Sustainable District Metering

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Introduction

District Metered Area (DMA) management is a well proven technique which when implemented correctly in conjunction with other measurers can effectively assist reduce or monitor leakage levels with the distribution network.

The technique as currently practised has been utilised for over 25 years. DMA management is basically the measurement of flows into discrete parts of the network and the subsequent analysis of the flow particularly at night to estimate the level of leakage (typically the night flow into an area minus the assessed customer night use) and determine the level leakage that can be reduced.

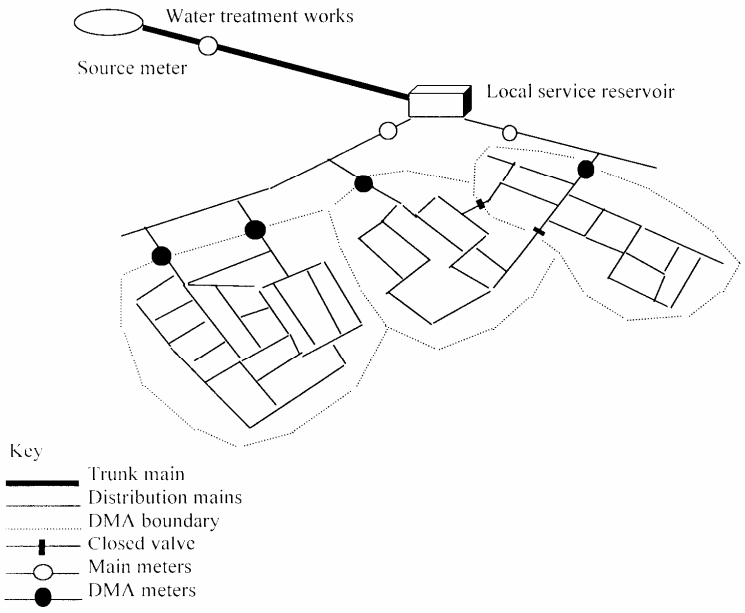

Figure 1: typical flow monitoring and DMA configuration

The use of DMAs has proved suitable for leakage control with many differing network configurations, irrespective of whether the customers are unmetered or metered and on both continuous and intermittent supply systems. One American network, which has a Customer Automatic Meter Reading System that allows for customer meter readings during minimum night hours, is linking actual customer consumption at night to DMA night flow to enhance the leakage analysis. (Philadelphia Water Department)

In combination with other techniques (such as pressure management, free/subsidised quick repair of bursts on private supply pipes, etc.), DMA management has helped the water industry in England and Wales reduce leakage significantly and one company has reduced leakage by nearly 50 percent over 10 years (Figure 2).

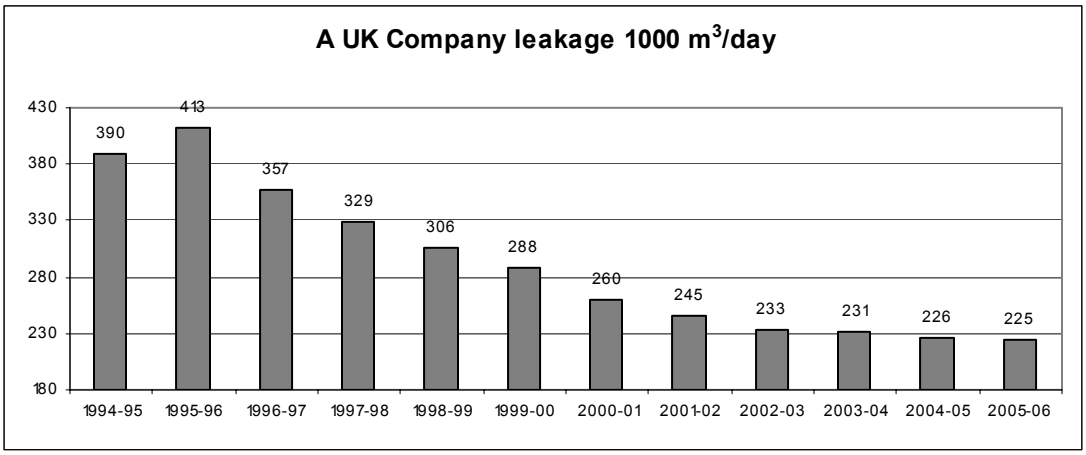

Figure 2. An example of how a UK water utility has reduced leakage by DMA management

Examples of the successful implementation of DMAs, and the subsequent reduction of leakage, are not confined to the UK, and the DMA Guidance Notes publishes examples from:

- **El Dorado Irrigation District, California, USA**
- **California, USA**
- **Water Board of Lemesos, Cyprus**
- **Johore, Malaysia**
- **Halifax Regional Water Commission, Canada**
- **Jakarta, Indonesia**

Over the last 20 years or so various key international documents have been published which aim to improve water loss management. These are:

1980 Leakage Control Policy and Practice (Report 26), UK [(1)]
1985 District Metering: Part 1: System Design and Installation, UK[(2)]
1987 District Metering: Part 2: System Operation, UK[(3)]
1994 Managing Leakage Reports, UK[(4)]
1999 A Manual of DMA Practice, UK[(5)]
2001 Leakage Management and Control, WHO, Geneva[(6)]
2002 Losses in Water Distribution Networks, UK[(7)]
2004 Managing Leakage by District Metered Areas, UK[(8)]
2005 Managing and Reducing Losses from Water Distribution Systems, Australia[(9)]
2006 Water losses control in drinking water systems, Portugal[(10)]

2007 Leakage Management Technologies, AWWA[11]

The latest publication, from the IWA Water Loss Task Force (WLTF), is "DMA Guidance Notes", available as a download from the WLTF web site www.iwaom.org/wltf. The Guidance Notes are intended as an introduction for leakage practitioners to the benefits, design and management of active leakage control activities based on the use of DMAs. It is part of a series of Guidance Notes prepared by the WLTF to cover all aspects of Water Loss Management.

Sustainable DMA Management

DMA management is only successful if it is introduced as part of a total sustainable package, as the technique is part of a permanent long-term strategy to monitor, reduce and control leakage. Often this long-term commitment is not well understood and planned for.

For the technique to be sustainable three key conditions have to be created:

- Commitment from key decision-makers within the utility
- Adequate technical understanding
- The organisational and information systems

Commitment

Many words have been written about how to persuade an organisation to accept new practices. However, the basic requirement is to develop a convincing argument in favour of change, and this should be soundly based on engineering principles and facts. In the utility there should be a long-term commitment at director level to the strategy, a clear understanding of what is required and the financial implications. This commitment should be cascaded down throughout the utility and the key requirements identified, to enable commitment and enthusiasm for the total package at all levels.

Unfortunately there are many instances where trial DMAs have been introduced into a utility, but in the long term these have not been successful because not all of the requirements to ensure sustainability have been put in place. DMA management is often considered as just the creation of areas that can be measured.

However, there are numerous examples of utilities where DMAs have been implemented successfully. These demonstrate that the technique can be sustained, and the IWA DMA Guidance Notes illustrate examples of these successes. There are also some simple but persuasive mathematical and economic models to illustrate the benefits of DMAs in practice.

Technical Understanding

The development of the 'BABE' (Background and Bursts Estimates) component analysis of leakage (Lambert, 1994) [12] has been a big contribution to the technical understanding and analysis of leakage. It enables the interaction of activities such as run time of bursts, and the pressure and size of DMAs to be understood. This technical understanding was further enhanced by the FAVAD (Fixed and Variable Area

Discharges) concept (May, 1994) [13], which allowed different BABE components of Real Losses to be assigned different pressure flow relationships, leading to the ability to separate 24-hour DMA inflow data into components. Figure 3 illustrates the diurnal flow pattern and the components of night flow.

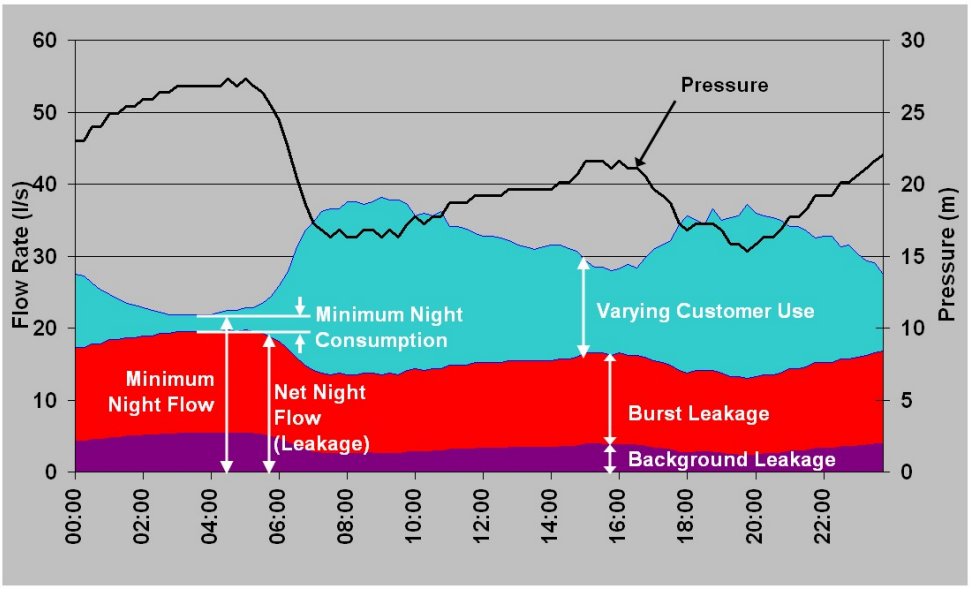

Figure 3. Components of night flow

For successful implementation, this technical understanding needs to be spread to a number of people within the organisation. To achieve this, a training programme will be required, tailored to the needs of the different departments and skill levels within the utility.

Good technical understanding of the issues also leads to good design. The initial design contributes to the sustainability of the DMA. The design should consider pressures, topography, size of DMA required and a good understanding of how the network is operated, with practical considerations. If these factors are considered there is no reason why the basic configuration of the DMA cannot be permanent - many of the DMAs set up some 20 years ago still function today as originally designed.

Systems

With this technical understanding it is possible to develop the systems required to make the DMAs sustainable. The criteria for this would typically be.

- Data flow capture
- Data storage and analysis of flows
- Work management
- Mapping of network GIS
- Customer records
- DMA maintenance

With the correct systems in place it is possible to have effective analysis of flows to direct leakage technicians to the most effective areas to carry out location and repair of bursts.

As each of the systems and methods are developed and enhanced, training should be seen as an ongoing commitment as new staff are recruited, systems developed and enhanced and new equipment becomes available to undertake the various tasks. Figure 3 summarises all the requirements, and their interaction, for system sustainability.

DMA management as one of the tools to monitor and control leakage must not be seen as a 'quick fix'. It is a long term commitment, which, if implemented correctly with a full understanding of the sustainable issues, can be one of the most effective measures to safeguard the planet's most precious resource.

Integration

To insure that the DMA management is sustainable it is necessary to make sure that the systems and leakage methodologies are total integrated to develop the leakage strategy. In many instances DMAs have been designed and set up but have not been maintained or the additional requirements put in place, as a result the potential technique of DMA management has been considered a failure to deliver a system to manage leakage going forward or the full benefits of low leakage levels have not been achieved.

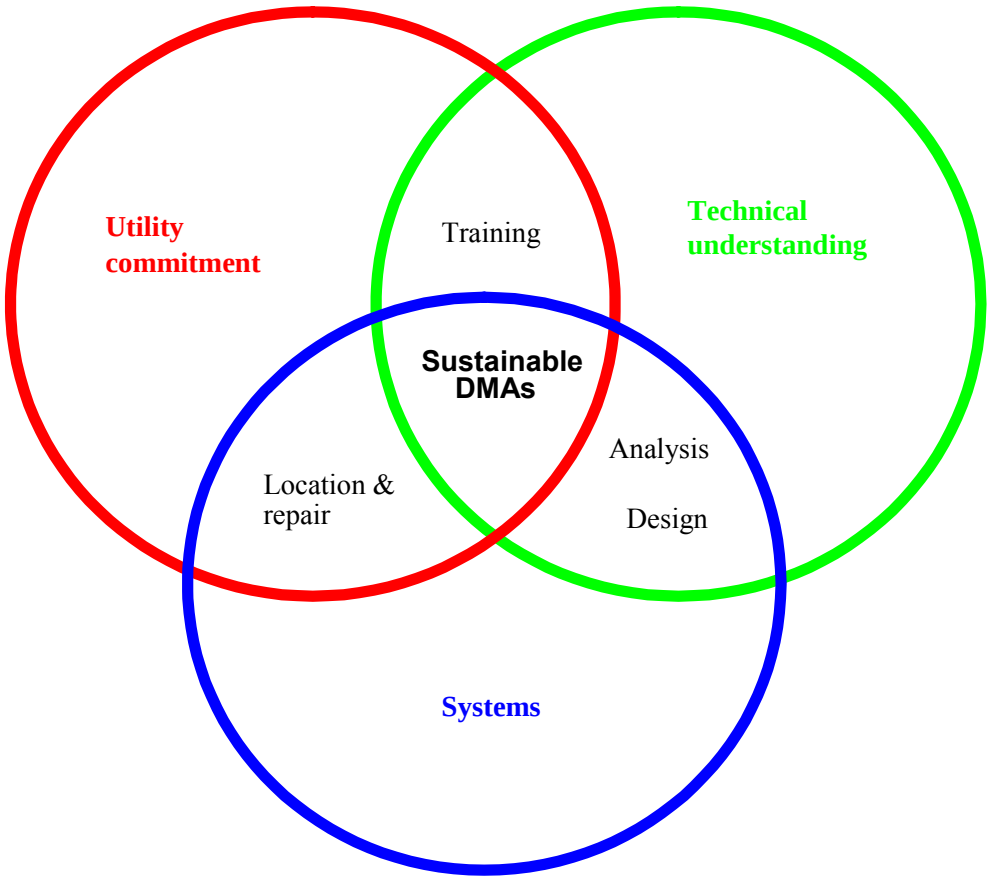

Figure 4. Requirements for system sustainability

The Way Ahead

For utilities there is an ever-growing range of software, equipment and techniques that are promoted as the way ahead. In reality each piece of software, equipment or technique is one of many tools available in the leakage control toolbox, which need to be evaluated for a particular application and used in conjunction with other tools.

Clearly with so many techniques equipment and software available one of the issues for the Leakage Task Force is to develop guidance notes with the aim to identify when the various techniques and tools are best utilised and how these should be integrated into the overall methodology for the utility to manage leakage.

This could be developed as an initial methodology to determine for a particular utility the broad way ahead to manage leakage. Based on a series of options and guidance as to when each technique should be utilised similar to the IWA the actions on leakage based on the International Leakage Index ILI that has been develop by the Task Force.

Table 1 IWA Leakage Task Force Summary of leakage options based on ILI

Band	ILI Developed countries	ILI Developing countries	Summary of potential actions
A	1 - 2	1 - 4	Options for further pressure management? Reduction in run time of burst? Determine economic level of leakage
B	2 – 4	4 - 8	As band A Identify options for improved leakage control
C	4 – 8	8 - 16	Pressure management review Improve speed and quality of repairs Introduce / improve leakage control Develop 5 year plan to achieve Band B
D	>8	>16	Peer review Likely poor utility management Identify changes in utility structure Develop 5 year plan to achieve Band C

For each of the systems that are required to run behind the scene to make DMA management sustainable a basic statement of requirements could be developed to give initial guidance as to what is required from each system. Clearly in the delivery of a

proprietary system several systems can be merged into one. In particular a mapping GIS system could provide many of the requirements.

For the utility there are also the choose of how many of these resources are provided and resourced i.e. increasingly specialist companies are offering services that range from

- Consultancy services to determine way ahead for leakage management
- Consultancy services to develop systems
- Consultancy services to design and implement leakage strategies
- Data capture and validation of flow and pressure data
- Burst leak location
- Network repair

For each of these activities there are advantages and disadvantages to buy in services and clearly part of this analysis will depend on skill levels within the utility.

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