



**Attachment 4:
Session 3 Presentations**

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Mr. Cor MERKS
Sector Specialist
Managing Consultant,
Ramboll Netherlands BV

**Session 2: Smart solutions for
reducing non-revenue water (NRW)**

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FIFTH MEETING
GMS Urban Development
 Working Group
 23 FEBRUARY 2022

Smart Solutions for Reducing Non-Revenue Water

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Smart Solutions for Reducing NRW (introduction Cor Merks)

Cor Merks, the Netherlands, cwam@ramboll.com

Sector Specialist

Managing Consultant at Ramboll Netherlands BV

Part time Non-Revenue Water Reduction Coordinator at the Netherlands' Water Utility Vitens

Active Member of the IWA Specialist Group on Efficient Urban Water Management

Active Member of the IWA Water Loss Specialist Group

Project Manager of the EU Reference document Good Practices on Leakage Management

WFD CIS WG PoM (© European Union, 2015)

Actively involved in the development of the Makassar Livable City Plan (AASCTF)

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Global water distribution network challenges (1)

The history and the specific operating environment of individual water service providers within each country and/or region is unique.



The drinking water distribution network connects supply and demand.

The drinking water distribution network challenges are universal.

“Turn data into Insight into Action”,
Thames Water, February 3, 2022



Global water distribution network challenges (2)



How to maintain high standards?

How to balance cost, risk and performance?

[High-level innovations](#)

Asset Management

Non-Revenue Water (NRW) Reduction Management, sometimes by Performance-Based Service Contract

The battle against lost water

A huge volume of the distributed drinking water is never invoiced to the customers: leakage, reservoir overflow, deteriorating infrastructure, deficient customer registration, inaccurate metering, inaccurate billing systems, and possibly illegal connections and theft.

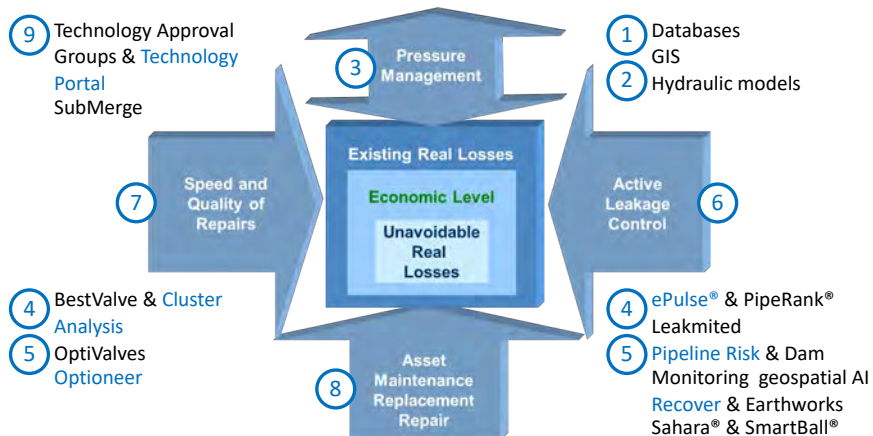
Real losses are caused by poor operation and maintenance, combined with poor quality of the underground assets of the operator.

NRW reduction is a big challenge to address and 'business as usual' will not fix it!

The **Strategy** builds upon proven smart solutions for water loss control and integrated innovative solutions, to turn NRW into Revenue Water.



Four pillars ↔ Digital solutions



Disclaimer and notices

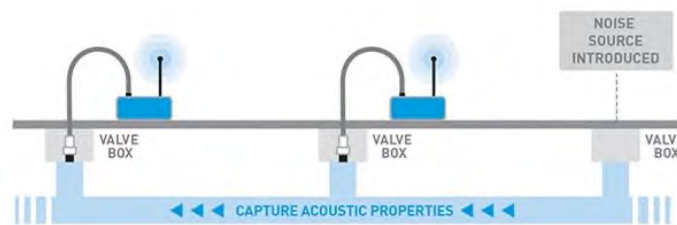
The materials herein are intended to furnish viewers with a summary and overview of general information on matters that they may find of interest, and are provided solely for personal, non-commercial, and informational purposes. The material and information contained herein are subject to continuous change and may not be current, correct, or error free, and should not be construed as recommendation or professional service. You should consult with the authors or other professional familiar with your particular factual situation for advice concerning specific matters.

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Echologics ePulse® Non-Invasive Condition Assessment



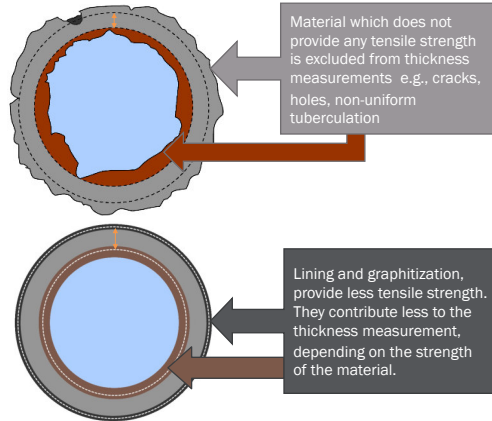
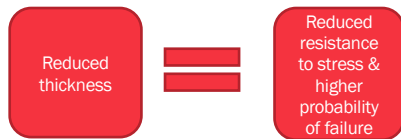
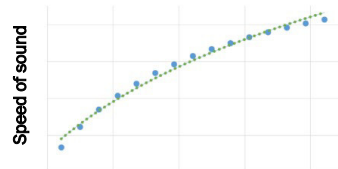
- Acoustic recordings are taken using LeakFinder-ST
- An out of bracket sound is introduced
- Advanced software techniques are employed in ePulse® software
- Accurate velocity of sound is determined
- Any leaks are investigated and pinpointed



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Echologics ePulse® Non-Invasive Condition Assessment

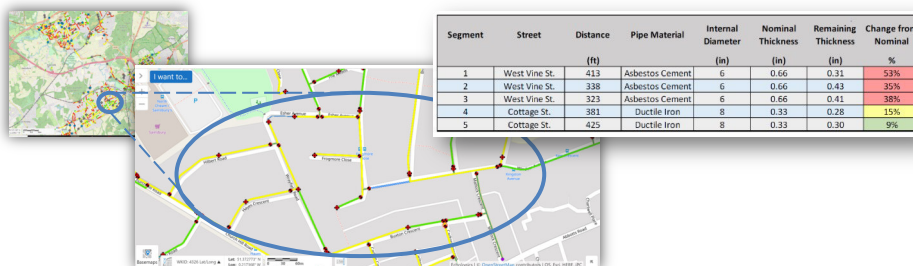
Pipe wall thickness can be found by measuring the speed of sound through the pipe and combining this with other known factors.



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Prioritising Investment Decisions

- Data analysts derive average pipe wall thickness from the field measurements. This is compared to nominal thickness to determine % degradation.
- Remaining service life or an Integrity Rating can be attributed with the addition of further information such as pressures (transient and cyclic), external loading, etc.
- Detailed reports, a GIS layer and tabulated data can be supplied depending on client needs.



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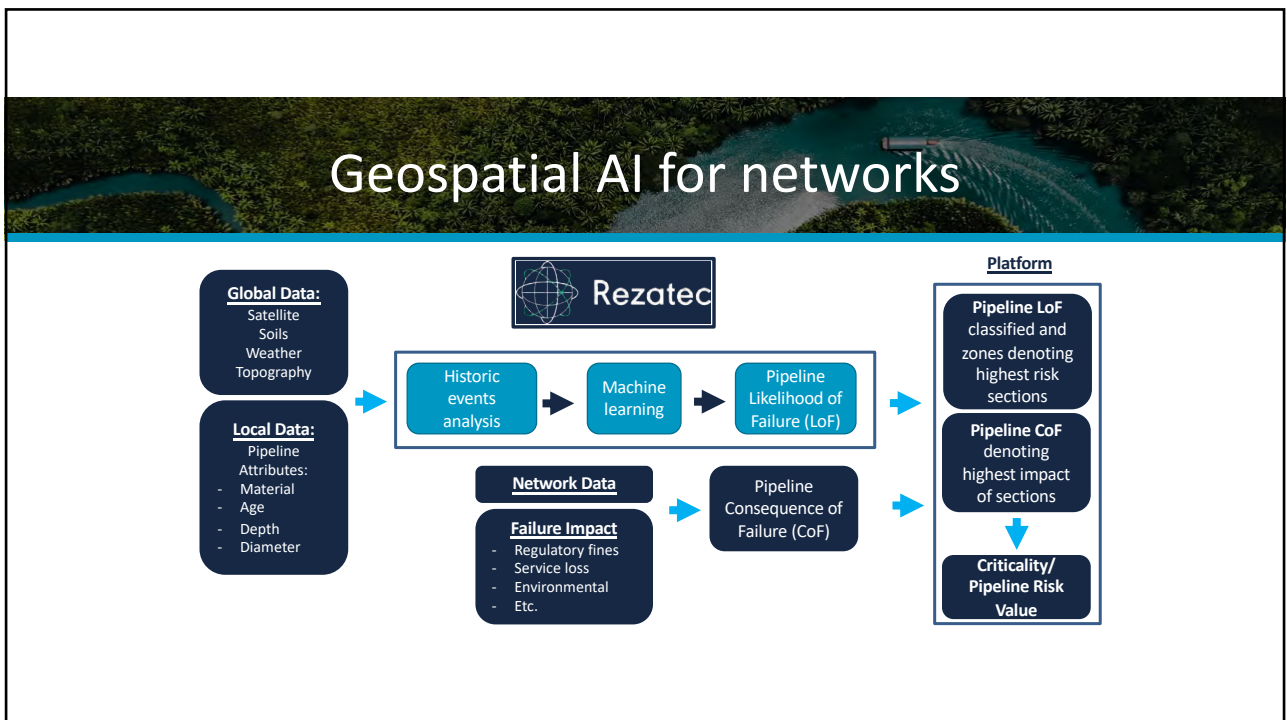
Geospatial AI – Pipeline Risk
The power to dynamically manage your ground assets and critical infrastructure. Remotely. At scale. Cost effectively.

Water Utilities | Energy | Agriculture | Energy

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Rezatec
Analyzing Earth Data


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Platform Demo

The screenshot displays a software interface for pipeline analysis. At the top, there is a table with columns for 'Segment ID', 'Length', 'Material', 'Diameter', 'Pressure Class', 'Segment Class', 'Segment Status', 'Segment Risk Rating', and 'Segment Risk Score'. Below the table, there is a bar chart titled '% Network LOP' and a map showing a network of pipes with red and blue markers indicating different risk levels or leak detection points.



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Recover
Leak Detection and Analysis

The image shows a trench with several large, dark pipes. A blue rectangular overlay is positioned on the left side of the image, containing the word 'Recover' in large white letters and 'Leak Detection and Analysis' in smaller white letters below it.

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Recover Methodology



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Recover's Impact

OVER 430 PROJECTS COMPLETED IN 57 COUNTRIES



CARBON DIOXIDE EMISSIONS REDUCED BY 14,500 METRIC TONS equivalent to 12.5M pounds of coal burned

More than 36,000 LEAKS VERIFIED

21,800 MWH of ENERGY SAVED yearly

3.5 LEAKS FOUND PER CREW DAY VS. 1.3 found using traditional acoustic methods (on average)

9200M GALLONS (5 million m³) WATER SAVED EVERY YEAR (EQUIVALENT TO 33% OF THE WATER USED BY A CITY OF 500K RESIDENTS)

• Utilis products contribute to three United Nations Sustainable Development Goals: 6, 9, 13. Utilis believes that sustainability is not only part of our business strategy, but it also guides our mission. With technological innovation, we can help public and private sectors overcome major water challenges.




Impact from January 2017 through June 2021

Calculate your impact!



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Spatial insight

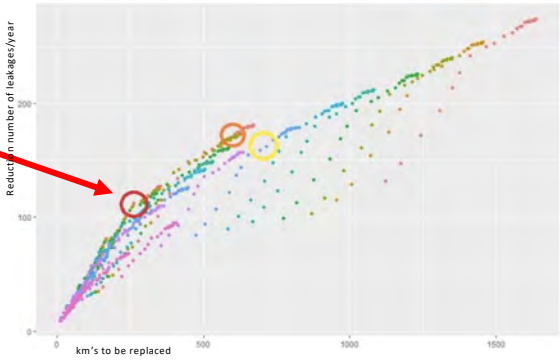
Data driven asset management
Introduction 2021

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Use cases in the Netherlands

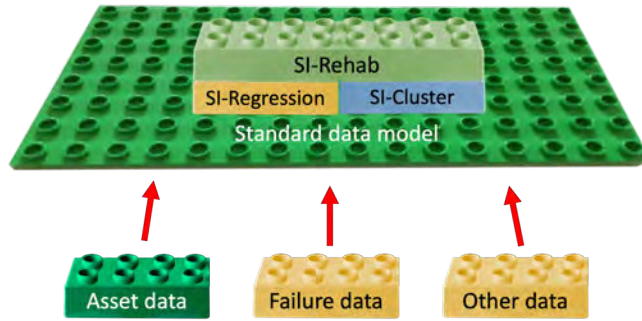


- ▶ Brabant Water: 250 km pipes (1.4% of network) have the highest replacement priority. Replacement of these pipes will result in 20% reduction of leakages
- ▶ Oasen: reduction of Non-Revenue Water from 5.5% to 4% in 3 years' time with data-driven asset management

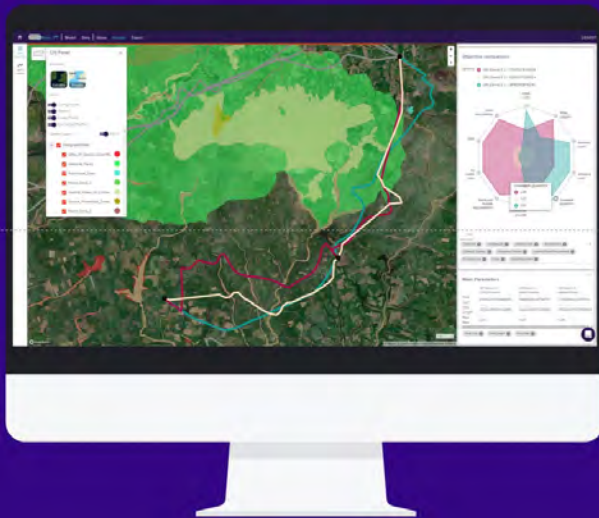


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Software products for data-driven asset management



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What problem does Optioneer solve?



To reduce construction risk and avoid delays during planning you need a robust pipeline route option assessment at the beginning of a project



However, schedule and resource constraints naturally limit the time available to explore all of the available route options in detail



Typically, this means using engineering judgement to quickly develop 2 or 3 route options in detail which avoid key environmental constraints



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Have you really considered enough options?



With Optioneer, you can rapidly explore thousands of route options and analyse them in detail using environmental, engineering and cost criteria



You decide what engineering, environmental and cost inputs to give Optioneer and it uses AI to explore the whole solution space






This means you can explore key trade-offs and demonstrate to stakeholders that all of the alternatives have been considered in detail




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We are the Isle Group








>6,000 technologies screened



>1,500 technologies in member portal



>100 consultants and experts



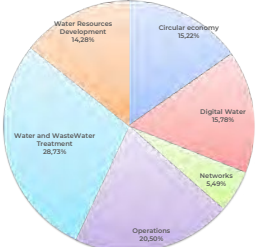
Serving >250 utilities and industries

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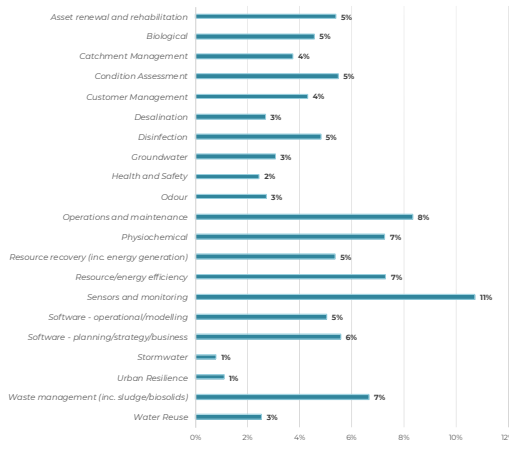
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Isle Technology Expertise

- ✓ Our deal flow team have evaluated more than 6,000 water technologies, during the last 15 years
- ✓ Every year we include more than 200 new technologies in our database.
- ✓ We focus on water technologies with Technology readiness level (TRL) > 6 up to 9.



8,000 TECHNOLOGIES BY SUB-CATEGORY



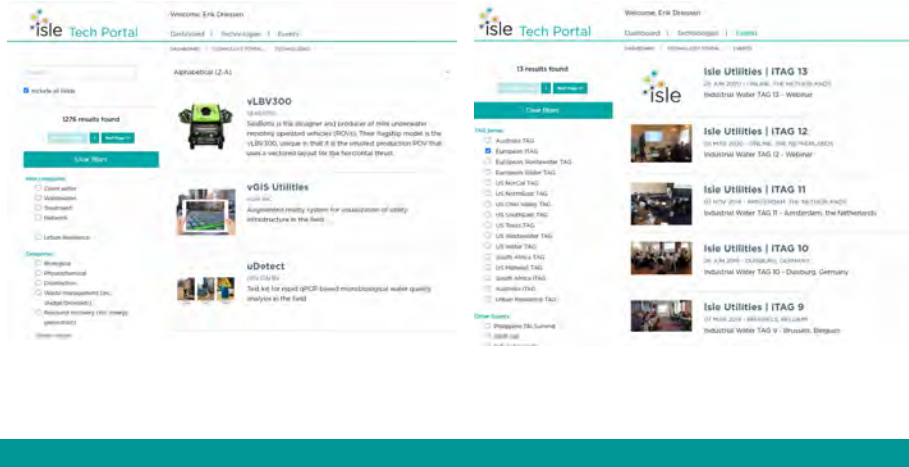
Sub-Category	Percentage
Asset renewal and rehabilitation	5%
Biological	5%
Catchment Management	4%
Condition Assessment	5%
Customer Management	4%
Desalination	3%
Disinfection	5%
Groundwater	3%
Health and Safety	2%
Odour	3%
Operations and maintenance	8%
Physicochemical	7%
Resource recovery (inc. energy generation)	5%
Resource/energy efficiency	7%
Sensors and monitoring	11%
Software - operational/modelling	5%
Software - planning/strategy/business	6%
Stormwater	1%
Urban Resilience	1%
Waste management (inc. sludge/biosolids)	7%
Water Reuse	3%

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Isle Technology Portal

A unique online collection of innovative water technologies for ITAG members



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Conclusions

NRW reduction is a big challenge to address and 'business as usual' will not fix it!

Real-world and digital representation of the real-world are becoming identical. It's a transformation that takes place at an accelerating pace.

Water service providers and innovators are increasingly working together on advancements in digital technology to be used, but various technologies are proven and readily available.

Integrated digital solutions can be used for planning, design, operation, maintenance and rehabilitation of water distribution networks worldwide.

Integrated digital solutions help balancing cost, risk and performance.

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Thank you

Many thanks to all suppliers that have provided information about their digital solution, product and/or technology:

<https://asterra.io/>

<https://www.continuum.industries/>

<https://www.echologics.com/services/condition-assessment/>

<https://www.isleutilities.com/services/technology-approval-group>

<https://www.kwrwater.nl/en/samenwerkingen/watershare/>

<https://www.leakmited.com/>

<https://www.rezatec.com/>

<https://www.spatial-insight.nl/en/homepage/>

<https://www.submerge.tech/>

<https://www.xylem.com/en-vn/>



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 7 DECEMBER 2021

Country Presentation:
Myanmar


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CONTENTS

- **Water Vision and Master Plan**
- **Activities of NRW Management in Yangon**
- **Proposed Plans towards Digitalizing the Water Sector**


Water Vision & Master Plan

Water Vision





6 CLEAN WATER AND SANITATION

Basic idea & 4 Concepts



SDG 6 global indicators




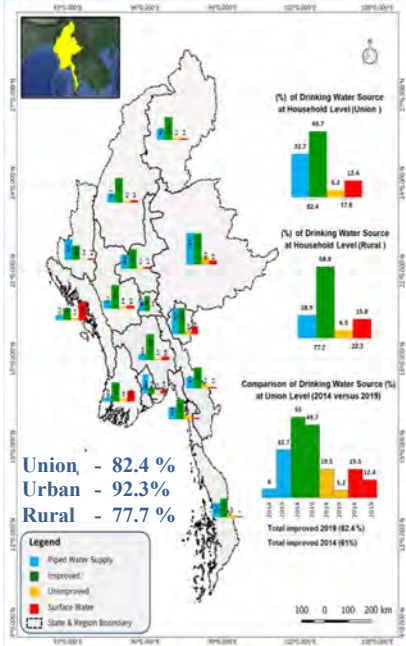


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23 FEBRUARY 2022

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Water Supply Condition in Myanmar





Union - 82.4 %
Urban - 92.3 %
Rural - 77.7 %

Comparison of Drinking Water Source (%) at Union Level (2014 versus 2019)

Year	Piped Water Supply (%)	Improved (%)	Unimproved (%)	Surface Water (%)
2014	82.4	17.6	0.0	0.0
2019	82.4	17.6	0.0	0.0

Total improved 2019 (82.4%)
Total improved 2014 (81%)

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2040 Future Plan for Yangon City Water Supply System



Lagunpyin Project

River Source Project:

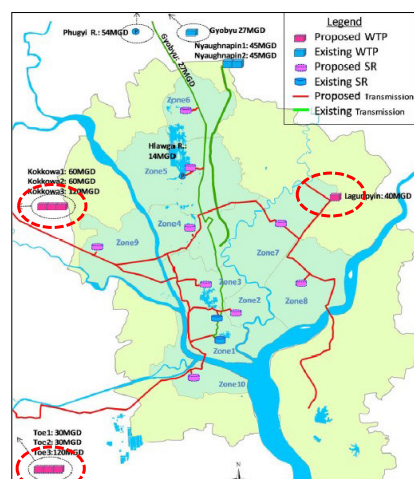
1. Kokkowa River
2. Toe River

Zoning System:

10 Zones with Service Reservoirs

Ground water:

0 in 2025



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Future Target Service Conditions

Source: JICA M/P in 2014

	unit	2011	2021	2025	2040
Population	person	5,142,000	4,699,000	6,464,000	8,520,000
Served population	person	1,920,000	2,115,000	3,764,000	6,810,000
Water coverage rate	%	37	45	58	80
Unit consumption	LPCD	95	120	135	178
Non-Revenue Water rate	%	66	50	35	15
Leakage rate	%	50	40	25	10
Daily maximum water supply	MGD (m ³ /day)	148 (673,100)	203 (922,856)	272 (1,238,400)	543 (2,467,300)
Water pressure	MPa (bar)	0.075 (0.75)	0.085 (0.85)	More than 0.15 (1.5)	
Supply duration	hours	8 on average	10 on average	24	
Water quality		Not drinkable	Not drinkable	Drinkable	

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Activities of NRW Management in Yangon



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Management for NRW Reduction

**We are trying to provide Safe and Clean Water to more Citizens
with Appropriate Volume, Pressure and Price.**

To Reduce NRW

- Formulating Master Plan
- Rehabilitating Distribution Networks and Facilities
- Initiating NRW Reduction Measures
- Capacity Building
- International Cooperation
- Implementing Water Quality Improvement
- Exploring New Water Sources



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Current NRW Reduction Measures

- Yearly Replacement of Aging water facilities and Damaged Meters
 - Average age of pipe > 80 years, not enough flow capacity resulting many booster PS in the city (Frequent Pipe Break & Leakage)
- Yearly Construction of DMAs and DMZs
 - Complex Distribution Without Zoning System
- Rehabilitations of Pumping Stations
 - Unstable Water Pressure, Intermittence water Supply
- GIS Data, SCADA, Customer Data, As-built Drawings & Maps
- Upgrading standards, regulations, SOPs and manuals
- Consideration Low level of water tariff (0.05\$/m3)
- Initiating Online Billing System & Upgrade Computer Skill
 - Limited computerization in billing, customer database management and accounting



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NRW Reduction Projects Implemented by International Cooperation

	Project name	Location	Completed year	Organizer	NRW Ratio	
					Before	After
1	NRW DMA pilot project in Ward No. 14 Ward, Yankin	Yankin	2014	JICA	75 %	15 %
2	Japanese Grass Root Project in Ward No. 5, Mayangone	Mayangone	2015	Japan consortium	76.59 %	32.2 %
3	Grant Aid Project for Urgent Improvement of Water Supply - Replacement of 42"φ Transmission pipe - Installation of DMA system in Ward No. 2,3 and 4, Yankin	Yankin	2016	JICA, TODA	70 %	8.2 %
4	Pilot District Metered area project for NRW reduction in Yangon City	Insein and South Okkalapa	2017	Manila+ Mitsubishi	52 % 56 %	17.32 % 12.29 %
5	NRW reduction pilot project in Ward No. 13, Yankin	Yankin	2019	JICA, TA	86.18 %	5.46 %
6	NRW reduction pilot project	Mayangone	on-going	Japan consortium	To Reduce >50%	
7	Consultancy Services for Rehabilitation Program of Yangon Water Supply Systems-Pilot Project	Tarmwe	On-going	AFD & Egis	To Improve Commercial Loss Management	

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NRW Reduction Projects in Yangon City

The map displays several project zones in Yangon City, each with associated photos and descriptions:

- Mayangone (Japanese Grant)**: Located in the northern part of the city.
- North Okkalapa (YCDC)** and **North Okkalapa (YCDC) (Ongoing)**: Located in the northern-central part.
- Insein & South Okkalapa (Manila Water - Mitsubishi)**: Located in the central-southern part.
- Thingangyun & Tarmwe (AFD & EGIS, France)**: Located in the southern part.
- Yankin (JICA Expert)** and **Yankin (JICA Grant Aid)**: Located in the western part.
- Yankin (T.A Pilot)**: Located in the central-western part.

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Activities for Overall Management

Activities for Institutional Management

Interview to YCDC Training Center

Problem analysis and solution

Discussion and suggestion

Activities for Non-Revenue Water Management

Problem analysis and solution

Training on software application

Ground survey on customers

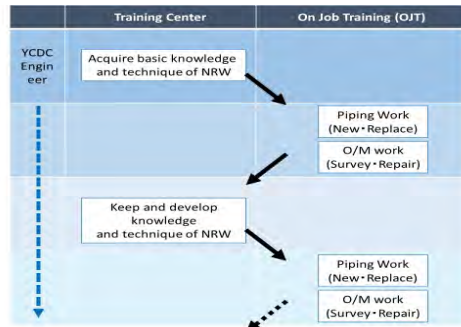
Activities for Water Quality Management

Seminar on Quality Monitoring

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Implementation of Training For NRW Management



- Training for
- Water Leak Detection & Branching Method
 - Pipe Jointing & Management of Regulating Valves
 - Water Pressure Test & Leakage Repair
 - House Connection Jointing & Water Meter Installation



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Inauguration of Laboratory for Water Quality Monitoring

No	Measurable Parameters	Units
1	Total Coliform	MPN/100ml
2	Fecal Coliform	MPN/100ml
3	Taste	mg/l
4	Odor	mg/l
5	Color	TCU
6	Turbidity	NTU
7	Arsenic	mg/l
8	Lead	mg/l
9	Nitrate	mg/l
10	Manganese	mg/l
11	Chloride	mg/l
12	Hardness	mg/l
13	Iron	mg/l
14	pH	mg/l
15	Sulfate	mg/l
16	Total Dissolved Solids(TDS)	mg/l
17	Calcium	NTU
18	Magnesium	TCU
19	Nitrite	mg/l
20	Ammonia Nitrogen	mg/l
21	Electrical Conductivity	µS/cm
22	Total Alkalinity	mg/l
23	Salinity	psu
24	Zinc	mg/l
25	Residual Chlorine	mg/l

ESTABLISHED IN 2014 JULY



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Public Awareness Program



Public Awareness in Schools



Calendar

Leaflet

Site Visit to W.T Facilities

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Proposed Plans towards Digitalizing the Water Sector

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Towards Developing A Smart Water Sector

- Transform to AMI Water Meter System
- Improve SCADA and GIS
- Strengthen International Cooperation
- Continue Capacity Development & PR
- Integrate Water Resources Management
- Sustainable Development
- Resilience of water Facilities



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Thank You Very Much



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Country Presentation:
THAILAND

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**Provincial Waterworks Authority
(PWA)**

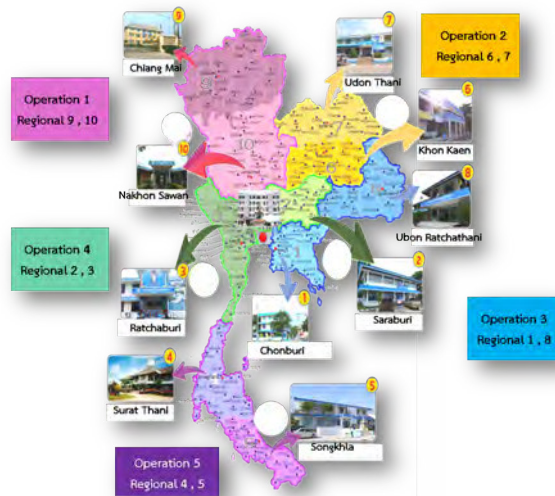


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PWA Water Supply Services

- PWA Regional Office 1-10
- 234 Waterworks Offices
- 74 Provinces
- 812 Municipalities
- 4.96 Millions of PWA Customer (Households/Connections)
- 1,996 MCM of Water Production
- 1,336 MCM of Water Sales
- 603 MCM of Non-Revenue Water



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Overview of Water losses Management

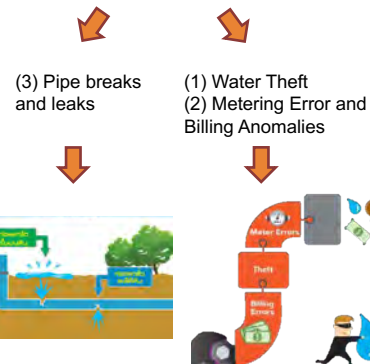
Definition of Water Loss

System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water
		Unbilled Authorized Consumption	Unbilled Metered Consumption	
Water Losses	Commercial Losses	(1) Unauthorised Consumption	(2) Customer Meter Inaccuracies and Data Handling Error	Non-Revenue Water
			(3) Leakage on Transmission and Distribution Mains	
	Physical Losses	(3) Leakage and Overflows from the Utilities Storage Tanks	Leakage on Service Connections up to the Customer Meter	

Water losses is often referred to as non-revenue water (NRW) – water that is produced in a network but never reaches the consumer. This might be due to aging networks which haven't been properly managed, metering inaccuracies, theft or unmetered authorised consumption, like water used from fire hydrants.

Components of Water Loss

Real losses **Apparent losses**



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Planning of Water Losses

PWA Water Losses Situation (2007 - 2021)

Water Losses Target → 20%

With or With out Water Losses Planning

Reducing Water Losses is cost saving and postpone water supply plant construction

	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571
Plant Capacity (million m³/y)	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280
With out Leakage Management	1,866	1,931	1,998	2,068	2,140	2,215	2,293	2,373	2,458	2,545
With Leakage Management Policy	1,838	1,834	1,821	1,814	1,831	1,849	1,869	1,889	1,912	1,935

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The Four Potential Intervention Tools of Leak Management

Pressure Management - Control Valve System

Speed and quality of repairs

Current annual Real losses

Pipeline and asset management selection, installation, maintenance, renewal, replacement

3

2

1

4

Unavoidable annual Real losses

Potentially recoverable Real losses

Active leakage control - DMA System
- Monitoring System (online) - DMAMA
- Active Leak Control

How long Unreported leaks run for before they are located?

Volume of water lost

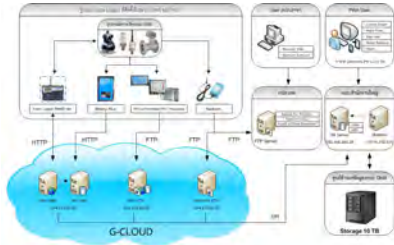
Awareness **Location** **Repair**

(Time)

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PWA Innovation for Active Leakage Control (Real losses)

Water loss Management



Real-time systems for monitoring

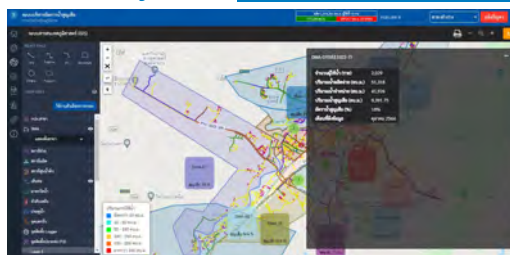
Date	Time	Flow	Pressure	Leakage	Alert	Action
2022-02-15	08:00:00	100.0	1.0	0.0	0	OK
2022-02-15	08:05:00	100.0	1.0	0.0	0	OK
2022-02-15	08:10:00	100.0	1.0	0.0	0	OK
2022-02-15	08:15:00	100.0	1.0	0.0	0	OK
2022-02-15	08:20:00	100.0	1.0	0.0	0	OK
2022-02-15	08:25:00	100.0	1.0	0.0	0	OK
2022-02-15	08:30:00	100.0	1.0	0.0	0	OK
2022-02-15	08:35:00	100.0	1.0	0.0	0	OK
2022-02-15	08:40:00	100.0	1.0	0.0	0	OK
2022-02-15	08:45:00	100.0	1.0	0.0	0	OK
2022-02-15	08:50:00	100.0	1.0	0.0	0	OK
2022-02-15	08:55:00	100.0	1.0	0.0	0	OK
2022-02-15	09:00:00	100.0	1.0	0.0	0	OK

Flow rate and Pressure monitoring



Data Analysis

<https://dmama.pwa.co.th>

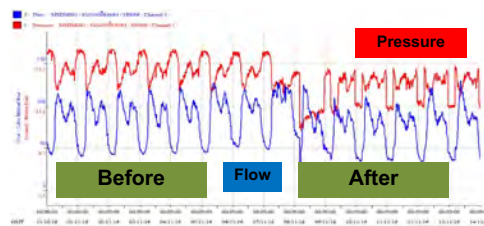
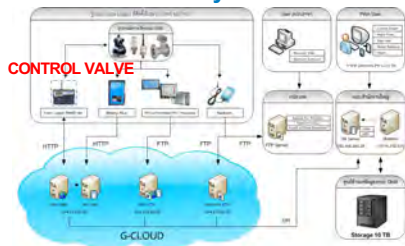


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PWA Innovation for Active Leakage Control (Real losses)

Control Valve System



Real-time systems for Pressure Management



<https://dmacontrol.pwa.co.th>

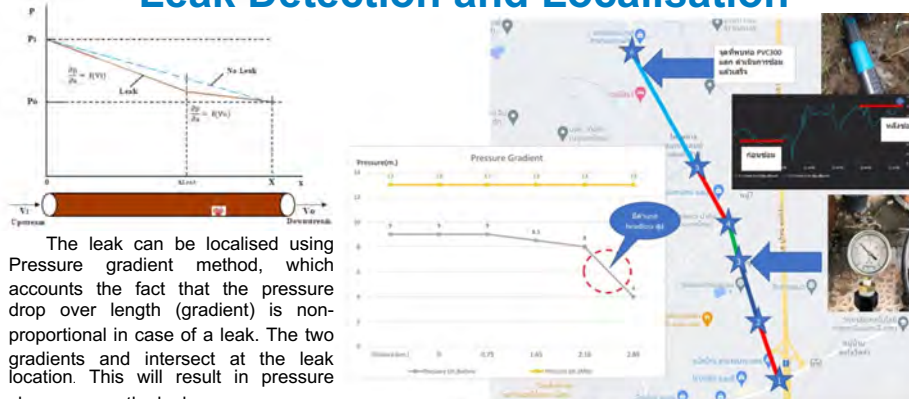
Name	Device Type	Control Mode	Pressure (psi)	Flow (l/s)	Last Update	Status
DMV-01-001	Flow Meter	Manual	100.0	1.0	2022-02-15 08:00:00	OK
DMV-01-002	Flow Meter	Manual	100.0	1.0	2022-02-15 08:05:00	OK
DMV-01-003	Flow Meter	Manual	100.0	1.0	2022-02-15 08:10:00	OK
DMV-01-004	Flow Meter	Manual	100.0	1.0	2022-02-15 08:15:00	OK
DMV-01-005	Flow Meter	Manual	100.0	1.0	2022-02-15 08:20:00	OK
DMV-01-006	Flow Meter	Manual	100.0	1.0	2022-02-15 08:25:00	OK
DMV-01-007	Flow Meter	Manual	100.0	1.0	2022-02-15 08:30:00	OK
DMV-01-008	Flow Meter	Manual	100.0	1.0	2022-02-15 08:35:00	OK
DMV-01-009	Flow Meter	Manual	100.0	1.0	2022-02-15 08:40:00	OK
DMV-01-010	Flow Meter	Manual	100.0	1.0	2022-02-15 08:45:00	OK



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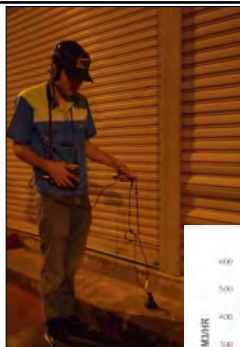
Pressure Gradient Method for Leak Detection and Localisation



The leak can be localised using Pressure gradient method, which accounts the fact that the pressure drop over length (gradient) is non-proportional in case of a leak. The two gradients and intersect at the leak location. This will result in pressure changes near the leak. A dip is observed in the pressure profile at the leak point. The leak location can be estimated by determining the intersection point of upstream and downstream pressure profiles.

Station	1	2	3	4	5	6
Distance (m.)	0.00	0.75	1.50	2.25	3.00	3.75
Pressure (m.) Before	14.00	14.00	14.00	13.50	13.00	12.00
Pressure (m.) After	8.00	8.00	8.00	8.00	8.00	8.00
Leak headloss (m/100m) After	0.00	0.00	0.98	0.68	0.00	0.00
pipe dia. (mm.)	300	300	300	300	300	300

Active leakage control & Speed and quality of repairs

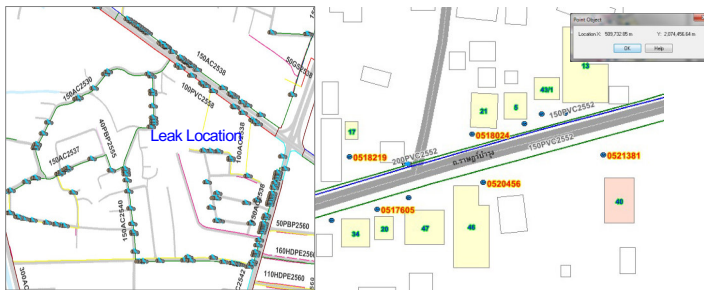


PWA Innovation For Pipeline and Asset Management (Real losses)

Wmap GIS system

Wmap, Important Tool for water loss management

- Planning Pipe Replacement
- Data and Location of Pipe, Valve, Meter and Leak location etc.



Info Tool	
PIPE_ID	34
PROJECT_NO	124/37
ASSET_CODE	
PIPE_TYPE	AC
PIPE_SIZE	150
CLASS	20
PIPE_FUNC	2
LAYING	1
PRODUCT	9
DEPTH	0.0
LONG	235.27739452303
YEARINSTALL	2537
LOCATE	
PWA_CODE	5510213
REC_DATE	
PASSWORD	
REMARK	

Data of Pipe Layer
Pipe ID, Type, Diameter, Length, Pipe age

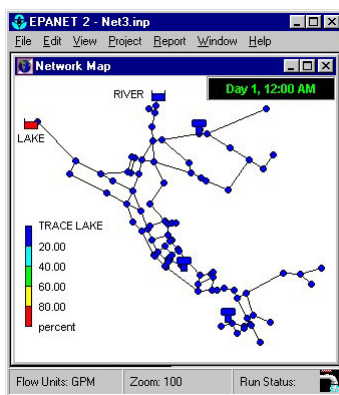


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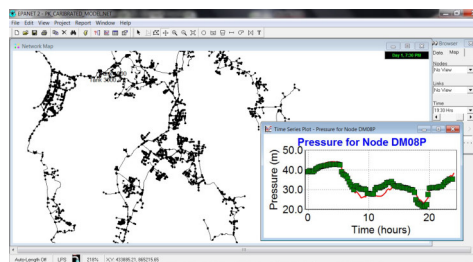
PWA Innovation For Pipeline and Asset Management (Real losses)

Hydraulics Model



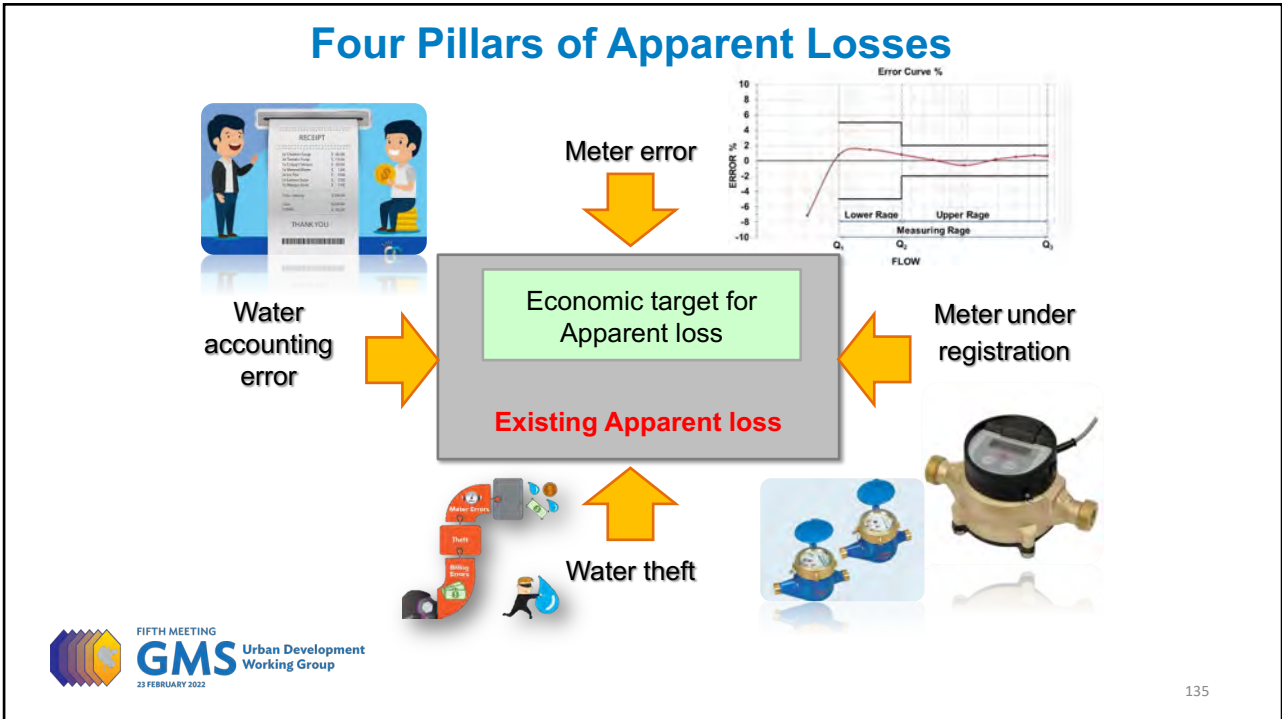
► Epanet : By United States Environmental Protection Agency

•EPANET is a software application used to model water distribution systems. It was developed as a tool for understanding the movement of water constituents within distribution systems, Ability to use pressure dependent demands in hydraulic analyses. Computes friction headloss using the Hazen-Williams, Darcy-Weisbach, or Chezy-Manning formulas. Includes minor head losses for bends, fittings, etc.



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PWA Innovation For Apparent losses

Meter Monitoring System

If any abnormalities are found, it can be detected immediately.

<https://rdmeter.pwa.co.th>

Instant image check

- Print a metric reading audit report from the system.
- Instantly validate data from the page image as of the random inspection date.

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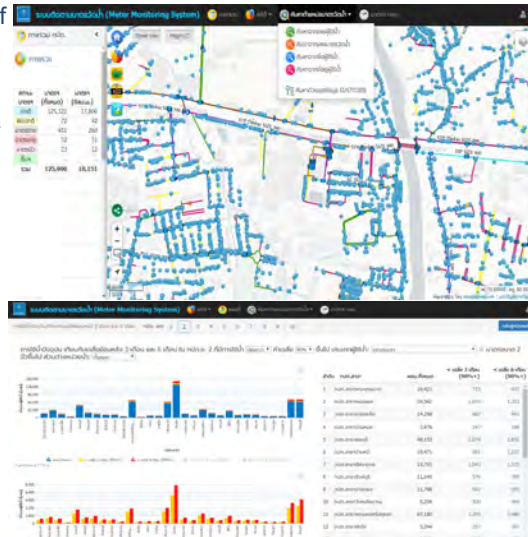
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PWA Innovation For Apparent losses

Meter Monitoring System

- Find the location and information of the water meter.
- It is used to analyze water loss using water usage statistics.
- Water consumption 0, 1-5, 6-10 m³ in the past 1-6 months.
- Compared Current water consumption and average water consumption rates for the past 3 and 6 months.
- Find Water meters aged 10 years and over.

<https://qisweb1.pwa.co.th/meterstat/>



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Stage of Leakage Control Work

Leakage control work

Decrease aboveground visible leakage

Decrease underground leakage
Decrease customer meter error and customer meter error



Prevent recurrence of leakage

Activity

Intensive repair activities,
Customer meter error replacement

Zoning, accurate piping maps, training & utilizing good quality equipment for detection,
Customer meter inspection and replacement



DATA, BUDGET

Increase in leakage control work,
starting replacement of deteriorated pipes, use of Ductile iron pipe.



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 การประปาส่วนภูมิภาค
Provincial Waterworks Authority

Thank You
www.pwa.co.th



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**Country Presentation:
Viet Nam**

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TECHNICAL INFRASTRUCTURE DEPARTMENT – MINISTRY OF CONSTRUCTION
 WATER SUPPLY MANAGEMENT DEPARTMENT

Smart Solutions in Management and Development of Vietnam's Water Supply

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I. Overview of Urban Water Supply

- Total design capacity: 11.6 million m³/day.
- Percentage of urban population supplied with clean water through **the complete concentrated** water supply system is 92% (over 95% in big cities).
- The rate of **unaccounted-for** water, **non-revenue water** reduced **at** 17.5%



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II. Urban Water Supply: Objectives & Solutions

- **Goals 2025:** Coverage rate: 100%; 120 liters/ person-day, 24/24h; TTTT rate < 15% & quality meets prescribed standards
- **Solutions:** (1) Water source; (2) Investment in development and management of water supply system; (3) Mechanisms and policies for the water supply sector; (4) Research and develop technology, materials and equipment for water supply; (5) Communication, training and human resource development; (6) Organization of management of water supply sector; (7) International cooperation; (8) *Building a water supply database.*

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III. Water Supply Management

State Management

- **Needs:** living, service, industry, agriculture and other uses
- **Water Management**
 - Water resources: surface water, ground water
- **Water production and business**
 - Extraction (from source) and treatment of water
 - Water transmission and distribution
 - Water supply service for consumers

*Water supply enterprise
Producing & trading in clean water*

Information technology applications

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IV. The need for IT application

- IT supports in all stages of water supply activities including: raw water extraction, treatment at water plants, transmission and distribution of clean water to consumers as well as in resource management, link and provide services.
- Smart water supply management requires a dynamic balance between **Supply** (to make the best use of increasingly scarce water resources) and **Demand** (to improve the efficiency of the entire clean water production and business process to meet needs of the people).
 - **Decisions based on information**

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V. IT application in O&M of Water Supply System

- Objectives: improve operational efficiency (resource utilization and allocation, cost, investment...), CNAT, energy saving, prevention of water shortages, improvement of customer service.
- IT application teams / software solutions
 - Water supply system database (integrated GIS)
 - SCADA software to control and monitor the device
 - Hydraulic computational model, water quality model
 - Asset management (operation and maintenance)
 - Customer management (invoices, electronic payments)
 - Website, business management and specialized applications...

IT infrastructure

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1. GIS database integrated with water industry

1. GIS creates an organic platform connecting with different sources of information – **georeferencing**
2. Meet needs and solve water industry challenges and improve efficiency by focusing on the problems :
 - Data management through integrated geospatial database system;
 - Analysis and planning based on aggregating tools, processing geographic analysis;
 - Workforce optimization with distributed databases and mobile applications;
 - Raise awareness in operating and serving customers through Web applications and in the cloud.

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2. Monitor device control (SCADA)

- Software for data collection and transmission
- Equipment control software (pump, smart valve ...)
- Applications of automatic sludge discharge, chlorine filling...
- Standalone application or integrated one in a SCADA system with a Web-based control center
- Integrate hydraulic models, water quality & other applications on GIS database platform.....

Inverter



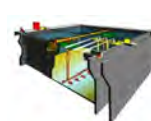
PLC



Smart valve



Datalogger



Mud scraper system



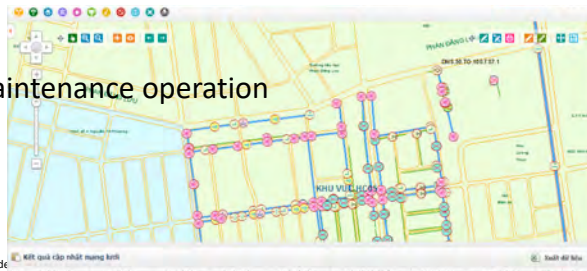
Clo System

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3. Water sector asset management

- Developing a database of assets of the water industry, including network of pipes, valves, pumps, network equipment...
- GIS-based integrated application
 - Database management with background GIS application
 - Asset Statistical Management
 - Inventory management
 - Planning and support maintenance operation
 - Statistics report

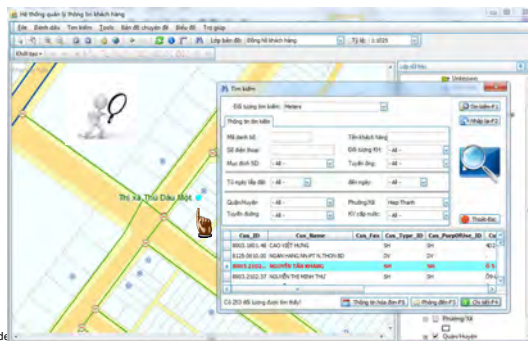


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4. Customer management

- Building customer database (& connection, customer's clock)
- Developing GIS-based applications
- Integration with applications use and convenience for customer service
 - Customer information channel (Web-based) – FEATURES FEEDBACK
 - Online Payment



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5. Operational management of water supply network

- The integrated application of GIS-SCADA-WaterGems optimizes the water supply system & prevents the loss of clean water.
- Building a GIS database - standard geodatabase form
- Hydraulic calculation model with WaterGems connected to GIS & SCADA
- SCADA system (dataloger) connect via SCADA connect
- Specialized applications WDMS, risk management...



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6. Overall Assessment : Efficiency and Challenge

- **Efficiency** for each specific management requirement - overall assessment is still limited and has not met expectations.
- Challenges:
 - **Data:** origin, availability (data sharing), data reliability & **standards**
 - Synchronization and compatibility between devices, the connection between software solutions & IT infrastructure
 - Limited resources, poor investment vision & difficult implementation
 - Business process, size and business management model
 - IT capacity, GIS, capability

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7. Roadmap of IT application in Water industry

1. Completing the urban water supply database & urban CNAT database with an institutionalized set of indexes.
2. Continuing in-depth research to build detailed overall IT application model for water supply enterprises.
3. Developing industry standards and industry data standards.
4. Technical support to develop the enterprise data connectivity modules and industry indicators.
5. Sharing experiences and building IT/GIS capacity
6. Developing and implementing the national program on IT application of water sector => national water sector information system

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VI. Policy on water supply development

1. Directive No. 34/CT-TTg dated August 28, 2020 on strengthening the management of clean water production and trading activities, ensuring safe and continuous water supply:
 - (a) Formulate the Law on Water Supply and Sewerage Management in 2022-2025;
 - (b) Building an online monitoring website on water supply index and clean water quality of water supply systems, implemented in the period 2021-2025.

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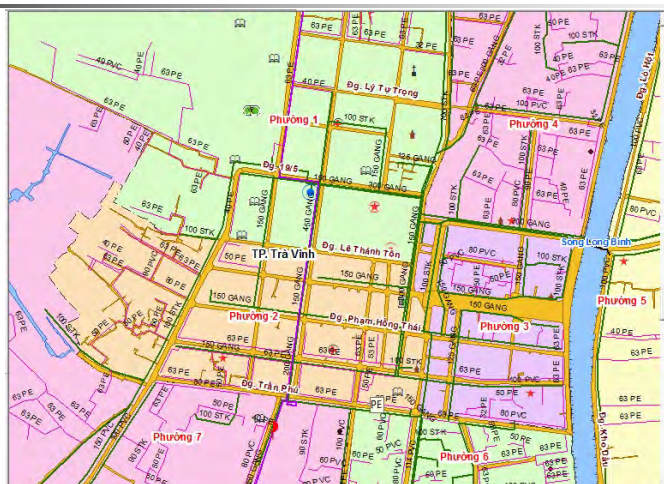
VI. Policy on water supply development

2. Circular No. 08/2012/TT-BXD **guiding the implementation of safe water supply**;
3. National program **for safe water supply during 2016 - 2025** in Decision No. 1566/QĐ-TTg dated August 9, 2016
4. Development orientations **for water supply for urban areas and industrial zones in Vietnam through 2025, with a vision toward 2050** in Decision No. 2502/QĐ-TTg dated December 22, 2016
5. National **unaccounted-for water, non-revenue water program to 2025** in Decision No. 2147/QĐ-TTg dated 24/11/2010

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