S13.3-13 INTENSIVE LECTURE ON GIS

Geographic

Map

GPS (Location)
[GIS Sub Team]

+

Information

Attribute

including
Water Supply Facility information
[NRW Action Team],
and
Customer Information
[Customer Service Sub Team]

System

store
in a computer

Collect Data

Combination and Accumulation

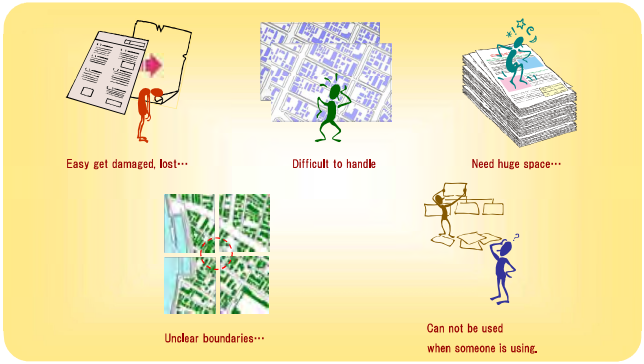
GIS Database

Data Utilization

1

Why is GIS convenient?

- It is possible to use paper maps. But …

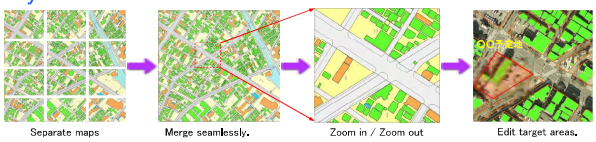


2

Why is GIS convenient?

- Before…

- If you use the GIS…



3

Why is GIS convenient?

- Before…

- If you use the GIS…

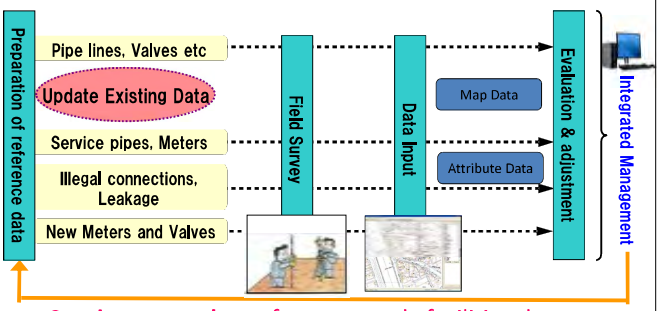
4

What are advantages?

You will be able to widely share a variety of information by using the GIS.

5

Workflow of data management



Continuous update of water supply facilities data

7

Purpose of the GIS Database

1 Management of Water Supply Facilities information

2 Improvement and optimization of operation & maintenance

3 Effective work procedures
→ Reduction of cost and time

Improvement of management

To Achieve the purposes

It is essential to construct appropriate water supply GIS Database which can be used sustainably.

6

Utilization of GIS Database

Case-1	Case-2	Case-3	Case-4
Basic functions / Search by Attribute data	Water rationing simulation	Link to other systems 1	Link to other systems 2
Zoom in/out and pan	Select Water rationing area	GIS Database	GIS Database
Layer on/off Calculate Length / Areas	Water rationing simulation	Pipe network analysis system	Printout through CS database
Search by Attribute data	Create the notices for the customers	Water pressure management	Settlement of bills

☑ **In the field of water supply facility management, the GIS is very useful !!**

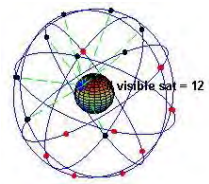
8

What is GPS?

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States government and is freely accessible to anyone with a GPS receiver. Initially it was for military use. GPS is well known throughout the world.

Also, a more recent development, Global Navigation Satellite Systems (GNSS) is now familiar for its many applications in daily life, such as car navigation, ship navigation, aircraft navigation and surveying. The GNSS uses many positioning satellites such as GPS (USA), GALILEO (EU), GLONASS (Russia), and Quasi-Zenith Satellite 'MICHIBIKI' (Japan).

*By we receive signals from several satellites in the sky, we can know about our current location.



[Unit]

*WGS84 is a standard coordinate system around the world.

*The GPS log data is recorded that based on the WGS84 coordinate system.

*Latitude and longitude use, "Degree, minute, and second" to the unit, but we will use the "m" unit in NRW project.

*We use UTM_zone57_South.

[Key Points for the observation]

*Charging condition

:Fully charged before observation.

*Turn on the device in advance before the start of observation

:The GPS are left in place can be received at least 20-30 minutes , before you start the real observation. Or please start the observed already after starting to receive. (Such as the car moving.)

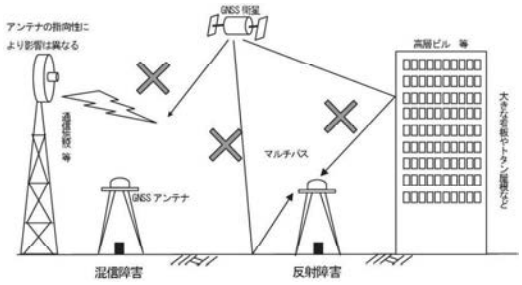
: GPS accuracy, the receiver sensitivity is improved in proportion to the time we receive communication measure.

: Reception status of the observation of the day, whether or not this work is closely related to the productivity.

: Keep horizontal.

Measurement conditions depend on some factors such as number of satellites, distance to the satellites, and buildings or trees that may obstruct the GPS signal.

<Multipath>

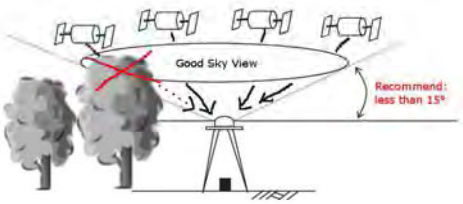


Multipath results when the direct path to your receiver is blocked (by your body, your house, roof, trees, mountains, tall buildings, etc.) and the signal from the satellite is REFLECTED by some object. The reflecting surface may be: buildings, mountains, the ground, or any object that happens to be a radio reflector at 1.6 GHz.

If your GPS does not have a clear sky view* then multipath errors are possible, even likely. These multipath errors can often cause both position and speed "spikes" on any consumer GPS receiver. EVEN IF you have a clear sky view, multipath is possible, but the possibility of multipath errors are at least minimized with a clear sky view since it is probable that the GPS will have more than the minimum 4 satellites in view and can perhaps throw out the "bad" measurements. NOTHING here should be construed to suggest that a "clear sky view" will always eliminate multipath or position or speed excursions under all circumstances. These multipath errors are just the nature of the technology at this point.

* A clear sky view means that the GPS can see in roughly a hemisphere of clear sky. That is: Your GPS antenna is unobstructed in ALL directions. For these reasons, an amplified external GPS antenna accessory may be desirable in a particular situation. Putting your GPS (or your GPS antenna) on your hat is a proven method to IMPROVE performance in difficult areas. But! Difficult areas are by definition difficult. You will not be disappointed if you expect to have large excursions in speed/distance/tracklog measurements in situations where multipath exists.

<Cycle slip>



The loss of signals between a GPS satellite and the receiver.

A discontinuity of an integer number of cycles in the measured (integrated) carrier phase resulting from a temporary loss-of-lock in the carrier tracking loop of a GPS receiver. This corrupts the carrier phase measurement, causing the unknown Ambiguity value to be different after the cycle slip compared with its value before the slip. It must be "repaired" (the unknown number of "missing" cycles determined and the carrier observation subsequent to the cycle slip all corrected by this amount) before the phase data is processed in double-difference observable for GPS Surveying techniques.

<Distance>

GPS satellites go around the altitude of about 20,000 km.

Since the layer of the atmosphere about 60 ~ 100 km above ground is charged with electricity, it delays the passage of the satellite signals.

S13.3-14 INTENSIVE LECTURE ON NRW

GENERAL

Review of NRW Reduction Activities

- To put it simply, Non Revenue Water (NRW) is …
- How has SW been affected by NRW in water services of Honiara City?
- Water Audit is for …

1

Revenue Water or Non Revenue Water ? (Honiara Case)

	Items	RW/NRW	Countermeasures
1	Consumption by "Registered metered customers with functioning meter"		
2	Consumption by "Registered unmetered/DL customers (up to 32m3/month)"		
3	Consumption by "Registered unmetered/DL customers (above 32m3/month)"		
4	Consumption by "Unregistered users taking water from transmission main distribution network"		
5	Consumption by "Unregistered users taking water from service pipeline to registered metered customers (before water meter)"		
6	Consumption by "Unregistered users taking water from service pipeline to registered metered customers (after water meter)"		
7	Consumption by "Unregistered users fetching water from registered metered customers (by bucket, etc)"		
8	Consumption by "Unregistered users taking water from service pipeline to registered unmetered/DL customers"		
9	Consumption by "Unregistered users fetching water from registered unmetered/DL customers (by bucket, etc)"		
10	Water for fire fighting		
11	Insensible water by meter inaccuracy (registered metered customers)		
12	Overflow from reservoirs		
13	Drainage water from reservoirs and drain valves along transmission mains and distribution networks		
14	Water leakage on transmission mains and distribution networks		
15	Water leakage on service pipelines (metered customer, before water meter)		
16	Water leakage on service pipelines (metered customer, after water meter)		
17	Water leakage on service pipelines (unmetered/DL customer, outside premises)		
18	Water leakage on service pipelines (unmetered/DL customer, inside premises)		
19	Water leakage at bathrooms or kitchen of registered metered customers		
20	Water leakage at bathrooms or kitchen of registered unmetered/DL customers		

3

Water Audit and Terminology

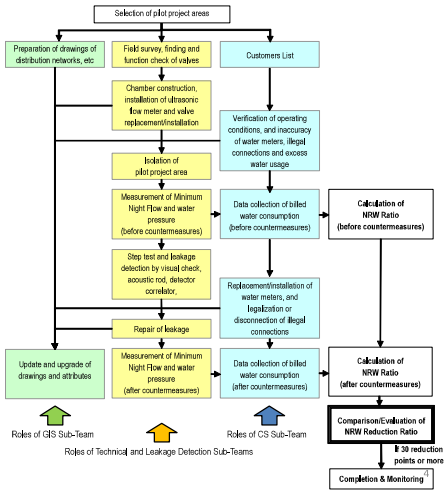
System input volume	Authorized consumption	Billed authorized consumption	Billed metered consumption	RW
			Billed unmetered consumption	
		Unbilled authorized consumption	Unbilled metered consumption	NRW
			Unbilled unmetered consumption	
	Water losses	Apparent losses	Unauthorized consumption	
			Customer metering inaccuracies	
			Data handling errors	
		Real losses	Leakage on transmission mains and/or distribution mains	
			Leakage and overflows at utility's storage tanks	
			Leakage on service connections up to customer metering points	

Apparent Losses – are the "paper" losses that occur in utility operations due to customer meter inaccuracies, billing system data errors and unauthorized consumption. In other words, this is water that is consumed but is not properly measured, accounted or paid for. These losses cost utilities revenue and distort data on customer consumption patterns.

Real Losses – are the physical losses of water from the distribution system, including leakage and storage overflows. These losses inflate the water utility's production costs and stress water resources since they represent water that is extracted and treated, yet never reaches beneficial use.

2

Flow of Pilot Project Implementation



4

	Items		Items in Connection Identification under Pilot Project	
1	Consumption by "Registered metered customers with functioning meter"	RW	Registered Metered	A
2	Consumption by "Registered unmetered/DL customers (up to 32m3/month)"	RW	Registered Unmetered/DL	B
3	Consumption by "Registered unmetered/DL customers (above 32m3/month)"	NRW	Real Loss, or Open-end/Excess by Registered Unmetered DL if measured	H or C
4	Consumption by "Unregistered users taking water from transmission main distribution network"	NRW	Unregistered Direct Open-end or Unregistered Direct Closed-end	D or E
5	Consumption by "Unregistered users taking water from service pipelaue to registered metered customers (before water meter)"	NRW	Unregistered Direct Open-end or Unregistered Direct Closed-end	D or E
6	Consumption by "Unregistered users taking water from service pipeline to registered metered customers (after water meter)"	RW		
7	Consumption by "Unregistered users fetching water from registered metered customers (by bucket, etc)"	RW		
8	Consumption by "Unregistered users taking water from service pipeline to registered unmetered DL customers"	NRW	Unregistered Direct Open-end or Unregistered Direct Closed-end	D or E
9	Consumption by "Unregistered users fetching water from registered unmetered/DL customers (by bucket, etc)"	NRW	Unregistered Indirect/Parasite	F
10	Water for fire fighting	NRW		
11	Insensible water by meter inaccuracy (registered metered customers)	NRW	Meter Inaccuracy	G
12	Overflow from reservoirs	NRW		
13	Drainage water from reservoirs and drain valves along transmission mains and distribution networks	NRW		
14	Water leakage on transmission mains and distribution networks	NRW	Real Loss	H
15	Water leakage on service pipelines (metered customer, before water meter)	NRW	Real Loss	H
16	Water leakage on service pipelines (metered customer, after water meter)	RW		
17	Water leakage on service pipelines (unmetered/DL customer, outside premises)	NRW	Real Loss	H
18	Water leakage on service pipelines (unmetered/DL customer, inside premises)	NRW	Real Loss	H
19	Water leakage at bathrooms or kitchen of registered metered customers	RW		
20	Water leakage at bathrooms or kitchen of registered unmetered/DL customers	NRW	Real Loss	H

5

Before Countermeasures

Connection Identification and Water Use Classification

Category of connection and other items				HH	Q (m3/d)
Registered	Metered		A		
	Unmetered/DL		B		
		Open-end/Excess only	C	( )	
Unregistered (Illegal)	Direct	Open-end	D		
		Closed-end	E		
	Indirect/Parasite	Closed-end	F		
Meter Inaccuracy			G		
Real Loss	Leakage, etc.		H		
Unconnection			I		
Total Households and System Input Volume (SIV)				100	150

Water Audit

Component				Q (m3/d)	Proportion (%)
RW	Billed Authorized Consumption	Metered	A		
		Unmetered/DL	B		
NRW	Unbilled Authorized Consumption	Metered			
		Unmetered/DL (Excess)	C		
	Apparent Losses	Unauthorized Cons. (Illegal) Closed-end	E+F		
		Unauthorized Cons. (Illegal) Open-end	D		
		Meter Inacc. Meter inaccuracy	G		
	Real Losses	Leakage, etc.	H		
System Input Volume (SIV)				150	100.0%

6

After Countermeasures

Connection Identification and Water Use Classification

Category of connection and other items				HH	Q (m3/d)
Registered	Metered		A		
	Unmetered/DL		B		
		Open-end/Excess only	C	( )	
Unregistered (Illegal)	Direct	Open-end	D		
		Closed-end	E		
	Indirect/Parasite	Closed-end	F		
Meter Inaccuracy			G		
Real Loss	Undetected leakage, undetected illegal connections		H		
Unconnection			I		
Total Households and System Input Volume (SIV)				100	100

Water Audit

Component				Q (m3/d)	Proportion (%)
RW	Billed Authorized Consumption	Metered	A		
		Unmetered/DL	B		
NRW	Unbilled Authorized Consumption	Metered			
		Unmetered/DL (Excess)	C		
	Apparent Losses	Unauthorized Cons. (Illegal) Closed-end	E F		
		Unauthorized Cons. (Illegal) Open-end	D		
		Meter Inacc. Meter inaccuracy	G		
	Real Losses	Undetected leakages, undetected illegal conn.	H		
System Input Volume (SIV)				150	100.0%

7

	Items		Items in Connection Identification under Pilot Project	
1	Consumption by "Registered metered customers with functioning meter"	RW	Registered Metered	A
2	Consumption by "Registered unmetered/DL customers (up to 32m3/month)"	RW	Registered Unmetered/DL	B
3	Consumption by "Registered unmetered/DL customers (above 32m3/month)"	NRW	Real Loss, or Open-end/Excess by Registered Unmetered/DL, if measured	H or C
4	Consumption by "Unregistered users taking water from transmission main distribution network".	NRW	Unregistered Direct Open-end or Unregistered Direct Closed-end	D or E
5	Consumption by "Unregistered users taking water from service pipeline to registered metered customers (before water meter)".	NRW	Unregistered Direct Open-end or Unregistered Direct Closed-end	D or E
6	Consumption by "Unregistered users taking water from service pipeline to registered metered customers (after water meter)"	RW		
7	Consumption by "Unregistered users fetching water from registered metered customers (by bucket, etc)"	RW		
8	Consumption by "Unregistered users taking water from service pipeline to registered unmetered/DL customers"	NRW	Unregistered Direct Open-end or Unregistered Direct Closed-end	D or E
9	Consumption by "Unregistered users fetching water from registered unmetered/DL customers (by bucket, etc)"	NRW	Unregistered Indirect/Parasite	F
10	Water for fire fighting	NRW		
11	Insensible water by meter inaccuracy (registered metered customers)	NRW	Meter Inaccuracy	G
12	Overflow from reservoirs	NRW		
13	Drainage water from reservoirs and drain valves along transmission mains and distribution networks	NRW		
14	Water leakage on transmission mains and distribution networks	NRW	Real Loss	H
15	Water leakage on service pipelines (metered customer, before water meter)	NRW	Real Loss	H
16	Water leakage on service pipelines (metered customer, after water meter)	RW		
17	Water leakage on service pipelines (unmetered/DL customer, outside premises)	NRW	Real Loss	H
18	Water leakage on service pipelines (unmetered/DL customer, inside premises)	NRW	Real Loss	H
19	Water leakage at bathrooms or kitchen of registered metered customers	RW		
20	Water leakage at bathrooms or kitchen of registered unmetered/DL customers	NRW	Real Loss	H

Before Countermeasures

Connection Identification and Water Use Clarification

Category of connection and other items				HH	Q (m3/d)
Registered	Metered		A		
	Unmetered/DL		B		
		Open-end/Excess only	C	( )	
Unregistered (Illegal)	Direct	Open-end	D		
		Closed-end	E		
	Indirect/Parasite	Closed-end	F		
Meter Inaccuracy			G		
Real Loss	Leakage, etc.		H		
Unconnection			I		
Total Households and System Input Volume (SIV)				**100**	**150**

Meter Inaccuracy (H) = A/(100%-Inaccuracy ratio)-A

Re-classification

Water Audit

Component				Q (m3/d)	Proportion (%)
RW	Billed Authorized Consumption	Metered	A		
		Unmetered/DL	B		
NRW	Unbilled Authorized Consumption	Metered			
		Unmetered/DL (Excess)	C		
	Apparent Losses: Unauthorized Cons. (Illegal)	Closed-end	E+F		
		Open-end	D		
	Apparent Losses: Meter Inacc.	Meter inaccuracy	G		
	Real Losses	Leakage, etc.	H		
System Input Volume (SIV)				**150**	**100.0%**

Meter Inaccuracy (H) = A/(100%-Inaccuracy ratio)-A

Exercise of Water Audit

Under the assumptions and conditions below, fill in the blanks in Water Audit tables on the follow pages 5&6.

Assumptions

- All metered consumption and unmetered/DL consumption (**32** m3 per month) are billed.
- An unmetered/DL customer consumes **1.06** m3 per day, which comes from **32** m3 per month as a standard.
- An unregistered user (closed-end) including parasite consumes **1.06** m3 per day too, same as the above.

Conditions (before countermeasures)

- In an isolated area, there are **100** houses (households:HHs) in total, including vacant and diconnected houses, of which registered metered customers are **50** households and registered unmetered/DL customers are **20** households.
- SW installed a flow meter at the inlet pipe to the isolated area and then measured MNF and 24 hours flow volume. Meanwhile, SW read all water meters of registered metered customers in the beginning and the end to measure consumption. As a result, the 24hrs flow volume into the isolated area was **150** m3, and the total registerd metered consumption of **50** households was **70** m3.
- In the field survey or visible leakage detection survey, SW found **two** of registered unmetered/DL customers have used the open-end service pipeline, at which water looks runinng for 24 hours. SW measured them mannualy and estmated it at **5.06** m3 and **7.06** m3 each per day.
- SW found that **seven** unregistered water users (households) have taken water directly through illegal pipe connection to distribution network, of which **one** has used the open-end pipe connection same as above. SW measured it mannualy and estimated it at **5** m3 per day.
- Moreover, as parasite users, SW found that **six** unregisterd water users (households) have got water routinely from registerd metered customers and also **four** from registered unmetered/DL customers.
- SW tested the inaccuracy of existing **50** water meters, and then calculated the average as **20** %.

Countermeasures

- SW detected leakages and repaired them.
- Against unregistered water users (illegals), SW legalized **five** households and disconnected **six** households.
- SW installed new water meters for all registered unmetered/DL customers and newly-registered (legalized) customers, and replaced inaccurate water meters of registered metered customers by new ones.

Conditions (after countermeasures)

- In an isolated area, there are still **100** houses (households:HHs) in total, including vacant and diconnected houses.
- No more registered unmetered/DL customers and unregistered users exist.
- SW installed a flow meter at the inlet pipe to the isolated area and then measured MNF and 24 hours flow volume. Meanwhile, SW read all water meters of registered metered customers in the beginning and the end to measure consumption. As a result, the 24hrs flow volume into the isolated area was **100** m3, and total metered consumption was **90** m3.
- SW tested the inaccuracy of all water meters, and then calculated the average as **2** %.

After Countermeasures

Connection Identification and Water Use Clarification

Category of connection and other items				HH	Q (m3/d)
Registered	Metered		A		
	Unmetered/DL		B		
		Open-end/Excess only	C	( )	
Unregistered (Illegal)	Direct	Open-end	D		
		Closed-end	E		
	Indirect/Parasite	Closed-end	F		
Meter Inaccuracy			G		
Real Loss	Undetected leakage, undetected illegal connections		H		
Unconnection			I		
Total Households and System Input Volume (SIV)				**100**	**100**

Meter Inaccuracy (H) = A/(100%-Inaccuracy ratio)-A

Re-classification

Water Audit

Component				Q (m3/d)	Proportion (%)
RW	Billed Authorized Consumption	Metered	A		
		Unmetered/DL	B		
NRW	Unbilled Authorized Consumption	Metered			
		Unmetered/DL (Excess)	C		
	Apparent Losses: Unauthorized Cons. (Illegal)	Closed-end	E+F		
		Open-end	D		
	Apparent Losses: Meter Inacc.	Meter inaccuracy	G		
	Real Losses	Undetected leakages, undetected illegal conn.	H		
System Input Volume (SIV)				**150**	**100.0%**

Meter Inaccuracy (H) = A/(100%-Inaccuracy ratio)-A

Connection Identification and Water Use Clarification

Category of connection and other items				HH	Q (m3/d)
Registered	Metered		*A*	50	70.00
	Unmetered/DL		*B*	20	21.20
		Open-end/Excess only	*C*	(2)	10.00
Unregistered (Illegal)	Direct	Open-end	*D*	1	5.00
		Closed-end	*E*	6	6.36
	Indirect/Parasite	Closed-end	*F*	4	4.24
Meter Inaccuracy			*G*		17.50
Real Loss	Leakage, etc.		*H*		15.70
Unconnection			*I*	19	
Total Connection and System Input Volume (SIV)				**100**	**150.00**

Water Audit

Component					Q (m3/d)	Proportion (%)	
RW	Billed Authorized Consumption		Metered	*A*	70.00	46.7%	**60.8%**
			Unmetered/DL	*B*	21.20	14.1%	
NRW	Unbilled Authorized Consumption		Metered				**39.2%**
			Unmetered/DL(Excess)	*C*	10.00	6.7%	
	Apparent Losses	Unauthorized Cons. (Illegal)	Closed-end	*E+F*	10.60	7.1%	
			Open-end	*D*	5.00	3.3%	
		Meter inacc	Meter inaccuracy	*G*	17.50	11.7%	
	Real Losses	Leakage, etc.		*H*	15.70	10.5%	
System Input Volume (SIV)					**150.00**		**100.0%**

Connection Identification and Water Use Clarification

Category of connection and other items				HH	Q (m3/d)
Registered	Metered		*A*	75	90.00
	Unmetered/DL		*B*	0	00.00
		Open-end/Excess only	*C*	(0)	0.00
Unregistered (Illegal)	Direct	Open-end	*D*	0	0.00
		Closed-end	*E*	0	0.00
	Indirect/Parasite	Closed-end	*F*	0	0.00
Meter Inaccuracy			*G*		1.84
Real Loss	Undetected leakage, undetected illegal connections		*H*		8.16
Unconnection			*I*	25	
Total Connection and System Input Volume (SIV)				**100**	**100.00**

Water Audit

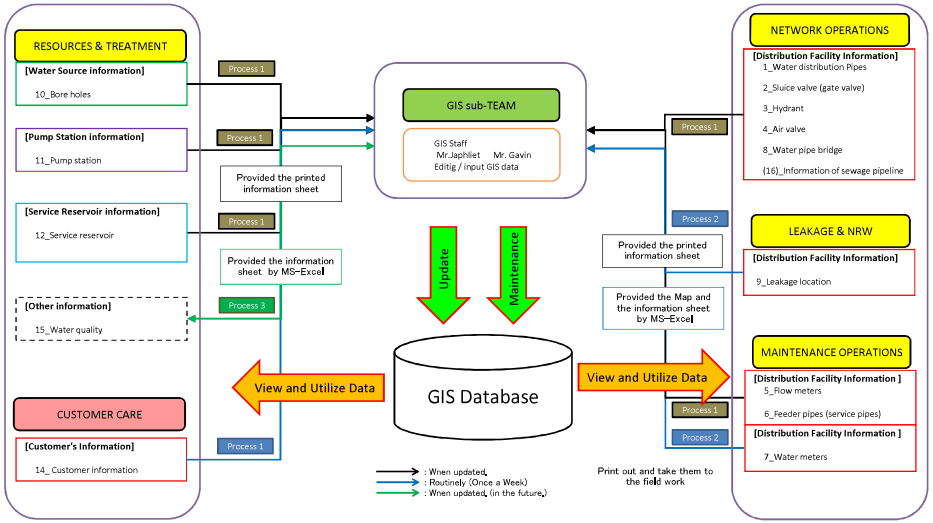
Component					Q (m3/d)	Proportion (%)	
RW	Billed Authorized Consumption		Metered	*A*	90.00	90.0%	**90.0%**
			Unmetered/DL	*B*	0.00	0.0%	
NRW	Unbilled Authorized Consumption		Metered				**10.0%**
			Unmetered/DL	*C*	0.00	0.0%	
	Apparent Losses	Unauthorized Cons. (Illegal)	Closed-end	*E+F*	0.00	0.0%	
			Open-end	*D*	0.00	0.0%	
		Meter Inacc.	Meter inaccuracy	*G*	1.84	1.8%	
	Real Losses	Undetected leakages, undetected illegal conn.		*H*	8.16	8.2%	
System Input Volume (SIV)					**100.00**		**100.0%**

Change in NRW: -29.2%

(4)

S13.3-15 WORKFLOWS OF GIS DATABASE

Draft Ver.010

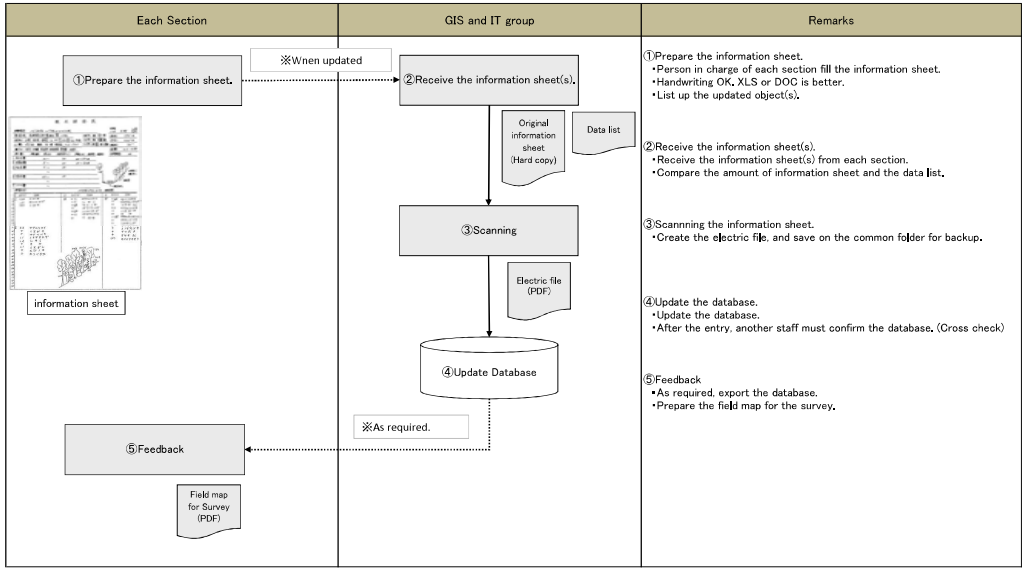


S13.3-15-1

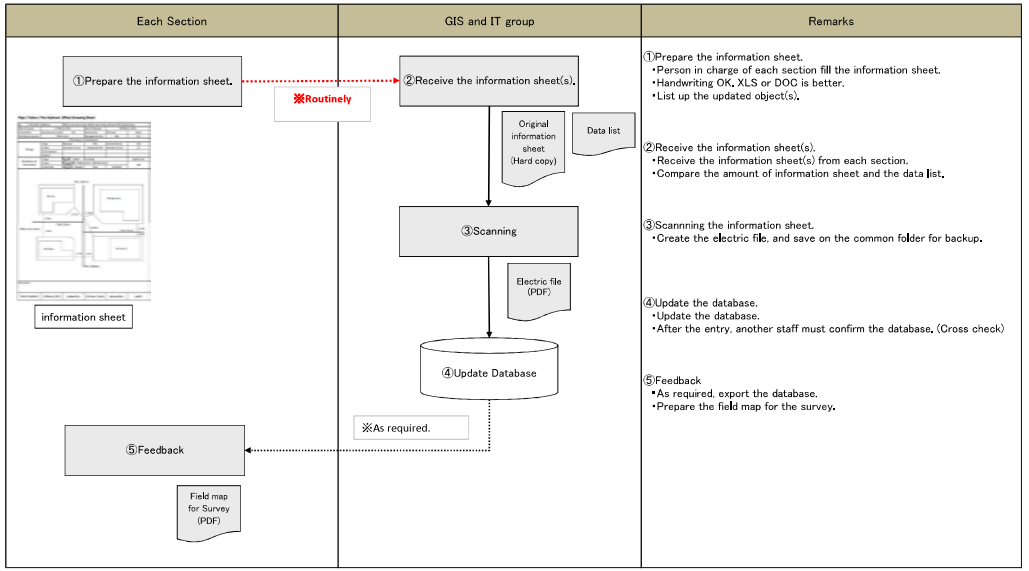
Draft Ver.010

Process No.	Category	What	from which section	How often	How to	Feedback
1 Black Arrow	Distribution Facility Information	*Water distribution Pipes *Sluice valve (gate valve) *Hydrant *Air valve *Water pipe bridge *Information of sewage pipeline	NETWORK OPERATIONS	When updated.	Printed information sheet	Field map
		*Flow meter *Feeder pipe	MAINTENANCE OPERATIONS			
	Water Source information	*Bore holes	RESOURCES & TREATMENT			
	Pump Station information	*Pump station				
	Service Reservoir information	*Service reservoir *Distribution area of source				
2 Blue Arrow	Distribution Facility Information	*Leakage location	LEAKAGE & NRW REDUCTION	Routinely (Once a Week)	Printed information sheet	Field map
		*Water meter	MAINTENANCE OPERATIONS			
	Customer's information	*Customer's information	CUSTOMER CARE		Excel	
3 Green Arrow	other information	*Water quality	RESOURCES & TREATMENT	When updated. (in the future)	Excel	Field map

Process-1 Annex-4.1



Process-2 Annex-4.2



RESOURCES, TREATMENT AND PLANT MAINTENANCE	GIS and IT group	Remarks
 Water Quality log sheet ※Wnen updated (in the future) ①Filing Printout ④Feedback Field map for Survey (PDF)	②Receive the log data. ③Update Database ※As required.	①Printout the log file and filing them. ②Receive the log data. ③Update Database ④Feedback ・As required, export the database. ・Prepare the field map for the survey.

S13.3-15-2

S13.3-16 INTENSIVE LECTURE ON METER READING, BILLING AND CUSTOMER CARE

Knowledge on water supply

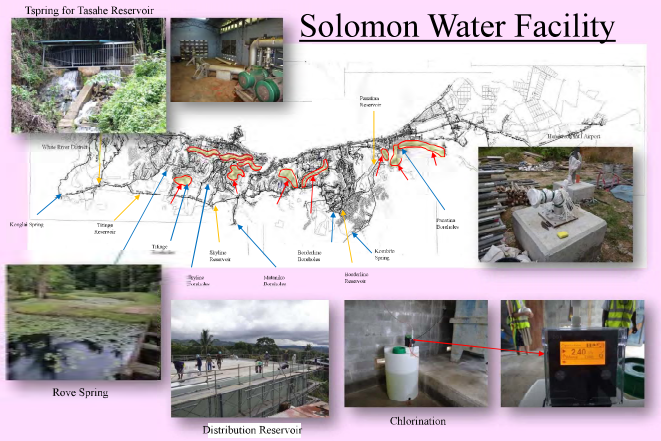
February 18 2014

Wada

Water source

- For protection water source area
  - ➢Keep forest around water source area clean
  - ➢Avoid discharging waste water directly
- Function of Watershed protection forests
  - ➢Storing water
  - ➢Purifying water
  - ➢Protecting flood

Solomon Water Facility



Protecting and cultivating the water source protection forests

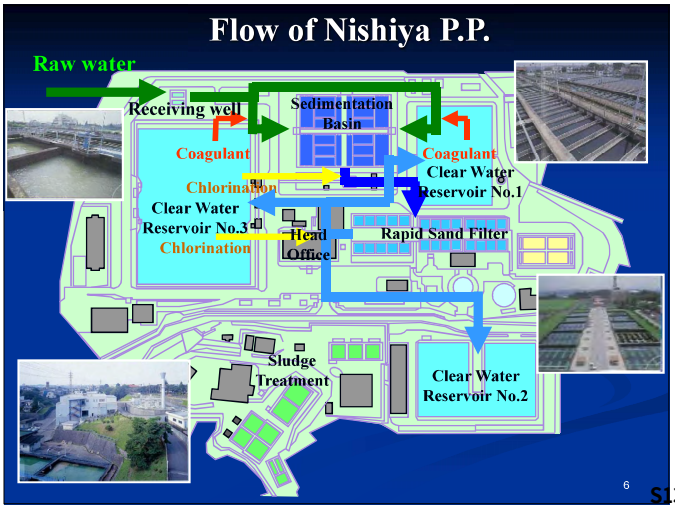
Storing water Purifying water Protecting flood

Water treatment

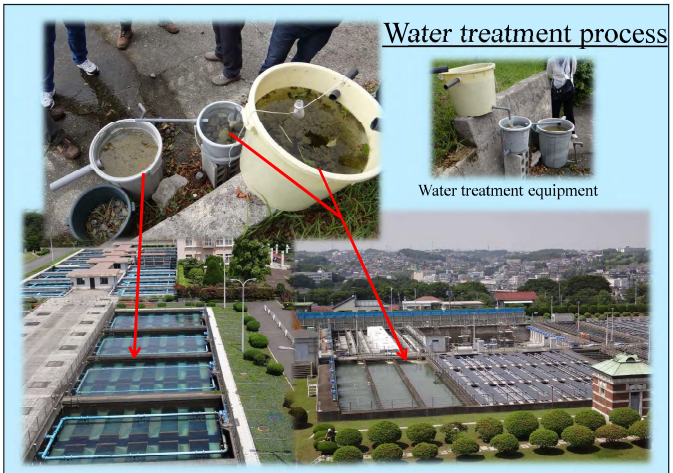
Treatment process

- Sedimentation and filtration process
  - ➢Waterworks low in Japan; under 2 NTU (Nephelometric Turbidity Units)
  - ➢1 NTU means that 1mg standard material is contained in 1L purified water.
  - ➢Coagulant is used for sedimentation.
  - ➢Sand and gravel are used at a filter.
  - ➢Turbid water causes water meter trouble.

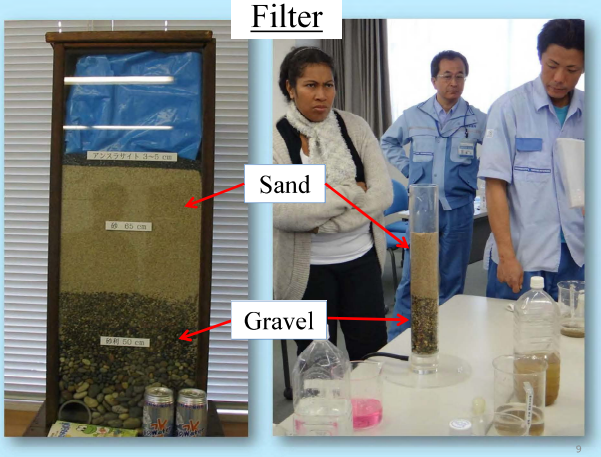
Flow of Nishiya P.P.



Water treatment process



Filter



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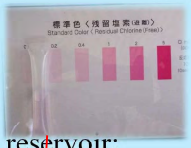
For drinking water

- Chlorination at the reservoir
  - ➢2~3L per hour
  - ➢Community near the distribution reservoir: Cl: 0.2 mg/L
  - ➢Chlorine kills bacteria in the water
  - ➢Chlorine removes manganese iron which cause black color water or uncomfortable smell/taste.
- Supply water 24/7
  - ➢Control water level at the reservoir



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Safe water

- Sodium hypochlorite is used as disinfection.
  - ➢0.1 mg/L at the tap by Waterworks Law

Calcium hypochlorite $Ca(ClO)_2$

Sodium hypochlorite NaClO

Liquid chlorine

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Distribution management

- Function of Distribution reservoir
  - ➢Keep clean water for customers
  - ➢Secure water at the disaster
  - ➢For using fire hydrant 170~180L/d/capita

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Distribution management

- Where to happen leakage?
  - ➢At the connection between distribution pipe and service pipe
  - ➢At a valve beside a water meter

Project; NRW reduction of 30% in each pilot area

How to deduce NRW?

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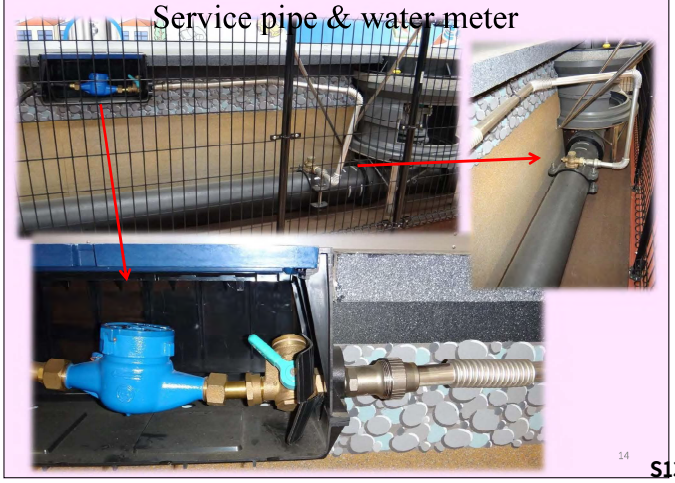
For saving water

Calculation 1
Bottle capacity: 600ml
Measuring time: 30 seconds
0.6 (L) /0.5 (minute) x 60 (minutes) =72 L/h
72 (L) x 24 (hours) / 1000 =1.728 m3/d
; around 52m3/m

Calculation 2
Glass capacity: 300ml
Measuring time: 120 seconds
0.15 (L) /1 (minute) x 60 (minutes) =9 L/h
9 (L) x 24 (hours) / 1000 =0.216 m3/d
; around 6.5m3/m

How to stop water?

Service pipe & water meter



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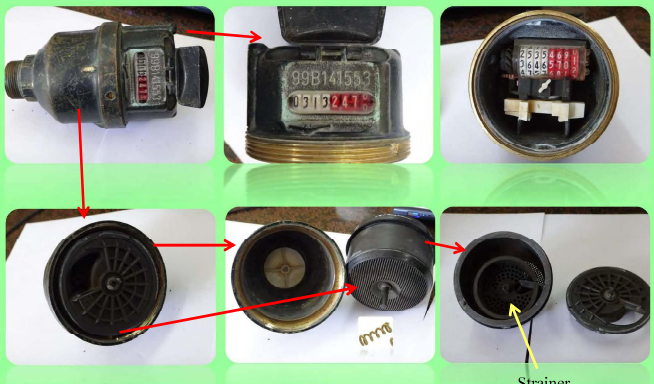
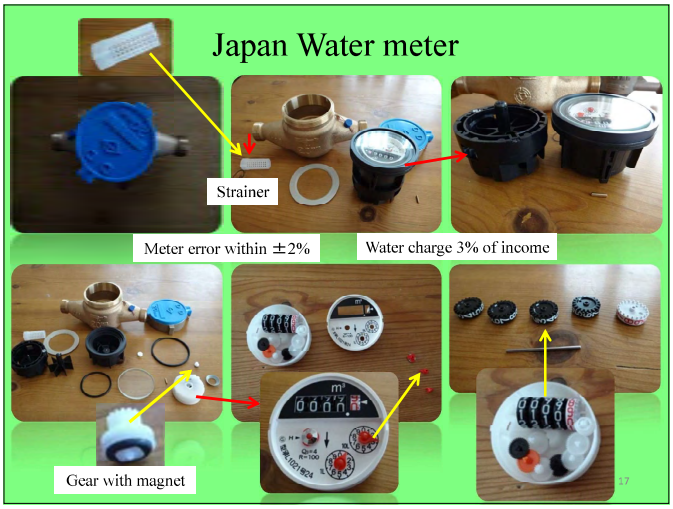
SW Water meter



16


Japan Water meter
Strainer
Meter error within ±2%
Water charge 3% of income
Gear with magnet

S13.3-17 FOLLOW-UP LECTURE FOR REVIEW ON NRW TECHNICAL

Revised Technical Procedures of NRW Reduction

Revised Points

(1) Proposed Criteria to carry out Step Test
If the per-km flow volume of all pipelines, which is calculated through results of MNF survey, is less than 3.0m3/hr/km, step test can be skipped.

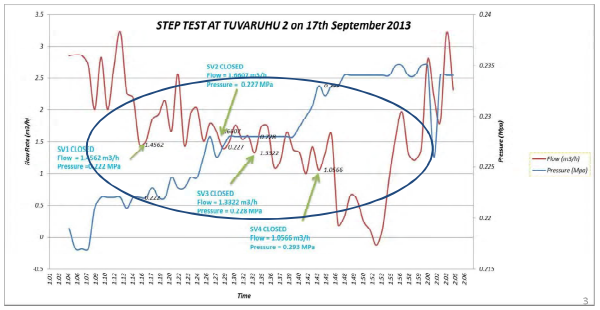
(2) Leakage Re-Detection
When the NRW reduction point is less than 30 between before and after countermeasures and also leakage ratio in NRW is 30% or more after countermeasures, Leakage Re-Detection should be conducted.

Activities in Leakage Re-Detection
- Leakage re-detection along the pipeline sections targeted by step test, particularly, of which per-km flow volume is 3.0m3/hr/km or more in MNF survey.
- Leakage detection along the suspected pipeline sections by correlator.
- Leakage detection along long service pipelines and meters.

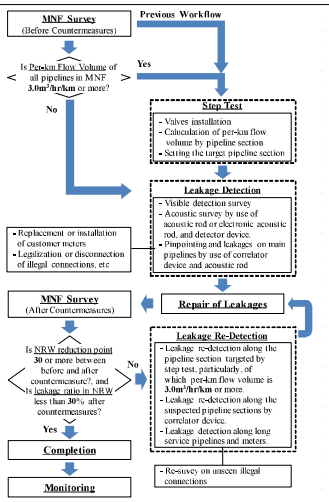
Besides, **re-survey on unseen illegal connections** should be conducted.

Skip of Step Test by Result of Per-km Flow Volume in MNF Survey

In MNF survey, if **per-km flow volume of all pipelines is less than 3.0m³/hr/km**, flow volume of each pipeline section may not be identified clearly due to little change of the volume.
For example, 1.47m³/hr/km was calculated in Tuvaruhu-2 as shown in the graph below, but it is difficult to identify changes in flow volume of pipeline sections.



Flow Chart of Revised Technical Procedures of NRW Reduction



Skip Criteria of Step Test by the Result of Per-km Flow Volume in MNF Survey

Pilot Area	Pipeline Length (m)	No. of Household	Flow Volume in MNF (m3/hr)	Per-km Flow Volume (m3/hr/km)	Necessity of Step Test
1	1,028	83	15.54	15.12	Yes
2	2,468	91	4.38	1.77	No
3	2,344	161	18.18	7.76	Yes
4	1,196	76	5.81	4.86	Yes
5	997	47	1.97	1.98	No
6	1,325	62	1.90	1.43	No

⇨ Per-km flow volumes are more than 3.0m³/hr/km in three out of six pilot areas. Therefore, step test should be conducted in these three areas.

Advantages of Skip of Step Test
- Activity can be made more efficient, that is, its period can be shortened.
- Materials such as valves and couplings can be economized.
- NRW Action Team pay attentions to flow volume in MNF survey and procedures of leakage detection.

Leakage Re-Detection

Leakage re-detection should be conducted if NRW reduction points is less than 30% and also leakage ratio in NRW is 30% or more after countermeasures.

(1) For the pilot area in which step test was conducted, select the target pipeline section(s) according to result (more than 3.0m³/hr/km) of the step test, and install some valves at appropriate locations to identify leakage points.

(2) For the pilot area in which step test was skipped, conduct step test, and select the target section(s) according to result (more than 3.0m³/hr/km) of the step test, and then install some valves at appropriate locations to identify leakage points

(3) Identify leakage along the suspected pipeline section by correlator.

(4) Identify leakage along long service pipelines and meters which are connected to the pipeline section having higher per-km flow volume (more than 3.0m³/hr/km), by tracing the pipeline route that is unknown or passing through under the properties.

(5) Conduct MNF survey again after countermeasures such as leakage repair.