China – UK, WRDMAP
Integrated Water Resources Management Document Series

Advisory Note 3.3/1: Implementing an Active Leakage Control Programme for Small to Medium Size Water Supply Companies

3. Demand Manage-ment

May 2010

Sounding in progress

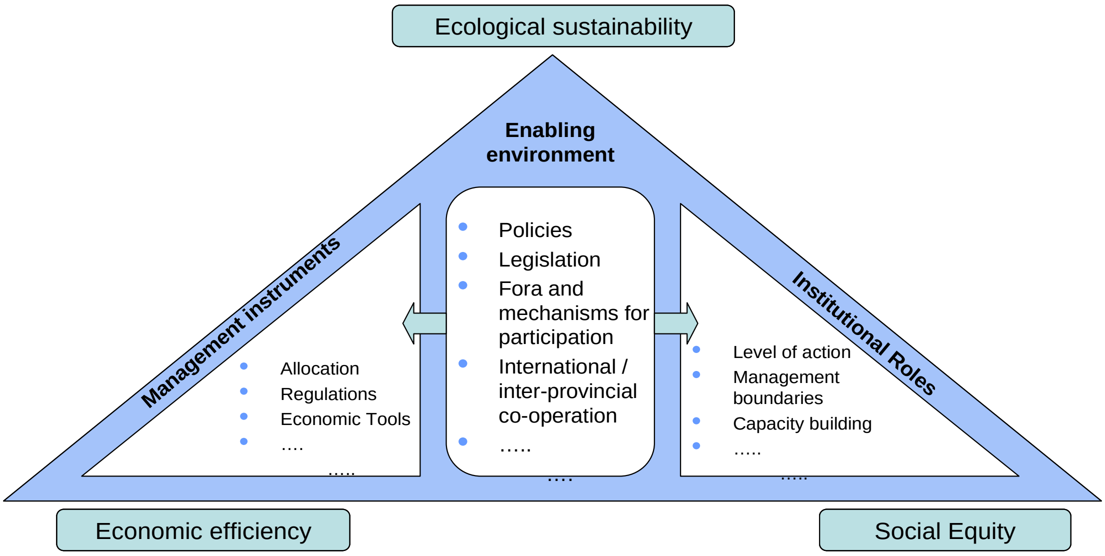
中国水利 CHINA WATER

DFID Department For International Development

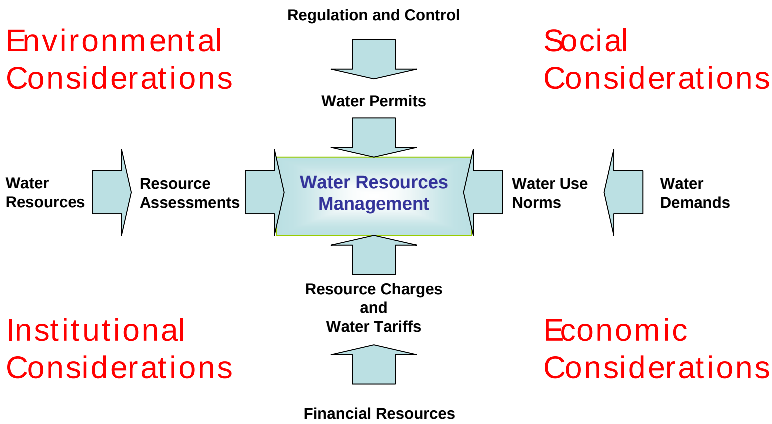
Mott MacDonald

Integrated Water Resources Management (IWRM)

(Basics after Global Water Partnership)



Driving Elements of Integrated Water Resources Management



(Second figure after WRDMAP)

Summary: Where there is competition for scarce water resources, eg for irrigation, industrial and domestic demands, and the nature of the water supply system incurs significant operating expenditure, such as power for pumping, then an **active leakage control** policy is likely to be appropriate. This is expected to be the case for water supply companies in China.

This document covers the following topics:

- Introduction
- Planning an active leakage control programme
- District meter areas – planning, design and establishment
- Assessing leakage levels and leak detection intervention
- Introducing leak detection activities
- Managing the leak repair programme
- Leak repair response times
- Assessing performance
- Supporting documents:
    - Leak detection / repair reporting – example form
    - Leak detection / repair database – example sheets
    - DMA operational costs

This document is one of a series covering topics on sustainable water resources planning, allocation and management. Details are given in the bibliography. It should be read in conjunction with the Active Leakage Control Manual in the same series.

The Ministry of Water Resources have supported the Water Resources Demand Management Assistance Project (WRDMAP) to develop this series to support WRD/WAB at provincial, municipal and county levels in their efforts to achieve sustainable water use.

1 Introduction

1.1 Policy drivers

Recognizing the impacts of rapid urbanization on the environment, the government has initiated reforms to address infrastructure and resource constraints concerning urban water. Water conservation and water use efficiency have been strongly promoted with the introduction of the Water Saving Society policy. These demand management approaches are particularly relevant in the water short cities of northern China.

Box 1 Demand management

Water demand management aims to reduce the wasteful use of water in order to meet objectives of economic efficiency, social development, social equity, environmental protection, sustainability of water supply and services, and political acceptability.

As supply-side solutions become exhausted, water supply companies (WSCs) will, increasingly, have no choice but to apply demand management in order to balance the future demand with available resources. Active leakage control is a key component of demand management for urban supplies.

Further discussion of demand management approaches for urban water supplies can be found in the Thematic Paper 3.2 in this series.

1.2 WSC business case for active leakage control

WSC management are concerned with the overall profitability of their company and meeting statutory requirements.

Leakage is seen as a waste of a precious resource – water, and of course money because the water lost has been abstracted, treated, and possibly pumped through the WSC network before being lost from the system.

Leakage from the WSC's pipe network is potential lost revenue. If the WSC is unable to meet all present demand then the leakage represents a lost opportunity to improve coverage or increase period of supply and, hence, increase revenue. Reducing leakage from pipe networks can delay the need to invest in new water sources to meet rising demand, or existing demand where demand is not satisfied.

The objective of leakage control is **not** to eliminate all leakage (which would be prohibitively expensive), but to **maintain leakage at an acceptable level which can be justified on economic terms**. The WSC management must assess the costs of controlling leakage to determine this *acceptable* level.

Setting leakage control targets requires consideration of:

- Economic leakage level – the optimum between cost and benefit
- Practicality in terms of data needs and implementation
- Sustainability in the long term and flexibility in the short term
- Consistency with the WSC's water resources plan
- Social and political aspects

Clearly cost-benefit analysis is important to target setting but other factors, often external to the WSC, should not be neglected.

The recommended best practice approach, **active leakage control**, necessarily demands human and financial resources in order to achieve the required leakage reduction.

An organisational structure needs to be established to manage the leakage control activities. Staff must be made available and committed to the continual monitoring and maintenance of leakage control procedures and processes.

> The support and guidance of senior WSC management is essential to achieve successful implementation of an active leakage control policy.

1.3 Active leakage control

Leakage within a WSC's distribution system is inevitable, given the task of containing pressurised water within underground pipelines. The initial integrity of distribution systems is dependent on good design, quality of materials and standard of installation, but even the best system will suffer some losses. Then, inevitably, losses will increase over time: joints tend to leak over time, pipes corrode, ground movement disturbs pipes and there is always the possibility of accidental damage.

Active leakage control continuously monitors network leakage levels to maintain them at acceptable levels and to actively detect leaks when the leakage level rises above the acceptable level.

National targets have been set for leakage minimisation (Box 2) but these represent a major challenge to WSCs, especially those with aging or poorly maintained distribution systems and those in weak financial circumstances.

Box 2 China leakage minimisation targets

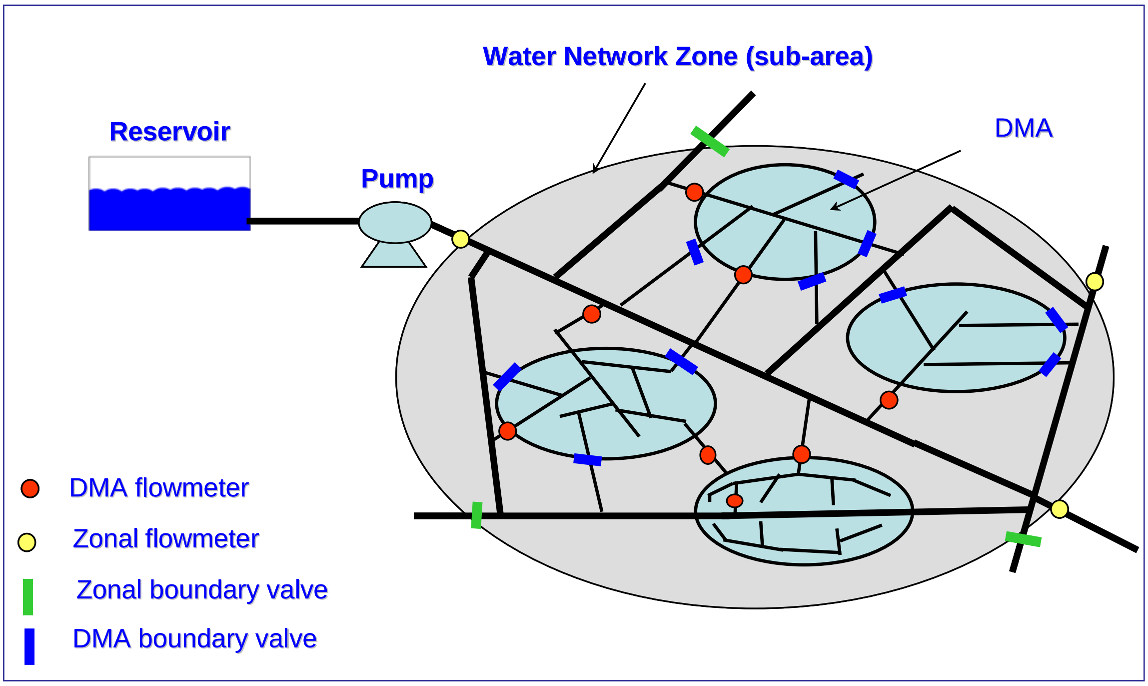
Leakage control standards for Urban Water Supply Pipeline Networks have set the allowable leakage rate at no greater than 12% of distribution input, with an adjustment of -2% to +3% depending on the length of network and water quantity supplied.

Source: Ministry of Housing and Urban-Rural Development, Standard CJJ92-2002

However, it should be noted that losses in the customer's pipes and controls may be significant contributors to overall leakage (in excess of 25% in many cases). This presents a difficulty for target setting and monitoring progress of an active leakage control programme, as well as creating noise that disrupts leak detection activities. For many WSCs it would be cost effective to assist customers to locate and repair such leaks even though it is not their responsibility. Further information on international best practice with regard to dealing with leakage from customer pipe systems is given in Thematic Paper 3.3 'Active Active Leakage Control as a Key Component in Increasing Efficiency in Urban Water Supply'.

Active leakage control is normally based on the concept of district metering whereby relatively small hydraulically defined areas are established, their inflows and, where applicable, outflows metered. These areas, known as **district meter areas** (DMAs), are a management tool to allow a structured approach to the determination of leakage levels in each DMA and, hence, the full pipe network. The DMA concept is illustrated in Figure 1.

Figure 1 District meter area (DMA) concept



2 Planning an Active Leakage Control Programme

Active leakage control involves configuring the pipe network into discrete areas and managing them for the purposes of measuring leakage levels and focussing leak detection where leakage is highest. This requires a good knowledge of physical assets such as pipes and fittings. Where this knowledge is missing or only partially complete, asset surveys and the location of pipes is a fundamental task vital to successful implementation of an active leakage control programme.

Pipe and other asset data are usually stored within a Geographical Information System (GIS). The GIS is used to make a preliminary identification of areas of the network that may be suitable for District Meter Areas (DMAs) in which supply and consumption levels are monitored.

Further information on asset management systems and GIS can be found in Advisory Note 3.3/2 'Asset Management for Small or Medium Size Water Supply Companies'.

DMAs are a management tool to allow a structured approach to the determination of leakage levels through an analysis of non revenue water (NRW) in each DMA.

> Non revenue water= Water supplied into the DMA *minus* Water billed and paid for
>
> [a high NRW level is normally indicative of a high level of leakage]

When DMAs cover the majority of a pipe network they represent a powerful operational management tool for monitoring the distribution network. Analysis of the network performance indicators allows the leakage control staff to focus on those parts of the network where leakage is shown to be highest.

Generally, DMA sizes range from 1,000 to 5,000 customer connections. DMAs can be established in most distribution networks although careful design and on-site testing of the design needs to be undertaken. There needs to be due regard to the maintenance of appropriate levels of service, eg. maintaining adequate supply pressures to all customers. This may require the installation of new pipework and valves to improve the water distribution within the DMA.

Leak detection comprises procedures for targeting and detecting leaks. **"Targeting"** is the process whereby the area of interest for leak detection is narrowed. **"Detection"** is locating the specific leak site.

There are several techniques commonly employed to target and detect leakage. All are reliant on the presence of 'leak noise' as the means of detecting and locating leaks through the use of equipment that picks up leak noises and, in some cases, can locate the leak location to within a few centimetres.

A prerequisite to leak detection is often the need to trace unknown or poorly documented underground pipes. Pipe location is, therefore, an integral part of leak detection.

Suggested steps in introducing an active leakage control programme where only reactive repair previously undertaken

1. Identify the scale of the problem

- Network audit
- Non-revenue water cost

2. Choose the pilot DMAs and carry out design and procurement
   - Confirm location of assets by field work if necessary
   - Assess likely scale of customer leakage
   - Procure equipment and arrange training
   - Design all necessary works
3. Create the pilot DMAs
   - Install valves and meters
   - Test to confirm hydraulic isolation
   - Monitor flows in and out of DMAs for a period to establish baseline
4. First round of active leakage control
   - Leak detection work
   - Follow up repair work
5. Evaluate progress
   - Monitor flows in and out of DMAs for a period to determine leakage reduction achieved
   - Improve processes
   - Set initial targets
6. Ongoing active leakage control
   - Monitor leakage against targets
   - Monitor costs
7. Plan roll out to more of the WSC distribution network

Pilot testing on a small number of DMAs will allow staff to become familiar with the set up and operation of active leakage control programme. Procedures can be refined before the programme is expanded.

3 District Meter Areas – Planning, Design and Establishment

DMA planning begins with an assessment of available data about the pipe network. The quality of these data will dictate the rate at which the design process can proceed. A GIS containing a full and accurate record of the pipe network and a network modelling capability are required to assist with the design of DMAs.

The DMA must be of manageable size, but contain enough properties to support the cost of establishment and optimise the leak location effort. The DMA boundary must be defined taking account of geographical features such as rivers, main roads, railway tracks, etc. which will assist in the preliminary identification of the boundaries.

The number of properties within a DMA should be within the range 1,000 to 5,000 wherever possible. A typical size would be 2,000 to 3,000 properties.

The effect of setting up each DMA must be critically examined to ensure no detrimental effect on levels of service to customers, either within a particular DMA or external to it.

Sizing of flowmeters are important. The likely flow range must be established for each DMA inlet point (and outlet point, where applicable) with flowmeters sized to accurately measure minimum and maximum flow rates. Where possible, DMAs should be arranged to avoid cascading (one DMA feeding the next, and so on). Once installed, flowmeters should be tested to verify they have been sized correctly.

The number of valve closures needed to set up the DMA should be minimised. Suitably located existing valves should be used, or new valves installed where necessary.

Each DMA must be tested to ensure adequate pressure is available at peak demand times.

The manpower and equipment required for the establishment of a typical DMA, whatever the individual circumstances of the area selected, are detailed in Table 1.

Table 1: Typical requirements for setting up a DMA

Item	Comments
DMA design	Hydraulic design: 20 man-days (includes network modelling and assumes the pipe network has already been loaded onto a GIS)
DMA testing	Pressure test: 5 man-days Isolation test: 5 man-days Data loggers (pressure only - internal transducers): 5 no.[(1)]
Flowmeter	1 no. flowmeter if the DMA can be isolated by valving and does not ‘cascade’ into other DMAs (2 or 3 flowmeters may be required depending on configuration of the DMA inflow and outflow pipework)
Flow and pressure data loggers[(2)]	One data logger at each flowmeter to measure flow and pressure plus one data logger to measure pressure at the critical point[(3)] in the DMA (for customer supply pressure monitoring)
Chambers / above ground cabinets for data loggers	Chamber for each flowmeter and pressure transducer at critical point plus suitable above ground cabinet for each data logger
Minor works	New valves and connecting pipework (quantities depend on the DMA pipe network configuration) to establish the hydraulic separation of the DMA and maintain acceptable pressures within the DMA
Estimated cost	RMB 150,000[(4)]

(1) One set of data loggers to cover all sites required for DMA establishment

(2) Data loggers - dual channel (external flow transmitter plus internal pressure transducer)

(3) A critical point is a point of reference within a DMA which is used to measure customer supply pressure, as an indication of service. This could be at the highest point of a DMA and the installed data logger would register pressure below a minimum – or critical – level.

(4) Estimated at 2008 prices, based on WRDMAP case study pilot DMA in Beipiao, Liaoning Province. Cost may differ significantly from this estimate depending on the extent of the minor works.

DMA designs must be verified on-site by checking all data relevant to the successful hydraulic isolation of the DMA. Those valves identified as necessary for isolation, known as Boundary Valves, must be positively identified and proved to be capable of water tight closure. Network connections should be verified on site and through consultation with WSC operational staff.

Hydraulic separation of the DMA and maintenance of acceptable pressures within the DMA may require new valves and connecting pipework (quantities will depend on the DMA pipe network configuration and available pressure).

More detailed guidance on the design of DMAs is given in the accompanying Manual 3.3 'Active Leakage Control Manual'.

4 Assessing Leakage Levels and Leak Detection Intervention

The primary aim of monitoring DMA flows is to determine the leakage level in the DMA. By comparing leakage levels in all DMAs those with leakage levels above target levels can be selected for leak detection. The use of DMAs allows leak detection resources to be used efficiently by deploying them in areas where leakage is highest. In any DMA leakage can be determined either by reference to the minimum night flow and net night flow or by an integrated approach.

Minimum night flow and net night flow

A particularly important use of flow data within a DMA is the measurement of the minimum flow, which usually occurs at night. This measurement is known as the minimum night flow (MNF) and is used to determine the DMA leakage level. As there is very little domestic use of water at night, in residential areas any significant MNF is often leakage and, therefore, high MNF measurements should be examined to ascertain the source of the high flow. As the MNF will contain some element of legitimate use, an allowance is made for known and estimated use. MNF minus these allowances is Net Night Flow (NNF). NNF is the most immediate measure of leakage level within a DMA and a high NNF above the intervention level should prompt immediate leak detection and repair. (Box 3 illustrates such a calculation.)

> Box 3 Pilot DMA testing in the Tianyuan Community, Beipiao County
>
> The minimum night flow (MNF) calculation at 02:46 on 19 July 2007 was:
>
> DMA Inflow (meter 1) = 75.3 m^3/h
> DMA Outflow (meter 2) = 4.0 m^3/h
> DMA Outflow (meter 3) = 10.4 m^3/h
> Therefore, MNF = 60.9 m^3/h
>
> [Pressure = 620 Kpa (63 m)]
>
> The MNF was 17.7 litres/property/hour. This MNF value suggested that significant leakage was occurring.
>
> Source: WRDMAP/Beipiao WSC

MNF and NNF are expressed in litres / property / hour. Using a value such as litres / property / hour gives an easily understood measure of the volumes lost and, whatever the size of a particular DMA, can be used comparatively against other DMAs to prioritise work for leak detection and repair teams.

Integrated approach

Using flow data from DMA flowmeters gives a value for water supplied, while the DMA billing data for the corresponding period provides a value for "accounted for water", ie customer consumption. The difference is "unaccounted for water" (UFW). Leakage is usually a significant part of UFW and, therefore, the UFW level is a good indicator of leakage levels. Careful analysis is needed, however, as it is impossible to obtain all customer meter readings at the same time. However, a good average of customer consumption can be arrived at given several months worth of billing data. A rolling average – continuous forward movement of the time period for assessment, say a rolling 3 month period, – can be used as the quantity of water billed in the UFW calculation.

The integrated approach is a higher level indicator and when all relevant data sets are available it provides a good overview of DMA status with respect to UFW. It also provides a validity check on NNF values. The integrated approach requires a significant amount of data collected over time.

Calculation of the intervention level

DMAs are ideally utilised as a means of continually monitoring flows and pressures and, therefore, continually assessing leakage levels. Within any DMA leakage levels are dynamic. An optimum level may have been achieved within a DMA but it is inevitable that the leakage level will increase over time. There will be occasions where a sudden burst will demand attention and even where these are not visible, they can be detected through the monitoring process. But the real value of DMA monitoring is to track the gradual change over time of increasing leakage levels. A level needs to be determined where intervention by leak detection teams is necessary to bring the level back down to the target level. The intervention level may well be different for each DMA. It will be set according to specific economics but essentially the level is when the cost of leakage is greater than the cost of leak detection and repair.

Over time, some DMAs will reach intervention level with increasing frequency. There is often a point where detection and repair is not cost effective and rehabilitation and/or replacement of this section of the network must be considered.

5 Introducing Leak Detection Activities

This section gives only a brief introduction to leak detection techniques, more detailed guidance on all these techniques is given in the accompanying Manual 3.3 'Active Leakage Control Manual'.

All commonly used leak detection techniques rely on the presence of leak noise being detected. Leak noise is caused by pressurised water escaping from a pipeline into the non pressurised environment around it.

Leak detection equipment ranges from the very simple sounding stick to complex micro-processor driven units for locating leaks to an accuracy of a few centimetres.

Sounding

Listening for leak noise, or 'sounding', is a basic and extremely useful skill. It requires only the cheapest and simplest equipment, such as a 'sounding stick' or acoustic rod, to listen to pipes, fittings such as hydrants and valves, or even over the ground surface. More sophisticated ground microphones are also used for sounding.

Sounding involves the minimum of technical ability but relies on hands-on experience to develop confidence and skill.

Noise logging

Noise loggers are relatively easy to deploy within a pipe network. They are an excellent leakage targeting tool as the minimum of on-site effort is needed to deploy and retrieve them. They record noise overnight and are retrieved for downloading on to a computer for analysis through a specific software programme. Data recorded can guide leak detection teams to areas of interest for more intensive on-site detection.

Correlating noise loggers collect and store data, as do ordinary noise loggers, but come with a software programme that is able to use this data to correlate leak noise between two or more loggers, thus being more effective than noise loggers in identifying leak locations, despite being more expensive.

Deployment of both types of noise loggers requires no specific skill but downloading and analysis requires some technical and hands-on training.

Correlating

Leak noise correlators are an expensive item of leak detection equipment, but can be very productive in locating leaks to within a few centimetres, thus minimising the leak repair cost. Correlators are micro processor-based with a specific inbuilt function to detect leak noise at two microphones deployed either side of a potential leak.

Correlators require specific technical and hands-on training to become proficient in their use.

Training

Training in the use of the equipment should always be delivered by the manufacturer to ensure operators are fully conversant with its use. Training should be undertaken **on-site** as well as the classroom. The trainer must be experienced in the use of the equipment to detect and locate leaks on-site, not just proficient in demonstrating it in the classroom. The amount of training will depend on the complexity of the equipment. For noise loggers and leak noise correlators a minimum training of one day in the classroom and three days on-site should be delivered by the manufacturer. The health and safety aspects of equipment operation should be included in the training.

6 Managing the Leak Repair Programme

Detecting a leak is the start of the repair process. The leak needs to be reported and recorded. A specific form should be used so that all relevant information to guide a repair team to the leak site, and a good indication of the likely type and size of the leak, is given. A typical leak detection / repair report form is presented in Annex A.

It is important that repair of identified leaks is carried out quickly and the exact nature of the leak and the repair materials used are fully reported back on the leak detection / repair form. Repair information should then be entered into a database thus providing accurate data for analysis and the reporting of progress. Example sheets from a typical leak detection / repair database are presented in Annex B.

Once a leak has been entered as repaired it is good practice for a leak detection team member to check the site and verify all leakage has ceased. This provides an element of quality control as well as covering the possibility that there may be more than one leak at the site.

Good use can be made of historical data about leaks and repairs within a network. For example, recurring failures, by type or location, can be identified. This analysis can highlight areas where pipeline replacement, rather than individual leak repairs, may be more cost effective in the long-term.

The number of leak repairs in a DMA can vary significantly depending on the characteristics and condition of the pipe network. Typical leak repair quantities that should be allowed *for budget planning purposes only* are presented in Annex C.

7 Leak Repair Response Times

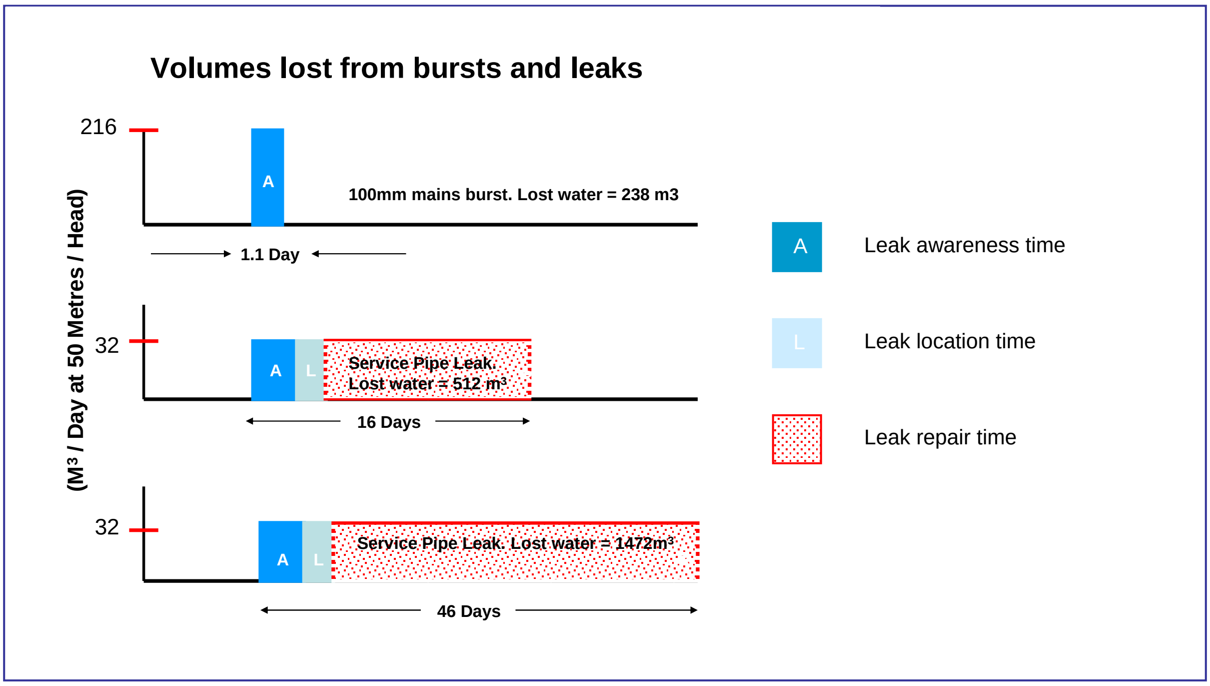
Understanding the potential water loss volumes from leakage is important for all involved in the detection and repair process.

Large bursts on mains are the most visible signs of leakage but are not necessarily the largest loss of water in volumetric terms since they are repaired quickly. Smaller, unseen leaks, running for long periods of time before detection and repair can ultimately be the source of the largest water loss by volume. It is important that repair teams follow on from detection quickly and effectively.

Leakage is not always so easy to detect

The importance of prompt detection and repair of all leaks is shown in Figure 2.

Figure 2: Scale of losses before a leak is repaired



Typical volume losses for different sizes of leaks are shown in Table 2.

Table 2: Potential leakage losses

Size of hole in pipe (mm)	m^3 per day
0.5	0.30
2.0	2.87
4.0	13.43
6.0	27.22
7.0	35.65

Figures are based on an internal pressure of 2 bar.

8 Assessing Performance

Assessing initial leakage level

In any DMA leakage can be determined either by reference to the minimum night flow (MNF) and therefore net night flow (NNF) or by an integrated approach (described in Section 4). The chosen methodology will probably depend on the level and quantity of data available. Calculation of the NNF allows for an immediate assessment of potential leakage levels whereas an integrated approach requires a significant amount of data, collected over time.

Calculation of the optimum leakage level

The optimum leakage level can be defined as 'that level of leakage where the cost of leaking water equals the cost of active leakage control.' This is an economic calculation, which will include the cost of developing new resources to meet the demand that would otherwise be met by reducing leakage and may include social and environmental costs if deemed appropriate. Once the level of leakage is known, the cost of that leakage can be determined. The cost of active leakage control will have been determined during initial active leakage control and the data sets are then available to calculate the optimum level.

Initial activity to reduce DMA leakage

Where little or no active leakage detection has taken place within a DMA, it is probable that leakage levels are relatively high. Moving into an active phase should aim to reduce and maintain the leakage level to its lowest achievable status.

This may take more than one leakage detection survey of the DMA and the number of these surveys is intuitive, but is guided by ongoing analyses of the leakage level. Once the lowest level of leakage has been determined, data is available for the costs associated with active leakage control.

Calculation of the intervention level

Refer to Section 4.

DMA operational costs

WSCs should prepare annual budgets for their active leakage control activities and monitor actual expenditure against them. Comparing this expenditure with the savings / additional sales revenue accruing from leakage savings allows assessment of the financial performance of the leakage control activity.

Typical operating costs for DMAs are presented in Annex C.

Leakage performance indicators

It is important to be able to assess a WSC's performance on leakage control and to measure the effectiveness of the selected leakage control policy. Ideally, performance comparators should allow stakeholders to compare the performance of "their" WSC against other similar WSCs. Leakage Performance Indicators (LPIs) focus on **performance measures** rather than cost comparators, primarily because cost definitions are difficult to standardise across WSCs due to differences in data collection methods and allocation of overhead costs. Suggested LPIs are presented in Table 3.

Table 3: Typical annual performance indicators to monitor a leakage control programme

Indicator No	**Leakage control performance indicators**
1	Leaks found per property surveyed (by type)
2	Leaks found per inspector (by type)
3	Flow data age
4	Response time between leak detection & repair (by type)
5	Proportion of dry holes
6	Proportion of repeat repairs
Indicator No	**Leakage control system descriptors**
1	Number of district meter areas (DMAs)
2	Percentage of properties covered by DMAs
3	Number of pressure reducing valves (1)
4	Average Zone Night Pressure (AZNP) target divided by AZNP (1)

(1) LPIs that indicate the WSC's performance in managing network pressures as a leakage control tool

Annex A Leak Detection / Repair Reporting – Example Form

Leak Data

DRF No.	**Sub Zone**	**Detect By**	**Date**
BP			

Address	Leak Comment

Report by Public ☐	Detect by Correlator ☐	Visible ☐

Leak Type	**Pipe Size**		**Pipe Material**		**Defect Location**	**Surface**
ServicePipe ☐	15 ☐	100 ☐	CI ☐	MDPE ☐	Footpath ☐	Paving ☐
StopValve ☐	20 ☐	150 ☐	DI ☐	HDPE ☐	CentreRoad ☐	Tarmac ☐
MeterJoint ☐	25 ☐	200 ☐	GI ☐	AC ☐	SideRoad ☐	Concrete ☐
Main ☐	40 ☐	250 ☐	ST ☐	PVC ☐	OpenLand ☐	Grass ☐
MainValve ☐	50 ☐	300 ☐	Other		Privateland ☐	PlantedArea ☐
Hydrant ☐		450 ☐	________		Other	RoughGround ☐
Standpost ☐	Other				________	Other
AirValve ☐	**Priority** 1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	
Ferrule ☐	Other leak type			Other surface		
Other ☐						

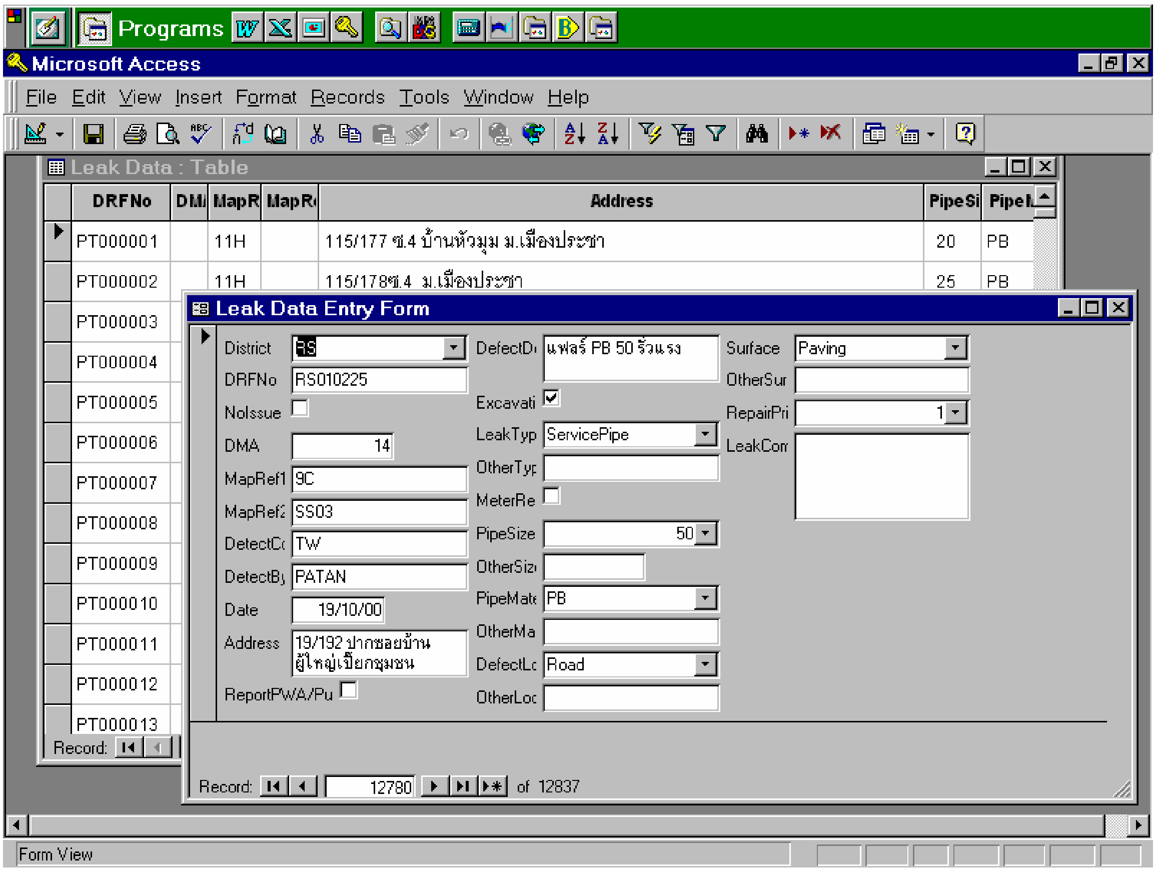
Sketch

Repair Data

Date	Start Time	Finish Time	Total Time	Manpower

Actual Leak Type/Size		**Pipe Material**		**Excavation**	**Photograph** ☐	
ServicePipe ☐		CI ☐	MDPE ☐	D_____W_____L______	**Materials Used**	
StopValve ☐		DI ☐	HDPE ☐	Obstruction Y ☐ N ☐	Q'ty	Item
MeterJoint ☐		GI ☐	AC ☐	Surface Type__________		
Main ☐		ST ☐	PVC ☐	____________________		
MainValve ☐		Other		Equipment Used________		
Hydrant ☐				____________________		
Standpost ☐		**New Pipe** ☐				
AirValve ☐		**Supervisor**		**Repair Comment**		**Dry Hole**
Ferrule ☐						
Other ☐						

Annex B Leak Detection / Repair Database – Example Sheets



Annex C DMA Operational Costs

Pipe and leak detection equipment

Each WSC should have the pipe and leak detection equipment detailed in Table C1 to equip one team of technicians undertaking leak detection activities through DMAs.

The electronic equipment (all those listed in the table with the exception of sounding sticks) should be replaced at the end of its useful life. Generally, replacement every 7 years should be allowed for budget planning.

Table C1: Pipe and leak detection equipment

Item	**Cost (RMB) (1)**
Pipe locator	50,000
Valve box locator (one per leakage team)	20,000
Sounding stick (one for each leakage field staff)	1,500
Electronic sounding stick (one per leakage team)	5,000
Ground microphone (one per leakage team)	20,000
Correlating noise loggers (set of 8 loggers)	150,000
Leak noise correlator	150,000

(1) 2007 prices (indicative)

Flow and pressure monitoring

The costs for maintaining and replacing the flow and pressure monitoring equipment that should be allowed for budget planning are detailed in Table C2.

Table C2: Flow and pressure monitoring equipment costs

Item	**Maintenance / Replacement Cost (1)**
Flow meter maintenance	4% of purchase cost per annum
Data loggers (dual channel)	Replace every 7 years at a cost of RMB 5,000 each

(1) 2007 prices (indicative)

Manpower resources

The frequency at which leak detection is carried out in a DMA depends on the natural rate of rise in leakage level for a DMA and the target leakage level for the DMA. Therefore, the manpower requirements for managing a set of DMAs will vary. Experience elsewhere in Asia suggests that a 3 man leakage team can normally manage 10 DMAs. Each leakage team will require transport (pick-up truck).

Management of a DMA comprises:

- Downloading and analysis of flow data to check DMA leakage level (at regular intervals and after leak repairs)
- Leak detection surveys by manual sounding and use of ground microphone and correlating leak noise loggers (field work plus analysis of results)
- Leak location using leak noise correlator
- Quality checks on leak repairs.

Leak repairs

The number of leak repairs in a DMA can vary significantly depending on the characteristics and condition of the pipe network. Experience elsewhere in Asia suggests that for a typical DMA of around 2,500 properties the leak repair quantities that should be allowed for **budget planning purposes only** are as detailed in Table C3.

Table C3: Leak repairs per DMA

Leak Repairs	**Quantity**
Mains – initial reduction in leakage to target level	75 [(1)]
Mains – regular leakage detection	10 per annum [(2)]
Connections/supply pipes – initial reduction in leakage to target level	225[(1)]
Connections/supply pipes – regular leakage detection	40 per annum [(2)]

(1) Similar project in Thailand, where no active policy previously undertaken

(2) Estimate

Document Reference Sheet

Glossary:

DMA	District meter area – typically a relatively small hydraulically defined area established within the pipe network where inflows and, if applicable, outflows are metered. Used as a management tool to allow a structured approach to the determination of leakage levels.
GIS	Geographic information system
LPI	Leakage performance indicators
MNF	Minimum night flow – as there is very little domestic use of water at night, in residential areas any significant MNF is often leakage
NNF	Net night flow – defined as the MNF minus both known and estimated legitimate use. A high NNF above the intervention level should prompt immediate leak detection and repair.
NRW	Non revenue water – defined as water produced for sale but for which no income is received
UFW	Unaccounted for water – the total of illegal consumption, leakage, and meter errors
WSC	Water supply company

Bibliography:

CJJ92-2002 'Urban Water Supply Distribution System Leakage Control and Evaluation Standard', Ministry of Housing and Urban-Rural Development

Related materials from the MWR IWRM Document Series:

Thematic Paper 3.2	Urban Water Supply Demand Management
Thematic Paper 3.3	Active Leakage Control as a Key Component in Increasing Efficiency in Urban Water Supply
Advisory Note 3.3/2	Asset Management for a Small or Medium Size Water Supply Companies
Manual 3.3	Active Leakage Control Manual for Small to Medium Size Water Supply Companies
Thematic Paper 5.7	Financial Management and Modelling in Small and Medium Water Supply Companies

Where to find more information on IWRM – recommended websites:

Ministry of Water Resources: www.mwr.gov.cn

Global Water Partnership: www.gwpforum.org

WRDMAP Project Website: www.wrdmap.com

China – UK, WRDMAP

Integrated Water Resource Management Documents
Produced under the Central Case Study Documentation Programme of the GoC, DFID funded, Water Resources Demand Management Assistance Project, 2005-2010.

3. Demand Manage-ment

Documents will comprise of:

Thematic Papers

Advisory Notes

Manuals

Examples

Training Materials

IWRM Document Series materials, English and Chinese versions, are available on the following project website

WRDMAP Project Website: www.wrdmap.com

Advisory Services by : Mott MacDonald (UK) leading a consultancy team comprising DHI (Water and Environment), HTSPE (UK), IWHR, IECCO (Comprehensive Bureau), CIAD (China Agricultural University), Tsinghua University, CAAS-IEDA, CAS-CWRR, Gansu WRHB and Liaoning WRHB.

中国水利 CHINA WATER

DFID Department For International Development

Mott MacDonald