What is the Infrastructure Leakage Index (ILI) and how did Waitakere City Council manage to achieve an ILI of 1.0?

Presentation by Richard Taylor
Location of Waitakere City
Aerial view of Waitakere City
Overview of Presentation

- BenchlossNZ Project
- Components and Terminology of the Water Balance
- Infrastructure Leakage Index (ILI)
- Four Key Factors influencing water losses in distribution systems
- Initiatives Implemented at Waitakere City
- Management Aspects
- Summary
BenchlossNZ Manual and Software

• Project by Water Supply Managers Group (NZWWA)
• Initially published in April 2002 by NZWWA
• Updated in February 2008
• Introduced internationally accepted terminology including the water balance and ‘95% confidence limits’ for components
• Introduced water loss performance measures including the Infrastructure Leakage Index (ILI)
• National resource for assessing and benchmarking water losses
## Water Balance

<table>
<thead>
<tr>
<th>Own Sources</th>
<th>System Input</th>
<th>Water Exported</th>
<th>Billed Water Exported to other Systems</th>
<th>Revenue Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Supplied</td>
<td>(allow for bulk meter errors)</td>
<td>Authorised Consumption</td>
<td>Billed Metered Consumption by Registered Customers</td>
<td>Non-Revenue Water</td>
</tr>
<tr>
<td>Water Imports</td>
<td></td>
<td>Unbilled Authorised Consumption</td>
<td>Billed Unmetered Consumption by Registered Customers</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Unmetered</td>
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<td>Metered</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Customer Metering Under-registration</td>
<td></td>
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<td></td>
<td>Leak on Mains</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Unauthorised Consumption</td>
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<tr>
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<td></td>
<td></td>
<td>Leakage on Service Connections</td>
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<td></td>
<td>up to the street/property boundary</td>
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</tbody>
</table>

- **Water Supplied**: Authorised Consumption
- **Water Exported**: Billed Authorised Consumption
- **Billed Water Exported to other Systems**: Billed Metered Consumption by Registered Customers
- **Non-Revenue Water**: Unbilled Authorised Consumption, Unmetered Consumption, Customer Metering Under-registration, Leak on Mains, Unauthorised Consumption, Leakage on Service Connections, up to the street/property boundary
Infrastructure Leakage Index (ILI)

- Uses concept of ‘Unavoidable Annual Real Losses’ (UARL)
- Current Annual Real Losses (CARL)
- ILI = Ratio of CARL / UARL (dimensionless)
- CARL is calculated using the water balance
- UARL is determined using a simple empirical formula
  \[ \text{UARL} = (18 Lm + 0.8 Ns) P \]

where \( Lm \) is the length of watermains in km, \( Ns \) is the number of service connections, and \( P \) is the average operating pressure at average zone point in metres
Infrastructure Leakage Index (ILI)

The Infrastructure Leakage Index represents the level of water loss from a supply system (excluding leakage from private water systems) while allowing for the supply pressure of the system.

The other main Performance Measure for real water losses for ‘urban’ systems is: Litres/connection/day

For rural/low density of connections: Litres/km/day

**Note:** Percentage water loss should **NOT** be used as it relates water losses to consumption
International Infrastructure Leakage Index (ILI) Results

New Zealand (5) Australian (17) and European (22) Cities
Current Annual Real Losses

Infrastructure Leakage Index ILI = CARL/UARL

Pressure Management

Unavoidable Annual Real Losses

Speed and Quality of Repairs

Active Leakage Control

Pipeline and Assets Management: Selection, Installation, Maintenance, Renewal, Replacement
Four Key Factors influencing Water Losses in Distribution Systems

• Speed and Quality of Repairs
• Pressure Management
• Active Leakage Control
• Pipeline and Assets Management: Selection, Installation, Maintenance, Renewal, Replacement
Water Loss Initiatives undertaken in Waitakere City since 1990

- Setting up and Monitoring of Discrete Supply Areas
- Active Leakage Control
- Pressure Management

Also:
- Speed and Quality of Repairs
- Pipeline and Assets Management: Selection, Installation, Maintenance, Renewal, Replacement
Setting Up and Monitoring of Discrete Supply Areas

- Bulk water to Waitakere City is supplied through approximately 30 Watercare bulk supply points (BSP’s)
- Telemetry system was used to monitor flows ‘real time’ using pulse units on existing Watercare bulk meters at BSP’s
- Supply areas were set up in the early 1990’s based on monitoring Watercare ‘Bulk Supply Points (BSP’s)’
- 17 main supply zones were set up in Establish ‘benchmarks’ for MNF for each zone – either based on number of properties and length of mains (UARL) or ‘best achieved’
Setting Up and Monitoring of Discrete Supply Areas

- Telemetry system was used to monitor flows ‘real time’ using pulse units on existing Watercare meters at Bulk Supply Points (BSPs)

- Supply areas were set up in the early 1990’s based on the location and supply pressure of the BSPs

- 17 main supply zones were initially set up. Now with pressure management, 34 discreet areas (District Metered Areas or DMAs) are monitored
Active Leakage Control

• Use real time monitoring of minimum night flows (MNF)
• Establish ‘leakage thresholds’ for MNF for each zone
• Target leak detection in supply zones with high MNF
• Reduced Leak Detection Programme costs – from $250k to $80k pa.
• Performance based leak detection contract
• Utilise new technologies eg noise loggers
Pressure Management

• **Approach**
  - Permanent system rezoning to reduce maximum pressures;
  - Cascade approach - creating pressure zones according to topography;
  - Created additional District Metered Areas with minor reticulation works;
  - Used basic Pressure Reducing Valve - fixed outlet pressure option.

• **Criteria**
  - Retain existing level of service: pressure 250 kPa & flow 25 l/min;
  - Statutory requirements - NZ Fire Service Code of Practice; and
  - Considered existing fire sprinkler requirements.
Example of Cascading – Zone 5
- Supply Point At Top Of Zone -

Pressure Reducing Valve
Without Pressure Management
With Pressure Management

Kelston | Glendene | Te Atatu South | Te Atatu Peninsula
--- | --- | --- | ---
65m | 75m | 65m

Static Pressure
Dynamic Pressure
Pressure Reducing Valve Installation
Speed and Quality of Repairs

- High awareness of ‘leaks’ in Waitakere City
- Clay soils assist in identifying leaks
- Real time reporting for maintenance work

Asset Management System and Renewal Programme

- Asset information and system (Hansen AMS) used to identify mains requiring replacement
- Effective watermain renewal programme
Infrastructure Leakage Index ILI = CARL/UARL

Current Annual Real Losses CARL

Speed and Quality of Repairs

Pressure Management

Unavoidable Annual Real Losses

Active Leakage Control

Pipeline and Assets Management: Selection, Installation, Maintenance, Renewal, Replacement

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Reduction in Real Water Losses in Waitakere City

Waitakere City - Level of Real Water Losses

[Graph showing water loss over years]

Water Losses - Litres / Connection / Day

Year

92 / 93 93 / 94 94 / 95 95 / 96 96 / 97 97 / 98 98 / 99 99 / 00 00 / 01 01 / 02 02 / 03 03 / 04 04 / 05 05 / 06 06 / 07 07 / 08

[eco city logo]
Management Aspects

• Culture for Change
  Eco City, Culture of promoting innovation and change
  Council’s Mission Statement – Open, Dynamic, Just

• Catalyst for Change
  1993 Water Shortage
  Allan Lambert’s visit to Auckland in 2000
Management Aspects continued

• **Commitment to Change**
  Commitment by dedicated staff over a long period
  Support of management

• **Structure for Change**
  Bulk/retail split & metering facilitated the monitoring programme
  The ‘size’ of Waitakere’s network and staffing levels encouraged innovation
Summary

- The Infrastructure Leakage Index (ILI) is a very useful performance indicator for comparing water losses between water distribution systems.

- Waitakere City Council has been very successful in reducing water losses since 1990 by implementing a number of initiatives.

- Waitakere City has achieved and maintained an ILI of 1.0 which is considered to be a ‘world class’ standard.

Thank you