Managing Losses in Water Distribution Networks

An international strategy for an international problem

Malcolm Farley

Water Supply Management Workshop, Hue City, Vietnam
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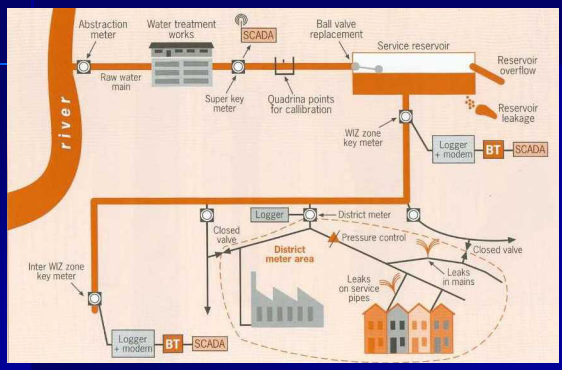
Dubai: 12 million litres of desalinated water in Wild Wadi Water Park

Calcutta, India: Mother bathing child

Water Loss Monitoring Points



Challenges and Limitations

- Resources - Water, Staffing and Finance
- Public v Private Sector
- Utility and Customer Perception
- Operation and Organization
- Policy Changes
- Social, Political and Cultural Issues
- Dependency Culture - Donors and Consultants
- Motivation and Skills
- Security
- Health & Safety

Developing a Strategy

The key to developing a strategy for any organisation is to:

- Ask some questions
- Select procedures and tools to find the solutions

The same applies to water loss management exception

Questions and Solutions

- How much water is being lost ?
  - Water Balance
- Where is it being lost from ?
  - Network Audit
- Why is it being lost ?
  - Review network and operational practices
- How to improve performance?
  - Strategy development
- How to sustain performance?
  - Training and O&M

IWA Water Losses Task Force

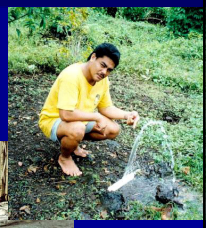
- International best practice
- Network of members involved in water loss reduction
- Focused activity groups
- Exchange of information
- Key actions for implementation
- Contributing to publications, workshops, and conferences

IWA Standard Water Balance

System Input Volume (corrected for known errors)	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water
			Billed Unmetered Consumption	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non Revenue Water
			Unbilled Unmetered Consumption	
	Water Losses	Apparent *(commercial)* Losses	Unauthorized Consumption	
			Customer Meter Inaccuracies and Data Handling Errors	
		Real *(physical)* Losses	Leakage on Transmission and Distribution Mains	
			Leakage and Overflows at Storage Tanks	
			Leakage on Service Connections up to point of Customer Meter	

Real or apparent losses?

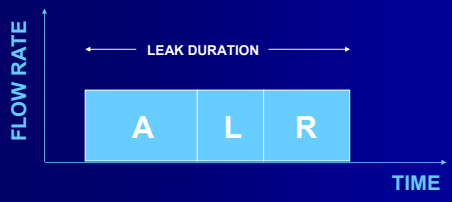
- How to prioritize?
  - Water Balance (how much and where?)
  - Analyze causes



Real loss component Analysis

Real Losses	Leakage and Overflows at Storage Tanks
	Background Losses
	Reported Bursts
	Unreported Bursts
	Excess or Hidden Losses

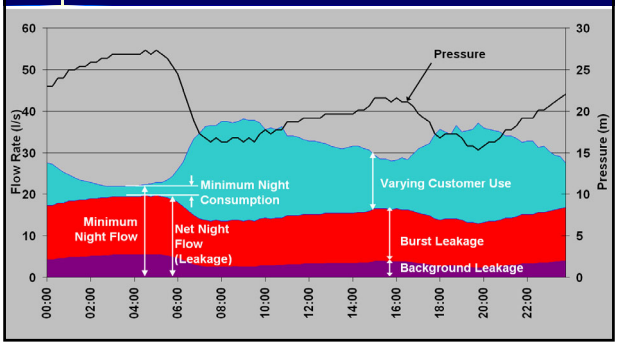
Leak Volume = Awareness + Location + Repair Time x Flow Rate

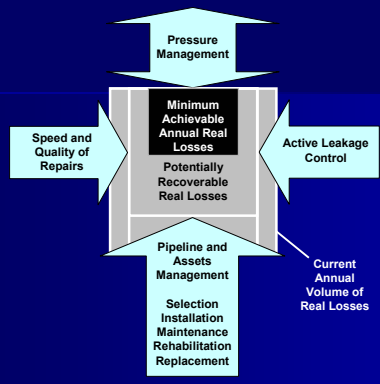


Bottom-up real loss assessment

- 24h inflow and pressure measurements
  - entire system (if small)
  - sample areas within the system
- Area data to be collected
  - length of mains
  - number of service connections
  - number of household properties
  - number and types of non-household properties

Zone inflow analysis



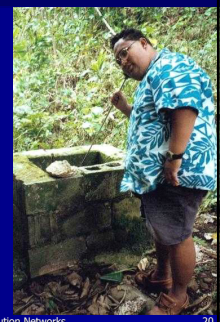


Network records and recording systems

- Update network plans and records
- Pipe location survey
- GIS

Review of network operating practices

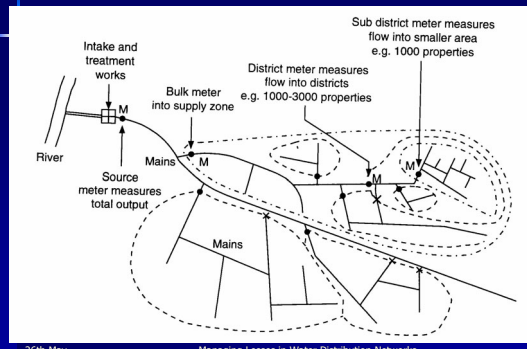
- Why is water being lost?
  - Management policy
  - Network characteristics
  - Operational practices
  - Technology and skills
  - Social and cultural influences



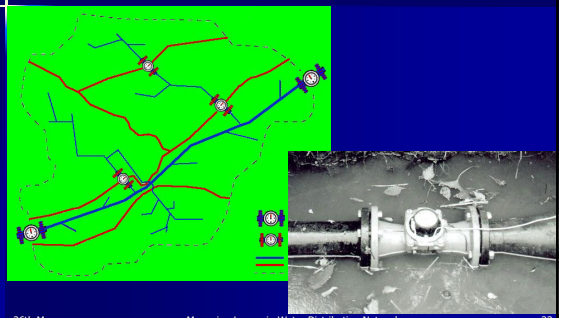
Improving the network

- How to improve the network?
  - Zoning (sectorization)
  - District Meter Areas (small zones)
  - Pressure management

Sectorization (Zoning)



District Metered Area (small zone)



Zonal Monitoring

- Volume of water
- Equivalent service pipe bursts
- Cost of lost water
- Prioritizing system
- Allows the operator to focus leak location effort to give most benefit

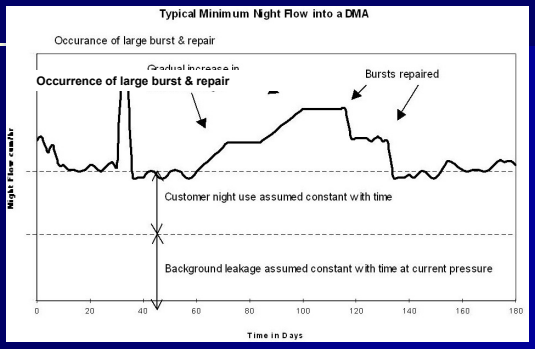
Design constraints and aids

Design constraints	Design benefits
■ network pressures	■ pressure testing
■ critical points	■ network model
■ too many closed valves	■ extra meters or re-design boundary
■ traditional values and reluctance	■ education and awareness training
■ intermittent supply	■ restore supply in pilot DMA

DMA (Zone) Maintenance

- Boundary integrity
  - record changes
  - mark boundary valves
  - educate staff!
- Plant and equipment
  - meter checks
  - instrumentation checks

Zone night flow data



Pressure management

- 'One-off' reduction in leakage
- Pressure Management Area (PMA)
- Design within DMA
- Cost beneficial
- Fast payback

Active leakage control

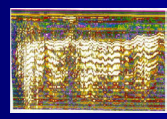
- Leakage monitoring (zones)
- Analysis of data
- Leak detection programs:
  - leak localizing (noise loggers)
  - survey (correlator/sounding)
  - leak location

Leak Localizing (noise loggers)

Leak Location (traditional)



Leak Location (new technology)


Infrastructure management and repairs


Illegal connections, theft and fraud



Customer meter under-registration

- Customer metering policy:
  - Measurement accuracy
  - Meter type
  - Installation procedure
  - In situ or workshop testing
  - Customer use pattern and plumbing (tanks filling, 'trickles and drips' etc.)

Billing and collection

- Tariff structure and charging policy
  - political/social factors
  - encourages demand management
  - low income concerns (health/hygiene)
  - can encourage damage and bypass
- Meter reading and revenue collection
  - integral part of strategy
  - supervision and checks

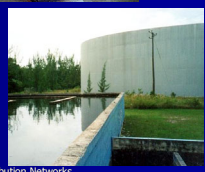
Maintaining the strategy

- Training and skills transfer
  - Workshops
  - Technology transfer
  - Field training
  - O&M programme

Case Study 1. Bahamas

Technical Problems

- Direct pumping into the system (6 PS)
- Fixed speed pumps
- No surge control
- Limited storage (~100 ML) and gravity supply
- Effect on burst rate



Issues for Improvement

- Additional sources
- Address pumping regime
- Increase storage
- Utilise cross-department skills
- Improve Quality Assurance and O&M policies
- Customer metering policy

Action Plan (1)

- Pressure Management
  - System Optimisation (PRVs, PCVs, SRVs, gravity flow)
  - Telemetry
  - Infrastructure Management
- Infrastructure Audit
  - GIS
  - Standards
  - QA/QC

Action Plan (2)

- Active Leakage Control
  - Monitoring and Testing Equipment
  - Meter Sizing/Calibration
  - NRW Reduction: Pilot Project / Performance-Based Contract
- Leak Repairs
  - Re-organisation
  - Establish standards
  - Outsourcing (internally/externally)
  - QA/QC
- Technical Assistance/Training

Project characteristics

- Duration: 4 years
- Reduction of real and apparent losses
- Outsourced to private contractors
- Total cost: US$ 27 M
- Includes establishment/refurbishment of 80 DMA zones and selective mains replacement

Conclusions

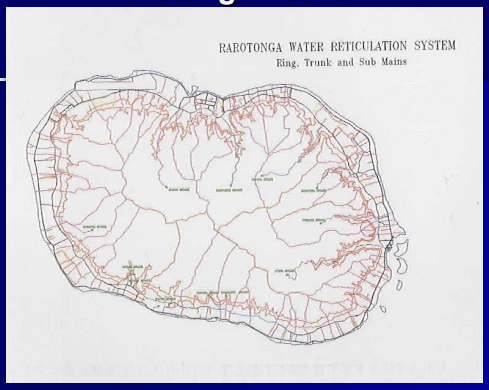
- Real losses can be calculated from top-down and bottom-up approach
- After knowing HOW MUCH? and WHERE FROM? the water loss reduction strategy can be designed
- Strategy addresses real and apparent losses
- Case studies demonstrate similar costs and benefits
- Strategy can be applied to any organisation anywhere in the world

Case Study 2. Rarotonga - Cook Islands

Rarotonga - main features

- **13 upland spring sources**
- **Limited storage (2.5 Ml reservoir)**
- **No active leakage control**
- **Coastal ring sub-mains, no zoning**
- **Some planned replacement**
- **High local and tourist demand (330-1000l/h/d)**
- **Successive drought years**
- **Planned pipe replacement and dammed valley augmentation**

Rarotonga network



Short and Medium Term Action Plans

- Bulk meters at sources
- Create source supply zones
- Use zones for water loss monitoring
- Set up customer use studies
- Set up pilot study areas
- Introduce leakage control teams
- Empower with equipment, vehicles and knowledge
- Conduct awareness seminars and training
- Plan network improvements while upgrading
- Plan water conservation programmes

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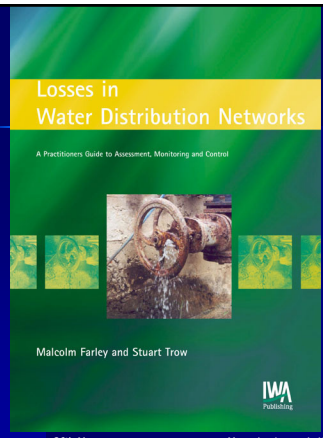

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