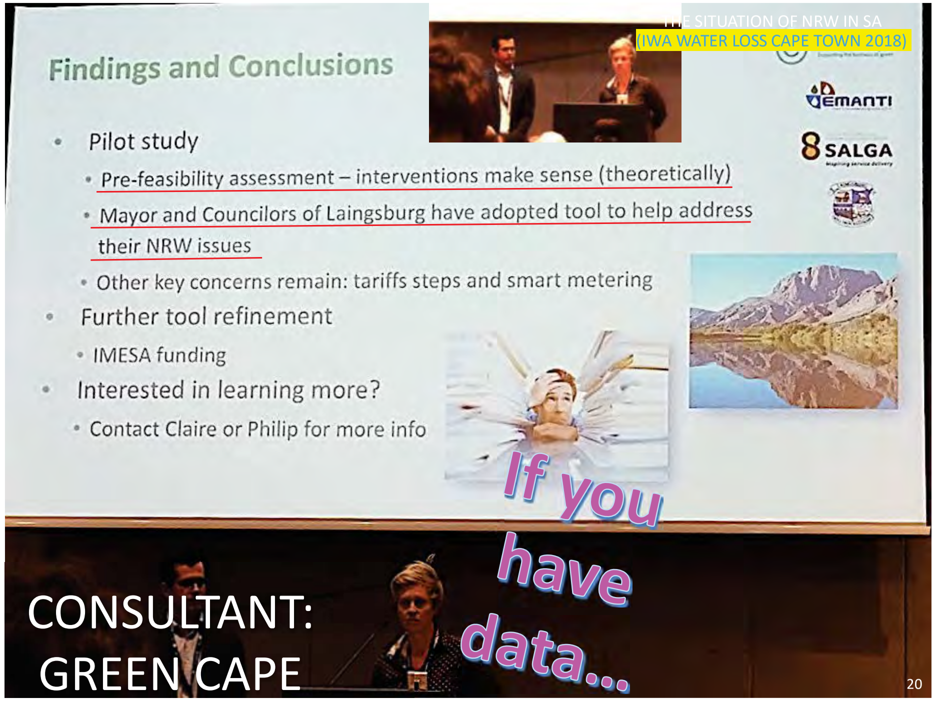
-very primitive !




CONSULTANT:
WRP
THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)
Potential savings
Existing balance
Billed metered
Billed unmetered
Unbilled metered
Unbilled unmetered
Commercial losses
Physical losses
Revenue water
Target balance
Billed metered
Billed unmetered
Unbilled metered
Unbilled unmetered
Commercial losses
Physical losses
Reduced system input volume
Revenue water
Saving
Benefits
Billed volume
Existing revenue
Additional billed volume
Additional revenue
Unbilled volume
Water loss
Reduced system input volume
Saving
If you have data...
17

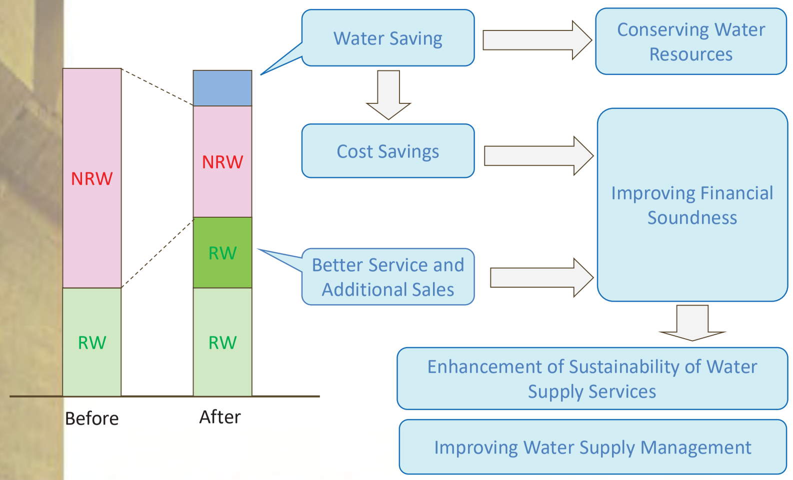

FUNDING AGENCY:
DBSA
THE SITUATIC
(IWA WATER LOSS CAPE TOWN 2018)
STATUS QUO ANALYSIS
MANAGE DEMAND RISK
SYSTEM REDESIGN OPPORTUNITY
FUTURE DEVELOPMENT IMPACT
If you have data...
18


THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)
Top Priority Interventions
Bulk meter installation (accurate water balance)
Implement "no cost" projects:
– Remove illegal connections
– Improve speed and quality of repairs
– Improve revenue collection efficiency
– Validate/calibrate smart meters
Implement short payback interventions:
– Meter all customers (cost = R25,600, payback = 0.4 years)
– Pressure reduction (cost = R1,8 million, payback = 3.3 years)
– Improve data transfer errors (cost = R200,000, payback 4.3 years)
DEMANTI
SALGA
19


THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)
Findings and Conclusions
Pilot study
Pre-feasibility assessment – interventions make sense (theoretically)
Mayor and Councilors of Laingsburg have adopted tool to help address their NRW issues
Other key concerns remain: tariffs steps and smart metering
Further tool refinement
IMESA funding
Interested in learning more?
Contact Claire or Philip for more info
DEMANTI
SALGA
If you have data...
CONSULTANT:
GREEN CAPE
20

Why NRW management is necessary?

Impacts by NRW management (example)

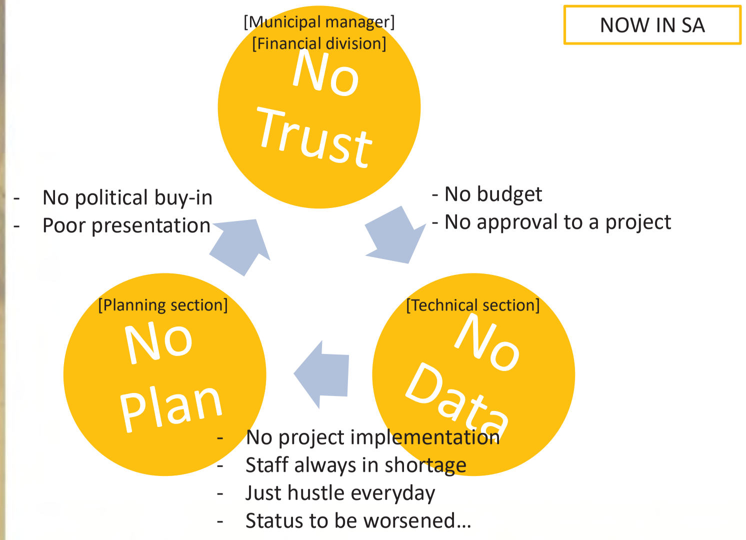


Why NRW management is necessary?

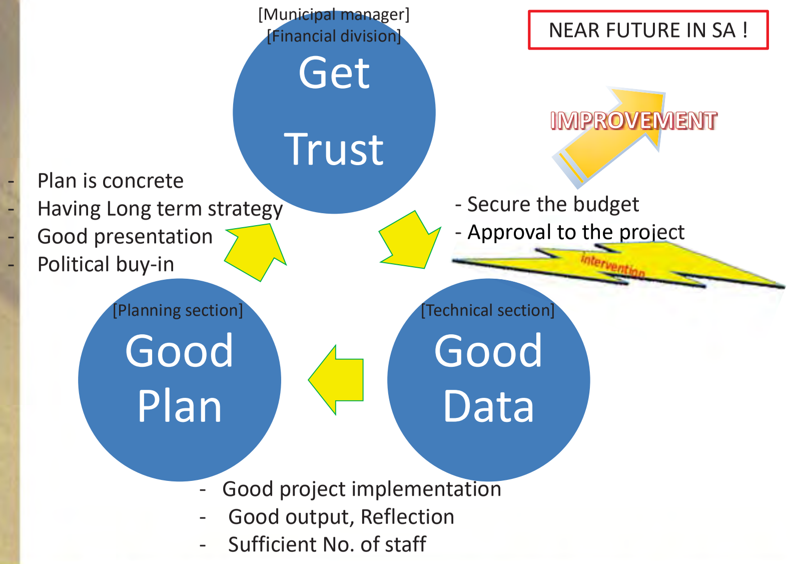
Impact of NRW management

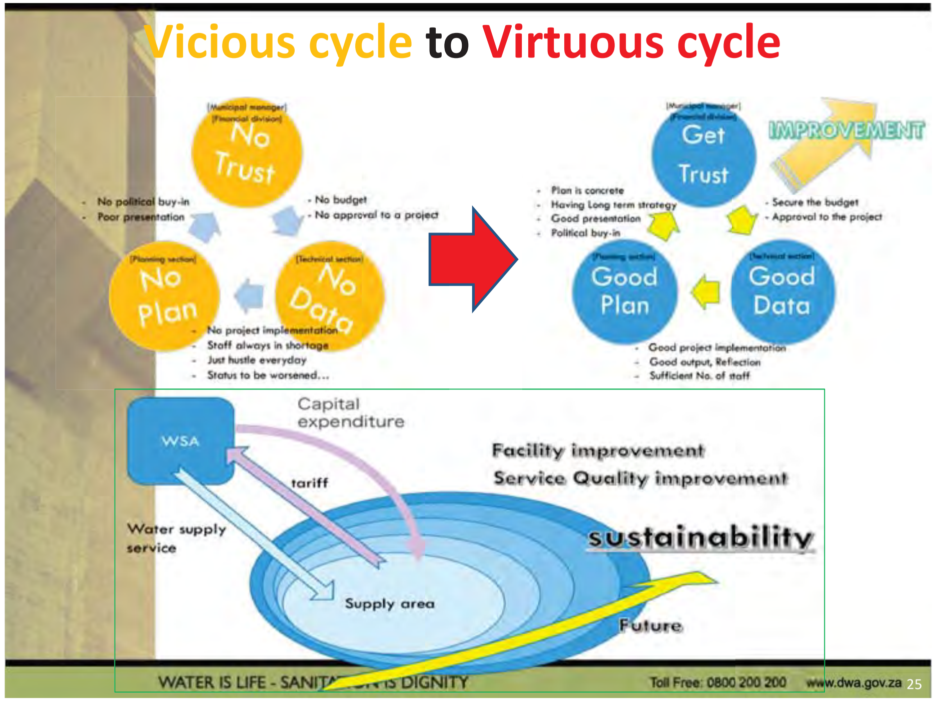
- Reduction of production cost
- Reduction of O&M cost
- Increased revenue generation
- Contribution to water conservation
- Saving/delaying capital investments
- Improvement of efficiency and financial sustainability
- Increase water supply coverage
- Improvement of customer satisfaction

Vicious cycle to Virtuous cycle



Vicious cycle to Virtuous cycle





Vicious cycle to Virtuous cycle
[Municipal manager]
[Financial division]
No Trust
- No political buy-in
- Poor presentation
- No budget
- No approval to a project
[Planning section]
No Plan
[Technical section]
No Data
- No project implementation
- Staff always in shortage
- Just hustle everyday
- Status to be worsened…
[Municipal manager]
[Financial division]
Get Trust
IMPROVEMENT
- Plan is concrete
- Having Long term strategy
- Good presentation
- Political buy-in
- Secure the budget
- Approval to the project
[Planning section]
Good Plan
[Technical section]
Good Data
- Good project implementation
- Good output, Reflection
- Sufficient No. of staff
WSA
Capital expenditure
tariff
Water supply service
Supply area
Facility improvement
Service Quality improvement
sustainability
Future
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25

PRESENTATIONS

(3RD GROUP/INTAKE, 1ST STAGE ONLY, ONLINE)

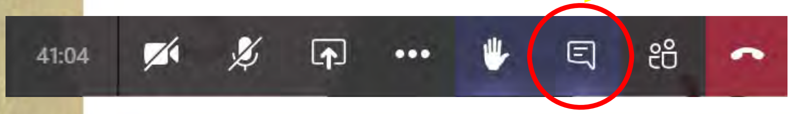
Housekeeping Rules

- Switch off video and microphone (mute audio)
- We request that delegates make use of the Q&A chat function to post all questions. These questions will be answered either as a live or type response by any, or your selected, facilitator (panelist/lecturer).
- Use the chat box to share general comments, ideas and engage in the dialogue.
- Delegates may raise their hand to indicate that they need to say something to either the host or anyone of the facilitators (panelists/lecturers).
- Wait for the facilitator (panelist/lecturer) to call on you or unmute you microphone.
- Presentations will be made available via email or cloud storage.

Webinar (Online-Training) Questions

- Submit questions to any panelist using the Q&A chat box at any time.
- The Q&A chat box allows you to track questions and answers throughout the webinar (online training).
- To use the Q&A chat box function

Click Here



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Department: Water and Sanitation
REPUBLIC OF SOUTH AFRICA

SALGA inspiring service delivery

Japan International Cooperation Agency JICA

The National Non-Revenue Water (NRW) Training
for Municipalities by Municipalities in South Africa

Part I: Orientation

under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Learners are asked to

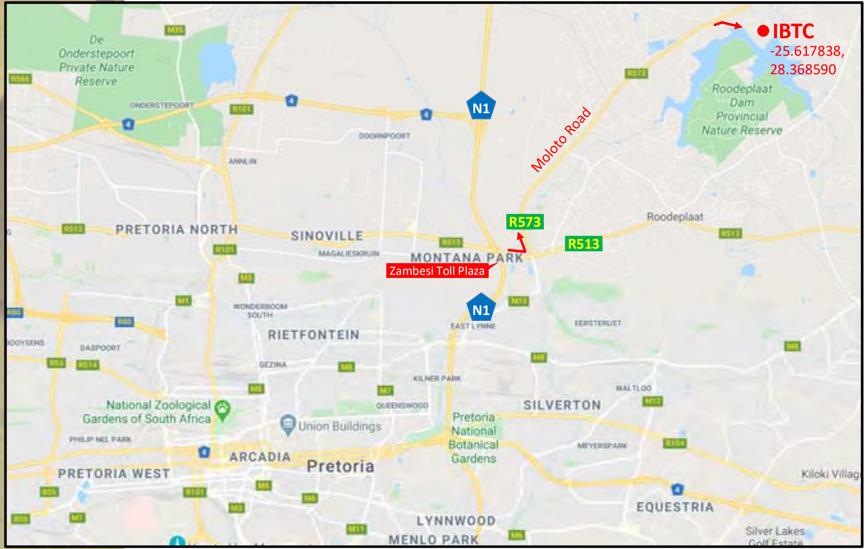
- Respect others, without any discrimination, regardless of culture, ability, race, gender, age or sexual orientation.
- Are courteous and respectful of host venues and training centres.
- Show a positive commitment to your own development and learning.
- Show respect for another learners' development.
- That you attend and arrive punctually to training/assessment events that you have been scheduled to take.
- That you cooperate with other learners, facilitators and IBTC staff.
- Understand that learner's progress at different paces.
- Understand that there is a certain amount of necessary paperwork which must be completed by each learner.
- Take care of equipment, facilities and buildings and show respect to others.
- Take due notice of health and safety related regulations applicable at IBTC (refer to IBTC facility induction).
- Preferably, put on the necessary protective equipment such as work suit and safety boots in the training yard.

Misconduct

- Failure to follow Health & Safety Regulations.
- Conduct which prevents, obstructs, or disrupts teaching, learning or administration of training/assessment.
- Disruption to a training course or assessment, either directly or by lack of cooperation, that affects other learners on the programme.
- Failure to follow the reasonable instructions and requests of the facilitator or a representative of the IBTC.
- Disorderly behaviour or the use of bad or abusive language.
- Causing damage to the premises, equipment or property of another learner, facilitator.
- Behaviour or language which is racially or sexually offensive, or which is offensive to those with disabilities and LGBT people.
- Violence or a threat of violence.
- Drunkenness or illegal use of drugs whilst on the IBTC premises while attending a training course/assessment.
- Activity that is classified as illegal whilst attending a training or assessment event.
- Failure to follow health and safety instructions that may cause or have caused serious injury.

Access to IBTC

SKIP



Source: Map from Google Map

IBTC Site and Facilities

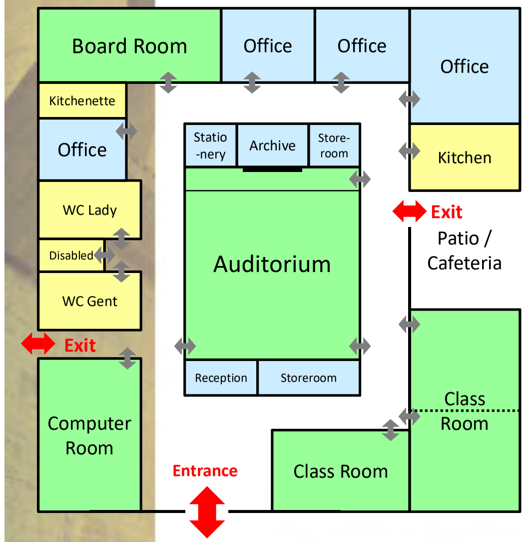
SKIP

Source: Satellite Image from Google Map

IBTC Facilities

SKIP

Main Building Plan with Evacuation



Main Building
- Auditorium (for 65)
- Class room x 3 (for 18 each)
- Computer room (for 18)
- Office room x 4
- Board room (for 25)
- Patio/Cafeteria and others

IBTC Guest House
- Bed rooms x 30 (for 54 max.)
- Dining hall (for 150)

Workshop
- Concrete material Test
- Diesel maintenance
- Plumbing

NRW Training Yard
- Bulk meter, PRV and fittings
- Data logging and pipe connection
- Leakage detection and water meter reading
- Zone configuration (drop test, step test)

Notices / Prohibitions in the Training Yard

SKIP

- No smoking and flammable: Keep fire away
- No firearms
- No food and drink
- No wasting water for water conservation
- No removal of facilities and equipment
- No access or operations without Facilitators or Yard Assistance being present
- No putting foot and standing on pipes and valves
- No leaning on hydrants and standpipes
- No operation of the pump except by Yard Assistance
- No operation of the pump when water is low or empty in the tank
- Not more than 9 bar for water pressure

The Nearest Store

SKIP

Source: Satellite Image from Google Map

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The National Non-Revenue Water (NRW) Training for Municipalities by Municipalities in South Africa

Part II: Programme

under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Key Concept:

"By Municipalities for Municipalities"

Partnering Municipalities for Facilitation

CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD
CITY OF TSHWANE
City of Ekurhuleni
ETHEKWINI MUNICIPALITY
Joburg
BUFFALO CITY
CITY OF MBOMBELA
GEORGE

Supported by

water & sanitation, Department: Water and Sanitation, REPUBLIC OF SOUTH AFRICA
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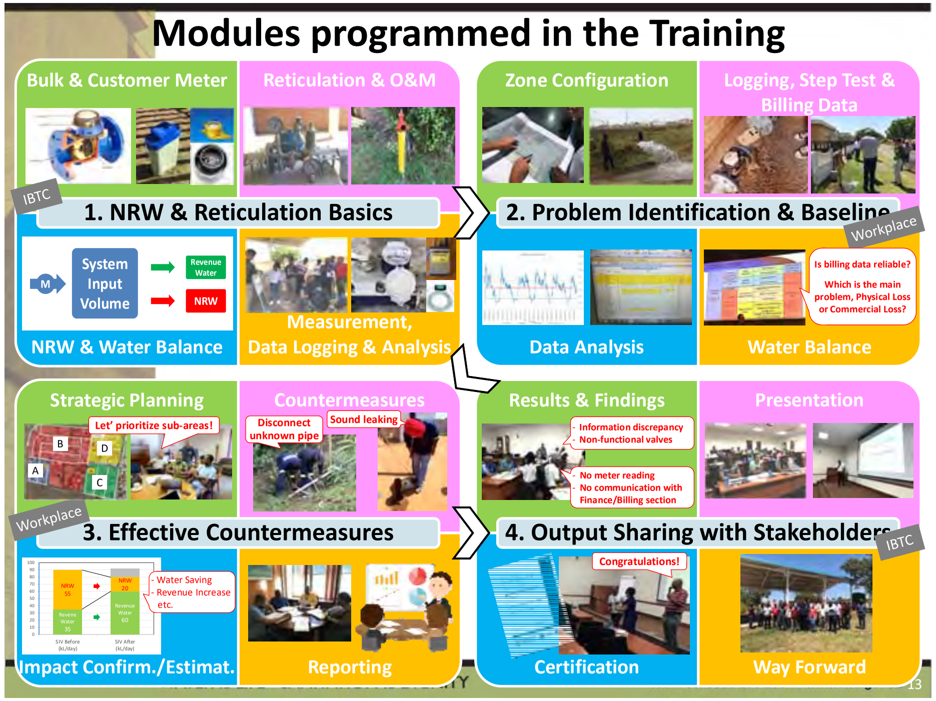

Programme Outline of Online Training (Knowledge)

Time	Module	By
17th Nov. 2020 Day-1: I. Introduction and Icebreak		
9:00-10:00	a. Orientation and Introduction	DWS
10:00-11:00	b. WCWDM and NRW in Municipal Water Services of South Africa	DWS
11:00-12:00	c. NRW-related Problem Awareness Workshop	DWS/Facilitator
12:00-12:15	Orientation to Day-2, Questionnaire and Homework (if any)	DWS
18th Nov. 2020 Day-2: II. Fundamental Knowledge and Skills for NRW		
9:00-10:00	d. Technical Aspects: Water Reticulation	Facilitator
10:00-11:00	e. Institutional Aspects: Metering and Billing	Facilitator
11:00-12:00	f. Data Collection (Logging)	Facilitator
12:00-12:15	Orientation to Day-3, Questionnaire and Homework (if any)	DWS
19th Nov. 2020 Day-3: III. Current State Analysis on the ground to Start Now		
9:00-10:00	g. Zone Configuration and Drop Test	Facilitator
10:00-11:00	h. MNF and Step Test	Facilitator
11:00-12:00	j. Practices by using a simulated DMA	Facilitator
12:00-12:15	Orientation to Day-4, Questionnaire and Homework (if any)	DWS
20th Nov. 2020 Day-4: IV. Case Study for On-the-Ground Actions		
9:00-10:00	k. Case Studies (from the previous trainings)	DWS/Facilitator
10:00-11:00	l. Data Utilization/Arrangement and Presentation	DWS/Facilitator
11:00-12:00	m. Actions and Way Forward	DWS/Facilitator
12:00-12:30	Orientation to the Practices/Workplace Training and Questionnaire	DWS

Practices @ Yard (IBTC, Pretoria) and Workplace components will be in February and March 2021.

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The National Non-Revenue Water (NRW) Training
for Municipalities by Municipalities in South Africa

Part III: Introduction

under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Introduction of Participants

1. Facilitator(s) and Lecturers
2. Learners from Participating Municipalities
3. DWS
4. SALGA
5. JICA Expert Team
6. Stakeholders

Introduction of Participating Municipalities

1. Profile of the municipality

- Population
- Location
- Geography
- Climate
- Socio-economy
- Industry, etc.

2. Outline of water services of the municipality

- Population serve
- Service connection
- Water sources
- Supply capacities
- Water section's organizational information
- NRW and ongoing measures if any, etc.

Tips for Presentation

1. Full-coverage information
2. Reconfiguration according to audiences
3. For decision makers, simple facts and recommendation in their languages
4. For colleagues in the practical level, details in procedures and setting
5. For non-technical people, interpretation to their languages
6. Highlighting by coloring, bold and inducing audiences' interests and questions
7. Slide numbering, recording, photos, graphic (visualization)
8. List of team members and contacts (in this training proramme)

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Thank You

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The National Non-Revenue Water (NRW) Training for Municipalities by Municipalities in South Africa

Introduction: Overview of Water Conservation and Water Demand Management and Non-Revenue Water

under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Typical Characteristics of SA Water Services

1. Water provision: constitutional responsibility of municipalities as Water Services Authority (WSA) and often Water Services Provider (WSP)
2. Regional bulk water distribution by Water Boards or own Municipalities' water sources
3. Urban, peri-urban and rural water supply systems
4. Water sources: Surface (gams and rivers) , Groundwater (boreholes, wells, springs), Rainwater
5. Piped system inside the house or the yard, and communal water points
6. Access to free basic water: 25LCD within 200m. 10lit/min (communal points), 6,000lit/HH/month (house connection)
7. Water scarce among various water users under drought-sensitive environment

Typical Backlog of SA Water Services

1. Weak governance
2. Slow decentralization particularly in financial aspects
3. Limited connection between national budgets and requirements for municipal water financing
4. Not autonomous financing (water sales in general accounting)
5. Lack of finance to meet investment requirements
6. Inappropriate financing and pricing arrangements
7. Weak monitoring and evaluation
8. Lack of better accountability and responsiveness to consumers
9. Lack of skills and knowledge transfer/management
10. Under-investment in infrastructure maintenance and refurbishment **Keyword (Key Performance Indicator) in the Training**
11. NRW at high ratio (limited improvement in the past decade)

Points to remember through the Training

1. Three key factors in water reticulation management: Water flow, pressure and quality
2. Necessity of understanding technical knowledge on reticulation (pipe, appurtenances, measuring) and its maintenance points
3. On-the-ground common problems in municipal water services (meter reading, meter conditions, data assembling and interface, and interdivisional communication, etc.)
4. The National NRW Training introduces a reticulation management methodology using a DMA(s) to solve NRW-related problems in the field.

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The National Non-Revenue Water (NRW) Training
for Municipalities by Municipalities in South Africa

Part-II: Background to Water Conservation and Water Demand Management

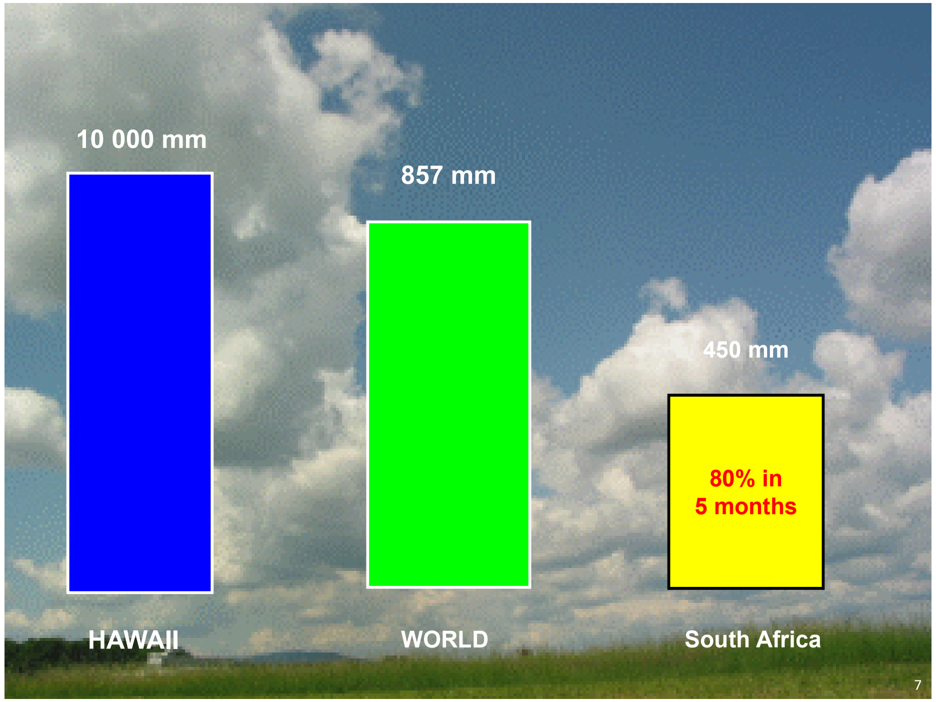
in South African Perspective

Directorate: Water Use Efficiency, DWS

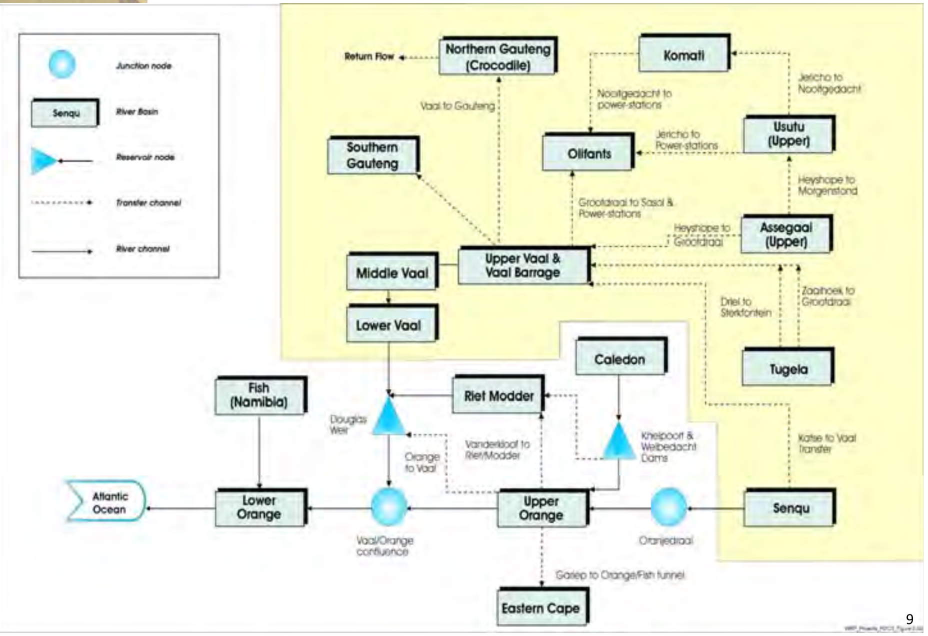
under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Presentation Overview

- **Water Availability Situation**
  - Water Scarcity and climate change
  - Competition for it
- **Need for WC/WDM**
  - Water losses, wastages and inefficient across sectors
  - WC/WDM Challenges
- **WC/WDM Planning Regime**
  - Logical framework approach to WC/WDM
  - IWA Water Balance
  - Situation Assessment, develop Business Plan and Implementation Strategies with monitoring and reporting
- **What needs to be done**
  - Explore simple WC/WDM solutions in the Municipalities
  - WC/WDM forms part of WSDP and IDP
  - National Water Services Information System
- **Conclusions**
  - WC/WDM integral part of water services macro planning



Simplified Complicated Integrated Vaal River System



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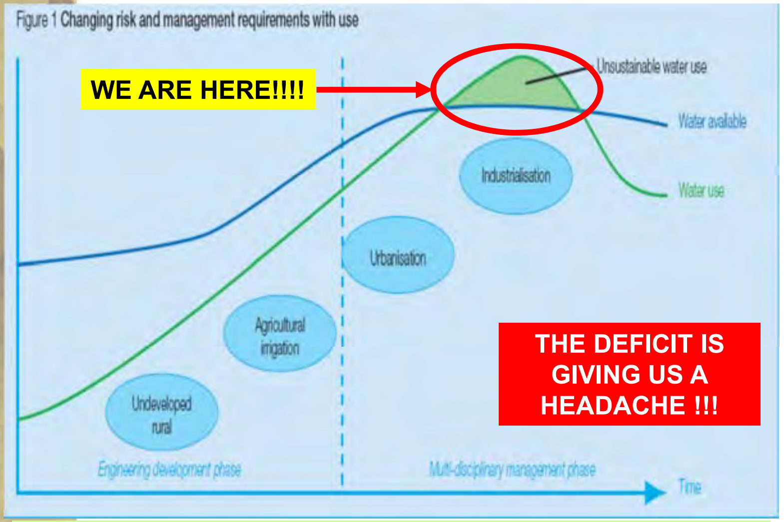
PUTTING THINGS IN PERSPECTIVE….



Pegram et al, 2007: ALLOCATING SCARCE WATER :
A Primer on Water Allocation, Water Rights & Water Markets…

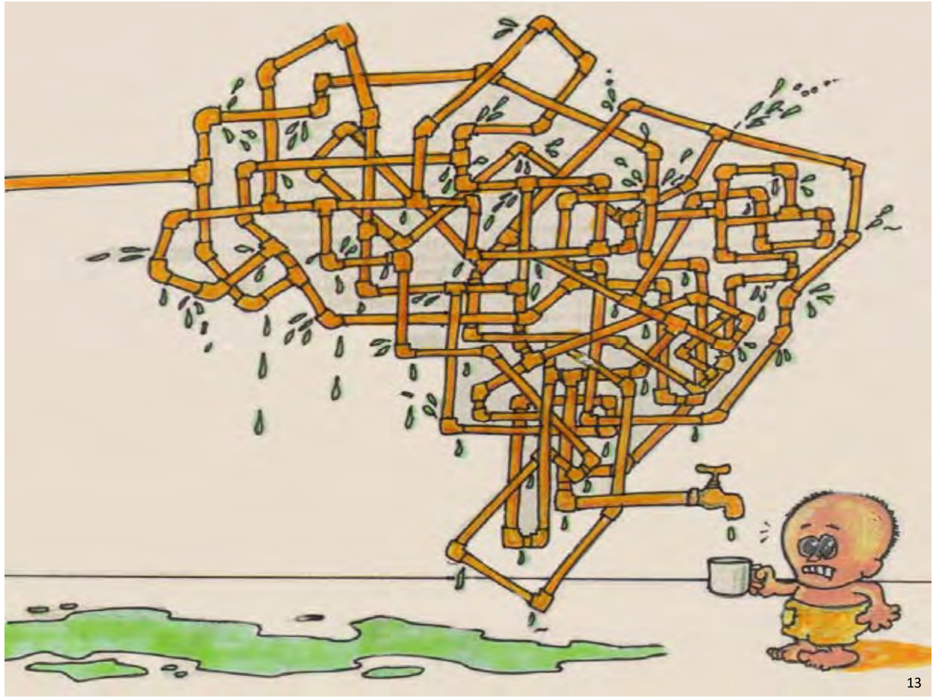
In the nut there is for WCWDM…

- SA is a water scarce country
- Many catchments are already in (water) deficit
- Water is required for:
  - Economic growth (6% NDP)
  - Basic human needs (Social dev)
  - Reserve (environment)
  - International agreements (Inco-Maputo)
  - Equity/ redistribution (WAR)
- Further augmentation increasingly expensive:
- **TRUE VALUE OF H_2O=Sustainable Water Services**

Reflecting On It

Do Opportunities exist for…

WC/WDM



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Example: ***** Local Municipality

System Input Volume 36 962 000 m³/annum	Billed and paid for Consumption 1 848 000 m³/annum	5%
	Free basic water 7 246 000 m³/annum	20%
	Apparent losses 1 396 000 m³/annum	4%
	UARL (2 to 3 times) 4 396 000 m³/annum	12%
	Potential saving on physical leakage and inefficient consumption 22 300 000 m³/annum	59%

Water Balance

15

Wondering Why Is It Not Happening?

- No institutionalization of WC/WDM within WIs
- WC/WDM NOT a PRIORITY (just a nice talk about)
- No Funding for WC/WDM programmes
- No Commitment, Teachability & Focus on WC/WDM

MINDSET ISSUE: A PARADIGM SHIFT TO OVERCOME THE WC/WDM INERTIA

WATER SERVICES PLANNING APPROACH FOR WC/WDM

- How much water is being lost?
- Where is the water being lost?
- Why is the water being lost
- What strategies (WC/WDM interventions) can
- be used to reduce water losses/manage demand and improve performance?
- How we maintain the WDM strategy & sustain the achievement gained?

IWA WATER BALANCE

AT THE HEART OF MUNICIPAL WC/WDM PLANNING

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

Prioritization = Know What To Do But Nothing Gets Done

–

Concentration = Demonstrate Excellence With No Progress

Prioritization

+

Concentration

=

Delivers Excellency In Service Delivery:

Hopefully Is Enjoyable Too!!

Project Approach & Methodology

OVERVIEW OF THE SITUATION ASSESSMENT AND BUSINESS PLAN

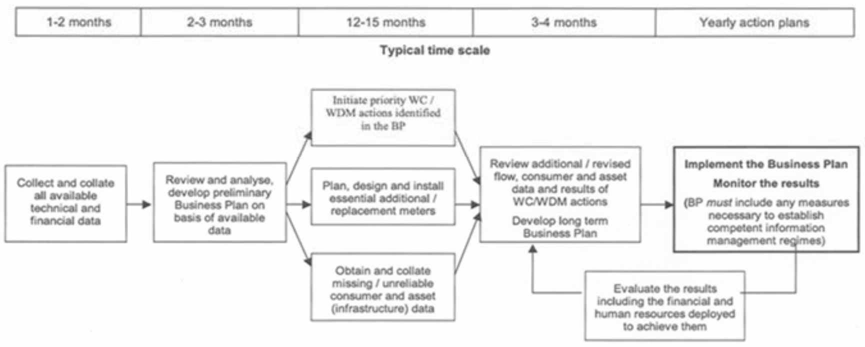

Figure 2.1: Stages in planning and implementation of WCDM Business Plan

VOLUME 2: WSI SITUATION ASSESSMENT AND BUSINESS PLAN *MARCH 2004* *PAGE 10*

Key Take-Away Points

- ✓ WC/WDM is an important part of Macro Planning.
- ✓ Provision of reliable, cost effective and sustainable water services rests on WC/WDM.
- ✓ Every Municipality is required to develop WC/WDM strategy plan as a part of WSDP and IDP.
- ✓ Every Municipality is required to report its progress quarterly to DWS.
- ✓ No need to plan and develop new or upgrade existing infrastructures at municipalities with high water losses.
- ✓ Priority requirement is to reduce water losses and Non Revenue Water.

The National NRW Training

- **To assist the participating municipalities practically in develop/improve WC/WDM (incl. Water Balance, No-Drop Assessment).**
- To expect your knowledge and experiences obtained through the Training to be used for not only your municipality but also water sector, particularly neighboring municipalities.

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The National Non-Revenue Water (NRW) Training for Municipalities by Municipalities in South Africa

Part II: NRW and Water Balance

under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Expected Outcome

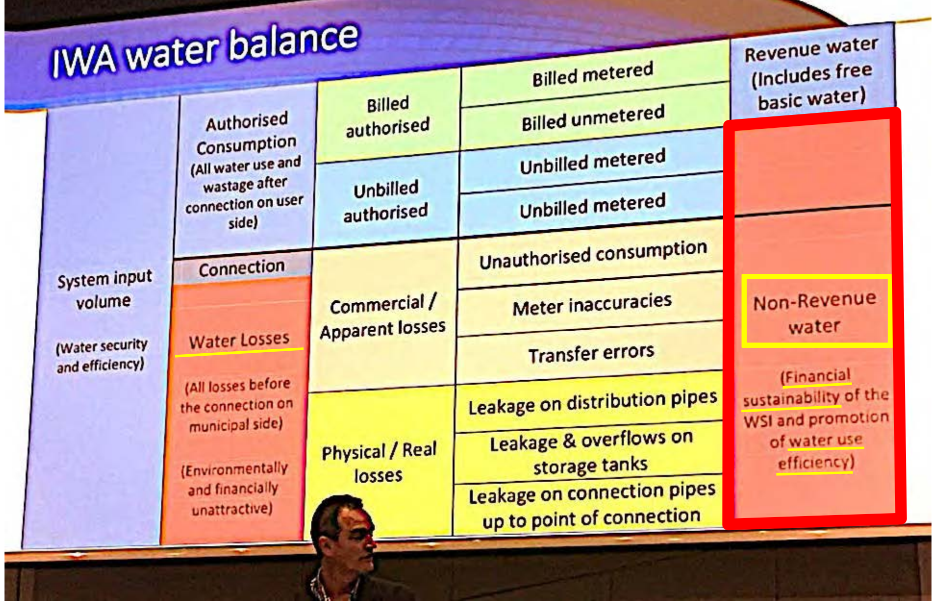
1. To understand the concept NRW
2. To understand why NRW management is necessary
3. To understand what water balance is

Non-Revenue Water Basics

Non-Revenue Water (NRW) :

Water that has been produced and is ‘lost’ before it reaches the customer, <u>and which is not billed</u>. Losses can be real (physical) losses (for example through leaks) or apparent losses (for example through theft, metering inaccuracies, data handling error, and so on)

What is NRW?



Water Balance

Water Balance by International Water Association (IWA)

System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water
			Billed Unmetered Consumption	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non-Revenue Water (NRW)
			Unbilled Unmetered Consumption	
	Water Losses	Commercial (Apparent) Losses	Unauthorized Consumption	
			Customer Metering Inaccuracies and Data Handling Errors	
		Physical (Real) Losses	Leakage on Transmission and/or Distribution Mains	
			Leakage and Overflows at Utility’s Storage Tanks	
			Leakage on Service Connections up to Point of Customer Use	

*Note: Free basic water is considered to be Revenue Water in SA

What is NRW?

NRW is a Key Performance Indicator (KPI), includes

- Physical Losses → *Technical aspect*
- Commercial Losses and Billing → *Institutional aspect*

It represents:

"Efficiency of Water Services as a Business" of each Municipality

Why business? :

Sustainability is vital ! (including financial aspect)

Non-Revenue Water Basics

How to identify municipal NRW

Technical Term

System Input Volume (SIV)

- The volume of water produced or purchased, and supplying municipal water supply system(s);
- These systems could be an entire water supply system, or a zone or an isolated area;
- The input volume must be measured by bulk input flow meter(s);
- Period of measurement could be on an annual, monthly, or daily basis etc (annual is more common)

Non-Revenue Water Basics

How to identify municipal Revenue Water

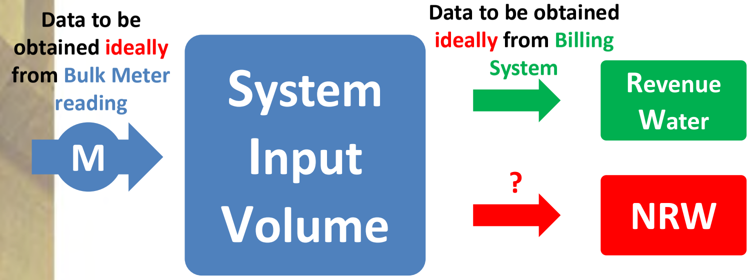
Technical Term

Revenue Water (RW)

- This is all billed metered and billed unmetered water consumption, which is measured and supplied to customers. In South Africa, free basic water is also considered to be revenue water.

Non-Revenue Water Basics

Simple way to identify NRW in the whole system or District-Metered Area (DMA)



SIV (kL) = RW (kL) + NRW (kL)   Volumes to be in the same period!

i.e. NRW = SIV – RW

NRW Ratio (%) = NRW/SIV x 100%

The Situation of NRW in South Africa

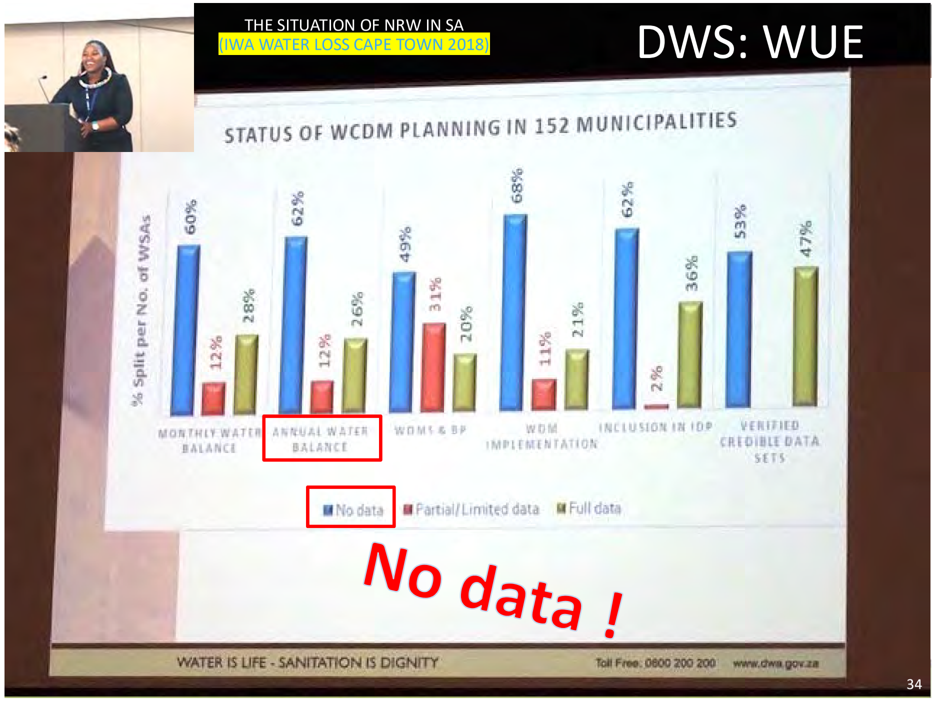
In general, we don't know the actual situation of NRW.

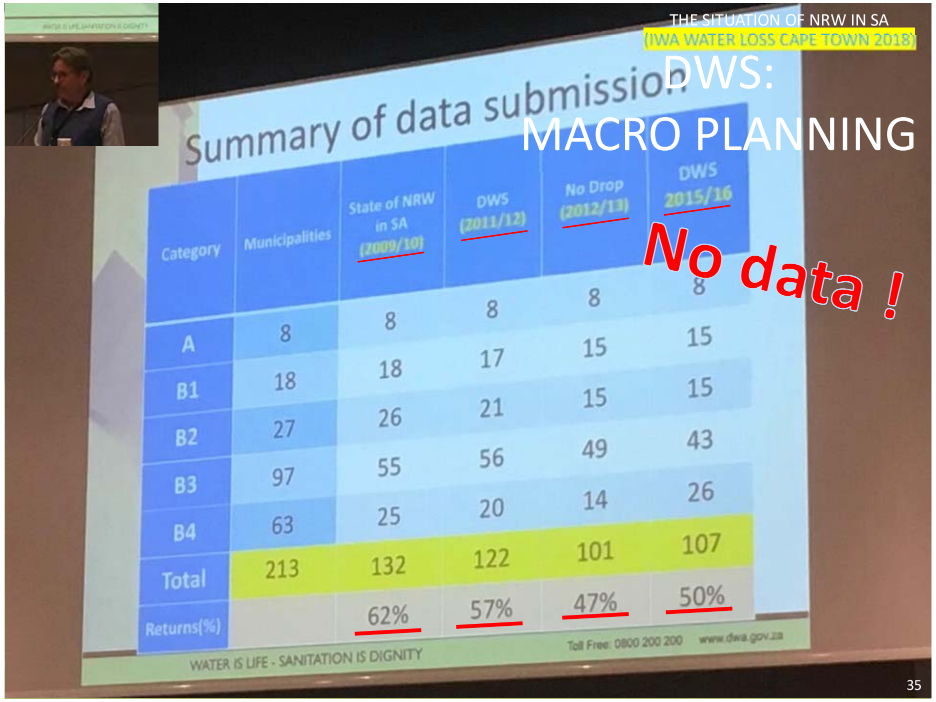
Because of **lacking of the data** (water balance)

No-Drop assessment submission and valid data set is only half!

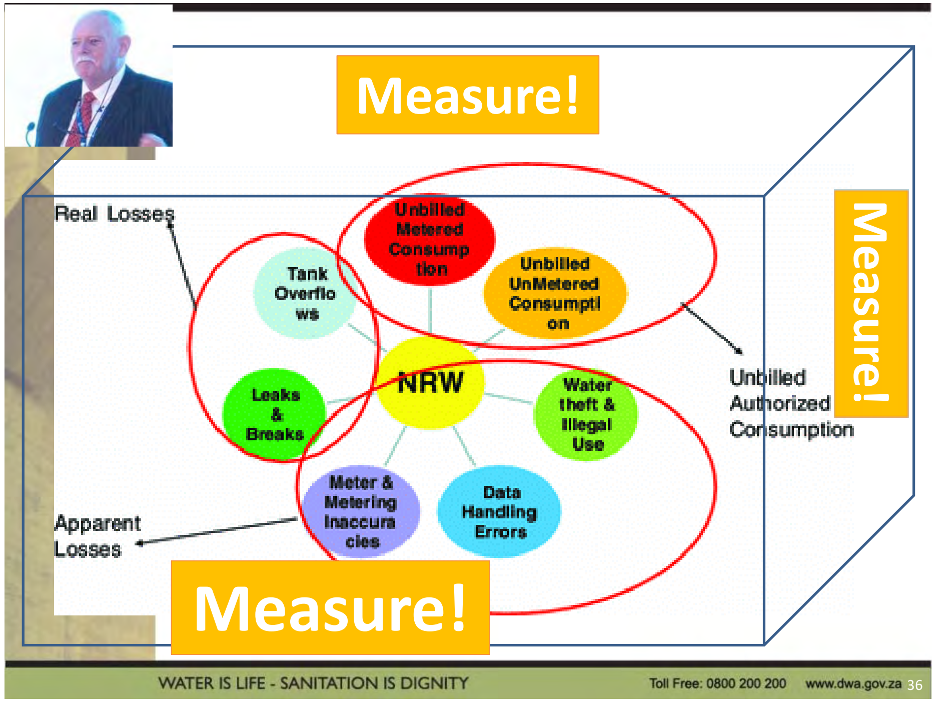
➡ The situation is that we don't know the status quo of NRW!

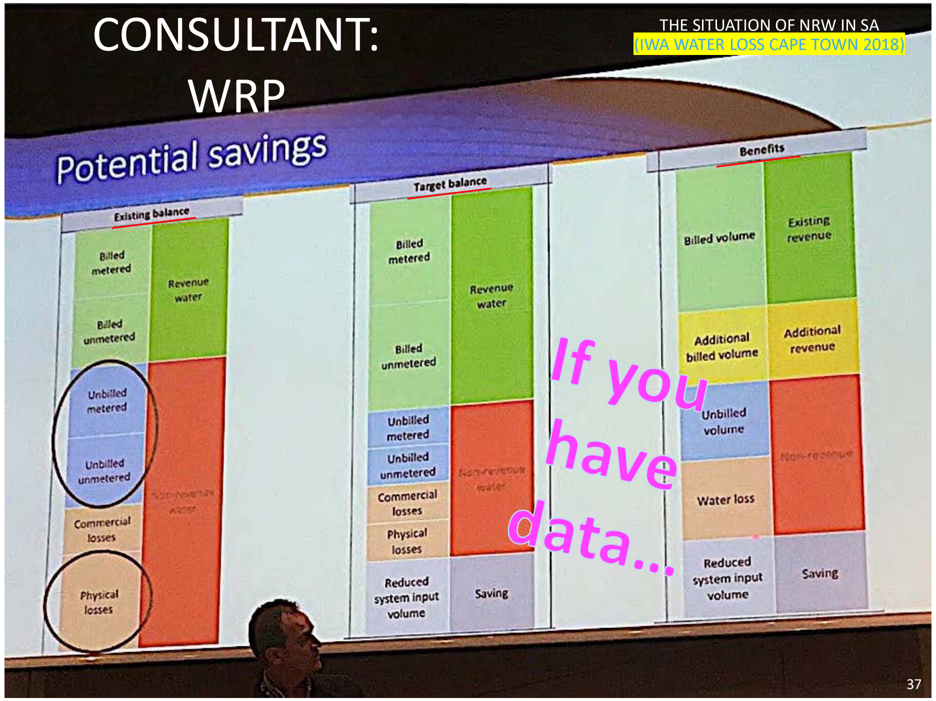
- **Very primitive !**



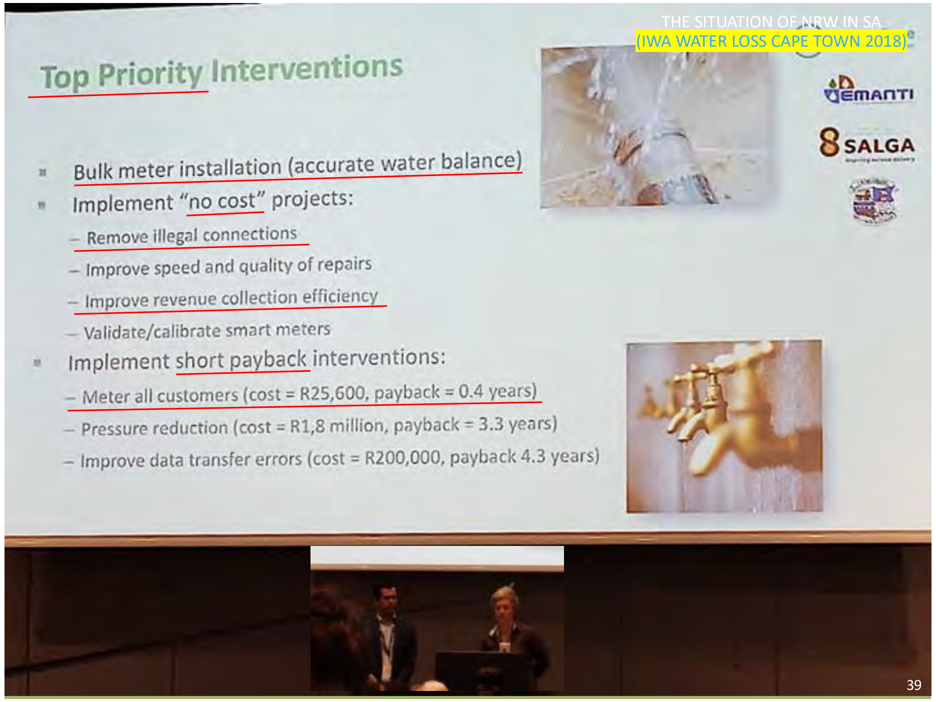


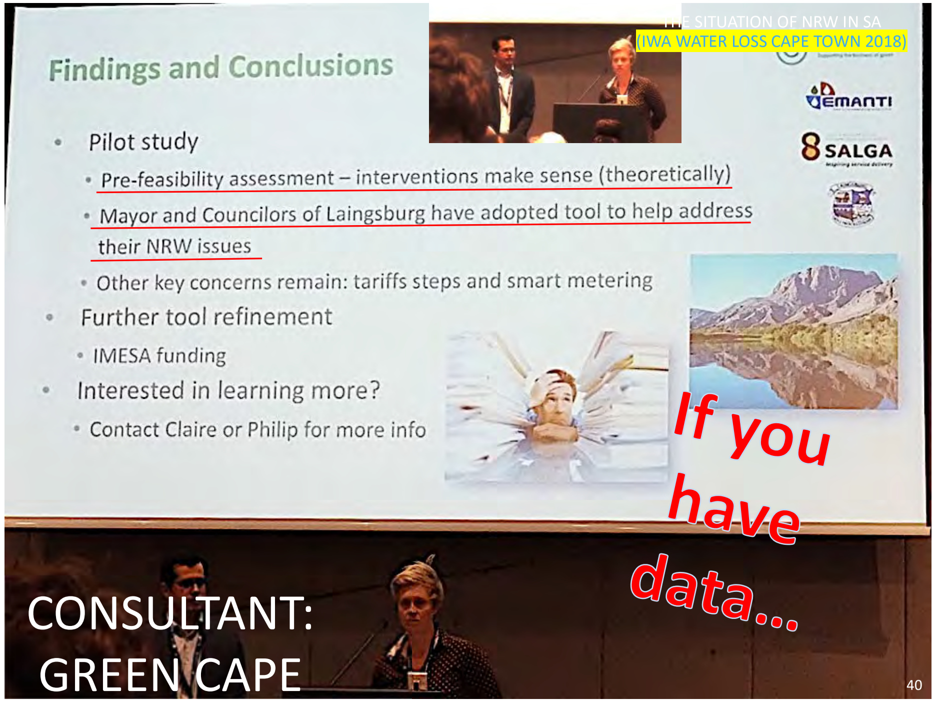
Category	Municipalities	State of NRW in SA (2009/10)	DWS (2011/12)	No Drop (2012/13)	DWS 2015/16
A	8	8	8	8	8
B1	18	18	17	15	15
B2	27	26	21	15	15
B3	97	55	56	49	43
B4	63	25	20	14	26
Total	213	132	122	101	107
Returns(%)		62%	57%	47%	50%

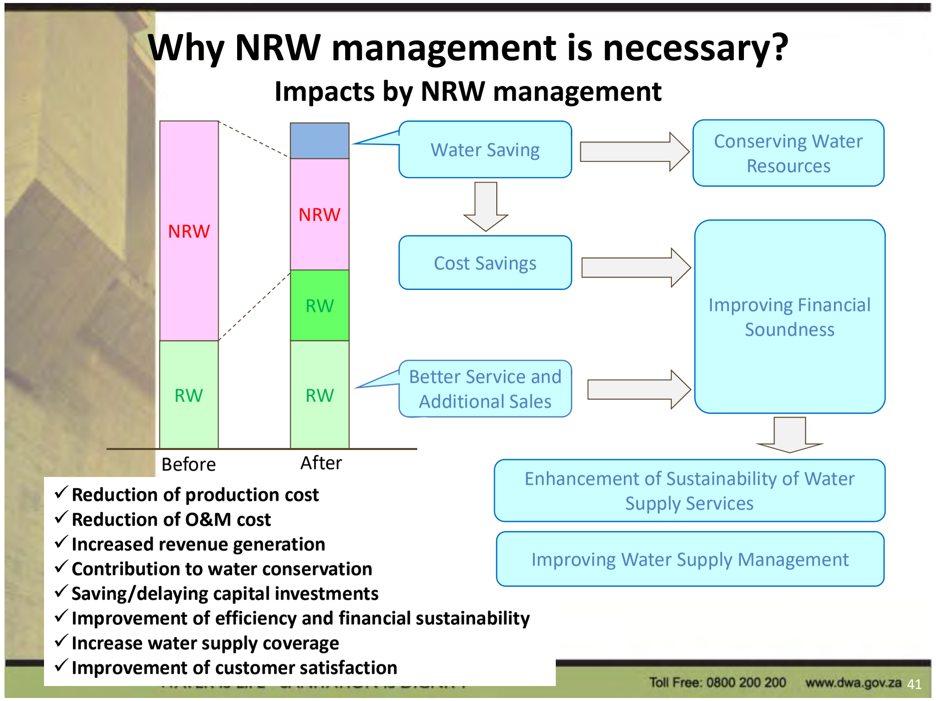



CONSULTANT:
WRP
THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)
Potential savings
Existing balance
Billed metered
Billed unmetered
Unbilled metered
Unbilled unmetered
Commercial losses
Physical losses
Revenue water
Target balance
Billed metered
Billed unmetered
Unbilled metered
Unbilled unmetered
Commercial losses
Physical losses
Reduced system input volume
Revenue water
Saving
Benefits
Billed volume
Existing revenue
Additional billed volume
Additional revenue
Unbilled volume
Water loss
Reduced system input volume
Saving
If you have data...
37

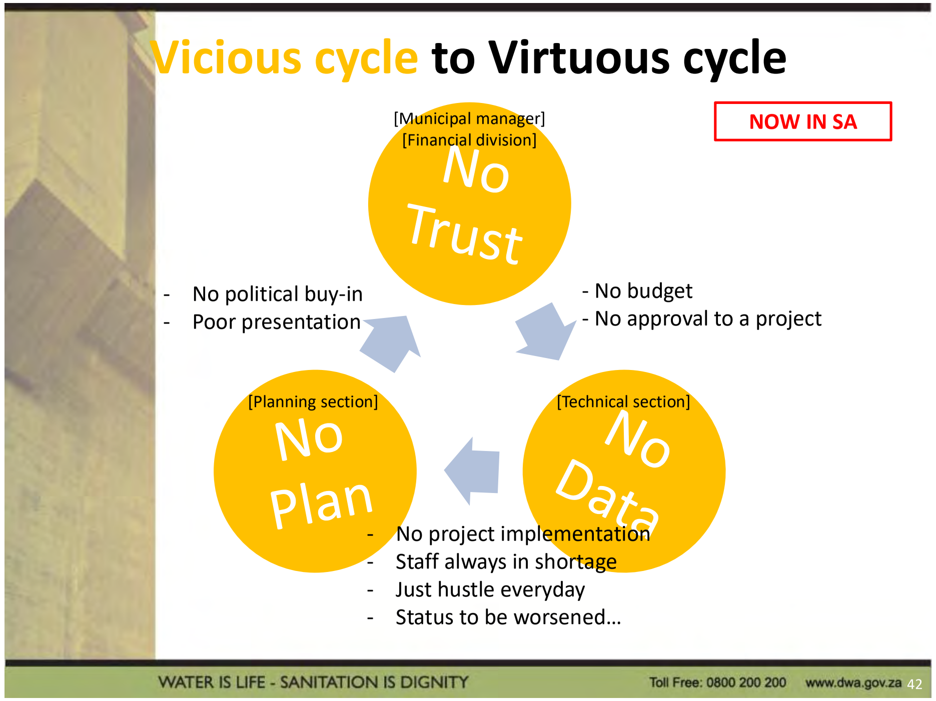
FUNDING AGENCY:
DBSA
(IWA WATER LOSS CAPE TOWN 2018)
STATUS QUO ANALYSIS
MANAGE DEMAND RISK
SYSTEM REDESIGN OPPORTUNITY
FUTURE DEVELOPMENT IMPACT
If you have data...
38


THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)
Top Priority Interventions
Bulk meter installation (accurate water balance)
Implement "no cost" projects:
– Remove illegal connections
– Improve speed and quality of repairs
– Improve revenue collection efficiency
– Validate/calibrate smart meters
Implement short payback interventions:
– Meter all customers (cost = R25,600, payback = 0.4 years)
– Pressure reduction (cost = R1,8 million, payback = 3.3 years)
– Improve data transfer errors (cost = R200,000, payback 4.3 years)
SALGA
39

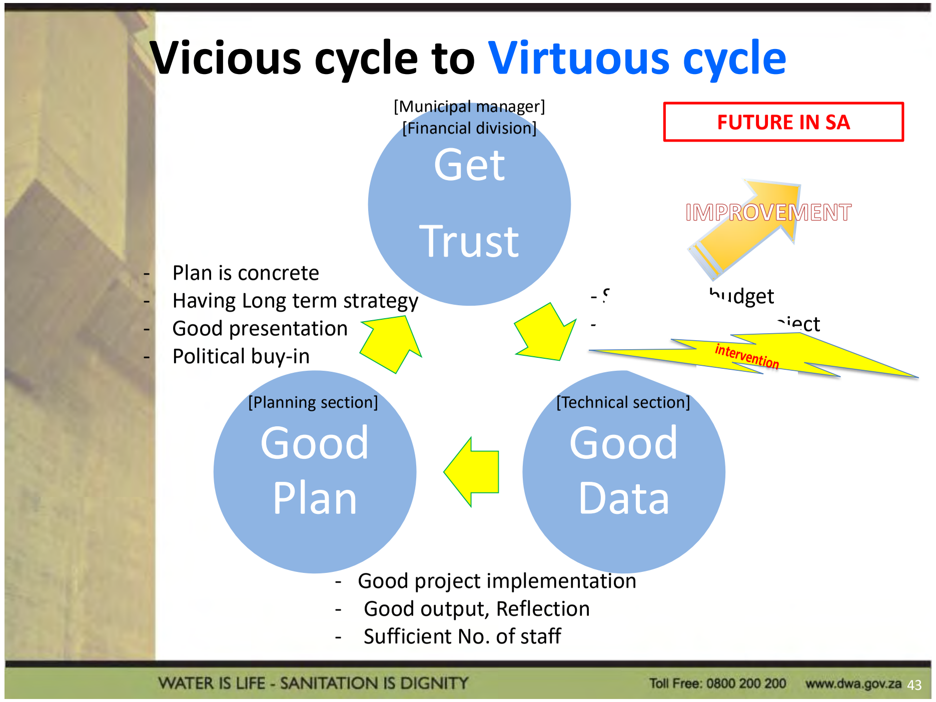

(IWA WATER LOSS CAPE TOWN 2018)
Findings and Conclusions
Pilot study
Pre-feasibility assessment – interventions make sense (theoretically)
Mayor and Councilors of Laingsburg have adopted tool to help address their NRW issues
Other key concerns remain: tariffs steps and smart metering
Further tool refinement
IMESA funding
Interested in learning more?
Contact Claire or Philip for more info
SALGA
If you have data...
CONSULTANT:
GREEN CAPE
40



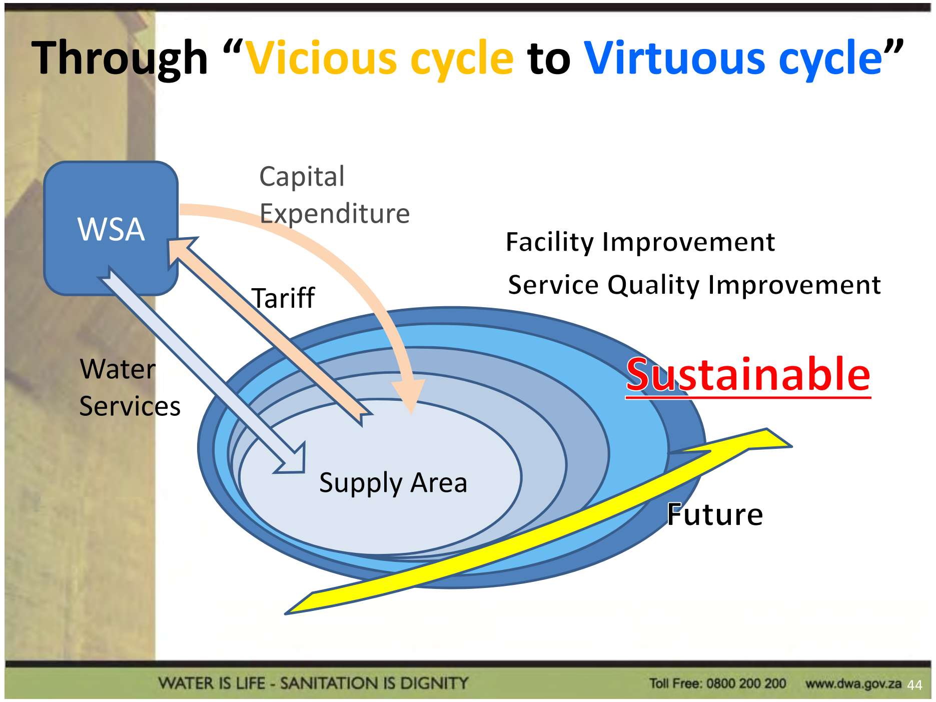
Why NRW management is necessary?
Impacts by NRW management
NRW
RW
Before
NRW
RW
RW
After
Water Saving
Cost Savings
Better Service and Additional Sales
Conserving Water Resources
Improving Financial Soundness
Enhancement of Sustainability of Water Supply Services
Improving Water Supply Management
✓Reduction of production cost
✓Reduction of O&M cost
✓Increased revenue generation
✓Contribution to water conservation
✓Saving/delaying capital investments
✓Improvement of efficiency and financial sustainability
✓Increase water supply coverage
✓Improvement of customer satisfaction
Toll Free: 0800 200 200 www.dwa.gov.za 41



Vicious cycle to Virtuous cycle
NOW IN SA
[Municipal manager]
[Financial division]
No Trust
- No political buy-in
- Poor presentation
- No budget
- No approval to a project
[Planning section]
No Plan
[Technical section]
No Data
- No project implementation
- Staff always in shortage
- Just hustle everyday
- Status to be worsened…
WATER IS LIFE - SANITATION IS DIGNITY
Toll Free: 0800 200 200 www.dwa.gov.za 42



Vicious cycle to Virtuous cycle
FUTURE IN SA
[Municipal manager]
[Financial division]
Get Trust
IMPROVEMENT
- Plan is concrete
- Having Long term strategy
- Good presentation
- Political buy-in
intervention
[Planning section]
Good Plan
[Technical section]
Good Data
- Good project implementation
- Good output, Reflection
- Sufficient No. of staff
WATER IS LIFE - SANITATION IS DIGNITY
Toll Free: 0800 200 200 www.dwa.gov.za 43



Through "Vicious cycle to Virtuous cycle"
WSA
Capital Expenditure
Tariff
Water Services
Facility Improvement
Service Quality Improvement
Sustainable
Supply Area
Future
WATER IS LIFE - SANITATION IS DIGNITY
Toll Free: 0800 200 200 www.dwa.gov.za 44

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The National Non-Revenue Water (NRW) Training for Municipalities by Municipalities in South Africa

NRW-related Problem Awareness Workshop

under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Keep an OPEN mind to brainstorm your observation related to NRW

Viewpoints around Learners

Water sector's and institutional issues and challenges in nationwide

- Free basic water (social welfare)
- Budget, grant and funding
- Measurement-related act or law
- National government politics
- Regulations

Physical, commercial, institutional issues and challenges in municipalities

- *Physical aspects*
- Reticulation (Pipeline Network)
- Flow Meter
- Customer Meter
- Drawings, etc.
- *Commercial and institutional aspects*
- Illegal connection
- Meter reading
- Flat rate and estimate
- Billing and system decoupling
- Mixed service levels
- Political interference, etc.

Wide-ranging viewpoints, Understanding and Efforts to manage NRW in municipal water services

Fundamental Data (Network Drawings, GIS, Bulk/In-Flow Metering, etc.)	Information and Data (Meter Reading, Billing, etc.)	Operation & Maintenance	Commercial Operations
Capacity and Know-how	Strategy and Planning	Financial Resources / Allocation	Management Support
Political Buy-In	Asset Management	Staff	Logistics
	Equipment, Materials and Supplies	Customer Support	

Key Messages from DWS/SALGA

- NRW ratio shows all aspects of the water services and results.
- Targeting NRW only does not help to reduce the NRW ratio.
- Analyzing the structure of **water balance** and identifying the **weak points** of the water services are very essential.
- To that end, the first thing to do is **zone configuration** and **flow measurement** to see the status-quo accurately.
- It is important to shift the viewpoint from how to reduce the NRW ratio to how to **create a proactive work style**. As long as there are water services, it will continue forever.
- In other words, the NRW management is to ensure the **sustainability** of water services.
- Change water services from vicious cycle to **virtuous cycle**.

If time allows

NRW Calculation Quick Exercise

NRW is:

A performance indicator of water services efficiency which include the following processes

- **Gathering of information for analysis**
- **Initiatives to reduce water loss and improve revenue**

Calculation of NRW can lead to incorrect results if SIV and RW data is "NOT" reliable or accurate in your municipality…

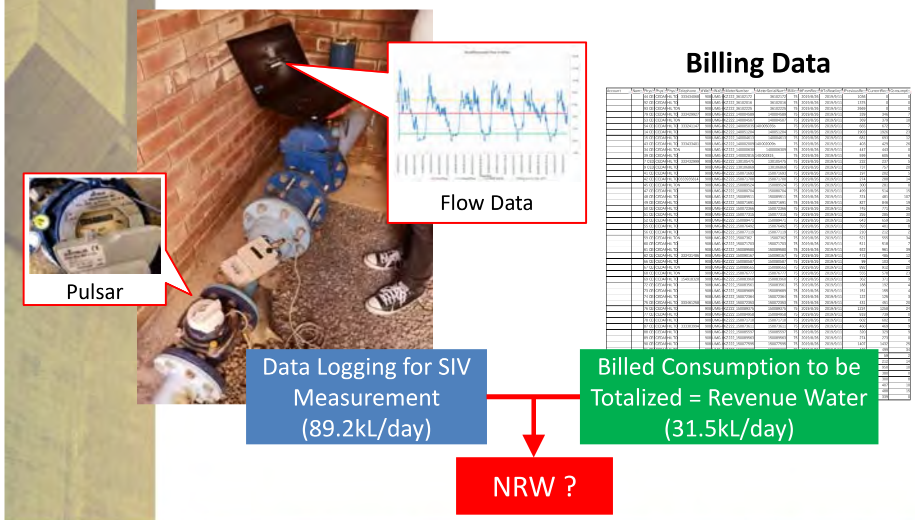
For example, on the condition that SIV reading differs from 80 to 90 due to its inaccuracy and RW is 60,

$$\text{NRW ratio} = \frac{90 - 60}{90} = 33\% \Leftrightarrow \frac{80 - 60}{80} = 25\%$$

If time allows

NRW Calculation Quick Exercise

Bulk Meter



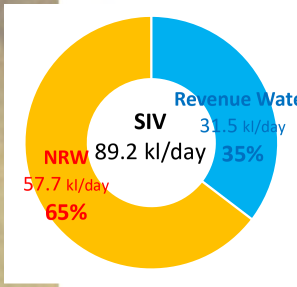
If time allows

NRW Calculation Quick Exercise

SIV 89.2 (kL) = RW 31.5 (kL) + NRW (kL)

i.e. NRW = SIV 89.2 – RW 31.5 = 57.7 (kL)

NRW Ratio (%) = 57.7 / 89.2 x 100% = 65%



water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

SALGA
inspiring service delivery

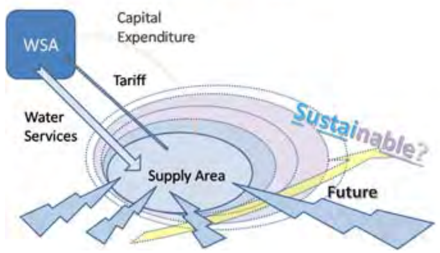
Japan International Cooperation Agency

The National Non-Revenue Water (NRW) Training
for Municipalities by Municipalities in South Africa

Technical Aspects:
Water Reticulation

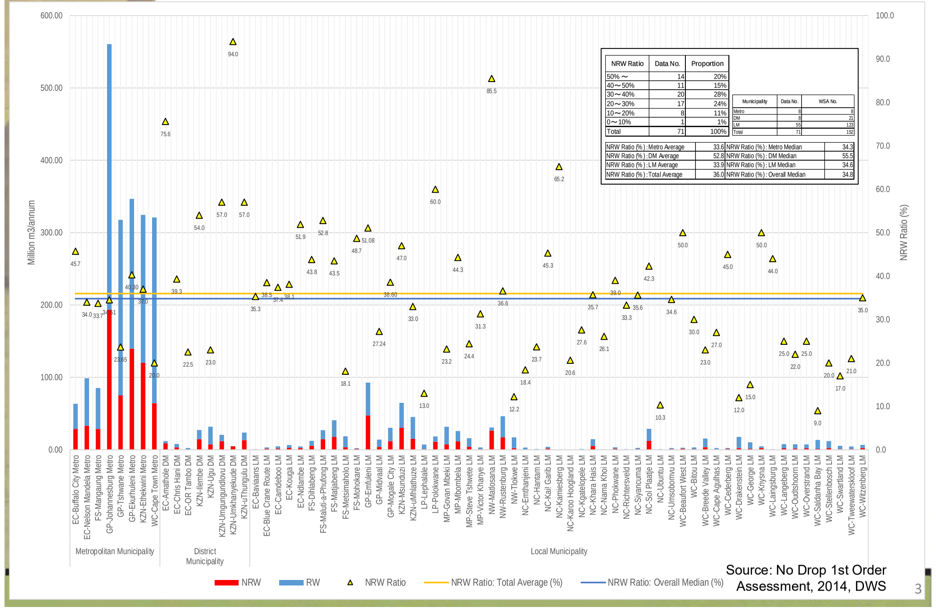
under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Water Services Business Model (Services Delivery)



NRW in South Africa

Water Balance of Municipalities (Revenue Water, NRW and NRW Ratio)



NRW Ratio	Data No.	Proportion
50% ～	14	20%
40～50%	11	15%
30～40%	20	28%
20～30%	17	24%
10～20%	8	11%
0～10%	1	1%
Total	71	100%

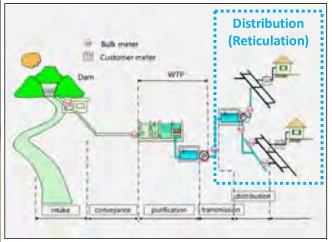
Municipality	Data No.	WSA No.
Metro	8	8
DM	8	21
LM	55	123
Total	71	152

NRW Ratio (%) : Metro Average	33.6	NRW Ratio (%) : Metro Median	34.3
NRW Ratio (%) : DM Average	52.8	NRW Ratio (%) : DM Median	55.5
NRW Ratio (%) : LM Average	33.9	NRW Ratio (%) : LM Median	34.6
NRW Ratio (%) : Total Average	36.0	NRW Ratio (%) : Overall Median	34.8

Source: No Drop 1st Order Assessment, 2014, DWS

Key Terms for Water Services Hard (Technical) Issues

1. Water Distribution (Reticulation) System



- By Energy:
  - Gravity
  - Pumping
- By Piping System
  - Branch Piping
  - Network Piping
- **Zoning**

Zoning(DMAs) makes water distribution (reticulation) easier to maintain

- Quality
- Flow
- Pressure

Physical Loss Component of NRW

Non-Revenue Water (NRW) :

Water that has been produced and is 'lost' before it reaches the customer, <u>and which is not billed</u>. Losses can be real (physical) losses (for example through leaks) or apparent losses (for example through theft, metering inaccuracies, data handling error, and so on)

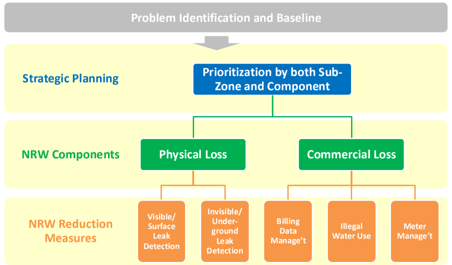
Water Balance

Water Balance by International Water Association (IWA)

System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water
			Billed Unmetered Consumption	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non-Revenue Water (NRW)
			Unbilled Unmetered Consumption	
	Water Losses	Commercial (Apparent) Losses	Unauthorized Consumption	
			Customer Metering Inaccuracies and Data Handling Errors	
		Physical (Real) Losses	Leakage on Transmission and/or Distribution Mains	
			Leakage and Overflows at Utility's Storage Tanks	
			Leakage on Service Connections up to Point of Customer Use	

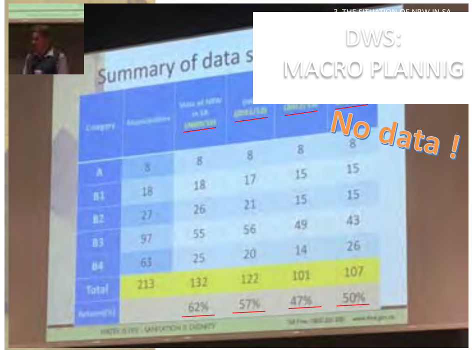
*Note: Free basic water is considered to be Revenue Water in SA

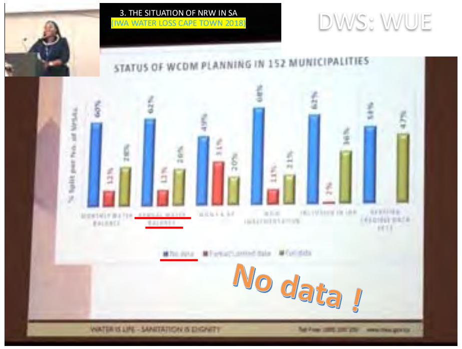
NRW Reduction Measures



To be selected cost-effectively and technology/labour-efficiently.

NRW Situation in South Africa





In general, we don't know the actual situation of NRW.
Because of lacking of the data (water balance)

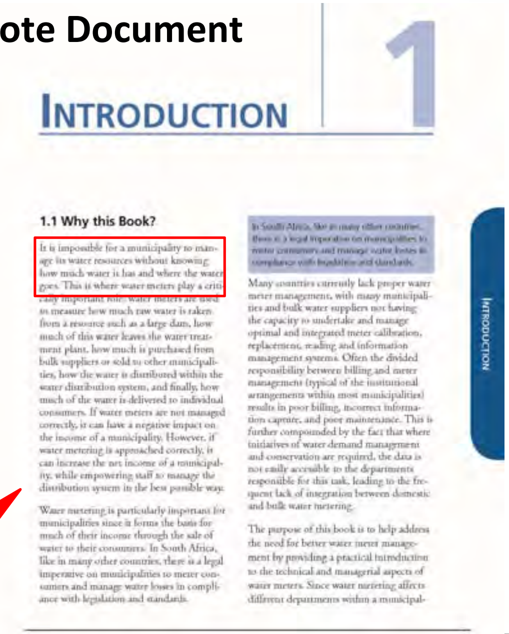
No-Drop assessment submission and valid data set is only half!

<u>The situation is that we don't know the status quo of NRW!</u>

- **Very primitive !**

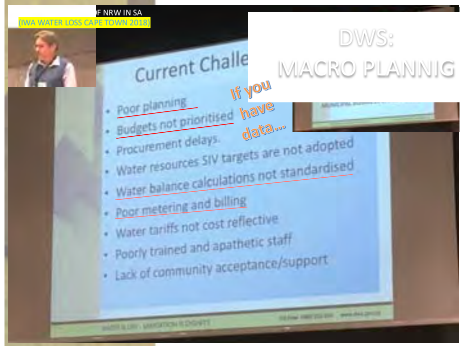
Common Problems in South Africa and How to Deal with them

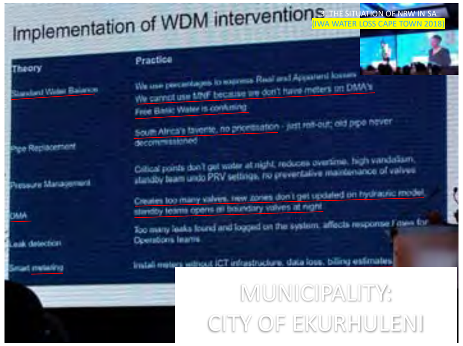
Keynote Document



It is impossible for a municipality to manage its water resources without knowing how much water it has and where the water goes. This is where water meters play a criti-

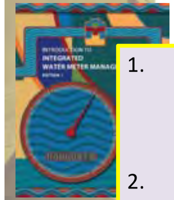
Current Challenges in South Africa





Struggling in Metering and Billing leads to Poor Planning

Main Steps for achieving our Goal



1. Identify all sources of water into your system and bulk transfers to other municipalities. Ensure that each source or bulk transfer has a meter that is correctly sized, in good condition and regularly read (preferably continuously, but at least weekly).
2. Identify bulk consumers (top 10 %) in the system. Ensure that each bulk consumer has a meter that is correctly sized, in good condition and regularly read (at least monthly).
3. Identify zones in the distribution system - the smaller the zones are, the better. Ensure that each zone has a meter that is correctly sized, in good condition and regularly read (preferably continuously, but at least weekly).
4. Log the zonal meters to determine the minimum night flow (and thus the leakage) in each zone.
5. Estimate current revenue water based on water sales to consumers
6. Do a preliminary water balance according to the IWA grid and identify the most critical areas for intervention. This will typically lead to a leak detection and repair programme focused on the zones with the highest leakage rates. A more comprehensive non-revenue control strategy should be developed from this initial effort.

Basics of Water Reticulation Facilities and their Management

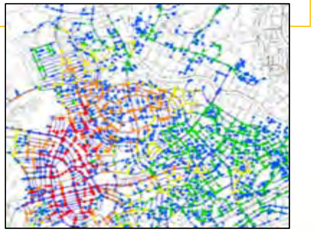
Zoning in Water Reticulation System

Advantage of Zoning

- The biggest benefit is that water supply area can be clarified and management become easier.
- Accurate measurement of water supply flow and pressure.
- Maintaining the high level of water quality management.
- Minimization of water supply disrupted area.

Disadvantage of Zoning

- The biggest bottleneck is the cost of pipe installation.
- This system requires more length of pipeline.
- Designing is difficult because hydraulic analysis becomes complicated.
- Water retention is likely to occur and causes deterioration of water quality.



Water Reticulation Facilities

Water Tower and Reservoir

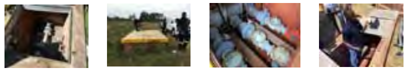
Role
1. Reserve treated water
2. Receive water from a bulk water supplier
3. Adjust & control water supply volume(depending on demand)
4. Pressure reduction

Design
1. Location: Upland for energy saving
2. Capacity: Customer consumption volume (Example: 12 hours)
3. Structure: Durability, water-tightness

Chambers for Operation and Measurement

Role
1. To store & protect measuring equipment
2. To store & protect valves and other facility
3. To make valve and other kind of operation easier
4. To reduce noise

Design
1. To secure enough space for operating valves and measurement equipment
2. To secure enough space for replacing equipment and an equipment to carry heavy material
3. To be durable and water-tight for the structure



Pump & Motors

Points for installation:
- Be careful of lightning and submergence
- Be prepared for power outages

Electrical Facilities

Control Panel

Electric Panel

Point for installation:
- Be careful of lightning and submergence
- Be prepared for power outages

How to retain the Function of Mechanical & Electric Equipment stable for a long term

Inspection

To inspect
- Daily, weekly, monthly, quarterly, yearly, every few years, etc.
- Visual, equipment and manufacturer inspections
- Based on the management plan

Data Storage

To store
- Inspection record
- Maintenance work record
- Maintenance management documents

Evaluation

To evaluate
- Contents of maintenance
- Efficiency of maintenance

To review
- Maintenance cycle

Important things you should know about Pipes

In particular, following two things are essential:

1. **Characteristics of Pipes**
   - Strength
   - Corrosion resistance
   - Flexibility
   - Unit weight
   - Unit price
2. **How to ensure Water Tightness of Pipe Connection**
   - Rubber ring
   - Mechanical compression
   - Fusion
   - Adhesive
   - Seal tape

Material	Pipe Type
Vinyl	Polyvinyl Chloride (PVC)
	High Density Polyethylene (HDPE)
Cement	Asbestos Cement (ACP)
Iron	Steel (Galvanized)
	Steel (SP)
	Ductile Iron (DIP)

Connecting Method (Water Tightness)

Drill

Which pipe connecting methods is applied ?

	PVC	PE	ACP	Galvanized	SP	DIP
Rubber ring						
Screw						
Metal Welding						
Mechanical Compression						
Flange						
Fusion						
Adhesive						

Connecting Method (Water Tightness) Drill

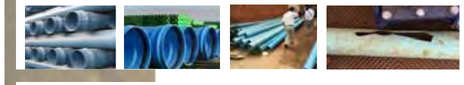
Which pipe connecting methods is applied ?

	PVC	PE	ACP	Galvanized	SP	DIP
Rubber ring	√		√			√
Screw	√			√√		
Metal Welding					√√	
Mechanical Compression		√ (small)	√			√√
Flange	√	√		√ (welded flange)	√ (welded flange)	√
Fusion		√√ (large)				
Adhesive	√√					

a. Polyvinyl Chloride (PVC) Pipe

Advantage

- **Light weight:** PVC Pipes offer a tremendous weight advantage over alternative piping materials.
- **Some Flexibility:** PVC Pipe's resistance to fracture is an extremely important performance advantage.
- **Watertight Joints:** A major requirement for all piping applications is joint tightness.
- **Coefficient of Friction:** PVC Pipes provide smoother wall surfaces that reduce fluid friction and resistance to flow.
- **Safe Material:** PVC pipe is a non-toxic and safe material
- **Resistant to corrosion**
- PVC pipes should **not be exposed to direct sunlight**



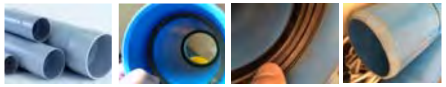
b. High Density Polyethylene (HDPE) Pipe

Advantage

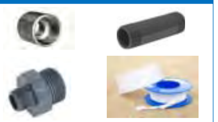
- **Rugged, flexible, and durable. HDPE has outstanding chemical and environmental stress crack resistance.**
- **Corrosion Resistance:** HDPE pipe does not rust, rot or corrode. It is resistant to biological growth.
- **Fatigue Resistance:** HDPE pipe is flexible and ductile, not rigid.
- **Extended Service Life:** HDPE pipe is a safe and durable product
- **Leak-Free Joints:** HDPE piping systems can be joined with heat fusion to produce permanent leak free joints.
- **Adaptability:** In addition to joining HDPE with heat fusion, HDPE pipe can also be joined with Stab or Mechanical Fittings.
- **Trenchless Installation:** The flexibility of HDPE, combined with its outstanding tensile strength and abrasion resistance, make it the preferred and proven choice for trenchless installation technology.

a. PVC Pipe Joint

Socket Joint



Thread Joint with Rubber Ring



Cement Glue

b. HDPE Pipe Joint

For Bulk Pipelines

Electric Fusion

Easy to manage using a system for fusion management. Auto calculation for each diameter, temp. and time.

Butt Fusion

Welding joint requires high skill level to joint properly.

For Service Pipes

Compression

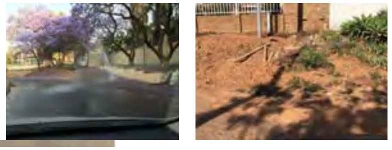
Socket Fusion

Metal Joint

c. Asbestos Cement Pipe (ACP)

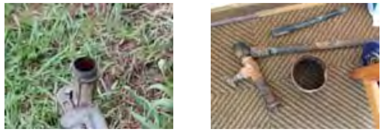
Asbestos cement pipe (ACP)

- Is fragile by impact and not durable.
- Has an adverse effect on health when it becomes dust.
- Requires careful treatment when you dispose of it.
- Should be replaced systematically.



d. Steel Pipe (Galvanized)

- Joint type is mostly mechanical.
- It can be arranged suitable shape of layout with different type of fittings.
- Subject to both internal and external corrosion. (zinc coating)
- Characterized by being slim and lighter than ductile iron pipe because thickness of pipe wall is thin.



e. Steel Pipe

- Joint types are welding and flange.
- Steel pipe can be arranged suitable shape of layout.
- Steel is subject to both internal and external corrosion.
- Steel pipes are characterized by being slim and lighter than ductile iron pipe because thickness of pipe wall is thin and the joints are welded.
- For this reason, it is used in places narrower than ductile iron pipe of the same diameter and in water pipe bridges.

f. Ductile Iron Pipe (DIP)

- The strength of ductile iron is due to spheroidal graphite.
- A lot of joint types.
- For Corrosion prevention coating is in need.
- Polyethylene sleeve is used for preventing outer surface corrosion.

Polyethylene Sleeve

Important things you should know about Appurtenance

In particular, following two things are essential:

1. **Mechanism of Appurtenance**
   - Moving part
   - Shutting plate
   - float
   - Rotate part
   - Vane
   - Spring
   - Bolt
2. **How to ensure Water Tightness of Appurtenance**
   - Rubber ring
   - Mechanical compression
   - Gasket

a. Isolation Valve

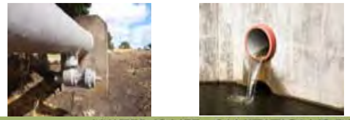
- ➢ Isolation valves are used to close off and thus prevent any flow through pipes.
- ➢ Isolation valves are installed at junctions in pipe networks and at regular intervals of one to two kilometers on transmission lines. They should be located near street corners and in line with property side-boundaries so that they are easier to find.
- ➢ Butterfly valve is compact and suitable for large diameter pipes.

b. Air Valve

- ➢ Air valves are installed on pipelines to control the flow of air into and out of the system.
- ➢ If the air is not released, it will accumulate at high points in pipes, restricting and even preventing flow altogether.
- ➢ Air valves operate by automatically opening a valve when air accumulates in the valve body or negative pressures occur in the system.
- ➢ High compressed air is very dangerous to pipelines and operators, it requires extreme caution.

c. Scour Valve

- ➢ Scour valves are used to draining for maintenance purposes. It typically consists of a reduced diameter off-take pipe closed with an isolation valve
- ➢ Mud and sludge get collected in the pipes at these depressions and remove from this point.
- ➢ On long pipelines, scour valves should be provided at the lowest points in the pipe profile. Each section of pipe that may require draining should be provided with a scour valve.

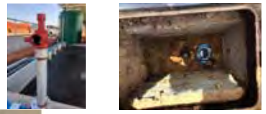


d. Non-Return or Check Valve

- ➢ Water flow only in one direction.
- ➢ Often installed to prevent backflow to meters, pumps and etc.

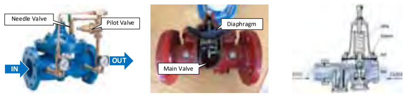
e. Fire Hydrant

- Fire hydrants are used to provide water from the distribution system for fire fighting. Fire hydrants incorporate an isolation valve and a standard fitting for connecting a fire hose.
- Hydrants are often used for operation and maintenance functions in water distribution systems, such as flushing pipes, releasing air and logging pressures.
- Hydrants should be serviced and their flow rate checked to comply with the required flow rate at least once per year.



f. Control Valve (including PRV)

- ➢ The pressure in a water supply system should be maintained as close to the minimum level as possible, as excess pressures increase the burst rates and reduce the service lives of pipes, potentially increase leakage rates substantially, increase water supply demands and require more energy (in pumped systems).
- ➢ However, if the distribution water pressure is partially high due to terrain or other conditions, use PRV. The use of PRV is only for a countermeasure when the water pressure in the zone is partially high. As a measure against NRW, avoid using many PRVs to reduce water pressure.
- ➢ When set up the secondary pressure with PRV, it is necessary to consider the water pressure at the location where the water pressure is highest.



Appurtenance Inspection Record and Management Database

Inspection Record Database

Record the results of daily inspections, periodic inspections, detailed inspections, and temporary inspections, and describes the following items:

- ➢ Valve management number
- ➢ Inspection date
- ➢ Inspection results (Evaluation of each inspection item)
- ➢ Specific damage status where damage is significant and urgent repair work is required or when detailed investigation is required
- ➢ When requesting repair work, the name of the department in charge of the request

Inspection Management Database

It manages the aging change such as the deterioration status in periodic and temporary inspection, and describes the following items:

- ➢ Inspection date
- ➢ Inspection results
- ➢ Damage situation
- ➢ Responsibility of repair work

* It is desirable to manage the large valves and plugs of the main pipeline in the ledger for each database. In addition, for small valve and plugs, the status of problems and countermeasures are managed in the inspection record management database.

Reference: "Water Valve Maintenance Manual" (Japan Waterworks Association)

Basics of Water Meters and their Management

Important things you should know about Meters

In particular, following two things are essential:

1. **Mechanism of Meters**
   - Rotate part (vane, piston or cylinder)
   - Counter (digital, needle)
   - Of which part does water flow
2. **Factors which affect Measurement Accuracy**
   - Velocity
   - Turbulence & straight length of pipes
   - Installation
   - Reading
   - Aging

Water Meter Types

1. Classification by Principal Mechanism

1a. Mechanical

1b. Electromagnetic

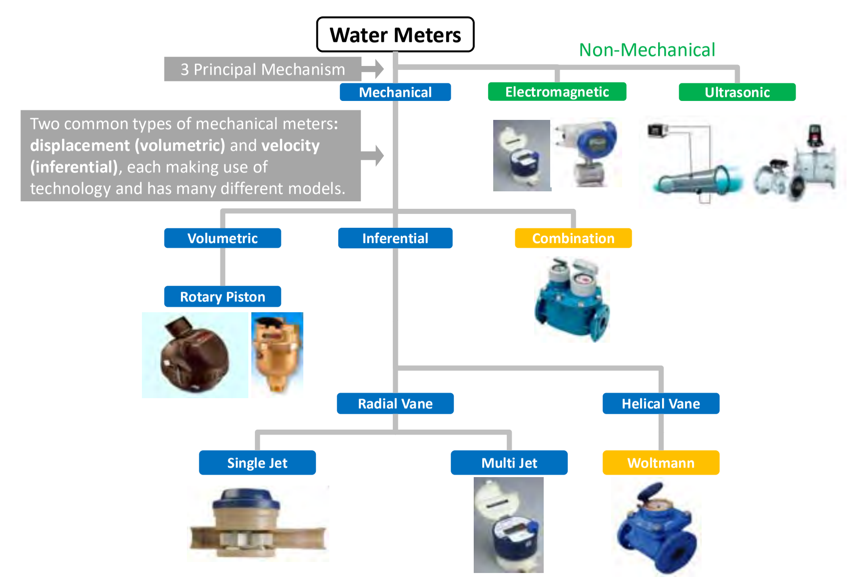
1c. Ultrasonic

2. Classification by Purpose

2a. Customer meter

2b. Bulk meter

Water Meter Types



Water Meter Types

Common Meters in South Africa by Classification

Purpose	Principal Mechanism	Mechanism
Customer Meter	Mechanical	Volumatic
		Inferential (Single Jet, Multi Jet)
		Combination
	Electromagnetic	-
Bulk Meter	Mechanical	Inferential (Waltmann)
	Electromagnetic	-
	Ultrasonic	-

1a. Mechanical: Volumetric Meter (Customer)

- There are some displacement type, volumetric meters.
- Common displacement designs nutating piston and oscillating piston meters.
- This method relies on the water physically displace the moving measuring element in direct proportion to the amount of water that passes through the meter. The disc or piston moves a magnet that drives the register.
- The meter incorporates a small bucket or piston with a known volume. The water flows through one orifice and fills the bucket which then rotates and lets the water flow out through a second orifice. The number of buckets of water is converted to a total volume by the counter gearing.
- Accuracy of low flow rang is better than inferential meters.

Displacement piston in the sample meter

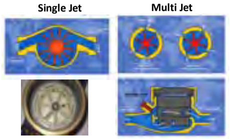
Source: [TT490-11_Introduction to Integrated Water Meter Management]

1a. Mechanical: Inferential Meter (Customer) Single Jet and Multi Jet Types

Inferential meter: Velocity-based designs include single jet and multi jet types and also turbine type.

Single jet type uses single flow stream to move the impeller which is converted to flow rate. Sizes 15mm to 40mm.

Multi jet type operates similar to the single jet but use multiple openings to direct the flow to move the impeller which is converted to flow rate. Sizes 15mm to 50mm



Source: Water Meter Training Manual

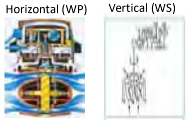
1a. Mechanical: Inferential Meter (Customer/Bulk) Waltmann Meter

Woltmann meter is an inferential type that uses an impeller with helical vanes. (Fan or boat propeller).

Type: horizontal(WP) and Vertical (WS)

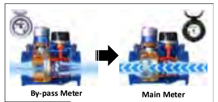
- Horizontal type has less sensitive to low flows, but handle better high flow rates.
- Vertical type has less susceptible to disturbance in flow and more sensitive to lower flows, but can not handle high flows(high Pressure loss).

Sizes 40-500mm and are the most commonly use over the world. Class B



Source: Water Meter Training Manual

1a. Mechanical: Combination Meter (Customer)



Combination Meter is the combination of two different classes (Piston, single or multijet with Woltmann) in such a way they act as one meter (bypass meter and bulk meter). Widest measuring range of any meter.

The Meter has areas with poor precision. In the case of a large-sized meter for example commercial and factory, it is difficult to accurately sense a small amount of water used at night. In order to complement the measurement of the small amount of water area, combining a large meter with a small meter is used.

At low flow rate, the change over valve closes and the flow through domestic by-pass.

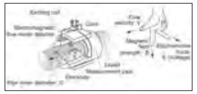
At the flow increases, the change over valve opens as a result of differential pressure and flow through into the bulk meter.

Source: Water Meter Training Manual

WATER IS LIFE - SANITATION IS DIGNITY Toll Free: 0800 200 200 www.dwa.gov.za

1b. Electromagnetic Meter - 1

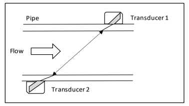
- Operation of an electromagnetic flowmeter is based upon Faraday's Law, which states that the voltage induced across any conductor as it moves at right angles through a magnetic field is proportional to the velocity of that conductor.
- Consists of Transducer to convert flow to electrical signals.
- Converter to convert electric signals to instrumentation signal.
  - Dia: 2.5mm to 3,000mm
  - Accuracy: +-0.1 to 0.5% (in ideal flow) [very high]
  - Use: Raw water, Purified water, Sewage, Chemical



Source: Keyence.com

1c. Ultrasonic Meter - 1

- Ultrasonic waves are transmitted at an angle across fluid in the pipe.
- Flow is measured by changes in the transit time for the ultrasonic waves.
  - Dia: 25mm to 3,000 mm
  - Accuracy: +- 1% (in ideal flow)
  - Use: Raw water, Purified Water, Chemicals



Transducers

Main Unit

Source: Water Meter Training Manual

1b. Electromagnetic Meter - 2

Points

- Measuring range is generally from 0.3m/s to 10m/s. Accurate flow rate is wider than other type of meters.
- Straight pipe, Upstream L=5D for 90 bend, T-joint, Reducers. L=10D after full open gate valve.
- Always full of water in pipe.
- Install horizontally.
- Avoid immediately after the chemical pump.
- Avoid strong magnetic field at transducer.

Advantage

- The obstruction to the flow is almost nil.
- There is no pressure losses.
- They are practically unaffected by variation in density, viscosity, pressure and temperature.
- It can be used as bidirectional meters.
- They are capable of handling extremely low flows.

Disadvantage

- Meters are expensive.
- These meters can be sensitive to damage from lightning strikes.
- Meters require electric power.

Source: Water Meter Training Manual

Source: Keyence.com

1c. Ultrasonic Meter - 2

Points

- Accuracy is higher in velocity faster than 1m/s, temperature in 0-40℃, and turbidity is less than 3,500NTU. The ideal flow velocity for good accuracy is 0.5 to 10 m/s.
- Always full of water in pipe.
- There are methods Z (penetrate), V (reflect), X (cross), and 2V. When it has turbulence, 2V is recommended for accurate measurement.
- Pipe inside lining, "material and thickness" shall be known as a parameter of the measurement.
- Straight pipe, is basically L=10D for upstream, L=5D for downstream. From upstream valve, L=30D, Pump L=50D.

Advantage

- Easy installation to clump on the outside pipe
- No pressure loss
- The cost does not increase with the diameter.
- Lower cost than electromagnetic meter.

Disadvantage

- Measurement is not possible when there are Air bubbles.
- Long section of straight pipe is required.
- Comparatively subject to turbulence if flow.

Source: Water Meter Training Manual

Source: Keyence.com

WATER IS LIFE - SANITATION IS DIGNITY Toll Free: 0800 200 200 www.dwa.gov.za

2a. Customer Meter - 1

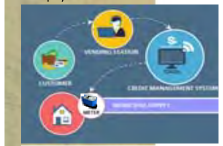
Roles

- Metering provides an equitable basis for charging consumers based on the amount of water that they consume. It also allows cross-subsidisation to be done fairly, and needy consumers to receive a free basic amount of water.
- Metering shows the value of water to the consumer and creates strong incentives for consumers to use water more efficiently.
- Measured consumption forms the basis of most water accounts, and thus affects municipal revenue directly — water meters are the cash registers of water suppliers.
- Many of the technical benefits of water meters, such as accurately measuring municipal water purchases, reducing water losses, and identifying and removing illegal connections.
- The demand data is critical to building accurate computer models for simulating water distribution systems.

2a. Customer Meter - 2

Prepaid Meter

- Prepaid meter consists of an Intelligent Valve fitted to a meter, intended to shut off once water credit has run out.
- Primary use is to curb non-payment of water.



Advantage

- Effective method to control non-payment.
- Money is paid up front for services

Disadvantage

- High operational cost (services, management systems)
- Battery driven. Battery life approx. 8 years
- Require additional maintenance. Not an "install and forget" solution!

Prepaid Meter

2b. Bulk Meter – 1

About Bulk Meters in this Training

What is Bulk Meter?

- Mostly used for large water volume measurement. Bigger than customer meters, 40mm or more depending on municipality and system.
- Meter accuracy is required because the amount of water received from or transmitted to other water utilities has a large amount of water as well as a large effect on fees (business).

Bulk Meter Type:

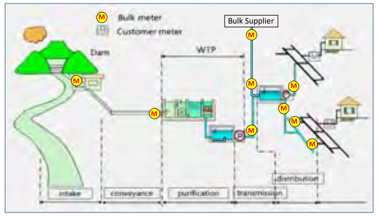
- Electromagnetic
- Ultrasonic
- Differential pressure
- Mechanical

Setting Positions:

- Outlet of treatment plant
- Outlet of reservoir
- Inlet to network and DMAs
- Receiving point from bulk supplier such as Water Board

2b. Bulk Meter - 2

Position of Bulk Meters



Bulk Meters available for **System Input Volume** measurement

- Outflow from WTP and reservoirs
- Inflow to networks and DMAs
- Receiving flow from bulk supplier

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Water Meter Accuracy

1. **Meter Accuracy**
2. **Meter Standards**
3. **Meter Installation (not in modules)**
4. **Meter Reading**
5. **Meter Maintenance (in the next module)**

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1. Water Meter Accuracy

Key Characteristics for Good Metering

Measuring Range

- Turndown Ratio. This gives an indication of the lowest flow rates attainable. Higher R value (Class) denotes better meter.

Correct Installation

- This prevents damage to metering components and ensures that the components perform as designed.

Accurate Reading

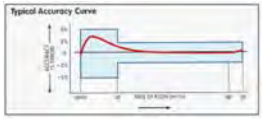
- Inaccurate reading reduces billing accuracy, which affects revenue generation.

1a. Causes of Meter Inaccuracy

- Inadequate size and class of meter installation (Large meter will not register low flows)
- Meter not installed properly according to the manufacturer's specification. (straight pipe length, horizontal installation only. Poor plumbing prat)
- Sediment to form the internal parts of meters (poor water quality)
- Damage by intermittent water supply (certain volume of air, sudden large increase in pressure)
- Aging of meter
- Meter tampering

1b. Meter Accuracy Curve - 1

- Meters have permissible range of error in standard specifications. It can mitigate proper selection of meter size.
- Inaccuracies in meters tend to increase with age.



Source: Water Meter Training Manual

Definitions	
Q4/Qs	Maximum flow rate (Overload Flow Rate): The highest flow rate at which the meter operate(within the required accuracy) for a short period without permanent damage to its accuracy (+-2% error).
Q3/Qp	Permanent flow rate: Permissible continuous load. Half the maximum flow rate (+-2% error).
Q2/Qt	Transitional flow rate: The flow rate at which the maximum permissible error of the water changes in value from +-5% error to +-2% error.
Q1/Qmin	Minimum flow rate: The lowest flow rate at which the meter is required to give indications within the maximum permissible error tolerance (+-5% error)

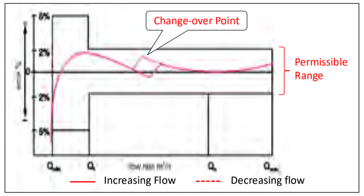
*(Q1-Q4 in the new international standards)

1b. Meter Accuracy Curve - 2

Combination Meter

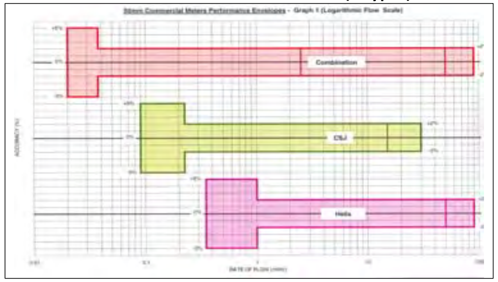
- Improve an unregistered flow amount by two different size meters

Combination Meter Accuracy Curve



Source: Water Meter Training Manual

50mm Meter Performance Sheet (3 Types)



If the flow rate is very different such as between day and night, and it is thought that a large size meter cannot supplement the small flow rate, it is desirable to select a combination meter.

Source: Water Meter Training Manual

1c. Meter Class - 1

Conventional Standard

- Water meters classified as Class A, B, C , D
- Class B, C, D are allowed install in SA for measurement of customer water consumption

New Standard

- Water meters are classified as difference of range of Q1 and Q3 (Q3/Q1)
- The meter class is represented by the coefficient 'R', the ratio is shown above "Q3/Q1".

1c. Meter Class - 2

15mm Meter Performance by Class

- Meter classes are defined by range from Qmin to Qt (Q1 to Q2)
- It means that all classes have same accuracy but classified according to differences in the range that can be measured accurately

CLASS	Unit	(Qmin +-5%) Minimum Flow Rate	(Qt +-2%) Transitional Flow Rate	(Qp +-2%) Permanent Flow Rate	(Qs +-2%) Maximum Flow Rate
A	L/h	60	150	1 500	3 000
B	L/h	30	120	1 500	3 000
C	L/h	15	22.5	1 500	3 000
D	L/h	11.25	17.25	1 500	3 000

This Range

Source: Water Meter Training Manual

2. Meter Standards

Reference

Difference of Meter Standards

- Instead of using the **symbols Qmin, Qt, Qp and Qs** respectively for these parameters, the new standards use the **symbols Q1, Q2, Q3 and Q4**.
- For any meter, the permanent flow rate is specified first. The minimum flow rate is then determined by using the **ratio of the permanent flow rate to the minimum flow rate (Q3/Q1)**.
- This ratio defines the meter accuracy range, and is often used with the **letter R** to describe the meter. For instance, a meter with **a Q3 to Q1 ratio of 160** will be described as a class.

1d. Meter Selection - 2 (Customer/Domestic)

Meters should be selected its size and class considering its performance.

Source: Water Meter Training Manual

1d. Meter Selection - 3 (Bulk)

Meters should be selected its size and class considering its performance.

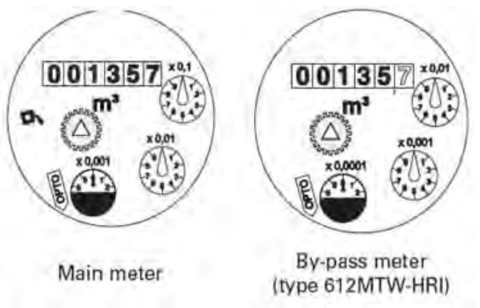
Source: Water Meter Training Manual

4. Meter Reading

Drill

How to read Meters

For a Combination meter, both registers must be added together.



1,357.^{000} + 135.7^{000}

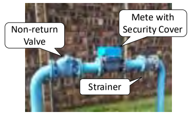
= 1,492.7 m^3 (kL)

Source: Water Meter Training Manual

3. Meter Installation

Meter above the ground

- Typical above ground <u>brass domestic meter</u> installation- a lot of Municipalities moving away from these installations due to theft.
- Larger domestic or industrial Meter installation- meter with security cover, strainer upstream with none-return downstream. Installation should have up and downstream isolating valves.
- Multi-jet meters are approved for horizontal installation only.



3. Meter Installation

- Incorrect installation may lead to high under-registration losses and shorten the service life of a meter.
- Metal-bodied meters can be installed in the open, but plastic meters must be protected from the elements by a meter box.
- Where a meter box is used, bricks or a small concrete slab must be placed as a foundation under the meter box and must be levelled to ensure that the meter box will also be level.
- The ground under the meter box must be well compacted. Sufficient space must be provided to access the meter for installation and maintenance purposes.
- A meter installation should comply fully with the municipalities' policies and manufacturer's requirements.

It has been clarified that the meter set in the box in advance is accurate even if there is no straight pipe in front and back.

Source: INTRODUCTION TO INTEGRATED WATER METER MANAGEMENT, WRC TT490/11

5. Meter Maintenance

1 Scaling	The flow path inside the piping narrows and restricts flow. If a thick layer of scaling attached to the inside of the pipe, the flow meter could become unable to measure the flow and maintenance would be required.
2 Sludge	Sludge can be removed using a strainer, complete removal is hard and sometimes refusal of sludge (debris) is required.
3 Rust	Air in the pipe, such as intermittent supply will be a cause of rust. Strainer will also prevent a damage due to rust.
4 Slime	A kind of corrosion in the pipe, sometimes with algae, bacteria in pipe. Maintenance is needed for turbine type meter.

Source: Keyence.com

5. Meter Maintenance

5 Slurry	Same as slime, periodical maintenance Is required for mechanical meter. Perforated water meter such as electromagnetic or ultrasonic is recommended.
6 Air Bubbles	Since Coriolis type flow meters measure mass flow, they are unaffected by air bubbles. For electromagnetic type flow meters, bubbles can cause unstable flow readings. This is due to the fact that detection is based on volume and the bubbles are mistaken for fluid.
7 Irregularity or Deviation in Flow	The degree of measurement error depends on the degree of irregularity in the distribution of flow velocity. Measurement performance can be improved by installing straight pipe sections upstream to make the distribution of flow velocity more uniform. (As a rough guide, the straight pipe section should be 5 times the bore diameter of the flow path.)
8 Pulsating Flow	One possible way to reduce pulsations is by using a damper such as an accumulator. Also, if the pulsations cause fluctuations in the numeric values of the flow meter over time, increasing the flow meter's response time is effective at stabilizing the numeric values.

Source: Keyence.com

End!

water & sanitation
Department: Water and Sanitation
REPUBLIC OF SOUTH AFRICA

SALGA
inspiring service delivery

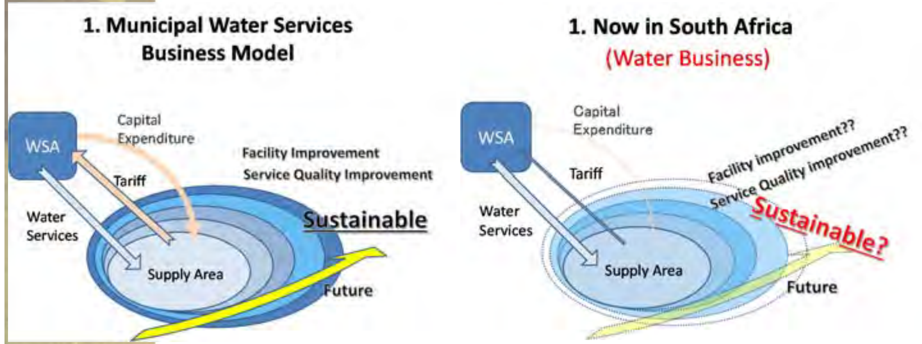
Japan International Cooperation Agency
JICA

The National Non-Revenue Water (NRW) Training
for Municipalities by Municipalities in South Africa

Institutional Aspects: Metering and Billing

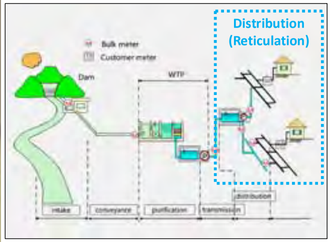
under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Water Services Business Model (Revenue Generation)



Key Terms for Water Services Soft (Institutional) Issues

1. Water Distribution (Reticulation) System



- By Energy:
  - Gravity
  - Pumping
- By Piping System
  - Branch Piping
  - Network Piping
- Zoning

Zoning(DMAs) makes water distribution (reticulation) easier to maintain

- **Metering**
- **Billing**
- **Internal Communication**
- **Customer Communication**

Commercial Loss Component of NRW

Non-Revenue Water (NRW) :

Water that has been produced and is 'lost' before it reaches the customer, and which is not billed. Losses can be real (physical) losses (for example through leaks) or apparent losses (for example through theft, metering inaccuracies, data handling error, and so on)

Water Balance

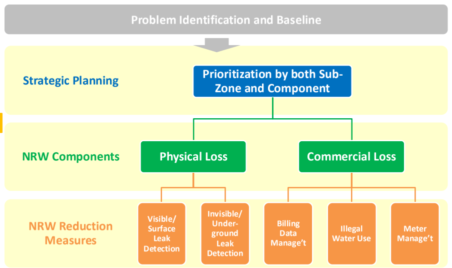
Water Balance by International Water Association (IWA)

System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water
			Billed Unmetered Consumption	Revenue Water
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non-Revenue Water (NRW)
			Unbilled Unmetered Consumption	
	Water Losses	Commercial (Apparent) Losses	Unauthorized Consumption	
			Customer Metering Inaccuracies and Data Handling Errors	
		Physical (Real) Losses	Leakage on Transmission and/or Distribution Mains	
			Leakage and Overflows at Utility's Storage Tanks	
			Leakage on Service Connections up to Point of Customer Use	

Apparent Loss

*Note: Free basic water is considered to be Revenue Water in SA

NRW Reduction Measures



To be selected cost-effectively and technology/labour-efficiently.

IWA Water Balance for Problem solving

IWA Water Balance Process (in SA)

A. Determine System Input Volume (SIV)
(Reading data of purchase water, outflows from WTWs, boreholes, etc.)

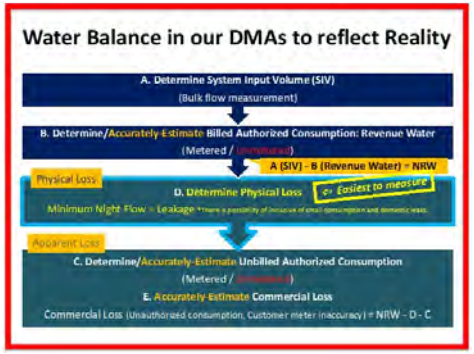
B. Determine/Estimate Billed Authorized Consumption: Revenue Water
(Metered / Unmetered)

A (SIV) - B (Revenue Water) = NRW

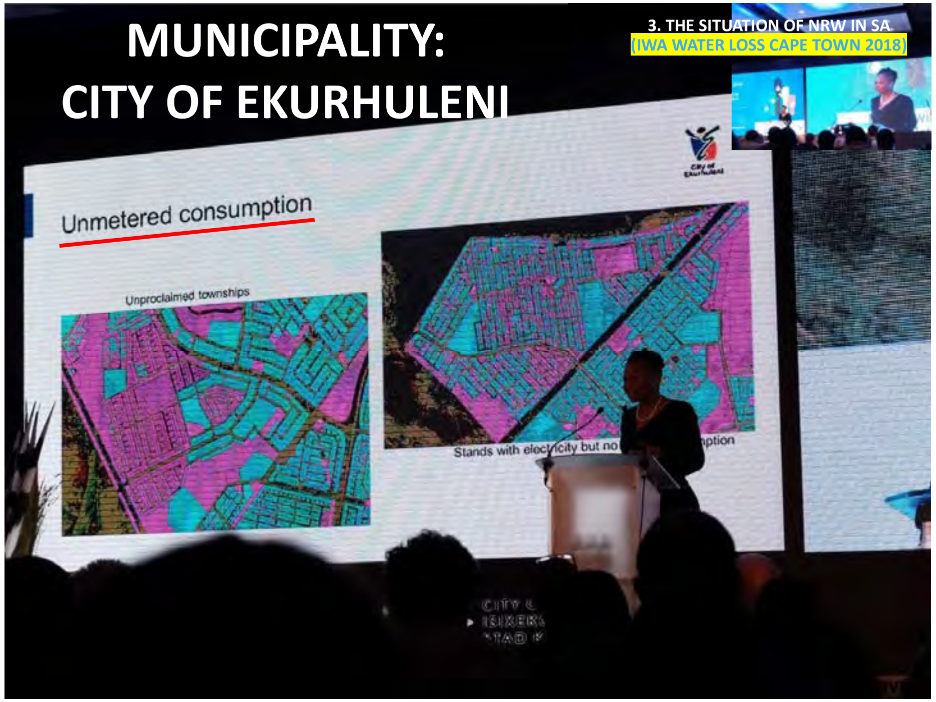
C. Determine/Estimate Unbilled Authorized Consumption
(Metered / Unmetered)

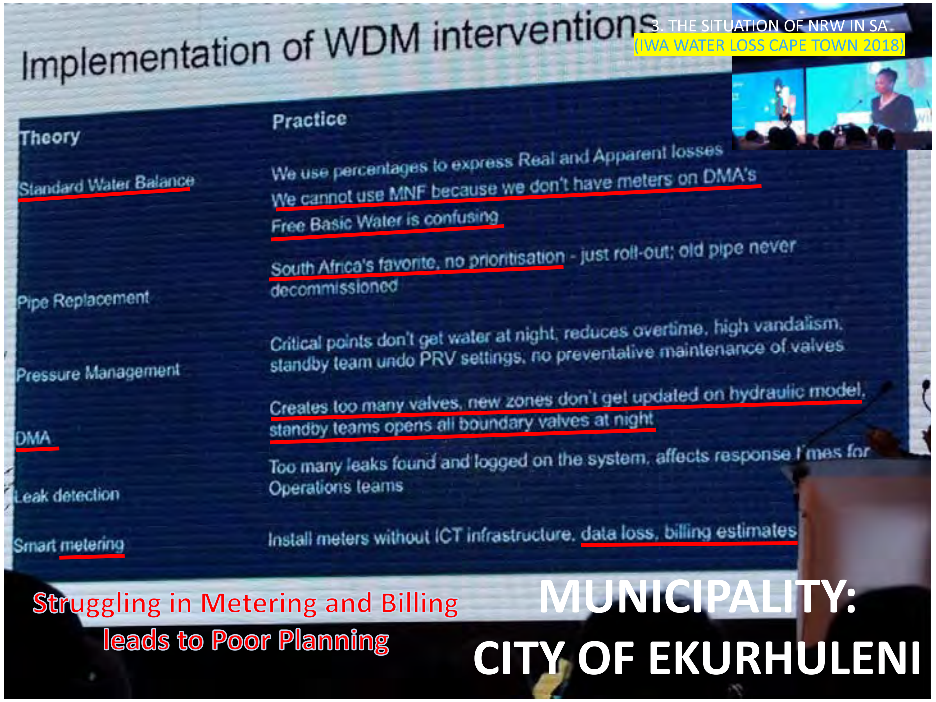
D. Estimate Commercial Loss
(Unauthorized consumption, Customer meter inaccuracy)

E. Estimate Physical Losses
Physical Losses (Leakages) = NRW - C - D

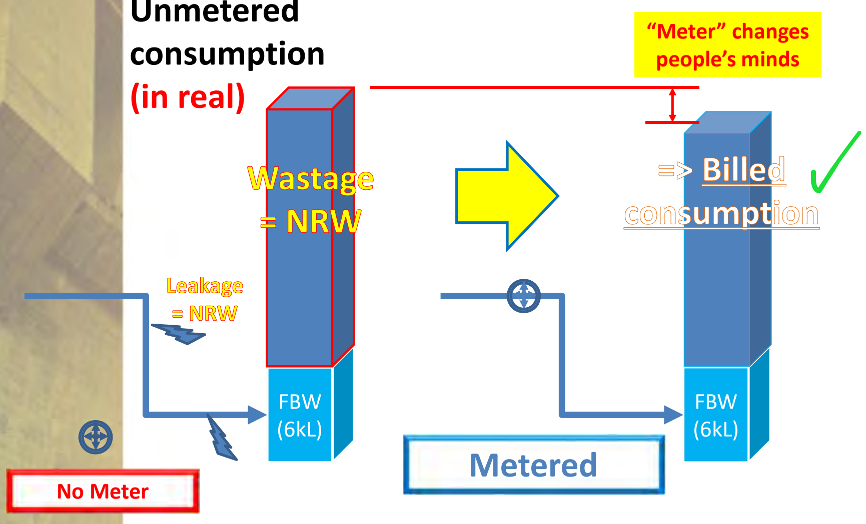


Common Problems in South Africa and How to Deal with them





Unmetered consumption (in real)



You should be aware of: SA's Institutional Aspects

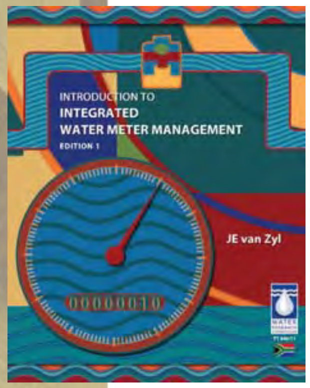
- **Free basic water policy**

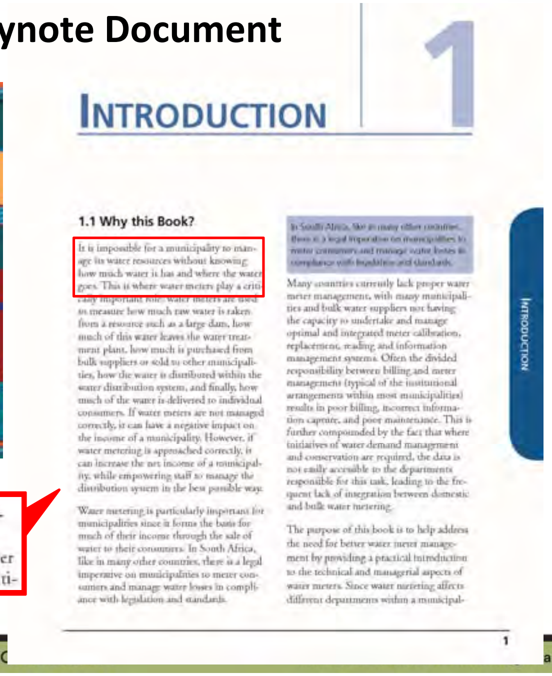
  Even with that policy, proper metering is essential for sustainable business improvement

- **Financial function is in other department**

  Meter reading and billing are in separate departments. The water supply department does not have the ability to spend budgets on new facility investments

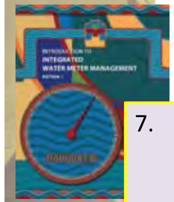
Keynote Document





It is impossible for a municipality to manage its water resources without knowing how much water it has and where the water goes. This is where water meters play a criti-

Main Steps for achieving our Goal



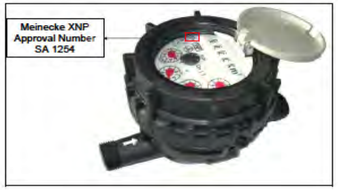
7. Perform an initial review of consumer water meters in the system using the meter database or records and limited, targeted field investigations. Develop a strategy for the evaluation of consumer water meters, focusing initially on more affluent areas where consumption and payment levels are likely to be higher. Consumers without meters should be identified and prioritised for meter installation. It is important that all consumers are metered, although it may be necessary to initially meter stand pipes or indigent consumers in groups. A comprehensive meter audit, testing and replacement programme should develop from this initiative based on a metering strategy adopted by the municipality.

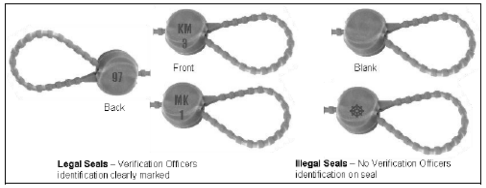
Water meter is the key to success

Basics of Meter Reading and Collection Management for Revenue Generation

1. Legal Requirement

- New water meters must be approved by the legally recognized agency, South African National Standard (SANS) Specifications 1529-1.
- Water utility must be able to confirm the meter approval number and Lead Seal.
- Where meters have been exempted from compliance with SANS 1529 (various parts), an exemption letter from the SABS shall be submitted.





Source: Water Meter Training Manual

2. Meter Standards

Reference

Meter standards used internationally have been revised. Some existing teaching materials in South Africa for water meters state that this revision has not been fully adopted and standards have not been revised.
Therefore, this presentation will be described based on existing standards.

International standards have undergone major revisions that have substantially changed the way water meters are classified.
Many countries have not yet adopted the new standards, and in any case it will take many decades before the new standards become the norm due to the long service lives of many meters currently installed. The approach followed in this book is to use the conventional meter standards, but to
include discussions of the new standards to allow the reader to understand both systems.

Source: INTRODUCTION TO INTEGRATED WATER METER MANAGEMENT、WRC TT490/11, Jevan Zyl, Oct, 2011, Page 13

2. Meter Standards

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Difference of Meter Standards

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- This ratio defines the meter accuracy range, and is often used with the **letter R** to describe the meter. For instance, a meter with **a Q3 to Q1 ratio of 160** will be described as a class.

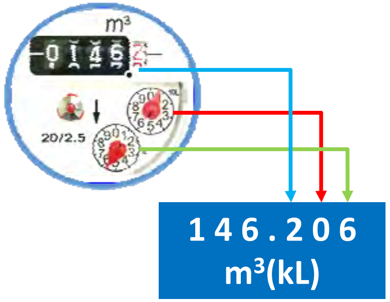
3. Meter Reading

Drill

How to read Meters

- ➢ There are some indicators: analog, digital and combined.
- ➢ Readers/staff must be able to read to the last digit.

Analog (Mechanical) and Digital Types



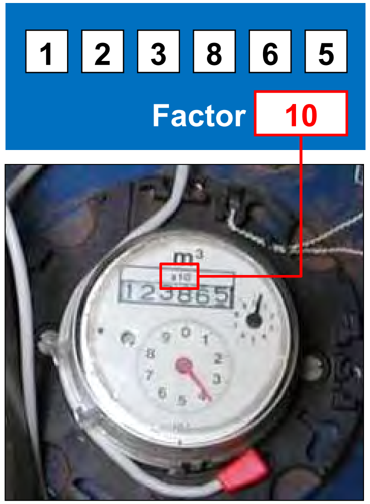
Source: Water Meter Training Manual

3. Meter Reading

Drill

How to read Meters

1. Record all numbers including 0
2. Ensure reading is right way up.
3. Record Meter Factor (e.c. 1 / 10 / 100)

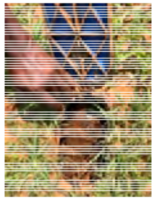


3. Meter Reading

Cause of Meter Reading Error

- ➢ Improper meter installation
- ➢ Stain and scratches on the meter glass
- ➢ Algae growth inside of the glass of meter (wet dial meter)
- ➢ Incompetent or inexperienced meter reader
- ➢ Corrupt meter readers
- ➢ Impossible to read
  - Buried by mud and grass
  - Submerged in water

Because meter readers are the utility's frontline in liaising with customers, their activities have an immediate impact on cash flow. Utility managers should therefore invest in training and motivating their meter readers to record and report information effectively and efficiently.



The meter readers should immediately report any observed problems, and the maintenance team should take action to remedy the problem immediately.

Commercial Loss

1. Billing Data Management
2. Illegal Water Use
3. Meter Management

Commercial Loss

Municipalities need to:

- Know types and reasons of inaccurate data in customer billing records. (How to find causes of error and correction method)
- Understand illegal water use
- maintain water meters in good condition

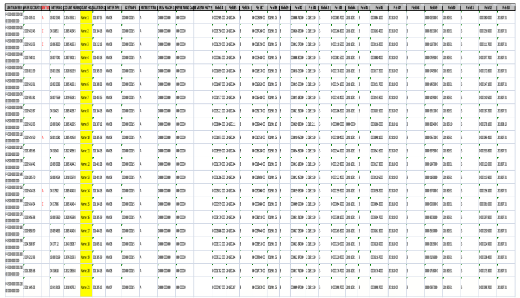
1. Billing Data Management

Data Verification and Processing

- To deal with customer bills and NRW analysis, customer consumption record is the essential database.
- However, the databases are often not accurate.
- It is important to know where to look in the data to see inaccuracies, how to check, and how to fix it into usable data.

Points

- How to get the correct and accurate customer consumption data for NRW calculation?
- Which department does supply the data?
- What do you think about data reliability?



1. Billing Data Management

Causes of Data Errors and How to Fix it

Causes of Data Errors and How to Fix - 1

Missing Customer	Despite being residents and using water, there are not on the customer list. Registration is essential.
Inconsistent Data	The system could not determine the order in which the readings took place due to data inconsistencies.
Spikes or dips in Consumption	Abnormally high or low consumption for a stand are often signs of errors in the meter readings.
Missing Readings	Where no readings are available for the last month, the system has to estimate consumption based on the consumption history for the stand.

Causes of Data Errors and How to Fix - 2

Long Gaps in Meter Reading	When a meter has not been read for a certain number of months (typically 3), consumption estimation become uncertain and an instruction should be given for a reading to be taken.
Incorrect Data	It must be corrected as much as possible for more accurate NRW calculations. The Municipalities need to decide in advance how to deal with the incorrect data if it found. Because some of them can be corrected with a software system, adoption such system should be considered.
Meter Clock-Over	This causes a very large water reading in a month to be followed by a very small reading the next. It is important to include information on the number of digits on the indicator to identify meter clock-overs.

How to find Suspicious Data

Registration Check	**To check whether all the people using water are registered as customers.** ➢ It is desirable to investigate with meter readers.
Abnormal Consumption Check in Data	**To investigate extremely low and high consumption customers.** ➢ Low consumption data imply illegal use sometimes. ➢ Field investigation and interview to the customer are required after listed up suspicious customers
Determining Average Consumption in Data	**To Determine the amount of standard water consumption to be classified.** ➢ This is also influenced by the living environment of the area, so consider the situation carefully and decide. ➢ List up low consumption customer
Suspicious Data	

2. Illegal Water Use

Illegal Water Use: Component of NRW **"Unauthorized Consumption"**

Important Points to find Illegal Water Use

- The first thing to do is to check if the water user is fully registered as a customer.
- Two ways are possible to find illegal water use: "consumption data analysis" and "site investigation". Combination of these ways are the most effective. At first data analysis, then site investigation based on the result of data analysis.

Follow-up Measures

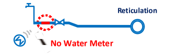
- After detection of illegal water use, follow-up measures against user(s) are necessary for normalization.

2. Illegal Water Use

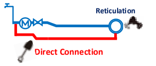
Type of Illegal Water Use

a. Without Water Meter (Metering Evasion)

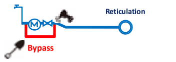
Remove meter & replace it by bridging (short pipe)



Connect domestic pipe directly from reticulation pipe

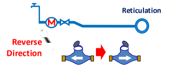


Bypass pipe before and after meter



b. Improper Water Meter Use

Remove meter and set it reversely



Tempering meter (magnet, put something in the gear, etc.)

c. Theft from Pipe and Fittings

- ➢ Reopen cock themselves if disconnected due to non-payment
- ➢ Brake pipe and fittings and get leaking water: pipe bridge, hydrant, air valve and loosen flange
- ➢ Theft water from facility: fire hydrant, fetch accidental leak water and public taps

2. Illegal Water Use

How to Find

2. Illegal Water Use
How to Find - 1

a. Site Survey: Confirmation of Customer Situation

- ➢ First check, if the property is been occupied or vacant.
- ➢ In investigating the minimum and maximum flow of meters should be looked at by the bill record. If a meter is too big or starting flow rate is to low the meter will not register small amounts.
- ➢ Check for signs of the meter being by-passed.
- ➢ Should the meter be older than ten years it is advisable to have the meter tested.

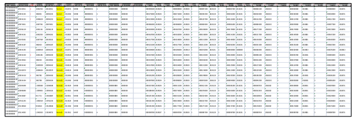
b. Physical Survey

- ➢ Investigation of customer meter
- ➢ If possible, illegal connection survey with other work such as house connection survey at the point of the meter.
  - • Excavation traces around the meter
  - • Water leak around the meter
  - • The sound even when the meter is stopped

2. Illegal Water Use
How to Find - 2

c. Investigation of Customer List

- ➢ As a first step, it is necessary to check whether all the people using water are registered as customers.
- ➢ This activity should be conducted meter reader.
- ➢ Regarding data analysis, refer to the Training Item "Problem identification of NRW reduction, (5) Billing Data Analysis"



3. Customer Meter Management

To measure consumption volume accurately and read meter properly

To measure consumption volume accurately and read meter properly

Important Points

- ■ Against meter-related problems, it is necessary to
- ➢ Establish a close relationship among meter installation/maintenance sections, billing/finance sections and credit control section
- ➢ Share information, experience and lessons learned among them
- ➢ Implement measures together cross-sectorally.
- ■ Maintenance and meter reading provide useful information for finding meter broken and illegal use.

Well-kept Meter Conditions

Record-Keeping of Installation Data	Installation Quality (Adequate Supervision)
Periodic Maintenance Performance	Service Life < 10 years

Installation Data: Meter No., Customer Name, Address & Location, Installation Date, Manufacturer, etc. and updates.

Interference in Meter Reading

- ➢ Buried in the soil
- ➢ No meter
- ➢ Borehole users are not grasped
- ➢ Leave the pre-paid meter broken
- ➢ Leaking water
- ➢ Some digital numbers can't be read because the inside of the glass surface is dirty

Done!

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JICA

The National Non-Revenue Water (NRW) Training
for Municipalities by Municipalities in South Africa

Data Collection (Logging)

under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

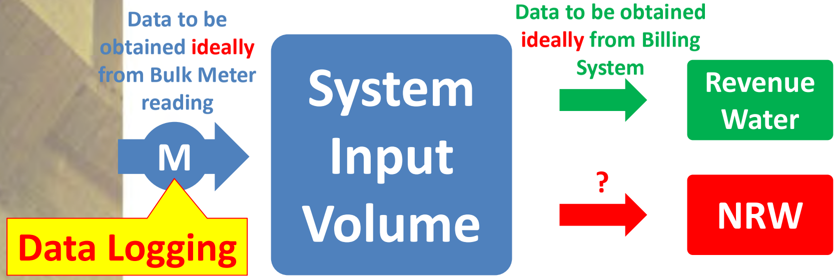
Contents

A. Purpose of Data Logging

B. Basic knowledge of Data Logging

A. Purpose of Data Logging

Data Logging
to monitor System Input Volume

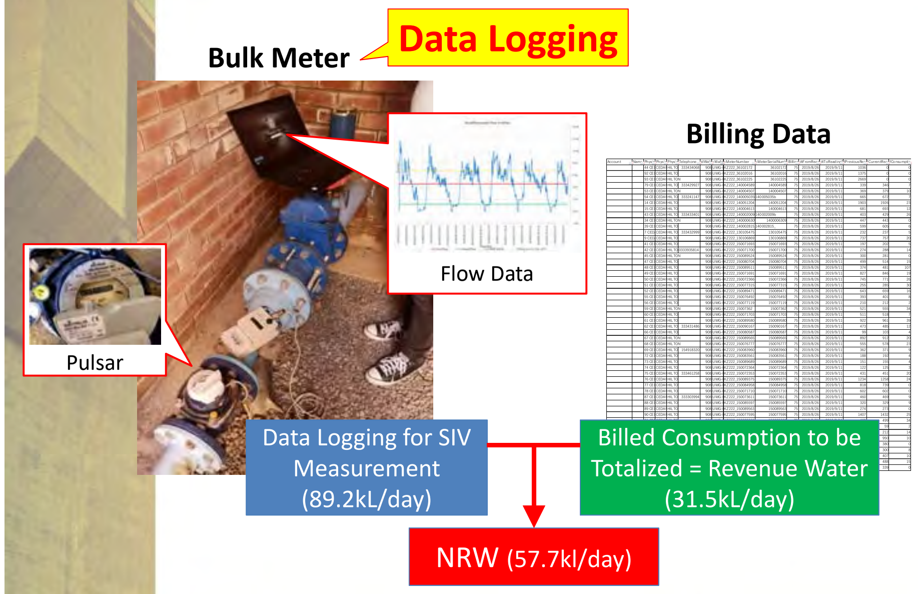


SIV (kL) = RW (kL) + NRW (kL)

i.e. NRW = SIV – RW

Volumes to be in the same period!

NRW Ratio (%) = (SIV-RW)/SIV x 100%



1. What kinds of data can be logged?

Optimization:

- Water Quality (Chlorine, Turbidity)
- Water Flow Monitoring ← Focused in the Training
- Water Pressure
- Power Usage and Chemical Dosing
- Quick Trouble Alarming

2. Monitoring of Working Efficiency

To monitor all the operation system and the data shows if it is working effectively and economically.

- Are water control systems (quality, flow, and pressure) and the calculation properly managed?
- Are targets or control constants are properly managed?
- Are power consumptions or chemical dosages properly managed?
- Are alarm settings and the countermeasures properly managed?

3. Notes about Hardware Aspect

- Earlier obsolescence due to technological development or innovation.
- Humidity or moisture will affect to hardware

Therefore, comparatively shorter terms of maintenance or update is needed.

✓ As a daily maintenance, to compare data itself with long-term monitoring data.

4. Notes about Software Aspect

- Software is modified or optionally revised easily.
- Sometimes it is in trouble in long term stability.
- Artificial mistake makes a trouble for entire system.
- Specialized staff or particular staff only use the software.
- A complicated system makes it time consuming to understand in detail.

✓ Ideally, to prevent dependence much on certain external organizations.

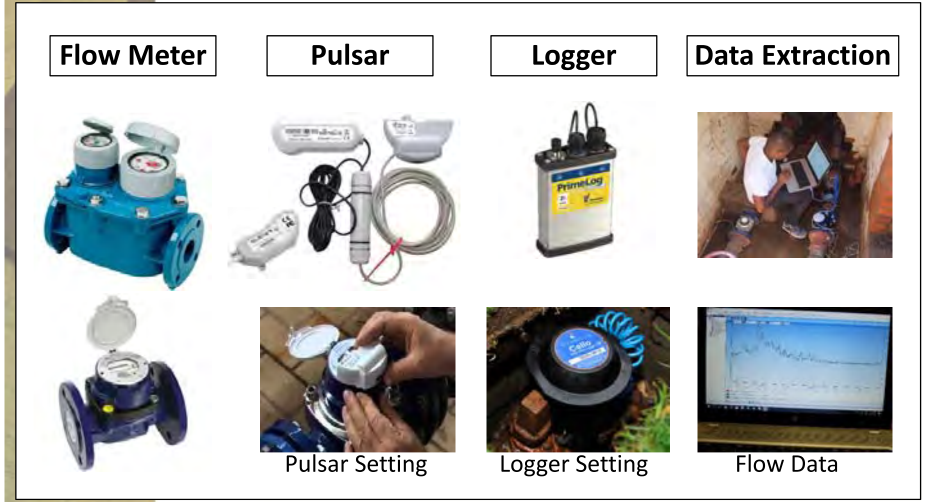
5. Maintenance

- Temperature, humidity, dust, shall be periodically monitored in Logging box such as air filters, PCBs (printed circuit board), connectors, ventilation system, dehumidification devices.
- To avoid logging box from rain water, temperature, humidity, continuous vibration and dust.
- Monitoring of transmission and distribution/ reticulation facilities which are usually unsupervised by staff at the sites.
- To avoid unnecessary water suspension due to maintenance.

B. Flow Data Logging

in the Pilot DMA

1. Flow Data Logging Equipment/Devices



Source: Xylem (Sensus), Elster Kent Metering (Pty) Ltd., Primayer Ltd., Technolog Ltd.

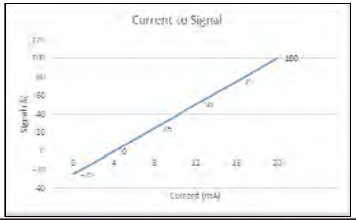
2. Basics of DC4-20mA Signal Input

Advantage

- 4-20mA current loop is the dominant standard in many industries.
- Simplest option to connect and configure.
- It uses less wire and connections than other signals, greatly reducing initial setup costs.
- It is less sensitive to back ground electrical noise.
- Since 4mA is equal to 0% output, it is incredibly simple to detect a fault in the system.

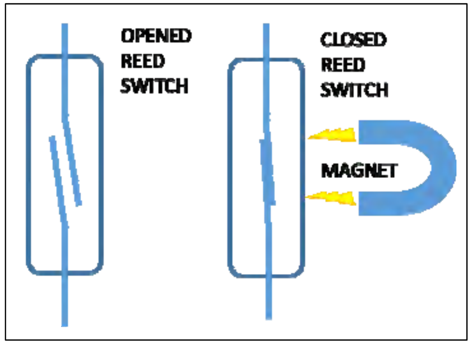
Disadvantage

- Current loops can only transmit one particular process signal.
- Multiple loops must be created in situations where there are numerous process variables that require transmission. Running so much wire could lead to problems with ground loops if independent loops are not properly isolated.



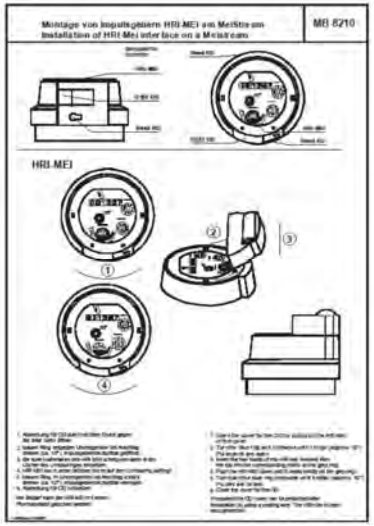
3. Basics of Pulse Signal Input

- When it comes to water meters, a pulse output is simple , single pole, single throw, dry contact reed switch.
- The switch is normally open. The switch closes when a magnet is in close enough proximity to pull the reed to the closed position, The magnet is positioned on a dial (or drum in some cases) that rotates due to water flow. The closure and opening of this switch is a single "pulse".



4. Pulsar (Example)

- Flow meters have a several pulse port for a pulse signal output.
- Each pulse port has an appropriate pulsar to register it.
- Pulsar installation depends on manufacturer of flow meter.
- Read an installation manual of flow meter and a pulsar carefully.



Source: Xylem (Sensus), Elster Kent Metering (Pty) Ltd

5. Pulse Values (Example)

Sensus: Meistream and WP Dynamic Type

Meistream

WP Dynamic

Meistream Pulsar Type		Diameter 40 to 125	Diameter 150 to 300
HRIMEI		0.01; 0.05; 0.1 or 1m^3	0.1; 0.5; 1 or 10m^3
OD01		0.001 m^3	0.01m^3
OD03		0.01m^3	0.1m^3

WP Dynamic Pulsar Type		Diameter 40 to 125	Diameter 150 to 300	Diameter 400
RD 01		1m^3 alternatively 0.01 and 1m^3	1 and 10m^3 alternatively 0.1 and 10m^3	10 and 100m^3
OD 01		0.001m^3	0.01m^3	0.1m^3
OD 03		0.01 m^3	0.1m^3	1m^3

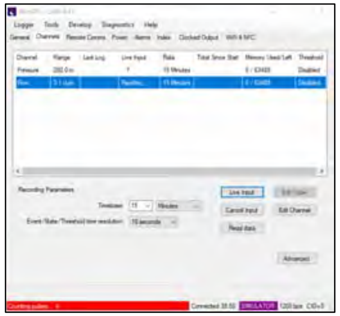
6. Pulsar Wiring Diagram (Example)

Sensus and Elster Kent

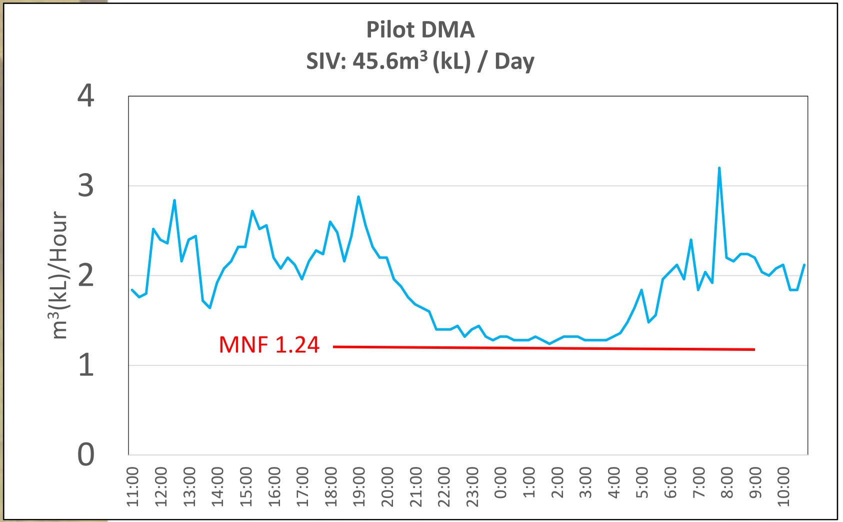
	Meter Model	Diameter (mm)	Pulsar Type	GND	CH1	Pulse Value (m^3)
Sensus	40SS	40	HRI Sentinel	Brown	White	0.001
	Meistream	40-125	HRI-Mei	Grey	White	0.01
	Meistream	150-300	HRI-Mei	Grey	White	0.1
	WP	50-100	Reed 01	White	Brown	0.1
	WP	150-250	Reed 01	White	Brown	1
Elster Kent	PR7	40-125	PR7 Pulsar	Black	Red	0.01
	PR7	150-300	PR7 Pulsar	Black	Red	0.1
	KSM/PSM	15-20	Domestic Reed	Black	Red	0.005
	KSM/PSM	25	Domestic Reed	Black	Red	0.005

7. Time Base, Pulse Value and Index Value

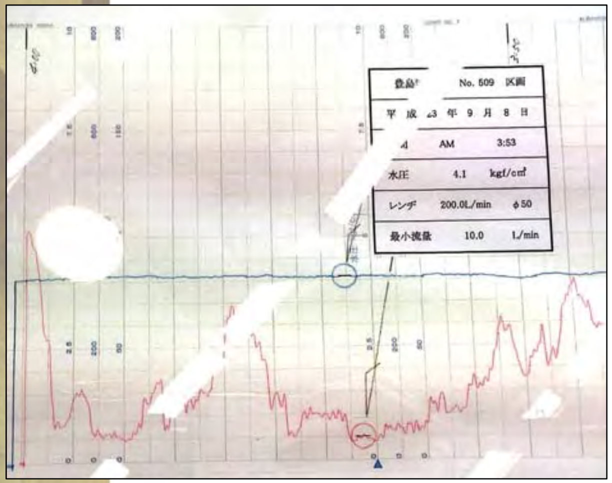
- Typical default time rate for channels is 15 minutes
- If you require shorter time base, set the time for more than three pulses output for proper data logging.
- Select Live input to take an instantaneous reading.
- Go to the Index tab to set up the meter reading in the logger.
- It is recommended to observe the meter index for a moment to verify that the logger index is showing the same increase in consumption as the meter index.



8. SIV and MNF as Outcomes (Example)



9. What is actual MNF like ?



Case of Tokyo Metro

- 500 connections
- 1 second logging interval
- 4.1 bar
- MNF=10L/min
- AM 3:53

Ideally, it needs precise measurement interval (per sec)

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The National Non-Revenue Water (NRW) Training
for Municipalities by Municipalities in South Africa

Zone Configuration (Drop Test)

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The Situation of NRW in South Africa

In general, we don't know the actual situation of NRW.

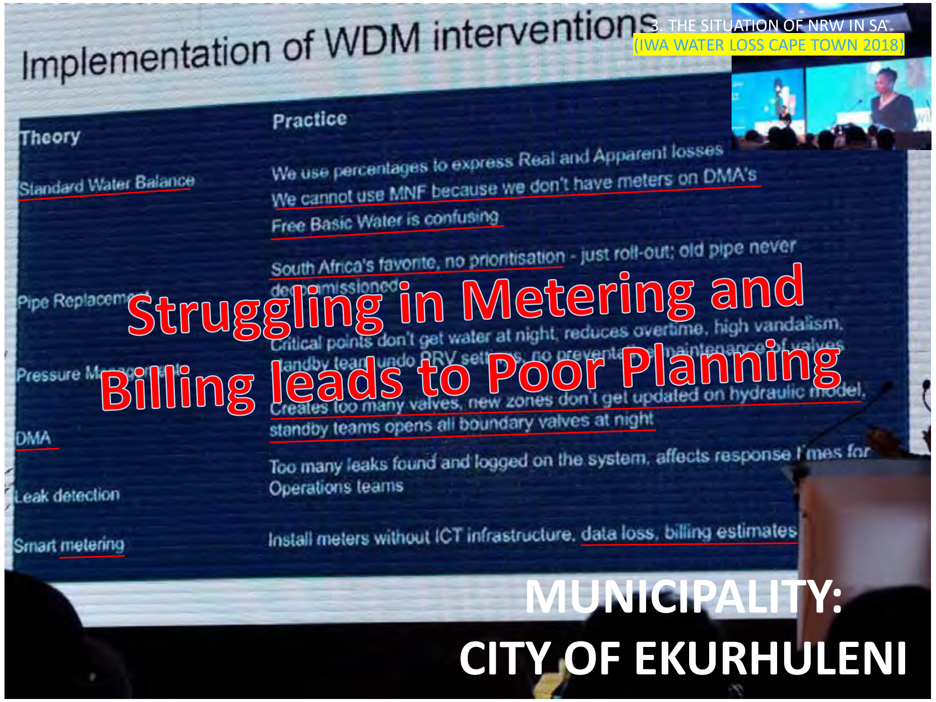
Because of **lacking of the data** (water balance)

No-Drop assessment submission and valid data set is only half!

➡ The situation is that we don't know the status quo of NRW!

- **Very primitive !**

3. THE SITUATION OF NRW IN SA
(IWA WATER LOSS CAPE TOWN 2018)



Struggling in Metering and Billing leads to Poor Planning

MUNICIPALITY:
CITY OF EKURHULENI

Vicious cycle to Virtuous cycle

NOW IN SA

- You don't see yourself (measurement).
- You don't know how much water you are sending to people and how much losing it as well.
- Just dig and fix is your work.

[Municipal manager]
[Financial division]
No Trust

- No budget
- No approval to a project

[Technical section]
No Data

Start from here!

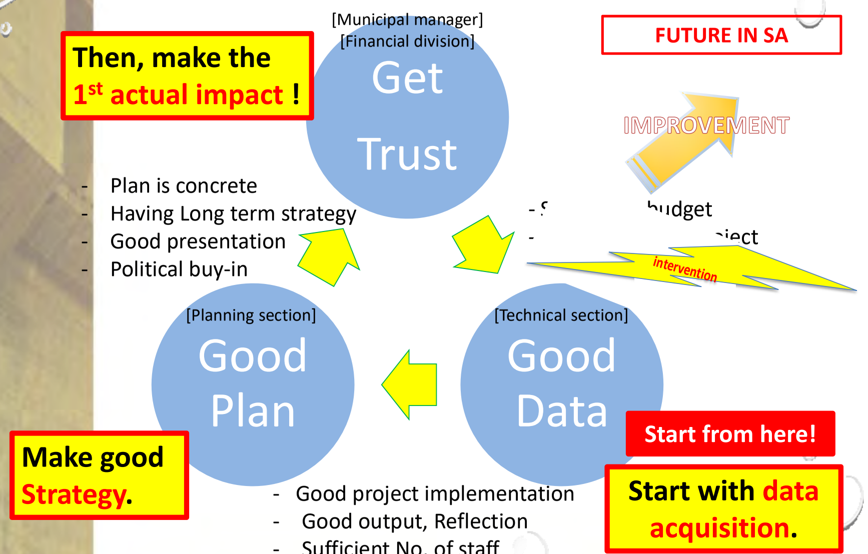
- No project implementation
- Staff always in shortage
- Just hustle everyday
- Status to be worsened…

[Planning section]
No Plan

- No political buy-in
- Poor presentation

However, the infrastructure require a long-term, sustainable improvement starting Now!

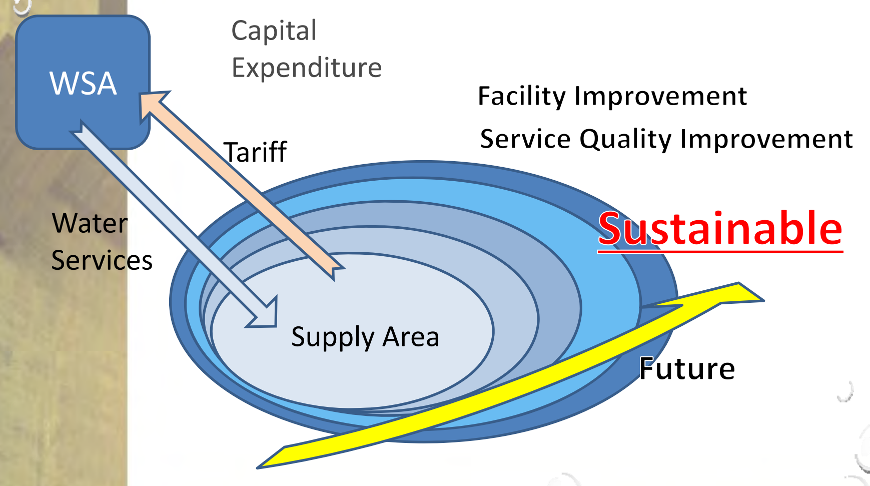
Vicious cycle to Virtuous cycle



- Plan is concrete
- Having Long term strategy
- Good presentation
- Political buy-in

- Good project implementation
- Good output, Reflection
- Sufficient No. of staff

Through "Vicious cycle to Virtuous cycle"



Physical Loss and Commercial Loss

Water Balance

Water Balance by International Water Association (IWA)

System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water
			Billed Unmetered Consumption	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non-Revenue Water (NRW)
			Unbilled Unmetered Consumption	
	Water Losses	Commercial (Apparent) Losses	Unauthorized Consumption	
			Customer Metering Inaccuracies and Data Handling Errors	
		Physical (Real) Losses	Leakage on Transmission and/or Distribution Mains	
			Leakage and Overflows at Utility's Storage Tanks	
			Leakage on Service Connections up to Point of Customer Use	

*Note: Free basic water is considered to be Revenue Water in SA

Physical Loss component of NRW

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System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water
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Commercial(Apparent) Loss component of NRW

If we measure this **We can also get this**

IWA Water Balance Process (in SA)

A. Determine System Input Volume (SIV)
(Reading data of purchase water, outflows from WTWs, boreholes, etc.)

B. Determine/Estimate Billed Authorized Consumption: Revenue Water
(Metered / Unmetered)

A (SIV) - B (Revenue Water) = NRW

C. Determine/Estimate Unbilled Authorized Consumption
(Metered / Unmetered)

D. Estimate Commercial Loss
(Unauthorized consumption, Customer meter inaccuracy)

E. Estimate Physical Losses
Physical Losses (Leakages) = NRW - C - D

Water Balance in our DMAs to reflect Reality

A. Determine System Input Volume (SIV)
(Bulk flow measurement)

B. Determine/Accurately-Estimate Billed Authorized Consumption: Revenue Water
(Metered / Unmetered)

A (SIV) - B (Revenue Water) = NRW

Physical Loss

D. Determine Physical Loss ⇦ ***Easiest to measure***
Minimum Night Flow = Leakage *There is possibility of inclusive of small consumption and domestic leaks.

Apparent Loss

C. Determine/Accurately-Estimate Unbilled Authorized Consumption
(Metered / Unmetered)
E. Accurately-Estimate Commercial Loss
Commercial Loss (Unauthorized consumption, Customer meter inaccuracy) = NRW - D -C

Main Steps for achieving our Goal

1. Identify all sources of water into your system and bulk transfers to other municipalities. Ensure that each source or bulk transfer has a meter that is correctly sized, in good condition and regularly read (preferably continuously, but at least weekly).
2. Identify bulk consumers (top 10 %) in the system. Ensure that each bulk consumer has a meter that is correctly sized, in good condition and regularly read (at least monthly).
3. **Identify zones in the distribution system - the smaller the zones are, the better.** Ensure that each zone has a meter that is correctly sized, in good condition and regularly read (preferably continuously, but at least weekly).
4. Log the zonal meters to determine the minimum night flow (and thus the leakage) in each zone.
5. **Estimate current revenue water based on water sales to consumers**
6. **Do a preliminary water balance according to the IWA grid and identify the most critical areas for intervention.** This will typically lead to a leak detection and repair programme focused on the zones with the highest leakage rates. A more comprehensive non-revenue control strategy should be developed from this initial effort.

Zone configuration (Drop Test)

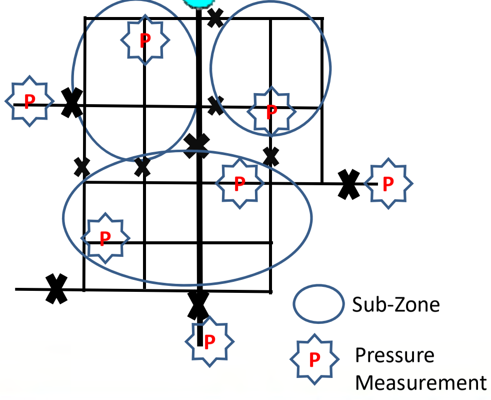
Confirmation Method for complete Hydraulic Separation

Zoning is the 1st step for Identifying the Problem.

Drop Test (Zero '0' Pressure Test)

Confirmation Method for complete Hydraulic Separation

- **Close all boundary valves and close inlet valve for DMA, then check water pressure at some points in the DMA.**
- **The easiest way is to open fire hydrant of the highest point in the sub-zones.**
- **It needs consideration the contour of the pipe network etc.**



What will happen in the Workplace Training?

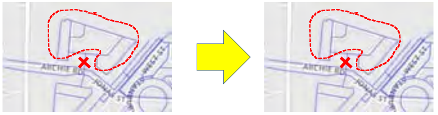
- ✓ 1. Select Pilot Focus Area (Pilot Area) --- on the map
- ✓ 2. Make ideal sub-zones /District Metered Area --- on the desk
- ✓ 3. Zone configuration (sub-zones in the pilot DMA) --- **Drop Test**
- ✓ 4. Flow measurement --- **MNF, Step Test**
- ✓ 5. Analyze the MNF, Step Test data

Get foundational skills to tackle NRW using Pilot DMA !!!

✓ **1. Select a Pilot Area**

Just select service area which has same character and the number of connection < 100.

✓ **2. Make ideal sub-zones /District Metered Area --- on the map**

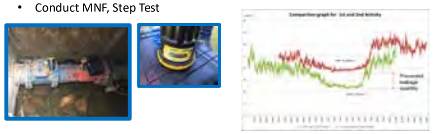


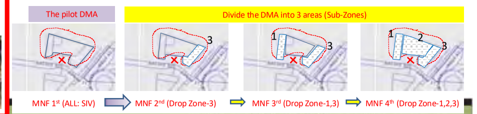
✓ 3. Zone configuration(sub-zones in the pilot DMA) --- **Drop Test**

- Drop test (DMA & each every zone)

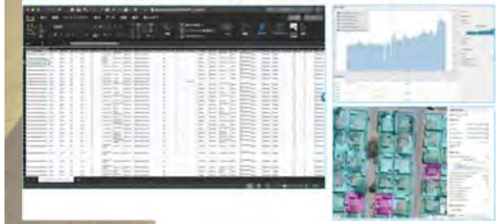
✓ **4. Flow measurement --- MNF, Step Test**

- Conduct MNF, Step Test





✓ **5. Analyze the MNF, Step Test data (Collect and analyze the billing data as well)**



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*Note: Free basic water is considered to be Revenue Water in SA

Procedure of Zone Configuration

Actual Zoning for Problem Identification

1) The purpose here is to confirm the position of the valves, operationality, and checking sectional supply of the zones
2) Check if the network is not inter linked.

*** The point is to examine how you can isolate the zones using valves already you have. You need to modify the shape of the zones flexibly.**

Confirmed by Drop Test Zone 1 | *Confirmed by Drop Test Zone 2* | *Confirmed by Drop Test Zone 3*

Record keeping for Zone Configuration(Drop Test)

A4-sized map

Write down every action and time in a notebook or the map:

- Valve closing time / by who
- Pressure checking points
- Pressure dopped time (to zero)/who
- Valve opening time / by who

(in conclusion)

- Which valve affects which area?

Purpose of DMA (Zoning)

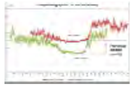
Why supply areas are segmented as DMAs? What is the purpose of DMA?

- **To ease water supply management, such as water supply volume, water pressure.**
- **In large supply area it has a difficulty to find what is the reason of NRW affected in detail. The smaller the area, the easier to find the reason for the most impacted on high NRW ratio.**
- **In DMAs, System Input Volume (SIV) measurement is carried out to know the important factor of NRW.**
- **And it is possible to measure the amount of water leakage by the Minimum Night Flow(MNF) measurement.**
- **It is easy to identify the required WDM interventions to reduce non-revenue water in each DMA.**
- **To enable better management of water supply systems as any future changes.**

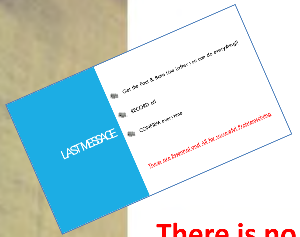
Key Techniques

1. **Zone configuration (Drop Test)**

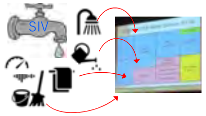
2. Measurement (MNF, Step Test)



3. Data Analysis (Billing data, Flow measurement data)



- ✓ **Confirm every time**
- ✓ **Log everything**
- ✓ **Safety first**



There is no shortcut to succeed! Practice makes perfect!

a. Isolation Valve

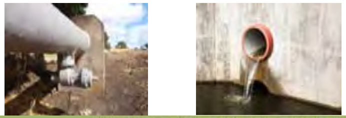
- ➢ Isolation valves are used to close off and thus prevent any flow through pipes.
- ➢ Isolation valves are installed at junctions in pipe networks and at regular intervals of one to two kilometers on transmission lines. They should be located near street corners and in line with property side-boundaries so that they are easier to find.
- ➢ Butterfly valve is compact and suitable for large diameter pipes.

b. Air Valve

- ➢ Air valves are installed on pipelines to control the flow of air into and out of the system.
- ➢ If the air is not released, it will accumulate at high points in pipes, restricting and even preventing flow altogether.
- ➢ Air valves operate by automatically opening a valve when air accumulates in the valve body or negative pressures occur in the system.
- ➢ High compressed air is very dangerous to pipelines and operators, it requires extreme caution.

c. Scour Valve

- ➢ Scour valves are used to draining for maintenance purposes. It typically consists of a reduced diameter off-take pipe closed with an isolation valve
- ➢ Mud and sludge get collected in the pipes at these depressions and remove from this point.
- ➢ On long pipelines, scour valves should be provided at the lowest points in the pipe profile. Each section of pipe that may require draining should be provided with a scour valve.

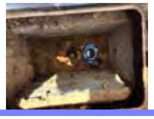


d. Non-Return or Check Valve

- ➢ Water flow only in one direction.
- ➢ Often installed to prevent backflow to meters, pumps and etc.

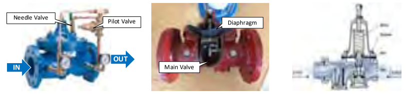
e. Fire Hydrant

- Fire hydrants are used to provide water from the distribution system for fire fighting. Fire hydrants incorporate an isolation valve and a standard fitting for connecting a fire hose.
- Hydrants are often used for operation and maintenance functions in water distribution systems, such as flushing pipes, releasing air and logging pressures.
- Hydrants should be serviced and their flow rate checked to comply with the required flow rate at least once per year.



f. Control Valve (including PRV)

- The pressure in a water supply system should be maintained as close to the minimum level as possible, as excess pressures increase the burst rates and reduce the service lives of pipes, potentially increase leakage rates substantially, increase water supply demands and require more energy (in pumped systems).
- However, if the distribution water pressure is partially high due to terrain or other conditions, use PRV. The use of PRV is only for a countermeasure when the water pressure in the zone is partially high. As a measure against NRW, avoid using many PRVs to reduce water pressure.
- When set up the secondary pressure with PRV, it is necessary to consider the water pressure at the location where the water pressure is highest.



Why do we start from a small pilot DMA?

✓ 1. Small start => No pain and special costs

✓ 2. We can't even reduce NRW in small area, much less large complicated area?

✓ 3. DMA requires us to enhance reticulation management skills => O&M upskill

✓ 4. Small DMA gives us specific results.

✓ 1. Start from small area => No pain and special costs

We've already have our own valves, fire hydrants, pipes, and water. Just we need a data logger.

✓ 2. We can't even reduce small area's NRW, much less large complicated areas.

We can learn from each pilot activity and improve.

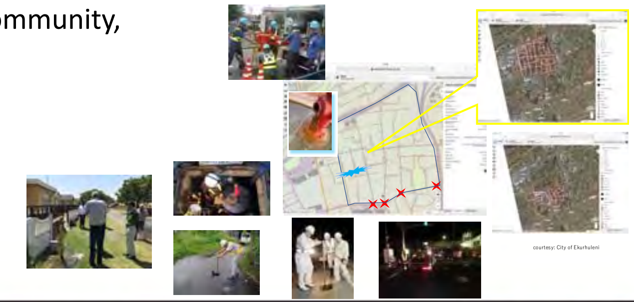
3. DMA requires us to enhance reticulation management skills => O&M upskills

Municipality must operate reticulation properly;

- Valves, Meters, Air valves, Fire hydrants, Cleaning valves, PRVs, Loggers, Communication tools

Municipality must understand reticulation properly;

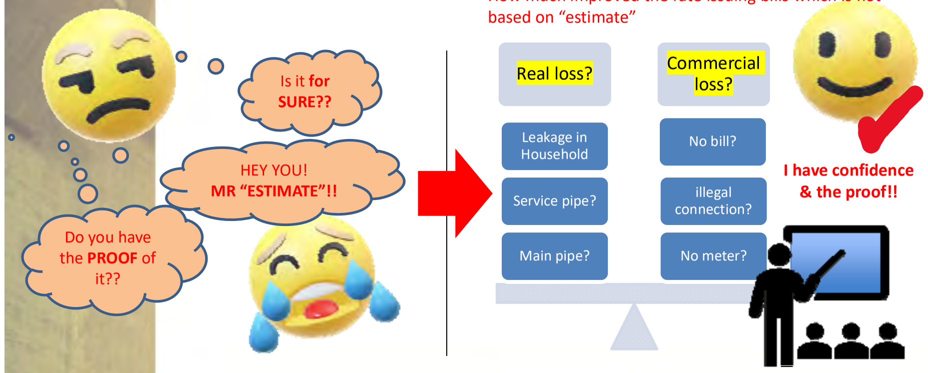
- Flow Direction, Velocity, Water Pressure, Topographical feature, Land use, the Community,



4. Small DMA gives us specific results

"What is the main cause of your NRW?" Can you explain?

- ✓ How much water have saved
- ✓ How much commercial loss have reduced
- ✓ How much water purchase from Water Board have saved
- ✓ How much NRW have reduced
- ✓ How our reaction time for next burst improved
- ✓ How much improved the rate issuing bills which is not based on "estimate"



Why don't we try to make and manage DMA?

All NRW management starts from here, because NRW represents your quality of skills for deliver water services.

There is no shortcut !!

Points (Drop Test)

- **Pilot DMA size : Smaller is better, about 100 connections**
- **Zone configuration : Be done perfectly!**
- **Pressure measurement : Check there is or not**
- Precise MNF measurement (measurement period: within 1second)
- Measures (**Baseline**) - Take Measures (**Intervention**) - Measures (**Output**)!
- Meter selection - according to the flow rate
- **Teamwork**
- **Imagine the flow to each zones**

The Facilitator team support your workplace activities. No worries!!

Workplace Training Members

+ Learners ----- 3 to 5 persons
+ Facilitators (Municipalities) ----- 2 persons
+ Coordinator (DWS) ----- 1 person
+ Technical support (JICA) ----- 1 person

Learners:

- Municipal water services officials (3 to 5 officials as a team consisting WCWDM, O&M, Billing, etc)

Facilitators:

- Skilled and experienced municipal water services officials
- DWS officials

Coordinator:

- DWS officials

End

The National Non-Revenue Water (NRW) Training
for Municipalities by Municipalities in South Africa

MNF and Step Test

under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

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A method to narrow down problematic zones by understanding changes in water flow

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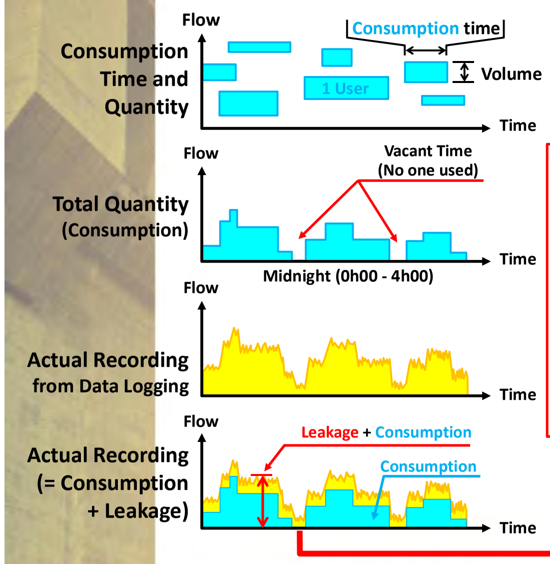
MNF (Minimum Night Flow)



Principle of Water Leakage Measurement

- Night-time, when residents asleep, almost no one uses tap water.
- If no one uses tap water, no-consumption.
- If there is no internal or external water leak in the DMA, flow-meter shows 0.
- The lowest flow volume at night, is called <u>Minimum Night Flow</u>, and it's used as an indicator of internal and external <u>Water Leakage</u>.

Purpose of Step Test

- <u>To narrowing down the area of leak occurrence or unaccounted water.</u>
- To reduce the time to find leaks
- To prioritize the sub-zones or pipelines to do leak survey.

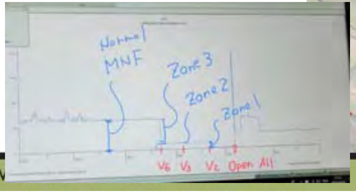
Before Step test, we need to know when MNF apereas.

If MNF occurs for long time, a step test can be done during that time to identify critical sub-zones.

How to conduct step test

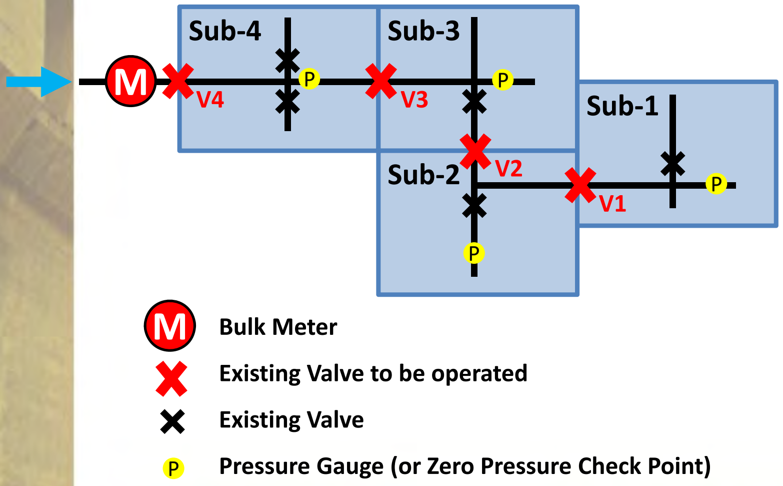
Example

1. Attach flow meter and data logger at DMA inlet.
2. Close boundary valves at each sub-zone (keep flow logging).
3. Wait 5 to 30 minutes for each sub-zone until flow and pressure to be stabilized. The time depends on size of the sub-zone.
4. When all area have measured, re-open the valves in reverse order.



Procedure of Step Test - 1

in a conceptual "DMA-A".



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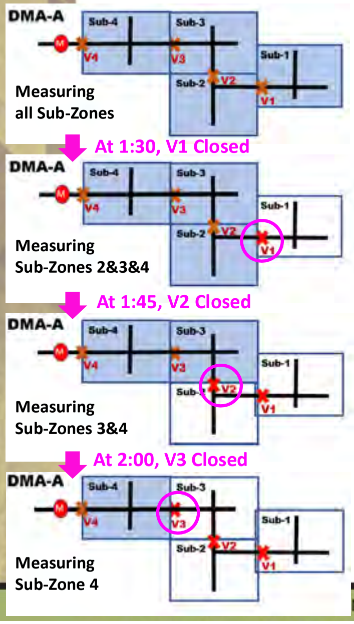
Procedure of Step Test - 2



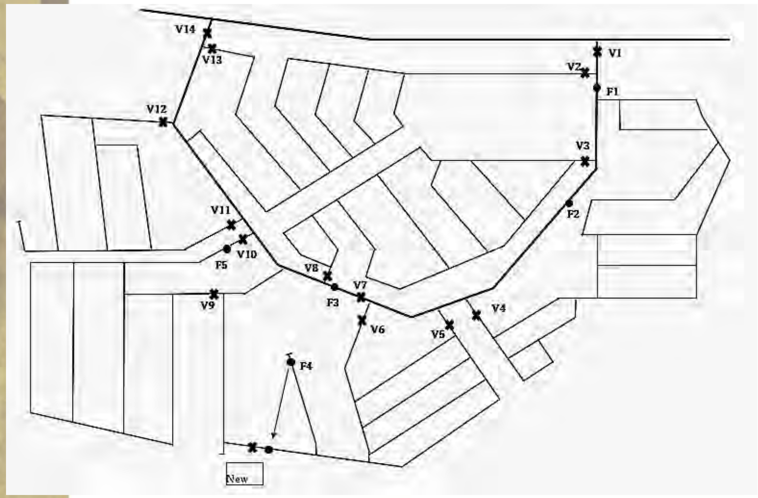
Step No.	Closing Valve ID	Openning Valve ID	Time of Valeve Operation
	-	-	-
1	V1		1:30
2	V2		1:45
3	V3		2:00
4	V4		2:15
5	Open valves	V4	2:30
6		V3	2:40
7		V2	2:50
8		V1	3:00

Summary of Step Test

- Step test is a method of localizing unaccounted water at the night into specific area of the distribution network, sometimes for leak detection and repair.
- It's an efficient approach to identify areas with suspected leaks or unaccounted water.

An example of Step Test

Pipeline drawing(s) is prepared before Sub-Zoning.



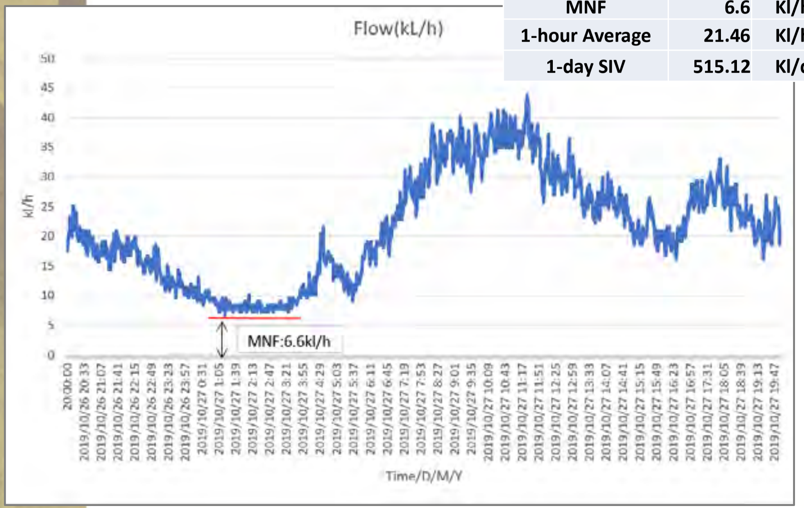
Sub-Zones are confirmed through Zone Configuration (Drop Test).

Data logger(s) is set up at bulk flow meter(s) ideally of mechanical type.

Ultrasonic flow meter is alternatively used if no existing flow meter.

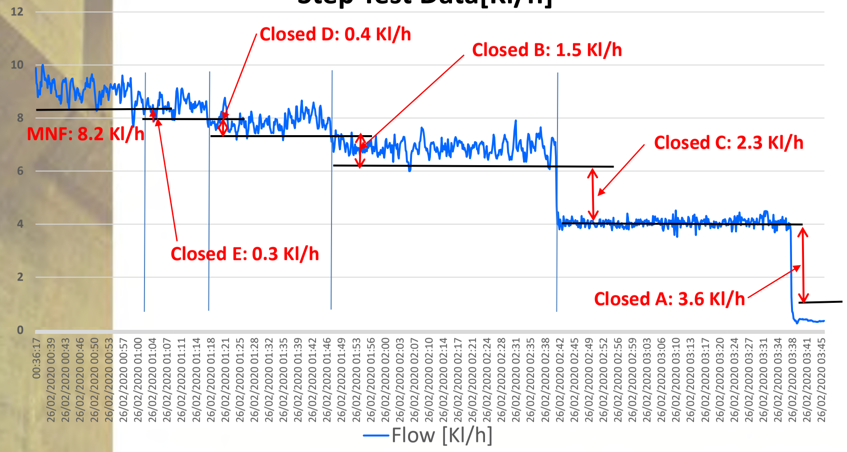
Flow data is measured for 24 hours.

MNF	6.6	Kl/h
1-hour Average	21.46	Kl/h
1-day SIV	515.12	Kl/d



MNF is stable 0:00 to 3:30 in this area.

Step Test for 5 sub-zones is done by closing valves in the MNF time.



Flow difference among 5 zones in MNF time is identified.

Night Flow						
Sub-zone	A	B	C	D	E	Total
No. of Connections	240	177	381	169	120	1087
Night Flow Kl/h	3.6	1.5	2.3	0.4	0.3	8.1
Night Flow per Connection	0.0150	0.0085	0.0060	0.0024	0.0025	

water & sanitation
Department: Water and Sanitation
REPUBLIC OF SOUTH AFRICA

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The National Non-Revenue Water (NRW) Training for Municipalities by Municipalities in South Africa

Practices: DMA/Sub-zoning and Consumption Data Analysis

under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Practices

1. DMA and Sub-Zones
2. Drop Test
3. System Input Volume (SIV) and Minimum Night Flow (MNF)
4. Step Test
5. Billing Data
6. NRW calculation

1. DMA and Sub-Zones

This is a reticulation map in a municipally in South Africa.
No bulk meter is existing.

V: Existing Valve   Water Flow Direction

Questions

(1) How many DMAs can be created in the simplest way? Where do you install a bulk meter(s)?
(2) If we need to set up sub-zones, how many sub-zones will be created?

V: Existing Valve   Water Flow Direction

Answers

This slide should NOT be shared with learners in advance.

(1) 2 DMAs can be created.
(2) To measure SIV, bulk meters are installed upstream of pipe near V1 and V10.
(3) Each DMA has 4 sub-zones, total 8 sub-zones can be created.

V: Existing Valve   Water Flow Direction

2. Drop Test

Questions

(1) How to confirm hydraulic separation?

V: Existing Valve   Water Flow Direction

Answers

This slide should NOT be shared with learners in advance.

DMA-1: Conduct drop test, do these steps.

a. Close V5,V6 and check pressure sub-zone-C
b. Close V4 and check pressure sub-zone-D
c. Close V2,V3 and check pressure sub-zone-B
d. Close V1 and check pressure sub-zone-A

V: Existing Valve   Water Flow Direction

Answers

This slide should NOT be shared with learners in advance.

DMA-2: Conduct drop test, do these steps.

a. Close V7 and check pressure sub-zone-E
b. Close V8 and check pressure sub-zone-F
c. Close V9 and check pressure sub-zone-G
d. Close V10 and check pressure sub-zone-H

V: Existing Valve   Water Flow Direction

3. SIV and MNF

Questions

(1) Which type of meter is suitable for SIV measurement, Mechanical, Mechanical combination, Clamp-on-type Ultrasonic, Electromagnetic?

(2) How do you get SIV of 1-day?

(3) Please explain MNF measurement method.

Answers

This slide should NOT be shared with learners in advance.

(1) Meter Type

a. Install a type of meter that can log data. If the flow rate data cannot be recorded, MNF cannot be measured.

b. If you have an existing mechanical meter which can be attached a pulse counter, it's best to use it.

c. For mechanical types, it may be necessary to install a combination meter if the measurement area is small and the amount used at night is very low.

d. If an ultrasonic meter is available, installing it will eliminate pipe cutting.

Answers

This slide should NOT be shared with learners in advance.

(2) 1-Day SIV

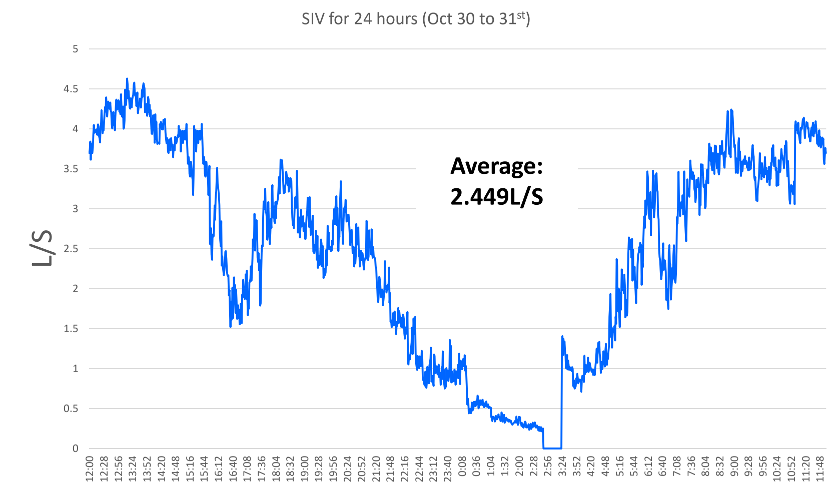
a. Software and devices that can accumulate data, the required data is displayed as an integrated value.

b. If you want to calculate the integral in Excel, use a function.
   - ➢ When there is a lot of data. First, average the data during the period, then multiply by the numbers of data in the period.
   - ➢ For hourly data. Totalize hourly data for 1-day.

Answers

This slide should NOT be shared with learners in advance.

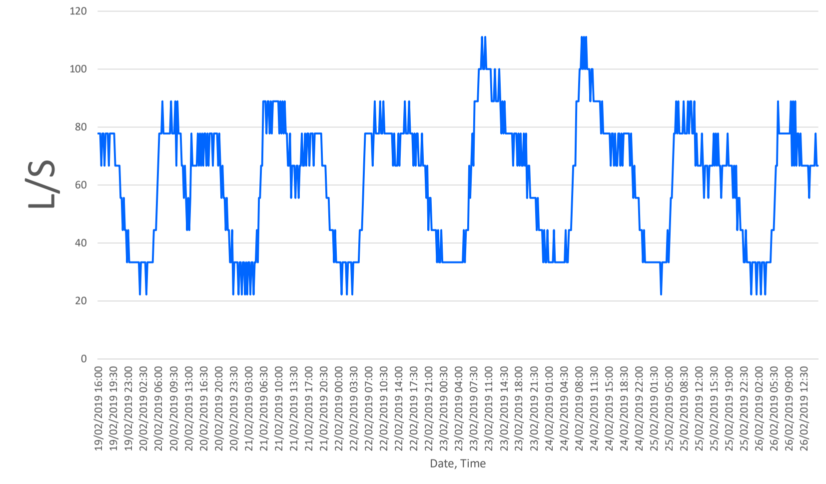
(2) 1-Day SIV Data (Sample Graph)



Answers

This slide should NOT be shared with learners in advance.

(2) 7-Days SIV Data (Sample Graph)



Answers

This slide should NOT be shared with learners in advance.

(3) MNF Measurement

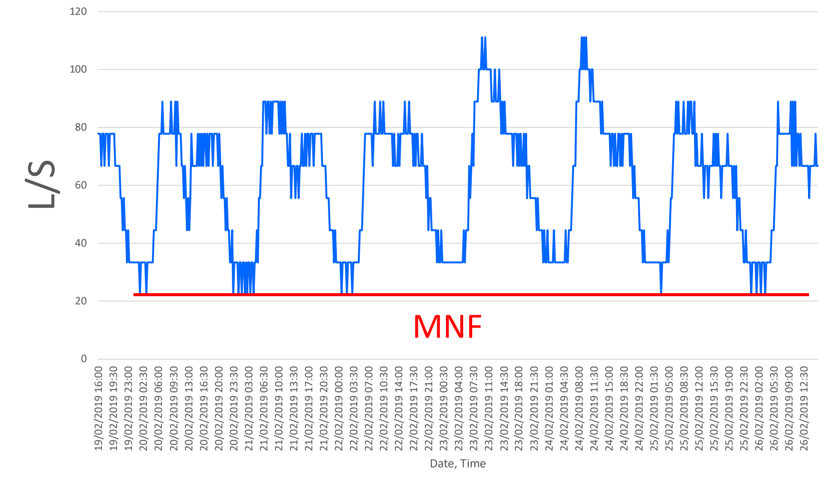
a. Set the equipment to log the meter data through the night.

b. The shorter the logging interval, the better, but the amount of data will increase, which may cause the computer to slow down during analysis.

Answers

This slide should NOT be shared with learners in advance.

(3) MNF Measurement Data (Sample Graph)



4. Step Test

Questions

(1) When a step test should be done?

(2) Please explain order of the step test in DMA-1 and -2.

V: Existing Valve   Water Flow Direction

Answers

This slide should NOT be shared with learners in advance.

(1) During the time MNF occurs.

(2) Order as below:

DMA-1

a. Measure all sib-zones.
b. Close V5,V6, remove sub-zone D: measure A+B+C
c. Close V4, remove sub-zone C,D: measure A+B
d. Close V2, remove sub-zone B,C,D: measure A

DMA-2

a. Measure all sib-zones.
b. Close V7, remove sub-zone E: measure F+G+H
c. Close V8, remove sub-zone E,F: measure G+H
d. Close V9, remove sub-zone E,F,G: measure H

Answers

This slide should NOT be shared with learners in advance.

Works to be done for Step Test

(1) Plan a step test on a Map.

(2) Check operation of valves: Improper closing valve generates "flow noise“.

(3) {Do a Drop test of each area by closing isolation valves} (If isolation has been confirmed it does not need) .

(4) When time becomes MNF occurring time, start flow logging.

(5) Continue a step test during the stable usage time at night. Check water pressure on each step. Keep time of operation of valves.

(6) When finish every steps, open valves by revers steps.

Answers

This slide should NOT be shared with learners in advance.

How to do Step Test to A to D

Step Test Procedure

From 23:00 (11PM) to 28:00 (4AM) as follows.
i. Start flow logging at the inlet point of the DMA-1.
ii.Close V5 and V6 to measure the flow volume of subzone A+B+D [Qm1] when sub zone C has no water.
iii.Subtract [Qm1] from [Qm] to estimate the flow volume of subzone.
iv.Close the valves as shown in the table below. The flow volume of each subzone is measured and calculated.

	Measurement of sub-zone A to D			
1	MNF of all sub-zones [Qm]			
2				▼CloseV5&V6
	Measurement of sub-zone A+B+D [Qm1]			Calculate [Qm] – [Qm1] sub-zone C
3			▼ Close V4	
	Measurement of sub-zone A+B [Qm2]		Calculate [Qm1] – [Qm2] sub-zone D	
4		▼CloseV2&V3		
	Measurement of sub-zone A [Qm3]	Calculate [Qm2] – [Qm3] sub-zone B		

Answers

This slide should NOT be shared with learners in advance.

How to do Step Test to E to H

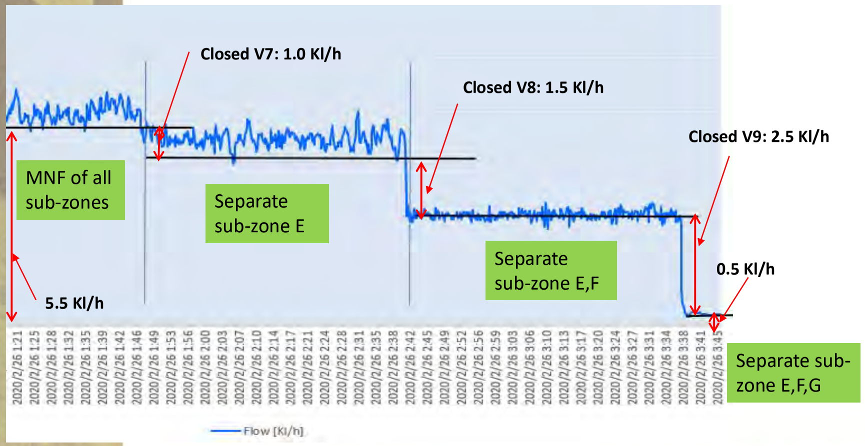
Step Test Procedure

i. Start flow logging at the inlet point of the sub-zones.
ii.Close V7 to measure the flow volume of sub-zone F+G+H [Qm1] when sub-zone E has no water.
iii.Subtract [Qm1] from [Qm] to estimate the flow volume of sub-zone-E.
iv.Close the valves as shown in the table below. The flow volume of each SSMDA is measured and calculated.

	Measurement of sub-zone E to H			
1	MNF of all sub-zones [Qm]			
2				▼CloseV7
	Measurement of sub-zone F+G+H [Qm1]			Calculate [Qm] – [Qm1] sub-zone E
3			▼ Close V8	
	Measurement of sub-zone G+H [Qm2]		Calculate [Qm1] – [Qm2] sub-zone F	
4		▼CloseV9		
	Measurement of sub-zone H [Qm3]	Calculate [Qm2] – [Qm3] sub-zone G		

Questions

(1) When you get the result of Step Test below, Which sub-zone should be prioritized for leakage detection works?



Answers

The higher the flow rate, the more likely it has leak.

Sub-zone	Flow Rate (kL/h)	Priority
All	5.5	---
E	1	3
F	1.5	2
G	2.5	1
H	0.5	4

5. Billing Data

Questions

(1) How do you get the customer consumption data?

(2) How do you handle data that is missing or obviously strange?

Answers

This slide should NOT be shared with learners in advance.

(1) In South Africa you need to request to the section that deal with meter reading and billing.

(2) If there is no data, estimate it or remove strange data to correct it.

a. As the estimated value, use the average value or a near rate value.

Questions

Which data do you use for average monthly consumption?

M	Y	Billing data
Jan	2020	30
Feb	2020	29
Mar	2020	28
Apr	2020	32
May	2020	27
Jun	2020	27
Jul	2020	36
Aug	2020	250
Sep	2020	37
Oct	2020	28
Nov	2020	32
Dec	2020	-

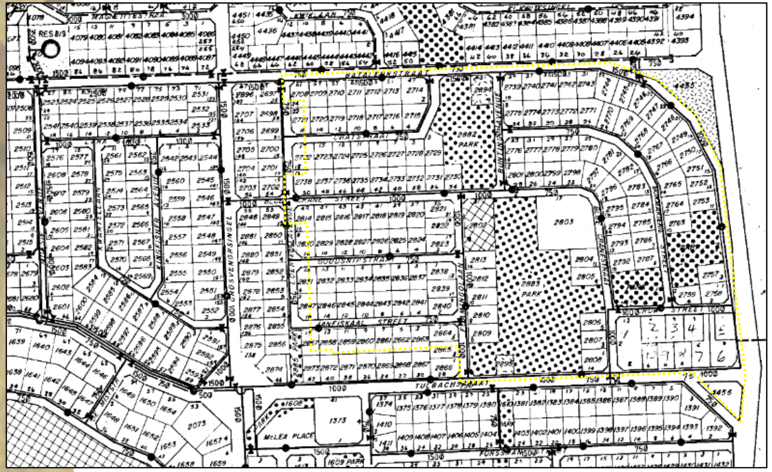
Answers

This slide should NOT be shared with learners in advance.

M	Y	Billing data	
Jan	2020	30	
Feb	2020	29	
Mar	2020	28	
Apr	2020	32	
May	2020	27	
Jun	2020	27	
Jul	2020	36	
Aug	2020	250	Be excluded.
Sep	2020	37	
Oct	2020	28	
Nov	2020	32	
Dec	2020	-	Be excluded.

Exercise

Billing Data Analysis in a sampled DMA
Search for strange data.



Exercise - Example (Billed Consumption Data)

Take care extremely larger than average and "0" or near "0"

No.	House No.	September 2019	October 2019	Ave/ Month	Ave/Day
1	2696	108	85	96.5	3.22
2	2697	55	54	54.5	1.82
3	2698	194	161	177.5	5.92
4	2699	0	35	17.5	0.58
5	2700	1440	880	1160	38.67
6	2701	50	33	41.5	1.38
7	2702	155	173	164	5.47
8	2703	35	34	34.5	1.15
9	2706	68	78	73	2.43
10	2707	75	54	64.5	2.15
11	2708	0	140	70	2.33
12	2709	117	89	103	3.43
13	2710	89	71	80	2.67
14	2711	12	0	6	0.20
15	2712	30	15	22.5	0.75
16	2714	96	112	104	3.47
17	2722	108	0	54	1.80
18	2723	27	25	26	0.87
19	2724	8	48	28	0.93
20	2725	36	35	35.5	1.18
21	2726	100	54	77	2.57
22	2727	56	68	62	2.07
23	2728	51	44	47.5	1.58
24	2730	63	46	54.5	1.82
25	2731	25	20	22.5	0.75
26	2732	18	14	16	0.53
27	2733	62	59	60.5	2.02
28	2734	108	65	86.5	2.88
29	2735	11	5	8	0.27
30	2737	23	19	21	0.70
31	2738	152	133	142.5	4.75
32	2739	104	69	86.5	2.88
33	2740	81	63	72	2.40
34	2741	0	0	0	0.00
35	2742	133	108	120.5	4.02
36	2743	0	52	26	0.87
37	2744	118	85	101.5	3.38
38	2745	21	23	22	0.73

39	2746	22	15	18.5	0.62
40	2747	3	0	1.5	0.05
41	2748	47	37	42	1.40
42	2749	0	0	0	0.00
43	2750	299	168	233.5	7.78
44	2751	32	114	73	2.43
45	2752	0	71	35.5	1.18
46	2753	125	106	115.5	3.85
47	2765	44	46	45	1.50
48	2766	46	42	44	1.47
49	2767	94	76	85	2.83
50	2768	48	39	43.5	1.45
51	2770	173	107	140	4.67
52	2771	111	89	100	3.33
53	2772	6	8	7	0.23
54	2773	86	68	77	2.57
55	2774	0	0	0	0.00
56	2775	70	67	68.5	2.28
57	2777	84	79	81.5	2.72
58	2778	33	54	43.5	1.45
59	2779	56	46	51	1.70
60	2780	123	89	106	3.53
61	2781	32	28	30	1.00
62	2782	113	108	110.5	3.68
63	2783	88	102	95	3.17
64	2784	67	26	46.5	1.55
65	2785	67	17	42	1.40
66	2792	0	14	7	0.23
67	2793	123	87	105	3.50
68	2794	45	43	44	1.47
69	2795	73	73	73	2.43
70	2796	106	90	98	3.27
71	2797	174	162	168	5.60
72	2798	73	51	62	2.07
73	2799	137	65	101	3.37
74	2801	95	75	85	2.83
75	2802	11	17	14	0.47
76	2803	128	98	113	3.77
77	2804	57	65	61	2.03
78	2805	167	78	122.5	4.08

79	2808	190	179	184.5	6.15
80	2809	139	121	130	4.33
81	2810	89	83	86	2.87
82	2811	84	68	76	2.53
83	2813	30	25	27.5	0.92
84	2814	0	105	52.5	1.75
85	2815	74	46	60	2.00
86	2816	61	33	47	1.57
87	2817	26	21	23.5	0.78
88	2818	28	15	21.5	0.72
89	2819	76	79	77.5	2.58
90	2820	51	43	47	1.57
91	2821	63	50	56.5	1.88
92	2822	51	57	54	1.80
93	2823	78	66	72	2.40
94	2824	37	37	37	1.23
95	2825	64	38	51	1.70
96	2826	20	19	19.5	0.65
97	2827	0	0	0	0.00
98	2828	55	52	53.5	1.78
99	2829	0	0	0	0.00
100	2830	448	329	388.5	12.95
101	2831	129	106	117.5	3.92
102	2832	111	112	111.5	3.72
103	2833	48	42	45	1.50
104	2834	63	52	57.5	1.92
105	2835	43	60	51.5	1.72
106	2836	64	74	69	2.30
107	2837	1	0	0.5	0.02
108	2838	180	150	165	5.50
109	2839	45	44	44.5	1.48
110	2840	65	49	57	1.90
111	2841	82	28	55	1.83
112	2842	0	0	0	0.00
113	2843	67	29	48	1.60
114	2844	0	0	0	0.00
115	2845	6	5	5.5	0.18
116	2846	68	46	57	1.90
117	2847	31	22	26.5	0.88
118	2848	59	51	55	1.83

119	2849	71	44	57.5	1.92
120	2850	78	10	44	1.47
121	2851	73	51	62	2.07
122	2852	59	57	58	1.93
123	2853	0	394	197	6.57
124	2854	86	75	80.5	2.68
125	2855	58	47	52.5	1.75
126	2856	57	49	53	1.77
127	2857	30	29	29.5	0.98
128	2858	76	59	67.5	2.25
129	2859	111	89	100	3.33
130	2860	35	24	29.5	0.98
131	2861	18	10	14	0.47
132	2862	73	53	63	2.10
133	2863	79	67	73	2.43
134	2864	86	83	84.5	2.82
135	2865	112	0	56	1.87
136	2866	102	103	102.5	3.42
137	2867	172	88	130	4.33
138	2868	106	155	130.5	4.35
139	2869	60	58	59	1.97
140	2870	78	70	74	2.47
141	2871	16	7	11.5	0.38
142	2872	49	19	34	1.13
143	2873	88	80	84	2.80
144	2874	33	24	28.5	0.95
145	2875	70	58	64	2.13
146	2876	71	83	77	2.57
147	2878	187	0	93.5	3.12
148	2879	95	83	89	2.97
149	2880	1148	883	1015.5	33.85
	Total	12,990	10,757	11,874	396
	Average	87.18	72.19	79.69	2.66

Total: 149 connections, Ave.: 2.66kL/day

Exercise (Billed Consumption Data)

Take care extremely larger than average and "0" or near "0"

	HOUSE NO	START	END	6days	1day
1	CROW 11	9912.2318	9915.9416	3.7098	0.62
2	CROW 05	47246.1611	47253.31	7.1489	1.19
3	CROW 01A	210.7161	210.8946	0.1785	0.03
4	CROW 01 B	474.1217	474.5112	0.3895	0.06
5	39/2739	3808.886	3819.8612	10.9752	1.83
6	40/2733	2706.769	2710.3715	3.6025	0.60
7	42/2734	557	557	0	0.00
8	44/2736	84141927	84141927	0	0.00
9	43/2817	2956.147	2959.319	3.172	0.53
10	45/2816	1125.61	1132.602	6.992	1.17
11	47/2815	6774.637	6777.361	2.724	0.45
12	46/2736	1928.8895	1928.8895	0	0.00
13	50/2738	8933.261	8943.741	10.48	1.75
14	3/2807	11138	11139.116	1.116	0.19
15	9/2805	1653	1656.2228	3.2228	0.54
16	10/2792	3707.41	3708.9664	1.5564	0.26
17	11/2804	4564.926	4570.42	5.494	0.92
18	12/2793	4757.298	4761.722	4.424	0.74
19	13/2803	2548.039	2550.894	2.855	0.48
20	14/2794	8405.601	8408.0713	2.4703	0.41
21	18/2802	7842.79	7868.0713	25.2813	4.21
22	20/2798	1017.193	1045.409	28.216	4.70
23	22/2798	5848.644	5854.027	5.383	0.90
24	NA	8233.661	8239.872	6.211	1.04
25	26/2800	9098.782	9103.6563	4.8743	0.81
26	28/2801	6490.897	6503.6563	12.7593	2.13
27	34/2775	5773	5776.311	3.311	0.55
28	36/2731	234.812	238.1839	3.3719	0.56
29	35/2821	5293.932	5293.9959	0.0639	0.01
30	37/2820	8147.448	8152.0419	4.5939	0.77
31	38/2732	2529.136	2532.8854	3.7494	0.62
32	134/2707	4691.1	4696.3913	5.2913	0.88
33	136/2706	1215	1218.1231	3.1231	0.52
34	140/2704			0	0.00
35	146/2881	8293.053	8297.1289	4.0759	0.68
36	148/2880	7945.112	7952.7841	7.6721	1.28
37	150/2879			0	0.00

38	21	9596.86	9613.3553	16.4953	2.75
39	8	4727.421	4737.8314	10.4104	1.74
40	6A	3155.181	3160.3435	5.1625	0.86
41	6B	3401.334	3419.0488	17.7148	2.95
42	4	3425.801	3428.2184	2.4174	0.40
43	1/2866			0	0.00
44	46/2874	5128.609	5128.6094	0.0004	0.00
45	46B	1933.687	1944.02	10.333	1.72
46	42/2873	8917.921	8927.6131	9.6921	1.62
47	38/2871			0	0.00
48	36/	4717.032	4725.5436	8.5116	1.42
49	34			0	0.00
50	3/2865	4469.1405	4479.1171	9.9766	1.66
51	6/2809	1404.3628	1429.9576	25.5948	4.27
52	8/2810	8196.7059	8199.9724	3.2665	0.54
53	10/2811	3631.4323	3637.9856	6.5533	1.09
54	12	4580.6231	4582.6152	1.9921	0.33
55	11/2839	2406.213	2411.1602	4.9472	0.82
56	14/2813	8337.1491	8340.2854	3.1363	0.52
57	19/2822	1306.7804	1312.2473	5.4669	0.91
58	21/2821	5293.9323	5293.995	0.0627	0.01
59	22	504.8727	505.1357	0.263	0.04
60	20	75.816	75.816	0	0.00
61	2/2823	3160.3719	3162.9974	2.6255	0.44
62	1/2838	6880.2773	6888.7134	8.4361	1.41
63	4B/2824	14.0755	14.0754	-1E-04	0.00
64	3B	928.11	934.42	6.31	1.05
65	5A/2862	2946.0931	2946.0931	0	0.00
66	5B/2862	4000.3673	4003.33	2.9627	0.49
67	6/2825	739.0846	743.634	4.5494	0.76
68	8A/2826	140.6753	141.1913	0.516	0.09
69	8B/2826	187.0178	187.8132	0.7954	0.13
70	7A/2835	1015.6544	1016.9048	1.2504	0.21
71	7B/2835	3011.894	3016.1407	4.2467	0.71
72	10/2827	2742.544	2742.544	0	0.00
73	9/2834	471	474	3	0.50
74	11/2833	4658.683	4660.0863	1.4033	0.23

38	21	9596.86	9613.3553	16.4953	2.75
39	8	4727.421	4737.8314	10.4104	1.74
40	6A	3155.181	3160.3435	5.1625	0.86
41	6B	3401.334	3419.0488	17.7148	2.95
42	4	3425.801	3428.2184	2.4174	0.40
43	1/2866			0	0.00
44	46/2874	5128.609	5128.6094	0.0004	0.00
45	46B	1933.687	1944.02	10.333	1.72
46	42/2873	8917.921	8927.6131	9.6921	1.62
47	38/2871			0	0.00
48	36/	4717.032	4725.5436	8.5116	1.42
49	34			0	0.00
50	3/2865	4469.1405	4479.1171	9.9766	1.66
51	6/2809	1404.3628	1429.9576	25.5948	4.27
52	8/2810	8196.7059	8199.9724	3.2665	0.54
53	10/2811	3631.4323	3637.9856	6.5533	1.09
54	12	4580.6231	4582.6152	1.9921	0.33
55	11/2839	2406.213	2411.1602	4.9472	0.82
56	14/2813	8337.1491	8340.2854	3.1363	0.52
57	19/2822	1306.7804	1312.2473	5.4669	0.91
58	21/2821	5293.9323	5293.995	0.0627	0.01
59	22	504.8727	505.1357	0.263	0.04
60	20	75.816	75.816	0	0.00
61	2/2823	3160.3719	3162.9974	2.6255	0.44
62	1/2838	6880.2773	6888.7134	8.4361	1.41
63	4B/2824	14.0755	14.0754	-1E-04	0.00
64	3B	928.11	934.42	6.31	1.05
65	5A/2862	2946.0931	2946.0931	0	0.00
66	5B/2862	4000.3673	4003.33	2.9627	0.49
67	6/2825	739.0846	743.634	4.5494	0.76
68	8A/2826	140.6753	141.1913	0.516	0.09
69	8B/2826	187.0178	187.8132	0.7954	0.13
70	7A/2835	1015.6544	1016.9048	1.2504	0.21
71	7B/2835	3011.894	3016.1407	4.2467	0.71
72	10/2827	2742.544	2742.544	0	0.00
73	9/2834	471	474	3	0.50
74	11/2833	4658.683	4660.0863	1.4033	0.23

Continued to the following slide

Exercise (Billed Consumption Data)

Take care extremely larger than average and "0" or near "0"

	HOUSE NO	START	END	6days	1day
76	13/2832	2876.644	2888.9045	12.2605	2.04
77	14/2829			0	0.00
78	16/2830	2662.1523	2662.7528	0.6005	0.10
79	2/2840			0	0.00
80	4/2841	3591.1136	3597.4858	6.3722	1.06
81	7A/2861	7150.1238	7158.9341	8.8103	1.47
82	7B/2861	4511.7638	4516.2426	4.4788	0.75
83	7C/2861	3327.1269	3328.6148	1.4879	0.25
84	7D/2861	5288.5091	5294.8809	6.3718	1.06
85	6/2825	9684.7205	9688.4057	3.6852	0.61
86	8/2826	1837.4524	1847.4016	9.9492	1.66
87	9/2834	3484.0516	3484.6971	0.6455	0.11
88	11/2833	5797.7116	5804.2241	6.5125	1.09
89	12/2828	883.0952	886.6327	3.5375	0.59
90	13/2832	3382.0687	3385.1013	3.0326	0.51
91	14/2829	3201.8838	3204.4362	2.5524	0.43
92	16/2830	1642.6568	1645.9993	3.3425	0.56
93	31/2743	3587.3929	3588.4011	1.0082	0.17
94	34/2775	1522.088	1523.5371	1.4491	0.24
95	32/2774			0	0.00
96	29/2778	3143.7918	3146.4967	2.7049	0.45
97	30/2773	4477.6944	4481.0475	3.3531	0.56
98	28/2772	7068.9278	7068.9278	0	0.00
99	27/2745	379.6727	382.7412	3.0685	0.51
100	26/2771	11359.22	11362.815	3.5953	0.60
101	25/2746	542.6019	547.141	4.5391	0.76
102	24/2770	4961.3799	4971.4553	10.0754	1.68
103	21/2744	4068	4169.7532	101.7532	16.96
104	22/2769	6024.46	6027.6771	3.2171	0.54
105	20A/2	3334.0201	3339.4657	5.4456	0.91
106	20B	0.2851	0.2851	0	0.00
107	17/2782	531.607	534.6651	3.0581	0.51
108	18/2767	872.7324	875.948	3.2156	0.54
109	13A/2783	307.4951	309.9251	2.43	0.41
110	13B/2783			0	0.00
111	16/2766	2553.1416	2557.2973	4.1557	0.69

112	11/2784	528.9715	535.7685	6.797	1.13
113	14/2765	8695.748	8699.8497	4.1017	0.68
114	12/2793	4517.81	4522.91	5.1	0.85
115	9/2785	7478.84	7483.3017	4.4617	0.74
116	6/2787	3434.892	3434.892	0	0.00
117	2/2758	188.5934	189.1478	0.5544	0.09
118	44	3241.866	3247.9442	6.0782	1.01
119	1/2855	2583.2147	2592.2513	9.0366	1.51
120	3/2854	5479.5223	5490.0111	10.4888	1.75
121	7/2852	2770.8264	2774.2543	3.4279	0.57
122	9/2851	2576.1373	2579.5306	3.3933	0.57
123	17/2701			0	0.00
124	19/2700	838.4402	845.5656	7.1254	1.19
125	21/2699	225.8684	260.1794	34.311	5.72
126	23A/2698	8806.7123	8808.5842	1.8719	0.31
127	23B/2698	7466.2078	7469.961	3.7532	0.63
128	23C/2698	6386.9174	6388.0513	1.1339	0.19
129	9A	1174.4677	1177.3155	2.8478	0.47
				Average	0.91
				(Houses) 160	145.22(KL/D)
				(Houses) 155	140.69(KL/D)
				(Houses) 150	136.15(KL/d)

Total 129 connections. Ave. 0.91kL/day

This slide should NOT be shared with learners in advance.

Exercise (Billed Consumption D

Take care extremely larger than average and "0"

	HOUSE NO	START	END	6days	1day
1	CROW 11	9912.2318	9915.9416	3.7098	0.62
2	CROW 05	47246.1611	47253.31	7.1489	1.19
3	CROW 01A	210.7161	210.8946	0.1785	0.03
4	CROW 01 B	474.1217	474.5112	0.3895	0.06
5	39/2739	3808.886	3819.8612	10.9752	1.83
6	40/2733	2706.769	2710.3715	3.6025	0.60
7	42/2734	557	557	0	0.00
8	44/2736	84141927	84141927	0	0.00
9	43/2817	2956.147	2959.319	3.172	0.53
10	45/2816	1125.61	1132.602	6.992	1.17
11	47/2815	6774.637	6777.361	2.724	0.45
12	46/2736	1928.8895	1928.8895	0	0.00
13	50/2738	8933.261	8943.741	10.48	1.75
14	3/2807	11138	11139.116	1.116	0.19
15	9/2805	1653	1656.2228	3.2228	0.54
16	10/2792	3707.41	3708.9664	1.5564	0.26
17	11/2804	4564.926	4570.42	5.494	0.92
18	12/2793	4757.298	4761.722	4.424	0.74
19	13/2803	2548.039	2550.894	2.855	0.48
20	14/2794	8405.601	8408.0713	2.4703	0.41
21	18/2802	7842.79	7868.0713	25.2813	4.21
22	20/2798	1017.193	1045.409	28.216	4.70
23	22/2798	5848.644	5854.027	5.383	0.90
24	NA	8233.661	8239.872	6.211	1.04
25	26/2800	9098.782	9103.6563	4.8743	0.81
26	28/2801	6490.897	6503.6563	12.7593	2.13
27	34/2775	5773	5776.311	3.311	0.55
28	36/2731	234.812	238.1839	3.3719	0.56
29	35/2821	5293.932	5293.9959	0.0639	0.01
30	37/2820	8147.448	8152.0419	4.5939	0.77
31	38/2732	2529.136	2532.8854	3.7494	0.62
32	134/2707	4691.1	4696.3913	5.2913	0.88
33	136/2706	1215	1218.1231	3.1231	0.52
34	140/2704			0	0.00
35	146/2881	8293.053	8297.1289	4.0759	0.68
36	148/2880	7945.112	7952.7841	7.6721	1.28
37	150/2879			0	0.00

38	21	9596.86	9613.3553	16.4953	2.75
39	8	4727.421	4737.8314	10.4104	1.74
40	6A	3155.181	3160.3435	5.1625	0.86
41	6B	3401.334	3419.0488	17.7148	2.95
42	4	3425.801	3428.2184	2.4174	0.40
43	1/2866			0	0.00
44	46/2874	5128.609	5128.6094	0.0004	0.00
45	46B	1933.687	1944.02	10.333	1.72
46	42/2873	8917.921	8927.6131	9.6921	1.62
47	38/2871			0	0.00
48	36/	4717.032	4725.5436	8.5116	1.42
49	34			0	0.00
50	3/2865	4469.1405	4479.1171	9.9766	1.66
51	6/2809	1404.3628	1429.9576	25.5948	4.27
52	8/2810	8196.7059	8199.9724	3.2665	0.54
53	10/2811	3631.4323	3637.9856	6.5533	1.09
54	12	4580.6231	4582.6152	1.9921	0.33
55	11/2839	2406.213	2411.1602	4.9472	0.82
56	14/2813	8337.1491	8340.2854	3.1363	0.52
57	19/2822	1306.7804	1312.2473	5.4669	0.91
58	21/2821	5293.9323	5293.995	0.0627	0.01
59	22	504.8727	505.1357	0.263	0.04
60	20	75.816	75.816	0	0.00
61	2/2823	3160.3719	3162.9974	2.6255	0.44
62	1/2838	6880.2773	6888.7134	8.4361	1.41
63	4B/2824	14.0755	14.0754	-1E-04	0.00
64	3B	928.11	934.42	6.31	1.05
65	5A/2862	2946.0931	2946.0931	0	0.00
66	5B/2862	4000.3673	4003.33	2.9627	0.49
67	6/2825	739.0846	743.634	4.5494	0.76
68	8A/2826	140.6753	141.1913	0.516	0.09
69	8B/2826	187.0178	187.8132	0.7954	0.13
70	7A/2835	1015.6544	1016.9048	1.2504	0.21
71	7B/2835	3011.894	3016.1407	4.2467	0.71
72	10/2827	2742.544	2742.544	0	0.00
73	9/2834	471	474	3	0.50
74	11/2833	4658.683	4660.0863	1.4033	0.23

38	21	9596.86	9613.3553	16.4953	2.75
39	8	4727.421	4737.8314	10.4104	1.74
40	6A	3155.181	3160.3435	5.1625	0.86
41	6B	3401.334	3419.0488	17.7148	2.95
42	4	3425.801	3428.2184	2.4174	0.40
43	1/2866			0	0.00
44	46/2874	5128.609	5128.6094	0.0004	0.00
45	46B	1933.687	1944.02	10.333	1.72
46	42/2873	8917.921	8927.6131	9.6921	1.62
47	38/2871			0	0.00
48	36/	4717.032	4725.5436	8.5116	1.42
49	34			0	0.00
50	3/2865	4469.1405	4479.1171	9.9766	1.66
51	6/2809	1404.3628	1429.9576	25.5948	4.27
52	8/2810	8196.7059	8199.9724	3.2665	0.54
53	10/2811	3631.4323	3637.9856	6.5533	1.09
54	12	4580.6231	4582.6152	1.9921	0.33
55	11/2839	2406.213	2411.1602	4.9472	0.82
56	14/2813	8337.1491	8340.2854	3.1363	0.52
57	19/2822	1306.7804	1312.2473	5.4669	0.91
58	21/2821	5293.9323	5293.995	0.0627	0.01
59	22	504.8727	505.1357	0.263	0.04
60	20	75.816	75.816	0	0.00
61	2/2823	3160.3719	3162.9974	2.6255	0.44
62	1/2838	6880.2773	6888.7134	8.4361	1.41
63	4B/2824	14.0755	14.0754	-1E-04	0.00
64	3B	928.11	934.42	6.31	1.05
65	5A/2862	2946.0931	2946.0931	0	0.00
66	5B/2862	4000.3673	4003.33	2.9627	0.49
67	6/2825	739.0846	743.634	4.5494	0.76
68	8A/2826	140.6753	141.1913	0.516	0.09
69	8B/2826	187.0178	187.8132	0.7954	0.13
70	7A/2835	1015.6544	1016.9048	1.2504	0.21
71	7B/2835	3011.894	3016.1407	4.2467	0.71
72	10/2827	2742.544	2742.544	0	0.00
73	9/2834	471	474	3	0.50
74	11/2833	4658.683	4660.0863	1.4033	0.23

Continued to the following slide

This slide should NOT be shared with learners in advance.

Exercise (Billed Consumption D

Take care extremely larger than average and "0"

	HOUSE NO	START	END	6days	1day
76	13/2832	2876.644	2888.9045	12.2605	2.04
77	14/2829			0	0.00
78	16/2830	2662.1523	2662.7528	0.6005	0.10
79	2/2840			0	0.00
80	4/2841	3591.1136	3597.4858	6.3722	1.06
81	7A/2861	7150.1238	7158.9341	8.8103	1.47
82	7B/2861	4511.7638	4516.2426	4.4788	0.75
83	7C/2861	3327.1269	3328.6148	1.4879	0.25
84	7D/2861	5288.5091	5294.8809	6.3718	1.06
85	6/2825	9684.7205	9688.4057	3.6852	0.61
86	8/2826	1837.4524	1847.4016	9.9492	1.66
87	9/2834	3484.0516	3484.6971	0.6455	0.11
88	11/2833	5797.7116	5804.2241	6.5125	1.09
89	12/2828	883.0952	886.6327	3.5375	0.59
90	13/2832	3382.0687	3385.1013	3.0326	0.51
91	14/2829	3201.8838	3204.4362	2.5524	0.43
92	16/2830	1642.6568	1645.9993	3.3425	0.56
93	31/2743	3587.3929	3588.4011	1.0082	0.17
94	34/2775	1522.088	1523.5371	1.4491	0.24
95	32/2774			0	0.00
96	29/2778	3143.7918	3146.4967	2.7049	0.45
97	30/2773	4477.6944	4481.0475	3.3531	0.56
98	28/2772	7068.9278	7068.9278	0	0.00
99	27/2745	379.6727	382.7412	3.0685	0.51
100	26/2771	11359.22	11362.815	3.5953	0.60
101	25/2746	542.6019	547.141	4.5391	0.76
102	24/2770	4961.3799	4971.4553	10.0754	1.68
103	21/2744	4068	4169.7532	101.7532	16.96
104	22/2769	6024.46	6027.6771	3.2171	0.54
105	20A/2	3334.0201	3339.4657	5.4456	0.91
106	20B	0.2851	0.2851	0	0.00
107	17/2782	531.607	534.6651	3.0581	0.51
108	18/2767	872.7324	875.948	3.2156	0.54
109	13A/2783	307.4951	309.9251	2.43	0.41
110	13B/2783			0	0.00
111	16/2766	2553.1416	2557.2973	4.1557	0.69

112	11/2784	528.9715	535.7685	6.797	1.13
113	14/2765	8695.748	8699.8497	4.1017	0.68
114	12/2793	4517.81	4522.91	5.1	0.85
115	9/2785	7478.84	7483.3017	4.4617	0.74
116	6/2787	3434.892	3434.892	0	0.00
117	2/2758	188.5934	189.1478	0.5544	0.09
118	44	3241.866	3247.9442	6.0782	1.01
119	1/2855	2583.2147	2592.2513	9.0366	1.51
120	3/2854	5479.5223	5490.0111	10.4888	1.75
121	7/2852	2770.8264	2774.2543	3.4279	0.57
122	9/2851	2576.1373	2579.5306	3.3933	0.57
123	17/2701			0	0.00
124	19/2700	838.4402	845.5656	7.1254	1.19
125	21/2699	225.8684	260.1794	34.311	5.72
126	23A/2698	8806.7123	8808.5842	1.8719	0.31
127	23B/2698	7466.2078	7469.961	3.7532	0.63
128	23C/2698	6386.9174	6388.0513	1.1339	0.19
129	9A	1174.4677	1177.3155	2.8478	0.47
				Average	0.91
				(Houses) 160	145.22(KL/D)
				(Houses) 155	140.69(KL/D)
				(Houses) 150	136.15(KL/d)

Total 129 connections. Ave. 0.91kL/day

6. NRW Calculation

Drills

(1) SIV

(2) Step Test

(3) MNF

(4) Prioritization of Sub-Zones

(5) NRW Ratio

Questions

(1) How much is SIV?
(2) When is the most suitable time to do step test?
(3) How much is MNF?
(4) Which sub-zone has the highest MNF?

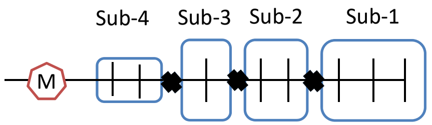
Model DMA 24hs Measurement

Time	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00
l/s	3.5	2.8	2.7	2.6	2.6	3.6	5.8	7.6	9.5	8	7.1	6	6.5
Time	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	
l/s	5.4	5.2	6	6.4	7	8.5	9	8.1	6	5.7	4.6	3.6	

1 day consumption		m3/d
MNF		m3/d

Step test

Sub-zone	Measurement steps		Flow l/s	Difference l/s
	ALL		2.6	
1	Separated	S-1	2.3	
2	Separated	S-1+2	1.2	
3	Separated	S-1+2+3	0.8	
4				



Answers

This slide should NOT be shared with learners in advance.

(1) Totalize data from 0:00 to 23:00
(2) Flow rate becomes stable around 1:00 to 4:00.
(3) MNF for all area is 2.6kL/s
(4) Sub-zone-2 has the highest MNF.

Model DMA 24hs Measurement

Time	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00
l/s	3.5	2.8	2.7	2.6	2.6	3.6	5.8	7.6	9.5	8	7.1	6	6.5
Time	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	
l/s	5.4	5.2	6	6.4	7	8.5	9	8.1	6	5.7	4.6	3.6	

In case hourly data only

1 day consumption	Σ 0:00~23:00	140.2	kl/d
MNF		2.6	kl/d

In case many data

Data average of 1 day		5.84167
1 day consumption	Ave x Number of data	140.20

Step test

Sub-zone	Measurement steps		Flow l/s	Difference l/s
	ALL		2.6	
1	Separated	S-1	2.3	0.3
2	Separated	S-1+2	1.2	1.1
3	Separated	S-1+2+3	0.8	0.4
4				0.8

The higher the difference volume, the more likely it has leak.

Questions

(5) How much is NRW ratio in this DMA ?
(6) Which is higher in this DMA, Physical Loss or Commercial Loss?
This DMA has 4 sub-zones.

SIV	**250 kL/h**
MNF	**26 kL/h**
Step Test Result	
All	26 kL/h
Difference volume when separate Sub-zone-1	3 kL/h
Difference volume when separate Sub-zone-1,2	10 kL/h
Difference volume when separate Sub-zone-1,2,3	3 kL/h
Remaining Sub-zone-4	4 kL/h
Billed customer consumption (September)	**96,150 kL/month**
Number of connection	**180**

Answers

This slide should NOT be shared with learners in advance.

For NRW ratio calculation, per-unit must be adjusted such as "Day", "Month" and "Year." The following per-unit is adjusted to "Day".

a. SIV:

250 kL/h x 24 hours = **6,000 kL/d**

b. Total billed customer consumption: Revenue Water

96,150 kL/month / 30 day = **3,205kL/d**

c. NRW ratio

[(6,000 - 3,205) / 6,000] x 100 = 2,795/6,000 x 100 = **46.6%**

d. Components of NRW

MNF: 26kL/h = 624kL/d

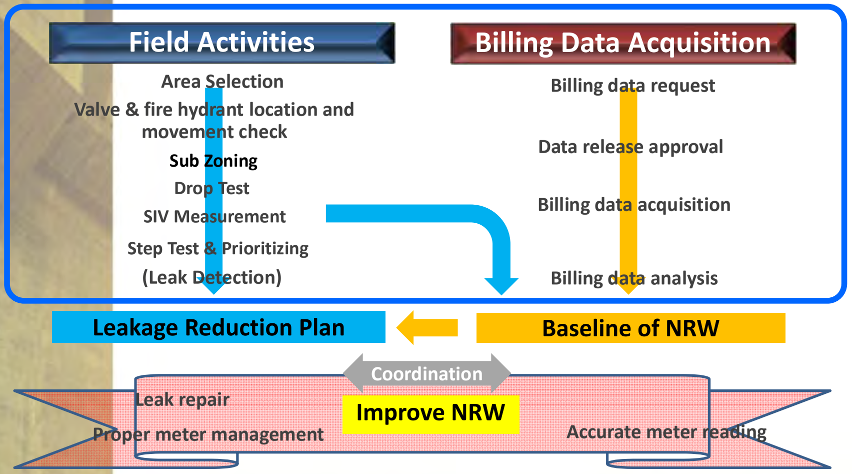
Physical Loss to NRW: 624/2,795 x 100 = **22.3%**

Commercial Loss to NRW: (2,795-624)/2,795 x 100 = **77.7%**

Commercial loss is higher than physical losses in this area.

Summary of Procedures

Practices in DMA



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The National Non-Revenue Water (NRW) Training for Municipalities by Municipalities in South Africa

Case Studies

under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Case Studies

1. Typical Outputs from Workplace Training
2. Revenue water is more than SIV?
3. 2 years for customer registration to start using water.
4. Consumption data is not associated with the house number.
5. Some data are less than the previous reading.

Case Study 1

Typical Outputs of Workplace Training

Table Of Content

1. Background
2. Methodology
3. Challenges/Findings
4. Recommendations

BACKGROUND

AREA SITUATED IN UNDER LOCAL MUNICIPALITY WARD 6

NUMBER OF HOUSEHOLDS: 107 (LOW COST HOUSING)

SYSTEM INPUT VOLUME: 4ML/MONTH

BULK WATER SUPPLY:

NEW INFRASTRUCTURE (2013) AND ALL HOUSES ARE METERED

THE AREA IS BEING BILLED BUT NOT PAYING

Methodology

- Physical bulk meter reading
- Analysing as-built drawings
- Zone configuration
- Drop-testing and flow analysis day time
- MNF (Step-testing and flow analysis)
- Logging Data analysis
- Billing Data Analysis

Physical Bulk Meter Reading

- Physical bulk meter readings were taken daily for daily monitoring.
- The daily consumption for the area was found to be 135Kl/day.
- The meter size is 80mm diameter, supplied by a 160mm pipeline and it a Sensus water.

Data Logging

- Data logging was done on our bulk meter.

Analysis of as Built Drawing

- Here we had to do physical verification of network, valve, meters and fire hydrants to ensure everything is operational.

Zoning

- Isolation Valve were used for Zoning

Drop Testing

- The purpose here was to confirm valves operation and checking sectional supply of the zones.
- Check if the network is not inter linked.

Zone Configuration

- First Zoning of the area

Zone Configuration

- Second Zoning of the area

Zone Configuration

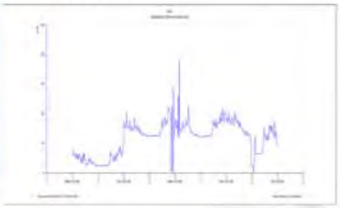
- Third Zoning for the area

Step Testing

- After we have confirmed our zoning, we then had to go ahead with our step testing.

Data Logging

Data Logging for a week



Results –

Through step testing, Zone 3 of the DMA was identified as a possible problem area.

Findings

- As builts drawings do not match what is on the ground
- Zone three is losing too much water (Major Leak)
- Billing data is not accurate

As builts drawings

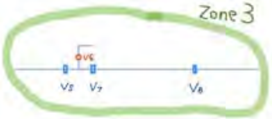
- Engage with our GIS office to update the record drawings

Zone Three

- Installing a new 50mm diameter RSV to be able to control the flow to the unknown pipeline.
- Will have to use the pipe finder to locate the position of the unknown pipe.

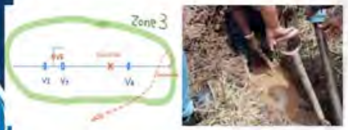
Results –

Additional valves was installed within Zone 3 in order to create a "new/mini DMA".



Results –

Through step testing within Zone 3, a leak between V7 and V8 was discovered and repaired.

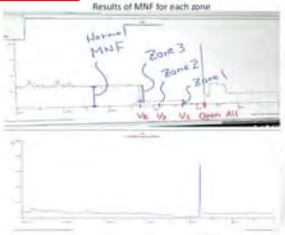


Results –

An unmetered / illegal connection within Zone 3 was discovered and disconnected.

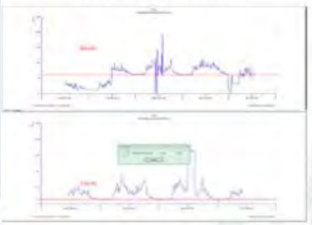
Results –

Results of MNF for each zone



Results –

Results of flows after the interventions



Billing data

- Further engagements with our finance department regarding the inaccuracy of our billing data.
- Physical verification of 35 houses missing on our billing data

Results –

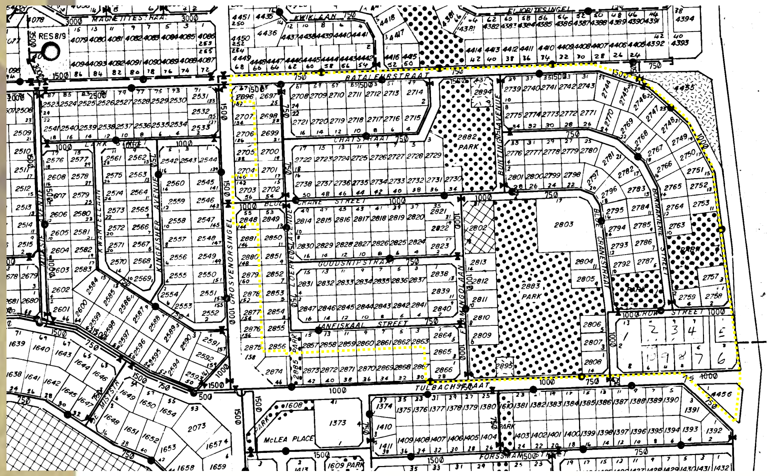
- Nett Results:
  - SIV before 135kl/day that equates to 4ml/Month
  - SIV after 61,2kl/day that equates to 1.8ml/Month
  - MNF before 5m3/h that equates to 3.6ml/Month
  - MNF after 1m3/h that equates to 0,72ml/Month
  - The Intervention equates to a saving of R 312 000 / year based on a R 9/kl selling price

Case Study 2

Revenue water is more than SIV?

Case Study 2 (1)

A DMA was confirmed by drop test.



Case Study 2 (2)

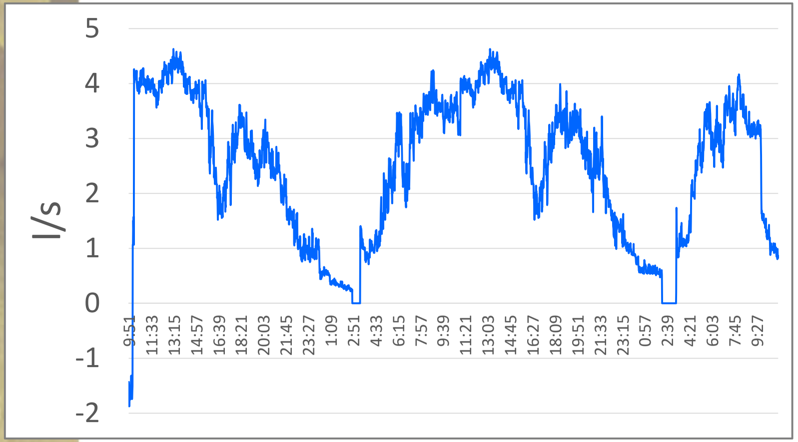
An ultrasonic flow meter was installed to DMA temporarily.

SIV Measurement

SIV Measurement

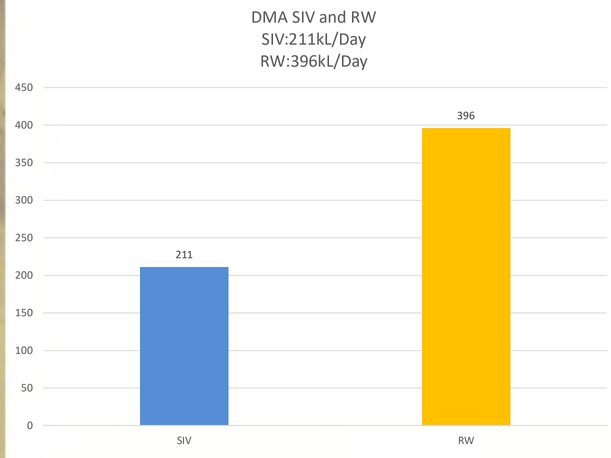
Case Study 2 (3)

SIV data had no MNF due to valve closing.



Case Study 2 (4)

Existing consumption data was more than SIV.



6/7/2021

Case Study 2 (5)

Meter reading and leak survey were conducted.

- Reading: 129 Houses
- Leak Survey:104 houses

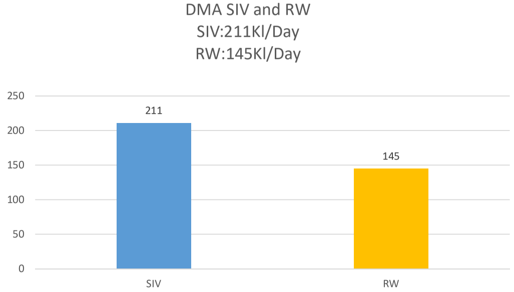
Case Study 2 (6)

NRW was 35% by meter reading data.

0.91 kL /Day/Connection

in total 160 houses = 145.6kL/Day/DMA.

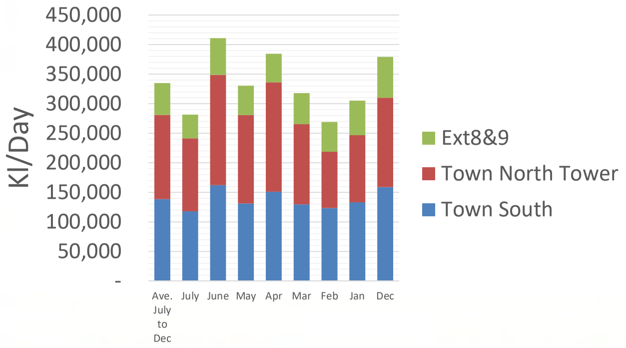
NRW is 35%



Case Study 2 (7)

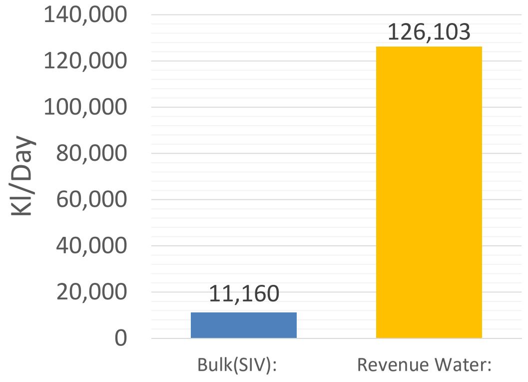
NRW analysis for whole town which have 3 reservoirs.

Workplace training did NRW analysis for the Town.
A Town: Water volume (SIV)
Total of 3 reservoirs from Dec 2018 to July 2019
Average: 334,825 Kl/Month; 11,160Kl/day



Case Study 2 (8)

Revenue water for whole town was more than SIV.



Case Study 2 (9)

Our ultrasonic flow meter shown almost the same as bulk meter reading.

	Bulk Meter	Our UFM Meter
Ext 8&9	1.3-1.2 m3/mmin	1.2 m3/min
South	220-235 kL/h	219-225 m3/h
North1	0.65-0.75 kL/min	0.69-0.71 kL/min
North 2	0.68 kL/min	0.69 m3/min

Case Study 2 (10)

Findings

- No MNF in DMA due to Reservoir Closing
- PSP data: Billed Consumption in the DMA is about 396L/D to SIV 211L/Day.
- Meter reading: Billed Consumption in DMA is 149L/D to SIV211L/Day.
- Bulk flow meter: Our ultra flow meter shows almost same volume as the bulk flow meters.

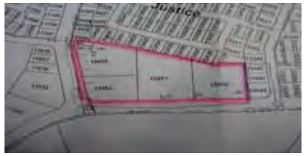
Case Study 3

2 years for customer registration to start using water.

Case Study 3 (1)

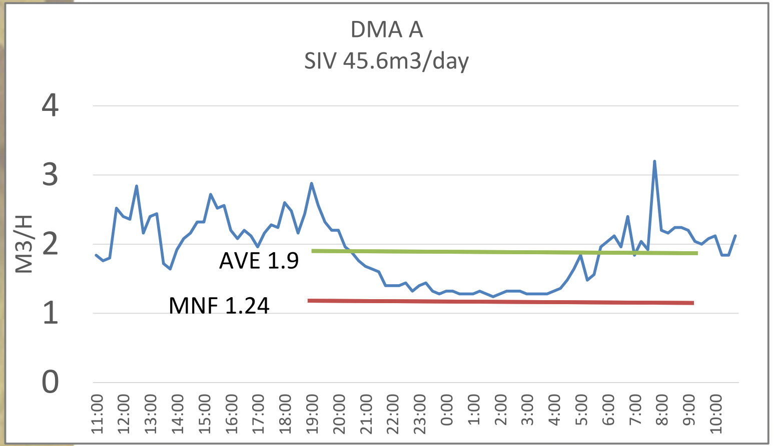
A DMA has selected without any map and billing data.

- Trial Data logging training to existing meter was conducted.
- Drop test was done to confirm boundary of the area on 11th Feb.
- A data logger was installed to get the SIV and MNF data.
- Maps and Billing data for DMA was requested to the municipal finance section but we could not get it.
- Customers are not registered for billing even though water supply started in 2018.



Case Study 3 (2)

SIV and MNF were measured.



Case Study 3 (3)

Minimum Night Flow was 1.24m3/hour

DMA-A

- DMA-A is a ring-feed with no internal valves thus unable to subdivide into smaller zones.
- SIV is 45.6m3/day for 52 houses, equals 870 L/day/house, 174L/day/person, (if family is 5 persons)
- MNF at 1.24 m3/hr, equals 0.3 L/sec

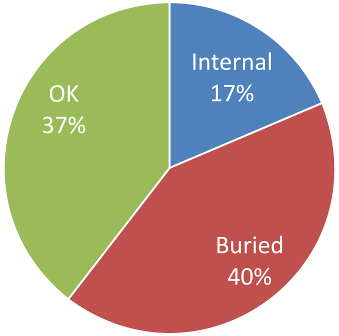
Case Study 3 (4)

Find causes of MNF

- The team undertook the Internal and External leak detection survey in the area.
- DMA-A is a ring-feed zone consisting of 52 houses, 45 houses were surveyed on the 25th Feb 2020 and 7 houses were not confirmed.
- There, installed meters are not read by the municipality and therefore this area is not billed for water.

Case Study 3 (5)

29/52 meter was buried and 8/23 has internal leak



Case Study 3 (6)

29/52 of water meter was buried.

Buried meters – there are 18 houses where the team couldn't locate meters because they were covered by soil/other debris i.e. 40% of houses in this area.

Case Study 3 (7)

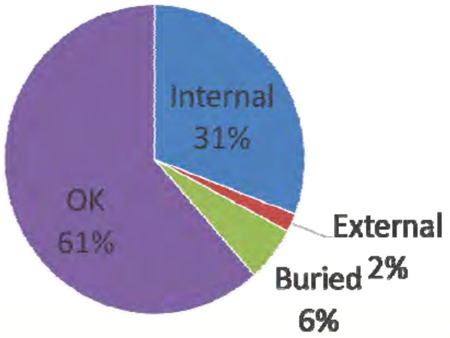
8/23 connections have internal leak

- The survey detected internal leak in 8 houses, possibly toilets and outside taps but further investigations needed. 34.7% of houses in this area.
- 17 connections has no problems.

Case Study 3 (8)
Excavation of buried water meters

The team undertook excavation of buried meter in the same area, for 52 houses. The survey indicated the following:

Internal leaks: 16
External Leak: 1
Buried: 3
OK: 32



Case Study 3 (9)
Findings

- It takes 2 years for meter registration for Finance system
- Unavailability of pipeline maps, bulk metes, valves, etc.
- 40 % of Meter is buried in the DMA.
- 31 % of connection has internal leak in the DMA.

Case Study 3 (10)
Recommendations and Way Forward

- Municipal technical and finance sections should work together and each section should have responsibility in reporting water balance.

Case Study 4

Consumption data is not associated with the house number.

Case Study 4 (1)

A area equipped with 3 different types of water meter installed.

Case Study 4 (2)

3 different types of water meter

Conventional Meter

Old Prepaid Meter

New Prepaid Meter

Case Study 4 (3)

The data provided by finance was 1 year ago.

- A billing data we have got from the finance section was about a month of 1 year ago.
- The data was not associated with the address, therefore, unable to sort it by DMA.

Account No	Name	Type	Meter No	Date	Reading	Consumption	Levy
100007	E VARACHIA	370	12941	2019/03/01	7120	27	549
100012	M MOHAMED	370	12876	2019/03/01	8149	5	75
100014	M NANABHAI	370	12881	2019/03/01	3498	3	45
100016	F DINDAR	370	12885	2019/03/01	1012	33	705
100017	I VARACHIA	370	12882	2019/03/01	9047	20	381
100018	FE BHABHA	370	C-UAC 7632	2019/03/01	4814	19	357
100024	Mr DM DULLABH	370	C-UAB 8709	2019/03/01	1828	10	166
100028	H JASSAT	370	C-EAB 1155	2019/03/01	1462	6	90
100031	Mr FO BHAYAT	370	YBI 362	2019/03/01	4891	1	15
100033	C GOKAL	370	12906	2019/03/01	4181	4	60
100034	JS JEKINSON	370	12903	2019/03/01	2257	29	597

Case Study 4 (4)

Consumption data is not associated with address.

- The consumption data was not associated with the address, therefore, unable to sort it by DMA.
- Some old conventional meters were not working.
- A lot of conventional meters are buried. It was not sure if meter readers read it every month.
- Most of old prepaid meters were not working.

Finally, in this case study, we have not estimated NRW ratio in the DMA.

Case Study 5

Some meter reading data are less than the previous reading.

Case Study 5 (1)

An area of 1,076 house connection

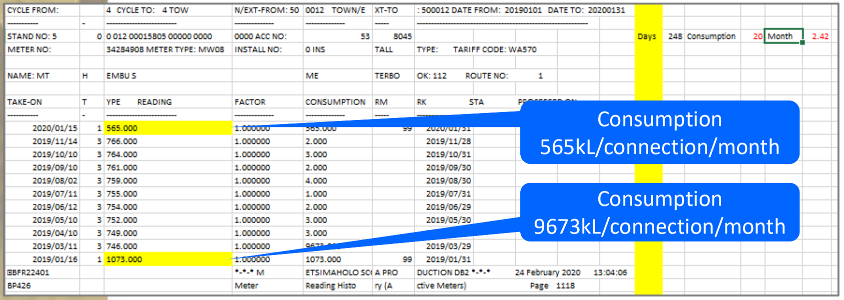
Case Study 5 (1)

Data were unreliable.

- There were 1076 connections on the map in a DMA. Finance section gave us a consumption data for DMA was 733 connections.
- The average consumption of 733 connections was 139kL/Day, however, there are some unreliable data.
- After data analysis, the average consumption of 733 connection was 101.7kL/Day

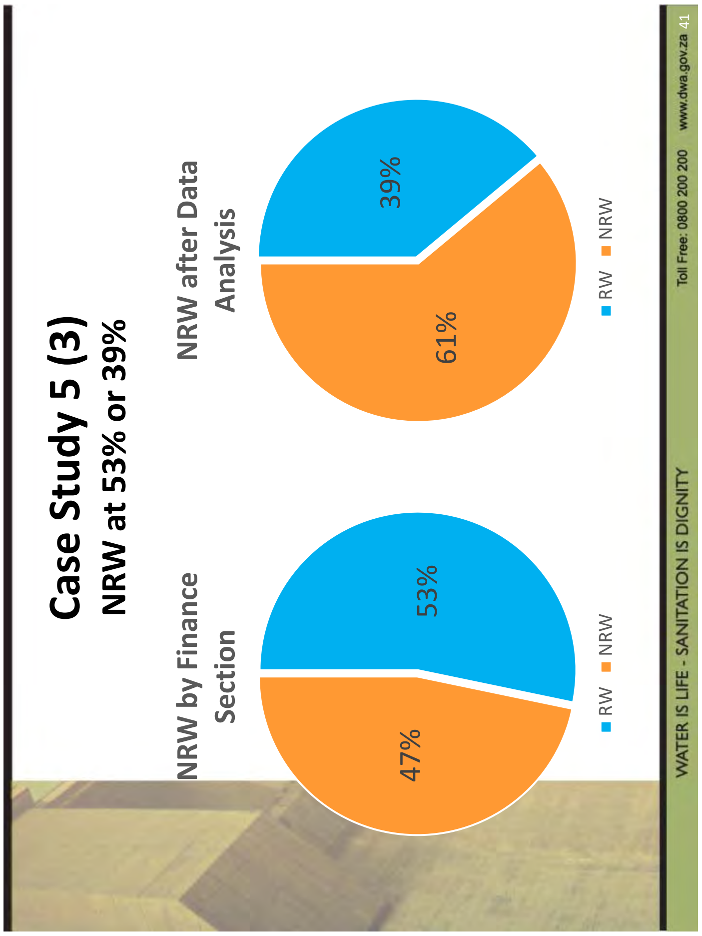
Case Study 5 (2)

Some data show less than previous month.



CYCLE FROM:		4 CYCLE TO: 4 TOW	N/EXT-FROM: 50	0012 TOWN/E	XT-TO	: 500012 DATE FROM: 20190101 DATE TO: 20200131	
STAND NO: 5	0	0 012 00015805 00000 0000	0000 ACC NO:	53	8045		Days 248 Consumption 20 Month 2.42
METER NO:		34284908 METER TYPE: MW08	INSTALL NO:	0 INS	TALL	TYPE: TARIFF CODE: WA570	
NAME: MT	H	EMBU S		ME	TERBO	OK: 112 ROUTE NO: 1	
TAKE-ON	T	YPE READING	FACTOR	CONSUMPTION	RM	RK STA	
2020/01/15	1	565.000	1.000000	565.000	99	2020/01/31	
2019/11/14	3	766.000	1.000000	2.000		2019/11/28	
2019/10/10	3	764.000	1.000000	3.000		2019/10/31	
2019/09/10	3	761.000	1.000000	2.000		2019/09/30	
2019/08/02	3	759.000	1.000000	4.000		2019/08/30	
2019/07/11	3	755.000	1.000000	1.000		2019/07/31	
2019/06/12	3	754.000	1.000000	2.000		2019/06/29	
2019/05/10	3	752.000	1.000000	3.000		2019/05/30	
2019/04/10	3	749.000	1.000000	3.000			
2019/03/11	3	746.000	1.000000	[illegible]		2019/03/29	
2019/01/16	1	1073.000	1.000000	1073.000	99	2019/01/31	
BFR22401			*-*-* M	ETSIMAHOLO SC	A PRO	DUCTION DB2 *-*-* 24 February 2020 13:04:06	
BP426			Meter	Reading Histo	ry (A	ctive Meters) Page 1118	

Finance: 261kL/day (SIV) (100%)
Revenue 139.0 (53.2%) + NRW 122 (46.7%)
After Analysis: 261kL/day (SIV) (100%)
Revenue 101.7(39.0%) +NRW159.3(61.0%)


Case Study 5 (3)
NRW at 53% or 39%
NRW by Finance Section
47%
53%
RW NRW
NRW after Data Analysis
61%
39%
RW NRW
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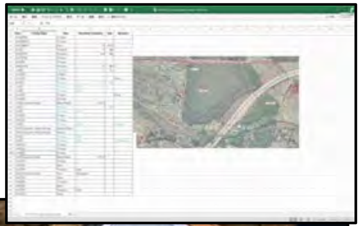
Data Management (Utilization/Arrangement) and Presentation

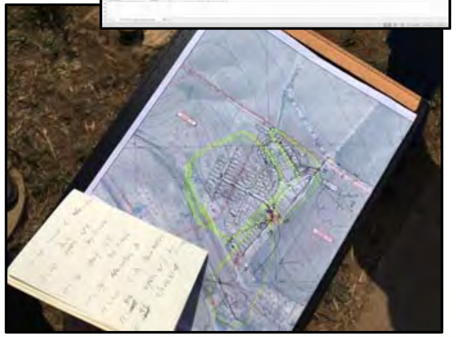
under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Importance of Data Management (Drawings, Memo, Measured Data, Billing Data, etc.)

Log all Activities - For Your Evidence

A4-sized map



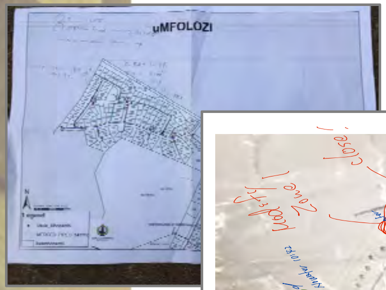


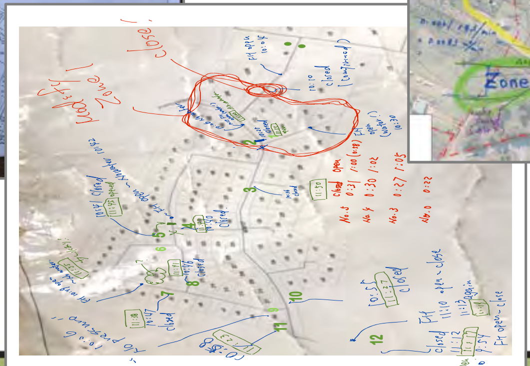
Write down every action and time in a notebook or the map, for example:
- Valve closing time and by whom
- Pressure checking points and zero-dropped time by whom
- Valve opening time by whom

Log all Activities - For Your Evidence

Examples

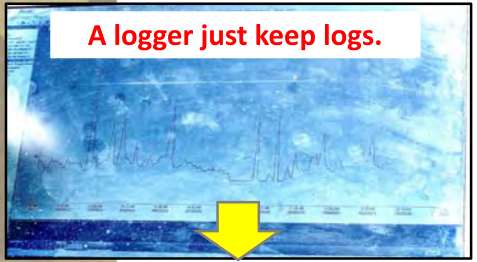
Hand-scrawled writing is OK!!
However, be readable and organized.

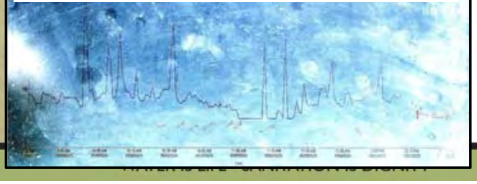


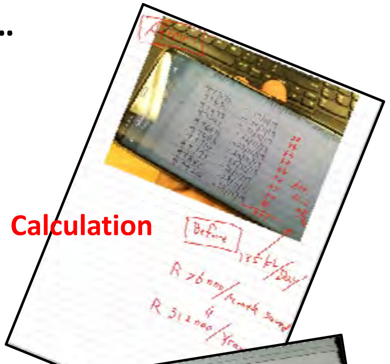


Log all Activities - For Your Evidence

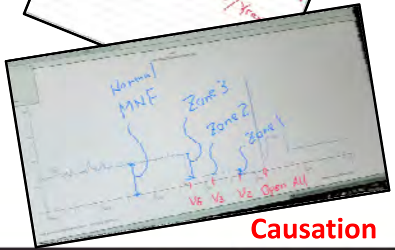
Doing so…







Calculation



Causation

Presentation

To make audiences understood your proposals

Points

Ask yourself who your audiences are?

a. Your colleagues or team members (Casual opportunity)
b. Colleagues in other organizations (Formal opportunity)
c. Your managers (Very formal opportunity, Time constraints, for Decision making)

Tell them why you think so (with evidences and data)

a. They do not know your experiences and knowledge

Tips for Presentation

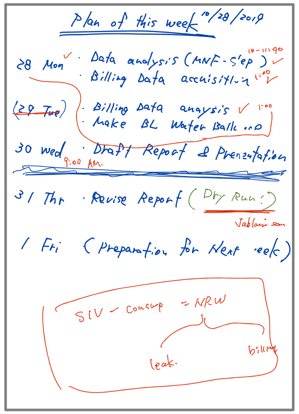
- Full-coverage information
- Reconfiguration according to audiences
- For decision makers, simple facts and recommendation in their languages
- For colleagues in the practical level, details in procedures and setting
- For non-technical people, interpretation to their languages
- Highlighting by coloring, bold and inducing audiences' interests and questions
- Slide numbering, recording, photos, graphic (visualization)
- List of team members and contacts (in this training proramme)

Depends on the audience!

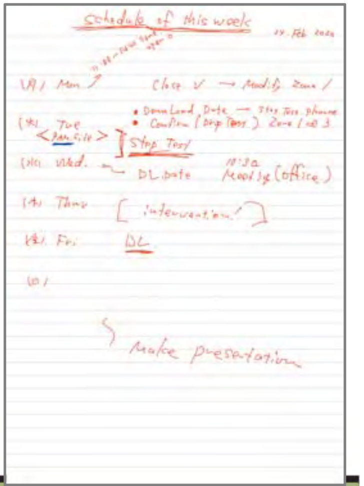
Presentation

To your colleagues and team members (Casual opportunity)

A4-sized map



Time schedule

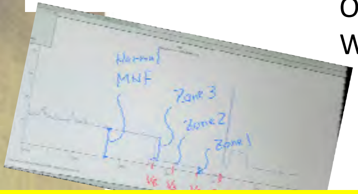


Points
Quick, Easy to understand, To work together efficiently

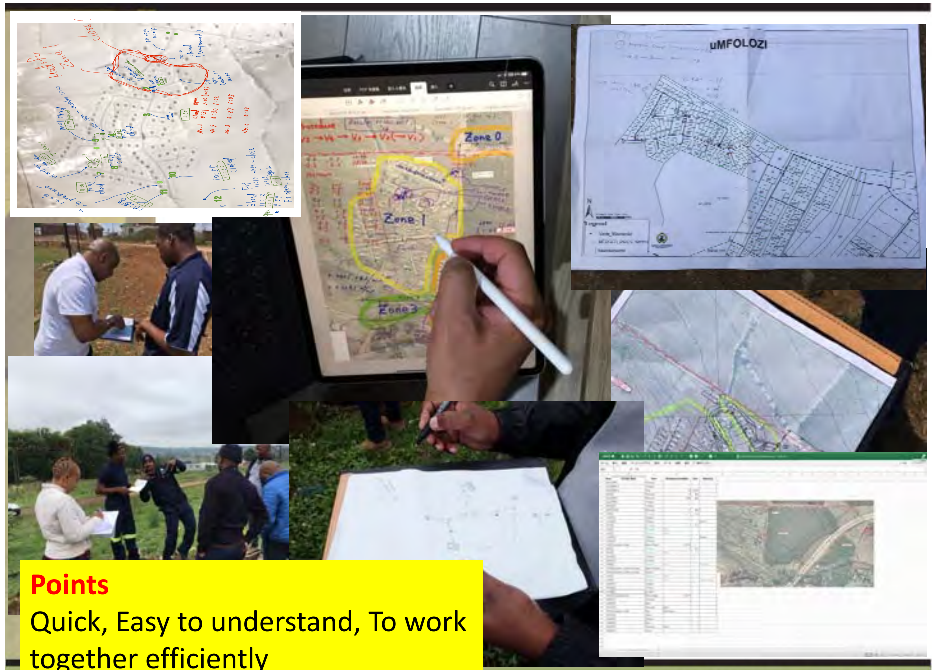
Presentation

To your colleagues and team members (Casual opportunity)

Only data is fine.
We know all about the background!



Points
Quick, Easy to understand, To work together efficiently



Points
Quick, Easy to understand, To work together efficiently

Presentation

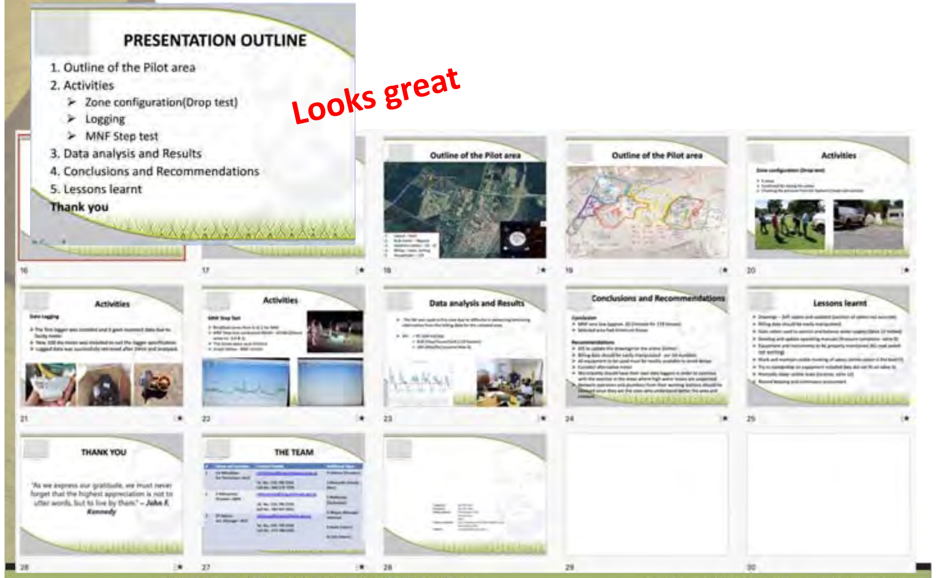
To colleagues in other organizations (Formal opportunity)

Contents (example)

a. Background
b. Methodology
c. Challenges and interventions
d. Findings and lessons learnt
e. Recommendations
f. Conclusion

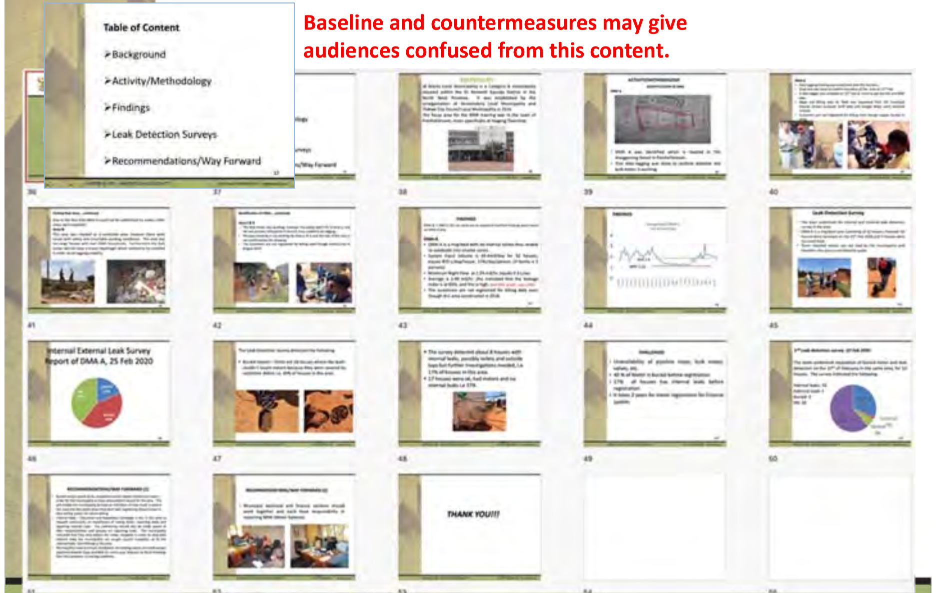
Points
- Being able to trace your idea, share your experiences and knowledge - need to be well organized!

Example: Municipality - A



Example: Municipality - B

Baseline and countermeasures may give audiences confused from this content.



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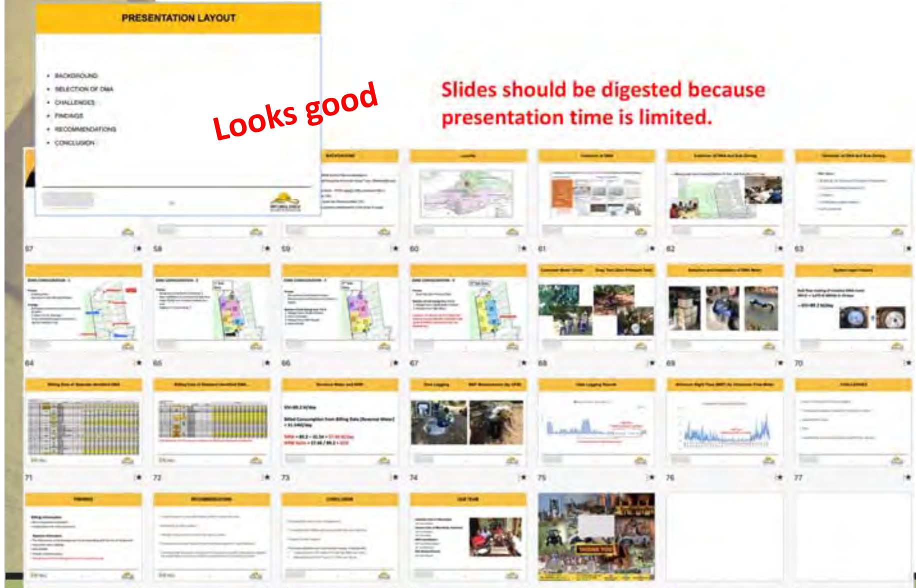
Example: Municipality - C

Slides should be digested because presentation time is limited.



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Example: Municipality - D

Content is missing in the beginnuing, and some slides may give audiences confused due to not enough logical arrangement of information.

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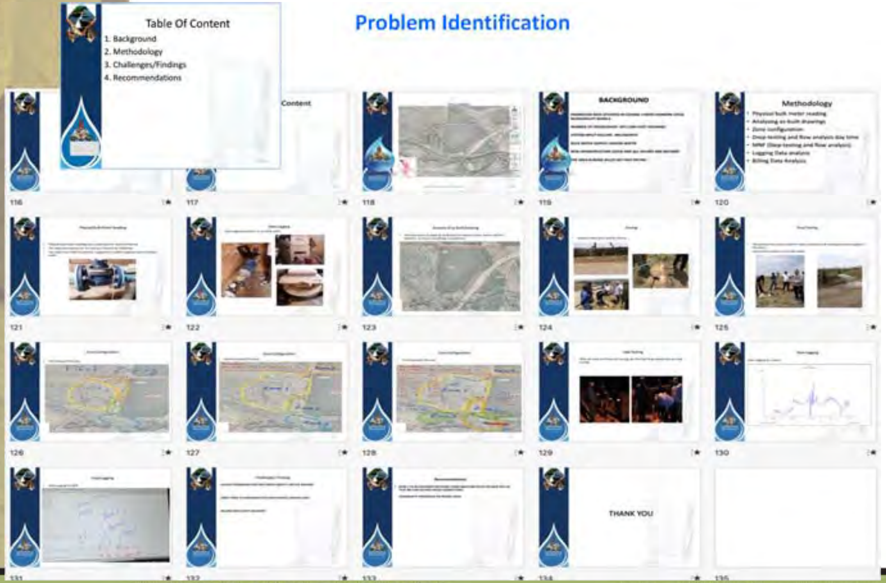
Example: Municipality - E (1/3)

Problem Identification



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Example: Municipality - E (2/3)

Problem Identification to **mitigation plan**

Example: Municipality - E (3/3)

Problem Identification to mitigation plan,
then to **Next activities and the results**,
finally to **Conclusions and way forward**

Step by step and be persuasive
It can be easy to trace

Presentation

To your Managers (Very formal opportunity)

Contents (example)

a. Background
b. Methodology
c. Challenges and interventions
d. Findings and lessons learnt
e. Recommendations
f. Conclusion

Point:
- Be Concise. "For what" and the conclusion be first!

(If they have time, tell them rest of the contents as they like.)

A4, one page hand-out would be useful for them

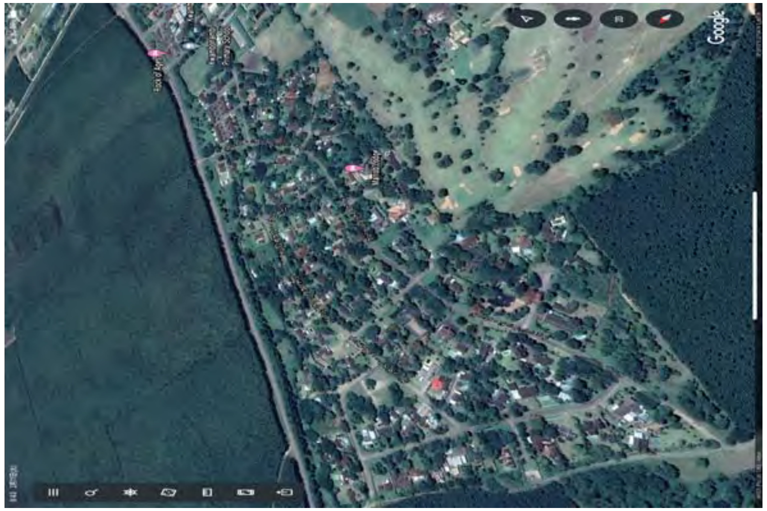
Tips for using PowerPoint (much faster)

in making presentation materials

1. Double click the photo → trim button (Trim photos): show what you'd like to show them
2. **Shift + corner drag** (Resize photos) : Keep the aspect ratio
3. **Option + Drag** (Copy the picture to anywhere you want): the quickest way
4. Put Heading in the Heading box: if you change the background, no need to adjust
5. **Copy & Paste headings**: the last procedure
6. Make nice textbox first then copy: formatting is the most time consuming
7. Put on the **page number on the master**: no need to do every pages!
8. Just double click: makes text box: the 2nd quickest way to input
9. **F5** starts presentation, ←, → to move, : the quickest way to control the presentation
10. File menu – **"compress the file"**(to make small file size): if you need to send the presentation file by email

Let's Drill it!

Google Map/Earth is also useful!



End!

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The National Non-Revenue Water (NRW) Training
for Municipalities by Municipalities in South Africa

Actions and Way Forward

under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

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The National Non-Revenue Water (NRW) Training
for Municipalities by Municipalities in South Africa

Part I: Preparation for the Next Step
Practices (Physical) and Workplace Training

under
The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

WATER IS LIFE, SANITATION IS DIGNITY

Programme Conceptual Flow in each Training Cycle

1st IBTC 5 days	NRW, Reticulation System and Basics (Partially replaced by Virtual/Online Training)
1st Workplace 5 days	Problem Identification and Obtaining the Baseline in Workplace (Zone Configuration, Flow Measurement, Step Test, Billing Data Analysis in pilot DMA) (Weak points of municipalities / Most crucial part of this programme)
2nd Workplace 5 days	Effective Countermeasures in Workplace
2nd IBTC 3 days	Results, Findings, Lessons learned, Suggestions and Actions to be taken. (Seminar with Stakeholders)
	Way Forward

Schedule from 2nd to 6th Week (3rd Group Training)

Day	Time	Contents	Remarks
2nd week (Preparatory)			
Day 6 -10	-	- Preparation by learners in workplaces (DWS Coordinators support learners if necessary) - Confirmation of pilot DMA at the site - Starting data logging - Collect billing data in the DMA by learners	-
3rd week (Workplace)			
Day 11 (Mon)	am	* Travelling (DWS Coordinators and Facilitators)	-
	pm	Participant assembly, meeting about training plan and courtesy call	Office
Day 12 (Tue)	am	DMA configuration	Site
	pm	DMA configuration	Site
Day 13 (Wed)	am	DMA configuration	Site
	pm	DMA configuration, MNF (by step measurement) at night	Site
Day 14 (Thu)	am	Data retrieval and Data analysis	Site and office
	pm	Reporting (Baseline & problem identification)	Office
Day 15 (Fri)	am	Presentation to managers of each Municipality Wrap up workplace training results	Office
	pm	* Travelling (DWS Coordinators and Facilitators)	-
4th week (Buffer)			
Day 16 - 20	-	(DWS Coordinators support learners if necessary) (MNF and SIV measurement if necessary)	-
5th week (Workplace)			
Day 21 (Mon)	am	Travelling (DWS Coordinators and Facilitators)	-
	pm	Participant assembly and meeting about training plan	Office
Day 22 (Tue)	am	NRW Countermeasures	Site
	pm	NRW Countermeasures	Site
Day 23 (Wed)	am	NRW Countermeasures	Site
	pm	NRW Countermeasures, MNF (by step measurement) at night	Site
Day 24 (Thu)	am	Data retrieval/analysis	Office
	pm	Preparation for presentation (Findings, results, remaining issues, strategic implementation planning with considering funding application)	Office
Day 25 (Fri)	am	Presentation to relevant managers Wrap up workplace training results	Office
	pm	* Travelling (DWS Coordinators and Facilitators)	-

6th week (IBTC)			
Day 26 (Mon)	-	-	-
Day 27 (Tue)	-	-	-
Day 28 (Wed)	-	* Traveling (facilitators and learners)	-
Day 29 (Thu)	8:30-10:00	Workplace training results, findings and actions to be taken, Q&A [Presentation]	Room
	10:15-11:50	Workplace training results, findings and actions to be taken, Q&A [Presentation]	Room
	Lunch		
	13:00-14:00	Modification of presentations	Room
	14:15-16:00	Follow-up lectures [Theory & Practices]	Room / Yard
Day 30 (Fri)	8:30-9:00	Output Sharing Seminar * Invite various stakeholders Introduction of participants [Orientation]	Room
	9:00-11:00	Workplace training results, findings and actions to be taken, Q&A [Presentation]	Room
	11:00-11:50	Overall evaluation and assessment	Room
	Lunch		
	pm	* Travelling (facilitators and learners)	-

2nd Week: Preparation by municipalities as well as DWS (WUE&IBTC) & JICA Team for their trip

Workplace Daily Activity: 9h00 to 16h00 (standard)

1st Workplace Training (Problem Identification & Baseline)

Preliminary SIV logging in pilot DMA

1) Zone configuration (drop test, isolation confirmation) in pilot DMA & sub-zones
2) Identification of problematic sub-zones by logging data and step test in pipt DMA
3) Analysis of billing data and calculate NRW from SIV in pilot DMA
4) Findings in NRW, O&M and billing (drawings, data, etc.)

Workplace Training Members

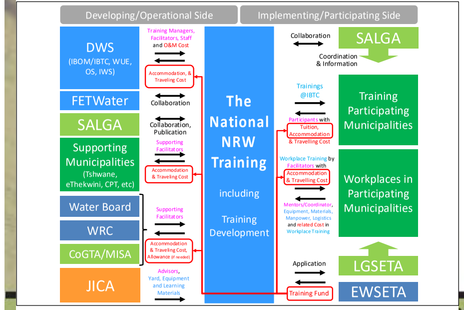
- Learners ----- 3 to 5 persons
- Facilitators (Municipalities) ----- 2 persons
- Coordinator (DWS) ----- 1 person
- Technical support (JICA) ----- 1 person

Learners:
- Municipal water services officials (3 to 5 officials as a team consisting WCWDM, O&M, Billing, etc)

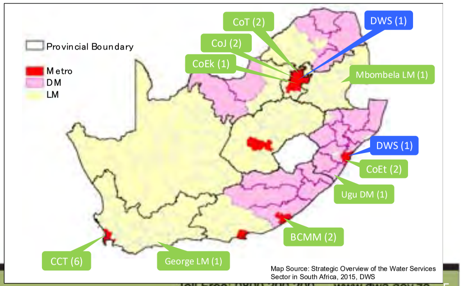
Facilitators:
- Skilled and experienced municipal water services officials
- DWS officials

Coordinator:
- DWS officials

Development Model of the National NRW Training



Facilitators from Municipalities (Start-up)



IWA Water Balance Process (in SA)

- **A. Determine System Input Volume (SIV)** (Reading data of purchase water, outflows from WTWs, boreholes, etc.)
- **B. Determine/Estimate Billed Authorized Consumption: Revenue Water** (Metered / Unmetered)
  - A (SIV) - B (Revenue Water) = NRW
- **C. Determine/Estimate Unbilled Authorized Consumption** (Metered / Unmetered)
- **D. Estimate Commercial Loss** (Unauthorized consumption, Customer meter inaccuracy)
- **E. Estimate Physical Losses** Physical Losses (Leakages) = NRW - C - D

Presentation for Workplace Training

- Details of the pilot DMA: pipeline information, existing flow meters (in/out flow), valves, air valves, hydrants, topographic conditions, customers and etc.
- Measurement plan: things to be confirmed/clarified, workflow, measurement procedures, possible risks, challenges and etc.
- Safety/security considerations
- Necessary preparation before Workplace

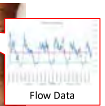
Tips for Presentation

- Full-Coverage Information
- Reconfiguration according to Audience
- If audiences are decision makers, Simple Facts and Recommendation in their languages
- If audiences are colleagues in the practical level, Details in Procedures and Setting
- If audiences are nontechnical, interpretation to their languages
- Highlighting by coloring, bold and inducing audiences' interests and questions
- Slide numbering, Recording, Photos, Graphic (Visualization)
- List of Team members and Contacts

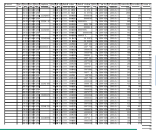
Data to Decisions

NRW Calculation Quick Exercise

Bulk Meter



Billing Data



Data Logging for SIV Measurement (89.2kL/day)

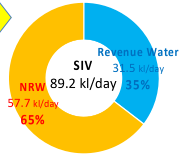
Billed Consumption to be Totalized = Revenue Water (31.5kL/day)

NRW?

SIV 89.2 (kL) = RW 31.5 (kL) + NRW (kL)

i.e. NRW = SIV – RW = 57.7 (kL)

NRW Ratio (%) = 57.7 / 89.2 x 100% = 65%



Prioritization = Know What To Do But Nothing Gets Done

–

Concentration = Demonstrate Excellence With No Progress

Prioritization + Concentration = Delivers Excellency In Service Delivery: *Hopefully Is Enjoyable Too!!*

Why NRW management is necessary?

Impact of NRW management

- Reduction of production cost
- Reduction of O&M cost
- Increased revenue generation
- Contribution to water conservation
- Saving/delaying capital investments
- Improvement of efficiency and financial sustainability
- Increase water supply coverage
- Improvement of customer satisfaction

Now, You have got to know

- ✓ WC/WDM is an important part of Macro Planning.
- ✓ Provision of reliable, cost effective and sustainable water services rests on WC/WDM.
- ✓ Every Municipality is required to develop WC/WDM strategy plan as a part of WSDP and IDP.
- ✓ Every Municipality is required to report its progress quarterly to DWS.
- ✓ No need to plan and develop new or upgrade existing infrastructures at municipalities with high water losses.
- ✓ Priority requirement is to reduce water losses and Non Revenue Water.

The National NRW Training

- **To assist the participating municipalities practically in develop/improve WC/WDM (incl. Water Balance, No-Drop Assessment).**
- To expect your knowledge and experiences obtained through the Training to be used for not only your municipality but also water sector, particularly neighboring municipalities.

Sustainable NRW Management

CONNECT TO FUNDING SOURCES

- Municipal Budget
- Government Grants and Subsidies (MIG, RBIG, WSIG, ACIP, etc.)
- Loan (Private Bank, DBSA, etc.)
- International Development Partners (IDPs) or Donors' Fund
- Partnership with Private and NGOs

***The stakeholders** should proactively provide information, guide/support municipalities for application and optimize the use of the advantage of scale because it is hard for the small- and medium-size municipalities to access funding sources by single municipality.*

Funding agencies will support your proposal if based on reliable data, information and your strategic plan.

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The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Part II: Regional Bulk Infrastructure Grant (RBIG) Water Services Infrastructure Grant (WSIG) and SALGA Initiative

Acknowledgment Mr. Refilwe Mathekga, DWS and Mr William Moraka, SALGA

The National Non-Revenue Water (NRW) Training for Municipalities by Municipalities in South Africa

Outline

1. Introduction
2. RBIG Definition
3. RBIG Background
4. RBIG Management Policy
5. RBIG Challenges
6. WSIG Background
7. WSIG Challenges
8. Summary of Allocations
9. Grants Monitoring
10. Funding Application Process

1. Introduction

- Chief Directorate: Regional Bulk Infrastructure Programme
- Two **Conditional Grants** namely
  Regional Bulk Infrastructure Grant (RBIG)
  Water Services Infrastructure Grant (WSIG)
- Provincial Offices (RBIG & WSIG)
- The grants funds **only Water Service Authority (WSA)**

2. Definition: Regional Bulk Infrastructure

The infrastructure required to connect **or augment** the water resource, on a **macro** or **sub regional** scale (over **vast distances**), with internal bulk and reticulation systems or any bulk supply infrastructure that may have a significant impact on water resources in terms of quantity and quality.

- **"Macro"** is defined as infrastructure serving extensive areas across **multi-municipal boundaries**
- **"Sub-regional"** is defined as large regional bulk infrastructure serving numerous communities over a large area normally within a specific district or local municipal area
- Over **"vast distances"** is considered as any distances **greater than 5 km**
  Bulk infrastructure that has a **"significant impact on water resources"** includes:
  Any bulk scheme that is designed for maximum demand of 5 Ml/day or more
  Any waste water treatment plant that discharges into a fresh water resource system
  Any water treatment plant that is designed for a maximum demand of more than 2 Ml/day

3. RBIG Background

Purpose of Funding

RBIG is a specific purpose capital conditional grant with the objective to supplement the financing of the social component for:

- The **development of new and/or refurbish, upgrade and replace ageing infrastructure** that connects water resources to infrastructure serving extensive **areas across municipal boundaries** or **large regional bulk infrastructure** serving numerous communities over a large area within a municipality.
- The development of new and/or refurbish, upgrade and replace **ageing waste water infrastructure** of regional significance.

4. RBIG Management Policies

- **Responsibility**: DWS is responsible and accountable for the management of this specific-purpose Water Services Regional Bulk Infrastructure Grant. (**Schedule 6 & 5**)
- **Accountability**: The transfer from National Treasury to DWS will take place as per The Division of Revenue Act (DoRA) and bi-lateral arrangements.
- **Co-funding**: While this fund must enable economic development, the proportional capital cost for higher levels of domestic, commercial and industrial uses must be obtained from suitable co-funding or financing mechanisms.

5. RBIG Challenges

1. **Budget** is significantly less than need (MTEF is approx. R18 billion).
2. **Priorities**: The limited budget cannot do adequate justice to the many water infrastructure priorities.
3. **Co-funding**: Lack of co-funding threatens budget allocation and projects.
4. **Large projects**: There are a number of large projects, that if funded fully through RBIG, will limit funds for others.
5. **Institutional capacity**: Many receiving WSA are not capable of managing large bulk infrastructure.
6. **Sustainability**: Limited capacity, systems and finances for adequate **O & M** by benefiting / receiving WSA.
8. **Reticulation :** RBIG projects implemented without internal reticulation plan in place by WSA.

6. WSIG Background

- **New water supply infrastructure** that can be subsequently upgraded to supply a minimum of basic water supply.
- **A temporary water supply infrastructure scheme** that will be removed once a more permanent water supply system will be provided.
- Any appropriate intervention that repairs or re-commissions **dysfunctional** existing infrastructure or water resources, to supply a minimum interim water supply.
- The **acceleration** of planned infrastructure projects to supply basic water.
- A water supply system that does **not involve fixed infrastructure** belonging to the Water Service Provider (i.e. roof rain tanks, etc.).
- A water supply system that makes use of the most **optimal existing and localized water resources** and can be developed and commissioned within a period of twelve months in order to provide a minimum interim water supply. (This can include local boreholes, streams or single purpose dams converted into multi-purpose dams).
- DWS provided support to WSAs to develop the **Business Plans (BP)**.
- WSIG was **subsequently split** into two schedules in terms the DoRA:
  - i. **Schedule 5B** (specific-purpose allocations to municipalities)
  - ii. **Schedule 6B** (allocations-in-kind)
- WSIG is therefore implemented by WSA's, the DWS or external Implementing Agents. IAs must be on DWS's IA list for consideration.

7. WSIG Challenges

- **Lack of capacity** by many WSAs to manage projects and services
- Money transferred to WSAs are **not used** to implement projects
- **Resistance** to the use of **Water Boards** by some weak **WSAs**
- Significant **unit cost for rural water supply particularly** in KZN
- **Demographics**: Scattered and informal settlements over vast distances and over difficult terrain
- **Resistance/rejection** to localised solutions, interim or intermediate solutions and the use of Community-Based Organisations
- **Limited capacity, systems and finances** for adequate **O&M** by benefiting/receiving **WSAs**.
- **Inadequate planning, inadequate BP and technical reports**
- **Lengthy delays** due to various reasons.
- Lack of capacity / poor performance / long delays by **Water Boards**
- **Schedule 5 syndrome** by many WSA who tend to use the money as they like or for other projects / initiatives besides the original BP.

8. Summary of Budget Allocations 2019/20

Programme	Budget Allocations
RBIG 6b	R3.279 Billion, Budget-cut R185m
RBIG 5b	R2.066 Billion
Transfer to WB	R783 million
WSIG 5b	R3.669 billion
WSIG 6b	R644 million

Total Budget R10.2 billion

Sustainable NRW Management

9. Funding Applications Process

RBIG: Applications for funding goes through provincial DWS office.
- Planning Process - Development of Feasibility Study and Technical Report
- Development of Implementation Readiness Study (IRS)
- Designs signed off
- Project move to implementation

WSIG: Applications for funding goes through Provincial DWS offices
- Development of Business Plan
- Business Plan is approved at National Office by Accounting Officer (AO) or delegated official.

DWS(IBTC)/SALGA will monitor, follow up and assist the participating municipalities periodically in their NRW management after the whole training course.

Expected Overall Outputs from this Programme

- Improving **Water Balance** (“**No Drop**”) submitting
- Concrete planning of metering
- Concrete planning of NRW reduction
- Funding from municipality or funding agencies
- Project **Implementation**
- Close communication with DWS-MP-MpS

➡ Kicking off **“vicious cycle to virtuous cycle”**

Vicious cycle to Virtuous cycle

NOW IN SA

- **You don't see yourself (measurement).**
- **You don't know how much water you are sending to people and how much losing it as well.**
- **Just dig and fix is your work.**

[Municipal manager]
[Financial division]
No Trust

- No budget
- No approval to a project

[Technical section]
No Data

Start from here!

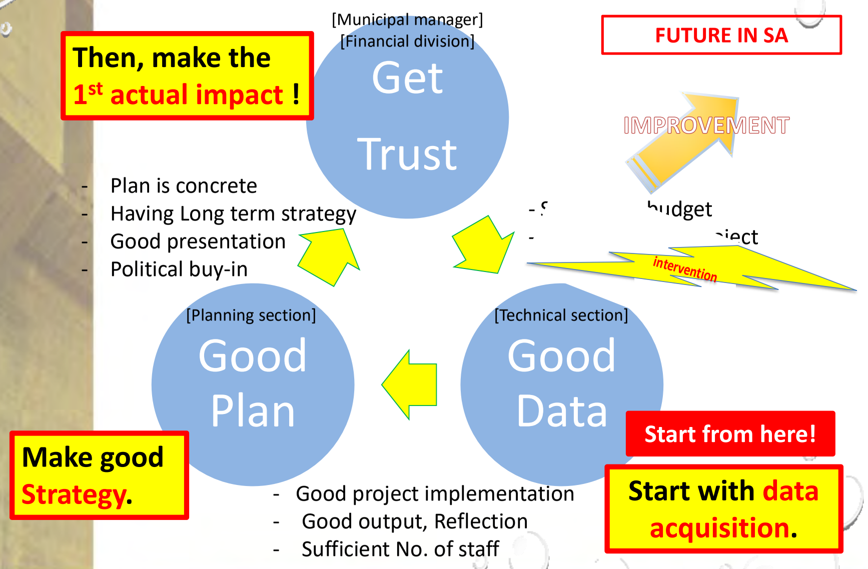
- No project implementation
- Staff always in shortage
- Just hustle everyday
- Status to be worsened…

[Planning section]
No Plan

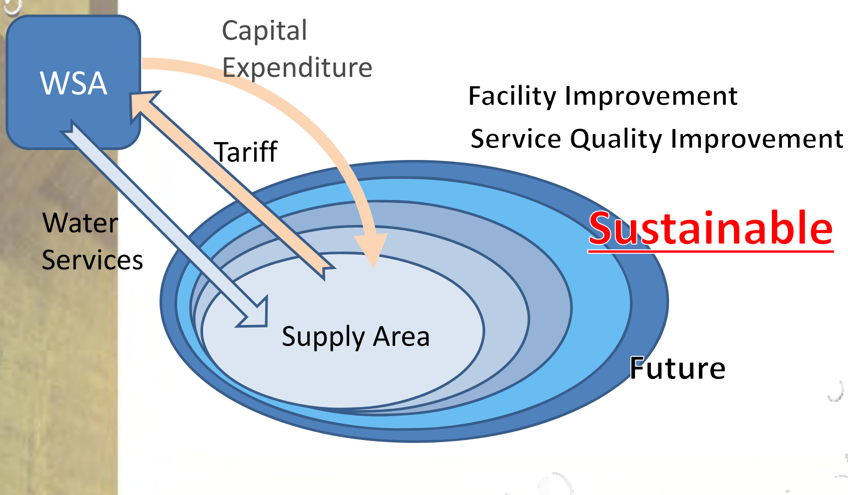
- No political buy-in
- Poor presentation

However, the infrastructure require a long-term, sustainable improvement starting Now!

Vicious cycle to Virtuous cycle



Through "Vicious cycle to Virtuous cycle"



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The Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Part III: "It's now or never. You can do it."

Acknowledgment Mr. Refilwe Mathekga, DWS and Mr William Moraka, SALGA

The National Non-Revenue Water (NRW) Training for Municipalities by Municipalities in South Africa

1. Start preparation for DMA Activities

(prior to Practices and Workplace Training)

Selection Criteria

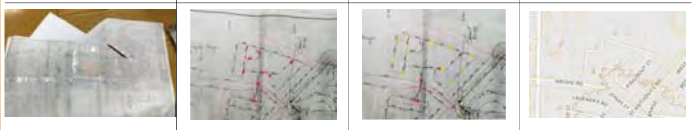
Regarding Project Document page5. article7.

Pilot DMA area:

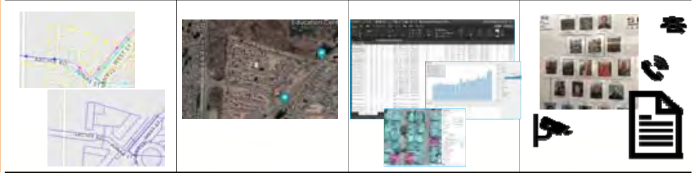
1. Is not so complicated land use (It is like normal residential area. If it includes a school or some shops is fine.)
2. Seems to easy to isolate by using existing valves
3. Has preferably only one input
4. Has area-bulk-water meter on the input line
5. Has No. of connection- under 300
6. Has safe working environment
7. Operation team are cooperative
8. Sites near its Area-Water-Depo Office and easy to access.

Required information

1. O&M Maps (Pipeline) -The one you are currently using distribution reticulation map -Diameter, Material, Age	2. Position of Valves	3. Position of Fire hydrants	4. Contours -If you have IMQS or the same, height interval by 1m



5. Flow rata & Pressure range -If you have IMQS or the same, height interval by 1m	6. Photos -Google map photo with name and address	7. Billing data -The one you are currently using table	8. Councilor and Municipal Police in charge

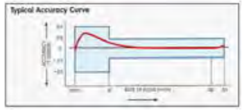


2. Check your bulk meter and water meters

(in the meantime)

Meter Accuracy Curve

- Meters have permissible range of error in standard specifications. It can mitigate proper selection of meter size.
- Inaccuracies in meters tend to increase with age.



Source: Water Meter Training Manual

Definitions	
Q4/Qs	Maximum flow rate (Overload Flow Rate): The highest flow rate at which the meter operate(within the required accuracy) for a short period without permanent damage to its accuracy (+-2% error).
Q3/Qp	Permanent flow rate: Permissible continuous load. Half the maximum flow rate (+-2% error).
Q2/Qt	Transitional flow rate: The flow rate at which the maximum permissible error of the water changes in value from +-5% error to +-2% error.
Q1/Qmin	Minimum flow rate: The lowest flow rate at which the meter is required to give indications within the maximum permissible error tolerance (+-5% error)

*(Q1-Q4 in the new international standards)

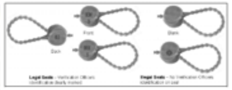
Meter Selection (Bulk)

Meters should be selected its size and class considering its performance.

Source: Water Meter Training Manual

Legal Requirement

- New water meters must be approved by the legally recognized agency, South African National Standard (SANS) Specifications 1529-1.
- Water utility must be able to confirm the meter approval number and Lead Seal.
- Where meters have been exempted from compliance with SANS 1529 (various parts), an exemption letter from the SABS shall be submitted.



Source: Water Meter Training Manual

Meter Reading

Cause of Meter Reading Error

- Improper meter installation
- Stain and scratches on the meter glass
- Algae growth inside of the glass of meter (wet dial meter)
- Incompetent or inexperienced meter reader
- Corrupt meter readers

Because meter readers are the utility's frontline in liaising with customers, their activities have an immediate impact on cash flow. Utility managers should therefore invest in training and motivating their meter readers to record and report information effectively and efficiently.

- Impossible to read
  - Buried by mud and grass
  - Submerged in water

The meter readers should immediately report any observed problems, and the maintenance team should take action to remedy the problem immediately.

3. Billing Data Check

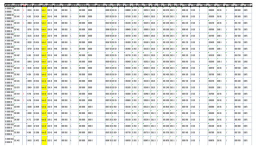
(in the meantime)

Data Verification and Processing

- To deal with customer bills and NRW analysis, customer consumption record is the essential database.
- However, the databases are often not accurate.
- It is important to know where to look in the data to see inaccuracies, how to check, and how to fix it into usable data.

Points

- How to get the correct and accurate customer consumption data for NRW calculation?
- Which department does supply the data?
- What do you think about data reliability?



How to find Suspicious Data

Registration Check	**To check whether all the people using water are registered as customers.** ➢ It is desirable to investigate with meter readers.
Abnormal Consumption Check in Data	**To investigate extremely low and high consumption customers.** ➢ Low consumption data imply illegal use sometimes. ➢ Field investigation and interview to the customer are required after listed up suspicious customers
Determining Average Consumption in Data	**To Determine the amount of standard water consumption to be classified.** ➢ This is also influenced by the living environment of the area, so consider the situation carefully and decide. ➢ List up low consumption customer
Suspicious Data	

Causes of Data Errors and How to Fix - 1

Missing Customer	Despite being residents and using water, there are not on the customer list. Registration is essential.
Inconsistent Data	The system could not determine the order in which the readings took place due to data inconsistencies.
Spikes or dips in Consumption	Abnormally high or low consumption for a stand are often signs of errors in the meter readings.
Missing Readings	Where no readings are available for the last month, the system has to estimate consumption based on the consumption history for the stand.

Causes of Data Errors and How to Fix - 2

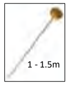
Long Gaps in Meter Reading	When a meter has not been read for a certain number of months (typically 3), consumption estimation become uncertain and an instruction should be given for a reading to be taken.
Incorrect Data	It must be corrected as much as possible for more accurate NRW calculations. The Municipalities need to decide in advance how to deal with the incorrect data if it found. Because some of them can be corrected with a software system, adoption such system should be considered.
Meter Clock-Over	This causes a very large water reading in a month to be followed by a very small reading the next. It is important to include information on the number of digits on the indicator to identify meter clock-overs.

4. Underground Leak Detection

(in Practices and Workplace Training)

House Connection Survey (Acoustic Method) -1

- To check noise at water meters and fittings (stop cocks, valves) travelling along the pipeline.



- **Benefits**
  - Leaks occur often on saddles
  - Immediate detection
  - Easy work
- **Note**
  - Close house connection valve, every time when sound occurs.
  - Leak sound does not travel when the saddle is far away from the meter.
- **Listening Stick**
  - A metallic bar with a vibration chamber and a plate.
  - To attach the tip to water meters and fittings (stop cock, valve), then sound travels on the bar and the traveled noise echoes inside the chamber.
  - To detect noise at fittings only, not for the pinpointing.

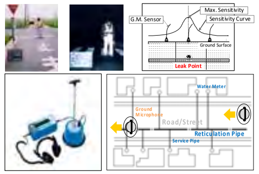
House Connection Survey (Acoustic Method) - 2

To put color marks on the map for suspicious leak noise. (example)

Ground Microphone Survey (Acoustic Method)

- To place a sensor on ground surface and listen traveled leak noises.
- To move the sensor to determine the loudest noise point (the loudest point is above the leak point).
- Effective for leaks on Main pipe, Connection, Saddle, and Boundary to house and road.

- **At night ideally**
  - Low environmental/traffic noise
  - With high water pressure
- **4 to 5 km per night/team ideally**
  - 2 persons per team
  - Person in charge of reticulation and service pipes
  - To keep a certain distance each other to avoid noise from another person

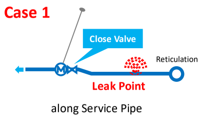


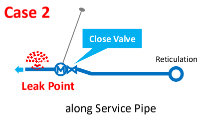
Is it an Internal or External Leak?

i. **Detect noise by Listening Stick at water meter or stop valve**
ii. **Close the stop valve (cock)**

Case-1: Noise continues -> **External** Leak (Reticulation) = **NRW**

Case-2: No noise -> **Internal** Leak (Customer) = **Revenue Water**





Lastly, one more thing:

Why has NRW Training been developed?

- Standpoints -

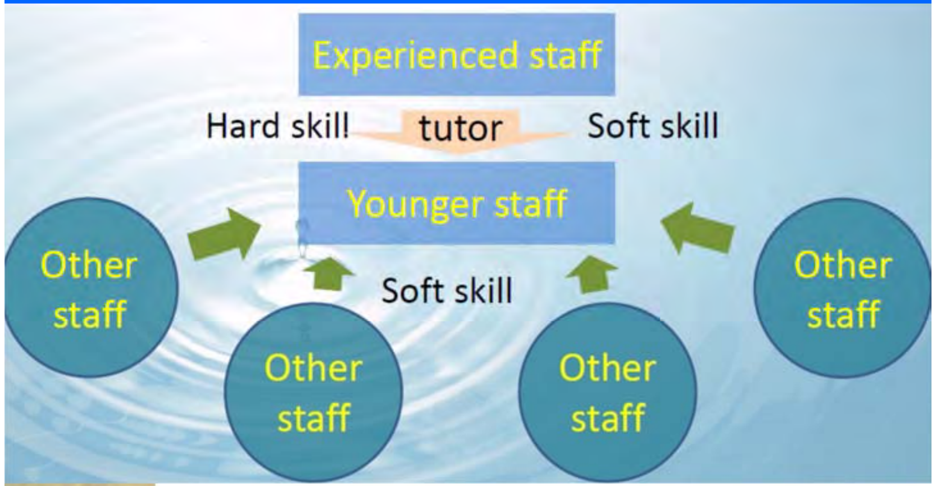
- Firstly, focus on "**measurement improvement**" (a main point to NRW management in South Africa)
- Be **practical** (I can do it!)
- To the point for each water services' issues (**real problem solution**)
- Bring in **active dialog** to the water sector (maintain IBTC as our platform)
- Make WCWDM contributable

Water services are important public assets and functions.

Great hopes that all water professionals/practitioners are to understand their roles, responsibility and pride.

On-the-Job Training (OJT) in Japan for Reference

OJT is an main approach in Human Resources Devlopemnt



End

WATER AND SANITATION GRANTS

Regional Bulk Infrastructure Grant	
Transferring department	• Water and Sanitation (Vote 36)
Grant schedule	• Schedule 5, Part B and Schedule 6, Part B
Strategic goal	• Facilitate achievement of targets for access to bulk water and sanitation through successful execution and implementation of bulk projects of regional significance
Grant purpose	• To develop new, refurbish, upgrade and replace ageing water and sanitation infrastructure of regional significance that connects water resources to infrastructure serving extensive areas across municipal boundaries or large regional bulk infrastructure serving numerous communities over a large area within a municipality • To implement bulk infrastructure with a potential of addressing water conservation and water demand management (WC/WDM) projects or facilitate and contribute to the implementation of local WC/WDM projects that will directly impact on bulk infrastructure requirements
Outcome statements	• Access to water supply enabled through regional bulk infrastructure • Proper wastewater management and disposal enabled through regional wastewater infrastructure
Outputs	• Number of regional bulk water and sanitation projects under construction • Number of projects/project phases completed • Number of households targeted to benefit from bulk supply • Number of municipalities benefitting • Number of job opportunities created
Priority outcome(s) of government that this grant primarily contributes to	• Outcome 6: An efficient, competitive and responsive economic infrastructure network • Outcome 7: Comprehensive rural development and land reform • Outcome 9: Responsive, accountable, effective and efficient developmental local government
Details contained in the business plan	• This grant uses approved implementation readiness studies (IRS) and memorandums of understanding (MoU) which include the following: o cash flow and implementation milestones o details of key stakeholders and main contractors o specific funding conditions related to the project o outline of the roles and responsibilities of the respective parties
Conditions	• The Regional Bulk Infrastructure Grant (RBIG) is intended to fund the social component of regional bulk water and sanitation projects approved by the Department of Water and Sanitation (DWS), unless exemptions based on affordability are recommended by DWS and approved by National Treasury • All identified projects must be referenced to and included in the municipal Integrated Development Plan (IDP) and Water Services Development Plans (WSDP) and show linkages to projects under the Municipal Infrastructure Grant (MIG) and/or the Water Services Infrastructure Grant (WSIG) • Funds may only be used for drought relief interventions based on a business plan approved by DWS **Schedule 5, Part B allocations** • The municipality must spend grant funds in line with the IRS approved by DWS • The municipality must submit monthly financial and quarterly non-financial reports to DWS on stipulated dates • Grant funds must be reflected in the capital budget of the municipality • All sources of funding for the cost of the project must be clearly outlined in the approved IRS • The financing plan with associated co-funding agreements must be in place prior to implementation of the project unless exemption to co-funding requirements has been approved by National Treasury **Schedule 6, Part B allocations** • This grant can be used to build enabling infrastructure required to connect or protect water resources over significant distances with bulk and reticulation systems • A financing plan with associated co-funding agreements must be in place prior to implementation of RBIG funded projects • All sources of funding for the full cost of the project must be outlined in the IRS and the MoU, which must be signed by DWS and the benefiting municipality • RBIG payments for Schedule 6, Part B allocations will be made to DWS's contracted implementing agent based on invoices for work done • All projects must be implemented and transferred in line with the approved IRS
Allocation criteria	• Projects are assessed individually, and allocations are made by DWS on a project basis, taking into account the following factors: o demand and availability of water o the overall infrastructure needs o the strategic nature of the project o socio-economic importance of an area o urgency and impact of the intervention
Reasons not incorporated in equitable share	• Regional bulk projects are closely linked to water resource planning and development, which is a DWS competency
Past performance	**2016/17 audited financial outcome** • Of an approved revised budget allocation (Schedule 5, Part B) of R1.8 billion; R1.8 billion (100 per cent) was transferred • Of an approved revised budget allocation (Schedule 6, Part B) of R3.5 billion; 98 per cent was spent

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Regional Bulk Infrastructure Grant	
	2016/17 service delivery performance • Five project phases were completed: ○ Masilonyana-Brandfort phase1 ○ Kalahari East to Mier pipeline ○ Steytlerville Water Supply Scheme ○ Noupoort Bulk Water Supply ○ Gariep Dam to Norvaltspond Bulk Water Supply • 81 project phases were in construction
Projected life	• The grant will continue until 2020/21, subject to review
MTEF allocations	**Direct transfers (Schedule 5, Part B):** • 2018/19: R2 billion; 2019/20: R2.1 billion and 2020/21: R2.2 billion **Allocation-in-kind (Schedule 6, Part B):** • 2018/19: R2.9 billion; 2019/20: R3 billion and 2020/21: R3.2 billion
Payment schedule	• Payments for Schedule 5, Part B allocations are made in terms of a payment schedule approved by National Treasury • Payments for Schedule 6, Part B payments are made after verification of work performed
Responsibilities of the transferring officer and receiving officer	**Responsibilities of the national department** • Support the development of Water Services Authorities' (WSA) water services infrastructure master plans • Ensure every municipality benefiting from a specific project or scheme is invited to participate in the feasibility study and IRS • Enter into agreements with WSAs regarding the construction, ownership, funding arrangements, and operation and maintenance of proposed infrastructure prior to the commencement of construction. These agreements must be specified in the IRS and/or in the funding agreement • If required, ensure the necessary authorisations including environmental impact assessment and water use licences are obtained • Provide detailed information on the selection criteria and conditions for the grant (RBIG Programme Implementation Framework) • Ensure that suitable agreements are in place between an implementing agent who will continue to operate the infrastructure after completion and the WSA • All drought related plans and expenditure must be shared with the National Disaster Management Centre
	Responsibilities of Water Services Authorities • Develop and regularly update water services infrastructure master plans • Submit monthly, quarterly and annual progress reports to DWS • Ensure that projects are appropriately linked to the municipality's water services infrastructure master plans, their IDP and WSDP and projects funded through the MIG and WSIG • Once a project is completed, ensure adherence to operations and maintenance plans and/or any other requirements agreed to as part of the funding agreement, and ensure the sustainability of infrastructure • Ensure integration of planning, funding, timing and implementation of bulk and reticulation projects • Ensure provision of reticulation services and/or reticulation infrastructure to connect to the bulk infrastructure funded through this grant
Process for approval of 2019/20 business plans	• Due to the long-term nature of projects, dates of the various processes are not fixed • All proposed projects which comply with the RBIG criteria must be registered and listed in DWS's bulk master plans • At regional level, a coordination committee of key stakeholders to assist with planning of regional bulk projects and the assessment of the IRS and feasibility studies must be in place • Pre-feasibility studies must assess potential for WC/WDM interventions • IRS and feasibility studies will be evaluated and approved by the transferring officer • All projects are allocated a budget by DWS and submitted to National Treasury for gazetting as indicative budget allocations • Project funding approval letters will be issued to the benefiting municipalities • Based on the outcome of the IRS, DWS will nominate the implementing agent for the construction phase of Schedule 6, Part B projects and designate the owner of the infrastructure. National Treasury and benefitting municipalities will be informed of the decisions

Water Services Infrastructure Grant	
Transferring department	• Water and Sanitation (Vote 36)
Grant schedule	• Schedule 5, Part B and Schedule 6, Part B
Strategic goal	• To assist Water Services Authorities (WSAs) to reduce water and sanitation backlogs
Grant purpose	• Facilitate the planning and implementation of various water and on-site sanitation projects to accelerate backlog reduction and enhance the sustainability of services especially in rural municipalities • Provide interim, intermediate water and sanitation supply that ensures provision of services to identified and prioritised communities, including through spring protection and groundwater development • Support municipalities in implementing water conservation and water demand management (WC/WDM) projects • Support the existing Bucket Eradication Programme intervention in formal residential areas • Support drought relief projects in affected municipalities
Outcome statements	• An increased number of households with access to reliable, safe drinking water and sanitation services
Outputs	• Number of households provided with water and sanitation through: o reticulated water supply o on-site sanitation o bucket systems replaced with appropriate sanitation facilities for households identified by the Department of Water and Sanitation (DWS) in the 2015/16 verification process o source identification o water conservation/water demand management provision • Number of households reached by health and hygiene awareness and end-user education • Number of job opportunities created
Priority outcome(s) of government that this grant primarily contributes to	• Outcome 7: Comprehensive rural development and land reform • Outcome 8: Sustainable human settlements and improved quality of household life • Outcome 9: Responsive, accountable, effective and efficient developmental local government
Details contained in the business plan	• Outcome indicators • Output indicators • Inputs • Key activities • Roles and responsibilities
Conditions	• All projects funded must be aligned to, and not duplicate, any existing or planned projects funded by other conditional grants or municipalities' own funds • Municipalities must demonstrate in their business plans how they plan to manage, operate and maintain the infrastructure over the long term **Schedule 5, Part B allocations** • Municipalities must submit business plans signed off by their Accounting Officer in line with their Water Services Development Plans (WSDPs) and Intergrated Development Plans (IDPs) • DWS must approve the business plans before projects can be implemented • WSAs may only spend funds in line with approved business plans • WSAs must submit monthly financial and quarterly non-financial reports to DWS • Funds must be reflected in the capital budget of the municipality • Grant funds must not be spent on operations and routine maintenance • The Project Management Unit funded through the Municipal Infrastructure Grant should be utilised to manage the implementation of projects funded through this grant • Funds may only be used for drought relief interventions based on a plan approved by DWS **Schedule 6, Part B allocations** • Municipal accounting officers must sign-off that business plans are in line with their WSDP/IDP. In the case of Bucket Eradication Programme projects, a memorandum of understanding (MoU) will guide implementation • DWS must approve the business plans before projects can be implemented • DWS must enter into a MoU with the relevant municipality before any project is implemented • Service level agreements (SLAs) between DWS and the WSA must specify: o the location of the project and communities impacted o the consultation process that was undertaken with affected communities o the alignment between the project plan and the municipality's WSDP and IDP o the interim/intermediate and/or localised infrastructure that will be built or the intervention that will be implemented o the cost of the project and timeframe for completion o how maintenance of the infrastructure will be conducted and funded in future by the municipality

Water Services Infrastructure Grant	
	○ details of how the capacity of the municipality will be strengthened through the project implementation process so that it can implement projects itself in future ○ DWS's implementing agent ○ agreement by the municipality that the project should be implemented as an allocation-in-kind
Allocation criteria	• Allocations are based on the number of households with water and sanitation backlogs, prioritising the 27 priority district municipalities identified by government • Allocations for the Bucket Eradication Programme in Schedule 6, Part B, are based on the remaining work needed to replace bucket systems with appropriate sanitation facilities for households identified by DWS in the 2015/16 verification process
Reasons not incorporated in equitable share	• The grant is earmarked for specific projects aimed at providing access to basic water and sanitation services
Past performance	**2016/17 audited financial outcome** • Water Services Infrastructure Grant (Schedule 5, Part B): ○ of the R2.8 billion allocated, R2.4 billion (83 per cent) was transferred • Water Services Infrastructure Grant (Schedule 6, Part B): ○ of the R311 million allocated, R297 million (95 per cent) was spent
	2016/17 service delivery performance • Water Services Infrastructure Grant: ○ 28 200 households served ○ 509 jobs created
Projected life	• The grant will continue until the 2020/21 financial year, subject to review
MTEF allocations	**Direct transfers (Schedule 5, Part B):** • 2018/19: R3.5 billion; 2019/20: R3.7 billion and 2020/21: R3.9 billion **Allocations-in-kind (Schedule 6, Part B):** • 2018/19: R608 million; 2019/20: R642 million and 2020/21: R678 million
Payment schedule	• For Schedule 5, Part B, transfers are made in accordance with a payment schedule approved by National Treasury • For Schedule 6, Part B, payments are made to contracted implementing agents (including water boards and private service providers) after verification of work performed
Responsibilities of the transferring officer and receiving officer	**Responsibilities of the national department** • Evaluate and approve the business plans for each project before funds can be transferred • Ensure that the conditions of the grant and approved business plans are adhered to • Submit statutory reports (monthly financial, quarterly non-financial and annual performance) to National Treasury • Ensure that implementing agents submit monthly financial and quarterly non-financial reports • In cases where DWS appoints a contractor, the contract between DWS and the appointed contractor must be signed before the project can commence • All drought-related plans and expenditure must be shared with the National Disaster Management Centre
	Responsibilities of water services authorities • Compile and submit signed-off business plans for each project (for the relevant financial year) • Sustainably operate and maintain funded water and sanitation projects over their lifetime • Ensure integrated planning for all projects funded through the different grants and programmes • Municipalities must submit a technical report for each project to the regional office • Ensure adequate participation and involvement of the public in each project • Manage project implementation in line with the business plan • Submit monthly, quarterly and annual progress reports in the format prescribed by DWS • Comply with all the funding conditions agreed to in the business plan and MoU
Process for approval of 2019/20 business plans	• Municipalities must submit a technical report for each project to the regional office • Regional offices must assess technical reports • Municipalities must prepare business plans based on the assessed technical reports • Business plans must be submitted to DWS by 29 March 2019 • Business plans must be approved by DWS by 1 May 2019

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TEXTBOOK

THE NATIONAL NRW TRAINING

October 2019, Ver. 1.0

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1. SIGNIFICANCE OF THE NRW MANAGEMENT

Outcomes in this Chapter

1-1 Understand the reasons of this training course (text).
1-2 Understand contents of NRW in municipality
1-3 Understand the necessity of NRW management
1-4 Understand current status of NRW in South Africa and National Development Plan.
1-5 Understand the reasons of NRW in South Africa.
1-6 Understand the NRW management-starting from" See your situation STRAIT"

2.1. Introduction of the National NRW Training

South Africa is a water-scarce country, and the availability of water resources currently does not meet the country's current water demand. In South Africa, there are several challenges that prevent effective water supply.

- Aged infrastructure
- Poor Operations and Maintenance
- Water wastages
- Inefficient use and water loss from water distribution systems.

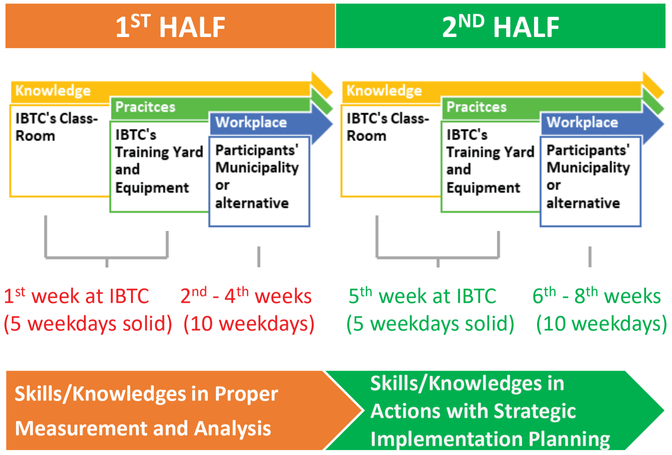
The National Water Act (Act 36 of 1998) (NWA) has provided an enabling environment for WC/WDM as a fundamental step in promoting water use efficiently. The Water Services Act (Act 108 of 1997) requires all spheres of Government to ensure water services are provided in an efficient, equitable and sustainable manner which is sufficient for subsistence and sustainable economic activity. This can only be achieved through a proper understanding of the system input volume, authorized consumption, water losses and NRW of all urban and rural potable water distribution systems. It is for this background that NRW management and its impact are central to ensuring water availability for the necessary socio-economic development, improving the economy and job creation whilst simultaneously achieving environmental sustainability as set out in the core objectives of the National Water Resources Strategy (NWRS 2).

NRW management thus becomes a crucial and telling indicator of the state and health of municipalities therefore a need for Water Service Authorities to have a comprehensive understanding of their level of leakages and aspects of NRW within their areas. However the water losses NRW status quo in the country paints a different picture that of seemingly a lack of technical understanding and expertise in dealing with municipal water losses/NRW challenges. This National NRW training is therefore aimed at helping to improve the technical and resource capacity of municipalities to provide adequate water supply.

2.1.1. Components and Timeframe of the National NRW Training

The National NRW Training has three components: that is, "Knowledge, Practices and Workplace". The duration of the training is 40 weekdays including two buffer weeks shown in Figure 2-1 of a training cycle.The 1st half of the programme focuses on knowledge and skills for "proper analysis and measurement to know about real issues and problems identified by the firsthand experiences".

The 2nd half of the programme focuses on knowledge and skills including strategic implementation of NRW management.

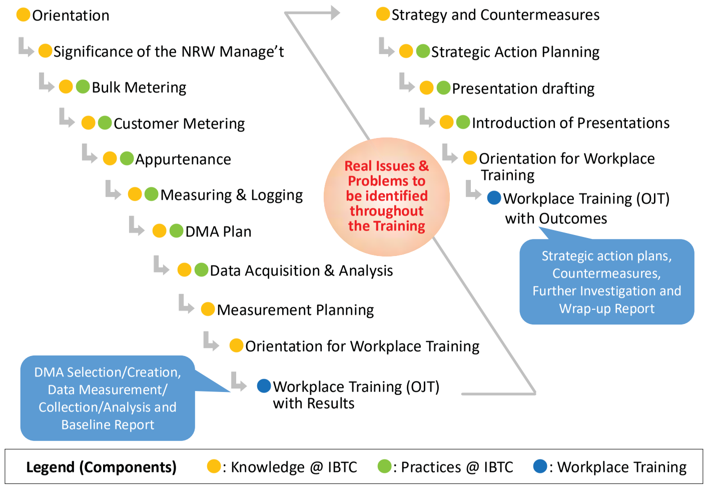


Source: JICA Expert Team

Figure 2-1 Components and Timeframe of a Training Cycle

2.1.2. Course Overview of the National NRW Training

Figure 2-2 shows course overview of a Training cycle.



Source: JICA Expert Team

Figure 2-2 Course Overview of a Training Cycle

> ***Point!***
> *National NRW Training provides municipalities with strategies and measures to get NRW reduction measures on track. National NRW Training is a specific training for NRW management that measures, quantifies/identifies NRW, develops and analyzes strategies. The National NRW training can be achieved through the knowledge and experience of facilitators/participants and field observations and surveys in South Africa.*

2.2. What is Non-Revenue Water (NRW)?

NRW in municipal water services is defined as: "the water which is produced at the costs but lost before reaching customers, or but not used effectively". NRW and its components will be explained more below in "Water Balance".

Therefore, the NRW level is regarded as a key performance indicator of operating efficiency of municipal water services, which is surrounded by (related to) various circumstances (see Figure 2-3).

Non-revenue water is a performance indicator of water service's efficiency which including the following process.

- Data management to visualize the efficiency
- Initiatives reducing water loss to improve revenue
- If SIV and RW data is inaccurate, the NRW ratio will not be a reliable one.
- For example, in the case of SIV reading differs from 80 to 90, and RW was 60,

NRW ratio = 90(SIV) -60(RW)/90(SIV) = NRW 33%, 80(SIV) -60(RW) /80(SIV) =NRW 25%

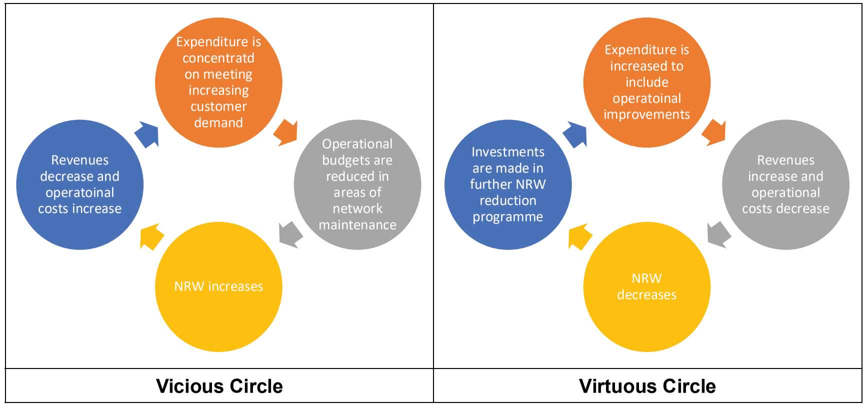
Source: JICA Expert Team

Figure 2-3 Circumstances surrounding NRW

2.3. What are impacts of NRW?

The "Vicious Circle" of NRW (Figure 2-4) is one of the key reasons for poor municipal performance and results in both physical and commercial losses. Physical losses, or leaks impede the delivery of water to customers, increasing operation costs. In addition, more investment is required to increase the network capacity for a stable water supply. Commercial losses, caused by customer meter inaccuracies, poor data handling, and illegal connections/bypassing, reduce income and thereby financial resource.

The challenge for municipalities is to turn the Vicious Circle into the "Virtuous Circle" (Figure 1-4). In effect, reducing NRW releases new sources of both water and finances. Reducing excessive physical losses results in a greater amount of water available for consumption and postpones the need for investing in new sources. It also lowers operating costs. Similarly, reducing commercial losses generates more revenue.



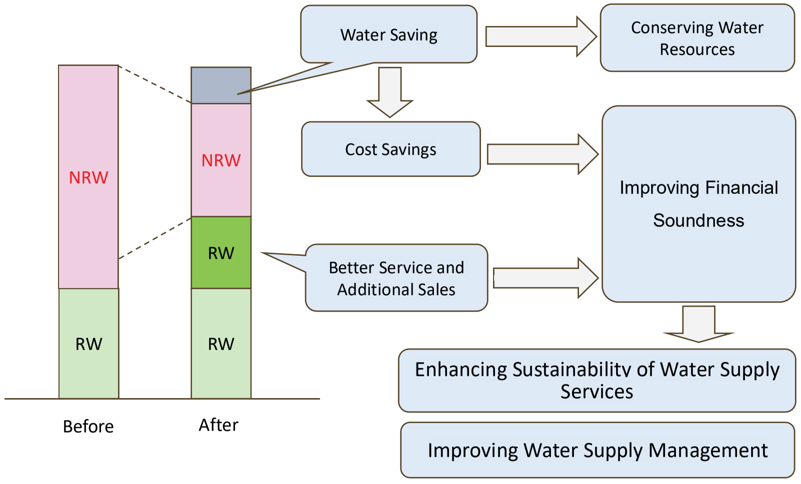
Source: JICA Expert Team

Figure 2-4 Vicious and Virtuous Circles of NRW

As summarized below, reducing NRW can contribute to various aspects of municipal water services:

- Reduction of O&M cost
- Increase in revenue generation
- Contribution to water conservation
- Saving/delaying capital investments
- Improvement in efficiency and financial sustainability
- Increase in water supply coverage
- Improvement in customer satisfaction

Figure 2-5 shows benefits of NRW reduction.



Source: JICA Expert Team

Figure 2-5 Benefits of NRW Reduction

Reducing NRW ratio increases the revenue water quantity that means additional sales to utilities. This increase in revenue water could be used to increase the level of service and/or the coverage area of service. Another quantity of water could be available after NRW reduction. Such quantity of water, if not needed by the customers, may conserve water resources and hence extend the life time of the resources. In addition to saving water, reducing non-revenue water saves on capital investment costs. For example, new water production facilities and renovations or upgrades of existing facilities. These savings will improve the financial health of the utility and enhance the sustainability of the water supply facilities that improve water supply management and water supply.

2.4. Status-quo of NRW in South Africa

The estimated national water balance (for all municipalities) based on the municipal data of up to 2018 indicate NRW 42% as per studies undertaken by DWS.

However, in some municipalities, the NRW cannot be calculated accurately, or is over under estimated due to lack of accurate measurement and sometimes institutional and political pressure to determine budgets and activities.

This leads to the false diagnosis of real problems that affect operational efficiency. In essence, this misleads the municipality attempt to increase its income by reducing NRW including the cost of measures.

Therefore, municipality needs to quantify/identify NRW and its components in order to effectively implement measures.

2.5. NRW Management Roadmap (Solutions)

- Define the purpose to be achieved,

a. Analyze the problems specifically to identify the root cause(s),

b. Brainstorm possible solutions to solve the problem,

c. List all resources to realize the solution,

d. Choose one or two of the most effective and cheapest (strategic) solutions,

e. Review procedures in timeline (planning), and

f. Monitor, evaluate effects and learn lessons

2.6. Water Balance

2.6.1. Water Balance and Components

International Water Association (IWA) clarifies NRW by using "Water Balance (or Water Audit in the USA)" as a standard (see table 2-1).

Table 2-1 IWA's Water Balance

System Input Volume(SIV)	Authorized Consumption	Billed Authorized Consumption	a. Billed Metered Consumption	Revenue Water
			b. Billed Unmetered Consumption	
		Unbilled Authorized Consumption	c. Unbilled Metered Consumption	Non-Revenue Water (NRW)
			d. Unbilled Unmetered Consumption	
	Water Losses	Commercial (Apparent) Losses	e. Unauthorized Consumption	
			f. Customer Metering Inaccuracies and Data Handling Errors	
		Physical (Real) Losses	g. Leakage on Transmission and/or Distribution Mains	
			h. Leakage and Overflows at Utility's Storage Tanks	
			i. Leakage on Service Connections up to Point of Customer Use	

Source: International Water Association

2.6.2. Definitions of Water Balance's Components

The following definitions of the terms were prepared in reference to IWA's definitions and modified in the South African context.

- **System Input Volume (SIV)**

"System Input Volume (SIV)" is the volume input to that part of the water supply system, zone or the isolated area for specified period (annual in general) from surface and ground water resources and bulk service providers and is calculated as follows.

System Input Volume =
Potable supply from water treatment plant (sum of meter/s on plant outlet)
+supply from bulk or other water services providers (sum of meter/s used for billing purposes)
+supply from boreholes, springs, fountains if not supplied through water treatment plant (meter/s on each borehole or bulk supply point)

"The potable volume input to the water supply system from the water utility's own sources, as measured at the water treatment works outlet, as well as any water imported from other sources."

- **Revenue Water**

a. Billed Metered Consumption

This **metered** consumption consists of "Billed Authorized Consumption", the amount of water that customers (domestic, commercial, industrial and institutions) are **authorized to use and are billed for**. Water is usually metered by conventional (mechanical) meters, prepaid meters and automated meter reading devices.

Billed metered consumption=
Metered water supply and billed to users inside utility's supply area
+Metered water supply and billed to users outside the utility's supply area (if applicable)
+Metered water supply and billed to internal departments (if applicable)
+Metered water supply and billed for fire-fighting

b. Billed Unmetered Consumption

This is **unmetered** (direct-line, flat-rate) consumption consisting of "Billed Authorized Consumption", the amount of water that customers (domestic, commercial, industrial and institutions) are **authorized to use and are billed for**.

Billed unmetered consumption =
Unmetered and billed authorized (flat rate) water supply to users,
+Unmetered and billed (at zero rate) free basic water to users

Point!
As long as they consume water within an amount of flat-rate, but, if they consume water more than the nominal quantity, excess water use may be categorized as a component of NRW.

- **Non-Revenue Water (NRW)**

Non-Revenue Water is calculated as the difference between the system input volume and the authorized consumption.

Non-revenue water = System Input Volume – Authorized Consumption
where Authorized Consumption = Billed metered + Billed unmetered + unbilled metered + unbilled unmetered

a. Unbilled Metered Consumption

This is metered consumption consisting of "Unbilled Authorized Consumption", such as water used for maintenance including backwash in water treatment plants and cleaning (washout) of pipelines by municipalities as well as sometimes water extraction for emergent fire-fighting, but some are not recurring consumption.

Unbilled metered consumption=
Metered water supply and unbilled to uses inside the utility's supply area
+Metered water supply and unbilled to uses outside the utility's supply area (if applicable)
+Metered water supply and unbilled to internal departments (if applicable)
+Metered water supply and unbilled used for fire-fighting

b. Unbilled Unmetered Consumption

This is unmetered consumption consisting of "Unbilled Authorized Consumption", such as water used for maintenance including backwash in water treatment plants and cleaning (washout) of pipelines by municipalities as well as sometimes water extraction for emergent fire-fighting, but some are not recurring consumption. This consumption should be treated at least as "Unbilled Metered Consumption" by installing meter and reading.

Unbilled unmetered consumption=
Unmetered unbilled water used for fire-fighting, mains flushing, parks, building, etc.
+ Unmetered unbilled consumption in excess of deemed or free basic water allocation.

Point!
*Other than these cases, **excess water use by unmetered (direct-line, flat-rate) customers** may be categorized here and should be metered.*

c. Unauthorized Consumption

As a part of "**Commercial (apparent) Losses**", this is caused by **illegal connections or tampering** in water reticulation network, for example, bypass connections by customers to avoid meter being read as well as direct connections by non-registered customers.
If customers of unmetered, prepaid meter and AMR meter are not monitored physically, this may lead to illegal connections or tampering.

d. Customer Metering Inaccuracies and Data Handling Errors

As a part of "**Commercial (apparent) Losses**", these are caused by malfunctioning, deteriorating (overage) and poor-quality of all types of meters.
Data handling errors may arise in the manual process such as meter reading and writing in memo paper in the field, data capturing in the office to billing system.

%Commercial Losses=% Unauthorised Connections + %Meter Error + % Data Transfer Error

Volume commercial losses=Water losses x % Commercial losses

e. Leakage on Transmission and/or Distribution Mains

As a part of "**Physical (Real) Losses**", leakage on transmission and/or distribution mains are categorized here.

f. Leakage and Overflows at Utility's Storage Tanks

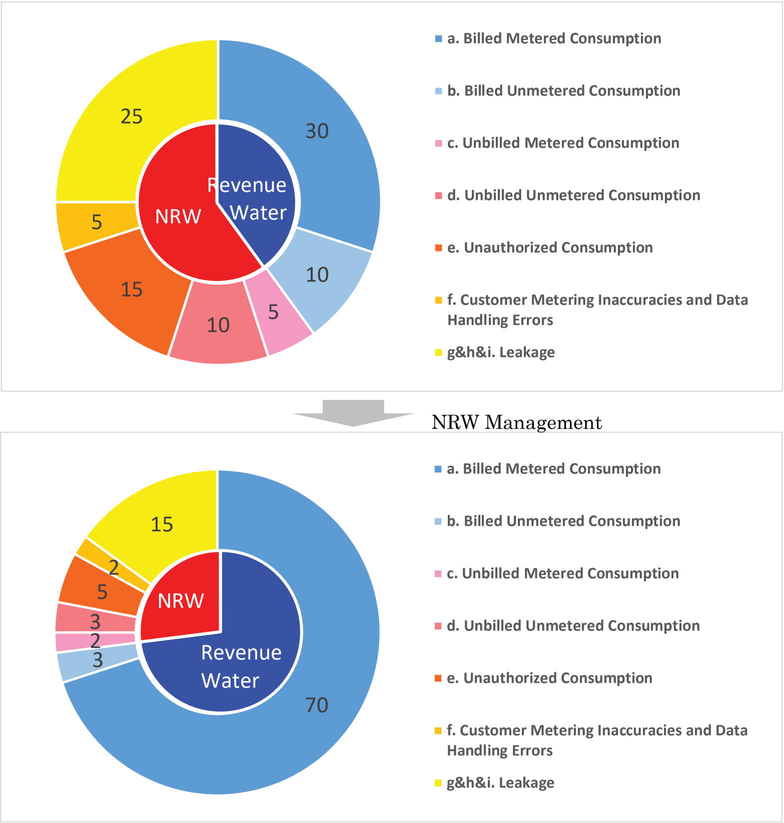
As a part of "**Physical (Real) Losses**", leakage and overflow from clear water tanks of water treatment plants and distribution reservoirs are categorized here.

g. Leakage on Service Connections up to Point of Customer Use

As a part of "**Physical (Real) Losses**", leakage along service connections (service pipes from branches to customer meters) is categorized here.

Point!
South African municipalities modify components as needed. For example, clarify the treatment of "Free Basic Water" and "Excessive water usage by unmetered customers."

Figure 2-6 shows changes of NRW volume by NRW management.



Source: JICA Expert Team

Figure 2-6 Change in NRW Volume by NRW Management (Example)

3. RETICULATION FACILITIES (PIPE & APPURTENANCE)

Outcomes in this Chapter

2-1 Understand reticulation system and its design. *By configuration with layout, gravity and 2-2 pumping up systems.

2-3 Understand concept of zone system and DMA.

2-4 Understand how to isolate the system (water pressure, valve isolation).

2-5 Understand roles and function of appurtenances by cut models and practices.

** Water hammer, GIS/IMQS, hydraulic modelling?*
** Importance of accurate pipe location and as-built drawings*
** Sectoriization and sub-sectorization*
** Lack of quality control*

3.1. Reticulation system

Point!

Flow structure type is a useful information for isolation of zone or other separation of the system.

3.1.1. Water flow structure

Reticulation system is divided into two types, gravity type and pump-pressure type. It depends on the topography and ground elevation relationship between the distribution facility and the distribution area. Water distribution facilities need to be able to maintain water quality and supply at an appropriate water pressure through easy maintenance.

In addition, when developing a water distribution facilities, it is necessary to minimize the impact on consumers by providing not only stable water supply during normal times, but also to backup system in the event of an accident and proper water supply during drought.

(1) Piping system

There are three types of distribution pipe system, Branch piping, Annular piping, and Network piping. When establishing a water distribution control area, consider the topography, ground, water supply area, actual demand, and economic efficiency.

■ **Branch piping**

Advantage: Pipe installation cost.

Disadvantage: In case of an unexpected situation, the water cutoff area will be larger.

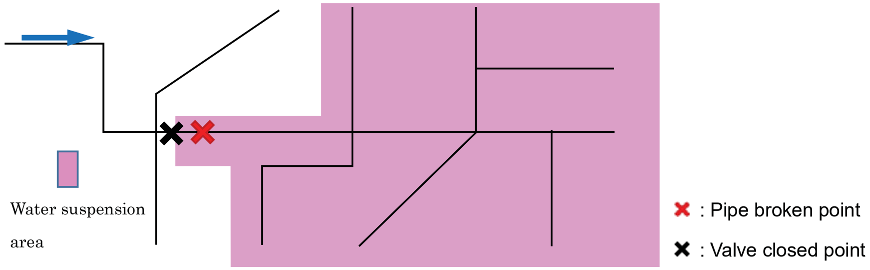


Figure 2-1 Branch Piping

■ **Annular piping**

Advantage: Smaller water cut-off area than branch piping.

Disadvantage: Higher pipe installation cost.

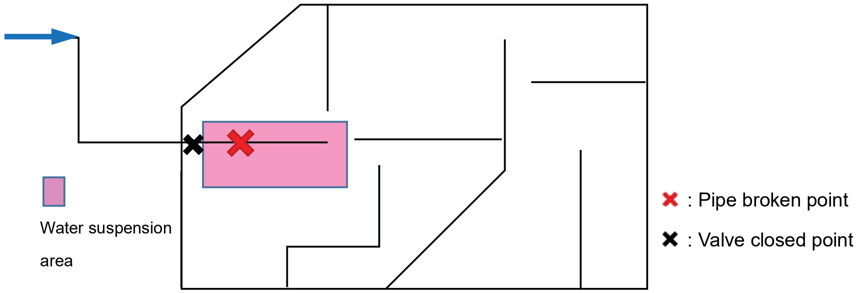


Figure 3-2 Annular piping

■ **Network piping**

Advantage: Minimum cut off area in equal pressure.

Disadvantage: Higher pipe installation cost

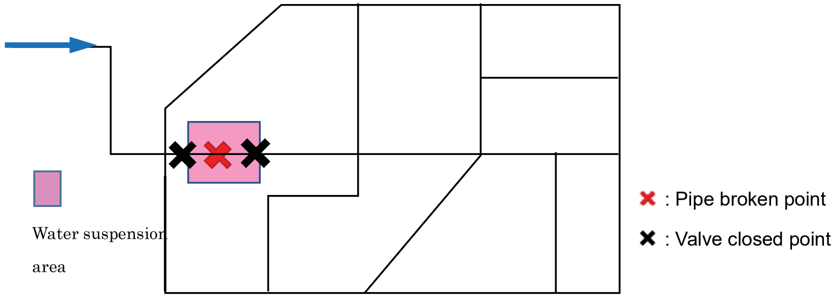


Figure 3-3 Network Piping

3.1.2. Reticulation management area

The typical system is described below.

(1) Large-sized Management (Zone System)

■ **Zone System**

Each distribution zone consists of one distribution reservoir and several pump stations, and the water supply area is divided into a natural flow system area (low area) and a pump system area (high area). Furthermore, by connecting the water distribution zones with a water pipe with a large diameter, water can be exchanged from adjacent water distribution zones.

Zone system is managed in accordance with the following principles for instance:

- There is one distribution reservoir in each zone.
- There are some pumping stations in the zone.

- There are areas of natural gravity and pressurized pimping zones.
- There are pipelines to connect zones in order to use water among the zones.

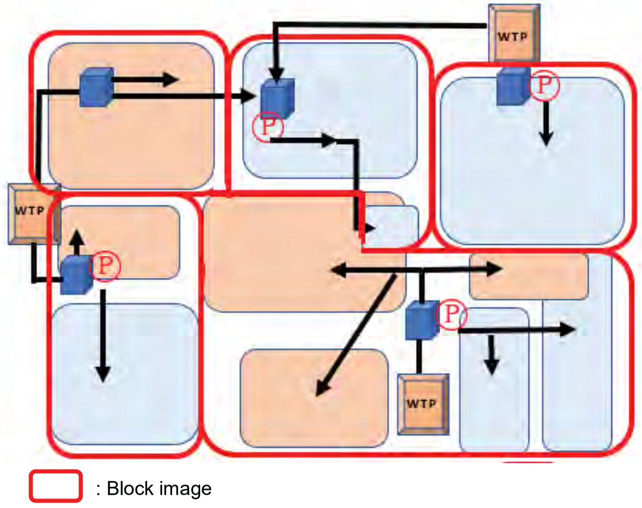


Figure 3-4 Zone System

■ **Benefits of the zone system**

- Compare the amount of water distributed and the amount of water used.
- Repair leaks promptly due to easier control.
- Manage the water pressure easily.
- Easier to resume normal service.
- Rapid recovery after disaster.
- Efficient water distribution control in drought.
- Easier control of turbid water

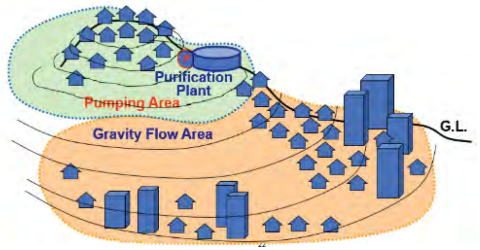
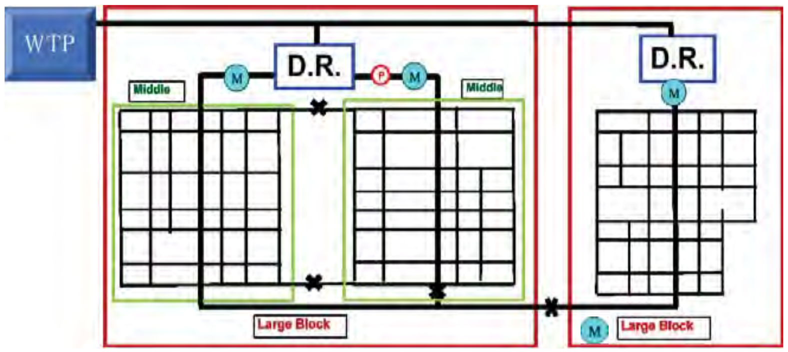


Figure 2-5 Image of separated supply area by zone



Source: Project Team

Figure 3-6 Connection Image of Blocks

(2) Monitoring points

Monitoring water such as flow rate, pressure and residual chlorine is important for sustainable water supply. Typical measuring points are, inlet point, highest and the lowest point. Monitoring data is used to control water supply management.

Point!
Select suitable size and location. If not, affect to the reticulation system analysis.
Install fittings properly. If not, affect to NRW management.

3.2. Reticulation Facilities

3.2.1. Reticulation Pipe

Reticulation facilities are reservoirs, pipes, pumps and other fittings such as valves, fire hydrants.

(1) Types of Pipe

There are various pipe materials, Cast iron, Ductile iron, Steel, High density polyethylene (HDPE), Glass reinforced plastic (GRP) are common materials used in distribution system. Pipe materials and joint affects planning, maintenance, operation and repair. Therefore, the material and pipe diameter should be selected in consideration with water demand, soil corrosiveness, and potential for stray currents, and distance to fuel storage.

Table 3-1 Types of pipe material

Type of Pipe	Characteristic	Remarks
Cast iron (CI)	Susceptibility to both internal and external corrosion.	Commonly used up to the middle of the 20th century.
Ductile iron (DI)	Greater strength, ductility and impact resistance. However it is subject to both internal and external corrosion.	A type of cast iron where the graphite particles in the iron
Steel (ST)	Steel is subject to both internal and external corrosion.	
High density polyethylene (HDPE)	Greater strength and can handle higher temperatures, tough	Welding used to join HDPE requires a high level of workmanship
Polyvinyl chloride (PVC)	High harness and strength, and resistant to corrosion	PVC pipes should not be exposed to direct sunlight
Glass reinforced plastic (GRP)	Highly resistant to corrosion and is sometimes used as a pipe material for large diameter pipes.	
Asbestos cement AC)	Significant cost and handling advantages over iron before the arrival of plastics. Material is brittle, tending to crack under external loads and is difficult to repair	Popular pipe material from the 1970s to the 90s

Source: WRC TT600/14, "Introduction to Operation and Maintenance of Water Distribution System"

Figure 3-7 DI and SP

Figure 3-8 PVC and Coiled/Installed HDPE

The pipe diameter should be sufficient to meet the demand and water pressure (at least 24m and 20m in South Africa). The pipe diameter can be calculated in the distribution analysis software by entering the provisional diameter, pipe length, C-value (depending on pipe material), altitude (height difference), and consumption. At that point, future water demand should be considered.

■ **AC pipe (Asbestos Cement)**

Initially, AC pipes were said to have higher pressure resistance, rust resistance, and chemical resistance than the cast iron pipes made of gray cast iron, which were the mainstream at the time of World War. And AC pipes were used as an alternative to "iron pipes" because they were cheaper. Although popular and used until the 1990s, the potential health risks of asbestos and the introduction of plastic pipes made asbestos cement obsolete as a new pipe. AC pipes need to be replaced to prevent health problems and water leakage.

Figure 2-9 AC

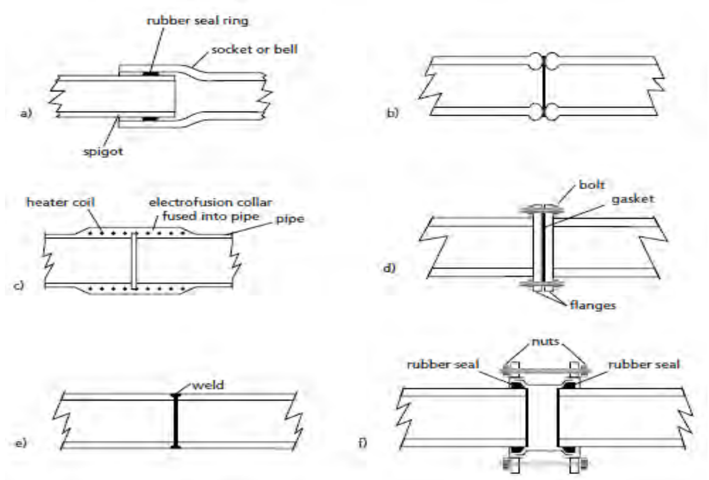
3.2.2. Pipe Joint

Point!
Type of pipe joints are useful information for leak repair. Select a pipe and a joint that has less leakage occurrence.

The type of joint used is mostly determined by the pipe material used, but also by other requirements such as the ability to handle tension forces, toleration of small deflections and ease of use in the field. The common joints are listed below and illustrated in Figure 3-10.

- In spigot and socket (or bell and spigot) joint, one end of a pipe section (the bell) is enlarged and provided with a rubber seal, while the other end (the spigot) is left unchanged.
- Butt fusion joint is used to connect HDPE pipes: the ends of both pipes are heated and then pressed together at a prescribed pressure to create a bond.
- Electrofusion is an alternative joint method for HDPE pipes that employs special collars with built-in heating coils.
- Flanged joints consist of both pipes ending in flanges with holes allowing them to be bolted together.
- Welding for the steel pipe. Large diameter steel pipes may be joined by welding them together in the field. Quality control is critical to ensure that welds are done properly.
- Flexible mechanical couplings that compress sealing rings when their bolts are tightened. These couplings can be used to join the same or different types of pipe with plain ends.

a) Spigot and socket; b) butt welded for PE; c) electrofusion for PE; d) flanged for metal pipe; e) welded for steel pipe; f) mechanical coupling



Source: WRC TT 600/14 [Introduction to Operation and Maintenance of Water Distribution Systems EDITION 1] JE VAN ZYL

Figure 3-10 Several Types of Joints

Practice

Pipe connection of PVC and HDPE

3.2.3. Reservoir and water tower

The function of the storage reservoir is to provide equilibrium storage between constant inflow and fluctuating outflow. Water meters should be installed on both inlet and outlet pipes at the reservoir. Reservoirs and water towers have different functions.

- Reservoirs are constructed above ground and provide most of the required storage to the supply area. The height of the reservoirs should be higher than the supply area to provide the required pressure.
- Water towers are used to provide additional pressure to users above the reservoir. Due to the high cost of providing elevated storage, water towers and the pumps are sized to meet hours of peak demand.

Figure 2-11 Tower

Figure 2-12 Reservoir

3.2.4. Appurtenance

(1) Pump

Pump energy consumption often makes up the majority of the running cost of water, so it is important to operate the pump as efficiently as possible. Therefore, it is desirable to plan a water supply system with a few pump facilities. Also, regarding the location of the pump, it is necessary to decide whether to install it in the reservoir or in the middle of piping considering the cost after operation.

Pumps should be provided with flow meters on their delivery sides, and pressure gauges on both sides to allow their pump curves to be measured.

Figure 3-13 Pump Station and Pump

(2) Fittings

Water distribution system requires a large range of fittings and accessories for the purpose of operation and maintenance.

■ **Valves**

There are two types of valves used in distribution system, a gate valve and a butterfly valves. A gate valve is used for small diameter pipe and a butterfly valve is for large diameter pipe commonly. Valves should be installed, at branching point, intersection point, front and rear of the bridge, bulk meter, discharge pipe, and regular interval of one or two kilo-metres on transmission lines.

Figure 2-14 Butterfly valve

Figure 3-15 Gate valve, Cut model sketch

■ **Air valve**

Air valves are installed on pipelines to control the flow of air into and out of the system. These valves are installed at high points in the pipe profile, where pipe bends downwards, pipe-bridge and same place of the structure of pipe, etc.

Figure 3-16 Air Valve Double, Small Single, Cut Model

■ **Pressure reducing valve (PRV)**

PRV ensures that the pressure on their downstream sides do not exceed a given value and should be installed the point where there is a need in distribution system.

Figure 3-17 PRV

Figure 3-18 Installed PRV

● **Pressure management**

Pressure control is one of the most important measures reducing water losses in the water supply system. Leak sometimes occurs due to excessive pressure, while it must be acknowledged that pressure control is not the answer in every case, still it is often one of the most cost-effective countermeasures to reduce leakage.

At higher pressures, there is a risk of more leak volume, more new leaks, shorter pipe life, damage to customer equipment such as geysers and washing machines.

Pressure control can bring savings, but the key to success is to manage pressure zones rather than the associated high-tech "add-ons" or valves. It must always be remembered that pressure control does not eliminate leaks or repair any existing leaks. All leaks in the network that occurs before introduction of pressure control will remain as leaks after the pressure control has been commissioned. The benefits of pressure control are mainly through the fact that the leak water will be reduced. Therefore, it is essential to control water pressure by introducing the distribution system such as zone system.

● **Pressure control method**

When planning a distribution pipe system, water pressure is properly calculated. However, depending on topographical conditions, it may be inevitable to include a high and low water pressure area. To tackle these cases pressure reducing valves are adopted for the case of high pressure, and pumps are adopted for the low pressure.

■ **Pressure reducing valve (PRV)**

The PRVs have four pressure control methods:

1	Fixed-outlet pressure control is done using a standard PRV that limits the pressure on its outlet to a certain maximum value. This is a cost-effective and simple solution, but it does not have the ability to modulate pressure in response to the demand in the system, and thus pressures will still be higher at night than during the day.
2	Time-modulated pressure control is done using a PRV similar to that of fixed-outlet control, but varies the pressure setting over a 24-hour period. Thus, it is able to reduce pressures more during the night when demand is at a minimum. Time-modulated control is able to reduce leakage more than fixed-outlet control and is still relatively simple to implement.
3	Flow-modulated pressure control is done by adjusting the PRV setting based on the flow rate into the PMZ and can thus adjust system pressure to the actual demand. It is significantly more sophisticated than time-modulated control but has the potential to reduce losses further. A major advantage of flow-modulated control is that the system is able to automatically respond when the fire service requires high fire flows.
4	Closed-loop pressure control is done by adjusting the PRV setting based on the pressure at a critical point in the PMZ, and thus has the best potential for maximizing the benefits of pressure management. However, these systems are also the most sophisticated and expensive.

Source: WRC TT 600/14 [Introduction to Operation and Maintenance of Water Distribution Systems EDITION 1] JE VAN ZYL

All the advantages and disadvantages of the different pressure controllers should be considered. The most sophisticated system is sometimes not the most suitable one. A simpler system sometimes provides a good result.

■ **PRV installation**

A selection of potential meter and PRV layouts are shown bellows;

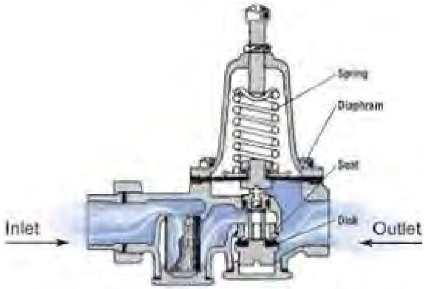
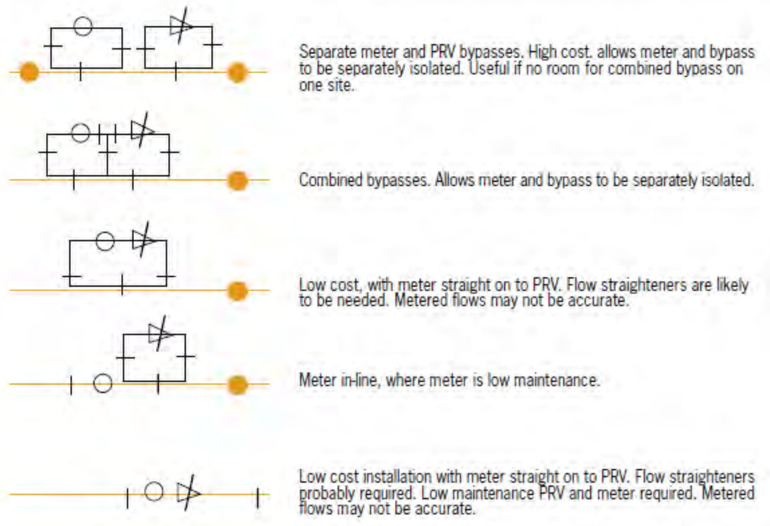


Figure 2-20 Cut model drawing of PRV

Figure 2-19 PRV



Source: WRC TT 600/14 [Introduction to Operation and Maintenance of Water Distribution Systems EDITION 1] JE VAN ZYL

Figure 3-21 A selection of meter and PRV installation layouts

■ **Fire hydrant**

Fire hydrants incorporate a valve and a standard fitting for connecting a fire hose. Fire hydrants should be installed at 120, 180 and 240m distances respectively in high, medium and low fire risk areas in networks on 75 mm diameter and larger pipes and end of pipe, etc. Hydrants are often used for operation and maintenance functions in water distribution systems, such as flushing pipes, releasing air and logging pressures.

Figure 2-22 Fire Hydrant

■ **Scour valve (Discharge pipe)**

This type of valves should be installed at the regular interval, dead-end and lowest place on the certain pipeline with appropriate drain facility such as river, rain discharge diches, and large sewage pipes, etc.

[PRACTICES AT THE Training Yard]

4. WATER METERING

Outcomes in this Chapter

3-1 Understand importance and role of flow measurement.
3-2 Understand features in flow-meters (installation, accuracy, maintenance, advantage and disadvantage, comparison).
3-3 Understand how to select flow-meter, comparing purpose/cost.
3-3 Understand how to install and read bulk/customer flow meters
3-4 Understand accuracy of flow measurement.
3-5 Understand the measured data is utilized in not only billing but analysis of water supply services including NRW management.

4.1. Purpose of Water Metering

Water metering have many direct and indirect benefits, following is four examples:

- equity
- water efficiency and loss
- economic benefits, and
- system management

(1) Equity

Comprehensive water metering provides an equitable basis for charging consumers based on the amount of water that they consume. This allows consumers to be responsible for their water usage and influence the amount paid for this service. It also provides fair mutual recognition and allows indigent consumers to receive a basic amount of water for free.

(2) Water efficiency and loss

Metering shows the value of water to consumers and creates an incentive to use water more efficiently. In fact, installing a water meter has been shown to reduce water consumption.

Water meters manage water demand and are essential for consumers to manage their water use, especially when water is scarce.

(3) Economic benefits

Measured consumption forms the basis of most water accounts and therefore has a direct impact on municipal income. A water meter is a cash register for the municipalities. Water meters have a positive impact on local government finances, including accurate measurement of municipal water purchases, reduction of water loss, and removal of illegal connections.

(4) System management

Consumption data is important to simulate water distribution systems, including pressure management, and expansion planning.

Source: [Water Meter Training Manual], [Introduction to Integrated Water Meter Management]

4.2. Types of meters

Customer meters are subject to laws and standards including SANS 1529. A water meter is like a local cash register for measuring and billing the water supplied to your customers. In South Africa, there is

a legal imperatives on municipalities to meter consumers and manage water losses in compliance with legislation and standards. This allows local governments to understand the correct NRW ratio, identify consumers who are over-consumed due to internal leaks, and take corrective action.

Figure 4-1 shows different types of meters.

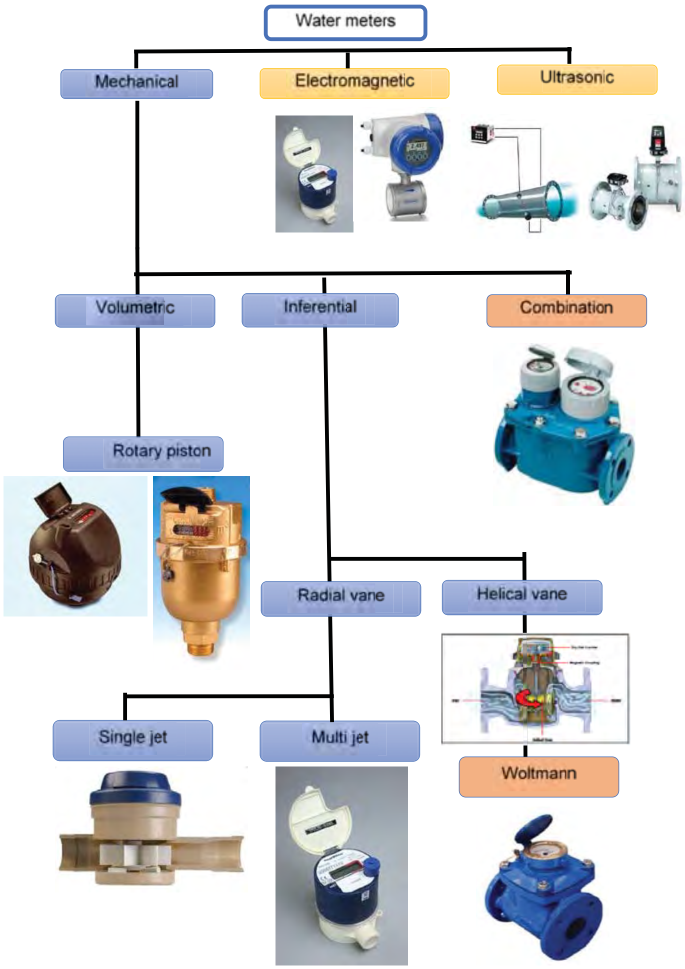


Figure 4-1 Types of Meters

(1) Velocity meter and Volumetric meter

There are two types of meters mainly used in South Africa. One is to measure the flow velocity, called inferential or velocity meter, and the other is to measure the volume, called volumetric or positive displacement meter.

These meters are divided into two categories, dry dials and wet dials, depending on whether a part of the dial counter is dry or wet. All meters have arrows on the body of the meter that indicate the direction of flow.

Table 4-1 Detail of Customer meter category

Flow			Mechanism	Dry dial	Wet dial	Install
Velocity			Sigle jet	Available	Available	Horizontal
			Multi jet	Available	Available	Horizontal
Volumetric	Rotary piston	Available	Available	Vertical and horizontal (South Africa only vertical approved)		

Figure 3-2 Volumetric (Displacement) Meter

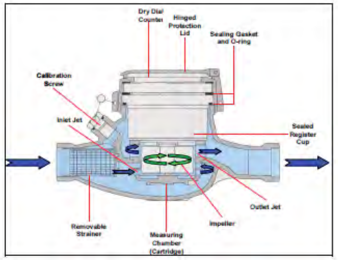


Figure 3-3 Inferential (Velocity) Meter

- **Multi-jet and single jet velocity meters**

Figure 3-4 Kent Optima 2002 Wet Dial Multi-Jet Meter

Figure 3-5 Dry (left) and Wet (right) Dial Multi-Jet Meter

As the water flows through the meter, the lower chamber inlet forms jet water that is directed at the fan wheel blades.

Single jet meters have only one inlet, while multi-jet meters have multiple inlets. All single and multi-jet meters must be installed in a horizontal position for accuracy. These meters are clearly marked with a capital H, This represents Horizontal.

- The wet dial type meter is a direct driving type, and the shaft of the fan wheel directly drives the gear of the counter.
- The Dry dial meter features full magnetic protection to prevent magnetic tampering. In order for this type of meter to be approved for trade use, it must pass the magnetic tampering test specified in the Trade Metrology Act.

Figure 3-6 Wet Dial Volumetric Rotary Piston

■ **Volumetric rotary piston meter (Positive displacement)**

Volumetric meters operate on the rotary piston principal. This type of meter can be installed in horizontal, vertical or inclined pipelines without affecting accuracy. The meter must be approved for vertical installation by the South Africa Bureau of Standard (SABS)). The arrow on the meter body indicates the direction of flow. The rotation of the piston is transferred to the dry dial counter via a magnetic coupling. The dry dial meter features full magnetic protection to prevent magnetic tampering.

4.2.1. Mechanical flow meter

> ***Point!***
> *Choose mechanical (turbine) meter in consideration with start flow, transient flow and maximum flow at the installation point. Mechanical meter is a basic meter for permanent zonal monitoring. Combination type has higher accuracy in low flow rate due to wider measurement range.*

(1) Woltmann WP Type Meter

The Woltmann WP type meter is a horizontal (parallel axis) meter designed to measure bulk flows of cold potable water. This speed-measuring type meter has relatively low head loss and has medium to high accuracy.

Figure 3-7 Kent Helix H4000 WP Meter

Principles of Operation of Woltmann WP Type Meter

- WP Meters inlets and outlets are directly in line with the pipeline with the axel of the helical vane and are parallel to the flow.
- Helical vane rotation is transferred to a counter reading (m^3) on a direct-reading dry deal seal by appropriate speed reducer and magnetic drive.

■ **Application of Woltmann WP Type Meter**

- Consumers for custody transfer purposes
- Zone monitoring
- Consumers with medium to high flow rate demand patterns

- Monitoring output flows from reservoirs or pump stations where there are relatively constant medium to high flow rates

Source: [Water Meter Training Manual],Text and Figures.

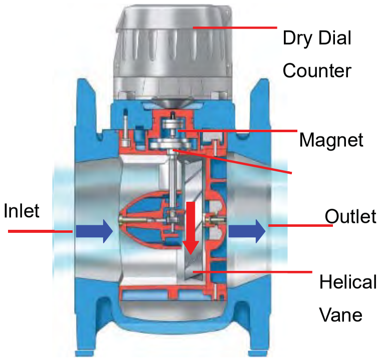


Figure 3-8 Principle of WP Type Meter

(2) Helical Vane WS Type Meter

The WS Meter is designed to accurately measure lower flow rates than the same size WP Meter, but it does not have the high measurement capability of the WP meter. This is velocity type meters.

■ **Principles of Operation of Helical Vane WS Type Meter**

WS Type Meters differs from the WP Type Meters in that the axel of the rotor is perpendicular to the pipe axis. The water flows through the meter in an “S” pattern rotating the rotor in a vertical plane. Rotation of the rotor is transferred to a direct reading dry dial in m³ by a suitable speed reducer and magnetic drive.

Application of Helical Vane WS Type Meter

- Consumers for custody transfer
- In applications where there are low night flows
- In areas where accurate zone metering is required

Figure 3-9 Sensus Cosmos WSD Meter

Source: [Water Meter Training Manual], Text and Figures.

(3) Combination Meter

The combination meter consists of two meters, a main meter (WP bulk meter) and a bypass meter (volumetric rotary piston type or multi-jet type customer meter). The combination meter has a wider measuring range than any water meter. The meter reader should read both water meters and sum the readings.

Figure 3-10　Kent C4000 in Line Combination Meter

Figure 3-11　Kent C3000 Bypass Combination Meter

■ **Principles of Combination Meter**

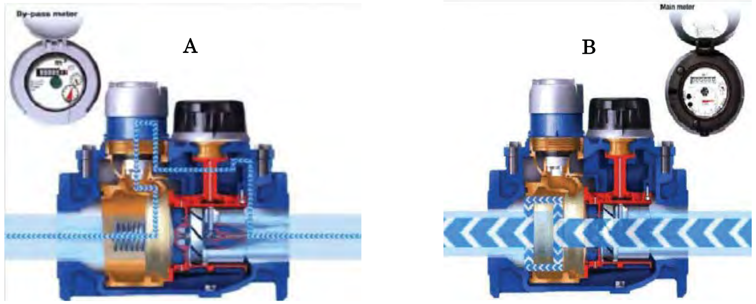


Figure 3-12　Principles of Combination Meter

The WP bulk meter measures medium to high flow, and the customer meter measures low flow. At low flow rates, the control valve closes to divert water flow through a domestic bypass meter with accurate low flow measuring capability (A). As the flow rate increases, the control valve opens at a certain flow rate as a result of differential pressure, allowing water to pass through the bulk meter to measure high flow rates (B).

■ **Application of Combination Meter**

- For the customer who has variations in their flow demand patterns e.g. factories, old age homes, hospitals etc.
- For the customer who uses for both domestic and firefighting

Source: [Water Meter Training Manual], Text and Figures.

(4) Single Jet Meter

The meter operates within the Class C measurement specifications in the horizontal position and Class B specifications in the vertical position. This is a velocity meter.

Figure 3-13　Sensus Meijet Single Jet Meter

■ **Principles of Operation of Single Jet Meter**

Single Jet Meter consists of one inlet jet/port, working chamber with impeller, and outlet port on the opposite side. Water flows into the jet port, collides with the meter's fan wheel, and the meter rotates. The rotation of the fan wheel is transmitted to the counter reading (m^3) of the direct-reading dry dial seal via a suitable reducer and magnetic drive.

■ **Application of Single Jet Meter**

- for custody transfer
- for low night flow
- for accurate zone metering
- Please note that the measuring range of a single jet is not as wide as a combination meter

Source: [Water Meter Training Manual], Text and Figures.

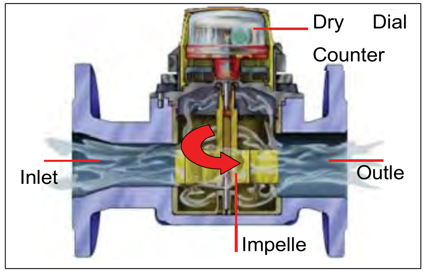


Figure 3-14 Principle of Single Jet Meter

4.2.2. Electromagnetic flow meter

Point!

Purpose and cost are important points for electro-magnetic flow-meter.

Electromagnetic or magflow water meters use an electromagnetic principle called Faraday induction to measure the velocity of water as it passes through.

The advantage of the electromagnetic flowmeter is that it does not impede the flow rate and there is no pressure loss. Since there are no moving parts, accurate measurements can be made without being affected by fluctuations in fluid density, pressure, viscosity, or temperature.

Figure 3-15　Krohne Optiflux 5300 Electromagnetic Flow Meter

■ **Principles of Operation of Electromagnetic Flow Meter**

The operation of electromagnetic flow meter is based on Faraday's Law. This shows that the voltage induced in a conductor as travels through a

magnetic field at right angle is proportional to the velocity of that conductor.

■ **Faraday's Formula:**

E is proportional to V x B x D where:

E = the voltage generated in a conductor

V = the velocity of the conductor, B = the magnetic field strength, D = the length of the conductor

Fluid being measured must be electrically conductive to apply faraday principle to flow measurement with a magnetic flow meter. Faraday's law shows that the signal voltage (E) depends on the average liquid velocity (V), magnetic field strength (B) and conductor length (D).

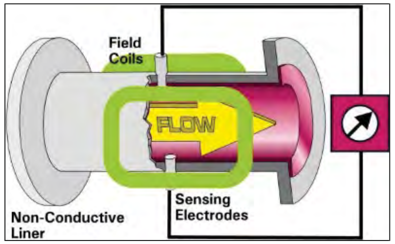
In case of a wafer type electromagnetic flowmeter, a magnetic field is generated over the entire cross section of the pipe. In an insertion type flowmeter, the magnetic field radiates outward from the inserted probe.

■ **Application of Electromagnetic Flow Meters**

- For a very large consumers for custody transfer e.g. breweries, soft drink manufacturers, etc.
- For network monitoring where there is a wide variation in flow rates.
- For an accurate forward and reverse flow monitoring needs to take place
- For a raw water measurement applications

1) Pros

Higher accuracy, Unaffected by liquid temperature, pressure, density, viscosity and corrosive liquid. Wider range with rapid response. No moving part, so no head loss and higher reliability. Both-way, forward and reverse, measurement possible. Handle slurry by selection of lining.



2) Cons

Cost compared with the other types. For Larger Dia., the cost is higher. Unsuitable for low inductance liquid. Accuracy affected by inductance changes, and electrodes stained with incrustation. Bypass pipe needed in case flow cannot be cut off.

3) Required length of strait pipe

Upstream 5D in case pump and valves are upstream

Upstream 10D see JIS B7554 for more details

4.2.3. Ultrasonic flow meter

Point!

Easy installation for tentative measurement by ultrasonic flow meter. Ultrasonic flowmeter needs longer straight section of pipeline compare to electromagnetic or mechanical flowmeter.

The ultrasonic flow meter measures the traveling times (transit time models) or the frequency shifts (Doppler models) of ultrasonic waves in a pre-configured acoustic field that the flow is passing through.

They can be categorized into two types based on the installation method: clamped-on and inline.

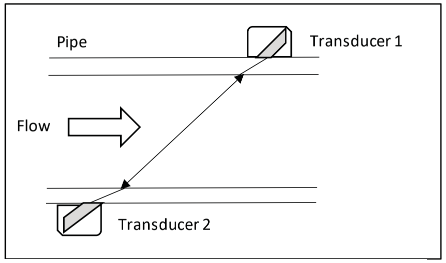


Figure 3-16 Ultrasonic Flow-meter

The clamped-on type is attached outside of the pipe and there are no wetted parts. It can easily be installed on existing piping systems without worrying about corrosion problems. Portability of the flow meter is higher in clamped-on designs.

The inline type, on the other hand, requires fitting flanges for installation. However, it usually offers better accuracy and its calibration procedures are more straightforward.

(1) Principles of Operation of Ultrasonic Meter

There are two flow measurement methods that use ultrasonic energy. Transit time is based on the difference in sound arrival times and Doppler measures the frequency shift of the generated signal. Both measurement methods work by generating ultrasonic energy through a piezoelectric crystal embedded in two separate resin blocks called transducers. The transducer is attached to the outer wall of the pipe using a coupling compound (usually silicone-based grease) and a retention band (usually a strap) to transfer ultrasonic energy from the transducer through the wall of the pipe.

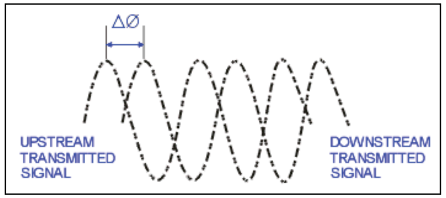


Figure 3-17 Time difference of signals

Transit time is used in clean water (low aerated/suspended) by measuring the difference in the arrival time of ultrasonic energy to travel between transducers.

The difference in time is directly proportional to the velocity of the moving water. Therefore, the higher the speed, the greater the conversion done by the digital signal processor of the flowmeter.

The volumetric flow rate is then calculated by multiplying the measured velocity by the effective internal area of the pipe.

Doppler is used with suspended/aerated water to measure the frequency shift of ultrasonic waves that reflect or bounce off particles and bubbles in a flow.

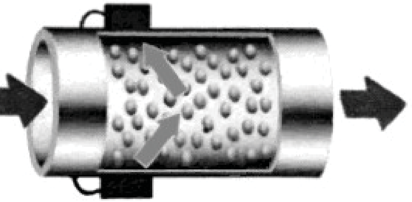


Figure 3-18 Doppler Application

One transducer produces the frequency and the other transducer receives it. When a sound wave bounces in a stream, it causes a frequency shift that depends on the velocity of the particles.

1) Pros

Measurable in inductive or non-inductive. No head loss due to no moving parts. Cost is not increase to pipe dia. Cheaper than electromagnetic flow meter for larger pipe dia.

2) Cons

Long straight section needed. Turbulences and bubbles in liquid affects accuracy. Thickness of pipe wall and lining should be known precisely.

3) Required length of straight pipe

Upstream 10D, Downstream 5D, in case pump and valves are upstream.

Upstream 30D Downstream 10D. See JEMIS 0321987 for more details.

4.3. Customer meter and Bulk meter

4.3.1. Customer meter

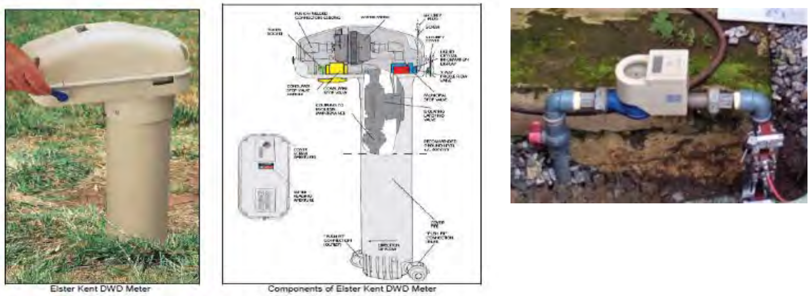
Meters are installed in homes and businesses, and the appropriate size is selected according to the application. If the flow meter is large, the minimum flow rate cannot be measured. Also, small water meters can cause damage and deterioration at maximum flow rates.

(1) Prepaid meter

The prepaid meter has the advantage that there are few errors in reading, processing, and billing, and that you can collect charges reliably.

■ Please note the following points:

- Advanced water meters have advantages and have advanced components that can break down and cause problems.
- The meter function only works if the meter is properly managed. Some African countries already use prepaid meters, but poor maintenance can result in poor performance.
- As for the accuracy of the meter, it is necessary to conduct a periodic accuracy check to maintain the required accuracy. Regular inspection and maintenance of these meter is more important than for conventional meters.
- A disadvantage is that consumers might be more inclined to tamper with or bypass the meter, because municipality staffs will not have the opportunity to see the device and will not know the condition of the meters.


Elster Kent DWD Meter　　Components of Elster Kent DWD Meter

Source: [Water Meter Training Manual], Text and Figures.

Figure 4-19 Prepaid Meters

Note: In South Africa, some reports warned that installation of hi-tech meters such as prepaid meters. The adoption of such meters must be guaranteed by commitment from customers and promise in advance that the community is willing to accept and pay for such a system. In many cases, the reason for withholding payments is related to other underlying problems, such as insufficient water supply and/or internal leakage. If these are the reasons for insufficient payment levels, the new smart metering system is useless and in fact only exacerbates the already dire situation. In these cases, the underlying supply issues need to be addressed before implementing a new metrology system.

(2) Automatic remote reading

Meter readings are automatically recorded by connecting a handheld device to a connection point on the meter. The meter reading is automatically transferred to the device. This allows for a high reading success rate and saves on labor costs since meter readers can read more meters in a day. However, special and more expensive meters need to be installed. Figure 4-20 shows an image of data collection by an automatic water meter.

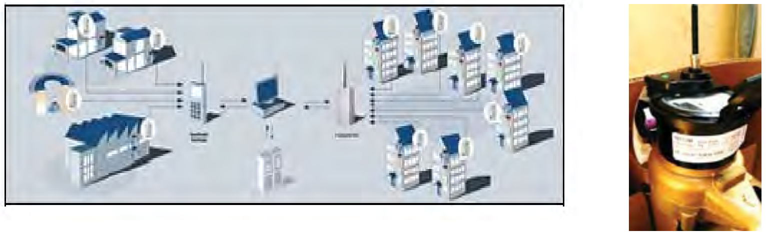
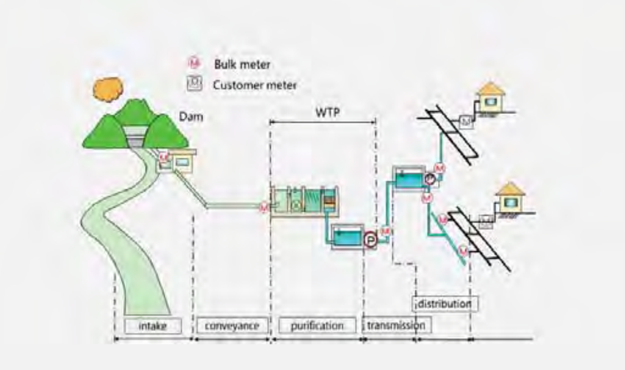


Figure 4-20 Image of data collection by AMR

> ***Point!***
> *Recently advanced technology equipped meters are developed. Adoption of these meters need careful consideration.*

4.3.2. Bulk meter

On the water supply system from water source to consumer, water meters record the quantities of water that in and out flow at many water supply facilities. Bulk meters measure large flow of water volume at the water source or an inlet point to DMA. The measured data at bulk meter is an essential information to manage the water supply system. One of the bulk meters, a district area meter that measures the amount of water entering a district metering area (DMA), is used to predict demand patterns, future demand, and leaks in an isolated area. Figure 4-21 shows an example of bulk meter installation location.



Source: Project team

Figure 4-21 Bulk meter installation location

The higher accuracy meter is recommended for measuring water exchanged with other water utilities. It measures large amounts of water and therefore has a big impact on price.

Following is recommended installation points:

- Outlet of treatment plant/Reservoir,
- Inlet of network and DMAs and
- Receiving point from bulk supplier such as Water Board

4.4. Accuracy of Water Meter

4.4.1. Definition of the terms

Knowing the definition of the terms will help you to choose a meter, as it will give you a better understanding of meter specifications.

- **Qmax – Maximum flow rate (Overload Flow Rate):**

The highest flow rate at which the meter is required to operate in a satisfactory manner for a short period without deteriorating.

- **Qp – Permanent flow rate:**

Permissible continuous load. Half the maximum flow rate (± 2% error).

- **Qt – Transitional flow rate:**

The flow rate at which the maximum permissible error of the water changes in value from ± 5% error to ± 2% error.

- **Qmin – Minimum flow rate:**

The lowest flow rate at which the meter is required to give indications within the maximum permissible error tolerance (± 5% error).

- **Starting flow rate:**

The flow rate at which the meter starts to measure without any known accuracy.

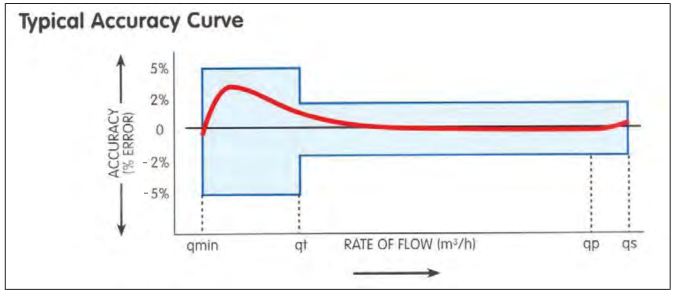
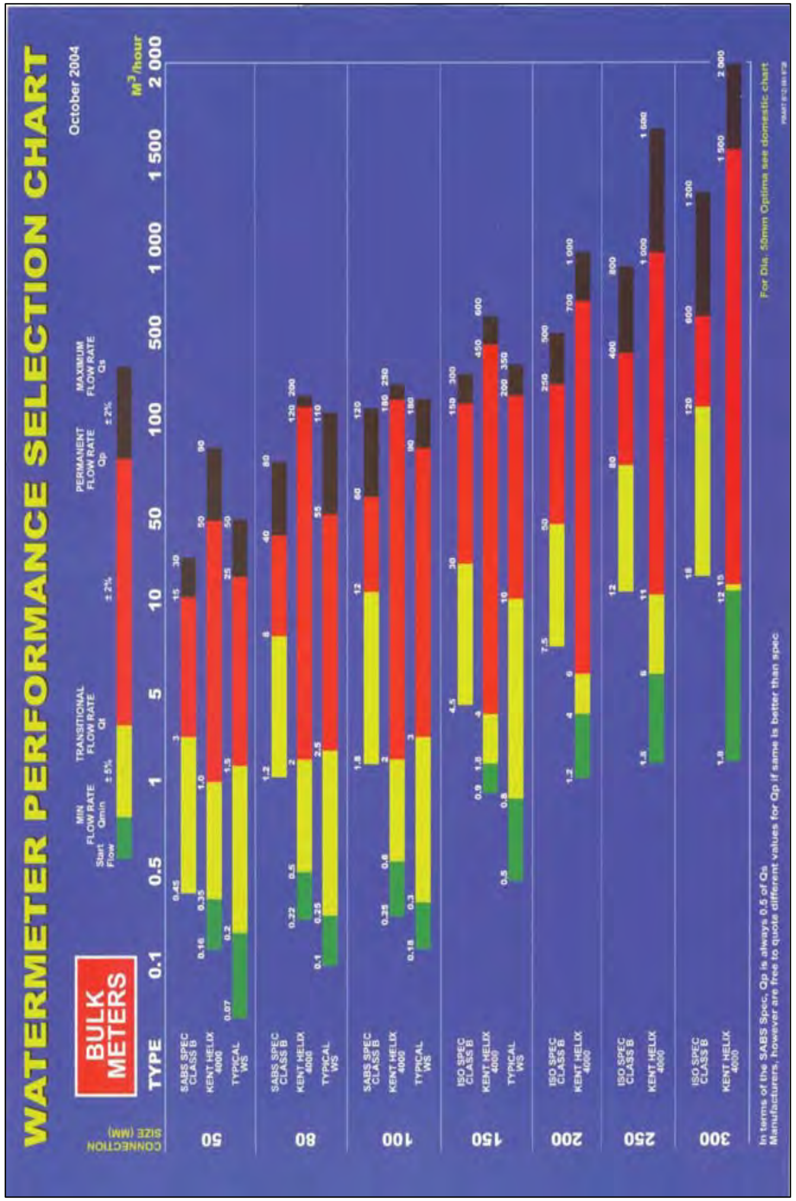


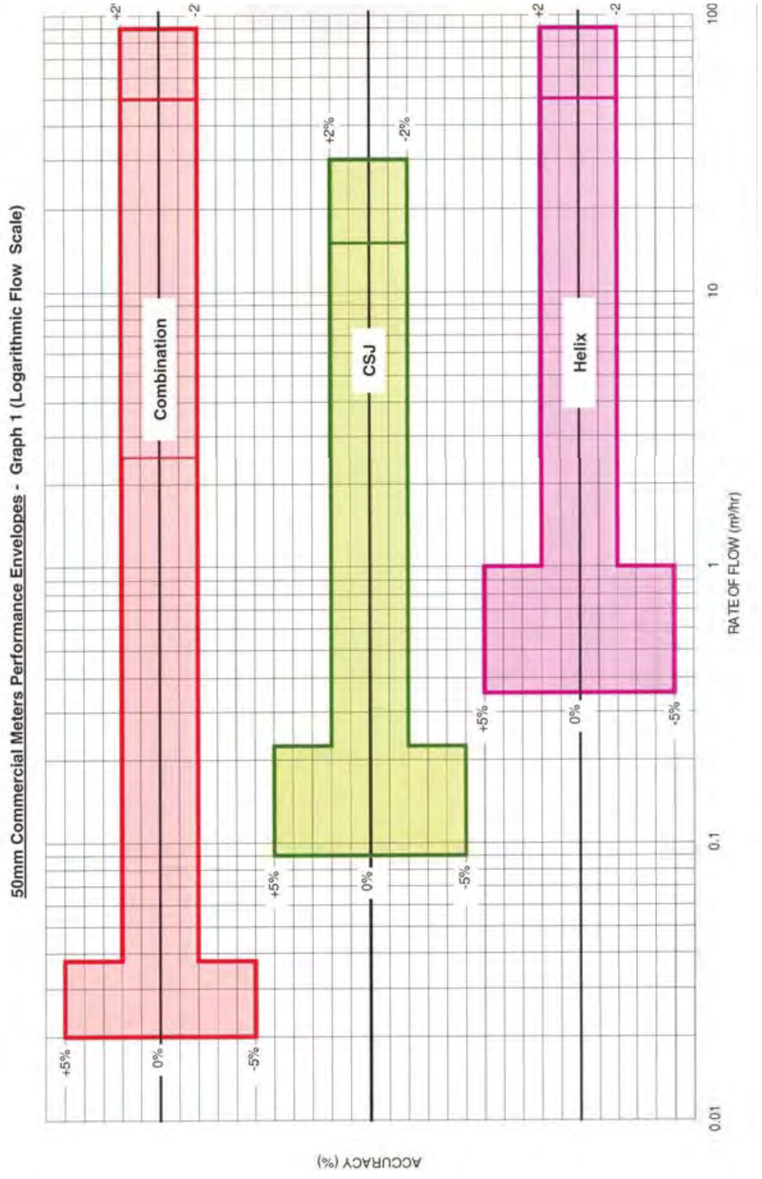
Figure 4-22 Typical Accuracy Curve

It should be noted that no water meter is 100% accurate. The above accuracy curve, shown in Figure 4-22 a T-Bar, and a ± 5% is allowed at Qmin and ± 2% at Qt.



Source: [Water Meter Training Manual],Text and Figures.

Figure 4-23 Bulk meter performance chart



Source: [Water Meter Training Manual],Text and Figures.

Figure 4-24 3 type of 50mm diameter bulk meters T-bar sheet

4.4.2. Classification of water meters by accuracy

Point!

Meter class and difference is the flow rate span from Qmin to Qt

Allowed class for customer meter is B, C, D

Meter lifespan is about 10 years

Meter classes are used to classify meters according to their accuracy performance. The conventional meter standards are being replaced in many countries by new standards that use a completely different approach to defining meter classes.

(1) Conventional Meter Classes

There were four Metrological accuracy classes of water meters in the Trade Metrology Act. Meter classes defined by SABS 1529 for permanent flow rates up to $10M^3$ are as follows:

Table 4-2 Meter Classification in SABS 1529

Class	Minimum Flow Rate (Qmin)	Transitinal Flow Rate(Qt)	
CLASS A	0.04 Qp	0.10 Qp	NOT legal for trade use.
CLASS B	0.02 Qp	0.08Qp	The minimum class legal for trade use
CLASS C	0.01Qp	0.015Qp	Legal for trade use
CLASS D	0.0075 Qp	0.0015Qp	Legal for trade use

The difference between the classes is at the point where they start measuring accurately. The higher the class the lower the starting point and also the lower the meter starts to measure within the ± 2% accuracy measuring range. Table 4-3 shows a 15mm meter's classes and flow rate.

Table 4-3 Classes and flow rates for a 15mm meter

CLASS	ℓ/h	(Qmin ± 5%) Minimum Flow Rate	(Qt ± 2%) Transitional Flow Rate	(Qp ± 2%) Permanent Flow Rate	(Qs ± 2%) Maximum Flow Rate
A	ℓ/h	60	150	1,500	3,000
B	ℓ/h	30	120	1,500	3,000
C	ℓ/h	15	22.5	1,500	3,000
D	ℓ/h	11.25	17.25	1,500	3,000

(2) New Meter Classes

New international standards such as OIML R495 follow a completely different approach to defining meter classes. They use the same definition for minimal, transient, permanent, and overloaded flows, but instead of using the symbols qmin, qt, qp, qs for these parameters respectively: The new standard uses the symbols Q1, Q2, Q3, Q4.

Permanent flow is specified first in any meter. The minimum flow rate is then determined by the ratio of permanent flow rate to minimum flow rate (Q3/Q1). This ratio defines the accuracy range of the meter and is often used with the letter R to describe the meter. For example, a meter with a Q3 to Q1 ratio of 160 is described as an R160 meter.

4.4.3. Legal requirements

Point!

Authorization of meter and how to check whether authorized or not.

A customer meter is like a cash register in a municipality because it measures the water supplied to different types of consumers. In most cases, these meter readings are used to charge the consumer for the amount of water consumed, so it is important to accurately record consumption.

Strict laws and standards, including SANS 1529, apply to consumer meters and must be adhered to. For example, class A meters cannot be used as consumer meters.

(1) Install approved meter in SANS 1529.

In order to install approved water meters, following should be aware:

- Customer water meters i.e. sizes 15mm, 20mm and 25mm must comply with the requirements of the South African National Standard (SANS) Specifications 1529-1 and must be approved in terms of section 18 of the Trade Metrology Act No. 77 of 1973 and Regulation 80 Part II.

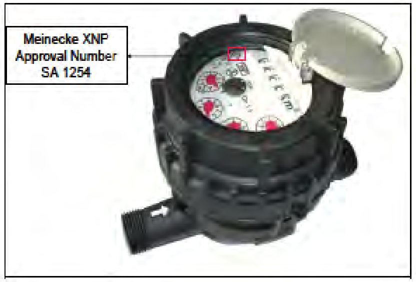
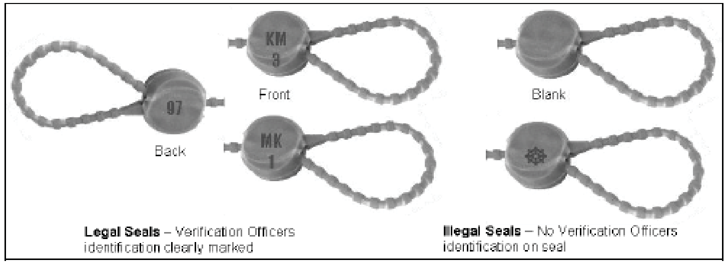


Figure 4-25 Water Meters with Approval Number

- The Trade Metrology Act and Regulations are Acts of parliament and as such overrules any municipal or local government approvals.
- SABS issues an authorization number for that particular product to all customers' water meters sold in South Africa, whether manufactured or wholly imported.
- The approval number is clearly engraved on the body or counter of every customer's water meter sold and installed in South Africa for the purpose of generating revenue.
- The accuracy need to be verified by a SANS accredited test facility, which meets the requirements of SANS 10378: 2003. within the borders of South Africa.
- Imported meters, which have been tested overseas, must be re-tested in South Africa in SANS accredited facility. It is illegal to install water meters which have overseas seals fitted, even if the seal has a readable alpha numeric code on it. This applies even if the meter itself has a South African approval number stamped on it.



Source: [Water Meter Training Manual], Text and Figures.

Figure 4-26 Lead Seals

- The products which have passed the test have a lead seal (shown in Figure 4-26) stamped by a verification officer in a SANS accredited test laboratory. There are meters fitted with blank lead seals without any marks of identification of officer.
- Opening the water meter and breaking the lead seal for repairs are prohibited.

4.5. Meter Reading

(1) Units of measuring water

- All water meters in South Africa are measured and read in cubic meter (m^3).
- $1m^3 = 1kl = 1000ℓ$

Point!

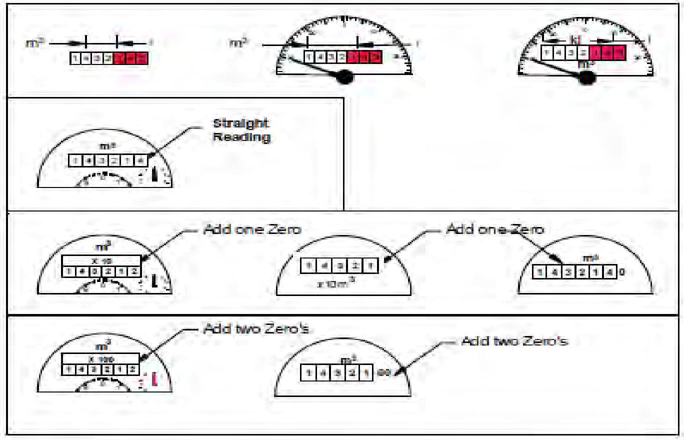
Meter readings data should be handled soundly.

(2) Types of counters

- Counters showing m3 with fractions (or litre and in some cases millilitre)
- Counters showing only m^3
- Counters that you must add a zero to the reading (or x10 counter)

Counters that you must add two zero's to the reading (or x100 counter)

See some samples shown in Figure 4-27.



Source: [Water Meter Training Manual], Text and Figures.

Figure 4-27 Types of Dial Counter

(3) Reading data and billing section

Followings should be in consideration;

- Responsible department, Outsourcing, and the billing system.
- Ensure that every consumer is billed for their month's consumption.
- Meters that are not used for billing purposes should also be read and managed as one of a consumption data. All the consumption data is essential for NRW management.

(4) Meter reading database

Meter readings are often processed by a billing system dedicated to financial functions. Financial databases are usually closed applications in the financial section. We recommend to design the financial database to meet the needs of other users, such as the technical department.

(5) Bulk customer

Most municipalities charge an "industrial water tariff", which is usually higher than the domestic tariffs for bulk customers. Large customers tend to use large amounts of water and pay full for their water, despite relatively high tariffs. Large consumer often accounts for a large portion of a municipal's total annual water income. It is important to monitor, bill, and control the water supplied to a small number of bulk customers.

Expected discussion

If the existing database and on-site situation was different, what should we do?

- -What are countermeasures to mitigate the problems.

4.5.1. Problems of meter

(1) Case of the problems

- Solids in the water block the strainer and prevent the meter from working properly.
- Leakage at meter connections.
- Vandalism on meters for scrap metal, sometimes 'retaliation' for water cut off.
- Damage to meters to due high velocity air flow when drained pipes are refilled by water.
- Deposition of lime or metal oxides inside the meter.
- Meters buried under soil and vegetation.

(2) Maintenance

- Cleaning of strainer
- Cleaning and repair of meter boxes
- Fixing leaks

-Meter testing at the laboratory test bench, the test methods used has to comply with metrology legislation and certification.

Source: WRC TT490/11, [Introduction to INTEGRATED WATER METER MANAGEMENT EDITION 1], Oct 2011

Mechanical water meters wear out with use. It is recommended that customer meters be replaced before ten (10) years, or bulk meters be checked and considered before five (5) years. Water meters therefore have a working lifespan of ± 10 years once installed. The meter does not stop "measuring", but its ability to measure low flow rates diminishes over time. Municipalities need to ensure meter accuracy for all customer meters and implement meter replacement plans to make accurate measurements.

(3) Meter inaccuracy

Point!

Meters should be accurate, but, meters have permissible range of error.

Meter inaccuracy has plus side (over registration) and minus side (under registration). If the water bill is higher than the actual usage, it will lose customer confidence.

Inaccuracies in meters tend to increase with age. It is necessary to check the accuracy of the meter by an error test.

1) Permissive error of meter used

There are permissible errors allowed for both new and repaired meters and for meters in use. The only meters which may be installed for trade use are meters which have passed the test for new meters. The maximum permissible error range for meter in use is larger than new meter, 8% in the lower flow zone and 3.5% in the higher flow zone. Table 4-4 and Table 4-5 shows allowable permissible error ratio for Class- B meter and Class-C meter.

Table 4-4 Permissive error for Class B

Test Description	Meter Size – Flow Rate in ℓ/hour			Permissible Error	
	Qp 1.5 (15mm) meter	Qp 2.5 (20mm) meter	Qp 3.5 (25mm) meter	New & Repaired	Meters in Use
Fast Test	2700 – 3000	4500 – 5000	6300 – 7000	2% over or 2% under	3.5% over or 3.5% under
Medium Test	120 – 132	200 – 220	280 – 308	2% over or 2% under	3.5% over or 3.5% under
Slow Test	30	50	70	5% over or 5% under	8% over or 8% under

Source: [Water Meter Training Manual]

Table 4-5 Permissive error for Class C

Test Description	Meter Size – Flow Rate in ℓ/hour			Permissible Error	
	Qp 1.5 (15mm) meter	Qp 2.5 (20mm) meter	Qp 3.5 (25mm) meter	New & Repaired	Meters in Use
Fast Test	2700 – 3000	4500 – 5000	6300 – 7000	2% over or 2% under	3.5% over or 3.5% under
Medium Test	22.5 – 24.75	37.5 – 41.25	52.5 – 57.75	2% over or 2% under	3.5% over or 3.5% under
Slow Test	15	25	35	5% over or 5% under	8% over or 8% under

Source: [Water Meter Training Manual]

2) Recommended meter test interval

Point!

- *Recommended meter replacement period by AWWA*
- *Meter replacement should be regularize in South Africa. For instance, the replacement period is 8 years in Japan by Law.*

■ **AWWA (The American Water works Association)**

- **Large-size Water Meters**

All large-size water meters need to be tested at regular intervals. The American Water Works Association (AWWA) recommends that meters between 25 and 100 mm are tested every five years, and meters of 100 mm and larger every year. Older meters and meters with the highest readings should be tested first as they are most likely to have deteriorated.

- **Small-size Water Meters**

AWWA recommends that small-size water meters are tested every 10 years. However, it doesn't make sense to try to test all customer and small meters due to the large numbers of meters in the system and small volumes involved. The recommended approach is select several meters to test.

4.5.2. Selection of water meters in SA

Any meter selected must be approved and comply with the SABS and the South African Trade Metrology's standards. A variety of water meters is on the market for different applications in the field. Therefore, you must know before installing a meter that the correct meter is selected for the consumer. If you select a meter that is too small, the meter may overrun and may not register correctly. If you choose a meter that is too large, the meter will not record the small amount of water used by the consumer.

(1) How to Select a Meter

All meters should be delivered with the specification which shows minimum, transitional, and maximum flow rate. The South African Trade Metrology Act requires consumer water meters of sizes 15 to 100 mm to comply with the requirement of SANS1529[4] and that municipalities must ensure that all meters under their control are kept in a verifiable condition at all times. This information should be studied before selecting or approval of any meter.

- First, you need to look what the meter is going to be used for.
  - For consumer meter connections placed into two categories: small up to 25mm) and large (> 25mm) connections.
  - Large connections are those that require meters larger than 25mm. Bulk consumers have the largest consumption in the distribution system.
  - Bulk transfer meters (custody transfer meters) are normally selected by the technical department (Engineering dept.). It is however necessary that you know how to select these meters to identify any possible faults on these meters. (E.g. high consumption, low consumption etc.)

(2) The specifications of the meters

The specifications of any type or size meter must be studied before selecting a meter. The following are important to know:

- Flow rates
- The type of meter
- The size of the meter
- Data required from meter (pulse outputs)
- If power supply is required

This information can help you to select the correct meter for any application in the field. (Source: [Water Meter Training Manual], Text.)

4.6. Installation of Meter

4.6.1. Installation of customer water meters

For the installation of any customer meters, it is important to follow the following basic steps.

- The meter should be installed in accordance with the direction of the arrow on the body.
- Before the meter is installed, the pipe work must be thoroughly flushed to remove any dirt inside. A separate strainer or filter fitted immediately upstream (in front) of the meter will trap the dirt where it can be readily removed.
- Run the pipe pressure test as specified and make sure the connections are leak free.
- Stop cocks must be fitted on both sides of the meter for meter maintenance purposes.

Figure 3-28 Pressure Testing Pump

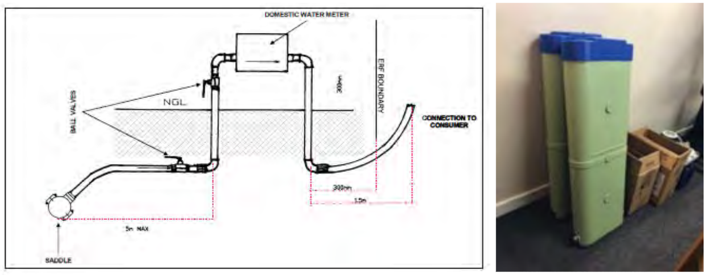
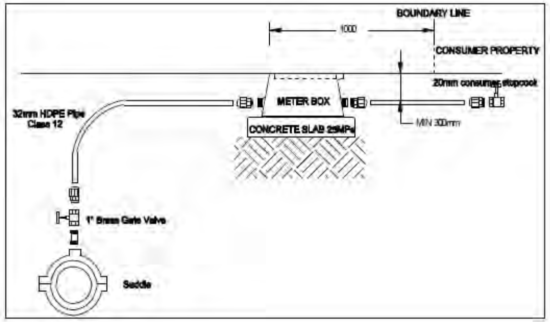


Figure 3-29 Typical Above-ground Domestic Meter Installation



Source: [Water Meter Training Manual],Text and Figures.

Figure 4-30 Diagram of Typical Water Meter Box Installation

4.6.2. Installation of Bulk Water Meters

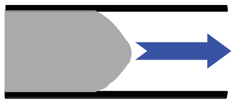
(1) Basic installation

A straight pipe section with a diameter three times or more is required to install the flowmeter. For a 50mm meter, the pipe length must be 150mm or more. If there is a fitting or valve, it cannot be called a straight pipe. See the water flow profile in the pipe diagram below.

- Select a position where the meter is always full of water. Do not place the meter at the discharge end of the pipe.
- The pipe diameter should not be reduced directly in front of or behind the meter.
- All regulation of the flow (e.g. PRV) should be done behind the meter.
- Pay attention to the installation requirements of horizontal/vertical. Many meters change the minimum flow accuracy when mounted vertically.
- The meter must be installed and tighten evenly.
- The gasket does not stick out from the flange into pipe.
- Before installation of the meter the pipe should be flushed thoroughly. A strainer or filter must be installed immediately upstream (in front) of the meter to catch any debris in the water. The strainer must be installed in a position that the strainer element can be easily removed for cleaning. The strainer should be cleaned regularly as part of a routine maintenance programme.
- Ensure that the meter is installed in the pipe with the flow direction indicated on the body of the meter.
- Turn on the flow gradually to ensure all air is expelled. If the meter reaches full flow before all air is exhausted from the system, the meter will be damaged. The pipeline must be deflated and completely filled with water for proper operation of the meter.
- Air pocket should be avoided at the location of the meter. Do not install a meter at a high part in the pipeline or try not to operate it in half of the full pipe.
- Qp, in the spec sheet, should not be exceeded for a certain periods. If so, meter will be damaged.
- The maximum temperature of the medium must not exceed 50 degree Celsius for cold water meters and 130 degree Celsius for hot water meters.
- The meter should be protected against sand, solids exceeding 5mm diameter and fibrous material.
- For large customer meter installations without meter boxes, ensure that the straight length of the pipe is at least 3 times the meter diameter.
- The pipe diameter should not be reduced directly in front of or behind the meter. (length of straight pipe > 3D)
- A flange adapter should be used to make it easier to remove the meter.

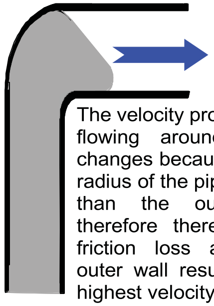
(2) Effects of Flow Disturbances on Bulk Meter Accuracy

Figure a



Laminar Profile
The velocity profile of water flowing in a straight pipe is at its highest in the centre of the pipe because there is friction loss against the walls of the pipe which slows the flow velocity down.

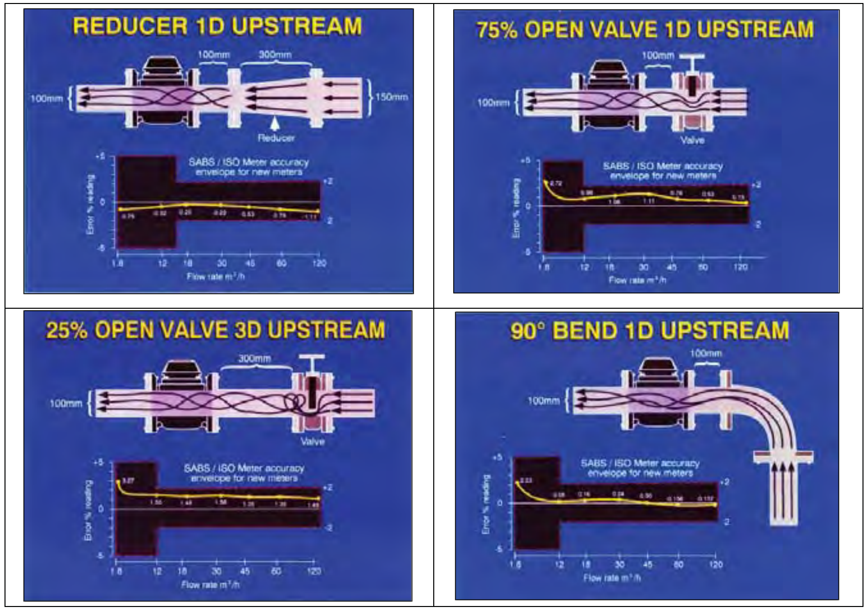
Figure b



The velocity profile of water flowing around a bend changes because the inner radius of the pipe is shorter than the outer radius therefore there is higher friction loss against the outer wall resulting in the highest velocity dropping to the bottom of the pipe.

Figure 4-31 Velocity profile of water in pipes

Any bend or fitting installed directly in front (downstream) or back (upstream) of a meter can influence the accuracy of the meter. Water naturally moves under pressure in the center of the pipeline. When a bend is fitted on a pipe, the flow of the water will naturally move to the bottom of the pipeline. When installing a bend directly in front of a meter the action of the water flowing to the bottom of the pipeline will speed up the vane of the meter and the meter will not register correctly. This principle applies for all fittings installed directly in front of the meter.



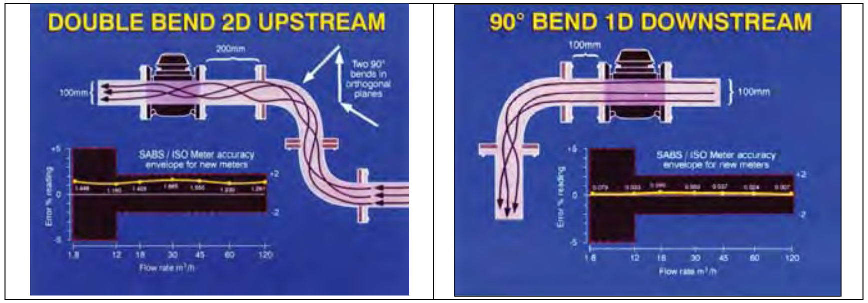


Figure 4-32 Water Flow Profiles to Water Meter

- Typical above ground installation of a bulk meter

Figure 4-33 Typical above ground meter installation (1)

Figure 4-34 Typical above ground meter installation (2)

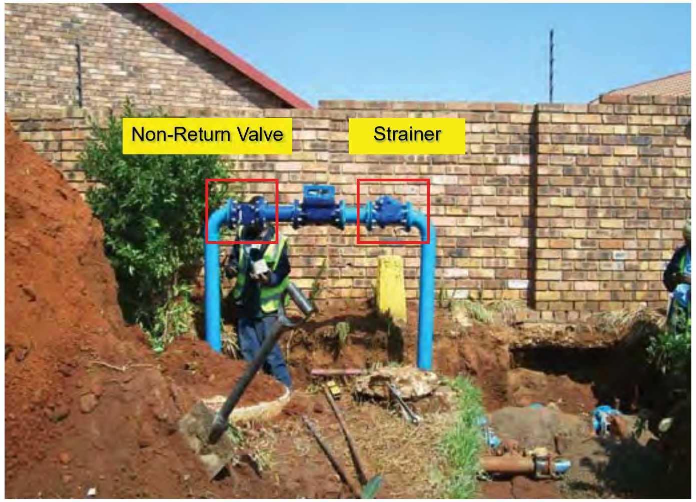


Figure 4-35 Typical above ground water meter installation (3)

Figure 4-36 Typical above ground water meter installation (4)

5. MEASURING AND LOGGING

Outcomes in this Chapter

4-1 Understand the reasons for flow/pressure data to be logged for NRW management.

4-2 Understand how to log flow/pressure data

5.1. Purpose of data logging

Measuring water pressure and flow in a water system is much like a doctor's pulse and blood pressure check-up. This water pressure and flow monitoring process can identify problems within isolated areas. The word logging refers to the procedure of recording data (such as flow, pressure and level of the reservoir) at regular intervals using mechanical chart recorders or electronic logging devices, which are referred to as data loggers. In a water network, flow logging is usually undertaken by connecting a data logger to a water meter. Pressure logging is usually undertaken by connecting a data logger to a fire hydrant and a tap. The data on the logger can be downloaded onto a computer for analysis.

(1) Purpose of Flow data monitoring

It is important to monitor flow rates in order to conduct appropriate distribution management. Customer consumption is essential in order to accurately charge the customer according to the amount used.

Flow-logging data is typically used for:

- The flow profile of a water management zone or a consumer.
- The minimum night flow for leakage analysis.
- The size of a new meter, pressure-reducing valve (PRV) or pipeline.
- A peak factor analysis which is the ratio between the maximum flow rate and the average flow rate over an extended time period.

(2) Purpose of Pressure data monitoring

Pressure-logging data is typically used for:

- The pressure analysis throughout a zone.
- Check the functionality of PRVs or pumps.
- Detect restrictions in a water network.
- Test zone discreteness and locate possible cross-boundary connections.
- Evaluate the potential for pressure management to reduce leak volume.

5.2. Flow-logging and Pressure logging

Logging can be undertaken through the following general steps:

- Select a data logger and obtain the necessary software with a user manual.
- Select required flow- and pressure-logging equipment. Follow the logger manufacturer's user guideline to program the logger.

For flow logging, this includes installing a flow pulsar on the meter and connecting the pulsar to the logger. Further information on selecting and installing flow pulsars can be obtained from meter manufacturers.

- For pressure logging, this includes installing a pressure transducer on a hydrant cap or tap, or by pressure tapping and connecting the pressure transducer to the logger

5.2.1. Flow logging

Flow data can be collected either digitally from water meters (generally via a pulsar fitted to the meter register) or via analogue connections to meters that emit an output signal between 4mA and 20mA (such as electromagnetic water meters).

This text describes pulse output and the logging on mechanical meters.

(1) Basic of pulse signal

When it comes to water meters, a pulse output uses simple, single pole, single throw, and dry contact reed switch as shown in Figure 4-1. The switch is normally open and the switch closes when a magnet is in close proximity to pull the reed switch to the closed position. The magnet is positioned on a dial (or drum in some cases) that rotates due to water flow. The closure and opening of this switch is a single "pulse". Table 5-1 shows an introduction of pulsar which commonly used for flow logging purpose.

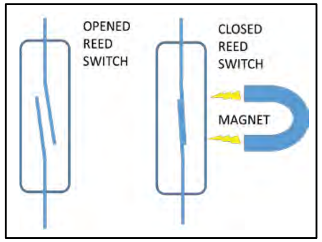


Figure 4-1 Reed Switch

Table 5-1 Pulsars for water meters

Reed switch pulsar	The reed switch type pulsar is an electrical switch that is activated by an applied magnetic field. It consists of a pair of contacts on metal reeds, which are housed in a sealed glass envelope. The water meter register contains a rotating magnet. When the magnet rotates past the reed switch, it causes the reeds to connect. This closes an electrical circuit and creates a pulse. The value of the pulse (e.g. 1 m^3, 0.1 m^3, 0.0001 m^3) depends on the position where the reed switch is inserted into the water meter. Normally two reed switch positions are available. The value of the pulse at each position is fixed and is dependent on the meter size and model.
Optical pulsar	The optical pulsar is a device comprising a photo emitter and a photodetector. The water meter register contains a rotating mirror wheel that reflects infrared light. A pulse is created when the mirror causes a break in the light detected by the photodetector. This pulsar can identify forward and reverse rotation, making it possible to record forward and reverse flow through the water meter. The pulse value is fixed and is based on the meter size. Normally, there is only one position available on a meter register for this pulsar.
Inductive pulsar	The inductive pulsar has a sensor that detects the rotation of a pointer on the meter register. The pointer is a metal disk, shaped in a half moon, which rotates when water passes through the water meter. The rotation direction of the pointer enables the inductive pulsar to distinguish between forward and reverse flow. The pulse value for this pulsar is printed on the pulsar. The pulsar is selected based on the meter size and expected flow rate.

Source: WRC Report [INTEPRETATION OF LOGGING RESULTS AS A WATER NETWORK PROBLEM SOLVING TOOL], October 2016, Text & Figure

A flow meter usually has several pulse ports for pulse signal output. And each pulse port has an appropriate pulsar to register it. Table 5-2 and Table 5-3 shows examples of a water meter and the compatible pulsars on each pulse output ports and pulse value of the water meter.

Table 5-2 Meistream water meter and compatible the pulsars

	Name	Photo	Diameter/Pulse Output	
Water meter	Meistream		Diameter 40 to 125	Diameter 150 to 300
Pulsar	HRI-MEI		0.01; 0.05; 0.1 or $1m^3$	0.1; 0.5; 1 or $10m^3$
	OD01		0.001 m^3	$0.01m^3$
	OD03		$0.01m^3$	$0.1m^3$

Table 5-3 DP Dynamic water meter and compatible pulsars

	Name	Photo	Diameter/Pulse output		
Water meter	WP Dynamic		Diameter 40 to 125	Diameter 150 to 300	Diameter 400
Pulsar	RD 01		$1m^3$ alternatively 0.01 and $1m^3$	1 and $10m^3$ alternatively 0.1 and $10m^3$	10 and $100m^3$
	OD 01		$0.001m^3$	$0.01m^3$	$0.1m^3$
	OD 03		0.01 m^3	$0.1m^3$	$1m^3$

Pulsar installation method depends on manufacturer of the flow meter. Read an installation manual of flow meter and a pulsar carefully. Figure 5-2 shows a photo of water meters which installed a compatible pulsar.

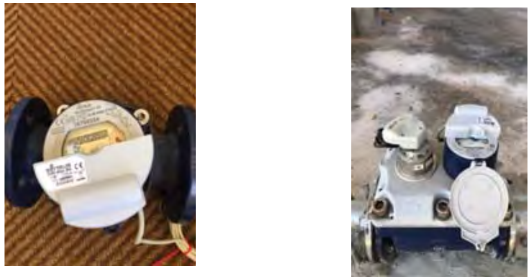


Figure 5-2 Pulsars attached to water meter

A pulse is generated each time a certain volume of water passes through the meter. The pulse value is used to program the logger and it should be the same as the pulse value obtained from the meter.

Pulse signal at mechanical meter shall be logged (recorded) to data logger for measurement. The data shall be handled by CSV or Excel format. Table 5-4 shows a specification of the flow data logger.

Table 5-4 Specification of Data Logger

Protection	Internally powered and housed in a robust, fully waterproof enclosure (IP68)
Battery	Battery life > 5 years
Flow Input	Channel type: Pulses counted over and recorded at pre-set intervals. Max 16,000 pusses 45Hz max frequency per logging interval
Serial Port	Type: Optically isolated, full duplex, asynchronous Data Rate: 1200/9600 baud, V2 for remote communication

(2) Logging interval

All data logged on a channel is average data (a number of samples will be taken and an average value derived from these samples). In addition to this average data, each channel will also record the minimum and maximum value within each day.

Point!
More than two pulses are necessary for accurate data logging during time interval.

(3) Meter reading index

It is recommended that the meter readings are recorded when installing or removing a logger. The difference between the end and start meter reading should be compared to the total recorded volume. If the volumes obtained from the meter readings and that from the logger are the same, then it confirms that the logging has been successful. If these volumes differ, the logging has not been successful and further investigation is required.

If the correct meter index is entered into the Meter Reading field, this will ensure accurate tracking of the site meter reading.

Point!
Logging unit is important to measure flow rate accurately.

5.2.2. Pressure-logging

Pressure logging is undertaken by connecting a data logger to a fire hydrant, tap or by pressure tapping. There should have no water leaks on the hydrant or tap coupling. If there is a leak, the data of pressure may be affected. Table 5-5 shows a pressure logger and fittings with some notes.

Table 5-5 Pressure logger and fittings

Pressure transducer External transducer internal transducer	Pressure data is collected via an internal or external pressure transducer or an analogue input port. A pressure transducer is a device that converts an applied pressure into a measurable electrical signal. A pressure transducer consists of two main parts: an elastic material that deforms when exposed to a pressurised medium, and an electrical device that detects the deformation.
Tap connection fittings	A tap connection fitting can be made by using commercial garden tap connectors with a combination of galvanized or brass fittings. The tap connection fitting can be used to connect a pressure gauge or a pressure transducer to a tap or any similar threaded connection.

Hydrant caps	A hydrant cap is a fitting that is used to connect a pressure gauge or a pressure transducer to a fire hydrant. Pressure logging at a hydrant is preferred over logging at a consumer tap since the pressure logged at a consumer tap is influenced by water usage elsewhere on the property (e.g. flushing toilets).

Source: WRC Report [INTEPRETATION OF LOGGING RESULTS AS A WATER NETWORK PROBLEM SOLVING TOOL], October 2016, Text & Figure

[PRACTICES AT THE Training Yard]

Bulk meter installation/Pulse logger setting

Pressure logger setting

6. DMA PLANNING

Outcomes in this Chapter

5-1 Understand the concept and purpose of DMA.
5-2 Understand DMA planning
5-3 Understand measurement of System Input Volume (SIV) and Consumption Volume.

6.1. Purpose of selection/creation of DMAs

(1) Purpose of DMA

District metered area (DMA) is an area of a distribution system that is isolated from the rest of the system except for one (or sometimes more) supply points. All supply points are metered.

From the time-series monitoring of the inflow to the DMA, the estimated leak amount and consumption pattern can be seen from the night-time minimum flow rate, which indicates the flow rate during times of low water use.

Leakage volume can be estimated by subtracting the estimated night-time consumption from the night-time flow rate. By comparing estimated leak data from several DMAs, municipalities can prioritize leak control areas. It is also possible to estimate the occurrence of new water leakage from changes in the flow rate.

The isolation, in other words, hydraulic separation from the other network of DMA is important for accurate DMA measurement. This is done using a zero pressure test as follows.

1) **Close all inlets (isolation valves).**
2) **Check whether the water pressure within the DMA drops to zero, since no water should now be able to enter the area.**

If the pressure does not drop to zero, then it is likely that another pipe is allowing water into the area and therefore needs to be addressed.

Step test is a work to stop the inflow to a specific area and measure the flow rate to other areas by closing the valve while continuously measuring the flow rate to the DMA. If there is a water leak in the water distribution area, the flow rate will change according to the amount of water leak. Step tests require drawings including valves and piping.

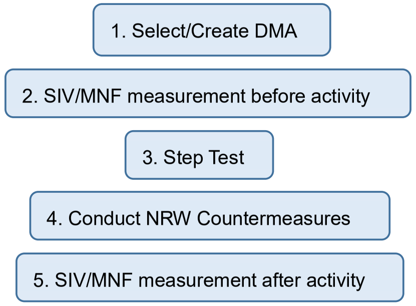


Figure 6-1 Typical activity in DMA

(2) DMA planning

Accurate pipe drawing is essential for DMA creation. A DMA is created as a model area to conduct countermeasures for NRW reduction. A DMA is set up to learn how to calculate and reduce the NRW.

If existing valve cannot be found/operated, unexpected pipe connections are found, the creation process will be delayed.

(3) DMA creation

Following is a typical steps to create DMA.

1) **Selection of DMA area by pipe drawing**

When setting up DMA to study the method of NRW countermeasures, the following need to be considered.

- Number of Isolation valves: The less new installation.
- Number of connections: Will be 500 to 3000 connections.
- Number of meter: The less new installation is easier.
- Method for measurement and data logging
- Sub-sectorization for step test:

A model DMA will be created as shown in Figure 6-2. In addition, following information is useful for the project.

- Registered customer list with water consumption
- Number of people in each house (per connection)
- Unregistered number of connection
- Pipeline information
- Water pipeline: Length, Diameter, Material, Elevation, Location and of existing valve and other appurtenances

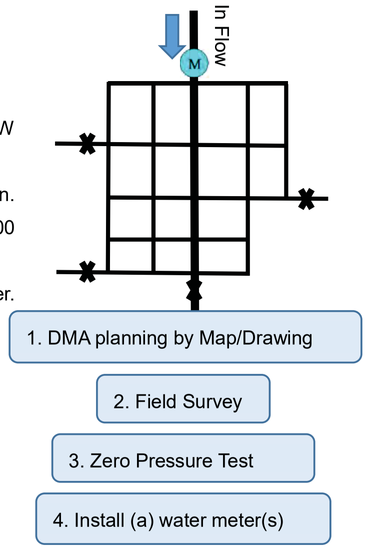


Figure 6-2 Creation of DMA

2) **Field survey**

Based on collected data, field survey will be done if there are valves on site as indicated in the drawing.

3) **Zero Pressure Test'**

The isolation of the DMA is confirmed by drop test as following procedures:

a. Closing isolation valves of the DMA

b. Check water pressure by pressure gauges or flow at opening taps

When confirm zero pressure at the all area, the DMA is isolated and you can start measurement of system input volume.

Sometimes, water does not stop due to some un-known pipelines or not fully closed valves. In the case of operation of valves, the proper closing can be checked by sounding of isolation valves using listening stick. Slightly opened valve generates noise of slight water flow, and the flowing sound can be listened by listening stick. Completely closed valve and completely opened valve has no-sound

vice versa. If it does not reach the expected water pressure, (differs depending on the elevation) drain water by opening hydrants and drain valves in lower level until expected water pressure.

When water pressure does not reach zero, the water head of more than two-story buildings may affect.

6.2. Measurement (SIV, MNF, Step Test)

There are two purpose of flow measurement in DMA, “System Input Volume (SIV)” measurement and “Minimum Night Flow (MNF)” measurement. SIV is measured to know the system input volume in the DMA and MNF is measured to estimate leakage volume in the whole DMA. And a step test is done to estimate leakage volume in each sub-area.

(1) System input volume (Inflow) measurement

■ **Types of Flow meter**

There are three types of flow meter for DMA measurement, a mechanical meter, an electromagnetic meter or an ultrasonic meter.

■ **Flow Trend**

Figure 6-3 shows water flow data for 24 hours in a DMA which measured at the inlet point.

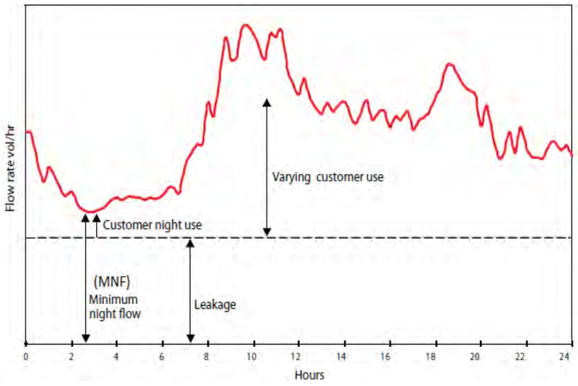


Figure 6-3 A flow trend in a DMA for 24 hours

■ **Minimum Night Flow (MNF)**

MNF appears at AM2:30 in Figure 6-3 when flow volume become lowest. It is noted that the measured MNF contains water volume that cannot be regarded as leakage in NRW such as customer night use and in house leakage.

■ **Step test**

Step test should be implemented during the time period of MNF observed. Therefore, MNF measurement must be conducted before Step Test. Step test is usually conducted at midnight.

a. Use a flow meter(s) of the DMA.

b. Close inflow valve of a target sub-section and keep flow record for 5-15 minutes until flow to be stabilized.

c. Then close a valve of a next target sub-section and keep recording.

d. These closing is continued till the end of supply area.

e. After the measurement, open valves in reverse order.

f. Water drainage should be done if water quality is deteriorated by valve operation.

g. The result of step test is visualized such as excel graph to visually understand the volume in each step.

h. Prioritize sub-section for leak detection activity.

PRACTICES AT THE Training Yard]

DMA Planning: SIV measurement & Step test

7. STRATEGY AND IMPLEMENTATIONS FOR THE NRW MANAGEMENT

Outcomes in this Chapter

7-1 Understand NRW strategy and implementation plans.

7-2. Understand various countermeasures

7-3. Understand technical terms

7.1. NRW Management Strategy and Implementation Plans

7.1.1. What are the Strategy and Implementation Plans?

The strategy shows a roadmap associated with implementation plans (means) to achieve the target(s) of organization by using municipal resources such as services (products), human and financial resources.

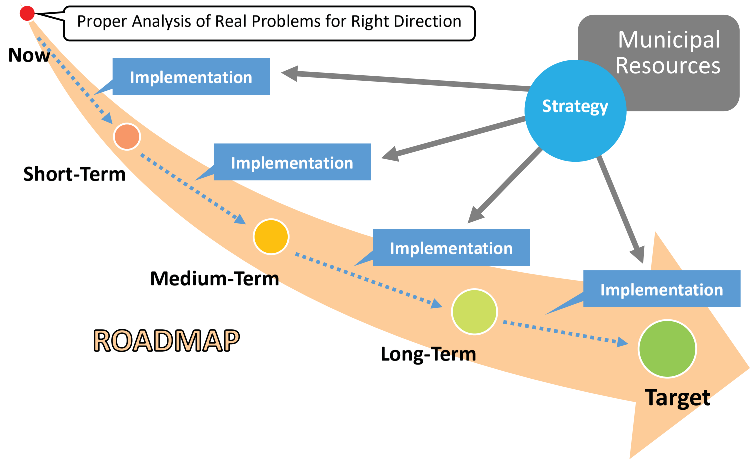


Figure 7-1 Strategy and Implementation Plans

7.1.2. Key Considerations and Aspects for the NRW Management Strategy

The following considerations and aspects are key in the NRW management strategy:

Figure 7-2 Key Considerations/Aspects in the NRW Management Strategy

(1) Driving Force (Champions/Coordinators and Supporters)

As a driving force, a dedicated Team for the NRW management should be established from cross-departmental/sectoral perspective to cover all NRW components as well as make the strategy feasible

in terms of physical application (logistics, equipment, works, workforce, etc.) and financial requirements.

For example, the Team is suggested to be comprised of members from:

- Leadership by champion/coordinator(s) or champion/coordinator(s)-to-be
- WCWDM
- Operation & maintenance (production, distribution, etc.)
- Meter reading
- Billing
- Finance
- Customer services
- Procurement
- Human resources and so on

Figure 7-3 Driving Force for the NRW Management Strategy (Example)

> *Point!*
> *NRW reduction requires the cooperation of both the Technical and the Finance Department.*

(2) Target Setting

To take a realistic approach(s), the target of the NRW management should be set at the achievable level (not much ambitious) by:

- Reviewing the existing target of NRW level if any
- Taking into consideration the other municipal vision, goal and/or policies that will either complement or conflict with the NRW management.
- Taking into consideration municipal resources
- Comparing the cost of water being lost and the cost of countermeasures

- Identifying the economic level of NRW

The target should be set and reviewed together with prioritization of implementation of countermeasures for the NRW management.

(3) Prioritization

To achieve the target of the NRW management, the Team should prioritize implementation of countermeasures as well as delineate a roadmap.

In the prioritization process, the Team should analyze cost and benefit of countermeasures and compare effectiveness among countermeasures.

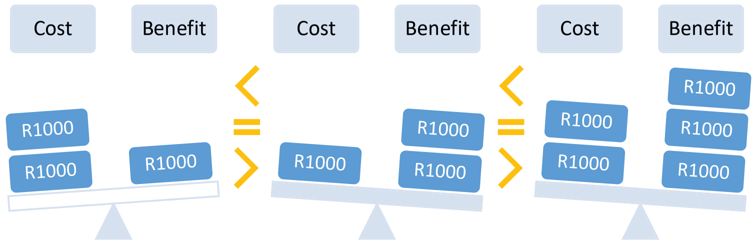


Figure 7-4 Cost and Benefit

Countermeasures and their effectiveness can be evaluated by monetary-based net benefit and cost-benefit ratio as below table, however they should be also evaluated comprehensively in consideration of various factors:

- Magnitude of the targeted NRW component to be reduced
- Period of countermeasures
- Immediate effectivity (production cost saving)
- Immediate effectivity (revenue increase)
- Reduction in recurrent operational costs
- Increase in water supply coverage
- Improvement in water services quality (24/7)
- Social/political impacts.

Table 7-1 A Sample of Cost Benefit Analysis and Comparison among Countermeasures

	Countermeasure		A Commercial (Meter)	B Commercial (Illegal)	C Physical Loss (Leak)	D Physical Loss (Leak)
a	Initial Cost (R)	-	R 5,000	R 5,000	R 10,000	R 20,000
b	Estimated NRW Reduction (kl)	-	500 kl	1,000 kl	1,500 kl	3,000 kl
c	NRW Reduction per Rand (kl/R)	b / a	0.10 kl/R	0.20 kl/R	0.15 kl/R	0.15 kl/R
d	Assumed Benefit per kl (R/kl)	-	30 R/kl (Water Tariff*1)	10 R/kl (Production Cost*2)	30 R/kl (Water Tariff*1)	10 R/kl (Production Cost*2)
e	Estimated Benefit (R)	b x d	R 15,000	R 10,000	R 45,000	R 30,000
f	Net Benefit (R)	e - a	R 10,000	R 5,000	R 35,000	R10,000
g	Cost-Benefit Ratio	e / a	3.00	2.00	4.50	1.50

*1: In case of possible immediate effectivity (revenue increase) by the countermeasure
*2: In case of possible immediate effectivity (production cost saving) by the countermeasure

Point!

- *Resolving commercial losses translates into immediate revenue increases. The lower the amount of commercial loss, the better the finance of the municipality. To increase our financial resources, it is important to reduce commercial losses.*
- *On the other hand, if the treated water in the water supply facility is insufficient and only supply for less than 24 hours, or if the supply rate is less than 100%, the better water supply is possible by reducing the physical loss. In general, the reducing physical loss saves operating costs.*
- *Accurate information such as facilities, equipment, drawings, GIS, billing data, and customer lists will help to implement NRW measures smoothly.*

(4) Financial Aspects

Point!

"Rome was not built in a day." There is no magic prescription to reduce NRW instantly. Long-term strategy is the key to success.

The development and implementation of countermeasures to achieve the target of NRW involve a large amount of budget. Particularly, medium- and long-term countermeasures and budget for them that are thoroughly discussed with key stakeholders will ensure that all parties are aware of the costs required and that the strategy is financially viable/sustainable. Otherwise, the strategy of the NRW management often fails or slows down due to budget shortfall over time.

Pilot project(s) to have first-hand knowledge of NRW's real problems as well as to demonstrate the effectiveness of the countermeasures is useful to develop/review the strategy for solutions. Each pilot project covers a small isolated area, be substantial enough to ensure that all countermeasures (components) are tested, and operate under financial conditions that can be replicated when countermeasures are implemented throughout the entire water supply system. The analysis of the pilot project(s) results should be used in the development of the economic level of NRW for the entire system.

In preparing a budget, the Team needs to identify the following costs (but not be limited):

- **Staffing (Workforce)**

Include staff for both direct NRW works (e.g. leakage technicians) and indirect support (e.g. procurement staff)

- **Equipment & Materials**

Include equipment installed permanently (e.g. DMA meters) and those used on a day-to-day basis (e.g. leakage detection equipment).

- **Logistics (Vehicles)**

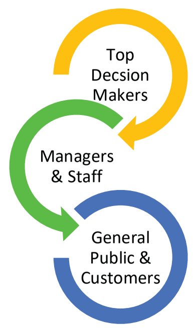
Include transportation costs, which can become an important issue in maximizing the work rate of all staff. Small teams generally cover the entire supply system for undertaking NRW works.

- **Works**

Include the costs for the planning, design, construction and commissioning of equipment such as meters, pressure reducing valves and detecting and repairing of all leaks

- **Awareness Creation**

Addressing NRW requires a combined effort from the management and staff throughout the municipality. However, the number of staff with a good knowledge of NRW is usually limited to engineers or technicians. Everyone, from the management to staff working at an operational level, should understand the importance of the NRW management and how it affects water services and their routine works.



Specifically, the following stakeholders for the NRW management should understand what NRW is and their roles:

- Top decision makers
- All levels of the management and staff
- General public and customers

- **Obtaining Approval/Buy-in of Top Decision Makers**

Top decision makers at the high level, such as mayors, municipal manager municipal councils or political/traditional leaders, are responsible for reviewing and approving the strategy. Presentations and discussions on NRW will help ensure that they understand the value of the NRW management. The decision makers should be informed of

- The present NRW level and problems
- Importance of the NRW management
- The NRW level to be targeted
- Roadmap (Strategy and Implementations) of the NRW management
- Budget required for the NRW management
- Benefits of the NRW management

> ***Point!***
> *Lack of approval/buy-in and inadequate funding from top decision makers leads to strategy failure.*

■ **Building Awareness and Consensus of the Management and Staff**

The municipal staff needs to understand NRW and how the NRW management can improve the organizational capacity. All the management and staff need to understand the NRW management and their roles in achieving the target NRW level. Managers are involved in providing information to enhance NRW reduction strategies and provide updates and changes to staff to increase their morale. How individuals in various departments/sections are involved in the implementation are, for example:

- WCWDM and O&M officers provide the schedule and request disbursement or procurement in a timely manner.
- Logistics and procurement officers ensure vehicles, equipment, materials and supplies required for countermeasures in a timely manner.
- Financial officers take the procedures of disbursing fund.
- Meter reading officers ensure regular/punctual reading and meter function check.
- Billing officers provide information of billed water consumption.
- Customer services officers promote customer awareness and communicate with customers on the NRW management.
- O&M officers record all works under countermeasures including locating, detection and repair of leaks, then reflect them into GIS and maintenance log books.

■ **Public Awareness Programs**

To sustainably provide better and more efficient water services, we need to understand how public people involve in NRW management. For example, it reduces problems with meter reading failures, meter or valve malfunctions, pipe bursts, water leaks, and illegal connections/bypasses.

Awareness programs, including media, conferences, and educational activities should be organized with a wide range of stakeholders from the public, including politicians, traditional leaders, community leaders, domestic, commercial, and industrial customers. The program should focus on the basic concepts of NRW, the importance of meter reading, free basic water, external/internal leaks, and how reducing NRW can help to sustain water services.

After the programs, all staff should work to ensure that customer confidence in the utility's services is maintained. A key element in this is "open communication". For example, the public should be able to easily contact the municipality to report the above problems. The municipality should establish a system to receive information or complaints from customers, and then disseminate it to the relevant operational sections/units so action can be taken quickly.

> ***Point!***
> *During the implementation of countermeasures for the NRW management, the customer should be informed of the actions for countermeasures are done for the purpose of sustainable water supply.*

7.2. Countermeasures

7.2.1. Three (3) approaches to Reduce Physical Loss

There are three approaches to reduce physical loss. Figure 7-5 shows a relation on the three approaches of countermeasures. The three approaches should be taken as a total physical loss reduction comprehensively.

(1) Fundamental approach

- Water Balance analysis to figure out actual condition of distribution volume and billed metered consumption volume.
- Appropriate water supply operations with pressure management.
- Replacement of aged pipes based on asset management

(2) Corrective approach:

- Repair visible leak and make report.
- Planned leak survey and repair underground leaks.

(3) Preventive approach:

- Replace old pipes in according to plans.
- Replace mains/sub-mains to less leak pipe materials
- Replace service pipes to less leak pipe materials
- Replace spaghetti service pipe lines into sub-mains

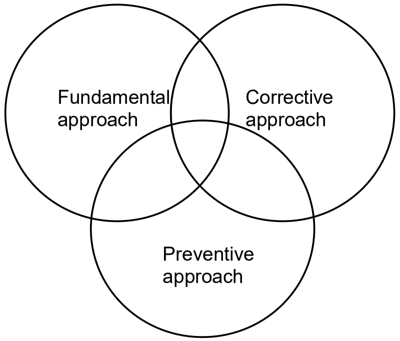


Figure 7-5 Three Approaches for Physical loss reduction

7.2.2. Approach through DMA Selection/Creation

Figure 7-6 shows a basic procedure of physical loss reduction for municipalities. Comparison between the system input volume and the billed metered consumption in the certain area is a must and responsibility of water utility who supplies water to residents as a water supply service provider. Firstly, municipality figures out how much volume of water purchased or produced as a system input volume and how much volume of water has been sold to customer. The balance of produced/purchased water and sold water should be continuously monitored in whole municipality to understand current situation.

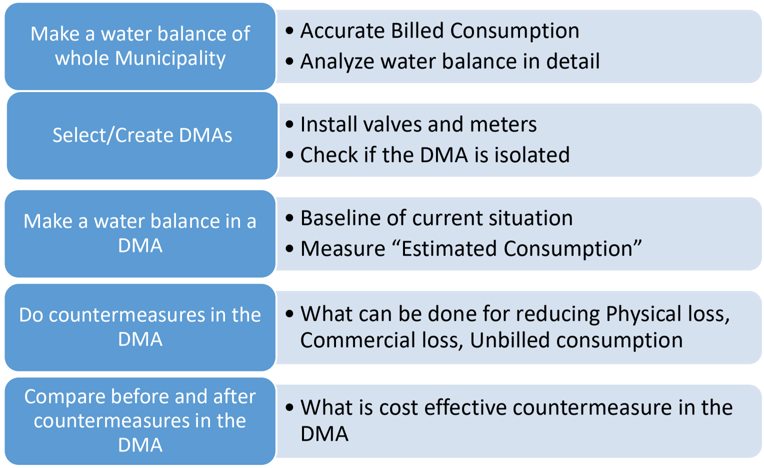


Figure 7-6 Procedure to reduce NRW

Selection/creation of DMA is recommended to measure and monitor system input volume and billed authorized consumption in detail as a baseline for the purpose of monitoring the water balance. Thereafter, an appropriate countermeasure to reduce NRW should be conducted in a DMA. The

smaller DMA defines what kind of countermeasure reduces NRW in the DMA and the result of countermeasures is usually adoptable to the other area to reduce NRW effectively.

(1) Typical Countermeasures for the NRW Management

Based on the results of analysis and pilot projects, the municipality proceeds to making implementation plans of countermeasures for the NRW management. For example, the countermeasures are:

- Bulk (system input) metering and accuracy
- Zonal metering and accuracy (including installation/refurbishment)
- Customer metering and accuracy (including installation/re-installation)
- Reservoir overflow control and monitoring
- DMA establishment
- Surface leakage locating and repair
- Underground leakage detection and repair
- Pressure management
- Meter installation
- System maintenance improvement
- Network drawing quality improvement
- GIS and hydraulic modelling improvement
- Meter reading and billing system improvement
- Treating "Free Basic Water"
- Record keeping improvement
- Pipe replacement (asset management)
- Reorganization (staffing) for the NRW management
- Awareness programme
- Customer awareness
- Monitoring & Evaluation

Table 7-2 shows countermeasures for physical loss, apparent loss (Commercial losses) and unbilled authorized consumptions. Those measures are applicable in South Africa, and municipality need to consider which countermeasure is the most cost effective for the municipality and their DMAs.

Table 7-2　Countermeasures for NRW Reduction

NRW reduction measures	Activities
Measures against real losses	
Lerakage	
Pipe lines	
pipe mapping	Make exact pipe drawings
zoning	Design & Installation of DMA
MNF measurement	Grasp leakage and distribution volume
Leak Detection	Utilizatoin of leak detectors
Leak Repair	Review Regulation of repair
Pipe rearrangement	Zoning
Facilities	
Leak Detection	Leak detection of facilities
Leak Repair	Review Regulation of repair
Facility rearrangement	Review of pump stations and reservoir tank
Measures against apparent losses	
Theft of water	
Survey	Detect illegal connections
Notificatoin and Persuation	Public awareness
Repair	Disconnection of illegail connection, Install customer meters
Fine & Penalty	Collection of fine
Meter error	
Customer meters	
Survey	Check accuracy of meter
Replacement	Relocation of water meter
Bulk meter	
Survey	Check accuracy of meter
installation	Intstall necessary meter, replace defect meter,
Meter readng error	
Replacement of meter	Easy read meters,
Remote meter reading system	Introduction of remote meter reading system
Data handling error	Careful work procedures and programming check
Measures against Unbilled Authrized Consumption	
Public use	Review of unbilled water for public use
Instituitional use	Estimate for flushing volume
Fundamental measures	
Data management	
Data Acquisioton and Recording	Abstructoin of pipes o be replaced, establishment of pipe replasement planning
Data Analysis	Pipe network analysis, predictoin of leakage & NRW rate,
Integrated Information system	GIS, Customer Information system, SCADA system, Management info
Planinng	
Planinng of Pipe rearrangement	Pipes to be replaced, pipe replacement plan
Planiing of water supply operatoin system	Optimum water presssure and quantity management system
structioal rearrangement	Review of Organizatoin, Staffing, Work method
Predictoin of Leakage rate of NRW	Cost-benefit analysis
Legal system	Penalty for theft, qualification system for plumbers, award system for exellent staff
Education and Training	
Staff Training	
Public awareness	

(2) Typical Implementation Models

The municipality should consider implementation models suitable/applicable for countermeasures of the NRW management, for example,

- Option-1: In-house implementation
- Option-2: Outsourced implementation
- Option-3: Outsourced performance-based project

Point!
Municipality can do in-house and supervising private plumbers, consultants and contractors by themselves using their knowledge and experience.

(3) Funding Sources

Budget is generally limited, therefore the municipality should consider following budget source for the implementation.

- Option-1: Municipal budget
- Option-2: Governmental grants and subsidies (Municipal Infrastructure Grant: MIG, Regional Bulk Infrastructure Grant: RBIG, Water Services Infrastructure Grant: WSIG, Accelerated Community Infrastructure Projects: ACIP, etc.)
- Option-3: Loan (Private Bank, DBSA, etc.)
- Option-4: International Development Partners (IDPs) or donors' fund
- Option-5: Partnership with Private and NGOs

7.3. Presentation

(1) Presentation

Presentation should be prepared for the target audience. The presentation for the NRW management is divided into two steps at least:

- Step-1: From the Team to the management (to be more practical, technical, scientific and evident)
- Step-2: From the management to the Top Decision Makers (to be more short, summarized/essentialzed and comprehensible with 5W1H, strategic, beneficial and favorable)

The presentations should include the following items essentially:

- The present NRW level and problems
- Cost benefit of the NRW management
- Roadmap (Strategy and Implementations) of the NRW management

Figure 7-7 Tips for Presentation

7.4. NRW implementation planning of your Municipality

(1) Strategy of workplace

Estimate expecting NRW ratio

(2) Model Procedure for Water Balance Analysis

STEP 1 - DETERMINE SYSTEM INPUT VOLUME

- **Identify sources of input (and export) volume:**
  - Water supplied to the network from own WTW sources
  - Water transferred in from adjacent networks
  - Water purchased from bulk suppliers Water exported from the network
- **Ensure meter accuracy:**
  - Establish meter accuracy from manufacturers' manuals (eg +/- 2%)
  - Check meter readings using downstream master meter or insertion meter
  - Replace or re-calibrate meters as necessary
  - Correct System Input Volume for all known errors
  - Apply 95% Confidence Limits

If there are any un-metered sources the annual flow should be estimated by using any (or a combination) of the following:

- Temporary flow measurements using portable devices
- Reservoir drop tests
- Analysis of pump curves, pressures and average pumping hours

STEP 2 - DETERMINE AUTHORISED CONSUMPTION

- **Billed Metered Consumption**
  - Extract consumption of the different consumer categories (e.g. domestic, commercial, industrial) from the utility's billing system
  - Analyze the data, paying special attention to large consumers.
  - Process the annual billed metered consumption information taken from the billing system to allow for meter reading time-lag
  - Ensure that the billed metered consumption period used in the audit is consistent with the audit period
  - Establish meter accuracy from manufacturers' manuals (eg +/- 2%)
  - Apply 95% Confidence Limits
- **Billed Unmetered Consumption**
  - Extract data from the utility's billing system
  - Identify and monitor unmetered domestic customers for a certain period, either by the installation of meters on those non-metered connections or by measuring a small area with a number of unmetered customers (the latter avoids customers changing consumption habits)
- **Unbilled Metered Consumption**
  - Establish the volume of unbilled metered consumption in a way similar to that for billed metered consumption
- **Unbilled Unmetered Consumption**

Unbilled unmetered consumption, traditionally including water used by the utility for operational purposes, is often seriously overestimated. This might be caused by simplifications (a certain % of total system input) or deliberate overestimates to "reduce" water losses. Components of unbilled unmetered consumption should be identified and individually estimated, for example:

- Mains flushing: How many times per month? For how long? How much water?
- Firefighting: Has there been a big fire? How much water was used?

STEP 3 - ESTIMATE COMMERCIAL LOSSES

- **Unauthorised Consumption**

It is difficult to provide general guidelines for estimating unauthorized consumption. There is a wide variation of situations and knowledge of the local situation will be most important to estimate this component. Unauthorised consumption can include:

- Illegal connections
- Misuse of fire hydrants and firefighting systems
- Vandalised or bypassed consumption meters
- Corrupt practices of meter readers
- Open boundary valves to external distribution systems (unknown export of water).

The estimation of unauthorised consumption is always a difficult task and should at least be done in a transparent, component based way so that the assumptions can be easily checked and/or modified later.

■ **Customer Metering Inaccuracies and Data Handling Errors**

The extent of customer meter inaccuracies, namely under- or over-registration, has to be established based on tests of a representative sample of meters. The composition of the sample should reflect the various brands and age groups of customer meters. Tests are done either at the utility's own test bench, or by specialized contractors. Large customer meters are usually tested on site with a test rig. Based on the results of the accuracy tests, average meter inaccuracy values (as % of metered consumption) will be established for different user groups.

Data handling errors are sometimes a very substantial component of commercial losses. Many billing systems do not reach the expectations of the utilities but problems often remain unrecognised for years. It is possible to detect data handling errors and problems with the billing system by exporting billing data (of say the last 24 months) and analysing it using standard database software.

The detected problems have to be quantified and a best estimate of the annual volume of this component has to be calculated.

STEP 4 - CALCULATE PHYSICAL LOSSES

The calculation of real losses in its simplest form is now straightforward:

Physical Losses = Volume of NRW minus Volume of Commercial Losses

This figure is useful for the start of the analysis in order to get a feeling for the expected magnitude of physical losses. However, it always has to be kept in mind that the water balance might have errors—and that the calculated volume of real losses might be wrong.

STEP 5 - ESTIMATING REAL LOSS COMPONENTS

To accurately split real losses into its components will only be possible with a detailed component analysis. However, a first estimate can be made using a few basic estimates:

■ **Leakage on Transmission and/or Distribution Mains**

Bursts on distribution and especially transmission mains are primarily large events—they are visible, reported and normally repaired quickly. By using data from the repair records, the number of leaks on mains repaired during the reporting period (usually 12 months) can be calculated, an average flow rate estimated and the total annual volume of leakage from mains calculated as follows:

NUMBER OF REPORTED BURSTS X AVERAGE LEAK FLOW RATE X AVERAGE LEAK DURATION (SAY 2 DAYS)

A certain provision for background losses and current undetected leaks on mains can then be added.

■ **Leakage and Overflows at Utility's Storage Tanks**

Leakage and overflows at storage tanks are usually known and can be quantified. Overflows can be observed and the average duration and flow rate of the events estimated. Leakage of storage tanks can be calculated by making a level drop test with in and outflow valves closed.

■ **Leakage on Service Connections up to Point of Customer Metering**

By deducting mains leakage and storage tank leakage from the total volume of real losses, the approximate quantity of service connection leakage can be calculated. This volume of leakage includes reported and repaired service connection leaks as well as hidden (so far unknown) leaks and background losses from service connections.

(3) Create a measurement plan of your Municipality

1) Measurement plan

Consider the measurement plan at the workplace on the drawings of each municipality. The order of examination is as follows.

Make a plan: 1st workplace training schedule

- Team configuration
- Measurement area (DMA)
- Necessary materials and equipment
- Installation work
- Flow measurement

a. Team configuration

Team leader:

Staff:

Examination of workforce. In the case of night work required (staff mobilization, safety measures, police reports etc.)

b. DMA

Determination condition of DMA: Number of connections about: 300-500 for pilot area

- Confirmation of existing information:
- Pipelines drawings with existing valve, pip diameter, pipe material
- Number of sub- sections
- Customer list and consumption

Table 6-3　Customer list sample

Account	Customer Nam	Premise #	Premise Address	Meter #	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total Usage
07069400-0	Yamada Taro	7069400	7069400 Madalaii	K034350	20,490.00	11,940.00	8,800.00	8,810.00	11,940.00	9,160.00	8,970.00	10,960.00	5,360.00	9,830.00	10,570.00	9,870.00	126,700.00
07069500-0	Watanabe Jiro	7069500	7069500 Madalaii	35217250W	24,100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40,580.00	21,000.00	23,930.00	109,610.00
07069500-0	Sato Sabro	7069500	7069500 Madalaii	K031120	45,540.00	28,740.00	35,010.00	49,110.00	49,940.00	42,370.00	51,030.00	47,600.00	48,120.00	0.00	0.00	0.00	397,460.00
07075900-0	Suzuki Shiro	7075900	7075900 Madalaii	K031150	30,280.00	7,840.00	7,500.00	6,860.00	10,660.00	8,470.00	11,260.00	12,830.00	10,680.00	11,040.00	18,080.00	37,710.00	173,210.00
07073900-0	Tanaka Goro	7073900	7073900 Madalaii	K031660	16,300.00	6,980.00	8,590.00	10,340.00	9,800.00	7,930.00	9,060.00	9,640.00	9,700.00	12,870.00	8,820.00	9,130.00	119,160.00
07078103-0	Ito Rokuro	7078103	7078103 Madalaii	K032380B	4,600.00	5,810.00	8,590.00	6,430.00	9,530.00	8,110.00	11,270.00	12,670.00	12,820.00	12,790.00	1,840.00	1,980.00	96,440.00
07073100-0	Yamamoto Nanao	7073100	7073100 MALAKAL	K032530	24,300.00	20,100.00	20,300.00	24,100.00	29,300.00	17,300.00	20,600.00	25,100.00	44,500.00	7,900.00	6,000.00	10,200.00	249,700.00
07075700-0	Nakamura Hachiro	7075700	7075700 Madalaii	K032630	15,910.00	0.00	0.00	0.00	0.00	0.00	0.00	7,180.00	19,480.00	17,710.00	15,610.00	15,730.00	91,620.00
07076000-0	Kobayashi Kyuji	7076000	7076000 Madalaii	K034250	2,740.00	1,630.00	3,220.00	2,250.00	1,530.00	1,650.00	1,790.00	560.00	2,150.00	320.00	30.00	50.00	17,920.00
07073800-0	Kato Ichiro	7073800	7073800 Madalaii	K035460	10,610.00	4,150.00	4,710.00	5,080.00	8,030.00	3,170.00	3,790.00	6,420.00	3,160.00	2,950.00	2,710.00	2,920.00	57,700.00
07079100-0	Yoshida Sakura	7079100	7079100 Madalaii	K036560	18,450.00	7,420.00	7,760.00	7,640.00	10,110.00	6,510.00	6,950.00	6,280.00	8,230.00	8,990.00	8,300.00	8,270.00	104,910.00
07081901-0	Sasaki Rin	7081901	7081901 Madalaii	K036590	54,720.00	23,730.00	23,530.00	22,760.00	33,880.00	25,950.00	28,050.00	23,790.00	34,010.00	29,160.00	22,290.00	23,120.00	344,990.00
07083800-0	Yamaguchi Hinata	7083800	7083800 Madalaii	K036600	0.00	10.00	0.00	20.00	30.00	20.00	0.00	10.00	210.00	30.00	60.00	10.00	400.00
07071900-0	Matsumoto Hana	7071900	7071900 Meyuns	K101050	3,820.00	2,370.00	2,830.00	2,800.00	3,580.00	2,250.00	2,800.00	2,110.00	2,610.00	1,750.00	2,710.00	2,250.00	31,880.00
07074400-0	Inoue Ren	7074400	7074400 Meyuns	K101190	16,570.00	8,750.00	6,810.00	6,300.00	10,300.00	7,370.00	7,810.00	8,720.00	2,300.00	16,400.00	8,740.00	9,510.00	109,580.00
07077102-0	Kimura Haruto	7077102	7077102 Meyuns	K103540	8,550.00	4,600.00	4,190.00	5,030.00	6,890.00	4,890.00	4,100.00	4,640.00	4,820.00	5,530.00	4,050.00	4,580.00	61,870.00
07074700-0	Hayashi Arata	7074700	7074700 Meyuns	K103690	9,370.00	4,880.00	1,100.00	2,420.00	2,610.00	2,110.00	1,890.00	2,720.00	2,170.00	3,000.00	4,820.00	6,780.00	43,870.00
07074300-0	SaitoAoi	7074300	7074300 Meyuns	K104720	14,170.00	8,430.00	7,270.00	11,160.00	15,340.00	11,840.00	9,570.00	8,010.00	8,190.00	8,840.00	5,880.00	7,110.00	115,810.00

c. Required materials and budget

Count required materials to measure SIV and sub sections. Based on the results of the MNF if there is a large amount of leakage in the DMA, step test will be planned as part of NRW counter measures to find out higher problematic area.

- Meter
- Valve
- Budget for procurement
- Procurement of materials

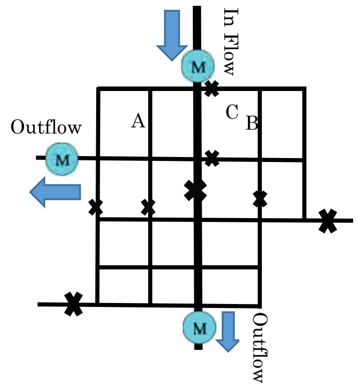


Figure 6-8　Isolation model

d. Installation of materials

Take into account the following points;

- Construction period
- Contractor
- Water supply management during water shortage
- Approval of excavation work
- Mobilization of night work staff, if necessary

(4) Measurement

1) SIV and MNF

If temporary meter (UFM, pulse counter logger) installation is required, following is considered.

- Installation date / time
- Power supply securing method if need
- Protection method

2) Step test

Make a step test plan at the midnight. Step test must be conducted out of the SIV measurement period so as not to affect measuring of consumption of the DMA.

From the results of step test, municipality should decide how to set the priority, and then conduct the water leakage survey.

(5) Present a plan

Prepare presentation material: 4 team respectively

- Presenter
- Presentation style
- Finding possible issue and countermeasures
- Q&A

(6) Discussion

- Difficulty of creating the plan
- Possibility of the implementation of the plan

Practice & Discussion

Conduct planning of your Municipally strategy and implementation plan for NRW reduction. [Drafting strategy & Implementation plans]

Case study, discussion by information collected from workplace training at the late stage of the National NRW Training to decipher results of water balance analysis as well as understand real problem(s) of participating municipalities.

8. CUSTOMER CONSUMPTION & BILLING DATA ANALYSIS

A 09 - 337

Outcomes in this Chapter

8.1 Understand how to find and rectify inaccurate data in billing data.

8.2 Understand how to find illegal use data in billing data.

8.1. Data Verification

Accurate customer water consumption is important for NRW analysis, but sometimes the data is inaccurate. In this chapter, we will learn how to extract inaccurate data from the water consumption data.

■ **Identification of errors**

Careful checking of the acquired data will help you build a more accurate database and calculate a more accurate NRW. Common errors on the system and handled by a meter reading database are given below:

- A data is not available.
- The date of meter reading is different.
- A misreading due to counter re-set to zero.
- Too high or too low consumption.

8.2. Illegal Water Use

Point!

- *Check if all water user is registered as a customer.*
- *Analyze consumption data to find out illegal connections. If the customer consumption is too low, visit the house for investigation..*

1) Type of illegal use

- Connect service pipe to the distribution line without meter
- Bypass a meter
- Reverse a water meter
- Remove meter then connect a short pipe
- Tampering meters (magnet, put something in the gear)
- Re-open stop cock by themselves when disconnected due to non-payment
- Brake a pipe or a fittings to get leaking water: pipe, hydrant, air valve, loosen flange.
- Theft water from facility: fire hydrant

■ **Investigation of customer list**

- Investigation of registered customer and water user at the site
- Make sure that the customer who has all the water supply equipment is registered as a customer.
- When the number of people using the house connection is known, the number of people will also be used as a reference of the consumption. If the water usage is low compared to the number of people, there is a possibility of unauthorized connection.

- List up higher and lower consumption customer than thresholds

■ **Site survey**

- Check if the property is occupied or vacant.
- Check if the meter is by-passed.

■ **Countermeasures**

(1) Ordinance /bylaw

- Establish an ordinance to be widely known by customers.
- Give violators penalties such as fines.
- The violator must be newly registered as a customer and encourage them to pay regularly.
- Give incentives for staff who discovered an illegal connection.

(2) Enhance Public Relation

- Promote payment for sustainable water supply.
- Enlighten saving water and economical use of water for sustainable water supply.
- Prepare of subsidies, discount for pipe installation, and reduction of water charge. (Other than FBW).

Practice & Discussion

Analyze customer consumption data and discuss how to investigate low consumption customer and how to deal with.

9. PRACTICES OF THE NRW MANAGEMENT [LECTURE]

Meter Installation, Meter Accuracy Test, Pipe Connection, Leak Detection, and Leak Repair

Outcomes in this Chapter

9-1 Understand appropriate customer meter installation.

9-2 Understand the method of meter accuracy test using reference meter.

9-3 Understand PVC pipe connection method and materials.

9-4 Understand survive pipe connection method and materials

9-5 Understand leakage repair method and appropriate repair materials.

9-6 Understand leakage detection method and operation of equipment.

9.1. CUSTOMER METER INSTALLATION

9.2. METER ACCURACY TEST

1) Test Methods

If the accuracy of a meter needs to be verified for trade purposes, such as in response to a consumer complaint, the test method has to comply with metrology of legislation. On the other hand, if the purpose of the test is to check the meter accuracy as part of a meter study and to obtain quick approximation as a customer service, following test will satisfy the requirements for the purpose.

Figure 9-1 Meter Test Bench

a. Test bench

The most precise method is to remove the meter from the field and test it on a laboratory test bench. This method is highly accurate and repeatable.

b. Field test

A simple way to test the accuracy of customer meters is to connect the reference meter to a tap on the property or directly to the meter or connect with a pipe and control the flow rate through both meters. It is noted that this method provides the test result approximately base not authorized measurement result, the obtained figures are as reference.

- **Number of test sample meter**

Statistical sampling methods are available, sample numbers of meter under the condition of the Tolerance: 5%, Trust rate: 95% are shown below;

Figure 9-2 Reference Meter

Table 9-1 Number of tested meters to be Tolerance 5% and Trust rate 95%

Total meters	No. of meters	Percentage against total number of meters
250	152	60.8%
300	169	56.3%
400	196	49.0%
500	220	44.0%
800	260	32.5%
1,000	280	28.0%
2,000	325	16.3%
3,000	345	11.5%
5,000	360	7.2%
10,000	370	3.7%
25,000	380	1.5%
50,000	385	0.8%
> 100,000	385	< 0.4%

[By statistical theory, the Tolerance: 5%, Trust rate: 95%, number of test meters for the number of connections]

More meters tested will result in a more reliable estimation of the meter accuracy. The meters to be tested should be selected randomly.

The test should be done in 3 flow ratios such as between start flow and transitional flow, transitional flow and permanent flow, permanent flow to obtain a meter error curve. However, this test method is just obtaining a quick approximation of error rate, therefore, test flow rate adopted is one that around rate of QP.

Figure 9-2 Meter error test at site

■ **Example of a meter accuracy calculation.**

An initial reading of a meter was 123.456 m3. After 200 l of water passed through, the meter indicates 123.654 m^3 within a period of 5 minutes.

The accuracy of the meter is:

- Actual volume Va = 200l.

Actual flow rate = actual volume / time = 200/5 = 40 l/min, or 2,400 l/h.

Indicated volume V, = 123.654 - 123.456 = 0.198 m3, or 198 l.

Error = V' - Va = -2 l, the meter under-registered by 2 l.

- Relative error = error / actual volume = -2/200 = -1%. This means the meter under-registers the flow by 1% at a flow rate of 2,400 l/h.

[PRACTICES AT THE Training Yard]

Meter accuracy test

9.3. PIPE CONNECTION

Pipes and joints must comply with the performance standards stipulated in the standards regarding pressure resistance and leaching, etc. Water service pipes include lining steel pipes, stainless steel

pipes, copper pipes, ductile cast iron pipes, and synthetic resin pipes. Synthetic resin pipes include a rigid polyvinyl chloride pipe, a polyethylene double-layer pipe, a polyethylene pipe, a cross-linked polyethylene pipe, and a polybutene pipe. The pipe type is selected considering the installation site, the geology of the buried part, the external force that the pipe is subjected to, the climate, the characteristics of the pipe, and the maintenance.

When connecting pipes, follow the system standard provisions regarding pressure resistance, leaching, etc. of the Standard Ministerial Ordinance. Following is the precautions for the construction of synthetic resin pipes.

■ **Synthetic Resin Pipes**

Among the synthetic resin pipes, those that can be used for water supply are vinyl chloride pipes, polyethylene pipes, and polybutene pipes. Hard polyvinyl chloride pipes, polyethylene double-layer pipes for water supply, polyethylene pipes are used as buried pipes on roads and residential areas.

Cross-linked polyethylene pipes and polybutene pipes are used for water supply and hot water supply pipes in indoor pipe header construction methods, pre-branching construction methods, and sheath pipe header construction methods.

(1) Polyvinyl chloride pipe (PVC)

1) Pipe

Hard PVC pipes are mainly used as buried pipes on roads and residential areas. It has excellent corrosion resistance, especially electrolytic corrosion resistance, and has a relatively high tensile yield strength compared to other resin pipes.
Following is a precautions for connection.

a. It has elasticity due to direct sunlight and temperature changes. As a measure to prevent deterioration due to direct sunlight, there is a method of applying weather resistant paint to the outer surface of the pipe or attaching a protective cover to the outer surface.

b. When connecting, chamfer the end face of the pipe firmly, apply an appropriate amount of adhesive to the pipe surface and joints, and hold it for a certain time so that the pipe does not come out.

c. After connecting the pipes, do not seal the pipe lines to allow sufficient ventilation.

d. Do not let the rubber ring of the pipe or joint contact for a long time with organic solvent, gasoline, kerosene, oil paint, creosote (preservative for wood), termite control agent, etc. In such a case, the material may be corroded, causing a water leakage accident or water quality accident due to cracking or swelling and softening of the rubber tube.

e. Do not use the "fire heat" connection that was partially implemented in the past as it will cause an accident.

f. When performing a water flow test or a water pressure test after adhesive connection, it must be done at least 24 hours after the adhesive, depending on the installation procedure of the adhesive used.

2) Joint

There are two joining methods: TS joint with an adhesive and RR joint with a rubber ring.

a. TS Joint

- Wipe off the dirt on the outer surface of the fitting insertion port and the inner surface of the receiving port.
- Apply a thin layer of adhesive to the outside of the insertion port and the inside of the receiving port.
- Immediately after applying the adhesive, insert it into the joint and hold it for 30 seconds or longer for nominal diameters of 50 mm or less and 60 seconds for nominal diameters of 75 mm or more to prevent pipe return.
- Immediately wipe off the adhesive that has squeezed out, and thoroughly ventilate the adhesive.
- There are adhesives for rigid PVC pipes, impact resistant PVC pipes, and heat resistant rigid PVC pipes, so use them properly for each type of pipe used.
- When conducting a water flow test or a water pressure test, observe the specified curing time (24 hours or more) for joints and adhesives.

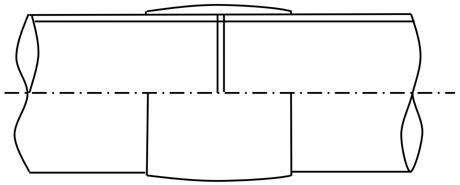


Figure 9-3 TS Joint

b. RR Joint

- Chamfer the cut surface of the pipe

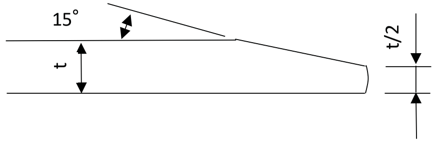


Figure 9-4 Chamfer

- Clean the rubber ring, rubber ring groove, and tube insertion port.

- Be sure to attach the rubber ring correctly. Try not to the front and back are opposite and not to twisted.
- To reduce the insertion load, apply a special lubricant up to the rubber ring and the marked line on the insertion port.
- To join, align the pipe axes and then insert the pipe in the marked line.
- After joining, check the entire circumference with a check gauge and check if the rubber is twisted or dislocated. A check gauge is a ruler to insert till the rubber ring.
- Bent fittings may be separated by water pressure, so protect them with separation prevention fittings or concrete blocks.

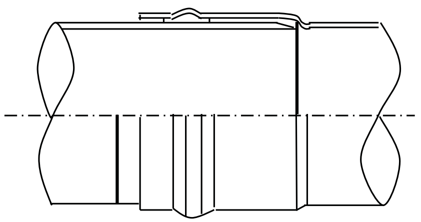


Figure 9-5 RR joint

(2) Polyethylene pipe

1) Pipe

Polyethylene pipes for water supply include double-layer pipes, polyethylene pipes, and cross-linked polyethylene pipes. Polyethylene pipes for water supply are mainly made of high density polyethylene resin and have excellent durability, corrosion resistance and hygiene. Hand-bending piping is also possible at the site, and it can be installed with a small number of joints for long plumbing. Followings is precautions for plumbing.

a. Not to store the pipe in direct sunlight and take care not to scratch or damage it.

b. Prolonged contact with organic solvents such as kerosene and gasoline may penetrate the piping and cause water quality accidents.

2) Joint

There are two joining methods: Compression Joint and EF joint.

a. Compression Joint

- Use a certified fitting that is compatible with the piping type (1 to 3 types).
- Put a marked line on the cutting position of the pipe and cut at a right angle to the pipe axis. If there is burrs on the cut surface, deburr it with a chamfer and clean the joint at the tip of the pipe with a waste cloth.

- Disassemble the fitting and pass the parts through the pipe in the order of cap nut, resin ring, and (hereinafter ring). The ring should have the split side facing the cap nut side.
- Push the in-core (core integrated type, one-touch type does not have an in-core driving step) into the pipe, and drive it fully with a plastic hammer. The ring should be sufficiently separated from the cut surface of the pipe.
- Pull the cap nut together with the ring toward the tip of the pipe, insert it into the joint, and tighten the cap nut sufficiently by hand.
- Use a pipe wrench to tighten with the following standard tightening torques.

Table 9-2 Standard Tightening Torque for Compression Joint

Unit: N/m

Diameter	13	20	25	30	40	50
Standard Torque	40.0	60.0	80.0	110.0	130.0	150.0

Source: Technical guide for water supply equipment construction 2020

Figure 9-6 Compression Joint

b. EF Joint

Power is supplied to the EF joint from the controller, the heating wire built into the EF joint is heated, and the resin inside and outside the joint is integrated by heat welding.

This method has the following features.

- The procedures for joining are well documented and the EF controller controls the optimal fusion conditions.
- Since the pipe weight is light and the joint is integrated by fusion, a long land joint is possible.
- No measures are required to prevent the bent pipe from coming off.

■ **Procedure**

- After removing the dirt adhering to the pipe end section, put line for the joint insertion allowance.
- Mark the insertion area of the joint and the fusion surface of the pipe and peel off this part with a special tool (peeler or scraper).

- Wipe the inside of the joint and the outside of the pipe with a special paper towel soaked in ethanol or acetone.
- After marking the insertion line on the pipe, set the joint and fix the pipe and joint using a clamp.
- Connect the connector of the controller to the joint and read the barcode of the joint to start energizing for electro fusion.
- After fusion, check the cooling for a predetermined time, and then remove the clamp.

■ **Notes**

- Use a special tool (peeler or scraper) for peeling off so that there is no unpeeled part.
- Wipe with a special paper towel with bare hands and do not touch the surface after cleaning.
- Make sure the pipe is inserted until the marked line. If the insertion is not correct, the fusion will be poor.
- Keep it clamped during cooling and do not apply any external force to the joint.
- Drain the water thoroughly to prevent water to connector on the EF contoroler during the fusion process. If it rains, use a tent or something to protect it from rain.

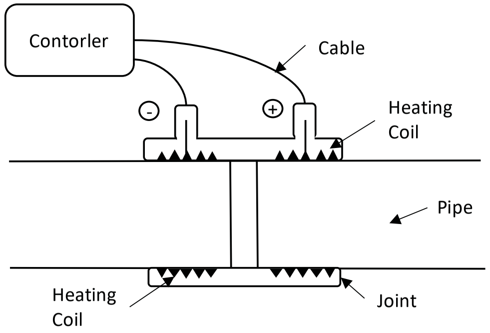


Figure 9-7 EF Joint

Part of connection work may be done at the meter installation.

[PRACTICES AT THE Training Yard]

10-3. Pipe connection and completion test

Pipe installation standard:

[SPECIFICATION DWS 1110 CONSTRUCTION OF PIPELINES, Revised: March 1998]

(1) General

Pipelines shall be hydrostatically tested as pipe laying proceeds and after installation of all valves, specials and fittings. The Contractor shall be responsible for providing all water required for testing, the source of which shall be subject to approval by the Engineer.

The length of pipeline to be tested in one operation shall be as approved by the Engineer. Where the method of test is in any way in variance to this specification, the Contractor shall submit a detailed method statement to the Engineer and no test shall proceed before approval of such method statement by the Engineer.

(2) Test pressures

Test pressures shall be as indicated on the tender drawings. Test pressures shall generally be 1.25 times the pipeline design pressure for design pressures up to and including 3.2 MPa and 1.1 times the design pressure for higher pressures. Design pressure shall be taken as the maximum pressure to which pipelines might be subjected under all conditions of operation and shall include allowance for transient pressures.

Test pressures over any length or section of pipeline under test, taking possible differences in elevation along the pipeline into account, shall be such that the test pressure at any point along the section is not less than 1.1 times nor greater than 1.40 times the design pressure at these points.

(3) Leakage rates

Leakage of a pipeline under test, taken as the aggregate quantity of water added over a 24 hour period to reinstate required test pressure, shall not exceed quantities equivalent to the following:

- Pre-stressed concrete, reinforced concrete and fibre-cement pipelines - 1/3000 of the volume of water in the section under test.
- Steel pipelines with flexible joints - 1/3500 of the volume of water in the section under test.
- Steel pipelines and cylinder type pre-stressed concrete pipelines with welded joints - 1/4000 of the volume of water in the section under test.

The leakage rate at any one joint in the section under test shall not exceed the following:

Q = Allowable leakage in 24 hrs of pipeline under test in litres/20N

Where Q = Leakage rate in litres / hour

N = Number of joints in section under test

9.4. LEAK DETECTION

9.4.1. Cause of water leak

Buried water pipe has been getting damage from the outside and/or internal cause by the corrosion, heavy traffic load, vibration, poor construction and water-hammer by the rapid water stop in the network system.

(1) Corrosion

Corrosion is well known as the cause of the water leak on the metallic pipe, and makes hole onto the surface of metallic material under the low-pH, wet soil, and high conductivity condition.

Especially, corrosion occurs when boundary of different conditions between the dry and wet conditions, and generates an electrical circuit on the pipe line.

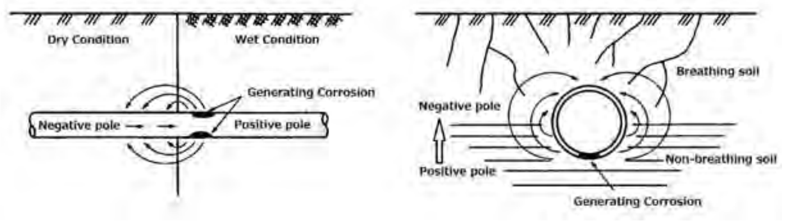


Figure 9-8 Image of corrosion

■ **Countermeasure of corrosion**

- Replace the corrosive pipe to the non-metallic pipe.
- Cover the joint part with the plastic film to avoid from the corrosive soil.

(2) Traffic load

When water pipe is buried underground less than 1 meter in depth, it is easy to break a pipe or loose the joint due to the traffic load and its vibration. This is the case that heavy traffic load sometimes made crack on the PVC main pipe due to the buried in shallow.

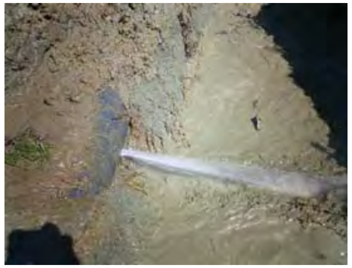


Figure 9-9 Leak at AC

(3) Pressure fluctuation

The figure below shows a crack on the asbestos cement pipe (ACP) generated due to pressure fluctuation by stopping water. When valve closed or pump stopped rapidly on the network, water flow moves to the backward and forward repeatedly inside pipe with a strong energy, that is called water hammer. When water hammer occurs, it gives a high stress to the pipe joint and curve point with strong impact wave, and it generates a breakage at a week point.

(4) Poor piping

Poor construction sometime makes a leak on the joints or connections as following causes:

- PVC joint with a less adhesive or without water supply stopping.
- The pipe (often PE) not being inserted straight to the pipe joint.

Figure 9-10 Leak at a joint

9.4.2. Leak Sound

(1) Mechanism of Leak Sound

Figure 9-12 shows the mechanism of the water leakage on the pipe. Water is leaking from the buried pipe spot by the pressure of water flowing inside the pipe, and it generates a noise, compounding the four elements which consists of; flow noise, impact noise, friction noise and vibration noise around the water leak point. These noise mix up and propagate inside the pipe, pipe wall and ground surface through the soil. This is called "leak sound". The leak sound does not only propagate to the ground surface but also transmitting to the pipe fittings. Leak sounds like a "Hiss" or "Whoosh" serves as a representative sound.

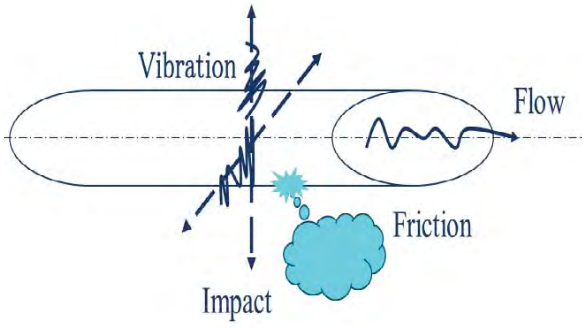


Figure 9-11 Mechanism of water leak sound

(2) Characteristic of leak sound

There are some points to detect the water leak easily or accurately at actual site.

■ **Sound loudness and water pressure**

The figure below shows that there is a relationship between water pressure and sound intensity. The leak sound is low and difficult to detect when the pressure is below 0.1MPa. This is the reason why leak detection work should be conducted at mid-night when water pressure becomes high due to the low consumption and silent environment.

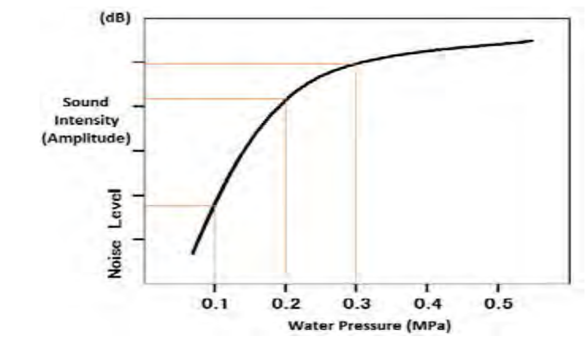


Figure9-12 Sound loudness and water pressure

■ **Water pressure and the quantity**

In the leak detection, it is easy to detect the leak sound under the high sound condition as much as high pressure. However, if water pressure becomes high, leak quantity also becomes high. This increases the water loss Figure 9-14 shows how leak quantity changes when water pressure becomes twice from the original pressure. If water pressure is at 0.1MPa, leak quantity is 10l/min, then leak quantity should be changed to 1.41 times (14.1l/min) when water pressure rate is increased twice. This is the reason why pressure control is more effective to save water loss in the high water pressure area.

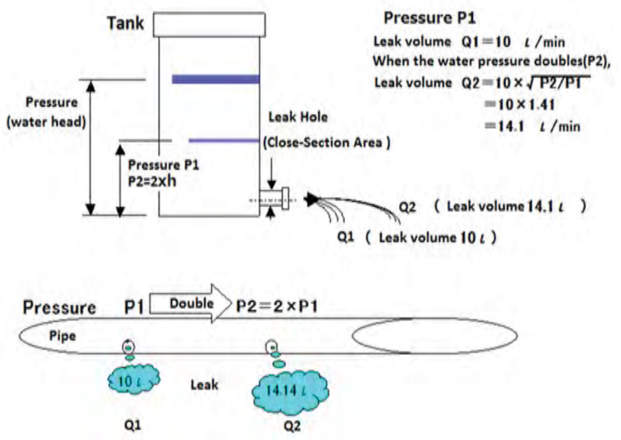


Figure 9-13 Water pressure and quantity

(3) Propagation distance of leak sound

Figure 9-15 shows a result of frequency spectrum analysis and sound intensity. Two sensors are installed both at 1m and 10m from the leak point. The propagation distance differs in CIP and PVC.

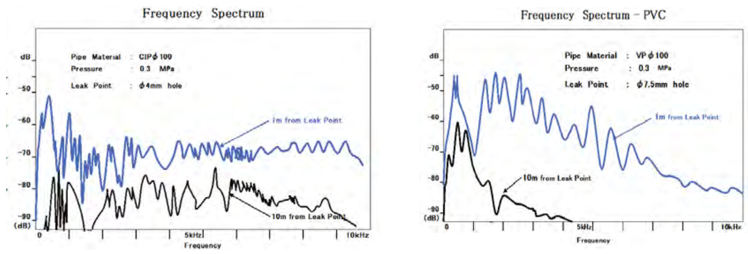


Figure 9-14 Comparison of Frequency Spectrum on CIP to PVC

In addition, leak sound at the CIP has a wide frequency between 200Hz to 10 KHz at 1m and 10m on both sensors. However, the leak sound level decreases at 10m compared with 1m. This means that sound intensity decreases at further point from the leak point.

PVC pipe has a frequency between 300Hz to 10 KHz at 1m from the leak point. However, the frequency which is over 5 KHz attenuates little by little. The frequency over 1.5 kHz disappears at the 10m from the leak point. This means the higher frequency sound does not travel longer distance.

Figure 9-16 shows that soft materials like a PVC and PE pipes which have a high attenuation and sound traveling distance shorter. On the other hand, hard materials like a CI, Galvanized, Steel and Lead pipe have small attenuation and the sound traveling distance longer. If condition is the same, leak sound on CIP travels 100m, on ACP travels 80m, and on PVC travels only 30m from the leak point.

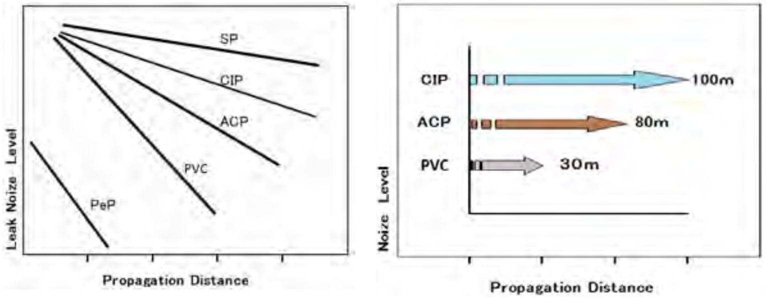


Figure 9-15 Difference of Propagation distance on each pipe material

(4) Frequency on each pipe materials

Metal pipes that are ductile iron, lead, copper and steel pipes and it transmits leak sound that are louder with a higher frequency than PVC, polyethylene or asbestos-cement pipes. Thus, the knowledge of the pipe material is important to detect the leak correctly.

Large diameter pipes, PVC, Concrete, Steel and other metallic pipes transmit shorter distance than small diameter's pipe with low frequency.

A: Non-metal pipe has its peak at approximately 200Hz, and adopt the filter for its frequency.

B: Concrete pipe has its peak at 400Hz, and

C: Metallic pipe has its peak at 1.5 kHz.

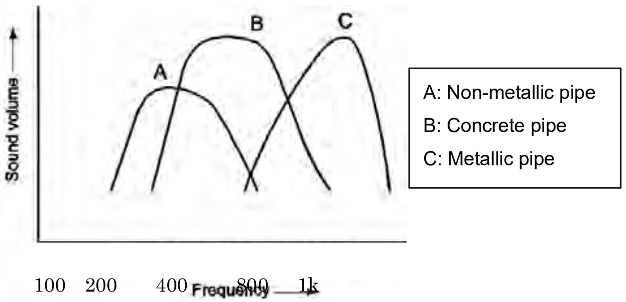


Figure 9-16 Frequency filter on the water leak detector

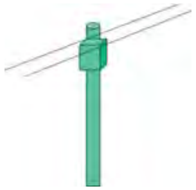
■ **Key points of leak sound**

- As Water pressure higher, the sound loudness is higher
- The sound travels longer on the Metallic pipe than PVC pipe.

(5) Similar noise to leak sound at actual site

Leak surveyor sometime detect a strange sound on the leak detection work. Surveyor should know the difference between a real leak sound and other similar sound like a leak sound.

■ **Electrical transmission sound**



Electrical transformer generates low vibration, the sound propagates to ground surface through the electrical pole. The sound is about 300Hz by making induction current and electromagnetic vibration.

When the surveyor detects the low frequency and vibration nearby electrical pole, try to closer the sound sensor to the electrical pole, and check whether the pole has a continuous low frequency noise or not.

■ **Motor sound (Air conditioner unit)**

AC motor is on, the vibration travels on the ground surface.

■ **Sewage sound**

Sometimes sewage pipe makes flowing sound and the sound echoes inside of vacant pipe. Sewage pipe and water pipe sometimes burred (buried) closer. Characteristic of sewage sound has 500HZ to 2 kHz frequency including flowing sound like a "Shara" "Shara".

■ **Usage water**

When a water tap is open, that makes a sound and the sound travels inside the service pipe and sometimes until the connection of main pipe. The meter counting shows the usage of water inside of the house. Illegal connection can be suspected if the water sound continues even though the meter does not counting. This is the most similar sound to real leak sound.

9.4.3. Leak Survey Method

(1) Survey Planning

A basic of leak survey method is to narrowing down from the large area to a point with a proper planning.

■ **Survey team**

Leak detection activities will be conducted by a team. It is important to make a plan consideration with the personnel, equipment, vehicles, etc. before conducting the survey.

■ **Survey area (Target area)**

The plan of survey area should be made consideration with the budget, survey period, and working staff, and the arrangement as a preparation work.

In case of DMA,

District Meter Area (DMA) is divided approximately by 10km distribution pipe length or 1000 to 3000 households normally, and measure the inflow volume and estimate leak volume by the district meter record at the inlet point. And prioritize the leak survey area analyzing the estimated leak volume at the area.

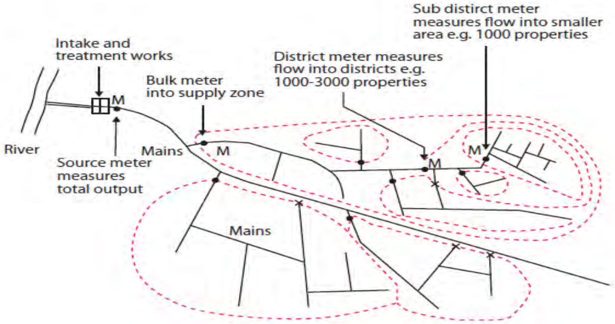


Figure 9-17 Image of District Metered Area (DMA)

■ **Survey map on the preparation work**

Before the water leak survey, a survey map with pipe lines, pipe material, pipe diameter, location of valve and fire hydrant should be prepared. 1/2500 to 1/5000 scale of survey area map is recommended.

■ **Visible leak**

Leaks can be divided into two categories: a) visible leak which can be seen without equipment by the patrol or customer's information, and b) invisible leak which is detected by special equipment which needs survey skills.

Recommended work time: Daytime

Distribution network has low water pressure and comparatively louder environment.

Key points: Check wet point even in sunshine.

Check the over-head tank or reservoir due to broken ball tap/close valve.

Check the drain pit inside if there is clear flow.

Figure 9-18 Leak water flowing into pit

1) How to distinguish leak from the pipe or underground water

Wet point should be confirmed if the water is from pipeline or the other source by the following methods;

■ **Residual chlorine method**

Drinking water from the pipe usually contains about 0.1 mg/L chlorine for sterilization. The sample water collected on the ground surface is determined by the chlorine reaction as drinking water from the pipe or ground water.

■ **pH method**

pH of potable water between 5.8 to 8.6 is the criteria in Japan. Although no clear standards have been identified in South Africa, but there is a tendency of pH values in tap water.

■ **Electrical conductivity**

Conductivity is an index showing how easily electricity flows in a liquid. Liquids, especially water, have a characteristics of dissolving various substances. In many cases, it becomes easier for electricity to flow when the substances is dissolved in water. Therefore, conductivity is in other words an indicator of how much substance is dissolved in the liquid (ionized).The distilled water is the value that is almost 0.

Table 9-3 shows that identify the value in the residual chlorine, pH and conductivity depend on water resources.

Table 9-3 Residual chlorine, pH and Conductivity on respectively water.

	Items	Residual chlorine concentration (ppm)	pH	Conductivity (μS/cm)
1	Portable water	More than 0.1	6.7～7.0	100～300
2	Rain water	Non	Less than 6.0	40～90
3	Well water	Non	6.4	Less than 600
4	Undrgroud water	Non	6.4～7.5	300～1000
5	Pond water	Non	More than 7.0	Less than 400
6	Sewer water	Non	More than 7.0	More than 500
7	Industrial water	Non	More than 7.0	160～700

■ **Water temperature**

Water temperature also can be an indicator to distinguish potable water to sewerage water. There is no difference in the temperature of potable water and ground water .

- Well temperature (15 to 20 degree Celsius)
- Potable water (15 to 20 degree Celsius)
- Sewer (Over 25 degree Celsius)

■ **Odor**

Potable water, industrial water, rain water and underground water have no odour itself, but sewerage water has odor.

9.4.4. Leak Survey Procedure

In order to detect a leak, the basic principle is to narrowing down from the distribution area to the line, and finally to the leak point. The procedure to narrowing down the area to the point will be planned by a leak survey team.

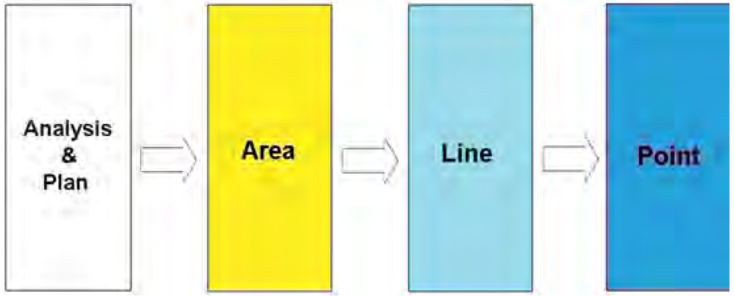


Figure 9-19 Procedure of Basic Method

(1) Analysis and Plan (Preparation)

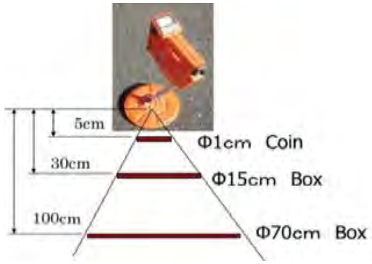
Collect the facility data such as inflow volume, estimated leak volume, distribution pipe length as well as number of houses in the survey area.

- Prepare a survey map with a pipe material, pipe size and valve.
- Locate invisible buried valve which is needed for the operation.

■ **Valve detection (Valve box locator)**

A buried valve cover/manhole cover can by located by metallic box locator. The detectable distance from the surface is about 100cm for Φ70cm round box cover.

Metallic box locator detects manhole cover by electromagnetic induction from the antenna.



■ **Pipe location**

1) Electromagnetic field (Metal pipe only)

A pipe locator can be used to locate buried pipe line. Pipe locator detect electro-magnetic induction field when AC current travels along metallic pipe.

2) Hitting

Hitting method uses a ground microphone. A ground microphone is used to detect hitting noize on ground surface which generated by hitting pipe fittings such as a pipe, a valve, or a meter or a fire hydrant in a uniform rhythm continuously with a rubber hammer.

3) Make a sound of flowing water by opening tap

When open the water tap, the flowing sound occurs and the sound travels along the pipe and detect the loudest point from the ground surface using ground microphones.

(2) Area method

it is important to know, the size of the survey area, survey period, staff arrangement that are required for the effective activity in the target area and prepare the budget before the leak survey.

On the area method, flow meter should be installed at the inlet of DMA or Sub section DMA which is smaller size and measure the minimum night flow (MNF) which is the minimum flow in the mid-night.

Generally, daily flow rate decrease in the mid-night because most customers are sleeping and not in use. MNF sometimes include water usage. However, this is close to leak volume.

If there are large consumers like a factory or apartment which have reservoirs in the subzone, read the average consumption or close the valves during the MNF survey.

■ **Sub section DMA metering area**

In the preparatory work before the leak detection, it is necessary to isolate it to Sub section DMA of 2 to 5 km of distribution pipe and less than 500 houses.

Bulk meter or other measurement unit is installed at the inlet of the Sub-section DMA.

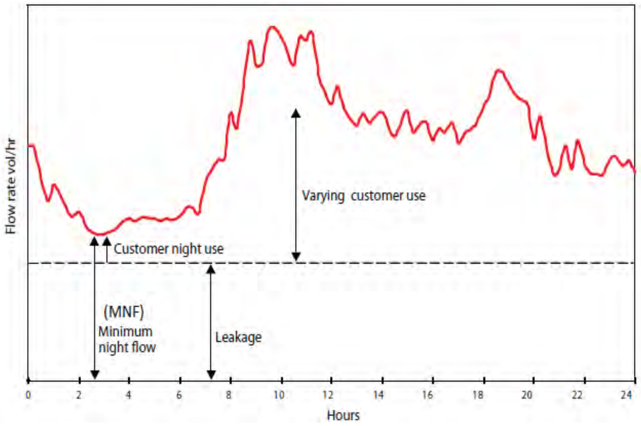


Figure 9-20 A flow trend in a DMA

■ **Step test**

Step test is to identify the most probable leaking sub-section or line by control supply area or pipe line. The difference in each supply volume of sub-zone is equivalent to leak volume of the sub-sector or pipe line.

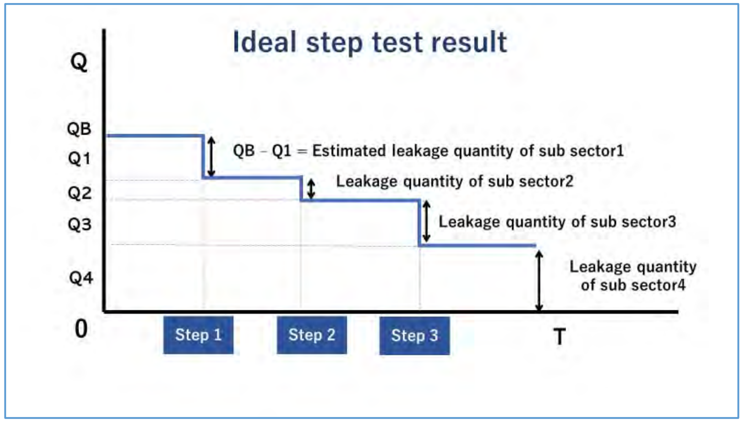


Figure 9-21 Ideal stage of step test

Figure 9-22 shows ideal step test result in case of the valve closing steps conducting orderly (Close valve: 1⇒2⇒3). Figure 9-23 shows changing flow data on the step test when some valves are closed and opened and flow is stable. (close and open valve: 1cl⇒1op⇒2cl⇒2op⇒3cl⇒3op)

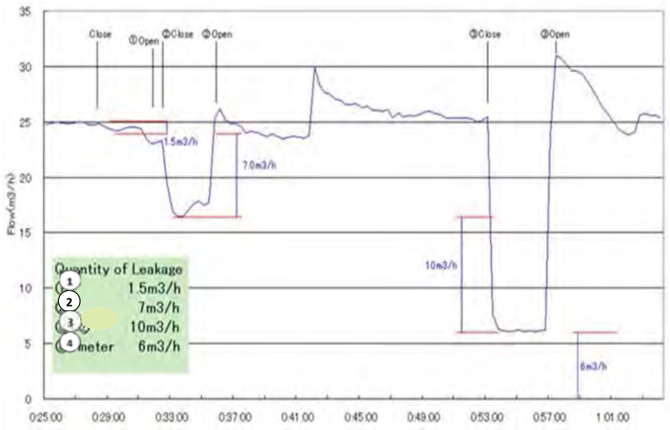


Figure 9-22 A sample of Trend graph of Step test

■ **Procedure (Case of taking orderly steps)**

a. Usually step test is conducted at the midnight, preparation of night works is required.

b. Conduct same procedures as minimum flow measurement such as meter installation.

c. Close inflow valve of a target sub-sector and keep flow record at least 5-10 minutes. In case a sub sector is large wait more period until water follow becomes stable.

d. Then close valves next target sub-sector and keep record.

e. These steps will be conducted to the end of supply area.

f. Open each valve reversely order of the close steps. Cleaning should be done when valves are opened from the nearest fire hydrant and drain pipe.

Then estimate the most possible much leak sub-section from the result of step test.

(3) House to house survey method

When decided the prioritized area, house to house survey should be conducted. House to house survey is that using listening stick and listen all meters in sub sectors. During this step, it is possible that illegal connection survey and defect meter survey will be done simultaneously. It is noted that preparing a map that described the location of the house and check that you have conducted the survey so that there are no missing survey connections.

(4) Line method

Line method is to identify the pipe line which causes the water leak.

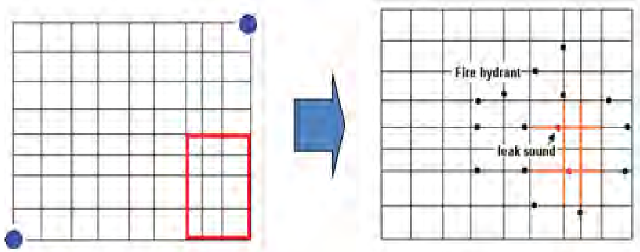
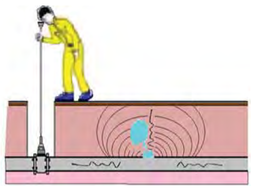


Figure 9-23 Image of a Line survey



As explained before, leak sound is travelled to the valve or water meter from the leak point. The propagated sound to the fitting is checked by the acoustic equipment. Leak sound is checked by the listening stick at the meter or valve.

9.5. Leak Detection Equipment

(1) Listening stick

Listening stick is the basic device used for the leak detection survey. Listening stick is a very simple device without electronic parts and maintenance free for a long time. However, this is the most dominant, principal device for leak detection.

Figure 9-24 Listening Stick

Listening stick consists of acoustic bar which is made of stainless steel or steel material and head part which has vibration room with metallic plate. When listening stick contacted to some fittings, leak sound travel along the bar and amplify the sound with the vibration plate in the head part.

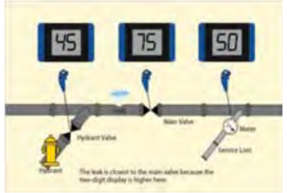
Surveyor needs to check the sound at all fittings of the area, and if a strange sound is listened, mark it on the survey map. The marked point is check again at confirmation survey.

(2) Electric listening stick

Leak sound on the PVC is small and lower frequency. Sometimes it is hard to listen to it by analogue listening stick. The electrical listening stick can amplify such a small sound to listen the leak noise easily through the head phone.

Figure 9-25 Electric Listening Stick

Acoustic survey using electrical listening stick is to make contact to the valve or meter and check the sound and level meter. Figure below shows nearest point from which leak a largest sound with 75other points further from the leak point has, the sound becomes smaller.



Leak survey operator can identify the roughly leak point by the sound level.

(3) Ground Microphone

This equipment has a long history and has been used on the leak detection survey.

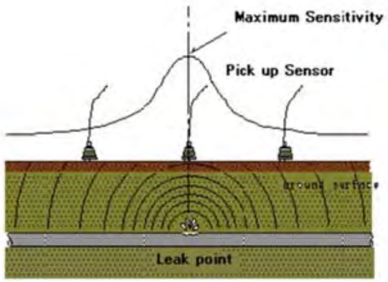


Figure 9-26 Ground Microphones

Water leak survey team should be at least two staff, and separate one operator to walk on the main pipe and the other to detect the leak on the service pipe and keep a distance to avoid foot noise of each other if a strange sound is heard, mark it on the survey map.

(4) Leak noise correlator

Leak noise correlator identifies the exact leak point even with noisy condition in the daytime.

Water leak noise correlator consist of two amplifiers with sensors and the main unit which is a built-in microprocessor.

■ **Principle of correlator**

Leak sound travels to both sides from the leak point at the same speed if pipe material and diameter are in same conditions.

When leak point is just centered between sensors blue and red, leak sound travels at the same time to both sensors. However, leak point is close to the red side like the figure below, it travels to the red side faster than blue with difference in time. This is called a Time difference (Td)

Leak noise correlator calculates Td which is transmitted from the preamplifiers every second.

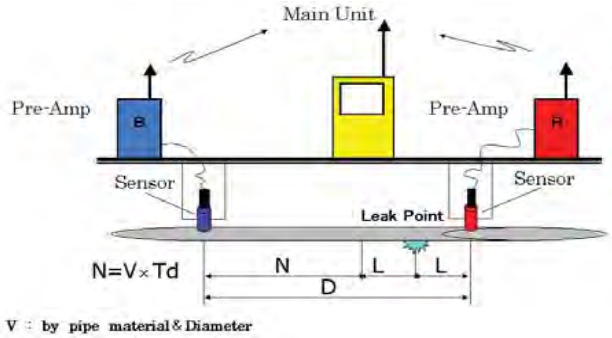


Figure 9-27 Principle of leak noise collerator

Definitions D: Total distance between the two sensors, is measured exactly over the pipe with a measuring wheel or measuring tape L: Distance from the leak to the nearest sensor, is calculated by correlator. N: Difference in the distance that sound travels to the farthest sensor, is calculated by correlator.

■ **Benefit**

Correlator can pinpoint even though leak sound does not traveled to the surface.

■ **Condition**

Leak noise correlator should be used with the following conditions;

- Leak sound must reach both sensors.
- Leak point must be between Blue and red sensor.

(5) Confirmation

All the suspected leak point needs to be confirmed by the confirmation survey Confirmation survey is the final pinpointing to avoid excavation of a wide area or miss-excavation cost.

■ **Drilling work**

To make a hole on the marked point by the drilling machine and power generator which is on the pinpoint survey.

■ **Boring work**

Boring bar need to be inserted carefully to a hole which made by a drilling machine near the pipe. Pipe depth is measured at valve point before the boring work to avoid braking pipe.

■ **Checking work**

Listening stick should be inserted into the hole until it touches the pipe position carefully, and listen to the leak sound and wet condition on the stick.

Figure 8-28 Confirmation

(6) Leak information

When the pipe is buried, no information is available. However, it is easy to get the pipe information or underground condition when leak repair work is done.

Leak information should be recorded on the record sheet this is necessary for replacement plan in the future. Collected information are as follows;

- Pipe information:
- Main or service pipe
- Material (DIP, CIP, ACP, PVC, GP, SP, PeP, Lead, CP,)
- Diameter
- Depth
- Leak information
- Main or service
- Location (Pipe, Connection, Meter Valve, Fire hydrant, Washout)
- Condition (Hole, Crack, Brakeage, Loose connection, Packing)
- Causes (Corrosion, Water Pressure, Aging, Wrong construction, Traffic load)
- Quantity
- Road or ground information
- Road condition (Asphalt, Concrete, Gravel, Grass, Soil)
- Ground water level (Above the pipe)
- Soil condition (Sand, Clay, Rubble, Rock)
- Leak repair information
- Excavation size
- Back foe working hour
- Fill buck sand (m3) gravel(m3)
- Surface compaction
- Material (kind, Diameter mm, length m)
- Joint (Elbow Tee, Socket, Nipple,)

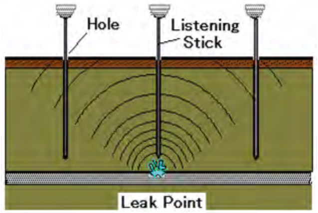


Figure 8-29 Image of confirmation

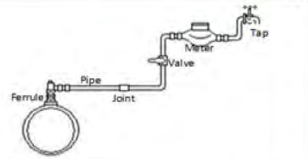
- Workers (Supervisor , fitter , Worker ,)(working hour)
- Leak data

Leak data which is collected at leak point should be recorded on the leak record sheet clearly with figure or picture, which include pipe information, leak information and subsurface information as seen in the sheet below.

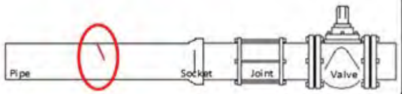
Table 9-4 Leakage record sheet

Leakage Record Sheet			Leak. No	4 - 13
Date of survey:	2012, Oct, 13		Street	Fairfield road
Pilot area	Kotahena-4		House No,	201/12
Main Pipe	(1.) CIP, 2. DCIP, 3. PVC, 4. GP, 5. Others		**Location**	(1.) Pipe, 2. Connection, 3. Ferrure, 4. Valve, 5. Meter, 6. Tap, 7. Reservor Tank, 8. Others,
Diameter	100	mm	**Condition**	1. Hole, (2.) Crack, 3. Brakeage, 4. Packing, 5. Loose Connection, 6. Over Flow, 7. Unknown, 8. Others
Service Pipe	1. PEP, 2. PVC, 3. GP, 4. Others ( )		**Cause**	1. Corrosion, 2. Deterioration (Aging), (3.) Traffic Load, 4. Wrong Construction, 5. Less Adhesive, 6. Pressure Fluctuation, 7. Defective Valve, 8. Vandalism, 9. Other Construction, 10. Unknown, 11. Others( )
Diameter		mm		
Depth	90	cm	**Surface**	(1.) Asphalt, 2.Concrete, 3.Gravel, 4.Grass, 5.Soil, 6.Others
Leakage Size	(1.) Large, 2. Middium, 3. Small, 4. Drops, Measured (150 L/Min) by flow meter		Detected Method	1. Patrol, 2. Customer Informing, 3. Acoustic, (4.) Pinpoint,

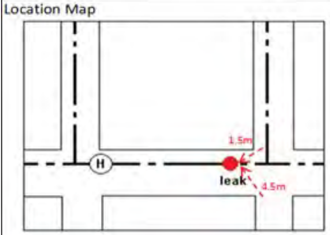
Leakage Point



Hole/Crack Size:(5 cm)



Location Map



Photo

Remarks:
leakage flow into the sewage pipe

Information of leakage repair

Excavation size: 1.5 m X 1.0 m X 1.2 m = (1.8 m³)

	Unit price	Hour	Volume	Sub total
Worker		2.0	3.0	
Plamber		2.0	2.0	
Supervisor		2.0	1.0	
Engineer		1.0	1.0	
Backhor		2.0	1.0	
Generator		1.0	1.0	
Drainage Pump		1.0	1.0	
Lighting equipment				
Sand			0.3	
Gravel			0.2	
Asphalt			1.5	
Total				

Used Material

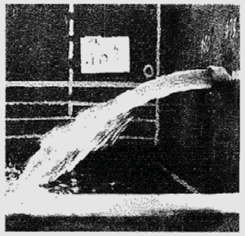
	Size/Type	Unit price	Volume	Sub total
Pipe-1	100 PVC		2.0	
Pipe-2				
Pipe-3				
Joint-1	100 Coupling		2.0	
Joint-2				
Joint-3				
Joint-4				
Joint-5				
Meter				
Packing				
Saddle				
Total				

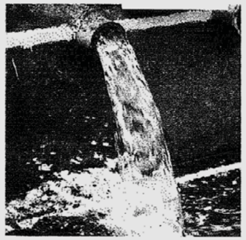
Pictures of water leak quantity

Diameter: 100mm

Discharge distance: 80cm	Discharge distance: 40cm	Discharge distance: 20cm
P: 0.2MPa, Q: 75m3/h	P: 0.2MPa, Q: 40m3/h	P: 0.2MPa, Q: 25m3/h
P1:0.3MPa, Q1:92m3/h	P1:0.3MPa, Q1:49m3/h	P1:0.3MPa, Q1:30m3/h
P2:0.4MPa, Q2:106m3/h	P2:0.4MPa, Q2:56m3/h	P2:0.4MPa, Q2:25m3/h

Diameter: 75mm

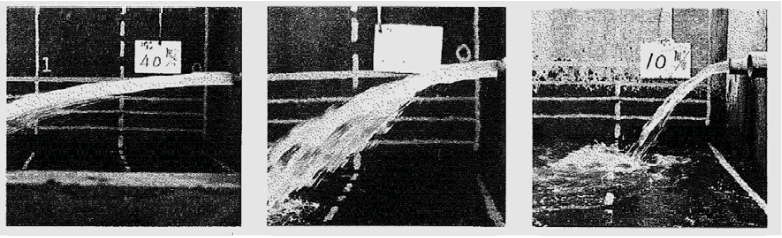




Discharge distance: 130cm	Discharge distance: 60cm	Discharge distance: 20cm
P: 0.2MPa, Q: 75m3/h	P: 0.2MPa, Q: 40m3/h	P: 0.2MPa, Q: 8m3/h
P1:0.3MPa, Q1:92m3/h	P1:0.3MPa, Q1:49m3/h	P1:0.3MPa, Q1:10m3/h
P2:0.4MPa, Q2:106m3/h	P2:0.4MPa, Q2:56m3/h	P2:0.4MPa, Q2:12m3/h

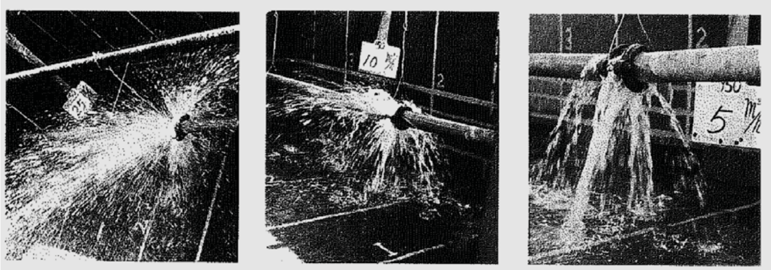
•

Diameter: 50mm



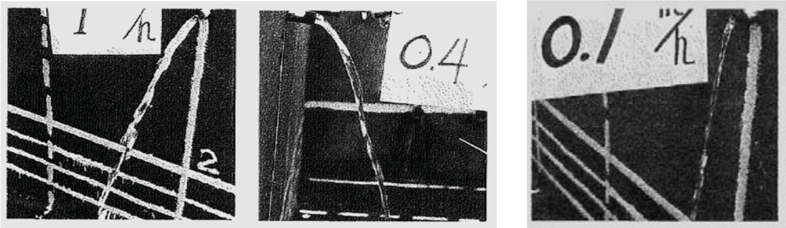
Discharge distance: 150cm	Discharge distance: 80cm	Discharge distance: 40cm
P: 0.2MPa, Q: 40m3/h	P: 0.2MPa, Q: 20m3/h	P: 0.2MPa, Q: 10m3/h
P1:0.3MPa, Q1:49m3/h	P1:0.3MPa, Q1:24m3/h	P1:0.3MPa, Q1:12m3/h
P2:0.4MPa, Q2:56m3/h	P2:0.4MPa, Q2:28m3/h	P2:0.4MPa, Q2:40m3/h

Diameter: 50mm (loosening of bolt and nut at joint)



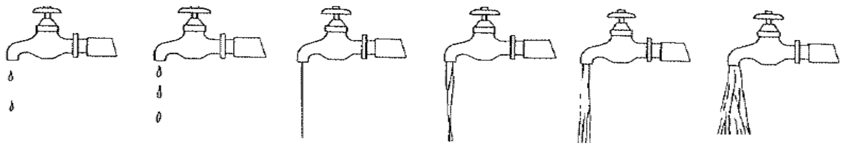
P: 0.2MPa, Q: 40m3/h	P: 0.2MPa, Q: 40m3/h	P: 0.2MPa, Q: 40m3/h
P1:0.3MPa, Q1:49m3/h	P1:0.3MPa, Q1:49m3/h	P1:0.3MPa, Q1:49m3/h
P2:0.4MPa, Q2:56m3/h	P2:0.4MPa, Q2:56m3/h	P2:0.4MPa, Q2:56m3/h

Diameter: 13mm



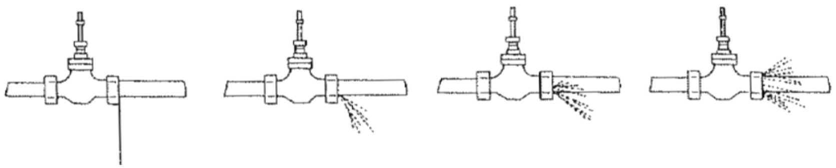
P: 0.2MPa, Q: 1.0m3/h	P: 0.2MPa, Q: 0.4m3/h	P: 0.2MPa, Q: 0.1m3/h
P1:0.3MPa, Q1:1.22m3/h	P1:0.3MPa, Q1:0.49m3/h	P1:0.3MPa, Q1:0.12m3/h
P2:0.4MPa, Q2:1.41m3/h	P2:0.4MPa, Q2:0.57m3/h	P2:0.4MPa, Q2:0.14m3/h

Tap ① ② ③ ④ ⑤ ⑥



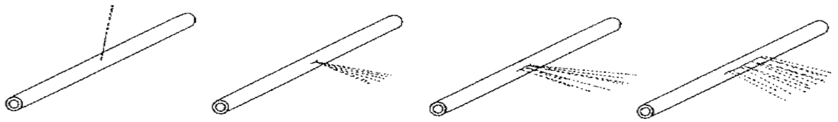
Water drop 30/min | Water drop 95/min | String like water | 90degree open | 180degree open | Full open

Valve ① ② ③ ④



String like water | Splaying (in part) | Splaying (half) | Spatter

Pep pipe ① ② ③ ④⑤⑥



Pin hole | Crack (1cm) | Crack (2cm) | Crack (3,4,5cm)

Dia:13mm Unit:m3/h

	①	②	③	④	⑤	⑥
Tap	0.0005	0.0015	0.004	0.129	1.65	2.36
Stop cock	0.002	0.096	0.125	0.296		
Pe Pipe	0.001	0.113	0.64	1.18	1.83	2.86

[PRACTICES AT THE Training Yard]

10-4. Leak detection

9.6. Leak Repair

(1) Introduction

Leaks should be repaired in the shortest possible time, using appropriate repair parts and work tools. Water utilities should monitor the time to find leaks and complete repairs as one of the NRW management performance indicators. Water utilities use a performance index called the completion rate of repairs within 24 hours. In order to shorten the repair time, it is necessary to improve the leak management system including the review of repair parts and work tools.

Repair of leaks involves several departments within the water utility. For example, the control room (observing the increase in consumption in the zone and requesting the person in charge to repair the leak), the material management department (storing repair materials and ordering as needed), and the leak repair staff themselves. It is important that all operational procedures are efficiently organized and well documented between the departments involved.

Water utility should make sure that frequently used parts are always in stock as long delivery times for required spare parts are not tolerable. Analyzing the failure database and failure rates might help to identify damage-prone types of pipes and valves.

The number of repair crews should be appropriate for the number of leaks and bursts needing to be repaired in specified target times. It is important that the leak repair personnel are well trained, motivated and equipped with all necessary equipment, vehicles, communication devices and safety gear.

The water utility's policy also has a strong influence on the speed and quality of repairs. Repair times can be reduced by setting performance targets for how fast a main break, a service connection leak or a defective valve have to be repaired.

Figure 9-30 Leak repair joint for 75 ϕ and 100 ϕ

(2) Leak repair parts

Leak repair parts should be in stock in the warehouse for speedy repair and emergency accident. The repair parts should be stored and classified in accordance with the size and types. The tools or devices such as blade of cutting machine and laminating equipment for night work should be stored. The common repair parts and tools for the daily work should be in leak repair vehicle.

1) Leak repair joint for the main pipe

Leak repair joint can be used as a leak repair work for the steel pipe, CIP and DCIP which has small size crack or hole. It has a bolt on the top of the joint, and decrease the water pressure by releasing water when cover it to the leaking point.

Figure 8-31 shows leak repair joints for 75mm and 100mm, which consists of parts with a water pressure releasing bolt. Tighten each bolt evenly with a wrench until rotation stops completely, and then close the water pressure release bolt. After tighten bolts, wipe the joint with a piece of dry cloth, and check if it has no-leak.

2) Pipe cutting

If the crack or other leak hole is larger than the joint, cut the pipe and replace it with a new pipe using the joint.

Use an engine cutter to cut metal or ACP pipe. Operators should wear dust-proof glasses, masks, gloves and safety shoes and be aware of the fast rotating blades.

Figure 9-31 Pipe cutting by engine cutter

3) Coupling joint

After cutting the pipe to eliminate leaks, install new pipes on both ends of the pipe. To replace the old line with the new pipeline, we recommend a coupling joint that simply tightens the bolts and nuts with a wrench. Tighten each bolt evenly until the wrench does not turn completely. After tightening the bolts and nuts, wipe the seams with a dry cloth to ensure that no water leaks under water pressure.

Figure 9-32 Coupling Joint

4) Earth retaining

If water comes out of the pipe, use the sheet pile stands upright on the excavation surface to ensure the safety of the workers. Especially for soft ground, the construction of sheet piles should be done carefully and reliably.

5) Trench Drainage

Trench drainage works will affect the construction schedule. Therefore, the amount of spring water and the amount of water in the pipe at the shut off part should be estimated in advance. Prepare a drainage pump with sufficient capacity and a spare pump in consideration with pump failure and efficiency reduction.

6) Pipe Washing out

Due to water leak repair work on the main pipe, rust inside may be removed and tap water may become turbid. The muddy water must be drained from the washout or fire hydrant until it becomes clear.

7) Leak repair on the service pipe

In the case of water leaks in the service pipe, cut the leak point in the same way as the main pipe, and replace it with a new fitting and pipe.

Figure 8-33 MC union joint

MC union joint can be used for the leak repair which has crack or hole in PE or PVC pipes. MC union joint is made of PVC, and have resistance to rust, chemical and stretching properties.

It can be installed easily in the water without heating and adhesive to repair leaks and can be connected just tightens up the union part at both sides with a wrench.

If there is no valve at PVC or PE service pipe, it's not possible to stop water for repair. In those cases, use a clamping device to stop the water. Clamp the pipe and push the air/oil jack handle until water has been stopped. MC-union-joint can be used at the clamped point to prevent leakage at clamped point.

(3) Record of Leak information

On-site observations are important for estimating leak rates. Estimate the leak volume if the leak is same amount as shown in leak volume table and keep a record at all times when repairing.

Please refer to the data recording sheet and take a picture of the amount leaked from the leak point.

By analyzing the failure (leak) database and failure rates, you can identify the types of pipes and valves that are easily damaged.

Figure 9-34
Clumping device to stop water

[PRACTICES AT THE Training Yard]

Leak repair

END

FACILITATION GUIDELINES

COMMON UNDERSTANDING

1. Common understanding (to be added/updated if any)

- The understanding of learners, particularly from field offices as well as non-technical section(s) including finance, whom knowledge about NRW may be limited. So, their understandings should be baseline.
- The words of these learners should be taken care of, and not only technical terms but plain words should be used to share common views.
- To make lectures and practices in not one-way communication but participatory and interactive ways. **Question from Facilitator to Learners and vice versa**.
- To avoid relying on textbook much in the training.
- Assistance required to record all remarks, Q&A. Productive remarks and questions from learners should be regarded highly as an assessment.
- Learners to ensure that all valuables and goods are kept safe at all times.

1. Aims of the Module

- **To introduce Facilitators, IBTC staff and learners**
- **To introduce training programme**
- **To think of why municipal NRW in South Africa is still high for the past decade.**
- **To understand what status-quo of municipal NRW and the target in NDP are.**
- **To think of why roadmap to problem solving in NRW management - starting from" see your situation STRAIT" is needed**

2. Length of the Module

50 minutes

Day 1 PM 10:00-10:50

3. Facilitators and Learners

Facilitator	Learner
Main-Facilitator (1): DWS (WUE) staff Sub-Facilitator (1): DWS (IBTC) staff Secretary for record & time keeping (1): Technical Support (2) JICA Observer:	Municipal officials from 4 municipalities

4. Check List for the Module

☐ Projector and screen ☐ PC for presentation (with anti-virus) ☐ White board, maker, eraser ☐ Pointer (with battery) ☐ Microphone: 4 (with battery) ☐ Recorder	☐ Presentation material (for facilitation)

<sample photos to be added>

5. Standard Facilitation Procedures of the Module

1 **Seating at the Venue**

1.1 Venue: Auditorium

1.1.1 Learners: Seating in the front rows grouped by municipality

1.1.2 Observers: Seating in the other rows

2 **Explanation of the Module (5 minutes)**

2.1 Explain outline of the module

2.2 Emphasize the key concept of the National NRW Training:
"For Municipalities by Municipalities with support from DWS, SALGA and stakeholders such as LGSETA."

3 **Introduction (15 minutes)**

3.1 Introduce facilitators and DWS staff (5 minutes)
- On the stage by using microphone
- Person to person
- With information of Organization and his/her post

3.2 Introduce learners (10 minutes)
- At his/her seat by using microphone
- Person to person
- Organization and his/her post

4 **Explanation of the National NRW Training and Q&A (30 minutes)**

4.1 Explain NRW and No-Drop statuses in South Africa (10 minutes)
- Engage learners to raise possible reasons of NRW at the high level, problems and challenges in their municipalities.

4.2 Explain the concepts of designing the National NRW Training (5 minutes)
- Based on the conclusion that fact findings and planning by proper measuring, measurement, and analysis of water volume are week.

4.3 Explain a series of modules of the National NRW Training (10 minutes)
- IBTC: 5 days – Workplace: 10 days – IBTC: 5 days – Workplace: 10 days
- Major modules

4.4 Q&A (5 minutes)

6. Preparation (10 minutes)

(1) Check the venue, tables, chairs, light and air condition early on.
(2) Check projector, screen, PC and microphones before the module.
(3) Check presentation material for facilitation
(4) Check spare, back-up and battery for the above items.
(5) Prepare white board on the stage.
(6) Microphone - 1: Main-Facilitator, 2: Sub-Facilitator or Moderator, 3&4: Learners
(7) Secretary prepares tools and devices for record & time keeping.

ORIENTATION: INTRODUCTION, TRAINING PROGRAMME AND PARTICIPANTS

<sample photos to be added>

7. Timeframe

Day 1 AM 10:00-10:50

09:50-10:00 Seating and Preparation

- ☐ 10:00-10:05 Explanation of the Module
- ☐ 10:05-10:20 Introduction
- ☐ 10:20-10:50 Explanation of the National NRW Training and Q&A

END

IBTC TOUR: FACILITIES, NRW TRAINING YARD AND EQUIPMENT

1. Aims of the Module

- **To introduce facilities explain rules of the facilities (OHS, Safety and Environmental)**
- **To introduce NRW training yard**
- **To introduce NRW training equipment**

2. Length of the Module

50 minutes

Day 1 PM 11:00-11:50

3. Facilitators and Learners

Facilitator	Learner
Main-Facilitator (1): DWS (IBTC) staff Sub-Facilitator (1): DWS (IBTC) staff Technical Support (2) JICA Observer:	Municipal officials from 4 municipalities

4. Check List for the Module

☐ NRW training yard setting ☐ NRW training equipment ☐ NRW training tools ☐ NRW training consumables	☐ Presentation material (for facilitation) ☐ Handouts (Leaners)

<sample photos to be added>

5. Standard Facilitation Procedures of the Module

1 Assembly at the venue

1.1 Venue: Training Yard (parking lot)

1.1.1 Ensure that all learners are present

1.1.2 Move to covered area of the training yard once all learners have been confirmed

2 Legal Compliance Briefing (5 minutes)

2.1 Explain the OHS, security and environmental rules of the facility:

- Emergency evacuation plan
- Emergency contact details

IBTC TOUR: FACILITIES, NRW TRAINING YARD AND EQUIPMENT

- Smoking zones

Notices / Prohibitions at the Training yard

- No smoking and flammable: Keep Fire Away
- No firearms
- No food and drink
- No wasting water for water conservation
- No removal of facilities and equipment
- No access or operations without Facilitators or Yard Assistance being present
- No putting foot and standing on pipes and valves
- No leaning on hydrants and standpipes
- No operation of the pump except by Yard Assistance
- No operation of the pump when water is low or empty in the tank
- Not more than 9 bar for water pressure

3 Introduction of the NRW Training Yard (20 minutes)

3.1 Provide learners with a diagram of the training yard

- A4 printout ~~clearly displaying section A, B and C including the different components~~

3.2 Explain the ~~complete~~ system to the learners and what each component represents or simulates in municipal infrastructure, and ensure there is a clear understanding of how Day 02 will play out.

- Water reservoir
- Pump
- Bulk meters
- Distribution pipeline
- Service pipeline
- Customer meters
- Consumer/customer

~~3.3 Explain the different training sections and what they represent~~

~~- Section A (Pipe assembly)~~

~~- Section B (Metering / water balancing)~~

~~- Section C (Leak detection)~~

3.4 Q&A (5 minutes)

4 Introduction of the NRW training equipment (25 minutes)

4.1 Briefly present and explain the use and function of all the NRW training equipment

- Physically present the equipment and give a summary of the use and how it works.

4.2 Q&A (5 minutes)

6. Preparation (30 minutes)

Before the Module:

(1) Check presentation material for facilitation
(2) Collect training equipment from the storage facility and prepare a display area.
(3) Unbox all training equipment
(4) Check that all training equipment is clean, in working condition and batteries are charged (if applicable).
(5) Ensure that training yard is clean and safe to access.
(6) Ensure that the training yard has sufficient water and electrical supply.
(7) Prepare the training yard reticulation for introduction (valve arrangements open/close)

After the Module:

(8) Take stock and box all training equipment
(9) Move training equipment to storage facility
(10) Secure and decommission training yard
- Remove pressure
- Open/close valves
- Switch off motor control centre

(11) Clean up training yard and equipment

<sample photos to be added>

7. Timeframe

Day 1 AM 11:00-11:50

10:30-11:00 Preparation
☐ 11:00-11:05 Legal compliance briefing
☐ 11:05-11:25 Introduction of the NRW training yard
☐ 11:25-11:50 Introduction of the NRW training equipment
11:50-12:00 Clearance

END

INTRODUCTION OF PARTICIPATING MUNICIPALITIES

1. Aims of the Module

- **To share major profile, water services, problems and challenges including NRW of participating municipalities.**
- **Icebreaking of learners.**

2. Length and the Module

1 hour 20 minutes

Day 1 PM 13:00-14:20

3. Facilitators and Leaners

Facilitator	Learners
Main-Facilitator (1): DWS Facilitator Sub-Facilitator 1 (1): Municipal Facilitator Sub-Facilitator 2 (1): DWS Facilitator Secretary for record & time keeping (1): Technical Support (2) JICA Observer:	Municipal officials from 4 municipalities

4. Check List for the Module

☐ Projector and screen ☐ PC for presentation (with anti-virus) ☐ White board, maker, eraser ☐ Pointer (with battery) ☐ Microphone: 4 (with battery) ☐ Recorder	☐ Outline information of municipalities (for distribution) ☐ Drawing for pilot DMA (for distribution)

<sample photos to be added>

5. Standard Facilitation Procedures of the Module

1 **Assembly at the Venue**

1.1 Venue: Auditorium

1.1.1 Learners: Seating in the front rows grouped by municipality

1.1.2 Observers: Seating in the other rows

IBTC National NRW Training
Day 01 PM 13:00-14:20
4 October 2019

INTRODUCTION OF PARTICIPATING MUNICIPALITIES

2 **Outline of the Module (5 minutes)**

2.1 Presentation time: 15 minutes (including Q&A for 5 minutes)

2.2 Determine a presenter from each participating municipality.

2.3 Facilitator get presenters' names.

2.4 Facilitator confirms presentation order.

3 **Presentation (60 minutes)**

3.1 Prepare microphones, 1: Main-Facilitator, 2&3: Sub-Facilitators, 4: Presenter

3.2 Keep time strictly.

3.3 Presentation and Q&A (15 minutes) x 4 participating municipalities (60 minutes):

3.3.1 Presentation (10 minutes)

- Profile of the municipality: population, location, geography, climate, socio-economy, industry, etc.
- Outline of water services of the municipality: population serve, service connection, water sources, supply capacities (m3 per day), water section's organizational information, NRW and ongoing interventions if any, etc.
- Outline of a proposed pilot DMA(s): location, area, land use, service connections, reasons of proposal, etc.
- Anticipation/wishes from the National NRW Training

3.3.2 Q&A (5 minutes)

- Question by a show of hands
- Limit number of question if many
- Make questions and answers concise

4 **Comments (15 minutes)**

4.1 Comments from Facilitators and technical supporters (10 minutes)

4.2 Wrap up by Main-Facilitator (5 minutes)

6. Preparation (10 minutes)

(1) Check the venue, tables, chairs, light and air condition early on.

(2) Check projector, screen, PC and microphones before the module.

(3) Check presentation materials from participating municipalities

(4) Check spare, back-up and battery for the above items.

(5) Prepare white board on the stage.

(6) Microphone - 1: Main-Facilitator, 2&3: Sub-Facilitators, 4: Presenter

(7) Secretary prepares tools and devices for record & time keeping.

<sample photos to be added>

INTRODUCTION OF PARTICIPATING MUNICIPALITIES

7. Timeframe

Day 1 PM 13:00-14:20

12:50-13:00 Assembly and preparation

- ☐ 13:00-13:05 Outline of the Module, determination of presenters and order
- ☐ 13:05-13:20 Presentation by participating municipality A and Q&A
- ☐ 13:20-13:35 Presentation by participating municipality B and Q&A
- ☐ 13:35-13:50 Presentation by participating municipality C and Q&A
- ☐ 13:50-14:05 Presentation by participating municipality D and Q&A
- ☐ 14:05-14:15 Comments from Facilitators and technical support
- ☐ 14:15-14:20 Wrap up by Main Facilitator

END

NRW, WATER BALANCE AND WATER RETICULATION BASICS

1. Aims of the Module

- **To understand what municipal NRW is.**
- **To understand why NRW management is necessary.**
- **To understand what water balance is.**
- **To understand water reticulation basics.**

2. Length of the Module

1 hour 30 minutes

Day 1 PM 14:30-16:00

3. Facilitators and Learners

Facilitator	Learner
Main-Facilitator (1): Municipal Facilitator Sub-Facilitator (1): Municipal Facilitator Moderator: (1): DWS staff Recording Secretary (1): Technical Support (2) JICA Observer:	Municipal officials from 4 municipalities

4. Check List for the Module

☐ Projector and screen ☐ PC for presentation (with anti-virus) ☐ White board, maker, eraser ☐ Pointer (with battery) ☐ Microphone: 4 (with battery) ☐ Recorder	☐ Sticky note (large size) ☐ Presentation material (for facilitation)

<sample photos to be added>

5. Standard Facilitation Procedures of the Module

1 **Assembly at the Venue**

1.1 Venue: Auditorium

1.1.1 Learners: Seating in the front rows grouped by municipality.

1.1.2 Observers: Seating in the other rows.

NRW, WATER BALANCE AND WATER RETICULATION BASICS

2 **Outline of the Module (5 minutes)**

2.1 To explain outline of the module.

2.1.1 Explanation of NRW

2.1.2 Explanation of Water Balance

2.1.3 Explanation of water reticulation basics

2.1.4 Q & A

2.2 To emphasize the importance of the module to be basic knowledge for the National NRW Training.

3 **Lecture and Q&A (1 hour 25 minutes)**

3.1 Explanation of NRW. (15 minutes)

3.1.1 Before going into details of NRW, to simplify NRW against Revenue Water in System Input Volume, for example

"SIV = RW + NRW" ⇒ "NRW = SIV – NR" ⇒ "NRW Ratio = NRW / SIV (%)"

"Revenue water is not bill-collected consumption but billed consumption."

3.1.2 To explain NRW as a performance indicator which leads to countermeasures to be taken by its analysis as well as to fact findings in the process of data collection and analysis.

3.1.3 To explain NRW involving a variety of aspects of water services (technical, non-technical, socio-economic, political, etc.), which needs wide-ranging viewpoints, understanding and efforts.

3.1.4 To explain anticipated impacts by NRW management.

3.2 Explanation of "Water Balance". (30 minutes)

3.2.1 To engage learners to think of method of Revenue Water calculation, its actuality and challenges if any in their municipalities.

3.2.2 To engage learners to list/brainstorm any items as possible NRW through their experiences (for example, pipe burst/leak, illegal use and domestic leak even it is not NRW.)

Point! It might be effective if facilitators utilize white board, sticky note, etc.

3.2.3 To demarcate the above items into components of water balance.

Point! Let learners grouped by municipality do it and present their results by workshop style.

3.2.4 To ensure highlighting Free Basic Water, excess use more than nominal consumption by flat-rate customer and domestic leak (e. c. water running in toilet) as awareness-raising items.

3.3 Explanation of water reticulation basics. (20 minutes)

NRW, WATER BALANCE AND WATER RETICULATION BASICS

- As basic knowledge for creating pilot DMA to be utilized at municipal workplaces in the National NRW Training

3.3.1 To explain basic categories of water reticulation by water flow.

3.3.2 To explain basics to zone/sectorize water reticulation and DMA.

3.4 Q&A (20 minutes)

6. Preparation (10 minutes)

(1) Check the venue, tables, chairs, light and air condition early on.
(2) Check projector, screen, PC and microphones before the module.
(3) Check presentation material for facilitation.
(4) Check spare, back-up and battery for the above items.
(5) Prepare white board on the stage.
(6) Microphone - 1: Main-Facilitator, 2: Sub-Facilitator or Moderator, 3&4: Learners
(7) Secretary prepares tools and devices for record & time keeping.

<sample photos to be added>

7. Timeframe

Day 1 AM 14:30-16:50

14:20-14:30 Assembly and Preparation
- ☐ 14:30-14:35 Outline of the Module
- ☐ 14:35-14:50 Explanation of NRW
- ☐ 14:50-15:20 Explanation of Water Balance
- ☐ 15:20-15:40 Explanation of water reticulation basics
- ☐ 15:40-16:00 Q&A

END

BULK METERING

1. Aims of the Module

- **To understand what importance and role of bulk flow measurement as function in the system are.**
- **To understand what features and difference in flow meter types (installation, accuracy maintenance, advantage and disadvantage, comparison) are.**
- **To understand what important points, purpose and cost on how to select flow meter type are.**

2. Length of the Module

50 minutes

Day 2 AM 9:00-9:50

3. Facilitators and Leaners

Facilitator	Learner
Main-facilitator (1) Municipal Facilitator Sub-facilitator (1) Municipal Facilitator Moderator (1) DWS staff Recording Secretary (1): Technical Support (1) JICA Observer:	Municipal officials from 4 municipalities

4. Check list for the Module

☐ Projector and screen ☐ PC for presentation (with anti-virus) ☐ White board, maker, eraser ☐ Pointer (with battery) ☐ Microphone: 4 (with battery) ☐ Recorder	☐ Presentation material (for facilitation) ☐ A demo unit : Mechanical Meter ☐ A demo unit : Ultrasonic Flow-meter

<sample photos to be added>

IBTC National NRW Training
Day 02 AM 9:00-9:50
4 October 2019.

BULK METERING

5. Standard Facilitation Procedures of the Module

1 **Assembly at the Venue**
- 1.1 Venue: Auditorium
  - 1.1.1 Learners: Seating in the front rows grouped by municipality.
  - 1.1.2 Observers: Seating in the other rows.

2 **Outline of the Module (5 minutes)**
- 2.1 To explain outline of the module.
  - 2.1.1 Roles and definitions of bulk meter
  - 2.1.2 Types of bulk meter
  - 2.1.3 Selection of bulk meter and points
  - 2.1.4 Accuracy of bulk meter
  - 2.1.5 Installation of bulk meter
  - 2.1.6 Q & A
- 2.2 To emphasize the importance of the module to be basic knowledge for the National NRW Training.

3 **Lecture and Q&A (45 minutes)**
- 3.1 Roles and definitions of bulk meter (5 minutes)
  - 3.1.1 Bulk meter of Water Boards to be included
  - 3.1.2 Figure: Water meter installation location is one of a most important figure to understand, why and where is the difference of water volume
  - Reference: Textbook "2.1 Role of bulk meter"
- 3.2 Types of bulk meter (10 minutes)
  - 3.2.1 Electromagnetic, mechanical (combination) and ultrasonic
  - 3.2.2 Demo unit of mechanical flow meter, and ultrasonic flow meter to know more practical information about flow meter.
  - Reference: Textbook "2.2 Variety of Bulk meter"
- 3.3 Selection of bulk meter and points (5 minutes)
  - 3.3.1 Understanding start flow, transient flow, maximum flow
  - 3.3.2 Introducing spec sheet of mechanical and ultrasonic flow meter
  - Reference: Textbook "Selection of water meters
- 3.4 Accuracy of bulk meter (10 minutes)
  - 3.4.1 How to read accuracy table
  - Reference: Textbook, "2.2.5 Accuracy of bulk meter"

BULK METERING

"Figure 2-18, 19, 20" is important to be able to select an appropriate water meter.

3.5 Installation of bulk meter (10 minutes)

3.5.1 Length from fittings

3.5.2 To understand why straight pipe is needed to install flow meter.

Reference: Text "2.2.6. Installation of bulk meter"

3.6 Q&A (5 minutes)

6. Preparation (10 minutes)

Before the Module:

(1) Check the venue, tables, chairs, light and air condition early on.
(2) Check projector, screen, PC and microphones before the module.
(3) Check presentation material for facilitation.
(4) Check spare, back-up and battery for the above items.
(5) Prepare white board on the stage.
(6) Microphone - 1: Main-Facilitator, 2: Sub-Facilitator or Moderator, 3&4: Learners
(7) Secretary prepares tools and devices for record & time keeping.
(8) Prepare demo units of bulk meter (mechanical and ultrasonic)

After the Module:

(9) Move training equipment to storage facility

7. Timeframe

Day 2 AM 9:00-9:50

9:00 Assembly at venue: auditorium

- ☐ 9:00-9:05 Outline of the Module
- ☐ 9:05-9:10 Roles and definitions of bulk meter
- ☐ 9:10-9:20 Types of bulk meter
- ☐ 9:20-9:25 Selection of bulk meter and points
- ☐ 9:25-9:35 Accuracy of bulk meter
- ☐ 9:35-9:45 Installation of bulk meter
- ☐ 9:45-9:50 Q&A

END

PIPE AND APPURTENANCE

1. Aims of the Module

- **To understand what reticulation systems and its design and gravity and pumping up systems.**
- **To understand what concept of zone system and DMA.**
- **To understand how to separate the system (water pressure, valve isolation) are.**
- **To understand what roles of appurtenances and function by cut models and practices in training yard are.**

2. Length of the Module

50 minutes

Day 2 AM 10:00-10:50

3. Facilitators and Leaners

Facilitator	Learner
Main-facilitator (1) Municipal Facilitator Sub-facilitator (1) Municipal Facilitator Moderator (1) DWS staff Recording Secretary (1): Technical Support (1) JICA Observer:	Municipal officials from 4 municipalities

4. Check list for the Module

☐ Projector and screen	☐ Presentation material (for facilitation)
☐ PC for presentation (with anti-virus)	☐ A cut model: Mechanical Meter
☐ White board, maker, eraser	☐ A cut model: PRV
☐ Pointer (with battery)	☐ A cut model: Valves
☐ Microphone: 4 (with battery)	☐ Sample pipes and joints: GP, HDPE, PVC
☐ Recorder	

<sample photos to be added>

PIPE AND APPURTENANCE

5. Standard Facilitation Procedures of the Module

1 **Assembly at the venue**
- 1.1 Venue: Auditorium
  - 1.1.1 Learners: Seating in the front rows grouped by municipality.
  - 1.1.2 Observers: Seating in the other rows.

2 **Outline of the Module (5 minutes)**
- 2.1 To explain outline of the module.
  - 2.1.1 Main pipe and the joints
  - 2.1.2 Advantage and disadvantage of pipe.
  - 2.1.3 Service pipe and the joints.
  - 2.1.4 Advantage and disadvantage of pipe.
  - 2.1.5 Roles and structure of appurtenance
  - 2.1.6 Pump, Valves, Air valves, PRV, (Pressure management using PRV,), Fire hydrant, Scour valve (drain valve)
  - 2.1.7 Q & A
- 2.2 To emphasize the importance of the module to be basic knowledge for the National NRW Training.

3 **Lecture and Q&A (45 minutes)**
- 3.1 Main pipe and Joint (10 minutes)
  - 3.1.1 Old main pipes and joints such as ACP, CI (welding)
  - 3.1.2 Current SA standard main pipe and joint
  - 3.1.3 Movie to explain proper main pipe connection (3mins)

  Reference: Textbook "4.2.1 and 4.2.2"
- 3.2 Service (Branch) pipe and Joint (10 minutes)
  - 3.2.1 Old service pipe and joint such as Lead pipe, Cupper pipe (welding), etc.
  - 3.2.2 Current SA standard service pipe and joint
  - 3.2.3 Movie to explain proper service pipe connection (3mins)

  Reference: Textbook "4.2.1 and 4.2.2"
- 3.3 Roles and Structure of appurtenance (Pump, Valves, PRV, Fire hydrant, Scour valve (drain)
  - 3.3.1 Pump
  - 3.3.2 Valves
  - 3.3.3 Air valves

PIPE AND APPURTENANCE

3.3.4 PRV

3.3.5 Fire hydrant

3.3.6 Scour valve (drain)

Reference: Textbook "4.2.4"

3.4 Q&A (5 minutes)

6. Preparation (10 minutes)

Before the Module:

(1) Check the venue, tables, chairs, light and air condition early on.

(2) Check projector, screen, PC and microphones before the module.

(3) Check presentation material for facilitation.

(4) Check spare, back-up and battery for the above items.

(5) Prepare white board on the stage.

(6) Microphone - 1: Main-Facilitator, 2: Sub-Facilitator or Moderator, 3&4: Learners

(7) Secretary prepares tools and devices for record & time keeping.

(8) Prepare demo units of bulk meter (mechanical and ultrasonic)

After the Module:

(9) Move training equipment to storage facility

<sample photos to be added>

7. Timeframe

Day 2 AM 10:00-10:50

10:00 Assembly at venue: auditorium

- ☐ 10:00-10:05 Outline of the Module
- ☐ 10:05-10:10 Main pipe and joints
- ☐ 10:10-10:20 Service pipe and joints
- ☐ 10:20-10:25 Roles and structure of appurtenance
- ☐ 10:25-9:35 Pump, Valves, Air valves, Scour
- ☐ 10:35-10:45 PRV
- ☐ 10:45-10:50 Q&A

END

CUSTOMER METERING

1 Aims of the Module

- To understand the importance and role of customer meter measurement as function in the system are.
- To understand the features and difference in customer meter types (installation, accuracy, maintenance, advantage and disadvantage, comparison) are.
- To understand the important points, accuracy and durability-on how to select customer meter type are.
- To learn how to install customer meters (vertical, horizontal) and right location
- To understand how to read customer meters.
- To understand the measurement data is utilized in not only billing but analysis of water supply services including NRW management

2 Length of the Module

50 minutes

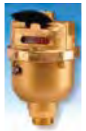
Day 02 AM 11:00-11:50

3 Facilitator and Learners

Facilitator	Learner
Main facilitator (1): Municipal facilitator Sub-facilitator (1): Municipal facilitator Moderator (1): DWS staff Recording Secretary (1): Technical support (1): JICA Observer:	Municipal officials from 4 municipalities

4 Check list for the Module

- ☐ Projector and screen
- ☐ PC for presentation (with anti-virus)
- ☐ White board, maker, eraser
- ☐ Pointer (with battery)
- ☐ Microphone: 4 (with battery)



- ☐ Recorder
- ☐ Presentation material (for facilitation)
- ☐ A sample unit : Volumetric, Inferential, Waltmann, IPERL water meter

☐

IBTC National NRW Training
Day 02 AM 11:00-11:50
5 October 2019

CUSTOMER METERING

5 Standard Facilitation Procedures of the Module

1 Assembly at the Venue

1.1Venue: Auditorium

1.1.1 Learners: Seating in the front rows grouped by municipality.

1.1.2 Observers: Seating in the other rows.

2 Outline of the Module (5 minutes)

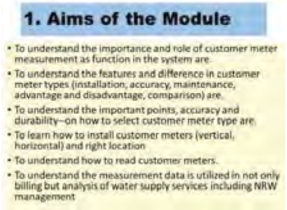
2.1To explain outline of the module. * Reference: Textbook "3 Customer Metering"

Meter sample: Volumetric meter, Inferential meter, Woltmann meter, Electromagnetic meter.

2.2To emphasize the importance of the module to be basic knowledge for the National NRW Training.

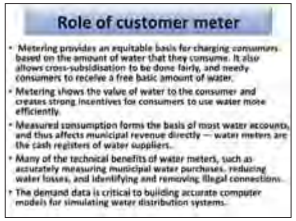
3 Lecture: Role of meter, meter structure, type, accuracy and installation, reading, accuracy of installed meter (40 minutes)

3.1 Aims of the module


1. Aims of the Module
- To understand the importance and role of customer meter measurement as function in the system are
- To understand the features and difference in customer meter types (installation, accuracy, maintenance, advantage and disadvantage, comparison) are.
- To understand the important points, accuracy and durability–on how to select customer meter type are
- To learn how to install customer meters (vertical, horizontal) and right location
- To understand how to read customer meters.
- To understand the measurement data is utilized in not only billing but analysis of water supply services including NRW management

3.2Measuring benefit (3 minutes) *Text book

3.1.1


Role of customer meter
- Metering provides an equitable basis for charging consumers based on the amount of water that they consume. It also allows cross-subsidisation to be done fairly, and needy consumers to receive a free basic amount of water.
- Metering shows the value of water to the consumer and creates strong incentives for consumers to use water more efficiently.
- Measured consumption forms the basis of most water accounts, and thus affects municipal revenue directly — water meters are the cash registers of water suppliers.
- Many of the technical benefits of water meters, such as accurately measuring municipal water purchases, reducing water losses, and identifying and removing illegal connections.
- The demand data is critical to building accurate computer models for simulating water distribution systems.

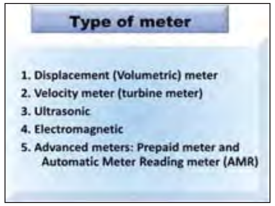
The base of getting income through the sale of water to the customers. If water meters are not managed correctly, it can have a negative impact on the income of municipalities.

- Metering provides an equitable basis for charging consumers based on the amount of water that they consume. It also allows cross-subsidisation to be done fairly, and needy consumers to receive a free basic amount of water.
- Metering shows the value of water to the consumer and creates strong incentives for consumers to use water more efficiently.
- Measured consumption forms the basis of most water accounts, and thus affects municipal revenue directly — water meters are the cash registers of water suppliers.
- Many of the technical benefits of water meters, such as accurately measuring municipal water purchases, reducing water losses, and identifying and removing illegal connections.

CUSTOMER METERING

- The demand data is critical to building accurate computer models for simulating water distribution systems.

3.3 Type of meters, showing sample meters Reference (5 minutes) TEXT3.1.2 Figure3-1



-Mechanical -----------Volumetric -------Rotary piston
-Inferential ------Radial vane ----Single jet
-Multi-jet
-Helical vane(Woltmann)
-(Combination)

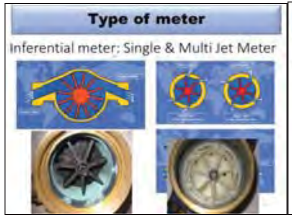
-Electromagnetic
-Ultrasonic

*Show sample water meters. Volumetric meter, Inferential meter, Woltmann meter, Electromagnetic meter.

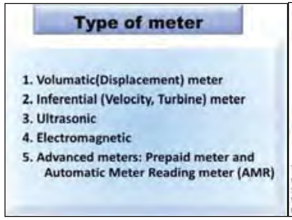
Explain structure and system of meter respectively.

-Velocity (Inferential) meter: measuring flow velocity, then transfer to water volume by mechanical system

-Volumetric meter: measuring volume



-Customer meter /Bulk customer meter: for consumer who use a significant volume. Very important customer.



CUSTOMER METERING

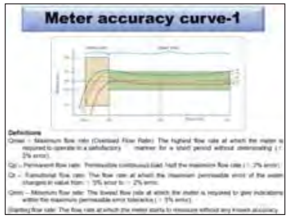
3.4 Meter accuracy and classes of meter (10minutes)

Reference: Textbook 3.1.3

(1) Accuracy

-Meters must have a defined accuracy. Low flow rate ± 5%. Rang of usual use is ±2%.

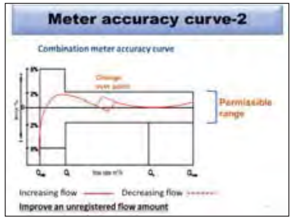
-The meter accuracy curve shows it visually, error range ±2 and± 5% .



-Combination meter

For customers who have a large difference in water usage, for example, customers who use a large amount of water during the day and use only a small amount of water at night. This case need a meter that can accurately measure both amount.

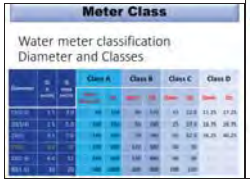
The accuracy curve of a combination meter is made up of the accuracy curves of the two meters that it consists of, but with a certain area of overlap between the flow rates at which the changeover valve opens and closes.

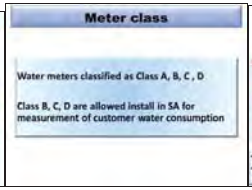


(2) Meter class *Reference: Textibook 3.1.4

-There are 4 metrological accuracy class: Class A,B,C,D. Allowed class for customer meters are B, C, D class.

The difference in meter class is the difference in the range of flow rate that can be measured accurately, not the accuracy itself. The difference between the metrological classes is at the point where they start measuring accurately. Explain Table 3-2 for example.

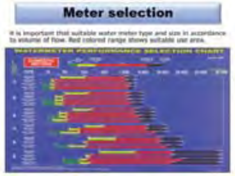




3.5 Selection of Meters (3 minutes)

Reference: Textbook 3.1.5

- Explain that it is important that suitable water meter type and size in accordance to volume of flow. Explain Figure3-13 if needs.
- Any meter selected must be approved and comply



CUSTOMER METERING

with the South Africa Bureau of Standard (SABS) and the South African Trade Metrology's standards.

3.6 Legal requirement （3 minutes） Reference: Textbook 3.1.6

- Meters must be approved by the legally recognized agency, South African National Standard (SANS) Specifications 1529-1.
- And water utility must confirm that meters have approved number and Lead Seal.

For example: SA1254, SA842. If you have a time let them see sample meters.

Lead seal:

If there is no South African number visible or if there are no readable details on the seal - reject the product, it is illegal.

@It is illegal, plumbers or any water supply utility staff break the lead seal and open water meters to clean meters and repair them at the site.

3.7 Installation of meters （3 minutes） Reference: Textbook 3.2.1

- All Single and multi-jet meter must be installed in a horizontal position for correct operation and for accuracy to be obtained.
- It is essential that shut off valves must be fitted on both sides of the meter for meter maintenance purposes.

-Meter set box is usualy installed. Meter, valve, and needed pipes are assembled in a plastic box. It is useful to new installation works.

Question to class - Advantages and disadvantages of above/below ground meters

3.8 Reading （1 minutes） Reference: Textbook 3.3

Facilitators should urge the learners to always pay attention to the accuracy of the meter reading data, as the department that reads the water meter is different.

-There are several type of meter, meter counter

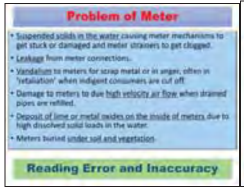
CUSTOMER METERING

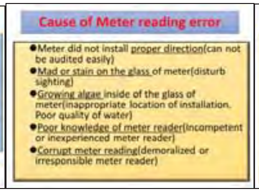
display is differ from type, it is important that pay attention to how to use m³ units and the decimal point, and over-roll.

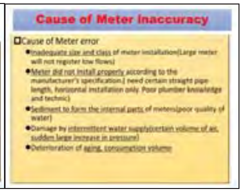
- ➢ Reading practice will be conducted at the TY

3.9 Problem of meter （5 minutes） Reference: Textbook 3.3.3

Suspended solid in the water causing meter mechanisms to get stuck or damaged and meter strainers to get clogged. Cleaning of strainer is common maintenance of meter.



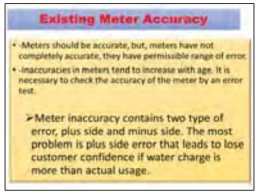




3.9.1 Existing meter accuracy Reference: Textbook 3.4

- Meters should be accurate in its life, but meters have not completely accurate, they have permissible range of error.

-Meter inaccuracy contains two type of error, plus side and minus side. The most problem is plus side error that leads to lose customer confidence if water charge is more than actual usage.

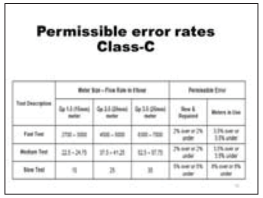


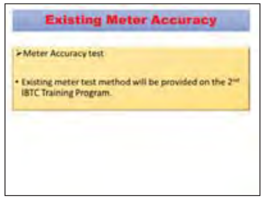
-Inaccuracies in meters tend to increase with age. It is necessary to check the accuracy of the meter by an error test.

3.9.2 Permissive error of meter used

There are permissible errors allowed for both new and repaired meters and for meters in use. The only meters which may be installed for trade use are meters which have passed the test for new meters. The maximum permissible error range for meter in use is larger than new meter, ±8% in the lower flow zone and ±3.5% in the higher flow zone. Meters not satisfying these requirements may not be reinstalled in the field. The accuracy of new meter is ±2% and± 5%

- ➢ Existing meter test method will be provided on the 2nd IBTC Training Program.





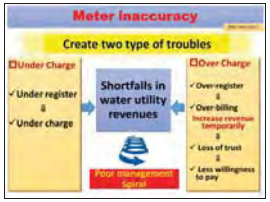
CUSTOMER METERING

-Meter inaccuracy create two type of troubles, under charge or over charge.

Under charge brings under resistser and decleasing income for the municipality. Limted budget can nor afford replace the inaccurate maters. This gose to under charge again.

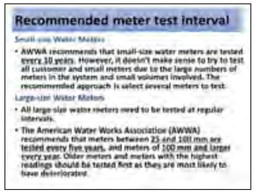
-On the other hand, Over charge bring over-register and over billng. This goes to loss of trust from the customer, then customer lose their willingness of payment and make difficult to collect water charge. Such an inaccurate meter will work against the municipalities in both cases, creating a spiral where it will continue to cause poor maintenance.

- In this connection, in Japan, meter replacement is determined by law every 8 years, and accurate metering is ensured.



3.10 Recommended water meter test interval (3 minutes)

- Recommended test years; small size (less than 25mm) meter test period by AWWA is 10 years. 25-100mm are every 5 years, larger than 100mm is every year.
- South Africa should regularize meter replacement period. For instance, the Measurement Law regulates replacement period of 8 years in Japan.



4 **Q&A (5 minutes)**

6 Preparation (10minutes)

- Several number of sample meters

7 Timeframe

Day 2 AM11:00-11:50
- ☐ 11:00-11:05 Explanation of the module
- ☐ 11:05-11:45 Lecture
- ☐ 11:45-11:50 Q&A

END

BULK METERING, PIPE & APPURTENANCE

1. Aims of the Module

- **To understand reticulation and pipeline features**
- **To understand procedures and point to remember of water filling and discharging**
- **To understand functions and point to remember of bulk meter**
- **To understand functions of appurtenance (components of a reticulation network)**
- **To understand installation and reading of water pressure gauge**

2. Length of the Module

1 hour 50 minutes (including 10 minutes break)

Day 2 PM 13:00-14:50

3. Facilitators and Learners

Facilitator	Learner
Main-Facilitator (1): Municipal Facilitator Sub-Facilitator (1): Municipal Facilitator Yard Assistance (1): DWS (IBTC) Technical Support (1): DWS Technical Support (1) JICA Observer:	Municipal officials from 4 municipalities to be divided into two Groups

4. Check List for the Module

☐ Yard: Reticulation pipelines	☐ Decomposed mode: Mechanical meter
☐ Yard: Inflow (SIV) bulk meter	☐ PE pipe (sample)
☐ Yard: Outflow bulk meter	☐ PVC pipe (sample)
☐ Yard: Water pressure gauge	☐ GI pipe (sample)
☐ Yard: Hydrants and valve key	☐ Asbestos pipe (sample)
☐ Yard: Air valve	☐ Tool (wrench, spanner, driver, a cut of cloth)
☐ Yard: Gate valves and valve key	☐ White board, maker, eraser
☐ Yard: Acrylic pipe	☐ A large-size yard drawing
☐ Cut-model: Mechanical meter	☐ A3 Yard drawing (for each learner)
☐ Cut-model: PRV	

<sample photos to be added>

BULK METERING, PIPE & APPURTENANCE

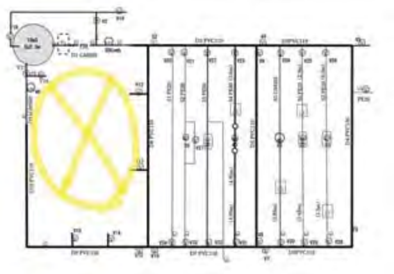
5. Standard Facilitation Procedures of the Module

1 **Assembly at the venue**

1.1 Venue: Training Yard

1.1.1 Ensure that all leaners are present

1.1.2 Move to Section A (underneath roof) of the training yard once all learners have been confirmed



2 **Confirmation of PPE (3 minutes)**

Uniform, protective shoes, helmet and gloves

3 **Re-confirmation of Rules (2 minutes)**

- No access or operations without facilitators being present
- Not put foot and stand on pipes and valves
- Not lean on hydrants and standpipes
- Not operate the pump (only Yard Assistance can do it.)

4 **Outline of the Module (10 minutes)**

4.1 Water Filling Demonstration

4.2 Water Flow Measurement

4.3 Installation of Meter

4.4 Water Pressure Measurement

4.5 Water Discharging Practices

4.6 Water Filling Practices

Group 1	Group 2
Water Filling Demonstration (10 minutes)	
Water Flow Measurement (15 minutes)	Installation of Meter (15 minutes)
Installation of Meter (15 minutes)	Water Pressure Measurement (15 minutes)
Water Pressure Measurement (15 minutes)	Water Flow Measurement (15 minutes)

BULK METERING, PIPE & APPURTENANCE

Water Discharging Practices (10 minutes)
Water Filling Practices (10 minutes)

5 Water Filling Demonstration (10 minutes)

5.1 To confirm water filling procedures (10 minutes)

5.2 To open all hydrants

5.3 To record starting time, start water filling at 50m head.

5.4 To observe air release during water filling, and close hydrants from the lower level after confirming water flows out without air.

5.5 To observe air valves and its function.

5.6 To confirm air does not remain any longer from the hydrant and the air valve at the highest level.

5.7 To open taps to observe air (as a customer)

6 Water Flow Measurement (15 minutes)

6.1 To confirm location and installed condition

6.2 To read meter(s). Each learner read, record, and plot it on graph.
Point! Check it for any misreading.

6.3 To flow water at the lowest and highest flow within proper range, and check flow visually through acrylic pipe (TBC)

7 Installation of Bulk Meter (15 minutes) *Not available now

*To assemble pipe and fittings around bulk meter in advance.

7.1 Facilitator to show a sample of installation.
Point! Proper direction of flow and meter, cleaning, gasket conditions and alignment

7.2 To let learner(s) install it by procedures with confirming points.

7.3 To consider points to remember for function, handling, installation and maintenance.

8 Water Pressure Measurement (15 minutes)

8.1 To show installation and measurement of water pressure gauge at a hydrant located at the lowest level.

8.2 To let learner(s) install the water pressure gauge at the hydrant.

8.3 To show installation and measurement of water pressure gauge at taps.

8.4 To let learners install the water pressure gauge at taps, one by one

8.5 To measure water pressure at the hydrant at the lowest level. (*gauges and adapters are in procurement.)

8.6 To estimate difference in pressure by heights.

BULK METERING, PIPE & APPURTENANCE

8.7 To measure pressure at taps from the lower level, compare them with estimated pressure (3 taps) to check precision of estimation.
*To measure the level difference among taps in advance.

8.8 Clean and put off water pressure gauge.

9 Water Discharging Practices (10 minutes)

9.1 To stop pump operation.

9.2 To open a hydrant at the highest level.

9.3 To open a drain valve at the lowest level.
Point! Let learners check air sucking from hydrants and understand negative pressure causes contamination in the pipeline.

10 Water Filling Practices (10 minutes)

In accordance of procedures the above section 5, let leaners practice water filling.

11 Q&A (15 minutes)

6. Preparation (30 minutes)

Before the Module:

(1) Collect tools, bulk meter, pipes, fittings for bulk meter installation and its cut model, and then prepare them at the yard.

(2) Prepare the large-size yard drawing on white board at the yard, which shows reticulation pipelines only (excluding service pipelines.

After the Module:

(3) Take stock and box all training equipment, tools and materials.

(4) Move training them to storage facility

(5) Secure and decommission training yard

- Remove pressure
- Open/close valves (let water remain in pipelines)
- Switch off motor control centre

(6) Clean up training yard and equipment

<sample photo to be added>

7. Timeframe

<Day 2 PM 13:00-14:50>

IBTC National NRW Training
Day 02 PM 13:00-14:50

4 October 2019

BULK METERING, PIPE & APPURTENANCE

13:00 Assembly at the venue (training yard)

- ☐ 13:00-13:05 PPE and reconfirmation of rules
- ☐ 13:05-13:15 Outline of the Module
- ☐ 13:15-13:25 Water Filling Demonstration
- ☐ 13:25-13:40 Group 1: Water Flow Measurement, Group 2: Installation of Bulk Meter
- ☐ 13:40-13:55 Group 1: Installation of Bulk Meter, Group 2: Water Pressure Measurement

<Break 10 minutes>

- ☐ 14:05-14:20 Group 1: Water Pressure Measurement, Group 2: Water Flow Measurement
- ☐ 14:20-14:30 Water Discharging Practices
- ☐ 14:25-14:35 Water Filling Practices
- ☐ 14:35-14:50 Q&A

END

CUSTOMER METER: INSTALLATION, READING, MAINTENANCE

1. Aims of the Module

- To understand installation considerations for different types of meters
- To understand how to read meter counters
- To learn meter maintenance

2. Length of the Module

60 minutes

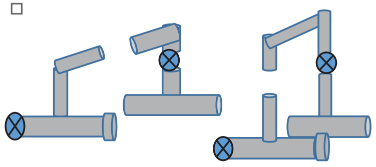
Day 2 PM15:00-16:00

3. Facilitators and Learners

Facilitator	Learner
Main facilitator（1）Municipality Sub-facilitator（1）Municipality TY management（1）IBTC Moderator（1）DWS Adviser（2）JICA Observer	Meter installation is performed by 4 groups for each utility. (Group A and B, 2 will install vertical type, and group C and D2 will install horizontal type) The meter reading will be done by the four types of meters installed in the TY.

4. Check List for the Module

□ Customer meter Volumatic type and Inferential type each 2) Total 4 units (15 ㎜) □ Meter installation pips (Pipes for vertical installation and horizontal installations are assembled in advance and only the front and back of the meter will be connected in practice) and connection parts (15 ㎜ PE or PVC), Refer drawings □ Connection hose 4 sets (tap and assembled meter) □ 「Meter reading record sheet」	□ Meter maintenance equipment (disassembled meter) □ Whiteboard, marker, eraser □ TY map: Displays the meters for reading practice □ Tools and consumables: 4 sets (wrench, spanner, piece of cloth, seal tape) □



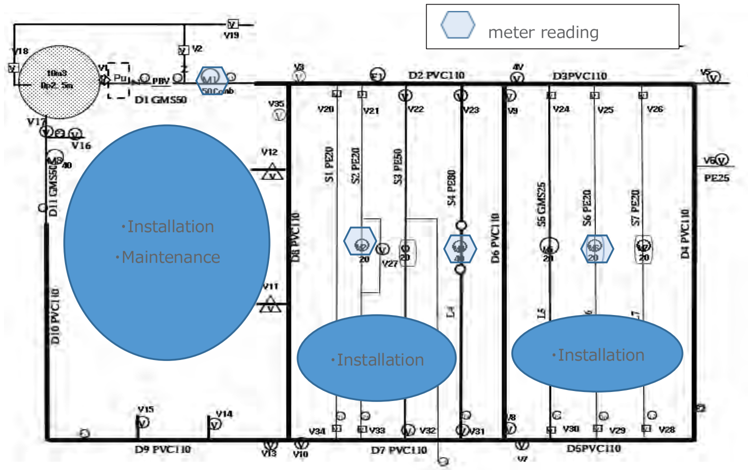
CUSTOMER METER: INSTALLATION, READING, MAINTENANCE

5. Standard Facilitation Procedures of the Module

1 Move to the yard (5 minutes)

1.1 Work clothes, safety shoes. Luggage can be left in the classroom except for valuables. (Classroom is locked)

Meeting place: Area A



2 Explanation of the Module (10 minutes)

2.1 The lecture in the morning provided the customer meter, type, precision, class, standard, installation method, meter reading. Reference: TEXT 3.1 and 3.2

2.2 Meter installation (vertical / horizontal and their piping) will be done by each municipality staff.

2.3 Be careful as water pressure is applied, so you will be injured if the pipe comes out.

2.4 Meters reading will be done 4 meters in the TY.

2.5 Meter maintenance will be done with explanation of the cause of meter failure, screen cleaning and meter box status check. The cause of meter trouble is described in TEXT 3.3.3.

3 Connection of meters (28 minutes)

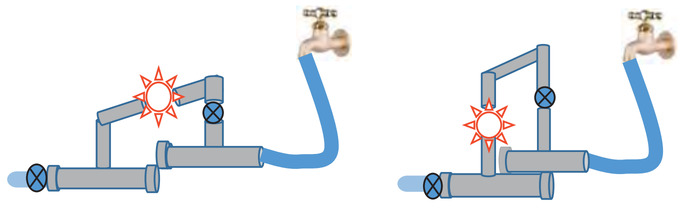
3.1 Demonstration by facilitator

- Explain the direction of the flow arrow on the meter body.

CUSTOMER METER: INSTALLATION, READING, MAINTENANCE

- Explain connection method with connection parts and do connect pipe and meter only one joint.

3.2 Connect a meter to each of the prepared horizontal and vertical pipes. Then run water, check water leak. (The following pipes are assembled in advance and only the meter is installed.)



3.3 Practice

- Check flow direction on the meter body and install way.
  - Note: Sigle and multi jet meters must be installed horizon, Volumatic meter is not this limitation.
- Install the meters with assembled pipes.
  - Note: Take appropriate connection sets. Roll up the seal tape is about 2-3 rounds, if old tape is remaining clean up completely.
  - Note: Do not over-tighten jointing parts, it causes broken of screw parts of pipe.
- After connection complete, connect with Tap for pressure test.
  - Note: pressure test is must
- First flow water until air is completely dehydrated and the close out flow valve and check leak.
- Remove meter from the support pipes.

4 Meter reading : Only reading, don't do consumption calculation (7 minutes)

4.1 Read counter of **M1, M2, M4, and M6**. Record reading data on the Reference-1 "Meter reading record sheet"

4.2 Each grope start different meter **A-M1, B-M2, C-M4, D-M6.** Groups read while changing places.

4.3 Check the figures that red by everyone.

4.3.1 Consumption calculation is home work.

5 Maintenance of meters (5 minutes)

5.1 Cleaning the meter screen: facilitator explains cleaning method with sample meter.

5.2 The facilitator explains how to bite the gear by pebbles that cause meter trouble using a meter that disassembles.

《It is not the illegal matter that the staff of water utility removes the meter and cleans the screen, but the meter must not be disassembled and cleaned by the staff of the water utilities. TEXT3.4.2 》> Also facilitator explains that the disassembled and cleaned meter must be tested in a formal manner and procedure and should not be re-installed or used unless it is certified.

IBTC National NRW Training 4 October 2019
Day2 PM 15:00-16:00

CUSTOMER METER: INSTALLATION, READING, MAINTENANCE

6 Q&A (5 minutes)

6. Preparation (20 minutes)

6.1 Water pressure will take from the supply water pressure; closeV17, openV2/V19

6.2 Tools, Assembled PVC or HDPE meter connecting parts, meters

6.3 Display and paste the location of meter using for meter reading on the whiteboard.

6.4 Finally, clean up the equipment and check the number of tools.

7. Timeframe

Day 2 PM15:00-16:00

- ☐ 15:00-15:05 Move to TY
- ☐ 15:05-15:15 Explanation of the module
- ☐ 15:15-15:43 Meter connection work
- ☐ 15:43-15:50 Meter reading
- ☐ 13:50－15:55 Explanation of meter maintenance
- ☐ 15:55-16:00 Q&A

Reference-1

Meter reading record sheet

Meter number	Previous	**New record**	Consumption
M1-L	999988.456		
M1-S	9989.345		
M2	9978.456		
M4	999789.567		
M6	9969.678		

DMA AND MEASUREMENT

1. Aims of the Module

- **To understand procedures and points to consider in DMA isolation and step test confirmation.**
- **To understand a method to identify a problematical part(s) in a reticulation system by water measurement.**
- **To understand procedures and points to consider in water filling and dewatering of a reticulation system.**
- **To review procedures of measuring SIV and water pressure.**
- **To understand assembling and analysis of measured data.**
- **To understand way to work efficiently by team**

2. Length of the Module

3 hours 10 minutes (including 20 minutes break)
Day 3 AM 9:00-12:10 (Group 1) / PM 13:00-16:10 (Group 2)

3. Facilitators and Learners

Facilitator	Leaners
Main-Facilitator (1): Municipal Facilitator Sub-Facilitator (1): Municipal Facilitator Yard Assistance (1): DWS (IBTC) Technical Support (1): DWS Technical Support (2): JICA	Municipal officials from 4 municipalities to be divided into two Groups 1 for AM and 2 for PM, further each Group into two sub groups (1A, 1B, 2A and 2B by municipality) (Day 3 Modules are alternated in AM and PM)

4. Check List for the Module

☐ Yard: Reticulation pipelines	☐ PVC pipe (sample)
☐ Yard: Inflow (SIV) bulk meter	☐ GI pipe (sample)
☐ Yard: Outflow bulk meter	☐ Asbestos pipe (sample)
☐ Yard: Water pressure gauge	☐ Tool (wrench, spanner, driver, a cut of cloth)
☐ Yard: Hydrants and valve key	☐ Data logger (2)
☐ Yard: Air valve	☐ White board, maker, eraser
☐ Yard: Gate valves and valve key	☐ A large-size yard drawing
☐ Yard: Acrylic pipe	

IBTC National NRW Training
Day3 AM 9:00-12:10 / PM 13:00-16:10
4 October 2019

DMA AND MEASUREMENT

☐ Cut-model: Mechanical meter	☐ A3 Yard drawing (for each learner)
☐ Cut-model: PRV	☐ SIV measurement log sheet (for learner)
☐ Decomposed mode: Mechanical meter	☐ Step Test plan (for learner)
☐ PE pipe (sample)	☐ Tags of service stopping at taps

<sample photos to be added>

5. Standard Facilitation Procedures of the Module

1 **Assembly at the venue**

1.1 Venue: Training Yard

1.1.1 Ensure that all leaners are present

1.1.2 Move to Section B and C (underneath roof) of the training yard once all learners have been confirmed

2 **Confirmation of PPE (3 minutes)**

Uniform, protective shoes, helmet and gloves

3 **Re-confirmation of Rules (2 minutes)**

- No access or operations without facilitators being present
- Not put foot and stand on pipes and valves
- Not lean on hydrants and standpipes
- Not operate the pump (only Yard Assistance can do it.)

4 **Outline of the Module (10 minutes)**

4.1 SIV measurement

4.1.1 To install data logger to inflow mechanical meter and start measuring SIV and water pressure *Keep this through the module.

4.2 Exercise of step test in DMA and site confirmation

4.2.1 To exercise step test procedures (develop step test plan) on map/drawing

4.2.2 To confirm map/drawing information and yard/site (physical situation)

4.3 Rehearsal of step test in DMA (confirmation of possibility)

4.3.1 To inform customers of water outage

4.3.2 To test step test

4.3.3 To restore reticulation (water filling, air release)

4.3.4 To review the procedures

4.4 Step test in DMA and measurement

4.4.1 To inform customers of water outage

DMA AND MEASUREMENT

4.4.2 To implement step test and measurement

4.4.3 To restore reticulation (water filling, air release)

4.4.4 To assembly and analyze date, which lead to identify or narrow down problematic block(s)

4.5 Data retrieval and analysis

- Data from the logger at mechanical meter, then make water flow and pressure graphs.

4.6 Additionally if possible, installation practice of ultrasonic flow meter, and comparison of data between mechanical and ultrasonic flow meters.

4.7 (Facilitator's Suggestion) To ensure leaners have reviewed the theory behind DMA/PMA - points to consider when designing a zone, components of a zone, water demand patterns, different land use types and best practice in terms of optimal operating pressures.

5 SIV measurement by data logger (20 minutes) – Sub-group A at M1, Sub-group B at M8

5.1 To install data logger on bulk meters by learners (one by one)

5.2 To log flow meter reading and average-per-minute flow in log sheet.
*Keep this through the module.

5.3 In parallel, to measure water pressure at SIV and three hydrants.
*Keep this through the module.

6 Exercise of step test in DMA and site confirmation (20 minutes) – Sub-group A&B jointly

6.1 To exercise step test procedures (develop step test plan with valve operation) of Blocks A, B and C on map/drawing

6.2 To confirm map/drawing information and yard/site (physical situation), and correct map/drawing if necessary
*Trick: On the map/drawing, to make discrepancy between them deliberately, valve location on drawing.

6.3 To propose installation of new valve(s) if necessary
*Not necessary in the yard

6.4 Topography and flow direction should be consider for valve operation.

6.5 Among a sub-group (a team of participating municipality), leadership and members' roles should be clarified in step test plan.

DMA AND MEASUREMENT

7 Rehearsal of step test in DMA (confirmation of possibility) – Sub-group A & B each (30 minutes)

7.1 To inform customers of water outage

- Although this process should be by municipal flyers or customer call, or through councilors in advance, the Module uses "notice tag of water outage" on taps at the yard as a substitute.

7.2 To implement step test in DMA in accordance with the step test plan.

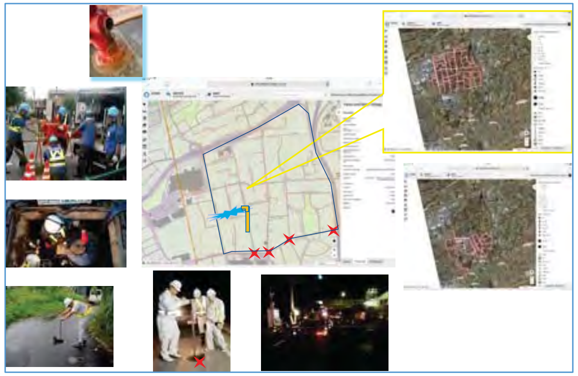
7.3 To measure and record water pressure at hydrants (before valve operation, after valve operation and after restoration of reticulation) (*gauges and adapters are in procurement.)

7.4 Step test for Block C, then Block B is confirmed respectively by using hydrants and reading water pressure.

7.5 To restore reticulation (water filling, air release)

7.6 To review the procedures
- If any problems in the procedures, to revise it and redo the rehearsal.
- At the real site, repairing, replacing or installing newly valves or facilities may be necessary due to their operational function.

DMA AND MEASUREMENT



8 Break (20 minutes)

9 Step test in DMA and measurement (30 minutes) – Sub-group A&B jointly

9.1 To inform customers of water outage

- Although this process should be by municipal flyers or customer call, or through councilors in advance, the Module uses "notice tag of water outage" on taps at the yard as a substitute.

9.2 To measure/record water flow by bulk meter for one minute.

9.3 To segment Block C out by step test, then measure/record water flow by bulk meter for one minute.

9.4 To segment Blocks C&B out by step test, then measure/record water flow by bulk meter for one minute.

9.5 To restore reticulation (water filling, air release)

9.6 To identify a problematic block(s) by reading/recording data

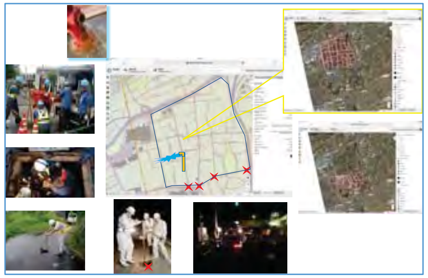
9.7 Option with time to spare

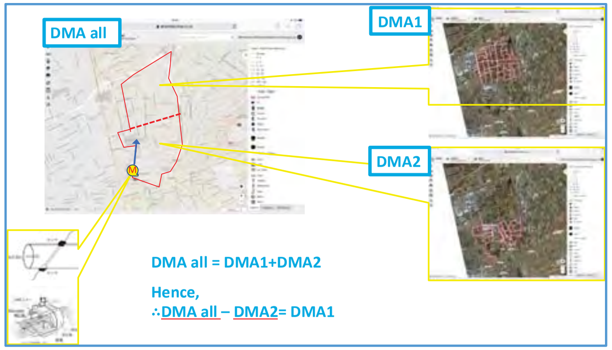
9.7.1 To conduct acoustic survey on taps in the most problematic block

9.7.2 To close cock/shutoff valves where leak sound is identified.

9.7.3 To measure water flow by bulk meter for one minute => to confirm leakage is repaired hypothetically

DMA AND MEASUREMENT





10 Installation practice of ultrasonic flow meter (15 minutes) – Sub-group A at M1, Sub-group B at M8 *when circumstances allow

10.1 Installation of ultrasonic flow meter, and comparison with mechanical flow meter for one minute

10.1.1 To discuss installation position and it reasons.

10.1.2 To check the range of water flow velocity.

10.1.3 To check pipe filled by water.

10.1.4 To check condition setting (such as how to know pipe thickness).

10.1.5 To input wrong condition deliberately (e. c. pipe material, thickness, water temperature), and check how they affect measurement.

11 Data retrieval and analysis at Computer Room (30 minutes)

11.1 To retrieve logging data of water flow and pressure into PC.

11.2 To assembly those data in data table of Excel

11.3 To make graphs

11.4 To identify changing points on the graphs by writing what the learner noticed..

DMA AND MEASUREMENT

12 Q&A（10 分）

6. Preparation (30 minutes)

Before the Module:

(1) Prepare the large-size yard drawing on white board at the yard, which does not show leakage points and is same information as handout to leaners.

(2) To set up pipe samples and equipment at the upside of the yard.

(3) To set up water reticulation

After the Module:

(4) Take stock and box all training equipment

(5) Move training equipment to storage facility

(6) Secure and decommission training yard

- Remove pressure
- Open/close valves
- Switch off motor control centre

(7) Clean up training yard and equipment

<sample photos to be added>

7. Timeframe

Group 1: Day 2 AM 9:00-12:10

9:00 Assembly at venue: training yard after changing cloth

- ☐ 9:00- 9:05 Confirmation of PPE, Re-confirmation of rule
- ☐ 9:05- 9:15 Outline of the Module
- ☐ 9:15- 9:35 SIV measurement by data logger
- ☐ 9:35- 9:55 Exercise of step test in DMA and site confirmation
- ☐ 9:55-10:25 Rehearsal of step test in DMA (confirmation of possibility)
- ☐ 10:25-10:45 Break
- ☐ 10:45-11:15 Step test in DMA and measurement
- ☐ 11:15-11:30 Installation practice of ultrasonic flow meter
- ☐ 11:30-12:00 Data retrieval and analysis at Computer Room
- ☐ 12:00-12:10 Q&A

Group 2: Day 2 PM: 13:00-16:10

13:00 Assembly at venue: training yard after changing cloth

- ☐ 13:00-13:05 Confirmation of PPE, Re-confirmation of rule
- ☐ 13:05-13:15 Outline of the Module

DMA AND MEASUREMENT

- ☐ 13:15-13:35 SIV measurement by data logger
- ☐ 13:35-13:55 Exercise of step test in DMA and site confirmation
- ☐ 13:55-14:25 Rehearsal of step test in DMA (confirmation of possibility)
- ☐ 14:25-14:45 Break
- ☐ 14:45-15:15 Step test in DMA and measurement
- ☐ 15:15-15:30 Installation practice of ultrasonic flow meter
- ☐ 15:30-16:00 Data retrieval and analysis at Computer Room
- ☐ 16:00-16:10 Q&A

END

1. Aims of the Module

- To understand the types and sources of inaccurate data of customer billing records. (Finding causes of error and correction method will be conducted 2nd IBTC training program)
- To understand illegal water use
- To understand how to handle FBW

2. Length of the Module

1hr and 20 or 30 minutes

Day 3 AM010:30-12:00 & PM14:30-16:00

3. Facilitators and Learners

Facilitator	Learner
Main facilitator (1) Municipality Sub-facilitator (1) Municipality Moderator (1) DWS Recording secretary (1) Technical Support (2) JICA Observer	Learners who can operate PC Excel will do operation he/herself, therefore those who don't know how to operate Excel are watch the screen which one can operate PC.

4. Check List of the Module

☐ Projector and screen ☐ PC for presentation (with anti-virus) ☐ White board, maker, eraser ☐ Pointer (with battery) ☐ Microphone: 4 (with battery) ☐ Recorder ☐ Presentation material (for facilitation) ☐ Whiteboard, marker, eraser	☐ Number of PCs (only those who can use Excel on a PC) ☐ Several USB (data distribution to PC) ☐ Sample customer data: Customer list with billing data for 1 year (monthly water bill) ☐ (If possible) Customer list with billing data for 1 year (monthly water bill) of candidate sites of DMA of each utility site

IBTC National NRW Training 4 October 2019.
Day3 PM 13:00-14:20 & AM 9:00-10:20
CUSTOMER METER ISSUES AND BILLING DATA ANALYSIS

5. Standard Facilitation Procedures of the Module

1 **Explanation of the module (5 minutes)**

Reference: TEXTBOOK 9

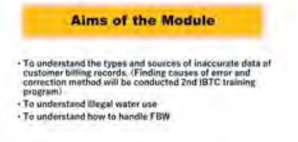
1.1 Data verification and processing, finding a presence of inaccurate data, etc.

1.2 Illegal water use. Finding method from the billing data and the field.

1.3 Drill: finding the presence of inaccurate data from the sample data sheet.

2 **Data verification and processing** (15 minutes) Reference: TEXTBOOK 9.1

2.1 Aims of the this module



2.2 Data verification and processing (2 minutes)

- To deal with customer bills and NRW analysis, customer consumption record is the essential database. However, the databases are often not as accurate. It is important to know where to look in the data to see inaccuracies, how to check, and how to fix it into usable data.

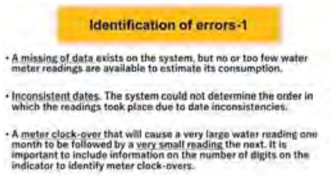
✧ Note: Consumption record will be fixed for only NRW calculation, don't apply fixed record for charge or trade. This is other matter.

@Aske learners [How to get correct and accurate customer consumption data for NRW calculation? Which department does supply the data? What do you think about data reliability?]

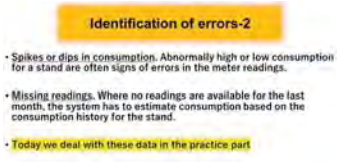
2.3 Identification of errors (5minutes)

CUSTOMER METER ISSUES AND BILLING DATA ANALYSIS

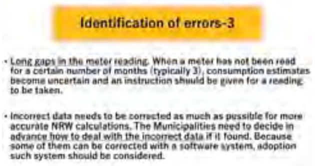
It is possible to calculate NRW more accurately by establishing a more accurate database by firmly confirming the acquired data, instead of using only acquired data. Some common errors on the system that should be identified and handled by a meter reading database are given below:



- A missing of data exists on the system, but no or too few water meter readings are available to estimate its consumption.
- Inconsistent dates. The system could not determine the order in which the readings took place due to date inconsistencies.
- A meter clock-over that will cause a very large water reading one month to be followed by a very small reading the next. It is important to include information on the number of digits on the indicator to identify meter clock-overs.



- Spikes or dips in consumption. Abnormally high or low consumption for a stand are often signs of errors in the meter readings.
- Missing readings. Where no readings are available for the last month, the system has to estimate consumption based on the consumption history for the stand.



- Long gaps in the meter reading. When a meter has not been read for a certain number of months (typically 3), consumption estimates become uncertain and an instruction should be given for a reading to be taken.
- Incorrect data needs to be corrected as much as possible for more accurate NRW calculations. The Municipalities need to decide in advance how to deal with the incorrect data if it found. Because some of them can be corrected with a software system, adoption such system should be considered.

3 **Illegal water use** (25 minutes) Reference: TEXTBOOK9.2

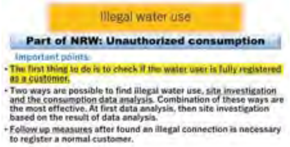
Aske learners [Are there many illegal water usages in your municipality?]

Aske learners [Do you have the experience finding an illegal use?]

CUSTOMER METER ISSUES AND BILLING DATA ANALYSIS

3.1 Important points (2 minutes)

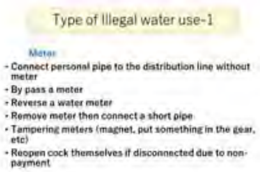
-Illegal water use is a part of unauthorized consumption of NRW



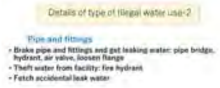
- The first thing to do is to check if the water user is fully registered as a customer.
- The first step to tackle illegal use of water, municipalities must find an Illegal connection. Two ways are possible, site investigation and the consumption data analysis. Combination of these ways are the most effective. At first data analysis, then site investigation based on the result of data analysis.
- Follow up measures after found an illegal connection is necessary to register a normal customer.

3.2 Type of illegal use (3 minutes)

3.2.1 Meter



- Connect personal pipe to the distribution line without meter
- By pass a meter
- Reverse a water meter
- Remove meter then connect a short pipe
- Tampering meters (magnet, put something in the gear, etc)
- Reopen cock themselves if disconnected due to non-payment



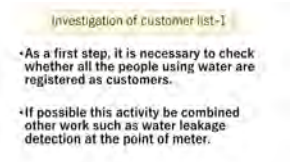
3.2.2 Pipe and fittings

- Brake pipe and fittings and get leaking water: pipe bridge, hydrant, air valve, loosen flange
- Theft water from facility: fire hydrant
- Fetch accidental leak water

CUSTOMER METER ISSUES AND BILLING DATA ANALYSIS

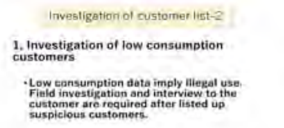
3.3 Investigation of customer list (5 minutes)

3.3.1 Investigation of registered customer and water user at the site



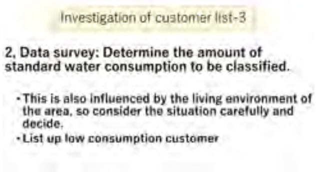
- As a first step, it is necessary to check whether all the people using water are registered as customers. It's important to look around the site with a customer list and a map that shows where the user lives. It is a time consuming and require many hands but one that cannot be avoided. If possible this activity be combined other work such as water leakage detection at the point of meter using acoustic stick.

3.3.2 Investigation of low consumption customers



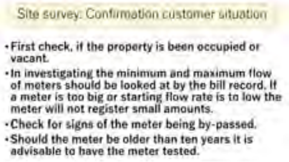
- Low consumption data imply illegal use. Field investigation and interview to the customer are required after listed up suspicious customers.

3.3.3 Data survey: Determine the amount of standard water consumption to be classified.



- This is also influenced by the living environment of the area, so consider the situation carefully and decide.
- List up low consumption customer

3.4 Site survey: Confirmation customer situation (5 minutes)



- First check, if the property is been occupied or vacant.
- In investigating the minimum and maximum flow of meters should be looked at by the bill record. If a meter is too big or starting flow rate is to low the meter will not register small amounts.
- Check for signs of the meter being by-passed.
- Should the meter be older than ten years it is advisable to have the meter tested.
-

3.5 Countermeasures for Illegal use (5 minutes)

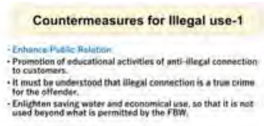
3.5.1 Institutionalization

IBTC National NRW Training
Day3 PM 13:00-14:20 & AM 9:00-10:20
4 October 2019.

CUSTOMER METER ISSUES AND BILLING DATA ANALYSIS

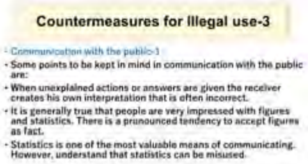
- The first step in addressing illegal usage is institutionalizing an illegal use reduction frame work. And base to on this frame work municipality must deal equally with violators, for instance, stop water supply, charge excess bill, fine, etc.
- Strengthening of penalties for violator.
- At the end it is important that offender must be registered as a regular customer and encourage them to pay regularly.
- Improvement of illegal connection discovery techniques by water flow volume management.
- Preparation of subsidies, discount system of installation of connection, and reduction of water charge. (Other than FBW).
- Incentive scheme to staff who discovered illegal connection.

3.5.2 Enhance Public Relation



- Promotion of educational activities of anti-illegal connection to customers.
- It must be understood that illegal connection is a true crime for the offender.
- Enlighten saving water and economical use, so that it is not used beyond what is permitted by the FBW.

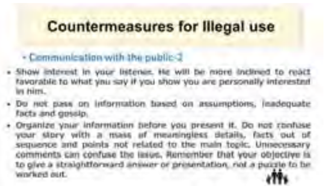
3.5.3 Communication with the public



Some points to be kept in mind in communication with the public are:

- When unexplained actions or answers are given the receiver creates his own interpretation that is often incorrect.
- It is generally true that people are very impressed with figures and statistics. There is a pronounced tendency to accept figures as fact.
- Statistics is one of the most valuable means of communicating. However, understand that statistics can be misused.

CUSTOMER METER ISSUES AND BILLING DATA ANALYSIS

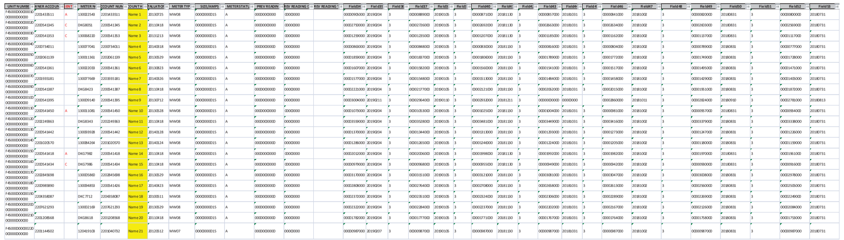


- Show interest in your listener. He will be more inclined to react favorable to what you say if you show you are personally interested in him.
- Do not pass on information based on assumptions, inadequate facts and gossip.
- Organize your information before you present it. Do not confuse your story with a mass of meaningless details, facts out of sequence and points not related to the main topic. Unnecessary comments can confuse the issue. Remember that your objective is to give a straightforward answer or presentation, not a puzzle to be worked out.

4 Sample data analysis by the PC (50-60 minutes)

4.1 Original data

Original data: 100 customers, meter reading record for 12 months



4.2 Monthly consumption

-Insert columns

-Use Excel function, make formula as subtract current month's data from last month to calculate monthly usage

4.3 Calculate Maximum, Minimum and Average

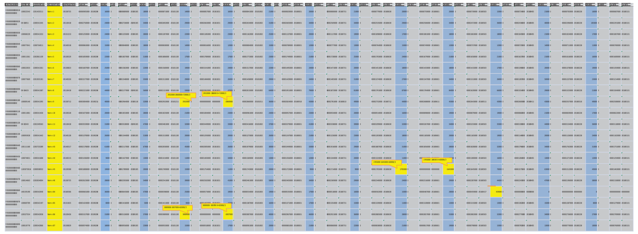
4.3.1 Calculate Maximum, Minimum, Average using Excel functions.

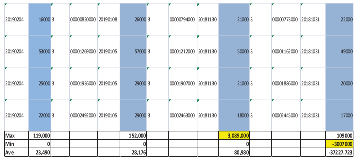
=MAX(AJ2:AJ103), =MIN(AJ2:AJ103), =AVERAGE(AJ2:AJ103)

-Find the abnormal value from them. Too much Max data, Too little Mini data

- Most of all minimum data is “0” consumption. It can be considered the following reasons.
  - Not used because people do not live during meter reading period
  - Not used because vacant house
  - Meter is broken

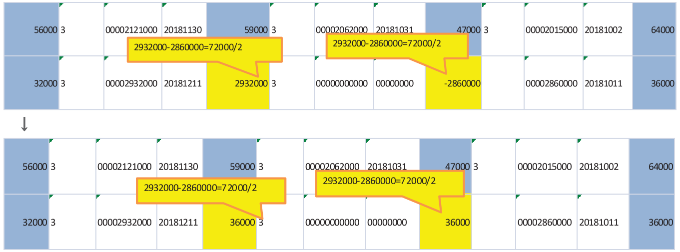
- Illegal use: Use water without meter
- Data handling error: data input miss, not read meter





4.3.2 Processing of “0” data

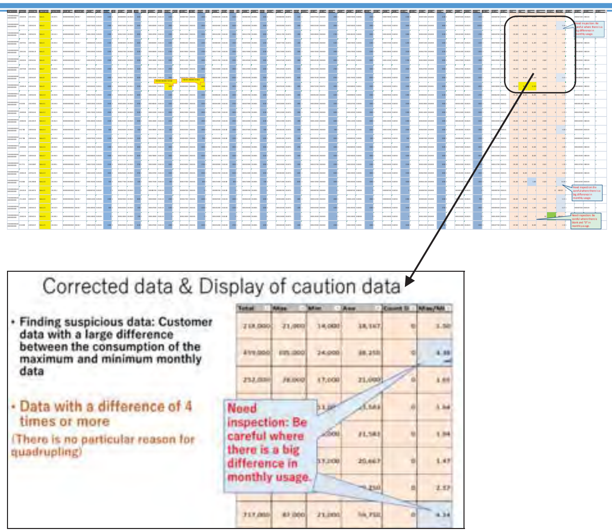
-Divide the usage difference from the month with data before and after the month without data by the number of months without data, and enter the average value.



4.4 How to find suspicious data

-Alternatively, find customers with large differences between maximum and minimum data

CUSTOMER METER ISSUES AND BILLING DATA ANALYSIS



4.4.1 Handling of FBW water volume

@ It must be acknowledged that confirmation of accuracy of billing data is important such as customer consumption which acquiring by other section in the municipality to know accurate NRW.

5 **Q&A（5 minutes)**

6. Preparation（10 minutes)

(1) Preparation of sample customer data: 100 connections case, monthly water consumption data for one year. Including missing and zero data. Also put FBW 6m³ and 8m³ indications.

7. Timeframe

Day 03 AM 10:30-12:00 & PM14:30-16:00

- ☐ 10:30-10:35, 14:30-14:35 Explanation of the module
- ☐ 10:35:10-45, 14:35-14:45 Data verification and processing
- ☐ 10:50-11:05, 14:50-15:05 Illegal water use
- ☐ 11:05-11:50, 15:05- 15:50 Sample data analysis
- ☐ 11:50-12:00 , 15:50-16:00 Q&A

END

National NRW training 4 October 2019.
Day3 PM 14:30-16:00 & 10:30-12:00

DMA PLANNING

1. Aims of the Module

- To understand what DMA and its concept are, and why DMA in the training.
- To understand what DMA planning and procedures for NRW management are.
- To understand how to select/create DMA by locating measurement point and isolating area.
- To understand what importance of measurement of water volume: system Input volume (SIV) and the consumption volume used by customer are.
- To understand advantages and disadvantages of DMA creation.

2. Length of the Module

90 minutes

Day 3 AM10:30-12:00 & PM14:30-1600

3. Facilitator and Learners

Facilitator	Learner
Main facilitator (1) Municipality Sub-facilitator (1) Municipality Moderator (1) DWS Recording Secretary (1) Technical Support (1) JICA Observer	Municipal officials from 4 municipalities

4. Check list of the Module

☐ Projector and screen	☐ Sample piping diagram for learners (5 DMAs, 5 subsections each, no meter installed, the number of existing valves is A demo unit: Ultrasonic flow meter
☐ PC for presentation (with anti-virus)	☐ Demo units: Pulse loggers
☐ White board, maker, eraser	☐ Demo units: Pressure loggers
☐ Pointer (with battery)	☐ Whiteboard, marker, eraser
☐ Microphone: 4 (with battery)	
☐ Recorder	
☐ only half of the required number)	
☐ Step Test answer sheet for learners	

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DMA PLANNING

<sample photos to be added>

5. Standard facilitation Procedures of the Module

1 **Explanation of total training menu (5 minutes)**

Reference: TEXT 6, "DMA PLANNING"

1.1 Purpose of DMA and How to create DMA?

1.2 Confirmation of hydraulic separation

1.3 DMA subdivision

1.4 Detail activities of measurement

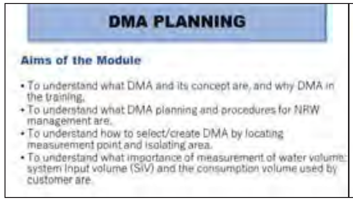
1.5 Drill-1 DMA creation on the sample pipelines.

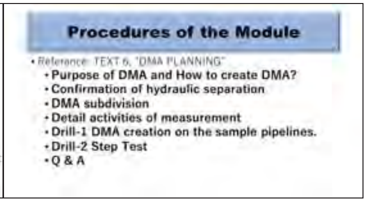
1.6 Drill-2 Step Test

1.7 Q & A

2 **DMA creation (25 minutes)**

—Aims of the Module





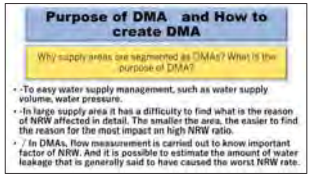
2.1 Purpose of DMA and How to create DMA (15 minutes) Reference: TEXT 6.1.2

2.1.1 Why supply areas are segmented as DMAs?

What is the purpose of DMA?

-To easy water supply management, such as water supply volume, water pressure.

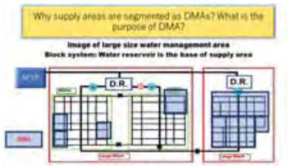
-In large supply area it has a difficulty to find what is the reason of NRW affected in detail.



The smaller the area, the easier to find the reason for the most impact on high NRW ratio.

DMA PLANNING

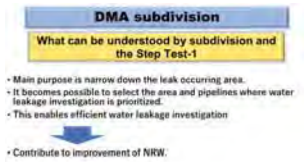
-In DMAs, flow measurement is carried out to know the important factor of NRW. And it is possible to estimate the amount of water leakage that is generally said to have caused the worst NRW rate.



2.1.2 DMA subdivision

This section is the explanation of **Step Test** that provide useful information about the amount of leakage and the area of occurrence.

- What can be understood by subdivision and the Step Test.



-Main purpose is narrow down the leak occurring area.

-It becomes possible to select the area where water leakage investigation is prioritized.

-This enables efficient water leakage investigation.

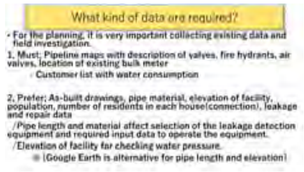
-Contribute to improvement of NRW.

2.1.3 What kind of data are required?

For the planning, it is very important collecting existing data and field investigation.

①Must; -Pipeline maps with description of valves, fire hydrants, air valves, location of existing bulk meter

- Customer list with water consumption

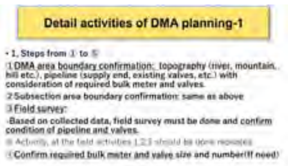


②Prefer; As-built drawings, pipe material, elevation of facility, population, number of residents in each house(connection), leakage and repair data

/Pipe length and material affect selection of the leakage detection equipment and required input data to operate the equipment.

/Elevation of facility for checking water pressure.

@ [Google Earth is alternative for pipe length and elevation]



2.1.4 Detail activities of DMA planning

DMA PLANNING

①DMA area boundary confirmation: topography (river, mountain, hill etc.), pipeline (supply end, existing valves, etc.) with consideration of required bulk meter and valves.

②Subsection area boundary confirmation: same as above

③Field survey:

-Based on collected data, field survey must be done and confirm condition of pipeline and valves.

@ Actually, at the field activities ①②③ should be done repeated.

④Confirm required bulk meter and valve size and number(If need)

⑤Installation of procured bulk meters and valves (If need)

2.2 Confirmation of hydraulic separation (10minutes)

When valves are installed, it needs confirmation of hydraulic separation of the DMA. And if a step test is planned, it is also necessary to perform a drop test in the subsections assumed in the step test.

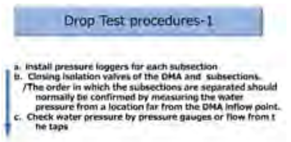
2.2.1 Procedures of Drop Test

-Drop Test procedures:

a. Install pressure loggers for each subsection

b. Closing isolation valves of the DMA and subsections.

/The order in which the subsections are separated should normally be confirmed by measuring the water pressure from a location far from the DMA inflow point.

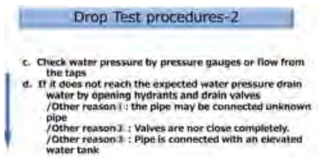


c. Check water pressure by pressure gauges or flow from the taps

d. If it does not reach the expected water pressure, (differs depending on the elevation) drain water by opening hydrants and drain valves in lower level until expected water pressure.

/Other reason ① : the pipe may be connected unknown pipe at somewhere, so watch out for changes in water pressure over time.

/Other reason ② : Valves are nor close completely. Check valves closed or not again.



DMA PLANNING

Hearing the valve noise is helpful to confirm.

/Other reason③ : Pipe is connected with an elevated water tank

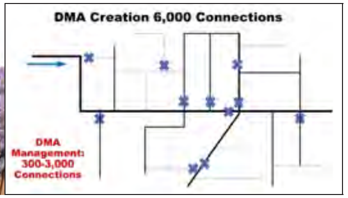
3 **Drill: DMA creation（25 minutes）** Reference: TEXT 6.1.3 "Measurement(SIV, MNF, Step Test"

3.1 Creation of DMA on the sample pipeline drawing. (25 minutes)

Flow of drill:

① Ask learners experience of DMA creation. If there, ask size of DMA and criteria of area selection.

② Hand out the drawing to learners



③ Ask learners [How many DMA will be organized with existing facilities?] (3minutes)

Do not show slides until learners answer

Explain on the PP slide, [2 DMAs]

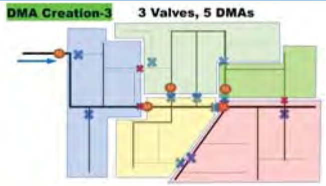
④ Ask learners [How many valves are required to create 3 DMAs?] (5minutes)

Ask some idea. Then explain on the PP slide, [1 valve]

⑤ Ask learners [How many valves are required to create 5 DMAs?] (5 minutes)

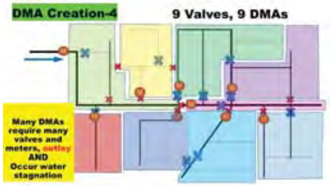
Ask some idea. Then explain on the PP slide, [3 valves]

DMA PLANNING



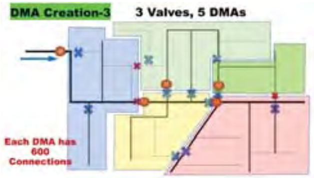
⑥ Ask learners [How many valves are required to create 9 DMAs?] (5minutes)

Ask some idea. Then explain on the PP slide, [9 valves]



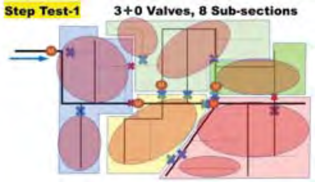
⑦Next step is sebsection creation

Show [DMA creation-3] slide.



Ask learners [How many subsections will be created without additional valves(3 + 0 =3 valves?] (2minutes)

Ask some idea. Then explain on the PP slide, [8 subsections. One subsection has less than 1000 connections. This is an example of extremely few existing valves]



⑧ Ask learners [How many subsections will be created with 3+6=9 valves?] (2minutes)

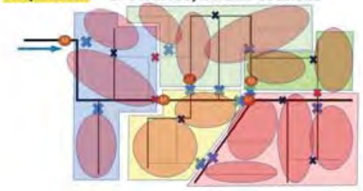
Ask some idea. Then explain on the PP slide, [8subsections]

This is difficult so don't take match time

DMA PLANNING

Then explain on the PP slide, [Add 3 + more 6=9 valves, we get 14 subsections.

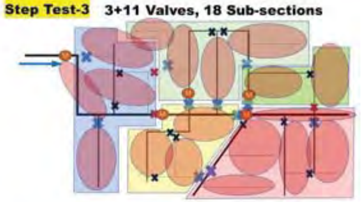
This case shows one subsection has less than 500 connections]



⑨Ask learners [How many subsections will be created with 3 valves and other extra valves? For example, 11 valves in order to one subsection has less than 400 connections]

Ask some idea. Then explain on the PP slide, [Add 3 + more 11=14 valves, we get 18 subsections] (2minutes)

<u>This is difficult so don't take match time</u>

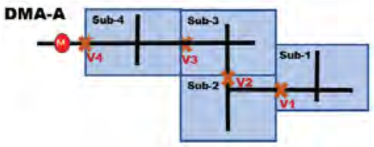


/Explain that it is desirable to set up an area that uses existing meters and gate valves as much as possible and minimizes new installations. The number of connections are 500-3000 is recommended. In this training at the "Work Place", we will plan to have as few as 300 connections in order to make it easier to do activities. (Consider the DMA with or without outflow, and different equipment depending on it).

@If you have experiences about creating DMAs, explain size of DMA from the aspect of management.

3.2 Drill: Step Test (25 minutes)

Model DMA



National NRW training
Day3 PM 14:30-16:00 & 10:30-12:00
4 October 2019.

DMA PLANNING

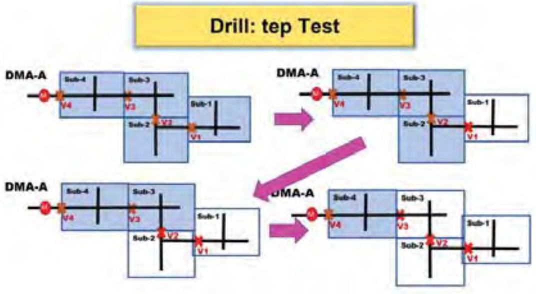
3.2.1 Order of close valve (5 minutes)

Ask learners [What order of valve operation is correct?]

Ask some idea. Then explain on the PP slide, [from V1 to V3. Usually V4 is not required operation, but the main inflow pipe downstream from the V4 valve is long and need to measure leak from the inflow main line, close V4]

[Explain with PP slide, steps of water suspended area by valve operation]

Do not show slides until learners answer



3.2.2 Calculation (20 minutes)

<u>Hand out the answer sheet to learners</u>

Ask learners [Calculate deference of each steps]

After learners completed the calculation, Which area has max volume of suspected leakage?

Aske their answer [Sub-3 is the largest volume of 50m3/h, half of the MNF volume occurred in this subsection and high priority of leak survey should be given]

DMA-A	SIV	Volume m2/h	500				
	MNF	Volume m3/h	100				
Step Test	Valve operation	Volume m3/h	Difference		Order		
Subsection		100					
1	Close V1	80	100-80	20	3		
2	Close V2	75	80-75	5	4	Min	Low priority
3	Close V3	25	75-25	50	1	**Max**	**High priority**
4	(Close V4)		100-(20+5+50)	25	2		

-Prioritization conditions (effects of pipeline length and number of connections)

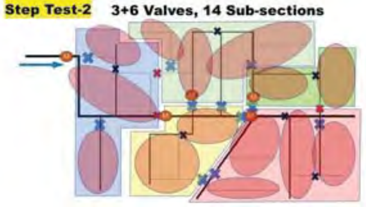
/Some of the criteria are considered for example Pile length, Number of connection, UARL

DMA PLANNING

Details of criteria should be determined depend of policy of municipality.

@Try model [Step Test-2; 5 DMAs and 14 subsections] case if we have time to spare time.

Number the subsections yourself and consider in what order the valves will close.



4 **Q&A（10minutes）**

6. Preparation（10 minutes）

(1) Sample piping diagram, Step test answer sheet, (If time is remaining , hand out PPT slide copy [Step Test-2;5 DMAs, 14 subsections])

(2) Ultrasonic flow meter, pulse counter logger, water pressure logger.

7. Timeframe

Day 3 AM10:30-12:00 & PM14:30-16:00

- ☐ 10:30:10:35 & 14:30-14:35 Explanation of total training menu
- ☐ 10:35-11:00 & 14:35-15:00 Purpose of DMA and How to create DMA?
- ☐ 11:00-11:25 & 15:00-15:25 Drill-1 DMA creation on the sample pipelines.
- ☐ 11:25-11:50 & 15:25-15:50 Drill-2 Step Test
- ☐ 11:50-12:00 & 15:50-16:00 Q & A

WORKPLACE MEASUREMENT PLANNING

1. Aims of the Module

- **To understand concept of the 1st workplace training.**
- **To understand procedures of the 1st workplace training.**
- **To prepare a workplace measurement plan by each municipality.**

2. Length and the Module

3 hours (including break)

Day 1 AM 09:00-12:00

3. Facilitators and Leaners

Facilitator	Learners
Main-Facilitator (1): DWS Facilitator Sub-Facilitator 1 (1): Municipal Facilitator Sub-Facilitator 2 (1): Municipal Facilitator Secretary for record & time keeping (1): Technical Support (2) JICA Observer:	Municipal officials from 4 municipalities

4. Check List for the Module

• Projector and screen • PC for presentation (with anti-virus) • White board, maker, eraser • Pointer (with battery) • Microphone: 4 (with battery) • Recorder	• Outline information of municipalities • Drawing for pilot DMA

<sample photos to be added>

5. Standard Facilitation Procedures of the Module

1 **Assembly at the Venue**

1.1 Venue: Auditorium

1.1.1 Learners: Seating in the front rows grouped by municipality

1.1.2 Observers: Seating in the other rows

WORKPLACE MEASUREMENT PLANNING

2 **Outline of the Module (5 minutes)**

2.1 Explanation of concept and procedures of the 1st workplace training

2.2 Preparation of workplace measurement plan

3 **Explanation of concept and procedures of the 1st workplace training (60 minutes)**

3.1 Facilitator to explain concept and procedures of the 1st workplace training

3.1.1 Basic flow of the 1st workplace training

3.1.2 Selection of pilot area

3.1.3 Isolation and making District-Metered Area (DMA)

3.1.4 Measurement in DMA

3.1.5 Analysis of measured/collected data

3.1.6 Reasons by using small pilot area

Point: No proper reticulation management skills in small area, No proper management skills in the whole system as well as No proper NRW management.

3.1.7 Schedule of the 1st workplace training

3.2 Q & A

4 **Break (15 minutes)**

5 **Preparation of workplace measurement plan (100 minutes)**

5.1 To group learners by a participating municipality as workshop style.

5.2 To utilize the drawings to be brought by the participating municipality

5.3 To confirm pipeline information, existing flow meters (in/out flow), valves, air valves, hydrants, topographic conditions, customers, etc.

5.4 To confirm possible locations for measurement/logging of water flow and pressure

5.5 To simulate the process of "DMA and measurement" on the drawings.

5.6 To prepare a workplace measurement plan during the 1st workplace training.

5.7 To prepare presentation of the workplace measurement planning.

6. Preparation (10 minutes)

(1) Check the venue, tables, chairs, light and air condition early on.

(2) Check projector, screen, PC and microphones before the module.

(3) Check presentation material.

(4) Check spare, back-up and battery for the above items.

(5) Prepare white board on the stage.

(6) Microphone - 1: Main-Facilitator, 2&3: Sub-Facilitators

WORKPLACE MEASUREMENT PLANNING

(7) Secretary prepares tools and devices for record & time keeping.

<sample photos to be added>

7. Timeframe

Day 4 AM 09:00-12:00

08:50-09:00 Assembly and preparation

- ☐ 09:00-09:05 Outline of the Module
- ☐ 09:05-10:05 Explanation of concept and procedures of the 1st workplace training
- ☐ 10:05-10:20 Break
- ☐ 10:20-12:00 Preparation of workplace measurement plan

END

PRESENTATION OF WORKPLACE MEASUREMENT PLAN

1. Aims of the Module

- **To share workplace measurement plans among participants.**
- **To learn different cases and good practices of measurement planning each other.**

2. Length and the Module

3 hours (including break)

Day 1 PM 13:00-16:00

3. Facilitators and Leaners

Facilitator	Learners
Main-Facilitator (1): DWS Facilitator Sub-Facilitator 1 (1): Municipal Facilitator Sub-Facilitator 2 (1): Municipal Facilitator Secretary for record & time keeping (1): Technical Support (2) JICA Observer:	Municipal officials from 4 municipalities

4. Check List for the Module

☐ Projector and screen ☐ PC for presentation (with anti-virus) ☐ White board, maker, eraser ☐ Pointer (with battery) ☐ Microphone: 4 (with battery) ☐ Recorder	☐ Outline information of municipalities ☐ Drawing for pilot DMA

<sample photos to be added>

5. Standard Facilitation Procedures of the Module

1 **Assembly at the Venue**

1.1 Venue: Auditorium

1.1.1 Learners: Seating in the front rows grouped by municipality

1.1.2 Observers: Seating in the other rows

2 **Outline of the Module (5 minutes)**

IBTC National NRW Training 4 October 2019
Day 04 PM 13:00-16:00

PRESENTATION OF WORKPLACE MEASUREMENT PLAN

2.1 Presentation time: 35 minutes (including Q&A for 10 minutes)

2.2 Determine a presenter from each participating municipality.

2.3 Facilitator get presenters' names.

2.4 Facilitator confirms presentation order.

3 **Presentation (155 minutes including 15 minutes break)**

3.1 Prepare microphones, 1: Main-Facilitator, 2&3: Sub-Facilitators, 4: Presenter

3.2 Keep time strictly.

3.3 Presentation and Q&A (35 minutes) x 4 participating municipalities (140 minutes):

3.3.1 Presentation (20 minutes)

- Details of a proposed pilot DMA(s): pipeline information, existing flow meters (in/out flow), valves, air valves, hydrants, topographic conditions, customers, etc.
- Measurement plan: things to be confirmed/clarified, work flow, measurement procedures, possible risks and challenges, etc.
- Safety/security considerations

3.3.2 Q&A (15 minutes)

- Question by a show of hands
- Limit number of question if many
- Make questions and answers concise

4 **Comments (20 minutes)**

4.1 Comments from Facilitators and technical supporters (15 minutes)

4.2 Wrap up by Main-Facilitator (5 minutes)

6. Preparation (10 minutes)

(1) Check the venue, tables, chairs, light and air condition early on.
(2) Check projector, screen, PC and microphones before the module.
(3) Check presentation materials from participating municipalities
(4) Check spare, back-up and battery for the above items.
(5) Prepare white board on the stage.
(6) Microphone - 1: Main-Facilitator, 2&3: Sub-Facilitators, 4: Presenter
(7) Secretary prepares tools and devices for record & time keeping.

<sample photos to be added>

PRESENTATION OF WORKPLACE MEASUREMENT PLAN

7. Timeframe

Day 1 PM 13:00-16:00

12:50-13:00 Assembly and preparation
- ☐ 13:00-13:05 Outline of the Module, determination of presenters and order
- ☐ 13:05-13:40 Presentation by participating municipality A and Q&A
- ☐ 13:40-14:15 Presentation by participating municipality B and Q&A

Break (15 minutes)
- ☐ 14:30-15:05 Presentation by participating municipality C and Q&A
- ☐ 15:05-15:40 Presentation by participating municipality D and Q&A
- ☐ 15:40-15:55 Comments from Facilitators and technical support
- ☐ 15:55-16:00 Wrap up by Main Facilitator

END

MODIFICATION OF WORKPLACE MEASUREMENT PLAN

1. Aims of the Module

- **To understand concept of the 1st workplace training.**
- **To understand procedures of the 1st workplace training.**
- **To prepare a workplace measurement plan by each municipality.**

2. Length and the Module

1 hour 20 minutes

Day 1 AM 09:00-10:20

3. Facilitators and Leaners

Facilitator	Learners
Main-Facilitator (1): DWS Facilitator Sub-Facilitator 1 (1): Municipal Facilitator Sub-Facilitator 2 (1): Municipal Facilitator Secretary for record & time keeping (1): Technical Support (2) JICA Observer:	Municipal officials from 4 municipalities

4. Check List for the Module

☐ Projector and screen ☐ PC for presentation (with anti-virus) ☐ White board, maker, eraser ☐ Pointer (with battery) ☐ Microphone: 4 (with battery) ☐ Recorder	☐ Outline information of municipalities ☐ Drawing for pilot DMA

<sample photos to be added>

5. Standard Facilitation Procedures of the Module

1 **Assembly at the Venue**

1.1 Venue: Auditorium

1.1.1 Learners: Seating in the front rows grouped by municipality

1.1.2 Observers: Seating in the other rows

MODIFICATION OF WORKPLACE MEASUREMENT PLAN

2 **Outline of the Module (5 minutes)**

2.1 Review of comments on presentations of workplace measurement plans

2.2 Modification of workplace measurement plan

3 **Review of comments on presentations of workplace training plans (10 minutes)**

3.1 Facilitator to remind comments on presentations of workplace measurement plans

4 **Modification of workplace measurement plans (50 minutes)**

4.1 To group learners by a participating municipality as workshop style.

4.2 To modify a workplace measurement plan during the 1st workplace training.

4.3 To clarify things to be prepared prior to the 1st workplace training and make a schedule for it.

5 **Q&A and Discussion (15 minutes)**

6. Preparation (10 minutes)

(1) Check the venue, tables, chairs, light and air condition early on.
(2) Check projector, screen, PC and microphones before the module.
(3) Check presentation material.
(4) Check spare, back-up and battery for the above items.
(5) Prepare white board on the stage.
(6) Microphone - 1: Main-Facilitator, 2&3: Sub-Facilitators
(7) Secretary prepares tools and devices for record & time keeping.

<sample photos to be added>

7. Timeframe

Day 5 AM 09:00-10:20

08:50-09:00 Assembly and preparation
☐ 09:00-09:05 Outline of the Module
☐ 09:05-09:15 Review of comments on presentations of workplace training plans
☐ 09:15-10:05 Modification of workplace measurement plans
☐ 10:05-10:20 Q&A and Discussion

END

ORIENTATION FOR WORKPLACE TRAININIG

1. Aims of the Module

- **To understand standard procedures of the 1st workplace training**
- **To understand roles and responsibilities, routines in a day, appointment of courtesy call, logistics clarification during the 1st workplace training**
- **To understand the workplace training programme as a standard.**
- **To share facilitator deployment plan during the 1st workplace training**

2. Length of the Module

1 hour 30 minutes

Day 5 PM 10:30-12:00

3. Facilitators and Learners

Facilitator	Learner
Main-Facilitator (1): DWS (WUE) staff Sub-Facilitator (1): DWS (IBTC) staff Secretary for record & time keeping (1): Technical Support (2) JICA Observer:	Municipal officials from 4 municipalities

4. Check List for the Module

☐ Projector and screen ☐ PC for presentation (with anti-virus) ☐ White board, maker, eraser ☐ Pointer (with battery) ☐ Microphone: 4 (with battery) ☐ Recorder	☐ Presentation material (for facilitation) ☐ Handouts (for learners)

<sample photos to be added>

5. Standard Facilitation Procedures of the Module

1 **Seating at the Venue**

1.1 Venue: Auditorium

1.1.1 Learners: Seating in the front rows grouped by municipality

1.1.2 Observers: Seating in the other rows

ORIENTATION FOR WORKPLACE TRAININIG

2 **Explanation of the Module (5 minutes)**

2.1 Explain outline of the module

3 **Explanation of 1st Workplace Training (60 minutes)**

3.1 Confirmation of roles and responsibilities, routines in a day, appointment of courtesy call, logistics clarification, etc.

3.2 Workplace training programme on Day 6

3.3 Workplace training programme on Day 7 to 14

3.4 Workplace training programme on Day 15

3.5 Deployment plan of facilitators

4 **Q&A (10 minutes)**

5 **Comments and Wrap up (15 minutes)**

5.1 Comments from Facilitators and technical supporters (10 minutes)

5.2 Wrap up by Main-Facilitator (5 minutes)

6. Preparation (10 minutes)

(1) Check the venue, tables, chairs, light and air condition early on.
(2) Check projector, screen, PC and microphones before the module.
(3) Check presentation material for facilitation
(4) Check spare, back-up and battery for the above items.
(5) Prepare white board on the stage.
(6) Microphone - 1: Main-Facilitator, 2: Sub-Facilitator or Moderator, 3&4: Learners
(7) Secretary prepares tools and devices for record & time keeping.

<sample photos to be added>

7. Timeframe

Day 5 AM 10:30-12:00
10:20-10:30 Assembly and Preparation
☐ 10:30-10:35 Explanation of the Module
☐ 10:35-11:35 Explanation of 1st Workplace Training
☐ 11:35-11:45 Q&A
☐ 11:45-12:00 Comments and Wrap up

END

WORKPLACE DAY-1 (COURTESY & SITE CONFIRMATION)

1. Aims of the Module

- **To experience protocol for securing the cooperation of municipal management**
- **To experience protocol for securing the cooperation of community**
- **To learn actual procedures, methods, equipment and tools at the site or office**
- **To learn necessary data for NRW and reticulation management**
- **To obtain skills for metering and measurement (to acquire, assemble and analyze data) for NRW and reticulation management**
- **To learn conditions and how to use/install equipment and tools for NRW and reticulation management**
- **To learn preparation and consideration for activities with safety**

2. Length of the Module

7 hours and 20 minutes (including lunch break for 60 minutes)

Day 6 8:40-16:00

3. Facilitators and Learners

Facilitator	Learner
Main-Facilitator (1): Municipal Facilitator Sub-Facilitator (1): Municipal Facilitator Moderator (1): DWS staff Assessor (1): IBTC staff Technical Support (1) JICA	Municipal officials (3 to 5 learners) Municipal officials (field staff in pilot DMA, to be coordinated by participating municipality in advance) Local police (as needed, to be coordinated by participating municipality in advance)

4. Check List

☐ Reticulation drawings (pipeline data, flow meter, valve, hydrant, PRV, etc. ☐ Hydraulic map (water flow velocity distribution map, water pressure distribution map) ☐ Topographic map with contours ☐ Color-coded map by water consumption ☐ Color-coded map by bill collection	☐ Tool set ☐ Vehicle(s) for team members ☐ Vehicle(s) for participating municipality ☐ Ultrasonic flow meter (as needed) ☐ Pressure data logger (as needed) ☐ Water flow data logger (as needed) ☐ Communication device (cellphones, walkie-talkies, etc.)

WORKPLACE DAY-1 (COURTESY & SITE CONFIRMATION)

☐ Workplace training plan to be prepared by participating municipality	☐ ID and employment card (team members) ☐ Workplace training record format (log sheets, daily report, etc.)

<sample photo to be added>

5. Standard Facilitation Procedures of the Module *To be flexible according to workplace situations

1 Team gathering

1.1 To be punctual at the meeting point

1.2 To introduce team members under DWS's initiative and explain this day activities

1.3 To explain about daily briefing at the beginning and daily review/evaluation at the end of the business day during workplace training.

2 Courtesy call to the participating municipality (45 minutes)

2.1 All team members to pay a courtesy call to municipal head office

2.2 DWS to explain about the Project and the National NRW Training (less than 3 pages, briefly, shortly and systematically)

2.3 Municipal coordinator to explain about workplace training for the next 2 weeks (less than 5 pages, briefly, shortly and systematically)

3 Move to the office or equivalent place in the community (15 minutes)

4 Outline of workplace training by using pilot DMA (60 minutes)

4.1 To assemble at the office or equivalent place in the community

4.2 To introduce team members, learners and field staff in the presence of community representative(s) or equivalent (10 minutes)

4.3 To explain about activities in the pilot DMA, schedule and benefits to the area (20 minutes)

4.4 Q&A

5 Move to pilot DMA site (15 minutes)

6 Site reconnaissance (45 minutes)

6.1 To confirm water supply, a SIV point and reticulation pipelines

6.2 To overview a pilot DMA area by driving

6.2.1 Community situation (house size, water use, water tank, floor/stories)

WORKPLACE DAY-1 (COURTESY & SITE CONFIRMATION)

6.2.2 Security situation
6.2.3 Topography and landscape conditions (height difference)
6.2.4 Locations of fire hydrants, PRVs, etc.
6.2.5 Major water consumers (shopping mall, school, factory, etc.)

7 Lunch break (60 minutes)

8 Survey/confirmation of a SIV Point at the site (60 minutes)

8.1 To reconfirm conditions of bulk (ultrasonic if needed) flow meter installation for the next day

8.1.1 Daily variation in water pressure
8.1.2 Daily variation in water flow
8.1.3 Pipe material, diameter and thickness
8.1.4 Required straight length
8.1.5 Suitable meter diameter by water flow volume
8.1.6 Existence/non-existence of strainer and its necessity
8.1.7 Reconfirmation of preparation for bulk (ultrasonic if needed) flow meter installation

Point: The above should be done in the preparatory (previous) week in principle, so municipal facilitator(s) should reconfirm understanding of learners at the site.

9 Return to the office or equivalent place in the community (15 minutes)

10 Confirmation of the next day's activities (30 minutes)

10.1 To confirm procedures of starting measurement bulk (ultrasonic if needed) flow meter installation)
10.2 Q&A

11 Review of this day's activities (60 minutes)

11.1 Municipal facilitator(s) to remind items of this day's activities (5 minutes)
11.2 Learners to write them in log sheet (20 minutes)
11.3 Each learner to present awareness and lessons learnt (20 minutes)
11.4 Facilitator(s) to make an overall comment (5 minutes)
11.5 Municipal coordinator to explain about preparation for the next day to learners (10 minutes)
11.6 Moderator (DWS staff) and/or assessor to collect log sheets of this day, let municipal facilitator(s) sign them.

WORKPLACE DAY-1 (COURTESY & SITE CONFIRMATION)

12 Wrap up meeting by team members only (30 minutes)

12.1 To review workplace training in terms of implementation and logistics, and the Project Team (secretariat) prepares a report.
12.2 To record attainment, problems and issues, lesson learnt in the report.
12.3 To consider occupational health and safety, security and communication of all participants
12.4 Moderator (DWS staff) and/or assessor to copy log sheets and return them to learners in the next day.

6. Preparation

(1) Prepare and carry tools and equipment for workplace training.
(2) The Project Team (secretariat) drafts log sheets in accordance with each workplace training plan in the preparatory week, and finalizes it with comments from facilitators.
(3) A role of main facilitator is to take leadership in workplace training together with municipal coordinator.
(4) A role of sub facilitator is to support/advise main facilitator and learners in technical aspects.
(5) Moderator (DWS staff) is a representative of the Project (National NRW Training) and has moderating function.
(6) Moderator (DWS staff) and/or assessor carry log sheets, take photos of workplace training, keep log sheets and ensure the objectivity.
(7) JICA experts provide technical advices and support.
(8) At the end of business day, the Project Team (secretariat) to email daily report to DWS/IBTC as well as other groups, then DWS/IBTC keeps daily reports.
(9) In case of problems, DWS/IBTC should provide consultation and instructions to the team.

7. Timeframe

Day 6 8:40-16:00

- ☐ 8:40-9:00 Team gathering (at the meeting point)
- ☐ 9:00-10:00 Courtesy call to the participating municipality
- ☐ 10:00-11:00 Outline of workplace training by using pilot DMA
- ☐ 11:00-12:00 Site reconnaissance

< Lunch break: 60 minutes >

- ☐ 13:00-14:00 Survey/confirmation of a SIV Point at the site
- ☐ 14:00-15:00 Confirmation of the next day's activities
- ☐ 15:00-16:00 Review of this day's activities

WORKPLACE DAY-1 (COURTESY & SITE CONFIRMATION)

- ☐ 16:00-16:30 Wrap up meeting by team members only

END

WORKPLACE DAY 7-14 (22-29) SITE OR OFFICE ACTIVITIES

1. Aims of the Module

- **To learn actual procedures, methods, equipment and tools at the site or office**
- **To learn necessary data for NRW and reticulation management**
- **To obtain skills for metering and measurement (to acquire, assemble and analyze data) for NRW and reticulation management**
- **To learn conditions and how to use/install equipment and tools for NRW and reticulation management**
- **To learn preparation and consideration for activities with safety**

2. Length of the Module

7 hours (including lunch break for 60 minutes)
Day 7-14 (22-29) 9:00-16:00

3. Facilitators and Learners

Facilitator	Learner
Main-Facilitator (1): Municipal Facilitator Sub-Facilitator (1): Municipal Facilitator Moderator (1): DWS staff Assessor (1): IBTC staff Technical Support（1）JICA	Municipal officials (3 to 5 learners) Municipal officials (field staff in pilot DMA, to be coordinated by participating municipality in advance) Local police (as needed, to be coordinated by participating municipality in advance)

4. Check List

☐ Reticulation drawings (pipeline data, flow meter, valve, hydrant, PRV, etc. ☐ Hydraulic map (water flow velocity distribution map, water pressure distribution map) ☐ Topographic map with contours ☐ Color-coded map by water consumption ☐ Color-coded map by bill collection	☐ Tool set ☐ Vehicle(s) for team members ☐ Vehicle(s) for participating municipality ☐ Ultrasonic flow meter (as needed) ☐ Pressure data logger (as needed) ☐ Water flow data logger (as needed) ☐ Other equipment ☐ Communication device (cellphones, walkie-talkies, etc.)

WORKPLACE DAY 7-14 (22-29) SITE OR OFFICE ACTIVITIES

☐ Workplace training plan to be prepared by participating municipality	☐ ID and employment card (team members) ☐ Workplace training record format (log sheets, daily report, etc.)

<sample photos to be added>

5. Standard Facilitation Procedures of the Module *To be flexible according to workplace situations

1 Team gathering and daily briefing
- 1.1 To review the previous day's activities.
- 1.2 To confirm this day's activities.
- 1.3 To check health of all participants
- 1.4 To check necessary safety measures (safe driving, communication, events, others)
- 1.5 To arrange transport for participants if needed.

2 Site or office activities

3 Lunch break (60 minutes)

4 Site or office activities

5 Confirmation of the next day's activities (30 minutes)
- 5.1 To confirm procedures of the next day's activities
- 5.2 Q&A

6 Review of this day's activities (60 minutes)
- 6.1 Municipal facilitator(s) to remind items of this day's activities (5 minutes)
- 6.2 Learners to write them in log sheet (20 minutes)
- 6.3 Each learner to present awareness and lessons learnt (20 minutes)
- 6.4 Facilitator(s) to make an overall comment (5 minutes)
- 6.5 Municipal coordinator to explain about preparation for the next day to learners (10 minutes)
- 6.6 Moderator (DWS staff) and/or assessor to collect log sheets of this day, let municipal facilitator(s) sign them.

7 Wrap up meeting by team members only (30 minutes)

WORKPLACE DAY 7-14 (22-29) SITE OR OFFICE ACTIVITIES

7.1 To review workplace training in terms of implementation and logistics, and the Project Team (secretariat) prepares a report.

7.2 To record attainment, problems and issues, lesson learnt in the report.

7.3 To consider occupational health and safety, security and communication of all participants

7.4 Moderator (DWS staff) and/or assessor to copy log sheets and return them to learners in the next day.

6. Preparation

(1) Prepare and carry tools and equipment for workplace training.

(2) The Project Team (secretariat) drafts log sheets in accordance with each workplace training plan in the preparatory week, and finalizes it with comments from facilitators.

(3) A role of main facilitator is to take leadership in workplace training together with municipal coordinator.

(4) A role of sub facilitator is to support/advise main facilitator and learners in technical aspects.

(5) Moderator (DWS staff) is a representative of the Project (National NRW Training) and has moderating function.

(6) Moderator (DWS staff) and/or assessor carry log sheets, take photos of workplace training, keep log sheets and ensure the objectivity.

(7) JICA experts provide technical advices and support.

(8) At the end of business day, the Project Team (secretariat) to email daily report to DWS/IBTC as well as other groups, then DWS/IBTC keeps daily reports.

(9) In case of problems, DWS/IBTC should provide consultation and instructions to the team.

7. Timeframe

Day 7-14 (22-29) 9:00-16:00

- ☐ 9:00-9:20 Team gathering and daily briefing
- ☐ 9:30-12:00 Site or office activities

< Lunch break: 60 minutes >

- ☐ 13:00-14:30 Site or office activities
- ☐ 14:30-15:00 Confirmation of the next day's activities
- ☐ 15:00-16:00 Review of this day's activities
- ☐ 16:00-16:30 Wrap up meeting by team members only

END

WORKPLACE DAY 15 (PRENSENTATION & REVIEW)

1. Aims of the Module

- **To share results, awareness, findings, lessons learnt and way forward among all participants**
- **To experience the process of presentation preparation to be effective and its improvement based on inputs**
- **To share expected outcomes, applied approaches, attainment and what individuals have learned for team's capacity development**

2. Length of the Module

4 hours 30 minutes

Day 15 9:00-13:30

3. Facilitators and Learners

Facilitator	Learner
Main-Facilitator (1): Municipal Facilitator Sub-Facilitator (1): Municipal Facilitator Moderator (1): DWS staff Assessor (1): IBTC staff Technical Support (1) JICA	Municipal officials (3 to 5 learners) Municipal officials (field staff in pilot DMA, to be coordinated by participating municipality in advance)

4. Check List

☐ Presentation materials ☐ Handouts ☐ Workplace training plan to be prepared by participating municipality	☐ Vehicle(s) for team members ☐ Vehicle(s) for participating municipality ☐ Communication device (cellphones, walkie-talkies, etc.) ☐ ID and employment card (team members) ☐ Workplace training record format (log sheets, daily report, etc.)

<sample photos to be added>

WORKPLACE DAY 15 (PRENSENTATION & REVIEW)

5. Standard Facilitation Procedures of the Module *To be flexible according to workplace situations

1 Team gathering and daily briefing

1.1 To review the previous day's activities.
1.2 To confirm this day's activities.
1.3 To check health of all participants

2 Presentation (60 minutes)

2.1 Outline of the Project (National NRW Training) by DWS staff
2.2 Outline and review of workplace training by learners
2.3 Aims, expected outcomes, applied approaches and attainment by learners
2.4 Details of results by learners
2.5 Q & A
2.6 Awareness, findings, lessons learnt and way forward

3 Revision and role sharing of presentation (60 minutes)

3.1 To revise the presentation for the 2nd IBTC training (30 minutes)
3.2 To share roles for the presentation in the 2nd IBTC training (30 minutes)

4 Review of this day's activities (60 minutes)

4.1 Each learner to make his/her report of workplace training and Q & A (45 minutes)
4.2 The Project team (secretariat) to brief the 2nd IBTC training (15 minutes)
4.3 Moderator (DWS staff) and/or assessor to collect log sheets of this day, let municipal facilitator(s) sign them.

5 Wrap up meeting by team members only (30 minutes)

5.1 To review workplace training in terms of implementation and logistics, and the Project Team (secretariat) prepares a report.
5.2 To record attainment, problems and issues, lesson learnt in the report.
5.3 To consider occupational health and safety, security and communication of all participants
5.4 Moderator (DWS staff) and/or assessor to copy log sheets and return them to learners.

6. Preparation

(1) Prepare and carry tools and equipment for workplace training.

WORKPLACE DAY 15 (PRENSENTATION & REVIEW)

(2) The Project Team (secretariat) drafts log sheets in accordance with each workplace training plan in the preparatory week, and finalizes it with comments from facilitators.

(3) A role of main facilitator is to take leadership in workplace training together with municipal coordinator.

(4) A role of sub facilitator is to support/advise main facilitator and learners in technical aspects.

(5) Moderator (DWS staff) is a representative of the Project (National NRW Training) and has moderating function.

(6) Moderator (DWS staff) and/or assessor carry log sheets, take photos of workplace training, keep log sheets and ensure the objectivity.

(7) JICA experts provide technical advices and support.

(8) At the end of business day, the Project Team (secretariat) to email daily report to DWS/IBTC as well as other groups, then DWS/IBTC keeps daily reports.

(9) In case of problems, DWS/IBTC should provide consultation and instructions to the team.

7. Timeframe

Day 15 9:00-13:30

- ☐ 9:00-9:20 Team gathering and daily briefing
- ☐ 9:30-10:30 Presentation
- ☐ 10:30-12:00 Revision of role sharing of presentation
- ☐ 12:00-13:00 Review of this day’s activities
- ☐ 13:00-13:30 Wrap up meeting by team members only

END

1. Aims of the Module

- To experience meter accuracy test
- To experience meter error in accordance with installation
- To make a plan to replace customer water meter and estimate the cost of meter replacement.

2. Length of the Module

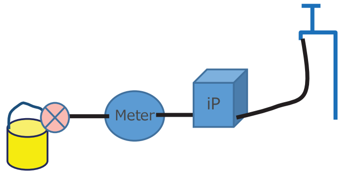
13:00～13:15 Room "Explain Meter Accuracy Test" (10 minutes) With PP slides
13:20～13:50 Yard "Meter Accuracy Test" (20 minutes) for a team
13:55～14:20 Yard "Meter Accuracy Test" (20 minutes) for a team

3. Facilitators and Learners

Facilitator	Learner
Main facilitator (1) Municipality Sub-facilitator (1) Municipality Moderator (1) DWS Advisor (1) JICA	Make 2 groups / per 10 persons

4. Check list of the Module

☐ Text ☐ Old customer meters ☐ Sensus iPERL meter ☐ 20 liter bucket	☐ Pipes and connection parts ☐ Tap connection hose ☐ PC, Projector, Microphone



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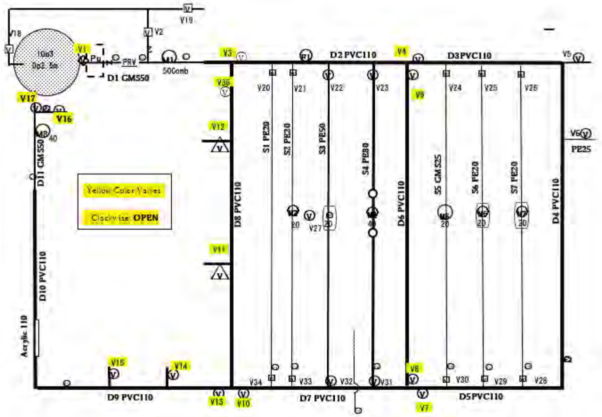
5. Standard Facilitation Procedures of the Module



1 **Explanation of the Module (5 minutes) :Reference: Text 10.2 Meter accuracy test**

1.1 Test method

If the accuracy of a meter needs to be verified for trade purposes, such as in response to a consumer complaint, the test methods used has to comply with metrology legislation and certification. If, on the other hand, the purpose of the test is to check the meter accuracy as part of a meter replacement study and to obtain quick approximation as a customer service. This will satisfy the requirements for such purpose.

1.1.1 Test bench

The most precise method is to remove the meter from the field and test it on a laboratory test bench. This method is highly accurate and repeatable.

1.1.2 Field test

A simple way to test the accuracy of customer meters is to connect the reference meter to a tap on the property or directly to the meter used with pipe works and control the flow rate through both meters using the valve. It is noted that this method provides the test result approximately base not authorized measurement result, obtaining figures are tentative.

1.1.3 No of sample meters

Sophisticated statistical sampling methods are available, sample numbers of meter under the condition of the Tolerance: 5%, Trust rate: 95% are showed below;

Example of the number of tested meters and rate against the number of connections

Total meters	No. of meters	Percentage against total number of meters

250	152	60.8%
300	169	56.3%
400	196	49.0%
500	220	44.0%
800	260	32.5%
1,000	280	28.0%
2,000	325	16.3%
3,000	345	11.5%
5,000	360	7.2%
10,000	370	3.7%
25,000	380	1.5%
50,000	385	0.8%
> 100,000	385	< 0.4%

[By statistical theory, the Tolerance: 5%, Trust rate: 95%, number of test meters for the number of connections]

In South Africa, as a general rule of thumb at least 30* meters should be tested. (Arreguiz recommends a sample of at least 50* users per group to test.) (*modular number of meters is not clear)

*Normally to obtain a meter's error curve, it needs a number of points of flow rate. However, this test method is just obtaining a quick approximation of error rate, therefore, test flow rate adopted is one that around rate of QP.

2 Meter Accuracy Test (30 minutes: 15minutes/group)

2.1 Set up pipe and meters

- Connect pipes with both side of "a customer water meter" ,
- Put a ball valve (20mm plastic) to the out let of a customer water meter.
- Connect an iPERL water meter to the customer meter,
- Connect a connection hose to the tap or V16 and put it on Tap,
- Supply water to the set. Remove air completely,
- Close a ball valve and check water leak. If you observe leaks, correct any leaks,

2.2 Measurement

- Read and make a memo of a counter of an iPERL meter and "a customer meter" before running water,
- Running water about 20 liter in a middle water volume (About 20L /min)
- Close ball valve.

- Read and make a memo of a counter of an iPERL meter and "a customer meter" .

2.3 Compare an iPERL and a customer water meter to check the accuracy.

-Accuracy % =[(Customer meter – Reference meter (iPERL)/ Reference meter) x 100

6. Preparation (10 minutes)

Connect 20 mm HDPE pipe, iPERL, a customer water meter.

Prepare a bucket with 20L

End

1. Aims of the Module

- To experience house connection survey
- To experience ground microphone survey
- To know leak confirmation method

2. Length of the Module

10:30～10:50 Room "Prepare Map & Paper for House Connection Survey（20 minutes)

11:00～11:30 Yard "House Connection Survey" (20 minutes)

11:30～12:00 Yard "Ground microphone survey"（30 minutes)

3 persons at one a time, (5 minutes for one team)

Day 18, AM10:30-12:00

3. Facilitators and Learners

Facilitator	Learner
Main facilitator（1）Municipality Sub-facilitator（1）Municipality Moderator（1）DWS Technical Support（2）JICA	Make groups of 3 persons

4. Check List of the Module

☐ Text ☐ Listening Stick * 5 units ☐ Ground Microphones ＊3 units, ☐ Hammer Drill ☐ Boring bar ☐ White board, marker, eraser	

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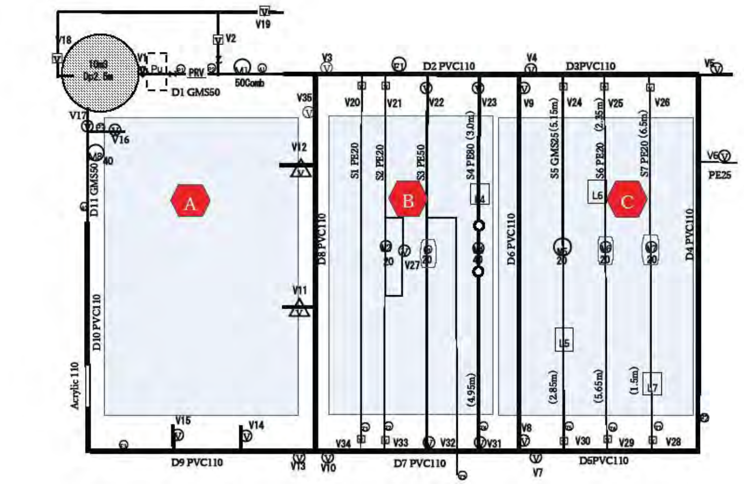
5. Standard Facilitation Procedures of the Module



1 Explanation of the Module (5 minutes)

2 House connection survey (15 minutes)

2.1 Explain how to use listening stick

2.2 Keep pressure of 3 bar and make a leak at L5, L6 only.

2.3 Use listening stick to listen sound of V24, V 25, and V26.

2.4 Make a note of listening survey result at V24, V25, and V26.

2.5 Keep pressure of 1 bar and make a leak at L5 and L6 L7 only

2.6 Use listening stick to listen sound of V24, V 25, and V26.

2.7 Make a note of listening survey result at V24, V25, and V26.

2.8 Keep pressure of 6 bar (if needed)

3 Ground Microphone Survey（20 minutes)

3.1 Explain how to use ground microphone. (3 types)

3.2 Keep pressure of 3 bar and make a leak at L5, L6 only.

3.3 Use ground microphone to listen to sound of ground surface along S5, S6, and S7.

3.4 Make a note of ground surface survey at L5, L6, and L7.

3.5 Keep pressure of 1 bar and make a leak at L5, L6, and L7.

3.6 Use ground microphone to listen to sound of ground surface along S5, S6, and S7.

3.7 Make a note of listening survey result at L5, L6, and L7.

4 Demonstration of Leak Confirmation (20 minutes)

4.1 On the soil surface of the ground near the training yard, use a hammer drill to make a 19mm hole to insert boring bar.

4.2 Insert a boring bar to the drilled 19φ hole on soil surface

4.3 Insert a listening stick after using the boring bar to hear leak noise (No leak at the ground site, so no sound of leak).

5 Demonstration of a Correlator (20 minutes)

5.1 Make a noise at valve 6 (open the valve 6 then sound occurs) as a simulated leak sound.

5.2 Set up a correlator and put blue sensor at valve 4, and put red sensor at valve 7.

5.3 Then correlation for to measure distance

6. Preparation (10 minutes)

How to use a Listening Stick, a ground microphone, a hammer drill, a boring bar, and make a memo as a survey result,

In case of more advanced training, a correlator is good for training in Training yard.

In that case,

End

WORKPLACE DAY 30 (PRENSENTATION & REVIEW)

1. Aims of the Module

- **To share results, awareness, findings, lessons learnt and way forward among all participants**
- **To experience the process of presentation preparation to be effective and its improvement based on inputs**
- **To share expected outcomes, applied approaches, attainment and what individuals have learned for team's capacity development**
- **To share the results of the training, way forward, proposed actions with Municipal Management**

2. Length of the Module

6 hours 30 minutes (including lunch break for 60 minutes)

Day 30 9:00-15:30

3. Facilitators and Learners

Facilitator	Learner
Main-Facilitator (1): Municipal Facilitator Sub-Facilitator (1): Municipal Facilitator Moderator (1): DWS staff Assessor (1): IBTC staff Technical Support (1) JICA	Municipal management Municipal officials (3 to 5 learners) Municipal officials (field staff in pilot DMA, to be coordinated by participating municipality in advance)

4. Check List

☐ Presentation materials ☐ Handouts ☐ Workplace training plan to be prepared by participating municipality	☐ Vehicle(s) for team members ☐ Vehicle(s) for participating municipality ☐ Communication device (cellphones, walkie-talkies, etc.) ☐ ID and employment card (team members) ☐ Workplace training record format (log sheets, daily report, etc.)

<sample photos to be added>

WORKPLACE DAY 30 (PRENSENTATION & REVIEW)

5. Standard Facilitation Procedures of the Module *To be flexible according to workplace situations

1 Team gathering and daily briefing
- 1.1 To review the previous day's activities.
- 1.2 To confirm this day's activities.
- 1.3 To check health of all participants

2 Preparation of Presentation (120 minutes)
- 2.1 Outline of the Project (National NRW Training) by DWS staff
- 2.2 Outline and review of the National NRW Training for the participating municipality by learners
- 2.3 Aims, expected outcomes, applied approaches and attainment by learners
- 2.4 Details of results by learners
- 2.5 Awareness, findings and lessons learnt by leaners
- 2.6 Recommendations and prioritization for measures to be taken based on available resources by learners
- 2.7 Discussion (suggestions, reviews and feedbacks by all participants)
- 2.8 Comments by team members (facilitators, moderator, assessor)
- 2.9 Revision/finalization of presentation

3 Presentation to Municipal Management (60 minutes) *MC: DWS staff
- 3.1 Introduction (5 minutes)
- 3.2 Outline of the Project (National NRW Training) by DWS staff (5 minutes)
- 3.3 Outline and review of the National NRW Training for the participating municipality by learners (5 minutes)
- 3.4 Aims, expected outcomes, applied approaches and attainment by learners (5 minutes)
- 3.5 Details of results by learners (5 minutes)
- 3.6 Awareness, findings and lessons learnt by leaners (5 minutes)
- 3.7 Recommendations and prioritization for measures to be taken based on available resources by learners (10 minutes)
- 3.8 Q & A (5 minutes)
- 3.9 Comments from Municipal Management (5 minutes)

4 Lunch break (60 minutes)

5 Review of the whole training (60 minutes)

WORKPLACE DAY 30 (PRENSENTATION & REVIEW)

- 5.1 Each learner to make his/her report of workplace training (30 minutes)
- 5.2 Each learner to make remarks/opinions/feedbacks about the training (15 minutes)
- 5.3 The Project team (secretariat) to brief support to the participating municipality (15 minutes)
- 5.4 Moderator (DWS staff) and/or assessor to collect log sheets of this day, let municipal facilitator(s) sign them.
- 5.5 Group photos

6 Wrap up meeting by team members only (30 minutes)

- 6.1 To review workplace training in terms of implementation and logistics, and the Project Team (secretariat) prepares a report.
- 6.2 To record attainment, problems and issues, lesson learnt in the report.
- 6.3 To consider occupational health and safety, security and communication of all participants
- 6.4 Moderator (DWS staff) and/or assessor to copy log sheets and return them to learners.

6. Preparation

(1) Prepare and carry tools and equipment for workplace training.

(2) The Project Team (secretariat) drafts log sheets in accordance with each workplace training plan in the preparatory week, and finalizes it with comments from facilitators.

(3) A role of main facilitator is to take leadership in workplace training together with municipal coordinator.

(4) A role of sub facilitator is to support/advise main facilitator and learners in technical aspects.

(5) Moderator (DWS staff) is a representative of the Project (National NRW Training) and has moderating function.

(6) Moderator (DWS staff) and/or assessor carry log sheets, take photos of workplace training, keep log sheets and ensure the objectivity.

(7) JICA experts provide technical advices and support.

(8) At the end of business day, the Project Team (secretariat) to email daily report to DWS/IBTC as well as other groups, then DWS/IBTC keeps daily reports.

(9) In case of problems, DWS/IBTC should provide consultation and instructions to the team.

7. Timeframe

Day 30 9:00-15:30

WORKPLACE DAY 30 (PRENSENTATION & REVIEW)

- ☐ 9:00-9:20 Team gathering and daily briefing
- ☐ 9:30-11:30 Preparation of Presentation
- ☐ 11:45-12:45 Presentation to Municipal Management

  Lunch break (60 minutes)
- ☐ 14:00-15:00 Review of the whole training
- ☐ 15:00-15:30 Wrap up meeting by team members only

END

添付資料 10

講師技術会合の資料

FACILITATOR TECHNICAL MEETING

(2019)

Last Update 2-Jul-19

Purpose of Facilitator Meetings/Workshops

1. To facilitate team building
2. To build consesus of the National NRW Training
3. To confirm appropriateness of annual programme and model schedule
4. To let facilitators take part in training development by inputs based on their knowledge and experience
5. To check availability and engagement of Facilitators as well as to ensure implementing structure
6. To make network among municipal officials at working-level
7. To improve knowledge and skills of Facilitators

Basic Modules/Contents of the National NRW Training

1. Orientation and general overview
2. Bulk meter knowledge, technique (including pipe fitting)
3. Customer meter knowledge, technique
4. Reticulation facility planning, operation and maintenance (valves, fire hydrant, air valves, etc.)
5. District-Metered Area (DMA) and Measurement planning
6. Data logging and analysis
7. Water balance analysis
8. NRW reduction strategy planning & presentation
9. Fundamental knowledge of active leakage equipment
10. Fundamental knowledge of conditional assessment

The 1st Facilitator Meeting/Workshop
Date: 3rd to 5th July 2019

Agenda Chairperson: TBC

Day-1: 3rd July (full day)

Time	No.	Items	Remarks	Officials responsible
am				
10:00	1.1	Opening remarks		DWS/SALGA
10:15	1.2	Introduction of participants	Participants list	
10:30	1.3	Project summary	Presentation, handouts	JICA Expert
11;00	1.4	Concept and outline of the National NRW Training (modules/ contents, workplace training model/process/methodology)	Presentation, handouts	DWS(WUE)
pm				
13:00	1.5	Tour of IBTC facilities, training yard and equipment	Handouts	IBTC
14:00	1.6	Draft annual training programme, schedule model, implementing structure, target participating municipalities	Handouts	DWS(WUE)
Reception (interaction)				

Day-2: 4th July (full day)

Time	No	Items	Remarks	Officials responsible
am				
8:30	2.1	Draft teaching/learning materials of the National NRW Training	To be emaild in advance.for prior reading. Handouts	DWS(WUE) & JICA Expert
pm				
13:00	2.2	Strength and interests of Facillitators by module/content	Prepare matrix. Prior mail-based confirmation is useful.	DWS(WUE)
14:00	2.3	- Deployment of Facilitators in knowledge, practice and workplace - Role-sharing arragement in annual programme (provisional) - Pre-confirmation of facilitators' engaement		DWS(WUE)

Day-3: 5th July (half day)

Time	No	Items	Remarks	Officials responsible
am				
8:30	3.1	- Schedule of the 2nd Facilitator Meeting/Workshop and delegation's debriefing - Detail schedule of the 1st&2nd National NRW Training - Pre-confirmation of role-sharing arrangement of Facilitators of the 1st&2nd National NRW Training	Handouts	DWS(WUE) & IBTC
11:15	3.2	Closing remarks		DWS/SALGA
11:30	3.3	Explanation of Training in Japan	Handouts	JICA Expert

Common item each date

-		Announcement and confirmation on training admin. (both Facilitator Meeting and the National NRW Training)	As needed and timely	IBTC

Inputs from Facilitators, Review and Update

The 2nd Facilitator Meeting/Workshop and Delegation's Debriefing
Date: 29th & 30th August 2019 (provisional)

Draft Agenda Chairperson: TBC

Day-4: 29th August (full day)

Time	No	Items	Remarks	Officials responsible
am				
10:00	4.1	Opening remarks		DWS/SALGA
10:15	4.2	Introduction of participants	Participants list	
10:30	4.3	Debriefing by delegation and Q&A	Presentation, report	Delegation
pm				
13:00	4.4	Confirmation of the National NRW Training (modules/contents, teaching/learning materials)	Handouts	DWS(WUE) & JICA Expert
14:00	4.5	Dry-run/rehearsal/demonstration of tne National NRW Training	Handouts	DWS(WUE) & JICA Expert
Reception (interaction)				

Day-5: 30th August (half day)

Time	No	Items	Remarks	Officials responsible
am				
8:30	5.1	Dry-run/rehearsal/demonstration of tne National NRW Training	Handouts	DWS(WUE) & JICA Expert
11:00	5.2	- Detail schedule of the 1st&2nd National NRW Training - Confirmation of role-sharing arrangement of Facilitators of the 1st&2nd National NRW Training	Handouts	DWS(WUE) & IBTC
11:45	5.3	Closing remarks		DWS/SALGA

Common item each date

-		Announcement and confirmatoin on training admin.(both Facilitator meeting and the National NRW Training)	As needed and timely	IBTC

The 2nd Facilitator Meeting/Workshop and Delegation's Debriefing
Date: 19th & 20th September 2019

Last Update 13-Sep-19

Draft Agenda

MC/PD: TBC

Day-4/5: 19th September (full day)

Time	No	Items	Remarks	Officials responsible
am				
8:30	4.1	Opening remarks and announcement		DWS/SALGA
8:45	4.2	Introduction of participants	Participants list	-
9:00	4.3	Overall project schedule and NRW Training programme per cycle (IBTC+Workplace)	Handouts	DWS(WUE) & JICA Expert
9:30	4.4	Role sharing arrangement by facilitators' mandate, experiences and knowledge	Handouts	DWS(WUE) & JICA Expert
10:00	4.5	Facilitation guidance by module/component by using textbook, yard and equipment	Handouts	DWS(WUE&IBTC) & JICA Expert
pm				
13:00	4.6	Facilitation guidance by module/component by using textbook, yard and equipment	Handouts	DWS(WUE&IBTC) & JICA Expert
16:30	4.7	Wrap up for the 2nd day		DWS(WUE)

Day-5/5: 20th September (half day)

Time	No	Items	Remarks	Officials responsible
am				
8:30	5.1	Facilitator allocation/deployment planning for the NRW Training (IBTC and Workplaces)	Handouts	DWS(WUE&IBTC) & JICA Expert
10:30	5.2	Debriefing by the delegation to Japan and Q&A	Presentation, external guests	DWS/SALGA/LGSETA/Munics
11:45	5.3	Closing remarks and announcement		DWS/SALGA

PROJECT MEMBERS AND NOMINATED FACILITATORS

SOUTH AFRICAN SIDE

NATIONAL	DWS and Stakeholders	Supporters	Facilitator, Implementation Supporter/Administrator	
DWS	IBOM (former NWRI)	Mr Aloious Chaminuka	-	-
		Mr Vincent Monene	-	-
		Mr Musara Tapiwanashe	Mr Musara Tapiwanashe	1
	IBTC	Ms Rosa M. Rahube	-	-
		Ms Kgoputso Sekgoilane	Ms Kgoputso Sekgoilane	1
		Ms Lerato Makola	Ms Lerato Makola	1
		Mr Armand Basson	Mr Armand Basson	1
		Mr Riaan Stassen	Mr Riaan Stassen	1
	WUE	Mr Hadebe Xolani	-	-
		Mr Thabo Masike	Mr Thabo Masike	1
		Mr Padi Andries	Mr Padi Andries	1
	OS	Ms Kentse Mathiba	-	-
		Mr Maputha S. Tsibiso	Mr Maputha S. Tsibiso	1
	IWS	Mr Albert Mmbidi	-	-
		Ms Zanu Mtsweni	-	-
SALGA	SALGA	Mr William Moraka	Ms/Mr	1
LGSETA	LGSETA	Ms Mkele Pumla	Ms Onkemetse Modise	1
		DWS-HQs and Stakeholders		**10**

MUNIC. & REGION	Municipality/Contact institutions	Municipal and institutional contact person	Facilitator	
Western Cape	City of Cape Town	Mr Zolile Basholo	Mr Jaco De Bruyn	6
			Ms Unathi Noludwe	
			Mr Mahdi Pathan	
			Mr Brandon Stevens	
			Mr Ndzululwazi Joni	
			Ms Mckaylin Adonis	
	George Municipaity	Mr Henry Jansen	Mr Henry Jansen	1
Kwazulu Natal	DWS Regional Office	Mr Michael Singh	Mr Michael Singh	1
	City of Ethekwini	Mr Ashan Nandal	Mr Ashan Nandal	2
			Mr Moodley Yagavasen	
	Ugu Municipality	Ms Thuli Mwelase	Ms Thuli Mwelase	1
Mpumalanga	Mbombela Municipality	Mr Koena Moabelo	Mr Koena Moabelo	1
	Silulumanzi	Mr Colin Thatcher	Mr Colin Thatcher	1
Gauteng	City of JHB	Mr William Mtshweni	Mr Pholo Nthutang	2
			Ms Faith Ramatsoele	
	City of Tshwane	Mr Trevor Westman	Mr Trevor Westman	2
			Mr Nico Schmulian	
	City of Ekurhuleni	Ms Mbali R. Matiwane	Mr Mulalo Bvumbi	1
Eastern Cape	Baffalo City	Mr Mark Weston	Mr Siyamcela Mamane	2
			Ms Sikiza Yekane	
		Municipalities and DWS Regional Office		**20**
			SA Total	**30**

JAPANESE SIDE

JPN	Position in the Project	Expert	
JICA	Chief Advisor / NRW Management	Mr. Akinori Miyoshi	
	Deputy Chief Advisor / NRW Management	Mr. Taketoshi Fujiyama	
	Skills Programme Planning/Organization Coordination	Mr. Kenichiro Sugiya	
	Water Leakage Detection	Mr. Hiroki Niimura	
	Water Distribution Control / Commercial Loss	Mr. Hiroyuki Morita	
	Training Yard Design and Supervision	Mr. Masuji Ide	
	Procurement / Administrative Coordination	Mr. Toshinobu Kasuya	
	Training Management/Human Resource Development	Mr. Nobutaka Maruyama	
		JPN Total	**8**

The Project for Strengthening the Training Capacity of IBTC on NRW

The National Non-Revenue Water (NRW) Training for Municipalities by Municipalities in South Africa

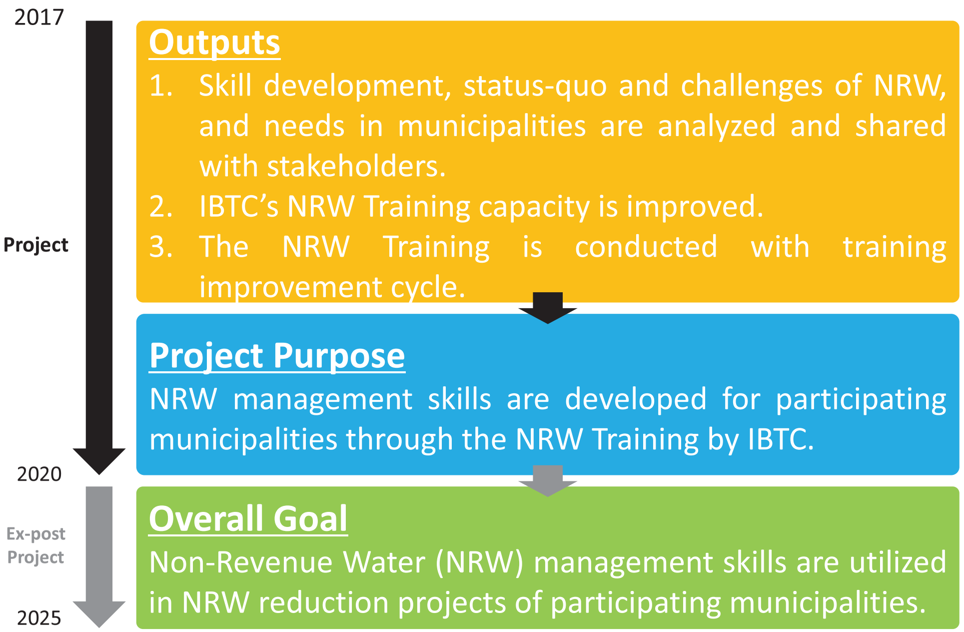
Project Summary

Project Team

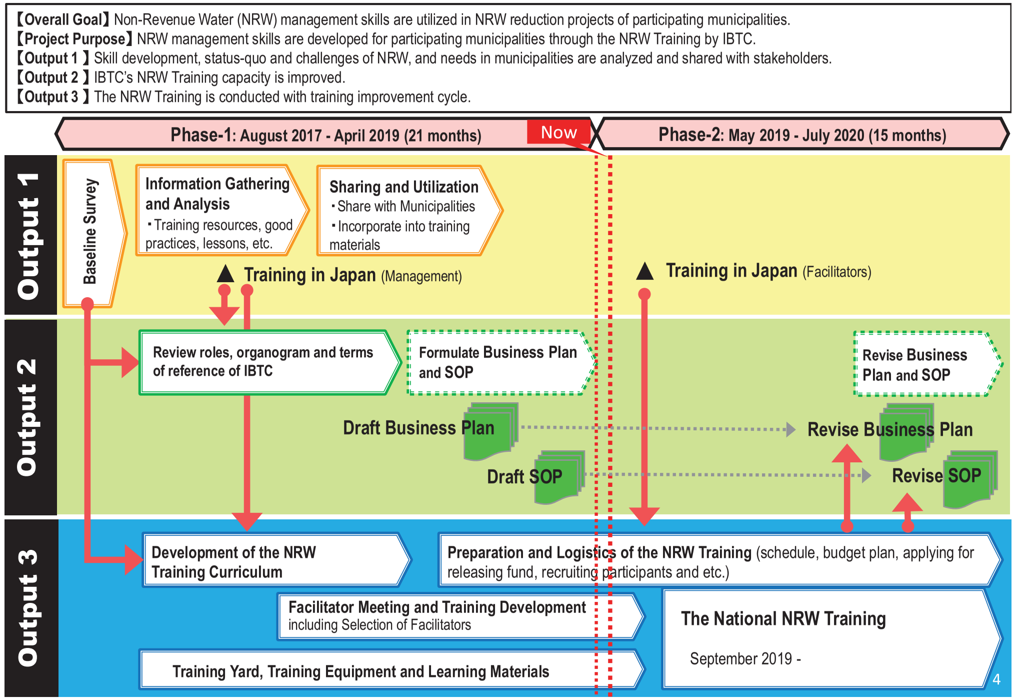
Outline of the Project

- **Project Period:**
  Phase-1: August 2017 to April 2019 (21 months)
  Phase-2: May 2019 to July 2020 (15 months)
- **Implementing Organization:**
  Department of Water and Sanitation (DWS) / Infrastructure Branch Training Centre (IBTC) at Roodeplaat Dam
- **Beneficiaries:**
  Participating Municipalities/staff, DWS/IBTC and their personnel and Facilitators
- **End Beneficiaries:**
  Customers / Consumers of water supplied by Municipalities

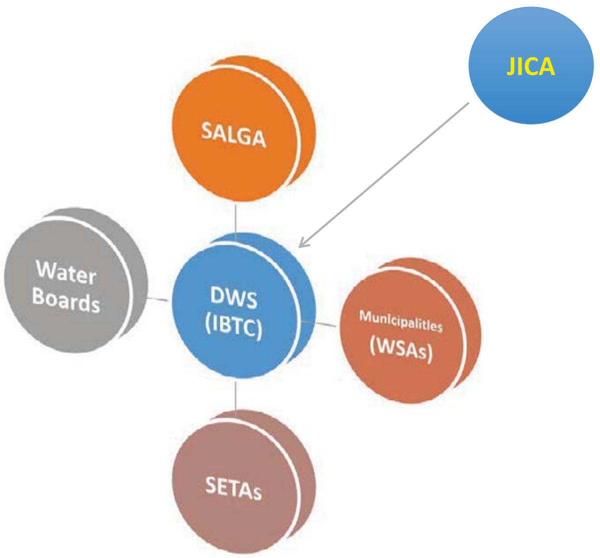
Outline of the Project (Project Design)



Project Outline (Timeframe)

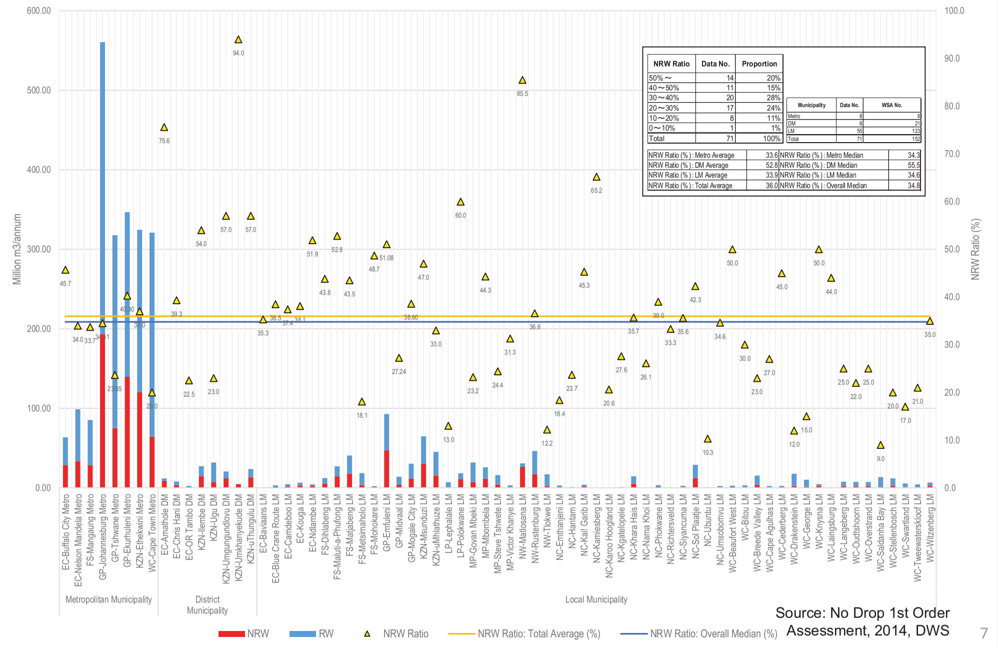


Technical Assistance Model expected by DWS



NRW in South Africa

Water Balance of Municipalities (Revenue Water, NRW and NRW ratio)



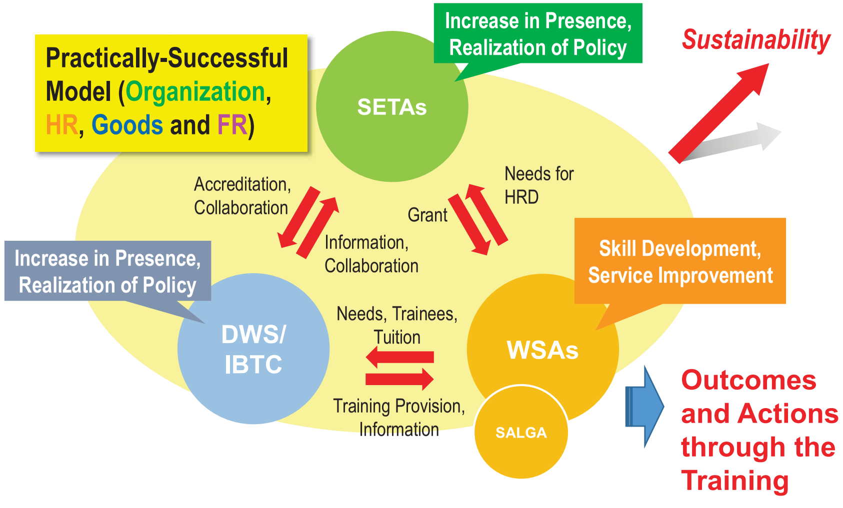
NRW Ratio	Data No.	Proportion
50%～	14	20%
40～50%	11	15%
30～40%	20	28%
20～30%	17	24%
10～20%	8	11%
0～10%	1	1%
Total	71	100%

Municipality	Data No.	WSA No.
Metro	8	8
DM	8	21
LM	55	123
Total	71	152

NRW Ratio (%) : Metro Average	33.6	NRW Ratio (%) : Metro Median	34.3
NRW Ratio (%) : DM Average	52.8	NRW Ratio (%) : DM Median	55.5
NRW Ratio (%) : LM Average	33.9	NRW Ratio (%) : LM Median	34.6
NRW Ratio (%) : Total Average	36.0	NRW Ratio (%) : Overall Median	34.8

Source: No Drop 1st Order Assessment, 2014, DWS

Skills Development Model targeted by the Project

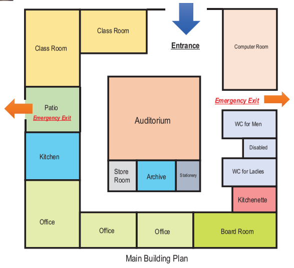


Current Situation and Issues surrounding IBTC

Roles to be added for IBTC

- "**An anchor, a hub, coordinating function**" of skill development in water supply sector
- "**An accredited training provider**" and "**a trade tester**" for the needs of water supply sector.
- Programme, provision and skill development through "**practical trainings**"

Regular/seconded staff: 10
Occupied (incl. doubling another post): 19
Past performance: **Difference between plan and actual achievement** (limited to un accredited trainings on appurtenant work for water infrastructure, basic occupational safety and health, and computer skill for DWS's junior workers)

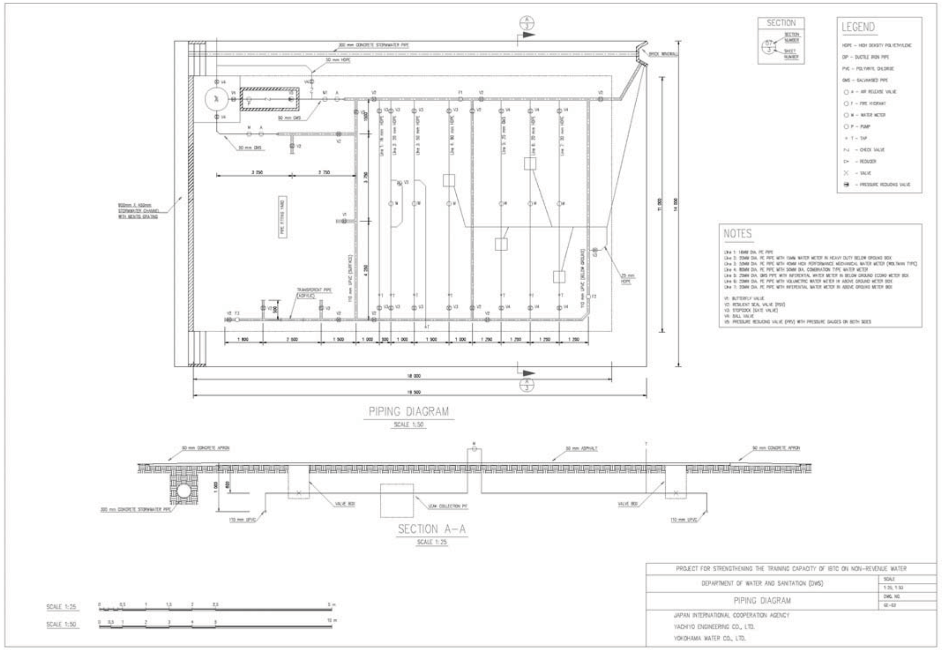


IBTC Facilities

1) Main Building
Reception, 4 Office Rooms, Auditorium (for 65 people), Board Room (for 25 people), 3 Class Rooms (18 people for each room), Computer Room (for 18 people), Archive Room, Server Room, Kitchen, Cafeteria, Restroom and etc.

2) Workshop Building
Concrete Material Test Room, Diesel Maintenance Work Room, Plumber Room

3) Accommodation Building
30 Bed Rooms/Maximum 54 guests, Dining Hall : 150 guests, Kitchen, Restroom



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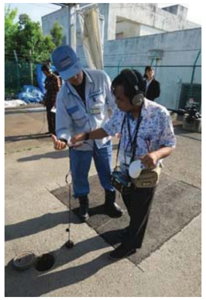
Training Yard in IBTC

10



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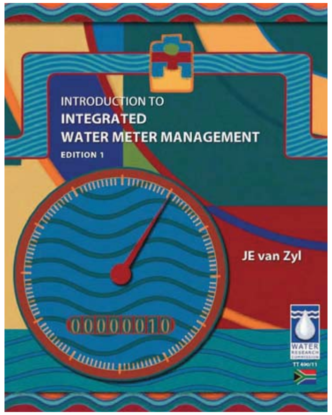
KEYNOTE DOCUMENT



It is impossible for a municipality to manage its water resources without knowing how much water it has and where the water goes. This is where water meters play a criti-

1 INTRODUCTION

1.1 Why this Book?

It is impossible for a municipality to manage its water resources without knowing how much water it has and where the water goes. This is where water meters play a critically important role: water meters are used to measure how much raw water is taken from a resource such as a large dam, how much of this water leaves the water treatment plant, how much is purchased from bulk suppliers or sold to other municipalities, how the water is distributed within the water distribution system, and finally, how much of the water is delivered to individual consumers. If water meters are not managed correctly, it can have a negative impact on the income of a municipality. However, if water metering is approached correctly, it can increase the net income of a municipality, while empowering staff to manage the distribution system in the best possible way.

Water metering is particularly important for municipalities since it forms the basis for much of their income through the sale of water to their consumers. In South Africa, like in many other countries, there is a legal imperative on municipalities to meter consumers and manage water losses in compliance with legislation and standards.

In South Africa, like in many other countries, there is a legal imperative on municipalities to meter consumers and manage water losses in compliance with legislation and standards.

Many countries currently lack proper water meter management, with many municipalities and bulk water suppliers not having the capacity to undertake and manage optimal and integrated meter calibration, replacement, reading and information management systems. Often the divided responsibility between billing and meter management (typical of the institutional arrangements within most municipalities) results in poor billing, incorrect information capture, and poor maintenance. This is further compounded by the fact that where initiatives of water demand management and conservation are required, the data is not easily accessible to the departments responsible for this task, leading to the frequent lack of integration between domestic and bulk water metering.

The purpose of this book is to help address the need for better water meter management by providing a practical introduction to the technical and managerial aspects of water meters. Since water metering affects different departments within a municipal-

INTRODUCTION

1

12

Main Steps in developing an Integrated Water Metering Management System

1. Identify all sources of water into your system and bulk transfers to other municipalities. Ensure that each source or bulk transfer has a meter that is correctly sized, in good condition and regularly read (preferably continuously, but at least weekly).
2. Identify bulk consumers (top 10 %) in the system. Ensure that each bulk consumer has a meter that is correctly sized, in good condition and regularly read (at least monthly).

13

Main Steps in developing an Integrated Water Metering Management System

3. Identify zones in the distribution system - the smaller the zones are, the better. Ensure that each zone has a meter that is correctly sized, in good condition and regularly read (preferably continuously, but at least weekly).
4. Log the zonal meters to determine the minimum night flow (and thus the leakage) in each zone.
5. Estimate current revenue water based on water sales to consumers

14

Main Steps in developing an Integrated Water Metering Management System

6. Do a preliminary water balance according to the IWA grid and identify the most critical areas for intervention. This will typically lead to a leak detection and repair programme focused on the zones with the highest leakage rates. A more comprehensive non-revenue control strategy should be developed from this initial effort.

15

Main Steps in developing an Integrated Water Metering Management System

7. Perform an initial review of consumer water meters in the system using the meter database or records and limited, targeted field investigations. Develop a strategy for the evaluation of consumer water meters, focusing initially on more affluent areas where consumption and payment levels are likely to be higher. Consumers without meters should be identified and prioritised for meter installation. (Continued…)

16

Main Steps in developing an Integrated Water Metering Management System

7. (Continued…) It is important that all consumers are metered, although it may be necessary to initially meter stand pipes or indigent consumers in groups. A comprehensive meter audit, testing and replacement programme should develop from this initiative based on a metering strategy adopted by the municipality.

Thank you very much for your attention.

water & sanitation
Department: Water and Sanitation
REPUBLIC OF SOUTH AFRICA

SALGA
Inspiring service delivery

Japan International Cooperation Agency
JICA

The Project for Strengthening the Training Capacity of IBTC on NRW

The National Non-Revenue Water (NRW) Training for Municipalities by Municipalities in South Africa

Outline of the Training

Project Team

1

This presentation is
for
Possible Collaboration with
Stakeholders and ongoing Projects/Programmes
which leads to Synergy Effects,
and for
Participation in the Training
by Municipalities for Municipalities
with supports from Stakeholders.

2

Contents

1. Observation in Baseline Survey
2. Concepts of the National NRW Training
3. Aims of the National NRW Training
4. Basic Modules of the National NRW Training
5. Course Overview of a Training Cycle
6. Business Model of the National NRW Training

3

1. Observation in Baseline Survey

- The **NRW is still high** in municipalities for the past decade.
- A lot of municipalities have **not calculated/evaluated NRW** properly. This may not lead to effective interventions.
- The municipalities **need proper analysis** based on adequate "measuring and metering".
- Have municipalities conducted **adequate reticulation management** and O&M ? (Inadequacy of essential information and analysis ability)
- Have municipalities taken actions with **strategic planning and budgeting** for tackling with NRW?
- Have real issues and problems been informed properly from working-level staff to decision makers?
- Does South Africa need to have a function/opportunity to cooperate at the working level among municipalities for tacking with NRW?

4

2. Concept of the National NRW Training

- Problem-solving oriented and flexible training programme for participating municipalities
- Training programme - targeting cross-sectoral/departmental/ hierarchical participants as a team
- Training programme- participating municipalities to approach root causes of the problems in the NRW management
- Training programme - establishing the municipal working-level network and encouraging municipalities to take positive actions.
- Training programme leading to strategic/effective use of limited resources through prioritization
- Stakeholders' participatory/interactive Training programme organized by DWS/SALGA
- Sustainable training programme contrbuting to nationwide water services and capacity development by accumulating knowledge/information

5

3. Aims the National NRW Training

Participants will be able to:	**Understand the NRW management using a pilot area, model District-Metered Area (DMA)**
	Look into and analyze NRW situation properly through adequate measuring and metering in DMA
	Select/take effective countermeasures or further investigation and see/utilize the results
Furthermore:	**Learn the importance of fundamentals and basics for O&M through the NRW management**

6

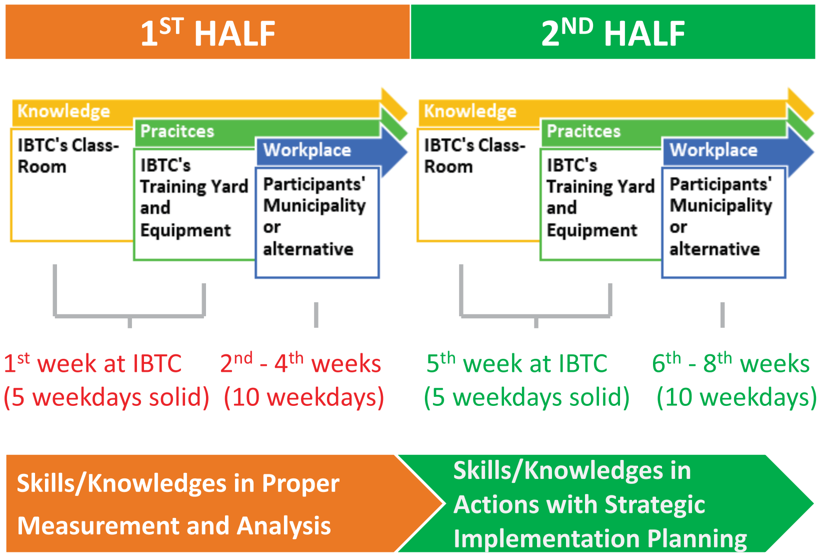
4. Basic Modules of the National NRW Training

1. Bulk Meter Knowledge and Technique
2. Customer Meter Knowledge and Technique
3. Reticulation Facility Planning and O&M (Valves, Fire Hydrant, Air Valves, etc.)
4. DMA and Measurement Planning
5. Data Logging and Analysis
6. Water Balance Analysis
7. NRW Reduction Strategic Planning & Presentation
8. Fundamental Knowledge of Active Leakage Detection
9. Fundamental Knowledge of Conditional Assessment

Remarks:
- The training should be customized and flexibly . This is based on participating municipalities' needs and status-quos.
- Full knowledge/skills of "8" and "9" should be targeted more intensively in the next stage.

7

5. Course Overview of a Training Cycle



8

5. Course Overview of a Training Cycle

- Orientation
  - Significance of the NRW Management
  - Bulk Metering
  - Customer Metering
  - Appurtenance
  - Measuring & Logging
  - DMA Plan
  - Data Acquisition & Analysis
  - Measurement Planning
  - Orientation for Workplace Training
  - Workplace Training (OJT) with Results

DMA Selection/Creation, Data Measurement/ Collection/Analysis and Baseline Report

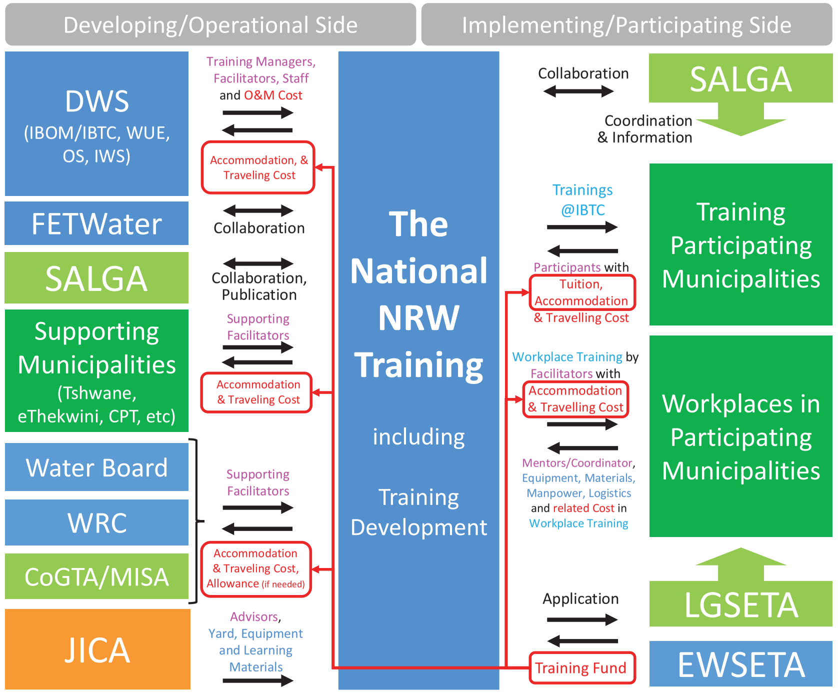
Real Issues & Problems to be identified throughout the Training

- Strategy and Countermeasures
  - Strategic Action Planning
  - Presentation drafting
  - Introduction of Presentations
  - Orientation for Workplace Training
  - Workplace Training (OJT) with Outcomes

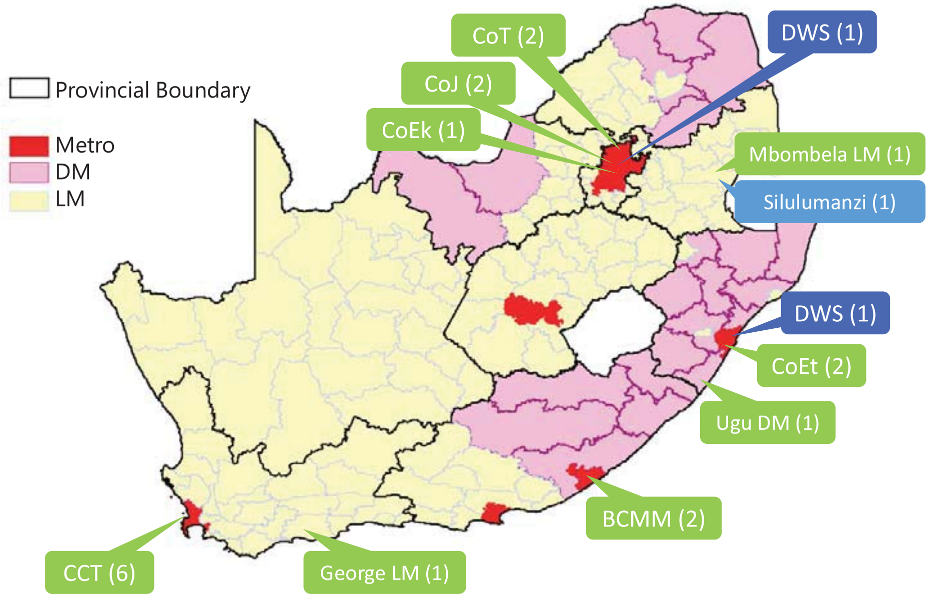
Strategic action plans, Countermeasures, Further Investigation and Wrap-up Report

Legend (Components) ●: Knowledge @ IBTC ●: Practices @ IBTC ●: Workplace Training

6. Development Model of the National NRW Training



7. Nominated Facilitators



Source: Strategic Overview of the Water Services Sector in South Africa, 2015, DWS

Thank you very much for your attention. Your cooperation and participation in the National NRW Training is welcome and key to its success.

water & sanitation
Department: Water and Sanitation
REPUBLIC OF SOUTH AFRICA

SOUTH AFRICAN LOCAL GOVERNMENT ASSOCIATION
SALGA
Inspiring service delivery

Japan International Cooperation Agency
JICA

THE NATIONAL NRW TRAINING

PROJECT DOCUMENT OF CAPACITATING WATER SERVICES AUTHORITIES (MUNICIPALITIES) TO IMPLEMENT NON-REVENUE WATER MANAGEMENT

DWS's Infrastructure Branch Training Centre

June 2019

Executive Summary

Water is a scarce resource in South Africa. The need to manage water equitably is espoused in the constitution of the republic and also in the National Water Act (Act 36 of 1998). Water Conservation and Water Demand Management (WC/WDM) is recognized in the Act as an instrument for managing water equitably thus aiming at reducing Non-Revenue Water (defined as water not billed or accounted for).

South Africa has very high water losses and non-revenue water with a national average of 41%. This is a major contrast compared to Japan with less than 10%. It is therefore prudent that South Africa learns from best practices in Japan to bring down the proportion of non-revenue water in the water supply system.

It is based on the above that None Revenue Water (NRW) management training should as the start; focus on developing practical skills to tackle water losses and NRW in the municipal environment. The Department of Water and Sanitation (DWS) together with municipalities, South African Local Government Association (SALGA), Local Government Sector Education and Training Authority (LGSETA) and other key players must collaborate to ensure support to the National NRW Training offered through the Infrastructure Branch Training Centre (IBTC). The future objective to ensure a national support will include collaboration with other training centres especially in the metropolitan municipalities to enhance NRW management training.

1 PROJECT DESCRIPTION

The government of the Republic of South Africa and the Government of Japan have entered into a bilateral cooperation in the field of water resources, the two governments represented by the Department of Water and Sanitation (DWS) and the Ministry of Land Infrastructure and Transport (MLIT) respectively have strong bilateral, economic and political relations.

The relationship between the DWS and MLIT of Japan date back from 2011, the relationship started through the joint resolution entered into by the then Deputy Ministers of both DWS and MLIT, with simple cooperation on common areas related to water infrastructure, its maintenance and operations.

There are two technical cooperation agreements signed by DWS and Japan International Cooperation Agency (JICA), functionary of Japan government. The first technical cooperation came to an end in 2016 focusing on water treatment plants. The Japanese government through JICA has been supporting the implementation of the first technical cooperation since 2011; however the coverage in terms of the beneficiaries of the programme has been low due to the distance and cost associated with the provision of such trainings in Japan. The various training was attended by officials, including municipal officials; are practical, easy to follow, although not accredited in South Africa.

The three year training programme supported by JICA came to an end in 2016. A new technical cooperation has been signed in April 2017 and was kick started on 17 August 2017 focusing on strengthening training capacity of DWS owned Infrastructure Branch Training Centre (IBTC). The technical cooperation is to be implemented by DWS and SALGA with JICA providing technical support.

The new technical cooperation will focus on the development of a training package on Non-Revenue Water (NRW) and will ensure that training provided by JICA are easily accessible and offered in South Africa to increase training coverage (no longer in Japan). The IBTC as the centre selected for the provision of the National NRW Training is already accredited as a training institution by MerSETA and is already offering training programmes on Carpentry, Bricklaying and Electrical.

As part of the implementation of the JICA supported programme, the South African water sector, led by the DWS, sent a benchmarking mission composed of Senior Managers from the Sector Education and Training Authority (SETA), municipalities, DWS and Tshwane University of Technology to Japan. The purpose of the mission was to benchmark Japanese trainings and ensures that a training package on NRW is developed and offered at the IBTC. The team was exposed to the Japanese NRW training model and identified areas to be incorporated into the South African training package.

The JICA Technical Assistance programme will have many benefits for the water sector. The Department in collaboration with its water partners responsible for the implementation of the project has the responsibility to develop and test the new training programme to ensure that it delivers the skills required to deal with non-revenue water in the country. The JICA support to the programme excludes the training of trainers in South Africa for the implementation of the training programme.

2 LINKAGE WITH THE SECTOR SKILLS PLAN

One of the mandates of local government, as stipulated in Section 152 of the Constitution, is to ensure the provision of services to communities in a sustainable manner including *inter alia* the provision of water and sanitation. Significant progress has been made since 1994 in the provision of water and sanitation, whereby between 2016 and 2017, the number of consumer units receiving water services grew from 12.8 million to 13 million (Stats SA, 2018b). However the gains have being offset by the ageing and dilapidated infrastructure which results in high water losses as evidenced by the current NRW of 42% countrywide.

Although there are many issues that could affect NRW at local government level, such as: poor planning, increased infrastructure development portfolio, and poor governance; however skills has been identified as one the key drivers that exacerbate the problem.

One of the most important skills implications of the ever-increasing role of technology is that the minimum skills requirements in many occupations are increasing. The use of technology in a function increases the minimum skills required to participate in that occupation. This poses an on-going risk for the number of poorly educated unemployed, whose number of entry level occupations is decreasing. Therefore it is against this backdrop that DWS, SALGA and the JICA have proposed the above programme to up skill existing employees in local government dealing with NRW.

3 PROJECT OBJECTIVE

The main purposes of the National NRW Training course are the following:

- To increase the skills and capacity of the water sector in particular local government in tackling Non-Revenue Water (NRW)
- To empower all identified beneficiaries with relevant skills and knowledge to manage NRW
- To develop the technical skills and knowledge on NRW in order to meet the demand of the daily routine work in municipalities

4 DESIGN OF THE NATIONAL NRW TRAINING

Based on the following observation and concepts from the baseline survey and development of new qualifications, the Project designed the National NRW Training as more practical training based on “Knowledge, Practice and Work Experience” to contribute to problem solution.

Observation

- A lot of municipalities have not conducted accurate water balance analysis with reliable data and information on NRW.
- Prior to taking NRW reduction measures effectively, a lot of municipalities are still at the initial stage “measuring/metering” for proper analysis which leads to planning.

Concepts

- The National NRW Training focuses on water measurement, proper water balance

analysis and planning in principle.

- The National NRW Training is “problem-solving-oriented” with secure positive effect and impact to participating municipalities.
- The National NRW Training develops not only individuals (Trainees) but also organization (participating municipalities) in tackling NRW.
- The National NRW Training curriculum is developed in consideration of occupational qualification standard model of QCTO: Knowledge (Theory), Practice and Work Experience (Workplace).

The main targets of the National NRW Training course are employees of municipalities as Water Services Authority or water service provider as defined by Water Services Act and National Water Act, respectively; and other water supply related organisations.

5 COURSE CONTENT/OUTLINE

To support and assist municipalities with NRW management, DWS/JICA and SALGA would like to implement intensive NRW programme comprising of the following knowledge, practical and workplace training components:

Knowledge and Practical Component

- Orientation and general overview
- Bulk meter knowledge, technique (including pipe fitting)
- Customer meter knowledge, technique
- Reticulation facility planning, operation and maintenance (valves, fire hydrant, air valves, etc.)
- District-Metered Area (DMA) and Measurement planning
- Data logging and analysis
- Water balance analysis
- NRW reduction strategy planning & presentation
- Fundamental knowledge of active leakage equipment
- Fundamental knowledge of conditional assessment

* The course may be customized flexibly by these components in consideration of the participating municipalities.

Workplace Training Component

Contents and log sheet are to be set along with the curriculum with support by DWS. Workplace training will take place at the respective municipalities.

Training Period and Stages

The National NRW Training is a crash course of net 30 weekdays (not consecutively) in 8 weeks period through the following stages (tentative) as a training group:

Stage 1: Theory & Practice: 5 weekdays solid at IBTC (20 trainees each group)
Stage 2: Workplace: 10 weekdays in participating municipalities with Mentor(s) with support from Facilitator(s)
Stage 3: Theory & Practice: 5 weekdays solid at IBTC (20 trainees each group)

Stage 4: Workplace: 10 weekdays in participating municipalities with Mentor(s) with support from Facilitator(s)

6 ROLES AND RESPONSIBILITIES OF FACILITATORS

Roles and responsibilities of the facilitators are:

- To undertake training for specific course modules during the training at IBTC as well as in the workplaces.
- To be punctual for the training.
- To facilitate course modules and trainees’ participation.
- To participate and provide his/her knowledge and experiences to develop leaning/teaching materials.
- To attend the facilitator technical meetings (workshops) at IBTC, Roodeplaat, Pretoria for the facilitator’s training and also familiarize themselves with learning/teaching materials and training yard at IBTC.
- To make sure that the attendance register is signed during all the training.
- To visit workplaces for trainings.
- To record, monitor and retain details of trainings.
- To provide the full record of progress of assessments.
- To participate in capacity assessment as a training resource of the National NRW Training.
- To cooperate for quality assurance, monitoring and evaluation of the National NRW Training.

7 ROLES AND RESPONSIBILITIES OF PARTICIPATING MUNICIPALITIES (TRAINEES)

Roles and responsibilities of the participating municipalities (trainees) are:

Municipalities

- To release 3 to 5 officials as trainees to participate in the training at IBTC for 10 weekdays (5 weekdays solid x two).
- To release 3 to 5 officials as trainees to participate in the workplace training in their municipality for 20 weekdays (10 weekdays x two).
- To ensure that the trainees attends the training
- To assign a leader or coordinator from the officials during the training
- To provide water supply and NRW-related information (drawings, billed water consumption data, customer classification, etc.) and efforts for the training.
- To create District-Metered Area (DMA) or equivalent as an isolated area for measurement and analysis in the workplace training
- To provide consumables such as piping materials, fittings, flowmeter(s), valve(s) and workforce, which will be used for the benefit of the municipality during the workplace training
- To provide tentative office spaces for facilitators during the workplace training.
- To provide understanding, assistance and necessary information to trainees for the training purpose.
- To provide and share NRW-related information with IBTC before/after the training continuously.

- To provide normal occupational health and safety (OHS) in the workplace training (Night-time works may arise.)
- Political/traditional coordination if necessary
-

* All provided information will be utilized only for the training purposes.

Trainees

- To attend surely the training at IBTC and workplaces.
- To be punctual for the training.
- To coordinate with other section in his/her municipality during the workplace training
- To cooperate for evaluation of the training by quality assurer.
- To follow instruction of IBTC and facilitators.
- To share own knowledge and experiences with other trainees.
- To evaluate the training course.

The NRW National Training expects ideally trainees from the municipality to be organized hierarchically and cross-sectorally "as a team" consisting of 3 to 5 officials from relevant sections such as:

- Water conservation and water demand management (WCWDM)
- Operation and maintenance (O&M), and
- Billing and finance if necessary
- Equivalent

Also, the NRW National Training targets the following officials of municipalities, who have accumulated a certain amount of education, knowledge, experience and expertise, for example:

- Technician (or Junior, Technician-to-be)
- Superintendent/Supervisor/Foreperson/Site-Manager (or Superintendent/Supervisor/Foreperson/Site-Manager-to-be)
- Artisan Plumber (or Artisan Plumber-to-be)
- General Worker if applicable, and
- Equivalent

8 FINANCIAL IMPLICATION

The costs to be covered by the Project are as below:

Facilitators

- Transport (return) between their municipalities and IBTC (own driving)
- Transport (return) between OR Tambo Airport and IBTC if flying
- Daily transport between accommodation and IBTC
- Accommodation and catering during training at IBTC
- Transport for workplace training (own driving)
- Accommodation and food allowance during workplace training (if away overnight)

Participating Municipalities (Trainees)

- Any kind of training tuition/fee and learning materials
- Accommodation and catering during training at IBTC
- Accommodation and food allowance during workplace training (if away overnight)

* The participating municipalities are in principle required to cover costs for transport for their respective municipal officials (trainees).

9 MONITORING AND EVALUATION PROCESS

For monitoring and evaluation, discussion on issues, challenges, solutions and way forward of the Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water, JICA, DWS and SALGA have established a Joint Coordination Committee (JCC) consisting of the following individuals listed in Table 1 (South African side) and Table 2 (Japanese side).

Table 1: South African Project Team

Position in the Project	Organization and Name
Project Management Committee (PMC) Chairperson	Chief Director, Engineering Services, NWRI, DWS Mr. Aloious Chaminuka
Project Director PMC Task Manager	Director, Technical Engineering Services, NWRI, DWS Mr. Vincent Monene
Co-Project Director	Director, Water Sustainability & Innovation, SALGA Mr William Moraka
Project Manager (Operational) PMC Task Manager	Centre Manager, IBTC, DWS Ms. Rosa Mfomadi Rahube
Co-Project Manager (Technical) PMC Task Manager	Director, Water Use Efficiency, P&I, DWS Mr. Hadebe Xolani
Member PMC Secretary / Task Manager	Director, ODA, IWS, DWS Mr. Albert Mmbidi
Member	Training Manager, IBTC, DWS Ms. Kgoputso Sekgoilane
Member	Quality Assurer, IBTC, DWS Ms. Makola Lerato
Member	Water Use Efficiency, P&I, DWS Mr. Thabo Masike / Mr. Padi Andries
Member	Director, Strategic Water Sector Support, P&I, DWS Ms. Iris Mathye
Member	Water Sector Institutional Development, P&I, DWS Ms. Margaret Matlala / Mr. Mtsweni Dennis
Member PMC Task Manager	Director, Operational Support, PMU, DWS Ms. Kentse Mathiba
Member	Water Sector Skill Development & Special Project, PMU, DWS Mr. Maputha
Member	Director, HRD, DWS Ms. Merriam Moagi
Member	HRD, DWS Mr. Matome Makwaeba
Member	Construction, NWRI, DWS Mr. Armand Basson / Mr. Riaan Stassen
Secretary	Official Development Assistance, IWS, DWS Ms. Mtsweni Zanu

Table 2: Japanese Project Team

Position in the Project	Organization and Name
Chief Advisor / NRW Management	Mr. Akinori MIYOSHI

Position in the Project	Organization and Name
Deputy Chief Advisor / NRW Management	Mr. Taketoshi FUJIYAMA
Skills Programme Planning/Organization Coordination	Mr. Kenichiro SUGIYA
Water Leakage Detection	Mr. Hiroki NIIMURA
Water Distribution Control / Commercial Loss	Mr. Hiroyuki MORITA
Training Yard Design and Supervision	Mr. Masuji IDE
Procurement / Administrative Coordination	Mr. Toshinobu KASUYA
Training Management/Human Resource Development	Mr. Nobutaka MARUYAMA

9 SUSTAINABILITY

The proposed programme has a potential to be built onto a full occupational qualification by progressively developing beneficiaries from short term learning programmes that will eventually lead to achievement of Water Reticulation Practitioner (WRP) occupational qualification. The completion of the NRW programme will allow trainees to articulate to much higher level of National Qualification Framework (NQF) in future, as envision by the National Qualification Framework Act, 2008 (No 67 of 2008).In future, the trainees will qualify to enroll for the already-registered WRP occupational qualification in some parts.

10 PROJECT TIMELINE

The overall goal of the Project is to continuously develop NRW management skills for municipalities under the direction of IBTC in collaboration with SALGA based on municipal NRW ratios. The National NRW Training is implemented in two groups in FY2019/2020.

Training Groups

The three groups in FY2019/2020 (until March 2020) are as follows:

Group 1: September 2019 - November 2019 (net 30 weekdays in 8 weeks period)

Group 2: **January 2019 - March 2020 (net 30 weekdays in 8 weeks period)**

11 IMPORTANT SCHEDULE FOR FACILITATORS ONLY

As a role and responsibility, the nominated facilitators are requested to be in the facilitator technical meetings (workshops) at IBTC, Roodeplaat, Pretoria for the facilitator's training and also familiarize themselves with learning/teaching materials and training yard.

The schedule are as below and details will be informed later:

- **2 - 3 days in the first week of June 2019**
- **2 - 3 days in the first week of July 2019**

12 CONCLUSION

In conclusion Skills development is one vehicle that supports the optimum management of NRW in the municipalities which requires integrated collaboration of stakeholders at National office, Local government and SETAs to ensure access of water to support the socio-economic activities in the sector. One of the strategic action of the NWRS2 Chapter 15 is to increase Intergovernmental relations, sector collaboration and partnerships through effective utilisation of existing structures and instruments to facilitate intergovernmental relations, sector collaboration and partnerships in addressing key education, training and skills development issues. This proposal seek to implement the above objective of the NWRS2 Chapter 15 and also monitor the agreement between DWS and other Global and African countries in terms of KPI's set for training and skills transfer, and advances in research and technology.

This project will assist with skilling and building capacity of municipalities to tackle water losses and related non-revenue water challenges. This will ensure a better provision of reliable water services and improve water security for the municipalities and the country.

Overall Programme of The National NRW Training

Last Update: 18-Jun-19

2019

JUNE

S	M	T	W	T	F	S
26	27	28	29	30	31	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	1	2	3	4	5	6

2019

JULY

S	M	T	W	T	F	S
30	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	1	2	3
4	5	6	7	8	9	10

2019

AUGUST

S	M	T	W	T	F	S
28	29	30	31	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
1	2	3	4	5	6	7

2019 JCC

SEPTEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	1	2	3	4	5
6	7	8	9	10	11	12

2019

OCTOBER

S	M	T	W	T	F	S
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9

2019

NOVEMBER

S	M	T	W	T	F	S
27	28	29	30	31	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
1	2	3	4	5	6	7

2019

DECEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	1	2	3	4
5	6	7	8	9	10	11

2020

JANUARY

S	M	T	W	T	F	S
29	30	31	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	1
2	3	4	5	6	7	8

2020

FEBRUARY

S	M	T	W	T	F	S
26	27	28	29	30	31	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
1	2	3	4	5	6	7

2020 JCC

MARCH

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	1	2	3	4
5	6	7	8	9	10	11

2020

APRIL

S	M	T	W	T	F	S
29	30	31	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	1	2
3	4	5	6	7	8	9

2020

MAY

S	M	T	W	T	F	S
26	27	28	29	30	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	1	2	3	4	5	6

2020

JUNE

S	M	T	W	T	F	S
31	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	1	2	3	4
5	6	7	8	9	10	11

2020

JULY

S	M	T	W	T	F	S
28	29	30	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	1
2	3	4	5	6	7	8

2020 *JICA Project termination & JCC*

AUGUST

S	M	T	W	T	F	S
26	27	28	29	30	31	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	1	2	3	4	5

2020

SEPTEMBER

S	M	T	W	T	F	S
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	1	2	3
4	5	6	7	8	9	10

2020

OCTOBER

S	M	T	W	T	F	S
27	28	29	30	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
1	2	3	4	5	6	7

2020

NOVEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	1	2	3	4	5
6	7	8	9	10	11	12

calendar:
https://www.timeanddate.com/calendar/?year=2019&country=62

Period	Phase	Paticipation

Preparation:

** Prepration for 1st Group Training (4 munics)*

Period	Phase	Paticipation
3 Jul. - 5 Jul.	Facilitator Meeting-1	All Facilitators
26 Aug.	Orientation	Nominated 17 officials only
29 Jul. - 9 Aug.	Training in Japan (excluding travelling days)	Nominated 17 officials only
29 Aug. - 30 Aug.	Facilitator Meeting-2	All Facilitators

1st Group

Period	Phase	Paticipation
16 Sep. - 20 Sep.	IBTC: 5 weekdays solid	All Facilitators
23 Sep. - 11 Oct.	WorkPlace: 10 weekdays	3-4 days of each week/Faciliotator (5 faci. x 4 munics.)
14 Oct. - 18 Oct.	IBTC: 5 weekdays solid	All Facilitators
21 Oct. - 8 Nov.	WorkPlace: 10 weekdays	3-4 days of each week/Faciliotator (5 faci. x 4 munics.)

** Review and improvement of the NRW training in November and December 2019*

** Prepration for 2nd Group Training (4 munics)*

2nd Group

Period	Phase	Paticipation
20 Jan. - 24 Jan.	IBTC: 5 weekdays solid	Facilitators incharged
27 Jan. - 14 Feb.	WorkPlace: 10 weekdays	3-4 days of each week/Faciliotator (2 faci. x 4 munics.)
17 Feb. - 21 Feb.	IBTC: 5 weekdays solid	Facilitators incharged
24 Feb. - 13 Mar.	WorkPlace: 10 weekdays	3-4 days of each week/Faciliotator (2 faci. x 4 munics.)

**** Submisson of 1st fiscal year completion report to LGSETA in March ? (if granted)***

**** JICA HQs Project Evaluation Mission (6 month prior to the Completion) in March or April***

** Review and improvement of the NRW Training in April 2020*

** Prepration for 3rd Group Training (4 munics)*

3rd Group

Period	Phase	Paticipation
18 May -22 May	IBTC: 5 weekdays solid	Facilitators incharged
25 May -12 Jun.	WorkPlace: 10 weekdays	3-4 days of each week/Faciliotator (2 faci. x 4 munics.)
22 Jun. - 26 Jun.	IBTC: 5 weekdays solid	Facilitators incharged
29- Jun. - .17 Jul.	WorkPlace: 10 weekdays	3-4 days of each week/Faciliotator (2 faci. x 4 munics.)
4-5 Aug. (tentative)	DWS-SALGA-JICA Project Closing Seminor	All Facilitators

**** JICA Project Termination on 12th August 2020***

** Prepration for 4th Group Training (4 munics)*

Legend (Color)

- (blue) : **IBTC Training**
- (yellow) : **Workplace Training**
- (red) : **Mile stones**

To be continued (until 2025), 3 to 4 groups per annum

Overall Programme of The National NRW Training

Last Update: 3-Sep-19

2019 — JUNE

S	M	T	W	T	F	S
26	27	28	29	30	31	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	1	2	3	4	5	6

2019 — JULY

S	M	T	W	T	F	S
30	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	1	2	3
4	5	6	7	8	9	10

2019 — AUGUST

S	M	T	W	T	F	S
28	29	30	31	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
1	2	3	4	5	6	7

2019 — SEPTEMBER (JCC)

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	1	2	3	4	5
6	7	8	9	10	11	12

2019 — OCTOBER

S	M	T	W	T	F	S
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9

2019 — NOVEMBER

S	M	T	W	T	F	S
27	28	29	30	31	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
1	2	3	4	5	6	7

2019 — DECEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	1	2	3	4
5	6	7	8	9	10	11

2020 — JANUARY

S	M	T	W	T	F	S
29	30	31	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	1
2	3	4	5	6	7	8

2020 — FEBRUARY

S	M	T	W	T	F	S
26	27	28	29	30	31	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
1	2	3	4	5	6	7

2020 — MARCH (JCC)

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	1	2	3	4
5	6	7	8	9	10	11

2020 — APRIL

S	M	T	W	T	F	S
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12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	1	2
3	4	5	6	7	8	9

2020 — MAY

S	M	T	W	T	F	S
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3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	1	2	3	4	5	6

2020 — JUNE

S	M	T	W	T	F	S
31	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	1	2	3	4
5	6	7	8	9	10	11

2020 — JULY

S	M	T	W	T	F	S
28	29	30	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	1
2	3	4	5	6	7	8

2020 — AUGUST (JICA Project termination & JCC)

S	M	T	W	T	F	S
26	27	28	29	30	31	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	1	2	3	4	5

2020 — SEPTEMBER

S	M	T	W	T	F	S
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	1	2	3
4	5	6	7	8	9	10

2020 — OCTOBER

S	M	T	W	T	F	S
27	28	29	30	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
1	2	3	4	5	6	7

2020 — NOVEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	1	2	3	4	5
6	7	8	9	10	11	12

calendar:
https://www.timeanddate.com/calendar/?year=2019&country=62

Preparation:

* Prepration for 1st Group Training (4 munics)

Period	Phase	Paticipation
3 Jul. - 5 Jul.	Facilitator Meeting-1	All Facilitators
26 Aug.	Orientation	Nominated 17 officials only
29 Jul. - 9 Aug.	Training in Japan (excluding travelling days)	Nominated 17 officials only
19 Sep. - 20 Sep.	Facilitator Meeting-2	All Facilitators

1st Group

Period	Phase	Paticipation
7 Oct. - 11 Oct.	IBTC: 5 weekdays solid	All Facilitators
14 Oct. - 18 Oct.	Prepration for Workplace	3-4 days of each week/Faciliotator (5 faci. x 4 munics.)
21 Oct. - 1 Nov.	Workplace: 10 weekdays	
4 Nov. - 8 Nov.	IBTC: 5 weekdays solid	All Facilitators
11 Nov. - 15 Nov.	Prepration for Workplace	3-4 days of each week/Faciliotator (5 faci. x 4 munics.)
18 Nov. - 29 Nov.	Workplace: 10 weekdays	

* Review and improvement of the NRW training in November and December 2019
* Prepration for 2nd Group Training (4 munics)

2nd Group

Period	Phase	Paticipation
20 Jan. - 24 Jan.	IBTC: 5 weekdays solid	
27 Jan. - 31 Jan.	Prepration for Workplace	Facilitators incharged
3 Feb. - 14 Feb.	Workplace: 10 weekdays	3-4 days of each week/Faciliotator (2 faci. x 4 munics.)
17 Feb. - 21 Feb.	IBTC: 5 weekdays solid	
24 Feb. - 28 Feb.	Prepration for Workplace	Facilitators incharged
2 Mar. - 13 Mar.	Workplace: 10 weekdays	3-4 days of each week/Faciliotator (2 faci. x 4 munics.)

* Submisson of 1st fiscal year completion report to LGSETA in March ? (if granted)
* JICA HQs Project Evaluation Mission (6 month prior to the Completion) in March or April
* Review and improvement of the NRW Training in April 2020
* Prepration for 3rd Group Training (4 munics)

3rd Group

Period	Phase	Paticipation
18 May -22 May	IBTC: 5 weekdays solid	Facilitators incharged
25 May -29 May.	Prepration for Workplace	3-4 days of each week/Faciliotator (2 faci. x 4 munics.)
1 Jun -12 Jun.	Workplace: 10 weekdays	
22 Jun. - 26 Jun.	IBTC: 5 weekdays solid	
29 Jun. - 3 Jul.	Prepration for Workplace	Facilitators incharged
6 Jul. - 17 Jul.	Workplace: 10 weekdays	3-4 days of each week/Faciliotator (2 faci. x 4 munics.)
4-5 Aug. (tentative)	DWS-SALGA-JICA Project Closing Seminor	All Facilitators

* JICA Project Termination on 12th August 2020
* Prepration for 4th Group Training (4 munics)

Legend (Color)

- : IBTC Training
- : Preparation for Workplace
- : Workplace Training
- : Mile stones

To be continued (until 2025), 3 to 4 groups per annum

Training Programme Outline

National Non Revenue Water Training Roodeplaat

1st Facilitator Meeting,3-5 July, 2019

water & sanitation
Department: Water and Sanitation
REPUBLIC OF SOUTH AFRICA

SALGA
Inspiring service delivery

JICA

1st Training in IBTC (1st Week)

Let us make normal

Structure of Training Programme

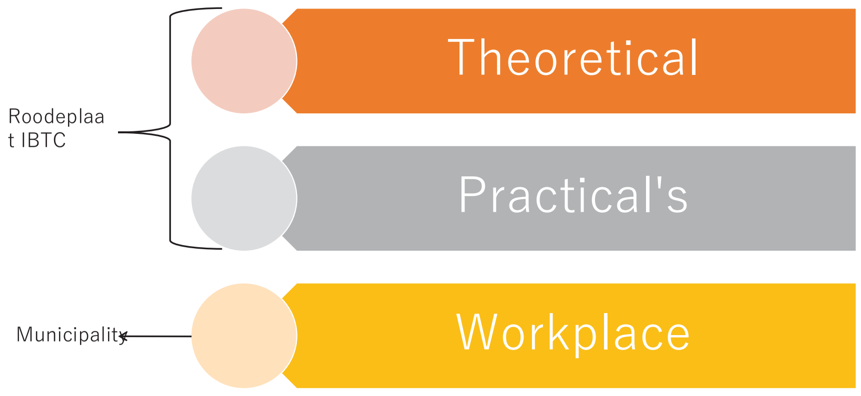


Table 2: 1st Training in IBTC (1st Week)

Day	Time	Contents	Remarks
Day 1 (Mon)	10:00-10:50	Orientation Introduction of the training course and participants	Meeting
	11:00-11:50	Introduction of the training yard and equipment	Yard
	Lunch		
	13:00-14:20	Water balance NRW Outline of countermeasures	Lecture
	14:30-16:00	Water balance Introduction of countermeasures	Yard
Day 2 (Tue)	9:00-10:20	Bulk metering -Role –Type: Mechanical, UFM, EMF	Lecture
	10:30-12:00	Bulk metering Mechanical meter pulse meter setting UFM setting / Pressure logging	Practice
	Lunch		
	13:00-14:20	Customer metering Billing data analysis	Lecture
	14:30-16:00	Customer metering(Installation, Meter reading, characteristic test by the test meter) Billing data analysis(data base analysis)	Practice
Day 3 (Wed)	9:00-10:20	Appurtenance Role: Air valve, PRV, valves, fire hydrant,	Lecture
	10:30-12:00	Appurtenance maintenance PRV setting and maintenance	Practice
	Lunch		
	13:00-14:20	Bulk Measurement and Logging	Lecture
	14:30-16:00	Bulk Flow & Pressure measurement: Mechanical, Ultrasonic	Practice
Day 4 (Thur)	9:00-10:20	DMA Planning Objectives, SIV, MNF, Sub-section creation, Step test	Lecture
	10:30-12:00	DMA isolation and measurement Mechanical meter pulse meter setting UFM setting / Pressure logging and data collection	Practice
	Lunch		
	13:00-14:20	Data acquisition & analysis SIV, MNF, Step test data analysis	Practice
	14:30-16:00	Measurement planning Making Pilot DMA in each municipality on map.	Practice
Day 5 (Fri)	9:00-10:20	Presentation on workplace measurement plan in each municipality	Lecture
	10:30-12:00	Orientation for workplace training	Discussion
	Lunch		
	13:00-14:30	Assessment	

Table 3: 1st Workplace Training (10days in following three weeks)

Day	Time	Contents	Remarks
Day 1	9:00-12:00	Review an planned design of DMA at site	Meeting
	13:00-16:00	Install a flow meter and pressure logger at site to measure SIV, start logging	Site work
Day 2	9:00-12:00	Make a drop test procedure to confirm isolation of DMA	Meeting
	13:00-16:00	Conduct a drop test to confirm isolation of DMA (2 days)	Site work
Day 3	9:00-12:00	Conduct a drop test to confirm isolation of DMA (2 days)	Site work
	13:00-16:00	Conduct a drop test to confirm isolation of DMA (2 days)	Site work
Day 4	9:00-12:00	Review and recalculation of consumption volume in DMA MNF measurement	Data analysis /Site work
	13:00-9:00	Review and recalculation of consumption volume in DMA MNF measurement	Data analysis /Site work
Day 5	9:00-12:00	Review and recalculation of consumption volume in DMA MNF measurement	Data analysis /Site work
	13:00-9:00	Review and recalculation of consumption volume in DMA MNF measurement	Data analysis /Site work
Day 6	9:00-12:00	Flow and pressure data retrieval	Site work
	13:00-16:00	Flow and pressure data analysis and make a visual material	Data analysis
Day 7	9:00-12:00	Flow and pressure data analysis and make a visual material	Data analysis
	13:00-16:00	Flow and pressure data analysis and make a visual material	Data analysis
Day 8	9:00-12:00	Flow and pressure data analysis to make a 1st water balance as the base line	Desk work/Meeting
	13:00-16:00	Make a 1st Water balance (Base Line)	Desk work/Meeting
Day 9	9:00-12:00	Make a 1st Water balance (Base Line)	Desk work/Meeting
	13:00-16:00	Make an assumption to reduce NRW in the DMA and make a NRW reduction plan 1st Draft (2 days)	Lecture /discussion
Day 10	9:00-12:00	Make a presentation of measurement result	Desk work /Meeting
	13:00-16:00	Make a report on results of workplace training and the findings	Discussion

Table 4: 2nd Training in IBTC (5th Week)

Day	Time	Contents	Remarks
Day 1 (Mon)	10:00-10:50	Orientation/Review and information sharing	Meeting
	11:00-11:50	Give a presentation on results of workplace training and the findings.	Meeting
	Lunch		
	13:00-14:20	Give a presentation on results of workplace training and the findings.	Meeting
	14:30-16:00	Give a presentation on results of workplace training and the findings.	Meeting
Day 2 (Tue)	9:00-10:20	Analyze results of workplace training.	Lecture /Discussion
	10:30-12:00	Analyze results of workplace training	Lecture /Discussion
	Lunch		
	13:00-14:20	Introduction of NRW countermeasures 1. Meter management(Bulk, Customer) 2. Review of Piping/Plumbing/Repairing method 3. Awareness 4. Leakage survey and countermeasures 5. Conditional assessment	Lecture
	14:30-16:00	NRW countermeasures 1 Characteristic of meters (by test meter)	Practice
Day 3 (Wed)	9:00-10:20	NRW countermeasures 2 Review of Piping/Plumbing/Repairing	Practice
	10:30-12:00	NRW countermeasures 3 Awareness	Practice
	Lunch		
	13:00-14:20	NRW countermeasures 4 Leakage survey and countermeasure	Practice
	14:30-16:00	NRW countermeasures 5 Conditional assessment	Practice
Day 4 (Thur)	9:00-10:20	Making strategy and implementation plan	Lecture
	10:30-12:00	Make strategy and implementation plan in DMA	Practice
	Lunch		
	13:00-14:20	Presentation for NRW reduction	Lecture
	14:30-16:00	Make presentation for NRW reduction plan	Practice
Day 5 (Fri)	9:00-10:20	Presentation	Practice /Discussion
	10:30-12:00	Presentation	Practice /Discussion
	Lunch		
	13:00-14:30	Orientation for workplace training	Lecture /Discussion

Table 5: 2nd Workplace Training (10days in following three weeks)

Day	Time	Contents	Remarks
Day 1	9:00-12:00	Review the detail NRW reduction plan and confirm the procedure	Meeting
	13:00-16:00	Customer Meter accuracy test in the DMA (20 meters)	Desk work
Day 2	9:00-12:00	Household Leakage survey (100 houses)/repair/make report	Practice
	13:00-16:00	Household Leakage survey (100 houses) /repair/make report	Practice
Day 3	9:00-12:00	Household Leakage survey (100 houses)/repair/make report	Practice
	13:00-16:00	Any NRW reduction activity or Leak survey (100 houses)	Practice
Day 4	9:00-12:00	Any NRW reduction activity or Leak survey (100 houses)	Practice
	13:00-16:00	Any NRW reduction activity or Leak survey (100 houses)	Practice
Day 5	9:00-12:00	Any NRW reduction activity or Leak repair/make report(100)	Practice
	13:00-16:00	Any NRW reduction activity or Leak repair/make report(100)	Practice
Day 6	9:00-12:00	Any NRW reduction activity or Leak repair/make report(100)	Practice
	13:00-16:00	2nd MNF measurement after NRW interventions	Practice
Day 7	9:00-12:00	Consumption data re-analysis	Practice
	13:00-9:00	2nd MNF measurement after NRW interventions	Practice
Day 8	9:00-12:00	Consumption data re-analysis	Practice
	13:00-9:00	Retrieve 2nd SIV data	Practice
Day 9	9:00-12:00	Analyze 2nd Water balance after NRW countermeasures	Discussion/ Desk work
	13:00-16:00	Make report of the Pilot DMA	Discussion/ Desk work
Day 10	9:00-12:00	Make a NRW reduction action plan including budget plan for whole municipality	Discussion/ Desk work
	13:00-16:00	Make a presentation to Municipal manager	Discussion/ Desk work

Day 2(Tue) [1st IBTC Week]

9:00-10:20 Bulk metering, -Role –Type: Mechanical, UFM, EMF Lecture

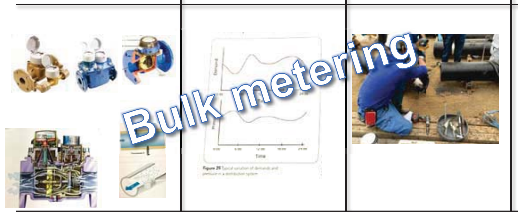
10:30-12:00 Bulk metering, Mechanical meter pulse meter setting, UFM setting /Pressure logging Practice

12:00-13:00 Lunch

13:00-14:20 Customer metering, Billing data analysis, Lecture

14:30-16:00 Customer metering (Installation, Meter reading, characteristic test by the test meter), Billing data analysis (data base analysis) Practice

1. Function	2. Characteristics of Bulk inflow	3. Setup and Operation	Target of the day



Target of the day
- ✓ Getting skills for accurate System Input Volume
- ✓ Grasping characteristics of Bulk flow
- ✓ Getting maintenance skills of Bulk meter

1. Function	2. From data to situation	3. Installation and Operation	Target of the day

Target of the day
- ✓ Get accurate consumption data
- ✓ Grasp situation from consumption data
- ✓ Get installation skills and maintenance skills of customer meter

Day 1(Mon) [1st IBTC Week]

10:00-10:50 Orientation Meeting

10:00-10:50 Introduction of the training course and participants Meeting

11:00-11:50 Introduction of the training yard and equipment Yard

12:00-13:00 Lunch

13:00-14:20 Water balance, NRW, Outline of countermeasures Lecture

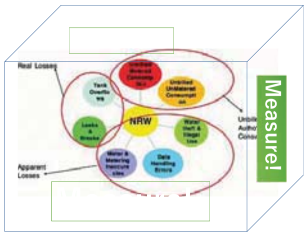
14:30-16:00 Water balance, Introduction of countermeasures Yard

1. Orientation & Opening Lecture

2. Self introduction(icebreaking)

Self-Introduction: trainer
Self-Introduction: staffs
Self-Introduction: trainee

3. What is NRW?/ Water Balance



Target of the day
- ✓ Ice break
- ✓ Give whole picture of this course
- ✓ Aim at NRW
- ✓ Motivate Participants

6

Day 3(Wed) [1st IBTC Week]

9:00-10:20 Appurtenance, Role: Air valve, PRV, valves, fire hydrant, Lecture

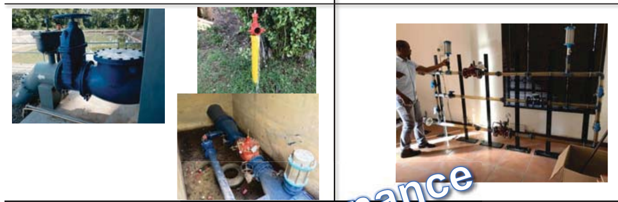
10:30-12:00 Appurtenance maintenance, PRV setting and maintenance Practice

12:00-13:00 Lunch

13:00-14:20 Bulk Measurement and Logging Lecture

14:30-16:00 Bulk Flow & Pressure measurement: Mechanical, Ultrasonic Practice

1. Function & Position	2. Relation of NRW and Facilities



3. Points of maintenance

Target of the day
- ✓ Getting idea of proper position in reticulation
- ✓ Getting idea of how it can work for WCWDM measures
- ✓ Getting maintenance skills to make them function properly 24/7

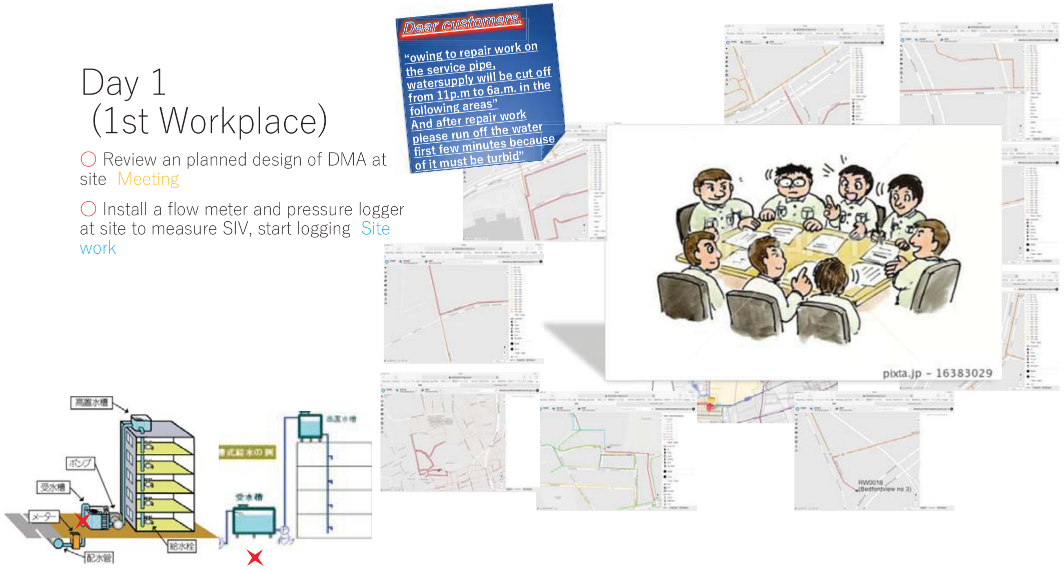
1st Workplace Training (10days in following three weeks)

Let us step by step

Day 1 (1st Workplace)

◯ Review an planned design of DMA at site Meeting

◯ Install a flow meter and pressure logger at site to measure SIV, start logging Site work



Day 4(Thur) [1st IBTC Week]

9:00-10:20 DMA Planning, Objectives, SIV, MNF, Sub-section creation, Step test Lecture

10:30-12:00 DMA isolation and measurement, Mechanical meter pulse meter setting, UFM setting / Pressure logging and data collection Practice

12:00-13:00 Lunch

13:00-14:20 Data acquisition & analysis, SIV, MNF, Step test data analysis Practice

14:30-16:00 Measurement planning, Making Pilot DMA in each municipality on map. Practice

Target of the day

- ✓ Proper selection of water meter
- ✓ Proper selection of measurement point
- ✓ Proper resource planning for measurement and sectorization

Day 5(Fri) [1st IBTC Week]

9:00-10:20 Presentation on workplace measurement plan in each municipality Lecture

10:30-12:00 Orientation for workplace training Discussion

12:00-13:00 Lunch

13:00-14:30 Assessment

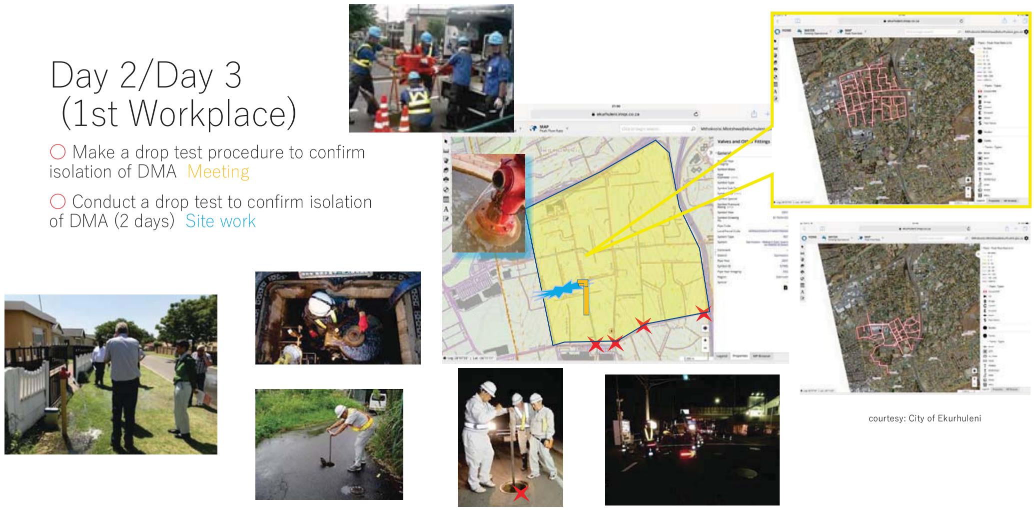
Target of the day

- ✓ Setting properly of logging specs
- ✓ Proper installation of logger
- ✓ Secure the data and security of logging equipment
- ✓ Organize and Analyzing the data

Day 2/Day 3 (1st Workplace)

○ Make a drop test procedure to confirm isolation of DMA Meeting

○ Conduct a drop test to confirm isolation of DMA (2 days) Site work

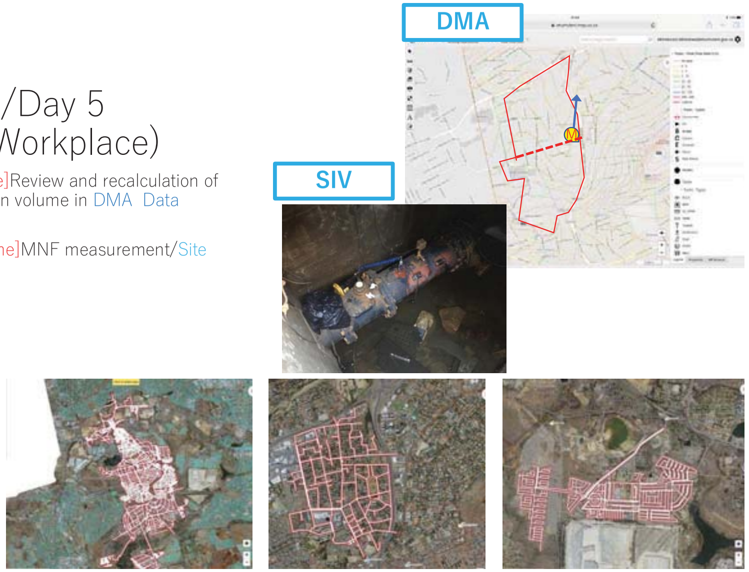


courtesy: City of Ekurhuleni

Day 4/Day 5 (1st Workplace)

○[Day time]Review and recalculation of consumption volume in DMA Data analysis

○[Night time]MNF measurement/Site work

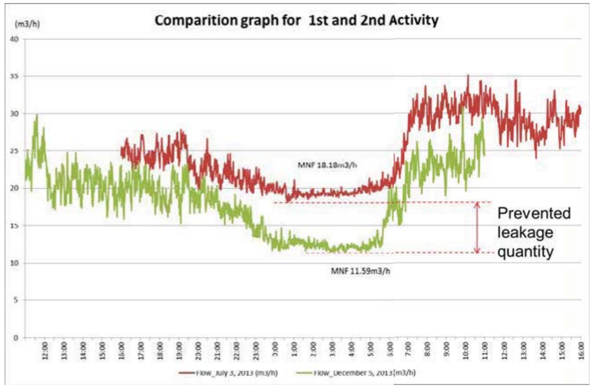


courtesy: City of Ekurhuleni

Day 6/Day 7 (1st Workplace)

○ Flow and pressure data retrieval Site work

○ Flow and pressure data analysis and make a visual material Data analysis

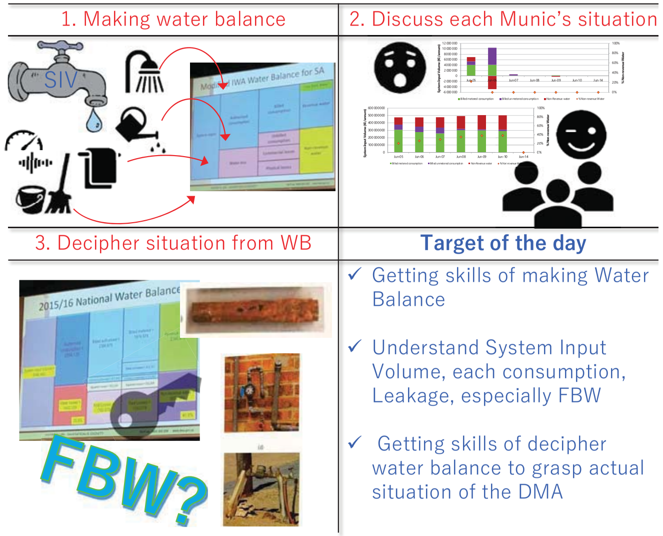


Day 8/Day 9 (1st Workplace)

○ Flow and pressure data analysis to make a 1st water balance as the base line Desk work/Meeting

○ Make a 1st Water balance (Base Line) Desk work/Meeting

○ Make an assumption to reduce NRW in the DMA and make a NRW reduction plan 1st Draft (2 days) Lecture/discussion



Target of the day

- ✓ Getting skills of making Water Balance
- ✓ Understand System Input Volume, each consumption, Leakage, especially FBW
- ✓ Getting skills of decipher water balance to grasp actual situation of the DMA

Day 10
(1st Workplace)

○ Make a presentation of measurement result Desk work/Meeting

○ Make a report on results of workplace training and the findings Discussion

2nd Training in IBTC (5th Week)

Day 1(Mon)
[2nd IBTC Week]

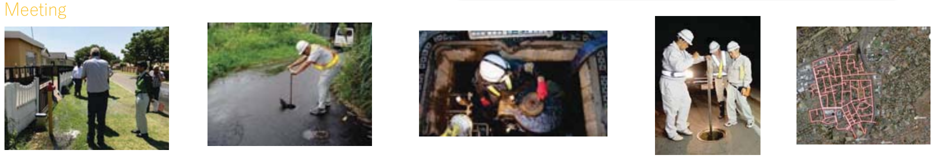
10:00-10:50 Orientation/Review and information sharing Meeting

11:00-11:50 Give a presentation on results of workplace training and the findings. Meeting

12:00-13:00 Lunch

13:00-14:20 Give a presentation on results of workplace training and the findings. Meeting

14:30-16:00 Give a presentation on results of workplace training and the findings. Meeting



Day 2(Tue)
[2nd IBTC Week]

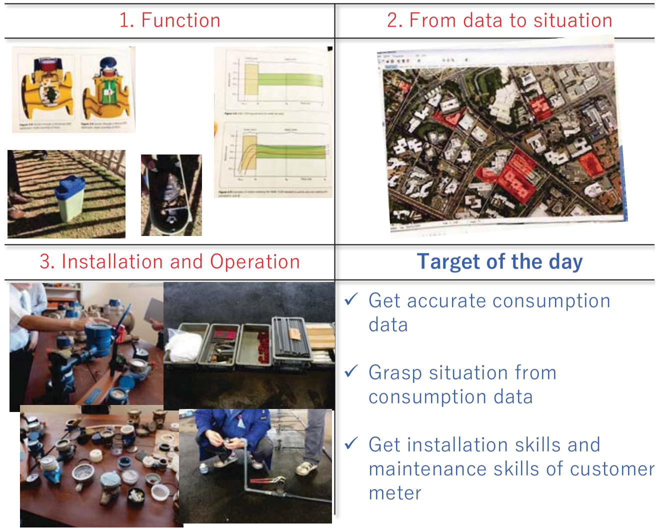
9:00-10:20 Analyze results of workplace training. Lecture/Discussion

10:30-12:00 Analyze results of workplace training Lecture/Discussion

12:00-13:00 Lunch

13:00-14:20 Introduction of NRW countermeasures 1. Meter management(Bulk, Customer, 2. Review of Piping/Plumbing/Repairing method, 3. Awareness, 4. Leakage survey and countermeasures, 5. Conditional assessment Lecture

14:30-16:00 NRW countermeasures 1, Characteristic of meters (by test meter) Practice



Day 3(Wed) [2nd IBTC Week]

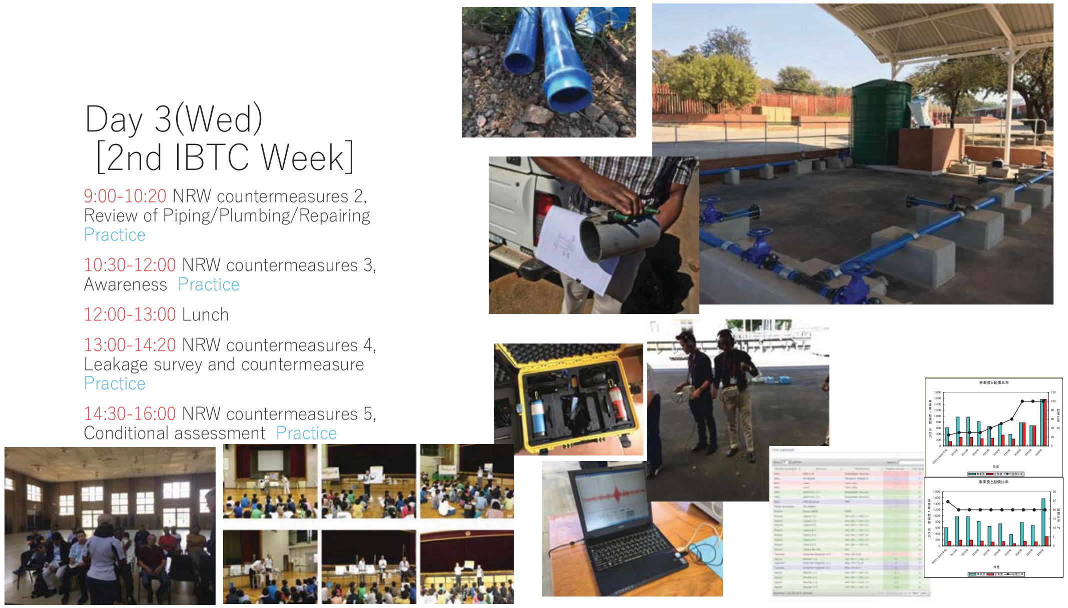
9:00-10:20 NRW countermeasures 2, Review of Piping/Plumbing/Repairing Practice

10:30-12:00 NRW countermeasures 3, Awareness Practice

12:00-13:00 Lunch

13:00-14:20 NRW countermeasures 4, Leakage survey and countermeasure Practice

14:30-16:00 NRW countermeasures 5, Conditional assessment Practice



Day 5(Fri) [2nd IBTC Week]

9:00-10:20 Presentation Practice/Discussion

10:30-12:00 Presentation Practice/Discussion

12:00-13:00 Lunch

13:00-14:30 Orientation for workplace training Lecture/Discussion

Day 4(Thur) [2nd IBTC Week]

9:00-10:20 Making strategy and implementation plan Lecture

10:30-12:00 Make strategy and implementation plan in DMA Practice

12:00-13:00 Lunch

13:00-14:20 Presentation for NRW reduction Lecture

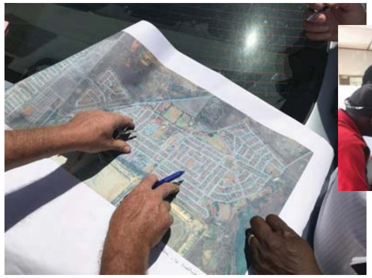
14:30-16:00 Make presentation for NRW reduction plan Practice

2nd Workplace Training (10days in following three weeks)

Day 1
(2nd Workplace)

○ Review the detail NRW reduction plan and confirm the procedure Meeting

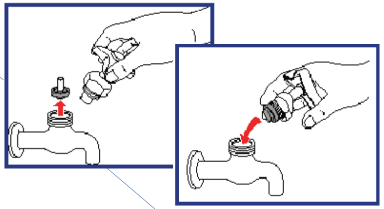
○ Customer Meter accuracy test in the DMA (20 meters) Desk work

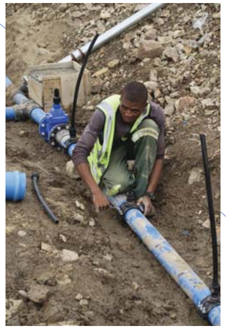


Day 5/Day 6
(2nd Workplace)

○ Any NRW reduction activity or Leak repair/make report(100) Practice

○ 2nd MNF measurement after NRW interventions Practice





Day 2/Day 3/Day 4
(2nd Workplace)

○ Household Leakage survey (100 houses)/repair/make report Practice

○ Any NRW reduction activity or Leak survey (100 houses) Practice

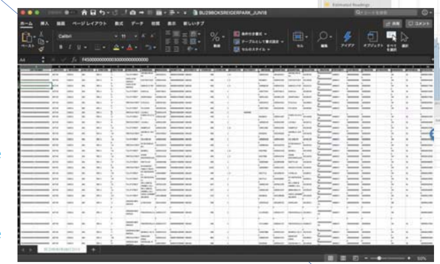
Day 7/Day 8
(2nd Workplace)

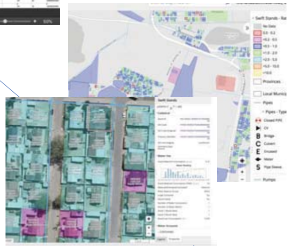
○ Consumption data re-analysis Practice

○ 2nd MNF measurement after NRW interventions Practice

○ Consumption data re-analysis Practice

○ Retrieve 2nd SIV data Practice

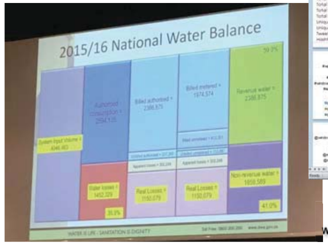


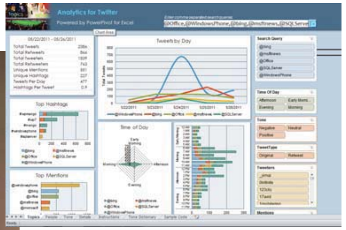


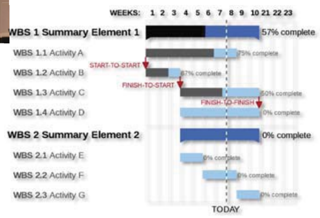
Day 9
(2nd Workplace)

○ Analyze 2nd Water balance after NRW countermeasures Discussion/Desk work

○ Make report of the Pilot DMA Discussion/Desk work







<table>
<tr><td rowspan="9">System Input Volume</td><td rowspan="4">Authorised Consumption</td><td rowspan="2">Billed Authorised Consumption</td><td>Billed Metered Consumption</td><td rowspan="2">Potential Revenue Water
Recovered Revenue</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorised Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="7">Non Revenue Water</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="5">Water Losses</td><td rowspan="2">Apparent Losses</td><td>Unauthorised Consumption</td></tr>
<tr><td>Customer Meter Inaccuracies</td></tr>
<tr><td rowspan="3">Real Losses</td><td>Leakage on Transmission and Distribution Mains</td></tr>
<tr><td>Leakage on Overflows at Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to point of Customer Meter</td></tr>
</table>

Day 10
(2nd Workplace)

○ Make a NRW reduction action plan including budget plan for whole municipality Discussion/Desk work

○ Make a presentation to Municipal manager Discussion/Desk work

Project for Strengthening the Training Capacity of Infrastructure Branch Training Centre (IBTC) on Non-Revenue Water

Results of the Benchmarking session in Japan (29 July – 9 August 2019)

Presentation Outline

- Introduction
- Background (Non-Revenue Water)
- Benchmarking
- Lessons Learnt And Observation
- Recommendations
- Conclusion

1. Introduction

The Department of Water and Sanitation in conjunction with SALGA entered into a 3 year Technical Cooperation Agreement with the Japan International Cooperation Agency (JICA) to strengthen the training capacity of the DWS Infrastructure Branch Training Centre (IBTC).

The project aims to skill and capacitate water service authorities (WSAs) employees on the management of Non-Revenue Water (NRW), learning from best practices in Japan.

Introduction (continued)

- First Benchmarking exercise:
  - The benchmarking session was conducted in May 2018.
  - Ten officials from the Department, Salga, Sector Education and Training Authority (SETA), Tshwane University of Technology and selected Municipalities
- Second Benchmarking exercise
  - Benchmarking session from 29 July to 9 August 2019.
  - 17 member delegation from DWS, SALGA, LGSETA and participating municipalities

Why Japan?

a) History Modern Water Supply and NRW

a) Measures and Impact on NRW

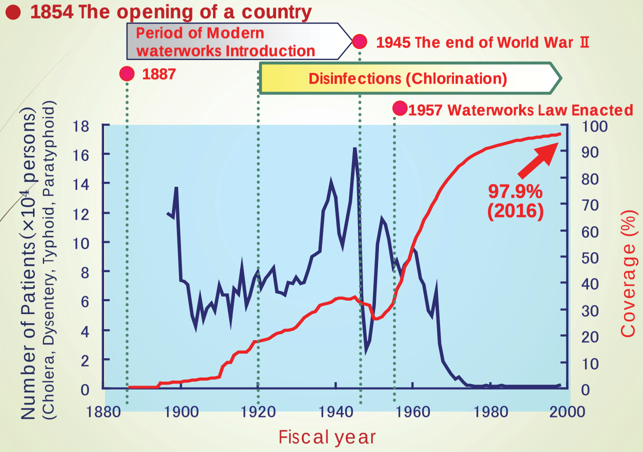
a) HRD and Skills Transfer

HISTORY OF MODERN WATER SUPPLY AND NRW

The first modern waterworks in Japan

1887	Yokohama City
1889	Hakodate City
1891	Nagasaki City
1895	Osaka City
1898	Tokyo
⋮	

CONTINUED.........

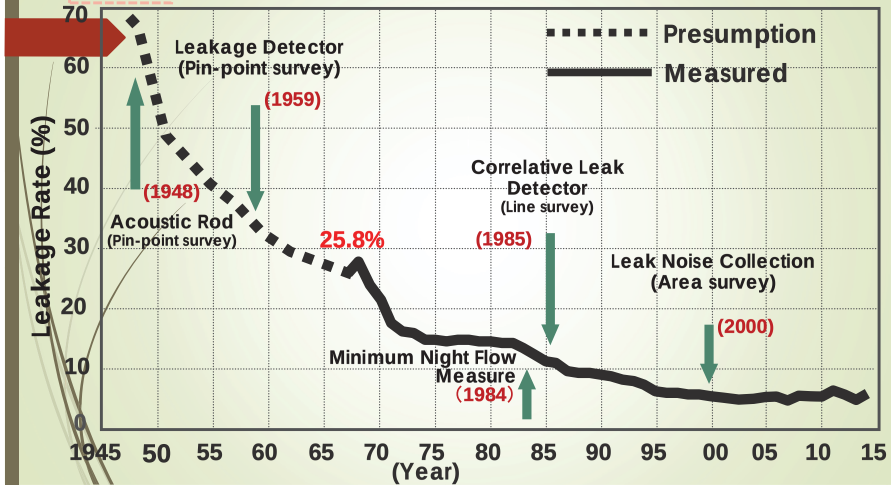


CONTINUED.........

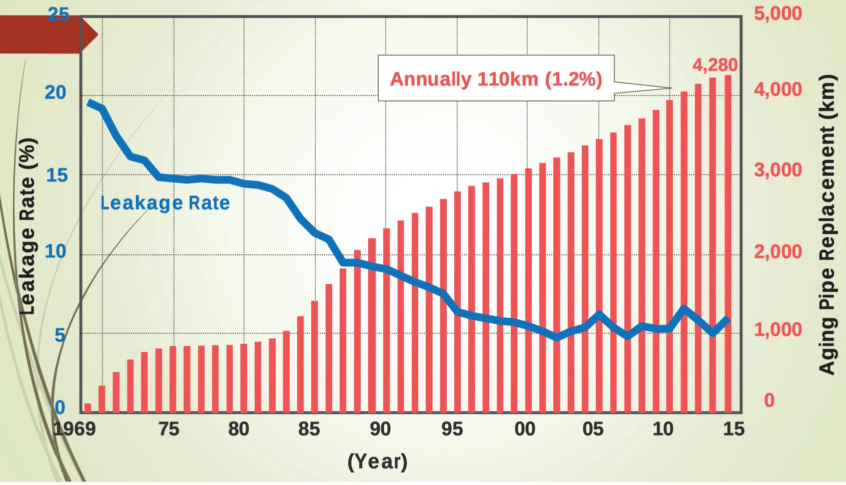
- NRW in 1948 assumed to be in the region of 70 to 80 % of the total system volume
- The assumptions were based on the following factor:
- Large Kanto earthquake measuring M7.9 in 1923
- Bombing of Japan in 1948: World War 2
- The following were measures introduced to reduce NRW in the country to date:
  - 1948: Various leak detection and repairs
  - 1984: Measurement of Minimum Night Flows
  - 1969: Replacement of old and weak pipes
- Resulting to 100% water supply coverage and metering as well as approximately 98% revenue collection.

*see impact on next slide!

1948~To Date Leakage Prevention Impact on NRW



Impact of Pipe Replacement/Renewal on Leakage



Water Balance for Yokohama: Japan=3-5% overall

Distributed Water 100%	Revenue 92.3%	Billed metered consumption	92.3
		Billed unmetered consumption	+0.0
	Non-Revenue 7.7%	Unbilled metered consumption	0.3
		Unbilled unmetered consumption	0.5
		Unauthorized consumption	0.0
		Customer meter inaccuracies	1.9
		Leakage Water (assumed)	5.0

HRD: SKILLS RETENTION AND TRANSFER

- HRD: Human Resource Development
- An individual chooses a company than a company choosing an individual
- The company places individuals in any part of the organization it deems suitable for the individual
- HRD based on needs of the organization than individual
- Technical or administrative training conducted in-house by experienced technical or admin personnel
- Most waterworks bureau have their technical training facilities for skills transfer
- Lecturers are either professors, industry professionals or internal experienced staff members
- They implement a three-pong approach, mostly concentrating on On-the-Job-Training (OJT), Off-the-Job Training (Off JT) and then self development.

Continued…..

Results:
- **Staff retention more than 75%**
- **Skills retention more than 90%**

ADMINISTRATION: SOUTH AFRICA

National Government

Ministry related to water (1 Ministry)

1	**Department of Human Settlements Water and Sanitation**	**Water supply**

Provinces (9)

Municipalities: Local, District and Metros (278 - Ratio; 226: 44: 8)

ADMINISTRATION: JAPAN

National Government

Ministries related to water (5 Ministries)

1	**Ministry of Health, Labour and Welfare**	**Water supply**
2	Ministry of Environment	Water Environment
3	Ministry of Land, Infrastructure, Transport and Tourism	River Control Water Resource Sewerage system
4	Ministry of Economy, Trade and Industry	Industrial water
5	Ministry of Agriculture, Forestry and Fisheries	Agricultural water

Prefectures (47)

Cities, Towns and Villages (1718)

GENERIC COMPARISON

ITEMS	Japan	SA
Institutional arrangement	• Water utilities are autonomous (water services is ring-fenced) • JWWA was formed voluntarily by water utilities for WU	• WSA have political interferences • WRC, JASWIC & SANAS
Administration	• Flexible (not policy oriented) • Procurement systems are more efficient is faster • Procurement: outsource all maintenance and construction work (they only supervise)	• Rigid and controlled by legislations and policies • Slow regulated procurement system • Mixed procurement methods

GENERIC COMPARISON CONTI……………..

ITEM	Japan	SA
Technical	• Design of infrastructure and material is based on their conditions hence less physical water loss • Design philosophy entails maintaining same pressure within a supply area. (7 bar)	• Infrastructure design good, but issues around workmanship and appropriate technology & costs remains a challenge • Design philosophy entails constructing reservoirs on high lying areas, difficult to maintain same pressure
Innovation and Technology	• Innovation is encouraged (infrastructure optimization e.g. Hydropower and solar)	• Innovation is encouraged but more compliance driven

GENERIC COMPARISON CONTI……………..

ITEM	Japan	SA
NRW Revenue water and Apparent loss	• No free basic • water Collection rate 100% • 0% of unauthorized (illegal)connections • Rising Block Tariff (cost reflective) • Standard brass mechanical water meters; replaced every 8 years • Water budget and revenue are ring-fenced	• Free basic water • Culture of non-payment • High % unauthorized (illegal) connections • Various Tariff regimes used • Various types of water meter employed but no regular replacement due to budget constraints • Water budget and revenue not ring-fenced

GENERIC COMPARISON CONTI……………..

ITEM	Japan	SA
Real losses	• 5 % • Pipe replacement program in place (1.25% ratio e.g. Yokohama) • Active leakage control • Response time on repairs and maintenance is effective	• 37% • Pipe replacement program in place but insufficiently funding, • Limited leakage control • Response time on repairs and maintenance is not effective

GENERIC COMPARISON CONTI……………..

ITEM	Japan	SA
HRD	• Lower emphasis is placed on formal qualifications • On-the-Job training system is effective, with less Off –the-job • Training mostly done by in-house technical experts • More practical • Use of Japanese language is which is seen an advantage • Three categories of plumbers: service pipe, reticulation and domestic	• Formal qualification is required and regulated • Little to no in-house training • Training mostly done by external service providers • More theoretical • Use of English as medium (2nd language- barriers to some people) • Only domestic plumber

GENERIC COMPARISON CONTI……………..

ITEMS	Japan	SA
Socio-cultural/political/Economic al	• Company oriented (lifetime employment) • Selection of company not a job (Sense of belonging) • No political interference	• Job oriented (temporary employment) • Select the job not the company • Political interference

Photo Slides

JICA TRAINING ALBUM.pptx

Facilitators Specialty Matrix for Materials Development and Team Building

	DWS and Stakeholders	Facilitator, Implementation Supporter/ Administrator	Significance of the NRW Management	Bulk Metering	Customer Metering	Reticulation Facility (Pipe & Appurtenance)	Measuring and logging (same as No.7)	DMA Planning	Data Acquisition (Logging) and Analysis	Water Balance Analysis	NRW Reduction Strategic Planning & Present. (Strategy & Implementations for NRW Mngmt)	Actual Customer Consumption and Billing Data Analysis	Practices for the NRW Management (Lecture)	Practices for the NRW Management (Training Yard)	Fundamental Knowledge of Active Leakage Detection	Fundamental Knowledge of Conditional Assess't	NRW Countermeasures	Strategy, Implentatoin, Action Planning			Mandatory	Experienced/Knowledgeable	Interested
		Material's Chapter No.	1	2	3	4	5	6	7	-	8	9	10	11	-	-	-	-			×	✔	○
DWS-HQs	IBOM (former NWRI)	Mr Musara Tapiwanashe	✔	×	✔	×	○	○	○	○	✔	○	✔	○	○	✔	○	○			2	5	9
	IBTC (Training Mngmt, QA, Admin.)	Ms Kgoputso Sekgoilane	Training Manager																		0	0	0
		Ms Lerato Makola	Quality Assurer																		0	0	0
	IBTC (Technical, Yard, Equipment)	Mr Armand Basson		○		×	○		○		○			×	✔	○					2	1	5
		Mr Riaan Stassen	○			×	○		○		○			×							2	0	4
	WUE (Supervision, Coordination)	Mr Thabo Masike	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?			0	0	0
		Mr Padi Andries	×	○	○	○	✔	○	×	×	○	○	×	×	○	○	×	○			6	1	9
Western Cape	City of Cape Town	Mr Jaco De Bruyn	×	○	○	✔	✔	✔	✔	×	×	×	✔	○		○	✔	×			5	6	4
		Ms Unathi Noludwe	✔	○	○	○	×	✔	×	○	✔	○		○	×		○	○			3	3	8
		Mr Mahdi Pathan	✔	×	×	×	○	✔	○	○	○	✔	○	✔	✔		○	○			3	5	7
		Mr Brandon Stevens	✔	×	×	×	○	✔	○	○	○	○	○	✔	○	○	✔	○			3	4	9
		Mr Ndzululwazi Joni	○	○	○	×	✔	✔	✔	×	✔	✔	✔	○	✔	✔	×	✔			3	9	4
		Ms Mckaylin Adonis	×	○	○	✔	✔	×	✔	✔	✔	✔	○	○	○	○	○	✔			2	7	7
	George Municipaity	Mr Henry Jansen	✔	○	✔	○			○	×	○	✔			○			○			1	3	6
Kwazulu Natal	DWS Regional Office	Mr Michael Singh	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?			0	0	0
	City of Ethekwini	Mr Ashan Nandal	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?			0	0	0
		Mr Moodley Yagavasen	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?			0	0	0
	Ugu Municipality	Ms Thuli Mwelase	×	○	○	○	○	○		○	✔	○	×				✔	×			3	2	7
Mpumalanga	Mbombela Municipality	Mr Koena Moabelo	×	✔	✔	✔	✔	✔	✔	×	×	✔	○	✔	○	✔	✔	×			4	10	2
	Silulumanzi	Mr Colin Thatcher	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?			0	0	0
Gauteng	City of JHB	Mr Pholo Nthutang	×								✔										1	1	0
		Ms Faith Ramatsoele	×							○	○		○								1	0	3
	City of Tshwane	Mr Trevor Westman	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?			0	0	0
		Mr Nico Schmulian	×		✔		×	✔		○	○				✔						2	3	2
	City of Ekurhuleni	Mr Mulalo Bvumbi	×	×	✔	×	×	×	×	×	×	✔	×	×	×	✔	×	×			13	3	0
Eastern Cape	Baffalo City	Mr Siyamcela Mamane	✔	✔	✔	✔	×	×	✔	×	✔	○	✔	○	✔	○	○	✔			3	9	4
		Ms Sikiza Yekane	○	✔	✔	○	×	✔	×	×	○	○	○	○	✔	○	○	○			3	4	9
		Mandatory ×	9	4	2	7	5	3	4	8	3	1	3	4	2	0	3	4					
		Experienced/Knowledgeable ✔	6	3	7	4	5	8	5	1	7	6	4	3	6	4	4	3					
		Interested ○	3	8	6	5	6	3	6	7	9	7	6	7	6	7	6	7					
JICA	Chief Advisor / NRW Management	Mr. Akinori Miyoshi																					
	Deputy CA / NRW Management	Mr. Taketoshi Fujiyama																					
	Skills Prog. Planning/Organ. Coordi.	Mr. Kenichiro Sugiya	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
	Water Leakage Detection	Mr. Hiroki Niimura																					
	Water Distribution Control / CL	Mr. Hiroyuki Morita																					
	Training Yard Design & Supervision	Mr. Masuji Ide	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
	Procurement / Admin Coordination	Mr. Toshinobu Kasuya	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
	Training Management/HRD	Mr. Nobutaka Maruyama																					

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Date: 04 July 2019

Venue: IBTC Roodeplaat

NRW FACILITATORS TRAINING WORKSHOP

Questions /Comments per chapter

1. Why the need of this course
   - To reduce NRW by 15% according to the NDP
   - South Africa is a Water Scarce country
   - To improve skills levels, and make a difference
2. What is NRW
   - (answer on 1.2, on the document)
3. What are the problems of water services in South Africa?
   - Information transferring
   - Maintaining statistics
   - Meters not replaced, unreliable
   - Lack of technical skills
   - Monitoring of the current infrastructure
   - Lack of bulk planning
   - Best practise of pipe line management
   - Issue of credit control and debt management
   - Vandalism
   - Understanding the entire value chain, integration of technical & social part of NRW
   - Proactive infrastructure maintenance
   - Maintenance planning
4. Why are we not winning the battle of NRW in SA
   - Don't follow through commitment
   - Try other avenues, our implementing strategies are vague. They must have meaningful impact through integration approach
   - We are not proactive, we are reactive towards intervention, rather than planning our intervention
   - The handover not done where projects are completed
   - Do not follow through operations and maintenance manual
   - No warm bodies to deal with WCWDM, institutionalisation, Unavailable budget

- Lack of benchmarking, to identify skills required in NRW
- Not ring-fenced
- Business process should be documented
- Filling of vacant posts
- No quality control of equipment bought and installation of equipment

5. How to develop roadmap?
   - Can Municipality evaluate or calculate NRW
   - Not enough confidence, inaccuracy in metering
   - Concentrate on Bulk meter, getting credible & reliable information
   - Manageable zones & DMAs, find out zones that are interconnected
   - Bigger metro municipalities have good strategies but not buy in because of political biasness
   - This course should also include politicians
   - Don't have people on the ground to do leak fixes.
   - No budget
6. Distribution system
   - Overview or network systems
   - Types of pipes used
   - Gravity or flat pump
   - Depending on the size and the number
   - Planning overview
   - Water hammer
   - Flushing of the system
   - Look at the design to avoid incaps design of the distribution system is important
   - GIS system to illustrate type of systems we have, will it not make use of it to feature here? Should be able to go to your computer in a GIS system component in the distribution system
   - Lack of built in information of municipalities, so GIS would not work well in this. Perhaps add as a new chapter Built Information
7. Outcomes for Zones and DMAs
   - Page 62 (see)
8. What is the purpose of zoning
   - For pressure management your zoning information is important
   - Topography to manage your pressure
   - DMAs Zone visibility of water used by users
   - Isolated systems
   - Staff knowing exactly their responsibility
   - Small managed site of visibility
   - Also an aspect of NRW
   - Division of valves & bridges
   - Identify which Pressure and demand management
   - Where to put pressure valves
   - See page (65)

9. Distribution facilities
   - Should understand the components of distribution network to know the area of supply & design and to meet the demand & sufficient water pressure
   - To know what types of pipes & valves and how to use them
   - To understand the characters of these pipes, what types of pipes having, how to go about managing water losses
   - What types of cuttling (joints) going to be used
   - How to go about mixing different types of pipes
   - Encourage staff to know what types of systems
   - Encourage to have clear SOPs, currently information not documented
   - Keep information
   - Define the information
   - Understand why the pipe burst, what is happening in the network systems
   - It is not the matter of fixing, Why is it reoccurring
   - Pipes must be joint properly
   - Have videos that can teach during training
   - To understand network needed
   - Whether due diligence was done
   - Understanding infrastructure
   - Lowering pressure resulting in lowering use of water
   - Understand the growth of the area in terms of demand and population for future
   - Fire hydrant & sprinklers need different pressure management
   - Not having enough pressure for higher building
   - Types of PRVs need to be included in this part
   - Important that system operators are brought on board in planning phase
10. Bulk metering (what is the importance of bulk metering)
   - Bulk metering measures input to downstream
   - Calibrate information for downstream users
   - Also measures large users in that zone
   - To measure demand required
   - To detect leaks in the system
   - Perhaps we need to define what is bulk & what is distribution (we see meters differently as municipalities)
   - No clear methodology in bulk metering, municipalities have different methodologies, is there a standardised methodology
   - Categorise it as according to municipalities
   - It's about understanding the importance & significance of metering
   - BM is In any size, but large meter that connects to more readings or connection downstream
   - 2.2 Varaiety of BM
   - 2.2.1 – More costly , It can handle high and low flow , easy to get data, easy to install, flexibility to move place to place
   - Who determines the type of meter to be installed

- 2.2.6 (page 32) installation of BM
- Ugu municipality representative to share SOPs available with other facilitators
- Check compliance if approved it can be included as part of the content
- Understand installation, reading
- Will the trainers get opportunity to install BM during training
- (page 33) important on how to install BM

11. Customer Meter (Role of customer meter)
    - (page 55) automated metering included on the content
    - Installation of CM
    - Location of the installation CM is important to have it outside the yard
12. Reticulation
    - Block systems are zone systems
    - DMA are 3000 users (small sized)
    - Pipes, pump station, meter, valves
13. Measuring & Logging (Why you need data logging)
    - Data is required
    - It is important to constantly do monitoring
    - Understanding the systems designs or if it I still performing as it was designed
    - Are water users receiving water
    - Data loggers must be sent back to manufactures if any problem
    - Some municipalities have meter testing centres to test the accuracy of a meter
    - Data loggers provide sound information for NRW
14. DMA planning
    - How to select systems input into a DMA
    - Accuracy of your device, your input adding to downstream
    - Actual method of understanding the installation of a clamp-on
    - Measuring input, calculating sub meters and adding up to your total
    - Using electronic equipment & analysing the data
15. Data acquisition & data analysis
    - Develop the ability to analyse data after logging
    - Understanding IWA Balance
    - Using data to produce IWA balance for the DMA
16. Strategy & implementation plan
    - Establish a Team and champion focused on that
    - The cost of managing NRW mustn't exceed the benefits
    - List countermeasures – costing, also in terms of water volumes to be saved

FACILITATOR TECHNICAL MEETING

(2020)

PROGRAMME

PROJECT FOR STRENGTHENING THE TRAINING CAPACITY OF IBTC ON NON-REVENUE WATER: FACILITATORS WORKSHOP

20 AND 21 OCTOBER 2020

VENUE: MICROSOFT TEAMS

PURPOSE OF THE WORKSHOP

TO EXPLAIN/DISCUSS TRAINING PROGRAMME AND CONTENTS, AND ASSIGN FACILITATORS

CHAIRPERSON: MR HADEBE, MASIKE AND BASSON

ITEM NO.		RESPONSIBILITY	TIME
DAY 1: SECTION A: PROCEDURAL MATTERS			
A.1	Opening and Welcome	Mr Monene and Moraka	10: 00 – 10:05
A.2	Attendance and Apologies	All	10:05 – 10:10
A.3	Purpose of the Workshop	All	10:10 – 10:15
A.4	Adoption of Agenda	All	10:15 – 10:20
A.5	Implementation Action Plan	Chairperson	10: 20 – 10:30
SECTION B:			
B.1	Progress on the Mobilization of the Identified WSA	WUE/SALGA	10:30 – 10:40
B.2	Finale Draft for Training Programme	JICA/WUE	10:40 – 10:50
B3	IT environment	IBTC	10:50 – 11:00
B.4	Discussion	All	11:00 – 11:10
	10 Minutes break		11:10 – 11:20
SECTION C: OVERVIEW OF TRAINING MATERIAL			
C.1	Modules A to C	JICA/WUE/Leading Facilitator (still to be identified)	11:20 to 12:00

ITEM NO.		RESPONSIBILITY	TIME
	Discussion	All	12:00 - -12:10
C.2	Modules D to F	JICA/WUE/Leading Facilitator (still to be identified)	12:10 - 12:50
	Discussion	All	12:50 – 13:00
	Discussion and closure		13:00 – 13:10
	CLOSURE		
DAY 2: SECTION C: OVERVIEW OF TRAINING MATERIAL			
	Recap	Chairperson	10:00 – 10:10
C3	Modules G to I	JICA/WUE/Leading Facilitator (still to be identified)	10:10 – 10:50
	Discussion	All	10:50 – 11:00
C.4	Modules J to L	JICA/WUE/Leading Facilitator (still to be identified)	11:00 – 11:40
	Discussion	All	11:40 – 11:50
C.5	Confirmation of the Allocation of Modules to facilitators	All	11:50 – 12:00
SECTION D: CLOSURE			
D.1	Discussion	All	12:00 – 12:10
D.2	AOB	All	12:10 -12:20
D.3	Closure		12:20 – 12:30

THE NATIONAL NRW TRAINING

Date: Tuesday 17th to Friday 20th November 2020

4-half-days Course for **Online Training** on **Knowledge** Component only

Partnering Municipalities for Facilitation

Cape Town, Tshwane, Ekurhuleni, eThekwini, Johannesburg, Buffalo City, Mombela, Ugu and George

PROGRAMME OUTLINE

Time	Module	By
17th Nov. Day-1: I. Introduction and Icebreak		
9:00-10:00	a. Orientation and Introduction	DWS
10:00-11:00	b. WCWDM and NRW in Municipal Water Services of South Africa	DWS
11:00-12:00	c. NRW-related Problem Awareness Workshop	DWS/Facilitator
12:00-12:15	Orientation to Day-2, Questionnaire and Homework (if any)	DWS
18th Nov. Day-2: II. Fundamental Knowledge and Skills for NRW		
9:00-10:00	d. Technical aspect: Water Reticulation	Facilitator
10:00-11:00	e. Institutional aspect: Billing and metering	Facilitator
11:00-12:00	f. Data Collection (Logging and Billing)	Facilitator
12:00-12:15	Orientation to Day-3, Questionnaire and Homework (if any)	DWS
19th Nov. Day-3: III. Current State Analysis on the ground to Start Now		
9:00-10:00	g. Zone Configuration and Drop Test	Facilitator
10:00-11:00	h. MNF and Step Test	Facilitator
11:00-12:00	i. Practices by using a simulated DMA	Facilitator
12:00-12:15	Orientation to Day-4, Questionnaire and Homework (if any)	DWS
20th Nov. Day-4: IV. Case Study for On-the-Ground Actions		
9:00-10:00	j. Case Studies (from the previous trainings)	DWS/Facilitator
10:00-11:00	k. Data Utilization/Arrangement and Presentation	DWS/Facilitator
11:00-12:00	l. Actions and Way Forward	DWS/Facilitator
12:00-12:30	Orientation to the Practices/Workplace Training and Questionnaire	DWS

Practices @ Yard (IBTC, Pretoria) and Workplace components will be in February and March 2021.

Day-1: I. Introduction and Icebreak

9:00-10:00
a. Orientation and Introduction
a1. Course orientation (programme, rules, etc)
a2. Introduction (self- or collective- or part- introduction or other ways)
a3. Participating municipality profile: Each leader. 5min x 4to5 municipalities
a4. Q&A
a5. Break & preparation: 10 min

10:00-11:00
b. WCWDM and NRW in Municipal Water Services of South Africa
b1. Overview of WCWDM and NRW in South Africa
b2. Q&A
b3. Break & Preparation: 10 min

11:00-12:00
c. NRW-related Problem Awareness Workshop
c1. Viewpoint-1: Water sector's and institutional issues and challenges in nationwide
c2. Viewpoint-2: Physical, commercial, institutional issues and challenges in municipalities
c3. Wrap-up
c4. Break & Preparation: 10 min

12:00-12:15
Orientation to Day-2, Questionnaire and Homework (if any)
1. Orientation: IBTC
2. Questionnaire: IBTC
3. Homework (if any):

Day-2: II. Fundamental Knowledge and Skills for NRW

9:00-10:00
d. Technical aspect: Water Reticulation
d1. Water services business model ideally, Key-terms for hard/physical issues, Physical loss in NRW, Common problems in South Africa, and Basics of water distribution facilities and their management
d2. Q&A
d3. Break & Preparation: 10 min

10:00-11:00
e. Institutional aspect: Billing and metering
e1. Water services business model ideally, Key-terms for soft/institutional issues, Commercial loss in NRW, Common problems in South Africa, and Basics of meter reading and collection management
e2. Q&A
e3. Break & Preparation: 10 min

11:00-12:00
f. Data Logging
f1. Data logging
f2. Q&A
f3. Break & Preparation: 10 min

12:00-12:15
Orientation to Day-3, Questionnaire and Homework (if any)
1. Orientation: IBTC
2. Questionnaire: IBTC
3. Homework (if any):

Day-3: III. Current State Analysis on the ground to Start Now

9:00-10:00
g. Zone Configuration and Drop Test
g1. Zone configuration and drop test method (valve location, isolation check, procedures, record-keeping, key points)
g2. Coping process and workaround against possible things, and map/drawing update
g3. Q&A
g4. Break & Preparation: 10 min

10:00-11:00
h. MNF and Step Test
h1. Sequential water flow data and MNF
h2. Step test method (procedures, record, key points)
h3. Q&A
h4. Break & Preparation: 10 min

11:00-12:00
i. Practices by using a simulated DMA
i1. Practices
i2. Q&A: ** min
i3. Break & Preparation: 10 min

12:00-12:15
Orientation to Day-4, Questionnaire and Homework (if any)
1. Orientation: IBTC
2. Questionnaire: IBTC
3. Homework (if any):

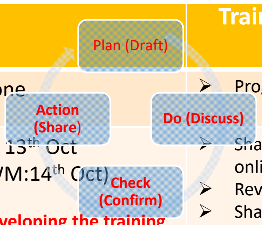
Day-4: IV. Case Study for On-the-Ground Actions

9:00-10:00
j. Case Studies (from the previous trainings)
j1. Case study 1: Physical loss
j2. Case study 2: Problems extraction and coping process
j3. Q&A
j4. Break & Preparation: 10 min

10:00-11:00
k. Data Utilization/Arrangement and Presentation
k1. Data utilization/arrangement and examples (memo, measured data, billing data)
k2. Presentation preparation and examples (as templates to the management)
k3. Q&A
k4. Break & Preparation: 10 min

11:00-12:00
l. Actions and Way Forward
l1. Cooperation with relevant divisions (Finance, GIS, Procurement, etc.), buy-in of the management, securing a budget, continuity and sustainability
l2. Support, cooperation, monitoring and follow up by DWS (IBTC/WUE/RBIG/WSIG) and SALGA
l3. Q&A
l4. Break & Preparation: 10 min

12:00-12:30
Orientation to the Practices/Workplace Training and Questionnaire
1. Orientation (schedule and readiness) and Wrap-up: IBTC/WUE
2. Questionnaire:



	Training Programme and Materials (Slides) Revision	IT and Web-site	Logistics and Mobilization for WS/WBN/3rd Training
Done	➢ Programme/modules were outlined	➢ Has communicated with IT ➢ Test web-site is available for brainstorming.	➢ 1st draft workshop agenda is ready. ➢ Share workshop agenda *1st draft.
By 13th Oct (WM:14th Oct) **Developing the training system with PDCA (experiencing processes)** By 19th Oct	➢ Share the slides and schedule for revision by online/cloud/web storage (T.T.) ➢ Revision and re-assembling ➢ Share slides by online/cloud/web storage (facilitator) ➢ Dry run for the workshop (T.T.)	➢ Secure and share online/cloud/web storage ➢ Draft web site outline ➢ Draft web site detail ➢ Prepare SOP web site and online/cloud/web storage ➢ Launch web site ➢ ~~Secure the line B ?~~ ➢ ~~Prepare IT questionnaires~~ ➢ Preparation for the workshop	➢ Draft general presentation materials for WS ➢ Confirm presenters for workshop (T.T.) ➢ Assign roles and responsibilities for workshop ➢ Draft assign table on facilitator ➢ Dry run for the workshop (T.T.) ➢ Preparation for the workshop
20th - 21st Oct Workshop	**Participants: Task Team members and Facilitators** **Purpose: To explain/discuss training programme and contents, and assign facilitators**		
By 27th Oct (WM:28th Oct)	➢ Reporting on lessons learned ➢ Collect comments from facilitators	➢ Reporting on lessons learned and trouble shooting ➢ Preparation for the webinar	➢ Reporting on lessons learned ➢ Municipality mobilization ➢ Preparation for the webinar
27th - 28th Oct Webinar (& WM)	**Participants: 1st to 3rd Participating Municipalities, Task Team members and if possible Facilitators** **Preliminary orientation, training background, IT environment check for the 3rd + feedback & monitoring to the 1st & 2nd**		
By 3rd Nov (WM:4th Nov)	➢ Share revised slides to facilitators ➢ Communicate with lecturers	➢ Draft online questionnaire form to leaners	➢ Facilitator confirmation, mobilization
By 9th Nov	➢ Collect comments from facilitators	➢ Preparation for the workshop/1-on-1 ➢ Check online questionnaire form to leaners	➢ Reconfirm to facilitators ➢ Preparation for the workshop
10th - 11th Nov Workshop/1-on-1	**Participants: Task Team members and Facilitators** **Purpose: Dry-run, feedback and polish up**		
By 16th Nov	➢ Reporting on lessons learned ➢ Revise slides ➢ Finalize all participants	➢ Reporting on lessons learned and trouble shooting ➢ Finalize online questionnaire form to leaners ➢ Preparation for the 3rd training	➢ Reporting on lessons learned ➢ Reconfirm attendance of all participants
17th - 20th Nov 3rd NRW Training	**Participants: 3rd Participating Municipalities (Candidate: Emfuleni, Ekurhuleni, Sol Plaatje, Amatole and Saldanha Bay), Task Team members and Facilitators** Till early Dec, followed by reviewing the 3rd Training and Preparation to Practices and Workplace components in Feb. and Mar. 2021		

2020

OCTOBER

S	M	T	W	T	F	S
27	28	29	30	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
1	2	3	4	5	6	7

NOVEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	1	2	3	4	5
6	7	8	9	10	11	12

DECEMBER

S	M	T	W	T	F	S
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9

2021

JANUARY

S	M	T	W	T	F	S
27	28	29	30	31	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	1	2	3	4	5	6

FEBRUARY

S	M	T	W	T	F	S
31	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	1	2	3	4	5	6
7	8	9	10	11	12	13

MARCH

S	M	T	W	T	F	S
28	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	1	2	3
4	5	6	7	8	9	10

2021

APRIL

S	M	T	W	T	F	S
28	29	30	31	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	1
2	3	4	5	6	7	8

MAY

S	M	T	W	T	F	S
25	26	27	28	29	30	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	1	2	3	4	5

JUNE

S	M	T	W	T	F	S
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	1	2	3
4	5	6	7	8	9	10

Public Holidays in South Africa

Public Holidays in Japan

Memo of the Workshop on 20th & 21st November 2020

Title: Online/Virtual Workshop (Resumption)
Date: SAST 10:00am, Tue&Wed, 20th & 21st November 2020
Venue: Microsoft Teams (hosted by Xolani)

Attendance

DWS:	Monene, Xolani, Thabo, Sekgoilane, Musara, Armand, Verusha, Samke, Zinzi, Lerato, Rosa, Thobejane
SALGA:	William, Fikile
Municipalities:	Nico, Joni, Brandon, Adonis, Faith, Koena, Thuli, Ashan, Ismail, Mahdi Pholo,
LGSETA:	Onkemetse
JICA:	Maruyama, Niimura, Morita, Sugiya, Miyoshi

Chaired: Xolani
Presentation: Training programme and slides of modules

Memo, Q&A and Discussion

Xolani
Participating municipalities under mobilization are: Amothole, Ekurhuleni, Emfuleni, Saldanha Bay, and Sol Plaatje.

Nico
Leaners should be levelled. It is difficult for facilitators to know how learners understand if they stop showing video.

Xolani
According to the concept, the NRW training will received them as cross-sectoral and hierarchical group.

Ashan
Establishing dedicated teams to continue the NRW management in the participating municipalities would be a condition to participate the NRW training, otherwise there won't be sustainability.

Also, ensuring/supporting the implementation with necessary equipment and logistics as well as ring-fenced budgeting is important. Dealing with not single municipality but multiple municipalities has scale merit for this. The training should not result in school lecture.
Stakeholders including water boards, MISA, DWS regional offices should be involved. In KZN, Umgeni water board is able to be a partner for the implementation in terms of financing and human resources.
Accreditation of the training and facilitators, and acquisition of CPD points should be considered for motivation.
Training video on each module will be great.

William
DWS/SALGA should bring up this programme to the higher (political) level of water sector, for example in the water week in March to expand facilitator network for sustainability.

Xolani
Noted with good inputs. DWS should consider them.

Rosa/Sekgoilane/Lerato
IBTC has worked on being an assessment centre of WRP qualification as well as has been preparing application of provision accreditation of the National NRW Training as a part of WRP qualification. Accreditation of facilitators should be considered.
IBTC with Kentse and Maputha will keep following up this issue.

Pathan
By when do we foresee classroom training to happen again this training is critical and needs to be successful, virtual training seems to have challenges especially for the learners that this will be completely new.

Xolani
About the specific names of municipalities should be removed from the slides.
> **Miyoshi** Noted.

Masike
Slides of case study will be enough with results of training.
> **Miyoshi** Not only results but process for outcomes is important in this training for

learners.

Pathan/Faith/Joni

About facilitator allocation, we go back to previous training that was in place.

> **Miyoshi** We should balance fairness among facilitators.

Armand

DWS will draft facilitator allocation plan and share it together with slides before Monday 26th October 2020, through cloud storage.

The next workshop (or 1-on-1 sessions) will be 10th and 11th November, and online training will be from 17th to 20th November as planned.

Note

Some facilitators were not able to see the slides duet to possibly connectivity challenges during workshop.

> Sharing of slide (handouts) in advance is important.

Project for Strengthening the Training Capacity of IBTC on Non-Revenue Water

Title: Facilitator Workshop
Date: 12 November 2020
Time: 11h00 – 12h30
Venue: Virtual

Agenda

1. Opening and welcoming
2. Confirmation of the online training:
    a. Dates
    b. Time
    c. Participating Municipalities
3. Roles and responsibilities
4. Readiness of facilitators:
    a. Confirm facilitator allocation
    b. Training material (presentations)
    c. IT Environment
5. General

THE NATIONAL NRW TRAINING

Date: Tuesday 17th to Friday 20th November 2020

4-half-days Course for **Online Training** on **Knowledge** Component only

Partnering Municipalities for Facilitation

Cape Town, Tshwane, Ekurhuleni, eThekwini, Johannesburg, Buffalo City, Mombela, Ugu and George

PROGRAMME OUTLINE

Time	Module	Presenter	Support
17th Nov. Day-1: I. Introduction and Icebreak			
9:00-10:00	a. Orientation and Introduction	DWS WUE	DWS IBTC
10:00-11:00	b. WCWDM and NRW in Municipal Water Services of South Africa	DWS WUE	DWS IBTC
11:00-12:00	c. NRW-related Problem Awareness Workshop	DWS WUE / Ndzululwazi Joni	WUE / Ndzululwazi Joni
12:00-12:15	Orientation to Day-2, Questionnaire and Homework (if any)	DWS WUE	DWS IBTC
18th Nov. Day-2: II. Fundamental Knowledge and Skills for NRW			
9:00-10:00	d. Technical Aspects: Water Reticulation	Nico Schmulian	Koena Moabelo Mahdi Pathan
10:00-11:00	e. Institutional Aspects: Metering and Billing	Koena Moabelo	Nico Schmulian Mahdi Pathan
11:00-12:00	f. Data Collection (Logging)	Mahdi Pathan	Nico Schmulian Koena Moabelo
12:00-12:15	Orientation to Day-3, Questionnaire and Homework (if any)	DWS WUE	DWS IBTC
19th Nov. Day-3: III. Current State Analysis on the ground to Start Now			
9:00-10:00	g. Zone Configuration (Drop Test)	Unathi Noludwe	Sikiza Yekane Mulalo Bvumbi
10:00-11:00	h. MNF and Step Test	Mulalo Bvumbi	Unathi Noludwe Sikiza Yekane
11:00-12:00	i. Practices (by using a simulated DMA)	Sikiza Yekane Siyamcela Mamane	Unathi Noludwe Mulalo Bvumbi
12:00-12:15	Orientation to Day-4, Questionnaire and Homework (if any)	DWS WUE	DWS IBTC

20th Nov. Day-4: IV. Case Study for On-the-Ground Actions			
9:00-10:00	j. Case Studies (from the previous trainings)	DWS WUE / Mckaylin Adonis	Brandon Stevens Ashan Nandal
10:00-11:00	k. Data Management (Utilization/Arrangement) and Presentation	DWS WUE / Brandon Stevens	Mckaylin Adonis Ashan Nandal
11:00-12:00	l. Actions and Way Forward	DWS WUE / Ashan Nandal	Brandon Stevens Mckaylin Adonis
12:00-12:30	Orientation to the Practices/Workplace Training and Questionnaire	DWS WUE	DWS IBTC

Practices @ Yard (IBTC, Pretoria) and Workplace components will be in February and March 2021.

water & sanitation
Department: Water and Sanitation
REPUBLIC OF SOUTH AFRICA

SALGA
Inspiring service delivery

Japan International Cooperation Agency
JICA

KEY MESSAGES

IN THE STORYLINE-BASED PROGRAMME

Day-1: I. Introduction and Icebreak

9:00-10:00
a. Orientation and Introduction
a1. Course orientation (programme, rules, etc)
a2. Introduction (self- or collective- or part- introduction or other ways)
a3. Participating municipality profile: Each leader. 5min x 4to5 municipalities
a4. Q&A
a5. Break & preparation: 10 min

- Orientation (rules, behavior, programme, etc.)
- Introduction
- Municipalities' profile

10:00-11:00
b. WCWDM and NRW in Municipal Water Services of South Africa
b1. Overview of WCWDM and NRW in South Africa
b2. Q&A
b3. Break & Preparation: 10 min

- Keynote lecture
- Introduction to NRW
- Bridge to the following workshop

11:00-12:00
c. NRW-related Problem Awareness Workshop
c1. Viewpoint-1: Water sector's and institutional issues and challenges in nationwide
c2. Viewpoint-2: Physical, commercial, institutional issues and challenges in municipalities
c3. Wrap-up
c4. Break & Preparation: 10 min

- Raising awareness (Their routine events relate to and affect NRW.)
- Inducing their interest
- Icebreaking

12:00-12:15
Orientation to Day-2, Questionnaire and Homework (if any)
1. Orientation: IBTC
2. Questionnaire: IBTC
3. Homework (if any):

Day-2: II. Fundamental Knowledge and Skills for NRW

9:00-10:00
d. Technical Aspects: Water Reticulation
d1. Water services business model ideally, Key-terms for hard/physical issues, Physical loss in NRW, Common problems in South Africa, and Basics of water distribution facilities and their management
d2. Q&A
d3. Break & Preparation: 10 min

- To understand technical/physical aspects related to SA's municipal NRW
- To understand importance of measuring the reticulation (called System Input Volume: SIV)

10:00-11:00
e. Institutional Aspects: Metering and Billing
e1. Water services business model ideally, Key-terms for soft/institutional issues, Commercial loss in NRW, Common problems in South Africa, and Basics of meter reading and collection management
e2. Q&A
e3. Break & Preparation: 10 min

- To understand institutional/ commercial aspects related to SA's municipal NRW
- To understand importance of metering customer consumption

11:00-12:00
f. Data Collection (Logging)
f1. Data logging
f2. Q&A
f3. Break & Preparation: 10 min

- To understand the importance of obtaining time-series data of SIV
- Getting familiar with data logging devices

12:00-12:15
Orientation to Day-3, Questionnaire and Homework (if any)
1. Orientation: IBTC
2. Questionnaire: IBTC
3. Homework (if any):

Day-3: III. Current State Analysis on the ground to Start Now

9:00-10:00
g. Zone Configuration (Drop Test)
g1. Zone configuration and drop test method (valve location, isolation check, procedures, record-keeping, key points)
g2. Coping process and workaround against possible things, and map/drawing update
g3. Q&A
g4. Break & Preparation: 10 min

- ☐ **To understand how to set up the area (zone) to identify the problems from drawings and field check**
- ☐ **To understand zone configuration by confirmation of hydraulic isolation**

10:00-11:00
h. MNF and Step Test
h1. Sequential water flow data and MNF
h2. Step test method (procedures, record, key points)
h3. Q&A
h4. Break & Preparation: 10 min

- ☐ **To understand a method to narrow down problematic sub-zones.**
- ☐ **To understand methodology of MNF and step test**

11:00-12:00
i. Practices (by using a simulated DMA)
i1. Practices
i2. Q&A: ** min
i3. Break & Preparation: 10 min

- ☐ **To experience zone configuration, MNF, step test, billing data analysis and NRW calculation**

12:00-12:15
Orientation to Day-4, Questionnaire and Homework (if any)
1. Orientation: IBTC
2. Questionnaire: IBTC
3. Homework (if any):

Day-4: IV. Case Study for On-the-Ground Actions

9:00-10:00
j. Case Studies (from the previous trainings)
j1. Case study 1: Typical outputs of workplace training
j2. Case study 2-5: Remarkable problems identified through the previous workplace trainings
j3. Q&A
j4. Break & Preparation: 10 min

- ☐ **To learn what outputs are expected at the end**
- ☐ **To know what kind of problems were identified**

10:00-11:00
k. Data Management (Utilization/Arrangement) and Presentation
k1. Data utilization/arrangement and examples (memo, measured data, billing data)
k2. Presentation preparation and examples (as templates to the management)
k3. Q&A
k4. Break & Preparation: 10 min

- ☐ **To understand the importance of documentation, recording, reporting as processes (efforts)**
- ☐ **To understand the importance of strategic presentation to others**

11:00-12:00
l. Actions and Way Forward
l1. Preparation for workplace training
l2. Support, cooperation, monitoring and follow up by DWS (IBTC/WUE/KBIG/WSIG) and SALGA
l3. Q&A
l4. Break & Preparation: 10 min

- ☐ **Preparation for workplace training (next step)**
- ☐ **Funding sources**
- ☐ **Recapping**

12:00-12:30
Orientation to the Practices/Workplace Training and Questionnaire
1. Orientation (schedule and readiness) and Wrap-up: IBTC/WUE
2. Questionnaire:

The National NRW Training Daily Evaluation Form (Day-1)

This is to reconfirm your attendance register.

* Required

* This form will record your name, please fill your name.

1. You name in full *

2. Name of your organization *

3. Select modules that you attended today *

- [ ] a. Orientation and Introduction
- [ ] b. WCWDM and NRW in Municipal Water Services of South Africa
- [ ] c. NRW-related Problem Awareness Workshop

4. Comments and suggestions to today's modules in terms of contents, facilitation and so on. *

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Microsoft Forms

The National NRW Training Overall Evaluation Form

Improve training programme, curriculum and facilitation/teaching methods by hearing directly from learners.

* Required

Name and Organization

1. Your name in full *

2. Name of your organization *

A. PROGRAMME OUTPUTS AND GENERAL

3. How satisfied are you with the knowledge you gained throughout the course? *

- ◯ Very satisfied
- ◯ Satisfied
- ◯ Neither satisfied nor dissatisfied
- ◯ Dissatisfied

4. The reason why you chose "Dissatisfied" in the above

5. Do you feel you achieved your desired learning outcome? *

- ◯ Yes a lot
- ◯ Yes
- ◯ Maybe
- ◯ No

6. The reason why you chose "No" in the above

7. How likely are you to recommend this course to your colleagues? *

- ◯ Very likely
- ◯ Likely
- ◯ Neither likely nor unlikely
- ◯ Unlikely

8. The reason why you chose "Unlikely" in the above

9. How was the length of the course? *

- ◯ Very long
- ◯ Long
- ◯ Average
- ◯ Short

10. How was the number of leaners? *

- ◯ Too many
- ◯ many
- ◯ Average
- ◯ Little

11. How did you learn from experiences of participants (facilitators and/or learners)? *

- ◯ Very well
- ◯ Well
- ◯ Somewhat well
- ◯ Not well

12. How did you communicate with participants (facilitators and/or learners)? *

- ◯ Very well
- ◯ Well
- ◯ Somewhat well
- ◯ Not well

13. How did you participate in discussions and exercises actively? *

- ◯ Very well
- ◯ Well
- ◯ Somewhat well
- ◯ Not well

B. ONLINE TRAINING SYSTEM

14. Web-conference platform *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

15. Audio visual conditions during the online training *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

16. Your own IT environment and connectivity during online training *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

17. Technical assistance from secretariat(s)/coordinator(s) and/or facilitators *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

C. PROGRAMME DESIGN (CONTENTS/MODULES)

18. The contents/modules met your expectations. This training programme design (composition and balance) was suitable and useful for your own works and your municipality. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

19. The contents/modules were at an appropriate depth and allowed for intellectual engagement. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

20. The contents/modules were logically sequenced. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

21. The course delivery methodology created the opportunity to address relevant and current issues. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

22. How effective were the learning materials (presentation slides) used in the course? (customised user-friendly and easy to follow) *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

23. What kind of content/module(s) should be included further? If any, please specify it (them) and the reason(s) why.

D. FACILITATORS AND FACILITATION

24. The facilitators introduced the topics, objectives and key points in a logical manner. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

25. There was enough time allocated for questions. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

26. The facilitators have extensive knowledge about the subject matter. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

27. The facilitation style and delivery (encouraged participation, voice projection, responsiveness to the group, organised) *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

28. The facilitators were well prepared. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

E. COORDINATION

29. The communication between DWS/IBTC and your organization before attendance was appropriate. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

30. The administrative arrangement/preparation was appropriate. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

F. OTHER REMARKS AND SUGGESTIONS

31. Please make comments and inputs that will improve the programme.

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Microsoft Forms

Workshop Memo
Time: 11:00, 12th November 2020
Venue: Virtual
Attendance: Xolani, Armand, Sekgoilane, Verusha, Pathan, Brenden, Nico, Mamane, Jansen, Miyoshi, Maruyama, Niimura, Morita, Sugiya

1. Confirmation of the online training
Xolani: Participating municipalities have still been mobilized. Ekurhuleni (4 learners), Amathole (2 learners) and Saldanha (not confirmed) Bay were confirmed but we have faced difficulty in communication with learners. Other two: Emfuleni and Sol Plaatje won't be taken this time.

2. Role and responsibilities, Facilitator Allocation
Armand: Facilitators should show slides with explanation, but IBTC needs to assist them during presentation. Some are not familiar with MS Teams.
Armand: I will share contacts among our members and facilitators

3. Training materials
Xolani: Due to time constraint, we skip explanation of all materials.
Miyoshi reminded key messages of each module.
Nico: We could download materials from OneDrive and feed back if any questions.
Pathan: Materials should not overwhelm learners.

4. IT Environment
Pathan: Always concerned about connectivity and IT environment of participants.
Miyoshi: We developed and will use IT questionnaires.

5. AOB
None

End

添付資料 11

全国無収水研修の評価結果

Appendix 11:

Evaluation Results of the National NRW Training

1ST AND 2ND GROUP/INTAKE

INFRASTRUCTURE BRANCH TRAINING CENTRE
EVALUATION SHEET/FORM

Please complete the evaluation form for training provided. Your feedback is valuable to us and is appreciated .The department is committed to continual improvement and suggestions will be considered for future training needs.

Course Name	The National Non-Revenue Water Training
Date of Training	
Service Provider	DWS: IBTC
Name of Presenter(s)	
Name & Surname:	
Organization:	

Attendance Dates (☑)	Date		27/Jan		28/Jan		29/Jan		30/Jan		31/Jan	
	am	pm	-	☐	☐	☐	☐	☐	☐	☐	☐	-

ITEMS
- NRW in Reticulation, Water supply infrastructure - Problem identification - NRW countermeasures, Strategy and implementation plans - Planning for workplace training

1. PROGRAMME OUTPUTS AND GENERAL

1.1 Did you achieve the above aims? ☑

☐ 4 ☐ 3 ☐ 2 ☐ 1 * 4= Excellent, 3= Good; 2= Average; 1= Poor

Reasons, comments (particularly if poor)

____

____

1.2 To what extend did you like the course, how did you feel about it? How relevant was the course to your work?

____

____

1.3 Which part of the course content did you like the most or were useful for you?

____

____

1.4 Which part of the course content did you like the least?

____

____

1.5 Which the course content was supposed to be included? (with reasons if any)

____

____

1.6 How did you feel about the length of the course? ☑

☐ 4 ☐ 3 ☐ 2 ☐ 1 * 4= Very long, 3= Long; 2= Average; 1= Short

SAMPLE

1.7 How was the number of leaners? ☑
☐ 4 ☐ 3 ☐ 2 ☐ 1 * 4= Too many, 3= Many, 2= Average; 1= Little
1.8 Could you learn from experience of participants (facilitators and learners)? ☑
☐ 4 ☐ 3 ☐ 2 ☐ 1 * 4= Enough, 3= Good; 2= Average; 1= Poor
1.9 Could you communicate with participants (facilitators and learners)? ☑
☐ 4 ☐ 3 ☐ 2 ☐ 1 * 4= Enough, 3= Good; 2= Average; 1= Poor
1.10 Could you participate in discussions and exercises actively? ☑?
☐ 4 ☐ 3 ☐ 2 ☐ 1 * 4= Enough, 3= Good; 2= Average; 1= Poor

Comments on Programme Outcome and General

2. FACILITIES

Criteria *(4= Excellent, 3= Good; 2= Average; 1= Poor)*	**4**	**3**	**2**	**1**
2.1 Venue and seating comfort ☑	☐	☐	☐	☐
2.2 Ventilation ☑	☐	☐	☐	☐
2.3 Security/emergency procedures ☑	☐	☐	☐	☐
2.4 Replenishment (water) ☑	☐	☐	☐	☐
2.5 Catering ☑	☐	☐	☐	☐
2.6 Personnel assistance ☑	☐	☐	☐	☐
2.7 Accommodation ☑	☐	☐	☐	☐

Comments on Facilities

3. CONTENTS AND PROGRAMME DESIGN

Criteria *(4= Excellent, 3= Good; 2= Average; 1= Poor)*	**4**	**3**	**2**	**1**
3.1 The content met my expectations. This training programme design (composition and balance) was suitable and useful for your own works and your municipality.	☐	☐	☐	☐
3.2 The content was at an appropriate depth and allowed for intellectual engagement.	☐	☐	☐	☐
3.3 The content of the course was logically sequenced.	☐	☐	☐	☐
3.4 The course delivery methodology created the opportunity to address relevant and current issues.	☐	☐	☐	☐
3.5 The course materials (presentation and textbook) was customised user-friendly and easy to follow	☐	☐	☐	☐
3.6 The time allocation was sufficient for practical exercises	☐	☐	☐	☐
3.7 The Training Yard was user-friendly	☐	☐	☐	☐

Comments on Contents and Programme Design

SAMPLE

4. FACILITATORS AND FACILITATION				
Criteria *(4= Excellent, 3= Good; 2= Average; 1= Poor)*	**4**	**3**	**2**	**1**
4.1 The facilitator introduced the main theme of the topic and objectives in a logical manner.	☐	☐	☐	☐
4.2 There was enough time allocated for questions	☐	☐	☐	☐
4.3 The facilitator has extensive knowledge about the subject matter.	☐	☐	☐	☐
4.4 The facilitator style and delivery (encouraged participation, voice projection, responsiveness to the group, organised)	☐	☐	☐	☐
4.5 The facilitator was well prepared.	☐	☐	☐	☐
Comments on Facilitators and Facilitation				

5. COORDINATION				
Criteria *(4= Excellent, 3= Good; 2= Average; 1= Poor)*	**4**	**3**	**2**	**1**
5.1 The communication between DWS and your organization before attendance was appropriate.	☐	☐	☐	☐
5.2 The administrative arrangement/preparation was appropriate.	☐	☐	☐	☐
Comments/Suggestions on Coordination				

OTHER REMARKS/SUGGESTIONS: *Please make any comments that will improve the programme, you may write on the separate page if the space provided is not enough*

Thank you for taking the time to help us improve our training

SAMPLE

1. SUMMARY OF AVERAGE SCORE OF EVALUATION BY PARTICIPANTS

Training Group		1. PROGRAMME OUTPUTS AND GENERAL						2. FACILITIES							3. CONTENTS AND PROGRAMME DESIGN							4. FACILITATORS AND FACILITATION					5. COORDINATION	
		1.1 Did you achieve the above aims?	1.6 How did you feel about the length of the course?	1.7 How was the number of leaners?	1.8 Could you learn from experience of participants (facilitators and learners)?	1.9 Could you communicate with participants (facilitators and learners)?	1.10 Could you participate in discussions and exercises actively?	2.1 Venue and seating comfort	2.2 Ventilation	2.3 Security	2.4 Replenishment (Water)	2.5 Catering	2.6 Personal Assistance	2.7. Accomodation	3.1 The content met my expectations. This training programme design (composition and balance) was suitable and useful for your own works and your municipality.	3.2 The content was at an appropriate depth and allowed for intellectual engagement.	3.3 The content of the course was logically sequenced.	3.4 The course delivery methodology created the opportunity to address relevant and current issues.	3.5 The course materials (presentation and textbook) was customised user-friendly and easy to follow	3.6 The time allocation was sufficient for practical exercises	3.7 The Training Yard was user-friendly	4.1 The facilitator introduced the main theme of the topic and objectives in a logical manner.	4.2 There was enough time allocated for questions	4.3 The facilitator has extensive knowledge about the subject matter.	4.4 The facilitator style and delivery (encouraged participation, voice projection, responsiveness to the group, organised)	4.5 The facilitator was well prepared.	5.1 The communication between DWS and your organization before attendance was appropriate.	5.2 The administrative arrangement/ preparation was appropriate.
		4= Excellent 3= Good 2= Average 1= Poor	4= Very long 3= Long 2= Average 1= Short	4: Too many 3= Many 2= Average 1= Little	4= Enough 3= Good 2= Average 1= Poor	4= Enough 3= Good 2= Average 1= Poor	4= Enough 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor	4= Excellent 3= Good 2= Average 1= Poor
1st Group	1st Half (IBTC only)	3.5	2.3	2.1	3.2	3.3	3.3	3.6	3.6	3.7	3.5	3.3	3.6	1.5	3.6	3.6	3.5	3.6	3.6	3.3	3.6	3.6	3.7	3.5	3.7	3.6	3.3	3.1
	2nd Half (IBTC only)	3.8	1.9	1.9	3.6	3.8	3.4	4.0	3.9	3.9	3.5	2.2	3.7	3.8	3.8	3.7	3.6	3.8	3.8	3.6	3.7	3.8	3.8	3.8	3.6	3.8	3.7	3.7
2nd Group	1st Half (IBTC only)	3.8	2.6	1.8	3.5	3.7	3.5	3.3	2.2	3.5	3.6	3.1	3.8	3.2	3.6	3.5	3.5	3.7	3.6	3.3	3.8	3.5	3.8	3.6	3.7	3.7	3.3	3.4
	2nd Half (WP&IBTC)	3.6	2.7	2.2	3.8	3.7	3.6	3.4	2.5	3.7	3.6	3.6	3.5	3.1	3.7	3.9	3.6	3.9	3.6	3.7	3.6	3.8	3.8	3.8	3.6	3.9	3.8	3.9

* Air-conditioner problem * Supplier's quality * Accomodation quality of DWS Guest House

2. SUMMARY OF SCORE OF EVALUATION BY PARTICIPANTS

	1.1	1.6	1.7	1.8	1.9	1.10	2.1	2.2	2.3	2.4	2.5	2.6	2.7	3.1	3.2	3.3	3.4	3.5	3.6	3.7	4.1	4.2	4.3	4.4	4.5	5.1	5.2
SCORE-4	43	10	0	32	40	31	41	33	46	43	30	43	16	43	43	38	48	43	36	47	39	45	39	40	44	34	31
SCORE-3	20	8	6	31	21	30	18	15	14	17	19	18	13	21	19	26	15	21	23	16	21	14	19	21	17	20	21
SCORE-2	1	41	52	2	3	3	5	7	4	5	9	1	8	1	2	1	2	2	5	2	0	1	1	0	0	5	7
SCORE-1	0	4	6	0	0	0	1	11	0	1	7	1	10	0	0	1	0	0	1	0	0	0	0	0	0	1	0
TOTAL	**64**	**63**	**64**	**65**	**64**	**64**	**65**	**66**	**64**	**66**	**65**	**63**	**47**	**65**	**64**	**66**	**65**	**66**	**65**	**65**	**60**	**60**	**59**	**61**	**61**	**60**	**59**

1.1	1.6	1.7
67%	16%	0%
31%	13%	9%
2%	65%	81%
0%	6%	9%

Enough	Very long	Too many
Good	Long	Many
Average	Average	Average
Poor	Short	Little

Average (1.8 to 1.10)	
34	53%
27	42%
3	5%
0	0%

Enough / Good / Average / Poor

Average (2.1 to 2.7)	
36	58%
16	26%
6	10%
4	6%

Excellent / Good / Average / Poor

Average (3.1 to 3.7)	
43	66%
20	31%
2	3%
0	0%

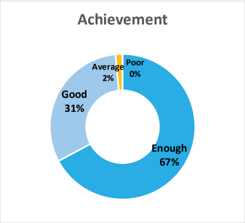
Excellent / Good / Average / Poor

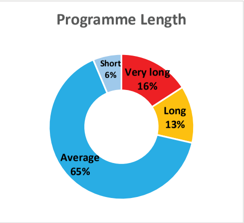
Average (4.1 to 4.5)	
41	69%
18	31%
0	0%
0	0%

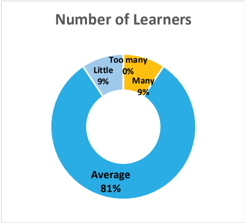
Excellent / Good / Average / Poor

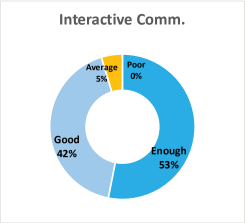
Average (5.1 & 5.2)	
33	54%
21	34%
6	10%
1	2%

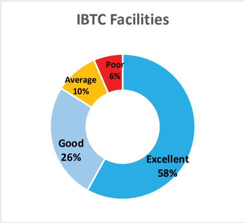
Excellent / Good / Average / Poor

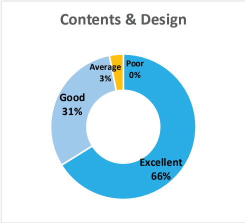


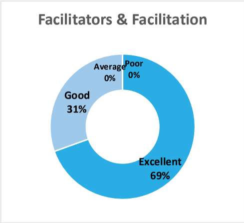


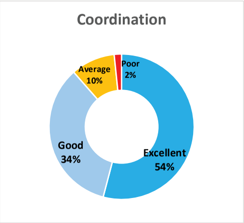












NATIONAL NRW TRAINING: AVERAGE SCORE OF EVALUATION BY PARTICIPANTS (1st Group - 1st Half, IBTC only)

Organization:	Name & Surname:	1. PROGRAMME OUTPUTS AND GENERAL											
		1.1 Did you achieve the above aims? 4= Excellent 3= Good 2= Average 1= Poor	1.1 Did you achieve the above aims? Reasons, Comments	1.2 To what extend did you like the course, how did you feel about it? How relevant was the course to your work?	1.3 Which part of the course content did you like the most or were useful for you?	1.4 Which part of the course content did you like the least?	1.5 Which the course content was supposed to be included? (with reasons if any)	1.6 How did you feel about the length of the course? 4= Very long 3= Long 2= Average 1= Short	1.7 How was the number of leaners? 4: Too many 3= Many 2= Average 1= Little	1.8 Could you learn from experience of participants (facilitators and learners)? 4= Enough 3= Good 2= Average 1= Poor	1.9 Could you communicate with participants (facilitators and learners)? 4= Enough 3= Good 2= Average 1= Poor	1.10 Could you participate in discussions and exercises actively? 4= Enough 3= Good 2= Average 1= Poor	Comments on Programme Outcome and General
Mogale City LM	Zacharia Tsaibacansanda	4		I achieve a lot on my side	For me it work excellent	All part	For those who don't pay	2	2	3	2	3	
	thibaielwi Nemlikula	4		The course was good and gives clear understanding and the expectation reached some of them)	The DMA part was the best at it will help me knowledge during day to day running of network, NRW comes as an eye opener	The practical and engagement	Survey daily routine need to be practice especially at site	2	2	3	3	3	
	Cikizwa Mandilt	4	Excellent	I want to learn more about NRW program it was an eye opener to hear and learn what exactly causes the NRRW.	DMA	N/A	Pressure management	2	2	4	3	4	
	France Delek		Excellent this course was an eye opener to me	I like this course because is addressing the common issues around all SA municipalities I feel good	DMA was the most useful for me following the type of different flow meters	the billing	I think it covered mos of what I did not know before	2	2	4	4	4	
	Daniel Mogonrave	3		Very relevant	Learn basic skills on O&M through DMA management	None		3	2	3	3	3	
	Muiko Mbhokodo	4		Very likely Its great and informative, its very relevant	DMA installation & Data logging	Customer metering	None	2	2	3	3	3	
uMgungundlovu DM	Philani Ngocobo	4		The training was ??? & will help us in the workplace to experience the water losses easily	Stepp testing & Data logging	None	None	2	2	4	4	3	
	Thobelani Mgabi	4		I have realized that the little you can do with the limited resources you can make a difference.	Is whereby it was clearly emphasized the issue of knowing what you have in the system (SIV)	None, in fact the entire course was precise and straight to the point.	Bearing in mind the issue of time, WDWDM should also be dealt with extensively.	2	2	3	4	4	
	Sihle Mkhwanazi	4		It was very good course and I'm very much happy with implementation stage so far. It is much relevant to my work area.	Where it talks about DMA	Finance because they are also the reason the billing part is not consistence.		2	2	3	3	3	
	Uabulani Dlamini	4		It well informative and will assist the municipality to reduce NRW water losses and relevant	Network analysis and data analysis	billing data analysis	WB/WDM	2	2	4	4	4	
	Xolani Shozi	3	N/A	It was very educational and motivational in such a way that now I understand more.	DMA and step testing also data logging to monitor the flows	None	None all is covered						
Mopani DM	Albertina Mojaji Rammalo	4		The course was extremely important, it is going to provide positive impact in our O&M.	The customer metering was the most that I like the most since it outlines very well how to account.	No one I've liked the least of all. The course presented they were all on point	Cost recovery cause on water usage by consumer need to be included.	2	2	3	3	4	
	Livhuwani Mutobru	4	-	The course is good for a water scarce country which SA, the course is relevant as we are NRW municipality	Bulk metering, for revenue collection	Non, the course was excellent	Strategy for revenue collection in rural areas. Revenue collection for the disadvantage areas	2	2	3	3	3	The general outcome of the training course is good
	Elliot Malepe	3	-	The was imlighting us to some of this to did not know about it was good and relevant to me intermes of metering, NRW RW	Data logging, NRW, RW, meter Instillation, cause of meter error e.g. higae??? And also un??estant types of valve etc.	N/A	Awareness to community interns of billing. It is important for community to know price of late and HOCO it is calculated. E.g. if price chemicals increases automatically price of litter will increase. I.e.. you divide production by expenditure to get liter price.	2	2	3	3	3	The programme has refurbished many things to me and revive all ideas even those that of left them at school.
	Solomon Chavalala	3	-	learn about the NRW. How to use PRV in our area to constant the pressure to min??Biceaksows???	Bulk metering	Pressure reaulation? Valve	-	2	2	4	4	4	-

A 11 - 6

1st-G 1st (IBTC only)2

NATIONAL NRW TRAINING: AVERAGE SC

Organization:	Name & Surname:	2. FACILITIES: 2.1 Venue and seating comfort (4= Excellent, 3= Good, 2= Average, 1= Poor)	2.2 Ventilation (4= Excellent, 3= Good, 2= Average, 1= Poor)	2.3 Security (4= Excellent, 3= Good, 2= Average, 1= Poor)	2.4 Replenishment (Water) (4= Excellent, 3= Good, 2= Average, 1= Poor)	2.5 Catering (4= Excellent, 3= Good, 2= Average, 1= Poor)	2.6 Personal Assistance (4= Excellent, 3= Good, 2= Average, 1= Poor)	2.7. Accomodatoin (4= Excellent, 3= Good, 2= Average, 1= Poor)	Comments	3. CONTENTS AND PROGRAMME DESIGN: 3.1 The content met my expectations. This training programme design (composition and balance) was suitable and useful for your own works and your municipality. (4= Excellent, 3= Good, 2= Average, 1= Poor)	3.2 The content was at an appropriate depth and allowed for intellectual engagement. (4= Excellent, 3= Good, 2= Average, 1= Poor)	3.3 The content of the course was logically sequenced. (4= Excellent, 3= Good, 2= Average, 1= Poor)	3.4 The course delivery methodology created the opportunity to address relevant and current issues. (4= Excellent, 3= Good, 2= Average, 1= Poor)	3.5 The course materials (presentation and textbook) was customised user-friendly and easy to follow (4= Excellent, 3= Good, 2= Average, 1= Poor)	3.6 The time allocation was sufficient for practical exercises (4= Excellent, 3= Good, 2= Average, 1= Poor)	3.7 The Training Yard was user-friendly (4= Excellent, 3= Good, 2= Average, 1= Poor)	Comments on Contents and Programme Design
Mogale City LM	Zacharia Tsaibacansanda	4	4	4	4	4	4	1		4	4	4	4	4	4	4	The training to me is good
	thibaielwi Nemlikula	2	1	4	3	2	1	1	Learners accommodation was disastrous single beds are for student from collage and university there was not rest at all. Even eating food where of poor happiness, no taste and not appetizing area was full of mosquitoes	3	4	3	3	4	4	4	Training reach expectation even the facilitator were good
	Cikizwa Mandilt	4	4	4	4	4	4	1	The accommodation is very poor the bed is uncomfortable, and its not ideal for adult.	4	4	3	3	3	2	3	
	France Delek	4	4	4	4	4	4	1	This is a top facilities I enjoyed being here. I have concern about the accommodation as an adult (Sleeping arrangement)	4	4	4	4	4	4	4	One of the top programme design
	Daniel Mogonrave	3	3		3			2		3	3	3	3	3	3	3	
	Muiko Mbhokodo	4	4	4	4	3	4	2		4	4	3	4	4	4	4	
uMgungundlovu DM	Philani Ngocobo	3	4	4	4	4	4	2	All is good condition	4		4	4	4	4	4	Though the programme was driven for the first time but it shows a very good successful potential
	Thobelani Mgabi	4	4	4	4	3	4	1	The IBTC is one of the best training center I have ever been to I plead with the center manager to make sure that its being taken care of.	4	4	4	4	3	3	4	
	Sihle Mkhwanazi	4	3	4	4	1	3	1		4	4	4	4	4	2	2	I think if we were divided into smaller groups so that everyone gets a chance. You can never know something you have not done practically. Training was bit small for the whole class.
	Uabulani Dlamini	4	4	4	4	1	4	1	Accommodation was not suitable and not acceptable. Food at the accommodation place was not well prepared and we had to eat out	4	4	4	4	4	4	4	
	Xolani Shozi	4	3	3	3	2	4	1	Very clean well ventilated and comfortable Accommodation was very very poor.	4	4	3	3	3	3	4	Easy to understand and user friendly
Mopani DM	Albertina Mojaji Rammalo	3	3	3	4	4	4	1	All of the above criteria were good except the accommodation that was booked for trainees by DWS, The sharing of the sleeping rooms was not suitable for adults, since the bed were small	3	3	3	2	2	4	4	Some of the presentations were without the handouts to the leaners hence it was something difficult to make comments of remarks as there was no reference to be made when follow the presentation
	Livhuwani Mutobru	3	4	4	4	4	4	1	Training facilities is good, accommodation sleeping bed and room not good for adults	4	4	4	4	4	4	4	Content and programme design is relevant
	Elliot Malepe	4	4	3	3	3	3	3	The facilities was good is just that some of the apparatus like data logging machine and others, I was not use to them.	4	4	4	4	4	2	3	The programme was designed properly but at least they showed have let us know before a s to what is going to be expected to us before, e.g. I never know maps for DMA is going to be needed.
	Solomon Chavalala	3	3	3	3	3	3	3	The accommodation where we were sleep was not good at ???, ore especial for sharing rooms for adult people is not recommended.	3	3	3	3	3	3	3	Co??? a lot out this contents a presentation design

NATIONAL NRW TRAINING: AVERAGE SC

Organization:	Name & Surname:	4. FACILITATORS AND FACILITATION						5. COORDINATION			OTHER REMARKS/SUGGESTIONS:
		4.1 The facilitator introduced the main theme of the topic and objectives in a logical manner. 4= Excellent 3= Good 2= Average 1= Poor	4.2 There was enough time allocated for questions 4= Excellent 3= Good 2= Average 1= Poor	4.3 The facilitator has extensive knowledge about the subject matter. 4= Excellent 3= Good 2= Average 1= Poor	4.4 The facilitator style and delivery (encouraged participation, voice projection, responsiveness to the group, organised) 4= Excellent 3= Good 2= Average 1= Poor	4.5 The facilitator was well prepared. 4= Excellent 3= Good 2= Average 1= Poor	Comments on Facilitators and Facilitation	5.1 The communication between DWS and your organization before attendance was appropriate. 4= Excellent 3= Good 2= Average 1= Poor	5.2 The administrative arrangement/preparation was appropriate. 4= Excellent 3= Good 2= Average 1= Poor	Comments/Suggestions on Coordination	
Mogale City LM	Zacharia Tsaibacansanda	4	4	4	4	4	They did well	4	4		We need more training going on to learn more
	thibaielwi Nemlikula	4	4	3	4	3		2	2	Communication was not well as we get information a day before last day of the week as we expected to start attendance on first day of next week I think it need to be improved	
	Cikizwa Mandilt	4	4	4	4	3		3	2		
	France Delek	4	4	4	4	4	Keep it up guys well done	4		None	I would also like the organizers to make a provision to make different municipalities to visit other municipalities to experience the way they operate. This will also help officials to gain or to experience different atmosphere and learn new things and implement to their own municipality.
	Daniel Mogonrave	3	3	3	3	3		3	3		The IBTC area can be used to make a good example of a DMA. Can also provide a platform to perform the most work that can be done in municipal environment e.g. Leakdetectio, pipe location, water metering, data logging. Et.
	Muiko Mbhokodo	4	3	4	4	3		4	4		
uMgungundlovu DM	Philani Ngcobo	4	4	4	4	4	With the facilitators they were well prepared & organized	4	4		I suggest that this programme doesn't be a once off session only but if it can be instilled to our municipal directors to be a continuous practice so as to improve the municipality financially due to water losses minimizing
	Thobelani Mgabi	3	4	3	4	4		4	4	Please sort the issue of accommodation and catering for the participant especially the training center kitchen our municipality released us knowing that other costs are being covered as per the initial management. So if we go back and we were not satisfied with food and accommodation in future, will not release us because of an extra cost that they will have to bear. WCWDM Please work on dealing with it more extensively.	
	Sihle Mkhwanazi	4	4	4	4	4	I think when facilitator make a comment should do so constructively regarding municipalities ways of operations and maintenance. And it wherever woks for other doesn't work for my municipality it doesn't necessarily were they are out to tune.	4	4	Head mic would be crucial in the future	Practices, I think should be done where may be participants would wear overalls and get their hands dirty.
	Uabulani Dlamini	4	4	4	4	4		4	3		
	Xolani Shozi	3	4	3	3	4	Very knowledgably, and has a good friendly communication with us	4	3	Well done well organized	This program is very educational and will surely assist our municipalities in achieving more revenue, and also improve our working relationship between department especially finance and technical on improving our revenue and reducint water leaks NRW.
Mopani DM	Albertina Mojaji Rammalo	4	4	4	3	4	In this part all was good	2	2	I've realized that some of the information that was needed from the municipalities was not available because the information was not given to municipality to come along with it.	The program was very good as it is going to assist the municipalities to come up with the right networks (reticulation & Billing water network) which will need to be maintained fully in order to cater for the non-revenue water in out networks as the municipality. The municipality will like to have a situation in which trainees need to see the way in which Japan do things and learned from them. Hoping the program will be tackle to the next level of sharing experience with the Japan country.
	Livhuwani Mutobru	4	4	4	4	4	Facilitators are knowledgably and good facilitator	4	3	Communicate and coordination was sufficiently prior to a training	The DMA should be performed to a rural and urban Municipality in other for expanding the difference of how rural and urban municipality perform. According it my understanding implementation of the training will be different of the rural municipality the p??? lack of facilities.
	Elliot Malepe	3	2	3	3	3	The facilitator was good particularly in terms of encouraging me and other towarns service of good quality to our communities.	2	2	Coordination with our municipality was not that good. Because we left some of information behind because we were not told.	.
	Solomon Chavalala	3	3	3	4	3	Good facilitators	1	3	When come here we were not ??? What ??? Going to happen ?? Su??? The information should be ??calldnt down to us before from over principals for us to prepare before	I go in 1st on this course, thorough I'm not ??recthy waling? With this type of whole because it base on water quality. Some of items are new to me. Its form today I understand why we do experience some bo????? Now ??? Become we are not maintain the PRV in most area.

Organization:	Name & Surname:	1.1 Did you achieve the above aims? 4= Excellent 3= Good 2= Average 1= Poor	1.1 Did you achieve the above aims? Reasons, Comments	1.2 To what extend did you like the course, how did you feel about it? How relevant was the course to your work?	1.3 Which part of the course content did you like the most or were useful for you?	1.4 Which part of the course content did you like the least?	1.5 Which the course content was supposed to be included? (with reasons if any)	1.6 How did you feel about the length of the course? 4= Very long 3= Long 2= Average 1= Short	1.7 How was the number of leaners? 4: Too many 3= Many 2= Average 1= Little	1.8 Could you learn from experience of participants (facilitators and learners)? 4= Enough 3= Good 2= Average 1= Poor	1.9 Could you communicate with participants (facilitators and learners)? 4= Enough 3= Good 2= Average 1= Poor	1.10 Could you participate in discussions and exercises actively? 4= Enough 3= Good 2= Average 1= Poor	Comments on Programme Outcome and General
		1. PROGRAMME OUTPUTS AND GENERAL											
DWS-WUE Champion	Nontokoqo Hleza (DWS-MP)	3	-	The course was well presented. I monitor 6? municipality olyants?	Using DMA, I think it will assist the municipality why? the IWA spreadsheet	None all relevant	Filling of spreadsheet a reporting back to DWS by municipality	2	3	3	3	2	The duration was fine since it 5 days was just theory and the number of learner was perfect tt? It. Was monitable sharing ideas and communication with other participant and discussion is wat? Made the course more interesting
	Gedion Siziba (DWS-MP)	3	My expectations were on IWA spreadsheet	If thought me on the water distribution sustains	Step test in and pipe connections	DWA's and how they function	IWS spreadsheet and Municipal by-low	3	2	2	3	3	
	SJ Phgsha	4	-	Relevant	DMA planning	IWA water balance spreadsheet		4	2	4	4	4	The presentation ??????
	Michel Maluleke (DWS-KZN)	3	-	This is very use for DWS as regular and support to municipality, we learn and understand municipal space better.	Presentation and immediately followed by onsite practices	When municipality were working on their work place plus, this was not busy time as I was not a facilitator	IWA water balance knowledge sharing by different municipalities and DWS officials	2	2	3	3	4	Th course was/is very good and should be extended to harder/larger group once the current programme comes to and end.
	Patrick Makhado	3	-	The course was relevant more especially when one will be analysing the IWA water balance	I can not separate the content since everything to linked to the other. The whole course content was useful.	None	IWA water balance spreadsheet, since it is important regarding water balance calculation and decision making	2	2	2	3	3	
Facilitator	Mahdi Pathan (Cape Town)	3		Very relevant	All content	N/A	-						-
	Ismael Waryawa (Cape Town)	3		Very much developed	Data logs and analysis	N/A	yes	2	2	3			-
	Unathi Noludwe (Cape Town)	3	Work place training will achieve the aims completely	Course validated and improve my knowledge on DMA's (logging & analysis) bulk and customer metering. Practical were well presented and eye opening	Understanding how to install meters and take reading. I was useful in DMA in the training yard.	Billing data @ but its critical for NRW analysis	-	3	2	3	3	3	-
	Sigoibo Nogaya (Cape Town)	3	-	Practical to implement, very informative	DMA planning, flow measurement	Data logging	-	3	2	3	3	3	-
	Ashan Nandlal (eThekwini)	4	-	It was interactive and last the training energizes	-	-	An improvement plan at the workplace to retain training inai???vars	2	3	3	4	3	-
	Nico (Tshwane)												
	Muiko (Ekurhuleni)												
	Tapiwanashe Musara (DWS)	4	Good maintained simple to understand	Good course	NRW, Water balance & Bulk metering		Prior analysis to be incorporated in the presentations to encourage participation of learners during training	3	2	3	4	4	-
Average		3.5						2.3	2.1	3.2	3.3	3.3	

	1.1	1.6	1.7	1.8	1.9	1.10
SCORE-4	13	1	0	6	8	9
SCORE-3	12	5	2	16	14	13
SCORE-2	0	18	22	2	1	1
SCORE-1	0	0	0	0	0	0
TOTAL	25	24	24	24	23	23

Organization:	Name & Surname:	2. FACILITIES								3. CONTENTS AND PROGRAMME DESIGN							
		2.1 Venue and seating comfort 4= Excellent 3= Good 2= Average 1= Poor	2.2 Ventilation 4= Excellent 3= Good 2= Average 1= Poor	2.3 Security 4= Excellent 3= Good 2= Average 1= Poor	2.4 Replenishment (Water) 4= Excellent 3= Good 2= Average 1= Poor	2.5 Catering 4= Excellent 3= Good 2= Average 1= Poor	2.6 Personal Assistance 4= Excellent 3= Good 2= Average 1= Poor	2.7. Accomodatoin 4= Excellent 3= Good 2= Average 1= Poor	Comments	3.1 The content met my expectations. This training programme design (composition and balance) was suitable and useful for your own works and your municipality. 4= Excellent 3= Good 2= Average 1= Poor	3.2 The content was at an appropriate depth and allowed for intellectual engagement. 4= Excellent 3= Good 2= Average 1= Poor	3.3 The content of the course was logically sequenced. 4= Excellent 3= Good 2= Average 1= Poor	3.4 The course delivery methodology created the opportunity to address relevant and current issues. 4= Excellent 3= Good 2= Average 1= Poor	3.5 The course materials (presentation and textbook) was customised user-friendly and easy to follow 4= Excellent 3= Good 2= Average 1= Poor	3.6 The time allocation was sufficient for practical exercises 4= Excellent 3= Good 2= Average 1= Poor	3.7 The Training Yard was user-friendly 4= Excellent 3= Good 2= Average 1= Poor	Comments on Contents and Programme Design
DWS-WUE Champion	Nontokoqo Hleza (DWS-MP)	3	3	3	3	3	3	3	-	3	3	3	3	3	3	4	Well presented through one presentation about DMA has missing spreadsheets
	Gedion Siziba (DWS-MP)	3	3	3	3	3	3	3	-	3	2	3	2	3	3	3	The yard meters and other valves need to the labelled for easy identification
	SJ Phgsha	4	4	3	1	4	4	4	Excellent	4	4	4	4	4	4	4	Well Designing
	Michel Maluleke (DWS-KZN)	4	4	4	4	4	4	4	I used private accommodation as DWS-KZN official	4	4	3	4	4	3	4	This is one of the best ??? By DWS, and if extend to larger group in water sector, it can help deal with WAR on Leaks & improve WCWDWI?
	Patrick Makhado	4	4	4	2	4	4	4	-	3	4	4	4	3	3	3	good
Facilitator	Mahdi Pathan (Cape Town)																
	Ismael Waryawa (Cape Town)	4	4	4	4	4	4	4		3	3	3	3	3	3	4	I would like to have more picture/videos as part of the presentations this will encourage more experience from learners and facilitator.
	Unathi Noludwe (Cape Town)	4	4	3	4	4	4	3	-	3	3	4	4	4	3	3	The content can be improved based of findings during the workplace training.
	Sigoibo Nogaya (Cape Town)	3	4	4	4	3	3	3	-	3	3	3	4	4	4	4	-
	Ashan Nandlal (eThekwini)	4	4	4	4	4	4	3	-	3	3	3	4	4		4	-
	Nico (Tshwane)																
	Muiko (Ekurhuleni)																
	Tapiwanashe Musara (DWS)	4	4	4	3	3	4		not	4	4	4	4	4	4	4	-
Average		3.6	3.6	3.7	3.5	3.3	3.6	1.5		3.6	3.6	3.5	3.6	3.6	3.3	3.6	
	SCORE-4	16	17	16	15	12	17	0		14	15	12	16	15	11	17	
	SCORE-3	8	7	8	8	8	6	2		11	8	13	7	9	10	7	
	SCORE-2	1	0	0	1	2	0	3		0	1	0	2	1	3	1	
	SCORE-1	0	1	0	1	2	1	10		0	0	0	0	0	0	0	
	TOTAL	25	25	24	25	24	24	15		25	24	25	25	25	24	25	

Organization:	Name & Surname:	4. FACILITATORS AND FACILITATION						5. COORDINATION			OTHER REMARKS/SUGGESTIONS:
		4.1 The facilitator introduced the main theme of the topic and objectives in a logical manner. 4= Excellent 3= Good 2= Average 1= Poor	4.2 There was enough time allocated for questions 4= Excellent 3= Good 2= Average 1= Poor	4.3 The facilitator has extensive knowledge about the subject matter. 4= Excellent 3= Good 2= Average 1= Poor	4.4 The facilitator style and delivery (encouraged participation, voice projection, responsiveness to the group, organised) 4= Excellent 3= Good 2= Average 1= Poor	4.5 The facilitator was well prepared. 4= Excellent 3= Good 2= Average 1= Poor	Comments on Facilitators and Facilitation	5.1 The communication between DWS and your organization before attendance was appropriate. 4= Excellent 3= Good 2= Average 1= Poor	5.2 The administrative arrangement/preparation was appropriate. 4= Excellent 3= Good 2= Average 1= Poor	Comments/Suggestions on Coordination	
DWS-WUE Champion	Nontokoqo Hleza (DWS-MP)	3	4	4	4	4	-	3	3	Well organized. As champions I think it was go to be more efficience if our municipality was part of the program	-
	Gedion Siziba (DWS-MP)	3	3	3	3	3	-	3	3	-	-
	SJ Phgsha	4	4	4	4	4	Facilitators ??? ??? The pro???	4	4	-	-
	Michel Maluleke (DWS-KZN)	4	4	3	4	4	Very happy with presentation. Though we believe there is room for improvement. But as first phase it was done very well.	3	2	-	May be on the last presentation, customer issues analysis presented on Thursday afternoon. Where each problem was identified in term of type of illegal connection, misreading of meter, I suggest solution be included immediately before go??ring many slides on problem and later bring solution on later slide. This makes it hard to compare problems and solution.
	Patrick Makhado	3	4	3	3	3	Good		3	-	The inclusion of IWA water balance spreadsheet
Facilitator	Mahdi Pathan (Cape Town)							3	3	-	I'm sure that this programme will enhance everyone's knowledge and the benefits will ensure sustainability of one most valuable commodity. This training shows not fall away as other did in the past. It will then become the more in municipalities.
	Ismael Waryawa (Cape Town)	4	4	4	4	4	-	4	4	-	-
	Unathi Noludwe (Cape Town)	4	3	3	3	3	There is room for improvement of facilitators. Next training will be better.	3	3	Booking tickets if they can be confirmed 3days before the training	
	Sigoibo Nogaya (Cape Town)	3	3	3	3	3	-	3	3	-	-
	Ashan Nandlal (eThekwini)							3	3	-	-
	Nico (Tshwane)										
	Muiko (Ekurhuleni)										
	Tapiwanashe Musara (DWS)						-			-	-
										-	-
Average		3.6	3.7	3.5	3.7	3.6		3.3	3.1		

	4.1	4.2	4.3	4.4	4.5	5.1	5.2
SCORE-4	14	16	12	15	13	11	7
SCORE-3	9	6	11	8	10	9	12
SCORE-2	0	1	0	0	0	3	5
SCORE-1	0	0	0	0	0	1	0
TOTAL	23	23	23	23	23	24	24

NATIONAL NRW TRAINING: AVERAGE SCORE OF EVALUATION BY PARTICIPANTS (1st Group - 2nd Half, IBTC only)

Organization:	Name & Surname:	1.1 Did you achieve the above aims? 4= Excellent 3= Good 2= Average 1= Poor	1.1 Did you achieve the above aims? Reasons, Comments	1.2 To what extend did you like the course, how did you feel about it? How relevant was the course to your work?	1.3 Which part of the course content did you like the most or were useful for you?	1.4 Which part of the course content did you like the least?	1.5 Which the course content was supposed to be included? (with reasons if any)	1.6 How did you feel about the length of the course? 4= Very long 3= Long 2= Average 1= Short	1.7 How was the number of leaners? 4: Too many 3= Many 2= Average 1= Little	1.8 Could you learn from experience of participants (facilitators and learners)? 4= Enough 3= Good 2= Average 1= Poor	1.9 Could you communicate with participants (facilitators and learners)? 4= Enough 3= Good 2= Average 1= Poor	1.10 Could you participate in discussions and exercises actively? 4= Enough 3= Good 2= Average 1= Poor	Comments on Programme Outcome and General
		1. PROGRAMME OUTPUTS AND GENERAL											
Mogale City LM	Zacharia Tsaibacansanda	4	it gives us more understanding about DMA	Very good	DMA	NRW	PRV	1	1	4	4	4	It was good I will take to do more in Mogale city
	Thibaielwi Nemlikula	4		I really like the couse is a good initiative and eye opener, Revive the and extend knowledge and working Area	Work place trainig as we've establish all area of working and many changes have been made.	All part was good	Safety-work plase need to be parctice	2	2	4	4	4	
	Nyeco Mbhokodo	4		Very likable, Very relavant	SIV, Imput, and the leak detections	None		2	2	3	3	3	
uMgungundlovu DM	Philani Ngocobo	4		The course was amaging and will have a big impact at work in terms of balancing or billing system	Data logging & Step testing but the rest of the course is all significant or important	None	The couse covers all according to my point of view	2	2	4	4	3	It is a balanced manner since other participants are on the administative others technical section as I'm in a technical section I wasn't exposed to admin section but since the beginning of the training I gaind from the admin section
	Thobelani Mgabi	4		It was good initiative from the department, it is more relavant to us as municipalites, it deals with municipal challenge	Identifying the problem (DMA) and also methods and techniques to solve the problems	None	IWA water balance because its related to the course	2	2	4	4	4	DWS must make sure that Senior managers in municipalities must comply with the programme
	Sihle Mkhwanazi	4		Very informaative, I felt good, and it was a true reflection of our situation in the municipality				2	2	4	4	4	
	Xolani Shozi	4	N/A	very imporatnt and educational	IWA water balance presentation	N/A	WC/WDM workshop	2	2	3	3	2	It's a good programme and very educational wish to continue with it and assist our municipality
Mopani DM	Livhuwani Mutobru	4	N/A	The course is relavant to my work place to improve billig system	The issue of data collection	Roles of department was SALGA, Municipality, was boards in thiese issues		2	2	3	4	3	The outcome of the tarining will improve the billing system in our area
Facilitator	Ndzululwazi Joni (City of Cape Town)	3		The course was very insughtful	Presentations by municipalities the feedback which led to the plans	None	N/A	2	2	4	4	3	
	Fikile Tbazbenga Millisent (SALGA)	3		The couse is highly reward to my work NRW reduction is of utmost importance for municipalities in South Africa	the entire course content was useful	None	None	2	2	3	4	4	The action plans will help the learners and facilitators boths improve their DMA studies and implemantation
Average		3.8						1.9	1.9	3.6	3.8	3.4	

	1.1	1.6	1.7	1.8	1.9	1.10
SCORE-4	8	0	0	6	8	5
SCORE-3	2	0	0	4	2	4
SCORE-2	0	9	9	0	0	1
SCORE-1	0	1	1	0	0	0
TOTAL	10	10	10	10	10	10

NATIONAL NRW TRAINING: AVERAGE SC

Organization:	Name & Surname:	2. FACILITIES								3. CONTENTS AND PROGRAMME DESIGN							
		2.1 Venue and seating comfort 4= Excellent 3= Good 2= Average 1= Poor	2.2 Ventilation 4= Excellent 3= Good 2= Average 1= Poor	2.3 Security 4= Excellent 3= Good 2= Average 1= Poor	2.4 Replenishment (Water) 4= Excellent 3= Good 2= Average 1= Poor	2.5 Catering 4= Excellent 3= Good 2= Average 1= Poor	2.6 Personal Assistance 4= Excellent 3= Good 2= Average 1= Poor	2.7. Accomodatoin 4= Excellent 3= Good 2= Average 1= Poor	Comments	3.1 The content met my expectations. This training programme design (composition and balance) was suitable and useful for your own works and your municipality. 4= Excellent 3= Good 2= Average 1= Poor	3.2 The content was at an appropriate depth and allowed for intellectual engagement. 4= Excellent 3= Good 2= Average 1= Poor	3.3 The content of the course was logically sequenced. 4= Excellent 3= Good 2= Average 1= Poor	3.4 The course delivery methodology created the opportunity to address relevant and current issues. 4= Excellent 3= Good 2= Average 1= Poor	3.5 The course materials (presentation and textbook) was customised user-friendly and easy to follow 4= Excellent 3= Good 2= Average 1= Poor	3.6 The time allocation was sufficient for practical exercises 4= Excellent 3= Good 2= Average 1= Poor	3.7 The Training Yard was user-friendly 4= Excellent 3= Good 2= Average 1= Poor	Comments on Contents and Programme Design
Mogale City LM	Zacharia Tsaibacansanda	4	4	4	4	3	4	4		4	4	4	4	4	4	4	It was well
	Thibaielwi Nemlikula	4	4	4	3	2	4	3	Telvision is needed after class for relacsation of mind	4	3	3	3	3	3	3	Training is good but try to shift few to workplace. Everything long lecture and repating same presentation
	Nyeco Mbhokodo	4	4	4	4	3	4	4		4	3	3	4	4	3	4	
uMgungundlovu DM	Philani Ngocobo	4	4	4	4	1	4	4	All good	4	4	4	4	4	4	4	It is logically seavenced according to my own point of veiw
	Thobelani Mgabi	4	4	4	4	1	3	4	It is very nice facility. Good for such training because s a isolated area, No noise and it keeps you concentrated what you here for.	4	4	4	4	3	3	3	
	Sihle Mkhwanazi	4	4	4	3	3	3	3	On accommodation I was losing a lot regarding sound african news (No TV) On catering breakfast was the same menu if that can be approved, it was good.	4	4	4	4	4	4	4	
	Xolani Shozi	4	3	3	2	1	3	4	Catering was poor, please do recommend next time and accomodation facility & sescurity was excellent	3	4	3	3	4	4	4	Excellent
Mopani DM	Livhuwani Mutobru	4	4	4	4	1	4	4	Facility is good for training but the catering was poor	4	4	4	4	4	4	4	
Facilitator	Ndzululwazi Joni (City of Cape Town)	4	4	4	4	4	4			3	3	3	4	4	3		
	Fikile Tbazbenga Millisent (SALGA)	4	4	4	3	3	4	4	Godd facliies all round	4	4	4	4	4	4	3	Programme design so sufficient and good
Average		4.0	3.9	3.9	3.5	2.2	3.7	3.8		3.8	3.7	3.6	3.8	3.8	3.6	3.7	

	2.1	2.2	2.3	2.4	2.5	2.6	2.7	3.1	3.2	3.3	3.4	3.5	3.6	3.7
SCORE-4	10	9	9	6	1	7	7	8	7	6	8	8	6	6
SCORE-3	0	1	1	3	4	3	2	2	3	4	2	2	4	3
SCORE-2	0	0	0	1	1	0	0	0	0	0	0	0	0	0
SCORE-1	0	0	0	0	4	0	0	0	0	0	0	0	0	0
TOTAL	10	10	10	10	10	10	9	10	10	10	10	10	10	9

NATIONAL NRW TRAINING: AVERAGE SC

Organization:	Name & Surname:	4.1 The facilitator introduced the main theme of the topic and objectives in a logical manner. 4= Excellent 3= Good 2= Average 1= Poor	4.2 There was enough time allocated for questions 4= Excellent 3= Good 2= Average 1= Poor	4.3 The facilitator has extensive knowledge about the subject matter. 4= Excellent 3= Good 2= Average 1= Poor	4.4 The facilitator style and delivery (encouraged participation, voice projection, responsiveness to the group, organised) 4= Excellent 3= Good 2= Average 1= Poor	4.5 The facilitator was well prepared. 4= Excellent 3= Good 2= Average 1= Poor	Comments on Facilitators and Facilitation	5.1 The communication between DWS and your organization before attendance was appropriate. 4= Excellent 3= Good 2= Average 1= Poor	5.2 The administrative arrangement/preparation was appropriate. 4= Excellent 3= Good 2= Average 1= Poor	Comments/Suggestions on Coordination	OTHER REMARKS/SUGGESTIONS:
		4. FACILITATORS AND FACILITATION						5. COORDINATION			
Mogale City LM	Zacharia Tsaibacansanda	4	4	4	4	4	It was well prepared it was good	4	4	Preparetion was well done	We need more trainnig if we have time
	Thibaielwi Nemlikula	3	4	4	4	4	The facilities are well prepared but I think workplace training is the most important. The thorritical part of Room trainig time allocation is too much Maybe days reduce o 3	4	4	Communication was best	Training is good and more influencing espacially workplace because that's where many issues arises I think 5 days are too much for 1st and 2nd IBTC training. Training course is only theory.
	Nyeco Mbhokodo	4	4	4	3	4		4	4		
uMgungundlovu DM	Philani Ngocobo	4	4	4	4	4	The facilitatiors are well prepared, well organized & mannederd in fact, they've god what it takes for them to drive the programme concept & for the facilitation will have a big impact to our municipalites to reduce NRW.	4	4	Well cordinated	My suggestion about the programme for the first session 5 days is OK & 4 days for the next session *Practical wise, if the number of the participants or trainees be reduced so as to be able to be satisfied may be per team, municipality, other than that all is in good order.
	Thobelani Mgabi	3	4	3	3	3	Even though there were not much facilitators present but the few (one or two) who were present and their best in terms of delivering the presentatoins	3	3	I feel there was a good coordination	
	Sihle Mkhwanazi	4	4	4	4	4	But there is always room for improvement	3	3		I think you need to keep this place open for such trainings and the training area need to be expanded (DMA) or prepared in such way that students/learnders have equial share of learning and understanding more on site
	Xolani Shozi	4	3	3	3	3	good	4	4	Excellent	Food please arrange good catering company programme is excellent
Mopani DM	Livhuwani Mutobru	4	4	4	4	4	good	4	4	Communication was good	The roles of DWS, SALGA, and local municipalites were board should be included in training package
Facilitator	Ndzululwazi Joni (City of Cape Town)	4	3	4	3	4					
	Fikile Tbazbenga Millisent (SALGA)						Facilitated during the intake	3	3	N/A	The programme is on the right path more buy-in to be souced from facilitatato employees to anable better assistance during workplace training period.
Average		3.8	3.8	3.8	3.6	3.8		3.7	3.7		

	4.1	4.2	4.3	4.4	4.5	5.1	5.2
SCORE-4	7	7	7	5	7	6	6
SCORE-3	2	2	2	4	2	3	3
SCORE-2	0	0	0	0	0	0	0
SCORE-1	0	0	0	0	0	0	0
TOTAL	9	9	9	9	9	9	9

NATIONAL NRW TRAINING: AVERAGE SCORE OF EVALUATION BY PARTICIPANTS (2nd Group - 1st Half, IBTC only)

Organization:	Name & Surname:	1. PROGRAMME OUTPUTS AND GENERAL: 1.1 Did you achieve the above aims? 4= Excellent 3= Good 2= Average 1= Poor	1.1 Did you achieve the above aims? Reasons, Comments	1.2 To what extend did you like the course, how did you feel about it? How relevant was the course to your work?	1.3 Which part of the course content did you like the most or were useful for you?	1.4 Which part of the course content did you like the least?	1.5 Which the course content was supposed to be included? (with reasons if any)	1.6 How did you feel about the length of the course? 4= Very long 3= Long 2= Average 1= Short	1.7 How was the number of leaners? 4: Too many 3= Many 2= Average 1= Little	1.8 Could you learn from experience of participants (facilitators and learners)? 4= Enough 3= Good 2= Average 1= Poor	1.9 Could you communicate with participants (facilitators and learners)? 4= Enough 3= Good 2= Average 1= Poor	1.10 Could you participate in discussions and exercises actively? 4= Enough 3= Good 2= Average 1= Poor	Comments on Programme Outcome and General
Mestsimaholo	Jimmy Motloung	3	I learn most of how to deal with the problems that we pneaintered from the different municipalities.	It is even similar to the course	NRW	DMA & NRW	PRV Curse	2	2	3	3	3	It was good I will take to do more in Mogale city
	Mbyyiswa Phillimo Dlamini	4		I like the course so much and I felt so good. It is relevant to my daily work but was an upgrading.	All practise at the training yard.	data acquisition and analysis	How the PRV is working	2	2	4	4	4	
	Mpho Isaac Sina	4		Now I understand how important is it to save water and billing customers correctly.	Detecting underground leaks.	Calculating the readings.		1	2	4	4	3	
King Cetshwayo	Zenzele Molenu	4		General course by the municipalities for the municipality, very relavant and exactly what the municipality ned.	NRW countermeasures	None	none for new	2	2	4	4	4	General programme, Revew possibility of re-organizing couse or program to deal with all related on first day
	Vika Mthethulo	4	yes the programme was very fruitful and I wish this program can go in the municipalities	The course was very informative and from now on I know exactly what step should be done	NRW this point fo course has reveal a lot of improvement infromation	Leak detection is a very inportant thing to our municpality but the usesage of equipment need more time.	Filling of water balance spread sheet and looking at examples	4	2	4	4	4	Enough but I think we should add number of learners from each municipalities. Choosing of leaners should incoparate different employees at different positions
	Xolani	4		Very much determent, even to an extend that they also tough things that I want know.	Data logging and analysis.	Water distribution / water supply infrastructure.		2	2	4	4	4	
JB Marks	Alocious Lechuki Mashiane	4						4	1	4	4	4	
	Boifang Frans Mpama	3	Yes	It was very much relevant because it all about admin and people work in the ground.	The reading of the metres.	Data reading	For WoW is non	2	1	3	4	3	The oprogramme was productive and we have learn a lot of things that we will teach our collegues at work place.
	Joe Zanbik Komosi	4		Course was good for us. I learn more to the course.	Part of the course a lot like is.	Water supply infrastructre.		4	3	4	4	3	
	Hans Tshabadiya			The first time attending and defenitely well informative	The artisan for the identification of areas with NRW.	None because for the training is relevant for the management of water resource.	DMS course and meter readings because lack of information how to read meter.	3	1	3	2	3	
Mbomblela	Skhway Elvis Shabalala	4		DMA, NRW, MNF, NWC, the sub-divisoin of DMAs into sob-zones and water losses, was tages and inefficient across sectors.	Step test, drop test, data logging and analysis, water balance analsysi and revenue basics	Testing apparatus like listening stick, ground microphone, leak detector etc was so interesting and knowledgeable.	The operation and maintenance part to be included	4	2	4	4	4	
	Nichol Moses Nkata	4		Yes I feel good it teach us very everything to do drop test and step test	Leakage control plan	Type of illegal water use	The operatoin and maintenance	4	2	3	3	3	It was a very good programme and in general it teach us new
DWS	Samke Mabaso			The couse was very good practical hands on work to drill works least theory	DMA identification and sub-zoning no dorop and step tests	Construction works improvement	I think the full water balance theory how to how to allocate it as DWS requirements	1	2	3	4	3	The length is short theory need to me be properly concepts etc the people like plumbers
	Zini Mboweni	4		The course was enjoyable and well structured. It is very relevant for my works. I learned a lot	The practices are the yard were useful. They put the theory into perspective.	The presentations are too long without breaks. In between one tend to loose concentration	I think the couse covered everything	3	2	3	4	4	
	Vukani Tshabalala	4		The first time attending and defenetely well informative	The methodology for the indentification of areas with NRW	None because the training is relevant for the management of water resource		2	1	3	3	3	Improve the presentation of DWS grant, Give more information
Facilitator	Nduzululwazi Joni	3	N/A	Relevant as water saving and supply forms opart of daily work tasks	All of the contents were useful	None	None I can think of at the moment	2	2	3	4	3	none
	Unati Noludwe	4		In in WDM department, it is relevant in loss reduction	DMA and sub-zoning, use of leak detection equipment to find invisible leaks			2	2	4	4	4	
Average		3.8						2.6	1.8	3.5	3.7	3.5	

NATIONAL NRW TRAINING: AVERAGE SC

Organization:	Name & Surname:	2.1 Venue and seating comfort 4= Excellent 3= Good 2= Average 1= Poor	2.2 Ventilation 4= Excellent 3= Good 2= Average 1= Poor	2.3 Security 4= Excellent 3= Good 2= Average 1= Poor	2.4 Replenishment (Water) 4= Excellent 3= Good 2= Average 1= Poor	2.5 Catering 4= Excellent 3= Good 2= Average 1= Poor	2.6 Personal Assistance 4= Excellent 3= Good 2= Average 1= Poor	2.7. Accomodatoin 4= Excellent 3= Good 2= Average 1= Poor	Comments	3.1 The content met my expectations. This training programme design (composition and balance) was suitable and useful for your own works and your municipality. 4= Excellent 3= Good 2= Average 1= Poor	3.2 The content was at an appropriate depth and allowed for intellectual engagement. 4= Excellent 3= Good 2= Average 1= Poor	3.3 The content of the course was logically sequenced. 4= Excellent 3= Good 2= Average 1= Poor	3.4 The course delivery methodology created the opportunity to address relevant and current issues. 4= Excellent 3= Good 2= Average 1= Poor	3.5 The course materials (presentation and textbook) was customised user-friendly and easy to follow 4= Excellent 3= Good 2= Average 1= Poor	3.6 The time allocation was sufficient for practical exercises 4= Excellent 3= Good 2= Average 1= Poor	3.7 The Training Yard was user-friendly 4= Excellent 3= Good 2= Average 1= Poor	Comments on Contents and Programme Design
		2. FACILITIES								3. CONTENTS AND PROGRAMME DESIGN							
Mestsimaholo	Jimmy Motloung	4	4	4	4	4	4	4	Very excellent	4	4	4	4	4	4	4	The programe is needed to be improved to earn municipality in order to get a good results that we are expected especial on NRW
	Mbyyiswa Phillimo Dlamini	4	4	4	4	4	4	3		4	4	4	4	4	4	4	
	Mpho Isaac Sina	4	2	4	4	4	4	4		4	4	4	4	4	4	4	
King Cetshwayo	Zenzele Molenu	4	3	4	4	2	4	3	Airconditioning sometimes not fnctioned	4	3	4	4	4	4	4	
	Vika Mthethulo	2	1	4	4	2	4	4	The venue has accomodated all of us and the programme was good set up.	4	4	4	4	3	2	4	The contents and programme design is excellent
	Xolani	4	3	4	3	2	3	2		4	4	4	4	4	3	4	The course is very fruitful.
JB Marks	Alocious Lechuki Mashiane	4	4	4	4	4	4	4		4	4	4	4	4	4	4	
	Boifang Frans Mpama	3	3	3	4	3	4	3	The facility was good because the assistance, and all other things were in good standing or perfect.	3	3	3	4	4	4	3	All the instruments and textbooks were well organised and also all the excisings were good and well understandable.
	Joe Zanbik Komosi	3	3	2	4	3	3	3		4	3	3	3	4	3	4	
	Hans Tshabadiya	3	1	3	2	3		2		2	2	1		2	1	3	
Mbomblela	Skhway Elvis Shabalala		1	4	4	4	4	2	Venue ventilation poor, and airconditions was not working	4	4	4	4	4	3	4	
	Nichol Moses Nkata	4	3	4	4	4	4	4	Venue and seating confort was good	4	4	4	4	4	4	4	It was good programme because it teach us to use new testing apparatus.
DWS	Samke Mabaso	3	1	3	2	2	4		Please sort the aircon in the lecture room.			3	3	3	4	4	There was context was no technical not easy to follow expecially for DWS and perhaps municipal personel such as plumbers
	Zini Mboweni	1	1	2	4	2	4		The room was too hot	3	3	4	4	4	3	4	
	Vukani Tshabalala	2	1	3	4	3	3			3	3	3	3	4	3	4	
Facilitator	Nduzululwazi Joni	3	2	3	3	3	3	3	none	3	3	3	3	3	3	3	N/A
	Unati Noludwe	4	1	4	3	3	4	3		4	4	3	3	3	3	4	
Average		3.3	2.2	3.5	3.6	3.1	3.8	3.2		3.6	3.5	3.5	3.7	3.6	3.3	3.8	

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2nd-G 1st (IBTC only)12

NATIONAL NRW TRAINING: AVERAGE SC

Organization:	Name & Surname:	4.1 The facilitator introduced the main theme of the topic and objectives in a logical manner. 4= Excellent 3= Good 2= Average 1= Poor	4.2 There was enough time allocated for questions 4= Excellent 3= Good 2= Average 1= Poor	4.3 The facilitator has extensive knowledge about the subject matter. 4= Excellent 3= Good 2= Average 1= Poor	4.4 The facilitator style and delivery (encouraged participation, voice projection, responsiveness to the group, organised) 4= Excellent 3= Good 2= Average 1= Poor	4.5 The facilitator was well prepared. 4= Excellent 3= Good 2= Average 1= Poor	Comments on Facilitators and Facilitation	5.1 The communication between DWS and your organization before attendance was appropriate. 4= Excellent 3= Good 2= Average 1= Poor	5.2 The administrative arrangement/preparation was appropriate. 4= Excellent 3= Good 2= Average 1= Poor	Comments/Suggestions on Coordination	OTHER REMARKS/SUGGESTIONS:
		4. FACILITATORS AND FACILITATION						5. COORDINATION			
Mestsimaholo	Jimmy Motloung	4	4	4	4	4	The facilitators were very prepared to give us there knowledge an functions.	4	4	I feel we must also have enough time on doing things practice in order to enable us to implement the understanding of what we have learn.	I feel strongly to bring all the stakeholders to be dart of the training in order to give us the knowledge about experience in their Work Place (problem) this excise will assist us to determine the problems.
	Mbyyiswa Phillimo Dlamini	4	4	4	4	4		3	4		
	Mpho Isaac Sina	4	4	4	4	4		3	4	I feel that DWS did not emphasise the point of finance billing section were supposed to be attend the course.	I thin if maybe the time from of the coerce can be a little bit long since there are so many things to do in short space of time.
King Cetshwayo	Zenzele Molenu	3	4	4	4	4		4	4		
	Vika Mthethulo										
	Xolani	4	4	4	4	4	Facilitators were very much informative.	3	4	If the coordinators can inform us/let us know that themes. Is no TV in the rooms	
JB Marks	Alocious Lechuki Mashiane	4	4	4	4	4					
	Boifang Frans Mpama	3	4	4	4	4	Our week facilitators were very well trained and they were presenting well.	3	3	The preraration was good and please keep in touch with the municipalities about all needed information.	I don't know as J.B Marks have received the information late at their municipality. I wish next time there must be always follow up to the municipalities. The training organiser must e-mail all the things that are needed during the training such as maps and others.
	Joe Zanbik Komosi	3	3	3	3	3		3	3		
	Hans Tshabadiya	3		2	3	4	Improve the presentation of DMS grants give more information.	2	3		
Mbomblela	Skhway Elvis Shabalala	4	4		4	4		4	4		Work place practices recommended to be done as per the progamme and logging of bulk meter to be done as well
	Nichol Moses Nkata	4	4	4	4	4	The facilitator introduced the us the topic was objectives logical moment so far he was well prepaired	3	2	The communication between DWS and my organizatoin before after was as well as appropriate	My first comment to this programme I think it must take little bit longer and also, it must improved many municipalities to this programm. Because this programme is very much important to our municipalities. So far this programme it take us how to solve problemss, new strategies and about new testing apparatus. So far so ggdo it was a very good programme.
DWS	Samke Mabaso	3	3	3	3	3					
	Zini Mboweni	4	4	4	3	4		4	4		
	Vukani Tshabalala	3	4	3	4	3	Improve the presetntatoin for DWS grant	4	3		
Facilitator	Nduzululwazi Joni						N/A	3	3	N/A	
	Unati Noludwe	3	3	3	4	3		3	2		Confirmation of flight and accommodationbooking must be done at least 3 days before the training date
Average		3.5	3.8	3.6	3.7	3.7		3.3	3.4		

NATIONAL NRW TRAINING: AVERAGE SCORE OF EVALUATION BY PARTICIPANTS (2nd Group - 2nd Half, Workplace & IBTC)

Organization:	Name & Surname:	1. PROGRAMME OUTPUTS AND GENERAL											
		1.1 Did you achieve the above aims? 4= Excellent 3= Good 2= Average 1= Poor	1.1 Did you achieve the above aims? Reasons, Comments	1.2 To what extend did you like the course, how did you feel about it? How relevant was the course to your work?	1.3 Which part of the course content did you like the most or were useful for you?	1.4 Which part of the course content did you like the least?	1.5 Which the course content was supposed to be included? (with reasons if any)	1.6 How did you feel about the length of the course? 4= Very long 3= Long 2= Average 1= Short	1.7 How was the number of leaners? 4: Too many 3= Many 2= Average 1= Little	1.8 Could you learn from experience of participants (facilitators and learners)? 4= Enough 3= Good 2= Average 1= Poor	1.9 Could you communicate with participants (facilitators and learners)? 4= Enough 3= Good 2= Average 1= Poor	1.10 Could you participate in discussions and exercises actively? 4= Enough 3= Good 2= Average 1= Poor	Comments on Programme Outcome and General
Mestsimaholo	Jimmy Motloung	3	I have learn how to measure MNF, step test as baseline analysis	According to my observation, it should also extended to the other municipalities who are experienced the NRW.	Instaration of ultrasonic flow meter, step test and also drop test	Billing DMA system because it need especially peoples from finance department.	People from finance depertment they supposed to be part of this project	2	2	4	4	3	My concern is that our municipality should adhered what we have learn and implementing the knowledge that we had acquired.
	Mbyyiswa Phillimo Dlamini	4	We managed all the exercises that we were supposed to practice even though the load-shedding disrupted us	I liked the course very much. I feel like doing it to the other level. This is like my daily week.	Proper and self installation of ultra sonic flow meter and doing the settings.	Billing seminar which was not done so that we can understand how it is done or daelt with	Billing dept in full force so we can understand it broughtly	2	2	4	4	4	
	Mpho Isaac Sina	4	Training was a success and an eye opener to some of the atractivities that we did.	Maintaing the leakages is our ODM and the course was very helpful in terms of knowing RWD NRW.	Step testing because now we know how much is our SIV on that NRW	Testing the valves	The size of bulk meters to be installed at our DMA based on the size of the main pipe supply	1	2	3	4	4	We learnt different types of leak detectors and we also learn how to measure NRW
King Cetshwayo	Vika Mthethulo	4		This course is very important. It helps me to look the water balancing and water conservation as in picture.	The first presentation that high ligjted all the key in Non-Revenue process and understanding different skills.		No-drop spreadsheet that we normally submit monthly to look at the standard formulas and how to fill the spreadsheet.	4	2	4	4	3	
	Xolani	4		NRW is the best ***** the zone *****, MNF, Step testing	The work place and training, when we were doing drop test, loading and step test	Baseline analysis		4	3	4	4	4	
JB Marks	Alocious Lechuki Mashiane	4	We did all thing not step test as and baseline analysis	The cource was good and was relevant. Because they taught us how to control NRW.	logging of to calculate the SIV	reading of the meters	Repairing the pipe lines when there is a leak	4		4	4	4	The room must have TV because it will be good that we look the news after the session
	Boifang Frans Mpama	3	We did all thing not step test as and baseline analysis	The cource was good and was relevant. Because they taught us how to control NRW.	logging to calculate the SIV	reading of the meters	Repairing the pipe lines when there is a leak	3	3	4	3	3	the program is productive and the outcome are good. We have learn a lot for our munincipalities or NRW.
	Joe Zanbik Komosi	4		I feel good	The courses were greatful	good	good	4	3	3	4	4	
Mbomblela	Skhway Elvis Shabalala	4	Excellent	Non Revenue water to be explored To be also exercised in other DMA's	Types of water meters and electro magnetic being the big, but expensive sub division of DMA's with test meters, Calculate	System input volume (SIV) maximum / minimum night flow and electronic and ultra sonic magnetic meters	key attributes: pressure reducing valves (PRVs) and pressure reducing tanks	2	2	4	4	4	
	Nichol Moses Nkata	4	Excellent	Yes. I like the course, and I feel that other municipalities should go this course	leakage detection	System input volume, maxum / minimum night flow	Pressure reducing valves		2	4	3	2	
	Ngobemi Si Pho	4		It is going to help me in solving issues that I face on daily basis. I needed it to help me in my work.	Measuing, water leak detector device	Non			1	4	4	4	
	Fit Zila	4		The cource was educational and relevant to my work	The presentation	Non		2	2	3	2	3	The program was educationally and give information about how municipalities experiencing in their work place
DWS	Samke Mabaso	3	Due to challenges on the ground tree were some measures that couldn't be done (e.g.step test)	very relevant to understand what happening on the fround type of challenges faced with NRW	DMA doing drop test, logging and MNF analysis leak detection, all measures.		Training on water balance spreadsheet as per DWS requirements	2	2	4	4	4	It's a good program. It should be expended to include finance profile in municipalities. There is a need to get in front all top management in municipalitiy in order to get support and impact of the program sustainability is key.
	Zini Mboweni	2	The municipality had lots of challenges and some of the aspects of the course were not covered	The course was very interesting	Workplace training	The theory part of the course		2	2	4	4	4	
Average		3.6						2.7	2.2	3.8	3.7	3.6	

NATIONAL NRW TRAINING: AVERAGE S(

Organization:	Name & Surname:	2.1 Venue and seating comfort 4= Excellent 3= Good 2= Average 1= Poor	2.2 Ventilation 4= Excellent 3= Good 2= Average 1= Poor	2.3 Security 4= Excellent 3= Good 2= Average 1= Poor	2.4 Replenishment (Water) 4= Excellent 3= Good 2= Average 1= Poor	2.5 Catering 4= Excellent 3= Good 2= Average 1= Poor	2.6 Personal Assistance 4= Excellent 3= Good 2= Average 1= Poor	2.7. Accomodatoin 4= Excellent 3= Good 2= Average 1= Poor	Comments	3.1 The content met my expectations. This training programme design (composition and balance) was suitable and useful for your own works and your municipality. 4= Excellent 3= Good 2= Average 1= Poor	3.2 The content was at an appropriate depth and allowed for intellectual engagement. 4= Excellent 3= Good 2= Average 1= Poor	3.3 The content of the course was logically sequenced. 4= Excellent 3= Good 2= Average 1= Poor	3.4 The course delivery methodology created the opportunity to address relevant and current issues. 4= Excellent 3= Good 2= Average 1= Poor	3.5 The course materials (presentation and textbook) was customised user-friendly and easy to follow 4= Excellent 3= Good 2= Average 1= Poor	3.6 The time allocation was sufficient for practical exercises 4= Excellent 3= Good 2= Average 1= Poor	3.7 The Training Yard was user-friendly 4= Excellent 3= Good 2= Average 1= Poor	Comments on Contents and Programme Design
		2. FACILITIES								3. CONTENTS AND PROGRAMME DESIGN							
Mestsimaholo	Jimmy Motloung	4	3	4	4	4	4	4	For future purpose the TVs are also needed at the campus rooms in order to release stress and general knowledge of some important news	3	3	3	4	4	4	4	The program contents more about how to save NRW. Management at our different municipalities and the importance teaching the concunities to report and loss of where from our municipalities.
	Mbyyiswa Phillimo Dlamini	4	4	4	4	4	4	3	Next time, provide a TV in dinning room, to allow leaners to come together watch and interest and make friend ship and give ideas of how to do right think at their different works as this course	4	4	4	3	3	4	2	The condition of the road was extremely poor. We could not drive through to reach our destination. Tools were not all the rimes available to open or close manholes.
	Mpho Isaac Sina	4	2	4	3	2	3	3	We had to walk some distance for food which can be tring. If maybe we can have some entertainment in our rooms like televisions.	4	4	4	4	4	3	4	
King Cetshwayo	Vika Mthethulo	4	2	4	4	4	4	3	The last two day the room that was allocated to me had cold water hence the rooms were very clean and seats.	4	4	3	4	3	2	4	This program should be extended to more months and phases to accommodate all the feature to different municipalities.
	Xolani	3	3	4	3	4	3	2		4	4	4	4	4	4	3	
JB Marks	Alocious Lechuki Mashiane	4	4	4	4	4	4	4	The room must have TV.	4	4	4	4	4	4	4	No comment. Everything was perfect
	Boifang Frans Mpama	3	4	4	4	4	4	3	The rooms must have TV because it will be good that we look the news after the session.	4	4	4	4	4	4	4	No comment. Everything was perfect
	Joe Zanbik Komosi	3	2	4	4	4		3		3	4	2	4	3	3	3	
Mbomblela	Skhway Elvis Shabalala	2	1	4	4	4	2	2		4	4	4	4	3	4	3	
	Nichol Moses Nkata	4	1	4	4	4	3		Facilities of this program was very good according to my thinking	4	4	4	4	4	4	4	Excellent
	Ngobemi Si Pho	4	4	4	4	4	4	4	If they can fix air conditioner	4	4	4	4	4	4	4	
	Fit Zila	3	2	2	3	4	3	4		3	4	4	4	3	4	4	
DWS	Samke Mabaso	2	2		2	3	3			3	3	3	4	3	4	4	
	Zini Mboweni	3	1	2	4	1	4		The facilities are not very good. The room is too hot. The catering is very poor. The tables are unstable and pose a safety risk.	4	4	4	4	4	4	4	
Average		3.4	2.5	3.7	3.6	3.6	3.5	3.1		3.7	3.9	3.6	3.9	3.6	3.7	3.6	

NATIONAL NRW TRAINING: AVERAGE S(

Organization:	Name & Surname:	4.1 The facilitator introduced the main theme of the topic and objectives in a logical manner. 4= Excellent 3= Good 2= Average 1= Poor	4.2 There was enough time allocated for questions 4= Excellent 3= Good 2= Average 1= Poor	4.3 The facilitator has extensive knowledge about the subject matter. 4= Excellent 3= Good 2= Average 1= Poor	4.4 The facilitator style and delivery (encouraged participation, voice projection, responsiveness to the group, organised) 4= Excellent 3= Good 2= Average 1= Poor	4.5 The facilitator was well prepared. 4= Excellent 3= Good 2= Average 1= Poor	Comments on Facilitators and Facilitation	5.1 The communication between DWS and your organization before attendance was appropriate. 4= Excellent 3= Good 2= Average 1= Poor	5.2 The administrative arrangement/preparation was appropriate. 4= Excellent 3= Good 2= Average 1= Poor	Comments/Suggestions on Coordination	OTHER REMARKS/SUGGESTIONS:
		4. FACILITATORS AND FACILITATION						5. COORDINATION			
Mestsimaholo	Jimmy Motloung	3	3	4	3	3	All of them they were good enough to respond and to clarify some of the questions that we directed to them. In all fairness, they were good enough from my side of point of view.	4	4	They were committed with their jobs and worse part of it. They were all punctual at their specified work place.	my suggestion is to involve all the stakeholders who were also affected in this kind of a program. (e.g. People from finance even some senior managers. The training should also extended to some municipality.
	Mbyyiswa Phillimo Dlamini	4	4	4	4	4	he is very serious about his work	4	4		
	Mpho Isaac Sina	4	3	3	3	4		4	4		I feel that the couese should include the management as most of the activities need them, so that they can be implemented at our munincipalities. This training is very important to our municipalities if it can reach to the necessary people.
King Cetshwayo	Vika Mthethulo	4	4	4	3	4	The facilitators have done a good presentation and you can see that they have done their reserch	4	4	The program should be introduced to all leadership and top management and water balancing and non-revenue project should be prioritised in the municipalities. These opportunities must be extended to know employees. This chance will be used.	1. The course should continue and have different phases. 2. The training must have be longer and be able to accommodate more candidates in municipalities. 3. Training Center should have challenges to grow them and monitor the use of grants and funds they are provided for NRW project. 4. Policies of free basic water and independent policy
	Xolani	4	4	4	4	4		4	4		
JB Marks	Alocious Lechuki Mashiane	4	4	4	4	4	They use good and friendly to answer questions	4	4	They did not inform me leaners what they…	
	Boifang Frans Mpama	4	4	4	4	4	They use good and friendly to answer questions	2		They did not inform the leaners exactly what the cause is all about so we can come with maps and well prepared.	When inviting the municipalities must specify what you want or you need from the municipalities. (e.g.) pipe line maps, data etc., While, the lettter to the directors and also finance depertment for the information your going to need.
	Joe Zanbik Komosi	3	3	4	3	4		4	4		
Mbomblela	Skhway Elvis Shabalala	4	4		4	4	Presentations by all various munincipalities were so excellent	4	4	Sub divisions of DMA's and sub zones to be continued done in other sections	
	Nichol Moses Nkata	4	4	4	4	4	Our Facilitators were totally good	4	4		
	Ngobemi Si Pho	4	4	4	4	4		4	4		
	Fit Zila	4	4	4	3	4		4	3		
DWS	Samke Mabaso		4	4	4	4					Presentation skills training should be a key part of the training not just a mention on tips, but actual practice undertaken during the theory test of the training. Program should during the theory phase include water balance spreadsheet training as pwe DMS requirements.
	Zini Mboweni	3	4	3	4	4		4	4		
Average		3.8	3.8	3.8	3.6	3.9		3.8	3.9		

3RD GROUP/INTAKE

(1ST STAGE ONLY BY ONLINE)

The National NRW Training Daily Evaluation Form (Day-1)

This is to reconfirm your attendance register.

* Required

* This form will record your name, please fill your name.

1. Your name in full *

2. Name of your organization *

3. Select modules that you attended today *

- [ ] a. Orientation and Introduction
- [ ] b. WCWDM and NRW in Municipal Water Services of South Africa
- [ ] c. NRW-related Problem Awareness Workshop

4. Comments and suggestions to today's modules in terms of contents, facilitation and so on. *

This content is neither created nor endorsed by Microsoft. The data you submit will be sent to the form owner.

Microsoft Forms

6/7/2021

The National NRW Training Daily Evaluation Form (Day-2)

This is to reconfirm your attendance register.

* Required

* This form will record your name, please fill your name.

1. You name in full *

2. Name of your organization *

3. Select modules that you attended today *

- [ ] d. Technical Aspects: Water Reticulation
- [ ] e. Institutional Aspects: Metering and Billing
- [ ] f. Data Collection (Logging)

4. Comments and suggestions to today's modules in terms of contents, facilitation and so on. *

This content is neither created nor endorsed by Microsoft. The data you submit will be sent to the form owner.

Microsoft Forms

6/7/2021

The National NRW Training Daily Evaluation Form (Day-3)

This is to reconfirm your attendance register.

* Required

* This form will record your name, please fill your name.

1. You name in full *

2. Name of your organization *

3. Select modules that you attended today *

- [ ] g. Zone Configuration and Drop Test
- [ ] h. MNF and Step Test
- [ ] j. Practices by using a simulated DMA

4. Comments and suggestions to today's modules in terms of contents, facilitation and so on. *

This content is neither created nor endorsed by Microsoft. The data you submit will be sent to the form owner.

Microsoft Forms

The National NRW Training Daily Evaluation Form (Day-4)

This is to reconfirm your attendance register.

* Required

* This form will record your name, please fill your name.

1. You name in full *

2. Name of your organization *

3. Select modules that you attended today *

- [ ] k. Case Studies (from the previous trainings)
- [ ] l. Data Utilization/Arrangement and Presentation
- [ ] m. Actions and Way Forward

4. Comments and suggestions to today's modules in terms of contents, facilitation and so on. *

This content is neither created nor endorsed by Microsoft. The data you submit will be sent to the form owner.

Microsoft Forms

The National NRW Training Overall Evaluation Form

Improve training programme, curriculum and facilitation/teaching methods by hearing directly from learners.

* Required

Name and Organization

1. Your name in full *

2. Name of your organization *

A. PROGRAMME OUTPUTS AND GENERAL

3. How satisfied are you with the knowledge you gained throughout the course? *

- ◯ Very satisfied
- ◯ Satisfied
- ◯ Neither satisfied nor dissatisfied
- ◯ Dissatisfied

4. The reason why you chose "Dissatisfied" in the above

5. Do you feel you achieved your desired learning outcome? *

- ◯ Yes a lot
- ◯ Yes
- ◯ Maybe
- ◯ No

6. The reason why you chose "No" in the above

7. How likely are you to recommend this course to your colleagues? *

- ◯ Very likely
- ◯ Likely
- ◯ Neither likely nor unlikely
- ◯ Unlikely

8. The reason why you chose "Unlikely" in the above

9. How was the length of the course? *

- ◯ Very long
- ◯ Long
- ◯ Average
- ◯ Short

10. How was the number of leaners? *

- ◯ Too many
- ◯ many
- ◯ Average
- ◯ Little

11. How did you learn from experiences of participants (facilitators and/or learners)? *

- ◯ Very well
- ◯ Well
- ◯ Somewhat well
- ◯ Not well

12. How did you communicate with participants (facilitators and/or learners)? *

- ◯ Very well
- ◯ Well
- ◯ Somewhat well
- ◯ Not well

13. How did you participate in discussions and exercises actively? *

- ◯ Very well
- ◯ Well
- ◯ Somewhat well
- ◯ Not well

B. ONLINE TRAINING SYSTEM

14. Web-conference platform *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

15. Which devices did you use throughout the training? *

- ☐ Desktop
- ☐ Laptop
- ☐ Phone
- ☐ Tablet
- ☐ Shared the device with other participant(s)
- ☐ Other device

16. Audio visual conditions during the online training *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

17. Your own IT environment and connectivity during online training *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

18. Where did you attend the training from? *

- ☐ Home
- ☐ Office
- ☐ Other

19. Did you attend the training at your own expense? *

- ◯ Yes, attended whole
- ◯ Yes, attended partially
- ◯ No (at your organization's expense)

20. Technical assistance from secretariat(s)/coordinator(s) and/or facilitators *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

C. PROGRAMME DESIGN (CONTENTS/MODULES)

21. The contents/modules met your expectations. This training programme design (composition and balance) was suitable and useful for your own works and your municipality. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

22. The contents/modules were at an appropriate depth and allowed for intellectual engagement. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

23. The contents/modules were logically sequenced. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

24. The course delivery methodology created the opportunity to address relevant and current issues. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

25. How effective were the learning materials (presentation slides) used in the course? (customised user-friendly and easy to follow) *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

26. What kind of content/module(s) should be included further? If any, please specify it (them) and the reason(s) why.

D. FACILITATORS AND FACILITATION

27. The facilitators introduced the topics, objectives and key points in a logical manner. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

28. There was enough time allocated for questions. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

29. The facilitators have extensive knowledge about the subject matter. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

30. The facilitation style and delivery (encouraged participation, voice projection, responsiveness to the group, organised) *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

31. The facilitators were well prepared. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

E. COORDINATION

32. The communication between DWS/IBTC and your organization before attendance was appropriate. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

33. The administrative arrangement/preparation was appropriate. *

- ◯ Excellent
- ◯ Good
- ◯ Average
- ◯ Poor

F. OTHER REMARKS AND SUGGESTIONS

34. Please make comments and inputs that will improve the programme.

This content is neither created nor endorsed by Microsoft. The data you submit will be sent to the form owner.

Microsoft Forms

THE NATIONAL NRW TRAINING (3RD GROUP/INTAKE, ONLY 1ST STAGE)
QUESTIONNAIRE BY MICROSOFT FORMS

DAY-1 (ONLINE)

ID	Name of your organization	Select modules that you attended today	Comments and suggestions to today's modules in terms of contents, facilitation and so on.
1	CoE	a. Orientation and Introduction ;b. WCWDM and NRW in Municipal Water Services of South Africa;c. NRW-related Problem Awareness Workshop;	Allow comments questions at end of each presentation First day was covering very basic but necessary items
2	Saldanha Bay Municipality	a. Orientation and Introduction ;b. WCWDM and NRW in Municipal Water Services of South Africa;c. NRW-related Problem Awareness Workshop;	Good
3	DWS	a. Orientation and Introduction ;b. WCWDM and NRW in Municipal Water Services of South Africa;c. NRW-related Problem Awareness Workshop;	None
4	JICA Team	a. Orientation and Introduction ;b. WCWDM and NRW in Municipal Water Services of South Africa;c. NRW-related Problem Awareness Workshop;	Would like to see the fece. we might see per Munic by Munic, each group when their introduction.
5	ETHEKWINI WATER & SANITATION	b. WCWDM and NRW in Municipal Water Services of South Africa;c. NRW-related Problem Awareness Workshop;a. Orientation and Introduction ;	We need to encourage trainee engagement during and after each presentation Maybe designated facilitators be assigned to a module to ensure consistancy and continuity of training material and content interpretation
6	ETHEKWINI MUNICIPALITY	a. Orientation and Introduction ;b. WCWDM and NRW in Municipal Water Services of South Africa;c. NRW-related Problem Awareness Workshop;	We should allow greater interaction of trainees during and after each presentation.
7	DWS	a. Orientation and Introduction ;b. WCWDM and NRW in Municipal Water Services of South Africa;c. NRW-related Problem Awareness Workshop;	I think we can improve on the administration/management of the sessions (time, introduction of speakers etc)
8	City of Ekurhuleni	a. Orientation and Introduction ;b. WCWDM and NRW in Municipal Water Services of South Africa;c. NRW-related Problem Awareness Workshop;	The content is very interesting, the online delivery feels a bit disjointed, but maybe it is just the participants that are not used to expressing themselves on this platform. Hopefully the interaction will feel less strained as we move forward. Thanks
9	Amathole District Municipality	a. Orientation and Introduction ;b. WCWDM and NRW in Municipal Water Services of South Africa;c. NRW-related Problem Awareness Workshop;	More time for questions and doscussions needed.
10	Amathole District Municipality	a. Orientation and Introduction ;b. WCWDM and NRW in Municipal Water Services of South Africa;c. NRW-related Problem Awareness Workshop;	The slides were clear and they way they were presented was good
11	Saldanha bay Municipality	a. Orientation and Introduction ;b. WCWDM and NRW in Municipal Water Services of South Africa;c. NRW-related Problem Awareness Workshop;	Smart water reticulation System
12	City of Ekurhuleni	a. Orientation and Introduction ;	The workshop/training was informative with the presenters clued up with their subject matter.
13	City of Ekurhuleni	b. WCWDM and NRW in Municipal Water Services of South Africa;	I have learnt a lot in relation to my experience regarding metering, a definite subject to be looked at indepth
14	JICA Team	a. Orientation and Introduction ;b. WCWDM and NRW in Municipal Water Services of South Africa;c. NRW-related Problem Awareness Workshop;	Joni struggled to join the meeting, so Mamane took NRW presentation (a part of item b). CCT's facilitators generally had challenges to join the meeting due to municipality system problem (if correct). And we didn't have municipality profile introduction due to no orientation (supposed to be done in webinar). Workshop was not done well due to absence of facilitator from not only municipality but also WUE. These are risks to be mitigated.

DAY-2 (ONLINE)

ID	Name of your organization	Select modules that you attended today	Comments and suggestions to today's modules in terms of contents, facilitation and so on.
1	City of Ekurhuleni	d. Technical Aspects: Water Reticulation;e. Institutional Aspects: Metering and Billing;f. Data Collection (Logging) ;	None
2	Amathole District Municipality	d. Technical Aspects: Water Reticulation;e. Institutional Aspects: Metering and Billing;f. Data Collection (Logging) ;	The modules are very much informative.
3	Ethekwini Municipality	e. Institutional Aspects: Metering and Billing;d. Technical Aspects: Water Reticulation;	Was well done
4	City of Cape Town	d. Technical Aspects: Water Reticulation;e. Institutional Aspects: Metering and Billing;f. Data Collection (Logging) ;	The process is still fairly new to most of the participants and will take some time getting use to it. Data on the presentations were sufficient however could have been more "point" form for ease of reference as a pose to large amounts of data displayed - students might lose focus
5	City of Cape Town	f. Data Collection (Logging) ;e. Institutional Aspects: Metering and Billing;d. Technical Aspects: Water Reticulation;	The process is still fairly new to most of the participants and will take some time getting use to it. Data on the presentations were sufficient however could have been more "point" form for ease of reference as a pose to large amounts of data displayed - students might lose focus
6	DWS	d. Technical Aspects: Water Reticulation;e. Institutional Aspects: Metering and Billing;f. Data Collection (Logging) ;	The content was good however more participation from participants are required. The comments and questions from Francis, Ashan, William and Nico were very useful, as they have lots of experience and have unique circumstances within their municipalities.
7	Saldanha Bay Municipality	d. Technical Aspects: Water Reticulation;e. Institutional Aspects: Metering and Billing;f. Data Collection (Logging) ;	Informative
8	City of Ekurhuleni	d. Technical Aspects: Water Reticulation;e. Institutional Aspects: Metering and Billing;f. Data Collection (Logging) ;	Presentations were good and informative, just ran over time. If you have information in presentations that were covered by other presentations, let the presenters just indicate that it has been covered. Thanks
9	JICA Team	d. Technical Aspects: Water Reticulation;f. Data Collection (Logging) ;e. Institutional Aspects: Metering and Billing;	Nico's presentation became a hour due to informative slides. Koena was not able to join, then Joni took it over at the last moment. Mahdi san faced struggling to show his slides, so we re-logged in. It looked solved but same problem happened, then Nico supported. These are risks to be mitigated in advance.

DAY-3 (ONLINE)

ID	Name of your organization	Select modules that you attended today	Comments and suggestions to today's modules in terms of contents, facilitation and so on.
1	Amathole District Municipality	g. Zone Configuration and Drop Test;h. MNF and Step Test;j. Practices by using a simulated DMA;	Presentations were very informative.
2	City of Ekurhuleni	g. Zone Configuration and Drop Test;h. MNF and Step Test;j. Practices by using a simulated DMA;	Good informative practical sessions.
3	Saldanha Bay Municipality	g. Zone Configuration and Drop Test;h. MNF and Step Test;j. Practices by using a simulated DMA;	very informative & technical
4	City of Cape Town	g. Zone Configuration and Drop Test;h. MNF and Step Test;j. Practices by using a simulated DMA;	Practical participation does not seem to be useful via a virtual medium - student/facilitator interaction is still the preferred method.
5	City of Cape Town	g. Zone Configuration and Drop Test;j. Practices by using a simulated DMA;h. MNF and Step Test;	Practical participation does not seem to be useful via a virtual medium - student/facilitator interaction is still the preferred method.
6	City of Cape Town	j. Practices by using a simulated DMA;h. MNF and Step Test;g. Zone Configuration and Drop Test;	Practical participation does not seem to be useful via a virtual medium - student/facilitator interaction is still the preferred method.
7	JICA team	g. Zone Configuration and Drop Test;h. MNF and Step Test;j. Practices by using a simulated DMA;	Participants waited to be admitted. Training started 30 minutes delayed. Announcing specific time in chat-box or by slide during the training is necessary for participants. We should know if participants are sitting in front of monitor through training. Unathi asked the Chair to check her voice and slide moving before staring. Mvumbi was not able to do presentation (because of ***) but was replaced by Joni, but due to a problem in monitor sharing so he was supported by Miyoshi. Mamane was not able to do presentation because he struggled in the meeting, and Niimura took it over. I suggest "Practices" be a homework of Day-3 and presentation with answers in the 1st session of Day-4. (by swapping sessions between Day-3: 3rd and Day-4: 1st).

DAY-4 (ONLINE)

ID	Name of your organization	Select modules that you attended today	Comments and suggestions to today's modules in terms of contents, facilitation and so on.
1	Department Water and Sanitation	k. Case Studies (from the previous trainings);l. Data Utilization/Arrangement and Presentation;m. Actions and Way Forward;	Enjoyed the training was very helpful and detailed
2	Amathole District Municipalitiy	k. Case Studies (from the previous trainings);l. Data Utilization/Arrangement and Presentation;m. Actions and Way Forward;	None
3	Ngqakaza	k. Case Studies (from the previous trainings);l. Data Utilization/Arrangement and Presentation;m. Actions and Way Forward;	N/A
4	DWS	k. Case Studies (from the previous trainings);l. Data Utilization/Arrangement and Presentation;m. Actions and Way Forward;	Good
5	City of Cape Town	k. Case Studies (from the previous trainings);l. Data Utilization/Arrangement and Presentation;m. Actions and Way Forward;	If possible to find a way that participating learners to engage
6	Saldanha Bay Municipality	k. Case Studies (from the previous trainings);l. Data Utilization/Arrangement and Presentation;m. Actions and Way Forward;	Good
7	Amathole District Municipality	k. Case Studies (from the previous trainings);l. Data Utilization/Arrangement and Presentation;m. Actions and Way Forward;	The presentations were very much informative and helpful, especially the examples of presentations for different audiences.
8	Amathole District Municipality	k. Case Studies (from the previous trainings);l. Data Utilization/Arrangement and Presentation;m. Actions and Way Forward;	Everything was in order and modules were clear and understandable
9	JICA Team	k. Case Studies (from the previous trainings);l. Data Utilization/Arrangement and Presentation;m. Actions and Way Forward;	Case study by Joni on behalf of Adonis, Data Management (Utilization/Arrangement) and Presentation by Brandon, and Actions and Way Forward by Miyoshi on behalf of DWS/WUE or Ashan.

THE NATIONAL NRW TRAINING (3RD GROUP/INTAKE, ONLY 1ST STAGE)
QUESTIONNAIRE BY MICROSOFT FORMS

OVERALL EVALUATION (ONLINE)

ID	Your name in full	Name of your organization	How satisfied are you with the knowledge you gained throughout the course?	The reason why you chose "Dissatisfied" in the above	Do you feel you achieved your desired learning outcome?	The reason why you chose "No" in the above	How likely are you to recommend this course to your colleagues?	The reason why you chose "Unlikely" in the above
1	Wilma Baptiste	Department Water and Sanitation	Very satisfied		Yes		Very likely	
2	Sindiswa Mvani	Amathole District Municiplaity	Very satisfied		Yes		Likely	
3	Andiswa Mahlongwe	City of Ekurhuleni	Very satisfied		Yes a lot		Very likely	
4	Xolani Hadebe	Department of Water and Sanitation	Satisfied		Yes		Very likely	
5	Unathi Noludwe	City of Cape Town	Satisfied		Yes		Very likely	
6	Beau Adams	Saldanha Bay Municipality	Very satisfied		Yes		Likely	
7	Francis Bacon	City of Ekurhuleni	Satisfied		Yes		Likely	
8	Nosikhumbuzo Loliwe	Amathole District Municipality	Very satisfied		Yes a lot		Very likely	
9	Aser Sekgoela	City of Ekurhuleni	Very satisfied	The training is very informative and educational	Yes a lot		Very likely	
10	Sibusiso Ngqakaza	Amathole District Municipality	Satisfied		Yes a lot		Very likely	

ID	Your name in full	Name of your organization	How was the length of the course?	How was the number of leaners?	How did you learn from experiences of participants (facilitators and/or learners)?	How did you communicate with participants (facilitators and/or learners)?	How did you participate in discussions and exercises actively?	Web-conference platform
1	Wilma Baptiste	Department Water and Sanitation	Average	Average	Very well	Well	Well	Excellent
2	Sindiswa Mvani	Amathole District Municiplaity	Average	Average	Well	Well	Well	Good
3	Andiswa Mahlongwe	City of Ekurhuleni	Average	Average	Very well	Very well	Well	Good
4	Xolani Hadebe	Department of Water and Sanitation	Average	Average	Somewhat well	Not well	Well	Average
5	Unathi Noludwe	City of Cape Town	Average	Average	Well	Well	Not well	Average
6	Beau Adams	Saldanha Bay Municipality	Long	many	Well	Well	Well	Good
7	Francis Bacon	City of Ekurhuleni	Average	Average	Somewhat well	Somewhat well	Well	Average
8	Nosikhumbuzo Loliwe	Amathole District Municipality	Average	Average	Very well	Very well	Very well	Excellent
9	Aser Sekgoela	City of Ekurhuleni	Average	Average	Well	Well	Well	Good
10	Sibusiso Ngqakaza	Amathole District Municipality	Average	Average	Well	Well	Well	Good

ID	Your name in full	Name of your organization	Which devices did you use throughout the training?	Audio visual conditions during the online training	Your own IT environment and connectivity during online training	Where did you attend the training from?	Did you attend the training at your own expense?	Technical assistance from secretariat(s)/coordinator(s) and/or facilitators
1	Wilma Baptiste	Department Water and Sanitation	Laptop;	Excellent	Excellent	Home;	Yes, attended partially	Good
2	Sindiswa Mvani	Amathole District Municiplaity	Laptop;	Good	Good	Home;	Yes, attended whole	Good
3	Andiswa Mahlongwe	City of Ekurhuleni	Laptop;	Good	Good	Office;	No (at your organization's expense)	Excellent
4	Xolani Hadebe	Department of Water and Sanitation	Laptop;	Good	Average	Home;	No (at your organization's expense)	Average
5	Unathi Noludwe	City of Cape Town	Shared the device with other participant(s);	Good	Poor	Office;	No (at your organization's expense)	Good
6	Beau Adams	Saldanha Bay Municipality	Laptop;	Good	Good	Office;	No (at your organization's expense)	Good
7	Francis Bacon	City of Ekurhuleni	Laptop;	Average	Good	Office;Home;	Yes, attended whole	Good
8	Nosikhumbuzo Loliwe	Amathole District Municipality	Laptop;Phone;	Excellent	Excellent	Home;Office;	Yes, attended whole	Excellent
9	Aser Sekgoela	City of Ekurhuleni	Desktop;	Excellent	Good	Office;	No (at your organization's expense)	Good
10	Sibusiso Ngqakaza	Amathole District Municipality	Laptop;	Good	Average	Home;	No (at your organization's expense)	Good

ID	Your name in full	Name of your organization	The contents/modules met your expectations. This training programme design (composition and balance) was suitable and useful for your own works and your municipality.	The contents/modules were at an appropriate depth and allowed for intellectual engagement.	The contents/modules were logically sequenced.	The course delivery methodology created the opportunity to address relevant and current issues.	How effective were the learning materials (presentation slides) used in the course? (customised user-friendly and easy to follow)	What kind of content/module(s) should be included further? If any, please specify it (them) and the reason(s) why.
1	Wilma Baptiste	Department Water and Sanitation	Good	Excellent	Excellent	Excellent	Excellent	
2	Sindiswa Mvani	Amathole District Municiplaity	Good	Good	Good	Good	Good	
3	Andiswa Mahlongwe	City of Ekurhuleni	Good	Good	Good	Good	Good	
4	Xolani Hadebe	Department of Water and Sanitation	Good	Good	Good	Good	Good	
5	Unathi Noludwe	City of Cape Town	Excellent	Excellent	Excellent	Excellent	Good	
6	Beau Adams	Saldanha Bay Municipality	Excellent	Excellent	Good	Excellent	Excellent	
7	Francis Bacon	City of Ekurhuleni	Good	Average	Good	Good	Good	
8	Nosikhumbuzo Loliwe	Amathole District Municipality	Excellent	Good	Good	Excellent	Excellent	Presentation were just fine for me
9	Aser Sekgoela	City of Ekurhuleni	Good	Good	Good	Good	Good	Finance management and metering
10	Sibusiso Ngqakaza	Amathole District Municipality	Excellent	Excellent	Excellent	Excellent	Excellent	None

ID	Your name in full	Name of your organization	The facilitators introduced the topics, objectives and key points in a logical manner.	There was enough time allocated for questions.	The facilitators have extensive knowledge about the subject matter.	The facilitation style and delivery (encouraged participation, voice projection, responsiveness to the group, organised)	The facilitators were well prepared.	The communication between DWS/IBTC and your organization before attendance was appropriate.
1	Wilma Baptiste	Department Water and Sanitation	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
2	Sindiswa Mvani	Amathole District Municiplaity	Excellent	Good	Good	Good	Good	Good
3	Andiswa Mahlongwe	City of Ekurhuleni	Excellent	Excellent	Excellent	Excellent	Excellent	Good
4	Xolani Hadebe	Department of Water and Sanitation	Good	Average	Good	Good	Good	Average
5	Unathi Noludwe	City of Cape Town	Excellent	Excellent	Good	Average	Good	Average
6	Beau Adams	Saldanha Bay Municipality	Excellent	Good	Excellent	Excellent	Average	Good
7	Francis Bacon	City of Ekurhuleni	Average	Good	Good	Good	Good	Good
8	Nosikhumbuzo Loliwe	Amathole District Municipality	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
9	Aser Sekgoela	City of Ekurhuleni	Good	Good	Good	Good	Good	Excellent
10	Sibusiso Ngqakaza	Amathole District Municipality	Good	Good	Good	Good	Good	Good

ID	Your name in full	Name of your organization	The administrative arrangement/preparation was appropriate.	Please make comments and inputs that will improve the programme.
1	Wilma Baptiste	Department Water and Sanitation	Excellent	
2	Sindiswa Mvani	Amathole District Municiplaity	Good	
3	Andiswa Mahlongwe	City of Ekurhuleni	Good	Well presented thank you.
4	Xolani Hadebe	Department of Water and Sanitation	Average	proper coordination by the course coordinators
5	Unathi Noludwe	City of Cape Town	Good	Participating learners should be more staff that is on the ground than the management and they should come prepared to share their selected pilot DMA.
6	Beau Adams	Saldanha Bay Municipality	Good	
7	Francis Bacon	City of Ekurhuleni	Good	
8	Nosikhumbuzo Loliwe	Amathole District Municipality	Excellent	The training and presentations were very much informative and helpful
9	Aser Sekgoela	City of Ekurhuleni	Good	The course is informative and if possible be extended to other municipalities
10	Sibusiso Ngqakaza	Amathole District Municipality	Good	

添付資料 12

全国無収水研修の参加地方自治体研修員による
成果プレゼンテーション

uMDM NRW PRESENTATION

08 NOVEMBER 2019

Table Of Content

1. Recap the findings
2. Interventions

Findings

- As builts drawings do not match what is on the ground
- Zone three is losing too much water (Major Leak)
- Billing data is not accurate

As builts drawings

- Engage with our GIS office to update the record drawings

Zone Three

- Installing a new 50mm diameter RSV to be able to control the flow to the unknown pipeline.
- Will have to use the pipe finder to locate the position of the unknown pipe.

Billing data

- Further engagements with our finance department regarding the inaccuracy of our billing data.
- Physical verification of 35 houses missing on our billing data

List of team members and contacts

- Jabulani Dlamini
- Thobelani Mgabi
- Xolani Shozi
- Nobutaka Maruyama
- Sihle Mkhwanazi
- Philani Ngcobo

THANK YOU

Mogale City

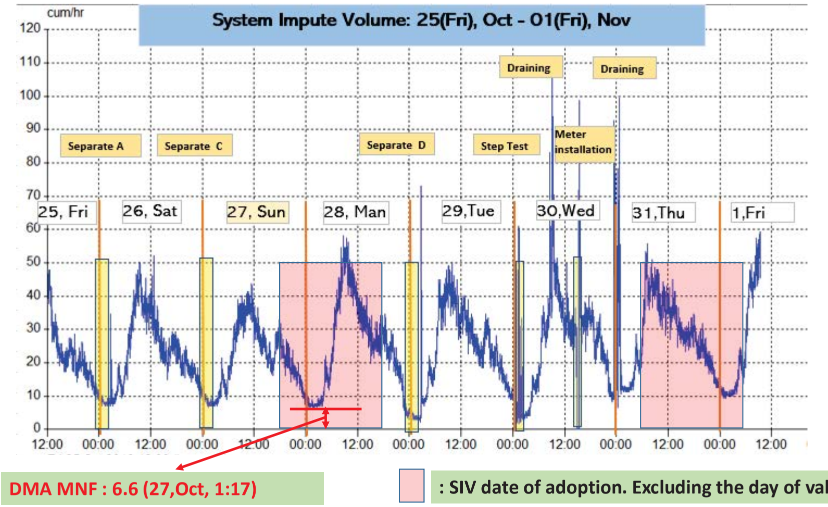
Local Municipality

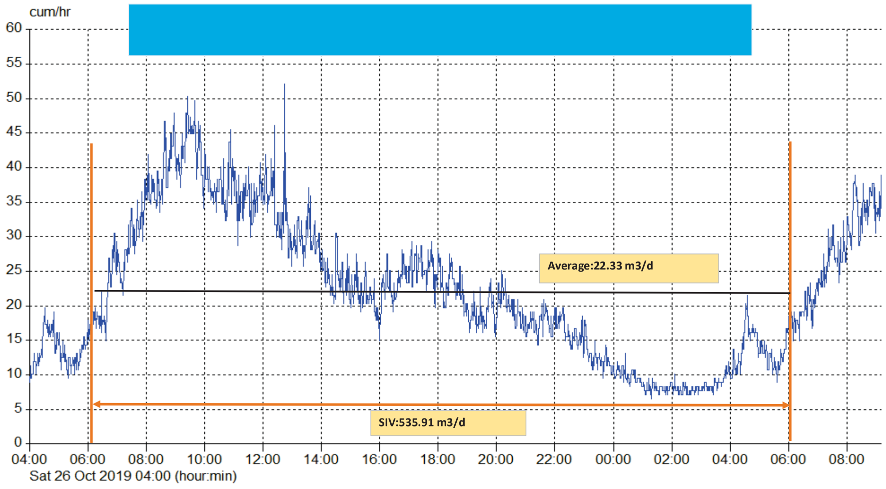
Presents By:
Nyiko Mbhokodo and Cikizwa Mandili

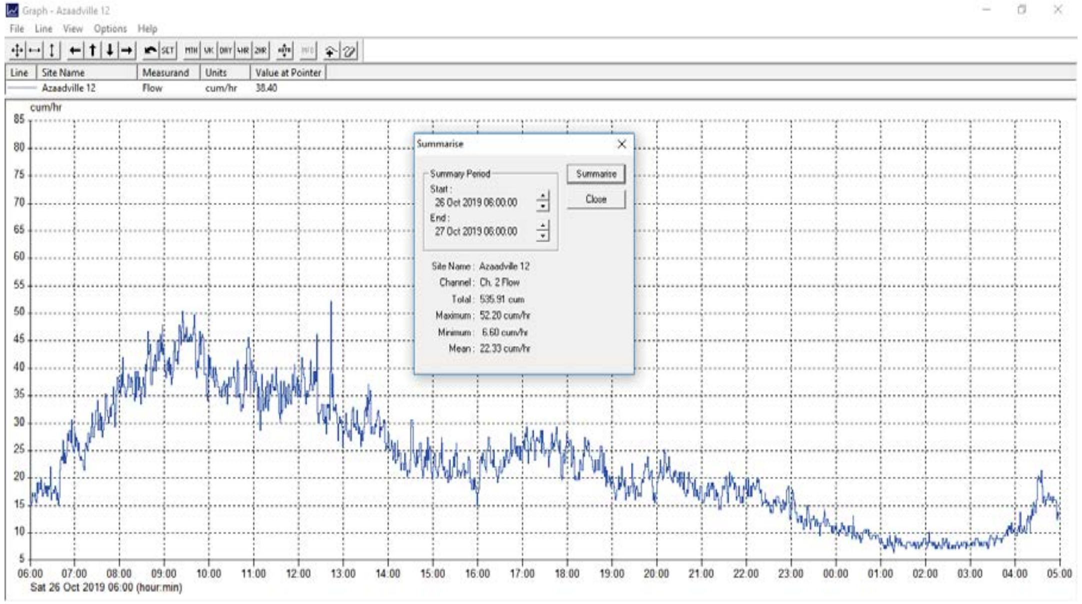
SELECTED DMA (AZAADVILLE)

SUB-SECTION

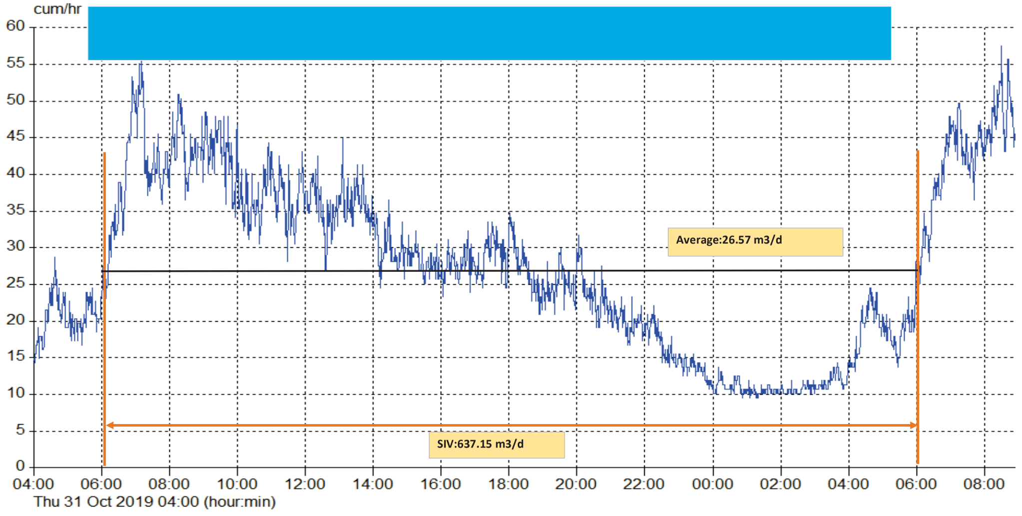
Flow measurement

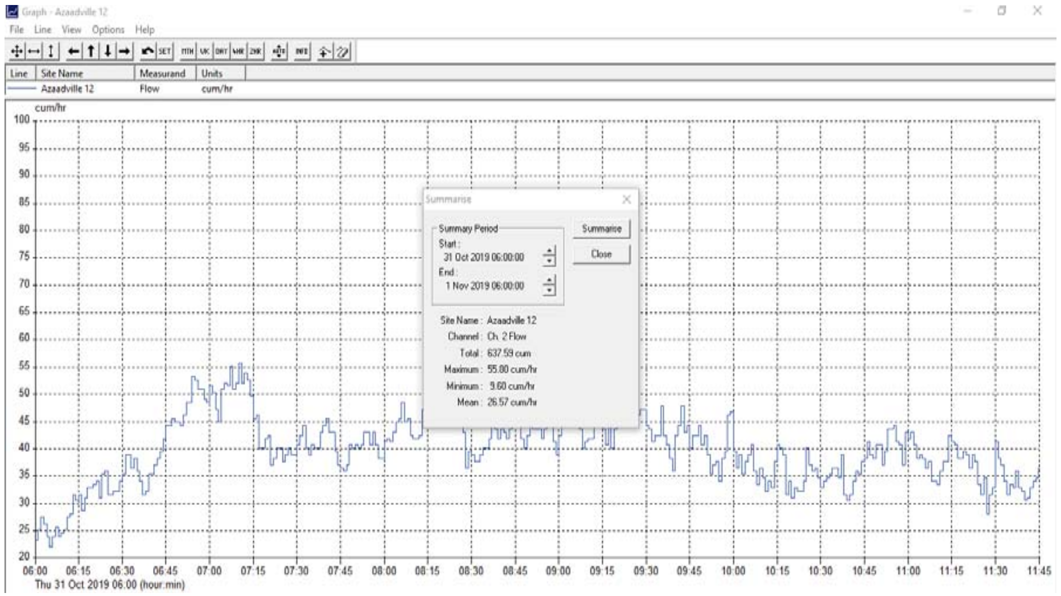






SIV measurement -2





SIV measurement -3

Result of the SIV: par day

SIV Measurement		
		SIV
Day	Time	m3/d
From 26	6:00	
To 27	6:00	535.91
Frm 31	6:00	
To 1	6:00	637.15
	Average	586.53

Flow meter Chamber

VALVE OPERATION TIME SUB-SECTION (MNF)

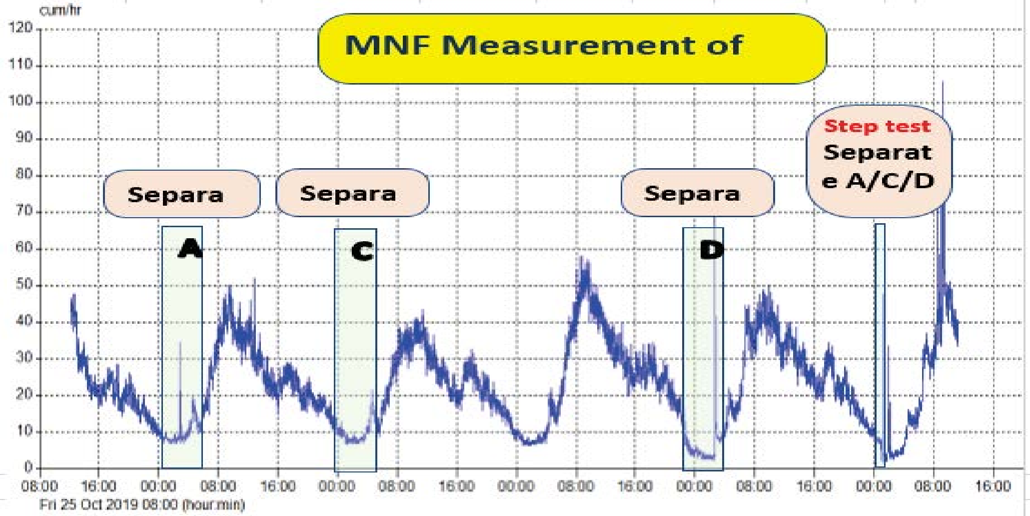
25 Oct/26 Oct/ 28 Oct 2019

○=Operation Va

Close
Va 23H00
Vc 23H00
Vd 23H00

Open
Vd 03H00
Vc 03H00
Va 03H00

MNF Measurement of sub-section



MNF Measurement of sub-section

Activity No	Date	Time	Separate Area	Area-1	MNF	Area-3	MNF	Step Test
1	25～26	23:00~3:00	A	BDC	7,2			
2	26～27	23:00~3:00	C	ABD	6,6			
3	28～29	23:00~3:00	D	ABC	2,4			
4	30	1:04~1:54	A&B&C	B	1,8	B=	**1,8**	1,8
Calcuraton No	Item	Area-1		Area-2	MNF	Area-3	MFF	
5	1－2	BDC-ABD=		C－A	0,6			
6	2－3	ABD-ABC=		D-C	4,2			
7	3－4	ABC-B=		A+C	0,6			
8	5＋7	C-A+A+C=		2C	1,2	C=	**0,6**	0,6
9	5＋6	C-A+D-C=		-A+D	4,8			
10	6＋7	D-C+A+C=		D+A	4,8			
11	9＋10	-A+D+D+A=		2D	9,6	D=	**4,8**	4,8
12	2－4－11	ABD-B-D=		A	0	A=	**0**	1,8
						Total	**7,2**	9

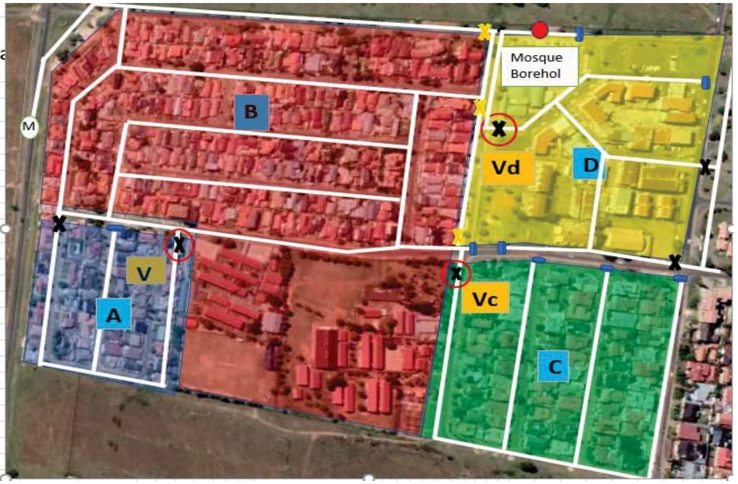
VALVE OPERATION TIME OF SUB-SECTION (STEP TEST)

30 Oct 2019

◯ =Operation Va

Close
- Va 0:06
- Vc 0:36
- Vd 1:04

Open
- Vd 9:14
- Vc 1:54
- Va 2:00



Record Table for Step Test

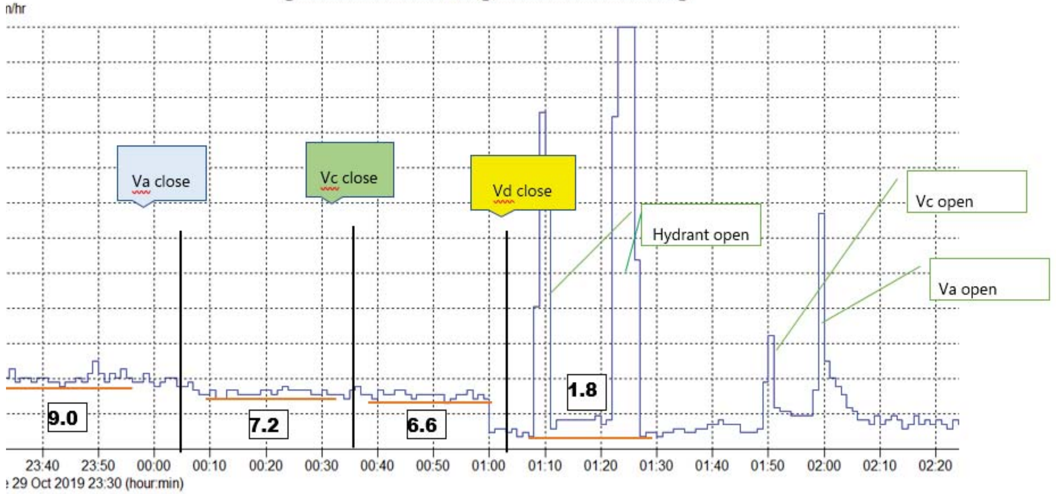
DMA No. : Azzadvill

Working Date(Time) 2019/10/30(0:00 ~ 0:200 :

Responsible Pers : Mr. Nyico, DWS, JICA

Operation				Record								Remark
Step No.	Closing Valve ID	Operator name	Valeve Operation time	Sub zone No.	Location of check	Pressure(Bar) Before Valve Operation	Pressure(Bar) After Valve Operation	Pressure(Bar) Diffrence	Flow(L/m) Befere Valve Operation	Flow(L/m) After Valeve Operation	Flow(L/m) Diffrence	
MNF	Meter chamber	Nyiko,Flamns, Zackaria, Cikizwa, Thiba, Albart	-	MNF	low meter chambe					9		Priority
1	Va		0:06	A		40			9	7,2	1,80	2
2	Vc		0:36	C		40			7,2	6,6	0,60	4
3	Vd		1:04	D		40			6,6	1,8	4,80	1
				B					1,8		1,80	2

Azaadville DMA Step Test



Azaadville

Account No	Name	Type	Meter No	Date	Reading	Consumption	Levy
100007	E VARACHIA	370	12941	2019/3/1	7120	27	549
100016	F DINDAR	370	12885	2019/3/1	1012	33	705
100017	I VARACHIA	370	12882	2019/3/1	9047	20	381
100018	FE BHABHA	370	C-UAC 7632	2019/3/1	4814	19	357
100024	Mr DM DULLABH	370	C-UAB 8709	2019/3/1	1828	10	166
100028	H JASSAT	370	C-EAB 1155	2019/3/1	1462	6	90
100045	B PATEL	370	C-DAB 4938	2019/3/1	1216	8	128
100048	M MORAR	370	C RAA 8059	2019/3/1	3854	18	333
100054	Y CHOHAN	370	40009077	2019/3/4	1424	27	549
100056	Mr AH PATEL	370	50208679	2019/3/1	355	32	677
100058	SC PATEL	370	C RAA 7897	2019/3/1	1746	16	285
100064	MA EBRAHIM	370	C RAA 7898	2019/3/1	3081	14	242
100069	Mr RS HASSEN	370	40050007	2019/3/1	514	7	109
100078	RA&UR RAGIE	370	12880	2019/3/1	5762	10	166
100082	A PATEL	370	MBM 783	2019/3/1	4371	19	357
100084	Mr EM LAHER	370	12908	2019/3/1	6097	8	128
100089	IM KOTWAL	370	C-HAA 6643	2019/3/1	802	31	649
100097	Mr A CAJEE	370	856860	2019/3/1	9939	20	381
100107	A GAFFOOR &	370	30087171	2019/3/1	1008	16	285
100115	S&A JINA	370	12936	2019/3/1	8081	35	761
100121	AK ESSOP	370	40050586	2019/3/1	495	20	381
100125	F&Z HASSAIN	370	12967	2019/3/1	3630	50	1196
100128	I JHAWIRPERS	370	12966	2019/3/1	6790	16	285

The outcomes of the workplace exercise

- To have a good engagement with the ward canceller when we do the DMA exercise
- To get a full detail map with the information needed on the selected DMA
- Old meters must be replaced.
- Incorrect meter reading (missing digit, estimates)
- To address inefficient use of water by consumers and identification of problematic areas and critical challenges in order to direct resources to where they are most needed
- To improve water revenue by ensuring all water purchase is not wasted by leaking networks and burst water connections
- Information sharing (Billing section and Technical section)

NO	HOUSE NUMBER						
	Anarkal Street	METER NUMBER	1ST READING	COMMENTS	2ND READING	7days consumption	1day
1	43	836694	8563.58	87		-8563.58	-1223.368571
2	31	30087171	1276			-1276	-182.2857143
3	27	C-RAA8653	1028.2728			-1028.2728	-146.8961143
4	25	225462	1179.68			-1179.68	-168.5257143
5	23	C-CLA0714	172.5531			-172.5531	-24.65044286
6	36	C-RAA6384	6129.264			-6129.264	-875.6091429
7	34	C-BKR 2013	279.684			-279.684	-39.95485714
8	32	12876	8198.601			-8198.601	-1171.228714
9	30	12881	3550.171			-3550.171	-507.1672857
10	24	OLD METER	-	Meter Broken			
11	22	8142623	3049.59			-3049.59	-435.6557143
12	20	12885	1064.064			-1064.064	-152.0091429
13	18	12822	4215.951			-4215.951	-602.2787143
14	16	C-UAC7632	5016.235			-5016.235	-716.605
15	14	C-JLC 5044	1056.776			-1056.776	-150.968
16	10	C-JLD 0293	1306.633			-1306.633	-186.6618571
17	8	140045573	65.3573			-65.3573	-9.336757143
18	6	1400337033	669.17			-669.17	-95.59571429
19	4	140138043	1657.0625			-1657.0625	-236.7232143
20	2	M3-C-UAB 8709	1922.4467			-1922.4467	-274.6352429
21	7	89243592	2546.24			-2546.24	-363.7485714
22		461590	8230			-8230	-1175.714286
23	15	40061152	1996			-1996	-285.1428571
24	21	140090767	43.7106			-43.7106	-6.244371429
25	45	140025707	21879.21			-21879.21	-3125.601429
26	47	C-CKX9586	0.345			-0.345	-0.049285714
27	53	50163071	70.827	Old Meter		-70.827	-10.11814286
	CHAMPA	METER NUMBER	1ST READING	COMMENTS	2ND READING	7days consumption	1day
28	40	C-CKX9010	182.9035			-182.9035	-26.12907143
29	37	C-AKL6411	557.3419			-557.3419	-79.62027143
30	38	130024975	2465.2538			-2465.2538	-352.1791143

MOPANI DISTRICT MUNICIPALITY

Greater Giyani Municipality

MOPANI DISTRICT MUNICIPALITY

Ba-Phalaborwa Municipality

Maruleng Local Municipality

TZANEEN MUNICIPALITY

Greater Letaba Municipality

"To be the food basket of Southern Africa and a tourism destination of choice"

Albetina Rammalo

Findings

- No MNF in DMA due to Reservoir Closing PM10:00-AM3:00.
- Billed Consumption is higher than SIV in Phalaborwa Town.
- Billed Consumption is higher than SIV in DMA.
- Consumption is not monitored by O&M team.
- Only Lepele Bulk Water Board can access to the meter for our payment.
- The volume of Bulk Water does not corresponds to consumption volume.

Finding 1: No MNF in DMA

DMA flow closing PM10:00 to AM3:00

Finding2. Map is not updated properly

Finding 3: Flowmeter at reservoir is only accessible by Bulk Water Borad

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Action Plan

- Short Term: 3weeks_Nov. 11 to Nov.29
- Mid Term: 6months_ Nov. 2019 to Apr.2020
- Long Term: Nov. 2019 to Dec. 2020.

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Short term to DMA

- SIV
  - Measure SIV again with Lepele (Water Board)
  - UFM to be installed in DMA
  - Pressure logger to be installed in DMA
  - If not, consider another area for measurement
- Billing Data
  - Prepare customer list with street name
  - 1st meter reading on 21st Wednesday
  - 2nd meter reading on 25th Monday

7

Ultrasonic Flow Meter

8

Short term to Phalaborwa

- SIV
  - Access 3 reservoirs with Lepele water (bulk board).
  - Read meter value by ourselves (24h, 48h, 72h)
  - Install our UFM at 3 reservoirs
- Billing data
  - Review 4240 consumption data

Mid Term

1. Update Mapping / Request DWS's grant RBIG/WSIG for updating budget.
2. Make a reservoir list with a customer list to do water balance monthly.
3. Make a 24 hours UFM measurement plan to all reservoir in Mopani DM.
4. Public awareness plan to reduce usage.

Mogale LM 24Kl/connection, in Phalaborwa 892Kl/connection

Long Term

1. Step tariff system for high consumer.
   - Request municipal committee to apply step tariff to reduce average consumption in Phalaborwa.
2. Measure all rural area and Informal Settlement

   to make a real NRW Balance in each Reservoir.

1. Pressure/Flow/Chlorine Monthly Report from LM
2. Leak Repair Report
   - Time of finding leaks, Time of repair to reduce repair time of duration.

To be continued

water & sanitation
Department: Water and Sanitation
REPUBLIC OF SOUTH AFRICA
SALGA inspiring service delivery
jbmarks LOCAL MUNICIPALITY
Japan International Cooperation Agency
JICA

The Project for Strengthening the Training Capacity of IBTC on NRW

JB Marks Municipality

Date: 10-28 February 2020
By Frans Mpama, Hans Tsabadira, Joe Kenosi, Alocious Lechuti

Table of Content

- Background
- Activity/Methodology
- Findings
- Leak Detection Surveys
- Recommendations/Way Forward

BACKGROUND

JB Marks Local Municipality is a Category B municipality situated within the Dr Kenneth Kaunda District in the North West Province. It was established by the amalgamation of Ventersdorp Local Municipality and Tlokwe City Council Local Municipality in 2016

The focus area for the NRW training was in the town of Potchefstroom, more specifically at Ikageng Township

ACTIVITY/METHODOLOGY

IDENTIFICATION OF DMA

DMA A

- DMA A was identified which is located in the Areaganeng Street in Potchefstroom.
- Trial data logging was done to confirm whether the bulk meter is working

DMA-A

- Data logging training was conducted with the learners.
- Drop test was done to confirm boundary of the area on 11th Feb.
- A data logger was installed on 12th Feb at 11am to get the SIV and MNF data.
- Maps and Billing data for DMA was requested from the municipal finance section however tariff data and Google Maps were received instead.
- Customers are not registered for billing even though supply started in 2018.

Finding New Area…..continued

Due to the fact that DMA-A could not be subdivided by valves, other areas were explored:

Area-B

This area was checked as a candidate area, however there were issues with safety and unsuitable working conditions. The area was too large houses with over 2000 households. Furthermore the bulk meter did not have a meter diaphragm which needed to be installed in order to do logging properly.

Identification of DMA…..continued

Area-C & D

- The bulk meter was working, however the pulsar didn't fit in Area C, and the out put was 100L/pulse in Area D, thus unable to do logging .
- The pipe drawing is not existing for Area-C & D and the size of the area is not confirmed by the drawing.
- The customers are not registered for billing even though constructed in August 2019.

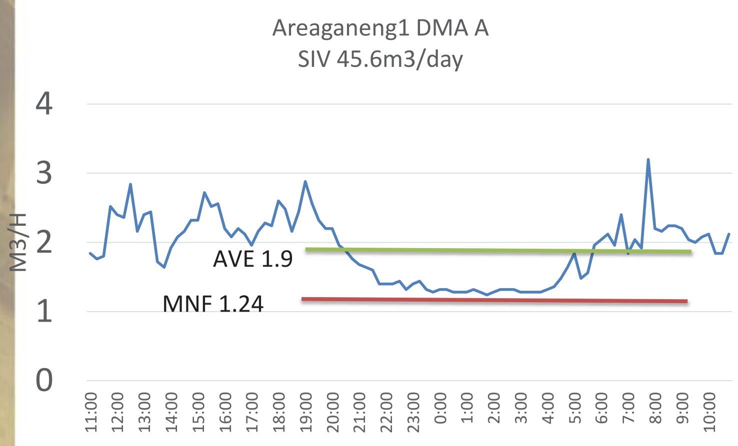
FINDINGS

DMA B, C AND D did not work out as expected therefore findings were based on DMA-A only

DMA-A

- DMA-A is a ring-feed with no internal valves thus unable to subdivide into smaller zones.
- System Input Volume is 45.6m3/day for 52 houses, equals 870 L/day/house, 174L/day/person, (if family is 5 persons)
- Minimum Night Flow at 1.24 m3/hr, equals 0.3 L/sec
- Average is 1.90 m3/hr ,this indicated that the leakage index is at 65%, and this is high. (see MNF graph, next slide)
- The customers are not registered for billing data even though this area constructed in 2018.

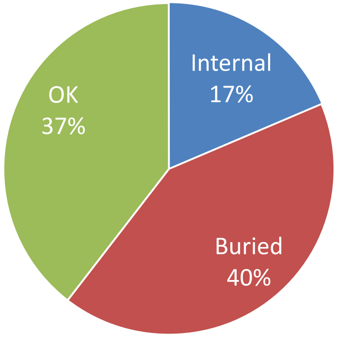
FINDINGS



Leak Detection Survey

- The team undertook the Internal and External leak detection survey in the area.
- DMA-A is a ring-feed zone consisting of 52 houses, however 45 houses were surveyed on the 25th Feb 2020 and 7 houses were not confirmed.
- There installed meters are not read by the municipality and therefore this area is not billed for water.

Internal External Leak Survey Report of DMA A, 25 Feb 2020



The Leak Detection Survey detected the following:

- Buried meters – there are 18 houses where the team couldn't locate meters because they were covered by soil/other debris i.e. 40% of houses in this area.

- The survey detected about 8 houses with internal leaks, possibly toilets and outside taps but further investigations needed, i.e. 17% of houses in this area.
- 17 houses were ok, had meters and no internal leaks i.e 37%

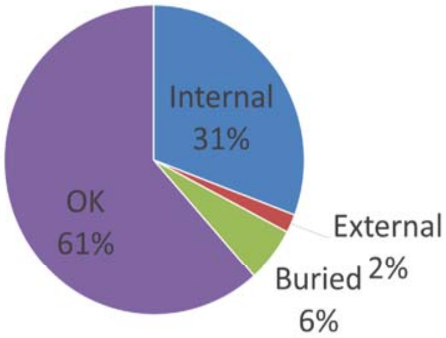
CHALLENGES

- Unavailability of pipeline maps, bulk metes, valves, etc.
- 40 % of Meter is buried before registration
- 17% of houses has internal leaks before registration
- It takes 2 years for meter registration for Finance system

2nd Leak detection survey -27 Feb 2020

The team undertook excavation of buried meter and leak detection on the 27th of February in the same area, for 52 houses. The survey indicated the following:

Internal leaks: 16
External Leak: 1
Buried: 3
OK: 32



RECOMMENDATIONS/WAY FORWARD (1)

- Buried meters needs to be uncovered and all meters need to be read in order for the municipality to have consumption record for the area. This will enable the municipality to have an indication of how much is used in this area and also assist when they start with registering these houses in their billing system for future billing.
- Internal leaks – Education and Awareness Campaign is key in this area to educate community on importance of saving water, reporting leaks and repairing internal ones. The community should also be made aware of their responsibilities and process on reporting leaks. The municipality indicated that they stop before the meter, however in order to deal with internal leaks the municipality can sought council resolution to fix the internal leaks (retrofitting) in the area.
- Municipality need to ensure installation of isolating valves and have proper pipeline/network maps available for every area. Request As-Build drawings from the contactor to manage pipelines.

RECOMMENDATIONS/WAY FORWARD (2)

- Municipal technical and finance sections should work together and each have responsibility in reporting NRW (Water balance)

THANK YOU!!!

KING CETSHWAYO
DISTRICT MUNICIPALITY

WORKPLACE TRAINING PRESENTATION

KING CETSHWAYO
DISTRICT MUNICIPALITY

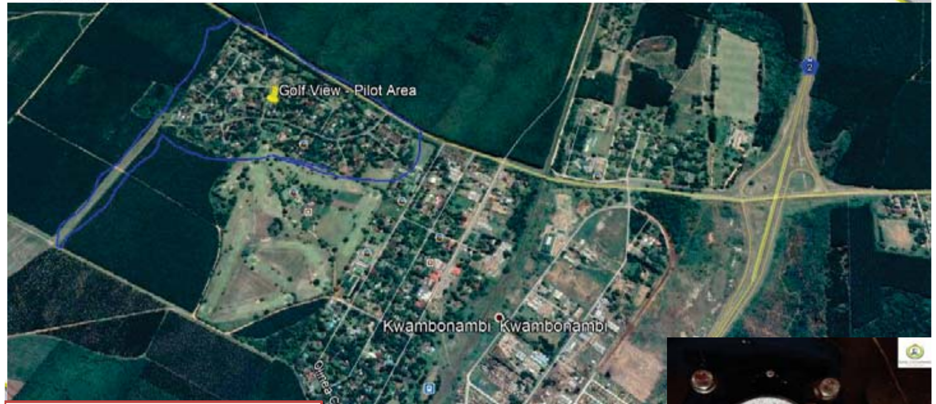
PRESENTATION OUTLINE

1. Outline of the Pilot area
2. Activities
   - Zone configuration(Drop test)
   - Logging
   - MNF Step test
3. Data analysis and Results
4. Conclusions and Recommendations
5. Lessons learnt

Thank you

KING CETSHWAYO

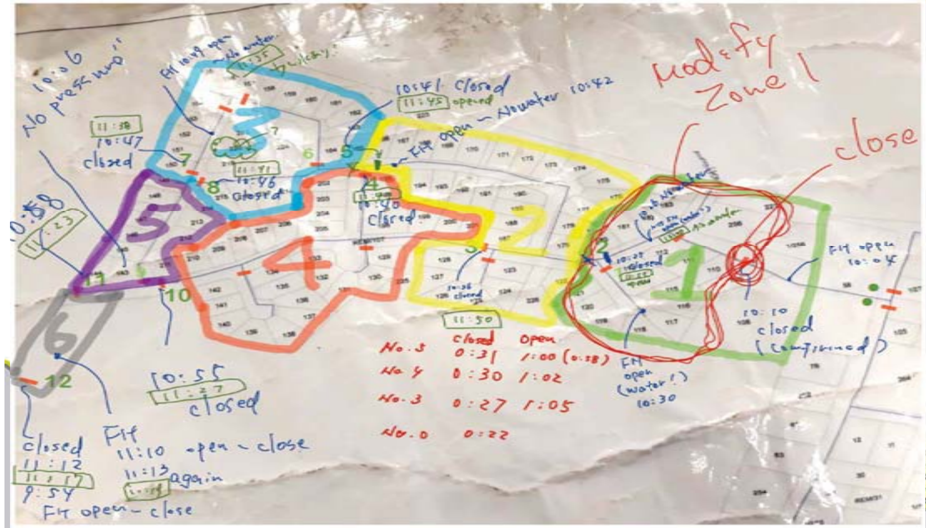
Outline of the Pilot area



1. Layout - Hard
2. Bulk meter – Replace
3. Isolations valves – 16 - 12
4. Billing – town, sorting
5. Households – 119

KING CETSHWAYO
DISTRICT MUNICIPALITY

Outline of the Pilot area



Activities

Zone configuration (Drop test)

- 6 zones
- Confirmed by closing the valves
- Checking the pressure from the Hydrants (inside and outside)

Activities

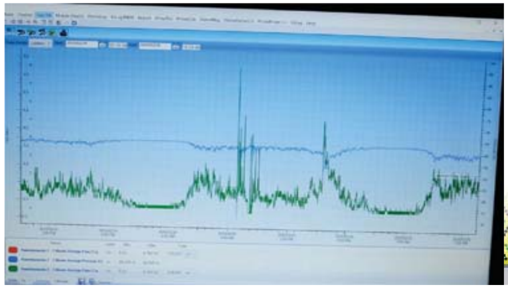
Data Logging

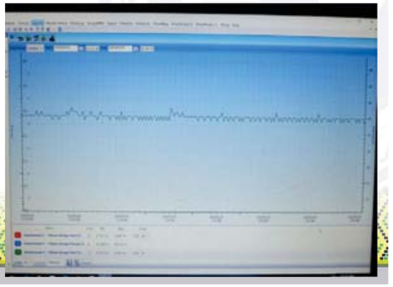
- The first logger was installed and it gave incorrect data due to faulty meter
- New 100 dia meter was installed to suit the logger specification.
- Logged data was successfully retrieved after 24hrs and analysed.

Activities

MNF Step Test

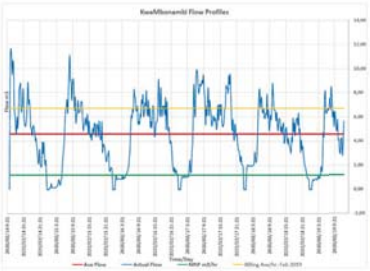
- Modified zones from 6 to 2 for MNF
- MNF Step test conducted 00h30 - 01h00 (Closed valve no. 3,4 & 5)
- The losses were very minimal
- Graph below - MNF results





Data analysis and Results

- The SIV was used in this case due to difficulty in extracting/retrieving information from the billing data for the selected area.
- SIV = 97.328 m3/day
  = 818 l/day/house hold (119 houses)
  = 205 l/day/Pp (assume Max 4)



Conclusions and Recommendations

Conclusion

- MNF very low (approx. 20 l/minute for 119 houses)
- Selected area had minimum losses

Recommendations

- GIS to update the drawings for the entire District.
- Billing data should be easily manipulated - per lot numbers
- All equipment to be used must be readily available to avoid delays
- Consider alternative meter
- Municipality should have their own data loggers in order to continue with the exercise in the areas where high water losses are suspected.
- Network operators and plumbers from their working stations should be involved since they are the ones who understand better the area and network.

Lessons learnt

- Drawings – Soft copies and updated (position of valves not accurate)
- Billing data should be easily manipulated.
- Gate valves used to control and balance water supply (Valve 12 trolled)
- Develop and update operating manuals (Pressure complains- valve 0)
- Equipment and instruments to be properly maintained (K1 read switch not working)
- Mark and maintain visible marking of valves (white colour is the best!!!)
- Try to standardize on equipment installed (key did not fit on valve 0)
- Promptly repair visible leaks (strainer, valve 12)
- Record keeping and continuous assessment

THANK YOU

"As we express our gratitude, we must never forget that the highest appreciation is not to utter words, but to live by them." – ***John F. Kennedy***

THE TEAM

#	Name and Surname	Contract Details	Additional Team
1	VV Mthethwa Snr Technician: WUE		PI Mkhize (Plumber) S Mavundla (Handy Man) S Makhanya (Technician) D Bhajun (Manager revenue) S Nsele (Intern) N Cele (Intern)
2	X Mkhwanazi Plumber: O&M		
3	ZP Ndlovu Act. Manager: WUE		

KING CETSHWAYO
DISTRICT MUNICIPALITY

Telephone	035 799 2500
Facsimile	035 789 1409
Postal Address	Private Bag X 1025 Richards Bay 3900
Physical Address	King Cetshwayo District Municipality House Richards Bay CBD
Website	www.kingcetshwayo.gov.za

The National NRW Training

Feed back from Metsimaholo WP training

Mr. Jimmy Motloung
Mr. Phillimon Dlamini
Mr. Mpho Sina

1

Participants

	First week	Second week
Metsimaholo	Jimmy Motloung Phillimon Dlamini Mpho Sina	Jimmy Motloung Phillimon Dlamini Mpho Sina
Coordinator	Sekgoilane Kgoputso Verusha Govender	Verusha Govender Lerato Makola
Facilitator	Jaco (City of CPT)	
JICA Expert	H. Morita	H. Morita

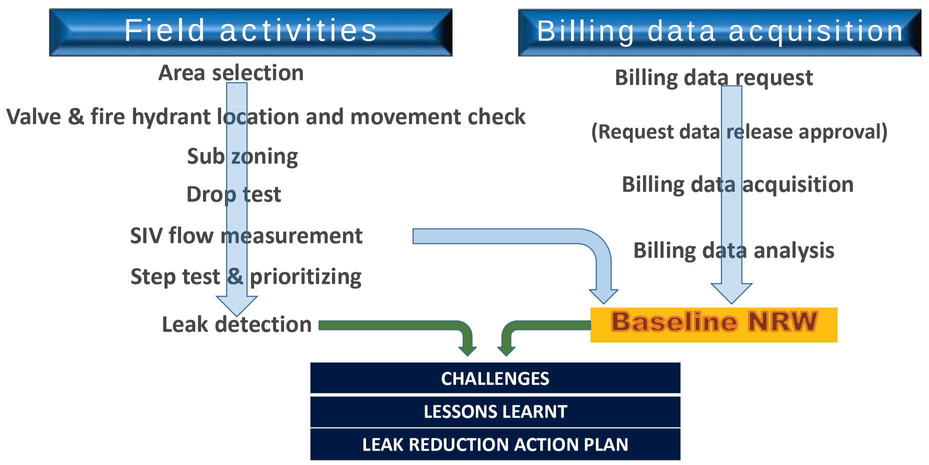
2

Profile of the Metsimaholo

- **Metsimaholo local municipality is a falling under the Fezile Dabi District Municipality in Free state province near the Vaal River.**
- **It has 21 wards, serving population of 149 000**
- **Economici empowered by Sasol oil company, Natref**

3

Contents of Presentation



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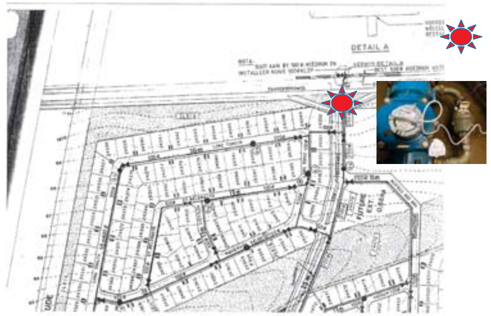
Metsimaholo DMA Selection 1/3

First candidate area:75 connections



Day time Flow volume almost "0"

The night time flow will be zero "0", and the step test and leak detection make no sense.

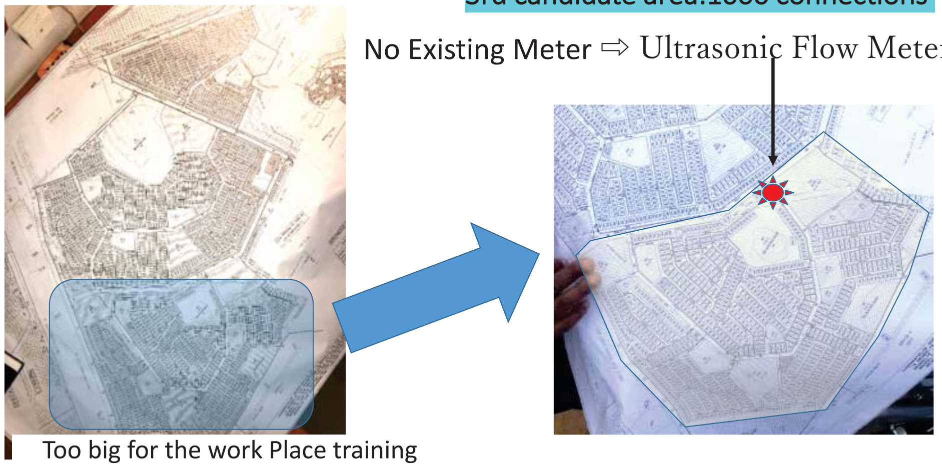
2nd candidate area:3000 connections

Too big for the work Place training

Metsimaholo DMA Selection 2/3

3rd candidate area:1000 connections

No Existing Meter ⇨ Ultrasonic Flow Meter



Too big for the work Place training

Metsimaholo DMA Selection 3/3

Check valve & fire hydrant location & valve movement

Found: One valve missing & One clockwise-open valve & Existing new valve

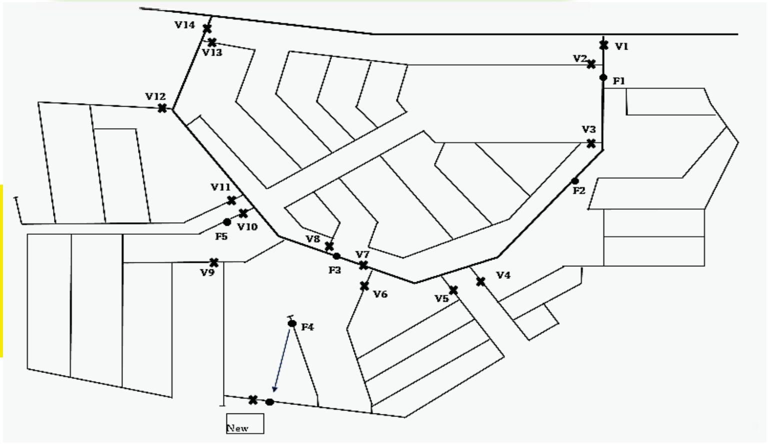
Check valve location & movement

Missing valve detection

Sub-sectorization & Drop test 1/2

Schematic Pipeline Drawing

Create piping diagram only for pipes to make subzone division easy to understand

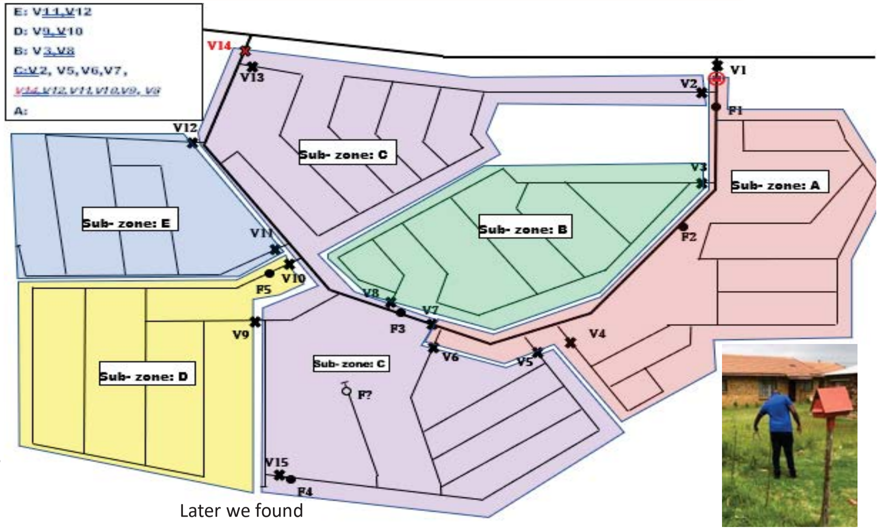


Sub-sectorization & Drop test 1/2

divide only with existing valves

5 sub-zones

[later found 6 zones were possible]

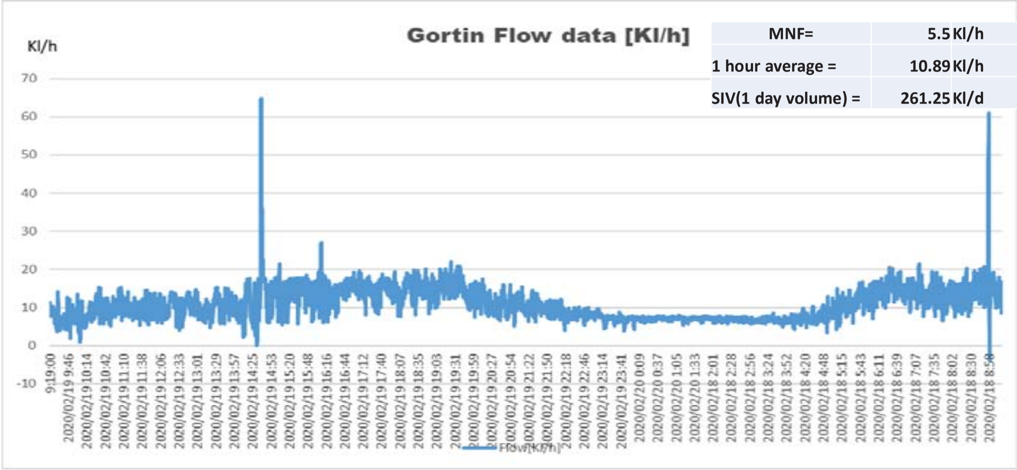


Later we found

UFM Installation

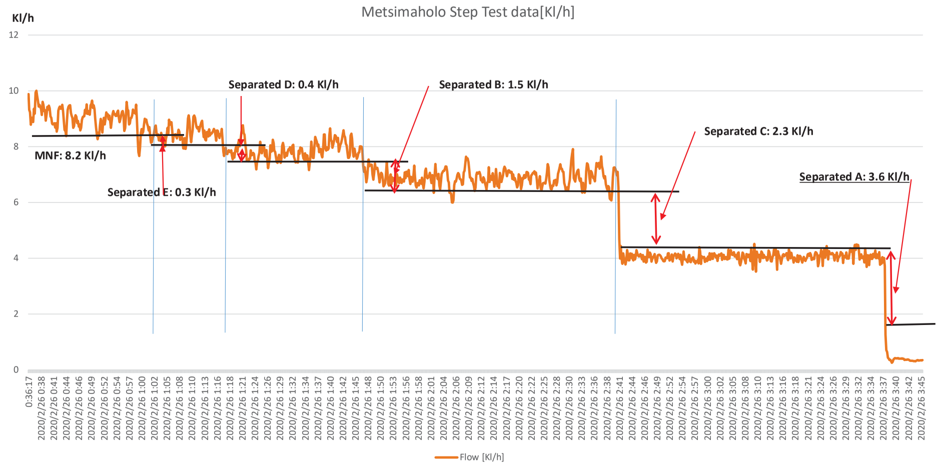
Digging/Installation /Protection

SIV & MNF Measurement



MNF=	5.5 Kl/h
1 hour average =	10.89 Kl/h
SIV(1 day volume) =	261.25 Kl/d

Step Test 1/2



Result of Step Test 2/2

Estimated water leakage [Including internal leak]						
Sub-zone	A	B	C	D	E	Total
No of Plots	240	177	381	169	120	1087
Deference volume Kl/h	3.6	1.5	2.3	0.4	0.3	8.1
Leakage volume/Plot	0.0150	0.0085	0.0060	0.0024	0.0025	
Priority	1	2	3	5	4	

Leak Detection 1/2

Target Are is Subzone -A

Flow of leak detection

- House to House survey
  - Listening rod & Electro listening rod

- Ground surface survey
  - Ground Microphone

Leak Detection 2/2

Leak detection

Target Sub-zone	A
No of Plots	240
No of Plots where Leak detection	82
Detected leak	20
Road surface	2
Leak (around the meters)	12
Internal leak	6

Equipment : listening rod, Electro listening rod, Ground microphone

*All leaks are visible

Billing Data 1/2

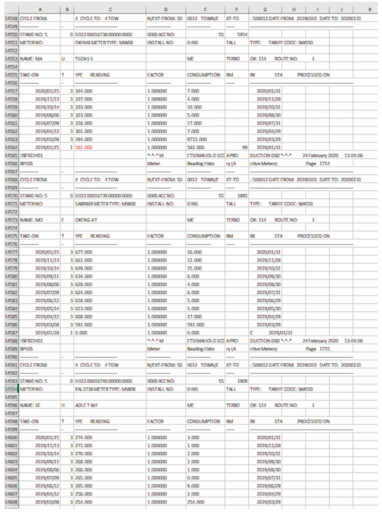
Meter reading

Meter Reader

Record note
Plot number & Reading figure.
In case it doesn't read, reason

Billing Data 1/2

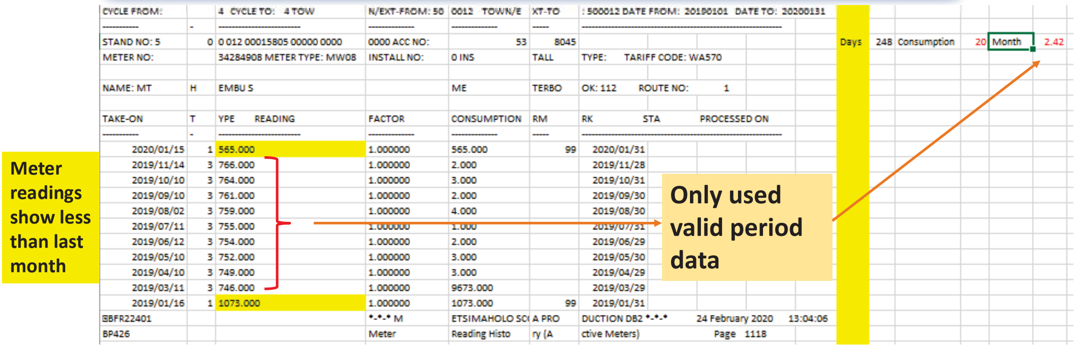
Meter reading record from Billing section



Billing Data Information

Area Name	Gortin
No. of connections	733
No. of connections not available for consumption calculation	88
Average consumption	139l/d/con
Average consumption (Exclude "0" customers)	156l/d/con

NRW [Base line]



Water balance Sheet[DMA:Gortin in Metsimaholo]

	Kl/day		Kl/day	%
SIV	261	Revenue: Billed (meter reading data)	101.7	39.0%
		NRW: 261-101.7=	159.3	61.0%

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CHALLENGES

- The initial area was too big, selected sub-zone and install ultrasonic flow meter.
- Valve 11 was buried, had to excavate to expose it.
- Valve 15 was not indicated on the map.
- Size of the valves differed, appropriate tools were not always available to open/close.
- Valve 6 opened anti-clockwise.
- Loadshedding disturbing the operation of the pumps which affected training activities scheduled for the day.
- State of the roads were extremely poor. Some areas were not accessible.
- Meter stop-cock are being used by consumers instead of their water taps.

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CHALLENGES cont…

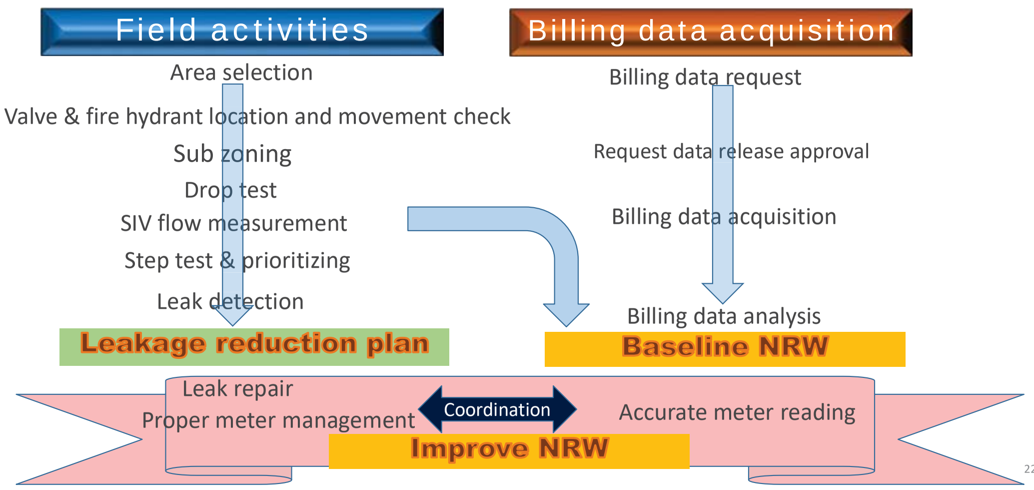
- Meter stop-cock are being used by consumers instead of their water taps.
- A number of meters were buried and readings could not be taken.
- Some meters are found inside the residents properly and not easily accessible for maintanence and readings.
- Billing data was a struggle to get. Received data after engaging the acting CFO in Week 2.
- According to the information provided the billing data was received for 733 connections out of 1074 plots in the DMA.
- Incorrect meter readings where captured resulting in inaccurate consumption readings.
- Technical team and billing section are currently working in silo's. No synergy between the two units.

20

LESSONS LEARNT

- Valves should be numbered to be easily identified, tested and maintained on a regular basis.
- Informal settlements should be metered.
- The Technical and Billing section should work together. When the meter readers pick up issues on the ground these should be reported to the Technical section and vice versa.
- There should be enough valves to be able to isolate the sub-zones.
- The existing meters are beyond their lifespan of 10 years and should be replaced.

Steps of Activities



LEAK REDUCTION ACTION PLAN

1. Report to Decision maker & Budget allocation.
2. Meter management
3. Billing Data Management
4. Distribution facility Management
5. Purchase of leak detection equipment and ultrasonic flow meter.
6. Awareness campaign to educate customers on amount of NRW and their role in reducing leaks.

CITY OF MBOMBELA

WORKPLACE TRAINING: HAZYVIEW

FINDINGS AND RECOMMENDATIONS

PRESENTATION LAYOUT

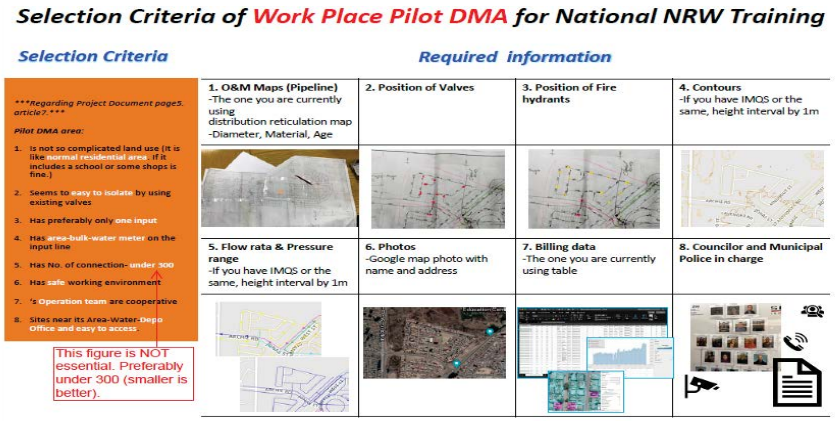
- BACKGROUND
- SELECTION OF DMA
- CHALLENGES
- FINDINGS
- RECOMMENDATIONS
- CONCLUSION

BACKGROUND

- Hazyview area is located 60KM North of Mbombela/Nelspruit
- Hazyview water supply system supplies three main areas: Town, Vakansiedorp and Numpipark
- Water supply system- Sabie River - WTW capacity 12ML produces 6 ML/d
- Population 4537 Household 1363
- Hazyview experience high levels Non Revenue Water 70%
- Suspicion consumption from private establishemnts in the areas of supply

Locality

Selection of DMA


Selection Criteria of Work Place Pilot DMA for National NRW Training

Selection Criteria

****Regarding Project Document page5. article7.****

Pilot DMA area:

1. Is not so complicated land use (It is like normal residential area. If it includes a school or some shops is fine.)
2. Seems to easy to isolate by using existing valves
3. Has preferably only one input
4. Has area-bulk-water meter on the input line
5. Has No. of connection- under 300
6. Has safe working environment
7. 's Operation team are cooperative
8. Sites near its Area-Water-Depo Office and easy to access.

This figure is NOT essential. Preferably under 300 (smaller is better).

Required information

1. O&M Maps (Pipeline) -The one you are currently using distribution reticulation map -Diameter, Material, Age	2. Position of Valves	3. Position of Fire hydrants	4. Contours -If you have IMQS or the same, height interval by 1m
5. Flow rata & Pressure range -If you have IMQS or the same, height interval by 1m	6. Photos -Google map photo with name and address	7. Billing data -The one you are currently using table	8. Councilor and Municipal Police in charge

Selection of DMA and Sub-Zoning

- Meeting was held to identify DMA on 5th Feb. and Kick-off on 11th Feb.

Selection of DMA and Sub-Zoning

DMA Status

- 86 Stands, 58 Occupied, 50 Customer Registration
- 7 Sub-zones (finally merged into 2)
- 12 Valves
- 1 DMA meter (newly installed)
- No Fire Hydrants

ZONE CONFIGURATION - 1

Process

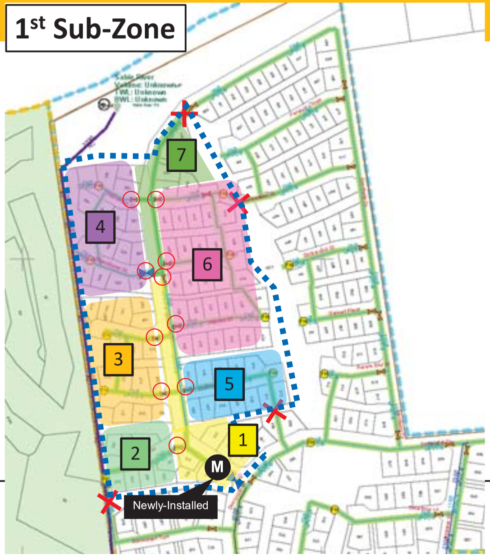
- Drawing check
- Interview to Site Officials/Workers

Findings

- Discrepancy between drawing and actual situation
  2 valves not on drawings
  4 non-connected pipelines (at least)
  No fire-hydrants at all

ZONE CONFIGURATION - 2

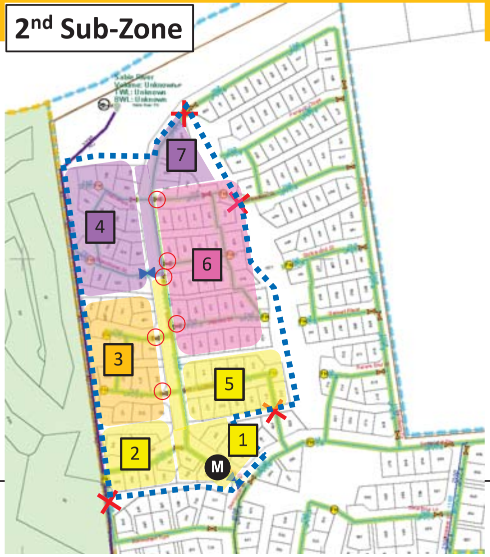
Process
- Designing a pilot DMA (“Goudsnip ”)
- New installation of a mechanical bulk flow meter (D100 mm, Precision Meters) at a inlet
- Original (1st) Sub-Zoning: 7



ZONE CONFIGURATION - 3

Process
- Site survey to check active houses
- Site survey to check valves and customer meters

Revision of Sub-Zoning from 7 to 4
1. Merged Zone 1&2&5 (Yellow)
2. Zone 3 (Orange)
3. Merged Zone 4&7 (Purple)
4. Zone 6 (Pink)

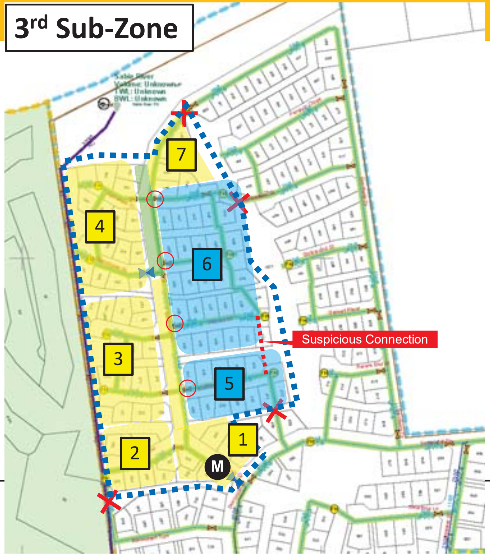


ZONE CONFIGURATION - 4

Process
- Drop Test (Zero Pressure Test)

Revision of Sub-Zoning from 4 to 2
1. Merged Zone 1&2&3&4&7 (Yellow)
2. Merged Zone 5&6 (Blue)

However, we did not reach to Step Test because we provisionally concluded main cause of NRW is commercial loss, not physical loss.



Customer Meter Check

Drop Test (Zero Pressure Test)

Selection and Installation of DMA Meter

System Input Volume

Bulk flow reading of installed DMA meter
183 kl -> 1,075 kl (892kl) in 10 days

-> SIV=89.2 kl/day

Billing Data of Selected identified DMA

Mbombela Pilot DMA (Hazyview)
Customer List

S/N	Active S/N	House No	Property Status	Meter	Street Name (Service Pipe from)	Sub-Zone (as of 13th Feb)	AADD [kL/d] Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	AVE
1		358	Merged to 362	-	Goudsnip	1	-	-	-	-	-	-	-	-	-	-	-	-	
2		359	Merged to 362	-	Goudsnip	1	-	-	-	-	-	-	-	-	-	-	-	-	
3	1	360		Meter	Goudsnip	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
4		361	Merged to 362	-	Bushoul Close	2	-	-	-	-	-	-	-	-	-	-	-	-	
5	2	362	7 properties	Not confirmed	Bushoul Close	2	12.80	14.26	16.48	-	21.17	6.71	6.69	3.73	0.67	0.67	0.68	0.69	7.687
6		363	Merged to 362	-	Bushoul Close	2	-	-	-	-	-	-	-	-	-	-	-	-	
7		364	Merged to 362	-	Bushoul Close	2	-	-	-	-	-	-	-	-	-	-	-	-	
8		365	Merged to 362	-	Bushoul Close	2	-	-	-	-	-	-	-	-	-	-	-	-	
9	3	366		Meter	Bushoul Close	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
10	4	367		Meter	Bushoul Close	2	0.47	0.46	0.49	0.49	0.51	0.23	0.22	0.16	0.11	0.09	0.09	0.14	0.288
11		368	Empty	-	Bushoul Close	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
12	5	369		Meter	Kuifkop (West)	3	0.26	0.34	0.48	0.57	0.57	0.68	0.76	0.85	0.68	0.63	0.58	0.49	0.574
13	6	370		Meter (Locked)	Kuifkop (West)	3	-	-	-	0.00	0.00	0.88	0.54	0.49	0.29	0.23	0.20	0.21	0.315
14	7	371		Meter	Kuifkop (West)	3	1.16	1.02	1.02	0.96	0.93	0.88	0.87	0.85	0.83	0.80	0.79	0.74	0.905
15		372	Empty	-	Kuifkop (West)	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
16		373	Empty	-	Kuifkop (West)	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
17	8	374		Meter (Locked)	Kuifkop (West)	3	0.81	0.81	0.82	0.82	0.81	0.74	0.81	0.79	0.76	0.77	0.75	0.80	0.790
18	9	375		Meter	Kuifkop (West)	3	0.58	0.56	0.59	0.61	0.64	0.61	0.58	0.56	0.62	0.63	0.67	0.70	0.614
19	10	376		Meter (Locked)	Pelican (West)	3	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.034
20	11	377		Meter	Pelican (West)	3	1.59	1.65	1.75	1.82	1.65	1.42	1.24	1.07	1.05	1.04	1.04	1.02	1.360
21		378	Empty	-	Pelican (West)	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
22	12	379		Meter (Locked)	Pelican (West)	3	0.29	0.31	0.32	0.25	0.19	0.18	0.19	0.19	0.19	0.18	0.21	0.20	0.224
23	13	380		Meter (Locked)	Pelican (West)	3	0.05	0.05	0.04	0.04	0.04	0.06	0.05	0.05	0.05	0.05	0.06	0.06	0.050
24		381	Empty		Pelican (West)	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
25	14	382		Not confirmed	Goudsnip	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
26	15	383		Meter	Goudsnip	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
27		384	Empty		Strandloper (West)	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
28	16	385		Meter (Locked)	Strandloper (West)	4	0.44	0.41	0.39	0.34	0.31	0.27	0.26	0.24	0.20	0.17	0.15	0.13	0.274
29	17	386		Meter	Strandloper (West)	4	0.51	0.50	0.51	0.53	0.53	0.48	0.54	0.54	0.55	0.56	0.58	0.61	0.536
30		387	Empty		Strandloper (West)	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
31		388	Empty		Strandloper (West)	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
32		389	Empty		Strandloper (West)	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
33		390	Empty		Strandloper (West) or Goudsnip	4 or 7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
34	18	391		Meter	Hamerkop (West) or Goudsnip	4 or 7	0.38	0.44	0.46	0.47	0.50	0.46	0.60	0.61	0.62	0.60	0.61	0.62	0.531
35	19	392		Meter	Hamerkop (West)	4	0.30	0.30	0.32	0.32	0.32	0.29	0.29	0.30	0.25	0.23	0.23	0.23	0.281
36		393	Empty		Hamerkop (West)	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
37	20	394		Meter (Locked)	Hamerkop (West)	4	0.63	0.63	0.60	0.56	0.55	0.53	0.52	0.51	0.51	0.51	0.50	0.50	0.545
38	21	395		Meter	Hamerkop (West)	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
39		396	Empty		Hamerkop (West) or Goudsnip	4 or 7	-	-	-	-	-	-	-	-	-	-	-	-	
40		397	Empty		Hamerkop (West) or Goudsnip	4 or 7	-	-	-	-	-	-	-	-	-	-	-	-	
41		403	Empty		Goudsnip or Stromvoel	1 or None	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
42	22	404		Meter (Locked)	Goudsnip	1	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
43	23	405		Meter	Goudsnip	1	1.96	1.82	1.72	1.63	1.49	1.42	1.35	1.34	0.89	0.81	0.64	0.53	1.301
44	24	406		Meter	Goudsnip	1	1.62	2.37	0.00	3.20	3.20	1.12	0.96	0.74	0.44	0.54	0.94	1.19	1.361
45	25	407		Meter	Kuifkop (East)	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
46		408	Empty		Kuifkop (East)	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
47		409	Empty		Kuifkop (East)	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
48	26	410		Meter	Kuifkop (East)	5	0.26	0.26	0.30	0.24	0.26	0.36	0.40	0.43	0.35	0.41	0.41	0.43	0.341
49	27	411		Meter	Kuifkop (East)	5	0.25	0.26	0.29	0.31	0.32	0.32	0.33	0.30	0.30	0.31	0.31	0.31	0.300
50	28	412		Meter	Kuifkop (East)	5	0.22	0.21	0.22	0.24	0.24	0.24	0.24	0.24	0.25	0.26	0.26	0.29	0.242
51		413	Empty		Kuifkop (East)	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
52	29	414		Meter	Kuifkop (East)	5	1.53	1.52	1.55	1.58	1.58	1.48	1.41	1.38	1.33	1.31	1.24	1.20	1.425
53	30	415		Meter	Kuifkop (East)	5	0.31	0.32	0.34	0.33	0.34	0.32	0.35	0.32	0.30	0.29	0.26	0.25	0.312
[illegible]	31	416		Meter (Locked)	Kuifkop (East)	5	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.063
[illegible]		417	Empty		Goudsnip or Kuifkop (East)	1 or 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	[illegible]	[illegible]	0.000
[illegible]		418	Empty		Goudsnip or Pelican (East)	1 or 6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	[illegible]	[illegible]	0.000
[illegible]	[illegible]	419		Meter	Pelican (East)	6	0.25	0.24	0.22	0.20	0.18	0.18	0.18	0.16	0.18	[illegible]	[illegible]	[illegible]	0.202
[illegible]	[illegible]	420		Meter	Pelican (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	[illegible]	[illegible]	0.000
[illegible]	[illegible]	421		Meter	Pelican (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	[illegible]	[illegible]	0.031
[illegible]	[illegible]	422	?	?	Pelican (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	[illegible]	[illegible]	0.000
[illegible]	[illegible]	423	?	?	Pelican (East)	6	0.00	0.00	0.00	0.00	0.00	0.50	0.51	0.61	0.68	[illegible]	[illegible]	[illegible]	0.411
[illegible]		424	Empty		Pelican (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	[illegible]	[illegible]	0.000

Billing Data of Selected identified DMA…

Mbombela Pilot DMA (Hazyview)
Customer List

S/N	Active S/N	House No	Property Status	Meter	Street Name (Service Pipe from)	Sub-Zone (as of 13th Feb)	AADD [kL/d] Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	AVE
63	37	425	?	?	Pelican (East)	6	0.73	0.81	0.93	0.86	0.90	0.86	0.89	0.86	0.93	0.90	0.90	0.91	0.873
64	38	426		Meter	Pelican (East)	6	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.07	0.07	0.07	0.06	0.07	0.063
65		427	Empty		Pelican (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
66		428	Empty		Pelican (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
67		429	Empty		Pelican (East) or Goudsnip	6 or 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
68	39	430		Meter	Strandloper (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
69	40	431		Meter	Strandloper (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
70	41	432	?	?	Strandloper (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
71	42	433		Meter	Strandloper (East)	6	0.30	0.31	0.32	0.25	0.24	0.22	0.20	0.18	0.16	0.15	0.12	0.11	0.212
72	43	434	?	?	Strandloper (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
73	44	435	?	?	Strandloper (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
74		436	Empty		Strandloper (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
75	45	437		Meter	Strandloper (East)	6	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.011
76	46	438		Meter	Strandloper (East)	6	0.27	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.041
77	47	439		Meter	Strandloper (East)	6	1.25	1.09	0.94	0.84	0.78	0.69	0.63	0.60	0.53	0.44	0.40	0.35	0.712
78	48	440	3 properties	Meter	Goudsnip (North)	7	8.60	8.64	8.60	8.94	8.26	7.15	6.29	5.73	5.07	5.03	4.68	3.43	6.702
79		441	Merged to 440		Hamerkop (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
80		442	Merged to 440		Hamerkop (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
81		443	Empty		Hamerkop (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
82		444	Empty		Hamerkop (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
83		445	Merged to 446		Hamerkop (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
84	49	446	2 properties	Meter 1	Hamerkop (East)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
85		447	In 446	Meter 2	Goudsnip (North)	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
86	50	448	2 properties	Meter	Goudsnip (North)	7	0.07	0.07	0.29	0.09	0.11	0.09	0.15	0.20	0.19	0.20	0.21	0.23	0.160
87		449	Merged to 448		Goudsnip (North)	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							39.82	41.72	41.78	26.67	48.44	31.20	29.34	26.05	21.08	21.01	20.69	19.64	31.54

From billing data, 25 to 30 houses are suspicious about billing (including meter malfunction)

Revenue Water and NRW

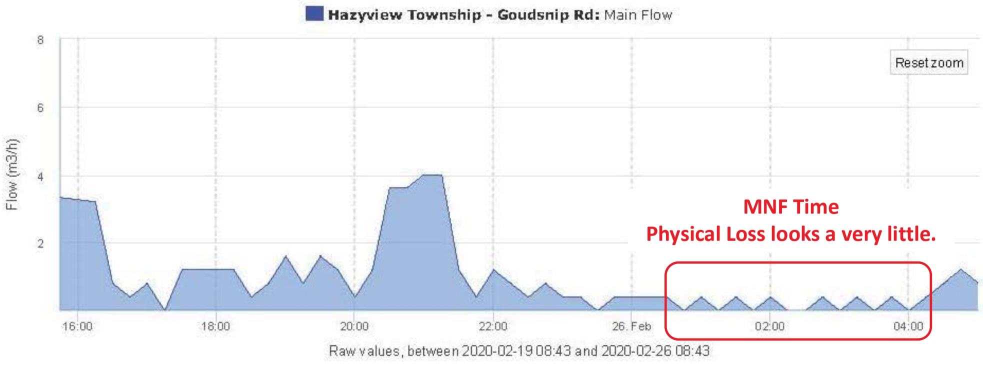
SIV=89.2 kl/day

Billed Consumption from Billing Data (Revenue Water) = 31.54kl/day

NRW = 89.2 – 31.54 = 57.66 kl/day
NRW Ratio = 57.66 / 89.2 = 65%

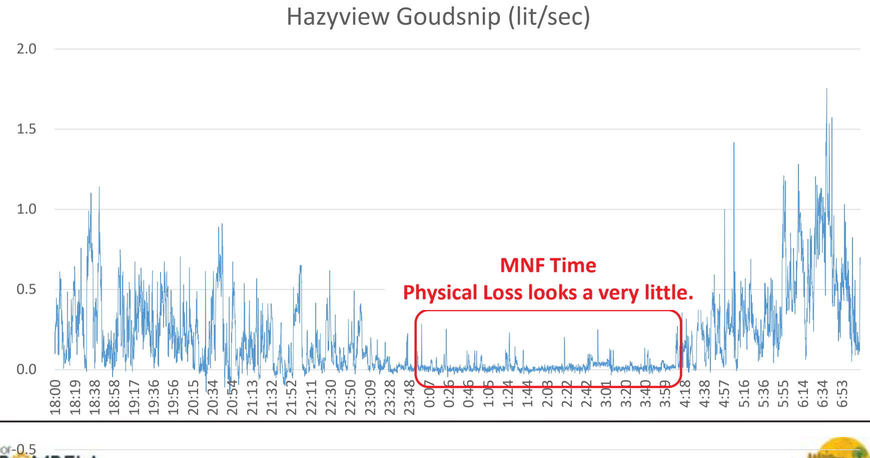
Data Logging MNF Measurement (by UFM)

Data Logging Results



15 minutes interval at 100 lit/pulse output

Minimum Night Flow (MNF) by Ultrasonic Flow Meter



CHALLENGES

- Lack of Vehicles from the municipality
- Unconducive weather conditions (Flooding the meter)
- Suitable DMA meter
- Theft
- Unavailability of valves and major water fittings (buried)

FINDINGS

Billing Information

- Zero consumption consumers
- Locked meters for some consumers

Baseline Information

- The information on the drawing was not corresponding with the one on the ground
- Inaccurate meter readings
- 65% of NRW
- Priority: Commercial loss
- Enough support from Management and the support groups.

RECOMMENDATIONS

- Technical team to meet with finance office to clarify the roles.
- Monitoring of meter readers
- Officials to be trained on how to the log the meter.
- Procurement process should include technical expects for specifications
- Technical staff should also be part of the receiving to confirm the delivery against the specification and ensure that the equipments are in working condition.

CONCLUSION

- Escalate this report to top management
- To identify other DMAs and proceed with the same exercise
- Expand to other regions
- **Put more attention on Commercial losses: Cost benefit**

✓ Replacement of 30 meters R18 000 @ R600 per meter

✓ Benefit/Gains R19 071 @ R 21.19/KL per month

OUR TEAM

Facilitator (City of Mbombela)

Mr. Koena Moabelo

Learners (City of Mbombela, Hazyview)

Mr. Elvis Shabalala

Mr. Nichol Nkata

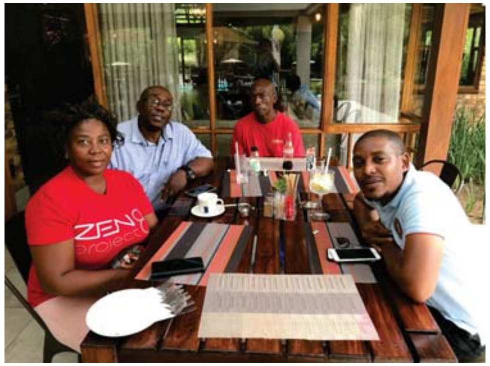
DWS Coordinators

Ms. Rosa Mfomadi-Rahube

Mr. Vincent Monene

JICA Advisor/Partner

Mr. Akinori Miyoshi



添付資料 13

引き渡し式典の資料

Official Handover and Opening of the Training Programme of Non-Revenue Water Management

Venue: IBTC, Roodeplaat Dam

Time & Date: 10h00, 22nd March 2021

PROGRAMME AND HANDOUT

See the attachment.

MEDIA

SABC News

- Minister Sisulu receives training centre for water management from the Japanese Embassy
  https://www.youtube.com/watch?v=IABb3_UJk64
- Japanese Embassy hands over a training centre for non-revenue water management in South Africa
  https://www.youtube.com/watch?v=QAS-O1eKvpI

South African Government

- Japan hands over the Roodeplaat Training Centre training centre to Minister Lindiwe Sisulu
  https://www.gov.za/speeches/japan-hands-over-roodeplaat-training-centre-training-centre-minister-lindiwe-sisulu-22-mar#

South African Government News Agency

- Japan hands over water training centre to SA
  https://www.sanews.gov.za/south-africa/japan-hands-over-water-training-centre-sa

Sunday World

- Japan hands over water training centre to SA
  https://sundayworld.co.za/breaking-news/japan-hands-over-water-training-centre-to-sa/

Engineering News

- Japan hands over training centre to South Africa to bolster water sector
  https://www.engineeringnews.co.za/article/japan-hands-over-a-water-training-centre-to-south-africa-2021-03-24/searchString

Ceremony Reception

Branding

High Table

Ceremony Venue

Unveiling Ceremony

Unveiling Ceremony

Project Board

Livestreaming

PROGRAMME

OFFICIAL HANDOVER AND OPENING OF THE TRAINING PROGRAMME ON NON-REVENUE WATER MANAGEMENT

VENUE: IBTC, ROODEPLAAT DAM - DATE: 22 MARCH 2021 - TIME: 10:00

training for the future

INFRASTRUCTURE BRANCH IBTC TRAINING CENTRE

PART A: HOLDING ROOM MEET & GREET AND MEDIA INTERVIEWS

TIME	ITEMS
09:45	Arrival of H.E. Minister Sisulu and conducted to the Holding Room
09:46	Arrival of H.E. Ambassador Maruyama Norio and conducted to the Holding Room
09:47	Minister Sisulu and Ambassador Maruyama meet and greet in Minister Sisulu's Holding Room
09:55	Minister Sisulu and Ambassador Maruyama are conducted to the Mobile Studio for the Media Interviews

PART B: BANQUET HALL OPENING CEREMONY

Time: 10:00 – 11:50

Programme Director: Deputy Minister of Water & Sanitation, Mr David Mahlobo

TIME	ITEMS	RESPONSIBLE PERSON
09:00–09:55	Arrival of Guests and Dignitaries	All
10:00–10:05	Opening & Introduction of Guests	Programme Director
10:00–10:08	Training Centre Safety Induction	Ms Mfomadi-Rahube Rosa
10:08–10:15	Welcome Remarks	MMC for Infrastructure: The City of Tshwane Metro: Cllr Phillip Nel
10:15–10:25	Overview of the RSA – Japan Technical Co-operation on Non Revenue Water Management	DWS DDG: International Water Co-operation, Ms Lindiwe Lusenga
10:25–10:30	Words of Appreciation by the JICA Programme Beneficiary Learner	Umgungundlovu District Municipality Beneficiary, Mr Jabulani Dlamini
10:30–10:40	Remarks by Japan International Co-operation Agency	JICA Chief Representative Mr Seki Tomohiro
10:40-10:50	Remarks by South African Local Government Association	SALGA President: Cllr Thembi Nkadimeng
10:50–11:05	Remarks by the Japanese Government	H.E. Ambassador Maruyama Norio
11:05–11:15	Virtual Remarks by Minister of Co-operative Government & Traditional Affairs	Dr Nkosazana Dlamini-Zuma
11:15–11:35	**Key Note Address**	**Minister of Human Settlements, Water & Sanitation, Ms Lindiwe Sisulu**
11:35–11:50	Guided Tour of the Training Centre led by DWS: Acting DDG Infrastructure, Mr Leornado Manus	Minister Sisulu, Ambassador Maruyama & Delegation

WATER IS LIFE - SANITATION IS DIGNITY

water & sanitation
Department: Water and Sanitation
REPUBLIC OF SOUTH AFRICA

NDP 2030

SOUTH AFRICAN LOCAL GOVERNMENT ASSOCIATION SALGA Inspiring service delivery

JICA Japan International Cooperation Agency

PART C: TRAINING YARD
UNVEILING AND HANDOVER CEREMONY

Time: 12:00 – 12:35

Programme Director: Deputy Minister Mahlobo

TIME	ITEMS	RESPONSIBLE PERSON
12:00–12:05	**Unveiling of the Plaque**	**Minister Sisulu & Ambassador Maruyama**
12:05–12:10	Handover of the Training Yard Equipment to Minister Sisulu	H.E. Ambassador Maruyama
12:10-12:15	Response by The Minister	Minister Sisulu
12:15–12:20	Demonstration of the Water Infrastructure Model	Mr Armand Basson assisted by the Beneficiary Learners
12:20–12:25	Interaction with the Beneficiary Learners	Ministers, Ambassador, SALGA President & MMC
12:25–12:30	Photo Opportunity with the Beneficiary Learners	Ministers, Ambassador, SALGA President & MMC
12:30–12:35	Media Door Stop	Minister Sisulu
12:35	Lunch & Departure	All

THE PROJECT FOR STRENGTHENING THE TRAINING CAPACITY OF IBTC ON NRW

- A national challenge in SA water sector: **Securing water resources**
- A solution: **Reduction** of **Non-Revenue Water (NRW)** at currently 40%.
- However, **NRW management practitioners** are **insufficient**.

➡ Technical Cooperation Project from August 2017 to March 2021.

The National NRW Training with a key concept "By Municipalities for Municipalities"

Our Partners
(Facilitators, training development and Implementation)

Achievement

- Baseline survey
- Benchmark trips to Japan (twice for 26 officials)
- Training business plan
- Standard operating procedures (SOPs)
- Sustainability plan and Steering Com.
- Training programme
- Textbook & teaching/learning materials
- Training yard construction
- Training equipment procurement
- Training (10 beneficiary munics. Approx. 50 learners)

Under COVID-19 Situation

- Development of online training (knowledge)
- SALGA-JWWA Joint Webinars on Water Supply (1,000 participants)

JWWA: JAPAN WATER WORKS ASSOCIATION

Developed Modules (Knowledge, Practical and Workplace)

Beneficiary Municipalities: Mogale City LM, Mopani DM, uMgungundlovu DM, JB Marks LM, King Cetsiwayo DM, Mbombela LM, Metsimaholo LM, Amathole DM, Ekurhuleni Metro, Saldanha Bay LM